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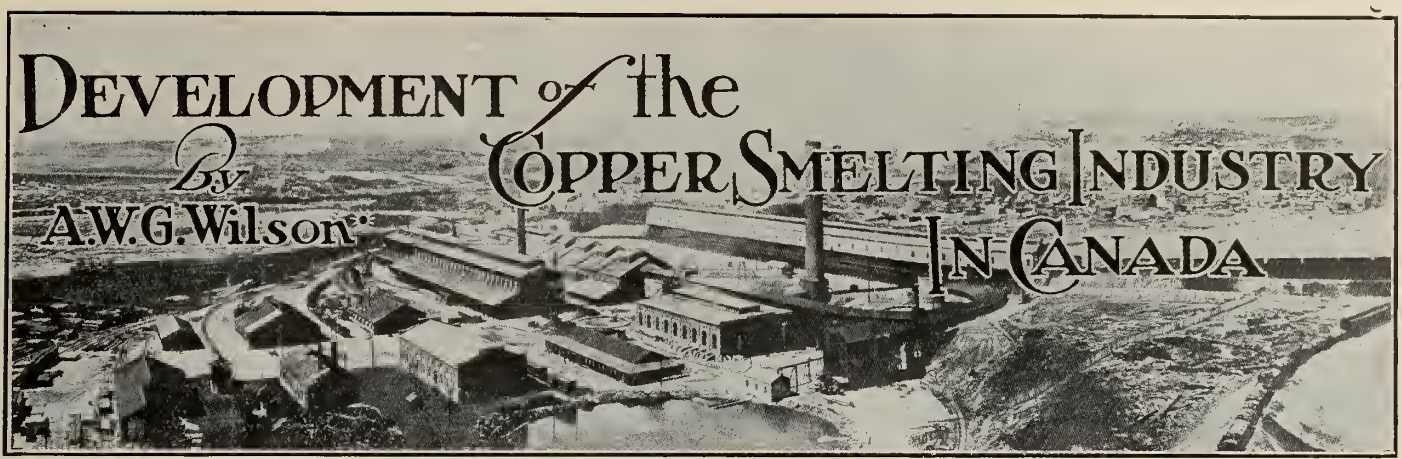
HINTS TO BUYERS



The present article is the first of a series which we hope to publish each month during the first half of this New Year. More or less detail treatment will be given the various smelting plants throughout the Dominion, beginning with that of the Canadian Copper Co., Copper Cliff, Ont., in this issue. Due to the European War this industry is much in the limelight.

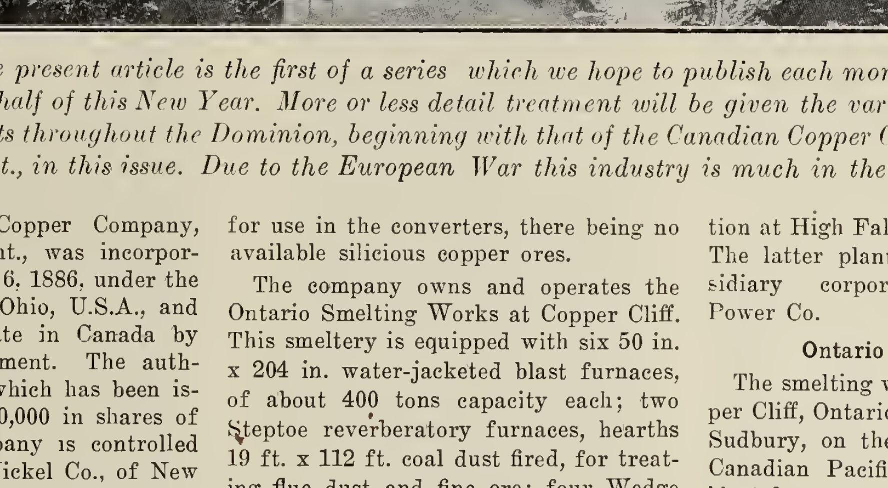
THE Canadian Copper Company, Copper Cliff, Ont., was incorporated on January 6, 1886, under the laws of the State of Ohio, U.S.A., and was licensed to operate in Canada by special Act of Parliament. The authorized capital, all of which has been issued, consists of $2,500,000 in shares of $100 each. The company is controlled by the International Nickel Co., of New Jersey, U.S.A., through ownership by them of practically the entire capital stock.

General.

The company is the largest producer of nickel ores in the world, and is also an important copper producer. It owns large areas of mineral lands in the Sudbury district, and holds mining leases on additional areas. It also owns the Alexo mine on lot 1, concession III, Township of Dundonald, in the Porcupine Mining Division.

The principal mines operated by the company are the Copper Cliff (now idle), No. 2 mine (now idle), Creighton, Crean Hill, Stobie (now idle). Extensive development work is now under way, preparatory to reopening the old No. 3 mine, now the Frood, on which one of the largest ore bodies of nickeliferous pyrrhotite yet discovered has been located and proved by diamond drilling. A quartz quarry at Dill, about 15 miles south-east of Copper Cliff, supplies silica for use in the converters, there being no available silicious copper ores.

The company owns and operates the Ontario Smelting Works at Copper Cliff. This smeltery is equipped with six 50 in. x 204 in. water-jacketed blast furnaces, of about 400 tons capacity each; two Steptoe reverberatory furnaces, hearths 19 ft. x 112 ft. coal dust fired, for treating flue dust and fine ore; four Wedge roasting furnaces, each with 7 hearths and 22 ft. 6 in. in diameter; the converter plant consists of 5 stands and 5 shells, Bessemer basic converters, of special design. These basic converters are each 37 ft. 2 in. in length and 10 ft. in diameter; the shells are operated by hydraulic machinery, oil being used in place of water.



GROUND PLAN, COPPER CLIFF P LANT, CANADIAN COPPER CO.

The company also owns and operates a small silver smelter, treating ores from the Cobalt district, Ontario, while other possessions include about 20 miles of standard gauge railway and operating equipment, and a hydro-electric installation at High Falls, on the Spanish River. The latter plant is operated by a subsidiary corporation, the Huronian Power Co.

Ontario Smelting Works.

The smelting works are located at Copper Cliff, Ontario, about 4.5 miles west of Sudbury, on the "Soo" branch of the Canadian Pacific Railway. The first blast furnace was installed at the old, or East smelter, in 1888, under the direction of Dr. E. D. Peters, Jr., and was blown in on December 24 of that year. This furnace was a 100-ton Herreschoff. A second furnace installed in the same building was blown in on September 4 of the following year. These furnaces were operated for some time on ore obtained from the Copper Cliff, Stobie, and Evans mines. Later, ore was received from No. 2 mine and from the Frood. The opening of the Creighton mine in 1901 and the increased supply of ore led to the addition of three other furnaces between the years 1900-1913. The first Bessemer plant was commenced in 1891 and completed in January of the following year.

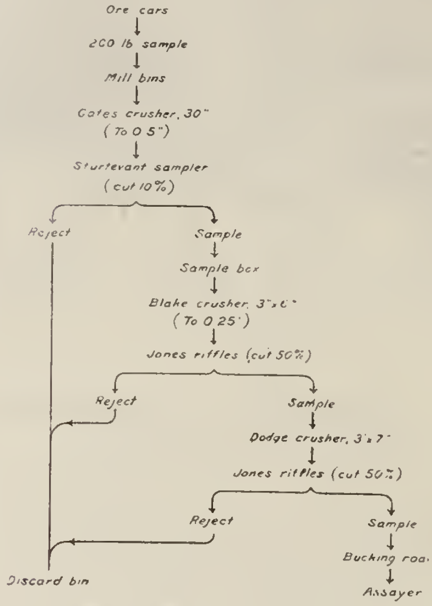
In 1899, during the superintendence of James McArthur, the West smelter was erected near No. 2 mine. This smelter at first contained only four furnaces, but soon afterwards four additional furnaces were added. The old or East smelter suspended operations in 1902.

*Chief of Metal Mines Division, Ottawa.

In 1900 the Ontario Smelting Works were erected by the Orford Copper Co., a concern closely associated with the Canadian Copper Co., and one of the corporations included in the amalgamation in 1902 by which the International Nickel Co., took over the interests of a number of other minor corporations. The first site of the Ontario Smelting Works was a short distance west of the Copper Cliff mine, nearly a mile from the West smelter. This plant was erected at the time of the adoption of a new method of increasing the grade of the matte, Bessemer converters having hitherto been used for this purpose. In this plant, low-grade matte was ground in a ball mill and roasted in long calcining furnaces of the Brown type, and then resmelted in brick cupolas to a matte containing 5-8 per cent. of iron and approximately 75 per cent. of copper and nickel.

In 1902, the International Nickel Co. was organized under the laws of the State of New Jersey to take over the interests of a number of mining companies and smelter companies owning properties in Canada, United States, Great Britain, and New Caledonia. This amalgamation included the properties of the Canadian Copper Co., the Orford Copper Co., the Anglo-American Iron Co., the Vermilion Mining Co., the American Nickel Works, the Nickel Corporation, Ltd., and the Societe Miniere Caledonienne. This corporation operates its Canadian business under the charter and title of the Canadian Copper Co.

In the meantime, the new method of raising the grade of the matte proving unsatisfactory, it was decided to build a new smelter, incorporating a number of improvements—the result of the experience gained in the earlier operations. A site was selected on a hillside, about



SAMPLE MILL FLOW SHEET.

half a mile from the now old West smelter, not far from the original East smelter, but on higher ground. These works were completed in 1904. During the period of construction, both the West smelter and the Ontario Smelting Works were badly damaged by fire, greatly interfering with the work. For a period of six months preceding the completion of the new works, the smelter of the Mond Nickel Co. at Victoria Mines was leased and used for Bessemerizing low grade matte, pending the completion of the converter plant at the new smelter. The new plant contained two blast furnaces of about 400 tons capacity each.

In 1905 it was again enlarged to a capacity of five 400-ton furnaces, and the converter plant was installed in a separate building. This converter plant consisted of 10 stands and shells, Allis-Chalmers type, 8 ft. x 10 ft., using a silicious lining, capacity about 5-7 tons of Bessemer matte without relining, according to the grade of furnace matte charged into the converter. After conducting a series of experiments, these converters were discarded in 1911, and 5 basic lined converters, a modified form of the Pierce and Smith basic converter, were installed. The new converters have proven very satisfactory and the operation of converting has been much simplified by the change.

In 1911, work was begun on the construction of two Steptoe reverberatory furnaces, hearth area 19 ft x 112 ft. each. These furnaces are fired with coal dust blast: the first one was blown in near the end of December, 1911, and the second in 1912. In the latter year, a new blast furnace and the foundation for a third reverberatory furnace were added to the

BASIC COPPER CONVERTERS, CANADIAN COPPER CO., COPPER CLIFF, ONT.

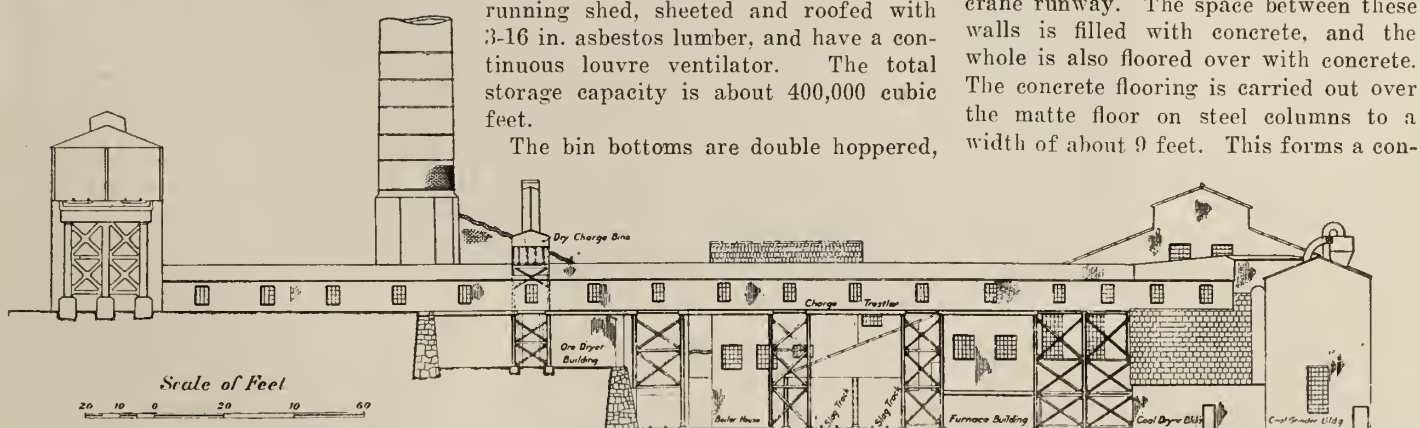
smelting equipment. Four standard seven hearth Wedge roasting furnaces, each 22 ft. 6 in. in diameter, have also been installed.

General Statement of Equipment.

The plant, as at present constituted, is considered to be the most complete and up-to-date of its kind in the world. The equipment includes six water-jacketed blast furnaces, five 50 in x 204 in., and one 50 in. x 240 in., five basic converter stands and five shells, 10 in. x 37 ft. 2 in., hydraulically operated with oil instead of water. There are two coal dust fired McDougall reverberatories, hearth area of each being 19 ft. x 112 ft.; and four Wedge roasting furnaces. The mechanical and construction departments are equipped to handle any work that may be required at the plant. The shops include a foundry, car and carpenter shops, machine shop, boiler shop, pattern shop, and storage. There are also a number of warehouses. The power is electric, a transformer station being located at the works. An auxiliary steam plant is installed for emergencies. There are extensive roast yards about half a mile from the smelter and large storage bins at the smelter, above the level of the charging floor. Transportation is provided by standard gauge railway tracks on several levels, and by electric haulage lines on the charging floor level and on the converter floor level.

Smelter Site.

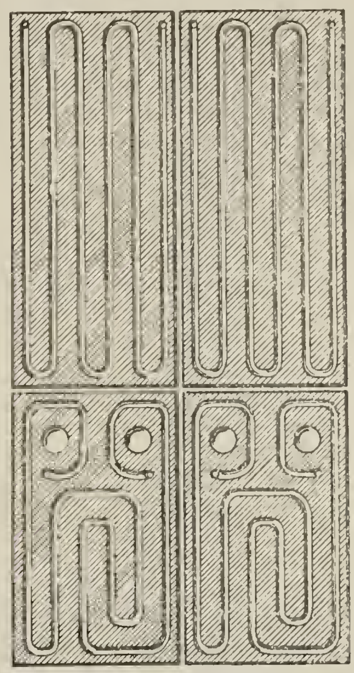
The site of the present smelter was chosen after very careful contour surveys had been made of all available ground. The nature of the ground made it necessary to design the plant for the most efficient handling of supplies and products on a site where the difference in elevation would be 67 feet between the tops of the storage bins and yard grade. Provision has also to be made for a slag dump. The storage bins, dust chamber, stack, sampling building, and laboratory are all built on solid rock; the furnace building, the reverberatory plant, the steam power house, and the electrical sub-station are partly on rock and partly on built ground. The other buildings, chiefly shops and warehouses, are on built ground, made by pouring slag to a depth of 7-20, as the nature of the topography required.



WEST ELEVATION, REVERBERATORY FURNACE DEPARTMENT, CANADIAN COPPER CO.

Ore Bins.

The ore bins on the side hill above the furnace building, parallel to it, and 200 feet distant, are of massive timber construction, with bents resting on masonry footings at 6 ft. centres. These bins are 700 feet in length, 35 feet outside width, 30 feet inside width, and 32 feet in height. They are subdivided into pockets of different lengths, according to the material and quantity to be handled. They carry two standard gauge tracks at 15 ft. centres. They are covered with a running shed, sheeted and roofed with 3-16 in. asbestos lumber, and have a continuous louvre ventilator. The total storage capacity is about 400,000 cubic feet.



SECTION SHOWING ARRANGEMENT OF OF COOLING PIPES IN CAST IRON FURNACE JACKETS.

The bin bottoms are double hoppered, with curved bin gates every 6 feet, directly over the charging tracks. These gates are a patented type, convex on the under side and hand-operated by gear cranks. Beneath the bins, on the level of the charging floor, run the two parallel tracks, 36 in. gauge and 15 ft. centres, on which the charge trains are operated. These bins receive ore from the roast yard, green ore from the mines, slag and scrap from the furnaces and converters, coal, coke, quartz, clay, and limestone. At one end of the bins is a set of 3-ton suspender track scales, one on each track. The beams and the office for the weigh clerk are placed between the tracks. A similar pair of scales are also installed near the centre of the bins. Beside the scales are small open bins, holding ore or other material for adjusting the components of the charge.

At the new reverberatory building, about 400 yards east of the main plant, storage bins of 7,500 tons capacity, for holding ore, flux, and coal, have been installed.

Furnace Building.

The blast furnace building is 86 feet wide and 418 feet long, with a lean-to, 30 feet wide and 280 feet long, on the south side. It lies parallel to the ore bins and about 200 feet away. One side wall is built of brick, with heavy pilasters, which carry one track of the crane runway; arch doorways, 8 feet wide, are placed in this wall at 20 ft. centres. The balance of the building is of steel construction. In each space between the furnaces a section of the roof, 12 feet in width, is raised 2 feet above the general level, to provide for ventilation. The roof is covered with reinforced concrete tile. A monitor, enclosed with louvres, is also carried up 8 feet above the main roof around each furnace.

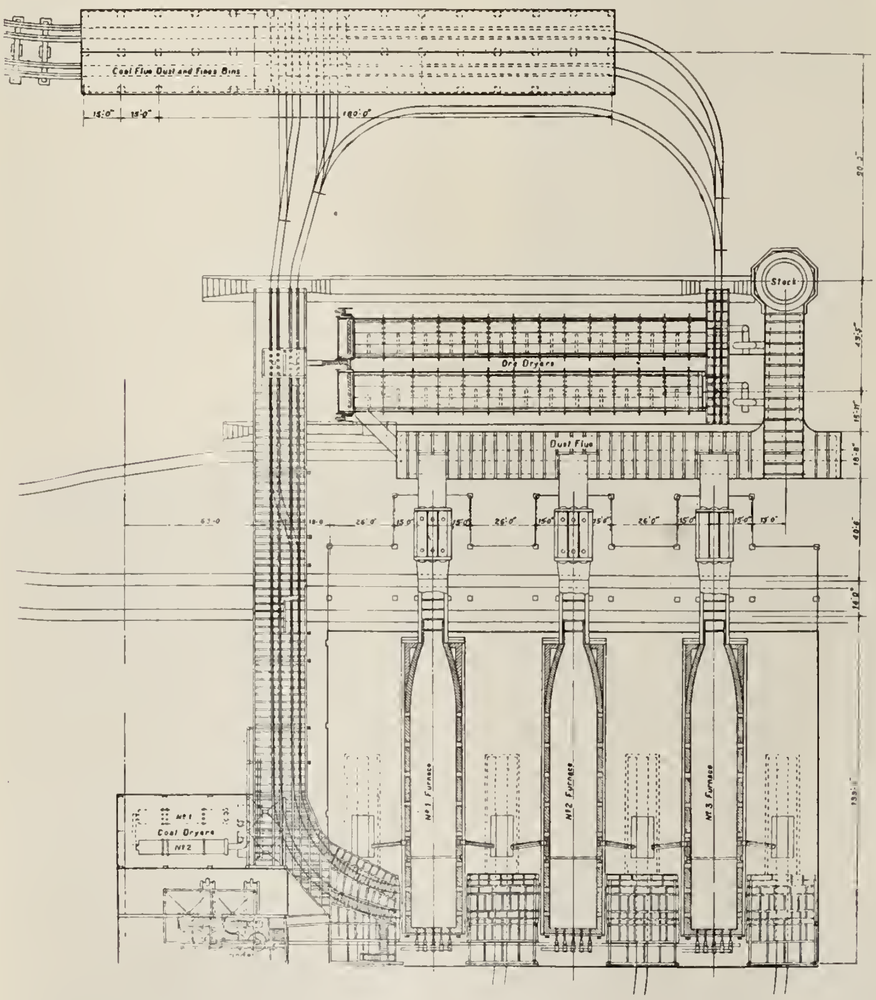
The furnace floor is 10 feet above the slag floor and 20 feet wide. The raised portion consists of massive masonry walls, which form the foundations for the furnaces and settlers, and for the columns which carry the charge floor and crane runway. The space between these walls is filled with concrete, and the whole is also floored over with concrete. The concrete flooring is carried out over the matte floor on steel columns to a width of about 9 feet. This forms a continuous tapping platform and furnace runway. The charging floor is 35 feet above the matte and slag floors and 25 feet above the furnace floor. This floor is 30 feet in width and is built of reinforced concrete, carried on heavy steel framing; the sides are sheeted up to the roof forming a separate enclosure.

The raised furnace floor divides the furnace building longitudinally into three sections. At the back of the building is the slag floor, 33 feet wide, served by two standard gauge tracks. In front is the matte floor, also 33 feet wide, and served by two 50-ton 5-motor Morgan electric cranes, 32 ft. 10 in. span and 20-ton capacity. The motors are variable speed induction type. A standard gauge track enters the building at the west end, on the matte floor, and runs for a distance of about 80 feet.

Converter Building.

The converter building lies parallel to the furnace building and about 60 feet away. It is of steel construction throughout, with special bracing to carry the heavy travelling cranes. The main building is 60 feet wide, 522 feet long, and measures 47 feet from the floor to the roof trusses. On one side is a lean-to, 30 feet wide and 392 feet long. A monitor, 24 feet wide and 8 feet high, built with louvres for ventilation, runs the entire length of the building except at the end bays. The roofing is of reinforced concrete tile, the sheathing is galvanized corrugated iron over the main part of the building covering the converters; at the relining end the greater protection against cold is given by a sheathing of cement plaster on metal. This building contains two departments, one for drying quartz and rock flues, and one for blowing the five basic converters .

The blowing end of the building is provided with a crane way of 55 ft. 8 in. span. It is served by two 50-ton, 5-motor, Morgan electric cranes, equipped with variable speed induction motors. The motor speeds on these cranes are a little faster than the motor speeds of the cranes in the furnace building. The main hoist on each of these cranes is capable of lifting at the rate of 18 feet per minute; the auxiliary hoist at 36 feet per minute, and the bridge travel is at the rate of 200 feet per minute.



GROUND PLAN, REVERBERATORY FURNACE DEPARTMENT.

Reverberatory Building.

This building houses the reverberatory furnaces and the coal crushing plant. It is located about one-fourth mile east of the main plant, on the side of a hill. Back of the building the storage bins are served by the high level railway line. The slag and matte cars enter the building at yard level, through tunnels in the foundation. The site for the building was prepared by clearing the rock on the side hill and then building forward a platform of poured slag. Concrete retaining walls were built in such a way as to leave space for three tunnels to enter the slag foundations at the yard level, one between the two original furnaces, and one at either side. A light trestle, about 14 feet in height, was built, leading over the foundations and, from this slag was poured between the retaining walls. In this way a solid block of slag, about 12 in. thick, was formed beneath each furnace. On this foundation the furnaces were built as described below. The foundation was extended to provide for the third furnace, the construction of which was started in 1912.

Electric Sub-station.

This building is 92 feet in width and 224 feet in length. The foundations, walls, and floors are of concrete construction, while the roof is of hollow book tile, covered with tar and gravel. The roof trusses are of steel and are carried on three rows of columns, two rows built into the opposite parallel concrete walls of the building, and one row down the middle. Two parallel runways for two 10-ton hand-power cranes are carried from end to end of the building on the walls and on the middle row of columns.

This building is the main distributing station of the company's electric system. It supplies motors, in the building itself and elsewhere, having a total capacity of over 8,000 h.p.; in addition, power for the arc and incandescent lighting in the two smelters, the shops, offices, and in the town of Copper Cliff is sent out from this station. Most of the circuits in the furnace and converter buildings are placed underground in fibre conduits laid in cement. The other circuits are carried on aerial lines. The transformer rooms and high tension switch tower are arranged along one side of the building, and separated by fireproof walls.

The equipment housed in this building is as follows: four banks of transformers, three to a bank; each transformer having a capacity of 667 k.w. 35,000/2,400 volts; one bank of three transformers, each 175 k.w. 2,400/575 volts. These latter supply the current for the majority of the motors outside the building, which operate at 550 volts. There is also an 8-panel switchboard and a storage battery. The engine room of this building contains the principal blowing engines, a large fire pump, and two small generators.

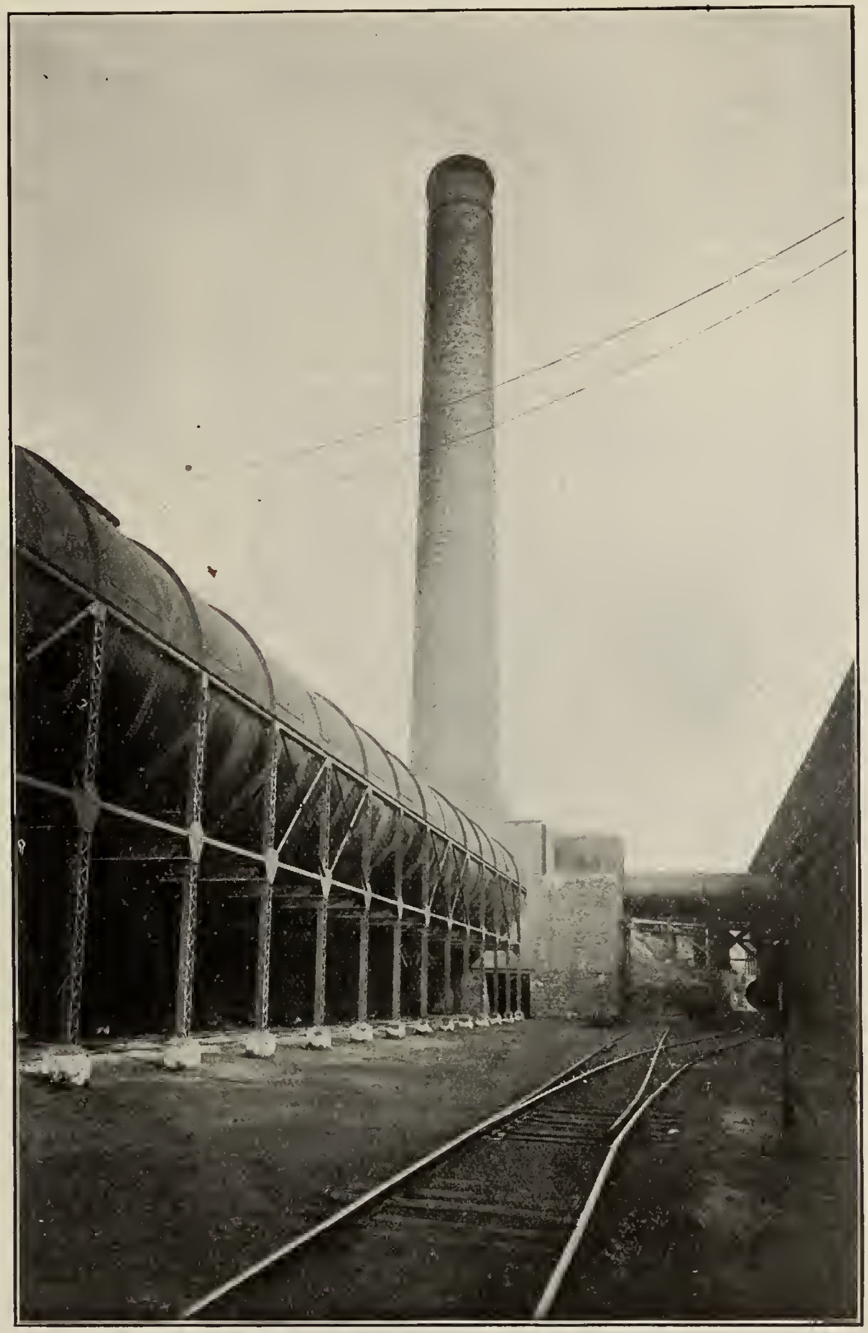
Direct current for operating the electric locomotives that are used on the charging floor is generated by two 40 k.w. Allis-Chalmers Bullock motor generator sets. The motor is operated by an alternating current at 550 volts, 40 amperes; the generator delivering direct current at 250 volts and 100 amperes. One 30 k.w. motor-generator set taking current at 550 volts, 40 amperes, and delivering direct current at 250 volts and 100 amperes, one 30 k.w. motor-generator set taking current at 550 volts, 40 amperes, and delivering direct current at 250 volts, 90 amperes, when running at 1,200 r.p.m., is also available.

One 100 k.w. frequency changer, changing the 25-cycle current from the transformers to a 60-cycle current for use in the arc lamps, is placed in this building. About 55 enclosed arc lamps are used for lighting the buildings and smelter yard, and 25 are supplied to the town of Copper Cliff for street lighting. A complete system of electric signals, with gongs and colored lights, connect this building with the furnace floor and the converter pulpits. By this means the operation of the various blowing engines can be quickly adjusted to meet changed requirements. The sub-station building is heated by air, which is blown over hot steam coils by a motor-driven fan and distributed to the rooms through ducts and floor registers.

Sample Mill.

The sample mill is a three-storey building, 30 ft. x 48 ft., placed near the east end of the furnace building. The upper floor is on a level with the charging floor, with which it is connected by a track tangent to the curve at this end of the belt line charging tracks, and carried to the mill on a trestle. In the building there are 24 wooden bins, with the tops on the level of the charging floor, to which cars can be hauled by an electric locomotive and dumped directly. These bins discharge through chutes to the crusher floor. The ore is received in small cars and trammed to the crushers as required.

The ore is received from the mines or roast yards in train load lots. A 200-pound sample is taken from each car of a train and the whole lot is sampled together. The sample passes through a Gates gyratory crusher, 30 in. size D, which crushes to 0.5 in. size. A Sturtevant sampler cuts one-tenth, which it delivers into a sample box; the discards passing to a bin. The sample subsequently passes a 3 in. x 6 in. Blake crusher, breaking to 0.25 in., and thence over a riffle sampler cutting one-half. This sample is passed to a 3 in. x 7 in. Dodge crusher and thence to a Jones riffle cutting one-half. The final sample is then sent to the bucking room where it is treated in laboratory pulverizers. All discards pass to a common bin at the bottom of the building, from which they are loaded into regular furnace charging cars and hoisted to the charging floor by an electric elevator at the end of the building. This elevator is also used for lifting to the crushing floor any samples that may arrive on the yard level. Power to operate the plant is supplied by motors; a 15 h.p. motor being used for the crushers and elevator, while a 5 h.p. motor operates the smaller machines.



BLAST FURNACE FLUE, CANADIAN COPPER CO., COPPER CLIFF, ONT.

Laboratory.

This building is of concrete, brick, and steel construction, with a roof of book tile carried on steel trusses. The building is only one storey in height, but there is a 9-ft. basement. It covers an area of 34 ft. x 79 ft. The principal room is the analysis room on the main floor, 32 ft. x 40 ft. It is open to the roof, and is ventilated by means of electric fans set in bull's-eye windows in each gable. The hood is of down-draft construction, with top light, and is made with concrete base, and iron and glass sides and top. Draft is supplied by a suction fan in the basement. Electric hot plates are used, the temperature being controlled by a rheostat in which plugs are inserted. Either acetylene gas or gasoline gas can be used in Bunsen burners where a heating flame becomes necessary.

A narrow hallway at either end of the main working room separates the other smaller rooms, of which there are four, two at each end of the building, from the main laboratory. Each of these four rooms measures 13 ft. x 18 ft. At one end are an assay room and a sulphuretted hydrogen room; at the other a balance room and the office of the chief chemist. The balance room contains a heavy bench, set on concrete piers, which run down to bed-rock. There is space for five balances on the bench, and the room is lighted from the north. The basement is provided with a separate entrance from the outside. It contains a large storage room for acids, etc., a small room for private research, a storage room for glassware, a large photographic dark-room with two sinks and eight lockers for photographic work, and a heating system similar to that installed in the electric substation.

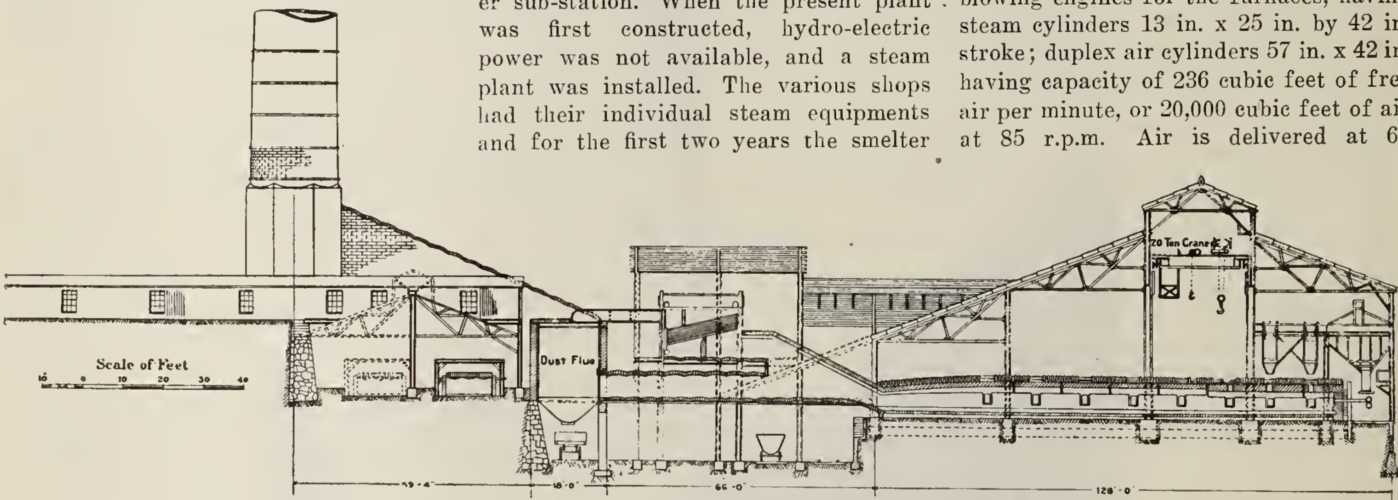
Other Buildings.

There are a number of other buildings, located in close proximity to the smelter, housing the various departments. As far as possible fireproof construction has been used throughout. A feature of some interest is the special form of reinforced concrete tiling, made at the works, which is used for roofing all new structures. This is the so-called Bonanza roofing of the American Cement Tile Co. These buildings include the old steam power plant building, 100 ft. x 160 ft.; car and carpenter shop, 60 ft. x 154 ft.; machine shop, 72 ft. x 154 ft.; foundry, 36 ft. x 98 ft.; pattern storage, 30 ft. x 84 ft.; boiler shop, 60 ft. x 98 ft.; warehouse, 60 ft. x 150 ft. They are all built of concrete, steel, and brick, with cement tile roofing. The various shops are very completely equipped with the most modern tools and machinery for handling almost all the repair and construction work needed around the plant.

The warehouse at the smelter is the central warehouse building, which serves as the main distributing point for supplies for the various plants and mines. The building is 60 ft. x 150 ft., and contains two storeys and a basement. It is built of concrete, brick, and steel, and the roof is made of concrete tile. The floors are of reinforced concrete designed to carry a load of 300 and 150 pounds per square foot for the main and upper floors respectively. A railway track runs parallel to the building at the edge of the unloading platform, which is 20 feet wide and 150 feet in length. A 3-ton electric elevator serves all three floors. The purchasing office, metallurgist's office, and the electrical repair shop are also located in this building.

Power

The power employed at the works is electric, received from the lines of the Huronian Power Co., a subsidiary corporation with extensive plant at High Falls, on the Spanish River. Power is transferred to the transformer house at the smelter at 35,000 volts. It is stepped down to 2,200 volts for use in the heavier motors and to 550 volts for use in most of the motors outside the smelter sub-station. When the present plant was first constructed, hydro-electric power was not available, and a steam plant was installed. The various shops had their individual steam equipments and for the first two years the smelter was operated by steam-generated power. This plant has been kept in good condition as a reserve. One boiler is kept under steam, banked in summer, and supplies steam heat to the various buildings in the vicinity in winter.



SECTION ON NO. 1 FURNACE, REVERBERATORY FURNACE DEPARTMENT.

Boiler Room Equipment.

The steam power house is a brick building with masonry foundations, 100 ft. x 160 ft. The roof is of hollow book tile, made at the works, covered with plastic slate and supported by steel trusses. The engine room is separated from the boiler room by a longitudinal brick fire-wall, which runs through the middle of the building. The floors are of reinforced concrete. The boiler room was originally equipped with four pairs of 400 h.p. Altman-Taylor water-tube boilers, each boiler being provided with a Snow feed pump. There are also feed water heaters, a hot well pump, a dry vacuum pump, 8 in. x 16 in., running at 120 r.p.m., and an Alberger barometric condenser, 24 in. in diameter, with a 34-ft. head. The boiler room also contains a 1,000 gallon Blake underwriter pump, a 700 gallon duplex furnace feed pump, and a cross-compound, 18 in. x 11 in. x 18 in. Rand air compressor. A purifying plant, which handles all the water for the smelter and for the locomotive water tank, is also installed here.

Since the erection of the reverberatory furnace plant, two pairs of the Altman-Taylor water-tube boilers have been moved to the reverberatory furnace building, where one pair has been installed in the flue at the front end of each of the first two furnaces erected. These boilers are used for power for the furnace pumps, etc. The other two pairs are held in reserve for spare steam blowing engines, steam pumps, and air-compressor. They are also used for heating some of the buildings at the plant.

Engine Room Equipment.

The engine-room equipment includes two cross-compound Nordberg-Corliss blowing engines for the furnaces, having steam cylinders 13 in. x 25 in. by 42 in. stroke; duplex air cylinders 57 in. x 42 in. having capacity of 236 cubic feet of free air per minute, or 20,000 cubic feet of air at 85 r.p.m. Air is delivered at 60 ounces pressure. In the same room are also placed the following machines, all electrically driven:

One 300 cubic ft. Connersville blower No. 2,007, driven by two Allis-Chalmers-Bullock 225 h.p. variable speed motors, with 14 ropes, 1½ in. diameter, English system. This machine has a capacity of 30,000 cubic feet of free air per minute.

One 400 cubic ft. Connersville blower No. 3,457, driven by two Allis-Chalmers-Bullock 300 h.p. motors. This engine delivers 44,000 cubic feet of free air per minute, at the maximum speed of 110 r.p.m.

One cross-compound Nordberg blowing engine for the converters, with steam cylinders 15 in. x 30 in, by 42 in. stroke; duplex air cylinders 40 in. x 42 in., with capacity of 120 cubic feet of free air per revolution, or 10,000 cubic feet per minute at a speed of 85 r.p.m. Air is delivered at 15 pounds pressure.

Industrial Accidents.—According to Safety-Engineering, about 25 per cent. of the accidents recorded under the British Compensation Act were due to insufficient lighting of industrial shops.

A Possible Solution of the Iron Ore Problem in Canada

By A. C. Dalton *

It is generally conceded that it is to the electric furnace we must look in order to make commercially profitable of development the widespread areas of our Dominion in which extensive deposits of low-grade iron ore exist. This type furnace has made a growing and all the time improving performance record, and there is little doubt that its complete adaptability will in the early future cope successfully with this iron ore problem.

THAT there exist extensive deposits of iron ore in Ontario is now a well established fact, but that these ores are scattered and frequently intermixed with non-productive materials, which often create difficulties that prevent successful commercial smelting of these deposits is also well known.

In the year 1911 only about 18 per cent. of the iron ores smelted in Ontario were of local origin, the rest being imported from the United States. This is not due altogether to a lack of ore deposits, but in considerable degree to the prevalent leanness of most of them.

Fortunately the ore deposits are chemically suitable for smelting purposes, although often intimately associated with rock material which necessitates their separation therefrom. It is this separation that causes the trouble, not that the rock cannot be separated from the ore, but rather that the condition of the ore after the separation is frequently of so fine a nature that further treatment is necessary to render it of practical use to the furnace man.

The extent of this preliminary mechanical treatment of the ore varies with its nature, and some idea will be obtained of the extent of this treatment, if we review briefly a few of the important iron ore districts of Ontario. It will also enable us to better appreciate the furnace and process to be described later. Much of the information in regard to mines is taken from the excellent Government reports that have lately been published, and for further detail readers are referred to the same.

Moose Mountain Deposits.

These deposits, some four miles in area, are situated in Hutton Township, north of Sudbury, and connect with a branch line to the Canadian Northern Railway. The character of the ore may roughly be separated into two classes:—

(1)—Banded quartziferous magnetite.

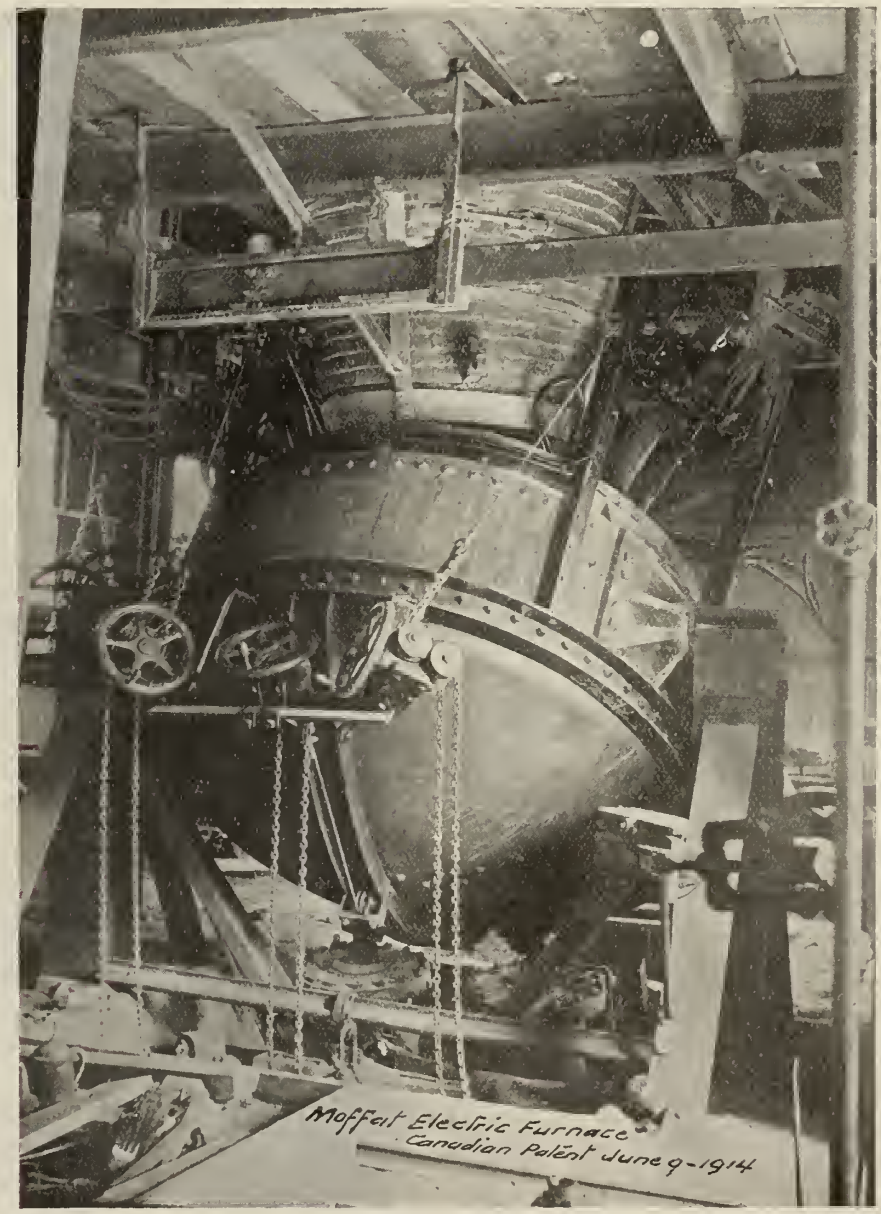
(2)—Magnetite associated with hornblend pyrozene, and epidote.

The banded siliceous variety occurs the more frequently, and is fine grained. The total area of the ore deposit is of considerable extent, though the district is divided into several deposits.

No. 1 deposit has been proved to a depth of 300 feet below its highest outcropping, and its area estimated at 47,000 square feet.

No. 2 deposit has a total length of 6,000 feet, with a width ranging from 450 feet to 150 feet, its full area being roughly estimated at 1,286,000 square feet.

For the whole district, the total area is calculated to be 3,256,000 square feet, which roughly corresponds to an ore quantity of 38,665,000 tons per 100 feet of depth of the ore bodies. Unfortunately the great bulk of this large tonnage is made up of banded siliceous magnetite requiring fine crushing and concentration with subsequent briquetting or noduliz-in. For concentration purposes these ores are ground to pass a mesh of 80 to 100. The analyses of the ore before and after concentration is as follows:—



SHOWING ELECTRODE GOVERNING WHEELS AND TOPS OF OSCILLATING HYDRAULIC CYLINDERS WHOSE RAMS TILT THE FURNACE; MOFFAT-IRVING SMELTERS, LTD., TORONTO.

*Superintendent, The Moffatt-Irving Steel Works, Ltd., Toronto.

	Crude Ore, No. 2 Deposit.	Concentrate.
Iron	36.70	65.68
Silica	45.20	8.69
Manganous oxide	0.04	0.04
Alumina	0.25	0.20
Lime	1.60	0.46
Magnesia	1.59	0.41
Sulphur	0.024	0.029

Central Ontario Magnetite.

The Central Ontario Railway traverses a district in which outcrop numerous deposits of iron ore, chiefly magnetite and occasionally titaniferous magnetite. Though these deposits are numerous, yet their magnitude is of a disputable nature, so that their commercial value at present is uncertain. The ore bodies are separable into two classes:—

(1)—Magnetites occurring along or near the contact of limestone and schists and various igneous rocks.

(2)—Titaniferous magnetite associated with gabbro eruptives.

The district is a scattered one, some eighteen mines being listed, but taking a few typical mines, the following may be mentioned:

	Square ft.
No. 4 deposit at Bessemer	50,000
Rankin & Child's properties	412,000
Blairton mine	155,500
Belmont mine	43,000

The following is the average analysis of the above ore deposits:—

	No. 4 Bessemer.	Rankin & Child's	Blairton.	Belmont.
Iron	54.29	42.30	50.10	51.20
Phosphorous.	0.019	0.085	0.046	0.032
Sulphur	0.062	0.187	1.423	0.371
Titanic acid.	....	0.10	0.10	0.10
Lime	6.86	7.91	3.52	4.87
Magnesia	1.35	1.87	1.64	3.93
Alumina	2.02	3.57	1.73	0.25
Silica	9.84	14.20	9.88	12.10

The sulphur contents of these ores is usually due to pyrites, but is occasionally due to pyrrhotite. In some cases these pyritous portions can be separated by cobbing; in others it is so fine as to render this impossible. Considerable cobbing has to be done to keep the ores up to market value and, in the case of Bessemer mines, the ore has been concentrated to give an iron content of 67.4 per cent.

Ottawa District.

This district is one of considerable extent, but, as little work has been done in any locality, it is extremely difficult to estimate the quantity of ore obtainable. The ores are chiefly magnetites, hematites, and a mixture of both, belonging to the Laurentian system. They are for the most part of the magnetic species, similar in geological and mineralogical character to the ores of the same system in the Adirondacks in Northern New York State. The ore is often disseminated in grains through the Laurentian gneiss, but the masses are generally associated with crystalline limestone. They frequently contain titanium, reaching in some localities as much as 17 per cent. The ore districts may be summarized as follows:—The Ottawa County, Pontiac County, Argenteuil County and Calumet Island.

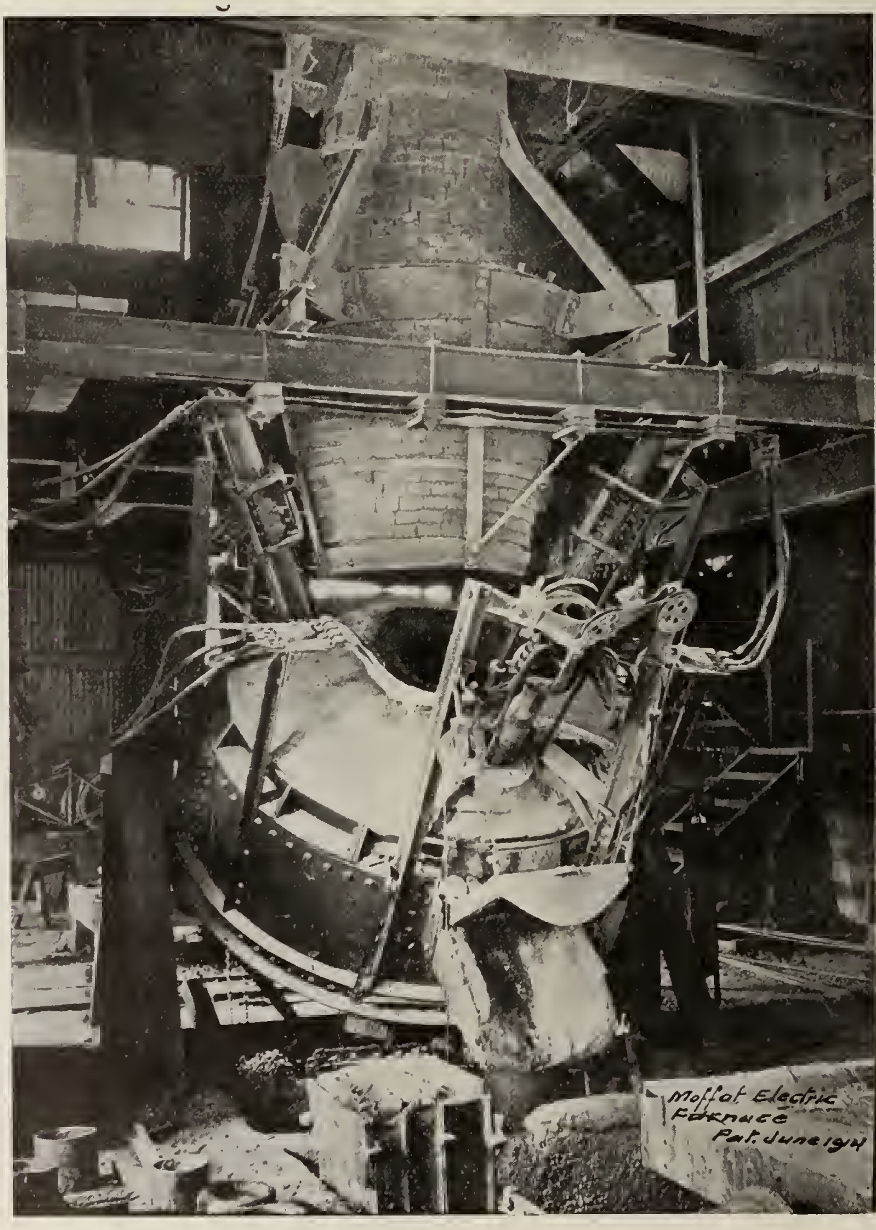
The deposits occur in veins or lodes of various thicknesses. The Hull iron range and the Bristol iron range have been proved to be of extensive area and to contain deposits of magnetite and hematite of excellent quality. A particularly noticeable feature connected with these magnetites is the abundance of medium grade ores occurring alongside the rich magnetites. The ores of this district require concentration before they can be commercially considered, as is pointed out by the history of these localities. These ores were worked so long ago as 1854, and in 1867 a blast furnace was erected, but all this is now a thing of the past. When ore is so intimately mixed with such minerals as calcite, chlorite, graphite, hornblend, pyrite, pyroxene and mica, it is easily understood how vital a question is concentration. The following analyses substantiate this statement:—

	Forsyth Mine.	Bristol Mine.
Silica	6.0 —14.0	9.0 —28.5
Metallic iron	54.0 —60.0	43.86 —60.4
Sulphur	0.075— 0.4	0.13 — 0.76
Phosphorous	0.005— 0.1	0.004— 0.006
Titanic acid	....	1.12 — 0.25
Magnesia	....	1.8 — 2.0
Lime	....	0.10 — 1.97

In other deposits, the titanium may rise to 15 per cent., as at Litchfield.

Michipicoten District—Helen Mine.

The ores of this district differ from those described above, being hematites and limonites. This mine is Ontario's largest single producer of iron ore. It is situated on the Algoma Central and Hudson's Bay Railway, in the Michipicoten district. The ore is mined in fairly lumpy condition, making it very suitable for blast furnace use, being easily reduced in the furnace. The chief impurity of the Helen ore is pyrite, which fortunately occurs in such a form as to allow of it being easily separated at the mines. As this ore has to be sub-



SHOWING POURING POSITION OF ELECTRIC FURNACE, AND VENT THROUGH WHICH ESCAPING GASES ENTER THE SUSPENDED STACK; MOFFAT-IRVING SMELTERS, LTD., TORONTO.

ject to little concentration compared with that at other mines, it claims little of our attention under these circumstances.

The Magpie Mine.

This mine, twelve miles north of the Helen Mine, and near the Magpie River, is chiefly composed of siderite. The ore has been proved for some 4,000 feet in length and at least 650 feet in depth, with an average width of 30 feet. In 1911, Dr. Goodwin reported 20,000,000 tons of ore proved by diamond drilling. The fresh siderite is compact and quite white, but soon weathers to the characteristic rust color of limonite. For comparison, the analysis of the Helen ore is given with the Magpie ore.

	Magpie.	Helen.
Metallic iron	40.00	57.77
Carbon dioxide	18.00-20.00	....
Lime	7.00	0.23
Magnesia	5.00	0.14
Manganous oxide	2.00	0.165
Alumina	4.00	0.88
Silica	8.00	4.40
Phosphorous	0.02	0.127
Sulphur	3.50	0.136

The high percentage of sulphur in the Magpie ore is, of course, prohibitive in the use of the raw ore, but fortunately it can be completely removed by roasting, reducing it as low as 10 per cent., while at the same time the ore loses about 20.0 per cent. of its weight, and the iron content rises to over 50.0 per cent. The ore, after roasting, is in nodules, hard enough to stand shipment, though it still retains its porosity, and only a little fine ore is produced.

Concentrates and Briquetting.

From the foregoing brief reference to the chief deposits of iron ore in Ontario, it is seen that in only very rare cases is the ore suitable for smelting as mined, owing to the considerable extent to which it is contaminated with the gangue material, or the iron content of the ore is too low to permit profitable smelting. It is, therefore, necessary that the ore be concentrated, and for this purpose magnetic concentration is generally employed. To enable this to be done satisfactorily, the ore has to be crushed to various degrees of fineness at the Moose Mountain from 80 to 100 mesh; and when experiments were made at No. 4 Bessemer, 50 per cent. of the crushed ore passed through a 200 mesh.

This fine ore cannot, however, be used in a blast furnace, therefore it is now necessary to nodulize or briquette it. In this there are great difficulties to be overcome, a suitable briquetting or nodulizing process for all ores having not yet been discovered, for, when nodulized, the ores must stand transportation, resist pressure in the furnace, and be fairly porous. Here, then, is the problem of the Canadian ores. As the majority of them have to be crushed either to separate the ore from the gangue material or increase the iron content, or both, could not the fine ore as it comes from the concentrator be successfully smelted? If this smelting could be done at the mine, might not the lessened tonnage for its transportation in the form of pig metal make it profitable? This is a considerable item when we think of the distances which ores frequently have to travel.

Electric Furnace Treatment.

This problem has occupied the attention of James W. Moffat for many years, and he has designed and patented an electric furnace which promises well to meet such conditions as exist relative to Canadian ores. When a large quantity of fine ore is used in the blast furnace, a large proportion of it is carried away with the rush of ascending gases from the furnace, filling up flues and accumulating under the boilers and in the blast stoves. Unfortunately, the proportion remaining in the furnace tends to produce irregular working and those ills to which a blast furnace is heir.

The idea occurred to Mr. Moffat to reverse the condition of the blast furnace, and instead of making the gas pass through the more or less dense body of descending material, reduction could be obtained by passing a shower of fine ore through a body of hot ascending gases. This is the basic idea of his furnace. To secure this condition, it necessitates the generation of heat by other means than the combustion of fuel, and electricity supplied this. After preliminary trials had been made on a small scale in the laboratory, a 300 k.w. furnace was built to meet commercial conditions by the Moffat-Irving Steel Works at Toronto. The experiments made up to date have proved entirely satisfactory and promise a solution of the ore question. The furnace of which illustrations are given is of 300 k.w. and three-phase type. Current is received at 12,200 volts, which is stepped down by means of a transformer to 80 volts. It is next delivered to the furnace through the usual copper bus-bars, then by means of copper cables clamped on to three graphite electrodes, the clamps being water-cooled. Bronze water jackets surround the electrodes where they pass through the roof of the furnace.

Moffat-Irving Furnace.

The electrodes are circular in section, being 5⅛ in. diameter and 40 in. long. They are fitted for continuous feed and are regulated by hand. The furnace itself consists of a hearth, a reduction chamber and a stack. The hearth, which is enclosed in a steel shell, is of the tilting type operated by two hydraluic cylinders placed underneath the furnace. The lining is of magnesia brick and magnesite and tar. In the centre of the roof is an opening registering with a similar one in the reduction chamber, and, when the hearth is tilted, the contact is broken at this junction. It is, however, rendered quite air-tight on replacing the furnace. The reduction chamber is in the shape of an inverted cone and opens direct to the stack where the ore, flux and carbon are fed into the furnace at a height of some thirteen feet above the hearth.

The ore, flux and carbon are stored in bins at the top of the building, and from the bottom of these bins the contents are led to hoppers placed at the side of the stack above the reduction chamber. The materials are separately showered into the furnace by means of worm screws, these being controlled by three variable speed cone pulleys driven by a 3- h.p. motor. They are so arranged that any single speed may be quickened or slackened independently of the others, thus permitting any desired ratio, or all can be regulated together by changing the speed of the large cone pulley directly connected with the main shaft.

Preliminary Experiments.

The material used for the preliminary experiments was blast furnace flue dust. This had several advantages: Firstly, that it was in a fine state of division, thus resembling the fine concentrates; secondly, it permitted a concentration test being made; thirdly, it was a waste product. The flue dust after concentration was of such fineness that 60 per cent. passed a 60-mesh screen, and all passed a 10-mesh screen. The analysis of this concentrate is given below. For reduction purposes, coke breeze was used, and for flux, air-slacked lime.

	Flue Dust.
Silica	**4.80**
Ferric oxide	87.36
Ferrous oxide	3.14
Lime	0.10
Alumina	2.40
Magnesia	0.30
Manganous oxide	0.56
Sulphuric acid	0.14
Phosphoric acid	0.115
Carbon	0.82
Loss on ignition	0.2
Metallic iron	63.60

Coke Breeze.		Lime.	
Ash	22.00	CaO	54.81
S.	1.26	MgO	1.01
Vol. Car.	6.30	SiO	2.08
Fixed	71.70	P O	0.004

On the above analyses, the quantities of materials were calculated, and the speeds of charging were calculated on the best Swedish practice of 1 lb. of metal per k.w. hour. Taking them as calculated, we used:

Flue dust for 1,000 lbs. of iron	1,572 lbs.
Coke dust for reduction	289 lbs.
Lime for fluxing	278 lbs.

Rate of Feeds.

One lb. of metal per k.w. hour at 250 k.w.—250 lbs. of metal into furnace per hour.

1,572 lbs. of ore at 393 lbs. per hour would take four hours.

Coke on the above basis, 72 lbs. per hour were used.

Lime on the above basis, 72 lbs. per hour were used.

On this particular run, the materials were all fed into the furnace 20 minutes under the four hours, and were all melted except for a small ring round the hearth which, when mixed, was clearly melted about 5 minutes afterwards. The slag was then poured off and the metal cast into pigs, which gave the following analysis:—

Carbon, 0.02; silicon, 0.01; manganese trace; sulphur, 0.131; phosphorous, 0.013.

On another occasion a run was made, using the same proportions only fed into the furnace at the rate of 1 lb. of metal per ¾ k.w. hour, or the equivalent to the reduction of 1,000 lbs. of metal in 3 hours. This heat was not quite so clearly melted when the ore had been fed into the furnace, but was completely so inside the 3 hours' time, and when poured the metal gave the following analysis:—

Carbon, 0.02; silicon, 0.04; manganese trace; sulphur, 0.138; phosphorous, 0.017.

On referring to the analyses of the materials charged, it will be noticed that the coke was high in sulphur, and that the flue dust was low in sulphur. The coke introduces 77.3 per cent. of all the sulphur entering the furnace, or nearly four-fifths. Had charcoal been used instead, the sulphur would have been reduced to about 0.03 in the pig. The reduction of the ore depends upon a rich supply of carbon monoxide gas.

Conclusions.

The process of electrically smelting finely-ground ores seems particularly adapted to such conditions as present themselves in the iron ore districts of Canada, where the ore has to be crushed to a considerable degree of fineness to separate it from the rock material; in fact, the finer the ore is crushed the better for smelting purposes, while the difficulty of getting a suitable briquetting process is entirely avoided. The transportation costs should be reduced 50 per cent. by shipping pig steel, instead of double its weight of ore. Pig steel being of high-grade quality, the product should be a desirable one on the market. Fortunately also the smelting operations could be carried out at the mines in a majority of cases, or at a common centre, as in Central Ontario and Ottawa districts, where there is abundant water supply, capable of delivering power at a low rate. The extensive forests in the neighborhood of the iron ore deposits would supply the necessary charcoal used in the reduction of the ores.

The possibility of electric smelting iron ores is not new to Canada. In the year 1904 the Dominion Government appointed a commission to investigate the electric furnace processes for smelting iron ores, as carried out in Europe, and, as a result of their report, an experimental plant was erected at Sault Ste. Marie, under the guidance of Dr. P. Heroult, of La Praz, France, the object being to test the possibility of electric smelting of the Canadian ores. The results of these experiments did not, however, further the electric smelting industry in Canada.

Since that date the general improvement in electric furnace manipulation and construction has made rapid progress, and, how much this is so, can be more readily realized by comparing the results of the furnace described in this article with the following statement published by the commission after a special run on ore had been made for them at La Praz by Dr. Heroult:—

"The ore employed was in a more or less finely divided condition. The gases developed in the zone of fusion and reduction could not, therefore, readily escape, and whenever the pressure of the formed gases exceeded the weight of the charge above it, a blow-out would occur, ejecting part of the charge. This, of course, would not occur if the charge consisted not of 'fines,' which prevent free egress of the gases formed, but of coarse material with interstitial spaces for the discharge of the gases."

In view of this statement, the foregoing results are of great importance, as they prove that not only are fines able to be smelted, but that fines alone have been successfully reduced. Again, the results are of value for their immediate bearing upon the future development of the iron ores of Canada.

The present year will see a lowering of wages and more unemployment in Canada than at present. The great question, and it is becoming very serious, is how to turn this waste energy to profitable use. If the war should be over early next year, which is hardly possible, 100,000 more men will be back looking for work. Fortunately the farm offers a splendid living and unusual profits, but our Departments of Agriculture and Labor are toying with the situation. Their policies are so ineffective as to lead the public to think they do not realize how delicate is Canada's business position at this time, and how much depends on what the heads of these departments do to relieve it.

A NEW MANGANESE STEEL. . .

AN improvement in manganese steel alloys is announced in a recent patent (U.S. 1,113,539—October, 13, 1914) granted to William Campbell, John H. Hall and Henry M. Howe. It offers a new class of such alloys, said to possess the characteristic hardness of the regular manganese steel but containing a lower amount of manganese. This is claimed to render production cheaper and afford practical advantages in certain other respects. Commercial manganese steel contains from 11 to 14 per cent. of manganese, and hitherto any attempts to produce a steel lower in manganese than 10 to 11 per cent. has tended to make a metal nearly as brittle as glass and unfit for commercial use.

The invention is based on the discovery, made by the inventors, that a certain critical relation exists between the percentage of manganese and the percentage of carbon employed with it in the alloy, and that by proportioning the carbon ingredients in accordance with this relation, a steel may be obtained containing from 6 to 9 per cent. of manganese or as low as 5 per cent., and "possessing to a very valuable degree the characteristic combination of ductility with hardness and the other important properties of the richer alloys."

It is believed that there is a practical limit, around 5 per cent., for the diminution of the manganese, according to the invention. For practical resons, the limits of this relation have been narrowed by the inventors so that in its preferred form, the product having in its composition an amount of manganese less than 9 per cent., and somewhat more than 5 per cent., contains carbon, other than graphite, between or not materially exceeding the following narrower limits, viz. 1.075—.04 of the percentage of manganese as one limit, and 1,075 + 1/3 of the percentage of manganese as the other limit, the percentages being taken with reference to the whole.

For example, for an 8 per cent. manganese steel, the preferable limits for the carbon are $(1.075 - .04 \times 8) = 0.755$ per cent. and $(1.075 + 1/3 \times 8) = 1.342$ per cent., the particular amount of carbon present being controlled within these limits and according to the degree of ductility required in the product. The ingredients of the product are preferably brought together in a molten state, as is usually the custom with manganese steel alloys and in the above proportions. After casting, the metal is properly water-toughened. The new alloy is a poor conductor of heat and practically nonmagnetic.

The patent has been assigned to the Taylor-Wharton Iron and Steel Co., High Bridge, N.J.—Iron Age.

PRODUCTION METHODS AND DEVICES

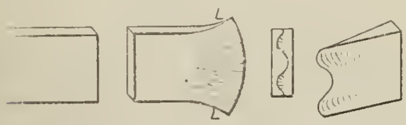
A Department for the Interchange and Distribution of Shop and Office Data and Ideas Evolved from Actual Practical Application and Experience

WEDGE FOR HAMMER HEADS.

By E. S. H.

ALL mechanics have trouble with loose hammer heads and disappearing wedges, but few bother to buy the patent contraptions sold to prevent this trouble. Let your mechanic try a "home-made-un" before losing his temper.

Take a strip of flat or round iron of suitable size. Flatten and spew out the end and nick at the proper length for breaking off. Hold edgeways on an an-



WEDGE FOR HAMMER HEADS.

vil and edge-in to a slightly wedge shape, when the entering edge will frill up, as shown in the sketch. All that is now necessary is to nick the shaft with a hack saw or chisel, and drive the wedge home. It will enter easily, do the expanding and not come out. With suitable material it can be easily made cold as well as hot.

CONCERNING FOUNDRY COSTS.

By "Melter."

THE problem of how to keep uniform foundry costs with a maximum efficiency at a minimum of time and expense is a difficulty experienced by all founders, and, while no two systems are identical in all details, the same basic principles are involved.

There are in all five distinct divisions into which costs may be divided, namely: materials, productive labor, unproductive labor, commercial, overhead.

These divisions are again subdivided into:

1.—Materials, consisting of metals used, alloys, lime, coke, sands, gravels, facings, core room supplies, chaplets, lumber for flasks.

2.—Labor, productive, consisting of moulding, moulders' helpers, cupola labor, core makers, core makers' helpers, cleaners, clippers.

3.—Labor, unproductive, consisting of salaries of superintendents and foremen, chemists, clerks, pattern makers, carpenters, blacksmiths, electricians, crane men, yard labor.

4.—Commercial, consisting of sales, administration.

5.—Overhead, consisting of interest on capital value, lighting and heating, fire insurance, compressed air, cost of painting, cleaning, repairs, maintenance of machines and equipment, rates and taxes.

Two convenient forms are shown which involve the above classification and give at a glance the main factors.

Summary of all Expenses.

	Per Cent.	Amount
Labor.		
Molding		
Melting		
Cores		Form No. 1.
Chipping room		
Foremen		
Clerks		
General labor		
Overhead expense		
Total		
Materials.		
Metals		
Coke and cupola material		
Molding		
Cores		
General		
Poor castings		
Total		
Grand total		
Castings.		
Machine made		
Green sand		
Dry sand		
Miscellaneous		
Total		

In order that all this information may be accurately preserved, it is necessary to have distinct record books; one for the mixture which gives the percentages of pig iron, cast scrap, steel scrap, alloys, the way in which they are charged into the cupola and the coke charges. Another book would give the information relating to the output and would be divided into columns giving the drawing number, total quantity, number of good and bad castings with their weights and to what cause the defective castings may be attributed. A further book should give the order number, invoice number,

Material. Date......

Material.	Quantity	Price	Amount
Melting			Form No. 2
Total			
Molding			
Total			
Core room			
Total			
Sundry expenses			
Total			
Output			
Total			
Summary.			
Metals			
Melting			
Cores			
Moulding			
Sundry expenses			
Total			
Average cost per 100 pounds	Material Labor Total		

description of casting, pattern number, average weight, total weight, number ordered and number shipped.

In connection with the order book, an order card should be employed. This card is filled in (with number required, etc.), and affixed to the pattern with a tack and placed in the rack where in due time it is put on the floor and filled in daily by the contract clerk, assisted by the molder. The card gives all

Order Card. **Date......**

Order Number.	Pattern Number.	Number Wanted.	Date Required.	Date Finished.
Price Per Mold.	Number of Cores Per Casting.			

Date	Number Molds Pored	Number Castings Good	Broken	Bad	Number Hours		Amount

information in connection with the particular casting in question and does away with all arguments between moulders and clerks.

The fourth book is the time record. There should be a page for every man, covering a month's work, and the facts which should be enumerated are: Name of workman, clock number, time record, total hours, rate, total value, amount contract, amount wages, balance; checked, initials.

To what order the castings are to be charged, description of work, number of operations, number of pieces, price each and amount of work is written in.

If it be desired to find the cost of an individual casting, the weight in pounds must be multiplied by the cost of metals used per pound, to which is added the percentage of non-production, the productive labor charges, proportion of commercial and overhead charges, all of which information is readily available if the above cited facts are recorded.

Stop Exportation of All Manganese.—The exportation of manageneses and ferro-manganese from Canada has been prohibited to all destinations, under an Order-in-Council now passed.

OUR LACK OF MANUFACTURING EFFICIENCY.

By "President."

WHILE the European war has given to Canadian manufacturers quite the greatest opportunity in their history, it has also developed a line of criticism of them that will undoubtedly be heard much of in the years to come. We are everlastingly hearing of Germany's successes in many fields, and the part that her efficient methods have played is always emphasized. One United States manufacturer in the machine tool and allied fields personally investigated conditions in Germany with a view to finding out why it was that the Germans were able to undersell him. He had been under the impression that German labor was very much cheaper, but found that when taxes and cost of living were considered, the Germans had an advantage of only 5 per cent. to 7½ per cent. Incidentally he found that German workmen saved more money than the average American workman. He also found that the Germans studied organization and the elimination of waste, much more than do the manufacturers of Great Britain, the United States and Canada.

Most Canadian industries have started with small beginnings and there are few successful manufacturers in Canada who will not to-day look back and express surprise that they had the pluck to chance their entire savings and the courage and perseverance to keep on in the face of many discouragements. The hardest thing they had to overcome was a lack of organization and trained employees. They, themselves, were not thoroughly familiar with the work they had undertaken and they had perforce to instruct ignorant employees. They had to fight the losses and worries the best part of their lives before they got an organization that was even fairly efficient. The elimination of waste, which is efficiency, they knew nothing of in the early days. The Germans on the other hand were taught this lesson at the outset and they have thousands of efficiency experts and thoroughly trained men for every department of their business. Great Britain, too, in many lines is most efficiently organized, and where she is so the Germans have not been able to compete with her in either cost of production or quality. They have beaten her in many cases in salesmanship.

Training Employees.

Kitchener says it will take two years to train a man to be a really good soldier. Yet the recruit is under capable instructors all the time. His work is simple. It is laid down exactly in the drill books and when he comes to apply his work in war he is under the direction of more highly trained men than himself and is required chiefly to obey their orders or use a fair degree of common sense when otherwise.

If all this training is required to make an efficient soldier how much more important is the question of training and efficiency in the factory? It is the most important matter before the Canadian manufacturers to-day. It will be used against them when they ask for more protection, or when they oppose a lowering of duties because of foreign competition.

To meet the situation effectively, Canadian manufacturers must be able to show that they are efficient. They must have a man or men in their plant who is responsible for this phase of their business alone, and they must themselves read, and encourage their employees to read the best business and technical papers.

Detinning Process.—A new method of removing tin from coated metals has been invented by Wallace Savage, Piedmont, Alabama. The inventor has discovered that at a temperature below 68 deg. F. and preferably at 32 deg. F., a coating of white tin can be changed to the non-adherent gray tin by the catalytic action of gray tin, applied in the form of a slimy mixture with a solution of tin ammonium chloride. A mixture of about 2,500 lb. of gray tin is used with a solution of 10 lb. of tin ammonium chloride in 100 gals. of water. Agitation may be employed, or the coated material may be merely moved through this slime.

TRADE AND COMMERCE RECORD

Dealing With the Steps Being Taken and Progress Made by Industrial Canada To Achieve and Maintain a Dominant Place in the Markets of the World.

BURLINGTON STEEL CO. OUTPUT

IT is very difficult to outline the steps that any industry takes to offset a trade depression. It necessitates, of course, many changes in the organization, such as more economical methods of production and smaller margin of profits. During the past year most industries have practically sacrificed their profits in order to obtain every pound of business which is going in Canada, and so keep their mills in operation and hold their organizations.

The Burlington Steel Co. have during the past year produced about 15,000 tons of steel bars, these consisting principally of reinforcing steel, angles, flats, channels, etc., for use among the agricultural implement makers and other industries using these commodities. The production of a number of special sections which up to the present time have almost entirely been made either in Germany or England, was also undertaken.

CANADIAN GOVERNMENT MEMORANDUM RE NICKEL.

THE following memorandum was issued by the Dominion Government on December 26:—

"Various criticisms have appeared in the press with regard to the export of nickel matte from Canada to the United States.

"The whole subject has been under careful consideration and investigation by the Government of Canada since the commencement of the war, and they have been in frequent communication with the British Government as to the precautions which should be taken to prevent export to Germany.

Periodical Inspection in Force.

"The books of the company concerned in New York are inspected at short intervals by a thoroughly trained and experienced accountant, who goes into all exports most thoroughly and reports to the Canadian Government. In addition to this, by an arrangement between the company and his Majesty's Government, certain control is exercised in London through the company's British representatives. The company is not under German control, but is controlled altogether in the United States, where the vast majority of its stock is held. There may be a few German shareholders, but the proportion is insignificant, and there are no German directors.. The steps taken by the Government of Canada have the entire approval and sanction of the British Government who express themselves as entirely satisfied with the precautions that have been taken.

U.S. Consumption.

"It must be borne in mind that nickel exported from Canada to the United States is used in a large number of industries in that country, and prohibition of the export, except for the most urgent reasons would be undesirable, as it would produce great business disturbances in a country, whose sympathies are very strongly with the cause of the allies. Moreover, the Government is informed that there is an output of nickel in Norway controlled by German interests which could furnish a sufficient supply for German requirements during the present war."

This European War is going to be a long drawn-out struggle, but we shall not sheath the sword which we have not lightly drawn until Belgium recovers in full measure all and more than all that she has sacrificed, until France is adequately secured against the menace of aggression, until the rights of the smaller nationalities of Europe are placed upon an unassailable foundation, and until the military domination of Prussia is fully and finally destroyed. That is a great task worthy of a great nation. It means for its accomplishment that every man among us, old or young, rich or poor, busy or leisured, learned or simple, should give what he has and do what he can.—H. H. Asquith.

DOMINION COAL CO. OUTPUT.

STEAMERS bearing coal for the Dominion Coal Company this year made 280 trips with 1,953,316 tons of coal for delivery to St. Lawrence river points, as compared with 1,714,276 tons during the navigation season last year in 258 trips, being an increase of 239,040 tons.

In addition to the total for 1914, arrangements have been made to deliver via Portland, Me., for the same territory about 75,000 gross tons, making a grand total for the year in the St. Lawrence district of 2,030,000 gross tons. The greater part of this amount has been delivered in Montreal, 1,633,988 tons in all, as against 1,457,647 tons last year.

Of this year's deliveries in Montreal, 643,279 tons have gone to Hochelaga and 990,709 tons to Windmill Point. Last year 629,716 tons went to Hochelaga and 827,931 tons to Windmill Point. The rest of the coal was delivered at the following points: Quebec, 109,968 tons this year as compared with 106,109 tons last year; Three Rivers, 153,636 tons this year as against 68,088 tons; and Levis, 55,724 tons as compared with 82,432 last year. Levis, is the only point showing a decrease in the amount shipped this year.

COKE PRODUCTION IN CANADA.

THE total quantity of coke made in Canadian coke oven plants during 1913 from both domestic and imported coals was 1,517,133 tons. The quantity of coal used for this production was 2,247,913 tons, of which 1,698,912 tons were domestic coal and 549,001 tons were imported. Of the total production during the year, 67 per cent., or 1,018,632 tons, was made in by-product ovens.

In 1912 1,406,028 tons of coke were made from 2,053,807 tons of coal, of which 1,528,509 tons were mined in Canada and 525,298 tons imported. The quantity of coke sold or used by the producers in 1913 was 1,530,499 tons, as compared with 1,411,229 tons in 1912.

The consumption of coke in Canada is much in excess of the domestic production, there being a considerable importation of coke chiefly into Ontario and Quebec for use in the metallurgical industries.

The imports of coke during the calendar year 1913 were 723,906 tons, and the exports 68,235 tons. Adding the production, 1,530,499 tons, to the net imports, a consumption is shown of 2,186,170 tons. Similarly estimated, the consumption in 1912 was 1,981,659 tons, and in 1911, 1,677,188 tons.

Manufacturing Locations.

In Nova Scotia, coke was made at Sydney, Sydney Mines, and Westville, during 1913, but the ovens at Stellarton and Londonderry were idle. The output was used almost entirely in the manufacture of iron and steel. The Ontario production was all from the ovens of the Algoma Steel Corporation, Ltd., at Sault Ste. Marie, the blast furnaces and coking ovens of the Atikokan Iron Co. at Port Arthur being idle throughout the year.

In Alberta, coke oven plants were operated at Coleman, only those at Lille and Passburg remaining idle throughout the year. In British Columbia, the ovens at Fernie, Michel, and Hosmer were active while those at Carbonado and Comox were out of commission. The coke output of these Western Provinces is used chiefly by the copper and lead smelters, finding a market in the United States as well as in Canada.

Coke Ovens in Operation.

The total number of ovens in active operation on December 31, 1913, was 1,720, while 1,375 were reported idle on the same date. In Nova Scotia, the Dominion Iron and Steel Co. has 620 finished ovens, all of the Otto Hoffman by-product type. The by-products from these ovens include tar, sulphate of ammonia, and gas. The tar is sold to the Dominion Tar & Chemical Co., whose works are contiguous to the coke oven plant, and this product is treated for the manufacture of refined tar, pitch of various grades, benzole, cresote, carbolic acid, and many other tar products. Sulphate of ammonia is produced in crystallized form for the trade, and the gas is used in the company's furnace operations.

The Nova Scotia Steel & Coal Co. has 30 ovens of the Bauer type and 120 Bernard ovens. The latter are situated near the blast furnaces, and the surplus gas is used for the production of steam for the electric power plant. The surplus gas from the Bauer ovens is used in generating steam for general colliery use. The other ovens in Nova Scotia number 178, and are all of the Beehive type.

In Ontario, the Atikokan Iron Co., has 100 Beehive ovens at Port Arthur, and the Algoma Steel Corporation, Ltd., 110 Koppers by-product regenerative ovens at Sault Ste. Marie, tar, sulphate of ammonia and gas are recovered as by-products.

In Alberta the International Coal & Coke Co. has 216 ovens of the Beehive type at Coleman. The West Canadian Collieries, Ltd., at Lille, has 50 ovens of the Bernard or Belgian type, and the Leitch Colleries, Ltd., has 101 Mitchell rectangular ovens at Passburg. The ovens of the latter two companies were idle during 1913.

The Crow's Nest Pass Coal Co. has 454 Beehive ovens at Fernie, 486 at Michel, and 240 at Carbonado, the latter having been idle for some years past. The Canadian Pacific Railway, Ltd. (Hosmer Mines) has 240 Beehive ovens at Hosmer, and the Canadian Collieries (Dunsmuir), Ltd., 150 ovens at Comox on Vancouver Island.

The exports of coke during the calendar year 1913 were 68,235 tons, as against 57,744 tons exported in 1912, and 9,852 tons in 1911. These exports are all from British Columbia and Alberta.

The imports of coke during the calendar year 1913 were 723,906 tons valued at $2,180,830, as against imports of 628,174 tons valued at $1,702,856 in 1912, and 751,389 tons valued at $1,843,248 in 1911.

Coke Ovens By-Products.

The production of by-products from coke ovens in 1913 at Sydney and Sault Ste. Marie included 8,371,600 gallons of tar and 10,608 tons of sulphate of ammonia. In 1912, the production was 8,428,896 gallons of tar and 11,289 tons of sulphate of ammonia.

DOMINION STEEL CORPORATION.

AT the close of last year there were some indications of a possible shrinkage in trade and of a reduction in industrial activity in Canada. During the earlier months of this year these conditions were more or less marked, but the operations of the Dominion Iron & Steel Co., Ltd., were kept about the average by orders received from Australia and South Africa. Later there came the promise of a renewal of activity in the shape of large contracts for rails and other materials required for the construction of the great railways and public works in the various parts of the Dominion, and orders for lighter forms of steel for general consumption.

Work on these had only well begun when war was declared, and general disruption of business arrangements ensued. For a time operations were reduced to a minimum, and the outlook was most discouraging. Efforts were made to secure market in Great Britain for some portion of the company's output and these were fairly successful. Operations have been gradually increased and the working force is now about two-thirds of the normal.

The output of the principal products during the year is approximately as follows:

	Tons.
Iron ore mined	335,000
Limestone quarried	295,000
Pig iron made	181,000
Steel ingots made	237,500
Rails made	120,000
Blooms & Billets for same	23,500
Wire rods made	37,700
Wire and wire products	26,000
Steel bars	15,000

CANADIAN STEEL FOUNDRIES, LTD.

THE Canadian Steel Foundries, Ltd., operate three plants, one at Welland, one at Point St. Charles, Montreal, and one at Longue Pointe, Montreal. The Welland plant consists of a steel foundry and rolling mill, and specializes in the manufacture of car couplers. There is a capacity of about 400 complete couplers per day, consisting of the Sharon, Simplex, Tower, Janney and others in upwards of 100 different types and sizes, suitable for freight and passenger cars, and locomotives of all descriptions and weights. These are the leading couplers in use in the United States and the capacity at Welland is such as to be able to care for the entire requirement of car builders and railroads in Canada. There is also full equipment at this plant for the manufacture of miscellaneous steel castings. The rolling mill has a capacity of about 4,000 tons of finished product per month, consisting of both iron and steel merchant bars, also standard angles, channels and "Z" bars, such as are used in steel car construction.

At the Point St. Charles plant are several departments, chief of which is a steel foundry with a normal capacity of 900 to 1,000 tons of miscellaneous acid open hearth steel castings per month. The frog and switch department is at this plant, there being capacity of 250 complete sets of switch material per month, in addition to built-up diamonds of all types for steam railroads. The spring department is also located at Point St. Charles, where are manufactured all classes of both coil and elliptic springs, although specializing largely on springs for cars and locomotives. Miscellaneous spring work from smallest types to the largest in both coils and elliptics is also turned out. The grey iron foundry here produces all classes of miscellaneous iron castings for the general trade.

At Longue Pointe there is a steel foundry and machine shop for the finishing and assembling of manganese track work for steam and electric roads. The foundry has a capacity of about 1,800 tons per month, the output in 1913 being at the rate of from 1,500 to 1,600 tons per month. All classes of castings irrespective of size or weight are made at this plant. The variation in weight runs from one pound to one hundred thousand lb. A specialty is made of castings for locomotives, steel rolls of all sizes for rolling mills, also castings for vessels of all types and sizes, the foundry being the only one in Canada, and one of the few in America, registered at Lloyd's and recognized by them as manufacturers of steel castings to be used in the construction of vessels to be classed at Lloyd's.

In addition to acid open hearth castings, there are made vanadium and manganese steel. The manganese steel amounts to a large tonnage and is used in all castings that are subject to excessive wear, such as discs for crushing machines, rubbing blocks, etc. Their principal use, however, is in track work, in which the company specializes, manufacturing solid manganese and insert manganese intersections, frogs and switches for street railways, also diamond crossings and frogs for steam railroads.

The output of the Canadian Steel Foundries for the year 1914 has been, as was to be expected, much below normal, the figures, as we go to press however, not being completely available for purposes of comparison.

IRON AND STEEL TRADE REVIEW, 1914.

THE industrial depression prevailing in Canada at the opening of the year was very apparent in the iron and steel trade. Conditions were similar to the last few months of 1913 when trade fell off after a period of good business earlier in that year. A noticeable feature during 1914 was the falling off in building permits; most districts, every month, showing a decrease over the corresponding month of the preceding year. This of course, vitally affected the steel trades, as it included in the decline larger buildings, also factory extensions. The financial stringency was of course responsible for the curtailment. It also had the effect of retarding the development of industries generally and putting a check on the building of new factories.

Another feature affecting the steel trade was the decline in railway construction which up to the last few months had been proceeding at a rapid rate. The railways were obliged for economic reasons to considerably curtail their expenditures, and new projects were the first thing to be abandoned. The policy of retrenchement was carried so far as to stop buying locomotives and rolling stock except that absolutely needed. Locomotive and car builders consequently suffered, and rail mills were quiet all the year. The Government grant to the C. N. R. raised great expectations of large expenditures in connection with the completion of the road, but the unexpected happenings in August put a stop to that also.

A revival in the steel trade was looked for in the late spring, but it did not materialize to any marked degree, although the industrial situation did improve during the summer. Prices on bars, plates and small shapes which had kept at a steady level until early in May dropped a dollar a ton and remained at that level until early in August when they went back to the original figure. It will be noted that during the first half-year the steel trade had been quiet but gradually improving towards the latter part of that period.

This improvement, however, was not destined to continue, for early in August, Great Britain and of course Canada, became involved in the most gigantic struggle that the world has ever seen. Naturally the trade of the country was then thrown into a state of chaos and for a time there was a species of panic in business circles. All industries were affected for a time, but gradually the commonsense attitude of the people asserted itself and a serious effort was made to keep the wheels of industry moving, and as many men employed as possible. This effort met with a certain amount of success and conditions were later on further improved when orders for several million dollars' worth of war equipment and material were distributed among Canadian concerns.

Good advice to produce more is heard on every hand, but there is little or no capacity shown in Governmental circles in the matter of affording opportunity to do so. Since the Minister of Finance advised the people of Canada to produce more, there has been a pause of eager anticipation for a Governmental move toward affording the opportunity.

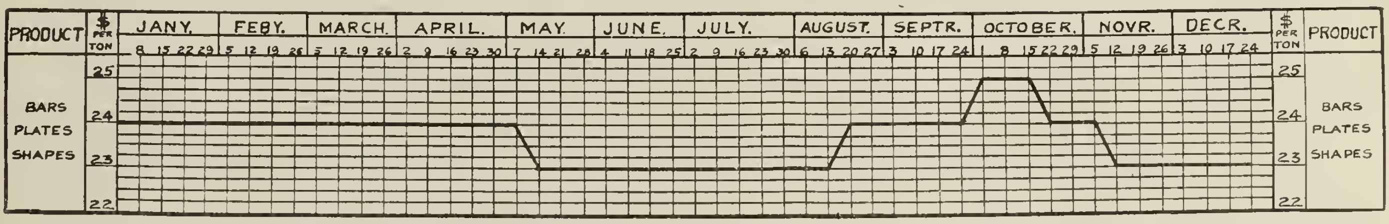
The steel trade was unfortunately rather badly hit by the war as the orders placed for war material did not by any means compensate for the loss of business from ordinary sources. The Dominion Steel Corporation were perhaps the most fortunate in this respect as they received fairly large orders for wire and wire products. Strong efforts were and still are being made by representatives of all the steel mills to obtain new business, but in this they have only so far been partially successful. There have been many views expressed as to the benefits which may accrue to the steel industry on account of the war. Up to the present the war has had a distinctly adverse effect, and the possibilities of much new business in this direction can only be conjectured.

During the second half-year, the financial stringency affected the steel trade as during the first half, but only more acutely. Manufacturing plants using iron and steel were exceptionally quiet, operating at considerably reduced capacity. Foundries were also in the same condition, and at the end of the year there are few signs of any immediate improvement. The building trade during the second half-year was even in a worse condition than at any time during the first half. The demand for structural shapes therefore fell off considerably. From the low level reached at the end of July, prices in August advanced to the same level as obtained in January. At the beginning of October the highest level of the year was reached but, by the middle of the month, prices began to decline until the present low level was reached early in November.

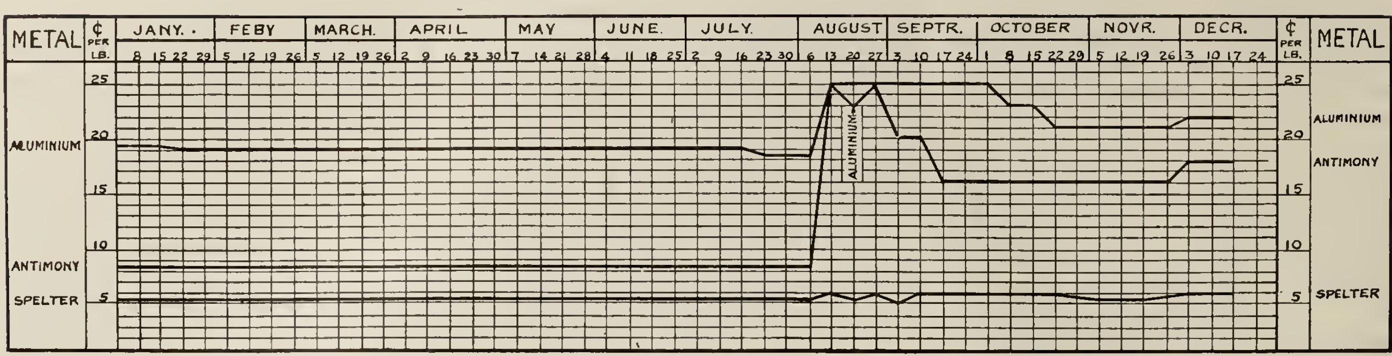
Pig Iron.

Pig iron, while subject to practically the same conditions as steel, did not fluctuate to the same extent, prices keeping fairly steady. Early in the year the market was weak and never assumed any degree of strength. Prices gradually declined and at the end of the year are at a slightly lower level than at the beginning. The Canada Iron Corporation's furnaces at Midland, Ont., were shut down throughout the year, but all other plants have produced some pig iron. At the end of September, the Victoria Furnace at Port Colborne, Ont., was blown out, while in November the Steel Company of Canada blew in a furnace at Hamilton which had been shut down for some time. There was a light demand all the year.

With regard to steel products generally, it is hardly necessary to mention them in detail as business was dull in all lines. The returns of the year when published will show a marked falling off even from the preceding year which could hardly be called a boom year. A satisfactory feature, however, is the optimistic spirit which prevails in business circles; a feeling that the depression is only of a temporary nature, and



PRICE FLUCTUATIONS OF STEEL BARS, PLATES AND SHAPES DURING 1914.



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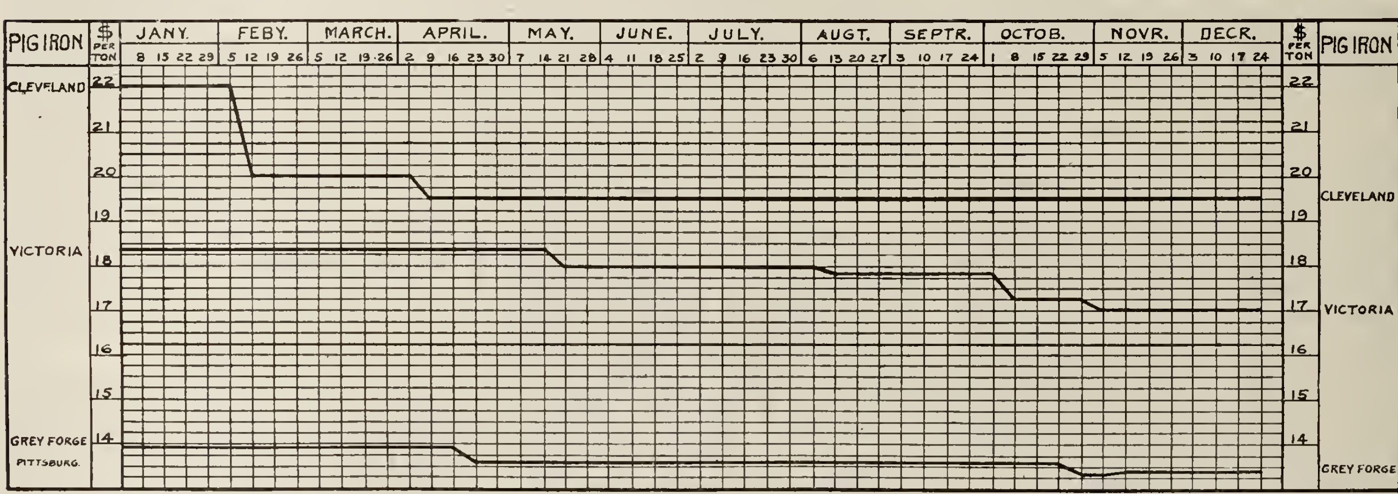
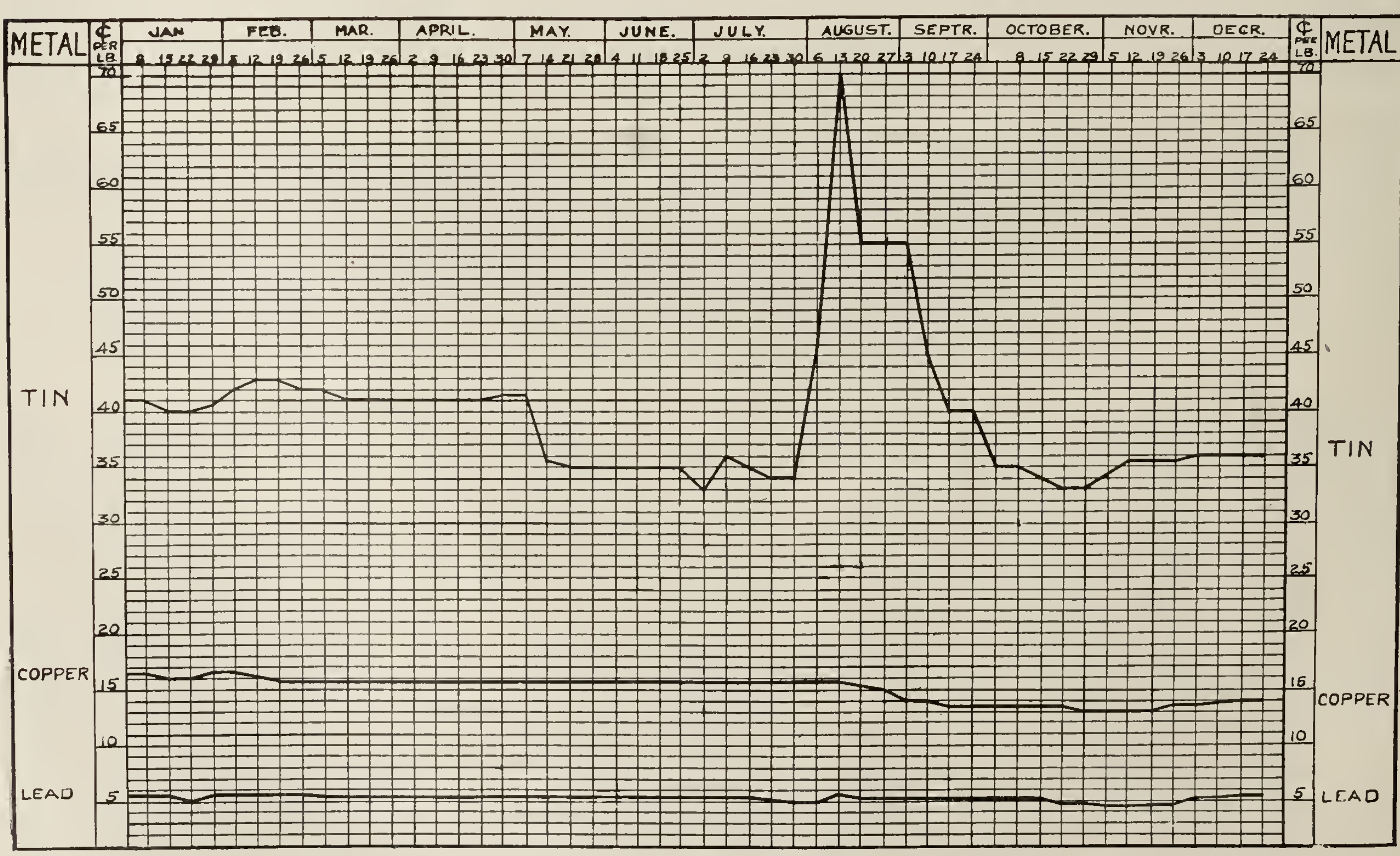


PRICE FLUCTUATIONS OF LEADING ENGLISH, CANADIAN, AND AMERICAN BRANDS OF PIG IRON DURING 1914.



PRICE FLUCTUATIONS OF TIN, COPPER AND LEAD DURING 1914.

that in time the steel industry will revive and develop to a greater extent than ever before experienced. One result of the war may be that a more extensive line of products will eventually be made in Canada. The opportunity has been presented, and it is to be hoped that it will be possible for the mills to take full advantage of the situation which is unparallelled.

METAL MARKETS DURING 1914.

THE year now closing will go down to posterity as one of the most momentous in the world's history. Never perhaps, was the trade of the world so badly disorganized as during the few weeks following the outbreak of the European war early in August. The important part which metals play in time of war will be conceded when it is realized that tin, copper, lead, and antimony are absolutely indispensable in the manufacture of its munitions. For this reason, the fluctuations in the metal markets have for the past five months been followed with more than ordinary interest. With the exception of tin, however, which reached a phenomenal figure, the other metals have, considering the situation, been fairly steady.

Tin.

At the beginning of January, tin was at a rather lower level than the average for each of the two preceding years. The market held fairly steady until May when the price dropped to around 35 cents, and early in July to 34 cents, reaching the lowest level of the year, although equalled again in the middle of October.

On the outbreak of the European war early in August, the price of tin went up to 70 cents, a figure never before reached. The price was, however, more or less nominal as the conditions were at the time so unsettled that little trading could be done; also the London and New York metal exchanges were closed down, making the situation more complicated, although it was advisable to take this step. There was for a time a great deal of uncertainty as to the possibility of obtaining supplies of the metal, but this situation was relieved as soon as it became apparent that the British navy had secured control of the trade routes. Little trouble was experienced eventually in obtaining supplies with the exception of one or two cargoes lost in the Indian Ocean.

After the destruction of the German cruiser "Emden," the possibility of further trouble was eliminated. Although the demand was and is still heavy, there has always been enough tin in sight to meet requirements, consequently the price soon came down to a more nominal figure, touching 35c at the end of September. Towards the end of October the market again became weaker, but since then it has been gradually getting stronger until the end of the year finds tin in a strong position at 36 cents. The metal exchanges in London and New York opened on November 9 and had a steadying effect on the market.

Copper.

In time of war, copper is one of, if not the most important of all the metals, but the market, considering the circumstances, has been remarkably steady. The market this year has not been subject to the same fluctuations even as in some previous years. The supply is more or less controlled according to the demand. The main sources of supply, the United States and Mexico, were never in danger of being cut off from the principal market, which this year has been Europe. The copper situation, however, is very unsettled, as being contraband of war, it is subject to seizure by Great Britain when consigned even to neutral ports. Negotiations, however, are under way between Great Britain and the United States towards possible relief of the situation.

At the beginning of the year, copper was at its highest level, being around 16.50 cents. Weakness in the market, however, developed during February, and the price dropped to a shade under 15 cents and was maintained until the middle of August, when the market developed further weakness, the price gradually falling to 13 cents at the end of October. This price held during November, but in December the market showed strength, and the price gradually rose to 14 cents, the present level.

> **Such opportunities to capture new outposts of commerce as now exist may never be with us again. They have been within our grasp for well nigh four months, and it still rests with our captains of industry to lead an attack upon them**

Lead.

The fluctuations in the lead market for the year represent about 1 cent. The highest point being reached early in August and the lowest around the end of October and early part of November; since then the market has been getting gradually stronger. Lead, considering the conditions which prevailed since the early part of August, has kept remarkably steady. In the first seven months of the year business was generally quiet, and the market featureless. Since the outbreak of the war, the ordinary business has fallen off, but the demand for it in the manufacture of munitions of war has increased in volume, and this will, no doubt, be maintained if not augmented during the coming year.

Spelter.

Dullness was the principal characteristic of the spelter market until August, when the war broke out and created a unique situation. The world's production and consumption are in normal times fairly evenly balanced. As the German, Austrian and Belgium productions are now cut off, the United States is the only large producing country. In ordinary times, the latter consumes practically its entire production, and this in conjunction with the present heavy demand from Europe, makes the spelter situation at the close of this year a strong one. There has been comparatively little fluctuation in prices during the year, the difference between the high and low levels being approximately 75 cents. The price was steady until August when the market became somewhat erratic. A high level of 6 cents was reached early in September and maintained until the end of the year with the exception of a temporary weakness early in November.

Antimony.

The heavy demand for this metal for war purposes has caused a considerable advance in price. On January 1, the market stood at 8.25 cents, and this held until the first week in August when the price jumped to 25 cents. The price began to drop at the end of August, until by the middle of September a 16-cent level was reached. This figure was maintained until the end of November when the market strengthened and the price rose to 18 cents, at which it has since continued firm. At the present time the situation is an interesting one, and there appears to be little doubt but that he present price of antimony will be maintained while the war lasts.

Aluminum.

This metal has, in common with others, been affected by the war conditions. The difference between the extreme levels was 6.50 cents, the gain since the first of the year being 2.50 cents. The year started with the price at 19.50 cents, but soon dropped to 19 cents this figure being maintained until towards the end of July, when the price dropped further to 18.50 cents. It did not stop at this level very long, as in the second week in August, the price jumped to 25 cents and, with the exception of one slight drop, it remained at that figure until October. After this, the market weakened and, by the end of October, 21 cents had been reached. Early in December the price advanced to 22 cents and that level has since been maintained. Until the war is over and business again becomes normal, metal prices are sure to fluctuate considerably.

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Vol. VI. JANUARY, 1915 No. 1

PRINCIPAL CONTENTS.

EMPLOYEES' WELFARE.

THE year just passed has been notable for the adoption throughout Canada of a number of Acts for workmen's protection and compensation in case of injury or death through accident in the course of their employment. Although these and similar legislation tend to make employees' welfare, to a certain extent, a legal necessity on the part of employers, the sphere in which the latter may show their personal consideration for their work people is not narrowed to any appreciable extent.

Much of the legislation referred to, notably the recently passed Province of Ontario Act, has been indirectly adopted from Germany and may yet require considerable amending before it will work smoothly under Canadian conditions. The objections so far urged come from the manufacturers, and are expressed in the matter of excessive and unequitable assessments. This difficulty has been partly overcome in New York State by a system of refunds, care being taken to so arrange the final assessment that the employer feels directly the result of extra effort in the care of the people in his employ. One aspect of employees' welfare work however, will be entirely changed by the present legislative enactments.

Steps taken and money invested in the preservation of the health of workmen and in reducing the hazard of their daily work have heretofore resulted in direct profit to the enterprising manufacturer. Provincial and national law will now make this a general condition attached to manufacturing and constructive business in Canada, and while the welfare of employees must, more than ever, be the result of personal thought and good-will on the part of their employers, it is not to be expected that as direct financial results will accrue to the latter as heretofore. There is, however, a vast field of activity in this direction open to the leaders of large corporations such as the provision of good homes, education, and the creation of healthy moral surroundings. These humanitarian branches of the employer's responsibility, while not yielding a financial profit, contribute immeasurably to the "holding" of workmen, the indirect importance of which has only recently been realized.

There have come to our notice several workman's benefit associations, but generally the only connection these societies have with the officials of the company organization is that the treasurer withholds from the pay envelopes each week or month the assessment for the benefit funds and which he turns over to the benefit society treasurer. The association is administered entirely by officials elected from among the employees and in some cases has been a far-reaching success. The greatest drawback, and in one instance the cause of failure has been the tendency of foremen to give the society little thought when hiring new help. Instead of taking on men more or less after the manner that insurance companies accept risks, they are inclined to hire those who may even be cheap on account of the lack of physical stamina. This eventually must tend to bring a heavy tax on the resources of the mutual benefit society. The most successful institution of this kind of which we have heard is that in which evidence of official interest is apparent by each member of the firm being assessed a monthly amount considerably in excess of that paid by the individual employees.

The welfare scheme that produces the best results and develops the greatest harmony between employers and employed is, and will always be the one that recognizes the personal element of good-will. Few managers realize that a Christmas present, if presented personally would be in every case worth many times more to both him who gives and him who receives, than if otherwise distributed. The director, shareholder or working official to-day who has not time to consider the welfare of his employees is like a mechanic who has no time to sharpen his tools, or the salesman who is too busy to brush his clothes.

THE patronage to which **Canadian Foundryman** since its establishment has been accustomed to increases with each succeeding year and we as its publishers take naturally some little pride in the fact. The spirit shown by our subscribers and advertisers in these trying days is such as will make 1915 from its dawn onwards the harbinger and bearer of greater opportunity and enlarged appropriation and, needless to say, as in the past, we are ready through the medium of our publication to measure up to every requirement.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

ABE WINTER'S LETTERS.—IV.

DEAR Henry,—Your purchase of the job shop was indeed a bold stroke at this particular time, but with perseverance and energy you will no doubt be able to keep the place busy, as repairing should increase from now on. You write thus:

"My knowledge of polishing wheel speeds is very limited and reliable advice is difficult to obtain in this locality. I do not get enough work polished in an hour to satisfy my requirements. Our work is general jobbing only, and must be economically handled to make a profit."

It is possible you are not acquainted with what might be reasonably termed an hour's work, but assuming that you are justified in your desire for greater output I can only advise you in a general way. No set rule can be laid down for the speed of either polishing or buffing wheels, and more especially is this true with reference to job shops because of the great variety of work treated.

Wheel Size and Speed.

Look over your machines and observe if there is excessive vibration, or if your wheels are running true. Perhaps you are using antiquated wheels. These are very expensive in almost every case. Modern compress wheels will save you money by reducing the time required to change or reset wheels and your actual wheel efficiency will increase at least 25 per cent. The above points are usually of greater importance than the speed of the wheel which of course must also receive due consideration and, with general reference to polishing wheels, should be approximately 2,000 to 2,500 r.p.m., for stove parts, forgings, brass castings, cycle parts, etc. This applies to wheels of from 10 inches to 14 inches diameter, but if smaller wheels are employed, the speed may be greater. Again, if larger wheels are used, much depends upon the skill of the workman whether a reduction of speed is necessary.

Glue and Emery Quality.

The quality of emery and glue used has a direct bearing on the speed of polishing wheels; i.e., the efficient speed will be limited by the melting point of the glue also by the hardness of the emery. Different grades of glue have different melting points, therefore it is necessary to select a high grade hide stock glue; the sheet or flake variety is preferable for emery.

Much waste and annoyance in emery polishing is caused by the use of inferior glue or by improper use of a good glue. The speed of the wheel and other conditions may be perfectly adapted to the class of work being treated and yet, if the application of the glue be wrong or the quality poor, the maximum efficiency of the wheel cannot be obtained. Some workmen abuse a polishing wheel by working on the glue after the emery is worn off, and then blame the wheel for burning the work, nevertheless a polishing wheel will not burn the work if properly used.

Wheel Glue Preparation.

Now just a word about preparing and applying the glue to the wheel. Assuming that you have the best grade of glue, the first point is to soak it thoroughly before placing it in the glue pot. Keep a clean pail or pan for the purpose. Soak the glue in cold water, and never under any circumstances use boiling water to dissolve it. In fact the glue should never be heated to more than 212 degrees Fah., the boiling point of water, because greater heat will ruin it. Again do not place the glue pot directly over the fire in an attempt to hasten the operation, as in so doing you are actually defeating the idea aimed at. Always bring the glue to the proper working consistency: by heating the glue pot while surrounded by a water jacket. Sheet glue requires soaking over night or several hours during the day. Ground glue does not require as long time soaking, 30 minutes being usually sufficient for this grade. The latter is not, however, an efficient glue for emery, although some men use no other.

Superheated glue loses its properties of adhesiveness and is utterly useless for polishing or other purposes. No matter how excellent may be its quality, overheating or scalding will ruin it. A service glue must be flexible, uniform in structure and of good adhesive strength. Inferior glue will not retain the emery and consequently the wheel efficiency is very limited.

The glue should not be applied to the wheel too thick, else there will be waste. If applied too thin, the emery cannot get the proper setting and naturally soon wears off. Emery should be so held by the glue that when the emery crystals are broken by wear the remaining portion of the crystals present a new set of firmly held edges to the work. Unless the crystal is retained solidly, it either flies from the wheel or is loosened to the extent of reducing its cutting power. To facilitate practical treatment of all ordinary metal work the maximum speed obtainable after considering the above mentioned points should be employed and will be found most efficient.

Speed of Buffing Wheels.

The speed of buffing wheels is entirely a different question and while to a certain extent practice alone can determine it properly, I may mention several points which you will find helpful when working out the economic limit on various classes of work. It is more practical to judge the speed of buffing wheels by the effective limit of periphery speed. For instance, a 12-in. buff should revolve at a speed sufficient to cause the circumference of the wheel to travel approximately 9,000 to 12,000 feet per minute for cutting down heavy nickel or copper plate, solid brass, etc. Some buffers insist on 15,000 feet, but 12,000 feet is a fair speed for miscellaneous work. A lathe with a spindle revolving 3,600 times per minute should prove highly efficient for all lines of work usually treated in the average shop. For coloring only, slower speeds are permissible: 6,000 to 10,000 feet per minute being ample.

Solid Emery Wheel Speeds.

Now with reference to solid emery or grinding wheel speeds, we have similar conditions to consider, as the speed has a direct bearing on the effect produced by the wheel. As in polishing or buffing the greater frequency of wheel surface strokes upon a given surface of the article being ground, the quicker the desired effect on the article is obtainable; yet in grinding, there is a tendency to exceed the effective limit of the wheel, and the grains of abrasive material become dull and heat the article being ground. To minimize this condition, a softer wheel should be used. Again, we may find that a wheel is operated too

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The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

slowly for economic wear—a change to higher speed causing less wear on the wheel for a given amount of work.

For ordinary grinding, such as is done in foundries and general machine shop practice, a surface speed of 5,000 per minute is a fair medium, giving a wheel stress of 48 lbs. per sq. in. Special occasions may demand a speed of greater or less velocity, but higher speeds should be used with caution. A 10-in. grinding wheel running at 5,000 feet per minute, would have to revolve at 1,530 r.p.m., or a 12-in. wheel at 1,275 r.p.m. approximately.

General Observations

The machines in all cases must be as free from vibration as it is possible to make them in order to obtain efficient results and maintain safe and economic conditions for the operator. The belts should be kept in good repair and properly adjusted and the oiling and cleaning of the machines must not be neglected. Everything else depends largely upon the skill of the operator and elimination of useless motions. If you are in doubt about the time required to finish a piece of work, try it yourself and, in so doing, endeavor to reduce the number of movements necessary to obtain certain results. Repeat the attempt until you are satisfied and then instruct the workman to follow your example; but do not criticize the efforts of an employee until you are sure he is at fault, as by so doing you encourage a degree of contempt in the mind of the workman for your knowledge of the business. A foreman should always be close to the situation, know what he is doing, and not take anything for granted.

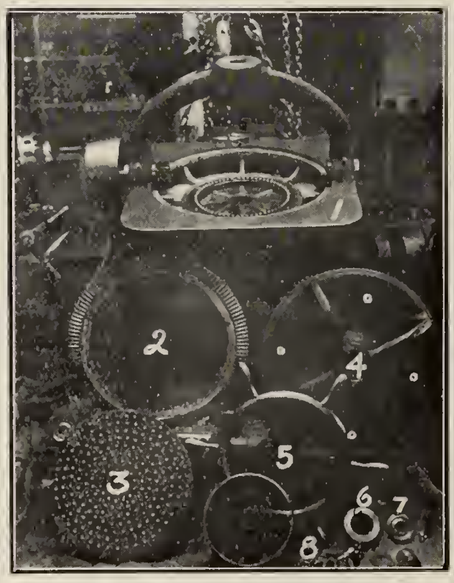
A NEW FACER BUFFER AND POLISHER.

By Wm. Gibbs.

THE straightening of flat or dished disks by hand is a tedious and difficult process and has, in fact, been regarded as a trade in itself, particularly when applied to circular saws and similar plates which require not only to be trued up but to be given a certain initial tension. In the accompanying illustration, is shown a machine designed for this purpose. It is properly known as a ball bearing, double plate rotary facer, buffer and polisher and was designed by Wm. Gibbs, of Brantford, for the purpose of straightening and polishing disk plats for plows, seed drills, plough coulters, grinder plates, saws, etc. Any disc up to 18 inches in diameter and up to $\frac{1}{4}$ inch thick can be conveniently handled by the machine.

The body of the machine is shown by numeral (1). This contains the grooved ball race which supports the bottom revolving plate upon a large circle of $\frac{5}{8}$ balls. This plate along with the upper revolving plate is driven by bevel gears attached to their outer edges. The driving is done by the small bevel pinion between the two plates as shown which obviously causes them to rotate in opposite directions. The bottom plate contains a 4-inch boss which fits into a corresponding depression in the base of the machine and, of course, is fitted with the steel ball race; the whole running in a bath of oil and giving a solid and uniform bearing capable of carrying a working load of seven tons.

The peining or straightening is done by the plate (3) which contains a large number of spirally arranged, hardened balls and the spiral arrangement insures that no two balls follow exactly the



BALL-BEARING BUFFING AND POLISHING MACHINE.

same circle on the disc. The effect of thus rolling the plate is to plate every part of the surface under a uniform tension and it leaves the machine, after 15 seconds treatment, perfectly flat and straight. The upper plate is shown at (4), while at (5) is the hand wheel for adjusting the pressure between the plates. At (6) is shown half of the small nut with the groove (7) in the upper half; (8) is a roller bearing supporting the screw. The weight of the complete machine with all attachments is 1,350 pounds.

The machine is driven by a belt so as to give either a polishing or a rolling speed. The work to be straightened and polished is first placed between the ball plates and sufficient prssure applied by means of the hand wheel and screw, this depending upon the nature of the material. After the batch has been thus peined at a speed of 300 r.p.m., the ball plates are exchanged for emery discs, the machine speeded up to about 1,800 r.p.m., and the work polished under a comparatively slight pressure. This change is accomplished in about five minutes by removing the four bolts shown by numeral (4). The whole constitutes a machine covering a wide range of difficult work and occupying little floor space.

GRINDING AND POLISHING MACHINERY.

GRINDING and polishing machinery was discussed at the second annual conference on industrial welfare and efficiency at Harrisburg, Pa., by Charles G. Smith, president and general manager of the Pittsburg Emery Wheel Co. The conference was called by the Department of Labor and Industry of Pennsylvania with the co-operation of the Engineers' Society of Pennsylvania.

About fifteen years ago, said the author, the taper on the sides of tapered wheels was $\frac{1}{2}$ in. to the foot on each side of the wheel and the flanges were made of grey iron castings, but when it was learned that about 30 per cent. higher speed than was commonly understood and recognized as a reasonably safe speed for emery wheels would give so much greater and more economical production, there were several instances where the flange has broken. We then, about ten years ago, changed this taper to $\frac{3}{4}$ in. to the foot on each side and increased the thickness of these flanges. Since then there have been practically no serious accidents. Nearly all accidents that have happened were because flanges were too small in diameter, leaving too much of the wheel exposed beyond the rim of the flanges.

Very recently there has been a strong movement demanding the removal of the dust from all grinding and polishing machines. There are now some manufacturers working on designs of devices for taking care of this feature in addition to the aforementioned features and there are already some machines on the market with all these provisions.

The National Association of Abrasive Wheel Manufacturers has a safety committee. This committee proposes to submit standards to the commissioners of labor of the various manufacturing states, insurance companies, various trades bodies, such as the National Metal Trades Association, National Association of Manufacturers, etc., as well as to the users of grinding and polishing machinery in an effort to get co-operation along these standards. In the enforcement of any law along the use of safety devices with grinding wheels, it must always be recognized there are certain operations that will prohibit the use of any protecting device and it will be impossible to make the application apply to every case. There are many special cases and in these the machine should be kept in good repair to minimize the liability of accidents and judgment should be used in such cases.


DIRECT FROM MANUFACTURER TO CONSUMER
Can. Mach.

Trade Gossip

The Don Foundry Co., Toronto, has been awarded a contract for the supply of brass castings by the Toronto Board of Control.

Sarnia, Ont.—The first war contract to come to Sarnia was one received by the Mueller Mfg. Co. just recently, calling for 50,000 brass parts for shrapnel shells for the Dominion Government.

Beaverton, Ont.—A by-law to authorize a loan of $6,000 to George Minorgin & Son of the Beaverton Foundry was carried her on Jan. 4 by almost unanimous vote. In addition to their present business, Minorgin & Son will manufacture an extensive line of toys and other goods.

The Smiths Falls Brass & Aluminum Foundry Co. has been incorporated at Toronto, Ont., with a capital of $60,000 to engage in the manufacture of brass, bronze and aluminum castings at Smiths Falls, Ont. Incorporators: J. McEwen, J. MacDonald and Monson G. Henniger, all of Smiths Falls, Ont.

Consolidated Mining & Smelting Co.—At the annual meeting held at Toronto, Ont., on Dec. 22, of the shareholders of the Consolidated Mining & Smelting Co., of Canada, Ltd., W. D. Matthews was elected president, and George Sumner, of Montreal, vice-president, the board of directors being re-elected as it stood last year, with the exception that J. J. Warren, of Toronto, replaces W. H. Adrich. The annual report, which had previously been sent out, was approved and general satisfaction was expressed at the volume of the year's business. A dividend of 2 per cent. for the quarter was declared some time ago, and was payable on January 1.

Pattern Wax.—The United Compound Co., Buffalo, N.Y., is offering a new and novel idea in the line of pattern wax made in two grades, the soft grade being about the same as beeswax, and the other hard, for use in filling defects in either wood or metal patterns. The distinguishing feature of this latter is the extra hard surface left on the pattern. Either grade will melt at about 150 degrees, and may be applied with a hot tool or melted and applied with a brush.

Canada Car & Foundry Co.—At a meeting held in Montreal on Dec. 22, the following officers were elected for the subsidiary companies:—Canadian Steel Foundries, Ltd.—Hon. N. Curry, W. F. Angus, K. W. Blackwell, W. W. Butler, M. E. Duncan, L. H. Curry and F. A. Skelton. The officers are: Hon. Nathaniel Curry, president; W. F. Angus, vice-president and managing director; K. W. Blackwell and W. W. Butler, vice-presidents; F. A. Skelton, secretary-treasurer. The Pratt & Letchford Co.—Hon. Nathaniel Curry, James Redmond, W. W. Butler, M. E. Duncan, L. H. Curry and F. A. Skelton. The officers are: President, Hon. Nathaniel Curry; vice-presidents, W. W. Butler, M. E. Duncan, and V. G. Curry; secretary-treasurer, F. A. Skelton.

Catalogues

The Hamilton Facing Mill Co., Ltd., Hamilton, Ont., are distributing among their friends an attractive calendar for 1915. It consists of a reproduction of the painting, "Scotland by the Sea," on a stiff white frame, mounted on a green background, the calendar being situated below the picture. Altogether it is quite an artistic production.

Hoists.—The Wright Mfg. Co., Lisbon, Ohio, has issued catalogue No. 6, descriptive of the Wright standard chain hoists, one type being a triplex or spur geared, and the other a screw hoist. The construction of each type is described in detail, while a series of tables give the price of each size and the prices of the various parts. The illustrations show the various types of hoist and the parts used in their construction, the latter being numbered to correspond with the tables for convenience when ordering spare parts. Other products described include the "Wright" differential chain block, steel trolleys and hand travelling cranes.

Oxy-Acetylene Welding and Cutting. An exceedingly interesting booklet has just been issued by L'Air Liquide Society of Montreal and Toronto, dealing with the above subject, with special reference to the blowpipe and its application in various trades. Numerous illustrations show examples of work done and in progress, clearly demonstrating the possibilities of this blowpipe and wide range of work than can be undertaken. The reading matter explains in detail the various classes of work in different trades than can be done by this process, the illustrations being arranged in accordance with the text to show examples of work under the various trades. Particulars are given of the different types of outfit and blowpipes, etc., while information regarding the company's oxygen plant is also included. The booklet is gotten up in an attractive manner with illustrations of a high order.

Presses.—The E .W. Bliss Co., Brooklyn, N.Y., has just issued the fourteenth edition of their general catalogue covering a full line of machines, such as presses, dies, punches, shears, slitters, trimmers, double-seaming machines, spinning lathes and special machines for working sheet metal, drop forging equipments and automatic tin-can machinery. The catalogue is of large size, and contains 840 pages, 9 x 6 in. It is divided into 21 sections, each being devoted to a particular type of press or machine. A brief description is given of each machine; in some cases, however, a more detailed description is given, as in the case of special machines. The principal dimensions and weights for each size are given in the form of tables, and in some cases a specification is included. A useful feature is included in section No. 20, which shows dies and work done on Bliss machinery, also a number of mechanical tables of value to sheet metal workers. In the last section, No. 21, is given a complete telegraphic code covering all machines listed throughout the catalogue, also numerical and alphabetical indices. The catalogue is bound in substantial cloth covers, and is a work of more than ordinary merit; much time and labor having been spent on its production.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS—Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

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W. W. Wells, Toronto.

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W. W. Wells, Toronto.

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Pangborn Corp., Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Machy. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Dominion Fdry. Sup. Co., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.
E. J. Woodison Co., Toronto.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Federal Frdy. Sup. Co., Cleveland.
Stevens, Frederic B., Detroit.
Shelton Metallic Filler Co., Derby Conn.
E. J. Woodison Co., Toronto.

Fillets, Leather & Wooden.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Fire Brick and Clay.
H. S. Carter & Co., Toronto.
Elk Fire Brick Co., Hamilton, Ont.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Whitehead Bros. Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Dominion Fdry. Sup. Co., Montreal.
Guelph Pattern Works, Guelph, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., West Allis, Wis.
E. J. Woodison Co., Toronto.

Foundry Coke.
Baird & West, Detroit.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
Sterling Wheelbarrow Co., West Allis, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Foundry Parting.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
J. S. McCormick Co., Pittsburg, Pa.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Dominion Fdry. Sup. Co., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Furnaces.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
W. S. Rockwell Co., New York.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

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Dominion Fdry Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Goggles.
Telghman-Brookshank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
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Jonathan Bartley Crucible Co., Trenton, N.J.
J. S. McCormick Co., Pittsburg, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Grinders, Disc, Bench, Swing.
Ford Smith Machine Co., Hamilton Ont.
Perfect Machinery Co., Galt, Ont.

Helmets.
Telghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

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A. R. Williams Machy. Co., Toronto.
Northern Engineering Works, Detroit.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

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A. R. Williams Machy. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.

Iron Filler.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Dominion Fdry. Sup. Co., Toronto.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Stevens, Frederic B., Detroit.
Midland Machine Co., Detroit.
J. S. McCormick Co., Pittsburg, Pa.
Tabor Mfg. Co., Philadelphia.
E. J. Woodison Co., Toronto.

Molding Sand.
Dominion Fdry. Sup. Co., Toronto.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Molding Sifters.
Dominion Fdry. Sup. Co., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Oil and Gas Furnaces.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.

Patterns, Metal and Wood.
Wells Pattern & Machine Works, Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Hamilton Pattern Works, Hamilton.
E. J. Woodison Co., Toronto.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
J. S. McCormick Co., Pittsburg, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
Columbian Facing Mills Co., Buffalo, N.Y.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Plating and Polishing Supplies.
W. W. Wells, Toronto.
E. J. Woodison Co., Toronto.

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Can. Niagara Device Co., Bridgeburg, Ont.

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Perfect Machinery Co., Galt, Ont.
W. W. Wells, Toronto.

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Canadian Ingersoll-Rand Co., Ltd., Montreal.
Dominion Fdry. Sup. Co., Montreal.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Dominion Fdry. Sup. Co., Toronto.

Rosin.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

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IF you want the correct 'phone number, you use the official telephone directory.

If you wish to definitely ascertain the location of a certain street, you consult a city directory.

If you are in need of equipment of any description, the best way to buy it is to consult our Buyers' Directory. If what you require isn't advertised in this particular issue, write to the firm or firms listed under the title of the machine you require, and catalog or literature will be gladly sent.

The firms listed in this Directory think enough of your business to ask for it, and they have unlimited confidence in the product they advertise.

Consult this Directory and you can't go wrong.

Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Hand, Trolley.
Dominion Fdry. Sup. Co., Montreal.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Melting Pots.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Standard Sand & Machine Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Dominion Fdry. Sup. Co., Toronto.
Stevens, Frederic B., Detroit.
Hamilton Facing Mills Co. Ltd. Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Rouge.
W. W. Wells, Toronto

Sand Dryers.
Pangborn Corp., Hagerstown, Md.

Sand.
Pangborn Corp., Hagerstown, Md.

Sand Blast Machinery.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton.
J. S. McCormick Co., Pittsburg, Pa.
Telghman-Brookshank Sand Blast Co., Philadelphia, Pa.
Pangborn Corp., Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
W. W. Sly, Cleveland, Ohio.
Telghman Brookshand Sand Blast Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.

Sand Blast Rolling Barrels.
New Haven Sand Blast Co., New Haven, Conn.
Pangborn Corp., Hagerstown, Md.
Telghman Brookshand Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Can. Niagara Device Co., Bridgeburg.
J. S. McCormick Co., Pittsburg, Pa.
Telghman-Brookshank Sand Blast Co., Philadelphia, Pa.

Sand Molding.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Panghorn Corp., Hagerstown, Md.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Saws, Hack.
Ford-Smith Machine Co., Hamilton.

Sea Coal.
J. S. McCormick Co., Pittsburg, Pa.

Shovels.
Can. Shovel & Tool Co., Hamilton, Ont.

Sieves.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Stevens, F. B., Detroit, Mich.

Silica Wash.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

Small Angles.
Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.
Dominion Fdry. Sup. Co., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.

Special Machinery.
Perfect Machinery Co., Galt, Ont.
Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Squeezers, Power.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.

Steel Rails.
Dom. Iron & Steel Co., Sydney, N.S.

Steel Bars, all kinds.
Dom. Iron & Steel Co., Sydney, N.S.
Dominion Fdry. Supply Co., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Talc.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.

Teeming Crucibles and Funnels.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Track, Overhead.
Dominion Fdry. Supply Co., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Tripoli.
W. W. Wells, Toronto.

Trolleys and Trolley Systems.
Can. Fairbanks-Morse Co., Montreal.
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Dominion Fdry. Supply Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks, Dryer and Factory.
Dominion Fdry. Sup. Co., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.

Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Tumblers.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.

Turntables.
H. S. Carter & Co., Toronto.
Dominion Fdry. Supply Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Northern Crane Works, Walkerville.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Vent Wax.
H. S. Carter & Co., Toronto.
Dominion Fdry. Sup. Co., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
United Compound Co., Buffalo, N.Y.

Vibrators.
Berkshire Mfg. Co., Cleveland, O.
Canadian Ingersall-Rand Co., Ltd., Montreal.

Wall Channels.
Dom. Iron & Steel Co., Sydney, N.S.

Welding and Cutting.
Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.
Dominion Fdry. Supply Co., Montreal.
Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
E. J. Woodison Co., Toronto.

Wire Wheels.
Dominion Fdry. Sup. Co., Montreal.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
W. W. Wells, Toronto.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Wire, Wire Rods and Nails.
Dom. Iron & Steel Co., Sydney, N.S.

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CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

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HINTS
TO
BUYERS

Development of the Copper Smelting Industry in Canada

By A. W. G. Wilson*

The present article is the second of a series which we hope to publish each month during the first half of this New Year. More or less detail treatment will be given the various smelting plants throughout the Dominion continuing with that of the Canadian Copper Co., Copper Cliff, Ont., in this issue. Due to the European War this industry is much in the limelight.

CANADIAN COPPER CO.—II.**

THE plant which supplies electric power for operating all the mines and the smelter of the Canadian Copper Co. is located at High Falls on the Spanish River, about four miles north of Nairn station, on the Soo branch of the Canadian Pacific Railway, and 23 miles west of Sudbury. It is connected with the main line by a spur line from the turbine station. The plant was built during the years 1904-5.

At the site selected, the Spanish River flows in two channels around a high and rocky island, about 2,000 feet in length and 900 feet in width. The fall is about 65 feet, and the island rises about 75 feet above the river level. A large forebay was cut out on one side of the island and two dams were erected in the channels, gaining a total effective head of 85 feet. These dams are of concrete construction and rest on solid rock. As much lumber is floated down this river, log slides and booms had also to be provided.

Water for the generators is conveyed from the bulkhead dam to the powerhouse at the foot of the falls by three 9-ft. steel penstocks for the generators and one 3-ft. penstock for the exciters. Provision is made for the installation of a fourth 9-ft. penstock, when required.

CANADIAN COPPER CO. POWER PLANT, HIGH FALLS, ON SPANISH RIVER.

Haulage and Distributing System.

The roast yards and smelter plant are served by the company's own railway line. At the smelter a high line, about 67 feet above the yards, serves the smelter ore bins and the reverberatory

*Chief of Metal Mines Division, Ottawa.
**From latest available Government report.

furnace plant. Standard gauge tracks are also laid throughout the yards, connecting with the smelter, converter building, various shops, and the warehouse. There are two standard 100-ton track scales installed, one at the roast yard, and the other in the main yard near the shops. Both are housed, the latter being within the building that also contains the transportation offices.

The charging floor is served by a 36 in. gauge track laid with 56-lb. rails and copper bonded throughout. The centre line of the smelter bins is parallel to the longer axis of the furnace building and about 200 feet from it. Two parallel tracks are carried under the bins and in front of the boilers in the steam power house. There are also two coaling pockets for locomotives.

Furnace charging trains are operated on these belt lines, running always in the same direction. Each train consists of a string of seven or eight side roll-dump cars. These cars are about 6 feet in length over all, being of the same length as the charge doors of the furnaces and the centre to centre spacing of bins gates. Each car weighs about 1,500 pounds and holds about 3,000 pounds of ore. These charging trains are also used to supply the coal pockets of the power plant before mentioned as being located in the trestles beneath the level of the charging floor. Charge trains are hauled driven winch. This truck is used to convey pots of furnace matte to the converters while still molten.

Blowing Equipment.

The blowing equipment, with the exception of the machines already noted as being placed in the old steam powerhouse, is located in the electric sub-station, which has recently been enlarged to accommodate it. It consists of the following machines and plant:

Two Nordberg radial valve duplex blowing engines, stroke 42 in., piston diameter 70 in., delivering 320 cubic feet of free air each revolution, are installed. The maximum capacity of each machine is 24,000 cubic feet of free air per min-

CHARGING FLOOR, BLAST FURNACE PLANT, CANADIAN COPPER CO., COPPER CLIFF, ONT.

also through the furnace building; in the latter, one track passes on either side of the furnaces. At each end these tracks are joined by semi-circular curves, forming two complete ovals. Suitable crossovers are also provided at convenient points. A tangent to the east curve connects with the sampling building. These tracks are covered with a light wooden shed between the buildings, and for a considerable distance parallel to the furnace slag track, they are carried on a trestle resting on 14-ft. masonry piers, to lessen the danger from fire owing to the slopping over of hot slag. This trestle also carries, under the charge tracks, coal pockets with chutes, which discharge by 5-ton electric locomotives, Canadian General Electric manufacture, 1,200 pounds drawbar pull at 6 miles per hour, taking current at 250 volts by trolley from an overhead line.

The slag floor is served by two standard gauge tracks at the back of the furnace building. Standard gauge tracks are also laid in three tunnels which lead through the reverberatory furnace building. These tracks connect with the converter building and a locomotive is used to haul 10-ton pots between the two parts of the plant. A track is also laid between the furnace building and the converter building, on which a small iron truck is operated by a rope and an air-

ute when running at 75 r.p.m.; the air is delivered at 50 ounces pressure. Each engine is provided with automatic gravity oiling system, automatic revolution counter, and automatic pressure gauge. These machines are each operated by a rope drive, on the English system, and are connected with separate motors; fourteen ropes, 1.5 in. in diameter, being used for each drive. The motors are Allis-Chalmers-Bullock induction type, one being of 600 h.p. and one of 500 h.p. These motors take the current at 2,200 volts, and are each fitted with special controllers for changing the poles and giving three speeds. Each of the blowing engines is connected to one or more blast furnaces by a 48-in. blast pipe, which is carried to the furnace building on steel trestles. Two of these pipes are carried through the building to the steam power-plant, where they are connected to the blowing engines of that portion of the plant which is placed in that building.

When work under progress is completed, there will be two more Connersville blowers, capacity 400 cubic feet of air per revolution, similar to the one at present installed in the steam power-house. These machines will be driven by one 600 h.p. and one 500 h.p. motor respectively, these motors having been taken from two Nordberg radial valve blowers that have been dismantled. It is the intention to replace the other two Nordbergs by two more Connersville blowers of the same type as those already installed. It is to be noted that each of these Connersville blowers is driven by a single motor, belt connected, the other impeller on each machine receiving its power through gears. All these blowing engines discharge their air into a common 6-ft. blast pipe connected by a nipple to each of the blast furnaces.

The air for the converter plant is supplied by one Nordberg blowing engine and two Allis-Chalmers engines. The Nordberg is a duplex Corliss valve type, 36 in. stroke with piston diameter of 40 in. It is run at 100 r.p.m., and delivers 10,200 cubic feet of free air per minute at a pressure of 12 pounds. The drive is by a 500 h.p. Allis-Chalmers constant speed induction motor running at 375 r.p.m. A rope drive of 16 ropes 1.5 in. in diameter is used. The Allis-Chalmers engines have a 60-in. stroke, and piston diameter of 48 in., and run at 70 r.p.m., delivering 20,700 cubic feet of free air per minute at 12 pounds pressure. The motors are Allis-Chalmers-Bullock, 1,200 h.p. constant speed induction type, running at 375 r.p.m. Forty-two ropes, 1.5 in. in diameter, are used on each drive. All engines are equipped with automatic unloading devices, gravity oiling systems, automatic revolution counters, and automatic pressure gauges. They deliver to a common receiver, from which a 36-in. blast-pipe, carried on a steel trestle, conducts the air to the converter building.

INTERIOR OF MATTE SHED, CANADIAN COPPER CO., COPPER CLIFF, ONT.

Air for power and other purposes throughout the plant is supplied by one cross-compound 100-lb. air compressor, made by the Laidlaw, Dunn-Gordon Co. This machine has a 24-in. stroke, and the high and low pressure cylinders are respectively 15 in. and 24 in. in diameter, the capacity being 1,500 cubic ft. of free air per minute. It is direct connected to an Allis-Chalmers-Bullock induction motor, 300 h.p. capacity, running at 120 r.p.m. The air from this machine is piped to every part of the plant and is used for various purposes, such as blowing out motors, driving winches and hoists, operating air tools in the several shops, and as an air blast for warming the basic converters with a fuel oil flame. All the blowing engines receive their air directly from the outside substation building, through a large cold-air duct in the basement, and all the intake valves connect with this duct.

Flue System and Stacks.

The down-take from each furnace is 8 feet in diameter and is lined with 4 in. of firebrick for the first 20 feet. It inclines at 30 degrees in a straight line from the furnace to the dust chamber, passing above the slag tracks. The dust chamber is of the balloon type, 20 feet in diameter, 34 feet in height, and 500 feet in length. It is built of 5-16 in. steel plate, and is carried on steel columns at 15 ft. centres, being provided with expansion joints every 60 feet. The only lining is placed opposite each down-take opening and covers a section about 12 feet square. Hoppers and doors for removing flue dust are placed every 6 feet; these discharge the dust into cars operated on a track running the length of the flue.

The stack is 210 feet in height and 15 feet inside diameter at the top. The base is 24 feet square, of granite masonry, with a circular lining of firebrick. The upper 150 feet of the stack is circular and is built of perforated radial stack brick. An independent steel stack, 12 feet in diameter at the base, 9 feet in diameter at the top, 125 feet in height, stands just outside the converter building. The hoods over the converter are connected with this stack by a steel flue.

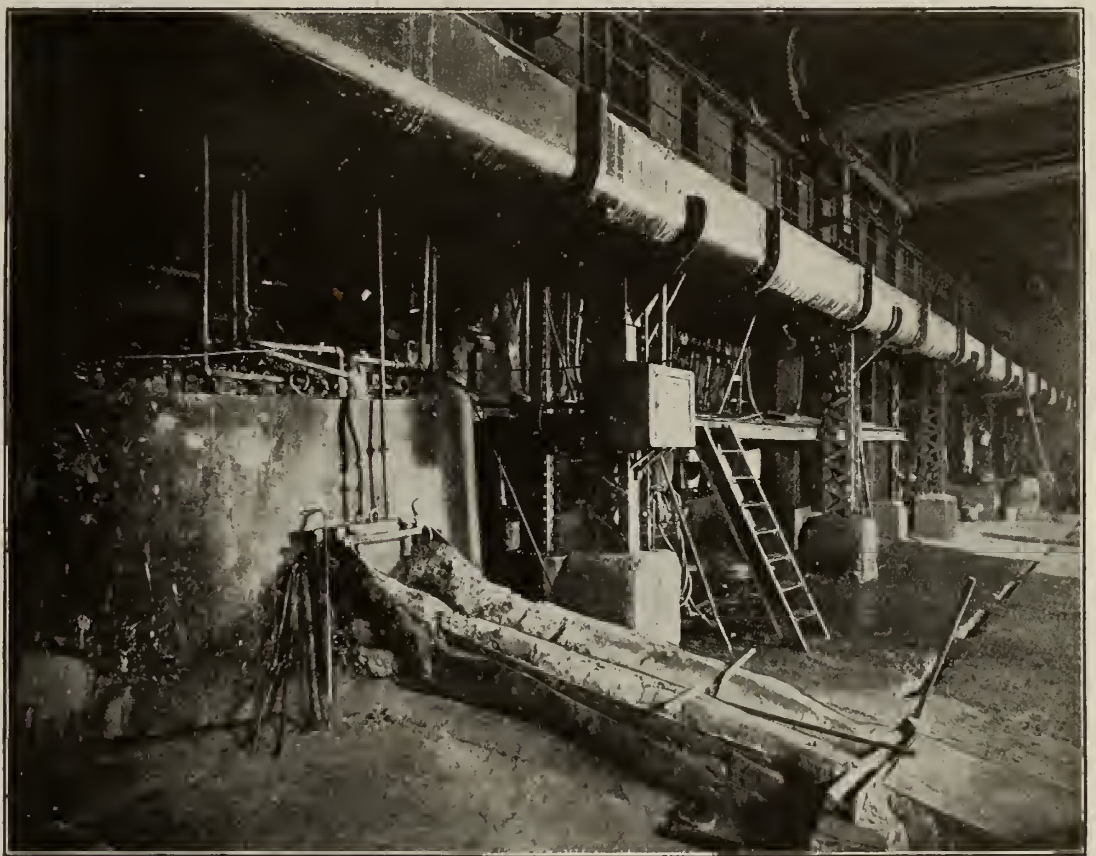
INTERIOR OF REVERBERATORY FURNACE BUILDING, CANADIAN COPPER CO., COPPER CLIFF, ONT.

OLD ACID CONVERTER PLANT, CANADIAN COPPER CO., COPPER CLIFF, ONT.

At the reverberatory furnaces a cross flue, 6 ft. x 9 ft., which is covered by cramps, passes directly behind the furnaces. This flue is 70 feet in length and leads to the main flue or dust chamber. The main flue is a brick chamber without baffle walls, 15 ft. x 19 ft. and 177 feet in length, and connects with the stack. The stack is built of Custodis radial brick. It is 17 ft. 2 in. in diameter at the bottom, 15 ft. 4 in. in diameter at the top, and is 200 feet in height. Practically no dust collects in the flue.

Ore, Coke, Fluxes.

The ores smelted at this plant are derived almost entirely from the Company's own mines, and only just very occasionally are small lots of any custom ore received. The Connelsville coke is used for the blast furnaces, and Pensylvania soft coal is generally used in the reverberatories. The soft coal is first pulverized in the coal-crushing plant which is installed close to the reverberatory furnace building. Quartz is obtained from the company's own quarry at Dill, about fifteen miles south-east of the smelter, but occasionally a small supply is received in the form of custom ores. A small quantity of limestone is also occasionally required, and this is obtained from the Fiborn (Michigan) quarries of the Union Carbide Co., not far from Sault Ste. Marie, Mich.



SETTLERS IN THE BLAST FURNACE BUILDING, CANADIAN COPPER CO., COPPER CLIFF, ONT.

Flue Dust.

From time to time attempts were made to briquette or sinter the flue dust from the furnaces, but these attempts were not successful, either through failure of the method, or because the high cost made them prohibitive. The flue dust was, therefore, allowed to accumulate in large dumps, to be utilized later in reverberatory furnaces. These furnaces were installed in 1911, and the accumulations of flue dust and fine ore from the mines (under $\frac{1}{4}$-in. diameter) are now being treated in the reverberatory plant.

Water System and Pumping Plant.

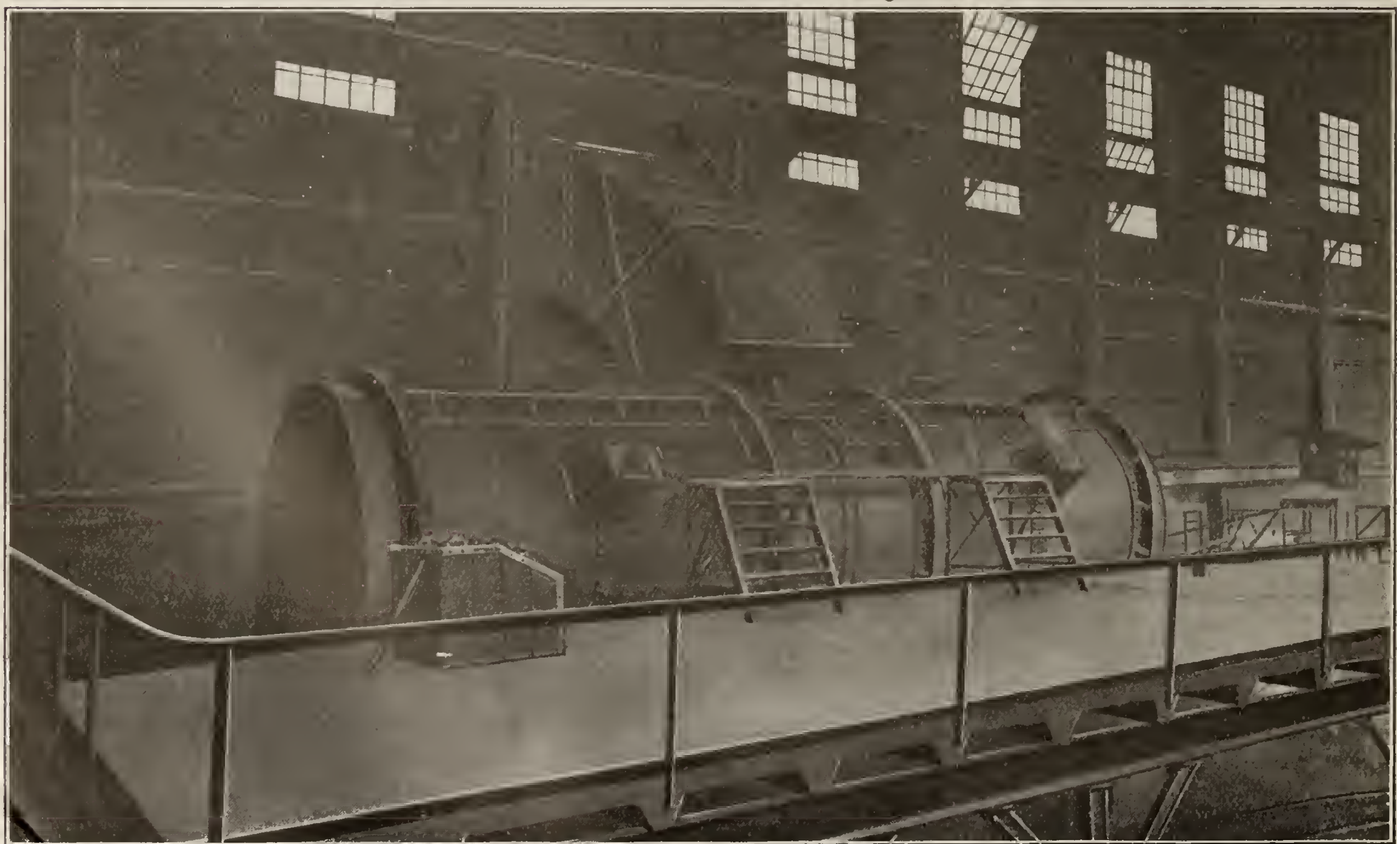
The general water supply is obtained by gravity from two small lakes situated about 3,000 feet north-west of the smelter. A heavy concrete dam was constructed at their outlet, forming a reservoir of very considerable area. A 16-in. cast-iron main leads from the reservoir directly to the smelter. Other smaller mains supply the shops and the town of Copper Cliff.

At the furnaces, the jacket water overflows into two continuous cast-iron launders, one on either side of the furnaces, sloping both ways from the middle furnace. It flows from these launders through 20-in. drains to an open cooling reservoir. As the water supply is limited and as the furnaces alone require about 1,000 gallons per minute each, it is necessary to pump most of this water back to the furnaces from the cooling reservoirs. For this service three pumps are installed at the reservoir. Two of these are 8-in. pumps of 1,500 gallons capacity, and one is a 14-in. pump, of 5,000 gallons capacity. All are single-stage turbine pumps, each direct connected to a constant speed induction motor. These pumps discharge through an 18-in. flanged cast-iron pipe into a reinforced concrete tank, 25 feet in diameter and 32 feet high, placed on the hill back of the smelter. Duplicate cast-iron mains, connected to this tank, run on either side of the furnaces just below the charge floor. The tank is also connected to the smelter supply main, the static head of the latter being just balanced in the tank. This adjustment gives a very steady pressure on the furnaces, the head being about 28 feet above the tops of the jackets. For the purpose of fire protection a series of dry fire lines are laid around the smelter building, while hydrants and hose houses are also located at very frequent intervals. A closed circuit electric fire alarm system with very conveniently-located signal stations has also been installed. The main pump for this system is located in the electric sub-station. It is a 6-in., 4-stage turbine fire pump, of 1,000 gallons capacity, and is direct connected to a 225 h.p. alternating current induction motor. In the steam power-plant is located a Blake underwriter's fire pump, capable of delivering 1,000 gallons per minute.

Blast Furnaces.

There are six rectangular water-jacketed blast furnaces: five of these are 50 in. x 204 in., and one is 50 in. x 240 in. at the tuyeres. The height from the hearth plate to the charging level is 19 in., and the smaller size is rated at 400 tons per day each. The furnaces are placed in line at 61. ft. 6 in. centres, with their longer axis parallel to the length of the building. Each furnace is supported on a concrete pedestal rising 30 in. above the solid concrete furnace floor. The four water-jacket hearth plates are supported on jacks resting on this pedestal. There are three tiers of water-jackets, the lower tuyere jackets

POURING SLAG. CANADIAN COPPER CO., COPPER CLIFF, ONT.



BASIC COPPER CONVERTER. CANADIAN COPPER CO., COPPER CLIFF, ONT.

being 4 ft. 7 in. in height, the middle jackets 4 ft. in height and the upper jackets 6 ft. 4 in.; the total height of the jackets being 14 ft. 11 in.

These two lower tiers of jackets are of special cast-iron, made in the works, having 1.25 in. water circulating pipes cast into an otherwise solid slab with stiffening flanges. The thickness of the jacket is 3.25 in., the width at the flange 8.25 in. and the flanges are cast about 1.25 in. thick. The jacket is stayed by a cast-iron web running up the middle of the plate, and is also thickened at the corners. The side flanges are slotted for two bolts; tie-bolt lugs are also cast on the jackets. The outside legs of the pipe for conveying cooling water are centred about 3½ inches from all the sides of the jacket and 4½ inches from the ends. In the case of the tuyere jacket, the tuyere opening is 6 in. in diameter and is centred 9 in. from the top of the jacket. The openings of the cooling water pipes in this jacket are placed 16½ in. below the top of the jacket. In all the earlier furnaces, the jackets in the lower tier were only ordinary tuyere jackets, 8 ft. 4 in. in height, and with four tuyeres to a jacket. In the present furnace each of these jackets has been replaced by a set of four cast-iron jackets. This type of jacket costs $35 and $30 each respectively for a tuyere section and a top section, or a total cost of $130 for a set of four sections. The cost is about half as much as for the single plate jacket originally used, and the life of the jackets is four or five times as long. The upper jackets are of the ordinary plate type, and 50 in. in width.

The supporting frame is of heavy steel construction, the charge deck being of cast-iron plates. The hood above the furnaces is formed by building 18-in. firebrick walls into a skeleton of very heavy structural steel. The end walls unite in a catenary arch to form a roof, the top of the arch being 33 feet above the charging level, making the total height of the furnace 58 feet above the tapping platform. The side walls are vertical and in one of them is the down-take opening, with its centre 27 feet above the charge floor. The down-take, as already noted, is 8 feet in diameter, is built of 3-16 in. boiler-plate, and is lined with 4 in. of firebrick for the first 20 feet. The charge doors are operated by counter weights in place of air-lifts.

Crucible Bed.

The crucible bed is made of rammed chrome "bats," and is made about 13 in. deep, but never retains that thickness, as it is eaten out by the matte. The side tap is notched out of one of the middle tuyere jackets on the crane side. It is filled with a water-cooled cast-iron side tap jacket 10 in. x 24 in. The slag spout is a special cast-iron water-cooled spout of local design. Both the spout and opening in the tap jacket are lined with chrome brick.

The Settlers.

The settlers are placed immediately in front of the furnaces. They are oval in form, 16 ft. 0 in. x 19 ft. 6 in. and 5 ft. 6 in. in height, and are made of 5-16 in. boiler-plate. They are lined with two rows of chrome brick laid end to end. The slag spout and the tap hole of each settler are diametrically opposite, the furnace spout discharging into the settler between them. The settlers are also fitted with cast-iron water-cooled spouts lined with chrome brick. The slag spouts of the settlers discharge into 25-ton slag pots carried on standard gauge trucks, and running in the cut back of the furnaces. These pots are sectional, with four side pieces and a separate bottom piece. The pots are poured by means of a rack and worm gear carried on the truck. Small cast-iron catch pots operated by hand winches are used to receive the slag streams while the big slag pots are being shunted in trains of six pots to the slag dump.

Matte from the settlers is tapped into 10-ton clay lined cast iron pots standing on the matte floor. These pots are placed by the traveling cranes. When full they are each lifted across the yard to the converter building by a small compressed air winch operating a small drum on which a haulage rope is wound.

INTERIOR BLAST FURNACE BUILDING, MATTE SIDE, CANADIAN COPPER CO., COPPER CLIFF, ONT.

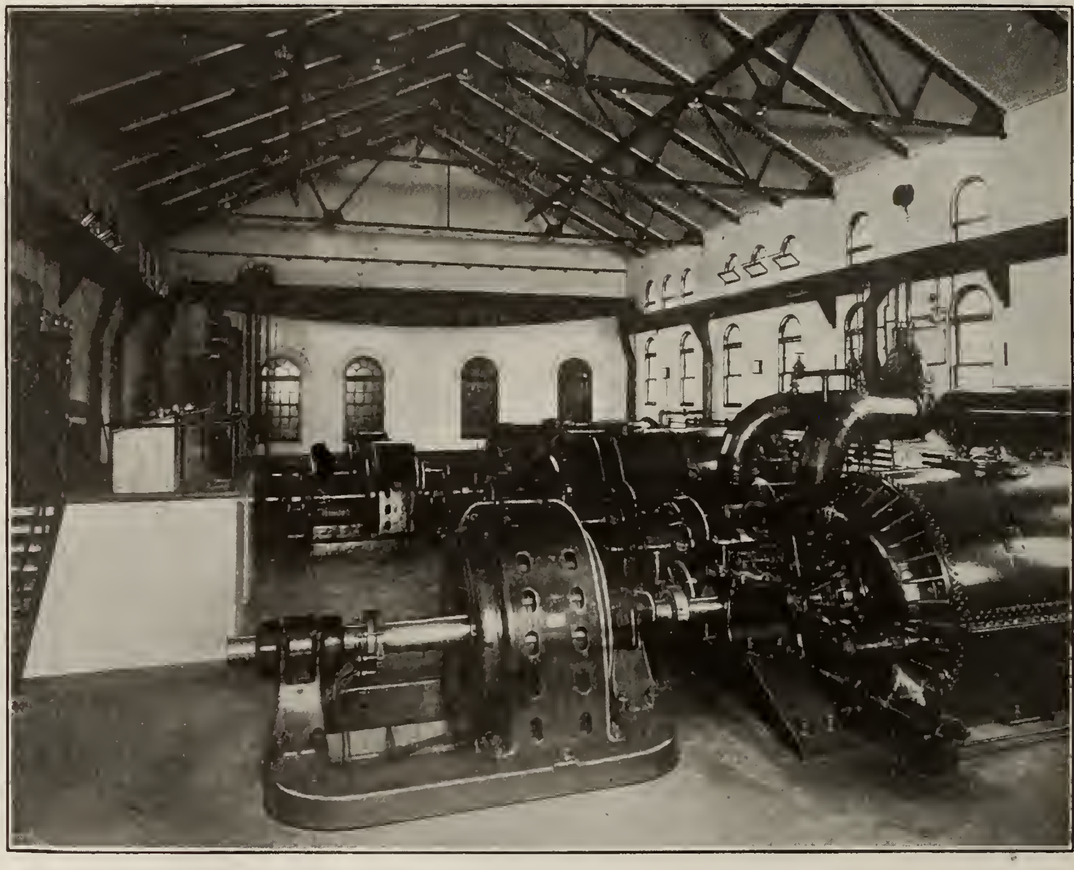
Reverberatory Furnaces.

The two reverberatory furnaces designed to burn pulverized coal were installed during the year 1911. The first of these was blown in at the end of December, 1911, the second in March, 1912, while the foundation for a third was laid in 1912.

These furnaces are of the Steptoe type and each has a hearth area of 19 ft. x 112 ft. As already noted in describing the reverberatory furnace building, the foundation for each furnace was made by pouring slag between concrete retaining walls, giving a solid block of slag about 10 feet in thickness. On this foundation, the side walls of the furnace, 27 in. in thickness, were built to a height of 10 feet. Slag was poured inside these walls to form a furnace bottom about 2 ft. in thickness. The side wall is built of chrome and silica brick, to a thickness of 18 in., the former kind being used near the coal dust burners, and the roof rests on this wall. Inside this wall, a flashwall 9 in. thick is built of magnesite brick, and brought up close to the roof, but does not support it. The roof is 20 in. thick for the first 35 feet near the coal burners, and 15 in. thick for the rest of the way. It is built of firebrick. The spring of the roof arch is 19 in., or a 2 in. rise to each foot of width. The extreme height inside is 6 feet. The hearth of the furnace was formed by evening up the poured slag bottom with concrete, so as to provide an inverted arch with a spring of 12 in. On this form, one layer of firebrick 2.5 inches thick, was laid flat, and upon this, 9 in. of magnesite brick was then laid to form the bottom of the hearth. This latter brick was laid in a mixture of ground magnesite and linseed oil. Expansion strips of wood were then placed between about every six courses, the expansion allowed being ¼ in. the foot.

The tap-hole is placed at the side about 18 feet from the inlet end of the hearth, and is placed high enough to retain 12 in. of matte in the hearth, so that the bottom will always be protected by a pool of matte. Slag is removed at either side of the furnace where the sidewalls commence to narrow in, about 11 feet from the front of the furnace. The space at the front of the furnace, usually occupied by the slag door, slopes up gradually from the hearth to form a straight outlet for the products of combustion. The area of the throat is about 27 square feet, and the gases meet no obstacles whatever, but pass straight into the cross-flue, 6 ft. x 9 ft., which is covered by cramps.

Two sets of charging bins are provided at the fire end of the furnace, and each bin has five hoppers discharging through the roof by slide gates. These bins are used to drop flue dust, ore fines, and other pulverized material into the furnaces. Openings are provided along each side of the roof for fettling. Hot converter slag is also charged into the furnace by a side door through a special chute on a carriage. This slag is brought from the converter building to the reverberatory furnace in 10-ton pots hauled by a locomotive which enters the tunnel between the furnaces. The reverberatory cranes pick up these slag pots through openings in the roof of the tunnel and discharge them into the furnace.



CANADIAN COPPER CO. GENERATORS AT HIGH FALLS.

These reverberatory furnaces are fired by coal dust blast burners, and coal for this purpose is brought to the works in 50-ton cars and dropped into storage bins in the high line trestle. From these bins it passes through a special coal crusher, which breaks to 0.5 in. size, to a conveyor belt. This belt discharges into a bin in the grinding room. A screw conveyer drives the coal from this bin into a Ruggles-Coles hot gas dryer, and thence into the boot of an elevator.

The coal is elevated to bins on the floor above. From these bins it is fed into two Raymond impact pulverizers, and these grind the coal to a very fine powder, most of which will pass a 200-mesh screen. This pulverized coal is sucked up by a fan into a separator at the top of the building. Here screw conveyers pass it into the reverberatory furnace building, dropping it into bins above the ends of the furnaces. In front of each furnace, five variable speed screw conveyers, each 4 in. in diameter, deliver the coal into five corresponding burners, each conveyer dropping its coal dust in front of a nozzle which carries air from a fan. The air blast sends the coal into the furnace in the form of a cloud or spray of dust which burns just like fuel oil. Each burner can be run independently and the amounts of coal dust or air can be varied at will.

It is claimed that the system of firing is quite satisfactory and that, due to the charge being put in through the bins, this method of firing is much cheaper than burning the coal on a grate. There is no fuel inefficiency, and all of the carbon in the coal is consumed. The ash has not offered any difficulty whatever, and the heat of the furnace is maintained at a uniform temperature.

Converters.

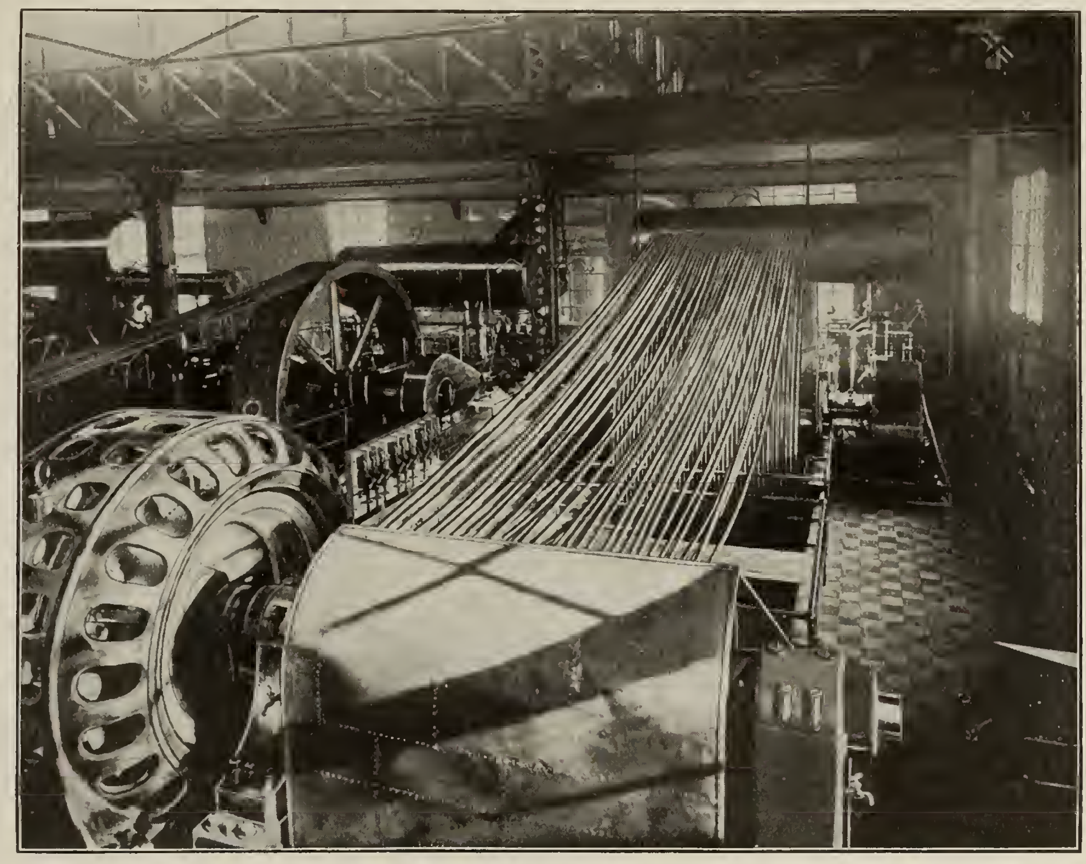
The old plant contained silica lined converters, 10 stands and 10 shells, 84 in. x 126 in., but these were replaced in 1911 by the present equipment of basic lined converters. The new plant consists of five stands and shells of basic lined converters. Each of these shells is a cylindrical steel drum, 37 ft. 2 in. in length and 10 feet in diameter, outside measurement. The stack opening in the roof for the escape of gas is placed in the middle of the top of the cylinder, instead of at one end, as in the Pierce-Smith basic converters at the Garfield plant. There are two openings with spouts in the front wall opposite to but above the tuyere line from which slag or matte can be poured. There are 44 tuyeres, each 1¼ in. in diameter, and 7 in. apart; no tuyeres are placed directly under the stack for a distance of 5 feet. The lining is special magnesite brick. The bottom lining is 24 in. thick, the back or tuyere wall 18 in. thick, the front 15 in. thick, and the roof is a 12-in. arch of silica brick. The tuyere bricks are 24 in. thick.

The shell is carried on four ring tracks 12 feet in diameter, and placed one at each end and one on either side of the central stack. These tracks rest on roller bearings mounted on cast-iron bedplates beneath the converter. The shell is turned by means of two wire ropes, each of which takes one-half turn around it, one being on either side of the stack. These ropes are led to a hydraulic piston working inside a horizontal cylinder and having a stroke of 9 feet.

As an ordinary hydraulic equipment would not be suitable in the climate of Northern Ontario, oil is used for rotating the converter shells. This is moved in the cylinders by air pressure. Two oil tanks are provided, one for regular use and one for emergency. Each of these is made of ¾-in. steel boiler plate, and is 4 feet in diameter and 15 feet in height. A small amount of oil is pumped into these tanks and the space above the oil is filled with air at 75 pounds pressure. An electrically driven pressure pump next forces more oil into the cylinders, compressing the air to 300 pounds pressure, at which point the pump stops automatically.

When it is desired to turn down a converter, a controlling valve is opened on the converter platform. This allows the oil to pass from one side of the hydraulic cylinder to the other, moving the piston, and so, by means of the rope tackle, turning the converter as desired. In this operation, the air in the tank above the oil expands and the pressure decreases. When it has fallen to 200 pounds, the oil pump automatically starts pumping oil into the tank until the pressure again reaches 300 pounds.

As the entire plant is operated by electric power, it is evident that if the power went off the line for any reason, the converter blower would stop blowing air into the tuyeres and if the air stopped, the matte would run back through the tuyeres unless they were turned, the ordinary mechanism for turning them being also dependent on electric power. To avoid this danger, a spare tank is provided in which oil is kept under 300 pounds pressure. This spare tank is connected to an hydraulic cylinder by a valve which is kept closed by a solenoid brake. After the power goes off, a blower engine will keep turning over and delivering air for perhaps 15 or 20 seconds owing to the momentum of the fly-wheel; this affords time for the solenoid brake to operate. The brake is electrically actuated and, the moment the power goes off, the brake drops, opening the valve and admitting oil to the proper side of the cylinder to turn the converter down. This device is absolutely automatic and entirely separate from the turning device regularly used, and has proved quite satisfactory.



INTERIOR OF SUBSTATION AT COPPER CLIFF, ONT.

Metallurgical Practice Roasting.

The metallurgical treatment of the ores received from the company's mines begins at the roast yards. These yards are located north of the smelter, on slightly higher ground. The site selected was a somewhat flat swampy area, which has been evened up and given a gentle slope from which drains rapidly remove surface water. The yard is served by a number of spur line tracks of standard gauge which traverse the length of the yard and divide it into a number of sections. The ore is roasted for the purpose of oxidizing the iron and to remove as much of the sulphur as possible without involving undue losses in the furnace slag. If the oxidation of iron is insufficient, the matte made in the furnace will contain so much iron that its re-treatment is too costly. On the other hand, if too much sulphur is expelled as a result of a too thorough oxidation, undue losses will occur in the furnace slags, which is, of course, undesirable.

Open heap roasting as practised at Copper Cliff is an old, simple, cheap, and very effective method of treatment for the accomplishment of the purpose desired. The roast piles differ in size according to the rapidity of roast required. These sizes vary from 30 ft. x 40 ft. or 36 ft. x 40 ft. to 50 ft. x 100 ft. Small heaps will contain from 800 to 1,000 tons and can be roasted in about 90 days. Large heaps will contain as much as 3,000 tons and will require from 6 to 9 months to roast properly. The most satisfactory product is obtained by the long-time roasts. The practice is to keep about six months stock of roasted ore in the yards ready for the smelter.

The wood used to form the base of a new roast heap is dry split wood, either hard or soft, spruce, pine, cedar, birch. The piles are made of the area desired and from 20 in. to 24 in. in height. Around the ends and edges, the sticks are piled crossed, while the interior is covered with sticks laid parallel to each other and in a position similar to shingles on a roof, being inclined at an angle of about 30°. About one cord of wood is required for every 25 tons of ore in a heap.

The ore arrives at the yards in 50-ton cars, and it has already been crushed to pass a 4 in. grizzly. Each car is run out to the place required and light planks are laid from the car to the heap. A shovel and barrow gang of about 10 men then transfer the ore to the pile. The coarse ore is piled above the wood to a depth of 5 to 6 feet, or more, according to the size of heap desired, and this is topped with 8 in. to 12 in. of fines. The tops of the piles are built with a top slope of about 1 foot in 15 feet, presumably for drainage purposes.

When the pile is completed, it is fired and allowed to burn slowly, being carefully watched not only until it is fairly alight, but afterwards to make the roast as uniform as possible. When the roast is completed and the pile has cooled off sufficiently, the heaps are blasted to loosen the ore. The roasted ore is then loaded by a Bucyrus steam shovel into 50 ton bottom-dump steel railway cars to be transferred to the smelter bins. All ore entering the roast yards is weighed in at Clara Belle junction, north of the yards, and all roasted ore is weighed out on a weigh scale at the foot of the yards and about one-third of a mile from the smelter.

Blast Furnace Practice.

Four trains of 8 cars each are used on the charging floor. The cars are loaded at the bins, the load being weighed and adjusted at the most convenient scales and the train run to the furnaces. An ordinary charge consists of 500-2,000 pounds of quartz, 10,000 pounds of roast ore, 3,000 pounds of green ore from Crean hill, and 3,000-4,000 pounds of converter slag and scrap, a total of 16,-500-19,000 pounds. The coke per cent. of the charge varies between 10 per cent. and 12 per cent. The charge varies somewhat inasmuch as the ore from the Creighton mine is deficient in silica. Occasionally a small quantity of lime is required to flux Crean Hill ores. On an average the furnaces are charged about three times per hour. The charge column in the furnace is maintained at about 13 feet; the blast pressure used being 30-35 ounces. The total quantity of blast required is about 1,313 tons of lent of about 22,600 cubic feet per air per furnace, per 24 hours, the equivaminute; at 32° F., and 29.92 in. Bar.

Slag flows from the furnace into the settlers in a continuous stream, while the overflow slag from the settler passes out of the slag spout at one side of the settler and is led in a cast-iron trough to the back of the tap platform, where it discharges into waiting pots in the slag track. Slag trucks are hauled to the dump by a steam engine. Matte is tapped from the settlers on the side opposite the slag spout, and is drawn off into matte ladles in 5-7 ton lots. The matte crane lifts the loaded pot upon a small lorry. The lorry is then hauled across the yard 60 feet to the converter building. Two tracks are provided for these matte transfer trucks.

Green ore from the Creighton mine, as it arrives at the roast yards, has the following composition:—S. 23.75; Cu. 1.46; Ni. 4.35; FeS. 35.69; FeO. 4.40; SiO_2. 18.80; CaO. 2.00; MgO. 1.5; Al_2O_3. 4.5.

A typical roast will eliminate sulphur and oxidize the iron, and the roasted ores will contain approximately 12 per cent. to 16 per cent. of sulphur.

Reverberatory Furnaces.

The materials charged to the reverberatory furnaces consist, at present, of green fines, which have been accumulating for many years, flue dust, and hot converter slag. Reverberatory slag is removed in 25 ton pots on standard gauge tracks laid in front of the furnaces and below the levels of the hearths. These pots are shunted to the slag dump by a steam engine.

Reverberatory furnace matte is drawn off into the same pots in which the converter slag was brought to the furnace. It is then hauled by the locomotive to the converter building and charged into the converter. The composition of the reverberatory charge varies considerably owing to the nature of mixture used.

Converters

The converters receive matte both from the blast furnaces and from the reverberatory furnaces.

The basic converters have been found to work very efficiently and make almost no scrap. The blowing time per ton of finished bessemer matte is not only greatly reduced, but the cost of lining per ton of matte produced is considerably less than when acid converters are used. The contrast between the two types of converters is further shown by the following table:—

Basic and Acid Converting on Copper-Nickel Mattes.

Converter type	Tons flux per ton of iron removed	Tons furnace matte per ton Bessemer matte produced	Tons Cu-Ni charged per ton B. matte produced	Loss of Cu-Ni by slag and slop per ton of B. matte.*
Acid	1.31	4.66 27.38% CuNi	1.28	0.48 tons.
Basic	0.91	4.13 22.58% CuNi	0.93	0.13 tons.

*One ton Bessemer matte contains 0.8tons of copper-nickel.

After the matte in the converters has been blown sufficiently to eliminate nearly all the iron contained, it is poured into a pot, which is shifted by a locomotive to the casting moulds along one side of the converter building. Here it is poured into moulds, each about 25 feet in length, and 6 feet in width, forming a cake of these dimensions and about 4 in. in thickness. After cooling, the slabs of matte are broken up and loaded into railway cars for shipment to the refinery.

BRASS DIE-CASTINGS.

FOLLOWING are a number of reasons why brass die-castings cannot be produced commercially:—The writer has seen produced brass die-castings of small machine parts, but due to advances that have been made in modern foundry and machine shop practice, these castings could be made cheaper when sand cast.

Modern automatic molding machines, automatic screw machines, etc., make it possible to produce small brass castings accurately machined at a comparatively low figure. In order to compete, brass die-castings must be made rapidly, must be accurate to within at least plus or minus 0.002 in., and must have smooth finished surface. The expansion and contraction of the metallic molds used make accuracy impossible.

Although it is possible to make brass die-castings by forcing molten brass into a metallic mold, it will be found that after 500 or 1,000 castings have been made the mold will crack or warp, necessitating the construction of a new die, which is usually very expensive.

Aluminum Die-Castings.

The die-casting of aluminum alloys shows some promise of becoming a permanent industry. Very complicated aluminum die-castings are now being produced, but the writer is not at liberty to discuss either the process or alloy used, since patents are pending for both.

Ottawa, Ont.—The C. P. R., G. T. R., and other Canadian roads filed with the Dominion Board of Railway Commissioners on February 4 their application for a sweeping increase in eastern freight rates.

EDITORIAL CORRESPONDENCE

Embracing the Further Discussion of Previously Published Articles, Inquiries for General Information, Observations and Suggestions. Your Co-operation is Invited

CONCERNING FOUNDRY COKE.

By "Melter."

COKE consists of carbon and ash with a small percentage of volatile matter, and is the residue from the expulsion of the large percentage of the latter from coal through the medium of heat. This volatile matter consists of hydrogen and oxygen, combined with each other and carbon, and is set free by the breaking up of the coal. Some of its compounds form gases and others when vaporised are condensed.

Coke Ovens.

There are several types of coke ovens, but here we shall consider only the beehive and by-product forms.

In the beehive oven, all the volatiles are burned in the same chamber adjacent to and above the coal. Heat is radiated from the top of chamber and, therefore, this allows some burning of the coke at the top.

In the by-product oven the volatiles are first taken away, then the tar and benzol are extracted by cooling, while the residual gases are returned and burnt in the flues around the oven; only as much hot air as is required being admitted. When the coal is coked, it is pushed out and quenched with water. In the beehive process, on the other hand, the whole oven is cooled which means that the next charge is heated up slower and proceeds slower. In the by-product oven, coal of high and low volatile constitution may be mixed to obtain best results.

The principal points to consider in choosing a coke for foundry purposes are:—Strength, density, melting rates, uniformity, sulphur, even taps, condition of cupola and ladles, height at which melting zone can be established and maintained.

Strength is necessary to resist breaking-up in handling—the waste being sometimes as high as 2%, and in crushing when throwing in the charge. If the coke be broken small, the amount of surface which is being burned is increased and, if the heat be not utilized as fast as produced, it is wasted.

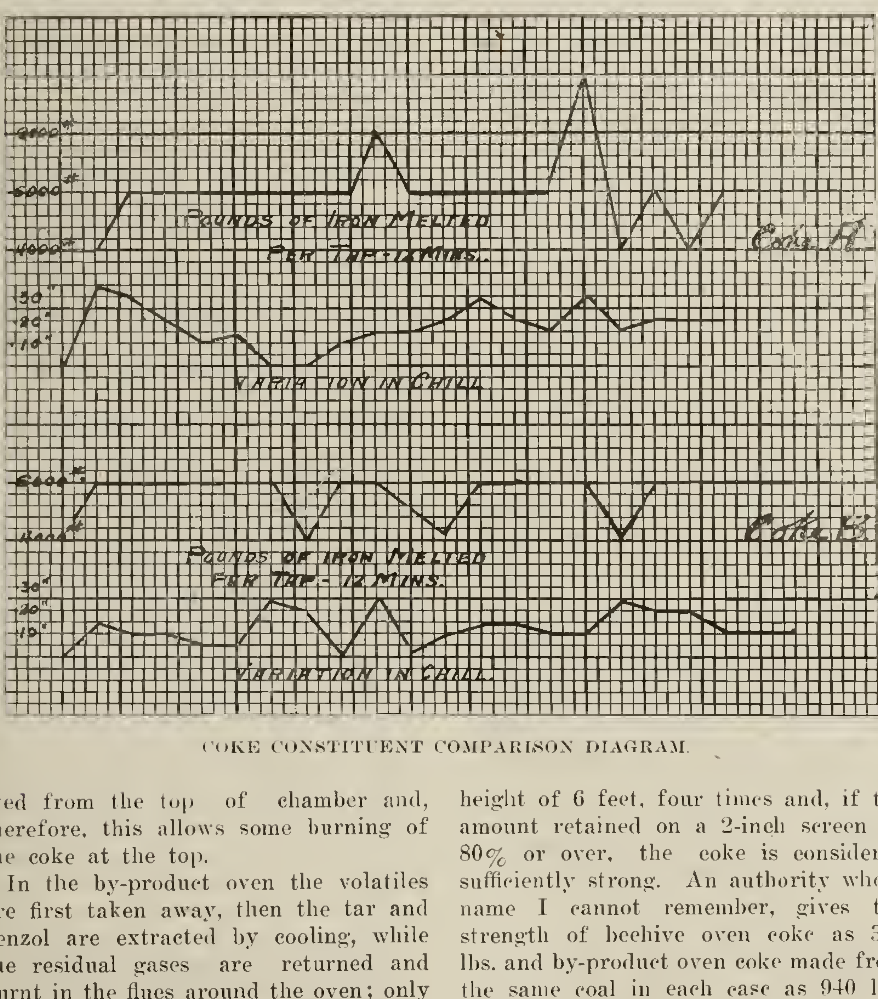
Some founders make a shatter test by dropping 50 pounds of coke from a height of 6 feet, four times and, if the amount retained on a 2-inch screen be 80% or over, the coke is considered sufficiently strong. An authority whose name I cannot remember, gives the strength of beehive oven coke as 300 lbs. and by-product oven coke made from the same coal in each case as 940 lbs. per cubic inch.

Density determines the concentration of heat possible. For every quantity of heat there is a quantity of coke to be burned and air to be supplied and, to consume the fuel economically, there must be concentration. Heat is supplied by contact with the coke also by gases and contact of metal with other hot metal. If one coke is denser than the other, there will be less area in the denser for equal weights, and the concentration will be greater on the denser consequently, all other things being equal, a dense, strong coke is better than a light, weak one.

Uniformity in analysis and structure from day to day means that a foundryman does not have to be continually altering weight of iron charges or varying quantity of coke to correct irregularities. This is explained by the fact that hard coke requires more blast and soft coke less blast. If we have hard and soft coke in the same cupola, and are in the act of heating metal with the hard product, the soft coke above or adjacent will be burning due to the air blast not all being consumed but working up through the charge. When the next charge descends to the melting zone, there will be insufficient coke, which means more oxidation of silicon, manganese and carbon with resultant harder iron, also colder.

Sulphur is injurious to iron and when melting in a cupola, in most cases, iron will absorb it. A coke which is high in carbon and which melts iron quickly even though high in sulphur, may be more beneficial for use than a slow melting coke lower in sulphur and which keeps the iron in contact with it for a longer period and which forms a thick, sticky slag, more or less conducive to high sulphur iron.

In the illustration, H represents a high sulphur coke, while coke B contains just half as much sulphur. It will be noted in the first mentioned coke that the curve showing variation in chill is erratic, the normal chill being .15 ins. It will also be noted that, while coke A is a faster melting product, coke B melts more uniformly. Both these fuels are by-product and have a very similar analysis with the exception of the sulphur and ash feature. Coke B is claimed to produce less slag and to require less limestone. We would not, however, judge from the analyses that such would be the case, but rather the reverse. The fact, although not yet determined, may be due to greater uniformity of size and slower burning, thus not allowing the blast to sluff off the brick lining. Coke B shows high in phosphorus, but this feature is watched so closely by manufacturers that no trouble is likely to result.



COKE CONSTITUENT COMPARISON DIAGRAM.

The A coke is hard, tough and much denser than B, their respective weights being 21 lbs. and 30 lbs. per cubic foot. Coke B, however, appears to have greater strength when incandescent, and requires less blast pressure for equal results, which may also be accounted for by the above-mentioned characteristics. To prove the contention that coke B was stronger when incandescent and did not burn away as rapidly in spite of its physical appearance when cold, the illustration shows consistently a softer chill. There was also hotter iron and a greater percentage left in the cupola after dropping bottom.

While the results obtained by using coke are largely a matter of product, it is often possible to vitiate these results by a poor understanding of the most ordinary laws governing combustion and general cupola practice:

	Coke A.	Coke B.
Carbon	91.05	90.00
Volatile combustible matter	3.65	1.30
Ash	5.50	8.50
Sulphur	1.00	0.50
B. T. U.	11,900	11,800
Ash Analysis.		
Silica	38.97	50.33
Alumina	28.94	32.28
Iron Oxide	23.23	8.53
Lime	3.32	1.08
Magnesia	0.68	1.14
Phosphoric Acid	1.06	3.82
Sulphuric Anhydride	0.85	1.85

BOOST THE MOULDING CRAFT.

By R. Micks.

EVERY mechanic should respect the trade that he has chosen to follow and do all in his power to put it in the front rank, but it is necessary that he should like his work and take a deep interest in it and try and master its every detail, otherwise he cannot expect to rise to the top.

For some reason or other, the moulding craft has never received its just dues from the manufacturing world and in a lot of cases moulders have themselves to blame for these conditions, as the only interest they seem to have in their work is to slam it up and get it out of the shop as soon as possible. Some of the travelling moulders also have helped to give the trade a hard name, their limits being pay-day, a spree and away. Many people judge the trade by such examples, although in reality there are some of the finest men and first-class mechanics serving at moulding who regard their work as an art and do their best to make it so. Every thinking man knows that the foundry is the foundation of all manufacturing business and it is therefore up to each moulder to boost his trade and not only respect it himself but make others do so.

There are many ways in which he can help himself to gain a greater knowledge of all branches of the foundry business, and thereby find out that it is not only a question of ramming sand but a business that takes a goodly amount of study if one wishes to understand both the practical and technical end of it. Many mechanics smile at the idea of learning your trade from a book, but it makes no difference how good you may be as an operator, you can never expect to work up to the position of foreman or superintendent if you have no technical training in the trade you follow.

Another danger to the moulding trade is that of too many specialty men, who, if taken off the class of work they are on, are useless in another shop and have to learn all over again, which is a waste of time and money for both them and their employer. This in time is going to bring on a serious condition in machinery and jobbing shops as very few are learning the trade in all its branches and sooner or later the jobbing and machinery moulder will be at a premium.

Foundrymen should try and make the conditions as pleasant as possible in their foundries, for no man or boy likes to be regarded as a machine, but likes to know that his best efforts are appreciated. A word of encouragement to a man who is doing well goes a long way towards making him feel satisfied with his work and surroundings.

It is the duty of all foundrymen to make the trade as attractive as possible so that a boy who is considering becoming a craftsman can see something ahead of him outside of hard work and a hump on his back in a few years. Make him feel that he is a part of the organization, and is just as necessary as the biggest man in the plant, and that the more energy and study he gives to his trade the better chance he has to rise to the top. If these points were explained to boys who are considering taking up a trade, I don't think there would be so much difficulty in securing good, intelligent apprentices for the moulding shop or other allied department.

CREATING AND EVOLVING INDUSTRIES.

By J. E. Cooley.

INDUSTRIES as a rule are founded on new inventions, and these inventions are generally ideas that were first evolved from the brain of some one man, who had been or still is a workman.

If it were possible to trace backward through the successive improvements of any particular invention of what is now a highly-perfected machine, and the manufacture of which has developed into a great industrial concern employing several hundred hands, to find the beginning of this invention, it would lead us to some garret, some wood shed, or some such fitted-up home workshop, where its rudimentary design or crude model was first brought forth.

The Lone Inventor.

Nowadays the work of experimenting on changes and new designs in machinery made through the suggestions of employees, is carried on in the factory, where they are later produced; but the work of developing original inventions—ideas that have never before as of old, carried on in humble surroundings as already mentioned, being very often done amid hardships, accompanied by great sacrifices, and by long and patient earnest toil.

Why is this? Because, while inventive workmen can have their ideas developed in places where they are employed, providing their ideas are suitable or can be applied to machines or products already being manufactured there, those who originate ideas on other lines seldom have them accepted, and are obliged to work and develop them on their own account.

Having the confidence in the success and usefulness of their inventions, some few of these inventive workmen succeed in bringing them out alone, while on the other hand, a great many other workmen with ideas just as useful and valuable never attempt to do so, because they lack initiative for one thing, and another and most important reason is that they require but never receive the proper encouragement to do so.

The greater number of inventions and improvements are from ideas and suggestions given to employers by their workmen skilled and experienced in mechanics. It has always been a theory of the writer, which is based only on his range of experience and observation, of course, that from five to ten out of every hundred workmen in any given factory are of a "mechanical turn of mind" or inventors.

Workmen of skill and ingenuity are always inventors, and though many of them have valuable ideas, they are unable to develop them owing to their circumstances or for various other reasons. The workman with an idea for a tapping machine, when employed in a place where cash registers are made, is as much handicapped as the workman with an idea for a cash register when employed where only tapping machines are made, yet the fact so long neglected or overlooked is that it is these stray ideas developed that build up new industries; and simply because of the lack of support or encouragement, many of the ideas are lost or die with the brain that conceived them.

New Ideas Stimulate Business.

Business is always dependent on new ideas. That business which is popular to-day, whether in manufacturing automobiles or furnishing war materials, will die out to-morrow, and must be superseded by something else; and this fact is always evident, that industry and welfare are ever dependent on new ideas. Where are these ideas to come from? As already stated, the most of them come from inventive employees.

If a lathe hand has an idea for a new tool-holder, another workman an idea for a quick-acting wrench, still another an idea for a universal joint, it is to the interest of the employer to ferret out these ideas and have them developed, even though having been perfected, the originators cannot undertake the work of manufacturing them. The principal thing is to be the aid in bringing forward the first models, for it is by this aid that new industries are going to spring up and, with them, new machinery requirements. Each manufacturer in taking up this work of developing new ideas helps to create new industries, and also creates opportunities for himself to serve them with machinery of his own.

Encouraging New Ideas Development.

Industrial committees who are ever reaching out in trying to secure new industries to locate in their respective communities will find it profitable to take up the work of encouraging mechanics to develop their ideas by providing a place and means for them to do so. With a very small outlay a public experimenting room could be fitted up with a few lathes, one or two shapers, a large and small drill press, and all the necessary tools to use with these machines, also a work bench with a few vises, and a forge. The room should be provided with a few closet spaces, where the inventor can construct his invention in secret and experiment with it.

Nearly every factory can boast of employee-inventors, many of whom are ambitious and desirous of having their ideas developed, and if these could be given a slight boost, or have the necessary facilities provided, it is only reasonable to believe that, wherever this aid were given, greater industrial progress would be realized.

COMMERCIAL TRAINING FOR STEEL PLANT MANAGERS.

IN a communication to the "Ironmonger," dealing with the commercial training of steel plant managers, E. Griffiths, M.I.Mech.E., Liverpool, England, says it is quite appropriate to advise British steel makers to modernise their plants so as to be able to reap the full advantage of the present opportunity of securing the world's markets, but the mere modernisation of plants is not sufficient, as commercial success must, after all, depend on the calibre of the men who run the plant.

The necessity of commercial training for engineers on the basis that to sell machinery successfully it is necessary for the salesman thoroughly to understand the product he is selling, applies equally, if not more imperatively, to the modern steel trade, where, by the introduction of small percentages of various alloys, the metal can be made adaptable to such varied uses. Therefore our steel works should be manned by a well-trained commercial technical staff, and controlled by men of initiative and ambition, who, to a sound basis training in engineering and the various branches of iron and steel manufacture, add a sound practical commercial and financial knowledge.

Profitable Business Getting.

The success of a steel company does not lie in the possession of a fine plant or highly technical staff, as without business these cannot be profitably employed. The fundamental point in all trades is the making of profits, and in the atmosphere of a general meeting of shareholders, who know little, and care less, about the technicalities of the particular industry their money is invested in, it is of little use for a chairman to point out that the collieries are admirably equipped, the coal washeries up-to-date, or that the coke ovens are of the latest type, fitted with highly efficient sulphate and benzol plant, or that the coke burden of the blast furnaces has been decreased by use of desiccated blast, or that the latest mixed pressure turbines are used for blowing purposes, utilizing the exhaust steam from the mill engines, or that the open-hearth and Bessemer plants are second to none, unless he can at the same time announce a satisfactory dividend.

Now that the opportunity of securing a large proportion of the world's trade has unexpectedly arrived, there is no time to train such men; but would it not be possible to secure the services of men who have had a good technical training in steel works and engineering in their early days, and who have since branched out into commerce and learnt the art of technical salesmanship, together with the equally essential science of financing a business? Such men have the power to utilize their technical knowledge to its fullest advantage on the market, and, all things being equal, they are most likely to be able to make an otherwise satisfactory plant supply that one requirement of the modern shareholder—dividends.

DOMINION STEEL PRESIDENT ON OUTLOOK.

THAT there is a fair amount of business offering in Europe for the Canadian steel companies, but that they are considerably hampered in handling it owing to the difficulty of getting steamers to transport their freight across the Atlantic, is the statement made by J. H. Plummer, president of the Dominion Steel Corporation, who has just returned from an inspection trip to the company's plants at Sydney.

"As regards our European business, conditions are very fair," said Mr. Plummer. "The trouble is that there is not much margin of profit in it, and that, because the British and French Governments have commandeered so many vessels, it is difficult to get shipping space. The result is that, although prices on steel and iron products in Europe have recovered from their recent depression, the increased cost of transportation to market offsets the higher quotations."

Mr. Plummer reports that the steel business in this country has not shown any improvement as yet, reflecting in this respect general trade conditions. Furthermore, he states that, in view of the unprecedented circumstances, it is exceedingly difficult to make any warranted deductions concerning the outlook.

The Dominion Steel Corporation is now operating between 66 2-3 per cent. and 75 per cent. of capacity, and is employing between 2,600 and 2,800 men. The employes are not all working full time, but the labor situation has improved in the last few months because of the European orders received.

VANADIUM STEEL IN LOCOMOTIVES.

THE following table shows vanadium parts applied to locomotives built or ordered in the United States from January, 1913, to May 15th, 1914:

Name of parts.	Number of engines equip'd.	Number of parts applied.
Driving axles	479	1,297
Main rods	377	822
Side rods	284	1,986
Frames	993	2,054
Crank pins	198	612
Piston rods	69	138
Springs (engine and tender)	366	....
Engine truck axles	62	62
Wheels	..	700
Tires	..	1,150
Cylinders (vanadium cast iron)	260	540

With the exception of wheels and tires the foregoing applies to new power only.

NEW EQUIPMENT FOR FOUNDRIES

A Record of New and Improved Machinery Tending Towards Higher Quality, Output and Efficiency in the Foundry and Pattern Shop.

STRIPPING PLATE JOLT MACHINE.

ANNOUNCEMENT is made of a new Osborn molding machine which automatically performs practically all of the operations necessary to mold-making, except shoveling of the sand, and is especially adapted for the making of moulds for journal boxes and work of a general nature. It of course delivers a better quality of mould than hand-work, reduces waste to a minimum, is very much easier at every step, and materially lessens labor cost, as skill is not an important qualification for the operator.

The apparatus is known as the Osborn Stripping Plate Jolt Machine No. 450, and is adapted to use with any of the standard types of stripping plate equipment in any size. As the pattern is drawn through the plate by power, accuracy is a feature on which much stress is laid. One of the most obvious advantages of the machine is the speed at which moulds are made—taking a single mould or, more particularly, continuous operation. The mould is automatically jolted and stripped much more quickly than by hand, and as all operations are positive, speed is further enhanced thereby.

The table size can be varied, which is sometimes desirable where the machine is to be used on one particular pattern, the advantage being that with the table made about 1/8 inch less than the flask sizes, the sand does not pile up on the table; or in other words, does not require the brush or blowing off of the sand before returning stripping plate to position.

Jolt.—The construction of the jolt is similar in all respects to the Osborn No. 100 plain jolt machine, being equipped with the Osborn air cushioned balanced jolt valve.

Drawing Mechanism.—The draw cylinders are cast in one piece and connected to the base of the machine by large fitted bolts. These cylinders extend below the base and are so designed as to set inside of 8 inch pipes inserted in the foundation. The piston rod, which is also the guide rod, is planed on the side and provided with gear teeth which mesh with pinions cut from a solid shaft extending from one cylinder to the other. Both this pinion shaft and the guide rods are entirely enclosed and self-oiling, while the pinion shaft is used to prevent one rod traveling faster than the other.

Air-Operated Flask Clamps.—The machine is provided with clamps operated by air in order to rigidly lock the flask and stripping plate to the table of the machine. This is not always required, but on certain classes of work it is found to work to great advantage. A bale swings over the end of the flask—the bale being made of spring steel, in order to compensate for unevenness in the height of flasks. The machine is fitted complete with all piping, valves, lubricators, etc., ready to set on the foundation; the purchaser only being required to bring his air line to the machine.

In operation.—After the flask has been filled and jolted, the air is turned into the draw cylinders, this rapidly stripping the flask and stripping plate upward from the pattern. After lifting mould away, the valve handle is thrown to the opposite position, which supplies air above the piston, rapidly returning stripping-plate ready for the next mould. This is an important feature of the machine, as it is not necessary to await the exhaust escaping from below the cylinder and then depend upon gravity for the return. In many instances it has been found that gravity is not sufficient to overcome the wedge action caused by sand between the pattern and stripping-plate. Both the stripping and lowering action are equally as fast as that of hand-power on the old-style machine.

The rated and maximum stripping capacities with 80 pounds air pressure are 800 and 1,000 pounds respectively, while the maximum jolting capacity is 1,200 pounds. The standard table size is 19 3/8 inches by 32 inches, the pattern draw 14 inches, and the height of table from floor 24 inches.

JOLT STRIPPING PLATE MACHINE READY TO RECEIVE FLASK.

THE NEW WILLSON GOGGLE.

T. A. WILLSON CO., Inc., Reading, Pa., have recently placed on the market a new goggle specially designed to meet the requirements of machinists and grinders. This goggle has a unique construction, and is claimed to offer workmen complete comfort and perfect eye protection.

By the use of a special frame design, this goggle is made light in weight, yet substantial, due to sturdy eye wire, temples, etc. It will stand rough shop usage. An adjustable bridge enables the wearer to easily fit the glasses to his face. This bridge is pliable, strong and securely attached to the eye wire, and does not touch the top of the nose at all, but the weight of the glasses is distributed over the sides of the nose and cheeks. Not resting on the nose, the glasses can be worn right over spectacles.

It is of the greatest importance that grinders and machinists be protected from dust, emery, and grit, which whirl around the sides of glasses. Side guards are necessary, and the light fine mesh wire sides of the Willson goggle contribute to complete protection, and are at the same time comfortable. Fine quality glass is used to insure freedom from eye strain.

Being made entirely of rust-proof metal, this goggle is perfectly sanitary, and can be thoroughly sterilized. Comfort is further assured by the flexible half cable temples, which easily conform to any face, and do not pull or cut into the ears. Lenses can be easily and quickly replaced by simply loosening one of the screws of the end piece.

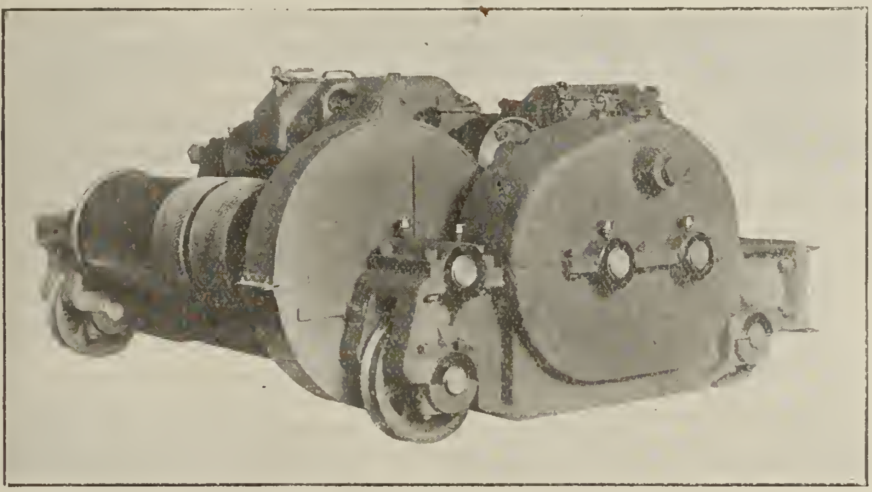
TYPE "E" NORTHERN CRANE TROLLEYS.

THE trolley shown has in its general form been on the market for some time, but during the past year or so several improved details have been added, and it now appears in a form thoroughly in accordance with the most recent crane engineering practice. Primary considerations have been safety—both in the way of strength and in the protection of working parts. Accessibility, rigidity and durability of gears and other moving parts have been sesured by enclosing and protecting them from dust and grit, and running them in an oil bath. The construction is now such that the covers of the gear cases must be in place or the gearing cannot run, thus insuring against the accidental omission of the gear covers, and emphasizing the safety feature.

Each train of back gears is rigidly mounted in a single frame, bearings being bored in line, and capped and fitted with through bolts, and bronze lined. The hoisting gear train from armature to drum gear is in one casting, insuring permanent alignment. while the drum gear is enclosed with steel gear enclosure. The trolley travel gearing is also entirely enclosed in a single rigid cast unit gear case of the same general type as that used for the hoist gearing. No overhung gears are used. As the gear covers are castings, the joint of the enclosed gear cases are planed so as to make a perfectly tight construction, thus preventing the leakage of oil and its dripping over the product of the plant. Lifting the cover of either gear cases removes the cap, and any gear with its shaft can be quickly lifted out without disturbing other parts. This cover can be easily lifted, as can the motor drum and other parts of the trolley, but for inspection and attendance, large manholes are provided, so that it is not necessary to remove the gear covers.

A point emphasized is the longer life of gearing when running in an internally lubricated design of this kind. Another point is the almost noiseless operation. The trolley is wired throughout with modern wiring in steel conduits, and is made in capacities from 2 tons to 125 tons for either mill or standard service. Mill service trollies have axle bearings of either the vertically or horizontally capped M.C.B. type.

The Northern Crane Works, Walkerville, Ont., are the designers and builders of this type crane trolley.



TYPE "E" NORTHERN CRANE TROLLEY.

NICKEL-PLATING ALUMINUM.

A communication has recently been presented to the Academie des Sciences by M. Le Chatelier. in which the author states that he has succeeded in nickel-plating aluminum, hitherto unaccomplished. This has considerably prevented the extension of employment of this metal, which lends itself to so many purposes. since its dull appearance, especially after prolonged use, has been much against it. The difficulty has been surmounted by a preliminary scouring of the aluminum in a bath of hydrochloric acid containing iron. The iron precipitated on the surface of the aluminium forms a kind of network, and when the piece of metal is then passed into the nickel bath, the nickel becomes fastened in this network and adheres strongly to the aluminium.

TECHNICAL MEN AND MANAGEMENT.

THERE is always room for argument as to the practical and the impractical, says Edwin S. Jackman in the Iron Age. President Harrison did a practical act for American trainmen when he urged Congress to pass the automatic coupler bill. Charles Dickens was a practical man when he wrote the "Christmas Carol" to pay his pressing debt; when he created Tiny Tim for old men to read to children.

The men whose knowledge of facts is merely incidental to strength of character and high purpose are the most useful men in trade or shops. Directors of companies do not weigh what a man knows, but they consider his completeness as a man for the work he has to do; and if a technical man is selected, the choice is for other and better reasons than his knowledge of undisputed facts.

Men for heavy burdens need self-control and wisdom more than knowledge of scientific discoveries or mechanical improvements. There is no short cut to real success in building commerce or in building character. Permanency in a nation's trade or in individual success is supported by something greater than the facts of chemistry, of astronomy, or of mechanics.

If a technical man fails as a salesman, his failure is not owing to his education or his training, but to the fact that he was not a salesman and could not love the work. If a technical man succeeds as a general manager his success is due more to his love of the work than to his knowledge of mathematics. A lawyer may fill the highest position in commerce or manufacturing, but his success is only incidentally through legal knowledge; and comes directly through judgment and his insight into human nature. Character is not made up of the material or the seen realities, but of struggles with disappointment and opposition, for out of tribulation grow faith, confidence and honor.

Facts alone cannot be trusted. Facts and science will drift man to all corners of the universe; from doubt to doubt and from error to error. They are good tools, but cannot teach man duty or take the place of faith. Man has discovered some of nature's laws, but all facts and all of man's discoveries are insufficient for his victory without the thumps of life's reverses, by which we learn that logic may be false; faith may be right; force may fail; kindness may succeed.

Graphitized Metal.—Injecting molten metal into graphite by air pressure gives a new product, known as "graphalloy," which has hardness and strength adapting it to many purposes, and retaining the lubricating property of the graphite. The new material is intended especially for bearings for light machinery, such as small motors, fans and windmills. The metal or alloy used with the graphite can be varied to meet the requirements of any particular use—bronze being most suitable for trolley-wheel bushings, for instance, and copper or copper alloys for electrical apparatus. The graphalloy can be machined into any desired form.

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Vol. VI. FEBUARY, 1915 No. 2

PRINCIPAL CONTENTS.

ROLLING BACK THE TRADE DEPRESSION.

INDUSTRIAL activity, not to speak of industrial enterprise, is still in the "dog days," and what strikes us is that comparatively little effort, or at least infinitesimal results as its consequence have accrued. The disposition seems to be that of expectation or, worse still, working up excitement over some more or less ridiculous and extravagant proposition. Too much valuable time and opportunity are being wasted in discussing probabilities of our building submarines in wholesale fashion, or in retailing stories of gigantic combines whose purpose is the establishment of equally gigantic shell manufacturing plants. There is just about as much to be gained in our adopted attitude as there are possibilities in the realization of the schemes to which it applies, and better far would it be for all concerned if we devoted our time and attention to giving a lead by doing what lies to our own hand. The following letter from David McLain, of Milwaukee, the well-known American foundry expert, is not only refreshing on account of its splendid and good sense optimism, but is clearly indicative as well of what should be our part in rolling back the cloud of depression which so threatingly challenges us. He says:—

> If you would refer to my advertisement on page 5 of the August issue of Canadian Foundryman. you no doubt will be surprised to learn that I predicted boom times in 90 days, and I believe I can hear you say "Bunk," or "Mack over-reached himself this time." The copy for this advertisement was furnished you early in July, and represented the results of a careful survey of conditions as reported to this office from many different sections of the United States and Canada. There was no stopping the boom under ordinary conditions, but you know "man proposes and the Kaiser disposes."
>
> Naturally, after going on record through the advertising columns of your paper I kept close tab on the market and war reports through the month of August and believed that September would open up fairly active and close good and strong.
>
> Beaten again, but by whom? Not the Kaiser this time, but by the business men in general, who had simply quit giving orders as soon as the war started and, of course, if no orders are going out, very little business is being done. I feel that the war is going to be a long, drawn-out affair, because even if the Allies do drive the Kaiser back into Germany, how are they going to lick him there? As soon as the Mohammedans get started, I am going to quit reading the daily papers and devote all of my time to my own business. This is my fourth experience with the trade depression and can recall that of '73, '93 and '07.
>
> Should the war last forever—or should the railroad companies be unable to get their hundred million increase—or should business men generally allow themselves to drift along until the sheriff gets them, then I believe that if the small and medium business men of Canada and the United States will devote all of their energies to their business, they soon will have no need to fear what the big fellows are doing, as they themselves have it in their power to say whether or not we shall have good or bad times. I firmly believe that if every firm requiring equipment or material would place its order now, the wheels of industry again would begin to turn at a merry pace.
>
> Foundry history shows, however, that there have been more dollars and cents than common sense invested in the business. The idea that a little sand and a little melted iron will make a casting must pass. Poor trade did not cause failures in one out of every four foundries. Prices were as high as ever and wages did not materially increase. No, the profit that was added to the job in the office was lost when the castings reached the shipping room.
>
> Why? That's the puzzle, and the answer is locked up in things that cannot be seen in the foundry. A man may have eyes, ears and hands, but unless he adds to these trained brains, he never can be a success in the foundry or any other game.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

OBSERVATIONS ON NICKEL-PLATING SOLUTIONS. *

By Dr. Oliver P. Watts.**

ELECTRO-PLATING is a branch of electro-chemistry which has engrossed my interest more and more, and its problems furnish a most fascinating line of research. During a recent period I have been conducting a series of experiments upon certain phases of the deposition of nickel and consider the results of sufficient interest to display here.

Anode Composition

The first topic to which I would refer is the composition of the anode. For many years it has been the practice of the makers of anodes in the United States to add to the nickel varying amounts of iron, carbon and tin, so that the resulting anode contained only about 92 per cent of nickel. The following formula for making nickel anodes is taken from one of the plating trade journals:—"Nickel 92 per cent., tin 4 per cent., old files 4 per cent." (Metal Ind., 1907, p. 116). Why old files are preferred to any other form of iron is not stated.

A more recent article says, "the anodes are cast in varying degrees of purity, the average commercial anode consisting of about 92 per cent. nickel and 8 per cent. tin, while other grades, consisting of 85 to 89 per cent. nickel and 11 to 15 per cent. iron and tin, are especially adapted to certain work. A few are made of pure nickel free from alloy, but are too hard for ordinary purposes." (Foundry, 1913, p. 17).

The purpose of these impurities has been explained as follows:—"Commercial nickel anodes contain in addition to nickel, iron, tin, and carbon. These are introduced intentionally to render the anode "soft", i. e. so that it will dissolve easily in the solution during plating." (Brass World, 1911, p. 154). Analysis of samples of commercial nickel plate (J. Amer. Chem. Soc. 1917, 29, p. 1268) has shown the presence of 0.08 to 0.09 per cent of iron, and one writer (Trans. Amer. Electro-chem. Soc. 9, 217) has ascribed the rusting of nickel plated articles to the presence of this iron. Whether this is true or not, these impurities in the anode are of no benefit either to the solution or to the nickel plate, and their presence in nickel solutions should no longer be tolerated.

*From a paper read at the annual banquet of the Chicago branch, American Electroplaters' Society.

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For a number of years European platers have been using anodes containing 98 per cent of nickel, and it is time that American platers followed their good example. In a solution containing only sulphates these pure anodes do not corrode well, but the addition of one or two ounces per gallon of a soluble chloride remedies this trouble. Nickel, sodium, or ammonium chloride should be added to a solution in which pure anodes are used.

The little 25-gallon plating tank at the University was formerly equipped with the standard American anode, containing iron, carbon, and a trace of copper. A heavy brownish sediment of ferric hydrate continually collected in the bottom of the tank, and when standing unused copper was precipitated on the anodes and a scum of iron rust formed on the surface of the solution. Becoming dissatisfied with this state of affairs, I precipitated the iron, added some sal-

ammoniac to cause good anode corrosion, and replaced the impure anodes by sheets of electrolytic nickel, (obtained from the Orford Copper Co.) Electrolytic nickel anodes have now been used for seven years, and have proved satisfactory. At that time it was, I think, impossible to secure cast anodes of high purity in this country, but to-day the plater who wishes to avoid introducing impurities into his solution from his anodes is not confined to the use of electrolytic anodes, as cost anodes of high purity are now obtainable.

High Power Nickel Solution.

Another improvement in nickel plating which has come to us from Europe is the high-power nickel solution. It may be profitable to consider for a moment what constitutes a high-power nickel solution. It is not some mysterious chemical of wonderful potency, but is merely a solution containing much more nickel than the old style bath, and which therefore permits of using a greater number of amperes per square foot of plated surface without causing a burnt deposit. Since the rate of deposition increases directly as the number of amperes, the time of deposition is lessened proportionally.

There seems to be a prejudice on the part of many platers against strong nickel solutions, as indicated by such statements as the following, taken from periodicals which regularly devote considerable space to plating. "A new bath composed of double sulphates and water not infrequently gives trouble from peeling in addition to the dark color, especially if the solution stands in excess of 6 degrees Beaume. To remedy, reduce the density to 4½ or 5 degrees and add the conducting salts." (Foundry, 1913, p. 106).

"Question.—Our nickel deposits come out dark gray and rough after 1½ hours deposit. The solution stands at 10 degrees, and we have added single salts.

"Answer.—Your solution is too concentrated. In America solutions that register 5½ to 6 Beaume give the best results, provided the metal content of the solution is correct. Concentrated solutions produce dark deposits that readily stain, and often cause peeling." (Metal Ind., 1911, p. 353).

Yet to-day many platers are paying 35 cents a pound for an imported mixture of unknown salts, making solutions having a density of 16 degrees, and obtaining extremely satisfactory results from these dense solutions. I secured a good nickel deposit made at 18 amperes per square foot from a solution of nickel and magnesium chlorides having a density of 31.3 degrees. In thickness it is equivalent to a deposit for 20 hours at 3 amperes per square foot. If high density of solution were capable of ruining a deposit, this would be the worst sample of nickel plating which you have ever seen. It is time that platers recognized that poor nickel deposits are due to some other cause than too dense a solution.

I have tested only one of the high-power salts now on the market, but for a period of two months this has done all that the dealer claimed for it. I cannot conceive that a plater who has once tried this salt would ever use the old double sulphate solution, if he could obtain the price of this high power salt. It must be admitted that the expense is great, 100 gallons of solution costing $70, instead of about $7 for the double sulphate solution. Even if we grant that one tank of highpower solution will do the work of four tanks of the double sulphate, the ratio of costs is still over two to one against the high-power solution.

Only when the composition of these salts becomes known, or platers discover equally good combinations of salts themselves, will the high power solution compare favorably with the old style solution as regards cost per unit output. When, however, freedom from peeling, and burning, and when in many cases a more satisfactory anode-corrosion is secured, even at present prices, the greater capital outlay required for the high power solution may be fully justified. There is, too, the possibility of using the new salts in half the concentration specified, thus cutting the investment in half, and running the solutions at 5 amperes per square foot instead of ten.

Dilute Solution Adaptation.

There are several methods of making a dilute solution do the work of a concentrated one. One method is to circulate or stir the solution, or to move the object,—any process that will break up the film of dilute solution formed around the object, and supply metal as fast as it is needed for deposition. Circulation and stirring of the solution have long been used successfully in the electrolytic refining of metals, but because of stirring up the sediment always present in plating tanks, or possibly for some other reason, these methods have not come into regular use in commercial plating. Where heavy deposits are necessary, as in silver plating, some means of shortening the time is desirable, and motion of the cathode rod has frequently been resorted to, thus allowing an increase of current density and a corresponding lessening of the time. This method is applicable in any case where a heavy deposit of metal is necessary, and its use has already been extended to the deposition of nickel.

There is, however, another and more effective way of transforming an ordinary dilute nickel plating bath into a high-power solution—that is to heat it. I have been experimenting with hot nickel solutions, and from one containing 10 ounces per gallon of the double sulphate at a temperature of 194 deg. F. and a current density of 29 amperes per square foot, a good deposit was obtained in twenty minutes, which would have required 3½ hours in the cold solution at the usual current density of 3 amperes per square foot. Similarly the current density in a high-power bath of full strength at 165 deg. F. was increased at intervals to a maximum of 206 amperes per square foot, without spoiling the deposit: this is the equivalent of 19 hours at 3 amperes per square foot.

To establish a record for the rapid plating of nickel, a brass tube ¾ inch in diameter was used as cathode, and rotated at 1,000 r.p.m. Many trials were made at increasing current densities and although a current density of 1,257 amperes per square foot was reached in one trial, the deposit was still excellent. Two minutes at this current density gives a deposit equivalent to 14 hours plating at 3 amperes per square foot, and in spite of this heavy deposit, 2 to 3 minutes with tripoli and rouge was sufficient to give it the polish of the sample shown.

How much higher the current density can be carried under the conditions of these three experiments I am at present unable to say, and it really does not matter to the electro-plater, as it has been shown that in a hot nickel solution the current density can be carried to such a point that the ordinary plating bath becomes a high-power solution. The efficiency of deposition on a rotating cathode at 625 amperes per square foot was found to be 99.8 per cent. There is, however, another result obtained in the hot solution which I regard as of more value to the nickel plating industry than rapidity of deposition—that is the softness, toughness and freedom from peeling of the deposit.

In the case of thick nickel deposits from cold solutions, their hardness makes buffing difficult and expensive, they are more liable to peel than thin deposits, and the time required for their production is excessive unless a high-power solution is used. In view of these facts, it is not surprising that in the past many platers have used altogether too light deposits. Much of this thin plating affords no protection to the underlying metal and is not even ornamental, for after a few months' use it wears off in spots and the articles look worse than if they had never been plated.

Hot Nickel Solutions.

Too much nickel plate is made to sell instead of to wear, but the latter can be offset by the hot nickel solution. Its use will enable the plater to produce a thick deposit in less time than is now required for a thin deposit. By heating the regular plating solution to 180 deg. F., or above, deposition can be carried on at twice or three times the rate of the present high-power solutions. By using a hot high-power solution, current densities of 100 to 200 amperes per square foot may be used on stationary cathodes, or, since such great current densities as these are not needed in plating, the high power solution may be diluted to three times its original volume and yet be used at 20 amperes per square foot.

The deposit from a hot solution is soft, never peels from a clean surface, and is quickly and easily polished even though it appear dull as it comes from the bath. This ease of polishing should result in a considerable saving in the time and labor required for buffing, and would partly defray the cost of heating the solutions. The heating coils should be made of lead.

The Soft Deposit Feature.

It has long been known that hot nickel solutions give soft deposits and the following extracts would seem to indicate that they have been tried and found wanting:

"Question No. 1283.—What is the advantage of running a nickel solution hot and what are the disadvantages?

Answer.—The advantage gained in using a hot nickel plating solution is that the nickel deposits faster and is brighter. In addition the nickel is apt to be slightly softer and more free from pits. Beyond these advantages a hot nickel solution has no other benefits. The disadvantages are the fact that the solution must be heated, and requires far more care and must be maintained at a constant temperature in order to obtain uniform results. Cold plating solutions are always used wherever possible, and in the case of nickel solutions it is generally considered that the slight advantage gained by using them hot does not warrant the extra labor involved. It is possible to obtain sufficiently good results in cold solutions of nickel." (Brass World, 1913, p. 145).

"Question No. 1324.—What will happen if a nickel solution is run hot?

Answer.—Nickel solutions can be run hot and give good results and soft deposits. They should, however, be used much weaker than when employed cold. It is generally found unnecessary to use them hot as the trouble of heating and maintaining them is more than the gain in quality. Hot solutions deposit nickel very rapidly." (Brass World, 1913, p. 258.)

In general these statements agree with my experiments, that a hot solution yields a soft nickel deposit, and permits

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ALL FOR NATION'S SAFETY.

"It should be plain to everyone that in the stress of danger to the life of any nation at war, the courts should be exceedingly careful not to hamper the actions of those expressly charged with the safety of the nation; careful, among other things, not to take up the time and attention of those who should be fighting the enemy in the field, in fighting law suits in the law courts over private rights. It is not a time when the prisoner is to have the benefit of the doubt: it is a time when in all things, great and small, the country must have every possible advantage."—Chief Justice R. M. Meredith.

of more rapid deposition, but on the question of whether heating will pay or not we have come to opposite conclusions. This is a matter which cannot be settled by argument, but only by trial on a small commercial scale. Cannot some local branch of the A. E. S. take up this question and carry it to a definite conclusion? Its potential importance merits an early and decisive trial by practical men.

The Ampere Function.

It will probably be found that careful temperature regulation is not essential to success when the plating tank is equipped with an ammeter so that the plater knows what current he is using, although it may prove otherwise if he has to depend entirely upon the voltmeter in controlling the current. This leads me to speak of the necessity of an ammeter, or ammeters, of suitable range so connected that the current passing in each tank may be read. It is the number of amperes per square foot of surface receiving the deposits will be good or bad; and not the volts across the tank.

The voltage itself has no influence on the character of the deposit, and may have any value that is necessary to send the proper number of amperes to the objects which are being plated. The voltmeter is better than nothing since, with its aid, the plater can make a better guess at the proper adjustment of the rheostat than he could without it, but it is a poor substitute for the ammeter. The plater needs both voltmeter and ammeter for proper regulation of currents and solutions. If a record is kept of the volts and amperes it will not only tell what current to use on a particular tank when partly, and when completely filled with work, but it will indicate changes in resistance of the solution. To calculate the resistance of a plating tank read the volts and amperes, open the switch, or otherwise break the circuit for a second,—just long enough to get a reading of the voltmeter. Subtract the second voltmeter reading from the first ,and divide by the current; the quotient is the resistance in ohms.

Since the resistance diminishes greatly with increase of temperature, a change in the resistance of a solution does not surely mean a change in composition unless the temperature is the same as when the resistance was measured before. It is not necessary that there should be as many ammeters as there are plating tanks, for a single instrument may be arranged to read the current in any one of the several tanks. At the outset it might be well to purchase only one ammeter, and use it until convinced that it is a great help in plating before putting in a full equipment.

LOCAL CASE-HARDENING.

LOCAL case hardening of steel formed the subject of paper read recently by Guillet and Bernard before the Societe d'Encouragement pour l'Industrie National of France. The methods employed were summarized as follows:

1.—The parts to be protected against cementation are covered with fire clay, but the protection thus furnished is not complete, as the gases penetrate the fire clay, besides in complex shapes the method becomes complicated and expensive.

2.—A tube is shrunk over the parts which are to remain uncemented, the thickness of the tube being slightly greater than the depth of case required. After the cementing process the tube is broken off. The method is obviously very limited in its application.

3.—The object is made with extra thicknesses in those parts which must not be hardened, and after cementation and before hardening, these extra thicknesses are machined off . The process is very expensive.

4.—The parts not to be cemented are protected by a metallic deposit which must be (a) solid at the cementing temperature; (b) impervious to the cementing materials; (c) easily obtained commercially, and (d) easily removed after the operation. Copper and nickel are the only metals which fulfil conditions (a) and (c), and the latter fails to comply with condition (b).

The metal may be dsposited by immersion in a salt solution, by electrolysis, or by the Schoop spraying process. The first-mentioned is not satisfactory owing to the thinness and uncertain adherence of the coating. The electrolytic process, is cheaper to install than the spray process, which, on the other hand, is quicker and more easily localized.

CAPTURING GERMAN TRADE.

A great deal has been written of late as to "capturing" enemies' trade—much of it sense, but still more of it nonsense .Many dillettante commercial experts, who have probably never been inside a factory and who have no practical knowledge of how trade and industry are financed and conducted, freely lavish allegations as to lack of initiative and out-of-date methods on the part of our manufacturers and exporters, and airily discuss the "capture" of the export trade of Germany and Austria-Hungary, valued at over six hundred millions sterling per annum. .We have no desire to discourage energy and enterprise in making the most of every opportunity for extending our trade—far from it—nor is it denied that in some directions our methods of business are capable of improvement, but to spread broadcast throughout the world the idea that our trade and industry is conducted on out-of-date principles is not only untrue, but is calculated to defeat the object which, presumably, such critics have in view. Up to now it has not been possible to do a great deal more than to survey the field and to pave the way for strenuous competition at the right moment, and much assistance in this direction has been afforded by the British Board of Trade, the London Chamber of Commerce and the Department of Trade and Commerce, Ottawa.

Questions and Answers

Question—We manufacture a line of embossed metal novelties and have been finishing them in nickel, silver, brass and grey. To obtain the grey we use a sulpho-cyanide black nickel solution. This deposit however does not relive easily and the effect is not satisfactory. We do not wish to resort to oxidizing with sulphurette, but would like to obtain a formula for a black or grey produced with electric current, which would be softer than the sulpho-cyanide finish.

Answer—For a ten-gallon bath that will produce a soft coating of greyish black and will permit easy relieving, saturate 8½ gallons of soft water (rain water), with carbonate of soda. Next saturate 1 gallon of strong liquid ammonia with a mixture composed of 2½ parts of plastic carbonate of nickel and ¼ part of plastic carbonate of copper. When both solutions are complete, add the saturated ammonia solution to the soda solution and stir well. Equip the bath electrically in the usual manner and operate cold with iron or clean nickel anode, and a tension of from 1½ to 3 volts.

* * *

Question—I would like to know how to make a cyanide copper solution plate of clear pink color and smooth. Also, how to obtain a bright deposit from a cyanide copper solution, the deposit to be harder than the ordinary copper plate.

Answer—To produce clear, pink copper deposits from a cyanide copper bath, first assure yourself that the metallic strength of the solution is normal then, for every 100 gallons of solution you wish to treat, dissolve 1 oz. of hyposulphite of soda in a little water and add a portion of the solution to the copper bath. Stir well and test by plating a piece of work. The chemical affects the deposit immediately and you will be able to judge the amount required with considerable accuracy. Care should be exercised in preparing and adding the soda solution to avoid an excessive amount of the chemical; more than 1 oz. per 100 gallon frequently proving disastrous, and less than 1 oz. per 100 gallon being sometimes sufficient. The composition of the bath influences the results. An excess causes blisters and black dirty deposits which are often troublesome to correct. If the proper amount be used, the rough red deposit will be followed by one of uniform color and quite smooth and clear. If you desire a bright deposit which is extra hard, do not use the hypo-sulphite of soda in the same solution. Use another bath and dissolve 1 pound of caustic potash in water then slowly add 10 oz. of carbonate of lead to the potash solution and stir well meanwhile. Next add 8 oz. of cream of tartar and mix the whole thoroughly together. Of this mixture, add from 6 to 8 oz. to each 100 gallons of copper solution, such additions being required every few days, depending on the amount of work treated by the bath. If the deposit be too hard, small quantities of sodium carbonate solution added to the copper solution will soften the deposit. Again if the deposit be too soft, use a little more cream of tartar in the above mixture. When additions are required to be made while the work is in the bath, shut off the current and stir in the mixture. Such additions may be avoided by replenishing at regular intervals. Keep the bath well balanced in metal and cyanide while using these modifiers if best results are desired.

* * *

Question.—Kindly publish a formula for a black nickel solution and give some particulars as to its operation.

Answer.—There are many formulae for so-called black nickel solutions, but those which are most popular contain sulpho-cyanide of potash. The formula here given contains no other chemical foreign to a white nickel solution. Dissolve 7 oz. sulphate of nickel, 3¾ oz. ammonium chloride and 1¼ oz. boracic acid for each gallon of water used, when the chemicals are dissolved and well mixed in solution, allow to cool and then add 2 oz. sulpho-cyanide of potash for each gallon; this should also be dissolved before adding to the previously made solution. When the two solutions are mixed, stir the whole thoroughly. The solution may be operated either warm or cold and only a very weak current is necesary, one of ½ volt to 1 volt tension being sufficient, and either brass anodes or old nickel anodes well cleaned may be employed. Points to be remembered while using this solution are that current stronger than 1 volt will produce a grey deposit, and that a current at ½ volt pressure will produce a fine black on polished or buffed surfaces, while dead or unpolished surfaces will be finished grey. When the solution fails to respond, or plates black streaked with grey or white, add carbonate of nickel previously dissolved in a small portion of the solution, to neutralize the excess acid. Ammonia should not be used in this solution as it renders the deposit brittle and liable to flake. The usual method of using this solution is to strike the work in white nickel, rinse and place in the sulpho-cyanide bath, but this strike is not necessary in every case. Deposits from solutions of this character should never be prolonged after the desired color is obtained, as the coating is not pure nickel but a combination with non-metallic substances and, when deposited to the thickness of more than a mere film, they invaribly scale or flake off. They are not flexible and should be discontinued as soon as the proper shade is obtained. If the solution be kept at about 100 degrees Fah., the deposits are more uniform, a denser solution being permissible and the deposition more rapid.

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Question.—We wish directions for producing a silver frost finish upon small sheet brass goods, also a French grey process without liver of sulphur.

Answer.—To produce the silver frost on brass, first clean the parts in mild caustic solution and then immerse in a solution made as follows: In 1 gallon of nitric acid dissolve 8 oz. sheet zinc by adding the zinc a few pieces at a time. When solution is complete, allow the acid to coll and then mix in 1 gallon of sulphuric acid. This mixture will produce a matte surface on brass goods immersed momentarily. The color will be dull. To obtain a bright matte surface suitable for frosted finish, dip the parts in a solution consisting of equal parts nitric acid and sulphuric acid in water equal to ¼ the volume of the acid mixture which also contains 1 oz. of hydrochloric acid per gallon. Rinse the work thoroughly after removal from the dip and then pass through a weak cyanide solution. Rinse again, and place in the silver dip which is composed of 8 oz. potassium cyanide, 12 oz. caustic soda, and 1¼ oz. silver nitrate dissolved in 3 gallon of clean rain water. Move the parts quickly to and fro while in the solution, then remove and allow to drain. Next rinse in clean, cold water and dry by aid of boiling water containing fish soap. Finish the drying by use of clean hardwood sawdust. Employ any good transparent dip lacquer. Sometimes a matte dip does not work correctly when freshly prepared; in which case, add 1 or 2 oz. of water, stir and test, and repeat until desired results are obtained. If the dip gives a course matte to the brass, add more sulphuric acid but, if the matte is too fine, add nitric acid. These additions should be small and be repeated, if necessary. The matte dip gives best results at a temperature of about 90 degrees Fah., while the silver dip should be used at about 150 degrees Fah. If the silvered parts appear yello wit indicates an excess of cyanide.

Trade Gossip

Sarnia, Ont.—The Mueller Manufacturing Co. is now working on the brass parts of shrapnel shells for the British Government.

G. G. Ulster, late of Fort William, Ont., has been placed in charge of the London, Eng., office, opened by the Canadian Car & Foundry Co., to look after foreign buisness.

Montreal, Que.—It is reported that the Canadian Steel Foundries, Ltd., have secured the contract to manufacture the castings for twenty submarines to be built by the Canadian Vickers. Ltd., for the British Government.

Thorold, Ont.—The Exolon Company, makers of an artificial abrasive, propose to build another unit to their plant, to cost $20,000. The present buildings and equipment represent an expenditure of $130,000. C. J. Brockbank is manager.

Cobourg, Ont.—A by-law authorizing the issue of debentures for the raising of $50,000 in aid of the Federal Steel & Foundry Co., Ltd., for the establishment of a manufactory of steel and iron products, forgings and castings has been carried by a vote of 572 to 90.

Midland, Ont.—The steel plant formerly known as the Georgian Bay Engineering Works, which has been standing idle for nearly fifteen months, will resume operations. Drummond Brothers have leased the plant, and will fit it up for the manufacture of shrapnel shells. J. J. Drummond is manager of the company.

G. A. Irwin has been appointed sales manager for the Algoma Steel Corporation, and assumed his new duties at the first of the year. He has been connected with Drummond McCall & Co. for the past thirteen years, which firm have been acting as sales agents for the Algoma Steel Corporation. Mr. Irwin had charge

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of the sales of all the products of the Algoma Steel Corporation, and in addition had charge of the sales of iron ore and pig iron. About July 1 last year the Algoma Steel Corporation decided to sell direct, hence the opening of the Montreal sales office of which Mr. Irwin is in charge, in the McGill Building.

Lessons on Oxy-Acetylene Welding and Cutting.—A second elementary winter course was started on Jan. 20 at the Montreal Technical School, 70 Sherbrooke street West, on the subject of Oxy-Acetylene Welding and Cutting Processes. Ten lessons will be given, one lesson every Wednesday evening from 7.30 to 9.30. An advanced course is also to be held every Friday, from 7.30 to 9.30, ten lessons in all. This began on Friday, Jan. 22, 1915. Theoretical lessons are being given by experts in both English and French, while the practical side will be taught in a fully equipped shop with individual benches.

Lake Superior Corporation. — A change has taken place in connection with the Lake Superior Corporation administration, by which J. Frater Taylor resigns, and Thomas Gibson, of Toronto, takes the office. This was effected at a meeting of the Board held recently in Montreal. Mr. Taylor continues on the Board of the Corporation, but his reason for resigning was explained in that he has undertaken the management, as well as the presidency of the Algoma Steel Corporation and subsidiary companies.

J. H. Plummer, president of the Dominion Steel Corporation, was in Montreal recently.

U. S. Copper Shipments.—Copper exports from the United States amounted to 15,389,322 pounds, valued at $2,067,356 during the week ended January 30. Of this 6,289,648 pounds went to France, 4,776,728 to England, 1,717,428 to Italy, 1,456,336 to Sweden and 691,142 to Canada.

Dominion Steel December Output.—The business of the Dominion Steel Corporation in the closing months of the year did not show great improvement. The output for December, 1914, as compared with the previous year in all departments is as follows:

	Dec., 1914. (Tons)	Dec., 1913. (Tons)
Pig iron	12,843	20,535
Steel ingots	19,787	19,082
Rails	3,700	10,411
Wire rods	3,762	1,484
Bars	410	265
Wire and wire products	2,567	1,556
Coal mined	317,003	396,824
Steel Shipments	12,048	5,549
Coal	221,597	261,316

Catalogues

J. W. Pearson Co., Philadelphia, Pa., are distributing a calendar for 1915, printed in bold type and featuring principally the "Albany" moulding sand.

Goggles.—Eye protectors of various styles are described in a bulletin issued by T. A. Willson & Co., Inc., Toronto. Each style varies to suit particular requirements, and illustrations are given of each, accompanied by a brief description.

McLain's System.—A bulletin, containing a synopsis of twelve lessons, giving particulars covering grey iron mixtures, cupola practice and the making of semi-steel, has been recently issued by McLain's System, Milwaukee, Wis. Each lesson deals with a different phase of foundry practice.

Friction Hoist.—The Herbert Morris Crane and Hoist Co., Toronto, are distributing bulletin B-11, dealing with the Morris belt-driven friction hoist. General particulars and prices are given of hoists with working loads up to one ton. Two illustrations of hoists in operation are given, while diagrams are included of suspended and floor type hoists, showing principal dimensions for each size.

Analysis by Sparks.—The spark test of steels in forge shops and tool room is placed next to precise chemical analysis by J. F. Keller, of Perdue University. A chart, 18 by 24 inches in size, has been prepared, and shows the colors and general appearance of the sparks for steel of many different compositions. Comparisons of the sparks with this chart serves to separate iron, mild steel, tool steel, high-speed steel, magnet steel, and so on.

Lighting Systems.—A comprehensive general catalogue, No. 71, has been issued by the National Stamping and Electric Works, Chicago, Ill. The principal systems described are the "Acme" air light gas system and the "Nulite" hollow wire lighting system. A full description is given of each, with instructions for installing and operating, accompanied by diagrams. Particulars are given of the various fittings and also of the gasoline portable and stationary lamps. The catalogue is fully illustrated and shows many different styles of lamps and chandeliers.

Anodes and Plating Salts are described in bulletin No. 600, issued by the Munning-Loeb Co., Matawan, N.J. The bulletin deals with anodes for plating processes, with special reference to the nickel anode and its principal features. Cast and rolled anodes made of other materials are also described. Other matter deals with salts and miscellaneous chemicals used in plating solutions. The bulletin is fully illustrated.

Dixon Crucible Booklet.—In a new edition of the booklet "Dixon's Graphite Crucibles," information is furnished concerning steel melting crucibles, file crucibles, crucible covers, tilting furnace crucibles, retorts, bottom-pour crucibles, stirrers, skimmers, dippers and self-skimming crucibles. Some good advice is given in two pages relating to oil furnaces and general hints. Foundry facings and a highly refractory cement for the repair of worn or cracked firebrick are also described. This little booklet is altogether worth while to the man interested in the subject of better foundry practice, and a copy is gratis to those who take the trouble of writing the Joseph Dixon Crucible Co., Jersey City, New Jersey.

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Ammeters.
Chas. J. Menzemer, Niagara Falls.
E. J. Woodison Co., Toronto.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Northern Crane Works, Ltd., Walkerville, Ont.
E. J. Woodison Co., Toronto.
Pangborn Corp., Hagerstown, Md.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
J. S. McCormick Co., Pittsburg, Pa.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
Manufacturers Brush Co., Cleveland, O.
J. S. McCormick Co., Pittsburg, Pa.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.
Chas. J. Menzemer, Niagara Falls.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
Chas. J. Menzemer, Niagara Falls, Ont.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Monarch Eng. & Mfg. Co., Baltimore.
W. S. Rockwell Co., New York.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
Monarch Eng. & Mfg. Co., Baltimore.

Castings, Brass, Aluminum and Bronze.
A. T. Gordon, Ottawa, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Castings, Malleable.
Can. Malleable Iron Co., Owen Sound.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Chain Blocks.
Herbert Morris Chain & Hoist Co., Ltd., Toronto.
John Millen & Son, Ltd., Montreal

Chaplets.
Columbian Facing Mills Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Wells Pattern & Machine Works, Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Chemicals.
Chas. J. Menzemer, Niagara Falls.
W. W. Wells, Toronto.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New Pennington, N.J.
E. J. Woodison Co., Toronto.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.

Core Cutting-off and Coning Machine.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.

Core Compounds.
H. S. Carter & Co., Toronto.
Columbian Facing Mills Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., Pennington, N.J.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Demmler & Bros., Wm., Kewanee, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Holland Core Oil Co., Chicago.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
E. J. Woodison Co., Toronto.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Core Wash.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.
W. D. Beath & Son, Toronto.
J. S. McCormick Co., Pittsburg, Pa.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Mussens, Limited, Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
J. S. McCormick Co., Pittsburgh, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore, Md.
Northern Crane Works Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Elk Fire Brick Co., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
Webster & Sons, Ltd., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Twyers.
Can. Hanson & Van Winkle Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.
E. J. Woodison Co., Toronto.

Cyanide of Potassium.
Chas. J. Menzemer, Niagara Falls, Ont.
J. S. McCormick Co., Pittsburg, Pa.
W. W. Wells, Toronto.

Dr.ing Ovens for Cores.
Webster & Sons, Ltd., Montreal.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
Chas. J. Menzemer, Niagara Falls, Ont.
W. W. Wells, Toronto.

Dust Collectors.
Pangborn Corp., Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Machy. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.
E. J. Woodison Co., Toronto.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Frdy. Sup. Co., Cleveland.
Stevens, Frederic B., Detroit.
Shelton Metallic Filler Co., Derby Conn.
E. J. Woodison Co., Toronto.

Fillets, Leather & Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Fire Brick and Clay.
H. S. Carter & Co., Toronto.
Elk Fire Brick Co., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Whitehead Bros. Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Guelph Pattern Works, Guelph, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., West Allis, Wis.
E. J. Woodison Co., Toronto.

Foundry Coke.
Baird & West, Detroit.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
Sterling Wheelbarrow Co., West Allis, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
J. S. McCormick Co., Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Webster & Sons, Ltd., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Furnaces.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
W. S. Rockwell Co., New York.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Goggles.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
J. S. McCormick Co., Pittsburg, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Grinders, Disc, Bench, Swing.
Ford Smith Machine Co., Hamilton Ont.
Perfect Machinery Co., Galt, Ont.

Helmets.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
A. R. Williams Machy. Co., Toronto.
Northern Engineering Works, Detroit.
Northern Crane Works, Walkerville.
Whiting Foundry Equipment Co., Harvey, Ill.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.

Hoists, Electric, Pneumatic.
A. R. Williams Machy. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
J. S. McCormick Co., Pittsburg, Pa.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Melting Pots.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Standard Sand & Machine Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Webster & Sons, Ltd., Montreal.
Stevens, Frederic B., Detroit.
Hamilton Facing Mills Co. Ltd. Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
Stevens, Frederic B., Detroit.
Midland Machine Co., Detroit.
J. S. McCormick Co., Pittsburg, Pa.
Tabor Mfg. Co., Philadelphia.
E. J. Woodison Co., Toronto.

Molding Sand.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Molding Sifters.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Oil and Gas Furnaces.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.

Patterns, Metal and Wood.
Wells Pattern & Machine Works, Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Hamilton Pattern Works, Hamilton.
E. J. Woodison Co., Toronto.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
J. S. McCormick Co., Pittsburg, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
Columbian Facing Mills Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Plating and Polishing Supplies.
W. W. Wells, Toronto.
E. J. Woodison Co., Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.
Perfect Machinery Co., Galt, Ont.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Resin.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

Rouge.
W. W. Wells, Toronto

Sand Dryers.
Pangborn Corp., Hagerstown, Md.

Sand.
Pangborn Corp., Hagerstown, Md.

Sand Blast Machinery.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton.
J. S. McCormick Co., Pittsburg, Pa.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Pangborn Corp., Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
W. W. Sly, Cleveland, Ohio.
Tilghman Brooksband Sand Blast Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.

Sand Blast Rolling Barrels.
New Haven Sand Blast Co., New Haven, Conn.
Pangborn Corp., Hagerstown, Md.
Tilghman Brooksband Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Can. Niagara Device Co., Bridgeburg.
J. S. McCormick Co., Pittsburg, Pa.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Molding.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Pangborn Corp., Hagerstown, Md.
Standard Sand & Machine Co., Cleveland.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Saws, Hack.
Ford-Smith Machine Co., Hamilton

Sea Coal.
J. S. McCormick Co., Pittsburg, Pa.

Shovels.
Can. Shovel & Tool Co., Hamilton, Ont.

Sieves.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Stevens, F. B., Detroit, Mich.

Silica Wash.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

Small Angles.
Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.

Special Machinery.
Perfect Machinery Co., Galt, Ont.
Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
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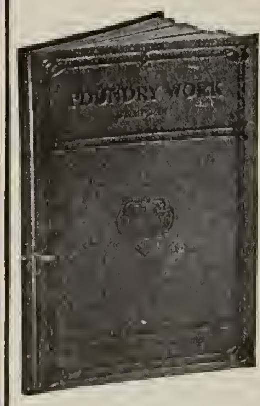

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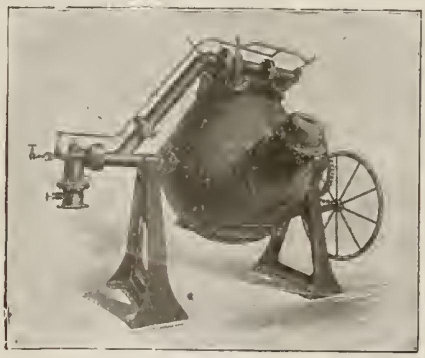

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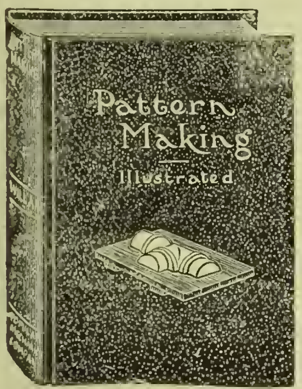

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Vol. VI. Publication Office: Toronto, March, 1915. No. 3

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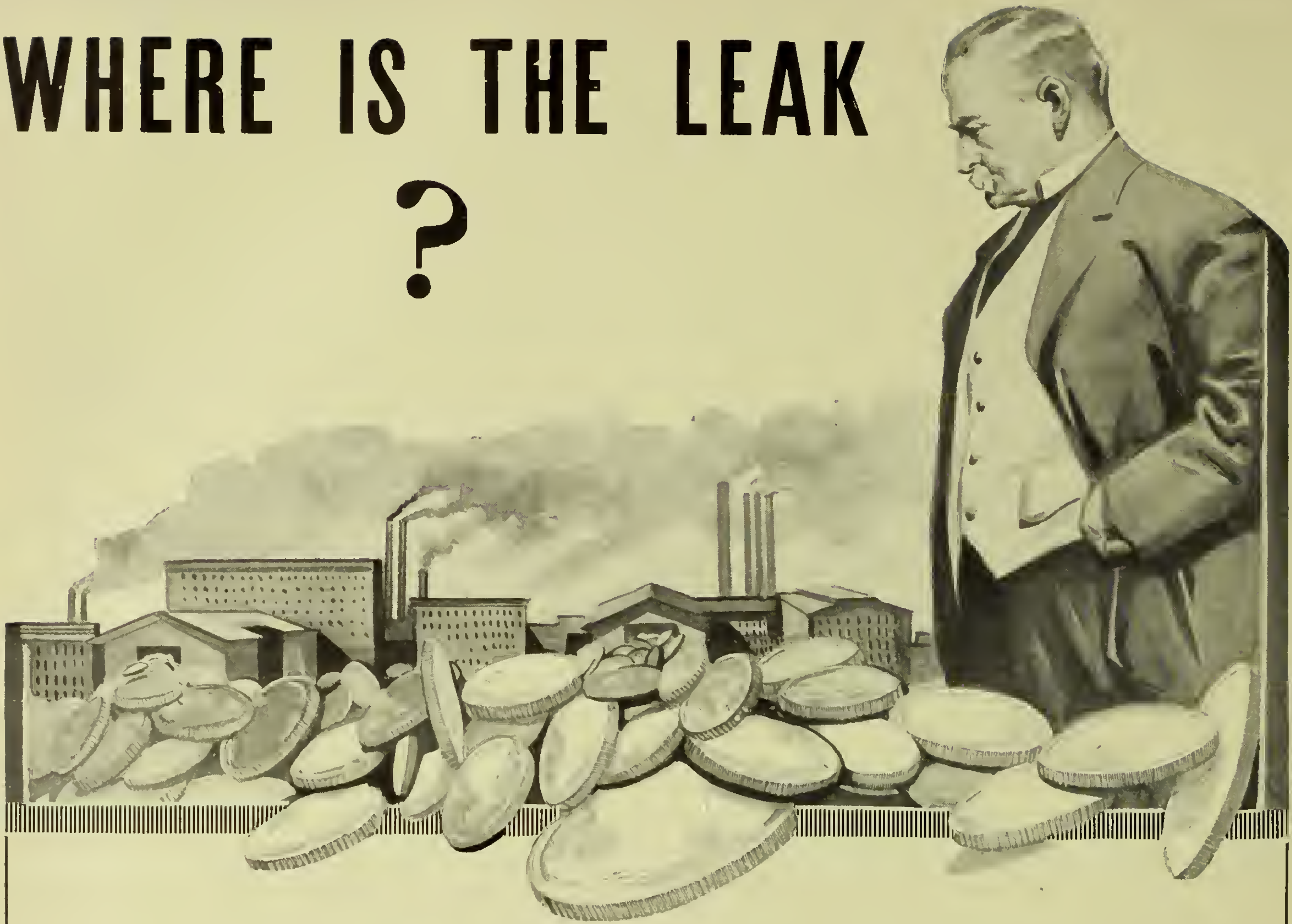

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Who Pays For Advertising?

SOME reminiscences of the late Thomas J. Barratt, who made Pear's soap famous through advertising, and who helped to make advertising famous through Pear's soap, appear in the "Strand" Magazine for March.

Mr. Barratt was the best known advertising man of his time, and spent millions in promoting the sale of Pear's soap through advertising.

The famous "Bubbles" picture, by Sir John Millais for instance, cost £2,200 (nearly $11,000) and hundreds of thousands of pounds have been spent in reproducing it in countless forms.

A good-sized fortune was spent in space in American publications in order to show Henry Ward Beecher's testimonial letter, secured under such unusual circumstances.

The article throws many interesting sidelights on the life of Mr. Barratt, and his achievements in the business world. Let us quote his answer to the question "Who pays the cost of advertising"?

> "Certainly not the consumer, certainly not the retailer. Here is the real truth of the matter. Money wisely spent in advertising increases sales and profits to such an extent that sufficient capital is provided for the operation of economies naturally resulting from buying and manufacturing in larger quantities. The bigger the volume of trade, the cheaper is the relative production; in fact, as all leading advertisers know, production is cheapened in a much greater degree by advertising than is represented by the money spent in advertising.
>
> "Much as we advertisers love the newspapers, to whose revenue we contribute so handsomely, we only perform this service because we get more out of the publicity they give us than they get out of us—with occasional exceptions perhaps, which are soon rectified. But what is of still greater importance is that, in ratio with the cheapening of production, there is a cheapening of the advertised article to the public."

This answer applies to-day just as well as when Mr. Barratt made it.

And it applies to Foundry Equipment as well as soap. It applies to technical journals as well as newspapers.

If anything, the answer carries added emphasis to-day because the standard of advertising is higher, and is being carefully guarded by the sentries of Vigilance Committees and other Protective Associations.

In short, it pays to buy advertised goods BECAUSE THEY ARE ADVERTISED.

Development of Our Nickel-Copper Smelting Industry

By A. W. G. Wilson *

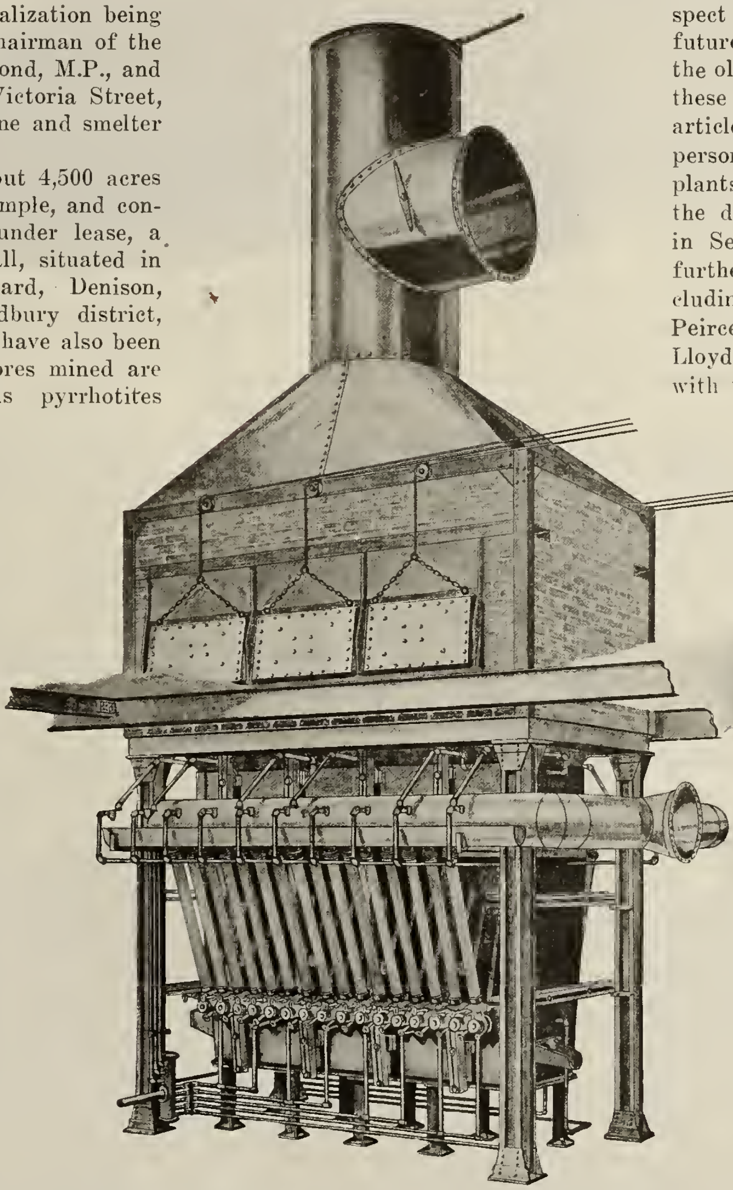
The accompanying article is the third of a monthly series descriptive of Canadian nickel-copper smelting plants. The European War has brought this particular industry very much into the limelight, on which account information relative thereto is of more than ordinary interest and moment. Section 3 of this description of the Mond Nickel Co. organization will deal with the Company's refining plant in Wales. Data and cuts are by courtesy of the Canadian Department of Mines and represent conditions existent in the fall of 1913.

MOND NICKEL CO.—I.

THE Mond Nickel Co. was incorporated September 20, 1900, under the laws of Great Britain, and operates in the Province of Ontario under license. The original capital of £600,000 sterling has been twice increased, the present capitalization being £2,400,000 sterling. The chairman of the company is Sir Alfred Mond, M.P., and the head office is at 39 Victoria Street, London, England. The mine and smelter office is at Coniston, Ont.

The company owns about 4,500 acres of mining lands in fee simple, and controls about 2,500 acres under lease, a total of 7,000 acres in all, situated in the townships of Blezard, Denison, Snyder, and Garson, Sudbury district, Ontario; additional areas have also been acquired recently. The ores mined are deposits of nickeliferous pyrrhotites containing some chalcopyrite, and occurring in norite; they contain about 2.3 per cent. nickel and 1.75 per cent. of copper in addition to small amounts of gold, silver, platinum and palladium. For many years the principal property was the Victoria Mine, first opened about 1890. Two ore bodies, about 160 feet apart, occurred on this property. They lay with their longer horizontal axis almost on an east and west line, and had a uniform dip of about 75° towards the east. Development work was by diamond drilling, followed by shaft sinking and the running of levels. The main shaft is a 3-compartment shaft, 800 feet in depth, 4 ft. x 12 ft. inside the timbers; ten levels have been driven from this shaft to reach ore body.

The other important mine which has supplied ore for a number of years is the Garson. There are two ore bodies at this mine, about 100 feet apart, and the development and mining have been through a 500 ft. shaft. Extensive diamond drill work, based on the results of magnetic surveys, has shown the existence of a large body of ore on property belonging to this company, adjacent to the Frood Mine, Lot 6, Concession VI., Township of McKim. Preparations have been made to mine this ore body on a large scale.



RECTANGULAR WATER-JACKETED COPPER BLAST FURNACE. ORIGINAL TYPE USED BY THE MOND NICKEL CO., 1909, VICTORIA MINES SMELTER (A.C. CO.).

The company also owned and operated a smelter at Victoria Mines, Ontario, on the Soo branch of the Canadian Pacific Railway, about 2 miles from the Victoria Mine, and 22 miles west of Sudbury; but the operation of this plant has now ceased, there having been erected to replace it a modern and fully-equipped plant at Coniston, about 7 miles east of Sudbury. The new plant is more conveniently situated with respect to railway transportation and the future ore supply. Descriptions of both the old and new works are here included, these being based upon several published articles and upon data obtained by a personal visit of the writer to the two plants. Relative to the plant at Coniston, the description represents its condition in September, 1913, since which date further equipment has been added, including another blast furnace, another Peirce-Smith converter, and two Dwight-Lloyd straight line sintering machines with the necessary auxiliary equipment.

The ore supplied for the old plant was conveyed to the roast yards and thence to the smelter over a Bleichert aerial tram line, 11,000 feet in length. Ore from the Garson Mine was brought about 31 miles in 50-ton bottom dump steel railway cars to Victoria Mines; from here a portion was sent to the roast yards over the tram line and the balance went directly to the furnaces. Ore supplies for the new smelter are derived chiefly from the Garson and the Frood Mines, a portion of the ore body of the latter being on the property of this company. The haulage distances to the new roast yards, about a mile and a quarter from the smelter, are 10 and 12 miles respectively, chiefly over the Canadian Northern Railway.

Power for the Victoria Mine and smelter was furnished by a hydro-electric plant, owned by the company, and located at Wabagishik Falls, on the Vermilion River, in Lorne Township, and about 8 miles from Victoria Mines.

---

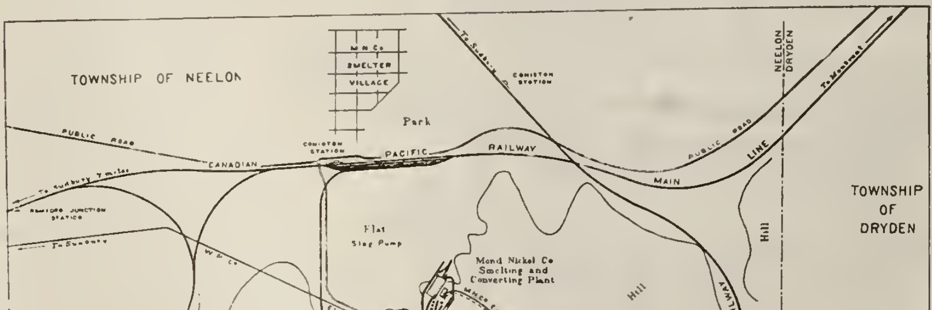
*Chief of Metal Mines Division, Ottawa.

Power for the Garson Mine was procured from the lines of the Wahnapitae Power Co., whose two power plants are located on the Wanapitei River not far from Coniston. The new smelter is operated by Wanapitei power.

Historical.

In the year 1899 the company began operations in the Sudbury district by extensive stripping and other development work at the Victoria Mine. This included the building of roads, the preparation of a roast yard and other preliminary work. In 1900 the smelter was erected on its present site, under the supervision of Hiram W. Hixon. The Bleichert tram line, 11,000 feet in length, was installed by the Trenton Iron Co. of New Jersey to connect the mine, roast yards, and smelter. The furnaces were first blown in early in 1901. The mine and smelter were closed down in December, 1902, and were not again in operation, except for a few months in the summer of 1903, until near the end of 1904. Since that date the plant had been in continuous operation, with only slight interruptions. The first furnaces were 44 in. x 120 in. at the tuyères; in 1908 the plant was remodelled and the size of the furnaces increased to 44 in. x 180 in.

In 1911 a site was selected at a point about 2 miles from Romford Junction, on the Canadian Pacific Railway, conveniently located, both with respect to two transcontinental railway lines and to the principal mines owned by the company, and a new modern smelting plant erected. There are now installed three blast furnaces, 50 in. x 240 in., three Peirce-Smith basic converters, 10 ft. x 25 ft. 10 in., together with the necessary auxiliary equipment.



GROUND PLAN, CONISTON PLANT, MOND NICKEL CO.

Victoria Mines plant.

This plant, although having ceased operation, has, however, served its purpose well, having been an important factor in the development of the copper-nickel industry of the Sudbury district. A brief description of the equipment and the method of operation is of interest, and may also be of future value as a matter of record.

GENERAL VIEW OF THE COMPLETED PLANT AT CONISTON. NOTE THE CURVED LINE OF TRESTLES CARRYING THE TRACKS THAT RUN UNDER THE ORE BINS AND ON THE CHARGING FLOOR LEVEL.

General Statement of Equipment.

The plant was equipped with two water-jacketed blast furnaces, 44 in. x 180 in., each capable of treating 400-450 tons of ore charge per day, under present practice. In converter building were two electrically-operated converter stands, and 6 shells, each 84 in. x 126 in., and a 30-ton, 3-motor, Morgan traveling crane. Power was electric, supplied by the company's plant at Wabagishik Falls, on the Vermilion River, with a boiler plant held in reserve at the smelter. The blower plant included two Connersville blowers and a Nordberg compressor for the converter air. The buildings consisted of office and laboratory, engine house,* well equipped shops, club-house, boarding houses, and about 40 detached dwellings.

Bleichert Tram Line.—This tram line was 11,000 feet in length and ran from the Victoria Mine to the smelter. It was equipped with loading terminals at the mine, at the roast yards, and at the smelter, and with discharging stations at the roast yards and smelter. The buckets each held about 700 pounds and travelled the two miles from the mine to the smelter at such a rate as to deliver about 100 loads per hour. The roast yards were located between the mine and the smelter and about half a mile from the latter. Ore from the Garson Mine was delivered into tram bins near the smelter by Canadian Pacific Railway ore cars; this ore being then raised by a small skip to charging bins on the tram line, whence it was conveyed to bins at the roast yard. The tram line also carried Victoria Mnie ore to the roast yards, roast ore to the smelter, and waste rock from the Victoria Mine to the dump. The operation of the tram line was such that each bucket was idle for only a very short portion of the entire round trip from Victoria Mine to smelter and return.

The difference in elevation between the mine and smelter was only about 160

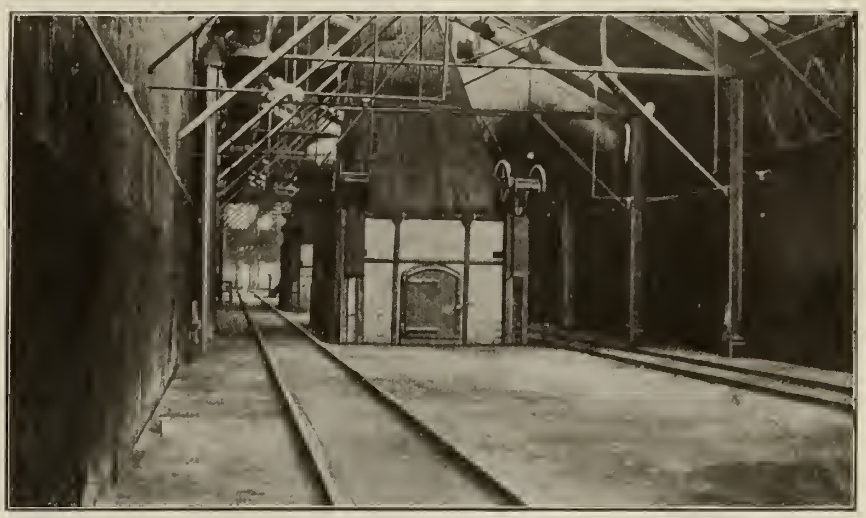
*The power plant at Victoria Mines was destroyed by fire on the day before it was closed down for removal to Coniston.

feet, but owing to the heavy duties required of the tram, this fall was not sufficient to operate it, and additional driving power was furnished by a 30 h.p. motor installed at the lower end.

Flue System and Stacks.—The downtakes of the blast furnaces led to a steel dust flue with continuous V bottom, and slides were provided on either side at about 4 ft. centres, for the removal of flue dust. The main stack was of steel plate, and about 115 feet in height. The lower part of the stack, about 24 feet in height, was shaped as a truncated cone, the upper portion being cylindrical. The converter flues connected with the main stack.

Buildings.—The smelter building was a steel frame structure, covered with corrugated iron sheeting, while the electrical sub-station, in which the power plant was also placed, was a wooden trussed brick building with concrete floors, 50 ft. x 90 ft. The roof was composite, being covered with corrugated steel on the outside and lined with matched pine. The various shops were housed in wooden structures.

Coke, Fluxes, Silica.—The coke used in the furnaces came from Pennsylvania, being shipped by water to Algoma Mills, 73 miles west of Victoria Mines, where it was loaded into box cars, or coke cars, and hauled to the smelter by the Canadian Pacific Railway. The freight charges amounted to about $5.60 per ton on coke that cost $1.10 per ton at the ovens. Limestone, which forms about 4 per cent. of the furnace charge, was obtained from the Fiborn quarries in Michigan. For converter linings, the



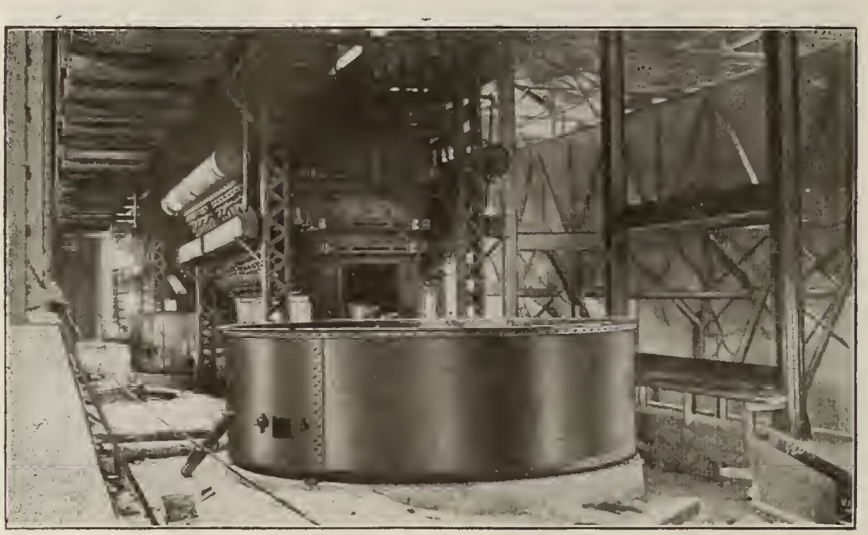
CHARGING FLOOR, SHOWING TOP OF A FURNACE.

siliceous ore from Bruce Mines, Ont., was used. This ore consists largely of quartz carrying about 3 per cent. copper in the form of chalcopyrite. The ore is hauled 121 miles over the Canadian Pacific Railway. When an additional supply of quartz was required, it was obtained from a local quarry not far from the smelter.

Blast Furnaces.—The two furnaces were each 44 in. x 180 in. at the tuyères, and were mounted on concrete foundations at an elevation of 6 feet above the converter floor. The superstructure was of structural steel above the charging floor; the hood, stack, and downtake leading to the flue being of steel plate. They were water-jacketed steel furnaces with brick tops, and cast-iron sole plate 2 in. thick. Their capacity was 400-450 tons of ore charge per 24 hours for each furnace, under the present method of operation.

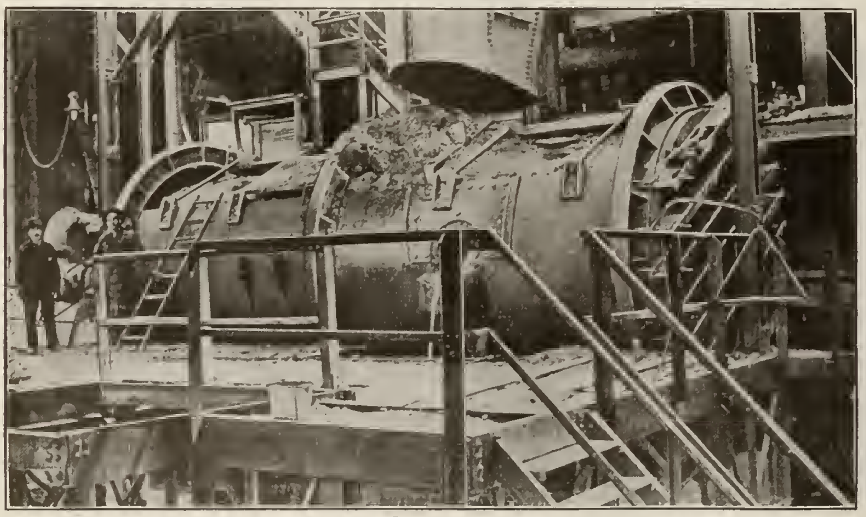
CONISTON PLANT IN COURSE OF ERECTION, MOND NICKEL CO., CONISTON, ONT.

The furnaces as originally constructed each consisted of two tiers of water-jackets, three jackets on each side to each tier. The upper tier had, however, been replaced by brick. The inside brickwork was of firebrick, and the outside



CONISTON PLANT, SETTLER ON FURNACE FLOOR.

of common brick. The furnaces were charged from the side, the charge doors being operated with a pneumatic lift. The charging floor was 14 feet above the tapping floor. The furnaces were provided with special water-cooled cast-iron spouts, each provided with only one set of water pipes, while the spouts were lined with chrome brick, similar brick being also used at the tap holes. The crucible was built within a plate steel box, and carried by the sole plate. Chrome brick laid in magnesite cement was used for this; the magnesite cement being mixed with magnesium sulphate water. The settlers were circular, each



CONVERTER IN OPERATION, CONISTON PLANT.

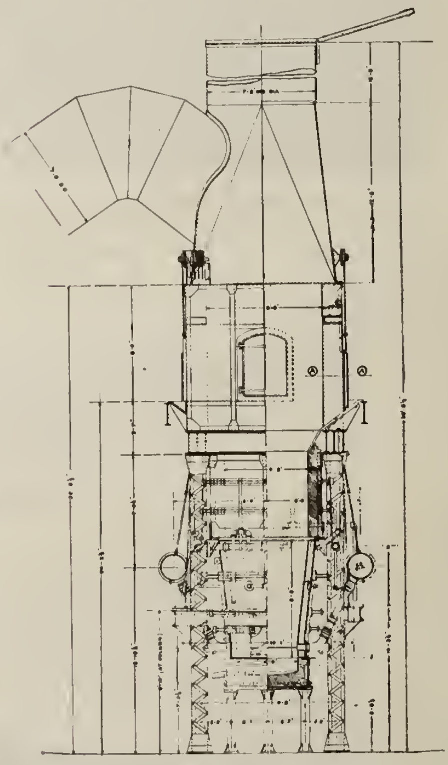
12 feet in diameter and 4 feet in depth.

Converters.—There were two electrically-operated converter stands and six Allis-Chalmers improved, 84 in. x 126 in. shells. The stands were operated from a pulpit by individual controllers and air valves, while the converter shells and 5-ton cast steel matte ladles were handled by one 30-ton 3-motor Morgan travelling crane. Lining for the converters was prepared by a 7 in. x 10 in. Blake crusher, and two 6 ft. Chilian mills direct connected to a 30 h.p. direct current motor.

Blower Plant.—Air for the blast furnaces was supplied by two Connersville blowers, each having a capacity of 15,340 cubic feet of air per minute at 40 ounces pressure, running at 130 r.p.m. Each of these was belt-connected to a 200 h.p. constant speed motor, taking current at 550 volts, and running at 580 r.p.m. The air pressure at the furnaces was about 38 ounces. Air from the blowers was delivered to a common receiver, and conducted to the bustle pipes of the furnaces. Bustle pipes ran along each side of each furnace and across one end.

Air for the converters was supplied by a Nordberg duplex air-compressor, capacity 6,000 cubic feet of free air per minute, compressed to 12 pounds pressure, at 82 r.p.m. The low pressure cylinder was 34 in. in diameter, and the stroke 42 in. The flywheel was 18 feet in diameter, and grooved for 18 ropes each 1.25 in. in diameter. The machine was driven by a constant speed 315 h.p. induction motor running at 345 r.p.m., receiving current at 550 volts. This blowing engine was fitted with mechanical inlet Corliss valves and poppet discharge, and was regulated by the air pressure from the receiver through floating levers to the governor, this controlling the cut-off on the Corliss inlet-valves.

Flue Dust.—Flue dust was drawn from the flue through the slide doors



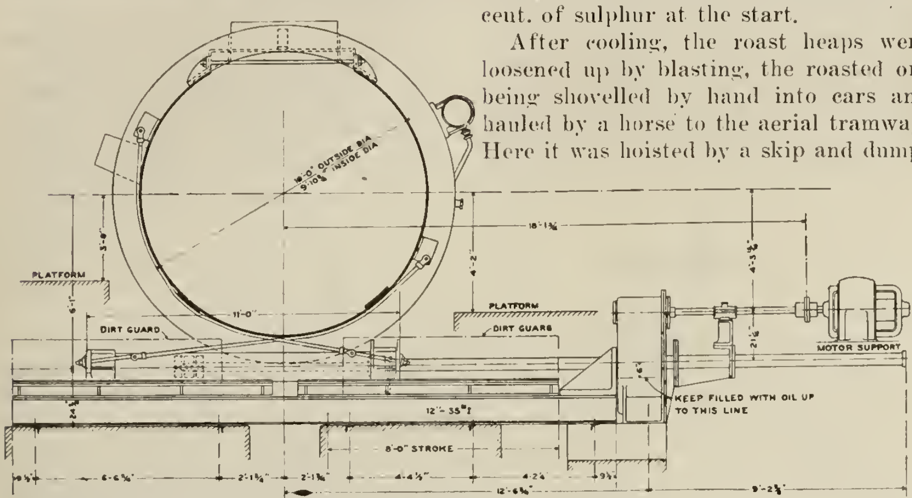
VERTICAL TRANSVERSE SECTION OF COPPER BLAST FURNACE (A.C. CO.), 1912. MOND NICKEL CO.

into a barrow. It was wetted and fed to the furnace from hand barrows.

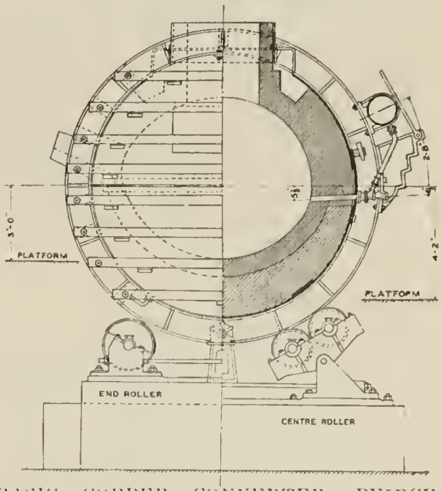
Smelting Practice. Roasting.—About two-thirds of the ore treated was first sent to the roast yards, about half a mile from the smelter and north of Victoria Mines station. Green ore was received at the tramway unloading station in the roast yards and dumped in a pile. Here it was shovelled into buckets and hoisted to the level of the staging built over the roast yards, and loaded into end-dumping hand lorries, holding about 1,000 pounds each, these being pushed by hand to the roast piles. Each roast pile, when completed, contained about 3,000 tons of ore and covered an area of 40 ft. x 150 ft., the piles being built in a row, with the longer axis parallel, and about 10 feet between piles. To build a new pile a light pole staging was erected over the roast bed, and rails were laid in this staging to accommodate the lorries. A bed of dry wood, about 3 feet in depth, carefully and properly piled, was then laid as a base for the proposed roast pile. Upon this wood ore was piled to a depth of about 10 feet. A top dressing of 8 in.-10 in. of fine ore was then spread over the top of the pile and down the sides and ends. The rails and stringers of the staging were afterwards removed, the poles being left standing in the pile. The wood of the pile was next ignited; the whole being alight in about four days. The pile was carefully watched, blow holes being stopped whenever they appeared, and the roast continued for about 100 days, by which time about half the sulphur had been burned out, the green ore containing about 20 per cent. of sulphur at the start.

After cooling, the roast heaps were loosened up by blasting, the roasted ore being shovelled by hand into cars and hauled by a horse to the aerial tramway. Here it was hoisted by a skip and dumped into the loading bins. Three men were required at the hoist in the roast yards; two men were required on each lorry; about 15 men in all being employed in these yards. The average output of the yards per day was approximately 475 tons of roasted ore, when the plant was operating at full capacity. All ore from the Victoria Mine was weighed into the roast yards at the mine, and that from the Garson Mine was weighed at smelter before being sent to yards. All roasted ore was weighed out of yards.

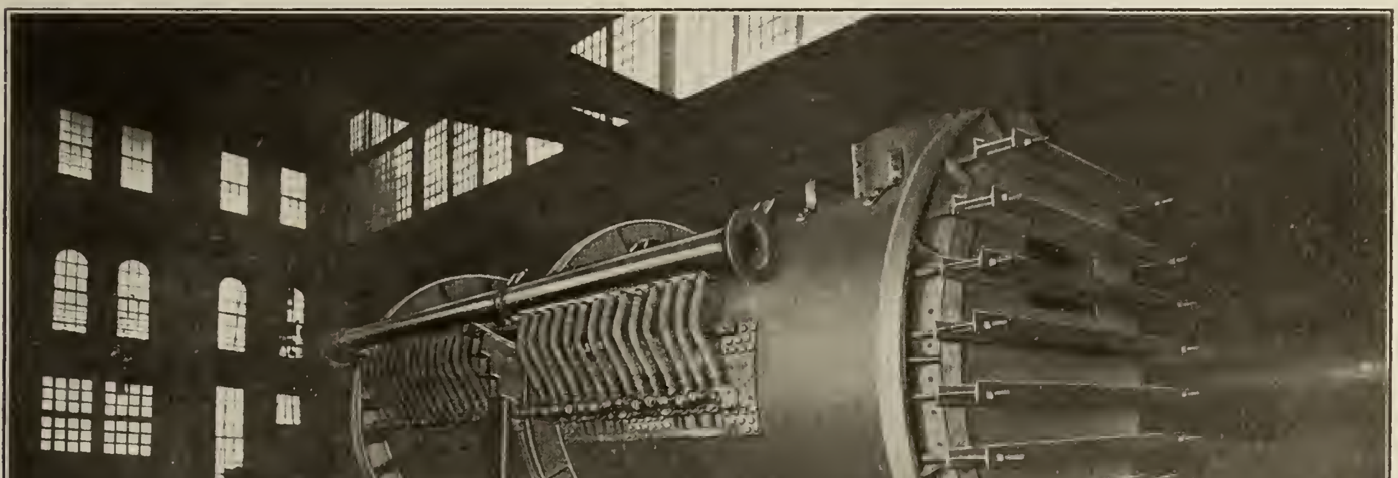
Smelting.—At the smelter, ore, coke, and fluxes were all stored in bins placed with their discharge chutes above the level of the charging floor, so that the charge barrows would be run beneath them. The furnaces were charged by hand lorries holding about 800 pounds each. The ore charge consisted of two parts roasted ore to one part of green ore; the coke making up about 8 per cent. of the whole charge. A typical charge consisted of about 1,200 pounds



BASIC COPPER CONVERTER, PEIRCE-SMITH TYPE, MOND NICKEL CO. TRANSVERSE SECTION SHOWING ATTACHMENT OF TILTING MECHANISM (A.C. CO.).



BASIC COPPER CONVERTER, PEIRCE-SMITH TYPE, MOND NICKEL CO., TRANSVERSE SECTION THROUGH WIND BOX AND TUYERE ON RING NEAREST THE TILTING MECHANISM (A.C. CO.).



PEIRCE-SMITH BASIC COPPER CONVERTER, CONISTON PLANT, MOND NICKEL CO.

of roasted ore, 600 pounds of green ore, 300 pounds of scrap and slag, including 75 pounds of limestone and 250 pounds of coke. The practice was to granulate the furnace slag, which was then flushed out to the edge of the dump.

Converting.—The furnace matte, containing about 33 per cent. copper and nickel, was collected in the settlers, which were tapped at intervals. From the settlers furnace matte was run into pots, which were lifted by the travelling crane and charged directly into the converters. Matte from No. 1 converter was blown up to about 60 per cent. copper-nickel. It was then skimmed and the slag sent to the furnace settler while still hot and liquid. The matte from converter No. 1 was then charged to converter No. 2, and blown to about 80 per cent. copper-nickel. The slag from this converter also went to the furnace settler, and the matte run into a pot, from which it was poured on a matte bed to cool. There were four of these matte beds, each 4 ft. x 15 ft. It was customary to draw matte from the settlers at the same time as converter slag was being poured, thus preventing the overloading of the granulating streams.

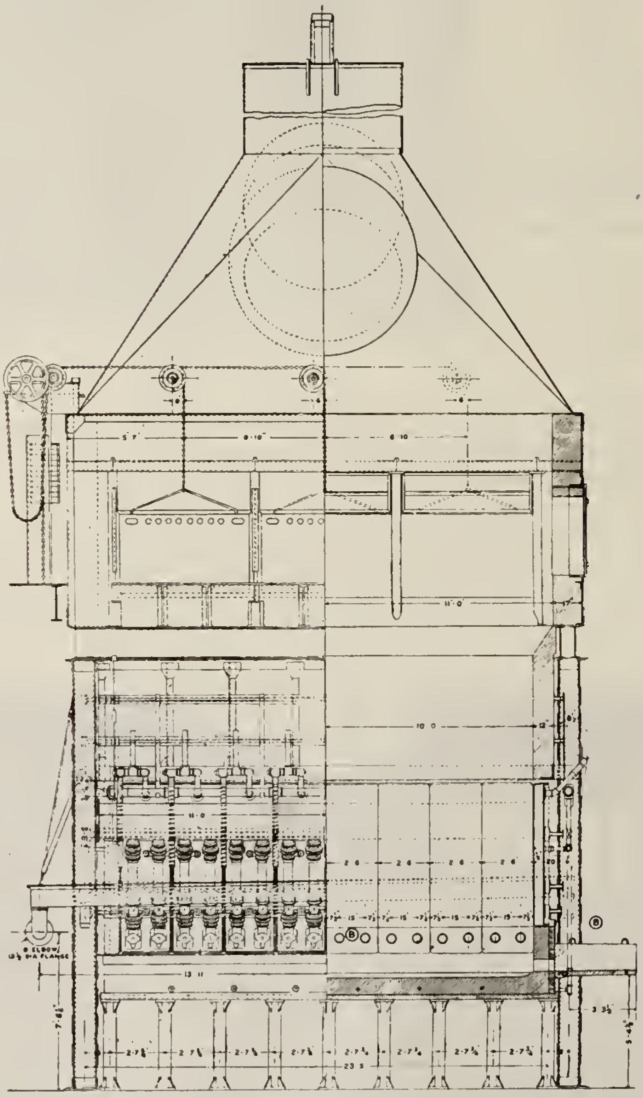
The final Bessemer matte produced contained about 38 per cent. copper and 42 per cent. nickel, and about 15 per cent. iron, the balance being sulphur and other impurities. It was broken up on the beds, put into barrels, and shipped to the Mond Company refining works at Swansea, Wales.

Coniston Plant.

The site for the new plant at Coniston was chosen only after very careful surveys. The new smelter is located on a rocky hillside overlooking a large swampy flat, which gives ample storage room for large slag piles. The general layout of the plant and the railway approaches are shown on page 42.

The roast yards are located about three-fourths of a mile from the smelter, to the south-east, on the other side of the ridge at whose foot the smelter is placed. They are connected directly with the Canadian Northern and the Canadian Pacific Railways, and are also connected with the smelter by a spur line belonging to the company. A new townsite has been selected and laid out, north of the Canadian Pacific line and about one mile from the smelter. Coniston will be a model town provided with every modern convenience available.

General Statement of Equipment.—The main smelter building has a concrete substructure resting on bed-rock, and a structural steel super-structure. In this building are placed two new modern water-jacketed blast furnaces, 50 in. x 240 in., and two Pierce-Smith basic converters, 10 ft. x 25 ft. 10 in. Provision has been made for an additional blast furnace, which will be added when required. The power building is located on the hill above the smelter. The ore bins



COPPER BLAST FURNACE, 1912, MOND NICKEL CO.
VERTICAL LONGITUDINAL SECTION (A.C. CO.).

are placed beyond this and a rock house stands south-east of the smelter and over the lower tracks. A semi-circular track leads from beneath the ore bins to the charging floor of the smelter building. It is carried over the slag tracks on steel trestles resting on concrete piers.

Receiving Ores.—As shown on page 42, spur lines have been built connecting both the Canadian Pacific and the Canadian Northern Railways with the roast-yards, the smelter yards, and the smelter ore bins. Ore from the mines to the north comes into the roast yards over the tracks of the Canadian Northern Railway and is delivered directly to the yards, or shunted over the company's spur line to the smelter bins. Ores from the west are diverted to the Mond Nickel Company's spur line at Coniston station, and can be run either to the smelter bins or on to the roast yards. Ore from the roast yards can also be conveyed over the spur line to the smelter bins on the high line above the smelter.

Power.—Power to operate the plant is entirely electric and is obtained from the power lines of the Wahnapitae Power Co. This corporation has two power stations on the Wanapitei River not far from Coniston.

Buildings.—The main smelter building is of steel construction with a concrete substructure, 90 ft. x 360 ft., resting upon solid rock; there is a monitor on the roof running the length of the building. A lean-to shed, 21 ft. x 240 ft., on the north-west side, houses the converter plant; a similar lean-to on the south-east, about 30 ft. x 210 ft., covers the slag track and the main flue.

A slag cut on the south-east side is provided with a standard gauge track. The tapping floor is 14 feet higher, and the charging floor 24 ft. 2½ in. above this. The furnace platform is 24 feet in width and 210 feet in length. The matte floor on the north-west side is 10 feet below the level of the furnace floor and about 56 feet in width.

The power house, built on the hill south-east of the smelter, is a brick and steel structure with concrete foundation and a tile roof.

Flue System and Stacks.—The main flue is rectangular in cross-section, 10 ft. x 15 ft., built of sheet steel. It leads to a dust chamber 30 ft. x 50 ft., built of stack brick, which connects with the base of the stack. The main stack rests on bed-rock. The lower 25 feet of the stack is square in section and is built of red brick, the upper cylindrical portion, about 16 feet in diameter, being built of Custodis stack brick. The height is about 175 feet.

Montreal Ammunition Co. has been incorporated at Ottawa, Ont., with a capital of $300,000, to carry on the business of manufacturers of ammunition, shells, bombs, etc., at Montreal, Que. Incorporators—E. E. Howard, J. DeWitt and H. C. McNeil, all of Montreal, Que.

Canada's War Budget--Tariff Changes and Tax Impositions

Anticipation that the Budget for 1915 would be of more than usual individual interest has been quite fully realized, and in order that our readers may readily familiarize themselves with its aims, provisions, etc., t here is provided the following detail summaries:

THE European war has affected the finances of Canada in two ways. It curtailed trade, which meant a reduction in the customs revenue, and made necessary expenditures which almost doubled the demands upon the treasury; besides, this came at a time when large obligations had been assumed for public works, and there had been going on for years development of administrative activities which meant heavy and permanent increase of the regular expenditures.

The estimates for the coming year laid before Parliament call for $146,000,000 for ordinary Governmental work and $44.000.000 additional for such purposes as completing the National Transcontinental Railway, constructing the Welland and other canals, and improving facilities for navigation. Then there is the war expenditure, for which a vote of a hundred million dollars is asked for the coming fiscal year, making the whole amount that may be required during the twelve months close to $300,000,000.

The probable revenue is only $120,000.-000, but arrangements have been made with the British Government for obtaining the money needed for the war at a low rate of interest. There will still be the necessity, however, for heavy borrowing for purposes other than that of the war.

Some $30,000,000 has been reckoned necessary to meet the increased interest charges, to bring revenue up to normal or ordinary expenditure, as well as to ensure a balance against eventualities

WAR BUDGET SUMMARY

Briefly stated, with a small list of exceptions, there is a general all-round increase of 7½ per cent. on the general and five per cent. in the British preferential tariff.

Special war taxes are imposed upon banks, insurance companies, railways, cable and telegraph companies and patent medicines.

On bank note circulation there is to be a tax of one per cent., and on trust and loan companies a tax of one per cent. on the gross income.

Insurance companies, except life and marine concerns, will pay one per cent. of net premiums

All cable and telegraph messages will pay a tax of one cent each.

From all railway and steamship tickets, the Government will collect five cents from each, where the ticket costs up to $5, and five cents for each additional $5 of cost.

On parlor car seats and sleeping berths there will be a tax of 10 cents each.

A tax of $1 is levied on steamship tickets costing up to $10 to all points other than in Canada, U.S. or West Indies; $3 for berths exceeding $30; and $5 for berths over $60.

There will be a stamp tax of 2 cents upon commercial paper, such as receipts, checks, transfer and business agreements, as well as on express and money orders.

Every letter and post card will bear a one-cent war stamp, bills of lading a two-cent stamp and postal notes one cent; patent medicines one cent for each ten cents of cost.

Upon non-sparkling wines there will be a tax of five cents per quart; upon champagne, 25 cents per quart.

By reason of the trade conventions with the British West Indies and France the increased duties do not apply to silk fabrics, velvets, ribbons and embroideries.

EXEMPTIONS FROM TARIFF INCREASE.

The list of items in the tariff schedules or in the former free list which are exempt from the general tariff increase announced, is as follows:

Fish from Newfoundland, animals for the improvement of stock, cocoa and chocolate products, tea, salt for the fisheries, Indian corn except for distillation purposes, wheat, wheat flour, sweetened biscuits, squid, oysters, seed and breeding; fish and fish eggs for propagating purposes; sugar, tobacco, wines from South Africa; books (printed), newspapers and magazines, news printing paper, matrix paper; nicotine sulphate, ores of metals, bells for churches; gold and silver coin and gold and silver ingots, blocks, bars, drops, etc.; typesetting and typecasting machines, newspaper printing presses; mowers, binders, harvesters and reapers, traction ditching machines; surgical and dental instruments; material for ships, binder twine, articles for the manufacture of binder twine, fish hooks, lines, twines and nets for the fisheries, artificial limbs, artificial teeth not mounted, articles specified in tariff for schools, hospitals and charitable objects, settler's effects. The customs duties on the foregoing remain unchanged.

Only five specific agricultural implements are exempt from increase in duty, viz:—

Reapers, binders, mowers, harvesters and ditching machines. All others are subject to the 7½ per cent. increase, which means an average increase from 20 to 27½ per cent. on ploughs, cultivators, harrows, discs, threshing machines, waggons, etc.

The tariff changes, according to custom, went into effect immediately on announcement, February 11. With regard to the special taxes, those on wine and champagne go into effect at once, and the others at a date to be fixed.

and, to provide this, a general tariff increase has been imposed of seven and a half per cent., general and intermediate, and five per cent. preferential, applying to all articles whether now dutiable or on the free list, with, however, a list of exemptions, including tea, cocoa and chocolate, sugar, wheat and wheat flour, tobacco, books, newspapers and magazines, agricultural implements. From the operation of the foregoing, a revenue of from $20,000,000 to $25,000,000 is anticipated.

In addition, special war taxes are imposed on banks, insurance, railway, cable and telegraph companies, and on patent medicines, from which sources a revenue of some $8,000,000 is expected.

In the accompanying table, columns 1 and 2, are shown the general nature and monetary value of the business done by Canada during the last year, while, based on same, in column 3 is given the revenue arising out of the new tariff and tax impositions. From the latter figures it will be noted that there is a close approximation to the $30,000,000 expected to be raised.

Dutiable Goods.

	Value	War Tax
Bar iron, etc.	$ 3,700,000	$ 277,500
Castings	1,400,000	105,000
Gas engines	2,500,000	187,500
Pipe fittings	1,000,000	75,000
Bridges	1,000,000	75,000
Pig iron	2,500,000	187,500
Portable engines	2,300,000	172,500
Threshing machinery	1,200,000	90,000
Spinning machinery	1,800,000	135,000
Machinery	14,800,000	1,100,000
Steel rails	5,000,000	375,000
Steel angles, etc.	2,800,000	210,000
Rolled beams	6,000,000	450,000
Steel plates	4,600,000	345,000
Galvanized sheets	1,000,000	75,000
Skelp iron	2,700,000	202,500
Iron and steel pipe	1,300,000	101,500
Steel plate, bridges	1,600,000	120,000
Rolled steel bands	1,000,000	75,000
Steel manufactures, N.O.P.	10,000,000	750,000
Jewelry	1,700,000	122,500
Boots and shoes	4,200,000	315,000
Magic lanterns, etc.	1,200,000	90,000
Lamps, etc.	1,500,000	112,500
Nickel-plated ware	1,400,000	105,000
Phonographs, etc.	1,000,000	75,000
Coal oil, etc.	1,300,000	101,500
Watch actions	1,200 000	90,000
Wood manufactures	2,000,000	210,000
Wool manufactures	20,700,000	1,652,500
Clothing—wool	2,600,000	195,000
Carpets, etc.	2,300,000	172,500
Oilcloth, etc.	1,500,000	112,500
Optical instruments	1,000,000	75,000
Packages	3,000 000	225,000
Paper, n.o.p.	2,500,000	187,500
Wrapping paper	2,400,000	180,000
Post office parcels	1,500,000	112,500
Butter	1,800,000	135,000
Bacon	1,000,000	75,000
Pork	1,200,000	90,000
Ribbon	1,800 000	135,000
Seeds	1,200 000	90,000
Silks and clothing	7,300 000	547,000
Brandy	1,200,000	90,000
Whiskey	3,000,000	225,000
Sugar	14,000 000	1,050 000
Sugarcane	1,000 000	75,000
Tobacco	1,400 000	105,000
Vegetables	1,500 000	112,500
Ales and porter	1,300 000	97,500
Pictures, etc.	1,000,000	75,000
Breadstuffs	3,200 000	240 000
Brass manufactures	2,000 000	150,000
Brick	1,300 000	97,500
Automobiles	11,000 000	825,000
Cotton	5,700,000	427,000
Prints	6,500 000	487 500
Sheets	1,200 000	90,000
Clothing, cotton	3,000 000	225 000
Cotton lace	1,200,000	90,000
Cotton socks	1,000,000	75,000
Cotton velvets	1 000 000	75,000
Cottons, n.o.p.	1 000 000	75 000
Medicines and drugs	2,000,000	150,000
Chinaware	2,000,000	150,000
Electric apparatus	6,500,000	487,500
Electric motors	1,800,000	135,000
Express parcels	2,000,000	150,000
Lace, n.o.p.	1,200,000	90,000
Toys, etc.	1,000,000	75,000
Linen damask	1,000,000	75,000
Fruits, nuts, etc	8,600,000	645,000
Furniture	3,000,000	225,000
Glass carboys, etc.	1,600,000	120,000
Window glass	1,500,000	112,500
Gloves and mitts	2,700,000	197,500
Waterproof clothing	1,600,000	120,000
Rubber tires	1,400,000	105,000
Rubber manufactures	1,000,000	75,000
Hats, etc.	2,000,000	150,000
Straw material	2,600,000	195,000
Railway cars	5,200,000	390,000
Bitumenous coal and stock	26,000,000	2,050,000
Cotton duck	1,000,000	75,000
Embroidery	1,100,000	82,500
Total		$20,837,000

Free List.

	Value	War tax
Iron ore	1,900,000 tons	$ 152,000
Fence posts and ties	$ 2,300,000	172,500
Lumber	12,000,000	915,000
Fur skins	2,200,000	165,000
Hides	8,700,000	752,000
Wool	1,800,000	135,000
Nitrate of soda	1,600,000	120,000
Jute cloth	2,700,000	202,500
Wire rods	1,600,000	120,000
Machinery	1,000,000	75,000
Tin blocks and plates	5,400,000	405,000
Wire	1,300,000	97,500
Petroleum	6,000 000	450,000
Cotton rags	1,400,000	105,000
Cotton	9,700,000	775,500
Bananas	2,600,000	195,000
Oranges, etc.	3,300,000	247,500
Manilla grass	1,300,000	97,500
Rice, uncleaned 0	1,100,000	82,500
Tobacco	5,000,000	375,000
Coke	2,000,000	210,000
Chicle	1,500,000	112,500
Rubber, crude	3,200,000	240,000
Cotton yarn	1,000,000	75,000
Coffee	2,000,000	150 000
Total		$ 7,439,000
Grand total		$28,276,000

SEMI-STEEL.

AN interesting discussion on semi-steel took place recently at the Lancashire branch of the British Foundrymen's Association. Mr. Roe, in opening the discussion, mentioned a difficulty which arose when the metal had to be carried thirty or forty yards before pouring. The difficulty consisted of hard spots at the riser end. Mr. McLain, the American expert on semi-steel, had suggested manganese as a remedy, but the reason for the addition of manganese was not clear since the latter is usually considered as a hardening element. The proportion of steel scrap to be used in the mixture depends, of course, upon the purpose for which the casting is being made. T. Craig used a mixture of 3 of steel scrap, 3 of hematite iron, and 1 of Apedale No. 4 for casting a plate shear about 1 ft. in diameter. The resulting casting contains about 1 per cent. silicon, 0.9 per cent. manganese, 0.08 per cent. sulphur, and 0.5 per cent. phosphorus, corresponding practically to a cold blast iron, but costing very much less. He had used 15 per cent. of steel in a mixture for mild chilled roll. This was a roll casting in chills, but which shows no chill when the skin is broken.

The discussion, whilst of a very interesting nature, did not elicit any definite remedy for the hard spots described by Mr. Roe. It is probable that the most efficient method of dealing with this trouble is to reduce the amount of steel scrap or increase the silicon content of the pig-iron. Another curious feature which places a tax upon the metallurgist to explain is that the use of high carbon scrap, such as old files, has a remarkable tendency to produce hard spots, whereas by using mild steel scrap, such as boiler plate punchings, the trouble is very rare indeed. This fact is all the more remarkable, since it is known that the scrap must absorb a very considerable proportion of carbon from the cupola coke, before its melting point is lowered to within the range of temperature available in a foundry cupola.

COMPOSITION OF ENGINE CASTINGS.

THE standard composition of British engine castings is given by Frank Foster in his paper, entitled "Essential Principles of Engine Design," read before the Manchester (England) Association of Engineers:

	Steam Cylinders	Frames	Flywheels	General
Total carbon, per cent.	2.90	3.30	3.50	3.50
Combined carbon, per cent.	0.90 to 0.95	....	0.37	....
Silicon, per cent.	1.10 to 1.30	1.60	2.00	1.70 to 2.20
Manganese, per cent.	0.60 to 0.90	0.65	0.40 to 0.50	0.30 to 0.40
Phosphorous, per cent.	0.40 to 0.60	0.50	0.90	0.40 to 1.40
Sulphur, per cent.	0.15	0.15	0.15	0.15
Transverse load, cwt.	35 to 46	34 to 38	30 to 33	29 to 32
Transverse deflection in inches	0.50	0.50	0.35 to 0.45	0.30 to 0.50
Tensile strength, tons per sq. in.	12 to 14	11 to 13	11 to 14	9 to 11

HARD CASTINGS REMEDY QUERY.

WE have a home-made cupola, the shell of which belonged to an old steam boiler. The cupola is lined with firebrick, and has an inside diameter of 26 inches. There are four tuyeres of 4 in. x 4 in. section, and the blast is delivered through a 7-in. pipe from a Boston Blower Co. exhauster. We use Albany molding sand mixed with our own yellow sand, the latter of which old molders claim to be all right when so employed. We can melt any amount of iron, but our castings are very hard, so much so that considerable trouble is experienced when they come to be machined. Suggestions as to a remedy or remedies for this hardness are invited from readers of Canadian Foundryman.—Allie Bros., Maniwaki.

The Production of Iron and Steel in Canada During 1913

By John McLeish, B.A.*

Iron and steel enter so largely into the industrial life of our country as constituents of manufacturing equipment and as the products of the latter that interest never flags in but rather looks forward with anticipation to statistics of every particular bearing thereon. This data from a recent Government report will therefore be found educative and valuable.

STATISTICS of iron ore, pig-iron and steel production gathered from the Department of Mines (Ottawa) report just issued for 1913, show increased shipments of iron ore from Canadian mines, an increased production of pig-iron and steel in Canadian furnaces and steel plants, and an increase in the imports of most classes of iron and steel products; but the general relationship of domestic iron ore supplies to furnace requirements exhibits no important change from the conditions that have obtained for a number of years past. Canadian furnaces continue to be operated almost entirely on imported ores, and Canadian iron and steel plants supply probably less than 30 per cent. of the present consumption.

Comment has previously been made on the comparatively small proportion of Canada's consumption of iron and steel now supplied from the country's domestic resources, and this fact is again emphasized in the statistics of production, imports, and exports for 1913. It is somewhat difficult to arrive at a complete estimate of the total consumption of iron in Canada because of the large value of iron and steel goods imported for which the quantity cannot be stated, nevertheless the percentage of consumption available from Canadian mines can be closely gauged. The imports and exports of iron and steel goods (not including iron ore) may be sub-divided into two classes, comprising the materials of which the quantity is stated and materials or goods of which the value only is recorded.

Value of Net Total Imports.

It is probably safe to estimate that the value of $72,181,060 of net imports represents not less than 100,000 tons of iron or steel and probably not more than 720,000 tons. Assuming these limits and assuming further that the iron or steel represents 50 per cent. of the original ore charged, we have net imports of iron and steel goods (exclusive of iron ore) equivalent to a tonnage of iron ore between the limits of 3,761,186 tons and 5,004,806 tons. Adding the consumption of iron ore in Canadian iron and steel furnaces, we have a total equivalent consumption of iron ore not less than 6,066,464 tons and probably not exceeding 7,310,088 tons. The production of iron ore in Canada in 1913, viz., 307,634 tons, was, therefore, sufficient to supply probably over 4.2 per cent., but not more than 5 per cent. of the country's requirement of iron.

*Chief of the Division of Mineral Resources and Statistics.

Iron Ore.

The total shipments of iron ore from Canadian mines in 1913 were 307,634 tons, valued at $629,843 at the shipping point, as compared with shipments in 1912 of 215,883 tons, valued at $523,315. Of the total shipments in 1913, 91,020 tons were sent to blast furnaces in Canada, 196,151 tons to the United States, 12,927 to Scotland, and 7,536 tons to Holland. The shipments comprised 92,386 tons of hematite and roasted siderite, 209,886 tons of magnetite (including some ores with an admixture of hematite), and 5,362 tons of titaniferous iron ore. Shipments in 1912 included 86,971 tons of hematite, 127,727 tons of magnetite, and 1,185 tons of titaniferous ore. Nova Scotia, New Brunswick, Quebec and Ontario were the shipping provinces. No production has been reported from British Columbia for the past seven years.

Exports and Imports of Iron Ore.

According to returns received direct from mine operators, 196,151 tons were shipped to the United States, 12,927 tons to Scotland, and 7,536 tons to Holland, or a total of 216,614 tons shipped to destinations outside of Canada during 1913. The exports from Canada during this period, according to the records published by the Department of Customs, were 126,124 tons valued at $426,681, and included 107,624 tons valued at $355,641 to the United States, 11,800 tons valued at $45,312 to Great Britain, and 6,700 tons valued at $25,728 to other countries.

The exports in 1912 were 118,129 tons valued at $382,005, including 95,579 tons valued at $295,213 to the United States, 16,800 tons valued at $64,712 to Great Britain, and 5,750 tons valued at $22,080 to other countries. The exports in 1911 were 37,686 tons valued at $133,411, all to the United States. That the Customs Department record of exports to the United States would appear to be understated in 1913 is confirmed by the record of imports of iron ore into that country from Canada, as shown in the "Monthly Summary of Commerce and Finance of the United States." According to this authority the imports of iron ore into the United States from Canada during the calendar year 1913 were 201,489 short tons valued at $413,314, as compared with 119,476 tons valued at $201,882 in 1912, and 56,538 tons valued at $106,038 in 1911.

The imports of iron ore into Canada were not separately shown by the Customs Department until April, 1912. The imports during the twelve months ending December, 1913, were reported as 1,942,325 tons valued at $3,877,824, and during the nine months ending December, 1912, 2,047,509 tons valued at $3,932,074. The imports in 1913 included: 1,072,156 tons valued at $3,007,653 from the United States, 869,669 tons valued at $869,669 from Newfoundland, and 500 tons valued at $502 from other countries.

There were used in Canadian furnaces in 1913, 2,110,828 tons of imported iron ores, as compared with 2,019,165 tons in 1912, the imported ores being obtained chiefly from Newfoundland and the iron ranges on the south shore of Lake Superior. The Newfoundland deposits are operated by the two Canadian companies operating coal mines and steel plants at Sydney and Sydney Mines in Cape Breton, and the total quantity of Newfoundland ores shipped during 1913 from the Wabana mines was 1,605,920 short tons, of which 1,048,432 tons were shipped to Sydney and 557,488 tons to the United States and Europe. In 1912 the shipments from Wabana, Newfoundland, were 1,331,912 short tons, of which 956,459 tons were shipped to Sydney and 375,453 tons to the United States and Europe.

According to the "United States Report of Commerce and Navigation," there were exported to Canada during the twelve months ending June, 1913, 1,367,928 tons (2,000 pounds) of iron ore valued at $3,684,233, and during the previous year 931,647 tons (2,000 pounds) valued at $2,806,238.

Pig-Iron and Steel.

The making of iron and steel in Canada is an industry which has been built up largely on the basis of imported ores, and the output continues to increase. The total production of pig-iron in 1913, not including the output of ferro products which is separately tabulated, was 1,128,967 short tons (1,008,006 long tons) valued at approximately $16,540,012, as compared with 1,014,587 short tons (905,881 long tons), valued at $14,-

550,999 in 1912, and 917,535 short tons (819,228 long tons), valued at $12,307,-125 in 1911. An increase of 11.3 per cent. is shown in the production of pig-iron in 1913 over the production of 1912, as compared with an increase of 10.5 per cent. in 1912 over that of 1911.

Pig-Iron Furnaces.

At the close of the year Canada had twenty-two completed furnaces grouped in twelve separate completed plants owned by nine companies or corporations. Of the twenty-two completed furnaces, five have been idle throughout the past two years, namely, the furnace at Londonderry, N.S., and the three small furnaces in the Province of Quebec, owned or controlled by the Canada Iron Corporation, and the furnace of the Atikokan Iron Company at Port Arthur. The aggregate daily capacity of these five furnaces was approximately 235 tons. During 1913, however, three new furnaces were brought into operation, with a total daily capacity of about 665 tons.

Of the total output of pig-iron in 1913, 23,696 tons valued at $423,140, or $17.86 per short ton, were made with charcoal as fuel, and 1,105,271 tons, valued at $16,116,872, or $14.58 per ton, with coke. The amount of charcoal pig-iron made in 1912 was 21,701 tons, and in 1911, 20,759 tons, while the quantity made with coke in 1912 was 992,886 tons, and in 1911, 896,776 tons.

The classification of the coke iron production in 1913, according to the purpose for which it was intended, was as follows: Bessemer 265,685 tons; basic 614,845 tons; foundry, including miscellaneous, 224,741 tons. The classification of the production in 1912 was: Bessemer, 256,191 tons; basic, 544,534 tons; foundry, including miscellaneous, 192,161 tons.

Provincial Pig-Iron Output.

The total production of pig-iron in 1912 and 1913 belongs to the Provinces of Nova Scotia and Ontario; the Province of Quebec having dropped out during these years, although formerly there had been a continuous though small output of charcoal iron which commanded a high price.

During 1912, Nova Scotia produced 424,994 tons of a value of $6,374,910, and in 1913 its output was 480,068 tons of a value of $7,201,020. During 1912, Ontario produced 585,593 tons of a value of $8,176,089, and in 1913 its output was 648,899 tons of a value of $9,338,992.

It should be explained that the value placed upon the pig-iron production of Nova Scotia is assumed or estimated, a large proportion of it being directly converted into steel, and the remainder only being sold as pig-iron.

Exports and Imports of Pig-Iron.

The total exports of pig-iron, including ferro-alloys, during 1913 were 6,326 tons valued at $351,646, or an average value per ton of $55.59, as compared with exports of 6,976 tons valued at $310,702, or an average of $44.54 in 1912. The exports during the past five years have not exceeded 10,000 tons in any one year, and have consisted largely, if not entirely, of ferro-alloys.

Considerable quantities of pig-iron are annually imported into Canada. During the calendar year 1913, the total imports of pig-iron, excluding ferro products which are separately stated, were 236,769 tons valued at $3,247,405, and included 213,969 tons valued at $2,888,-974, or an average of $13.50 per ton, from the United States, and 22,800 tons valued at $358,431, or an average of $15.72 per ton, from Great Britain. The total imports in 1912 were 272,565 tons valued at $3,511,599, or an average of $12.88 per ton; and in 1911, 208,487 tons valued at $2,610,989, or an average of $12.52 per ton. The 1913 imports included 926 tons of charcoal pig-iron valued at $12,528, or $13.52 per ton, as compared with imports of 115 tons of charcoal pig-iron in 1912 valued at $1,-370, or an average of $11.91 per ton.

Ferro-Products.

Ferro-silicon, ferro-phosphorus, and ferro-manganese were produced in Canada in electric smelting plants in 1913, the latter two products in small quantities only. Ferro-silicon and ferro-manganese were made at Welland, Ont., by the Electro Metals, Ltd., and ferro-phosphorus was made at Buckingham, Que., by the Electric Reduction Co. The Algoma Steel Corporation did not operate their electric furnace at Sault Ste. Marie during the year.

The total production in electric furnace plants during 1913 was 8,075 short tons of ferro-alloys valued at $493,018. In 1912 the production was 7,834 short tons valued at $465,225, and in 1911, 7,507 short tons valued at $376,404.

The imports of ferro-silicon, ferro-manganese, etc., during the calendar year 1913 were 30,355 tons valued at $940,-443, or an average of $30.98. The imports for the calendar year 1912 were 19,810 tons valued at $469,884, or an average of $23.72 per ton; and in 1911, 17,226 tons valued at $429,465, or an average of $24.93 per ton.

Consumption of Pig-Iron.

An estimate of the total consumption of pig-iron and ferro-alloys in Canada may be arrived at on the basis of the record of production, imports and exports. The total production of pig-iron in 1913 was 1,128,967 short tons, and of ferro-alloys 8,075 tons. The imports of these products during the same period were 267,124 tons, and the exports 6,326 tons. The deduced consumption of pig-iron and ferro-alloys was approximately 1,397,840 tons. Of this amount, 943,130 tons were used in steel furnaces in the production of steel, leaving 454,710 tons for foundry and other uses.

Steel.

The production of steel ingots and castings in 1913 was 1,168,993 tons, as compared with 957,681 tons in 1912, and 882,396 tons in 1911. In 1913 the production of open-hearth ingots was reported as 824,818 tons; Bessemer ingots, 301,932 tons; direct open-hearth castings, 39,217 tons; and other steels, 3,026 tons. The total increase in production over 1912 was 211,312 tons, or about 22.06 per cent.

The total quantity of pig-iron used in steel furnaces during the year 1913 was 913,722 tons, of which 860,360 tons were produced by firms reporting, and 53,362 tons purchased. The quantity of ferro-alloys used was 29,408 tons purchased. Scrap, etc., was used to the extent of 406,403 tons, being 277,509 tons produced by the firms reporting, and 128,-894 tons purchased. Ores used included 1,342 tons of manganese ore and 55,018 tons of iron ore, while 197,028 tons of limestone or dolomite flux were used, and 10,687 tons of fluorspar. In Ontario, a little over 413,000,000 cubic feet of natural gas were used, while in Nova Scotia coke-oven gas was used at Sydney, of which a record of quantity was not obtained.

In 1912, the total quantity of pig-iron used in steel furnaces was 735,559 tons, of which 706,895 tons were produced by firms reporting, and 28,664 tons purchased. The quantity of ferro-alloys used was 24,237 tons purchased. Scrap, etc., was used to the extent of 336,265 tons, being 223,404 tons produced by the firms reporting, and 112,861 tons purchased. Ores used included 985 tons of manganese ore, and 43,006 tons of iron ore, while 148,045 tons of limestone or dolomite flux were used, and 9,709 tons of fluorspar. In Ontario, a little over 423 million cubic feet of natural gas were used. The following is a list of firms making steel in Canada:—

Steel Producing Firms.

Dominion Iron and Steel Co., Sydney, N.S.

Nova Scotia Steel and Coal Co., New Glasgow, N.S.

Canadian Steel Foundries, Ltd., Montreal, Que.

Beauchemin et Fils, Sorel, Que.

The Algoma Steel Corporation, Sault Ste. Marie, Ont.

The Steel Company of Canada, Ltd., Hamilton, Ont.

The Dominion Steel Foundry Co., Hamilton, Ont.

The Wm. Kennedy & Sons, Ltd., Owen Sound, Ont.

The Moffat Irving Steel Works, Ltd. (Electric), Toronto, Ont.

Rolled Products, etc.—Complete statistics of the production of rolled products and of manufactured steel have not been received; returns from several of the largest producers, however, show a production of blooms, billets, slabs, etc., of 1,134,277 tons, of which 1,098,877 tons were used by the producer for further manufacture, and 35,400 tons sold to other rolling mills.

The production of rails was 554,481 tons; of rods, 57,389 tons; of bars, 266,915 tons; and of other rolled products, 53,835 tons. The production of steel rails in 1912 was returned as 471,422 tons, and in 1911 399,760 tons.

Exports and Imports of Iron and Steel Goods.

The exports of iron and steel from Canada consist chiefly of manufactured goods, such as agricultural implements, automobiles, bicycles, machinery, etc. Compared with the value of imports, the total value of the exports is small, amounting to not more than 10 per cent. of the former. The total value of iron and steel exported during the calendar year 1913 was $13,999,149, as compared with a value of exports in 1912 of $10,682,484, and in 1911 of $9,907,281. The exports during 1913 included: pig-iron and ferro-products, etc., to the value of $351,646; crude iron and steel valued at $483,813; stoves, gas buoys, castings, machinery, hardware, etc., valued at $1,070,476; steel and manufactures of steel, $1,051,004; agricultural implements, $7,411,246; automobiles and bicycles, $3,630,964.

The exports during 1912 in similar grouping were: pig-iron and ferro-products, etc., $310,702; scrap iron and steel, $145,250; stoves, gas buoys, castings, machinery, hardware, etc., $1,290,762; steel and manufactures of steel, $785,731; agricultural implements, $5,967,545; automobiles and bicycles, $2,182,494.

The total value of the imports of iron and steel goods during the calendar year 1913 was $141,272,357, as compared with a value of $144,400,949 imported during the fiscal year ending March, 1913, and a value of $102,568,832 imported during the fiscal year ending March, 1912. The total value of the imports during the fiscal year 1911 was $85,319,541, and during the fiscal year 1910, $59,952,197.

The rapid growth in imports of iron and steel is thus clearly shown in this statistical record. It will be observed, however, that there has apparently been a check to these imports during the last nine months of 1913, there having been a falling off in the total imports during the twelve months ending December, 1913, as compared with the twelve months ending March of the same year.

The imports during the twelve months ending December, 1913, subject to duty were valued at $125,082,378, the imports duty free during the same period being valued at $16,189,979, making a total value of $141,272,357. The imports during the fiscal year ending March, 1913, subject to duty were valued at $129,131,275, and the imports duty free during the same period were valued at $15,269,674, making a total of $144,400,949. These imports include all classes of iron and steel goods manufactured as well as those of the cruder form.

There were imported during the twelve months ending December, 1913, 1,832,475 tons of iron and steel goods valued at $55,927,607, or an average value per ton of $30.52, together with other iron and steel goods of which the quantities are not stated, valued at $85,344,750. During the twelve months ending March, 1913, there were imported 1,875,172 tons of iron and steel goods valued at $53,239,212, or an average of $28.39 per ton, together with other manufactures of iron and steel of which the quantity is not stated, valued at $91,161,737.

The imports of pig-iron have varied considerably during the past six years and the imports in 1913 are not very much larger than those of 1908. The imports of ferro-products and chrome steel have increased during six years by over 90 per cent. The imports of ingots, blooms, billets and puddled bars have more than doubled in that period. The imports of scrap iron and scrap steel show an increase of about 40 per cent. in the six years. The imports of plates and sheets, and of bars, rods, hoops, bands, etc., were nearly three times as great in 1913 as in 1908. The imports of structural iron and steel have increased steadily since 1909, but were larger in 1908 than in any other year of this period, with the exception of 1913. The imports of steel rails, pipe and fittings, nails and spikes, iron forgings, castings, and manufactures have varied considerably, but reached a maximum in 1913.

A very large proportion of these imports is derived from the United States, records published in the "Commerce and Navigation of the United States" showing the exports of iron and steel goods from that country to Canada. According to this authority there were exported to Canada from the United States during the twelve months ending June 30, 1913, 1,695,916 tons of iron and steel goods valued at $51,936,616, together with other iron and steel goods of which the weight is not given, valued at $54,053,014, or a total value of imports from the United States of $105,989,630.

During the twelve months ending June 30, 1912, the corresponding exports to Canada were 1,175,464 tons valued at $36,637,305, together with other iron and steel goods valued at $46,020,989, or a total value during the year of $82,658,294.

WAR SCRAP.

IN an article upon "War Scrap," in a recent issue of the Foundry Trade Journal, the author says that before very long there is no doubt that a large quantity of cast scrap iron and steel will be available.

In dealing with war scrap there is as a rule a fair bulk of unbroken shells as well as broken stuff of various kinds and, with the unbroken shells considerable care has to be taken, as there is always a risk of having one or more fully charged. Needless to say, a charged shell is a very dangerous thing to get into a cupola, because in the event of even a 3-in. or 75 mm. shell exploding, in all probability the cupola would be wrecked and other damage done, while the workmen would probably receive more or less injury.

For this reason all unbroken shells need special examination, and all those holding anything inside them, or which still are plugged at the charging end, must be laid on one side, either to be dealt with by someone who understands shells, or to be taken away by someone connected with the War Office. A communication to the latter will bring an inspector down pretty quickly where explosive war material is concerned—at least, that has been the writer's experience. The safest course, however, is to insist than only broken shells be sent by the iron merchant, as this places on him the responsibility of dealing with probably dangerous goods.

The Sorting-out Process.

It is not usual for copper, or copper alloy parts, to be sent out from the merchant's yard, owing to their value, but at times such metals do come out. In one case the writer got over 300 lb. of bronze fittings from a lot of piping coming from a chemical works, and it is interesting to note that $2.50 per ton was allowed off the price of the scrap iron on account of its being very dirty. In dealing with war scrap, however, much of the metal is dirty, and it is quite possible for a fair amount of copper or brass to be missed in the collection and quick overhaul given by the merchants, for which reason the sorting of the metal at the foundry should be done with the view of taking out all foreign metal from the iron.

Do not attempt to take metal plugs out of unbroken shells; it is too risky unless the work is done by skilled men used to the class of projectile dealt with. This matter must be rather carefully kept in mind. Somewhat careful sorting of the metal will have to be done to get different grades, for while most of the iron and steel used is good, there are variations in both quality and hardness, a small Maxim shell being of different quality from a 14-pounder. Many of the shells also are made from scrap metal, which again causes a difference in quality and this has to be considered, but generally a good sorter can turn out very regular piles of graded metal for most purposes.

For work which has not to be made to any particular specification, old scrap from the battlefield forms a fairly cheap and handy form of metal, and probably will form a large part of the iron used in many places in the near future, as the supply will be extremely large. Probably some kind of flux will be necessary in the furnace when melting to secure the better amalgamation of the different irons, but will only be determinable where the scrap is being dealt with.

Other scrap, such as cartridge shells, rings, and plugs from heavy gun shells, bullets with their nickel cases loaded with lead, and similar waste, will be collected and eventually find their way into the hands of melters and foundrymen, and as they are all good metal according to their kind, they usually are worth buying. Some care is necessary to see that live cartridges are not present amongst the smaller stuff, and as a rule cartridge cases should be melted by themselves after careful sorting and examination. Detonations sometimes occur where cartridges have not exploded and such things should be viewed with suspicion, although they are not always dangerous.

In sorting this form of scrap, brass, gunmetal and copper, nickel and lead will be found, and as each is of good quality, the metals can be used right away, but generally it is desirable that they should first be run into ingots to maintain regularity of content. Of course, the bullets will be heated to separate the lead from the nickel, the molten lead being at once run into ingots, while the nickel shells, after being well roused about to shake out the molten lead, will have to be melted down in crucibles. In this sort of work, large crucibles of at least 450 lb. capacity should be used, and for this purpose tilting furnaces will be found very convenient. Most of the soft scrap metal requires the use of some deoxidant flux when melting for making into ingots, but after being once cleaned out there should be no further difficulty in regard to occluded oxides and dirt, the actual casting work being practically the same as with new metal.

PISTON RING TROUBLE

Question.—We are at present turning out a quantity of piston rings varying from 3/16 in. to 5/16 in. in thickness by 6 in. in length, using high grade scrap, No. 1 Eglinton pig and Georgia coke, analysis of the latter herewith. The proportion of scrap to pig is 2 to 1. In almost every instance pin-holes and blowholes develop below the skin of the casting. We would greatly appreciate your interest in suggesting the cause and at same time a remedy for the trouble.—A. & McK.

No. 1 Eglinton Pig.

Silicon	3.000%
Sulphur	.015%
Combined carbon	.440%
Specific carbon	3.060%
Phosphorus	.793%
Manganese	1.800%
Iron (by difference)	90.892%

Coke.

Moisture	.30%
Volatile	2.17%
Ash	6.26%
Sulphur	.76%
Carbon	90.48%

Answer.—The following are two analyses which have given good results for piston rings:—

No. 1 Analysis.

Silicon, 1.50 to 2 per cent.; sulphur, 0.06 to 0.08 per cent.; phosphorus, 0.40 to 0.60 per cent.; manganese, 0.45 to 0.60 per cent.; graphitic carbon, 3.50 per cent.; combined carbon, 0.45 to 0.55 per cent.

No. 2 Analysis.

Silicon, 1.50 to 2.0 per cent.; sulphur, 0.08 per cent.; phosphorus, 0.30 to 0.50 per cent.; manganese, 0.45 per cent. to 0.60 per cent., and graphitic carbon low.

In these analyses, the high percentage of silicon is for the lighter castings and low percentage for the heavier one. From investigation of your trouble it is apparent that there is an excess of sulphur in some of the materials in your mixture. Your pig iron is also too high in silicon, which causes you to use a large percentage of scrap, and as you seem to have no analyses of the latter, I think it is probably responsible for most of your trouble.

In making the moulds for these castings, the moulding sand should be worked as dry as possible. Use a good skim gate and cut a flow-off-riser on the opposite side of the mould from the gate, this allows the gas and steam that is generated when pouring to escape, and lessens the chance of blow-holes. See that the moulds are well vented and pour with good hot iron. The addition of one pound of 80 per cent. ferro manganese to every 100 lbs. of your present mixture will overcome your pin-hole and blow-hole difficulty as it will eliminate the gases that cause same. It should be added in the ladle, and stirred to mix it with the molten iron. This will give you a tough, close-grained iron that will machine up quite smooth. When slagging your cupola, use about 40 lbs. of good limestone to each ton of metal melted, as this also helps to throw off the impurities from the iron.—R. Micks.

INTERESTING CUPOLA INSTALLATION.

IN the November issue of the Journal of the American Science of Naval Engineers, a description is given of a foundry cupola of 600 lb. capacity, installed at the Puget Sound navy yard. It was constructed to avoid the great waste that followed the use of a 6,000 lb. cupola when only a few small castings were required, and was made largely from scrap material. It is only about 4 ft. high from the base, and the internal diameter inside the lining is 14 in. The tuyeres, two in number, are rectangular in shape and expanding, with their lower edges 10 in. from the bottom. The opening is 6½ in. wide at the broad end and about 5 in. at the narrow end, by 4 in. deep, and the ratio of cupola area to tuyere area is approximately three to one. The bottom plate is a casting incorporating the spout, while the cylinder is made of steel plate. The blast is taken from the compressed air system of the yard. It induces air in a three-stage injector and delivers it to the cupola about fifteen times it own volume. The cupola is hinged at the front to the base so that it may be turned on its side for repairs and relining. It has proved entirely satisfactory.

According to Sherard Cowper-Coles, if sheets of electrolytic and ordinary rolled iron be freed from scale and oxide and placed in a very dilute solution of sulphuric acid and connected to a millivolt meter, it will be found that the current flows in such a direction as shows that electrolytic iron is electro-positive to ordinary rolled iron. It will thus be seen that a coating of electrolytic iron forms an excellent protective coating, and if afterwards coated with zinc the result is still better.

Goggles.—Eye protectors of various styles are described in a bulletin issued by T. A. Wilson & Co., Inc., Reading, Pa.

Safety First as Applied to Overhead Travelling Cranes *

By H. F. W. Arnold

The purpose of this paper as will be noted is not so much to consider the detailed design of a traveling crane as to direct attention to those fundamental matters relating to design and operation which tend to lessen the possibility of accidents, arising more or less therfrom.

IT is well for us to realize that in considering this subject of Safety as Applied to Traveling Cranes that we have to deal with a force which is always on the alert, never napping, but ever ready to take advantage of man's carelessness and inattention. The force of gravity is no respecter of persons; its laws are carried out swiftly and surely, and the unsupported object returns to earth in a manner that is quite sure to spell disaster, in case it is connected in any way with a traveling crane.

Employees working beneath a crane are perfectly justified in assuming that all necessary provisions have been made to ensure their safety, for under proper conditions, the traveling crane is a safe and reliable medium for transferring material from one part of the shop to another with smoothness and despatch. However, serious accidents are only too frequently due, to the breakage of defective parts, poor and inadequate equipment, negligence or carelessness on the part of the crane operators, or those who attach the chains or sling to the object to be moved. The greater bulk of these accidents may be avoided by the exercise of a reasonable amount of care and foresight and an appreciation of the dangerous features by the builder, the owner, and the operator.

After a crane is once installed, it becomes a fixed part of the equipment of the factory or building, and remains in service for a long term of years. Even if it is deficient in the essentials of satisfactory service, it will nevertheless be continued in use, as a rule, for a considerable time, a source of danger, inefficiency and expense. Of course, a poorly arranged installation can be improved to a certain extent by eliminating, where possible, its hazardous features and providing the safety devices which should have been incorporated with the crane when it was built. In new equipment there is no excuse for not writing the specifications in such a manner that the defects of the past will be avoided, and apparatus secured, that is safe, serviceable and durable.

Tracks and Runways.

It is usually safe to assume that the runways and tracks were designed by a competent engineer, and consequently are of safe proportions. However, it is necessary to see that the rails and rail fastenings are maintained in good condition. The nuts on the bolts or clips holding the track to the runway frequently work loose, due to vibration. They should be supplied with efficient lock-washers and kept tight at all times. Effective rail stops should be provided to eliminate the chance of derailment from over-running.

The Bridge.

The bridge and end trucks should be designed to have sufficient strength to provide against severe strains from sudden starting and stopping, and should show very little vertical or lateral deflection in service. The end trucks should be connected to the girders with turned bolts in reamed holes. The driving gears and pinions should be properly guarded. Each girder should be equipped with a platform with substantial metal handrailings, extending the entire length of the bridge, and these platforms should be provided with skirting boards to prevent objects from being knocked off and falling on the heads of those below. It is not a difficult matter to apply the above described platforms to cranes which are already in service without them.

The accompanying illustration shows one of the cranes at the plant of the Jeffrey Mfg. Co., which was equipped in this manner. The raised platform at the centre is for the purpose of trimming or adjusting the high lamps, the latter operation being an exceedingly dangerous one if the trimmer is obliged to stand on a greasy crane bridge without safety guards of some sort. The danger element is practically eliminated in the case illustrated. Guards should be provided extending ahead of the truck wheels, the purpose being to warn a thoughtless person, who may be resting his hand or arm on the track or runway, of the approach of the crane, which he may fail to notice because of other noises.

The Trolley.

It is not advisable to use cast iron in the construction of the trolley, which

*From the transactions of the Ohio Society of Engineers.

TRAVELLING CRANE EQUIPPED WITH PLATFORM AND HANDRAILINGS.

should be of the enclosed type with no overhanging gears. All gears, including the drum gears and traverse drive, should be enclosed in oil-tight cast iron cases, which render personal injury practically impossible and at the same time exclude all dust and grit, and enable the gears to operate in a bath of oil or soft grease. All gear-cases should be provided with large covers that can be easily and quickly removed for the purpose of inspection. The parting lines of the gear cases should be so placed that oil cannot leak out and spoil the clothes and temper of the men below.

Old equipment which is not of the enclosed type should have wire nets provided beneath all gears or other parts which might fall and inflict injury in case of breakage or parts working loose. If continuous platforms are provided on each girder, they will take care of the overhanging parts. The trolley should be completely floored to prevent loose parts or tools from falling. The rail stops for the trolley should not be overlooked when the systematic inspections are made.

Load Brake.

No part of the electric crane exceeds in importance the load brake. It should be so designed as to insure safety and efficiency in handling the load, and should be exceptionally accessible for inspection and adjustment.

Electric Motor Brake.

The electric motor brake should be capable of holding the full load independently of the load brake, although its chief function is to bring the hoisting motor promptly to rest and prevent drifting when the current is shut off. Its efficient operation is extremely important on close work, and in connection with the safety limit switch.

Bridge Foot Brake.

The bridge foot brake should be powerful and effective, and should be kept in working order at all times. In the case of old equipment, the foot brake is often allowed to become more ornamental than useful.

Automatic Limit Switch.

Many accidents have come under the writer's notice due to the fact that the automatic limit switch was not in working order, or was not set to operate at the proper limit. This part of the crane should be tested at least daily, and maintained in good working order. In setting the limit switch, proper allowance must be made for the distance the block will drift while the motor is coming to rest after the current is shut off.

Operator's Cage.

Care should be taken to provide a safe means of enabling the operator to enter and leave the cage. It should be provided with a continuous skirting board or guard at least six inches high from the floor to prevent tools or other objects from being knocked out, and injuring those below. A suitable switchboard should be provided with a main switch, circuit-breaker, and enclosed fuses for the individual motors.

A pilot lamp should be located in the cage, within the operator's vision, to enable him to detect any interruption of the current. He should be provided with a danger sign to hang on the main switch while he is working on the crane with the current shut off. The cage should be so located as not to intercefere in any way with hoisting when the trolley is at the extreme end of travel.

Controllers.

The controllers are an exceedingly important part of the crane or hoist, and should receive frequent inspection and attention. Powerful blow-out magnets should be provided on direct current controllers, capable of promptly disrupting the arc formed when the circuit is open. In order to promote smooth and safe working, all burned contacts should be promptly repaired or replaced, as otherwise, sticking of the controller might occur at a critical time and the results be extremely disastrous.

Cables.

The superiority of wire rope over chain has been too thoroughly established to admit of any uncertainty, providing rope of a proper quality and size is used in connection with drums and sheaves of a suitable size. Special flexible crane rope should always be used. It is false economy to use a cheaper construction. In choosing the size of cable, a factor of safety of not less than eight should be used, as sudden stops and starts, and careless taking up of slack, subject the cable to a very great tensile strain. Provision for equalizing the stress among all the ropes should always be provided. At least two full turns of the cable should be on the drum when the hook is at the extreme lower limit of the travel.

Great care should be taken to have the grooves and drums of the sheaves perfectly smooth and of the proper size to fit the cables, being neither too large nor too small. When the cable is subjected to the proper working conditions, the wires comprising the strands will wear nearly half through before they fracture. If, on the contrary, the wires break square off before wear has taken place to any extent, and the cable has been in service but a short time, the working conditions are improper. The fault should be corrected, and the defective cable replaced by a new one immediately. The breaking of the wires in this way is often due to the ropes being bent around sheaves of too small diameter, or to the grooves of the sheaves being too narrow, causing the rope to be cramped or too wide, so that the rope flattens out. Drums and sheaves should have a diameter equal to at least thirty times that of the cable.

It is not necessary to replace a cable having only a few broken wires in a single strand, although it should be watched closely and discarded just as soon as several wires in adjacent strands are broken. Whenever there is any doubt or question, it is better to be on the safe side. In addition to lessening the cable's strength, the broken wires may separate out and become a menace to persons or property.

If small pieces of broken wire appear in the lay of the rope, it is an indication that the inside wires are breaking. In a case of this kind, the cable should be replaced at once, as it is impossible to determine how many of the wires are broken. Consequently it is extremely dangerous to continue to use the cable. It is just as important to lubricate wire ropes as any other rubbing surfaces. Several good rope dressings are on the market, or a mixture of heavy cylinder oil and graphite may be used with good results.

Clevises and clips should fit the rope perfectly. Sharp bends in wire ropes are very dangerous and injurious, for this reason the cable should always be bent around a thimble to make a loop. A high grade of commercial zinc should be the metal employed when using a wire rope socket. All water and moisture should be kept from wire cable as much as possible, as the deterioration due to corrosion is very rapid. It is hardly necessary to state that under no circumstances should crane cables be spliced.

Shafting.

All shafting should have the diameter uniform from end to end. Reductions in area should be avoided, as change in section with sharp re-entrant angles introduces an element of weakness. Even when the design calls for a liberal fillet, poor workmanship may defeat the purposes of same. The cracks which start at the shoulder cannot be detected, as this part of the shaft is usually in contact with the box. Set-screw holes should not be drilled in shafts, as it weakens the section, and many accidents have resulted from this practice.

Care and Maintenance.

The electrical traveling crane of today is a fairly complicated machine, and as such it should be kept in first-class operating condition by a competent mechanic possessed of at least some electrical knowledge. While this matter is a vital requirement for the safety of all concerned, it is one which receives far too little consideration, especially in the smaller plants where only one or two cranes are in service. In the larger plants, competent men are usually available. The practice of leaving such important equipment to the care of incompetent or inexperienced men cannot be too strongly condemned.

Operation.

The safe operation of the crane depends more than anything else upon the man in the operator's cage. It is a man's job, and a man should be furnished. For the safety of the hitch, a certain amount of judgment and prompt action is needed, not only when an emergency arises, but in the routine operation. In judging the weight of the load to be lifted, and the safety of the hitch, a certain amount of experience is necessary; consequently an inexperienced man should never be placed in charge of a crane until after he has been under the direction of an experienced operator long enough to become proficient. For certain classes of crane work, a high degree of skill is required, and one of the best preventives of accidents is to avoid the frequent change of operators.

An efficient method of signalling, by the use of colored electric lamps, or other means, to indicate to the operator where the lift is to be made, is exceedingly important. It promotes smooth working and does away with shouting, pounding on metal and other undesirable methods of attracting the crane operator's attention.

The speed of the different functions of a traveling crane depends so much upon the local conditions that it is impossible to give figures that will apply to all cases. However, it is believed that the figures given below should be considered as maximum and should not be exceeded. It must be borne in mind that the greater the speed, the greater the possibility of accident, and the more disastrous the results.

TABLE II. SAFE LOADS IN TONS FOR ROPES, CHAINS AND CABLES.

Manila Rope				Chains				Wire Cable			
Diam. Rope, Ins.	Single Rope, Tons.	Two Part, Tons.	Four Part, Tons.	Diam. Link Stock, Ins.	Single Chain, Tons.	Two Part, Tons.	Four Part, Tons.	Cable Diam. Ins.	Single Cable, Tons.	Two Part, Tons.	Four Part, Tons.
½	⅛	¼	½	¼	½	⅞	1½	½	1	2	3½
⅝	¼	½	¾	⅜	1	1¾	3	⅝	1¾	3¼	6½
¾	⅜	¾	1¼	½	2	3½	6	¾	2½	4½	9
⅞	½	1	2	⅝	3	5	9	⅞	3¼	6	12
1	¾	1½	2½	¾	5	9	15	1	4	8	16
1¼	1	2	3	⅞	6	10½	18	1¼	6	12	24
1½	1¼	2½	4	1	8	14	24	1½	10	19	36
1¾	2	4	6	1⅛	11	19	33	1¾	13	25	48
2	2½	5	8	1¼	13	23	39	2	16	32	60

Maximum Speeds.

Bridge Travel	400 ft. per min.
Trolley Traverse	200 ft. per min.
Hoisting Speed	50 ft. per min.

In order to assist the operator in judging the weights to be lifted, it is desirable that a table giving the weights of the more common materials be posted in a conspicuous place in the operator's cage. Table 1 gives the necessary information of this character.

TABLE I. WEIGHT OF MATERIAL.

Material.	Weight in Pounds per cubic foot.	Shafting — Diameter in inches.	Shafting — Weight in Pounds per lineal foot.
Cast iron	450	6	95
Steel	489	8	169
Lead	709	10	264
Oak	59	12	368
Concrete	155	14	676

Inspection.

Systematic inspection at regular intervals has long been recognized as indispensable to the safe operation of traveling cranes. For the ordinary factory crane, a daily inspection of the chief mechanical and electrical features is advisable. It is a good rule to have the inspections made by a man who does not do the actual work of repairing. Without question, a great many potential accidents will be prevented by the conscientious inspector.

Chains and Slings.

Chains and slings should be kept in first-class condition. Cable slings are much preferable to chains, as they give warning before breaking. Chains that are in constant use should be annealed every six months, the date of annealing being stamped with stencils upon the hook or ring. It should be impressed upon all concerned that when a Manila rope sling becomes old or worn, it cannot be expected to be as strong as when new. The writer has found it a good rule to instruct the crane operator never to make a lift when a hitch is improperly made or when the load is in excess of the safe limit of a chain or sling.

HIGH-GRADE STEEL MANUFACTURE IN CANADA.

M. J. BUTLER, managing director, the Armstrong-Whitworth Co. of Canada, takes exception to the statement made by several steel importers that high grades of steel are not produced in Canada.

"While for a long time fine grades, such as vanadium steel and high tension machine steel, were not produced in Canada," says Mr. Butler, "they are now being manufactured at our Longueuil works. We hope that the imposition of this new war duty will not advance the price, but of course that will depend upon many circumstances which cannot be foreseen in war times. Our firm has started the manufacture of high-grade steel goods, and while we have accidentally fallen into the benefit of this unforeseen war tariff, it will undoubtedly aid in the establishment of our market, and we shall produce these special grades of steel in sufficient quantities to supply the Canadian market."

Mr. Butler stated that while the Armstrong-Whitworth people were not as yet producing steel tyres for locomotives, it was about the only thing they did not turn out. They, however, were manufacturing the special grade of steel required for steel tyres, and he had no doubt that before long, as a result of the new tariff, these tyres would be made in Canada.

"There is no doubt," said Mr. Butler, "that the new general war tariff will result in the production of many steel supplies in Canada which have hitherto been imported either from Germany, Great Britain or the United States, and Canadian business and Canadian labor will be the gainer thereby."

ONTARIO WORKMEN'S COMPENSATION ACT.

UNDER Section 101 of the Ontario Workmen's Compensation Act, manufacturing groups are authorized to form protective associations in order to reduce risk of accident, and, consequently, their rates of assessment.

A general movement is now under way among manufacturers to take advantage of this clause. The first to form a protective association were the small electric power companies. The canners followed, and the quarrymen and meat packers have now incorporated their protective associations. Machinery builders, iron and steel fabricators and erectors, flour millers and others are in process of organization.

The idea of the Compansation Act is to charge just what compensation costs. The commission pays the cost of inspectors in some cases, charging it to the group at the end of the year. The movement is, we understand, progressing very satisfactorily.

Modern Alchemy.—Assuming that lead is a disintegration product, there is reason to believe that lead from thorium may have higher atomic weight than that from uranium, though the two may be chemically identical. This seems to be confirmed by evidence obtained by F. Soddy and H. Hyman. Of the 0.35 per cent. contained in the mineral thorite, ten-elevenths is derived from thorium and only one-eleventh from uranium, and samples of this lead gave 208.5 and 208.3, the international standard of atomic weight being 207.1. In spectroscopic comparison, one distinct line of ordinary lead became visible in thorite lead only after long exposure.

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PRINCIPAL CONTENTS.

'TIS NO TIME TO WHINE.

HOWEVER unconsciously we may have become participants in this almost all-European War, there is no disputing the fact that, as the weeks and months have sped since early August last, we have been in process of realizing that not only were we involved but, as a privilege and of necessity, we had also a duty to perform. In these particulars as regards accomplishment we have nothing to be ashamed of and we no doubt are determined to surpass rather than merely maintain the present achievement record. It may at once be said that we have given quite unstintingly of our manhood, our womanhood and our substance for the cause of Empire, notwithstanding which, as a nation within that Empire we are relatively richer in many respects than otherwise.

Within the past month we have again been reminded—rather more forcibly perhaps because of its imperiousness, that we are involved with Britain, and that her affairs, of whatever nature, are ours as well. Canada's War Budget has been declared, and even though as regards details, to a large extent anticipated, it has, judging by appearances and noting observations, aroused considerable excitement and caused much commotion in the various spheres of our commercial, domestic and individual relationships and activities.

Arising out of the Budget proposals generally, as was naturally to be expected, all manner of extravagant ideas and statements are being promulgated. Business men we are led to believe have been precipitated headlong into a maze of figures and probabilities, and numbers of them—we had almost quoted Scripture, and said: "A multitude of them that no man could number,"—are ready to shut down. Criticism of certain details has also not been lacking in the elapsed although short period, and while always justifiable for cause or reason, may nevertheless often be narrow and circumscribed in its outlook.

In its essence, our War Budget gives added protection generally to Canadian manufactured products and at the same time added preference comparatively to imports from Britain. The latter, however, is meantime and will continue to be for the next two years or more somewhat of an "intangible asset" to British manufacturers, due to the fact that their output for home requirements is and will continue to be for at least the period named, far below the demand.

Regarding the 7½ per cent. increase in non-preferential instances, it may be incidentally remarked that the amount is substantial, but at the same time neither a real or imaginary barrier to hinder anyone purchasing what they want, just because they want it from necessity.

The Minister of Finance has taken full and cunning advantage of the exceptional opportunity afforded. He has not only sought by the various enactments to foster Canadian industry, but he has done so at a time when tariff or no tariff, the all pervading application of our varied enterprise is that due to the European War, and for the profitable accomplishment of which we have had and will have of necessity to import largely.

The purpose of the tariff and tax imposts, particulars of which are to be found in another section of this issue, is to provide additional revenue, and this can best be achieved by our practising "Business as Usual." This, mark you, has no kinship with the "Business as Usual" propaganda with which the opening weeks of the war was haloed. Rather is it the unaffected war-tariff-and-tax—unconscious pursuit of our affairs that has in recent weeks marked our steady uplift to early future normal times again.

We have said that criticism of the Budget provisions is in evidence, and some people individually or collectively, or both, may be rather heavy sufferers comparatively. A number of the enactments are almost sure to become permanent; as for instance the stamps on commercial paper, while others again may be more or less tardy of erasure from the statutes. In any case, the personal and individual exemptions as burden bearers are few, and taken altogether, who of us would be disposed to bear any less share in supporting our Empire in the cause to which she with her Allies are committed?

Canada's 1915 Budget is a call to her people's patriotism, and that they will respond equally whole-heartedly as with her sons and daughters there is not a glimmering of doubt. Let us continue then to make it "Business as Usual."

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

WELDING GALVANIZED AND TIN PLATES.

INQUIRIES are frequently made as to the possibility of obtaining satisfactory welds on plates or articles that have been galvanized or tinned. In most cases the welds obtained are excessively brittle, and in the case of welding galvanized material, the health of the welder is seriously affected by the fumes produced under the action of the blowpipe. It is therefore necessary for the welder to know the difficulties he has to contend with, and the methods to adopt in order to produce satisfactory welds on these materials.

Galvanizing.

Zinc forms a cheap and excellent protective coating for iron and steel. It has the great advantage over tin and lead in being attacked in preference to the iron when the two metals in contact with each other are exposed to corrosion. For most articles zincing—or galvanizing, as it is wrongly called—is most cheaply and conveniently applied by dipping the iron or steel articles in a bath of molten zinc. Previous to dipping the articles are cleaned by acid and friction, coated with a flux of sal-ammoniac and heated. With certain articles this method has disadvantages; for example, in large objects, tanks for instance, it is difficult to heat the molten zinc evenly, besides the bath would have to contain many tons of zinc. In these cases, the depositing of the zinc electrically, known as electro-zincing, has marked advantages. The zinc is deposited cold, and does not alloy appreciably with the surface of the iron to be protected.

The application of oxy-acetylene welding to finished galvanized articles is the exception rather than the rule. There are cases where, owing to the distance from a galvanizing plant, articles are constructed from galvanized plates and oxy-acetylene is applied during the construction. In other cases, the blowpipe is frequently applied to correct defects of manufacture, for example, welded or riveted tanks which have failed under hydraulic test. Lastly, the blowpipe is an indispensable tool for the repair of galvanized articles.

Galvanized Plate Welding.

In welding galvanized plates numerous precautions are necessary. The white jet of the blowpipe in contact with the plates produces abundant vapours and oxide fumes. These can interfere with the course of the work and, more important, seriously affect the health of the welder. Without proper preparation, the welds always include as impurities, zinc and slag, and the mechanical strength and soundness of the welds are directly dependent on the amount of such slag and zinc incorporated into the iron whilst molten.

The operation of hot galvanizing produces at the surface of the galvanized plate a layer of pure zinc and a series of intermediate alloys of iron and zinc, rich in zinc near the surface and rich in iron where the alloy comes in contact with the plate. As already indicated in describing the operation of cold galvanizing or electro-zincing, the zinc does not alloy appreciably with the surface of the iron. Under the action of the blowpipe the layer of zinc near the surface is volatilized, but this is not the case with the layer of alloy in contact with the iron or steel plate. Part of the alloy is dissolved in the iron, but the greater part forms a well-known earthy slag, and it is difficult to avoid its incorporation in the weld. The effect of including the zinc-iron alloy is to produce a very brittle weld, and the effect of incorporating the slag is to produce a defective weld with a consequent loss of strength.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.

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PLACE AND DATES OF MEETING. The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

Zinc Removal Imperative.

It is obvious that to produce good, sound welds on galvanized articles, it is necessary to remove the zinc from the vicinity of the weld. The zinc should be entirely removed for a distance of 1 in. to 1½ in. on either side of the centre line of the weld. This preparation makes the cost of the weld higher, and many firms neglect this precaution. Where the strength of the joint is of small importance, the direct application of the blowpipe may be sufficient. In such cases the health of the workman should be considered, and a suitable respirator be provided together with a plentiful supply of milk as an antidote. The plates should be bevelled as soon as the thickness reaches ⅛ in., otherwise burning of the iron and lack of penetration are sure to result.

The welding rod should be of Swedish iron, of dimensions appropriate to the thickness to be welded, and the power of the blowpipe should be that given for the welding of iron and steel plates of identical thickness, that is, the hourly consumption of acetylene should be 240 to 320 litres (8½ to 11 cubic feet) for every ⅛ in. thickness to be welded. The removal of the zinc in the vicinity of the weld also removes the protective covering and it is not usual to replace it by re-galvanizing. The superiority of zinc over other protecting metal coatings is important in this case as it is possible for the exposed iron to be protected by the surrounding zinc. It is advisable, however, to clean thoroughly the welded parts and paint them with a protecting paint having an aluminium base.

Tin Plate Production.

Tin plates are sheets of iron coated with a very thin film of tin. The manufacture of tin plate consumes the larger part of the world's output of tin. The plates resist the corrosive action of salts and acids, and tinned articles are commonly met with in practice. The process consists in annealing, washing, pickling and rolling the plates to get a good surface, they are then coated with tallow or palm oil previous to dipping in a molten bath of tin. The tin readily alloys with the iron at the surface of contact, and a thin film of tin adheres to the alloy. Alloys of iron and tin, even when only traces of tin are present, are extremely brittle hot or cold.

Tin Plate Welding.

In the oxy-acetylene welding of tin plates, the tin is not eliminated as a vapor or as oxide fumes as in the case of zinc. Although tin melts at a low temperature (450 deg. Cent.), its vaporizing point is in the neighborhood of the melting point of steel (2,790 deg. Fah.), and further, the tin does not separate from the iron, but is entirely absorbed by the iron as soon as the latter reaches red heat, so that when the iron becomes melted by the blowpipe the iron-tin alloy is added to the molten bath. The result is that the weld consists of very large crystals, which are separated by numerous fissures or cracks.

In endeavoring to weld tin plates without preparation, the welder observes cracks forming behind the blowpipe during the execution of the weld.

These cracks are produced by the expansion and contraction strains. For ordinary welds on iron and steel plates, these strains are either negligible or easily overcome, but in the case of tin plates they are sufficient to break up the structure of the iron-tin alloy which is formed during the course of welding. It is, therefore, absolutely impossible to weld tin plates satisfactorily without first carefully removing the tin from the line of welding and its immediate vicinity in the manner indicated for the welding of galvanized plates. The instructions given for obtaining satisfactory welds on galvanized plates hold good for tin plates.—Acetylene Lighting and Welding Journal.

FOUNDRY PRACTICE QUERIES.

Question.—We have always found that Lehigh coal gave us a softer casting than coke. What would be the reason why?

Answer.—The hardness and softness of castings are determined from the elements contained in the iron being used, also the method and manner of cooling, particularly if the castings be of light section, and the iron only agricultural machinery scrap, which usually runs about the following analysis: Silicon, 2.; sulphur, .80; phos., .60, and mang., .60. This analysis would be suitable for general machinery castings. The silicon would drop in remelting to about 1.80, while the sulphur would raise possibly to .90 or over, according to the sulphur contents in the fuel and the temperature of the cupola. Phos. would remain about the same, and mang. would drop according to the amount of sulphur present, as there is a great affinity between sulphur and mang., resulting in manganese sulphide, which is carried off with the slag. Softer castings would therefore result. Foundry coke contains sulphur from .50 to 1.50, but over 1 per cent. is unfit for foundry use; Lehigh coal, .30 to .90, and splint coal, .30 to 2.50 per cent. In using Lehigh coal you are more likely to get a more uniform sulphur content than in many cokes that are upon the market and called Penna. coke. Bessemer foundry and Solvay process cokes give uniform analyses, however.

* * *

Question.—Do you know an inexpensive method of softening iron while being melted or during the pouring process. We used to get a soft casting from Lehigh coal, but it does not seem so easy to get it now.

Answer.—An inexpensive method of getting soft castings is by the use of ferro-silicon in the ladle if the iron is low in silicon, but if the iron be high in sulphur use ferro-manganese. In the Lehigh districts, anthracite coal used to be got at very low cost and of good quality but, with the increasing demand, the price has gone up and what used to be thrown on to the slate banks is now mixed with the good coal and shipped. Nothing goes to waste that has the appearance of coal.

BALL-BEARING POLISHING AND GRINDING MACHINES

THE description and illustrations refer to two recent products of the F. E. Wells & Son Co., Greenfield, Mass., being known respectively as their No. 10 Ball-bearing Polishing Machine and their No. 11 Ball-bearing Grinder. The polishing machines are arranged to be driven from the shaft attached to the ceiling of the room beneath, or if the building is only one storey, then the shaft can be run in a trench with the shaft bearings upheld by floor stands. The idler pulley for tightening the belt is located inside the base and is raised or lowered by means of the handle on the outside of the latter.

When starting up, the pulling up of handle forces the idler pulley against the belt, thus taking up all slack, and when it is required to stop the machine, the controller handle is simply lowered. The ball bearings are specially enclosed and completely protected from dust. The diameter of spindle in bearings is 1.7725 inches, diameter of arbor $1\frac{1}{4}$ in., diameter of wheel flanges 5 in., height of spindle from floor 36 in., size of base 17 x 22 in., net weight 510 pounds.

The No. 11, or grinding machine, is similar to the No. 10 polisher, except that an overhead drive is arranged.

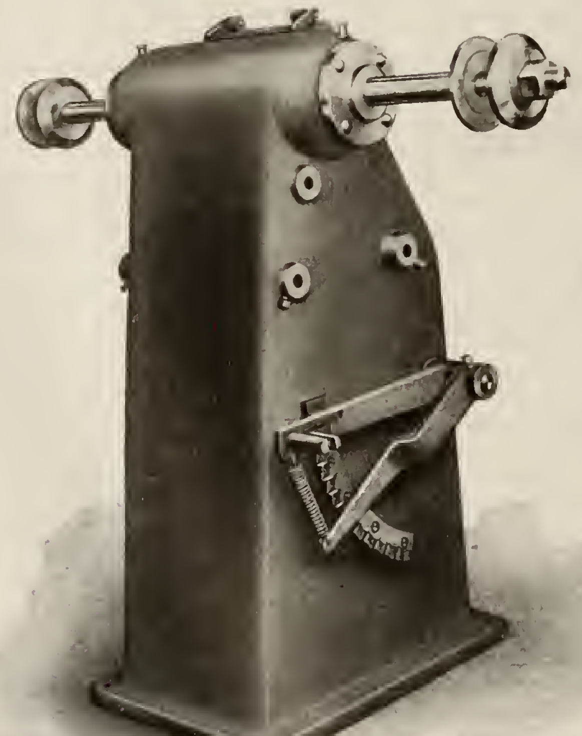

FIG. 1. BALL-BEARING POLISHING MACHINE.

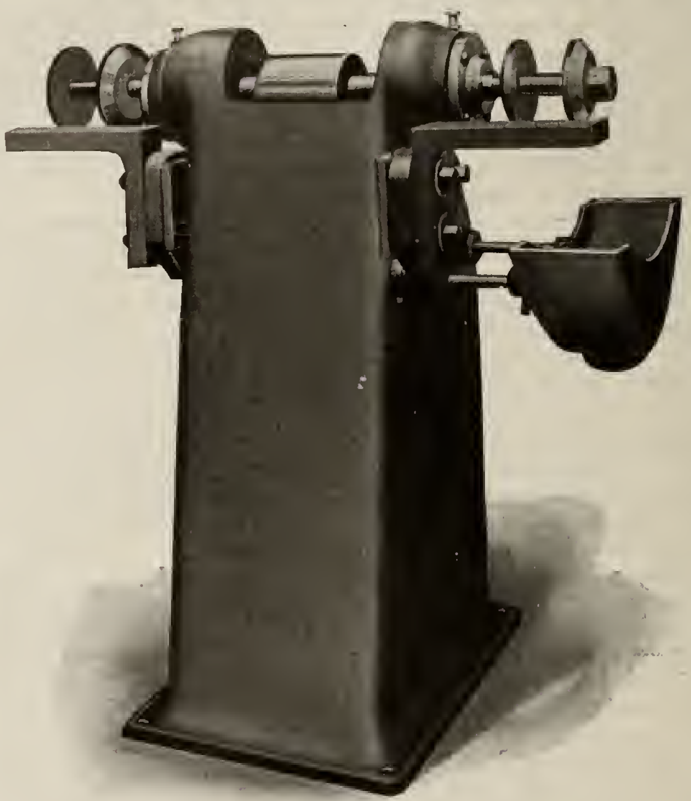

FIG. 2. GRINDING MACHINE WITH BALL BEARINGS.

Questions and Answers

Question—Recently we have experienced difficulty in nickel plating short steel tubes which we plate on tree shaped holders, each holder containing twelve tubes. We have plated thousands of these pieces in the same bath without any evidence of burning, but during the past few weeks the pieces on the upper arms of holders burn while the lower pieces are mottled and greyish white spotted of a denser shade than the intermediate tubes. The bath is one we have used for the past five years and has given excellent results. What is the cause of the present trouble and how may we correct it?

Answer.—Problems such as you submit are often very difficult to solve by correspondence. There are usually several conditions which have either a direct or an indirect bearing on the subject and require consideration, yet are not recorded in the submitted description of the case. Efforts to prescribe a remedy or find the true cause may prove, therefore, to be more or less unsatisfactory in result. Usually conditions such as you first describe are the result of operating a nickel solution with a poor metallic content. The solution conductivity has apparently remained normal owing to the presence of ammonia or other conducting agent; for this reason the unsuspecting plater does not realize the true state of affairs until something happens as in your case. An ammeter in the circuit would, however, keep the plater informed of such changes. Again, the pieces on upper arms of the tree-shaped holders have a greater volume of solution to draw from than those beneath. This point will be at once apparent. Adjacent holders are in closer proximity to one another at the bottom of tank and consequently there is a decreased tendency to burn the tubes. If the solution be alkaline, neutral or only faintly acid, the upper portion will cause the liberation of an excess of hydrogen at the separated points and the condition known as burnt nickel is the result. Now, if the bath be acid this burnt condition would usually be found at the lower portions and very pronounced at each end of the cathode rod. If you will increase the metallic strength of the bath by additions of single nickel salts, the deposit should be obtained uniform on all portions of the holder, and at all points in the tank. This increase in the metallic strength of the solution will also improve the deposits obtained on lower arms of holder, that is, the mottled effect will be much less noticeable, as the proper content of metal will facilitate the settling of the bulky residue which by reason of its presence suspended in solution, comes in contact with the lower tubes and partially prevents the deposition of metal on such spots. This fluffy material, often merely iron, is held in more compact form at the bottom of a solution rich in nickel. If, however, this accumulation of slime is excessive, the solution should be filtered, or the clear portion syphoned off and the lower portion of the solution filtered, this being usually quite rich in metal. Wash the anodes and remove the loose material from them before replacing in the tank. Do not depend on hydrometer indications for guidance in management of the solution. The hydrometer merely shows that your solution is a certain number of degrees heavier than water. This is not necessarily metal, as ammonia, acids, etc., all aid in boosting the little glass tube. Watch the anodes, see that they are delivering metal, and, if the solution becomes unusually turbid when no sodium chloride is in it, add metal in the form of nickel sulphate.

* * *

Question.—Why is a "strike" solution used when silver plating steel? How much silver is used per gallon of "strike" solution?

Answer.—The silver "strike" is a very essential preliminary when silver plating steel. Careful platers use two, and often three striking solutions. The first solution contains little or no silver and acts as an electric cleaner. Gas is liberated at the cathode and all traces of oxides, grease, etc., are removed from the surface of the work. Steel knives which otherwise would prove troublesome if silvered direct on the steel are now very successfully treated by using the strike. Where two or more strikes are employed, the second strike serves to cover the surface of the article in a very rapid manner. This solution contains only a small amount of silver and an excess of cyanide of potassium, the latter giving great covering power to the solution when operated with proper current. While the small amount of silver in solution makes the deposition of only a slight film impossible, each successive strike contains a little more silver and less cyanide than the previous bath, and the deposit is thereby gradually brought into shape to be placed in the regular silver plating solution. The actual time elapsing between the immersion in first solution and the immersion in regular bath is only a few seconds or minutes in any event. The anode suspending rod is sometimes of iron and the entire rod, anode and all are completely submerged in the plating solution, thus eliminating any possible loss of current or power through faulty contacts. The amount of silver used per gallon varies with different platers according to class of work treated and disposition of employers to furnish the metal as required, etc. The quantities range from 3 to 10 dwts. of metallic silver per gallon for the second strike. Probably the average bath will contain about 6 or 8 dwts. of silver per gallon. The metallic silver is of course converted into chloride before adding to the solution.

* * *

Question.—Can platinum be deposited from solution? If so what is the bath composed of when used commercially?

Answer.—Platinum may be deposited from a solution of its salts in the same manner that other metals are deposited. The most successful baths are chloride solutions. It has been employed commercially to electro-plate copper, brass and other metals, but owing to an extremely high price, it is substituted by some less expensive finish. The solutions vary according to the tastes of the plater and the effect desired. A platinum plating solution which has been used by a very reliable and well known firm is prepared as follows:—Convert 180 dwts. of platinum into chloride, dissolve this chloride in one quart of distilled water. In another quart of distilled water dissolve 8 oz. ammonium phosphate; while in another vessel containing two quarts of distilled water dissolve 2½ pounds of sodium phosphate. Now add the ammonium phosphate solution to the platinum solution and stir well. A dense precipitate will form. When precipitation is complete, continue stirring for a moment, then add the sodium phosphate solution and stir the whole rather vigorously. Boil the completed solution until no odor of ammonium is detected. The solution should now turn blue litmus paper faintly red. Add water to make up for loss by evaporation, the bath to be one gallon in volume. Owing to the insolubility of platinum anodes, the solution requires frequent replenishing by additions of small quantities of prepared solution. Some firms prefer to prepare entirely fresh solutions for use, boiling down the old, then adding this to the new. In either case, the solution is very expensive, and in view of the fact that there are quite practical solutions which may be substituted for the genuine, the above formula, which we believe originated with Roseleur, is not now popular.

* * *

Question.—I have a nickel solution which has become absolutely useless. Work plated for seven or eight hours does not receive a deposit equal to 1½ hours in normal solution. Color of deposit is very dark grey or dirty. The deposit is also rough and coarse grained and impossible to color by buffing. Solution is clear and of good green color, while current used is same as usual. Stronger current merely intensifies the trouble, and weaker current produces no deposit. Where is the trouble?

Answer.—Your nickel solution is evidently too acid and probably contains boracic acid. It is also in a badly depleted condition but not beyond point of rebuilding. We have yet to see a nickel solution so exhausted that it could not be rebuilt. Contaminated solutions which may prove expensive to save are almost invariably possessed of a nearly normal metallic strength. If you can spare the solution for a week proceed as follows. Suspend as a cathode, a small brass or copper article, and have the suspending wire amply large so that all available current may be used. Electrolyze the solution in this manner for an entire week, without adding anything to it. The electrolyzing treatment will effect a freer disintegration of the anode and increased anode efficiency will result without the aid of a conducting salt other than the ammonium introduced by the addition of double nickel salts as will be advised. Try the solution after electrolyzing in order to obtain a knowledge of the real value of the treatment, then add 25 pounds each of single and double nickel salts to each 100 gallons of solution treated. Place the salts in a barrel or crock with a portion of the solution. After the addition, stir the whole solution thoroughly and when cool the bath should respond in satisfactory form. An increase in current density will also be permissible and consequently more rapid deposition of metal with no disastrous effect upon the deposit. Such conditions are often caused by nickel anodes having a hard surface crust which is practically insoluble ordinarily. The metal is, therefore, drawn almost entirely from the solution and in a short time the exhausted condition follows. The bath is unable to produce metal as there is practically none in solution. Low temperatures also increase the liability to this difficulty. Keep the solution at the normal temperature of the room.

FIRE GILDING.

FIRE gilding, commonly known as mercurial gilding, is, as its two names clearly indicate, a method of gilding which makes use of both heat (or fire) and mercury. The oldest form of plating known to us, this process is still in use in cases where a heavy gold deposit is required, and expense is little consideration.

The alchemists, shortly after the discovery of mercury, found that base metals could be coated over by means of what they called amalgams, or the alloys of gold and silver with mercury, and that when the articles thus treated were heated sufficiently, the mercury was driven off, leaving a firm adherent coating of the gold or silver. This is the principle of the process as performed today, though to achieve satisfactory results requires great skill.

The first step in the process consists in the preparation of the amalgam. The gold, pure or alloyed, is rolled into very thin sheet, preferably .0005 in. in thickness. Two parts of pure mercury are taken to one part of gold. The mercury is warmed in a graphite crucible and the gold is introduced in small pieces, and the whole is stirred with an iron rod. The heat must be below red-heat or the mercury will volatilize. The amalgam that forms is poured into cold water, and is soft and easily worked with the fingers, to squeeze out excess mercury.

The next step is the preparation of the article, as only those that can stand great heat can be treated, and all joints must be hard soldered. A rough surface is given either by means of the sandblast or by dipping, and every trace of grease and oxide is removed by cleaning. The blue dip used in silver plating is then given, so as to allow the amalgam to spread more evenly over the surface of the article. The dip is as follows:—

Water	1 gal.
Cyanide	2 oz.
Chloride of mercury	1/8 oz.

A momentary immersion is sufficient and the article is ready for receiving the coating of amalgam. This is applied by means of a fine wire scratch-brush, which is freed from grease and coated with mercury by dipping in solution of nitrate of mercury. Every part of the surface of the article must be completely covered as evenly as possible. When this is done, the article is ready for "firing," or removing the mercury by heat. A charcoal fire is preferable for this purpose, though an iron plate heated by gas may also be employed.

The article is held by tongs or wire, and slowly, evenly heated, so that the mercury is gradually driven off. It is then plunged into water, scratched-brushed and again heated to remove any mercury spots that remain. It is next dipped into a mixture of 1 gallon of water and 1 quart of muriatic acid, which brightens the surface, giving a dead gold lustre. To give a more completely dead finish, a paste of the following composition is applied:

Saltpetre	8 oz.
Common salt	4 oz.
Alum	4 oz.

This mixture, ground and mixed with water to form a paste, is applied to the surface of the article, which is then heated till the whole mass fuses. It is then plunged into water, which removes the paste.

The advantages of the process consist chiefly in the beauty and durability of the coating, which is much heavier than that obtained by plating. For these reasons it is still much used for buttons and similar articles. The cost, the heat which must be applied and the dangers from mercury fumes, are only a few of the disadvantages which have caused it to be superseded by electro-plating methods.—Brass World.

DECARBURIZATION IN SALT BATHS.

THE use of baths of molten alkaline salts for heating steel for hardening has now become general. They allow of the rapid heating of small parts of a uniform temperature and easy measurement of heat temperature. It is also generally believed that since the steel is not in contact with air during the heating superficial decarburization is avoided.

A. M. P. Portevin, in an interesting note on the subject to the last Iron and Steel Institute session, referred to experiments carried out with a steel containing 1.46 per cent. of carbon and with soft iron in a series of baths of different salts. Molten potassium chloride appreciably decarburizes steel at 900° C., and still more so as the temperature rises above this point. A mixture containing potassium chloride, sodium chloride, soda, potassium ferro-cyanide, described as Brayshaw's mixture (although Brayshaw disclaims the latter) was also shown to decarburize specimen badly.

An interesting feature was noted in the case of baths containing potassium chloride with an admixture of potassium cyanide. Samples of steel containing .78 per cent. carbon and Lancashire iron were treated simultaneously. Whilst the steel was decarburized, the iron was actually carburized from the bath. The action depends upon the cyanide admixture, the decarburizing action being almost constant, whilst beyond 25 per cent. of cyanide the carburizing action on iron decreases. The employment of cyanide of potassium requires careful investigation owing to decomposition which sets in if the bath is taken beyond a certain temperature, and owing to the possibility of introducing nitrogen into the steel.

SALT WATER GILDING SOLUTION.

THE original solution for salt-water gilding, as patented by Berthoud in 1860 consists of the following:—

Water	1 gal.
Yellow prussiate of potash.	4 oz.
Sodium phosphate	2 oz.
Potassium carbonate	1½ oz.
Sodium sulphite	1 oz.
Gold (as fulminate)	2 dwt.

Where the shade of gold is to be changed, by the addition of silver, a solution is made up, as above, except that 10 dwt. of silver as chloride takes the place of the gold. Copper is also added in a similar manner to alter the shade of color.—Ex.

ADJUSTING MEN TO CONDITIONS.

IN a contribution to a recent month's issue of "System," entitled "Adjusting Men to Conditions," F. R. Hazard, president the Solvay Process Co., epitomises the human side of shop management as follows:

Men who fall down on their jobs are not necessarily drones. Three causes not entirely of their own making may be behind their apparent incompetency.

First, they may be round pegs in square holes. That the man and the job must fit is an old story. Still, how many of us list the job's requirements and the man's abilities before we pass judgment?

Secondly, jealousies may have taken all the attractiveness out of the work. A foreman, for instance, may not have been big enough to train up somebody for his job. The men under him see that he is afraid to risk his own pay envelope and so the men lose the incentive they deserve.

Thirdly, an unhealthy spirit may have spread dry rot and stagnation through the entire organization until the best men are the first to become disheartened. There must be a healthy esprit de corps if a business is to swing ahead into its fullest opportunities.

Each one of these causes, and others about as self-evident, must be taken into account before a man is written down a drone.

We say that a manager "works well with men" when he makes these everyday adjustments that give the best answer we know how to get to the human equation problem. They do not usually come "just natural" to a manager, I think. He may use them almost as a matter of second nature, but he knows that he is using them.

The wise manager has an understudy for each position above a certain point, but below that point, in a large proportion of the vacancies, men must be trained when gaps occur. Not every business man sees that the cost of this training is very real. Here in our business we find that it costs anywhere from $50 to $200 to train each new man.

Oxidising Sheets.—Oxidising steel or iron sheets so that they will have a uniform bluish color instead of the varying colors produced by the ordinary processes of annealing, is the subject of a patent—United States, 1,115,281, October 27th, 1914—granted to John E. Carnahan and Arthur J. Maskrey, Canton, Ohio. The ordinary sand-sealed annealing box is enclosed in another sand-sealed box, which constitutes the main point in the invention. By conducting the annealing in one box enclosed by another, it is found that the subsequent separation and oxidation results in a substantially uniform color throughout each sheet and the prevention of an excessively deep scale at or near the edges of the sheets. This is due to the more uniform temperature in the second box and to the fact that the sheets are better protected from the products of combustion.

Trade Gossip

Regina, Sask.—At a recent meting of the Board of Trade the following officers were re-elected: President, S. C. Burton; vice-president, E. A. McCallum; second vice-president, F. J. James, and secretary, L. T. McDonald.

Prompt Shipment Record.—A record for prompt shipment was recently made by the Whiting Foundry Equipment Co., Harvey, Ill., on an order for a three-motor electric traveling crane, 10 tons capacity, 30 ft. span. Telegraphic order was received at their plant January 23, calling for delivery of crane complete on purchaser's runway at New Bridge, Del., February 10, 1915. Drawings were made, crane constructed, and shipment made January 29, 1915. Crane reached New Bridge February 4th, and was erected complete ready for service February 6th, or four days ahead of schedule time.

Dominion Steel Corporation.—J. H. Plummer, president of the Dominion Steel Corporation, states that the company is selling its entire output of steel billets in Great Britain, which is an active buyer. Mr. Plummer says the report that the Corporation is now operating its plant almost to capacity is not correct. The three blast furnaces and the open hearth plant are being operated, the company actually operating on a ratio of about 55 per cent. of its capacity. Prices for steel products have improved somewhat of late, but the advances are not sufficient to make up for the rise in freight rates.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS—Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

Air Compressors.
A. R. Williams Machy. Co., Toronto.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.
E. J. Woodison Co., Toronto.

Alloys.
Hermann Boker & Co., Montreal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Anodes, Brass, Copper, Nickel, Zinc.
Chas. J. Menzemer, Niagara Falls.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.
E. J. Woodison Co., Toronto.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Northern Crane Works, Ltd., Walkerville, Ont.
E. J. Woodison Co., Toronto.
Pangborn Corp., Hagerstown, Md.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
J. S. McCormick Co., Pittsburg, Pa.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
W. S. Rockwell Co., New York.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
Manufacturers Brush Co., Cleveland, O.
J. S. McCormick Co., Pittsburg, Pa.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.
Chas. J. Menzemer, Niagara Falls.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
Chas. J. Menzemer, Niagara Falls, Ont.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Monarch Eng. & Mfg. Co., Baltimore.
W. S. Rockwell Co., New York.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
Monarch Eng. & Mfg. Co., Baltimore.

Castings, Brass, Aluminum and Bronze.
A. T. Gordon, Ottawa, Ont.
Tallman Brass & Metal Co., Hamilton, Ont.

Castings, Malleable.
Can. Malleable Iron Co., Owen Sound.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Chain Blocks.
Herbert Morris Chain & Hoist Co., Ltd., Toronto.
John Millen & Son, Ltd., Montreal

Chaplets.
Columbian Facing Mills Co., Buffalo N.Y.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Wells Pattern & Machine Works, Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Chemicals.
Chas. J. Menzemer, Niagara Falls.
W. W. Wells, Toronto.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Supply Co., Cleveland.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New Pennington, N.J.
E. J. Woodison Co., Toronto.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.

Core Cutting-off and Coning Machine.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.

Core Compounds.
H. S. Carter & Co., Toronto.
Columbian Facing Mills Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., Pennington, N.J.
Frederic B. Stevens, Detroit.
E. J. Woodison Co., Toronto.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Demmler & Bros., Wm., Kewanee, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Holland Core Oil Co., Chicago.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
E. J. Woodison Co., Toronto.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Core Wash.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.
W. D. Beath & Son, Toronto.
J. S. McCormick Co., Pittsburg, Pa.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Mussens, Limited, Montreal
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
J. S. McCormick Co., Pittsburh, Pa.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore, Md.
Northern Crane Works Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Elk Fire Brick Co., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
Webster & Sons, Ltd., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa
Monarch Eng. & Mfg. Co., Baltimore
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Elk Fire Brick Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cupola Twyers.
Can. Hanson & Van Winkle Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.
E. J. Woodison Co., Toronto.

Cyanide of Potassium.
Chas. J. Menzemer, Niagara Falls, Ont.
J. S. McCormick Co., Pittsburg, Pa.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Webster & Sons, Ltd., Montreal.
Oven Equipment & Mfg. Co., New Haven, Conn.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
Chas. J. Menzemer, Niagara Falls, Ont.
W. W. Wells, Toronto.

Dust Collectors.
Pangborn Corp., Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Machy. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
J. S. McCormick Co., Pittsburg, Pa.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.
E. J. Woodison Co., Toronto.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Federal Fdry. Sup. Co., Cleveland.
Stevens, Frederic B., Detroit.
Shelton Metallic Filler Co., Derby Conn.
E. J. Woodison Co., Toronto.

Fillets, Leather & Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
E. J. Woodison Co., Toronto.

Fire Brick and Clay.
H. S. Carter & Co., Toronto.
Elk Fire Brick Co., Hamilton, Ont.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Fire Sand.
Webster & Sons, Limited, Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Guelph Pattern Works, Guelph, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., West Allis, Wis.
E. J. Woodison Co., Toronto.

Foundry Coke.
Baird & West, Detroit.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Webster & Sons, Limited, Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Machy. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
Sterling Wheelbarrow Co., West Allis, Wis.
Whiting Foundry Equipment Co., Harvey, Ill.
E. J. Woodison Co., Toronto.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, Frederic B., Detroit.
E. J. Woodison Co., Toronto.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
J. S. McCormick Co., Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
E. J. Woodison Co., Toronto.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

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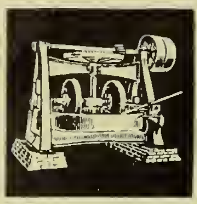
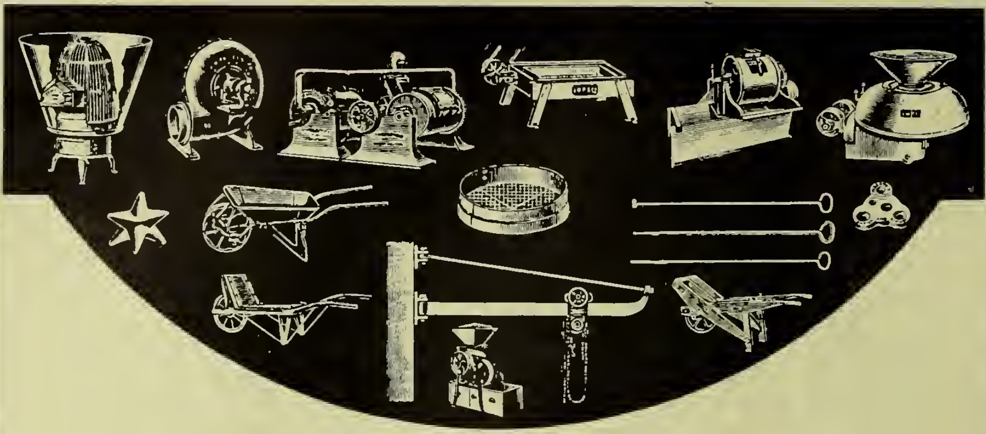
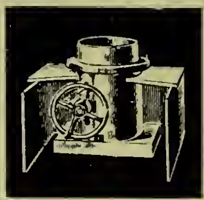

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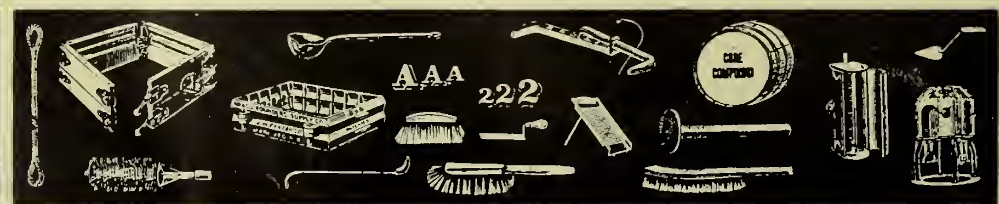


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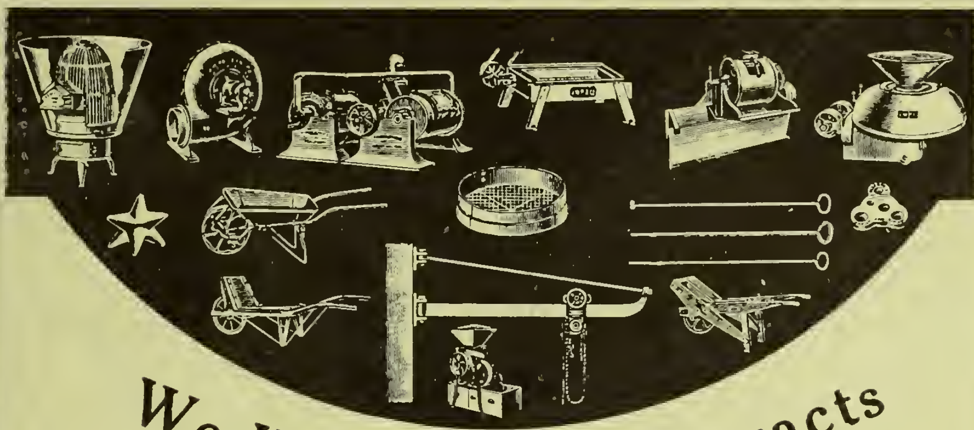

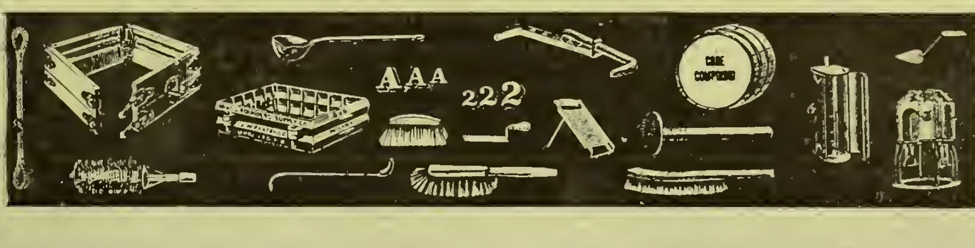

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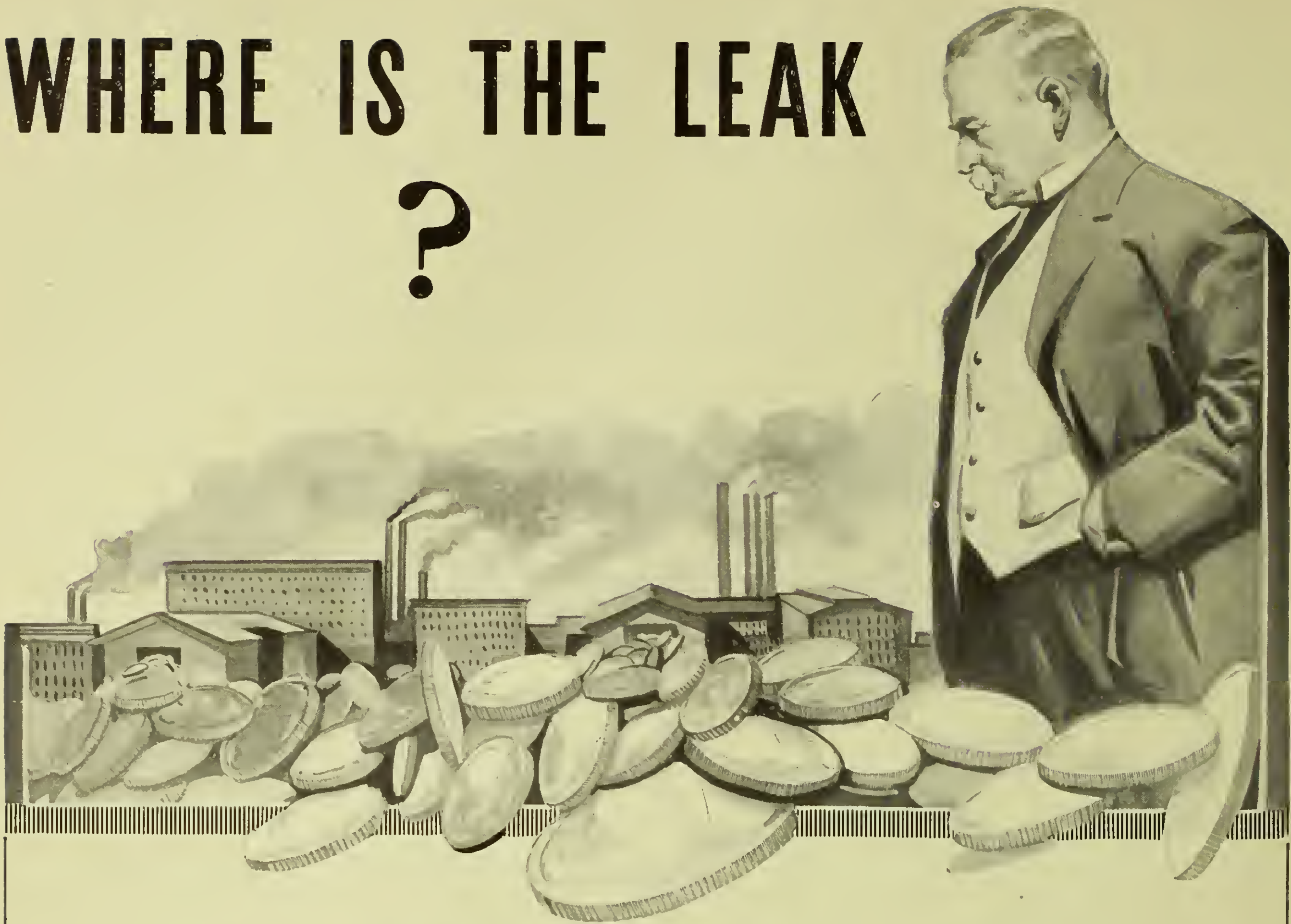

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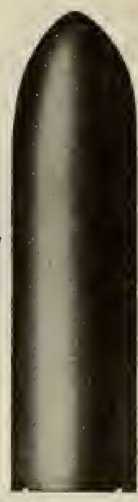

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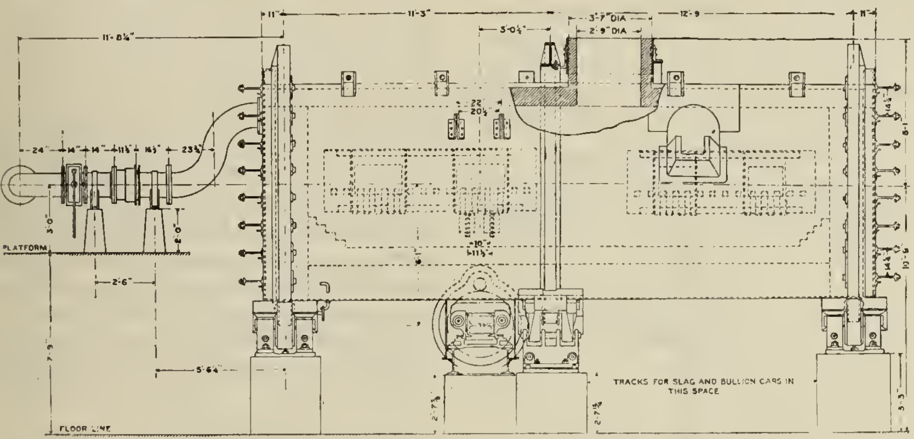
Development of Our Nickel-Copper Smelting Industry

By A. W. G. Wilson *

The accompanying article is the third of a monthly series descriptive of Canadian nickel-copper smelting plants. The European War has brought this particular industry very much into the limelight, on which account information relative thereto is of more than ordinary interest and moment. Section 3 of this description of the Mond Nickel Co. organization will deal with the Company's refining plant in Wales. Data and cuts are by courtesy of the Canadian Department of Mines and represent conditions existent in the fall of 1913.

MOND NICKEL CO.—II.

A CONTINUATION of the description of the smelting plant at Coniston, Ont., in its various features, and a description of the Wabagishik hydro-electric power plant, also the property of the company, are the substance of this second and concluding article on the Mond Nickel organization in so far as its Canadian operations are concerned.



BASIC COPPER CONVERTER, PEIRCE-SMITH TYPE, MOND NICKEL CO. VERTICAL LONGITUDINAL SECTION (A.C. CO.).

The main flue is provided with 27 hoppers, placed at 7.5 ft. centres, in sets of two, between the main bents of the supporting structural steel work. There are also four large hoppers placed between the main flue and the brick dust chamber. The bottom of the dust chamber is fitted with 6 rows of steel hoppers, 9 to a row, the distance from centre to centre being 56 in.; each hopper is provided with a circular discharge gate 13 in. in diameter, closed by a lever-operated slide. The hopper chutes beneath the dust chamber deliver to a common space so arranged that the flue dust can be run into a V-shaped auxiliary hopper of sheet steel hanging above a standard gauge track in the slag cut. Six chutes deliver from this hopper to a car placed beneath.

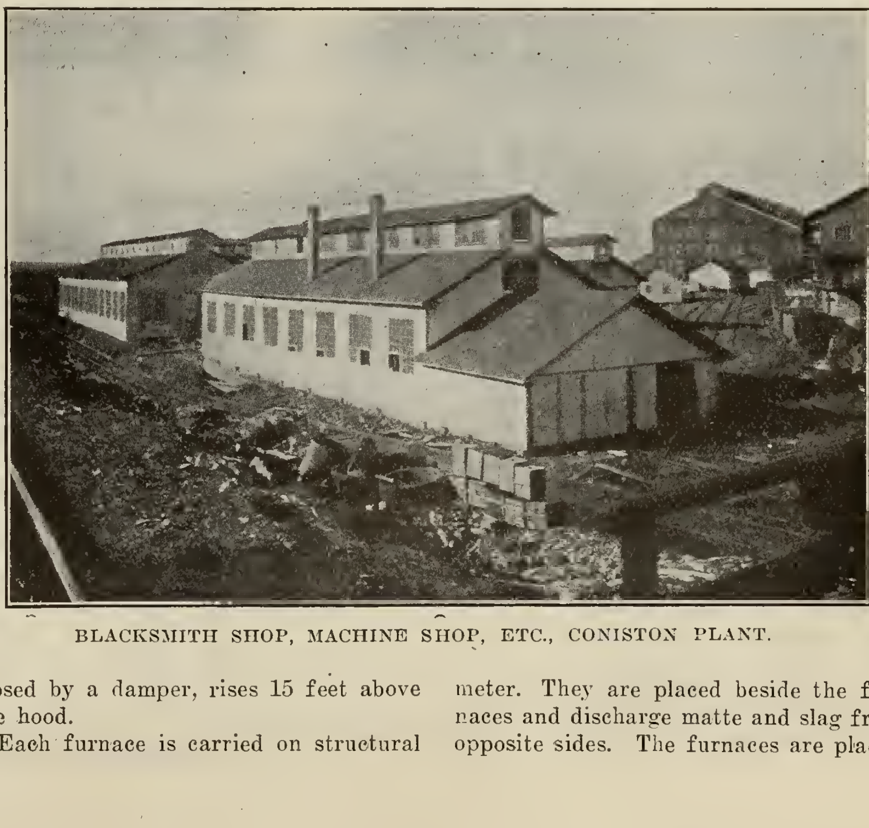
Blowing Equipment. — In the power building are three Connersville blowers and two Nordbergs. The blowers at the Victoria Mines plant were transferred to the new plant and one new Connersville and one Nordberg were added.

Blast Furnaces.—There are two Allis-Chalmers rectangular water-jacketed copper blast furnaces, 50 in. x 240 in., each furnace being provided with a brick-lined steel crucible and a brick top above the single tier of jackets. The height of the furnace is 32 ft. 2½ in. to the base of the hood. The hood measures 12 ft. 6 in., giving a total height of 44 ft. 8½ in. A goose-neck, 7 ft. 6 in. in diameter, connects each furnace with the main flue, and a straight stack, closed by a damper, rises 15 feet above the hood.

Each furnace is carried on structural steel columns, the jackets being hung from I beams. The crucible rests on three rows of nine supporting columns each 5 feet in height. It consists of a rectangular steel frame about 6 feet in width, 21 ft. 9 in. in length, and 25 in. in depth, made of I beams; the sole plate is of cast-iron in four sections. This crucible box is lined with chrome brick around the sides, ends, and bottom, reducing the internal width to 4 ft. 2 in.

Above the crucible there is a single tier of water-jackets, eight on each side, each 8 ft. 2 in. in height. The width of the furnace is 4 ft. 2 in. at the tuyeres, and at the top of the water-jackets it is 5 ft. 9 in.

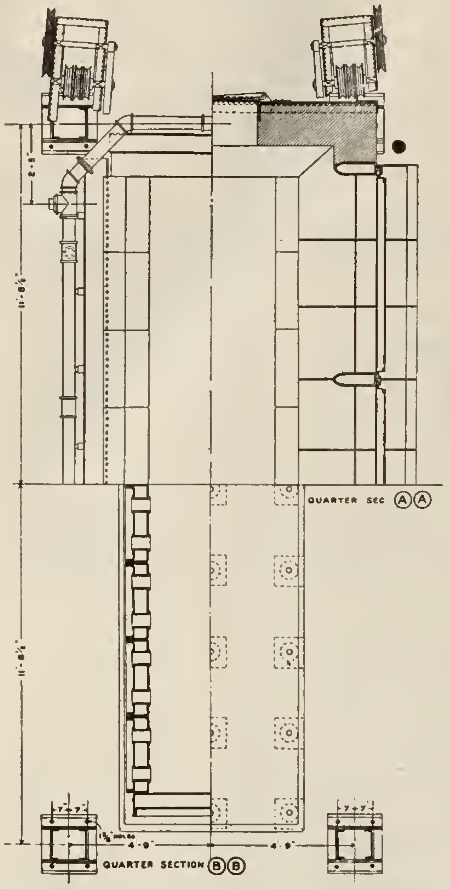
The throat of the furnace above the water-jackets is built of ordinary brick and lined with firebrick, forming a jacket 12 in. in thickness, the top being 3 ft. 7 in. below the charging floor. The space between the charging floor and the top of the brickwork is bridged by inclined apron plates. At the ends of the furnace the brickwork is carried to the top of the furnace, 8 feet above the charging floor. The charge doors along the sides of the furnace are operated by counter-weights. The settlers are about 15 feet in diameter. They are placed beside the furnaces and discharge matte and slag from opposite sides. The furnaces are placed



BLACKSMITH SHOP, MACHINE SHOP, ETC., CONISTON PLANT.

*Chief of Metal Mines Division, Ottawa.

parallel to the length of the building and may be charged from either side. Space has been provided for three, but only



COPPER BLAST FURNACE, 1912, MOND NICKEL CO. HORIZONTAL TRANSVERSE QUARTER SECTIONS (A. C. CO.).

two are being installed at the present time.

Converters.—The converters installed in the new plant are of the Pierce-Smith type of basic converter with shells 10 ft. in diameter, and 25 ft. 10 in. in length. Two have been installed in the building. The lining of each shell consists of 16 in. silica brick and 9 in. magnesite brick at the bottom, and 9 in. magnesite brick at the top. At the tuyeres, special 18-in. magnesite brick is employed. Each shell is provided with 30 tuyeres placed 14 on one side of the stack and 16 on the other, none coming directly below it.

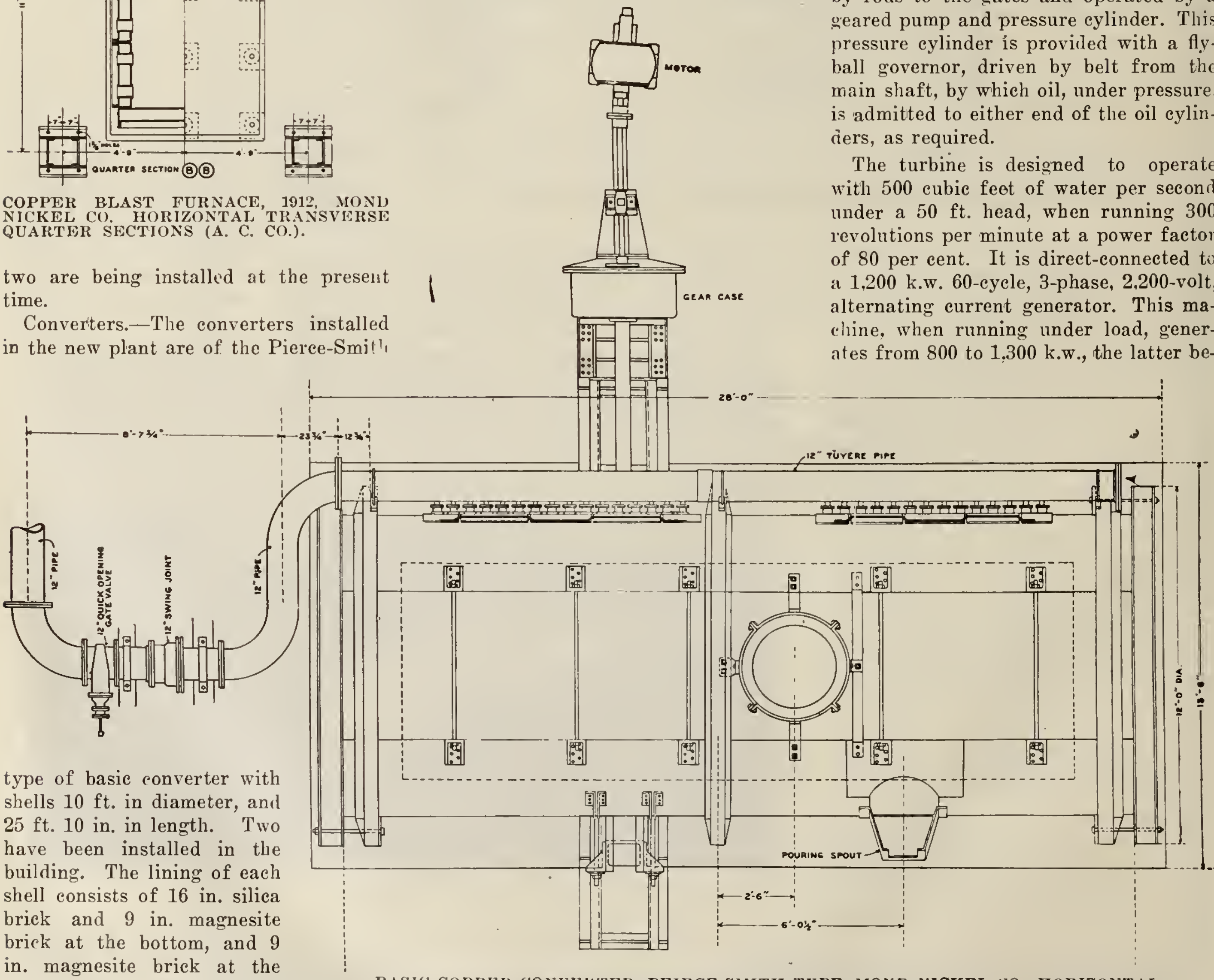
The blowing stack is 3 ft. 7 in. in diameter, but the lining reduces the free space to 2 ft. 9 in. It is placed near the median riding track, its centre being 11 ft. 2 in. from the end of the shell opposite the bustle pipe. The pouring spout is placed 7 ft. 7½ in. from the same end and about 77° of arc below the stack. The ends of the shell serve as annular tracks upon which it may be rotated, and a third riding track placed 7.5 in. to one side of the middle of the length of the shell has also been provided. The tracks rest on rollers carried on cast-iron bearing plates, bolted to a concrete foundation. The shells are turned by steel ropes pulled by a sliding gear operated by an electric motor and a worm screw, with an 8 ft. stroke. The converter floor is served by two 50-ton Whiting cranes.

Wabagishik Power Plant.

The hydro-electric plant belonging to the company is located at Wabagishik falls, on the Vermilion river about 8.5 miles from Victoria Mines station on the Canadian Pacific Railway. The power-house is a concrete block structure, 46 ft. x 90 ft., and is equipped with an overhead travelling crane of sufficient capacity to lift the heaviest single piece of the turbine unit. The steel pipe-line leading from the dam to the power house is 450 feet in length, and 8 feet in diameter.

The main turbine is of the horizontal twin type, with a pair of cast-iron runners secured to the main shaft, all enclosed in a steel housing arranged so that the water enters parallel to the shaft, and discharges into a common draft-chest. The top part of the housing is made in removable sections to facilitate quick inspection of all internal parts. The regulating gates consist of two sets of movable guide vanes, operated between two rings moved by short links, and regulating rings that are connected to the regulating shafts by rods and levers. The machine is governed by an hydraulic cylinder with piston connected by rods to the gates and operated by a geared pump and pressure cylinder. This pressure cylinder is provided with a flyball governor, driven by belt from the main shaft, by which oil, under pressure, is admitted to either end of the oil cylinders, as required.

The turbine is designed to operate with 500 cubic feet of water per second under a 50 ft. head, when running 300 revolutions per minute at a power factor of 80 per cent. It is direct-connected to a 1,200 k.w. 60-cycle, 3-phase, 2,200-volt, alternating current generator. This machine, when running under load, generates from 800 to 1,300 k.w., the latter be-



BASIC COPPER CONVERTER, PEIRCE-SMITH TYPE, MOND NICKEL CO. HORIZONTAL LONGITUDINAL SECTION. (A. C. CO.).

ing the peak load when the mine hoist is suddenly thrown into action.

The exciter unit consists of one single horizontal-shaft turbine, mounted in a cast-iron casing, with regulating gate made up of guide vanes pivoted on pins between two heads, and operated by means of a split regulating ring on the front head, connected by links to the governor. The generator is direct connected to the shaft, and is a 60-k.w., 120-volt machine. It is designed to operate on 27 cubic feet of water per second, at 50 ft. head, when running 875 r.p.m.

The switchboard apparatus at this power plant consists of one panel for control of the exciter, one panel for control of the generator, and one line panel provided with 16,500 volt lightning arrester and accessories. The generator voltage is 2,200, and this is stepped up to 16,500 volts for transmission over the power lines. The transformer equipment at the power house consists of one bank of transformers (three) of 800 k.w. capacity each. Power is transmitted over a line of No. 6 copper wire.

The smelter sub-station was equipped with three 350 k.w. oil-insulated, water-cooled transformers, which stepped the power down from 15,000 to 600 volts.

The Victoria mine sub-station is equipped with three 200 k.w. transformers, 15,000 to 600 volts.

NICKEL REFINING IN CANADA.

IN view of the fact that in another section of this issue there appears the second and concluding article on the Mond Nickel Co. plant at Coniston, Ont., and also that in next week's issue we will deal with the same concern's refining plant in Wales, the following extract from a contribution to the Toronto Globe will be found not only interesting but to some extent supplementary.

Much, says the author of the article, has been written of late on the nickel question, some of the statements made being fairly truthful, but a large proportion betraying either gross ignorance or a suspicious bias in favor of interested parties, yet it is doubtful if there is a conscientious metallurgist to-day that can advance any sound objection to the refining of nickel in Canada.

The Lack of Raw Materials.

The lack of some necessary raw materials has been cited as an insuperable obstacle, but what these are is a mystery. If salt cake or any sodium compound be one of them, has not Canada unlimited quantities of common salt within her territory, as well as factories turning out alkaline products of various kinds? The installation of a nickel-refining plant would be a powerful stimulant to other industries that produce the materials it requires and, if the excess of by-products be considered a serious matter, let us remember that Canada is growing and developing every day.

Within the next twelve months there may be a market for double and treble the output of some of our factories, for one new industry begets many others. Hydrochloric acid has been mentioned as a by-product hard to dispose of in this country, and it may be advisable to point out here that the Hybinette refining process for nickel requires this article in large quantities.

Does any reasonable person fear that such a profitable business as the production of nickel will collapse if an export duty is placed on the matte or ore? It is far more probable that Canada will see within six months of the date of the order the most intensive job of plant construction ever performed in this country. There need be no fear of a monopoly, and by insisting on the refining of our nickel within the Empire we shall escape from the pitfalls of contraband law, a harassing event in war times, and such serious and complete financial disaster as has lately befallen the other nations to control the markets of Australian zinc industry.

There is a strong and rapidly growing feeling prevailing throughout the Empire that we should no longer permit other nations to control the markets of products derived from the Empire's natural resources, and this is a matter that the next Imperial Conference should take cognizance of, formulating some plan that will be fair and satisfactory to all the Dominions and colonies. "Made-in-Canada" is a good cry, but "Empire-made" has a broader and more significant meaning, releasing us all as it will from the domination of the Guggenheims, Hirchs, Sondheimers and other foreign exploiters.

The writer himself has unlimited confidence in the future of Canada, with her almost illimitable prospects, and faith and co-operation are all we require to insure us that prominence in the commercial world to which we are justly entitled.

DISEASES OF METALS.

By R. Micks.

THAT certain metals are subject to disease under certain conditions may sound strange to the general run of people, but men who have spent most of their lives in their study will tell you that it is an actual fact that metals become tired and have fatal diseases.

Take the malleable foundry, for instance, in plants where light work is made. There is always an excess of sprues and other hard scrap, and this is melted over and over until it becomes tired or dead, and, therefore, impossible to run light castings with it.

Of course, there is a remedy for this trouble, as the addition of high silicon pig or ferro-silicon in the mixture will bring the metal back to almost its normal state.

There are, however, some metal diseases whose cause and cure science has not yet diagnosed. One of these diseases attacks tin or hard solder having a high percentage of tin in its composition. It is a special disease of cold weather and proves very destructive at about 54 degrees below zero, as parties who have visited the Arctic and Antarctic regions can abundantly testify. It is even more destructive at a still lower temperature. This disease was the cause of Capt. Scott losing part of his gasoline supply in his Antarctic expedition. It seems to affect tin only, slowly changing it into allotropic form as tin powder.

Another one of these freak diseases broke out in a French military store house among the helmets and other articles, which were made of an alloy of copper and aluminum. It first showed up as spots of a light grey color and spread very rapidly. Under the influence of this disease, the metals composing the alloy are changed in proportion to nature, forming a bronze of aluminum. Little holes afterwards appear, and in a short time the object affected falls into complete decay.

Men of science have devoted much time and study to these diseases, but so far have not been successful in either discovering the cause or remedy.

NICKEL SILVER.

SINCE the war began, states the Ironmonger, people interested in the electroplate trade have ceased to describe their base metal as "German silver," and have substituted for it the term "nickel silver." The change is not likely to cause inconvenience, because many of the makers, workmen and distributors of electro-plate have long used the latter term. The best quality of this metal for plating purposes at the present time is an admixture of 65 per cent. copper, 20 per cent. zinc, and 15 per cent. nickel. In his "History of Old Sheffield Plate," Frederick Bradbury states that the term "German silver" dates from the year 1830, when a Mr. Guitike, of Berlin, brought to Sheffield the first sample of this compound metal which was seen in that town.

A highbrow is a man who understands everything but the obvious; who can do everything but make a living.

* * *

There is a radical difference in business methods now and those of a decade ago. Business men do not always get all the credit due them.

THE ROMANCE OF COPPER.

IF there is one metal in the world upon which general attention is riveted it is—next, of course, to gold—copper. Its increasing necessity to industrial development and its comparatively restricted occurrence have long rendered it a metal which came peculiarly within the scope of the financial operator, and now, when the law of supply and demand was regulating itself on lines of economic stability, and copper was becoming less of a speculative medium and more of a prosaic commodity of ordinary commerce, there comes the war to emphasize at once its special utilities, and at the same time its unequal geographical distribution.

Copper in Early Weapons.

Time was when Britain ruled the world of copper as she rules the seas. The weapons and the armour which the ancient Greeks and Trojans used in their sanguinary combats were of copper, and as likely as not British copper at that. The Roman warrior or his craftsmen contemporaries knew a little more than Homer's heroes, for his sword was made of the alloy bronze, really a mixture of copper and tin, such as later was made into another type of death-dealing instrument and styled gun metal. The average Roman sword blade consisted of 91.4 per cent. of copper, and the remainder tin; while the English 8-pounder cannon in vogue before the wired steel gun came into existence contained 91.66 per cent. of copper and the balance tin. When man discovered how to work iron, copper had less "military significance," but it was again pressed into service as bronze or gun metal when the Chinese (or Roger Bacon) or some other benefactor of the human race found out the slaughtering properties of a certain explosive powder. In the meantime copper had been largely used for more peaceful purposes, and so it has been throughout the history of civilization.

Copper Smelting in Britain.

Copper is the metal which has been prominently identified with the arts of peace—and war. Somewhere round the year 1500, perhaps earlier, smelting works were established at Neath, and a hundred years or so later the smelting industry was firmly seated at Swansea. There were also smelting works in Staffordshire and Lancashire, but Swansea easily led the way, just as the Cornish mines did among the supply sources. At the commencement of the nineteenth century the output of refined copper from the Cornish mines was close upon 5,000 tons, Anglesea ores being responsible for another 2,000 tons. This 7,000 tons constituted 75 per cent. of the world's output, yet a hundred years later the same mines only produced the almost negligible quantity of 550 tons. In the interim the smelters of Swansea quite realized what the discoveries of easily procured copper abroad meant, and they imported vast quantities, so that from 1850 to 1860 the Associated Copper Smelters of Swansea enjoyed a monopoly.

Copper Smelting Abroad.

Such a condition of things, however, could not long continue. New sources of supply were rapidly being exploited. In 1830 Chile was sending large consignments of copper ore to South Wales, and in 1842, in order to achieve a more liberal profit than that allowed by the monopoly, the Chilians commenced to smelt for themselves, with the aid of expert workers from South Wales. The same year saw the Kapunda and Burra Burra mines opened, and in 1844 the copper resources of the Lake Superior area were exploited. In fact, copper was systematically searched for the world over, and side by side with this extensive development of the supply field there were new processes for the recovery of copper from waste ores, with the result that the refuse of earlier workings was made to yield a rich harvest, and mines which had long been shut down were reopened.

The Speculative Feature.

Naturally, the exploitation of new sources of supply and the failure of old have contributed not a little to foster the speculative spirit in copper trading. The Swansea smelters managed to ensure high prices in the 'fifties, and the Secretan Syndicate in 1887-9 aimed at absolute control of the copper supply, and actually controlled 85 per cent. of the world's output. Such a corner as this necessitated a huge expenditure, the Comptoir d'Escompte loaning the syndicate over six millions sterling. Copper went up from 11 cents to 18 in a month. Fortunately, there was one source of supply which the Syndicate had overlooked, and as prices rose arbitrarily consumers refused to buy and preferred to wait until the old copper and bronze, etc. collected from heterogeneous sources, was re-smelted. The quantity of copper forthcoming from this scrap was such that the Syndicate had to climb down. From over £100 per ton, copper had dropped to £70, and then it fell to £35 in a single day ; the corner collapsed ; and, of course, the Syndicate had to face financial ruin. Another effort at controlling the world's copper—that of the Amalgamated Copper Company, of the United States—was also unsuccessful.

World's Annual Supply

The world's annual supply of copper is now over one million tons, of which the United States produces over 600,000 tons. Mexico is responsible for about 75,000 tons ; Japan and Spain and Portugal produce about 60,000 tons; Australasia about 50,000 tons; Chile, 40,000 tons; Canada and Russia, about 35,000 tons; Peru, about 30,000 tons; and Tanganyika, whose deposits are said to be both rich and extensive, 20,000 tons. With the exception of Spain and Portugal the copper requirements of European countries have to be made up by importation. If there is an exception, it is Norway, whose mines produce about 12,000 tons. Italy produces 2,500 tons, and Austria about double that amount. Germany's output, however, is about 25,000 tons, which is probably one-eighth of the quantity she consumes. Austria's annual consumption in normal times is about 35,000 tons.

Requirements Arising From the War.

What the requirements of these countries are now it is impossible to say, but they must be enormously greater. No copper means no bronze, no brass, no gunmetal, and hence no material for the scores of purposes for which it is used in war material, whether ashore or afloat; and over and above this, no copper means a very serious restriction of the manufacture of electrical appliances for field telegraphs and field telephones, appliances for which copper is a prime necessity. Copper is thus to a great extent vital to a nation conducting a latter-day war, and hence the whole civilized world is interested in the question of whether or not Germany will be enabled to replenish her supplies. Of course, the position of the United States is quite intelligible. They are business people and they produce somewhere in the neighborhood of 60 per cent. of the world's output. They are desirous of doing business as usual, and perhaps naturally, do not wish to understand why, because two nations are at war, one should prevent the other receiving United States copper. In this connection it is certainly significant that, while Germany should receive 140 million pounds of copper from the United States, Holland, which is hardly a manufacturing country, should have received over 200 million pounds of American copper in the same year. The propinquity of Rotterdam to the Rhine instantly suggests itself, as also does the fact that Italy is neighbor to Austria. The copper trade of neutrals with easy access to Germany has increased enormously. The ultimate destination of their abnormal importations is obvious, and English statesmanship will be failing in its duty to civilization if it allows the common enemy of humanity to receive ad lib so prime a necessity to the prosecution of his unjust war.—Syren and Shipping.

FOUNDRY PRACTICE AND EQUIPMENT

Practical Articles for Canadian Foundrymen and Pattern Makers, and News of Foundrymen's and Allied Associations. Contributions Invited.

INCREASING THE OUTPUT OF YOUR FOUNDRY.*

By G. K. Hooper.**

LIKE every other manufacturing establishment, a foundry is a device for making money out of labor; therefore, in designing such a plant, every means should be embodied to enable the laborers, whether skilled or unskilled, to do the utmost useful work which they are reasonably able to perform, having in mind their bodily, mental and social necessities.

In the early beginnings of the foundry business, so little information was available concerning its fundamental sciences of metallurgy, practical geology and the hydrodynamics of molten metal that skill in an operative was largely a matter of intuition or genius. The trade, therefore, being built upon this, has not adapted itself as freely as possible to the sub-division of labor and use of mechanical appliances as have other trades, and the productiveness of the labor in it has not advanced rapidly. The processes, also, under this condition have a tendency to be wasteful in time and space.

In the foundry where no sub-division of labor is used, this productiveness averages, according to studies which I have made, from 50 to 60 per cent. With the sub-division of labor and the use of mechanical appliances and power, it rises to about 75 per cent. With well arranged machine tools in the machinist trade, we are advised that the productivity of the labor has risen as high as 80 per cent., and on some classes of work to a higher figure.

What Adam Smith Said.

As there are yet a number of foundry executives who believe that it is unwise, if not impossible, to use machinery and divide their labor, or in other words, to use what is known as the gang system, I would like to quote what Adam Smith, the first great expounder of economics, says about sub-division of labor in his work known as "The Wealth of Nations," written about 1755. He speaks as follows:—

The greatest improvement, in the productive powers of labor and the greater part of the skill, dexterity and judgment with which it is anywhere directed or applied seems to have been the effects of the division of labor. The great increase in the quantity of work which in consequence of the division of labor the same number of people are capable of performing, is owing to three different circumstances:—

First—The increase of dexterity in every particular workman.

Second—To the saving of time which is commonly lost in passing from one species of work to another.

Third — To the invention of a great number of machines which facilitate and abridge labor and enable one man to do the work of many.

It is the great multiplication of the production of all of the different arts in consequence of the division of labor which occasion in a well-governed society that universal opulence which extends itself to the lowest ranks of people. Every workman has a great quantity of his own work to dispose of beyond what he himself has occasion for, and every other workman being exactly in the same situation, he is enabled to exchange a great quantity, or, what comes to the quantity of his own goods for a great same thing, for the price of a great quantity of theirs. He supplies them abundantly with what they have occasion for and they accommodate him as amply with what he has occasion for, and a general plenty diffuses itself through all the different ranks of society.

This sounds something like a treatise on the evils of restricting output. Mr. Smith gives also some statistics concerning results of sub-division in the pin and nail-making industries, generally as follows:—With pins, one man by hand could make but about 20 per day, or 10 men could make 200 per day; whereas, by sub-division of the 18 different operations and with indifferent machinery, 10 men do make about 48,000 per day. With nails, he reports:—

A blacksmith who has been accustomed to make nails can seldom, with his utmost diligence, make over 800 to 1,000 nails per day. I have seen several boys under 20 years of age who had never exercised any other trade but that of making nails, and who when they exerted themselves could make, each of them, upwards of 2,300 nails per day, the same person blowing the bellows, stirring and minding the fire, heating the iron and forging every part of the nail, being also obliged to change his tools in forging the head.

We might conjecture from the foregoing that there were scientific management and efficiency experts, even as early as 1750, and that achievement in the efficiency profession has fallen off since that time as no such percentages of improvement as the above figures entail, are offered us to-day. With the better technical understanding which now exists concerning the underlying sciences of the foundry trade, there is more and more application of engineering talent to the investigation of the problems which arise. It is also as much a matter of engineering to find out what the human machine can be reasonably expected to perform as it is to properly judge the fitness of any mechanical device for foundry operation.

In foundry design, quite as much as in any other occupation, the quantity, quality and form of the product establish the limits within which a design must be contained in order to reach that most desirable situation, the providing for improvement of plant and equipment and the obtaining of substantial net profits.

Application of Labor to Product.

The application of labor to the product is the next consideration. If skilled labor is necessary, means must be used to apply the skill only to those operations in which it is needed, sub-division of labor and the use of mechanical appliances and power being embodied wherever this can be profitably done.

In the molding and casting operations, a considerable number of foundries to-day do sub-divide the labor on their product and employ separate labor gangs for pouring, shifting and shaking-out, sand-handling and core-setting. Some objection is made to this practice, but, as you have heard, it is sound economics to sub-divide the labor, when the amount of product warrants it and an increase of skill may reasonably be expected to result, giving an increased production with corresponding reduction of cost. Some confusion may arise at the commencement of such a method of operation, but this can be minimized by using the most skillful and intelligent operatives as gang bosses.

*Presented at a meeting of the Newark, N.J., Foundrymen's Association.

**Of the Hooper-Falkenau Engineering Co., New York.

To do away with the laborious part of lifting and transporting materials, there is the industrial railway with or without locomotive, the overhead monorail trolley track, either with or without power-driven traveling hoist, the air hoist, the jib crane, traveling wall crane and overhead crane which covers nearly the entire floor area. Combinations of these are frequently used.

Molding Machines.

For molding, molding machines of one kind or another, from the simple hand squeezer and the pneumatic hand rammer to the more elaborate power-ramming, pattern-drawing, rock-over type are available, each well adapted to some particular purpose. The molding machine is employed to advantage on a great variety of product and more and more uses are found for it every day. You are, however, familar with mistakes which have been made in the wrongful selection of molding machinery for any given work resulting in confusion as to the merits of such devices, and in loss. The general proposition still exists, however, that molding machinery properly adaptable to the work will increase profitably the productiveness of the laborer.

Metal Pouring.

Arrangements are made for improving the productivity of the pouring operations by bringing large quantities of hot metal to the work in bull ladles; by taking the molds to the melted metal, at or near the cupola; by trucks running on the floor; by cars on industrial tracks pushed by steam or electric locomotives, and by conveyors on which the molds are weighted or clamped, sometimes jacketed; poured while in motion; cooled and removed at the proper time and with flasks, bottom boards, weights, etc., returned to the molding stations while the sand and castings go elsewhere for suitable attention. There also are special forms of ladles, such as the multi-lip, which add to the productiveness of the labor.

Metal Melting.

In melting equipment, there is available for the cupola the tilting or rocking spout and the charging machine; for the reverberatory furnace in malleable work, the overhead traveler for lifting bungs and handling the fresh charge in dumping trays or skips; for the open hearth steel furnace, the charging machine and gas producer. To these two latter types of furnace, a number of attempts are being made to attach the mechanical stoker and to utilize also the direct burning of coal in powdered form. For non-ferrous metals, there is the tilting furnace.

Sand and Castings Handling.

In sand-handling, a number of devices are successfully used from the simple sand-cutting machine operating on the sand heap on the foundry floor to the complete apparatus which takes shaken-out sand, cools, cleans and tempers it, mixes it with the proper proportion of new sand and delivers it again to the mold maker.

In shaking out and handling castings, sprues, etc., mechanical appliances also have been developed from the simple grating on which molds are dumped to the complete conveyer which carries the shaken-out sand and castings to shaking gratings on which they are separated and from which they are discharged into some suitable arrangement for cooling, the sprues and runners having been disposed of at the proper time. The cranes, travelers and industrial tracks, previously mentioned, also are available for this work, it being a matter for study in each case whether it is more economical to move the iron to the molds by hand or mechanical means, or vice versa.

When quantities are large and the product such that a few sizes of molds may be standardized, even though of considerable difference in size, there will be combined all of these devices, such as the molding machine, sand-handling system, mold conveyor and shaking-out conveyor, all of the operations being conducted uninterruptedly throughout the entire working day. Attempts have been made to operate such plants by means of two or three shifts throughout the whole 24 hours. The success of this development so far is doubtful. You will recognize that such 24-hour operation could not, in any way, increase the relative productivity of the labor.

Cleaning Castings.

In cleaning, progress has been made from the hammer and chisel, steel brush and emery wheel to the power chipper, metal saw, sprue cutter, exhaust tumbler and sand blast machine. Long tumbling mills have been attempted a number of times in which the castings to be cleaned were fed in at one end and discharged fully cleaned at the other. These present attractive possibilities when material is fairly uniform in size and shape, and is not hollow, deeply cored, recessed or of considerable variation in size.

For these latter conditions, it has been found that while certain sizes in the charge may be satisfactorily cleaned in this way, the whole contents will not be as satisfactorily cleaned, so that on the whole, these devices have been a success only where the work is uniform in size and simple in nature. The exhaust tumbling mill and the sand blast machines, such as the revolving and traveling table machines and the sand blast barrel each are in satisfactory operation to increase the productiveness of labor in cleaning operations. Mechanical appliances embodying grinding wheels are available, increasing the effectiveness in removing roughness. They also are used to roughly-dimension such pieces as can be finished in this way.

Acid Cleaning.

When large quantities of castings are made, which on account of being machined require careful cleaning to save time and tools, pickling plants, embodying mechanical handling, are designed in which the castings are handled on pans, acid poured upon them by ladles or from a hose connected with a reservoir to which the acid is again pumped after draining. The castings then are delivered to a washing floor where they are washed while still on the tray by streams of water under considerable pressure, after which they are dried and sorted. This means has given economical results for castings which are required to be very clean.

In the core department, various problems present themselves calling for the application of sub-division of labor and of mechanical devices. There are sand driers, mixers for properly amalgamating the necessary materials, ramming machines of various types, cutting - off and pointing machinery, handling devices for saving steps for the coremakers and ovens, more or less elaborate, for making the best use of time, labor and fuel.

A raw material yard also is a problem for engineering thought. There we have lifting and carrying machinery in the shape of locomotive and overhead cranes and industrial cars, together with scrap and pig breakers. There is also the sprue breaker which simplifies considerably the handling of this awkward and bulky material. Elevators to the charging floor usually come under the head of yard machinery, and here we have also the slag barrel and water barrel for preventing waste of material.

Attention is now being given to the saving of sand by rebonding processes in order to economize in raw material and in the disposal of waste, as in sand the binding material is but a small proportion of the entire mass and injury to this binding element which prevents its further usefulness results in the loss of disproportionately large quantities of the refractory portion of the mass.

The Foundry Building.

The building which is to house the proper arrangement of apparatus is also a subject for engineering thought. The first consideration, of course, is that the full possibilities of the arrangement of the apparatus and operations shall be developed. Care should be executed to prevent the manufacture of anything that might be an obstacle to the development of any particular function, that is, the building should be of such type of construction that changes in its form, openings, etc., may readily be made. The march of improvement is so rapid in this country that it is impossible to predict how often the manner of turning out products will be changed. The building, therefore, must be adaptable.

Two Storey Foundry.

I personally prefer brick and steel construction to any other and have had no reason to alter this opinion after considerable experience in building this type of manufacturing plant. Where much machinery is used, especially conveying machinery, it often develops that instead of using sub-grade construction, an advantage, both in first cost and operation, is gained by making the building of more than one storey. This has led to the so-called two-storey foundry, which is in successful use where the quantity of production is great and the use of machinery extensive. Co-existent with the foregoing considerations are those of proper lighting, ventilation, heating, etc., that the human machine may operate in freedom from mental or bodily discomfort, thus securing the utmost which it is reasonable to expect from human endurance. The construction itself calls for careful study that wear and tear from usage and the elements shall be properly attained without too great a first cost.

Among the elements to which the structure is most subject to attack is fire; principally from the inside on account of the nature of the occupation and somewhat from the outside, by reason of the proximity of other structures. There are available the sprinkler, the metal window sash, wire glass and the tile roof to minimize this source of loss. They are big dividend payers to the foundryman.

Permanent Molds.

A considerable economy is to be attained in operation in the present state of the foundry business by the use of the well-recognized principles of subdivision and application of machinery and power. From a 50 per cent. productivity in the case of labor not subdivided and little or no machinery, to 75 per cent. to be attained where these principles are most fully applied, represents a saving of 50 per cent.

A productivity of 75 per cent. is, in my belief, about the limit that can be reached in the foundry art with such operations as are necessary at this time. There may be, of course, individual instances which will exceed this, but the figure refers to the average. It may be that we shall find in the permanent mold a method which will considerably increase the relative productivity of the labor. Time studies on repetition work to which the permanent mold would be applicable, show that there is many times as much labor consumed in making the present mold by present methods as is used in pouring and shaking-out, while the material handled in the making of molds is frequently ten-fold or more the weight of the castings produced. Also, there are several pieces of equipment to be handled to one casting or gate of castings. If the permanent mold could be developed these ratios would be cut down and less material as well as fewer parts would be handled. Of the 50 per cent. increase in productivity of the man, at present available, however, you can all secure a part. Some sub-division of labor and some mechanical apparatus is applicable to part or a whole of the operations in the jobbing shop and in the shop which handles a considerable range of standard work.

A mechanical engineer and manufacturer of world-wide reputation has said that "the achievement of a result regardless of cost, is not engineering." Having this in mind, it is essential to carefully study all conditions. In arriving at a practical conclusion as to the installation of machinery and the subdivision of labor, the cost of installation and operation and the possible increase of product must be considered as well as the increase of productiveness of labor.

We have been called upon to examine cases where unintelligent application of mechanical devices materially diminished the productiveness of the labor in addition to entailing heavy expense in installation and operation. On the other hand, the highest productivity and hence, greatest economy in production have been obtained where the apparatus and sub-division of labor have been most intelligently employed.

PIPE PATTERNS AND CASTINGS.

By A. Midgley.

THE accompanying article formed the subject of a lecture recently before the Halifax Branch of the British Foundrymen's Association. Patterns and castings were discussed relative to straight pipes, standard tees, elbows and specials.

Straight Pipes.

For a few years there was in use at the foundry at which the author was employed a range of wood models varying from 4 in. in diameter to 24 in. diameter. The patterns up to 9 in. diameter were made in two solid halves jointed and dowelled. The flanges were made to fit the diameter of the prints, this being better than recessing them into the print when the pipes were subject to constant alteration. The prints were 6 in. long, and in those sizes of pipes which were most in use, several lengths were made, 9 ft., 6 ft., 3 ft., 2 ft., 12 in. and 6 in. Thus it was possible to avoid extra long boxes for short pipes and also to make a great many pipes of the same diameter, but varying in length, on the same day.

Above 9 in. diameter the pipe patterns were lagged up on bearers or circular blocks, these blocks in most cases being gussetted on one side in preference to crossing the grain at right angles as believed to be the usual practice. By this method, the diameter of the pattern remained more correct and for a longer period than by crossing the grain. Care should be taken to have the gussets at least as thick as the timber used for the bearers. These patterns served their purpose for a number of years, but as the number of pipes required increased, it was decided to lay down a range of iron models from 4 in. to 9 in. diameter inclusive, with suitable boxes, and these proved a decided advantage.

The iron models were made in 9-ft. lengths with due allowance for contraction and machining. They were turned up to correct diameters all over, flanges included. The flanges were recessed into the pipe at each end 1/4 in. below the diameter of the print, this ensuring that they sat perfectly true on the pipe without being fastened. The prints were respectively 9 and 12 in. long, the longest coming well out of the end of the box and having 1 1/2-in. diameter hole drilled through, this hole enabling the moulder to insert a bar and give the pipe a slight turn before removing the top part, thus breaking any adhesion that might exist between the pattern and the sand and giving a perfectly clean and satisfactory mould.

Where square or rectangular flanges had to be used they were provided with a centre dowel and suitable hole in the recess of the pipe to ensure that each flange would be square with the other, also all flanges were provided with a fillet, as the absence of these would sometimes cause the flange to draw away from the body of the pipe. Fillets should never be made so big as to interfere with bolt heads.

Standard Tees and Elbows

These were used in great variety. They were all wood models with half coreboxes, and it had been found that very seldom was more than half needed, especially when the elbow or tee was set equal either way. These were made in the usual way, and scarcely required describing.

Specials.

Great numbers of these were made, spring bends, S-shaped bends., Y-shaped bends and almost every shape of pipe known to the trade. A series of large pipes including taper pipes and elbows tapering from 39 in. to 36 in., some with flanges at both ends and some with one flange and bell-shaped at the other end had just been finished at the author's foundry.

In handling these pipes, the same method was followed as adopted with template pipes. Formerly when a template pipe order was received from the drawing office, although all the information possible was given, there was much left in doubt. A template pipe was a pipe which had to fit between two existing pipes, and if the angles of the flanges were not correct, when being put into its final position on the job a great amount of work was caused.

On receiving the template, the practice formerly was to try and place it in a position of a level board approximating to the position it would finally occupy. When put into its place on the job for which it was intended that was not always easy, as sometimes very difficult angles had to be obtained. Although generally successful in this part, it was still necessary to transfer those angles and measurements to the loam patterns, a proceeding which was found to be decidedly awkward. A loam pattern was not the best material on which to fasten flanges that needed to be accurate, and although a great amount of thought and ingenuity was devoted to the matter only indifferent success was attained, for however accurately the flanges might be placed on the loam pattern there was always the danger of these being disturbed before they were finally rammed up in the mould. The present method of dealing with template pipes was:

Improved Method Adopted.

The total length of the template was measured to decide the amount of contraction required, and any special features were noted. Next half-circular pieces were prepared to fix on each flange, these pieces being made thick enough to provide for contraction and a definite amount of machining in the total length of the pipe. To these were affixed half-circular prints made to the size of the box of the pipe. In fixing these to the template, care had to be taken to see that they were parallel on the joint, as by so doing a perfectly true joint was ensured.

The next procedure was to make a core-plate to follow the contour of the pipe, from which plates were cast and from which the coremaker struck up the loam core, afterwards striking the required thickness of loam on to make it the size required for the pattern. Two strickles were prepared, one for the core and one for striking on the thickness of loam for the metal.

Assuming that the core and pattern were ready the moulder bedded the template into the floor in the ordinary way, rammed up to the joint of the flanges, and there made a joint half-way (round the flanges only). Two stakes or files were then driven into the sand against the outside face of the flanges, these being allowed to project against the joint in order to ensure the top half of the flange following the same angle as the bottom half.

The template was then drawn out of the sand and two half-flanges were dropped into the impressions left by the template. The loam pattern was placed between the two flanges, the top halves of the latter being placed on the top of the pattern and rammed up in the ordinary way. When the pattern was liberated by the moulder, the extra thickness allowed for metal was taken off, leaving the core, which was now dressed off ready to go back into the mould. This method was found to be more sure and much easier than any other they had tried.

AMERICAN FOUNDRYMEN'S ASSOCIATION CONVENTION.

THE annual meeting of the American Foundrymen's Association will be held at Atlantic City during the week of Sept. 27, with headquarters at the Marlborough-Blenheim hotel, business and technical sessions being conducted on Young's steel pier, almost directly opposite the Marlborough-Blenheim. The exhibit of foundry equipment and supplies under the auspices of the Foundry and Machine Exhibition Co., will be held on the steel pier, and will open on Saturday, Sept. 25. A tentative program of the convention has been adopted as follows:

Monday, Sept. 27.

Registration at headquarters, Young's steel pier.

Tuesday, Sept. 28.

10 a.m. — Opening session, joint meeting between the American Foundrymen's Association and the American Institute of Metals.

2 p.m.—Operating session.

Wednesday, Sept. 29.

10 a.m.—Joint General session between the American Foundrymen's Association and the American Institute of Metals.

2 p.m.—Gray iron session.

8 p.m.—Business session, annual address by president, election of officers.

Thursday, Sept. 30.

10 a.m.—Simultaneous sessions on steel and malleable iron.

2 p.m.—Simultaneous sessions on steel and malleable iron.

7 p.m.—Annual banquet.

Friday, Oct. 1.

10 a.m.—Final business session.

It will be noted that this tentative program provides for two sessions for the discussion of cast steel and two meetings will be devoted to malleable iron. At the last meeting in Chicago, insufficient time was allotted for the discussion of the many valuable papers presented, and to enable those who are interested in these topics to discuss the papers at length, two sessions will be devoted to steel and malleable work. The change in the session at which officers are elected was effected for the purpose of giving the new officers an opportunity to meet prior to the close of the convention for the purpose of outlining the ensuing year's work.

The committee on papers is actively at work and members desiring special topics discussed should send suggestions either to the secretary, A. O. Backert, Cleveland, Ohio, or to Harry B. Swan, chairman of the papers committee, Cadillac Motor Car Co., Detroit. The various committees appointed at the last annual meeting are also at work, and many interesting and valuable reports will be presented.

Dominion Steel Output.—The output of the Dominion Steel Corporation has been going largely to Great Britain recently, and there the company has meantime a satisfactory outlet for its product if shipping facilities can be assured. A fair improvement in pig iron, wire rods, bars, and wire products is shown in the output for March. The production in tons, is reported as follows:

	1915.	1914.
Pig iron	23,669	22,619
Steel Ingots	25,807	28,352
Rails	6,102	18,359
Wire rods	4,543	2,981
Bars	316	....
Wire and wire products	3,359	2,246
Shipments	20,086	16,813

The coal output was 364,542 tons in 1915, compared with 391,887 tons last year.

Immunity from fires depends upon either prevention or extinguishing. Prevention is the real remedy; extinguishing, the emergency resort. Fire prevention is as available for the small plant as for the large one; it is only in extinguishing that the small plant is handicapped, prevention consists of equal parts—cleanliness and care, well mixed.

Case and Surface Hardening by the Oxy-Acetylene Process

By C. Royer *

The oxy-acetylene process of rapid heating of machine parts for various purposes is being very generally adopted, not only on account of its wide range of usefulness, but because of the simplicity and portability of the apparatus required and the decreasing cost of the gases used. The two newer applications herein described represent an important development.

WHILE the oxy-acetylene flame has come to be an almost indispensable adjunct of the repair shop, where it lends itself equally well to welding broken parts, building up worn parts, cutting metals, melting lead out of pipe joints, taking apart of shrink fits and many other uses, its application to manufacturing has been somewhat slower though none the less certain and far-reaching. The oxy-acetylene blow pipe furnishes a highly concentrated and very intense source of heat which permits local heating in such good conductors of heat as copper and aluminum, these metals now being successfully welded by this process.

Local Hardening.

The local hardening of tool steel, particularly the high speed varieties, and the case hardening of mild steels opens up a comparatively new sphere for the employment of the oxy-acetylene blowpipe which, as the methods become better known, bids fair to become very important. The most aggressive experimenters in this line are perhaps the French Association of Autogenous Welding whose tests have proved conclusively that the blow-pipe can be used with advantage for case hardening.

It is unlikely that this process will replace, to any extent, that, at present in use but case hardening will now be available to many classes of work heretofore decidedly out of its range of application.. Large pieces requiring but a small hardened area can be successfully treated by heating scarcely more than the surface to be hardened and the consequent expense, warping, and other difficulties incurred by heating the large mass in a coke fire or furnace is obviated. Also, parts already assembled in machines whose removal would entail taking down a large part of the mechanism, can be hardened in place without danger to other parts, the process being so rapid that the heating is purely local and has little time to be transmitted to other parts of the work.

Orthodox Case Hardening.

Case hardening, as is ordinarily practised, consists of carburizing the outside shell of a mill steel casting or forging, thus transforming the outside skin to a high carbon steel which hardens easily upon being quenched. This result is obtained by heating the steel and keeping it, for a certain time, in contact with red hot charcoal or other carburizing substance. The metal absorbs more or less carbon, which absorption is much more rapid if the steel already has some carbon in its composition. Some elements such as nickel and manganese also facilitate the absorption of carbon while, on the contrary, certain impurities such as slag retard the penetration of the hardening substance. For this reason, where good or deep hardening is desired, only the best and purest qualities of steel should be used. About one-half of one per cent. of nickel also gives excellent results.

The rapidity of the process and the depth of penetration depend upon the temperature, and the quality of the case hardening is shown by the depth of the hardened surface. Also, as the percentage of carbon varies from the outside to inside of the surface layer, it is also necessary to take into account the maximum and medium percentages throughout. Case hardening well done should affect a sufficient thickness of the metal treated, and the amount of carbon should decrease gradually from the outside to the inside and should not consist of a film of hard metal without a gradual transition to the condition of the original metal.

The Surface Feature.

When the process is carried out in a closed vessel by means of animal charcoal, carbonate of baryum, cyanide or other organic matter, a very hard and resisting surface is obtained which will not split or shell off because by this method, the decrease of hardness from the surface inward is very gradual and regular. On the other hand, a surface produced by rubbing on the red hot metal, a powder, generally containing ferro cyanide of potassium, gives a very hard thin skin which is liable to flake away during hardening or in service.

The use of the blow-pipe permits the obtaining of either of the above results at the will of the operator by means of suitable handling of the instrument. By using a well-regulated flame to heat the steel and afterwards giving a slight excess of acetylene, one can obtain quick, deep case hardening but it is essential that the inside tip of the flame be kept at a distance of at least one inch from the surface being treated. Being so regulated, the flame contains an excess of free carbon which is very easily absorbed by the metal which is being kept hot by the flame. Again, by keeping the inside tip of the flame too near the part to be heated, a very hard and thin layer of high carbon steel is obtained which is liable to flake **away**.

Blow Pipe Results.

The following results have been obtained by experiment but, in all cases, care was taken to keep the piece, while being treated, at a cherry-red heat. By the white, inside cone of the flame being kept for two minutes at a distance of five-eighths of an inch from the surface of a piece of open hearth steel, a hardened layer was obtained 0.0197 inch thick and the surface of the metal gave, upon analysis, 2 per cent. of carbon. This is approximately the same condition as is obtained by the use of a chemical powder.

By maintaining the inside flame of the blow-pipe with an excess of acetylene, at a distance of 1¼ inches from the surface of the same metal for a period of 10 minutes, the depth affected was found to be 0.1181 inch and the maximum percentage of carbon, that in the outside surface, was not more than 0.85. From this it is evident that, to obtain a deep and evenly graduated treatment, care should be taken to hold the flame far enough from the surface being treated. Otherwise the surface is liable to be transformed into a kind of white cast iron, which is very hard and brittle, and is liable to flake off in the hardening process. It is, therefore, evident that any desired degree of hardness or toughness can be obtained in case-hardening by the oxy-acetylene process by varying the distance at which the flame is kept from the work and the time during which the surface is exposed to the carbonizing flame.

Tool Steel Surface Hardening.

The use of the blow pipe for case-hardening mild steel should not be confused with its application to the surface or local hardening of high carbon and high-speed steel. In the former case the heat of blow pipe is used to maintain the metal treated at a high temperature,

*Manager, L'Air Liquide Society, Montreal.

while, at the same time, the purposely-produced excess of carbon in the flame changes the chemical composition of the steel. In the latter application only the rapid heating power of the flame is utilized as a convenient method of heating a small portion of the surface of a piece of steel, while the rest of the metal is being kept cool by running water or other method.

Surface hardening has received a great deal of attention in England at the works of Messrs. Vickers & Maxim, and has proved to be a cheap and rapid method for the treatment of the wearing surfaces of steel parts. It is applicable to the hardening of the surface of gear teeth, cast steel shafts and boxes, templet holes, and, in general, to the hardening of any small areas upon the surface of large articles, especially in cases where the ordinary process of heating and hardening would cause distortion that would be difficult to remove by subsequent grinding. The lack of warping forms one of the chief advantages of the process. The metal is only heated to slight depth; the surface is cooled as fast as heated, and a very small area is in the heated condition at a single time.

The work to be hardened locally is placed in a tank of water, so that, if possible, the water covers all except the small surface being operated upon. If this is not convenient, it is often quite possible to arrange a stream of water from a hose so as to keep running water on the surfaces which it is desired to keep cool. The flame used should be powerful, and should be held close to the part to be hardened. The flame is directed so that the outer portion flows in the direction along which the blow pipe is being moved. The cooling water is made to follow as closely as possible without interfering with the flame and thus prevent heating.

Speed of Heating.

Special care should be given to the speed of heating and movement of the burner. As the flame passes along, it quickly heats up the surface, which is instantly cooled by the water or by the cold surrounding body of metal, leaving it at the maximum hardness to be obtained with that material. To secure a thin but intensely hard surface, the part to be treated should be barely covered by the water, and the force of the flame should blow the film of water away from the part being heated. This is done by increasing the oxygen pressure.

The normal treatment gives a hard surface about 1-16 inch deep, but greater depth can be obtained by prolonging the heating without burning or oxidizing the surface. This is easily accomplished by moving the flame slightly but rapidly back and forth over the part so that a larger area is heated at once. Experience has shown that no matter how thin or how hard the surface layer produced, it shows no tendency to flake off from the body of the piece.

The process is carried out with the ordinary oxy-acetylene welding outfit fitted with different sizes of blow pipes, care being taken not to employ an oxidizing flame. It is claimed that even cast iron and some kinds of malleable iron can be greatly improved in the degree of surface hardness by being subjected to the same treatment.

The number of uses to which the great heat of the oxy-acetylene flames can be put has grown more rapidly perhaps than the similar development of any other apparatus. The two particular applications above described will, no doubt, open up large fields within themselves and the oxy-acetylene welding apparatus will become more and more an essential part of the modern manufacturing institution, where it will enjoy the same prominence it has held for some time past in the repair plant.

THE MOULDING MACHINE.

By M. O. S.

WHEN the moulding machine was first put on the market, it was regarded as a hugh joke by the moulder, and although up-to-date foundry men admitted that it was an artistic piece of machinery, there were very few who considered it practical. As time went by, however, and the moulding machine continued to gain ground and become more perfect in its output,, some of the more wide-awake foundrymen began to sit up and take notice, for it looked very much as if the machine had come to stay. The rapid developments in the last few years have proved its efficiency and sufficiency beyond a doubt. It is now possible for the foundryman to produce moulds by machinery for almost any casting that can be made in a two-part flask.

No machine even invented had a harder fight to make good than the moulding machine, for the moulders "knocked" it and did everything in their power to discourage its use. This was a great mistake on their part, for if they had accepted it and given it a fair trial, the handyman and machine operator would never have had the same footing in the foundry as they hold to-day.

The Accuracy Feature.

That a moulding machine is more accurate in duplicating work than a moulder goes without argument, as no two moulders rap or draw their pattern the same way. A machine-made mould is always the same size, providing it is made by a careful operator. This is an advantage that lots of foundrymen have never considered, and thousands of pounds of metal are wasted annually from castings being over-weight.

We hear many reports about big discounts and scrap in machine moulding, but, when this is traced back, the real cause of this trouble is usually carelessness in making or handling the moulds, and not by the failure of the machine to do its work. The one thing that is essential to make machine moulding a complete success is to secure first-class operators, see that these men are instructed in how to temper the sand for the different classes of castings, and also are shown how to ram and pour the different work. Unless these three points are drilled into a green man's head, you will have very little success, and a little time and patience with a new man on the job will give you good returns. In most cases whese the results with a moulding machine have not been satisfactory, the machine gets the blame, when the truth of the matter is that the operator has never had the proper instruction that is necessary to a new man on this line of work.

Selecting a Moulding Machine.

When buying a machine, if there is any doubt in your mind as to the successful production of any class casting, it is wise to consult a reliable manufacturer, for every man who makes these machines understands that the reputation of his product depends upon the accuracy of his judgment on this point. His opinion is, therefore, valuable. Another question to be considered in buying a moulding machine, is whether it will pay a sufficient return on the money invested.

A very important detail in connection with the making of moulds by machinery is that there is not nearly as much expense required to keep the patterns in repair, as the pattern plates are not subject to as much damage as the gated pattern, when it is used in a sand or clay match or follow-board.

The Output Feature.

The main advantage of producing castings on the moulding machine is the great increase in output. This is many times that of the moulder. There are numerous other ways in which it is a great boon to the foundryman. It gives him good, uniform castings without high priced skilled labor; the latter being sometimes difficult to get. The best proof that the moulding machine has come to stay is that on investigation it will be found that the largest and most up-to-date foundries in both the United States and Canada have hundreds of them in operation, and are not only satisfied with the results obtained from them but are installing more from time to time.

Shrapnel Shell Service and Constructional Features

Staff Article

Arising out of this European war, not the least interesting feature, if only on account of its novelty, although its significance is much more diversified and potent because of the stimulus given to both our industries and to our Empire patriotism, was that of the decision to manufacture shells in Canada. Interesting data relative to shells generally are here given.

In view of the fact that shrapnel shell manufacture in Canada has developed to an extent hardly anticipated a few months ago, and in response to numerous requests from interests only indirectly in touch with the production side, we take pleasure in bringing to the attention of our readers a brief statement concerning this much-used death-dealing projectile.

Projectiles, commonly known as shells, have a number of different purposes and vary widely in construction. In Fig. 1 is shown a simple and much-used form of

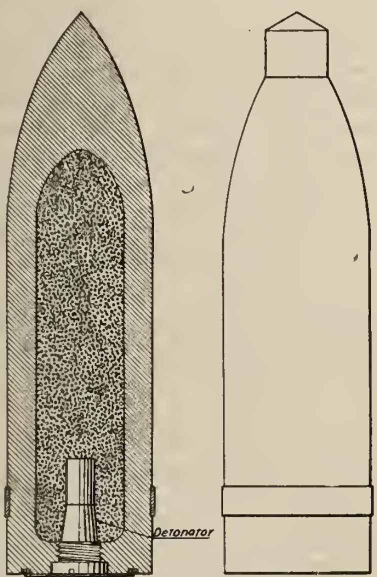


FIG. 1. SIMPLEST FORM OF EXPLOSIVE PROJECTILES.

explosive projectile. The explosive charge is seen encased in the solid steel of the shell and is provided with a detonator at the rear end which is intended to explode the charge upon impact or immediately afterwards. The left half of the figure represents a projectile designed for the destruction of fortresses, earthworks, etc., where high explosive power is required. When required to pierce hardened steel armor, this shell is provided with a covering of softer metal over the hardened point. Otherwise the shell would simply shatter itself without perforating the hardened projective surface.

Shrapnel Shells.

For the destruction of men and other animate objects, the type of projectile known as shrapnel is employed. Two typical shrapnel projectiles are shown in Fig. 2, and their operation is as follows: The nose or time-fuse can be adjusted to explode the shell at any predetermined time after its discharge from the gun, and an effort is made to have the shell explode about a hundred yards in front of the enemy and directly above him. The case is made of a high grade of steel and is not itself shattered.

The flame from the time-fuse explodes the powder in the central tube and the rear end of the shell. This simply blows the fuse-end off and discharges the whole load of bullets straight ahead as if shot from an enormous shotgun. The explosive charge is not large in comparison to the weight of metal discharged but, as the projectile as a whole has a very considerable initial velocity, each bullet will have sufficient energy to administer a disabling wound at 100 yards, and bullets enough are provided to furnish one for every square yard of surface attacked.

Timing Arrangements

Shells are timed both by clockwork and by a time fuse. A typical example of the latter is shown in Fig. 3. Upon discharge from the gun the inertia of the percussion plunger P causes it to shear off the resistance ring R and fly back against the firing pin A which explodes the primer charge J. The flame from this passes through the hole B and ignites the fixed time-train C. This fixed time-train burns around until it comes to the hole E, through which the flame can pass to the movable time-train at its lower end. The movable time-train burns back until the hole D is reached through which the flame obtains access to the powder G which forms part of the bursting charge of the shell.

It is easily seen that, by rotating the movable ring M so that the holes E and D become further separated around the circumference of the shell, the time required for the train C to burn around to the hole E and back along the movable train to the hole D is increased. The time allowed, of course, depends upon the distance the shell has to travel from the gun to the point where it is desired to discharge the bullets, and if the holes E and D be placed directly in line, the shell will explode but a few feet from the muzzle of the gun.

The time-train rings do not form complete circles so that for transportation, or if it be not desired to use the time fuse, the hole E is set opposite the blank part of the time train C. In case the shell fails to explode through the agency of the time-fuse, it will explode upon impact. Upon firing, the percussion ring H slips back over the plunger which carries the firing-pin K. Upon impact of the shell with some solid object, the whole flies forward, the pin K exploding the primer charge T. This instantly ignites the exploding charge G through the tube O.

The Explosive.

The explosive used in all kinds of shells is, in nearly all cases, a high grade of black powder. Few of the higher explosives are suitable for this purpose.

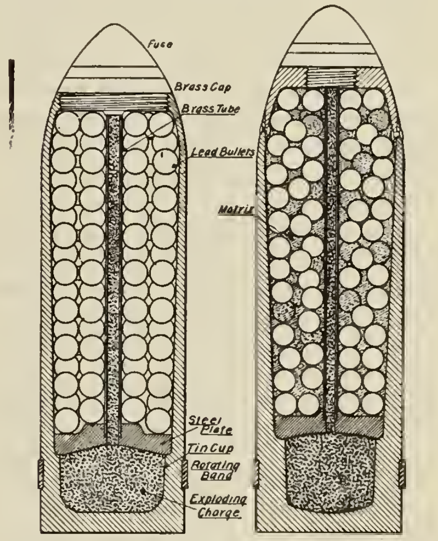


FIG. 2. TYPICAL FORMS OF COMMON SHRAPNEL.

Any of the compounds of nitro-glycerine or other explosives which are liable to detonate by shock are manifestly unsuitable. Many deteriorate in long storage, and acids will react with the metal walls of the projectile. Picric acid or its salts, alone or in combination with other substances intended to make it less sensitive to detonation, are much used in the form of the Japanese shimose and the British lyddite. Great care must be exercised with these, however, to prevent the explosives coming in contact with the metal surface of the shell.

The Canadian-Made Article.

In Fig. 2, the left-hand figure represents a typical 18-pound British shrapnel shell such as, along with 15-pounders, are, at present, being made in large quantities in Canadian factories. The body is forged by hydraulic pressure from a solid billet of high grade steel, and the machining represents two simple series of operations on turret lathes. After the finishing of the machine work and inspection, the cases are subjected to a heat treatment and oil quenching.

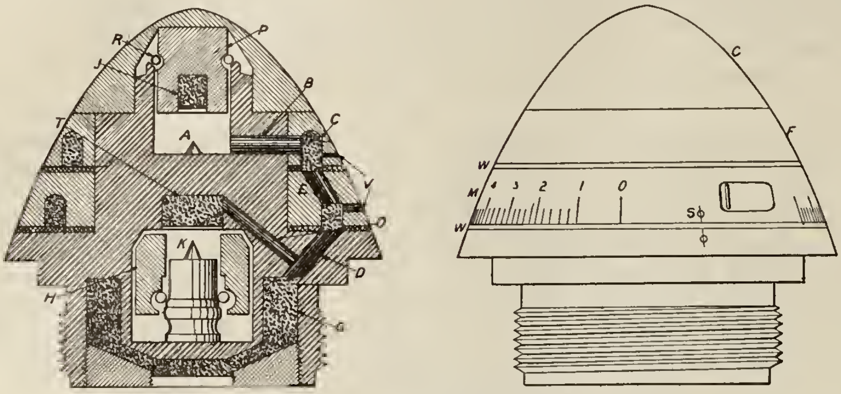


FIG. 3. DETAILS OF ADJUSTABLE TIME FUSE.

The brass cap which screws into the steel body and carries the fuse is turned from the rough casting in four turret lathe operations and is fitted with a brass plug for the purpose of protecting the thread until the fuse, which is made at the Government Arsenals is screwed in place. The fuse is kept from becoming loose and screwing out by means of small grub screws.

The central pipe carrying part of the explosive charge is of drawn brass tubing cut to length; shouldered and threaded to screw into the steel plate at its lower end, and is soldered into the brass cap at the top. The powder is contained in a tin cup which is formed accurately to fit the inside of the base of the shell. This means simple press and soldering operations. The bullets, which are about one-half inch in diameter and, of which 364 are required for each shell, are made of a mixture of lead and antimony and are formed cold in dies under presses. The copper rotating bands are rolled to size and are fastened in place by means of a closing press for the purpose. The interstices between the bullets are filled with a matrix composed of certain forms of pitch or other inflammable substances designed to protect the bullets from deformation when the shell is being discharged from the gun, and to indicate by its smoke, the exact point where the explosion of the shell takes place.

All the work in connection with the making up of the shell need not be done in a single plant or by a single firm. They are completed with the exception of the bursting charge and addition of the fuses, and are packed in special wooden crates designed to hold six each for shipment. The distribution of the contracts for the manufacture of shells in Canada is in the hands of a special shell committee, and the difficulties encountered in placing, collecting, assembling and inspecting the wide variety of the work involved are much greater than is realized by the man not directly in touch with the task. Some seemingly insurmountable obstacles have been met and overcome and, at the present time, the work is being done almost entirely in Canada, by Canadians, creditably alike to the latter and to the Empire of which they form a part.

ELECTRO-DEPOSITING.

ELECTRO-DEPOSITING is very largely used in printing offices, not only in the making of process blocks, but also in plating or facing stereotypes with copper or nickel for the purpose of hardening the surface and permitting much longer runs than is possible from the plain stereo. Ordinary copper electrotypes, when not nickel-faced, soon wear down, and give a poor impression.

The usual method of making an electrotype of a process block or an engraving in an electrically-driven works is to first of all prepare a wax mould in the electrically-driven hydraulic press. The surface of this is then rendered conducting by treatment in an electrically-driven black-leading machine, and a copper shell is then deposited on the wax mould in the electric bath, the shell being afterwards backed up with molten metal and fixed to a wood block "type high." For long runs, the face of the block may be nickel-plated. The latest method is to electrically deposit nickel steel direct on to the prepared wax mould, a very thin deposit only being necessary. The mould is then washed and transferred to the copper bath, where it is electrically backed up with copper and is afterwards backed and prepared in the usual way.

Blocks so prepared possess a very hard surface and give a very sharp impression. To obtain the best results, the electrical baths must be kept at a definite temperature and the solution agitated by air bubbles passing up between the electrodes from pipes fixed at the bottom of the bath and connected to an air compressor.

CALORISING.

A NEW process, called "calorising," or placing a protective coating on iron and steel and other metals, especially for use under high temperature conditions, has been worked out in the research laboratory of the General Electric Co., New York. According to the Iron and Coal Trades Review, "calorising," which is the discovery of T. Van Aller, consists in heating metals in revolving drums with mixtures containing, among other things, finely divided aluminum, so that a surface alloy containing aluminum is produced.

In the case of copper, this alloy is of the nature of an aluminum bronze, but richer in aluminum than the ordinary alloy of that name and more resistant to heat, so that copper thus treated is protected, up to the melting period of the alloy, from the scaling which occurs when untreated copper is heated above 300 deg. Cent. The same general result is obtained in the case of iron and steel.

Some use was made of this process for treating copper soldering irons and iron-resistance wires for heating devices. Pieces which, because of their shape or size, are not adapted for tumbling, may be calorised by packing them in, or painting them with, a suitable mixture and heating them. There are many places where it is desirable to use iron vessels or apparatus at temperatures above red heat, and at such temperatures ordinary iron rapidly oxidises and scales away. After iron is calorised, the effect of heating is slight.

CANADA'S TRADE WITH BRITAIN.

FOLLOWING are the official figures of trade between Canada and Great Britain in the undermentioned articles, during February:

Imports From Canada.

	1915	1914
Wheat	£580,907	£569,860
Wheatmeal and flour	174,482	137,375
Oats	33,938	14,556
Barley	6,559	31,126
Bacon	304,710	73,775
Hams	64,098	12,066
Cheese	90,506	57,981
Canned salmon	108,849	260,191
Canned lobsters ...	15,712	15,607

Exports to Canada.

Spirits	£ 40,028	£ 47,814
Wool	21,105	7,505
Pig iron	110	1,416
Wrought rails	......	14
Galvanized sheets ..	2,303	23,347
Tinned plates	3,153	8,935
Steel bars	3,916	11,415
Pig lead	425	7,338
Cutlery	3,745	5,121
Hardware	1,798	7,784

PRACTICAL ARTICLES BY OUR READERS

Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

CONCERNING CORE COMPOUNDS.

By "Melter."

CONDITIONS under which core compounds are selected do not appear altogether satisfactory, either from the standpoint of consumer or from that of the producer. This, however, is not surprising as the materials involved differ greatly in composition and are subject to varied applications.

Cores are of two kinds—green sand and dry sand. Those of the former will not be considered here as they do not require compounds to create binding power but rely altogether on the shape of the grains of sand.

The Sand Feature.

The suitability of a core for any special line of work depends largely on the nature of the sand and binder mixed with it. The chemical composition, the degree of fineness and shape of grains of sand are all-important factors. A sand high in alumina will bake harder than one with a smaller percentage of alumina and the harder condition would be detrimental to good venting. The coarser the sand, other things being equal, the greater will be the strength, at least up to a certain limit.

Organic matter gives bond, but burns out when molten metal comes into contact with it, causing the core to fall or crumble. For this reason, river sands are better than bank sands as all foreign matter is washed out. Iron, manganese, magnesia and lime are all detrimental, and have the effect of causing the core to crumble as already noted.

A medium coarse grade of sand should be used, say, with a degree of fineness of from 55 to 75. A grade coarser than this does not permit of its voids being all filled by the binder, and the result is a weak core. For instance, a 35 grade sand when new was 40 per cent. weaker, comparatively, when mixed with the same proportion of compound, sand and clay wash, and baked for the same length of time and at the same temperature as a 50 grade sand. The degree of fineness of a sand may be found from a sieving test by multiplying separately the number of grains passing through each sieve by its mesh number, adding the results and dividing the whole by 100. Sieve meshes of 100, 80, 60. 40 and 20 are used.

The most convenient way is to weigh out exactly 100 grains of sand, sift for one minute on the 100 mesh sieve, weigh what goes through, sift the balance on the 80 mesh sieve for one minute, and so on. Any loss is counted on the 60 mesh, and what does not go through the 20 mesh is credited to the one mesh sieve. If the sand is very fine, more binder will be required and a close hard core with poor venting will result. It is possible to use 85 per cent. old and only 15 per cent. new sand and get good satisfaction. If machine mixing is practical, more old sand can be used than when mixing is done by hand.

It is not beneficial, however, to run up old sand much beyond 85 per cent. Used sand has the alumina (clay) burned out, and each grain of silica has a coating or film of carbon around it. This film of carbon does not permit the binding material to be as effective as it would be if new sand were employed. If there is much fine sand in the old, more binder will be required as the dust needs as much binder as is necessary for the grains.

Core Binders.

Core binders may be divided into four groups—dry compounds, oil, paste, and those which are capable of being dissolved in water.

Flour.

Flour is a paste binder. It burns out easily and is, therefore, good for long thin work, although it has very little green binding power. The core should be used almost immediately, as moisture is taken up from the air and moulds.

When using flour, a good brand should be had, as it is the starch and glutin which gives binding power. Poor grades of flour are yellow, mealy and oily because they contain bran. They are high in fibre, fats and ash and create more gas. Tests have shown that a flour containing 50 per cent. less crude fibre, fat and mineral matter had 65 per cent. more strength than the inferior product, and 25 per cent. less flour was required to obtain equal strength which result would more than counteract the difference in cost. It has been found that some flours are adulterated with as much as 40 per cent. mineral matter. This should not be over 1 1-3 per cent. Fat, on the other hand should not exceed 2½ per cent., and fibre 1¼ per cent.

A simple test of further difference invisible to the naked eye, is to spread out on a piece of glass a small portion when the yellow color is easily seen. Another way of testing is to mix a little dough and try for toughness and dryness. A strong flour is shown by its readiness to absorb water, and make a clean dough that shows tenacity when pulled out. This result will be accentuated if the dough is left exposed for a short time before trying. If, in working, it is still sticky, the flour is not so good, but if it break short it is undoubtedly inferior.

Oil Binders.

Oil hinders are made from linseed, fish, mineral oils and resin. Clay absorbs oil and therefore it is not beneficial to mix the two. Oils and gums flow through the sand and get in between the particles, while flour, resin and starch do not, but just bind adjacent grains. This segregation of binder causes an excess of gas at the point of segregation. Oil cores have very little green binding power though they are better than paste or dry binders. Oils containing mineral oil need longer to bake because the mineral adulterant must be volatilized before gums or pitches act.

Dry Compounds.

Dry compounds are made up of resin, pitch, dextrin, coke dust, and sometimes a little sawdust is added to facilitate removal from the casting. Dextrin is a green binder which is soluble in water and therefore flows to the contact points of grains of sand, when there is sufficient moisture added. Resin will not stand a high heat when baking as it melts at from 100 to 140 C. It is not soluble in water and has no green binding power. Pitch when in contact with molten iron forms coke which will not clean out.

Binders Soluble in Water.

Binders which are dissolved by water are molasses, sour beer, glue and the by product of the sulphite paper industry. The latter is very plentiful in Quebec Province, is strong, cheap, a good green binder, and can be used with clay wash or mixed efficiently with any other binder. It is composed of gums and resinous liquors which flow through the sand, giving contact at all points.

Testing Compounds.

In testing compounds, the relative cost per pound should be figured and a set of test cores made with constant quantities of new and old sand. The amount of compound should vary so that each set of cores costs the same amount. A convenient core box is a mold used for cement testing, and having enlarged ends for gripping in the test machine, while the area on which the load is applied is exactly one square inch. Some people prefer to use test cores 2 ins. square by 13 ins. long, and test transversely on 12 ins. centres. It is immaterial, however, what size bar is employed.

Core Tests.

Cores are examined for green binding power, change of shape, time of drying, appearance of exterior and interior, and strength. In recent tests, some cores even made of new molding sand having a degree of fineness of about 55. These were 300 per cent weaker than when made from the same old moulding sand having the same degree of fineness.

Another set of cores were made from new core sand with a degree of fineness of 35, and these cores were very much weaker than anything tested. The latter result was possibly due to the voids being too large in proportion to the quantity of compound used. The two tests confirm, however, that it is necessary to have a sand carefully selected as to size shape of grains and freedom from vegetable matter.

We found also that the by-product from the paper industry (sulphite process) could be used in the proportion of 55 sand to 1 binder with the same amount of clay wash as the latter; that it was 130 per cent. stronger than the cheapest oil tested; 150 per cent. stronger than the two dry black compounds tested, and about 140 per cent. stronger than flour. All were mixed with a constant quantity of the same sand, placed in the oven at the same time, and given the same degree of heat for the same period. The amount of binder, however, was varied in quantity according to the cost, so that all cores required the same amount of financial outlay. A number of the compounds tested contained the following substances:—

Black Compound.—Pitch, coal, resin, sawdust.

Oil Binder.—Dynamo oil, linseed oil.

Paper Industry By-product. — Gum resin, dextrin, pitch, sour beer.

Although the dollars and cents savings on the adopted practice over that recommended are not apparently very large, when taken in conjunction with the better casting features, there is to be noted a quite appreciable over-all benefit.

The costs were based on:—

New core sand at $1.60 ton net.

Blue clay at $1 ton net.

Old compound at $1.87 per lb.

New compound at $1.17 per lb.

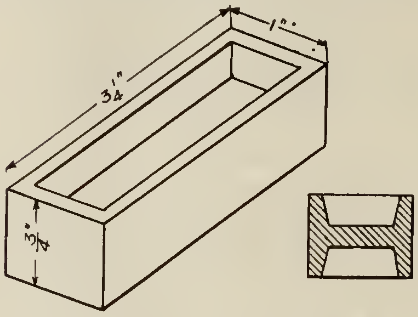
	Old Mixture. Lbs.		New Mixture. Lbs.	
Old sand	315	......	375	......
New sand	105	00.063	63	00.037
Compound	14	26.18	8.4	9.828
Clay	10	.05	8	.400
		26.293		10.265

This shows a difference 16.028 cents on 420 lbs. of sand in favor of the new mixture, and as there was a monthly consumption of 22,000 lbs. of new sand, a saving of $8.38 was effected.

PROJECTED FOUNDRY DATA REQUIRED.

By D. A. Hampson.

A MANUFACTURER uses about 3,000 castings a day, of a general shape as shown in the accompanying sketch, and each lot averages about 500 lb. weight.



LARGE QUANTITY CASTINGS SAMPLE.

They are made from brass patterns, eight on a gate, and there are thirty different sizes with a corresponding number of pattern sets. In addition to this, there is a daily consumption of about 800 lb. of similar shape castings, mostly in larger sizes, and a limited amount of smaller cored work.

The nearest foundry doing this class of work is sixty miles away, which makes it inconvenient to secure prompt delivery or hurry orders and to change patterns quickly when large quantities of a few sizes are wanted ahead of others. Anothed trouble experienced is the variety in sizes of castings from the same metal pattern, due probably to the work of different men, all molding being hand rammed.

In order to overcome much of this difficulty and inconvenience, it has been under consideration to erect a small foundry in conjunction with the present machine plant for doing this work, and answers to the following questions in this connection are desired:

How many men would be required for such a foundry?

About what equipment would be most suitable?

About what type, and how many moulding machines would be required, and would machine moulding give more uniform castings?

Would it be necessary to change the size of the patterns when mounting these on machines.

Question and Answer Series for Foundrymen

Foundrymen having difficulties in connection with their work are invited to forward particulars of them to this department for solution. The greatest possible care will be taken to give only reliable and tried-out advice on all questions and problems submitted for solution.

Question.—What effect does manganese have on babbitt metal? We wish to make a manganese babbitt that will be somewhat similar to the well-known nickel babbitt.

Answer.—Manganese cannot be used to advantage in babbitt metals, as it is so strongly oxidizable as to make the alloy mashy. The addition of less than 1 per cent. of manganese-copper to a tin bronze will convert 25 per cent. of this alloy to a thick slate-colored mush, which shows a purple and gold coloring on top after being plastered into ingot moulds. A few pounds of this mush added to 500 lbs. of melted genuine babbitt metal will cause the ingots to surface ozidize at a low temperature. It can then be poured cool and will assume the rich gold coloring preferred by some makers of babbitt on their ingot metal.

* * *

Question.—We are making yellow brass castings, and have considerable trouble in getting a good color, also in getting them to run sharp. We are using a commercial yellow brass ingot, we watch the metal and temperature as closely as possible, and pour as soon as ready. With all these precautions the castings are rough and curly on the outside. We have tried a little aluminum, but this interferes with dipping, as the acid does not seem to touch the aluminum. We make lots of red brass and have no trouble with it.

Answer.—Have your chemist give you an analysis of your yellow brass ingot, and I think you will find it is either high in iron or very low in tin. This will explain your curly castings and their lack of color. You might also try skin drying your moulds, as this is also a big help when yellow brass runs curly.

* * *

Question.—Will you kindly tell us what you consider the best material for the floor of a foundry? Our product is stove-plate and the floor must be as level as possible.

Answer.—Put in about 5 or 6 inches of cinders or broken stone, level this up with fine cinders from cupola or boiler, and over this put one or two inches of sharp sand. Level with a straight-edge; then lay hard red brick flatwise, and breaking joints lengthwise. Put plank on bricks to keep them from breaking and pound them down so that they are solid and level. Next make a grout of one part cement and two parts sharp sand, and pour it over bricks until all cracks are filled. Leave no cement on surface, except to fill cavities and uneven places. Brick makes a good gangway, as it resists the iron better than anything except clay. Clay gangways are, however, hard to keep even. To make stove-plate true, your floor must be level, and the above composition and arrangement will give the desired results.

* * *

Question.—We use a lot of brazing metal, and would like to make it ourselves. Can you give us a good mixture?

Answer.—The following mixture is extensively used for brazing purposes:—Copper, 87 per cent.; zinc, 12 per cent.; lead, 1 per cent. Zinc is used in preference to tin in making brazing metals, because the copper-zinc alloys possess a certain amount of ductility at a red heat, and do not crumble with the same facility as the copper and tin metals. The color of the metal varies from a coppery hue, with small percentages of zinc, to a reddish yellow, with higher percentages. The structure of the metal is fibrous. The copper should be melted under a cover of charcoal; a little salt being added when the ingots become red. After the copper is melted and appears limpid beneath the charcoal cover, the zinc having been previously warmed, is added in small pieces. The lead is put in next, the mixture thoroughly stirred, after which pouring is in order.

* * *

Question.—Can steel be melted to advantage in a cupola?

Answer.—A few years ago Hugh F. Jones, of Los Angeles, Cal., patented a process for producing steel castings by cupola melting. The method consists of charging the cupola with alternate layers of coke, flux and steel scrap, and the ratios mentioned are from 7 lbs. steel and 1 lb. of coke, up to 10 lbs. steel and 1 lb. of coke. The coke should be coarse, and the prices of steel should not exceed 25 lbs., the smaller pieces being charged first. Open-hearth steel should be used when the castings are to be machined, but if not, the charge can consist of 75 per cent. Bessemer steel and 25 per cent. open-hearth scrap. The flux, which principally consists of silica and iron oxide, is used in the proportion of 10 lbs. to each ton of scrap when the coke contains 2 per cent. of sulphur. For each 1 per cent. of sulphur over or under 2 per cent., one pound of flux is added or deducted. The blast used depends on the percentage of fixed carbon in the coke; thus, for 70 per cent. fixed carbon, 8-ounce pressure is used, and for each 5 per cent. above or below this, the blast is reduced or increased 1 ounce. Additions of aluminum and ferromanganese are made in the ladle.

* * *

Question.—We have trouble in getting a sand match that will stand the wear and knocking around to which it is subjected in the foundry. Could you advise us of any good mixture for this purpose?

Answer.—If you will try the following I think it will be satisfactory in every way:—Finely sifted gangway sand, 89 parts; finely sifted steel or iron borings, 1 part; pulverized litharge, 3 parts; boiled linseed oil, 7 parts. Mix the sand, borings and litharge when dry, taking care to keep out all moulding sand, gravel or water. After thoroughly mixing, add the 7 parts boiled linseed oil, and mix to the same temper as moulding sand. Ram this mixture into your cope-match or frame, and secure firmly with screws in preference to nails. A match made with this mixture will last for years if given half a chance. A coat of shellac and lampblack when it is dry will also help this match.

* * *

Question.—Please inform us in your columns devoted to questions and answers which you consider the best lining for a cupola. We are lining a new one, and we are undecided whether to use stock brick or cupola blocks.

Answer.—Cupola blocks require less labor and fireclay to build a lining than stock brick. A more uniform diameter to your lining can also be secured by using blocks, as there is a smaller number of joints in the block lining. It is, therefore, evident that it will outlast a lining made of stock brick, all things being equal in the material of which both are made. Have your lining divided into four or five sections, supported by rings of angle iron attached to the cupola shell. This will give you a chance to repair your melting zone without disturbing the other sections of your lining, as the melting zone burns out much more rapidly than the rest of your lining.

* * *

Question.—Kindly give us a good formula for phosphor bronze?

Answer.—The term phosphor bronze is rather vague, as it is applied to a large number of alloys of widely different compositions. When used for the purpose of a bearing, it contains a considerable percentage of lead. The following is a good bearing alloy:—Copper, 81 per cent.; phosphor-copper (15 per cent.), 3 per cent.; tin, 7 per cent.; lead, 9 per cent. Melt copper under charcoal and, when thoroughly liquid, add phosphor-copper. Let the metal stand a few minutes with furnace covering partially removed, then add tin and, lastly, the lead; afterwards stir vigorously. Of late there has been a tendency to confine the term phosphor-bronze to the strongest grades of copper-tin alloys, thus indicating by the use of this name that a bronze is required possessing the highest physical properties possible in a copper-tin alloy. A good formula for such an alloy follows:—Copper, 90 lbs.; tin, 5 lbs.; phosphor-tin (5 per cent.), 5 lbs. Add phosphor-tin first.

A RAPID ENAMELING PROCESS.

AN enameling process, the distinctive feature of which is a quick-drying secured by heating the objects treated in large ovens under a relative high percentage of humidity, has been perfected by the Fickling Enameling Corporation, Long Island City, New York. By this method, known as the Radio-enameling process, an automobile can be refinished in three days.

After the initial enamel has been applied by either dipping or spraying, the parts are placed in these specially constructed ovens and dried under a uniform temperature and humidity. Thermostatic control keeps the temperature between 110 and 120 degrees F., and water control on a diaphragm regulates the humidity at a point about 40 per cent. of saturation. Where the character of materials allows, the temperature is increased to as much as 200 deg. The final enamel is subjected to a similar baking at a slightly lower temperature.

Drying in the ovens under the constant relation of temperature and moisture, and the use of water-washed air are said to secure more lasting enamel than is possible by ordinary air drying. Keeping the outer surface green permits the inner layers to dry and set, thus securing a hard and enduring foundation. When dried in the open air the surface becomes hard, while the under coatings may be green for some time. On automobile hoods this results in sweating. W. I. Fickling, president of the corporation, is of the opinion that the radio method will have wide industrial uses because of the time saved in drying. One oven 19 ft. x 6 in. x 42 ft. is in use at present and Mr. Fickling holds that the method would be efficient with even a larger oven.

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Vol. VI. APRIL, 1915 No. 4

PRINCIPAL CONTENTS.

THE CANADIAN NICKEL QUESTION.

In spite of the most emphatic official statements to the contrary, there is apparent a lingering suspicion both harbored and expressed that nickel products of our Dominion are finding their way into enemy hands, and, to the man in the street, the situation appears to become daily more perplexing. He believes himself to be the goat of either an "Ananias Club" officialdom or, through over-sensitiveness, the victim of a "Doubting Thomas" fraternity.

It is not in any sense reassuring, however, to find that the Ontario Government has decided to appoint a Nickel Commission to make an exhaustive investigation into the matter, nor is it any more so to realize that any report arising therefrom may not most probably be received until after the war is over. In any case, as generally happens, the patriotic feature will doubtless be sacrificed for that of party.

Numerous applications have, we understand, been received for the post of commissioners, of whom there will be three, but meantime one only has been decided upon as suitable, although his acceptance has not yet been indicated. There is difficulty it appears in getting men with the necessary qualifications, and this is not to be wondered at when we are officially told that the Commission will be expected to find some means of refining Ontario's nickel ore within the Province, and failing this, their appointment is supposed to constitute an opportunity to invent a means.

Money, as in every other feature of our complex existence, with a few rare exceptions, will refine Ontario's nickel ore within the provincial boundaries, just as it may also defeat that objective. Money will also enable Germany to procure our product and is doubtless doing so if the suspicions of the "Doubting Thomas" brigade prove to be well founded. We are giving of our manhood and substance for the cause of Empire and the rehabilitation of Belgium and France, yet there appears to be no absolute assurance that we are not also being made the medium to offset these gifts. Canada has been and still is being exploited by insiders as well as outsiders in almost endless, subtle and devious ways, and little surprise will be evidenced if sooner or later we awaken to the knowledge that the enemy got our nickel, our patriotism notwithstanding.

The hearts of our people are deeply stirred on this question of our nickel export destination, and their demand is that all quibbling on the one hand and cavilling on the other should cease. Britain's navy can be relied upon to prevent direct shipment to Germany, but not necessarily, through neutral countries, indirectly to her. Canadian statesmanship can, if it is worthy the name, make the latter contingency as impossible as the former; otherwise let that statesmanship take the bit between its teeth and admit its failure.

This nickel refining business has, we believe, more to it than any political-party-appointed-and-directed Commission will be able to unearth, however capable and conscientious its individual constituents. The principal producers of nickel from Canadian ore are the Mond Nickel Co., with its refineries in Wales, and the International Nickel Co., with its refineries in New Jersey, U.S.A. The former, as we might assume, is a British concern and the latter is American.

The nickel refining process has always been regarded as of a more or less secret nature, and reasonably so, because of the fact that most published matter relating thereto has been remarkable for its important detail feature omissions. Again, the cost of the process is reputed to be high, both from a material and labor point of view. Just then what Ontario's Nickel Commission will make out of their task—barring the pocketing of good fat salaries, is somewhat problematical. One thing is certain, however, a report will be presented, but we are not too sanguine that its achievement will amount to more than the distinction of being filed.

For the present or for the duration of the war, there is no real urgency for our embarking on a nickel refining enterprise, but there is real urgency in our people being absolutely assured that the product of our Canadian mines is being used as fully as requirements call for on our behalf, and that not an ounce of it is being used against us.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

TORONTO BRANCH, AMERICAN ELECTRO-PLATERS' SOCIETY.

THE Toronto Branch of the American Electro-platers' Society extend a cordial invitation to all interested in the electro deposition of metals, to be present at their meeting in the Occident Hall, corner Queen and Bathurst streets on Thursday, April 22, at 8 p.m. The following interesting program has been arranged:—

J. T. Burt-Gerrans, of Toronto University, will lecture on the electrolysis of copper solutions, using a projecting lantern and copper bath in operation to demonstrate the electro-chemical action which takes place during deposition of metal. Mr. Burt-Gerrans is a very fluent and energetic speaker, besides being an authority on the subject he will present.

Mr. Morrison also of Toronto University, will speak on the advantages of a training in electro-chemistry as applied to electro-plating. Mr. Morrison is instructor in the electro-plating class at the Toronto Technical School, and having had practical experience in electroplating work, his remarks will be of particular value.

W. S. Barrows will describe the uses and advantages of Cobalt electro deposits, giving a brief historical sketch, also explaining in non-technical terms the results of his extended experiments relative to this neglected metal. Mr. Barrows will illustrate his paper with a display of ores, oxides, and salts of cobalt, also specimens of various lines of goods plated with metallic cobalt. This feature will be particularly valuable to the manufacturers of plated goods, as well as to the nickel plater.

Cobalt is rapidly becoming prominent as a metal substitute for nickel, and as it is comparatively new in the electroplating industry, a special request is extended to those operating nickel plating plants to attend this meeting. The society desires a good representation from the metal section of the Toronto Branch, Canadian Manufacturers' Association, also from such other bodies as are in any way interested in the commercial electrodeposition of metals.

THE ADVANCE OF THE PLATING INDUSTRY.

By Carl Dittmar.

THE plating industry has grown steadily each year, and now its scope is considered almost unlimited. This fact is causing the manufacturer and the technical man to pay more attention to this branch of industry than ever before. With this growth, competition has grown keener, which, in turn, has drawn the attention of the efficient expert to the plating department.

There is hardly a large manufacturing plant where a cost system has not been introduced to determine the cost of operating the plating department. The manufacturer has called for increased output, and in order to enable the plater to meet this demand, has installed modern equipment. He has installed high efficiency electrical apparatus. The plating barrel or mechanical plating tank was introduced and is steadily growing in favor, as it enables the plater to handle a large amount of work at one time, thus reducing labor cost. Only the most important part of the electroplating department has been neglected—the solution itself. The expense and the possibilities of the electro-plating field have now drawn the attention of the technical man to this most vital part of the electro-plating industry.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.

Officers:

President—John A. Magill, 591 St. Clarens Ave., Toronto.
Vice-President—William Salmon, 48 Oak Street, Toronto.
Secretary—Ernest Coles, P.O. Box 5, Coleman, Ont.
Treasurer — Walter S. Barrows, 628 Dovercourt Road, Toronto.

PLACE AND DATES OF MEETING. The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

The Chemist Feature.

It is only during the last few years that the chemist has been consulted. That electro-plating is simply a branch of electro-chemistry and a very important one, was recognized for the first time when the American Electro-Chemical Society gave a symposium on electroplating at their meeting at Atlantic City in April, 1913, to which the American Electro-Platers' Society was invited.

This was the first meeting of the practical man and the theoretical man for the purpose of discussing electro-plating problems, and that meeting has done much towards dispersing the prejudice which the practical plater has had against the chemist, whom he considered nothing short of a "meddler." The plater now looks upon the chemist as a friend who can help him out of the difficulties which present themselves from day to day.

Another step in this direction has been taken by the Bureau of Standards at Washington, which has undertaken to standardize acid plating solutions, and it is only a question of time when the matter of alkaline or cyanide solutions will receive the same consideration. This institution, recognizing the unlimited scope of the electro-plating field, has taken the initiative in bringing the matter before its students. This is being done for the sole purpose of increasing the efficiency of plating solutions. In order to obtain maximum efficiency in the plating department the plater must be positive that the solution has been made up not only most economically, but with materials which will assure perfect deposits in the shortest possible time.

Solution Features.

The plater is now working in harmony with the chemist. He is becoming more intimately acquainted with his solutions. He wants to know what he can expect of his bath in a given time. In order to be able to do this, however, there must be eliminated from the plating solution not only detrimental matter—that is, material which actually retards the action of the current, but also that which does the solution no good. He must eliminate all ingredients which lie dormant in solution, and confine himself to materials which serve a specific purpose. All he draws from his solution is metal, and this factor should, therefore, receive the most consideration. It should be introduced into the bath in the purest state possible at the lowest cost.

The Electrolyte Feature.

The next consideration is the electrolyte, which reduces the metal from the anodes and deposits it upon the cathode. In the joint investigations of the chemist and plater it has been brought home that in the past the plater has been working under serious handicaps. He has been compelled to get results with all conditions against him, being compelled to use materials which contain large proportions of impurities, the nature of which he had no way of determining. The metal salts have varied in metal contents so that he was never sure just how much metal he was introducing into his bath.—Brass World.

DIE-CASTING PRACTICE.

By Chas. Pack.**

DIE-CASTINGS may be defined as finished castings, the metal having been poured and allowed to solidify in permanent metallic molds. This definition would include a number of casting processes, the products of which are not commercially recognized as die-castings, such as the casting of cheap lead figures, lead battery plates, dental appliances, etc. Here the molten metal is poured from an iron ladle into a permanent metallic mold, filling the mold by its own gravity and using no external pressure. To exclude these processes, die-castings must be defined as "finished castings made by pouring molten metal under pressure into a metallic mold."

The process of die-casting consists essentially in melting the die-casting alloy in a suitable container and forcing it, under pressure, into a metallic mold or die, producing smooth finished castings requiring little or no machining, and being ready for buffing or plating without any grinding or cutting down. The process is best adapted to small intricate parts where accuracy and uniformity are essential. The process is limited to a group of alloys having a tensile strength not exceeding 20,000 lb. per sq. in., which limits the application of this process to machine parts not subject to severe strain or shock. It is, however, possible by a careful study of the service conditions to re-design castings, either by the addition of ribs, webs, fillets, etc., or by the insertion of steel or bronze inserts to so strengthen die-cast parts that they may successfully displace the stronger alloys of copper and iron.

Although the principles of die-casting have been known and practised for many years, the advent of successful die-casting as an individual industry dates back to a period of no more than fifteen years. By careful study and experiment it has become possible to enlarge the area of its application, and at the present time the manufacture of die-castings forms an important branch of the non-ferrous metal industry.

Die-castings are now used extensively for both useful and ornamental purposes. They constitute the vital parts of various types of automatic vending machines, photographing machines, typewriters, cash registers, magnetos, motor starting devices, time controlling devices, counting machines, water circulating and force feed pumps, player pianos, roller and ball bearings, connecting rod and crank shaft bearings for internal combustion motors, gas meters, electrical measuring devices, mechanical and electrical horns, phonographs, and for many other purposes too numerous to mention here.

*From a paper presented before the American Institute of Metals, Chicago, September 8.
**Doehler Die-Casting Co., Brooklyn, N.Y.

Die-Casting Processes.

The processes in use for the manufacture of die-castings may be divided into two groups, viz.: Air machines and plunger machines. In the former type of casting machine, the metal is melted in a suitable iron pot fitted with air-tight cover. The air valve is opened to admit air, which forces metal upward into the die. Although there are a number of air machines where metal is poured downward with gravity, the greater number called to the attention of the writer force the metal upward and against gravity.

The plunger type of casting machines, although open to a number of objections, have proved more successful in practice and are used to a much larger extent than the air machines. The writer will confine himself to the machine and process patented by H. H. Doehler in 1907. This process, which is undoubtedly the best of either type, is now being successfully used in all parts of the United States, as well as in Canada, Great Britain, Germany, Austria and Hungary.

Construction of Dies.

Dies are constructed from model or blueprint furnished. The design and construction of the dies constitutes one of the most vital factors in the successful operation of the process. The designer of the die must find the proper location for the gate, which is a very important factor, far more so than in foundry practice. A machine part often pronounced a casting impossibility may be made a possibility by the ingenuity of the die designer.

A better understanding of the importance of the die construction may be gained by a consideration of the die cost. Dies for simple parts may cost from $25 to $100; for more intricate parts from $100 to $500, and for very complicated parts die cost may run as high as $1,000. Although the latter figure seems high, die-castings made from such die still show big savings, since otherwise there would be no demand for such dies.

The predominating features of die-castings are their high degree of accuracy and uniformity. Die-castings can be made to specifications of plus or minus 0.005 in., and when necessary, if conditions permit, to specifications of plus or minus 0.0005 in. These conditions depend upon the alloy to be used and construction of die. Generally, specifications of plus or minus 0.0005 in. can only be had on castings whose dimensions do not exceed 1 in. either way. It must, however, be understood that closer specifications requre more careful die work and consequently higher die cost. Limitations should, therefore, be made as liberally as requirements will permit. From the foregoing it will readily be seen that in the construction of dies only high skilled mechanics can be employed. The employment of inferior labor in this department would be a false economy, since a single misstep may ruin weeks of good work.

The alloys used for die-castings may be divided into three groups, viz.: A, zinc alloys; B, tin alloys; C, lead alloys. The writer in his experience has found the constituents of Group A alloys to vary as follows:

Zinc	70 to 90 per cent.
Tin	0 to 20 per cent.
Aluminum	0 to 5 per cent.
Copper	2 to 5 per cent.
Antimony	0 to 2 per cent.
Lead	0 to 2 per cent.

A typical example of this group of alloys is the following:—Zinc, 84.5 per cent.; tin, 9.0 per cent.; copper, 4.5 per cent.; aluminum, 2.0 per cent. Zinc alloys of the type given have a tensile strength not exceeding 18,000 lb. per sq. in., and an exceedingly low elongation and reduction of area. The strength of these alloys compares favorably with cast iron. Zinc alloys are corroded by aqueous solutions of any kind, and should not be used for food containers or conveyors. Gasoline, which theoretically should be inert toward metals, has been found to corrode zinc alloys, when in direct and constant contact, due to impurities in the commercial gasoline sold to motorists. A good copper-plating, however, will aid a zinc alloy to resist the action of gasoline.

Zinc alloy die-castings may also be plated with nickel, silver, brass, etc., and such coatings protect the castings from corrosion. Zinc alloy die-castings may be buffed to a beautiful white polish, which, unfortunately, becomes dull upon exposure to atmospheric conditions for a few days. A permanent white polished surface may be imparted to zinc die-castings by electro-plating with nickel and buffing. Of all die-castings produced on this Continent and in Europe, approximately 85 per cent. are made from zinc alloys, 10 per cent. are made from tin alloys of group B, and 5 per cent. from lead alloys of group C.

An understanding of the extensive application of zinc die-castings may be gained by a partial enumeration of the parts for use in the motor vehicle industry: Magnetos, self-starting devices, water-circulating pump bodies, force-feed oil pumps, ball-bearing cages, speedometers and wing nuts for windshields. Many of the inventions patented annually would not be commercial possibilities if the present-day zinc alloy die-castings were not available. The numerous automatic vending machines on the market to-day illustrate this fact.

Group B Alloys.

This group, containing 60 per cent. and upward of tin, may be said to consist entirely of babbitt metals. The original tin, antimony, copper alloy patented by Isaac Babbitt, has undergone numerous changes. Constituents have been varied, lead and zinc have displaced the higher-priced tin in many cases, and at the present time any white metal alloy used for bearings is usually styled babbitt metal. Die-castings of this group are mostly used for motor bearings, although they are also used for machine parts where resistance to corrosion is of major importance and where high tensile strength is not required.

In the die-casting process, the metal is poured under pressure into a water-cooled metallic mold. The rapid chilling produces a close-grained babbitt bearing, free from blows and dross spots, so often encountered in the place-poured bearing. An automobile concern producing 50,000 cars per year has used successfully die-cast bearings for eight years without a single complaint and many die-cast bearings on that particular make of car have traveled 50,000 miles and more, only requiring slight adjustment occasionally. The alloy used by this company is of the genuine babbitt type, i.e., containing only tin, copper and antimony in proportions varying only slightly from the original Babbitt formula.

The die-casting company producing these bearings uses only primary Straits tin, Cookson's antimony and the finest drawn or rolled Lake copper. This alloy is mixed by a process in which no constituent is heated above 750 deg. F. and, after mixing it, it is kept below this temperature until cast. Die-cast bearings made in this manner are far superior to those cast in place around the shaft and also more economical.

Under this group of alloys mention must also be made of Parson's white brass, an alloy of tin, zinc and copper. This alloy cannot be cast in the plunger type of machine (due to freezing of plunger), and only with difficulty in the air machine. The alloy, although partially molten at 400 deg. F., is not thoroughly fused and entirely liquid until a temperature of 1,000 deg. F. is reached, at which temperature the alloy drosses excessively, segregates easily and is in general a poor die-casting alloy. There has been, however, a demand for die-castings of the tin-zinc-copper type, and this has caused the placing on the market of a bearing metal known as Comet white bronze, an alloy consisting essentially of tin, zinc and copper, in such proportions and treated in such manner as to overcome the objections to which Parson's white brass is open, although retaining its good bearing qualities.

Group C Alloys.

These alloys, containing 60 per cent. and upward of lead, are so well known as to require no further discussion here beyond saying that the die-casting process is not limited to any particular composition and is applicable to all alloys of this type.

Questions and Answers

Question.—We nickel plate cold rolled steel stampings which must be finished very cheaply. We must, however, get an adherent coating of nickel. Owing to the surface of the stampings being very greasy, we find it rather difficult to clean them quickly, and with little labor expense. We have tried an electric cleaner, but the results obtained tained were not all that could be dethere any other method we could employ to better serve our purpose?

Answer.—Unless the oil used previous to plating be a mineral oil of very low grade, you should be able to clean the stampings by first tumbling them in sawdust and then treating in the electric cleaning bath. However, if you find this method ineffective, the next cheapest rapid method we would advise is the use of a hot copper solution, to be employed as a strike only. This is simply a hot cyanide of copper solution, rich in cyanide. The bath must be operated with the maximum available current and the full voltage of the dynamo, the deposition being merely of a few seconds duration. The cyanide in the solution together with the copious evolution of hydrogen at the cathode will produce a clean surface which is instantly coated with a film of copper. Remove quickly and rinse until cold in clean water; then pass through a cyanide dip. Rinse again and transfer the stamping to the nickel solution. Youw ill find the first cost of this method a trifle greater than others, but it is reliable and incurs no extra labor. Do not depend on the copper solution to remove the bulk of grease from stampings, as such a procedure would result in a contaminated solution. Skim the surface of the bath regularly. This method is equally as simple as the electric cleansing process usually employed and requires no preliminary scouring of stampings. Use electrolytic copper anodes.

* * *

Question—In the process of manufacturing parts of electrical fixtures, our plating department output exceeds our lacquering room capacity. As a result, a large quantity of parts necessarily await treatment after bright dipping the brass parts. These, we find become tarnished to such an extent that they must be redipped. Can you inform us whether there is any method we could employ which would prevent the parts tarnishing so quickly?

Answer.—Prepare a solution as follows:—Dissolve 6 ounces of potassium bitartrate in one gallon of hot water, and use the cleanest, purest water obtainable if you wish best results. Allow this solution to cool and use it cold. After bright dipping the brass parts, rinse them well in clean cold water and immerse immediately in the potassium bitartrate solution, then remove and dry in hot clean sawdust. Parts treated in this manner will remain free from tarnish, and maintain a uniformly bright condition for a considerable time even in the atmosphere of the average plating room.

* * *

Question.—I would like to receive information about the "French brown" finish which is used on small ornamental pieces of the various metals. The process must be one using a solution, and not obtained by pigments.

Answer.—The first consideration is that of the metal to be coated. If iron, or a soft metal such as antimonial, lead, etc., the piece should be given a copper strike in a cyanide copper bath, then rinsed and transferred to an acid copper bath where it should receive at least 1½ or 2 hours deposit of copper. Brass, while not actually requiring the copper deposit, will finish to better advantage if lightly covered with a soft film of copper. The "French brown" dip consists of sulphate of copper, 3 pounds; and caustic potash, 1 ounce each of which should be dissolved separately in a small volume of water, and then mixed in sufficient water to make the total volume one gallon. Upon mixing the two solutions, a hydroxide of copper is formed, and the solution must be vigorously stirred for some minutes until this precipitate disappears. When thus prepared, the solution is ready to use when heated to boiling point. Maintain the solution in a boiling condition while in operation, immerse the article to be bronzed in the solution and note the gradual change in color. After a few trials the exact color desired may be obtained repeatedly. A deep red brown is obtained in about 8 minutes. Lighter shades precede this color and for many purposes are to be preferred. When finished, the article may be rinsed and dried, and the final surface luster imparted in several ways. A soft bristle brush gives better results than a brass scratch brush, while waxing will be found a satisfactory method for finishing life-like models, where the natural shades are to be retained. If lacquered, use a flat lacquer.

* * *

Question.—Is common table salt suitable to use in a nickel solution to improve the color or whiteness of the deposit? Some condemn it, while others who obtain splendid results recommend the salt.

Answer.—The reason why some platers condemn common salt (sodium chloride) as an additional agent or conducting salt for nickel solutions is because it introduces chlorine into the solution, and when used upon steel or iron work, it has a tendency to hasten corrosion beneath the nickel deposit. However, if the iron or steel is first given a reasonably heavy strike in a cyanide copper bath, the nickel deposit from a bath containing a moderate amount of sodium chloride will not prove defective by reason of the presence of the salt. The usual method is to use the sodium chloride together with a small quantity of boracic acid. This both increases the whiteness of the deposit and renders it tougher. A nickel deposit from a solution containing sodium chloride and no boracic acid lacks the toughness that characterizes the deposit from a bath containing the latter chemical. Three ounces of sodium chloride and 3 ounces of boracic acid per gallon will rejuvernate a sluggish solution, if the proper metal content be present. The anodes liberate metal freely and the deposit has a silvery white appearance which is so desirable.

* * *

Question.—We copper-plate cold-rolled steel stampings and steel tubes previous to nickeling. The copper deposit has been first class until recently, the trouble being a blistered and rough hard plate which is very difficult to buff to satisfactory color. We have added cyanide regularly each week and keep the anodes free from black coatings. The tank is connected direct to the dynamo and the voltage is about 5 volts at the tank. The deposit blisters after about 2 minutes run, the entire surface of the cathode being affected. Your advice will be appreciated.

Answer.—Your copper solution is altogether too dense, and, as you do not mention having added copper in any form, we are of the opinion that the cyanide content of the bath has gradually increased until the solution has a density of possibly 10 or 12 degrees Beaume. If by testing with the hydrometer you find this to be the case, the remedy will be very simple. Remove about one-half the total volume of solution and preserve it in a clean barrel or crock for future use. Next, add clean water to the solution left in the tank until the original volume is obtained. Stir the solution thoroughly so that it becomes uniform in composition and test again with the hydrometer. It will now stand about 5 or 6 Beaume. Filtering the copper solution will aid in improving the deposit, if the solution be dirty or has an accumulation of waste material at the bottom of the tank. After disturbing in the above manner, the solution will not work properly for several hours following resumption of operations, but it will gradually become balanced and the resulting deposit be dense, soft and velvety in structure. Your voltage is proper, but avoid using too high current density, as such is liable to cause rough deposits even when the bath is in proper condition. Less frequent additions of cyanide will also be advisable in order to prevent a recurrence of present conditions.

* * *

Question.—When our cyanide copper bath is filled with work and kept in operation with full load, we do not experience any difficulty. If, however, we wish to plate only a few pieces, the deposit is invariably blistered and spoiled. The density of the solution is about 9 degrees on the hydrometer, and the tank is not supplied with a resistance board. The solution has had additions of sal-soda and bisulphite of soda. What shall we do?

Answer.—If you wish to retain the bath at its present density, agitate the cathode during deposition to remove the gas. A more practical method, however, would be to reduce the density of the solution, thus eliminating the necessity of personal attention during a run. You could also use a resistance in the circuit so that the current may be reduced for small surface areas. The solution with a density of 9 to 12 degrees will no doubt prove more efficient for rapid work if the deposit be required heavy. It must, however, be operated with a degree of caution, due regard being paid to current strength. For ordinary purposes, and when used as a strike, the solution is more practical and easily managed if kept at 5 degrees or less. The injudicious introduction of bisulphite of soda is frequently the cause of blisters, as sodas in any form are not productive of the many benefits in copper solutions which are attributed to them. We invariably discourage their use except in special cases. A copper solution composed of potassium or sodium cyanide, carbonate of copper and water, can easily be operated so that the deposits therefrom will equal any obtained from a bath containing soda. The same may be said of brass solutions, except where a very bright deposit is desired and of a golden yellow color. In this case, potassium hydroxide is a valuable addition agent. Every copper or brass solution should be equipped with a coil for heating. This does not necessitate using the solution hot or warm, but an occasional heating after additions are made will be found helpful, giving new life to the solution.'

Trade Gossip

St. John, N.B.—Messrs. Eagles, Hogan & Sterling, all of this city, will establish a brass foundry here.

Moncton, N.B.—The Record Foundry and Machine Co. has received an order for lyddite shells from the Shell Committee.

Toronto, Ont.—A building permit has been issued to the St. Clair Foundry Co. for the erection of an addition costing $2,000 to their plant.

Sarnia, Ont.—The Sarnia Metal Products Co., which has recently completed its plant, will start operations in a few days. Lloyd Lott is sales manager.

Canadian Pig Iron Ore.—Most of the ore used for the manufacture of pig iron in Canada during 1914 was imported from Newfoundland, only 182,964 tons being the product of Canadian mines.

Tara, Ont.—John S. Clark, of Paisley, has gone into partnership with John Foster, of Walkerton, and purchased the Gerolamy foundry in Tara. Mr. Clark was formerly with the Goldie & McCulloch Co., of Galt.

Charlottetown, P.E.I.—The foundry and blacksmith shop of the Bruce Stewart Co., were destroyed by fire on March 20. The damage to the buildings and machinery is estimated at $10,000 with $5,000 insurance.

T. A. Willson & Co., Inc., Reading, Pa., manufacturers of eye protectors and goggles, were awarded a grand prize at the Second International Exposition of Safety and Sanitation recently held at the Grand Central Palace, New York City.

Canada Iron Foundries, Ltd., has been incorporated at Ottawa, Ont., with a capital stock of $4,500,000 to acquire and take over as a going concern the undertaking and business now carried on by the Canada Iron Corporation, in liquidation at Montreal, Que. Incorporators: W. R. Lorimer Shanks, F. G. Bush and G. R. Drennan, all of Montreal, Que.

Alex. Taylor, of Toronto, formerly assistant secretary, has been appointed secretary of the Lake Superior Corporation, the Algoma Steel Corporation, and the subsidiaries of these concerns. Mr.

Taylor succeeds Thomas Gibson, who recently resigned, and is now president of the Lake Superior Corporation, succeeding Mr. Frater Taylor of Sault Ste. Marie, who, however, retains the presidency of the Algoma Steel. Mr. Taylor has also been added to the board of the Lake Superior Corporation.

Frederick Winslow Taylor, a well known engineer, died at Germanstown, Pa., on March 21, aged 59 years. The late Mr. Taylor was the pioneer of scientific shop management and methods, and he devoted the greater part of his career to the study and application of his theories. His work has been of a far-reaching character, and has revolutionized factory management. Mr. Taylor collaborated with Maunsel White in the discovery of the Taylor-White process of heat treatment.

Catalogues

Semi-Muffle Furnaces for case hardening, annealing, carbonizing, heat treating, general hardening and heating work, are described in a bulletin issued by the Gilbert & Barker Mfg. Co., Springfield, Mass.

Flexible Shafts for drilling, grinding and buffing operations are described in bulletin No. 54, being distributed by the Stow Mfg. Co., Binghampton, N.Y. These flexible shafts are shown in combination with electric motors and particulars are given of two types. The Stow two-spindle drill is also described.

Exide Batteries, type Z for motor cycle service, are described in a bulletin recently issued by the Canadian General Electric Co., Toronto. A full and detailed description is given of this battery covering its construction and lighting capacity. Tables are included giving the principal dimensions of each type.

Brass Foundry Equipment. — The Whiting Foundry Equipment Co., Harvey, Ill., has just issued a new bulletin No. 114, dealing with equipment for brass foundries. Among the lines described are brass melting furnaces, cranes, crucible tongs, and tumblers. Each product is illustrated and tables give the principal dimensions. Copies will be mailed free on request to those interested.

Tumblers for foundries are described at length in a catalogue No. 113, recently issued by the Whiting Foundry Co., Harvey, Ill. A number of styles are illustrated and the principal features are stated together with tables giving the leading dimensions of each size and other data. Other illustrations show interior views of cleaning rooms with batteries of tumblers installed. Copies may be had free on request.

Belt Conveyors.—The Jeffrey Manufacturing Co., of Columbus, Ohio, have issued a new belt conveyor bulletin No. 167. This bulletin contains 24 pages of interesting illustrations and descriptive matter which give a comprehensive idea of the wide variety and adaptability of the Jeffrey belt conveyer equipments for handling practically all kinds of materials. A free copy will be gladly sent to intending purchasers of elevating and conveying machinery.

Saw Sharpening Machines. Honeywill Bros., London, England, have issued a catalog dealing with an automatic saw sharpening machine, which is fully described and accompanied by a specification. The illustrations show the machine with the necessary attachments for grinding, circular, frame and band saws. A representative list of tooth profiles which can be sharpened on this machine is included among the illustrations. One view shows a machine sharpening a circular saw six feet in diameter.

Brass Foundry Equipment.—A new 48-page bulletin of more than ordinary merit is being distributed by Frederic B. Stevens, of Detroit, Mich., and Windsor, Ont. All equipment required in a brass foundry is dealt with in its pages, including furnaces, blowers, crucible tongs, core ovens, sprue cutters, magnetic separators, flasks, etc. Each line is illustrated and carefully described, and accompanied by dimensions where necessary. Special reference is made to the various types of crucible furnace using coke, gas or oil fuel.

The Jeffrey Mfg. Co., of Columbus, Ohio, have recently issued a new 48-page bulletin, No. 147, illustrating and describing the prominent features of their complete line of swing hammer pulverizers, giving full information regarding capacities, speeds, horsepower, general dimensions, etc. More than 1,000 of these machines are now in daily operation reducing limestone, shale, gypsum, clay, coal, coke, ores, tankage, bark, oyster shells, rock for road top dressing, and many other materials. A free copy of this bulletin may be obtained by writing to their home office.

A Study of the Malleable Furnace is the third of a series of booklets which have been issued by the Harbison-Walker Refractories Co., Pittsburgh, Pa. This is a most interesting and instructive volume, containing a fund of information on malleable practice, written in simple language. It aims to present the vital points in as clear and concise a form as possible, so that a fair understanding of the principles involved in connection with the production of malleable iron may be readily acquired by those not familiar with the scientific aspect of such work. The booklet contains six chapters, describing in a comprehensive manner the characteristics and properties of malleable iron and its manufacture. The micro-structure of malleable iron, also air and annealing furnaces are dealt with. The forty-nine illustrations consist principally of a number of interesting photographs of fractures and photomicrographs. The booklet contains 112 pages and is a high-class production, being printed on coated paper and bound in attractive covers.

The Buffalo Forge Co., Buffalo, N.Y., has recently published a series of bulletins and catalogues which contain much useful data on fans and blowers. Catalogue No. 200 describes the Buffalo planoidal fans, a modification and improvement on the older type of steel plate heating and ventilating fans with a comparatively small number of radial blades. Catalogue 201 deals with Niagara conoidal fans, and catalogue 182-E is a collection, for convenient reference, of the various types of blowers and exhaust fans, which are regularly built for direct connection to motors. This includes everything from large ventilating and drying fans down to the little "Baby" conoidals for ventilation of moving picture booths and drying cabinets, also electric blowers for single forge fires, which take less than half the horsepower of an ordinary electric lamp.

Book Reviews

The Canadian Mining Manual for 1914, by Reginald G. Hore, editor of the Canadian Mining Journal, published by the Mines Publishing Co., Toronto. This is the first issue of the manual since it was taken over by the present publishers although several years have elapsed since its inception. The manual contains 273 pages, and gives much valuable and reliable information concerning the mineral resources and the mining industry of Canada. The opening pages are devoted to descriptions of the chief mineral products of Canada, giving particulars regarding location of the deposits and output for 1913. The illustrations in this section are colored to correspond with the natural color of the metal or mineral and form an interesting feature. The succeeding pages contain a series of reviews of the mining industry in the various provinces with the production for 1913. A list of mining companies operating in Canada is included with particulars of each concern. The concluding pages contain a list of Canadian mining companies arranged in order according to product. The manual is fully illustrated and will form a useful book of reference for those interested in Canadian minerals and the mining industry.

Electric Elevators, by Elmer G. Henderson; 90 pages, 7½ in. x 5 in. Published by the Joseph G. Branch Publishing Co., Chicago, Ill. Price, $1 post-paid. This book deals with the construction and operation of electric elevators in a practical way, all technical matter having been avoided where possible. The author is a practical elevator constructor, and is thus able to treat the subject in a manner which should be readily understood by those engaged in the construction and operation of elevators. It will, therefore, be inferred that the book was written for this class of reader. The book contains twelve chapters. The first three deal with elevators of various types, including the different arrangements of the mechanical and electrical equipment and the counter-balancing of elevator motors. The following two chapters deal with the construction of D.C. and A.C. motors. In chapters 6, 7 and 8 the construction of various types of controller are described and their relation to the operation of the elevator dealt with fully. Governor and push-button devices are described in chapters 9 and 10, while chapter 11 contains an extract from the Chicago building ordinances. The concluding chapter contains a number of useful electrical tables. The book contains 41 illustrations carefully indexed, while in addition there is the usual table of contents. The book is practical, covers the subject thoroughly and contains much useful information for those engaged upon electric elevator construction.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS--Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

Air Compressors.
A. R. Williams Machy. Co., Toronto.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.

Alloys.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
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Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
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F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
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Webster & Sons, Ltd., Montreal.
Wells Pattern & Machine Works, Limited, Toronto.

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Webster & Sons, Ltd., Montreal.
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W. W. Wells, Toronto.

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McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
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Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
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Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

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Webster & Sons, Ltd., Montreal.
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H. S. Carter & Co., Toronto.
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Webster & Sons, Ltd., Montreal.
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Webster & Sons, Ltd., Montreal.
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Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
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Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

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Webster & Sons, Ltd., Montreal.
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Stevens, F. B., Detroit, Mich.
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A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

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Stevens, F. B., Detroit, Mich.

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Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
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Hamilton Facing Mills Co., Ltd., Hamilton, Ont.
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Midland Machine Co., Detroit.
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CIRCULATES IN EVERY PROVINCE IN CANADA

CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited. Toronto, Montreal, Winnipeg, and London, England

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The Publisher's Page

By B.G.N.

SIGNS OF THE TIMES

¶ Even the worst calamity howler in the country doesn't need a telescope now in order to get a glimpse of the silver lining of the cloud that has been drifting over us for the last nine months.

¶ With the coming of spring a noticeable change has taken place, and all the signs are hopeful. There are many indications that business is gradually returning to normal, and we look for a steady improvement.

¶ "Banks' Position Very Exceptional," says the Financial Post—"Savings Deposits much higher than heretofore," "Business outlook more cheerful—Crop reports continue to be excellent."

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¶ The once familiar sign—"Help Wanted" is again coming into more general use, and we know of no more encouraging sign of the times than this. A Toronto daily paper, noted as a "want ad" medium, reports a heavy increase in advertisements classified as "Help Wanted."

¶ With the gradual return to normal, and very likely unexampled prosperity, there will be a proportionate increase in the purchasing power of Canadian industries. This should suggest prompt action in influencing that particular share of business which, under proper conditions, should belong to **YOU**.

¶ The wise farmer sows his seed in the spring time, and takes his chances on the harvest. Don't wait until you see the other fellows reaping their harvest before you start **your** campaign of seeding and cultivating. You can't hustle around, sow your seed, and force a crop in a few weeks. It just can't be done.

¶ A half-page well planted now will yield greater returns than a full page hurriedly sown when the harvest should be ripe.

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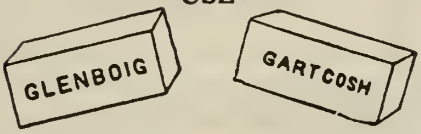

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WRITE FOR LITERATURE.

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Sole Agents for Canada

AIR

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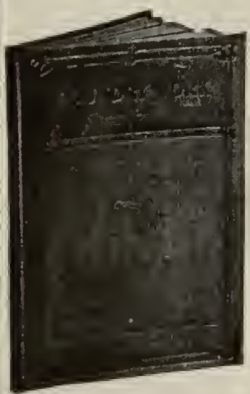

Foundry Work

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Canadian Foundryman

143-149 University Avenue, Toronto

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Development of Our Nickel-Copper Smelting Industry

The European War has brought this particular industry very much into the limelight, on which account information relative thereto is of more than ordinary interest and moment. The two immediately preceding articles dealt with the Mond Nickel Co. smelting plant features. In the present instance, a brief account is given of the Company's refining plant in Wales, and, in addition, considerable light is thrown on the value of nickel as a commercial, naval, military and domestic utility. The information given is more or less official.

MOND NICKEL CO. REFINING PLANT.

BEING a purely British corporation, and in view of the fact that the ore is mined and smelted in Empire territory by the Mond Nickel Co., it is only natural to expect that the refining or ultimate process, whereby the nickel product becomes a marketable commodity, should also take place within the like bounds.

Refining Works at Clydach, Wales.

The Bessemer matte is shipped from the company's smelters at Coniston via the Canadian Pacific Railway or the Canadian Northern Railway to Montreal, and thence to Swansea, Wales, near which port the company's refining werks are situated. Here the matte is refined by the Mond Nickel or Nickel Carbonyl process. Five operations in all are required to produce the nickel:—

1.—Roasting to free the matte from sulphur.

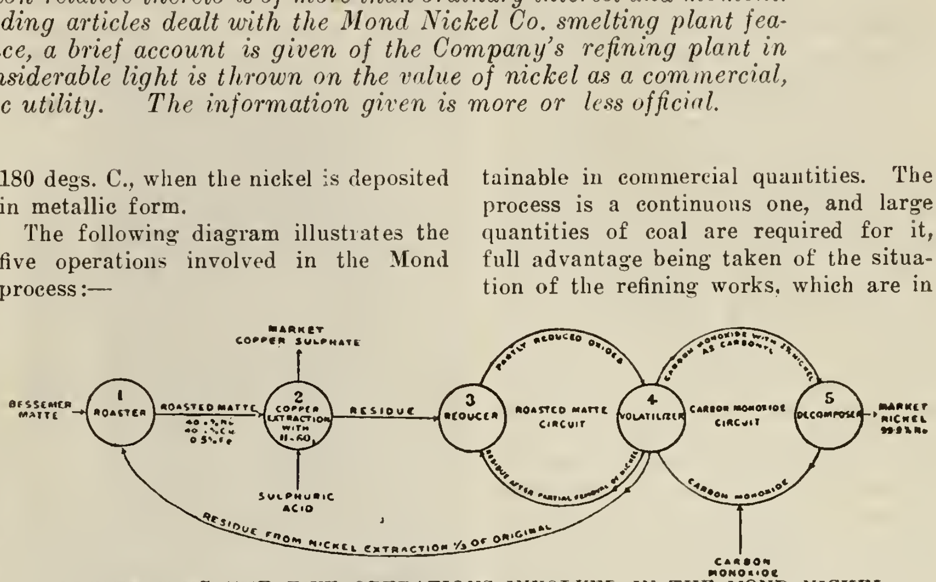
2.—Extraction of two-thirds of the copper by sulphuric acid.

3.—Reduction of the nickel and remaining copper by water gas rich in hydrogen at a temperature not higher than 400 degs. C.

4.—Treating the reduced matte in an apparatus called a "volatiliser," by carbon monoxide at a temperature not exceeding 80 degs C.

5.—The nickel-carbonyl gas produced by the previous operation passes into a "decomposed" in which it is heated to 180 degs. C., when the nickel is deposited in metallic form.

The following diagram illustrates the five operations involved in the Mond process:—



ILLUSTRATING THE FIVE OPERATIONS INVOLVED IN THE MOND NICKEL REFINING PROCESS.

The process is not completed, however, by one passage through the five stages, as only about 60-70 per cent. of the nickel has been removed from the matte by the nickel-carbonyl gas. The residue from this operation, which does not differ very much in its composition from the original matte, is returned to the first operation and follows the same course as before. In operation 5, the carbon-monoxide is released and returned to the "volatiliser," to take up a fresh charge of metal. The nickel is deposited on granules of refined nickel, which are automatically removed after they have grown to a certain size.

The product obtained contains between 99.8 per cent. to 99.9 per cent. of nickel, not including cobalt, and is the purest form of nickel which is at present obtainable in commercial quantities. The process is a continuous one, and large quantities of coal are required for it, full advantage being taken of the situation of the refining works, which are in the midst of the Welsh anthracite and steam coalfields. It is therefore possible to secure at very low cost the necessary supply of coal which in the process is largely used for power, steam and gas. The products made in the process are:—

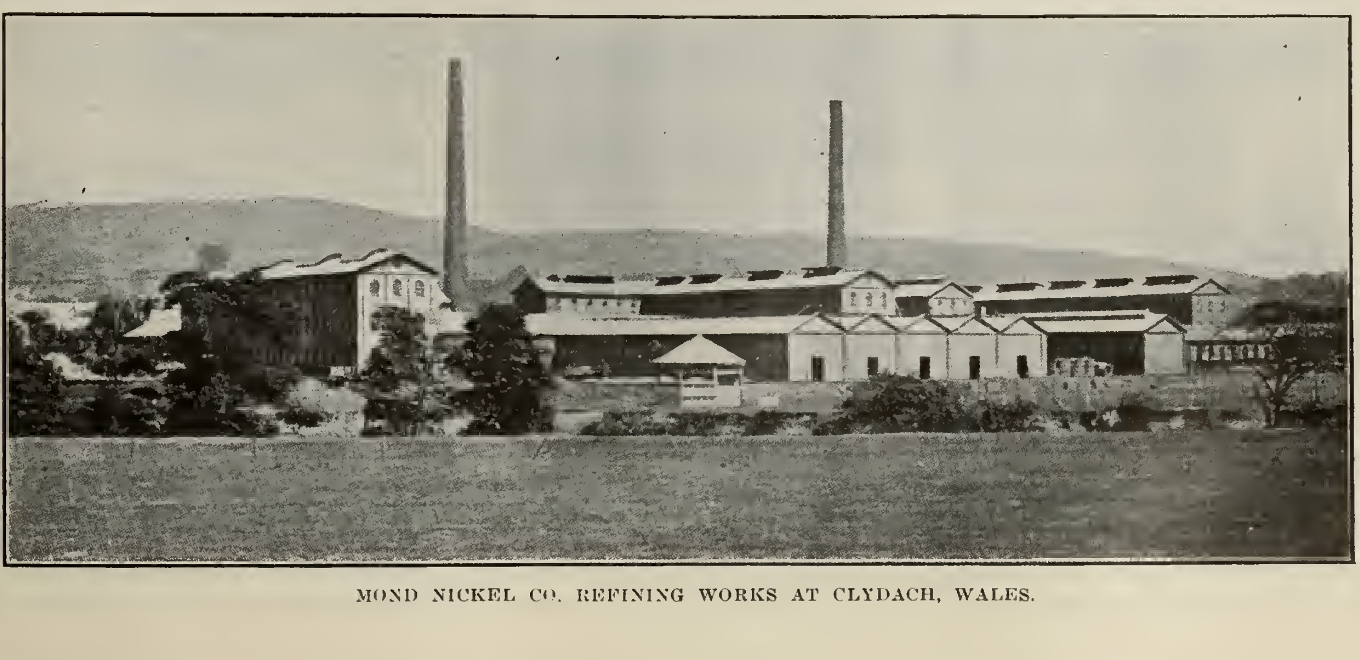
1.—Sulphate of copper.

2.—Nickel.

3.—Nickel salts.

Copper Sulphate.

The copper sulphate is shipped from Swansea to Italy, France, and Spain, and other wine-producing countries, to be used for spraying the vines, in order to prevent mildew and other fungoid diseases. It is recognized that the spraying of sulphate of copper is the only preventative against these diseases. Copper sulphate is also used for prevention of



MOND NICKEL CO. REFINING WORKS AT CLYDACH, WALES.

diseases in other plants, for spraying potatoes, olive-trees, for killing weeds, etc.

Nickel Salts.

The nickel salts manufactured by the company are largely used in the nickel-plating industry, and also as a catalyser for fat-hardening purposes.

Company's Village at Clydach

The Mond Nickel Co. have done much in the interest and comfort of their employees. With this object in view they erected a model village near the refining works at Clydach, where comfortable and distinctive accommodation is provided for the workmen and their families.

The social activities of Clydach Village centre round its club, which was opened in January, 1909, and that it has fully justified its existence is shown by the fact that it can boast of over 500 members. The club house itself was built by the company at a cost of nearly $20,000, its main feature being a large concert hall with seating accommodation for 450, wherein fortnightly concerts are held throughout the winter. Admission is free and members are entitled to introduce their friends. There are also a billiard room with two tables, and air-rifle range, a photographic dark room, a reading room, a refreshment room and the usual committee rooms.

In the club library, which is well stocked with excellent works of fiction, biography, travel, science, etc., there are more than 1,000 volumes from which members can make their selection, while, in the reading room, technical publications, the leading daily newspapers, as well as weekly and monthly journals, are provided for their entertainment.

The Clydach club is not limited by four walls, its activities extending far beyond the actual club house. For instance, affiliated to the club are football, cricket, hockey and curling sections, and members of a musical turn of mind have an opportunity to display their talents in the brass band, orchestral, or male voice party sections. In addition, the club has a photographic section, not to mention a flourishing gardening society, in connection with which a flower show is held every year. In fact, every employee at the Mond Nickel Co. Refining Works at Clydach is pretty sure to be able to find in the club some opportunity for the gratification of his particular tastes in whatever direction they may lie.

Uses of Nickel.

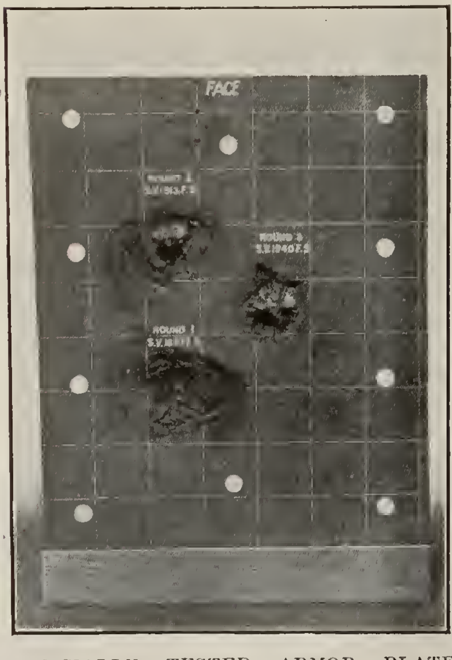
The uses of nickel are so many and are multiplying so rapidly as to be almost innumerable, and although the importance of pure nickel is growing daily, the chief use of the metal is in the production of alloys, particularly nickel steel, in which the greater part of nickel refined is still employed. The alloy of nickel and iron is no novelty, since all native iron of terrestrial as well as meteoric origin contains nickel. Moreover, as far back as 1822, experiments were made by Faraday in alloying nickel and iron, and since then improvements in the process have been made continually.

Nickel Steel.

Nickel steel has many uses and is constantly finding new applications. Steel containing from 2½ per cent. to 3½ per cent. of nickel has certain of its properties greatly improved, so that in many directions it is replacing ordinary structural steel. The following table, which shows a comparison of carbon and nickel structural steels gives some idea as to its superiority:

Characteristics.	Med. Carb. Strength	Med. Nickel Steel
Percentage of carbon	0.20	0.38
Percentage of Ni	0	3.50
Elastic limit (lbs. per sq. inch)	30,000 (Min.)	60,000 (Min.)
Ultimate strength (lbs. per sq. inch)	60,000 (Min.)	105,000 (Min.)
Modulus of elasticity	29,000,000	30,000,000
Safe working stress in tension (lbs. per sq. in.)	16,000	28,000

Perhaps the most important use to which nickel is put is for the manufacture of armour and heavy ordnance, where its great strength and toughness have proved of great value. It has been used for engines and propeller shafts for a number of years and has proved so much superior to other steels that it is now considered unrivalled for such purposes. On account of the increase in strength or decrease in weight, it has been used for crank pins, light forged engine frames, bolts for extreme hydraulic pressure, hydraulic forged cylinders and railway axles. From its peculiar resistance to fatigue under vibration, it is employed very successfully for piston rods in steam engines and drills.



OFFICIALLY TESTED ARMOR PLATE FOR BATTLESHIP—MADE BY SIR. W. G. ARMSTRONG, WHITWORTH CO. MOND NICKEL USED IN MANUFACTURE.

The value of nickel steel for armour plates, when cemented and face-hardened, consists not only in its greater resistance to penetration, but in its non-fissibility. So completely is this recognized, that since the Washington Navy Yard first began experimenting with nickel steel in 1876, every country in the world has come to rely on nickel steel for the armour-plating of its first-class ships of war. Incidentally, it may be mentioned here that nickel prepared by the Mond Nickel Co. is largely used in the manufacture of armour-plates for the British Government.

Nickel Steel for Bridge Building.

There is also an increasing demand for nickel steel for the building of bridges. Nickel steel is being used for the rebuilding of the Quebec bridge which collapsed so disastrously a few years ago. It also entered largely into the construction of the Manhattan bridge at New York. This is the heaviest suspension bridge in existence, and for its length the heaviest bridge of any kind in the world. Although its span is 140 feet less than the span of the big cantilevers of the Forth Bridge, the enormous load which the bridge is designed to carry calls for a weight of cables and suspended superstructure that makes it by far the heaviest and strongest bridge yet constructed.

The suspension bridge proper, disregarding the approaches, consists of a main span 1,470 feet long and two side spans, each 725 feet in length. The total width of floor is 120 feet. A novel feature is the use of nickel steel in the upper and lower truss chords, which are subjected to a working stress of 40,000 lb. per square inch. The nickel steel rivets are subjected to a working stress of 20,000 lb. per square inch, and notwithstanding the higher cost of the nickel steel, the saving in weight is such as to make the trusses actually cheaper than if they were built entirely of ordinary structural steel. The weight of steel in the superstructure from anchorage to anchorage exclusive of the cables, is 10,500 tons of carbon steel and 8,000 tons of nickel steel. The weight of the cables is 6,300 tons and the total weight of steel in the whole bridge, including anchor chains, cables, towers, and suspended span, is 42,000 tons. The following paragraphs show the approximate saving in weight and cost of bridges effected by the use of nickel steel:

Mixed nickel and carbon steel—saving in weight up to 25 per cent; saving in cost up to 17 per cent.

Nickel steel throughout—saving in weight 10 to 30 per cent.; saving in cost up to 12 per cent.

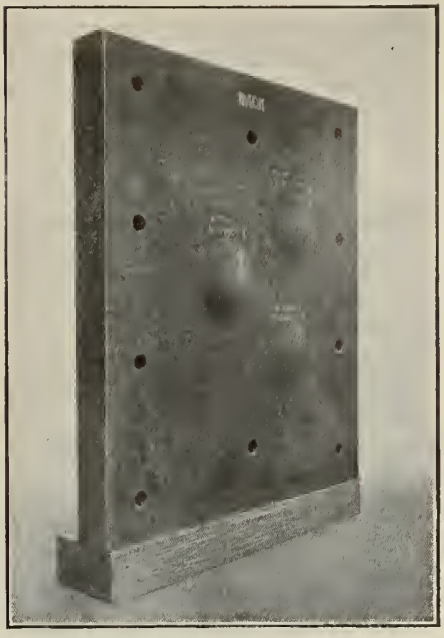
General Uses.

Nickel steel is especially suitable for motor car parts, because it possesses high tenacity and is very durable and has a remarkable co-efficient of expansion. For this same reason it is particularly well adapted for steel rails, and in places liable to special stress it is much used. For instance, it is estimated that in a sharp curve one nickel steel rail has a life as long as that of four rails made of ordinary steel.

Nickel steel is also used in wire cables, torpedo defence netting, electric lamp wire, corset wire, mountings of lenses, mirrors, balances for clocks, weighing machines, springs, cutlery, harness mounting, boiler tubes, axles, brake-beams and transoms for field artillery wagons as used by the French Army since 1898.

Currency

A great many countries have adopted nickel or nickel alloy for the manufacture of small currency, for the reason that only nickel and nickel alloy completely fulfil the requirements of such currency. The metal used must be comparatively cheap, of handsome appearance, not liable to oxidation or alteration by any chemical agent; and it must be not too difficult to mould, roll, punch and stamp; be capable of taking a good impression of the die, durable in wear and difficult to counterfeit.



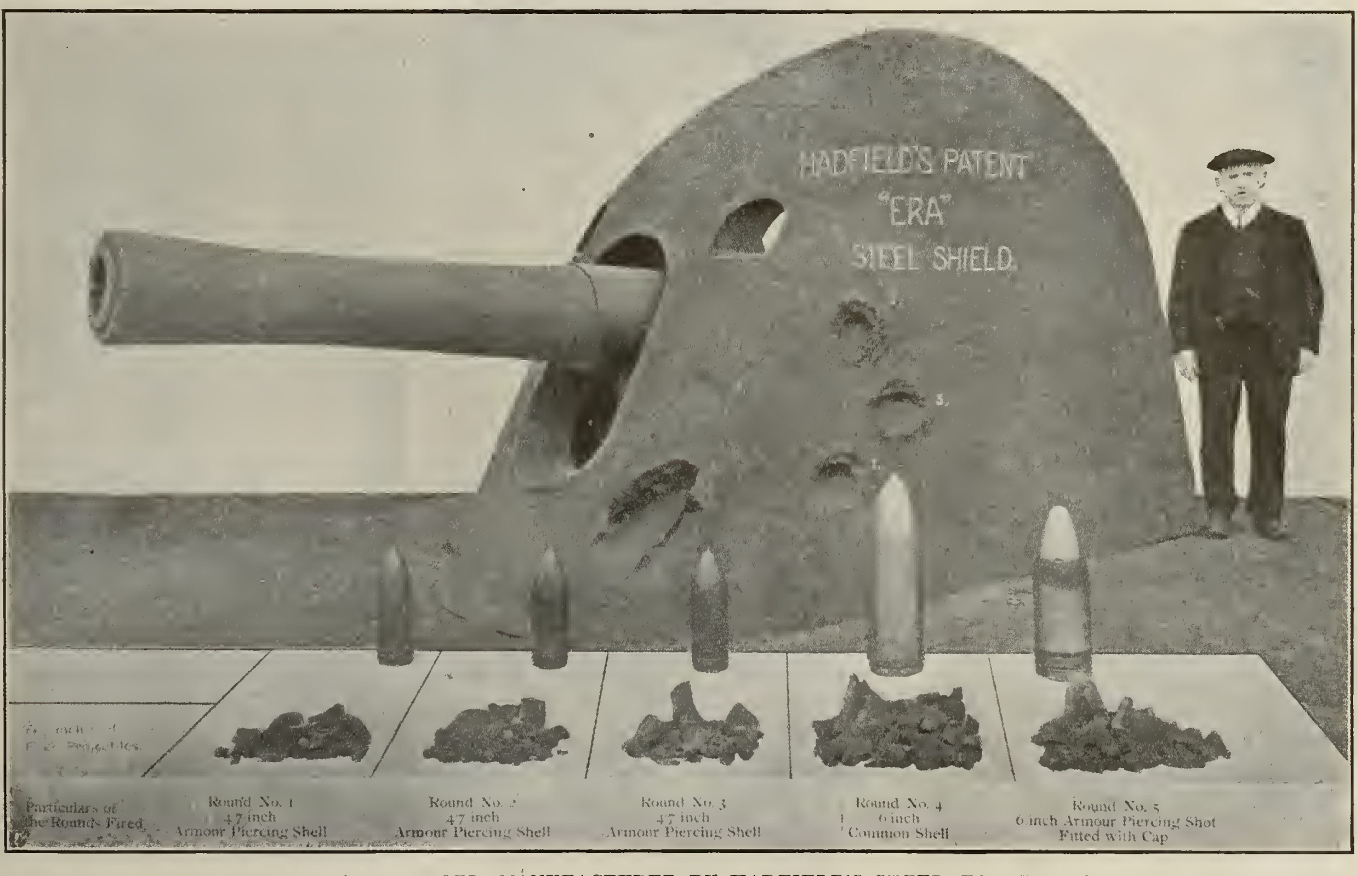
OFFICIALLY TESTED ARMOR PLATE FOR BATTLESHIP—MADE BY SIR. W. G. ARMSTRONG, WHITWORTH CO. MOND NICKEL USED IN MANUFACTURE.

Formerly, pure copper was most frequently used for the commoner coins in nearly all countries. It is cheap and easy to work, but very liable to oxidation and too soft. Moreover, the risk of counterfeiting can scarcely be avoided, as copper can be had everywhere and offers no difficulty in working.

Bronze has also been tried in order to enhance the hardness of copper, but the coins of this alloy suffer from nearly all the disadvantages of those made of pure copper.

German silver, which is an alloy of nickel, copper and zinc, has been used for coins in various states of South America, but although better than copper and bronze, it oxidizes too readily and soon loses its bright appearance. German silver, with an addition of pure silver, was tried by the Swiss Government, but the coins made of this alloy soon became yellowish and unsightly, and Switzerland has since adopted pure nickel and nickel alloy for its coinage.

Small copper coins coated with silver have been used in many countries, but the silver coating soon wore off and the appearance of the coins became so paltry



PROJECTILES MADE FROM NICKEL STEEL, MANUFACTURED BY HADFIELD'S STEEL FOUNDRY CO., SHEFFIELD, ENGLAND. MOND NICKEL USED FOR NICKEL STEEL.

and the dirt stuck to them to such a degree that many countries in which they were in use discarded them altogether.

The first experiments with alloys of nickel and copper were made in the United States and Belgium. The compositions varied from 10 per cent. nickel and 90 per cent. copper to 50 per cent. nickel and 50 per cent. copper. In both these countries and later in several others (including Germany) it has been proved that an alloy of 25 per cent. nickel and 75 per cent. copper possesses to a high degree the qualities desirable for material for small currency. Coins of this alloy being harder than bronze, the material being much dearer, and greater skill and a powerful plant being required to work them, it is practically impossible for counterfeiters to produce imitations with any chance of success.

It is only a few years ago that a process was discovered to roll, hammer and stamp pure nickel, and already the governments of Austria-Hungary, Italy, Switzerland, Denmark, Montenegro, Mexico and other countries are being supplied with coins of this metal. These coins are the most excellent that have ever been made, are most durable in wear, they never oxidise and it is simply out of the question to endeavor to counterfeit them successfully. How widespread is the use of nickel and nickel alloy for small currency can be seen by the following table of the countries which have adopted nickel coinage:

Argentine	Japan
Austria-Hungary	Jamaica
Belgium	Kiatchaow
Bolivia	Luxembourg
Bulgaria	Mexico
Brazil	Montenegro
Ceylon	The Netherlands
Congo	Nigeria
Chile	Peru
Columbia	Portugal
Corea	Persia
Costa Rica	Paraguay
Crete	Phillipine
Denmark	Panama
Egypt	Roumania
Ecuador	Reunion
France	Servia
Germany	Switzerland
Greece	Siam
Guadaloupe	Salvador
Guatemala	United States of America
Hayti	
Honduras	Uruguay
India	Uganda
Italy	Venezuela

Kitchen Utensils.

The remarkable properties of nickel, which approaches the precious metals in its chemical powers of resistance, while far exceeding them in hardness and toughness, have in later years led to its employment, firstly for cooking utensils and kitchen ware, and secondly in an ever-increasing degree, for cookers, dishes, basins, baths, crucibles, stills and hollow vessels of every description used throughout the technical arts.

Indeed, as a metal for cooking utensils, nickel is the ideal. Tinned or "tin" vessels (sheet iron coated with tin) are mostly thin and very liable to injury, while enamelled vessels have the great drawback that the enamel coating is liable to chip. Thus, when damaged enamel utensils are used the food comes into contact with the iron and is apt to acquire a metallic flavor. There is also the great danger of detached chips of enamel being swallowed with the food.

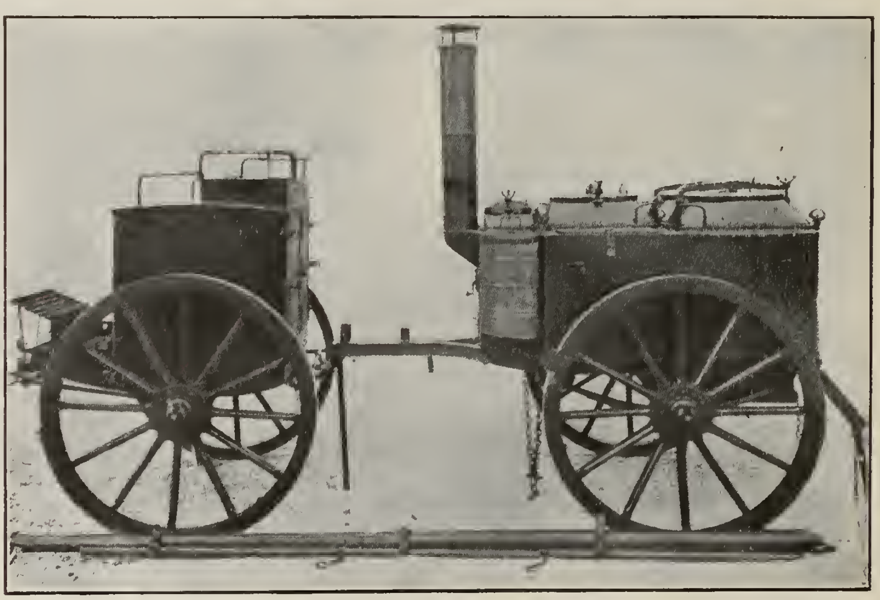
Copper cooking utensils undergo strong oxidation, and can only be used provided they have a thick inside coating of tin. This coating wears away very rapidly and has often to be renewed; thus there is always the danger of the formation of poisonous copper salts which dissolve in the liquid food. Copper utensils under any circumstances mean a great deal of work for the kitchen staff, for every time after use they must be not only washed, but scoured to remove the discolorations caused by the fire. One of the main advantages of the use of nickel kitchen utensils is that they do not require tinning.

ARMY COOKING CHEST MADE OF PURE NICKEL.

Nor do cooking utensils made of aluminum provide a satisfactory substitute for copper or iron. The melting point of aluminum is comparatively low, so that it is extremely sensitive to the action of heat, and vessels of aluminum unfilled with water frequently melt if they are put on a strong gas flame or fire. Moreover, the constant recurrence of a dull gray layer of oxide necessitates constant scouring; and aluminum, being exceedingly soft, requires specially careful and delicate handling in this operation. Aluminum is also dissolved in liquid food and forms metallic salts which may sometimes be poisonous.

ARMY FIELD KITCHEN—INTERIOR FITTINGS OF PURE NICKEL.

All the dangers and disadvantages enumerated are entirely absent from nickel utensils. Pure nickel does not oxidise like iron, copper or aluminum; it is harder than these metals, and is therefore much more durable; it may be, therefore, described as positively indestructible. Pure nickel utensils, moreover, when worn beyond possibility of further service, still retain a high metal value.



ARMY FIELD KITCHEN—INTERIOR FITTINGS OF PURE NICKEL.

Field Kitchen Appliances.

From the ordinary barrack's cooker, it is only a short step to the manufacture of field kitchen appliances, for, owing to the great strain and rough treatment to which military cooking appliances are exposed, they must be made of a material:

(a) — Which possesses sufficient strength and durability to withstand even the rough handling inevitable in the field.

(b)—Not liable to injury, even if the cooker be wrongly heated—i.e., when empty or insufficiently filled.

(c)—Which is faultless from a hygienic standpoint, and precludes every possibility of injury to health.

(d)—Which does not require repair in field such as would inevitably happen with copper and iron, owing to the necessity of re-tinning.

Pure nickel alone is capable of responding to these varied requirements. The field-kitchens for military purposes are designed in such a way that they can prepare the food for 250-260 men in the course of a few hours, even during marches.

A further article for the efficient feeding of troops, especially mountain troops, is the cooking-chest. This consist of a pure nickel field kettle of about 5.72 gallons capacity, together with an iron under-frame for heating. The kettle and hearth or under-frame telescope into each other and are put into a chest made of veneered wood, lined with asbestos straw, oil-paper and cork. The chest is fitted in such a way as fully to retain heat. Some hours before the meal is required, the food is heated to boiling temperature, and the kettle is then put into the chest: the latter closed and mounted on the saddle, and during transport the food becomes thoroughly cooked. The design of the chest is so ingenious that after 18 hours with an outside temperature of 30 deg. F., the food is still found to have a temperature of 182 deg. F.

CUPOLA DEVELOPMENT AND OPERATION.

By R. Buchanan.

WITH respect to those types of furnace which were drawn in at the bottom, I have made up my mind that this feature was an advantage, and have often debated whether the saving of coke effected was not more than counterbalanced by the cost of the extra labor required in fettling, to say nothing of the risk of hanging up just where the contraction of the contour started.

Receiver Feature.

With regard to having a receiver, opinion among foundrymen is very varied. To my mind the question whether or not a cupola should have a receiver depends largely upon the class of work to be done. A founder who was casting very large cylinders told me that he had worked a furnace without a receiver, but having tried a receiver he would not now do without it. One obvious advantage of a receiver was that a foundry with a particularly small output, but with occasionally a large casting and requiring very clean work, could gather the metal and so utilize the small cupola with advantage in making the large casting. There was thus avoided the necessity of having two cupolas, one of which would be most of the time standing idle. That consideration, to my mind, covered the question, though it is also to be noted that, with a receiver, one can have the tuyeres nearer the bottom than if the metal had to be gathered in the cupola itself. It should, however, be borne in mind that with a receiver more work was required to get the complete apparatus ready for melting than was necessary when there was no receiver.

In the Machiel cupola the receiver was really the bottom part of the cupola. There was a bridge extending over four-fifths of the bottom, and everything was kept up by that bridge. The metal when melted remained in the receiver and was gathered there. I prefer that cupola, as it is possible to get exceedingly hot metal with a comparatively very small expenditure of coke; but the coke and the debris has to be drawn out at the end of the cast, whereas in drop-bottom types the bottom can be dropped, and the cleaning out takes very little time. The Whiting cupola has two rows of tuyeres, whereas the Thwaites has three. The tuyeres in the Whiting are made adjustable, but my experience of adjustable tuyeres is that if we work for a time with one row only and then try to use the second row, they can not be got open.

I consider it an advantage to have a second row, but only big enough to supply sufficient air to burn the gases which were formed below. This is better than letting the gases go up and burn by admitting air at the charging door. The latter was quite a common practice at some foundries, but when one saw a flame 9 or 10 ft. long coming out at the top of a cupola the inference was that the owner either had a lot of money to burn or did not know how to run a furnace. The second row of tuyeres should serve to burn the gases, but not to burn the coke, though it is probable that some of the coke also would be burned.

As far as I know, there is no melting in the cupola now done by gas. In experimenting with the latter some years ago, the ash-bed was filled up with coke and instead of pure air a mixture of gas and air was played on to the bed. I melted 2,800 lbs. practically without wastage of the coke; the cupola melted slowly, but hot, and I took out practically as much coke as I put in. That, of course, was not melting altogether by gas, because a bed of coke was used.

Contour of Linings.

There are many different opinions as to the best form. The tendency is towards a perfectly vertical section, the cylindrical form. One often wishes that we could get the linings of cupolas to last as long as did those of blast furnaces. I have seen a blast furnace which ran for eleven years without relining, but in the more modern blast furnace they are going back more to the type of the cupola. There was no doubt that in a wide blast furnace carbon was deposited on the walls and so preserved them, whereas in a blast furnace of the cupola type no carbon was deposited on the walls.

I have seen only one water-cooled cupola, that in a steel works, and the wastage of the lining there amounted from 12 in. to 15 in. in a week, so that each week the lining, from the melting zone up to the charging door, had to be renewed. In the ordinary cupola frequent renewals are, of course, necessary, but it does not seem that it should be an absolute impossibility to design a cupola, the lining of which would last at least a week without requiring any renewal.

Blast Pressure.

With regard to blast pressure, it has been shown that as the blast is increased the hardness increased. A few years ago it was pretty generally thought that the more air was blown in the better; but that idea was wrong.

RECRUITING FOR MUNITIONS.

A new recruiting poster has made its appearance all over London, England, calling for recruits of "any age, any measurements, any medical qualifications or disqualifications," so long as they are good mechanics or capable of doing any of the work necessary for turning out war munitions.

Men who volunteer for this service will register their names with the recruiting officers, but they will be employed directly by the armament firms, not by the Government. The recruiting officers thus become a sort of labor exchange for the firms which are producing shells, rifles and other necessaries of war. The new poster appeal is headed, "The Man the Army Wants Now," and bears a sketch of an artisan at work.

One foundryman known to me used a 22-oz. blast, his object being to get a very close-grained metal, but in such a case it would be better to select a different metal to begin with and use an easier blast instead of using a soft iron and then hardening it by heavy blowing. On the other hand, another foundry used 1,700 lbs. of scrap to 560 lbs. of pig, and the castings came out quite soft, a 4-oz. or 5-oz. blast being used. That foundry was, in fact, buying coke instead of pig-iron.—From a recent address before the Birmingham Branch of the British Foundrymen's Association.

STANDARDIZATION OF THERMOMETERS AND PYROMETERS.

IN a communication to the Institution of Mechanical Engineers, R. G. Whipple states that the question of standardization is of great importance to all users of thermometers, whether they are employed to measure high or low temperatures.

The boiling points of aniline, 184.1 deg. C.; naphthalene, 218.0 deg. C.; benzophenone, 306.0 deg. C., may all be used for standardization points. Aniline, however, oxidizes readily. Naphthalene is satisfactory, as it is cheap and readily obtained of sufficient purity. This is best tested by taking its freezing-point, which should be 80.0 deg. C. A special, but simple, boiling-point apparatus must be used with both naphthalene and benzophenone. For higher temperatures, it is advisable to use the melting-points of pure metals or eutectic alloys and the freezing-points of pure salts. The following will be found useful and satisfactory points:

Freezing-point of tin, 231.92 deg. C.
Freezing-point of lead, 327.43 deg. C.
Freezing-point of zinc, 419.37 deg. C.
Boiling-point of sulphur, 444.70 deg. C.
Melting-point of antimony, 630.7 deg. C.
Melting-point of sodium chloride, 800 deg. C.
Melting-point of silver, 960.88 deg. C.
Melting-point of copper, 1083.0 deg. C.

In the case of radiation and optical pyrometers, the best way is to sight upon a piece of firebrick or porcelain placed in either a small tube electric furnace or gas-fired muffle. A stardardized thermo-electric couple is mounted either on the face of the firebrick or through a hole in its centre, the pyrometer being focused on the couple. The furnace is then heated and the readings of the pyrometer compared at various temperatures. If a thermo-couple is not available, a single melting-point will be a valuable check on the pyrometer. A triangle is cut out of a piece of thin sheet silver, and one side partly folded over so that the sample will stand up when placed in the furnace. The pyrometer is then focussed on the tip of the triangle, and the temperature at which it melts (960.88 deg. C.) observed.

E. H. MUMFORD DEAD.

E. H. MUMFORD, very prominent and well known in the molding machine manufacturing industry, died on April 18 at his home in Plainfield, N.J., following a short illness. Mr. Mumford was born in Groton, Mass., 52 years ago. He received his education in New England, graduating in 1886 from the Massachusetts Institute of Technology. In that year he was one of six members of the graduating class who were selected by Charles Francis Adams, of Boston, to serve a course of training in the shops of the Union Pacific railroad.

In 1890, Mr. Mumford left railroading to take a position as foundry superintendent of the Henry R. Worthington steam pump foundry, then located at Elizabethport, N.J. Some time later, Mr. Mumford became the New York representative of the Bement-Niles Co., Philadelphia. About 1895 he went into partnership with Harris Tabor to form the Tabor Mfg. Co., which engaged in the manufacture of moulding machines designed by Mr. Mumford. These machines for several years were made at the plant of Samuel L. Moore & Sons Corporation at Elizabethport.

In 1900, this business was moved to Philadelphia and Mr. Mumford remained identified with it until 1905, when he left the Tabor Mfg. Co. and formed the E. H. Mumford Co., which also located in Philadelphia. In 1909, the E. H. Mumford Co. was sold to the Mumford Molding Machine Co., and of the latter company Mr. Mumford was vice-president and general manager until last November.

Since then Mr. Mumford had revived the E. H. Mumford Co. and made arrangements once more for the manufacture of molding machines at the plant of Samuel L. Moore & Sons Corporation, at Elizabethport. The business will be continued by E. W. Mumford and T. J. Mumford, who are, respectively, vice-president and secretary of the E. H. Mumford Co.

RECORD COPPER SHIPMENTS.

EXPORTS of 5,853,254 pounds of copper from ten principal customs districts in the United States for week ending April 10, compare with shipments of 10,623,-248 pounds in the preceding week and 22,503,362 pounds in the week of March 27.

The only shipments exceeding a million pounds in the week of April 10 were to France, 2,747,861 pounds, and England, 1,882,499 pounds.

Shipments for two weeks have been as follows:—

	April 10.	April 3.
France	2,747,861	2,713,523
England	1,882,499	6,242,436
Scotland	168,066	....
Norway	......	11,000
Sweden	448,062	....
Netherlands	6,141	331,157
Italy	558,936	784,796
Russia	......	....
Canada	11,054	372,087
Cuba	2,261	23,065
Brazil	......	5,328
All others	28,374	139,856
Total	5,853,254	10,623,248

WOULD STOP U.S. SHELL SHIPMENTS.

A COMPLAINT was filed on April 29, under the so-called "discovery" statute of Wisconsin to secure information to determine whether the Allis-Chalmers Co., a corporation, Otto Falk, its president, and others have entered into a conspiracy with the Bethlehem Steel Co., and others not yet known, to manufacture and ship shrapnel shells to European belligerents, contrary to the Wisconsin law.

The complaint was filed by Samuel Pearson, who declares he is a citizen of the United States and that he has valuable property interests located within the boundaries of the German Empire; that he is owner of securities issued by the German Government; and that the German Government is and for some time past has been engaged in war with Great Britain, France, Serbia, Montenegro, Russia and Japan.

The complaint sets forth that it is the belief that the defendants have entered into an unlawful conspiracy with the Bethlehem Steel Co. and others, and that such conspiracy indicated is made a criminal offence under the laws of Wisconsin, the penalties for which are defined in the Wisconsin statutes.

The complaint states that one type of ammunition indispensable to the belligerents is a projectile known as the shrapnel shell, designed but for one purpose, the destruction of human life and property, and that the intent of the war now being conducted by the several countries named against the German Empire is so to cripple the said empire by destruction of the lives of its citizens and of its property. A hearing has been set for this month.

Suggestive.—A Glasgow engineering firm has issued a colored map of Scotland with the intimation—"This map will not be altered."

Artificial Lighting in Relation to Manufacturing*

By G. H. Stickney**

Not one of the least prominent features of the "Safety First" movement is that relating to the improvement of the natural and artificial lighting of our workshops and factories. In the accompanying article, the more important considerations to be accounted in the matter of artificial illumination are exhaustively discussed from a variety viewpoint.

WHILE a very conspicuous advance in lighting methods has been made by progressive manufacturers, notably in the iron and steel industry, there are still a large number of manufacturers who seem to regard the lighting as an expense to be reduced to the lowest possible minimum.

The increased appreciation of daylight is indicated by the modern type of building construction, in which the light-finished, high studded workroom, with large window areas, often equipped with diffusing glass, and sometimes supplemented with saw-tooth roofs, permits the fullest possible utilization of natural light.

Artificial Lighting Progress.

It is in the artificial lighting, however, that the greatest progress has been made. The wonderful developments in high efficiency units have greatly enlarged the possibilities of factory lighting during the hours of diminishing daylight and darkness, or in places where daylight cannot penetrate; so that now a proper lighting installation is not only an important safeguard, but an actual economy. Manufacturers who are to-day securing poor illumination with older form of illuminants, can, by a revision of their lighting equipment, procure a good illumination, not only without much additional cost, but in many cases with an actual reduction in the operating cost.

Economic Value of Good Lighting.

The economic value of good illumination, aside from accident prevention, is evident when we consider the greater facility with which an employee can work under good illumination, and the greater accuracy with which gauges can be read and tools set. One large manufacturer, on investigating his lighting conditions, found certain departments in which, during the winter months, the operatives were practically idle for about an hour a day solely on account of darkness.

Good artificial illumination can be furnished in such a factory for eight hours a day at a cost equivalent to about five minutes of the time of the workmen benefited. This illustrates the extravagance of poor lighting. For a great variety of conditions, good illumination reduces the manufacturing costs by increasing production, raising the quality of workmanship and reducing the number of defective parts and "seconds."

Safety Feature.

The question of safety as influenced by illumination presents two phases:—First, the prevention of accidents; and second, the preservation of eyesight. While these two phases are often closely related, there are many conditions in which they are entirely independent of each other. The phase of accident prevention is illustrated in the case of the foundry or other shop where cranes or other powerful machinery are in operation. The liability of crane and elevator accidents is very much reduced with proper lighting.

In the foundries and yards of a plant, it is practically impossible, even with safety committee inspection, to eliminate irregularities under foot. If not illuminated these may readily cause falls, with resulting injuries; and in foundries where molten metal is carried and hot metal abounds, they may often cause serious burns.

Again, even though guarded to the fullest extent, powerful machinery—in which materials are machined and fashioned into articles of commerce, and in which the arms and limbs are as readily crushed—presents a menace unless the operatives are given an opportunity to see and thus avoid the danger points.

Eyesight Preservation Feature.

Although the blind are trained to do remarkable work in certain lines, there is practically no manufacturing operation in which a blind person is not at a disadvantage, while there are so many which cannot be carried on without accurate visual inspection. Some of these operations produce considerable strain even under good illumination, and to require their performance under poor illumination is certain to result in more or less rapid impairment of vision. While economy should in all cases require the best lighting practice, humanity demands it.

Defining Good Lighting.

In view of the preceding, one might very properly ask: "What is good illumination?" and judging from some of the attempts that have been made to solve lighting problems, the conclusion might be drawn that simply a higher intensity of light is the answer. Undoubtedly a higher intensity of illumination is needed in most workrooms, but there are other features of equal and sometimes greater importance. The minimum intensity acceptable generally depends upon the reflecting power of the surfaces to be seen, the fineness of the detail to be observed, the time of observation and the closeness of application. Unless glare be introduced, a higher intensity of light is rarely objectionable, except from the standpoint of cost.

Owing to the remarkable adaptability of our eyes, we are able to get along satisfactorily with very much lower intensities of artificial light than are usual with natural light, and perhaps the best way to consider the other features of good illumination will be to point out some of the most common shortcomings found in factory lighting.

Factory Lighting Defects—Glare.

From my own observations, the most common defect is excessive glare and absense of diffusion. Glare is usually caused by bright lights in the field of vision. This may emanate directly from the light source or may be reflected by a glossy surface; it can also be caused wherever excessive contrast of intensity appears in adjacent fields of vision. The dazzling effect is not only unpleasant, but interferes with seeing. Under continued exposure, eye strain and even permanent injury to the eye may result.

The unshielded light hung over a machine is a common source of eye fatigue. The glare may not be very evident at first glance, but when the workman's eyes have been subjected to such light for a long time, discomfort and inability to see result. The workman frequently complains of insufficient light when in reality the intensity may be higher than is required for the work. In case an attempt is made to meet the complaint by installing a larger light, the workman's eyes are subjected to a still more severe strain. The proper correction should be to shield the light by means of a proper reflector, and as such a reflector would tend to direct more of the light upon the work, the working intensity would be increased; so in many cases it is possible to reduce the size of the lamp, or better yet, to relocate the

*From a paper presented before the American Museum of Safety.
**Edison Lamp Works, Harrison, N.J.

lamp so as to enlarge the area illuminated.

When a light cannot be removed entirely from the field of vision, its brilliancy should be reduced by means of a diffusing globe or reflector, so as to increase the apparent size of the light source and reduce the contrast between it and the background. This has the additional advantage of reducing the sharpness of shadows in the illumination, a result which is of considerable importance in rendering the various parts of a machine or other object readily discernible.

Glare received from specular reflection of glazed paper, desk tops, polished metal, etc., often induces eye trouble, headache, and other indispositions; though the sufferers may not be aware of the cause. The remedy is to change the relative positions, so that the reflected light is kept out of the eyes as much as possible, and to enlarge the dimensions of the light source, as already mentioned.

Improper Light Distribution.

Another defect commonly found in industrial lighting is improper distribution. This may be due to too wide a spacing of lighting units. Under this condition some parts of the room are insufficiently lighted while other parts may have more light than is necessary. Improper direction of light may illuminate the wrong side of the machine, leaving the important parts in shadow. If the bright parts are near the shaded ones whatever illumination may fall upon the shaded portion is rendered less effective by contrast. Unsteady or flickering illumination is always objectionable; both on account of discomfort and the inability to see. Such variation should always be avoided, whether caused by the units themselves or by the light passing through moving wheels, etc.

Since the purpose of the lighting is to enable the operative to see, good illumination can not be prescribed until we have some knowledge of the use to which it is to be put. In order to plan the lighting of a factory properly, one should be familiar with the processes employed, the arrangement of the machinery and the work tables, as well as the quality of the product manufactured. Practice has established certain methods of lighting which, if properly applied, are satisfactory for the different processes of manufacture. Thus, we know approximately how much illumination is necessary for the ordinary grade of work as performed on a lathe, as well as the direction desirable. As far as possible, therefore, the experience gained in well-lighted factories should be utilized in planning the lighting installation.

Where extensive lighting problems are to be solved, it is advisable to retain a competent engineer with illuminating engineering experience. However, the following comments on various methods of factory lighting will give some idea of the general practice. Factory lighting has developed along a few fairly definite lines, which may be designated as localized lighting, general lighting, combined general and localized lighting and localized general or group lighting.

Localized Lighting.

Localized lighting originated with the low power portable or semi-portable lighting units. These were under the control of the individual workman, to be placed or shifted wherever he desired. Such lamps were commonly used without reflectors and produced small patches of uneven illumination, as well as more or less glare. In many cases lighting with these lamps is now being supplanted by other methods, on account of the following disadvantages. Lamp breakage is likely to be high, and the expense for installing, energy supply and maintenance excessive, depending upon the conditions and arrangement of work. Moreover, the attention of the workman is called to the lighting and much time is often lost from his regular work in adjusting the lamp.

There are, however, certain operations which require light inside of a small cylinder or other enclosed space; or where very high intensities are required over small areas, and for these no other method is as practicable as localized lighting. For such conditions, the lamp should be equipped with a reflector to shield the workman's eyes and reflect the light in useful directions.

General Lighting.

General lighting came into common practice with high power lamps. Since with these units economy makes a wide spacing necessary, the best method of applying is to equip them with diffusing globes and reflectors, so arranged as to distribute the illumination as evenly as possible. Lamps are hung high, in proportion to their power and the intensity required, and equally spaced throughout the room. The ideal sought is equal intensity over the entire area.

General lighting is provided in three principal ways, which are known as direct, indirect and semi-indirect lighting. With direct lighting, the larger part of the light is distributed directly from the lighting unit to the surfaces to be lighted. With indirect lighting, the light source is concealed and the light thrown upon the ceiling or wall and thence re-distributed for use. With the semi-indirect lighting, the light source is shaded by a translucent reflector and the larger part of the light thrown upon the ceiling or walls for redistribution.

Direct lighting, depending upon the equipment, may have excessive brilliancy or any degree of diffusion. It is used to a much larger extent in factory lighting because factory ceilings are seldom good reflectors. Direct lighting units are less affected by dust accumulations. The indirect and semi-indirect give excellent diffusion, and are often applied with good effect in offices and drafting rooms when light ceilings are available.

Combined General and Localized Lighting.

Combined general and localized lighting is often desirable. With this, a low general illumination is supplied by large units and more intense localized illumination at particular points by low power units. The localized lighting may be supplied continuously or temporarily as needed. For example, in lighting automatic machinery, a moderate illumination may be sufficient at all times except a machine is being inspected, set up or adjusted, when a localized light may be needed for the particular machine.

Localized General or Group Lighting.

Localized general or group lighting is a recent practice which has sprung up since a range of intermediate sizes of lighting units has become available. This practice differs from general lighting in that, instead of striving for even intensity throughout the room, lamps are arranged to give higher intensities and correct direction of light at the machines or tables and a lower intensity at intermediate points. It differs from localized lighting in being planned so as to give some illumination, sufficient for the needs, in all parts of the room. It is, therefore, an intermediate practice between the extremes of localized and general lighting. Its application is extending very rapidly, since it meets effectively and economically factory requirements for a large portion of the ordinary processes and buildings.

Each of these various methods of lighting has some field in which it is to be preferred to any of the others, and the selection depends upon the character and construction of the building, the process of manufacture, the source of energy available and various local conditions.

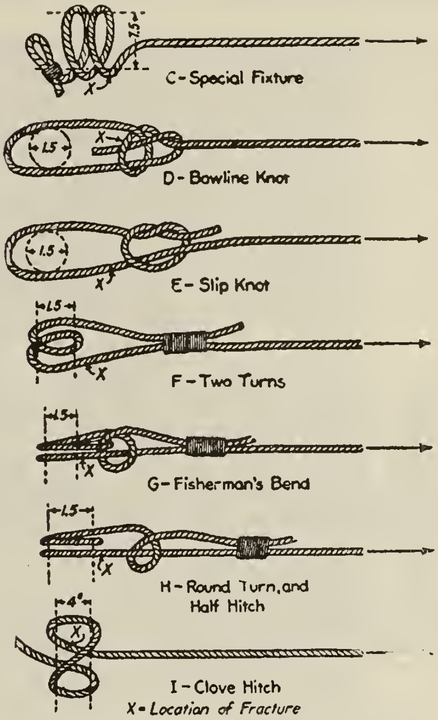
That the progress in good factory lighting will be even more rapid in the future seems unquestionable.

While good factory lighting is likely to be made compulsory by law, it is hoped that the manufacturers will be sufficiently awake to their own interests to take any necessary steps of their own initiative rather than through compulsion.

STRENGTH OF MANILA ROPE FASTENINGS.

NINE methods of fastening Manila rope were tested to destruction recently at the U.S. Watertown Arsenal. Tensile strength developed varied from 4,140 to 9,350 lb. per sq. inch. A series of 22 of these tests, made on three-strand Manila rope with a diameter of about 0.85 in., and a circumference of 2.68 in., is described in the Engineering Record.

In addition to fastenings of the types illustrated, there were fastenings A, consisting of an eye-splice with two tucks on each strand; eye-splices B of the same character except that for the first two tucks the full section of the strand was used. For the third tuck about one-third of the section was cut away, and for the fourth tuck another third was cut away, thus producing a splice which tapered gradually to the diameter of the rope. As a result of the tests, it was concluded that eye-splices are the most satisfactory considering the high strength which they develop in the specimen. Their cost is not excessive when compared with many of the fastenings which require much more rope to make. Even with the eye-splices, the full strength of the rope is not developed, as shown by the fact that the fracture almost always occurs at the inside end of the splice. The weakness of fastenings appears to be caused by the low strength of rope at small radius bends. The average breaking loads for the different fastenings are shown in the accompanying table.



MANILLA ROPE FASTENINGS TESTED.

Average Breaking Loads for Fastenings.

Kind of fastening	Rope required for 2 fastenings ft.	Time to make 2 fast'gs min.	Tensile str'gth, lb. Total	per sq. in.	Locat'n of failure
A	3.8	15	4,672	8,287	At end of splice
B	4.0	30-40	4,872	8.640	At end of splice
C	11.0	5	3,142	5,540	In fixture
D	6.0	4	2,253	3,970	At short bend
E	5.0	3-5	3,099	5,463	At pin
F	5.0	..	2,346	4,140	At pin
G	7.0	15-20	2,448	4,310	At bight
H	7.0	10-15	2,856	5,040	At bight
I	7.0	3	3.650	6.515	At bight

STEEL BLANKS OR FORGINGS DISTORTION.

ARTICLES made from steel blanks or forgings, states Alfred Herbert's Monthly Review, are frequently out of truth after the machining is finished, in spite of the fact that the machining may have been done with the greatest accuracy. Gear blanks may be distorted, crank shafts bent, holes or pins machined parallel may be no longer parallel when removed from the machine, and other inaccuracies may arise. Such troubles can only be overcome with certainty by one method—heat treatment after roughing out and before finishing. The removal of material invariably releases forces which, so to speak, have bound each other. The effect of this is often slow, and change of form does not occur until some time after the metal has been removed.

Heat treatment, if properly, conducted, restores the internal equilibrium of the molecules, and the small amount of material left for finishing does not seriously affect the balance of the minute internal stresses left after heat treatment. The nature of the treatment required depends upon the material used and on the final condition required, and it ranges from simple annealing to delicate tempering processes. Care must be taken to ensure that the heat treatment does not introduce fresh internal stresses.

GRAPHITE AND STRENGTH OF CASTINGS.

THE deleterious effects of graphite were emphasized by Dr. J. E. Stead in a recent lecture in Birmingham, England, on "Some Scientific Features of Cast Iron." He described graphite as the enemy of the foundryman, and likened it to thin plates of mica which can be split along their cleavage planes with the utmost ease. He summarized the results of a large number of tests, undertaken with a view of ascertaining the influence of graphite on the strength of castings, in the following table:

Graphite, per cent.	Transverse strength, cwt.	Tenacity, tons.
3.00 to 3.25	20.4	8.25
2.600 to 2.85	27.1	13.24
2.15 to 2.55	31.9	14.54
2.00	40.0 above	17.10
None, with 3 per cent. silicon	91.0	88.60

He deprecated the rule-of-thumb practice which has led foundrymen to adopt a hostile attitude towards types or grades of pig iron with which they were unfamiliar, citing the case of some irons of superlative quality which were unsalable and had to be reinserted because their fracture presented some unusual features. He argued that any class of iron could be made to yield the results desired if only it were "mixed with brains"; that even sulphur, sometimes considered the foundryman's worst enemy, could be turned to useful account if intelligently handled. This element should be regarded as a friend, said Dr. Stead, because it prevents carbide from parting with its graphite.

MANUFACTURE OF CHARCOAL.

THE British Board of Agriculture has issued an interesting leaflet dealing with the manufacture of charcoal. It states: "In consequence of the war the demand for charcoal, both for heating purposes and for ammunition, has already greatly increased, and it is probable that it will remain high as long as hostilities continue. There is no difficulty in manufacturing charcoal in kilns; the initial expenditure is small, and the amount of skilled labor required is not very great, while wood which might not otherwise be utilized is turned to account. It would be unwise, however, to attempt to make charcoal without some skilled labor, and, although it has been found possible in an emergency to employ twenty to thirty unskilled men under a skilled charcoal-burner and a good foreman, there are some operations which only a trained and experienced man can efficiently perform."

Details are given of the site for the kiln, the covering and firing of the kiln, regulation of the burning, opening the kiln, and the yield of charcoal.

PRACTICAL ARTICLES BY OUR READERS

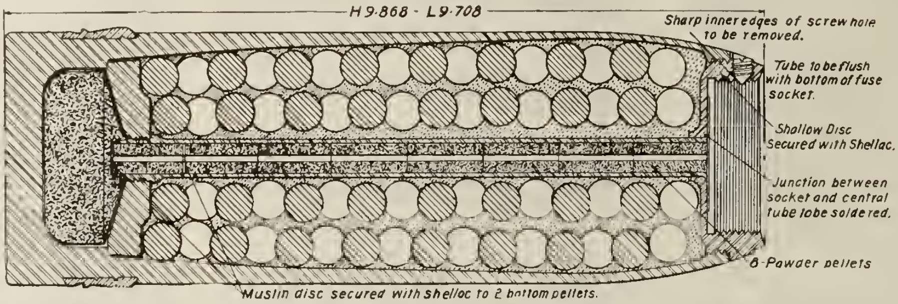
Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

BRASS SOCKETS AND PLUGS FOR SHRAPNEL SHELLS.

By J. P. S.

THE manufacture of the brass sockets and plugs for the noses of shrapnel shells forms a sort of diversion from the main objective. These are made of a brass composition, which is such that the castings cannot be moulded in their final shape. Instead, they are simply poured in the form of slugs in cast iron moulds. As fast as the metal chills, the moulds are emptied so that the process is continuous. To obtain the desired shape and uniformity of metal, the slugs are put through a forging operation. For this purpose a heavy stamping press is employed and the dies required are very simple. In the illustration at F to the rear of the press, the oil furnace in which the slugs are brought to a red heat is shown. Three men are employed. One looks after the heating, a second places the slugs in the die, and a third operates the press and removes the finished forging.

The punch is stripped from the forging by an application of oil by means of the swab S before each stamping. The stripping from the die is accomplished by two rods extending down through the die plate by the upper bolster. The operation is very rapid and either sockets or plugs can be formed practically as fast as they can be conveniently handled. Throughout the whole process, the castings require no cleaning or pickling, the only preparation for the forging being a rough sizing cut over one face. These parts are finished rapidly in the usual way on small monitor brass lathes, and are fully inspected by Government officials before leaving the department. The office of the plug is simply to protect the thread for the fuse, and to prevent foreign materials entering the tube until the fuse is placed in position. The brass socket is shown on the line drawing screwed into the open end of the steel shell.



CONSTRUCTIONAL FEATURES OF BRITISH 18-POUNDER SHRAPNEL SHELL.

PERCUSSION PRIMERS FOR QUICK-FIRING CARTRIDGE CASES.

By C. M.

AMONG the many incidentals in connection with the Canadian manufacture of 18-pdr. shrapnel shells, and in quantities commensurate with the number of shells turned out, are the percussion primers which are used with the cartridge cases.

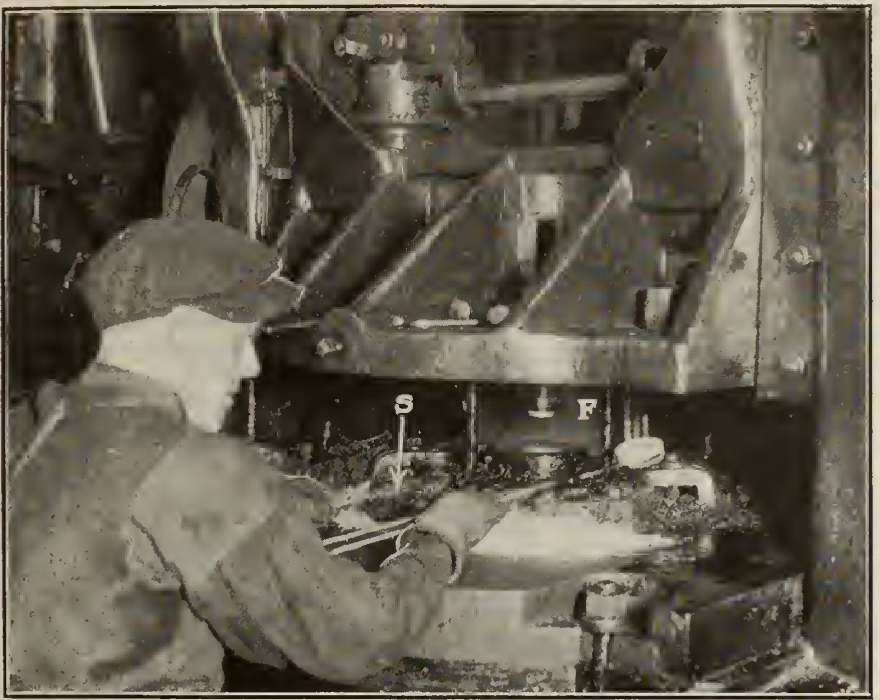
Field guns are of two general types, viz.: Those using fixed ammunition and those using separate ammunition. By fixed ammunition is meant the arrangement of the shell and propellant in a single package which reduces the loading process to a single operation and thus brings the gun into the quick-firing class. The procedure is as follows:

In the leisure time of the gun crew, the powder package is placed in the cartridge case and a shell is slipped into the open end, which it fits snugly, until

ONE OF THE CONTINUOUS MELTING BRASS FURNACES.

CONTINUOUS POURING OF SLUGS FOR SOCKETS AND CAPS.

it is stopped by the rotating band. A primer is now screwed into the base of the cartridge and the unit is ready for firing. The cases may be used for from three to five shots before they become so swelled that they will not enter the gun



FORGING SOCKETS FROM BRASS SLUGS.

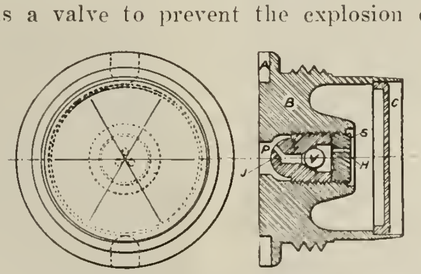
freely. In order to use a case a second time, the old primer must be removed by a special spanner wrench and a new one put in place.

These primers consist of several parts, most of which are well suited for rapid production upon automatics. As shown in the accompanying cut, they consist of the body B, the screw plugs L and S, the copper ball V, and the closing disc C. The complete assembly consists also of a cap inserted in the space P, and gunpowder in the space below the closing disc and two paper discs.

The body is made on turret lathes or automatic machines from drawn brass rods. and these rods must fulfil the following physical requirement under tensile test:—Elastic limit, 12 tons per square inch; ultimate strength, 20 tons per square inch, and an elongation in 2 inches of 30 per cent. The rods are cast in bars about 2 inches in diameter and are reduced by successive drawing and annealing operations to 1 7-16 in. in diameter. After each annealing operation, they are pickled in a sulphuric acid solution of one to four, and then washed in water. The rods may also be formed by the extrusion process. The specified chemical composition is: Lead, 1.77 per cent.; copper, 65.93 per cent., and zinc, 32.2 per cent.

The complete body can be made at a single setting of a good automatic equipped with tap and die for the threads, and, in fact, involves a very interesting set-up. All that remains to be done is the milling of the flange for the spanner and the stamping. The screw-plugs, L and S, are made in a similar manner, the set-up, of course, being much simpler.

The physical requirements of these parts are, however, considerably lower, namely: Elastic limit, 6 tons; ultimate strength, 12 tons; and elongation in 2 inches, 10 per cent. The plug L has three small holes drilled radially into the spherical end which faces the primer cap. The copper ball is approximately one-eighth of an inch in diameter and acts as a valve to prevent the explosion of



FULL-SIZE SECTION OF BRASS PERCUSSION PRIMER.

the main charge acting backwards against the primer cap. The plug S contains three small holes drilled vertically through it, and whose purpose is to allow the flame to reach the powder in the space beyond.

The closing disc C may be either turned from the solid bar or stamped from strip brass, as it must go through a press operation anyway to produce the radial cuts; the latter method is obviously the one to adopt. After filling the large space in the body with R-FG² powder under heavy pressure, the edges are spun down over it, and the primer unit is complete. The above term refers to the fineness of the grain of the rifle powder used.

SAFE HAND TOOLS IN THE SHOP.

PERSONAL caution is the greatest safeguard, says Bulletin No. 19, issued by the National Founders' Association Committee on Safety. whether observed in the general and apparently important affairs of industrial life or applied to specific and seemingly trivial details. A spill from a twenty-ton ladle of molten metal may cause a serious burn, yet a chip struck from the battered head of a twenty-cent chisel may result in blindness to an employee. A defective weld in a crane chain may allow a load to "let go" with disastrous consequences, but the use of a weak, cross-grained or splintered sledge handle may let the sledge fly across the shop and injure workmen who may be in its path. Considerable injury may also be traced to the use of loose-fitting wrenches, splintered or broken shovel handles and to other uncared-for hand tools.

Tools Contributing to Injuries.

The largest contributors to injuries in the latter class are chisels, punches, wedges, blacksmith's tools, stonecutters' tools and similar small hand tools which are subjected to frequent hammer-blows, in consequence of which their heads become readily "mushroomed." A mushroomed head presents a dangerous condition, for the next hammer-blow may break off one of the slivers of steel hanging to the body of the tool and send it flying through the air, with great risk of injury to the man handling the tool or to others nearby. The remedy costs little, is well known, simple and effective. When the head of such a tool is found to be chipped, cracked or mushroomed, it should be promptly laid aside and not used again until the head has been ground down or dressed to its proper shape.

A good practice applicable to cold-chisels and other tools that must be sharpened frequently is to grind down their heads every time the tools are sharpened, thus preventing the development of a mushroomed condition, at the same time retaining the hammer-hardened ends which will not spread so rapidly in the future life of the tools; this practice also avoids much waste of the steel which would otherwise have to be cut off if the heads of the tools were re-forged.

As a further precautionary measure, all steel hand tools that are liable to be struck by hand hammers or sledges should have the upper part of the shanks shaped round and slightly tapered from the top downward before they are used at all; care should also be taken to make such tools of the right grade of steel, else the battered, over-hanging portions of the tools will readily break off. The heads of chisels used in pneumatic tools are usually hardened and will chip very easily when struck with an ordinary hammer; such chisels should never be used in this way.

Hammer and Sledge Handles.

The character of hammer and sledge handles and their method of fastening is worthy of more than passing notice. If not straight-grained, or if the wood used is "short" in texture, it must be expected that such handles will quickly splinter and break. If attached in a slipshod manner, or if insecurely fitted, or if wedged by nails instead of wedges, or if the handle is water-soaked so as to swell and become only temporarily tight in the hammer head, it is obvious that these ill-fitted handles will become loose, and that the hammers or sledges will fly off when the nails loosen up or when the handle dries and shrinks. When it is recognized that the peculiar function of hammers and sledges is to strike blows with considerable force, it becomes clear that there is no economy in cheap but weak handles, and that all handles should be carefully purchased and properly fastened in place.

The use of defective file or screwdriver handles also contributes to the sum of injuries caused by hand tools. When such handles are split, the handle end of the file or screw-driver is apt to be forced through the handle and puncture the user's hands, and when these tools are used without handles similar injuries sometimes result. The use of only the best handles is a safe as well as an economical measure.

When smooth-faced hammers or hatchets are used for driving nails, the nails frequently glance and strike persons who are working in the vicinity. This danger can be minimized by the use of hammers or hatchets with their faces roughened.

Wrenches.

Wrenches are wrongly used and abused, sometimes because the management is over-economical, but usually because the employee is too lazy or impatient to secure the right wrenches for the job in hand. Solid wrenches that are too large for the nut or bolt-head are soon worn into a rounded shape that allows them to slip and bruise the workmen's hands, also spoiling the shape of the nut or bolt-head, which in turn presents an added risk of the same kind. Wrenches of the right size but worn beyond the possibility of giving safe and effective service, cause similar injuries. Again the remedy is simple and even economical; the wrenches should be ground or milled to suit larger size nuts, or if there is too little stock left, they should be scrapped. Monkey-wrenches or Stillson wrenches with bent jaws or worn adjusting parts, are also apt to cause injury by slipping; such wrenches should be repaired or replaced. Wrenches are cheap; when in good condition they are not only safest, but do more and better work than the faulty variety.

Electrical Purpose Tools.

The rapidly growing use of electricity for power and light requires that workmen should be instructed to use proper tools when making adjustments on electrically charged apparatus. Screw-drivers, pliers and other tools used for this purpose must be insulated. When the voltage is more than 110, insulated tongs made of hard fibre or other non-conducting material should be provided for safely removing or replacing fuses.

General.

Some effective system should be adopted and carefully followed in each shop to prevent the use of improper or defective handles or tools. Only such handles and tools should be purchased or put into service as are safest and best for the purpose. Even these may in time become unsafe by wear; it therefore becomes imperative that they should be inspected regularly and their safe condition maintained. In shops where such tools are turned into the tool-room or stock-room every night, the storekeepers can be instructed to issue only such tools again as are safely fit for service.

COMING CONVENTIONS.

National Association of Manufacturers, Waldorf-Astoria, New York.—May 18-19.

National Machine Tool Builders' Association, Atlantic City, N.J.—May 20-21.

Master Boiler Makers' Association, Chicago, Ill.—May 26-28.

American Iron, Steel and Heavy Hardware Association, St. Francis Hotel, San Francisco, Cal.—May 25-28.

American Supply and Machinery Manufacturers' Association and National Supply and Machinery Dealers' Association, Hotel Bellevue-Stratford, Philadelphia, Pa. (Joint convention.)—June 3-5.

American Railway Master Mechanics' Association, Atlantic City, N.J.—June 9-11.

Railway Supply Manufacturers' Association. Convention and exhibit in conjunction with the Railway Master Mechanics and the Master Car Builders.—June 9-16.

Master Car Builders' Association, Atlantic City, N.J.—June 14-16.

American Society of Mechanical Engineers, Buffalo, N.Y. (Spring meeting.)—June 22-26.

American Society for Testing Materials, Hotel Traymore, Atlantic City, N.J.—June 22-26.

American Foundrymen's Association, Atlantic City, N.J.—Sept. 27-Oct. 1.

Foundry and Machine Exhibition Co., Atlantic City, N.J.—Sept. 25-Oct. 2.

SHELL AND CAR ORDERS PLACED.

THE Eastern Car Co., New Glasgow, N.S., has been given an order by the Russian Government for 2,000 steel frame box cars, and the Nova Scotia Steel & Coal Co. has received an order for shells worth $3,600,000 from the Imperial Government. Work will begin at once on both orders.

The cars will be shipped in sections from Pictou Landing for Vladivostock, where they will be set up on Russian soil. It will take eight or ten ships to transport the cars, and whether the company's own steamers will be used or whether ships shall be chartered by the company for this purpose has not yet been decided.

The shell order for the Nova Scotia Steel Co. includes 18-pounder shrapnel, 4.5 lyddite shells and 60-pounder shells. The company has been making 18 and 15-pounder shells for the British Government, but this is the first order for lyddite and 60-pounders. The Nova Scotia Steel Co. will make the shells and put in the bullets, but the explosive will be inserted at Quebec. Some new machinery will be required.

The company's contract is to manufacture all the shells, finishing as many as possible, but other concerns finishing will be given orders to assist. Under the former contract the "Scotia" Co. has been making 8,000 to 10,000 shell blanks daily.

These orders are officially announced, and the carrying out of them will mean much to the industrial life of Nova Scotia.

When you have a long line of shafting to drive with a motor, it is well to remember that if you put the motor in the centre, instead of at one end of the shaft, you can use a lighter shaft, and thus save in first cost, weight and loss by friction.

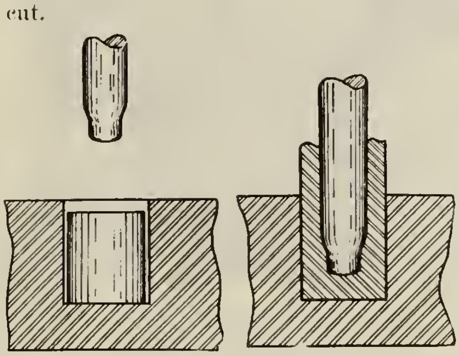
Shrapnel Shell Manufacture--The Forging Feature

Staff Article.

In view of the fact that the war interest of our readers extends far beyond the confines of their own particular craft, and that Canadian engineering concerns are devoting themselves almost entirely to the production of shrapnel shells in one or more of their consistent features, we believe the accompanying brief article dealing with the inception of the shell from the steel bar will not only be found educative, but will indicate in a more or less graphic way the grip that our metal working plants have taken of this impromptu Canadian industry.

THE steel used in the production of shrapnel shell forgings comes from the mill in bars, $3\frac{1}{2}$ in. diameter by 9 ft. long, and is known as high carbon machinery steel. In the plant from which the accompanying data have been procured, the bars are first sawn into billets, each being about $4\frac{1}{2}$ in. long. Four 24-in. Newton inserted tooth cold saws operate constantly on their production. The saws are driven by individual motors, as will be seen by referring to Fig. B, while the clamps are operated by compressed air. A neat arrangement for handling the bars is part of the equipment of each saw. The bars are carried to the saws by an overhead electric travelling crane and are placed on racks which are built with a slight incline. A bar is allowed to roll off the rack by gravity into the saw carriage.

Provision is made to insure that the bar is moved ahead the proper distance each time a new cut is taken. The bar itself is moved by means of a handwheel which traverses the carriage, through the medium of a rack and pinion. A steel rod is attached to a casting fixture which can be moved along the bed of the machine and clamped at any position. A part of the saw carriage upon which the bar being cut up into billets is mounted, fits over the steel rod, and the fixture which carries the rod is moved up close to the lug from the carriage and clamped solidly. Thus, at the completion of a cut, the saw is withdrawn and the air clamps released. The bar is then moved up for the next cut.



SHELL FORGING—FIRST OPERATION OF PIERCING THE BILLET.

The projecting lug from the saw carriage follows the steel rod until it comes up against a stop collar on the latter, and when the rod is moved this distance it is in position for a new cut to be made. The clamps are then applied and the saw started in to work again. Meanwhile, the stop casting is unclamped from its position, and is moved up till the lug is again against the stop casting, where it is again clamped, ready to measure off the next length. It takes one of these saws one minute and thirty-five seconds to cut through the $3\frac{1}{2}$-in. round. Water lubricant is used on the saw.

The saws have inserted teeth and are giving excellent satisfaction. The time a set of teeth will run without re-grinding varies, but a casual inquiry, however, resulted in the following information being given: A saw was put in commission at noon one day and three days later at 4 p.m. it was still doing good work. Two men keep the four machines running, and the maximum production of one machine per hour throughtout the twenty-four hours will be a little over thirty billets.

Heating Billets and Forging.

The furnace used to heat the billets when operations were first started was an ordinary Rockwell plate-heating oil furnace. However, as the plant began to run smoothly, the capacity of this furnace was not sufficiently great to feed the presses, its capacity limiting the output of the forging plant to 1,600 forgings per day. The firm then designed and built a special oil furnace, the muffle of which was constructed on a slight incline. The billets were fed into one end of the furnace and were taken out of the other, the movement of the billets being caused wholly by gravity. The production of the plant is

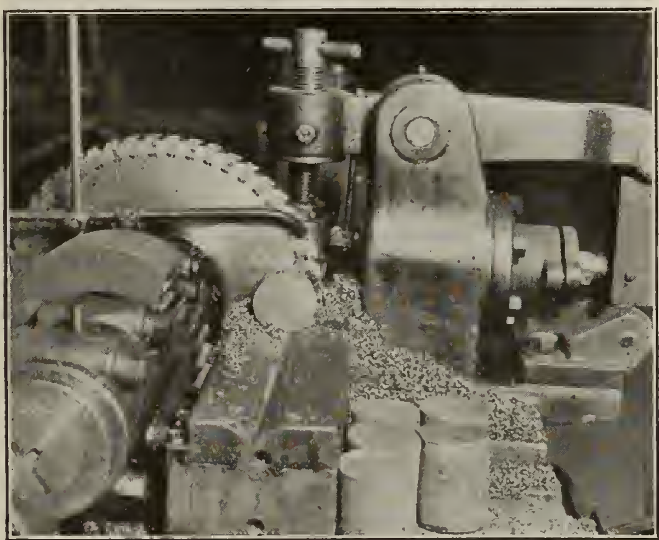


FIG. A—NEWTON SAW CUTTING SHELL BILLETS FROM THE STEEL BAR.

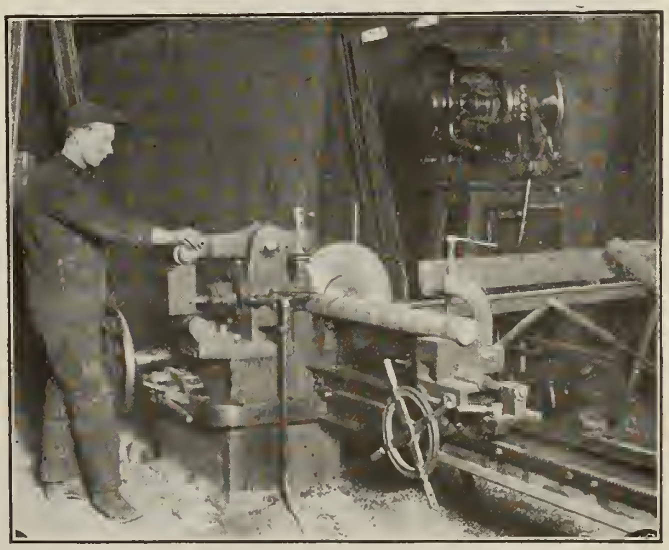


FIG. B—NEWTON SAW SHOWING MOTOR AND STEEL BAR FEED MECHANISM.

now about 3,000 shells per twenty-four hours.

The billets are heated up to about 2,100 deg. F. and the shell forging is completed in two operations with one heating. The billets are taken from the furnace two at a time by two men. They grasp the billets with tongs and swing them into the dies, knocking the loose scale off in transit by striking the hot billets against a steel block. The punches are well greased with graphite mixed with heavy black oil.

The first or "piercing" operation is performed on a 350-ton two-punch hydraulic press. The billet is pierced and the length of the shell is increased from $4\frac{1}{2}$ inches to roughly 8 inches, as shown in Fig. F. The forgings are taken from the big press immediately to the smaller 250-ton two-punch presses. Here they are placed in a forming die and the punches are allowed to descend. This operation forms the bottom or back end of the shell and makes it the proper size for the drawing die operation, which follows immediately.

The punches are lifted and the forgings are taken up with the punches. The small base-forming dies are removed, the punches again descend, and the forging passes through a series of drawing dies which draw it out to length. It has been found that all these operations can be accomplished with one heating now that the men have become accustomed to the work, and with dies and punches of proper design.

The large press can handle about 150 billets per hour, being its maximum capacity under favorable conditions. The punches in the smaller presses have two operations to accomplish, and this not only takes up more time, but heats the punches and dies considerably. Thus, the maximum capacity of these machines is only about half of that of the larger press, or 75 an hour.

The billets after passing through the drawing-out dies are taken from the under side of these and placed in the

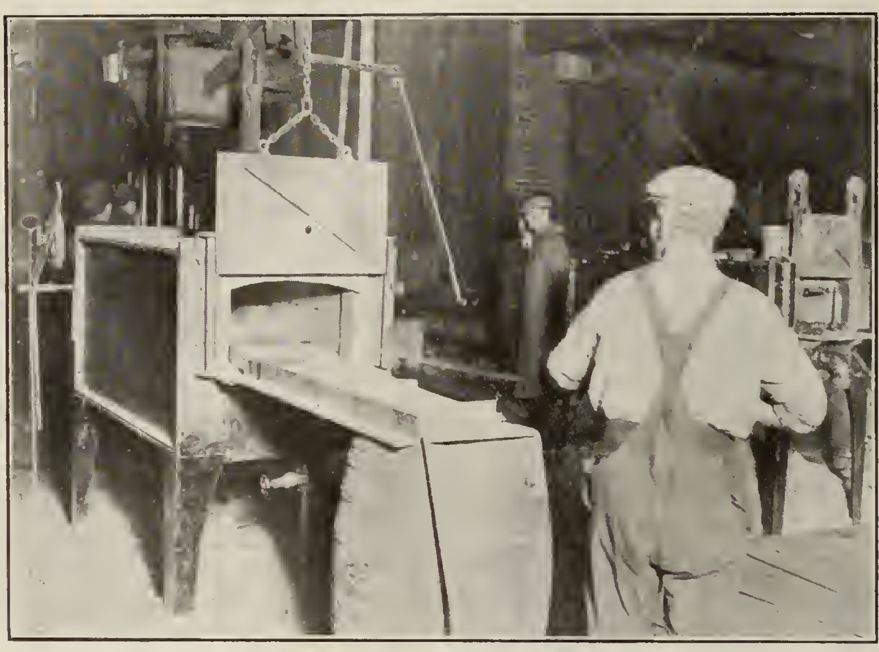


FIG. E—BELLEVUE ANNEALING FURNACES FOR HEAT TREATING STEEL SHELL FORGINGS IMMEDIATELY THEY LEAVE THE WOOD PRESSES.

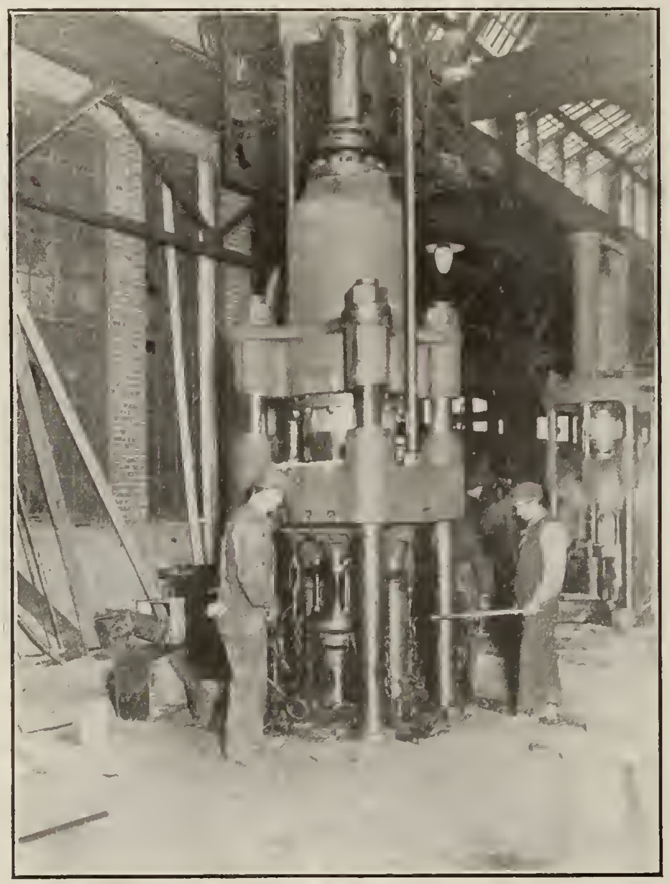
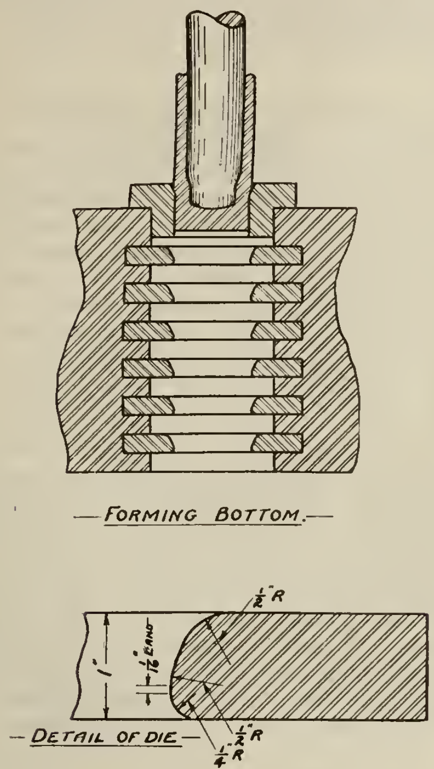
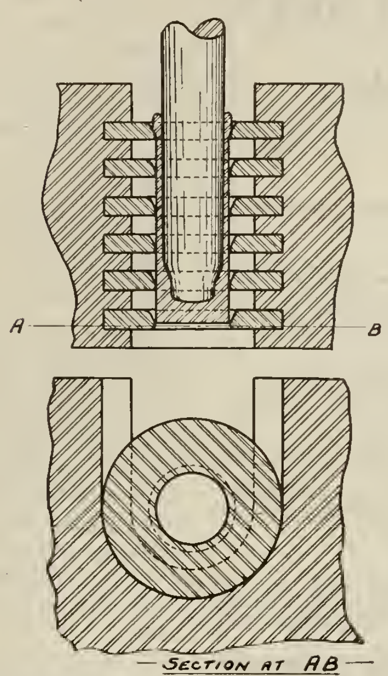


FIG. C—350-TON R. D. WOOD HYDRAULIC PRESS PERFORMING FIRST OPERATION ON 18-POUNDER SHELL FORGINGS.

FIG. D—250-TON R. D. WOOD HYDRAULIC PRESSES PERFORMING SECOND AND FINAL OPERATION ON 18-POUNDER SHELL FORGINGS.

Bellevue annealing furnaces, shown in Fig. E. This process is to remove the effects of the chill caused by the comparatively cold dies and punches, and





SHELL FORGING—DRAWING-OUT OPERATION IN SECOND PRESS.

prepare the forging for machining. One reheating Bellevue furnace is placed between the large press and the small presses, and any semi-finished forging which is delayed in the first operation or for any reason appears too cool to go to the second presses, passes through same. A certain number of billets going through the presses at the same time are all placed in one rack and a heat number assigned to them.

The presses are supplied with water at a pressure of 1,500 pounds per square inch from a 100-h.p. Westinghouse motor-driven Dean pump, and a Snow steam auxiliary pump is held ready to take up the load should a break-down occur in the motor-driven unit. The production at present approaches three thousand shells per day of twenty-four hours.

ALTERNATING CURRENT FOR ARC WELDING.

IN the "question and answers" section of the General Electric Review the following question appears: "Attempts have been made by a steel foundry to fill holes in steel castings by using alternating current for arc welding, but the welds produced have been unsatisfactory. The energy was supplied from a 50 cycle, 440-60-volt, 25-kilowatt single-phase transformer, and the welding current was raised from 100 to 400 amperes. Is failure due to the fact that alternating current was used? If not, wherein is the apparatus unsatisfactory?"

In reply one of the company's engineers says: "We would attribute the lack of success to the use of alternating current. Attempts have been made to utilize alternating current for arc welding, but, as far as we know, all of them were practically failures. . . . The best equipment would be a flat-compound wound direct-current generator driven by a constant speed induction motor, the motor to have an automatic control device for regulating the amount of current drawn from the line and for preventing injury to the generator when starting the arc."

BRASS TRADE OPPORTUNITITS.

ITALY, in 1912, took £408,500 worth of brass and brassware from Germany. Norway and Sweden together took £274,600 worth, and the United States of America took £146,200 worth. Then there are the valuable South American markets, such as Argentina, to which Germany sent brass goods to the value of £165,000; Brazil, which accounted for £112,700 worth; Chili, which took £49,500 worth, and Uruguay, which was a customer to the extent of £24,000. Austria's exports, too, although much smaller than those of Germany, are worthy of notice, amounting as they did last year to £1,057,750. Her principal markets were: The United Kingdom, £88,700; British India, £36,600; Russia, £98,700; Italy, £90,400; Roumania, £79,000; Turkey, £37,700; France, £26,300; and Argentina and Brazil, £16,800. In all these markets our manufacturers have such opportunities as they never had before for capturing Austria's brass trade.

Soldering. — It often happens when soldering with killed spirits as a fluid, that the latter cannot be applied thick enough to insure a good joint. Add some starch to the killed spirit, and boil the mixture, so as to make a sort of syrup, and you will find that you can make a far stronger job than otherwise, especially when soldering up tins which have to withstand pressure from within, such as preserve tins. The starch is, of course, turned to charcoal; but this does not hinder in the least, and can be wiped off.

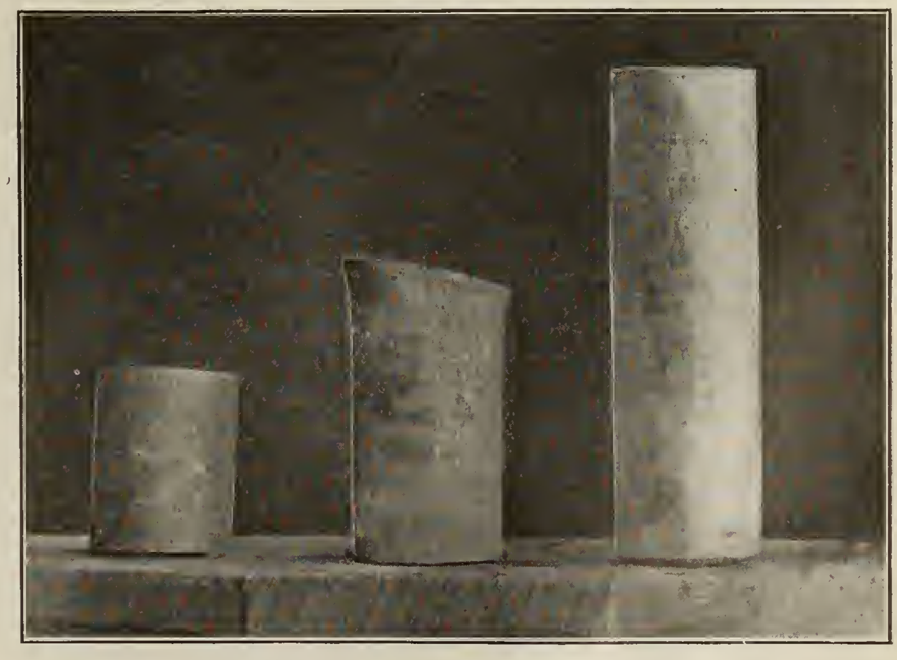


FIG. F—SHOWING STEEL BILLET, SHELL AFTER FIRST OR "PIERCING" OPERATION AND FINISHED FORGING.

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PRINCIPAL CONTENTS.

THE LABOR PURCHASING DEPARTMENT.

WE are informed upon the very best authority that the average labor cost of foundry products runs from 50 to 75 per cent. of the ultimate cost. The employment office, however, is often but the more dignified appellation of the gatekeeper's shelter or, the taking on of men may be one of the duties of an already overworked receiving clerk, and this official, to save his precious time, is generally furnished with display signs indicating the exact character of help required, in addition to that which says "No Help Wanted To-day." The foreman of a department is required to inform the gatekeeper of the class of men wanted and the wages to be paid, and here his responsibility ends until the new help appears, to be made the best of.

When a plant has grown to certain proportions, it is obviously impossible for the manager or superintendent to devote his time to the details of careful hiring of men any more than he can give his whole thought to the best market quotations on material. The employment department, which really represents the greater investment, should therefore be in the hands of a thoroughly competent and responsible man whose duties do not end with the hiring stage. He should follow his proteges' installation in the plant, should determine their efficiency and rating and should represent the last court of appeal between man and foreman.

There are numbers of little disagreeable jobs in connection with the rating and disciplining of help that are detrimental to the influence of the foreman with his men if he be required to perform such duties. The proper man to do this work is the man who does the hiring. Carelessness in the choosing of men is liable to result in the getting of careless employees. The quality of workmen is many times more valuable than the price or quality of material, and it is safe to say that the man who shrewdly controls the quality and efficiency of the human element holds the real guiding reins in the destiny of the institution.

MAINTAINING SUFFICIENCY OF TRAINED MECHANICS.

IN connection with the recent discussions on the losses entailed by employers in replacing trained mechanics who have been discharged or otherwise lost to the organization, the side of the men themselves deserves some consideration. Take the case of the apprentice, we find the instances where he is provided with a practical demonstrator or any kind of technical instruction decidedly few, it being usually a case of apprentice learn from apprentice or pick up what he can from more or less indifferent journeymen. The average ambitious young man therefore looks forward to the time when he will be free to explore new fields in his chosen trade or occupation and acquire the knowledge worth while which will secure him higher degree remuneration.

There are some notable manufacturing concerns who make a practice of developing their own skilled help and raising up their own department heads. In these cases the plants are large, involve the best practice in their respective lines and are in a position to provide better conditions for their older hands than these could perhaps obtain elsewhere. Still, more cases have come to our attention where strangers brought into the plant are paid more than the men who have spent the best years of their lives with the institution.

Again, if men are to be kept indefinitely in the same shop at the same work, and if no new blood be brought in, there will have to be some powerful influence on the part of the management to prevent a gradual slackening of interest and zeal and consequent efficiency in the work. The molder does not get the highest mechanics' wages by any means, and the ability to travel and educate himself is one of the things he gets besides his money that helps to make up.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

COPPER CYANIDE PLATING SOLUTIONS.*

By Dr. Max G. Weber.

THERE are three things which are necessary for the deposition of metal, current, electrode and electrolyte, or plating solution, but as the plating solution is the most important, I will confine myself to this item.

Cyanide Solutions Feature.

The object in employing cyanide solutions for the deposition of copper is to be sought in the fact that in such solutions iron does not replace copper, notwithstanding their places in the electrolytic series, a phenomenon which is due to the complexity of the salt in which the copper is present. The complex salt, which makes this feasible, is the double cyanide or sodium copper cyanide, the anion of which is Na, the cathion $Cu(CN)_2$; that is, by the action of the electric current, Na travels toward the cathode, and $Cu(CN)_2$ toward the anode. In other words, copper is not present in an ionized stage. Under proper current conditions, i.e., not too high current density and a suitable concentration of the solution, Na is not discharged at the cathode, but reacts with an undissociated part of $Na(CN)_2$, as shown in the following equation:—

$$Na + Na\ Cu(CN)_2 = Cu + 2\ NaCN,$$

proving that the deposition of copper is a secondary reaction, and that free cyanide is formed. On the anode, the anion $Cu(CN)_2$ combines with the copper of the electrode, forming cuprous cyanide,

$$Cu(CN)_2 + Cu = 2\ CuCN.$$

Cuprous cyanide is insoluble in water but soluble in cyanide solution, and for this purpose the free cyanide generated at the cathode is required. Supposing we have proper conditions—low current density on both electrodes—enough free cyanide is produced on the cathode in order to keep in solution the cuprous cyanide formed on the anode. As the free cyanide of the cathode is really needed on the anode for dissolving purposes, and as in a still solution the mixing velocity is very slow, stirring and warming of the electrolytic bath would expedite this matter considerably and bring the bath very near to an ideal stage. However, warm and agitated solutions require a more careful observation, for which reason these two items have not as yet been paid the attention they actually deserve.

*From a paper read before the Lewis Institute, Chicago.

High Current Density.

If a too high current density is used on the cathode, all the Na ions do not act on the sodium copper cyanide, reducing it, but they are partly discharged, forming sodium hydrate and hydrogen by acting on the water of the bath:—

$$Na + H_2O = NaOH + H$$

This reaction accounts for the development of hydrogen or gasing at the cathode. It means that less copper is deposited per current unit and not sufficient free cyanide is formed in order to keep the anode clean. The solution therefore needs the addition of sodium cyanide, as otherwise the anode becomes coated and the passage of the current is interrupted. A too high current density on the anode leads to the same results, viz., covering of the electrode with an insulating film of cupri-cupro cyanide.

In regard to current density, it must be borne in mind that warmed and agitated solutions can be worked with a higher current density than cold ones, and that a density of approximately 30 amp. per sq. ft. is quite feasible without yielding a burned and blistered deposit.

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Deposit Per Amp. Hour.

Another feature which is quite interesting is the amount of metal deposited per amp. hour. In a copper cyanide solution which contains the metal in the cuprous stage, the same amount of current should yield twice as much metal as in an acid bath, providing, of course, all the favorable conditions are prevailing, i.e., a strong solution, warmed and agitated, worked with a minimum amount of free cyanide at a low current density.

As, however, common plating solutions are worked on nearly the contrary conditions, the relative amount obtained from a cyanide bath is much lower. How much lower depends entirely on the relative conditions, and only one feature should be emphasized which has been mentioned above; that the more hydrogen develops on the cathode, so much lower is the percentage of the metal deposited per current unit. A low current density results in a high percentage of the metal deposited per electrical unit, while the deposition is slow. A high current density yields a lower percentage proportionately, but consuming less time for a certain amount of metal deposited, there results a greater deposition of metal per time unit.

Furthermore, cyanide solutions yield a finer, more homogeneous texture and brighter metal film than the acid baths on account of the secondary copper deposition and because hydrogen may develop more freely on the cathode in such a solution without fear of burning or blistering the deposit. These few remarks give an idea how complicated the reactions in a plating solution are, and that it requires skill and experience to procure a satisfactory deposit.

Copper Cyanide Bath.

The first part of this paper shows that the constituent which is essential in a copper cyanide bath is the double salt (sodium copper cyanide), consisting of copper cyanide and sodium cyanide, and which is easily formed by adding the necessary amounts of each chemical to water. A high-grade sodium cyanide has been obtainable for quite a number of years, but copper cyanide could only be procured at prices which made its use prohibitive for technical purposes. For this reason many salts—one might call them subterfuges—have been used which were intended as a substitute for copper cyanide, forming this salt when brought together with cyanide solution.

One should bear in mind that whatever copper salt is brought together with sodium cyanide solution, the final compound is the double salt, sodium copper cyanide. Another fact which should not be lost sight of, is that one chemical can replace another only to the extent of the requisite elements, and that by the reaction of two such salts, a by-product is always formed which contaminates the compound desired. This is the case with the copper cyanide.

Copper carbonate, copper sulphate, copper acetate and cupri-cupro sulphite have all been employed in order to form copper cyanide by mixture with sodium cyanide and water. That by these reactions an inert by-product consisting of sodium sulphate or sodium sulphite or sodium acetate or sodium carbonate is formed to a high percentage, every one was aware of, but took it for granted as the product necessary, copper cyanide, being not obtainable commercially.

Copper Carbonate.

When using copper carbonate, which is really basic copper sulphate containing a small percentage of carbonate, according to the temperature at which it is precipitated, approximately one-half pound of inert matter is formed for every pound of copper carbonate, consisting of sulphates and carbonates. By the use of copper acetate, or cupri-cupro sulphite this inert matter is still further increased, and for each pound of the compounds used, from nine to ten ounces of inert salts are produced.

These salts accumulate in the bath more and more with every addition of the respective copper salt, and finally yield such a dense solution, overloaded with these waste compounds, that it cannot be worked in a satisfactory manner any longer as plated articles are blistered, and the solutions are of necessity discarded. The reason for this is that a bath of this kind has a relatively low metal concentration and a much higher one of the inert salts. As a rule, the electric current deposits the metal easiest to discharge, which in this case, is the alkali metal. As the current density increases, an excess of hydrogen is generated, which causes burning and the current output drops considerably.

After considering this crude method of forming copper cyanide one should remember that the copper in a cyanide plating solution is in the cupro state, while copper carbonate, copper sulphate and copper acetate are cupri salts, and cupri-cupro sulphite is a mixture of both. This means that these salts must be first reduced to the cupro state before they are fit for plating. This reduction is executed at the cost of the sodium cyanide, which is actually intended for bringing the copper metal into solution only. Further, neutral copper salts as copper acetate, copper sulphate and cupric sulphite, when brought in contact with cyanide solutions first form cupric cyanide, which, being an unstable compound, decomposes into cuprous cyanide and cyanogen. The latter escapes into the air, and on account of its highly poisonous character, is most detrimental to the health of the plater.

Chemically Pure Cuprous Cyanide.

Taking into consideration all the disadvantages resulting from the present method of producing a plating solution, every progressive plater should greet with joy the fact that a chemically pure cuprous cyanide is now on the market at a price making its use more economical than that of any other copper salt.

Cuprous cyanide contains nothing but the ingredients necessary in a plating solution—copper and cyanogen—so that by dissolving it in cyanide solution no inert, unnecessary products are added. This enables the plater to have perfect control of his solutions at all times as whenever metal is needed, he adds it in the form of copper cyanide, and when cyanide is needed, he adds sodium cyanide, thus simplifying matters. On account of its high precentage of metal—it contains 70 per cent. pure copper, the rest being cyanogen — solutions highly concentrated in metal can be worked at a relatively low specific gravity. This is a further advantage, as a bath low in density is much more easily controlled than a very concentrated one.

Copper cyanide being a cuprous salt, does not consume any cyanide in order to be transferred to the cuprous stage, and because of its being a cyanide itself it requires less sodium cyanide than any other copper salt to yield the double salt, sodium copper cyanide, the essential constituent of a plating solution. This fact points out a more economical method for producing a plating solution. In other words, it saves money.

When one buys a metal salt for plating, one should not forget that it is not the price of the metal in the salt itself which constitutes the economy of the salt, but the price at which the metal is put into solution as a double cyanide. It is this economy of the copper cyanide, combined with its high technical qualities, which makes copper cyanide superior to any other plating salt.

ELECTROPLATING AND FINISHING ALUMINUM.

By J. A. Haslip.

VARIOUS writers on aluminum plating have emphasized the difficulty of this work, and possibly my experience may be of assistance to readers. I have had considerable success in this class of work, and my method of treating aluminum before plating is as follows:

The articles should be polished in order to get a smooth surface, the same as is done in the case of other metals. The most important part of the process is in the cleansing before immersing in the bath, as more than ninety-five per cent. of the operator's difficulty in having the metal adhere firmly can be traced to improper cleansing or rinsing.

Remove the heaviest oils, greases and compositions by washing through benzine or gasoline and putting through dry sawdust to absorb surplus. Next, wash in hot potash or caustic soda for a short time only, one-quarter pound to each gallon of water, until gas bubbles appear; then rinse in cold water, brush with water and fine powdered pumice until all traces of grease and oil are removed. The articles will have lost the high lustre procured by the polishing operations, but the smooth surface will remain, providing immersion in an alkali bath be not for too long a period, as this would cause pitting or frosting.

The articles are now passed through a dip of two parts nitric acid and one part sulphuric acid to remove any oxide formed by the operations through the alkali bath. These operations must be executed with most painstaking exactness, because on them chiefly depends the success of the electro-plating process. The articles are now ready for the nickel solution, which should be slightly acid. In order to be given a high lustre after plating, the articles must receive a heavy deposit with a low current density.

The articles having been thoroughly covered with nickel, and care having been taken during the process that they do not become dry, since other metals do not adhere well under such circumstances, deposits of other metal or desired finishes may be proceeded with.

Aluminum can be oxidized to resemble oxidized silver in the following dip:—One gallon muriatic acid; two ounces, arsenic; one ounce, sulphate of iron; two ounces, sulphate of copper. It should stand at about fifteen degrees Bé. Clean articles from heavy greases, oils and compositions as for plating, before immersing in the dip; potash until gas bubbles appear, then rinse in cold water and afterwards oxidize. They will come from the dip a jet black, and while wet can be striped by using a cloth with powdered pumice, or by drying if scratch-brushed, can be toned a dark grey, or be relieved with light sand blast. Lacquer afterwards, using dip or spray.—Brass World.

Questions and Answers

Question.—I wish to dry tumble small sheet steel stampings. The steel is quite smooth, free from score marking from press, and only slightly burred on edges. I would like to know what material is most effective for this purpose?

Answer. — Procure a quantity of leather meal, this being cheaper than sawdust if used properly. Mix the work with a quantity of the meal in the tumbling barrel, which should be of wood; also add about a pint of Vienna lime for each bushel of meal used, or moisten the meal with coal oil. Rotate the barrel at a speed of approximately

40 revolutions per minute and continue the treatment for from 5 to 10 hours.

* * *

Question.—Does the cyanide salt used in plating baths and dips decompose readily if exposed to the air?

Answer.—Both the cyanide of potash and the cyanide of soda used in plating operations decompose very rapidly when exposed to moist air, such as usually is found in plating rooms. When cyanide of potash is thus exposed, the cyanogen gas is liberated. The rate of decomposition depends on the condition of the surrounding air and the amount of carbonic acid gas in the room. As the cyanogen gas is given off, the carbonic acid gas replaces it, and forms carbonate of potash. The carbonate of potash absorbs moisture from the air and the substance becomes pasty. If, however, the cyanide of soda is exposed to similar influences, the resulting effect is a powdery substance, because the carbonate of soda does not absorb moisture. If the cyanides are obtained in large containers, these should be made as near air-tight as possible after being opened; otherwise the cyanide should be removed to an air-tight receptacle. Cyanide may also be purchased in smaller containers, but at an increase in cost. Much needless loss of material is daily allowed by thoughtlessness in this respect.

* * *

Question.—Will an excess of cyanide in a copper or brass bath cause blisters to form?

Answer.—When coppering steel, cast iron or wrought iron, an excess of cyanide will not cause blisters if the bath is not contaminated and the proper current density employed, while a bath deficient in cyanide operated with an excessive current density will produce blisters. When copper plating the softer metals, less cyanide is advisable, also a lower current density. If the anodes remain black and the deposit blisters, use a weaker current and go slow. Add cyanide at the close of the day and yet avoid too frequent additions. By keeping the density of the bath in the neighborhood of 5 degrees Beaume a good sound adherent deposit of excellent color should result. If the bath be operated at a density of from 10 degrees to 12 degrees Beaume, the possibility of blisters is increased, the deposit being in no way benefited by being operated at such a density. The most successful platers avoid dense copper solutions.

* * *

Question.—What amount of boracic acid is usually employed to whiten a nickel deposit? Would any other chemical serve the same purpose?

Answer.—The actual effect of boracic acid in a nickel bath depends largely upon the condition and composition of the bath at the time the addition of boracic acid is made. In a bath composed only of nickel, salts and water, the effect is quite pronounced, and a glossy deposit is obtained after the introduction of the acid. If a chloride, such as common salt, or sal-ammoniac, is present in the solution, the effect is less pronounced, and a greater quantity of boracic acid is required to influence the deposit to the same degree. In the first instance, 2 oz. of boracic acid per gallon should suffice, while in the latter case from 3 to 5 oz. may be required. The boracic acid tends to the production of a tougher deposit and one with a close grain or less matte than when the ordinary solution is used. Three oz. of ammonium chloride and two oz. of boracic acid per gallon of nickel solution will effect a remarkable improvement when the conductivity of the bath is poor and there is sufficient metal present in the bath.

* * *

Question.—How may I add arsenious acid to a gold solution for producing green tones?

Answer.—Finely powder the arsenic, dissolve 1 ounce of caustic potash in a pint of water, add the arsenic to the caustic potash solution, and heat until the arsenic is completely dissolved; ½ oz. of arsenic will be sufficient for the given quantity of potash. When dissolved, dilute to one gallon. You will probably require about ¼ or ½ oz. of the solution per gallon of gold solution. Make the additions cautiously, as an excess will result disastrously and the color cannot be easily regained.

* * *

Question.—How should we dip or pickle brass castings to brighten them?

Answer.—Castings covered with sand which is embedded in the metal should be pickled in a hydrofluoric acid pickle for about 30 minutes or 1 hour. Use the pickle warm. Castings free from sand or scale may be washed in lye to remove grease or oil, and then transferred directly to a dip composed of equal parts oil of vitriol and nitric acid. Avoid introducing water into the latter dip unless you desire a matte surface.

* * *

Question.—Kindly furnish me with a formula for oxidizing brass, one containing sugar of lead preferred.

Answer.—Use a hot solution of 4 oz. sugar of lead and 4 oz. hyposulphite of soda dissolved in one gallon of water. Immerse the brass until the desired shade is obtained; 30 seconds usually suffices. To retain the color, the brass must be lacquered with a good body lacquer.

* * *

Question.—In the construction of flying boats we use fine piano wire; some of this has a scale on the surface which we desire to remove before coating the wires with a preservative. Can you advise us of some formula which would not injure the wire?

Answer.—To 50 gallons of water add 25 lbs. of citric acid and 1 oz. of caustic soda. Use the solution at a temperature of about 200 degrees. From ½ to 1 minute should be sufficient time to remove the scale. This solution will not injure the finest wire, but attacks oxides and scales very effectively.

SHRAPNEL SHELL CARTRIRGE CASES.

THE development of a shrapnel shell represents a vast amount of experimenting and study, but the shell itself is not comparable with the wonderful processes and tools which are employed in its manufacture. The interesting phases of shrapnel manufacture are the formation of the brass case, the forging of the steel shell and the finishing of the various shell and fuse parts to the degree of accuracy required. The production of a brass case 11½ inches long, 3 3-5 inches diameter (the British 18-pounder) requires 17 different operations.

It is formed from a flat circular blank 6¼ inches in diameter and ⅜ of an inch thick. This is first drawn into a shallow cup shape, and is then gradually elongated by being forced through steel dies which are progressively smaller in diameter. These drawing operations are so controlled that only the sides of the case are made thinner, the bottom retaining practically the original thickness to insure the necessary strength. After a smooth seamless case is drawn by the method referred to, the bottom is turned true and a central hole bored out and threaded to receive the primer or cap for exploding the propelling charge. As these brass cases, as well as those for other kinds of ammunition, contain about 65 per cent. of copper, the importance of this metal in modern warfare is apparent. This explains why the cost of copper has increased over 200 per cent. in Germany since the beginning of the war.

Nickel Plating.—Light nickel-plating can be accomplished by heating a bath of pure granulated tin, argol and water to boiling, and then adding a small quantity of red-hot nickel oxide. A brass or copper article immersed in this solution is instantly covered with pure nickel.

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CANADIAN TRADE.

THE statement of Canadian trade, issued on April 27, shows a grand total for the fiscal year of $1,078,173,240, as compared with $1,112,562,107 for the previous year, a particularly good showing in view of the dislocation of the world's trade by the war, and the unfavorable economic conditions which prevailed before the war.

In the last month of the year a very decided improvement was noticeable, the trade total being $110,540,998, as against $92,887,053 in March, 1914.

Imports for the year amounted to $587,364,363, and domestic exports to $409,419,503. In 1914 the imports were $633,564, and the domestic exports, $431,589,658.

March imports, which were $54,520,229 in 1914, declined to $40,858,179 in 1915, but the exports of domestic products showed a marked increase, the figures being $26,701,026 in 1914, and $45,118,922 in 1915. Imports of coin and bullion for the year were $131,992,922, as against $15,235,305 in 1914.

The statement is particularly interesting in its reference to exports for the month of March, exports of manufactures having increased from $6,239,290 to $15,600,790, agriculture from $6,512,346 to $12,438,145, and animals and animal products from $3,202,060 to $5,471,249.

Trade Gossip

Calgary, Alta. — The Calgary Ironworks will manufacture shells.

J. A. Disney has been appointed eastern sales manager for H. A. Drury Co.

The Western Foundry Co. has increased its capital stock from $150,000 to $200,000.

W. M. Maybank will handle the foundry supply line of the E. J. Woodison Co. in Canada.

Sackville, N.B.—The Fawcett foundry which has been closed for some months will, it is expected, resume operations shortly.

Sarnia, Ont.—A heavy shipment of brass goods for shells arrived on May 7, from Detroit, on the steamer Wauketa for the Mueller Brass Co. This concern is working night and day.

The Sarnia Metal Products Co. has been incorporated at Ottawa, Ont., with a capital of $100,000 to manufacture sheet metal products at Sarnia, Ont. Incorporators: Lloyd Lott, A. MacD. Lott and J. Garroch, all of Sarnia, Ont.

The Franklin Steel Works, Ltd., has been incorporated at Toronto, Ont., with a capital of $40,000 to manufacture toe calks at Hamilton, Ont. Incorporators: William Lees, Thomas Hobson and R. P. McBride, all of Hamilton, Ont.

Steel Co. of Canada.—On April 29 the annual meeting of the Steel Company of Canada was held at Hamilton. All the directors were re-elected and the officers also. Charles S. Wilcox is president; Cyrus A. Birge, vice-president; and Robert Hobson, vice-president and general manager.

Dominion Steel April Output.—The Dominion Steel Corporation reports its output for April as follows:

	April, 1915. tons.	Previous year. tons.
Pig iron	23,130	20,861
Steel ingots	25,343	26,397
Rails	1,633	13,712
Rods	6,512	3,021
Bars	924	2,203
Wire & wire prod'ts	3,254	2,380
Coal output	357,335	410,382

Catalogues

Electric Hoists made by the Link Belt Co., Philadelphia, Pa., are described in Bulletin No. 207. The principal features of this hoist are enumerated in detail, while the illustrations shown give a general idea of the construction.

Flinn Steam Trap made by Richard J. Flinn, West Roxbury, Mass. The bulletin describes fully the construction and operation of the Flinn steam trap. The various conditions under which it can be used are given with a reference to its chief characteristics. A sectional view is included, showing the general construction of the trap.

Gas Furnaces, made by the Gilbert & Barker Mfg. Co., Springfield, Mass., are dealt with in catalogue "B" recently issued. The various types of furnace for welding, forging, hardening and melting, etc., are illustrated and described, and the principal dimensions are given for each size.

The Monarch Engineering & Mfg. Co., Baltimore, Md., have sent us a series of bulletins describing their heating, melting and galvanzing furnaces, forges, etc. built for all fuels. Full particulars and principal sizes are given for each type of furnace together with illustrations showing clearly the general design.

Drop Forgings.—The Gotham Advertising Co., New York, are distributing a catalogue of drop forged machinists' tools made by the J. H. Williams & Co., Brooklyn, N.Y. A complete line of "Agrippa" and "Vulcan" tools are described and illustrated, while prices and essential dimensions are given for each size.

Patternmakers' Grinders, made by Charles H. Besley & Co., Chicago, Ill. This catalogue deals almost entirely with the No. 15-30-C Besley grinder, although other types very similar in design are also described. A very complete general description is given of the grinder, followed by descriptions of various typical operations, all illustrated. Brief specifications are given of the A and B types of machine. The illustrations show the grinders with various attachments and also in operation.

Electric Arc Welding.—Bulletin No. 48,904, just off the press, has been issued by the Canadian General Electric Co., Toronto. The bulletin deals briefly with three processes of welding by means of electricity, which is followed by a full description of a general process of electric arc welding, covering the principal features in its operation. Full particulars are given of the welding equipment and its application to various forms of service. A number of illustrations are included showing different classes of work done by electric arc welding. Copies of this bulletin can be obtained on application.

Grinding Machinery. — Catalogue No. 101, issued by the Wilmarth & Morman Co., Grand Rapids, Mich., is devoted to a description of various types of drill grinders and other lines of grinding machinery. Special reference is made to the "New Yankee" drill grinders and their essential features are described in detail together with some useful hints in regard to drill grinding. The other types of grinder described cover a variety of work and a specification is given for each. The illustrations which cover each type and numerous attachments are excellent reproductions and give a general idea of the respective designs.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

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Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
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J. W. Paxson Co., Philadelphia, Pa.
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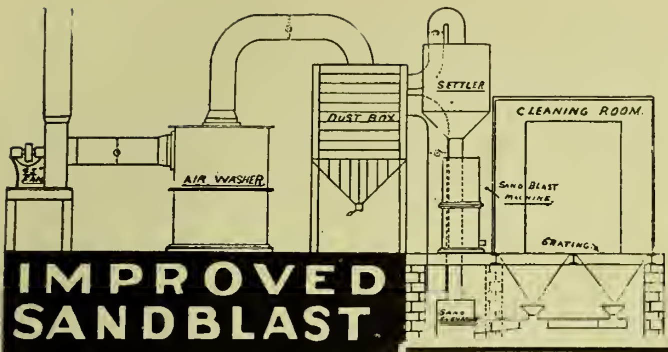

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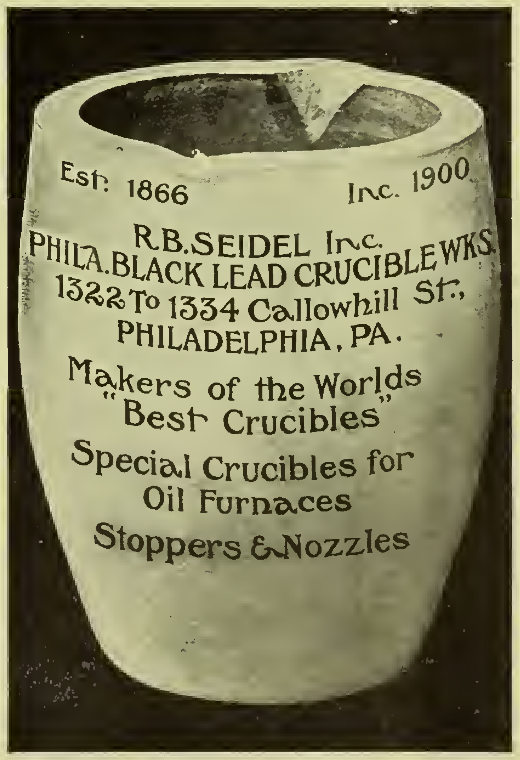

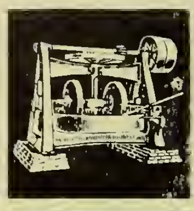

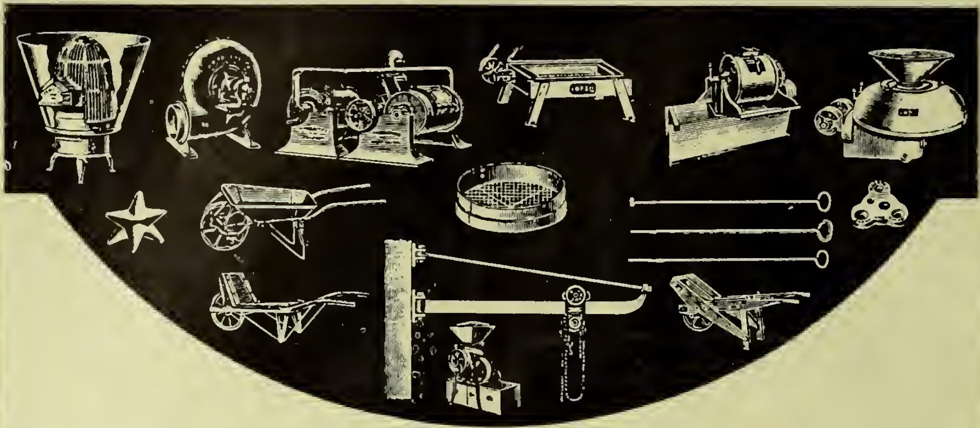

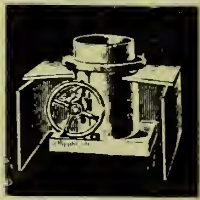

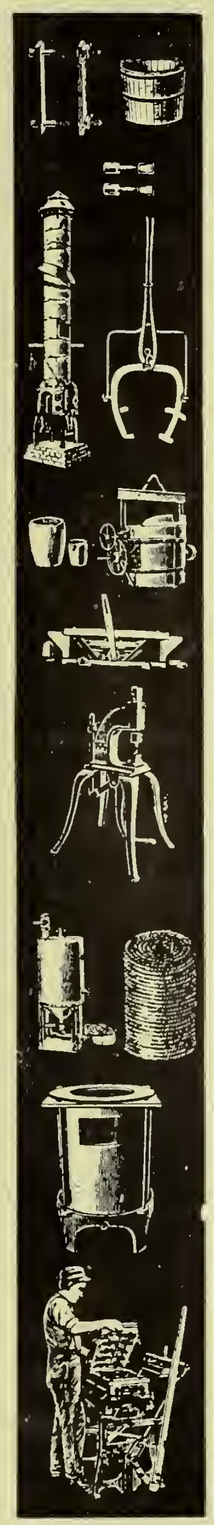

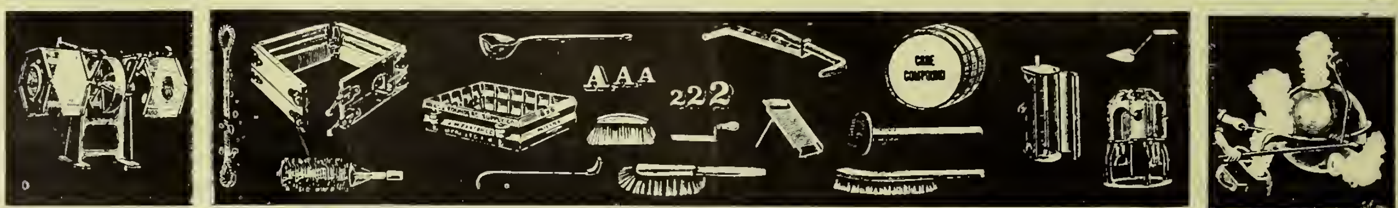
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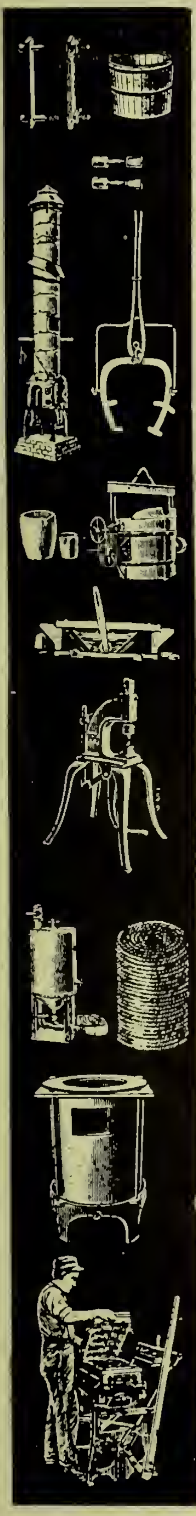

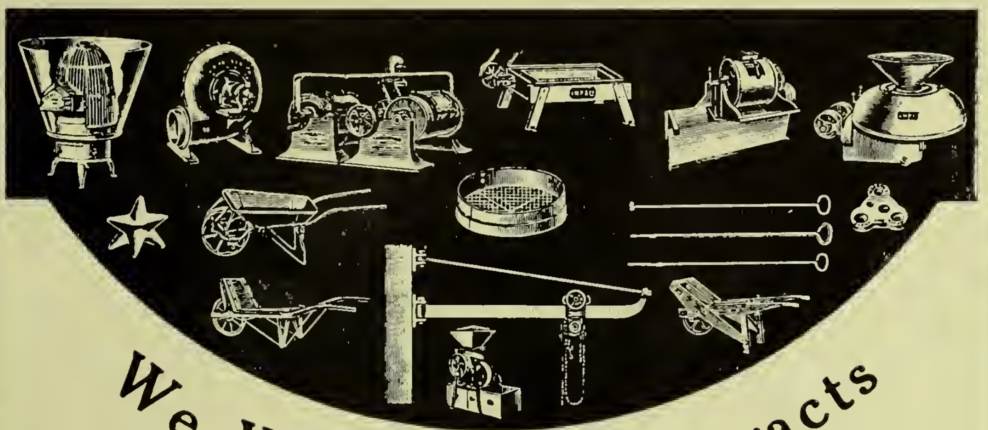

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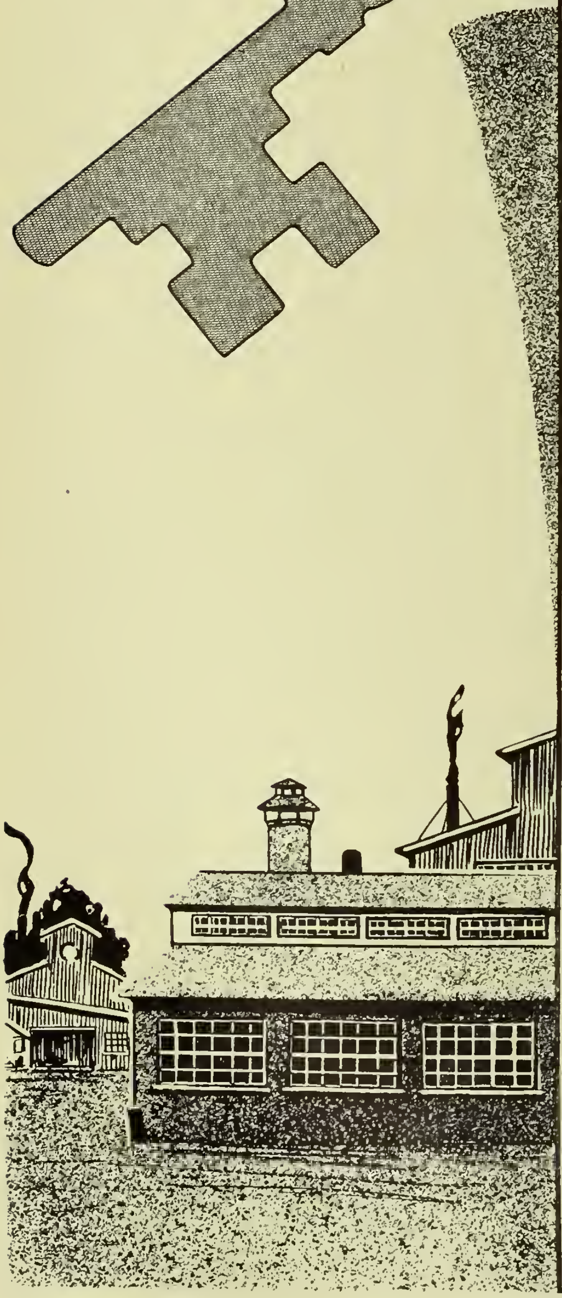

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The Publisher's Page

By B.G.N.

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Impromptu Production of Shell Cartridge Cases

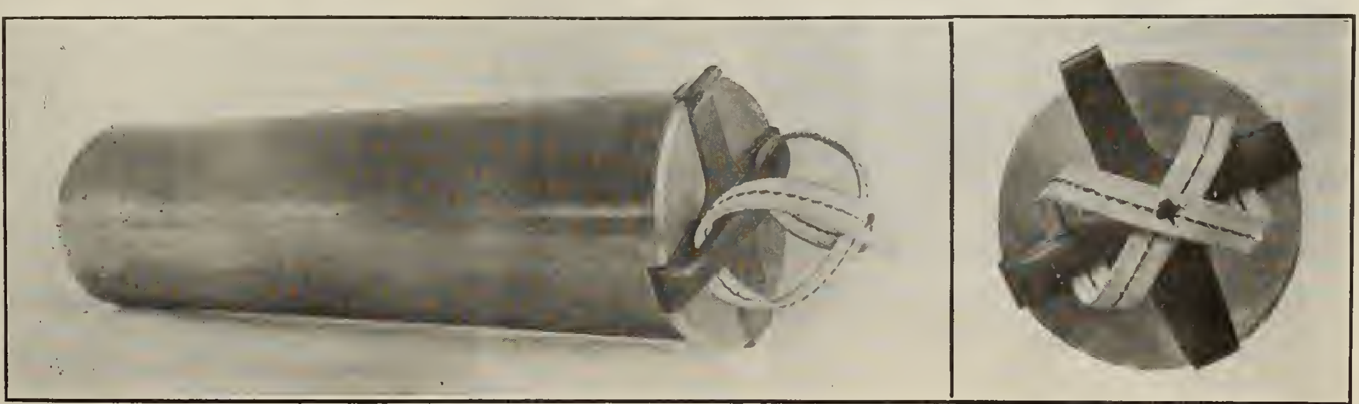
Staff Article

In addition to the manufacture of shrapnel and high explosive shells, there is also being undertaken in our midst the production of the accessory brass cartridge cases for these respective and meantime highly useful and necessary commodities. The accompanying illustrations and description refer in their entirety to the methods and devices employed and the equipment adaptation found in the motive power department of one of our leading railroad corporations. It will be easily apparent from perusal of the data that ingenuity of no mean order has been displayed and relative success achieved.

TO-DAY, while there are upwards of two hundred Canadian machine shops engaged in the manufacture of shells of various kinds, the number of concerns manufacturing the brass cartridge cases can perhaps be counted on the fingers of one hand. This industry will, no doubt, however, soon occupy a larger portion of our attention than it does to-day. Up until the present there has never been a demand for cartridge cases in Canada, hence there was no machinery designed or installed especially to serve this particular purpose. In the shop which this article is intended to describe no special equipment has been purchased to carry out cartridge case work, and for that reason the tools, dies, fixtures, and machines are all the more interesting. This is true not only from their educational value to the men engaged in the business, but because their very nature is so ingenious that the interest of every mechanic and engineer, even though engaged in work of a vastly different character, is attracted.

The elaborate system of dies and punches fitted up on bulldozers, planers and hydraulic presses have been most carefully designed and delicately made. However, the varying natures of the machines to which they have been attached verily causes us to hold up our hands in wonder and astonishment. These machines, which in times of peace, have been employed exclusively in railway work, are indeed now contributing to a page in Empire history. Our engineers and shop superintendents have risen to the occasion in developing tools and in designing machines and equip-

CANADIAN-MADE 18-POUNDER SHRAPNEL SHELL AND CARTRIDGE CASE.



CARTRIDGE CASE WITH DRAWING CLIP ATTACHED.

This clip is one of the invidentals being made in Canada for the British Government and forms an interesting job of blanking, piercing and drawing.

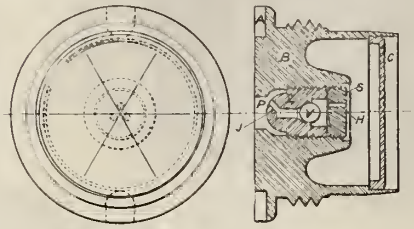
ment, and the successful outcome shows them to be as resourceful and ingenious as those of the older and perhaps more highly developed countries.

Quality of Brass.

Whether manufacturing the short cartridge case for the howitzer or the long case for the shrapnel, an extended series of drawing-out processes is required and between each drawing-out operation, annealing must occur to restore to the metal the ductility which the draw has destroyed. The composition of the brass can be roughly stated as being two parts copper and one part zinc. This metal possesses very high tensile strength when annealed and of the proper hardness. It is received in large sheets or plates of .380 of an inch in thickness. In this shop two types of cartridge cases are made. The first type is for the 18-pdr. shrapnel shell which is being manufactured in Canada today on a larger scale than that of any other. The second cartridge case is the type for the 4.5 howitzer. In this article only the former will be dealt with, that of the 4.5 howitzer cartridge case being reserved for treatment in a subsequent issue.

18-pdr. Shrapnel Cartridge Case—First Operations.

The first operation is to punch out from the plates of .380 thickness round discs of diameter 6.22 inches. These plates then pass to the cupping or second operation. This cupping operation is done on a motor-driven Williams & White, Moline, Ill., bulldozer, which is shown in Fig. 1. As will be seen, there are three punches fitted to the frame, while the three sets of dies are on the travelling carriage of the machine. The central punch performs the cupping operation. Fig. 2 shows the nature of the dies and punch which cup the disc. The dies, as will be seen, are bevelled



FULL-SIZE SECTION OF BRASS PERCUSSION PRIMER.

at an angle of 45 degrees to facilitate the entry of the disc therein. It will be noted that there is a small air vent in the punch which allows any trapped air to escape, and thus prevents wrinkles in the cupped disc. For similar reasons, practically all the punches are equipped with these air vents.

By referring to Fig. 3, the dimensions of the cupped disc are plainly seen. The dies and punch are covered with mineral tallow, which has been found to be about the best lubricant for this work. The third operation is annealing. The cupped discs are placed in boxes at the rear of the machine, whither they are conveyed by the motion of the punch. Immediately upon leaving the dies, the cases slide into a galvanized iron conveyor tube, and, as the punch comes through the dies, it pushes the cups along the tube with each stroke. They are pushed into a wooden chute at the rear of the machine and slide into boxes at the rear of the bulldozer. These boxes are put on trucks, which run on the standard gauge tracks throughout the shops, and are thus carried to the blacksmith shop, where the huge annealing furnaces are situated. The furnaces are of the oil-burning type, built in the shops of the company. One of these furnaces is shown in Fig. 4, and each furnace is equipped with a Bristol pyrometer. The iron baskets which serve to hold the cartridge cases are seen plainly, as the workmen are in the act of drawing out a basket.

As the trucks are wheeled beside the furnaces, men unload the cartridge cases from the boxes into the iron baskets and put these baskets of cartridge type for the 4.5 howitzer. In this article only the former will be dealt with, that of the 4.5 howitzer cartridge case being reserved for treatment in a subsequent issue.

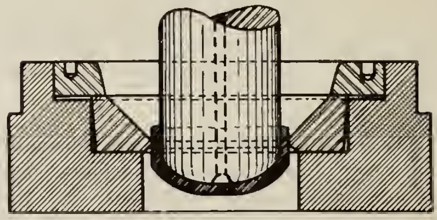


FIG. 2. CUPPING DIES.

after cupping is 650° C., or 1,200° F. They are left in the furnace for thirty-five minutes. They are then pulled out by long bars with hooks on the ends. An air hoist next picks up the basket and conveys it to a tank of water, where it is immersed and cooled.

It may here be said the effects of the annealing are in no way lost by the rapid cooling of the brass. It is, therefore, of no special benefit to cool the cases slowly, and thus, as time is one of the greatest factors in this work, the quick cooling by the immersion in a tank of water gains time and facilitates the rapidity of production. The annealing, of course, leaves a certain amount of scale on the case, which must be removed before any drawing operations are done, as this scale would ruin the punches and dies very quickly. In consequence, the fourth operation is to place the cases in an acid bath, which consists of a weak solution of muriatic acid. The shells then pass on to a hot bath of water in which some washing soda has been introduced. This latter bath removes all traces of the acid and leaves the metal clear of scale. After each annealing operation a similar wash must be given the cartridge cases.

First Drawing Operation.

The shell now passes to the fifth operation, which consists of the first of a series of six drawing operations. This first drawing operation is done on the same Williams & White bulldozer as is shown in Fig. 1. The two outside

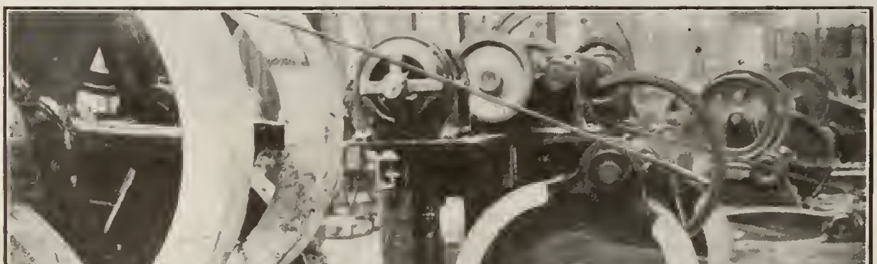


FIG. 1. BULLDOZER WITH THREE SETS OF DIES AND THREE PUNCHES FOR CUPPING AND MAKING THE FIRST DRAW ON 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES. NOTE CONVEYER TUBES FOR CARRYING CASES TO REAR OF MACHINE.

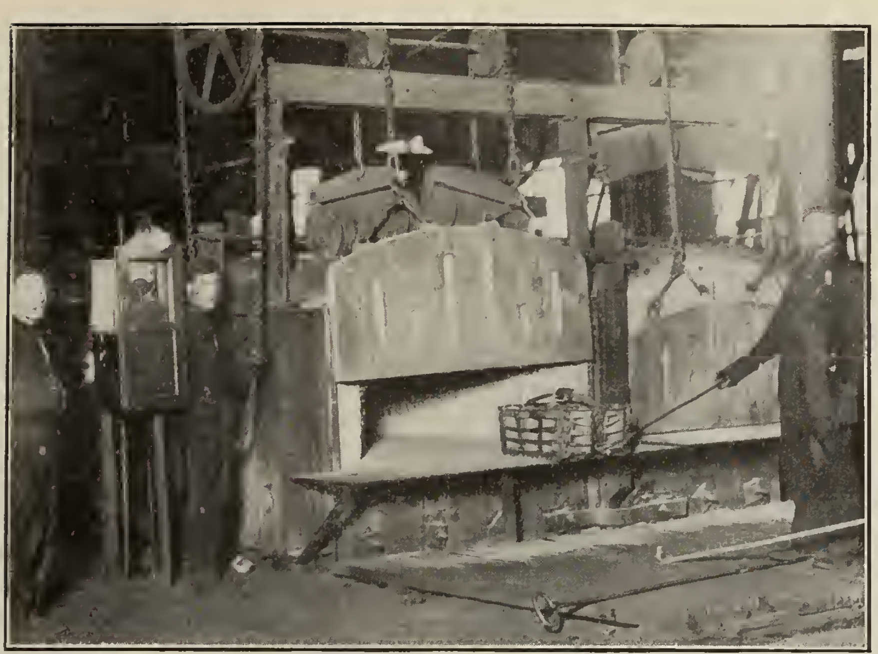
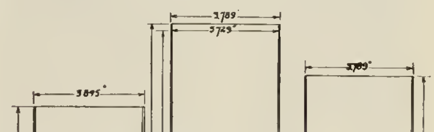


FIG. 4. FURNACE IN WHICH CARTRIDGE CASES ARE ANNEALED. THE BASKET CONTAINING THE RED HOT CASES IS BEING REMOVED FROM THE FURNACE AFTER ANNEALING.

punches work into the drawing dies that accomplish this operation. The dies and punch are shown in detail in Fig. 5, the dies being bevelled to an angle of 15° only to admit the case. By referring to Fig. 3, the size of the case and its shape can now be seen. The outside and inside diameters of the case are 4.31 inches and 3.873 inches respectively, while the over-all length is approximately 3.45 inches. Tallow and oil are placed on the work as lubricants, while the tools are copiously covered with soap and water. As in the case of the cupping operation, the punches push the cases clear of the dies and slide them into galvanized iron tubes, which convey them up to the wooden chutes at the rear of the machine. These chutes deliver the cases into boxes, which are placed on trucks and they carry them to the next operation.

Sixth and Seventh Operations.

The sixth operation is the annealing of the cartridge cases again. Each drawing operation seems to rob the brass of its ductility, hence to restore this ductility and prepare the shell for the succeeding drawing operations the case must be annealed. The cartridge cases are placed on trucks and again carried to the blacksmith shop annealing furnaces. They are placed in similar iron baskets as before, and are annealed for a period of thirty-five minutes at a temperature of 650° C. or 1,200° F. As in the previous cooling operation, tanks of water are employed, after which the shells are carried back to the cartridge shop to have the second



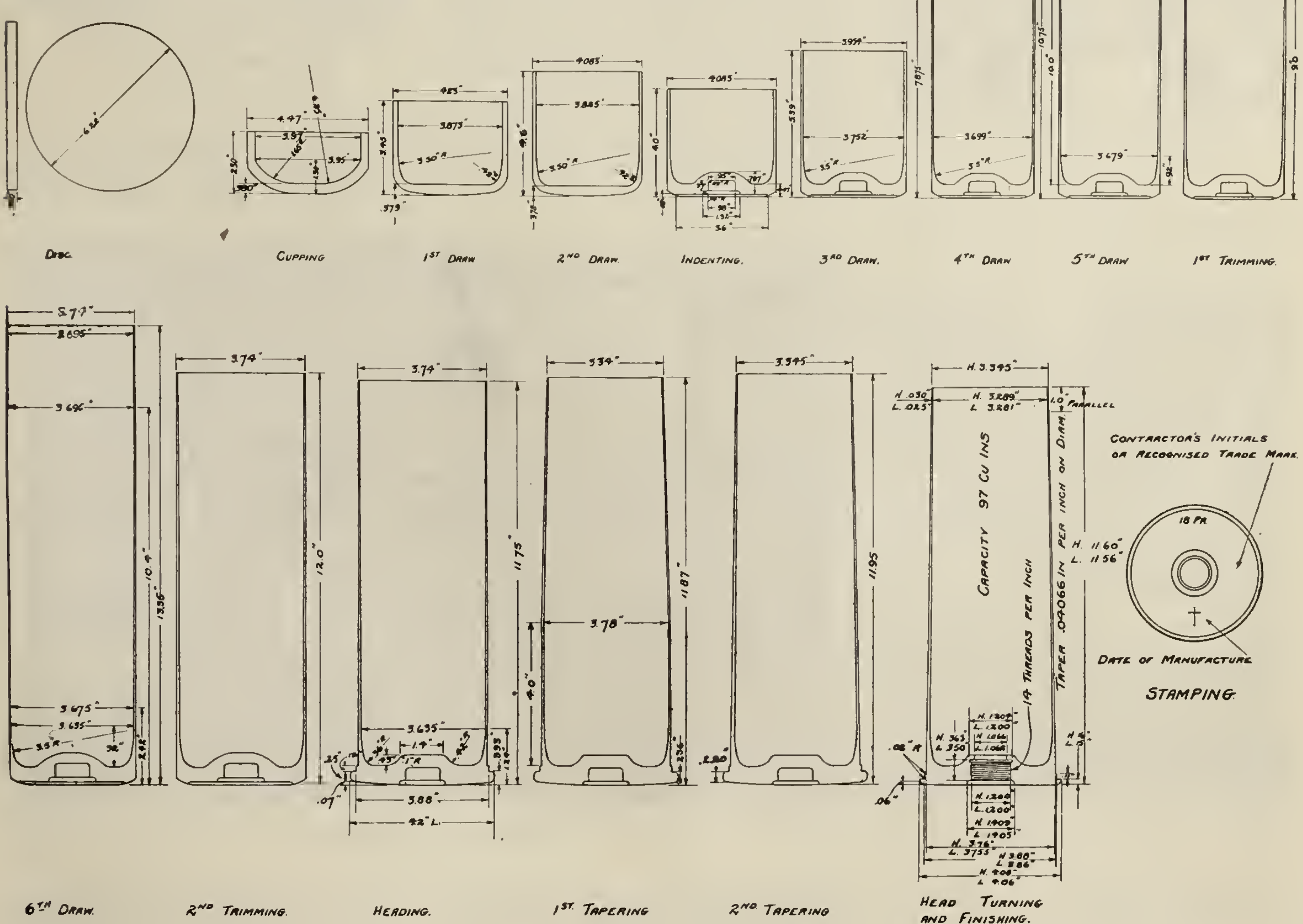


FIG. 3. CARTRIDGE CASE FOR 18-PDR. Q.F. IN ITS VARIOUS STAGES OF MANUFACTURE.

drawing operation accomplished after washing the cases. This drawing is done on a Williams & White bulldozer, but on a smaller machine than that on which the cupping and first drawing opera-

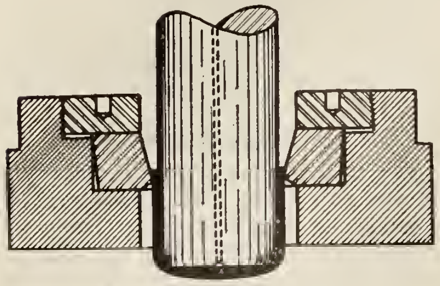


FIG. 5—FIRST DRAW.

tions were done. The machine is, however, fitted up with dies and punches similar to those shown in Fig. 1. The details of the dies and punch are shown in Fig. 6. As will be seen here, these

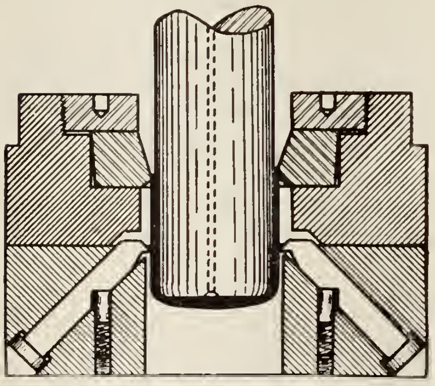


FIG. 6. SECOND DRAW.

dies are also bevelled at an angle of 15° to facilitate the entry of the shell. The same lubricants as in the first draw are used. The case is so long now that stripping jaws have to be used to pull it from the punch. All of the cases are collected from the rear of the machine as before and transported to the blacksmith shop to be indented. The outside and inside diameters of the case are now 4.083 inches and 3.825 inches respectively, and the length is approximately 4.6 inches.

Indenting (Eighth Operation) and Annealing.

The next operation is that of indenting. It was formerly the practice to make a first and second indenting, but this idea has now been abandoned, and all is done in one operation. The work is done on a 500-ton hydraulic press, the pressure being obtained from a motor-driven vertical triple Aldrich pump. The pressure head on the delivery line is 1,500 feet, which corresponds to a little over 650 pounds per square inch. Water is pumped into a huge accumulator.

The details of the dies are shown in Fig. 7, while Fig. 8 shows the 500-ton press on which the indenting is accomplished. No lubricant is used on the dies or the case. The punch is held in the stationary portion of the press, and on the table attached to the ram are placed the dies. This table revolves, and is located for pressing at every quarter turn. The central die is pushed into position by a lever at the first position and is forced up into the cartridge case. As soon as this is done, the table is revolved by hand for one-quarter turn, and the moment the table revolves its stationary part comes under the central die and holds it in place. After a quarter has been traversed, a stop locates the table in position for another cartridge case to be placed in the dies. This done, another quarter turn of the table is made, and here the whole table is raised by the water pressure of the hydraulic ram. The punch causes the indentation to be made in the case. The table is now lowered and given another quarter turn, then raised again, thereby causing the cartridge case and central part of the die to be pushed out by a fixture on the stationary head of the press. The central portion of the die is passed on to be again placed in position to indent another case.

A case is placed in the dies, one indented and one pushed out every raise of the table, thus the press requires three men to operate it. One man places the cases in the dies, one man operates the water, and the third man takes the cases from the dies. Only one press is engaged in this work. The cases are next taken to one of the annealing furnaces and heated to 1,200° F. for a period of thirty-five minutes, and after cooling they are taken back to the cartridge shop, and are again drawn. The length of case has been reduced to approximately four inches during the process of indenting.

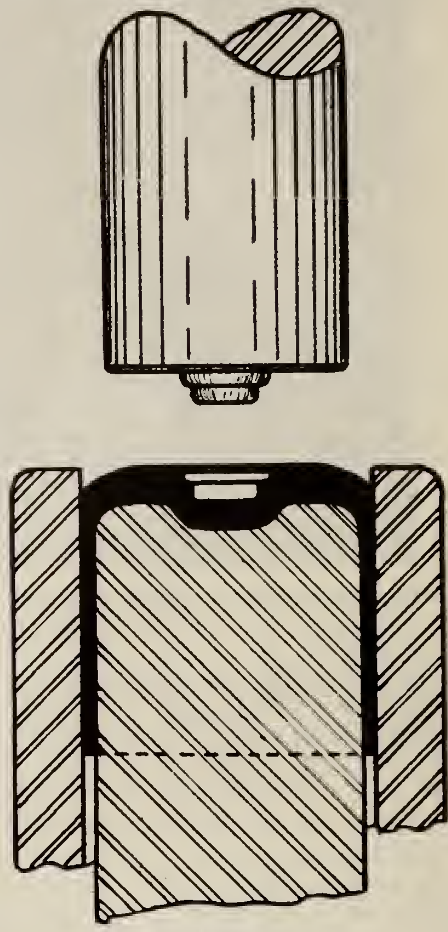


FIG. 7. INDENTING DIES.

Third and Fourth Draws.

The cartridge cases are now taken to a Williams & White bulldozer for the third draw, which is the ninth operation. The details of the dies and the punch for this are shown in Fig. 9. The

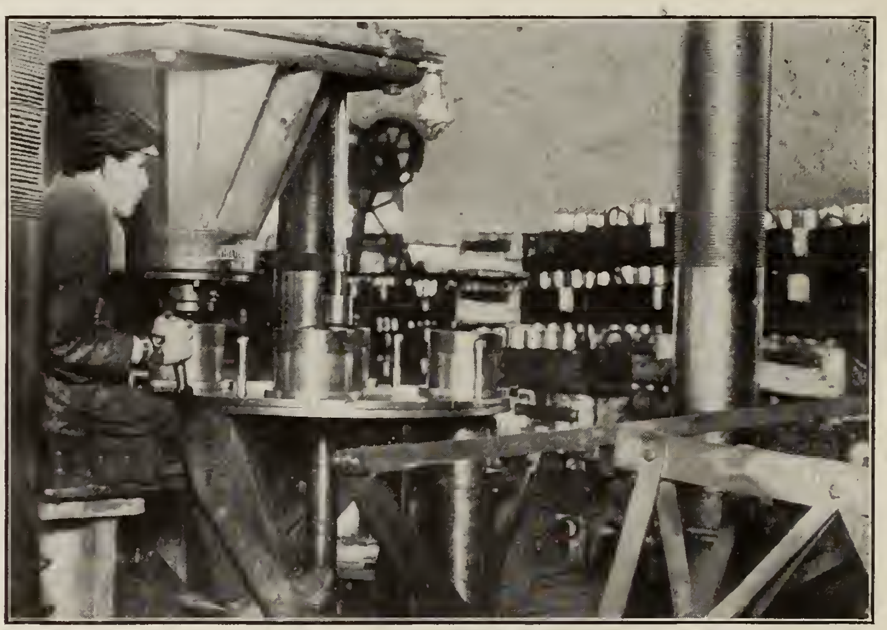


FIG. 8. INDENTING 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES ON A 500-TON HYDRAULIC PRESS.

dies and punch are fitted to the bulldozer in much the same way as in the two previous drawing operations. Mineral oil and tallow are used on the case, and soap and water is placed on the punch and dies. These dies are equipped also with stripping jaws. The cartridge case outside diameter is reduced from 4.083 inches to 3.954 inches, while the length is increased from about four inches to approximately 5.39 inches. The inside diameter has also been decreased from 3.825 inches to 3.752 inches.

The shells are again taken to the blacksmith shop for the tenth operation, which is annealing, being again placed in the furnace and kept for thirty-five minutes at a temperature of 1,200° F. Once more they are brought back to one of the Williams & White bulldozers, on

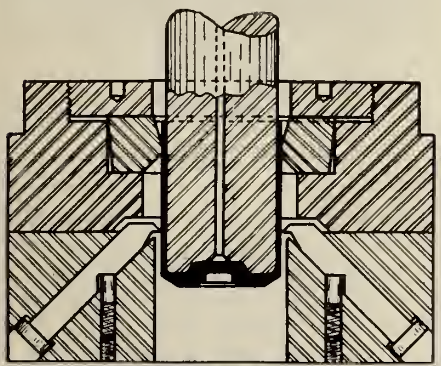


FIG 9. THIRD DRAW

which they undergo the eleventh operation or the fourth draw. The punch and dies, which are shown in Fig. 10, are again covered with soap and water, and the cartridge case is covered with tallow and oil. The outside diameter is decreased from 3.954 inches to 3.845 inches, and the inside diameter is decreased from 3.752 inches to 3.699 inches,

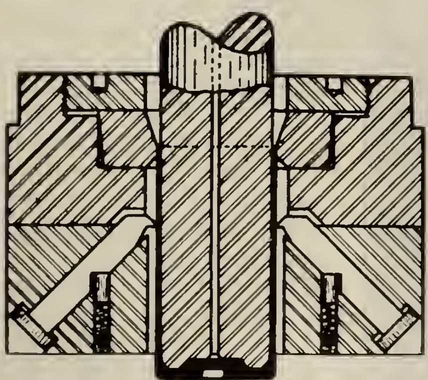


FIG. 10. FOURTH DRAW.

while the length is increased from 5.39 inches to 7.875 inches. The shells then go to the blacksmith shop to be again annealed for thirty minutes at 1200 degs. F. This annealing constitutes the twelfth operation.

Fifth and Sixth Draws.

When the cartridge cases return from the blacksmith shop after having been last annealed, they are ready for the fifth draw or the thirteenth operation. The case has now become so long that

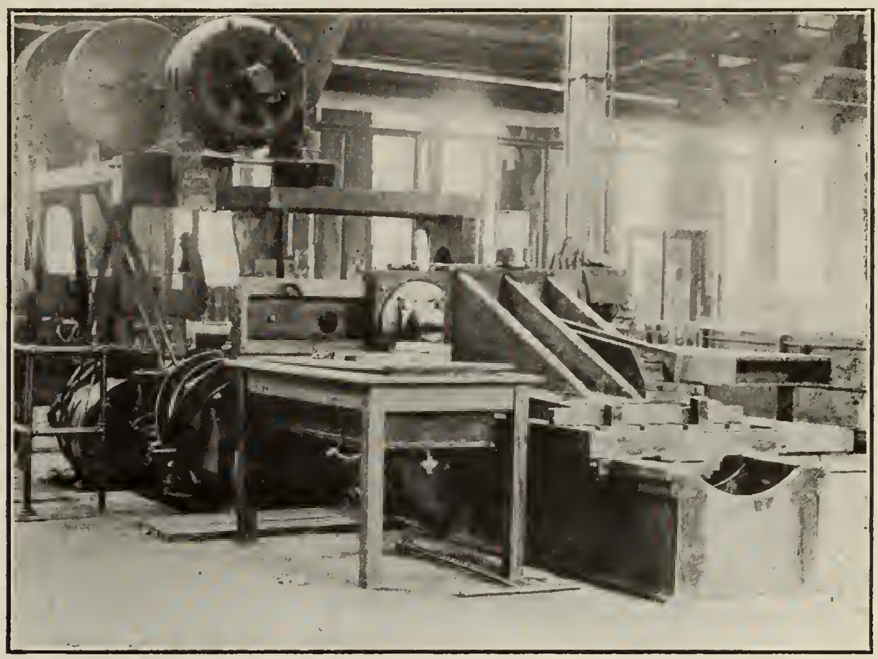


FIG. 11. FIFTH DRAW OF 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES ON A "BERTRAM" PLANER.

the stroke required to accomplish these last two drawing out operations is greater than that of the bulldozers, so planers have been fitted up to do this work. Figs. 11 and 12 show two views of the punch and dies fitted to a Bertram standard type planer. The details of the dies and punch are shown in Fig. 13. The diameter of the cartridge case outside is here reduced from 3.845 inches to 3.789 inches, while the inside diameter is tapered. After the fourth draw, the inside diameter was 3.699 inches for the whole depth, and after the fifth draw the inside diameter is 3.679 inches at the bottom and 3.729 inches at the mouth. The length of the case is also increased from 7.875 inches to 10.75 inches. The case is given a bath of tallow and oil just previous to being put on the punch, while the punch and dies are lubricated with soap and water. The cartridge case now passes on to the fourteenth operation where it is trimmed by little motor driven circular saws to nine inches length. The trimmed ends are collected and pressed in a hydraulic press into bales and are sold to scrap dealers.

The fifteenth operation consists of annealing for thirty minutes in the oil furnaces in the blacksmith shop, at a temperature of 1200 degs. F. The shells are then returned to the cartridge shop

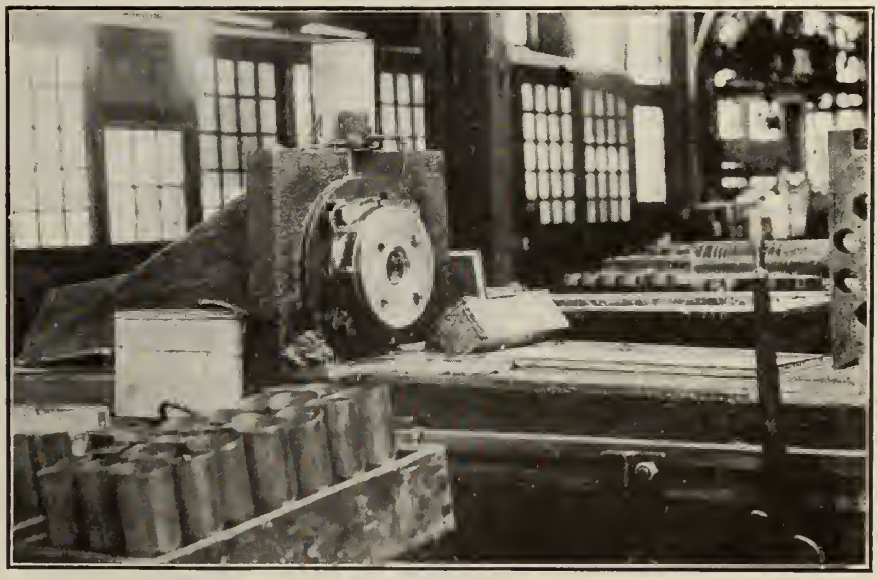


FIG. 12. FIFTH DRAW OF AN 18-PDR. SHRAPNEL SHELL CARTRIDGE CASE ON A "BERTRAM" PLANER.

for the sixth draw which is the sixteenth operation. This draw is also accomplished on Bertram planers with the same lubricants. The outside diameter is now reduced to 3.74 inches, while the inside diameter is shown clearly in Fig. 3. There are two tapers on the inside. The length of the case has been increased

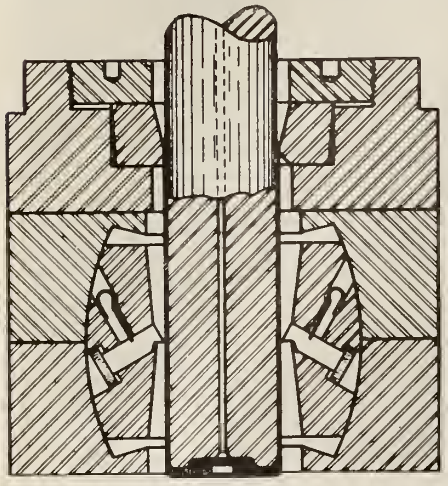


FIG. 13. FIFTH DRAW.

to 13.35 inches in this operation. Details of the punch and dies are shown in Fig. 14.

The seventeenth operation consists of trimming the shell down to 12 inches length, after which it is cleaned in caustic acid and dried in sawdust.

Heading.

The shells are again taken to the blacksmith shop where two 800-ton hydraulic presses are fitted up with dies and punches to do the heading, which is the eighteenth operation. Fig. 15 shows one of the presses. There are four sets of dies on a revolving table. which is pulled around by hand, and locks at every quarter turn. The machine requires three operators. The cartridge cases are first tried over a plug gauge and then into a ring gauge to see if the bodies are within the proper limits to fit the dies. When this test is passed a case is placed in the dies, and with a quarter turn of the table it is placed under the heading punch. The next quarter turn brings it from under the punch, and the third quarter turn brings the dies. This hydraulic piston which ejects the case from the dies. This hydraluic piston thrusts the cartridge case upward until it is grasped by the jaws, which are shown clearly in Fig. 15. The hydraulic piston ram is also clearly seen. No lubricant is used in the heading process. The cartridge cases are now shortened from 12 inches to 11.75 inches, and the shape of the head is seen in Fig. 3. After this the cases are returned to the cartridge shop.

Semi-Anneal and Tapering.

The nineteenth operation is to semi-anneal the cartridge cases in a gas furnace built in the shops. This furnace is clearly seen in Fig. 16. There are eight holes into which the cases are placed mouth first. They are left there for thirty-five seconds only, and then pass to the twentieth operation which is taperin in two stages on a Williams & White bulldozer. Two sets of dies are placed on this machine, and two operators are required. The first operator receives the cartridge case after it comes from the semi-annealing and places it on the first set of tapering dies. With the return stroke of the bulldozer, the shell is taken out and placed on the second tapering dies, after which it is removed. Neat's-foot oil is used as a lubricant in this process. The tapers are clearly shown in Fig. 3, also the accompanying elongations.

Machining.

The twenty-first operation is the machine finishing of the cartridge case and all the operations can be accomplished with one setting on one machine which is a special Bullard turret lathe. The operations required are shown in the

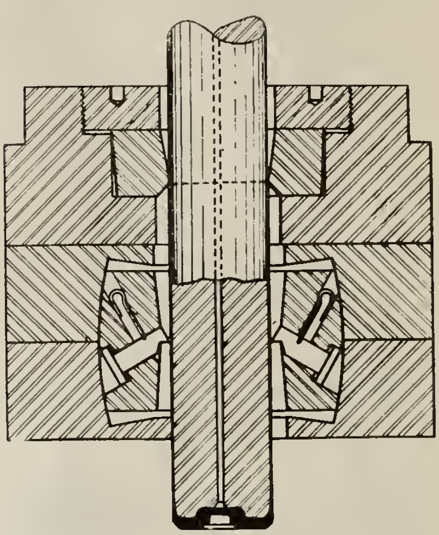


FIG. 14. SIXTH DRAW.

chart on Fig. 3. A turret is mounted on the lathe, and the lathe is equipped with a hollow spindle and a special type of friction chuck. The mouth of the cartridge case extends through the headstock, and a boring tool is mounted on an extension of the lathe bed. The cartridge case is trimmed to 11.60 inches in length and then for a distance of one inch it is bored parallel by this tool. The diameter is then tested by means of a limit plug gauge. The operation trues up the inside of the case for the reception of the shell. The specifications do not allow of any extensive process of boring, as it is thought that perhaps a manufacturer may be tempted to substitute a brass casting for a drawn cartridge. One attendant looks after this operation. The second operator, meanwhile, is machining the head.

Fig. -7 gives an idea of the turret tooling on these machines. There is fitted to the cross-slide a tool which faces the end of the cartridge case, and on completing this operation, as the cross-slide is fed further in toward the centre. Other tools are brought into the work which turn the various diameters shown in Fig. 3 at the head of the cartridge. All tools approach the work from the near side, and the cartridge case is chucked against a stop and the carriage is locked to the lathe bed. The cross-slide

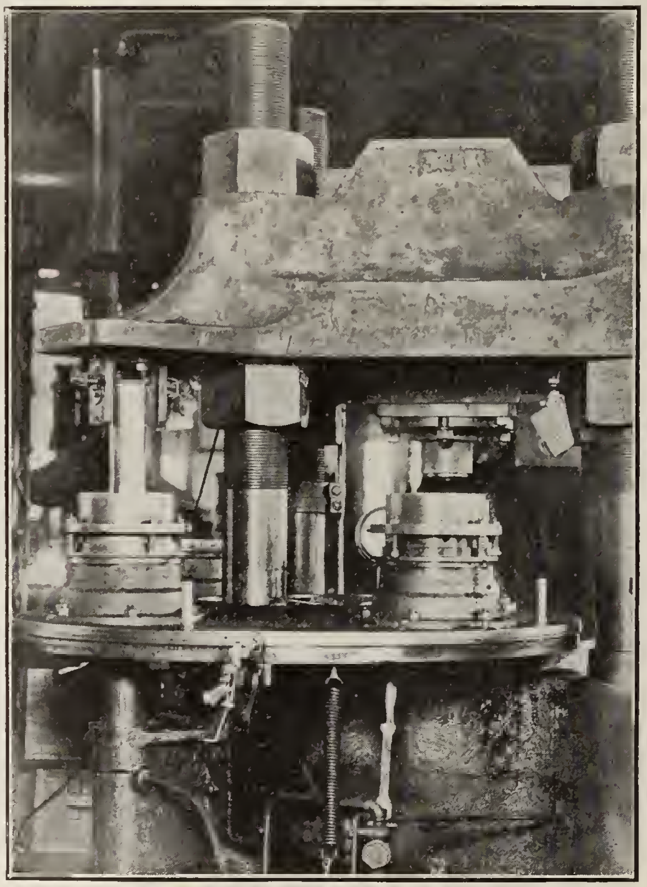


FIG. 15. HEADING 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES ON AN 800-TON HDRAULIC PRESS.

Note at the left foreground the small hydraulic ram which forces the cartridge case out of the dies and also the little jaws which hold it up from the dies as they return to their normal position.

is fed inwards until it is against a stop, hence the machine is almost fool proof. After these operations, the turret tools are fed into the work.

The first tool is a twist drill of several diameters which is fed into the end of the case, and when this tool has been fed in the proper distance a stop indicates same to the operator. The next is a little tool on a boring bar which is placed in the hole just bored. The turret is placed up against a stop and then the tool is fed into the work laterally by means of a cam in the boring bar, which cam is actuated by the little lever shown in Fig. 17. This tool is so ground that it cuts the undercutting groove shown in

HEADING DIES.

Fig. 3, and faces the inside of the hole. The proper depth of the groove is determined by the cam which causes the tool to have cut the groove to the proper depth when the high spot of the cam is pressed against the tool. The next tool is a collapsible tap which taps the hole. Finally a solid reamer is put into the work and this tool completes the series of operations. Soda water is used as a cutting lubricant. As it was not possible on short notice to get the required number of these special Bullard lathes, all the machining is not accomplished on them, several turret lathes having been tooled up to finish the heads of the cartridge cases as well.

Cartridge cases so finished have to be trimmed and have their mouth bored on a separate machine. They are simply chucked in a long jaw collet chuck and gripped firmly enough to resist the tendency to turn with the boring tool and at the same time not be sprung out of shape. These lathes are usually hollow spindle machines, and a hand-wheel on the end of a rod is used as a medium to open and close the jaws of the collet chuck.

Fig. 18 shows a Warner & Swasey turret lathe tooled up for finishing the heads of the cartridge cases. As will be seen, the facing tool on the cross slide approaches from the far side while the turning tools are on the near side. The cartridge case is chucked in an internal expanding collet chuck mounted in a cast iron casing which is screwed to the live spindle of the lathe. This cast iron casing is very long, as the whole length of the case has to be gripped, and the outer end is supported in a bearing which is bolted to the ways of the lathe. The shell is chucked against a stop, and, as the facing tool is fed into the work, the cartridge case is faced to length. The carriage is, of course, locked to the lathe ways. Thus, when the cross slide is moved so as to bring the turning tools into the work, these tools enter the work at the proper position. The cross slide comes against a stop when the proper diameters have been turned. The next

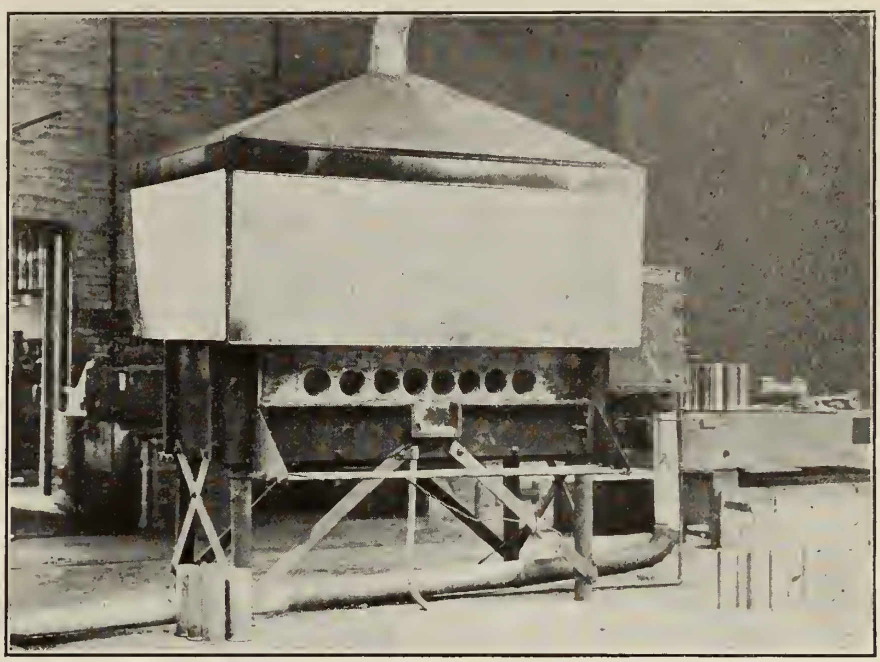


FIG. 16. GAS FURNACE FOR SEMI-ANNEALING 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES PREVIOUS TO TAPERING.

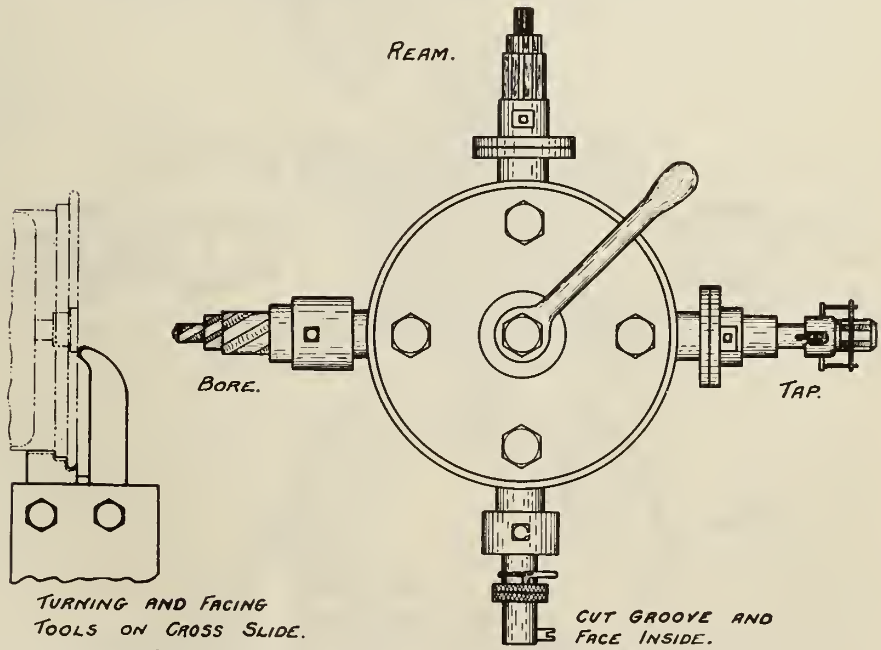


FIG. 17. TOOLS ON SPECIAL "BULLARD" TURRET LATHE.

operations are accomplished by the turret tooling, a diagram of this being shown in Fig. 19.

On the first boring bar there is a twist drill. which bores the rough hole, and the next boring bar carries a flat drill which has several diameters and finishes all the counterbores. Next the inside facing and grooving tool is fed into the work, this being the same tool as was fitted to the Bullard turret lathe. Another boring bar carries the collapsible tap, which is followed by a solid reamer. After this the cartridge case is tested for length with a limit gauge. The thickness of metal at the ends is also tested, together with the inside and outside diameters, the latter by means of plug and ring gauges. The taper is tested with the gauge shown in Fig. 20.

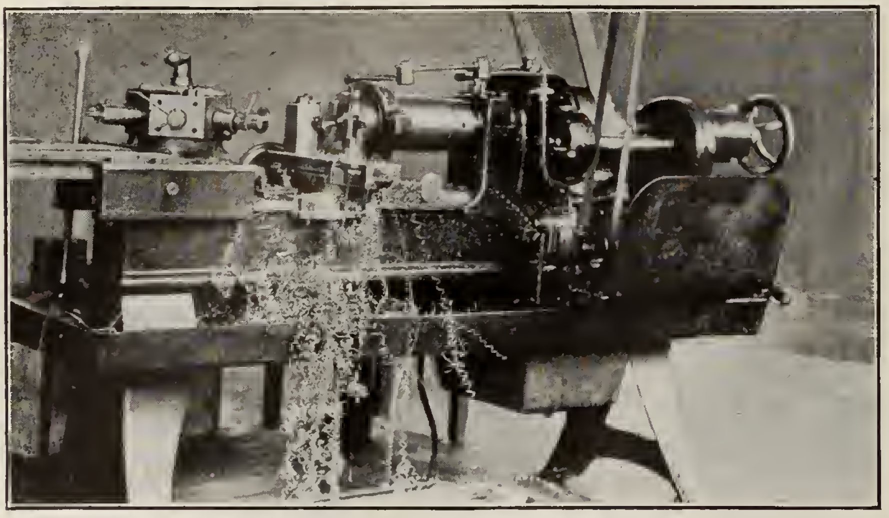


FIG. 18. FINISHING BACK ENDS OF 18-PDR. SHRAPNEL SHELL CARTRIDGE CASES ON A WARNER & SWASEY BRASS TURNING TURRET LATHE.

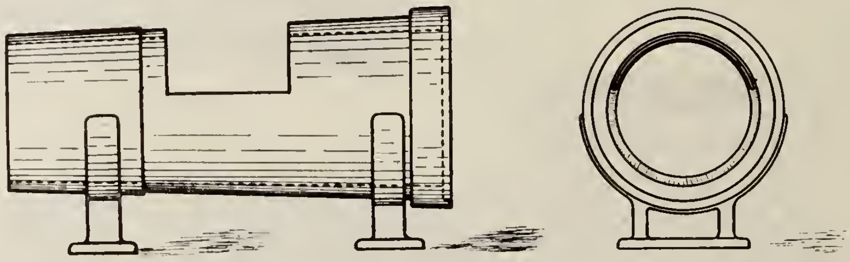


FIG. 20. JIG FOR TESTING TAPER AND OUTSIDE DIAMETER OF BACK ENDS.

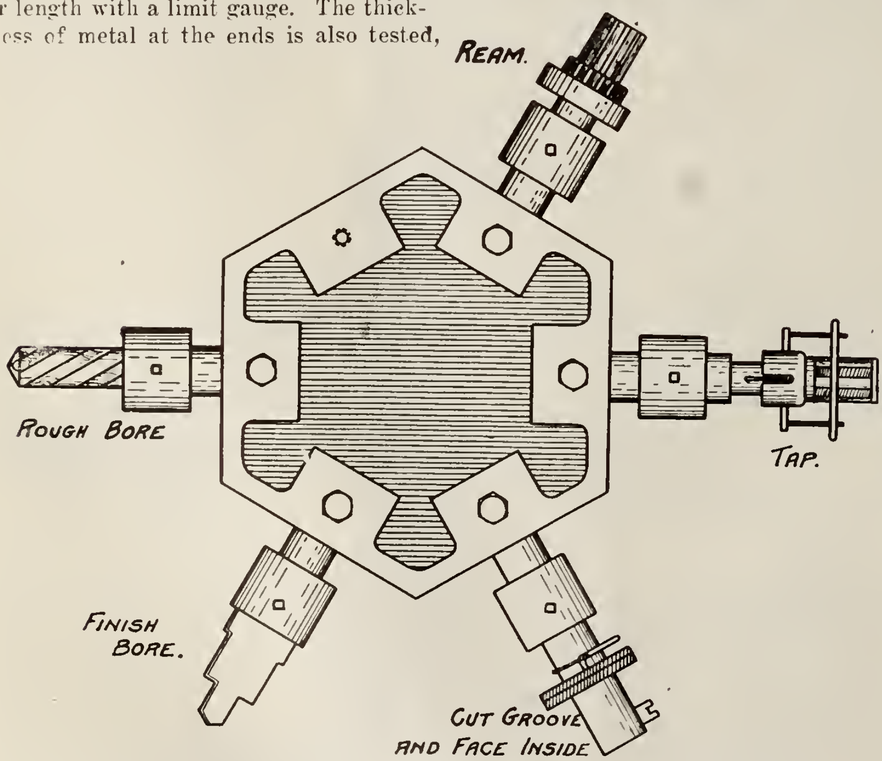


FIG. 19. TOOLS CARRIED ON THE WARNER & SWASEY TURRET.

Finishing on the Bench.

The twenty-second operation is the final testing on the bench. Here the cartridge cases are placed in vises, and a finishing tap is run through the hole in the head. This tap is shown at A, in Fig. 21, which illustrates the gauges and tools used in the bench work. Next, the gauge B is placed in the hole at the head to see if the outer counterbore is of the proper diameter and depth. If it is not right, the hand reamer is used to correct it. Next the tapped hole is tested to ascertain if it is concentric with the counter-bore, tool D being used for this purpose. The low limit size thread is at the same end of the gauge as the flange, while the high limit size thread is at the opposite end. If the tapped hole is not concentric with the counter-bore, the tap is placed in the hole and the reamer E is placed over the tap, and the counterbore is reamed out concentric with the tapped hole. The plug gauge F shows the high and low limit size of the hole in the socket. The low limit must pass through the hole, and the high limit must not.

Stamping, Cleaning and Sand Blasting.

The twenty-third operation is to mark the shell as indicated in Fig. 3, after which the shell is taken to a lathe which has a brass casting screwed on the live spindle. The casting is turned down on the end opposite the head stock. This shank has a thread cut on it to accommodate the tapped hole in the head of the cartridge case, the latter being screwed up against the large solid shoulder of the main casting and held solidly there while it is cleaned up. The twenty-third operation is sand blasting, which prepares the cartridge case for the final operation of black lacquering the inside. This completes the series of operations on the 18-pdr. shrapnel shell cartridge case.

The Letter E.—Some one has advanced the opinion that the letter "e" is the most unfortunate character in the English alphabet, because it is always out of cash, forever in debt, never out of danger and in hell all the time. We call attention to the fact, however, says the Charleston Gazette, that "e" is never in war and always in peace. It is the beginning of existence, the commencement of ease and the end of trouble. Without it there would be no meat, no life and no heaven. It is the centre of honesty, makes love perfect, and without it there would be no editors, devils or news.

Notes and Observations on Modern Foundry Practice—I*

By R. Onions

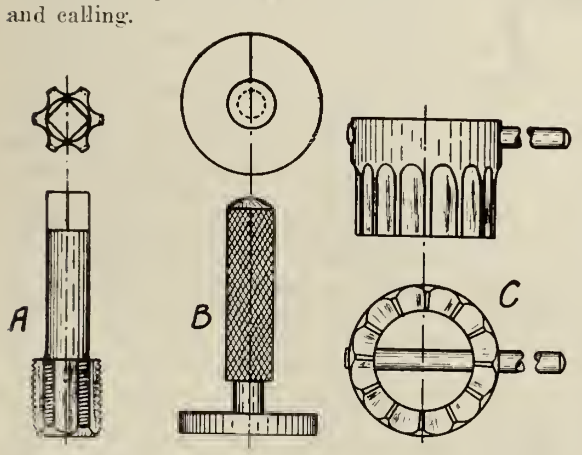
In the introduction to his paper, the author referred to the fact that the art of ironfounding was in existence previous to the written records of history. He at the same time hazarded the suggestion that to the scientist and practical man of to-day it offered not only a wide field for research, but one also in which individuality had the widest possible scope.

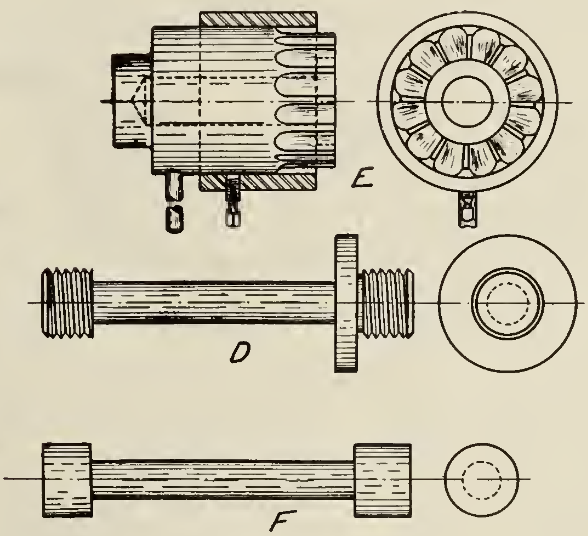
IN these strenuous war-time days, the iron foundry is not conspicuously prominent either in its production of war munitions or its development demonstration. Its devotees are neither idle at the desk nor on the floor, however, and, if for the nonce, the steel mill and the forge divide the honor of premier place in industrial engineering enterprise, the day is becoming appreciably nearer when the iron foundry will again assert its claim and demand whole-hearted attention.

In what follows in our present and immediately succeeding issues, sufficient of the substance of the subject matter discussed by the author in his paper will be reproduced, so as to give an idea of the comprehensiveness of the detail embraced and incidentally re-awaken the interest of foundrymen to the achievement possibilities of their craft and calling.

It is difficult to understand why oil sand cores are not more widely used. The labor question has a considerable influence, but when judiciously introduced and men see that they will work satisfactorily, they are looked upon with more favor. One objection to guard against as far as possible is the smell from fish oils. Two parts of whale oil and one part of boiled linseed oil work well.

The bending of core irons in wooden core boxes is responsible for a good deal of damage, involving pattern shop repairs. Bad work and delay creep in if patterns and core boxes are allowed to deterioriate. A periodic examination and general clean up and varnishing is good practice; it leads to the worker taking more interest in his job; and tends to recruit a better class of man.





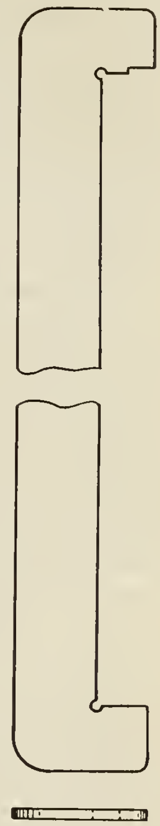


FIG. 21. GROUP OF BENCH TOOLS.

Core Making.

Good results are obtained by the use of sea sand and oil for certain classes of core work, such, for instance, as the core required for the combustion chamber of gas or oil engine and steam ports of cylinder, where the core is entirely surrounded and good venting is necessary. A man will take five or six hours to make the water jacket core irons for a gas engine of 100 h.p., and a great deal of care is necessary to have the vents from all the parts to the outlet. Such a core is well suited for oil sand, and, when it is used, no grid is required, as the core dries so hard that a few irons crossed and tied for lifting purposes are all that is wanted.

When quantities enter into the question, labor-saving devices should be considered, and by attention to details which go towards eliminating the fatigue of the operator, particularly where girl labor is employed, the output will be enhanced. It should, therefore, be an axiom not to do anything by manual labor which may sensibly be performed by power. The illustration on next page shows such a device, being a pneumatic core box cramp, which is operated by the opening or closing of the air tap.

Green or Dry Sand Castings.

The main points to consider when deciding what castings to make in green or dry sand are, the amount of machining on the finished piece, the cost of the mould and the number of cores it contains; the risks in closing, and the class of skilled labor available. The human element also steps in to a very considerable extent.

For dry sand, one first class, and, say, three indifferent moulders, may form a squad. The leading hand should be employed in finishing and closing, and the others in ramming up and partly finishing. For green sand every man must know his job, the drying very often making good the defective venting and ramming which would be quite fatal to the green sand mould. Dry sand castings are not so sharp as green sand; the difference being quite noticeable in fine pattern work.

There are many quite elementary points which are found in actual practice to be missed, and so cause serious leakage in the way of lost work. A pipe for example should not be rapped sideways, but tapped lightly on both ends with a wooden mallet. Rapping sideways tends to disturb the sand along the edge of the box, nevertheless, it is the practice with moulders to loosen pipe patterns sideways. The advent of the moulding machine with its vibrator has

*From a paper read recently before the Manchester Association of Engineers.

shown that patterns of quite moderate size can be satisfactorily loosened by quite light tapping. Gaggering of dry sand moulds is generally much overdone, and it is one of the many details of moulding where men may be working hard and still wasting their time. In ramming a green sand mould, care should be taken never to go too close to the pattern, as this is the sole cause of many scabs. Pneumatic rammers shake the arms, and, partly owing to this, the moulder cannot feel the degree of hardness the same as with the hand tool.

Compressed air service at 80 to 100 lb. square inch pressure with convenient connections for india rubber tubing is an advantage for blowing out dust and pieces from deep dry sand moulds. The same connections may be used for crude oil burners, which are sometimes used instead of coke buckets for skin drying green sand molds. Iron molds may be made to supersede a good deal of open sand castings, such as grids, anchors for holding down bolts, core grids and such castings that have taper on all sides.

Moulding Machine Advantages.

The foundry in order to be on equal terms with the machine shop must produce with precision also. Castings which are uniformly rammed, loosened and drawn by machines must score in this respect over those produced by hand moulding. Some form of moulding machine where the pattern plate is easily and cheaply made, and is capable of being worked by unskilled labor, is a great advantage.

When making wood patterns, the management cannot always say whether or not any particular detail may become a standard design before trial, and so a difficulty comes in to determine whether it should be machined moulded. Patterns intended to produce moulding machine plates are sometimes required to have a double contraction. This difficulty is best met by adopting a class of metal which will have little or no contraction; the material should also resist corrosion and not be too brittle. The following mixture of metal is cheap and meets the conditions well:

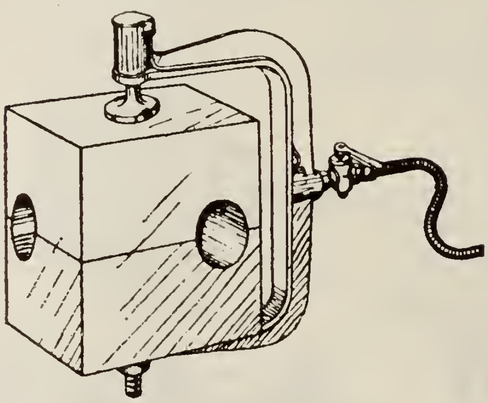
Lead	85%
Antimony	10%
Tin	5%

In all moulding machines, except the class where a stripping plate is used, the method of first starting the draw should be so under the control of the operator that any degree of movement may be obtained whilst the vibrator is still in action, as moulders know it is on the first attempt to disturb the pattern that damage may be done.

Centres of pin holes and sizes of boxes are important matters to determine, as they soon multiply in number, and changes afterwards cannot well be made. These dimensions are settled by the class of work and when decided upon, jigs are necessary for drilling pin holes in frames of machines which will correspond exactly with those in moulding boxes. Good jointing is essential for accurate work, and this can only be obtained by keeping all pins and holes in good condition. The holes stand well if bushed with 3 per cent. nickel steel, and pins resist corrosion when made of the same material.

Plate Moulding.

Plate moulding may be said to come between the ordinary moulding with loose patterns and the moulding machine. Like all other classes of moulding, it has its sphere of usefulness in practically every foundry. The principal advantages gained are that by it a good joint is assured, the plate being extended over the box, the pins forming a guide when drawing the pattern off by hand, so that less patching and mending is required, and the castings in consequence come out cleaner and nearer to the actual size of patterns. The machining allowance can also be less.



PNEUMATIC COREBOX CRAMP.

The general trend of engineering demands from the iron founder more complicated castings, capable of standing higher fluid and gas pressures, greater stress and sliding surfaces to work satisfactorily up to 900 ft. per minute, and to have test pieces cast which must satisfy severe transverse and tensile tests. The foundry man meets the conditions demanded sometimes by the grading of metal or the placing of running gate or risers over particular places, whilst cases will occur where all ordinary methods fail and the desired result after many trials is only possible by the application of a chill or densifier at some particular spot.

Chills.

Chills may be cast in the body of castings and remain as part of the finished product, as in the case of flywheel bosses, where a ring of cast iron may be placed in the heavy section, but clear of the machined surface. We have also the class of chilling to obtain from one grade of metal, two distinct grades in the casting, such as a hardened surface to stand wear. The hardness or denseness obtained bears a relation to the respective massiveness of the chill and the casting, or the time they are allowed to be in contact. In applying chills, it is therefore necessary to leave the surface so that it can be machined and to have the chilling effect so deep that after machining the surface is sufficiently hard.

Various types of fettling-shop rumblers capable of holding up to five tons, are made, and these seem to impart some property which appears to be beneficial, probably by helping to set free contraction and skin stresses, and so making the casting more normal in this respect.

Cupola Management.

The cupola and its management may be considered the section of ironfounding offering the widest scope for investigation, and considerable skill and experience must be exercised in the design, building, and working if the operations are to be carried out to give, in regular work the best results.

Amongst the many modifications or special appliances added to the ordinary cupola which have for their object the reduction of coke consumed per ton of iron melted, probably the one which makes the strongest appeal is that patented by Greiner and Erpf. These inventors claim that with a second row of comparatively large tuyeres the burning is so concentrated, and thus the temperature maintained is so high, that the carbon dioxide formed is sufficiently hot to react on hot coke and form carbon monoxide again. Their cupola has one main row of tuyeres, and then a series of small tuyeres distributed for a considerable distance up the cupola. The idea of this arrangement is, that by supplying the extra air in small quantities, they burn all the carbon monoxide without raising the temperature of the coke high enough to be followed by the reaction of the carbon dioxide again.

Experiments have been made with the Greiner and Erpf's air distributor and other experiments with the ordinary tuyeres in the way of sending the blast in different directions, such as obtaining a swirling motion, directing the blast downwards and with the openings made to increase the velocity to send the air to the centre. These went to confirm that the tuyeres arranged horizontally and directed towards the centre, with an increasing area to give a soft and well-distributed blast, having a velocity not exceeding 2,500 ft. per minute, will give good all-round results; the lining under these conditions being easily repaired and the shape readily maintained.

A receiver attached to the side or bottom of a cupola appears to claim a good many advantages. By mixing thoroughly the various grades of metal, and by allowing the metal as it melts to flow away from the influence of the coke, it will pick up less of its impurities. It also has the advantage that, by taking away the slag, apart from the furnace proper, the coke is not brought down so quickly; on the other hand, it takes a little longer to get hot metal than is the case with the ordinary cupola.

Attempts have frequently been made to economize the fuel by connecting the top of the receiver to the cupola and so making use of a hot blast. With such an arrangement difficulty is experienced owing to the connecting pipe getting choked with a kind of slag deposit, impinged quite hard against the interior, in the form of sparks. Temperature has a considerable influence on the microstructure of castings. For one cause or another, various castings have to be cast at different temperatures, so that practically every casting will have a corresponding casting temperature to suit allround conditions.

Castings Cost.

When considering the question of costs of castings, we must look at it from a point which goes beyond the foundry—as, after all, this is only one of several sections of an engineering works which go to make the whole. Here, then, it is necessary to exercise a good deal of sound judgment, which can only come by long experience. For instance, a slight increase in foundry costs may result in a large decrease in finishing costs. Certain holes, say, in a bedplate, may do quite well if cored, but from their position in the mould the risk of a "crush" may be too great to set against the drilling time.

Management and Organization.

On drawing this paper to a close, it may be as well to pause for a moment and ask ourselves the question, "What does successful iron founding mean?" However necessary good equipment and tools may be, they are useless in the hands of bad management and poor organization. It may be conceived on this score alone that the so-called out-of-date shop may beat a foundry equipped on the most up-to-date lines. Clearly then it is not so much the equipment we have to look to, as the supervision and the skilled men of the foundry, and as they are the men who earn the profit, everything possible should be done to relieve them of anything which may take them off their job—in short, the skilled man is no use when laboring.

The gun shield of a British field gun is about 20 sq. ft. in area.

DOMINION STEEL CORPORATION NEAR CAPACITY.

THAT the mills of the Dominion Steel Corporation are as active at present as during the busiest periods of its history, is the statement made by J. H. Plummer, the president. Operations are now being carried on at about 90 per cent. of the capacity of the entire works, and there are orders on the books of the company which assure operations to the same extent for at least the next four months. Business on normal Canadian account is, however, practically nil.

At the present time the output of the Dominion Steel Company is about as large as during the most active periods in its history. It should be explained, however, that the business is almost entirely for export, and therefore, not so profitable as domestic trade. The rail mills will presently begin rolling on the 35,000-ton order received for shipment to South Africa, while the steel required for the manufacture of 1,500,000 shells will mean at least partial operations of the bar mill for at least six months. Inquiries now being received give encouragement that further new business will develop in rails and other products in due course.

STEEL INGOT MOULDS.

INGOT moulds made of hematite iron, says Le Génie Civil, have not given satisfactory results, and are now in some works replaced by ingot moulds made of cast steel, which offer important advantages over the cast iron ones. It is true that they cannot be cooled down by water, and that a large area is required to allow them to cool down in the air, but this is the sole disadvantage attendant upon their use. In the manufacture of steel ingot moulds, the core consists of an inner cast iron centre surrounded by straw, on which is put the loam covering, 70 mm. (2¾ in.) thick; this thickness is made up of successive layers, the core being dried in the stove after each layer. When completed, the cores are placed in cast iron boxes lined inside with firebrick and a layer 20 mm. (¾ in.) thick of loam. Cast steel ingot moulds have an average life of 380 castings.

COPPER REFINING PLANT PROPOSED

THE establishment of a plant for copper refining will likely take place, following a conference recently held between the Minister of Militia, General Hughes, the chairman of the Shell Committee, Col. Bertram, Col. Carnegie, Dr. Wilson of the Department of Mines, Messrs. W. D. Matthews and Warren, of Toronto. It is intended to have every part of the shells which Canada is supplying made in Canada, and as far as possible of Canadian products. The smelting of copper in Canada is now considered feasible, and the plant will in all probability be located in New Ontario. Canada is now turning out 30,000 shells a day, and Canadian factories are making high explosive as well as shrapnel shells. A very large amount of Canadian lead has been used in the manufacture of munitions for the British army, the lead mines having contributed 50,000 tons of lead, shipped to England since the outbreak of the war.

ROD CASTING IN NON-FERROUS METALS.

A NOVEL method of casting rods in non-ferrous metals is now being used in the United States. It is known as the Mellen method, after its inventor, and was described in a paper read before the American Institute of Mining Engineers some time ago. The moulds are formed by cutting grooves in two blocks which face each other. Two endless chains are formed of a series of these blocks, and are arranged to run in vertical water-cooled guides. The liquid metal is poured in at the top and the velocity of the chains of moulds, or the height of the machine, is such that by the time the moulds open where they turn round the bottom guide pulleys the metal is solid. Thus a continuous rod of solid metal issues from the lower end. The flow of liquid metal is controlled by an electrically-operated mechanism.

MONTREAL CUSTOMS RECEIPTS.

FOR the month of May, 1915, the Customs receipts at the Montreal Custom House came within $157,173.02 of equaling the receipts for the same month in 1914. If it had not been for the scarcity of tonnage, which has made it difficult for Canadian merchants to get goods from Great Britain, the receipts for last month would probably have exceeded those of May last year. If the same number of regular liners had been coming to the port as there were last year, it is estimated that they would have been able to carry considerable cargoes, owing to stocks being low in the country.

The total receipts for May were $1,854,980.45, as against $2,012,153.47 in May of last year. For April, the receipts were $1,580,738.38, as against $1,571,255.19. Up to the end of May the receipts in 1915 have been $8,342,419.23, made up as follows:—January, $1,541,064.56; February, $1,680,107.41; March, $1,685,528.43; April, $1,580,738.38; and May, $1,854,980.45.

NEW PROCESS DEVELOPMENTS

Inventive Genius and Research Operate to a Dual End — They Aim to Improve What We Now Possess and Bring to Our Service Commodities Before Unknown

ELECTRIC IRON ORE SMELTING IN NORWAY.

In Sweden the adoption of electric furnaces for the reduction of iron ore is apparently spreading, and the results obtained are encouraging and likely to lead to further developments in this direction.

In Norway matters have not progressed quite so smoothly, owing to the different conditions prevailing in the two countries. In Sweden charcoal is used as the means of reduction, but in Norway charcoal becomes too expensive and, unless coke can be used, the process cannot be worked with advantage, in spite of Norway's wealth of water-power. The first attempt with coke at the Hardanger works proved so little encouraging that the whole works eventually stopped, although the ores used were rich in iron.

At Tinfos, however, the very opposite experience has been encountered. A regular and remunerative manufacture of electric iron has now been going on for some time, and the production for the present year is estimated at 10,000 tons of electric pig. This satisfactory result is all the more noteworthy inasmuch as the ores used are rather poor so far as their percentage of iron goes, but otherwise what may be called good ore, hailing from three mines—Klodeberg, Grevinde Wedel, and Fon Anker—averaging some 45 per cent. of magnetic iron ore.

The Tinfos Electric Furnace.

The illustrations show the Tinfos electric furnace. It differs from the Swedish furnace used at Trollhättan (description of which has already appeared in our columns) by having a shaft on each side, so that the ore is led on to the two square electrodes. The upper electrodes each consist of three or four smaller electrodes.

The electric current proceeds from the electrodes through the charge, the slag, and the liquid pig-iron, down to the bottom electrode. This furnace, consequently, differs from the Swedish furnace, not only in having a bottom electrode, but, also it has no gas circulation and requires very little water for cooling purposes. The fourth furnace differs from the three others by having three heavy round electrodes with nipples. The question of a furnace with but one shaft is by no means excluded. The charge consists of iron ore, coke, and according to circumstances, limestone, the quantity of which depends upon the nature and blending of the ore, the quality of the coke, and the quality of pig-iron wanted. Charcoal, as already mentioned, is not used.

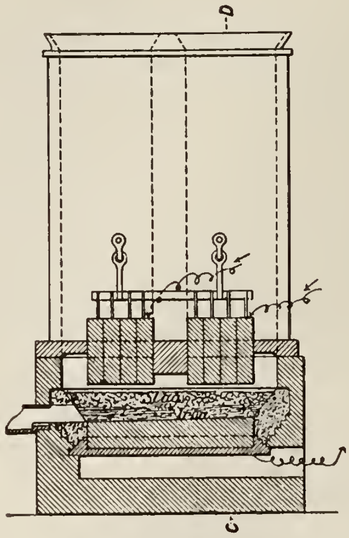


FIG. 1. SECTION AT A.B.

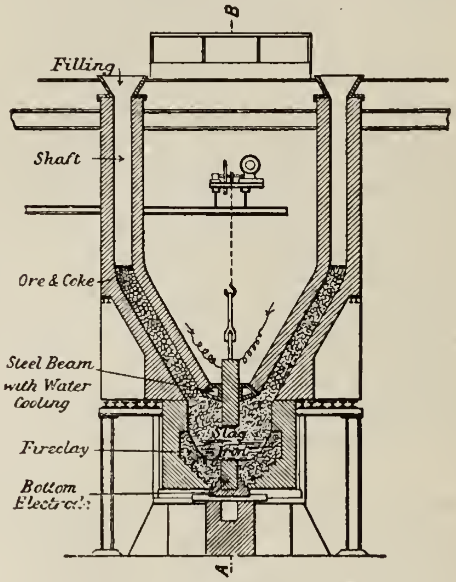


FIG. 2. SECTION AT C.D.

A couple of years' patient experimenting in different directions, and not always under the most favorable conditions, have led to the production of pig of high quality, strong, and comparatively tough. Even at an early stage of the experiments it could be ascertained that the iron produced promised exceedingly well, thanks to certain good qualities in the ores used. When coke is used, the shafts of the furnace need not be very high, and, as a rule, the charge does not reach higher than a little beyond the bend in the shaft. The upper part of the shaft serves as a chimney, which produces the necessary draught in the furnace. To fill the shafts any higher with ore than shown in the illustration is not to be recommended when the ore contains zinc.

Tinfos Electric Pig Iron.

The Tinfos electric pig-iron is close, being produced electrically, without any air being blown into the furnace. This pig can thus with advantage be used for all kinds of foundry goods which require much strength, such as cylinders, presses, pumps, propellers, etc., and it can with advantage be added to ordinary cheap and less strong pig, used in the foundries with or without addition of ferro-silicon.

Tinfos pig, inasmuch as its chemical composition can be altered and regulated, can also profitably be used in Basic Martin steel-smelting, for all electric steel-smelting, or for softened castings. Among the different Tinfos pig-irons are such as contain:

Si. per cent.		Mn. per cent.	S. per cent.	P. per cent.
0.3	with	0.1 to 1.0	0.03 to 0.1	0.02 to 0.04
0.4 to 0.8		0.1 to 1.0	0.04	0.02 to 0.04
1.0 to 1.5		0.1 to 1.0	suspicion to 0.02	0.02 to 0.4
1.0 to 1.5		1.5 to 2.0	" 0.02	0.02 to 0.04
1.5 to 2.0				
2.0 to 2.5				
		0.1	" 0.02	0.065

The cost of production, including ore, coke, limestone and electrodes, besides wages, crushing, weighing and transport of materials, mounting of electrodes, repairs, storage of iron, the laboratory and electric energy, can, according to what so far has been experienced, be kept at from $17.75 to $18.25 per ton of pig-iron (perhaps based on cheaper coke than present quotations) when all three furnaces are kept going, exclusive of management, sinking fund and taxes.

From the beginning of the present year

all four furnaces have been worked regularly, one being always kept in reserve. Each furnace produces about 9 tons per day, or 27 tons for the three, making some 10,000 tons per annum. The percentage of pig-iron from the ore varies from 44 to 47 per cent. according to the quality of the latter. The current in the furnace may be as much as 1,200 k.w. to 1,400 k.w.—Engineering.

ONTARIO MINERAL PRODUCTION.

THE production of gold, nickel and iron ore in Ontario increased during the first three months of the year, but the output of silver, copper, pig iron, cobalt, and cobalt and nickel oxides substantially decreased. The drop was most noticeable in silver and pig iron, the decrease in the former being about 30 per cent. and in the latter 50 per cent. The increase in the production of gold amounted in value to $365,541, the total for the quarter being $1,568,043.

Low prices of silver and the shortage of water for power purposes, which impeded operations, are chiefly responsible for the fall in silver production, although the exhaustion of some properties which formerly produced freely was a factor. There is little demand for iron ore, which explains the drop in output, and the war has shut off all exports of oxides to Europe. On the other hand, the war has boomed the nickel industry, and all mines are being worked to full capacity.

The following are the comparative figures for the quarter:

	1st 3 months.	Decrease.
Gold	$1,568,043	*$ 365,541
Silver	2,488,909	1,060,647
Copper	526,338	65,650
Nickel	1,496,622	*50,610
Iron ore	50,592	*37,664
Pig iron	1,158,462	1,344,088
Cobalt	3,718	5,180
Cobalt and nickel oxides	19,686	149,279

*Increase.

OPENING FOR NAIL WIRE IN AUSTRALIA.

AN opening for trade in Australia is in the supply of wire for making nails. All supplies at present are received from the United States. American nail wire is found most suitable, not only for the nail itself, but for the nail-making machine.

Some years ago English wire was tried, but did not suit, and then a trial was made with German, with like results. Moreover, from the similarity of the English and German wires it was judged that the English wire was drawn from German rods. The English wire, it is stated, disarranged the cutters of the machine, and the head stampers also, more frequently than the American. The machine needed to be set from two to six times a day with the English wire, whereas with American wire adjustment is necessary only once every two or three days. This means not only loss of time, but expenditure in labor for sharpening the cutters. The consumption of nails is extraordinary.

One of the two factories in Sydney never allows its stock of nail wire to get below 200 tons. Even in a brick building there is a considerable quantity of nails used for flooring, but in weather board houses the consumption is enormous, and practically all the houses in the country and a fair proportion in the cities are of weather board. The trade is worth capturing.—C.C. Journal.

FURNACE RECORD WITH DRY BLAST.

A NOTEWORTHY record was made in April by furnace B of the Steel Company of Canada plant at Hamilton, Ont. The furnace was operated with dry blast carrying an average of 0.826 grains of moisture per cubic foot, the average moisture in the atmosphere during the same period being 2.841 grains per cubic foot. The yield of ores for the month was as follows: For basic iron, 50.64 per cent.; for foundry iron, 51.55 per cent.:

Day of Month.	Product, gross tons.	Average silicon.	Coke per ton, lb.
Basic Iron.			
1	474	1.25	2016
17	445	1.09	2073
18	418	1.00	1976
19	463	1.08	1861
20	412	1.00	2151
21	473	1.09	1892
22	483	.85	1818
23	453	.95	1917
24*	418	1.05	2100
25	479	1.05	1833
26	438	1.10	1965
27*	432	.89	1914
28	463	.73	1861
29	456	.87	1925
30*	473	.64	1802
Average	452	.97	1911
Foundry Iron.			
2	326	2.71	2532
3	374	3.15	2256
4	347	3.25	2407
5	368	2.90	2200
6	371	2.31	2156
7	379	2.23	2067
8	383	2.60	2177
9	390	2.97	2140
10	389	3.16	2102
11	391	2.98	2137
12	380	3.08	2198
13	387	3.01	2201
14	418	2.63	2038
15	417	2.70	2000
16	398	2.60	2030
Average	381	2.82	2157

*Lost 38, 55, 55 min. tuyeres respectively.

Detonating.—If iron is hammered it becomes hot. Similarly, if gunpowder is hammered it becomes hot enough to explode. The method of exploding guncotton is by means of fulminate of mercury, which, when ignited by a blow, expands to 2500 times its own size. In expanding with enormous rapidity it gives to the gun-cotton surrounding it, a blow sufficiently severe to ignite the latter.

NICKEL DEMAND TAXES CANADIAN OUTPUT.

THE unprecedented demand for nickel, largely for the manufacture of munitions of war for the allies, has necessitated a further increase in the output of the leading producers of the Copper Cliff, Ont., district.

The reverberatory furnace department of the Canadian Copper Co. was started up recently for the first time since last August. This will take care of all the fine ore from the mines not used in the blast furnaces, as well as the flue dust, and will smelt some 15,000 tons of ore a month. The ball mill and wedge furnace plant will also be put in operation to pulverize and roast the ore for the reverberatory.

Even with the present smelter going full blast the output will not be sufficient to meet the demand, and the construction of a new 25-foot blast furnace has already been begun. This is larger than any blast furnace in the district, though it is surpassed in size by some of the furnaces in the West. It is planned to have the new furnace in operation by the fall.

More ore is being mined at the Creighton mine than ever before, and preparations are being made for a considerably increased production. Already work has been begun on the sinking of the new inclined five-compartment shaft, and, in addition to this, a complete new hoisting and rock crushing equipment will be installed.

When complete, the new hoist will be surpassed by only one mine on the continent, namely, at North Butte. Many new houses are being built and many others transported on flat cars from the company's town at No. 3, Frood mine, which has been closed down since last August.

The demand for nickel has resulted in the International Nickel Company increasing the dividend on its common stock. A large number of the employees of the Canadian Copper Co. are holders of this stock, a certain number of shares being allotted to each employee yearly, under a plan similar to that in force at the U. S. Steel Co. and several other large plants.

The war has been the principal cause of the big demand for nickel, as the metal is used in cartridge cases as well as in armor plate, which averages 3 per cent. nickel. Nearly all the nickel is now sold in the metallic form, while before the war nearly half was sold as oxide.

Varying percentages of copper are also contained in all the ores, and the fact that this metal has been selling around 19c has increased considerably the profits of the companies operating.

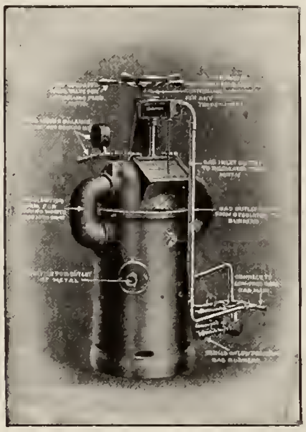
NEW EQUIPMENT FOR FOUNDRIES

A Record of New and Improved Machinery Tending Towards Higher Quality, Output and Efficiency in the Foundry and Pattern Shop.

AN ALUMINUM FURNACE.

THE application of aluminum and its alloys to industrial purposes has extended so considerably in recent years that the subject of their melting is bound to appeal to a large number of manufacturers. Generally, the melting of these metals has been effected in open crucibles, which allow atmospheric oxygen to attack the molten metal with the consequent formation of dross. Other drawbacks to melting aluminum in this manner are well known to those familiar with the subject. A gas-fired furnace, on what are claimed to be entirely new principles, for melting aluminum and its alloys has been evolved after many experiments by the Monometer Mfg. Co., of Aston, Birmingham, England.

Melting pots made of metal are subject to the objection that the re-action



AN ALUMINUM FURNACE.

which takes place between the molten aluminum and the impurities in the metal of which the pot is composed, spoils the aluminum. In the furnace in question, this re-action is claimed to be eliminated by the employment in the parts subject to attack, of a special composition of metal, which extended experience has shown to be perfectly resistant to the action of impurities. It is well known that a considerable proportion of the molten metal goes to waste as oxide, and to prevent this deleterious action, the melting pot is installed in a chamber containing inert gases incapable of oxidising the molten metal. As there is no oxidation, it follows that there is no dross, and hence considerable saving of material. The method of constantly replenishing the enclosed melting chamber with inert gases, consists in causing the products of combustion to traverse the melting chamber on their way to the outer flue. This sealing of the melting chamber precludes, further, the ingress of dirt and other foreign matter to the melting pot.

Turning to the heating arrangements, we find that a very ingenious device is incorporated in connection therewith, in order to take care of the gas supply when the melting point of the metal has been reached. The thermostat of the patented regulator, termed by the makers a "Monometer," controls and governs the quantity of gas supplied to the burners, so that immediately the aluminum is melted the quantity of gas combusted by the burners is reduced and the uniform heat essential to the melting of aluminum is automatically maintained. The Bunsen burners under the melting pot are of novel construction, having contracted nozzles of such a design that a proper admixture of the gas and air is secured and therefore the fullest utilization of the heat in the fuel. The heat obtained by these low pressure atmospheric burners which are coupled to the ordinary town supply, is comparable with that attained by high-pressure gas, but without using compressors or fans.

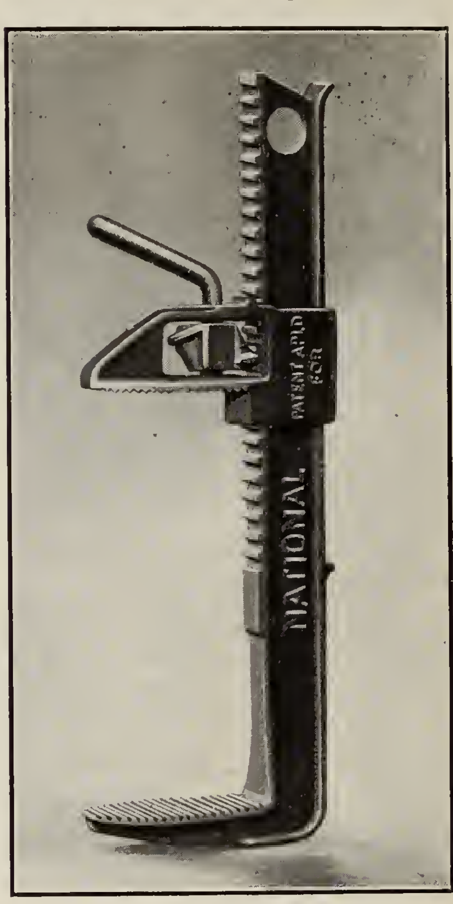
The equipment of the furnace is completed by a central cone valve seated in the bottom of the melting pot and controlled by a conveniently arranged handwheel by which the molten metal issuing from the pouring spout can be regulated or entirely shut off. At the top of the furnace are located two doors through which the swarf or metal is introduced into the melting pot, these doors being balanced so that they remain either in the closed position or in the open position, without being held by the operator. To facilitate casting, the furnace is mounted on a wheeled carriage which can readily be moved on the rails from one part of the foundry to another, flexible gas pipes being, of course, a necessary auxiliary.

ADJUSTABLE FOUNDRY CLAMP.

AN adjustable foundry clamp for use in place of clamping iron and wedges has been placed on the market recently by the National Clamp Co., 1657 Monadnock building, Chicago.

The constructional features consist of a jaw combined with a toothed rack along which a movable jaw slides, and this movable jaw carries a worm that is operated by a cold rolled steel handle. The worm has a heavy thread, a part of which is cut away to allow the movable jaw to slide freely along the rack. The remainder of the thread, when engaging the teeth of the rack, gives the clamping pressure. One turn of the handle causes a pressure movement of about ¾ of an inch.

In operation, the stationary jaw is placed under and the movable jaw on top of the flask, after which a short turn of the handle gives the pressure neces-



ADJUSTABLE FOUNDRY CLAMP.

sary to clamp tightly. The device is of malleable iron, and of simple construction, and the claim is made that flasks are fastened quickly with a straight downward pressure, eliminating shifting and jarring. The action of the worm on the rack is positive and when drawn tight, the clamp will not loosen even on a jar-ramming machine. Five sizes are manufactured.

COMPRESSED AIR METER.

THE aim and purpose of this compressed air meter, which is a product of the New Jersey Meter Co., Plainfield, N.J., is to measure the air consumption of any machine or application of compressed air, and the actual net production of air by any pump or compressor within its capacity. The meters have only one moving element—which floats on air, and is consequently frictionless and non-wearing.

The principle on which these meters operate is the well-known law deduced by the French scientist Poncelet, which may be briefly stated as follows:—The volume of a definite compressed fluid or gas flowing under small constant head through multiple orifices of the same shape and size is directly proportional to the number of orifices exposed to the flow.

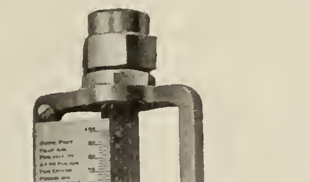
The moving element consists of a weighted piston in the upper or metering cylinder, a small piston in the oil dashpot cylinder and a rod joining the two pistons and extending upward where it moves freely, without contact, inside the sight glass at the top of the meter. This rod rises and falls with the pistons so that its height in the sight glass corresponds exactly to the position of the piston in the metering cylinder. The scale plate mounted against the outside of the sight glass permits reading the exact height of the top end of the rod.

Air enters at the lower left-hand opening into the chamber surrounding the dashpot cylinder and passes through ported openings into the interior of the metering cylinder, the wall of which is drilled with a large number of small, accurately reamed holes uniformly spaced. To pass to the outlet chamber the air lifts the piston and exposes some of the holes to the flow.

A small "head," or difference of pressure, is established between the interior of the cylinder and the outlet chamber; this pressure difference, only a few ounces per square inch, being fixed by the exact weight of the moving element and the area of the piston on which the difference of pressure acts. The moving element rises until the weight is exactly supported by the difference in pressure. The pistons and rod are then floating in static balance in a position corresponding exactly to the volume of air flowing, the number of holes exposed and the height of the top of rod in sight glass. It is evident that the meter automatically adjusts itself to the conditions required by the principle or natural law stated above. The divisions of the scale plate are calibrated by comparison with a standardized instrument to read correctly.

It should be noted that this is not a velocity meter which would give readings proportional to the square of the volume flowing, but is a direct volume gauge with a uniform scale on which one cubic foot is represented by the same distance whether working at low or high capacity. The loss of pressure is so slight that it can not be detected by a gauge and the meter can not be injured by a flow in excess of its metering capacity There are no leather pockets, rubber or leather discs, bearings, gears, valves or other parts which can develop defects to affect the accuracy; while the use of bronze parts prevents corrosion or rusting.

The Tool-om-eter (10 to 100 feet capacity, 1 in. openings) is designed to apply to small tools, such as chipping and riveting hammers, plug, hammer and air-feed drills, wood boring and metal drilling machines, etc., rated by manufacturers at not over 60 feet per minute when new.



COMPRESSED AIR METER.

The Drill-om-meter (50 to 300 feet capacity, 2 in. openings) is adapted to mounted rock drills, coal punchers, diamond drills, sand blasts, air lifts, channelers, hoists, pumps, pile hammers, motors, etc., where the actual consumption is not over 300 feet per minute.

STEEL WORKS AT NEWCASTLE. N. S. W.

OF more than passing interest to the administrations of Canadian steel products plants is the following statement from the columns of the "Weekly Bulletin," Department of Trade and Commerce, Ottawa, relative to the establishment of a steel works of considerable magnitude at Newcastle, New South Wales, Australia:

After an expenditure of about $5,000,000, the company recently commenced operations, the blast furnace being now at work and the rest of the plant is rapidly approaching completion. Contracts have already been taken for the supply of large quantities of steel rails for the Transcontinental Railway and for the various State Railway Systems throughout the Commonwealth. The company has started operations at a singularly opportune time when oversea competition is minimized by the excessive freight rates now ruling. In no branch of production is it more imperative that a country should be independent of outside supplies than in iron and steel, and in the matter of large contracts for the railways and other public utilities, the company is bound to receive a preference in accordance with the established precedent of the country. When the works are completed, the plant will, in addition to steel rails, produce structural steel, angle iron bars, sheets, fencing wire and allied goods.

In South Australia, the company owns a most valuable mountain of iron stone of exceptional quality which is conveyed by steamer, some 1,100 miles, to the extensive plant erected beside the finest coal mines in the Southern Hemisphere.

GOVERNMENT WORKS WILL BE CONTINUED.

IN connection with the request of the delegation of Canadian Mayors that measures be taken by the Dominion Government to relieve unemployment, it is announced that the Government will continue the construction of all public works under contract in Canada. The total expenditure of the Dominion for the year, apart from the war, will reach $200,000,000, while the war expenditure will make $100,000,000 additional. The Federal Government is, therefore, raising about $1,000,000 per day, exclusive of Sundays, to maintain its existing programme and carry on the war.

In addition to outlays in other departments, the Government programme for the current year includes expenditure upon public works of over $25,000,000, on railways and canals of $27,000,000, on capital account alone and on works of Harbor Commissioners of over $3,500,000.

Since the outbreak of the war, the Dominion has used every effort not only to prosecute the war, but to minimize unemployment in Canada by maintaining its programme of public works, including the I.C.R. terminals at Halifax, Welland Canals, Quebec Bridge, N.T.R. and Hudson Bay Railroads, terminal elevators and harbors at Halifax, St. John, Quebec, Montreal, Toronto, Hamilton, Port Arthur and Fort William, Vancouver and Victoria.

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A Monthly Technical Journal devoted to the Foundry and Metal Industries.

PETER BAIN, M.E., Editor.

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Vol. VI. JUNE, 1915 No. 6

PRINCIPAL CONTENTS.

RECRUITING OUR MECHANICS FOR BRITAIN.

COINCIDENT with the development of shrapnel and high explosive shell manufacture here in Canada, and arising also out of organized concentration in the Motherland to produce an output of these and other equally effective mechanisms, contrivances and engines of war to supply in full measure the most exacting requirements of our soldiers and sailors and their allied comrades, there has arisen a somewhat natural demand for all classes of mechanics.

Figuratively speaking, the fiery cross is ablaze throughout the length and breadth of the British Isles and this Dominion of ours calling for enlistment to the ammunition supply column, and as a consequence, mechanics of every rating have little difficulty in finding employment, although due to the scope of the offerings they are perhaps relatively unsettled in determining what for them will ultimately have been the wisest course of action.

A mechanic and a soldier are synonymous terms these days, each being the complement of the other, and at no time in the world's history has this particular fact been given such forceful expression or has its importance been so vividly portrayed. While it is something for all of us to be alive, so far, in this stirring time, and more so perhaps to be of such an age and sufficiently patriotic as to step out of our chosen routine and take the King's shilling, it is equally something to have acquired a trade and such a trade as will help to furnish the weapons and missiles with which our Empire soldiers and sailors may crush the enemy's bombast, rapine and tyranny.

Just at the moment a rather interesting development is apparent in Canada relative to the recruiting and enlistment of mechanics for service in the production of munitions of war in the Old Country, and what surprises us in connection therewith is the easy equanimity with which our Government authorities take cognizance of the situation.

Little stir is in evidence (and as for alarm, oh no, because unthinkable), at our Departments of Trade and Commerce and Labor Headquarters, although several scores of our mechanics have already been shipped to Britain and many times more are in process thitherward. Do not the responsible heads of these Departments recognize that the production of shells and other munitions of war is equally important here as in England, and that the work can be equally as well and expeditiously performed. Besides, isn't it well that Canadian industrial enterprise be fostered and encouraged?

Our manufacturers, particularly those engaged in the production of shells, have not had nor are likely to have for some time to come, anything in the nature of a picnic in the planning and prosecution of the work entrusted to them. Difficulties have had to be met and overcome in the rearrangement of their peace-time equipment, in the securing of prompt delivery of additional machine tools, and in maintaining steady, continuous employment for their operators because of, in the first place, a lack of shell steel bars, and secondly because of a lack of shell forgings. Depletion of the labor market by allowing our skilled mechanics to go to Britain will perhaps more than all the foregoing, hit our engineering and metal working plant managements hardest.

We quite realize, that meantime neither our Government nor any Department of it may interfere with the liberty of our mechanics to choose for themselves what they shall do or where they shall go. We have neither got to the stage of martial law nor any other law which may make of us unwilling accessories, but we have reached the point at which a clear declaration should be forthcoming of the absolutely certain, and, as well, almost certain, war business which our craftsmen will not only get the opportunity to produce but will have to do so right here in at least the near future months, or, for that matter, while the war lasts. An idea is all too prevalent among our people, be it inspired or otherwise, that we are simply stopping the gap until the British plants be extended, ultra-equipped and definitely organized, and this feature is, we believe, more than anything else, responsible for the ease with which our mechanics can be constrained to leave our shores.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

REGULATION OF ELECTROTYPING SOLUTIONS.

SOLUTIONS employed for copper electrotyping contain, in addition to water, only copper sulphate, and sulphuric acid. Since these substances and also the anode copper are generally fairly pure, there is no marked tendency for impurities to accumulate in the solution. The principal changes taking place in the composition of such solutions are due to mechanical loss of the solution adhering to the "cases" (cathodes) when removed from the vats, and solution of a greater amount of copper from the anodes than is deposited on the cathodes.

The first factor would in itself cause a decrease in the density of the solutions, if, as is customary, the level of the latter be maintained approximately constant. Water should be added to the vats at intervals in order to replace that lost by evaporation. The second action will cause a decrease in the acidity and an increase in the density of the solutions, owing to a consumption of sulphuric acid, with the production of a corresponding amount of copper sulphate. In all cases thus far observed, the latter effect is predominant. The exact causes of this consumption of acid and the best method of reducing or eliminating it are now the subjects of investigation by this Bureau.

Solutions Composition.

In general, it is necessary at intervals to determine and correct the composition of the solution. The mere determination of the density of such solutions, whether with a Beaumé or specific gravity hydrometer, is not sufficient to fix their composition. If, however, the density of the solutions and also the amount of free sulphuric acid present are determined, the composition is fixed. Thus, for example, a solution with a specific gravity of 1.16 (20 deg. Beaumé) and containing 45 grams per liter (6 ounces per gallon) of free sulphuric acid has a perfectly definite and reproducible composition. The above figures do not, to be sure, indicate the amount of copper sulphate present in such solution, but this is of no consequence to an electrotyper except when he is preparing a new solution. For such cases, tables showing the amount of copper sulphate required to produce solutions of any desired density, with any specified acid content, would be desirable, and will probably be prepared for some future edition of this circular.

The Bureau is not yet able to recommend any composition of the solutions as best adapted to any given conditions of operation. In various commercial solutions thus far tested, the specific gravity ranges from 1.12 (15.5° Bé) to 1.20 (24.2° Bé) and the acidity from 25 g/l (3.3 oz./gal.) to 90 g/l (12 oz./gal.). In general, the lower the voltage employed the more acid is required to produce a given current strength and rate of deposition, and vice versa. For the present, each operator should find a composition of solution which will give him satisfactory results under his conditions, and maintain it as nearly constant as possible by adjusting the density and acidity at regular intervals (e. g., once a week) by the methods described in the following sections.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.

Officers:

President—John A. Magill, 591 St. Clarens Ave., Toronto.

Vice-President—William Salmon, 48 Oak Street, Toronto.

Secretary—Ernest Coles, P.O. Box 5, Coleman, Ont.

Treasurer — Walter S. Barrows, 628 Dovercourt Road, Toronto.

PLACE AND DATES OF MEETING.

The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

Density.

Before testing solutions, they should always be adjusted to the normal level of the vats by the addition of water if necessary, and thoroughly mixed. The hydrometer should always be read in the same way, preferably by floating it in a glass jar or cylinder containing the solution. By placing the eye slightly below the level of the solution, and then gradually raising the eye, the surface, first seen as an eclipse, becomes a straight line, the intersection of which with the hydrometer scale should be taken as the reading of the hydrometer. For practical purposes, and especially for comparison, the readings will usually be sufficiently accurate if made by observing the hydrometer scale above the surface of the liquid. The density should always be taken at approximately the same temperature, preferably 60 deg. F.

Having determined the density of the solution (which will usually be found to be higher than is desired), it may be adjusted to the desired density by the following method, based on the assumption that the excess density of the solution (above that of water) is approximately proportional to the content of the dissolved substances.

Specific Gravity.—If a specific-gravity hydrometer is employed, divide the difference between the observed and desired specific gravities by the difference between the observed specific gravity and the specific gravity of water, which is 1.000. The result is the percentage of the solution which should be replaced with water.

Therefore, replace with water 10.6 per cent. of the solution, or 10.6 gallons for every 100 gallons in the vat.

Beaumé.—If a Beaumé hydrometer be used, the calculations are even simpler, and for practical purposes are sufficiently accurate. In this case we simply divide the difference between the observed and desired density, in degrees Beaumé, by the observed degrees Beaumé, to obtain the percentage of the solution to be replaced with water.

Determination of Acidity.

Principle.—The amount of free sulphuric acid in the solution is determined by measuring the volume of an alkali solution of known strength which is required to neutralize the acid present in a measured volume of the solution. An indicator (methyl orange) is added to the solution in order to show, by its change in color, when all the acid is neutralized by the alkali. The method as applied to such solutions is not original, having been published by Wogrinz in 1913. Even before that time it was used in a few electrotyping establishments in this country. The only essential pieces of apparatus for making this test are a pipette to measure the copper, the standard alkali, and a few bottles.

Solutions.

Alkali.—A sodium hydroxide (caustic soda) solution of any known and convenient strength may be employed. In the preliminary circular a solution prepared of a strength (0.61 normal) equivalent in the titration to 3.0 grams per liter of sulphuric acid was suggested. In view of the greater ease of securing a normal solution of sodium hydroxide we now recommend the use of a normal solution. One cubic centimeter (1 c.c.) of such a solution will neutralize 0.049 grams of sulphuric acid. If, therefore, a sample or 10 c.c. or 1-100 of a liter of the copper solution be titrated, each cubic centimeter of the sodium hydrox-

*Issued by Department of Commerce, Washington, D.C.

ide required is equivalent to 4.9 grams per liter (or for most practical purposes 5 g/l or 0.67 oz./gal.) of sulphuric acid. Solutions of other strength may be employed, provided the calculations be correspondingly changed. Since the sodium hydroxide may change in strength on standing (owing to its attacking the glass of the container), it should either be renewed, or restandardized by a chemist, at intervals of about six months.

Methyl orange solution (1 part methyl orange in 5000 parts water) serves as an indicator changing its color when all the sulphuric acid is neutralized.

Titration.

To carry out the titration, measure with a pipette 10 c.c. of the copper sulphate solution to be tested (after the bath has been adjusted to the desired specific gravity and thoroughly mixed), and run it into a small flask. Add to it about 2 c.c. of the methyl orange solution. To adjust the sodium hydroxide solution to the zero mark in the burette, turn the centre stopcock so that the burette is connected with the stock bottle, and, with the bulb, pump the solution till it is above the zero mark, and then shut off this stopcock.

Next turn the side stopcock and allow the solution to run into any convenient vessel (for waste) till all air is displaced from the side tube and the lower edge of the curved surface of the liquid is just at the zero mark. Now run the sodium hydroxide solution into the copper sulphate solution slowly with constant shaking, until the violet color of the solution just disappears. If a decided green color, or appreciable precipitate appears, too much alkali has been added and a new portion should be titrated. Note the position of the lower edge of the curve at the end of the titration.

Calculation.

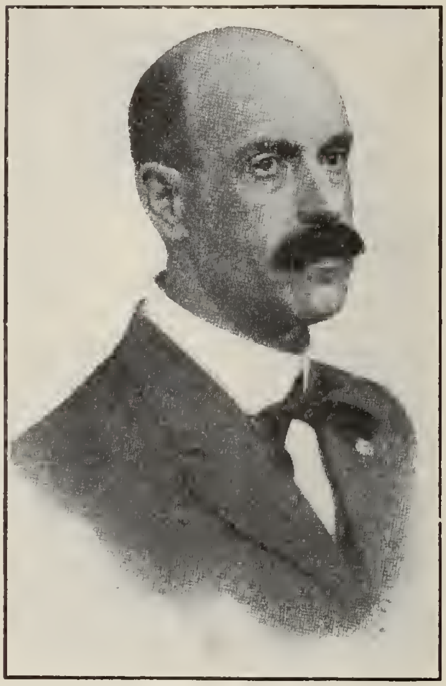
To find the number of grams per liter of sulphuric acid in the copper solution, multiply by five, the number of c.c. of alkali used in the above titration. To find the number of pounds of acid to be added for each 100 gallons of the bath, deduct the amount of sulphuric acid thus found, from the prescribed content, and multiply the result by 0.83. Since one gallon is equal to 3.79 liters, or 100 gallons equal to 379 liters, we multiply by 379 the number of grams per liter required; and since there are 454 grams in one pound, we divide the last result by 454. For practical purposes, therefore, we multiply by 379÷545 or 0.85. For any given capacity of tank, the correct factor can be readily determined.

In the above operations and calculations extreme accuracy is not required, since all that can be accomplished is to keep the composition of the solutions approximately constant. The chief value of such tests will be to enable the operator to avoid obtaining defective work, or, in cases where the work may prove defective to determine immediately whether the composition of the solution or some other condition is at fault.

A permanent record of all titrations and of all changes in or additions to the solutions should be kept, as such records will ultimately furnish valuable information regarding the operation of the bath.

Nickel Electrotyping Solutions.

Owing to the great variations observed in the composition of solutions employed in nickel electrotyping which yield fairly satisfactory results, it is impossible to state at this time the best composition of the baths or the best methods of operation. Obviously, the object of work in this field should be to determine the simplest solution which will give satisfactory results and to devise methods for controlling its composition. Additions of such substances as sodium chloride, ammonium chloride, boric acid, vanadium salts, etc., render the testing and adjustment of the solutions far more complicated, and should not be used except so far as it can be shown that any beneficial effect exerted by them outweighs the above objection.



WALTER S. BARROWS,
Supreme President, The American Electro-Platers' Society.

CANADA'S ELECTRO-PLATING CRAFT HONORED.

THE third annual convention and exhibition of the American Electro-Platers' Society was held at Dayton, Ohio, from June 3 to 5 inclusive. The meetings were a pronounced success from start to finish, betwen three and four hundred representatives of the art and craft being present from all over Canada and the United States. A feature of special interest to Canadian members is the well-merited honor conferred on Walter S. Barrows, 628 Dovercourt Rd., Toronto, by reason of his election to the Association presidency.

The round table conferences and banquet took place at the Society Headquarters, Hotel Algonquin, while the business sessions and exhibition were held in the famous National Cash Register Co. Hall of Industrial Education. Demonstrations of many interesting processes were given in the plating department of the National Cash Register Co. In addition many important matters bearing on the education and general welfare of those engaged in the electro-plating business came up for consideration and discussion. The evening sessions were largely devoted to the reading of papers, among which were the following:—

Commercial Aspects of Cobalt Electro-Plating, by Walter S. Barrows, Toronto, Ont.

Experiments with Cobalt Plating Solutions, by Messrs. Buchanan and Haddow, New York City.

Cyanide Copper Solutions, and Their Management, by Geo. B. Hogaboom, New Britain, Conn.

Sight-seeing trips in the vicinity of Dayton, Ohio, together with visits of inspection to the numerous factories in and around that city, contributed much to the social and recreative side of the convention function.

Officers of the Society for the ensuing year were elected as follows:—

Supreme President—Walter S. Barrows, Toronto.

Supreme First Vice-Pres.—H. H. Williams, St. Louis, Mo.

Supreme Second Vice-Pres. — Mr. Stratton, Bridgeport, Conn.

Supreme Secretary-Treasurer. — Walter Fraine, Dayton, Ohio.

Editor-in-Chief.—Col. J. H. Hanjosten, Kokomo, Indiana.

The next convention will be held in Toronto, Ont., in July, 1916.

ORGANIZED DEVELOPMENT OF CANADIAN EXPORTS.

ANNOUNCEMENT is made that plans whereby Canadian manufacturers and producers should have opportunity to push their wares in the world's markets have taken definite shape. Application is being made for a Federal charter for a company to be incorporated with an authorized capital of half a million dollars. Provisional directors have been

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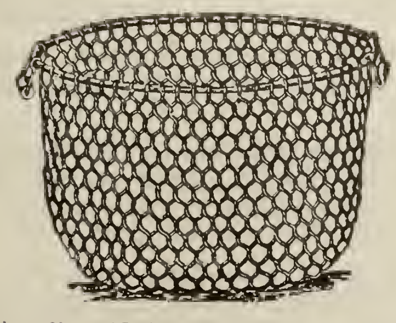
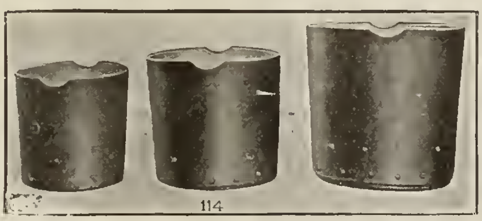
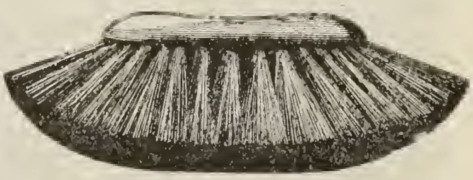
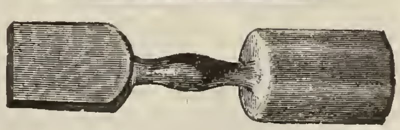


Coke or Charcoal Basket—Made of galvanized steel wire.



Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.





Bench Rammers—Made from Maple Hardwood well oiled.

named and managers appointed. The company is to be known as the Export Association of Canada, Limited, and the head office will probably be in Montreal.

To Operate on Broad Lines.

It is intended that the company shall operate on broad national lines, and while the leading part in its formation is being taken by prominent members of the Canadian Manufacturers' Association, it is not proposed to limits its activities to the handling of manufactured goods, but to operate on the broadest possible basis.

The possibilities of such an organization are enormous, and if carried through successfully should have a most beneficial effect on all Canada. One of the serious factors in the industrial life of Canada has been the restricted market spread over a wide area, which made selling expenses high and added to the percentage of overhead costs. The working up of a large export trade on a permanent basis will at the same time reduce the average cost and add to the employment of labor.

Provisional Directors.

The provisional directors appointed are: J. H. A. Acer, Laurentide Co., Montreal; G. F. Benson, Edwardsburg Starch Co,, Montreal; C. N. Candee, Gutta Percha & Rubber, Ltd., Toronto; G. H. Duggan, Dominion Bridge Co., Montreal; H. L. Frost, Frost Wire Fence Co., Hamilton, Ont.; C. B. Gordon, Dominion Textile Co., Montreal; R. H. McMaster, Steel Co. of Canada, Ltd., Montreal; W. W. Near, Page-Hersey Iron Tube & Lead Co., Toronto; J. H. Sherrard, Alaska Feather & Down Co., Montreal; A. W. Wheatly, Canadian Locomotive Co., Kingston, Ont.

General Managers Appointed.

The provisional directors have arranged to secure the services of F. C. Armstrong, of London, England, and R. J. Younge, of Montreal, to organize the association, and afterwards for the first year of operations to act as joint general managers.

Mr. Armstrong, who will have charge of the offices outside of Canada, is a Canadian by birth, and has had a wide experience in foreign trade. During the past fifteen years he has carried out important undertakings abroad on behalf of British interests with whom he was associated, and has thus had an opportunity of studying at first hand the various countries in which the association may expect to find a market for Canadian goods.

Mr. Younge (of R. J. Younge & Co.), who will direct the Canadian office, was for several years general secretary of the Canadian Manufacturers' Association, and is known personally to the leading manufacturers of the Dominion.

Purpose of the Company.

Briefly stated, the object of the Export Association of Canada, Ltd., is to provide an organization to secure for Canada a new and larger portion of the world's trade under the changed conditions brought about by the war, and to develop and carry on the export trade in Canadian products upon national co-operative lines. Assurances have been given of co-operation by the Dominion Government, the railways and large manufacturing interests for the proposed organization.

Its functions will be: First, to create a favorable strategical position in foreign markets for Canadian industry as a whole; second, to do the work of a commission agent in the sale of Canadian goods in the countries where its branches are established. It should as well be able to render important services in connection with arrangements for overseas transport and for banking facilities necessary for foreign trade. The activities of the association will not be restricted to manufactured goods, but also embrace the assistance of trade in agricultural and natural products.

Proposed Organization.

The head office of the company will probably be in Montreal and will work in close connection with the Canadian Manufacturers' Association and other Canadian producers, in whose interests the export campaign is to be developed. This office would be so organized as to be able to deal effectively and promptly with all the situations arising from the developing relations between the manufacturers, on the one side, and the foreign branches and their customers on the other.

In its relations abroad the association would aim in the first place at utilizing and strengthening the position of already existing organizations which have developed trade within the Empire, and notably with New Zealand, Australia and South Africa.

Office in London.

In the second place it is intended to open at once an office in London, England., to assist in securing favorable consideration for Canadian trade in all directions where Governmental assistance can properly be requested, or the influence of financial houses interested in the prosperity of Canada can effectively be brought to bear. Its functions will also be to connect up Canadian manufacturers with all the great purchasing and distributing agencies, both Governmental and private, which make London their headquarters.

Attention will be directed to the French and Belgium markets which will open up, particularly during the reconstruction period, and also to the immense Russian market opening up for manufactured goods of all kinds. Further extensions of the activities of the association to markets such as those of South America, India and the Far East will be made from time to time, as the opportunity seems favorable and the resources of the association permit.

NICKEL AND ALUMINUM.

By E. V. Pannell.*

IT is seldom that we are at variance with the views of your journal, but our attention has been called particularly to the statements of your contributor on page 84 of a recent issue. In making certain claims on behalf of nickel, he draws an invidious comparison with aluminum, involving a number of misstatements regarding the latter metal.

In the first place, aluminum when manufactured in the form of cooking vessels is not a soft metal, except in relation to steel and the hard bronzes.

Secondly, the oxide coating on such vessels is an enamel-like film, hard, stable and neutral, and should not be scoured under any circumstances.

In reference to burning, a very light aluminum vessel on a very hot fire might melt if kept empty. We have never heard in all our experience of any aluminum utensils melting under practical conditions. The statement that aluminum is dissolved in liquid food and forms poisonous metallic salts, we can absolutely deny, and we have ample evidence of tests which have been conducted refuting this contention.

While admitting the wonderful progress made in nickel refining and the wide field opened to this metal, we are inclined to doubt the advisability of employing it in any direction where it is only replacing equally good and cheaper materials. The market price of nickel to-day is 45c and that of aluminum 20c. The lighter metal is, however, only one-third the weight of nickel, so that nickel is just about seven and a half times more costly than aluminum in any manufactured form.

The economy and efficiency of the light metal has already been widely recognized by military authorities in their specifications for canteens and water bottles for which aluminum is now being quite generally employed.

---

*British Aluminum Co., Toronto.

Trade Gossip

E. P. Clarke has been appointed manager of the Thor Iron Works, Toronto.

Perth, Ont.—The Westport Plating Co. will probably remove to another town.

Toronto, Ont.—The St. Clair Foundry Co. has received a permit and will construct an addition to its factory to cost $2,000. Work will be started at once.

Montreal, Que.—Estey Bros. Co. of this city have secured the contract for the ornamental iron and bronze work on the Sun Life Building, Montreal.

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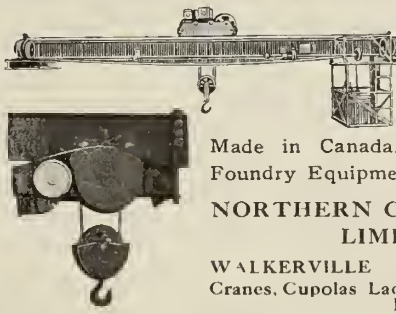

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If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Fort William, Ont. — A Government commission will visit this district to examine the iron resources and possibility of development. J. Dix Fraser, manager of the Atikokan Iron Works, is interested.

Sidney, N.S.—The city council has awarded a contract to the Canada iron Corporation for cast iron pipe and fittings, and R. Musgrave & Co. for structural steel for the new pumping station at Middle Lake.

Pierre Martin, one of the inventors of the Siemens-Martin process of steelmaking, commonly known as the open hearth method, died at Paris on May 23. He was a member of the firm of Martin Bros. of Sireuil, France.

Lieut. James Gordon Ross, of the 13th Battalion, whose name recently appeared in the casualty list as wounded, was consulting engineer of the Milton-Hersey Co., Montreal, and was a lieutenant in the 5th Royal Highlanders.

Brig.-Gen. Bertram, chairman of the Shell Committee, has, we understand, confirmed the statement that negotiations are now under way for the establishment of a copper refining plant in Canada. He stated that although nothing has been as yet settled, it was likely the plant would be situated at Trail, B.C., in close proximity to the works of the Consolidated Mining and Smelting Co.

Canada's Coal Output.—Coal formed more than one-fourth of Canda's total mineral output in 1914. The Dominion production of marketable coal in that year amounted to 13,594,984 short tons, valued at $33,433,108 as against 15,012,178 tons, valued at $37,334,940 in 1913. British Columbia's output totalled 2,238,339 tons in 1914, a decrease of 476,081 tons, while that of Yukon Territory was 13,443 tons, a decrease of 6,279 tons.

Canadian Trade Returns.—An increase of $10,000,000 in Canadian trade during April over the corresponding month last year is shown by figures just issued. The total trade last month was $65,000,000. Exports of manufactured articles were valued at $13,000,000 compared with $4,000,000 for the same month in 1914, while experts of merchandise totalled $28,691,000 as against $17,751,000 for April of last year. While exports increased, imports decreased considerably, totalling $28,391,000 as against $36,937,000 for April, 1914, the duty realized being $5,986,000 compared with $6,458,000 for the corresponding month of last year. Of the exports that of animals and their produce bulked largest, being $3,312,000 compared with $1,860,000 in 1914.

Maximilian, Eugene Duncan, vice-president and general manager of the Canadian Car & Foundry Co., died on May 23 at his home in Montreal, as a result of a hemorrhage of the brain. Mr. Duncan was born in New York city on March 28, 1862, and joined the executive of the Canadian Car & Foundry and its subsidiary companies three years ago. Previous to coming to Montreal he was general sales agent of the American Car & Foundry Co., at St. Louis, Mo.

THE LATE MAXIMILIAN EUGENE DUNCAN.

Arthur Putnam Scott, who has recently been appointed head of the metallurgical department of the Snyder Electric Furnace Co., of Chicago, is a Nova Scotian, eldest son of the Rev. E. Scott, D. D., of Montreal. He graduated from McGill University, with the degree of B.A., and the Logan gold medal for Natural Sciences in 1896 and with the degree of B.Sc., and the British Association Medal in chemistry and metallurgy in 1898. Following graduation, he remained at the University as demonstrator in chemistry until the spring of 1899, when he accepted the position of assistant chemist with the Dominion Iron & Steel Co., of Sydney, N.S., becoming chief chemist and assistant metallurgist of that company in 1904. He resigned this post in 1908 to enter the service of the General Electric Co., of Schenectady, N.Y., as representative metallurgist at the Brackenridge plant of the Allegheny Steel Co. He remained at Brackenridge until 1911 when he was recalled to Sydney as metallurgist and superintendent of the steel department of the Dominion Iron & Steel Co., which position he occupied with signal success. February of the present year he severed his connection with the Dominion Iron & Steel Co., and took up consulting work with headquarters in Montreal. One of his earliest consulting cases was to investigate the operation of the Snyder Electric Furnace. Its possibilities impressed him so that he decided to accept an invitation to remove to Chicago and affiliate with its manufacture. In the course of his metallurgical duties, Mr. Scott has spent considerable time at various European steel plants. He received the degree of Master of Science from his Alma Mater in 1914.

Catalogues

Furnaces.—The Monarch Engineering & Manufacturing Co., Baltimore, Md., are distributing a bulletin devoted to melting and refining furnaces for treating various metals. The different types of furnace are illustrated and accompanied by a brief description covering the principal features of each with sizes and capacities. Other equipment described includes core ovens, blowers and fuel burners.

Wagon and Truck Loaders.—The many uses to which the Jeffrey wagon and truck loaders are adapted are described in bulletins No. 5, 165 and 166 recently issued by the Jeffrey Manufacturing Co., Columbus, Ohio. These bulletins describe in detail the standard types of loaders for handling coal, coke, crushed stone, sand, and other loose materials. The various types are illustrated and specifications are included for each with prices and weights, etc. Copies will be mailed to interested readers upon request.

A Safety Code for the use and care of abrasive wheels has been compiled by the Safety Committee of the Abrasive Wheel Manufacturers of Canada and the United States. The code is to be used as the foundation of a campaign for uniform laws and insurance rules in an endeavor to overcome present and prevent future unsafe practices. The whole subject of grinding has been carefully covered and many valuable suggestions are included. Copies of the code may be obtained from the Canadian Hart Wheels, Ltd., Hamilton, Ont.

Grinding Wheels.—The Canadian Hart Wheels, Ltd., Hamilton, Ont., have issued a standard grinding wheel price list which will be effective on July 1, 1915. This new list does not attempt to fix new prices, but simply introduces a method of ascertaining consistent list prices. When the present list is withdrawn, new discounts will be issued, where necessary, to apply to the new list adopted by the leading manufacturers of grinding wheels in Canada and the United States. The new lists have been adopted in order to correct the inconsistencies in the present standard lists in relation to the value of different size wheels to each, and in their relation to the cost of manufacture. Users of grinding wheels may obtain copies on application to the above.

The June issue of Graphite, the house organ of the Joseph Dixon Crucible Co., contains upon its cover a splendid reproduction of "The Pour," a bronze statue at the offices of the Damascus Bronze Co., Pittsburgh, Pa. "The Pour" was modeled by H. Mueller and and imported from France. Though efforts have been made to trace its origin, no further knowledge of it has been obtained. Graphite contains its usual miscellany of good things to read.

Theory and Practice of Sherardizing is the title of a booklet written by Dr. Samuel Trood for the United States Sherardizing Co., Newcastle, Pa. The booklet contains a scientific explanation of what the sherardizing process really is, and the practical conditions under which it should be employed. A great deal of valuable information is given in this booklet on the subject and also a detailed description covering the application of this process. In addition, the advantages and disadvantages of different processes of protection of iron and steel against corrosion are discussed at length. The illustrations show different views of a sherardizing plant and a diagram entitled Rust Protection is also very instructive. Copies of this booklet may be obtained from Chambers, Ltd., Don Esplanade, Toronto, who hold the Canadian rights for this process.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS--Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

Air Compressors.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Pangborn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd. Toronto.
John Millen & Son, Ltd., Montreal.

Chaplets.
Webster & Sons, Ltd., Montreal.
Wells Pattern & Machine Works Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Chemicals.
W. W. Wells, Toronto.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Walkerville, Ont.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Grinders, Disc, Bench, Swing.
Ford-Smith Machine Co., Hamilton, Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.
Geometric Tool Co., New Haven, Conn.

Helmets.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Melting Pots.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Stevens, F. B. Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.
Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works,

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.
W. W. Wells, Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rosin.
Webster & Sons, Ltd., Montreal.

Rouge.
W. W. Wells, Toronto.

Sand Blast Machinery.
Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd. Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Molding.
H. S. Carter & Co., Toronto.
Hamilton Facing Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.
Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.
Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.
Pangborn Corporation, Hagerstown, Md.

Sieves.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Silica Wash.
Webster & Sons, Ltd., Montreal.

Small Angles.
Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Special Machinery.
Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Squeezers, Power.
Davenport Machine & Foundry Co., Iowa.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Steel Rails.
Dom. Iron & Steel Co., Sydney, N.S.

Steel Bars, all kinds.
Dom. Iron & Steel Co., Sydney, N.S.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Talc.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Taps.
Geometric Tool Co., New Haven, Conn.

Teeming Crucibles and Funnels.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.
Geometric Tool Co., New Haven, Conn.

Track, Overhead.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tripoli.
W. W. Wells, Toronto.

Trolleys and Trolley Systems.
Can. Fairbanks-Morse Co., Montreal.
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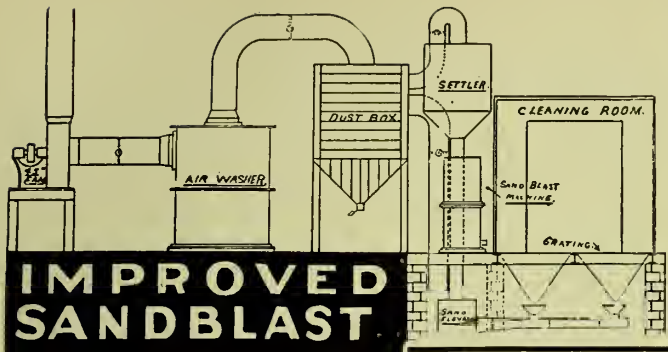

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Two Essential Requirements.

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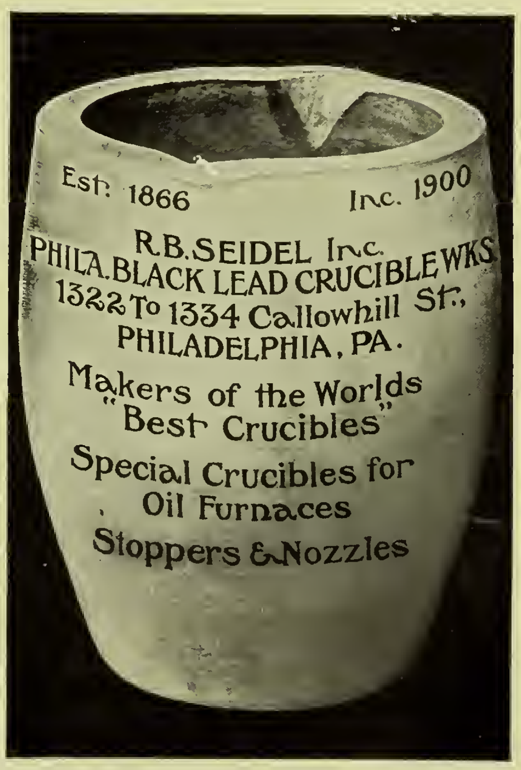

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CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited, Toronto, Montreal, Winnipeg, and London, England

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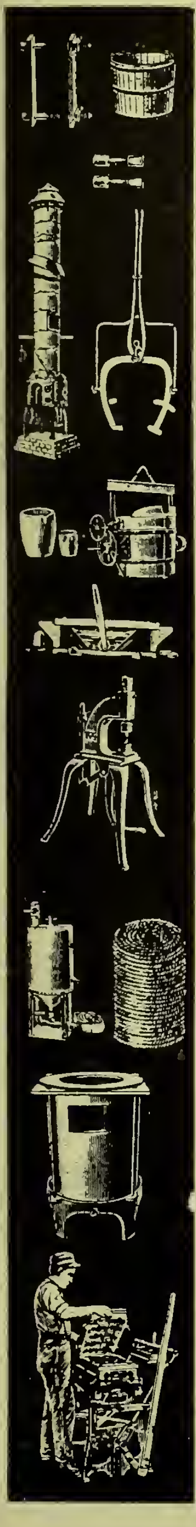

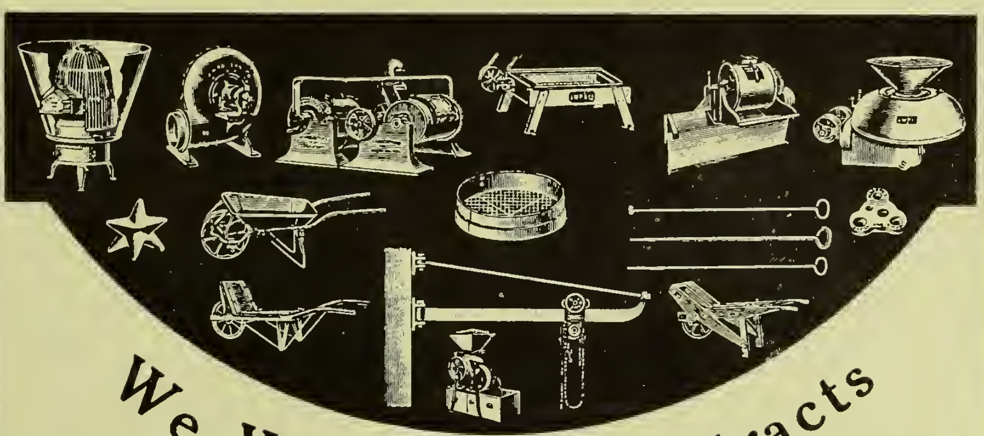

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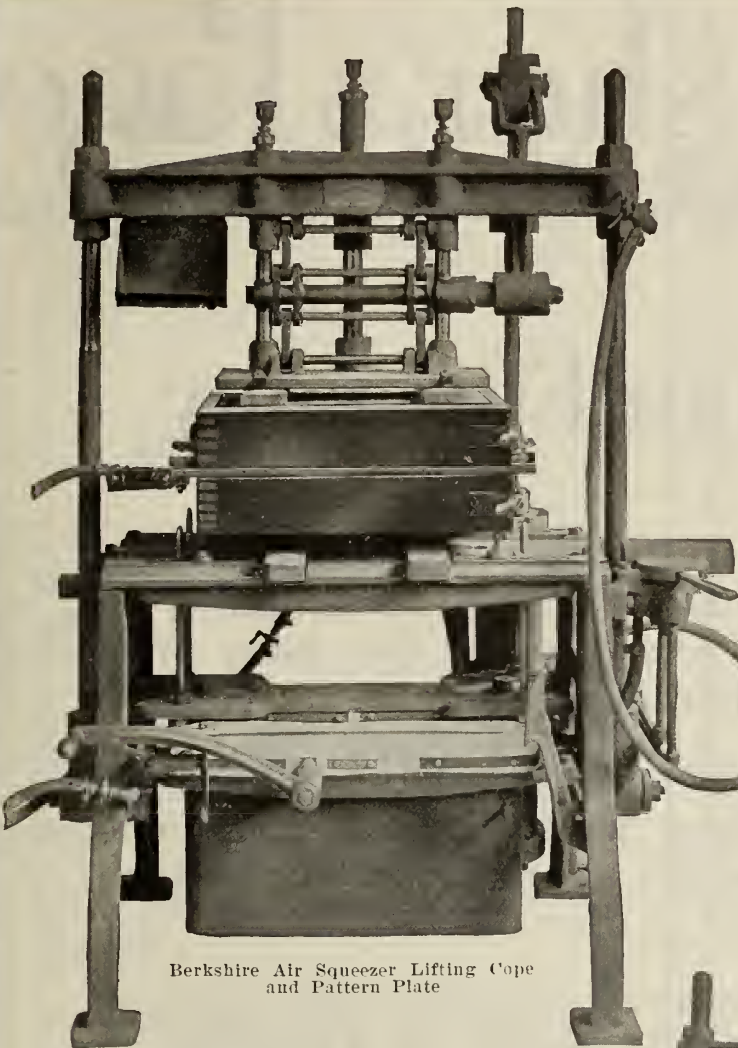

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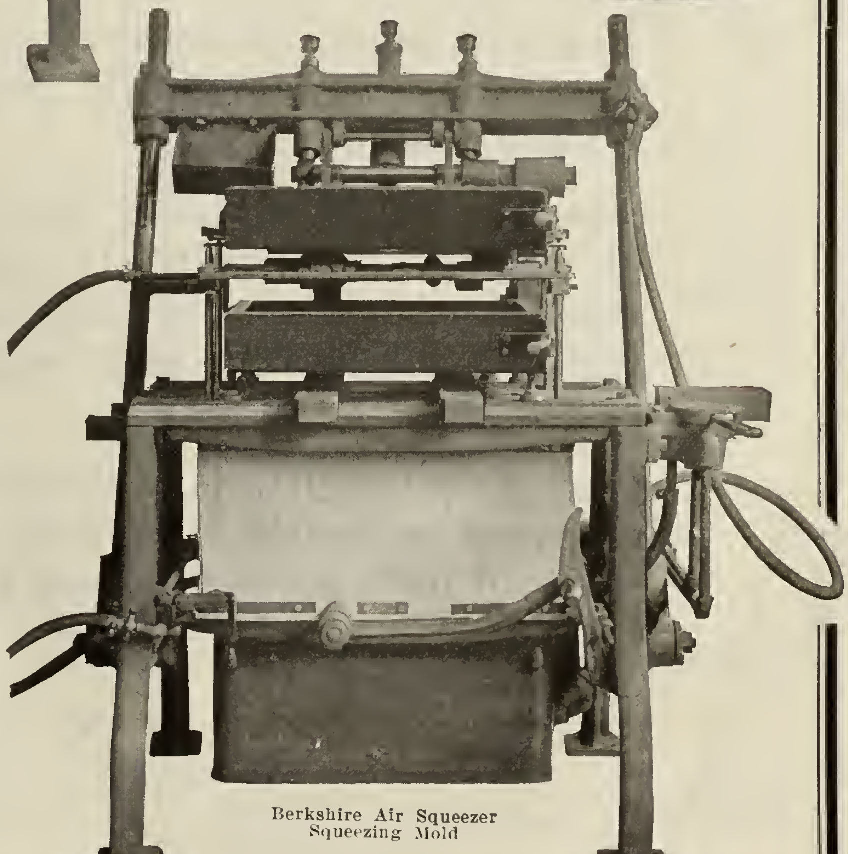

Berkshire Air Squeezer Squeezing Mold

The Publisher's Page

By B.G.N.

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CANADIAN FOUNDRYMAN

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If what you want is not advertised in this issue consult the Buyers' Directory at the back.

Notes and Observations on Modern Foundry Practice--II.*

By R. Onions

In the introduction to his paper, the author referred to the fact that the art of iron founding was in existence previous to the written records of history. He at the same time hazarded the suggestion that to the scientist and practical man of to-day it offered not only a wide field for research, but one also in which individuality had the widest possible scope.

IN our June issue, the subject matter discussed consisted of core-making, green or dry sand castings, machine molding, plate molding, chills, cupola management, castings cost, management and organization.

Runner Basins and Gates.

Runner basins and gates are the channels found in the sand and provide the way by which the metal enters the mold from the ladle. They also serve to feed the mold after the pouring by means of a rod worked up and down by hand, giving a kind of impact to the metal itself, which fills up any thick portions that may have been drawn upon as the casting cools. The cavity where the metal is first received from the ladle is known as the runner-basin. All vertical passages are known as down gates, and the horizontal passages as in-gates or sprues.

As shall be seen directly, the disposition, shape and area of these gates and basins are important and interesting details. They bring into play principles, such as are met with in hydraulics, as vortices, centrifugal force, velocity and momentum, each of which property may be eliminated or taken advantage of as may be considered desirable for any particular case. On them depends the fate of the casting, and whilst in some cases a clean casting may be got at the expense of an enormous riser or header, it will be found, with a more suitable gate, that a much smaller header, or indeed no riser at all, will be required.

Molder's Experience a Factor.

The moulder has to rely entirely upon his experience as to what combination of the principles involved will form the best runner for any particular case. Generally, the metal must enter the mould quietly, and with as little velocity as possible. There are instances, however, where a fairly high velocity is a distinct advantage, as in the case of a ring or line, Fig. 1. Then, a small in-gate is made at a tangent to the mould, and a large down-gate. We as a result have a swirling motion which keeps the metal agitated, and so the dirt, being lighter and not allowed by the agitation to cling to the core or mould, is carried to the top. This swirl, under favorable conditions, will be maintained to a height of 18 in. or 20 in. in a liner with a 15-in. core and 1¼-in. metal. As this principle cannot be taken advantage of for liners which are over 20 in. long, other means have to be resorted to, and other difficulties creep in for which provision must be made.

Runner-Gate for Long Liners.

Fig. 2 shows an arrangement of runner-gate and sprues which have been found to do well on long liners. In this case we have to keep the metal "alive" or agitated as well as possible all the way up, whilst we have also to counteract the cooling influence of the core and mould because of the relatively large surfaces exposed to the metal. It will be noticed that the metal falls direct from the runner-basin into a knob, with which the in-gate is connected, and this leads to an annulus formed around the core, from which lead several small sprues, equally spaced all around. It will be seen that with a large down-gate exceeding the combined area of the small channels, the metal will fill the knob, and also keep filled the annular space, and so make all the small sprues effective.

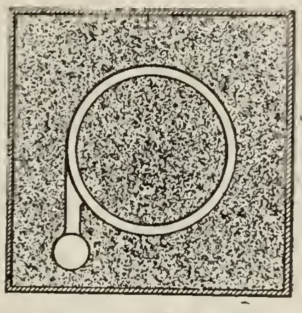


FIG. 1. GATING TO PRODUCE A SWIRLING MOTION.

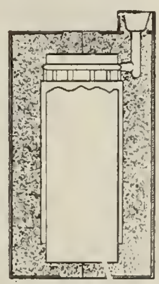


FIG. 2. GATING FOR LONG LINER.

We then have a kind of shower bath, which is falling all the time on the surface of the metal, keeping it in agitation, breaking up the kish and oxide which forms into a mass as the metal is rising, this mass being easily caught by any depression or belt on the liner, and so carrying the dirt to the top. The in-gate in this case is made a little taper so as to increase the velocity of the metal and send it as quickly as possible around the core, and so, by coming in close contact with the core and mould, keeps the surfaces heated in front of the rising metal. Large liners may be cast in this way with a riser only a few inches long and no thicker than the casting itself.

Runner-Basin Features.

It may be well here to examine what features there are common to runner-basins and gates, which are found in practice to give good results, and the reason why. Fig. 3 illustrates an ideal form of runner-basin, and common to all conditions. In this a knob is provided, into which the metal from the ladle is poured. By this arrangement the metal is instantly quietened, and the velocity as it leaves the knob is so small that any dirt has time to float. It will also be noticed that the shape of the basin immediately over the down-gate is square, and it is most important that it should be so, because it goes to prevent a vortex, as it is well known that any swirl over the gate tends to bring down dirt which would otherwise remain in the head. With this form, no vortex can be noticed until the metal gets about half-way down the basin; this is a detail the importance of which moulders generally do not appreciate.

The flow of metal from the ladle to the runner-box is under observation, and the rate at which it is poured may be regulated so that the header is always about full, and by ordinary care a constant supply can be maintained, which goes towards a quiet entry, and minimizes splash. Whilst this form of basin may take a few more minutes to make than other forms, it will be found to pay well to adopt, and where specially clean work is required, a plug should be used over the gate, to allow of the basin being filled.

Simple But Unsatisfactory Runner-Basin.

In Fig. 4 is shown a form of runner-basin which is much more simple and quicker to make. It is, however, unfortunately an exception to the general rule in foundry work that the simplest and

*From a paper read recently before the Manchester Association of Engineers.

least-complicated is the best. This is a runner-basin of the worst kind, and, it will be seen, defeats all the points those shown in Fig. 3 are designed to achieve. We have here a basin situated directly over the down-gate, which has the objection that the the metal is most likely to splash in the mould, particularly on the commencement of pouring, where the man handling the ladle often gets in such a position that too much metal is leaving the spout, and this he suddenly checks to a too small amount, and so the pouring oscillates as it were for a second or two before settling down to a regular flow.

It may easily be seen that, as regards Fig. 3, any such irregularity does not tell directly on the down-gate. Metal if allowed to rush into a mould causes by its momentum undue pressure, strains the mould, tending to lift the top box, and is a common cause of run-outs. The funnel shape also encourages the formation of a vortex, and, if the pouring be observed, a swirl may be seen on the surface even when the basin is quite full. Whilst this form of runner-basin is freely used in some foundries, it has little recommendation beyond its cheapness, and on investigation it will be found responsible for a good many wasters. It may be good enough for some jobs but it would be difficult for the management to discriminate what head box to use.

Serviceable Form of Gating.

Fig. 5 shows the best form of gating for the great majority of castings. If we follow the course of the metal from the runner-head, the construction of the passages at each point is such as will give a quiet entry of the metal to the mould, and without much velocity, an entry at or near the bottom of the mould, and without splash. The in-gate should be placed at such a position that the metal will have a continuous and definite flow from the moment it enters the mould, entering at or near the thinnest portion, so as to have the hottest metal at the light section, and if a feeding-gate be considered necessary, this should be placed over the heavy section. In order to get these conditions, the down-gate from the basin is distinctly smaller than the down-gate in the drag or the in-gate to the mould. The down-gate from the cope discharges into a knob as also the down-gate in the drag.

These knobs serve much the same purpose as a dashpot to a governor; they control any sudden rush or irregularity, the object being to give a uniform and quiet flow. This saves many castings from scabs or pellets being shot all over the mould, chilling in their flight with a coating of oxide, from which state they do not usually melt again, but are found on the top of the casting. These pellets are generally considered to be due to phosphide eutectic.

Cylinder Head Experience.

Here it may be well to relate an experience with several cylinder heads. These castings were so full of pellets they had to be scrapped, and on enquiry it was found that the gate had been put on the casting, the moulder's intention being to drop the metal between two cores; owing, however, to the gate not being straight, the metal had been playing against the corner of one of the cores, which shot the metal across the mould into pellets below a flange, most of them being trapped there. A great many of them came to the top of the casting, however, the iron used only showing on analysis 0.3 per cent. phosphorus, and the pellets gave just the same percentage.

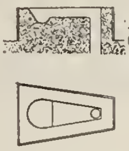


FIG. 3. IDEAL RUNNER BASIN.

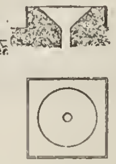
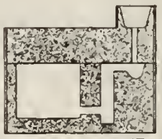
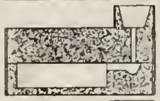
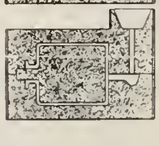


FIG. 4. BAD RUNNER BASIN.

Gates made in the way just described give good results in regular practice; but they are in direct opposition to the contentions of many authors on foundry work, who, however, do not always state their reason.







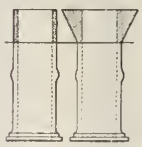


FIG. 5. IDEAL GATING.
FIG. 6. GENERAL FORM OF GATING.
FIG. 7. GATING HINDERING FREE ESCAPE OF GAS.
FIG. 8. HEADERS GIVING SAME METAL PRESSURE.

Miscellaneous Service Gating.

Fig. 6 shows the class of gate as used for moulds generally, and, when choosing this type, consideration must be given to the depth of mould and bulk of metal. If danger be anticipated from high drop of metal into mould, Fig. 5, gate should be used. It is, however, desirable to retain the knob, and the down-gate should form the controlling area for the reasons already given.

In the case of a silencer for internal combustion engines we have a casting covering a considerable area and having an exceptionally large core compared with the bulk of metal. If the whole of the gas and air from the core has to escape through the branch at the end, the down-gate has to be comparatively small so as to fill the mould at such a rate as will allow the gas to escape. To counter-balance the cooling effect of the large exposed area, the metal has to be cast as hot as possible.

Again, we may have a mould with a thin section of metal and containing several small cores, each having points of connection through which the gas and air can escape. Here we have to provide for the large cooling influence of the cores, and so the casting has to be run sharply with hot metal. A quick cast in such cases is permissible because of the facilities for venting, which allow the air to escape as it is chased in front of the rising metal.

Balance-weights and hammer-blocks should be cast with a large gate. If this class of work is not cast smartly, the top of the mould runs the risk of being drawn down, due to long exposure of heat while the mould is filling.

Solid pieces are better cast with an in-gate three or four times the size necessary to fill the mould, and the rate of filling regulated by a plug in the runner-box. This will be found to feed most castings without the use of a rod through the riser.

No rule can, therefore, be laid down governing the area of gates; this is a matter which must be left to experience. Some moulders, after considering the design, weight, and area of a mould, will say that it should be cast in, say, 40 seconds or 1 minute, and on this basis the area of gate may be arrived at approximately.

Surface Blackening of Runner-Gates.

The whole surface of runner-gates and sprues should be carefully blackened. If in long down-gates the ordinary swab cannot be got to the bottom, it must be fastened to a rod. Should this precaution be not observed, the gates will be scabbed, indicating where patches of sand have been washed into the mould. The cause of many otherwise mysterious defects will be located by an examination of the gate before it is broken off the casting. It is remarkable the number of experienced moulders who will neglect this most important detail by blacking the mouth of the gate only.

As to risers and headers generally, it will be found that moulders incline to the belief that a comparatively big quantity of metal at the top is an advantage. If, however, the runner-basin and gates are properly made, very little dirt will have to be accounted for. A few extra inches will be found as good as a foot, and so the only other advantage that may be expected is to so construct the head that this will be the last part of the metal to set, and thus the feeding-rod may be used to the best advantage. The pressure due to the extra depth of metal, whilst a distinct advantage, is no more than will be obtained by an ordinary feeding-plate of equal depth.

Some foundrymen do not appear to have sufficient confidence in their hydrostatic knowledge to say that the pressure due to the head is the same in both cases, Fig. 8. In the right hand sketch, however, there is a considerable amount of metal in bulk, often amounting to one-half the weight of casting required. This large bulk of metal will remain fluid long after the bottom portion has set, thus proving a real disadvantage, not only increasing the cost, but by the slow rate of cooling, allowing the carbon to separate out in large flakes, making the top of the casting more open.

SELECTION OF EMPLOYEES.

IN a talk on "First Aid" before the Newark, N.J., Foundrymen's Association recently, Dr. Henry Satchwell, of that city, emphasized the need on the part of employers to give more and stricter attention to selection of their employees, as nearly all accidents give opportunity of liability claim being made against them. He said:

"All workmen should be subjected to medical examination, in order that all hidden defects, either physical or mental, shall be known in advance. Injury by accident to the normal workman is a small factor; by far the greatest loss is from accident to the diseased man. If a sick man is well enough to get work, but is afterward injured, the employer is totally liable; therefore, the great importance of selecting labor. It will save more money than all subsequent economies. In foundries, where a great part of the work is heavy, ruptures are the bugbear. Heart disease, weak arterial walls and similar deficiencies incapacitate a man for such labor.

"The proper reporting of accidents is a duty that all manufacturers should require. It serves more than one purpose. It gives the employer a chance to check up false claims and to apply the right treatment at the earliest possible moment. Regulations for reporting accidents are almost worthless unless a penalty is attached to the failure to report.

"It has been found that factories that pay well both in wages and in medical treatment have the least trouble. It has been suggested that if the careful inspection of employees should be carried out, a large class of workmen would be unable to find employment. This would call for a legislative remedy, one that would enable a company to hire a man without being liable for disability caused or contributed to by some existing disease of the man."

SUBSTITUTE FOR WOOD IN PATTERN-MAKING.

A COMPOSITION that has many advantages over wood for small patterns can be made as follows With hot water mix into a thick paste three parts by volume of starch, one part ground glue, two parts fine resinous sawdust. The sawdust should not be added until the starch and glue have been dissolved by the water. After the ingredients are thoroughly mixed, heat the whole to 190 degs. Fahr., and continue the heating until the whole become a hard mass, then allow to cool and remove from the receptacle. The resulting composition is a strong, hard, horn-like substance that can be machined, sand-papered, and varnished the same as wood.

The principal advantage of this composition over wood lies in the fact that it has no grain, and, therefore, turned and complicated patterns made from it do not have to be built up or glued together. For the same reason it is easier to turn and machine, and offers a smoother surface when finished. It is also more fireproof than wood and not so readily affected by atmospheric changes.

CANADIAN MINERAL PRODUCTS FOR BRITAIN.

THROUGH the medium of the High Commissioner's Office, trial orders have been given by the British authorities for certain Canadian mineral products found in Ontario and Quebec, and those who grumble about Canada's share of war contracts have no conception of the large orders already passed, at least so we are given to understand. The Imperial Government is adopting the policy of giving the Dominion every possible chance.

Col. Pelletier, agent-general for Quebec, is also supplying certain minerals from Quebec to the French analysts, who hold out great hopes of utilizing the same for war munitions.

The Swedish Crucible Steel Co., of Canada, Ltd., Windsor, Ont., have been authorized to increase their capital stock to $200,000.

IMPROMPTU MANUFACTURE OF HOWITZER SHELL CARTRIDGE CASES.

(Staff Article.)

IN our June issue the impromptu manufacture in a Canadian plant of shrapnel shell cartridge cases was dealt with at considerable length. Most of our readers are doubtless aware that 4.5 howitzer shells are also being turned out in considerable quantity by our steel foundries, forge and machine shops; it naturally follows that cartridge cases for these too are required. The present article deals with the manufacture of the 4.5 shell cartridge case in the same plant as described in our June number.

The howitzer cartridge case is very much shorter than the shrapnel cartridge case, but the general line of manufacture is much the same. They are annealed in the same furnace and at the same temperatures as the shrapnel cartridge cases. Fig. 23 shows the complete series of operations, while Fig. 22 shows the Williams & White bulldozer on which all of the four draws are accomplished. The dies and punches are changed to suit the operation. In Fig. 22 the bulldozer is cupping the discs, and the operator is sliding in a disc. The shortness of the case enables all draws to be made on a bulldozer.

The indenting and heading operations are accomplished on hydraulic presses in the boiler shop of the plant. The tapering is done in two stages on one Williams & White bulldozer.

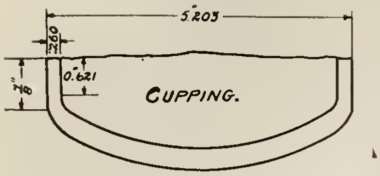
The semi-annealing is accomplished by a very simple gas burning arrangement. Two vertical spindles carry two discs on their ends, and bevel gears from a pulley driven shaft, revolve the two vertical spindles. A circular pipe with holes drilled on its inner side forms the gas burner. Thus the cartridge case is annealed, by being placed on the revolving discs. The machining of the cases, and the tools, fixtures and gauges are similar to those for the 18-pdr. shell case.

General.

At present the shop is not fully equipped and the organization has not been perfected, but the estimated production of the 18-pdr. shrapnel shell cases is 5,000 per day of 24 hours. About 4,000 Howitzer cases, it is expected will shortly be turned out during the same time. The shells are carried about the shop on Chapman Double Ball Bearing Company trucks, in boxes of twenty-five each. Trucks on standard gauge tracks take care of the inter-shop traffic.

The hardness of the brass must be within certain limits or it will not perform its duty when under fire; thus cases have to be sent to the military authorities to undergo a firing test. They have, however, proved to be up to all requirements, and with all the unavoidable disadvantages under which this shop is working, it has most assuredly scored a huge success. The greatest credit is, therefore due to its engineering department for their ingenuity, perseverance and patriotism.

While the layman's appreciation of the time, trouble and worry involved, and of the degree of success achieved, in such an undertaking as the manufacture of shrapnel and howitzer shell cartridge cases by means of equipment altogether foreign to the purpose—not to speak of the necessity of the latter's preservation against radical change in design and arrangement, may be such as to elicit the highest praise and create wonder and amazement, it really falls to the practical mechanical man to give the work being done its true rating.



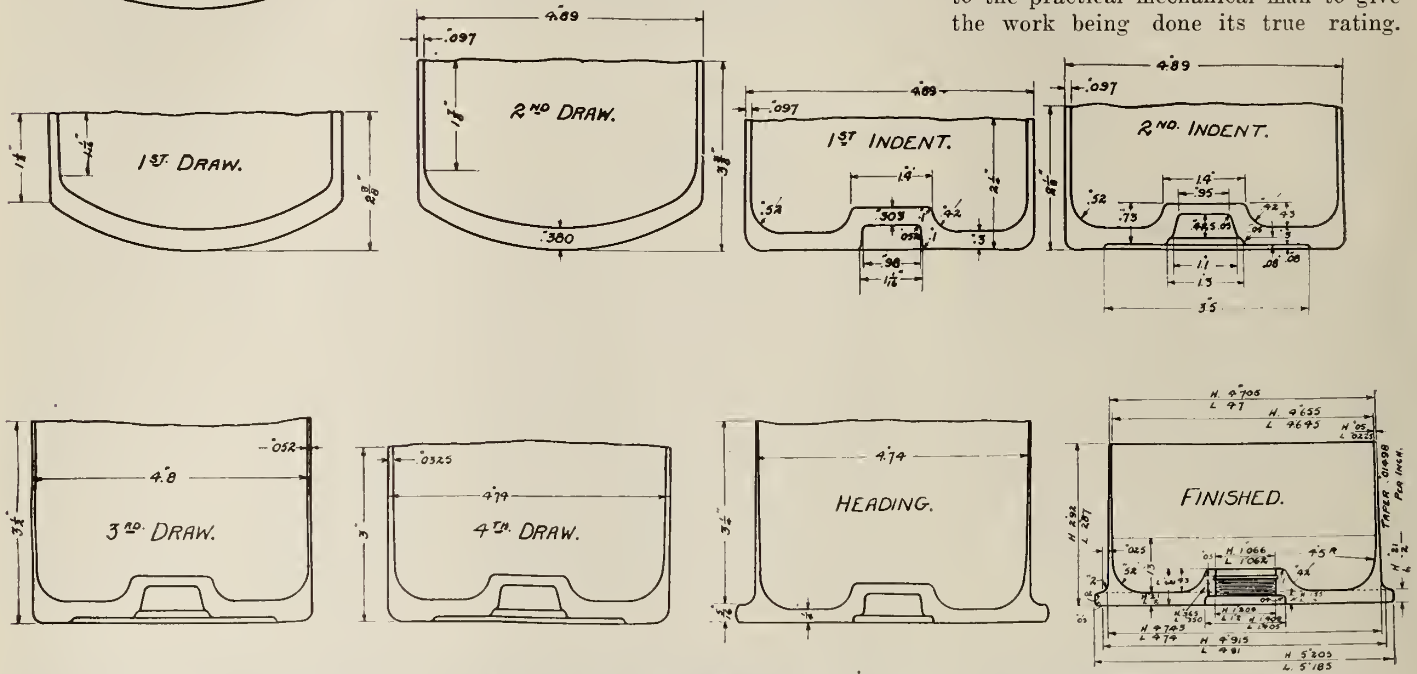


FIG. 23. SERIES OF OPERATIONS THROUGH WHICH THE 4.5 HOWITZER CARTRIDGE CASE PASSES IN THE PROCESS OF MANUFACTURE.

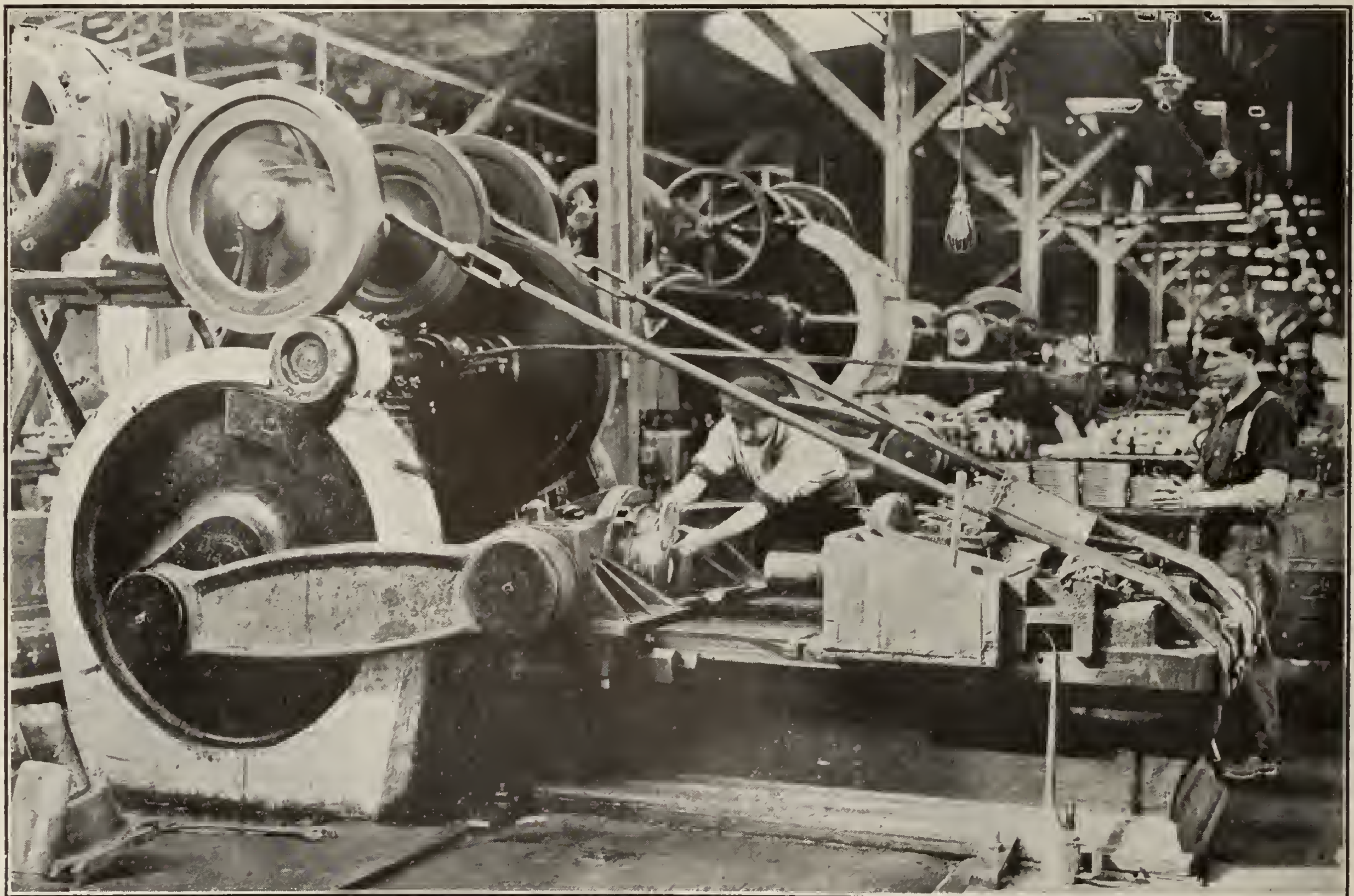


FIG. 22. CUPPING BRASS DISCS IN THE MANUFACTURE OF 4.5 HOWITZER CARTRIDGE CASES ON A "WILLIAMS & WHITE" BULLDOZER.

PRODUCTION METHODS AND DEVICES

A Department for the Interchange and Distribution of Shop and Office Data and Ideas Evolved from Actual Practical Application and Experience

THE IMPORTANCE OF CORRECT GATING.

By Arthur Smith.

IT is perhaps not an exaggeration to state that fully fifty per cent. of the castings proving defective in a foundry are the result, either directly or indirectly, of incorrect gating. A careful and efficient foreman will see that the moulders are provided with proper equipment in the way of flasks; he will insist upon the necessary sands and facings, and will insure that the mould is fully secured and vented, but will leave the location and size of the gates to the judgment of the mechanic.

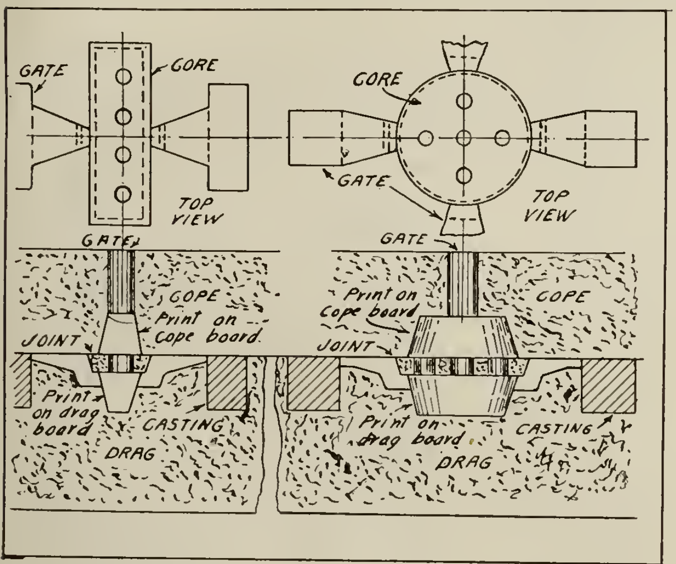
Correct gating is an art, and it is unfortunate that so few moulders value it at its true worth. We are all aware that if any dirt at all ocurs in a casting it will likely be found at or near the gate. Still, many mechanics will place the gate right against or upon a finished face, simply because it offers a convenient place for the metal to enter the casting. Another delusion is that a heavy casting must have large gates, sight apparently being lost of the fact that several small gates will fill the casting equally fast, while the runner box may be kept full at all times and the danger of slag and dirt going down materially reduced.

Top or "Pop" Gate.

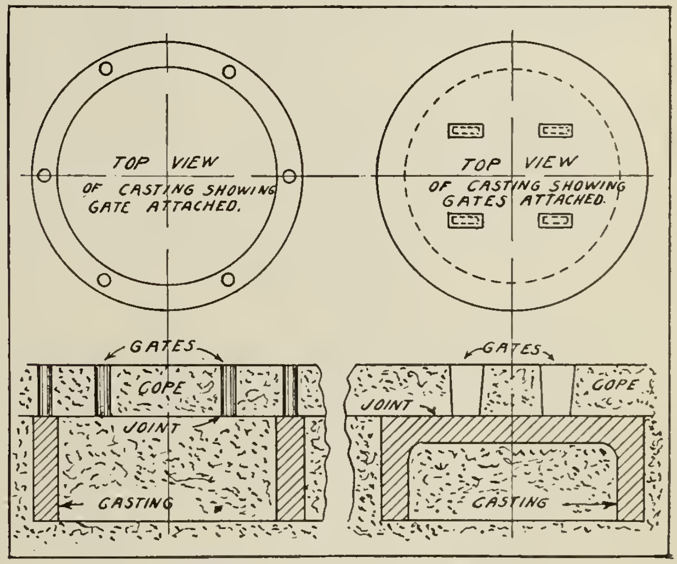
Many moulders lean toward the top or "pop" gate. This is a round gate, 3/8 in. or 1/2 in. in diameter, placed directly on top of the casting, and in a great many cases it is a first-class arrangement. One of the principal objections to its general use, however, is that the metal falls continuously upon the face of the mould or core, and is apt to cause cutting or scabbing unless the mould is nailed where the metal strikes. In castings having flanges or pockets where a pool is almost instantly formed, the "pop" gate can not be improved upon.

Flat or "Stove Plate" Gate.

The flat or "stove plate" gate is often used for light work with good results. This gate is usually 1/4 in. or 3/8 in. in diameter by from 2 in. to 4 in. wide, and is placed directly on top of the pattern. As the name indicates, it is used extensively for stove-plate work, thin plates, etc. It is remarkable how fast one or two of these gates will take the iron, and the mould fills so rapidly there is little danger of cutting.



STRAINER GATE RECTANGULAR. STRAINER GATE ROUND.



POP GATE. STOVE PLATE GATE.

The "Strainer" Gate.

The "strainer" gate for small gated work is one of the most satisfactory that has ever come under the observation of the writer. When using this gate, the metal is strained through a perforated oil sand core, and it is almost impossible for any dirt to enter the mould. In a moulding machine shop, where the work is poured by foreigners, whose chief desire seems to be getting the iron out of the ladle, this gate is invaluable. While the initial expense of equipping machine boards with strainer gates may seem formidable, they will quickly pay for themselves in castings saved.

An attractive method of pouring heavy castings is through the "block" gate. This is a modification of the well known "horn" gate, and its success lies in the fact that the metal is so thoroughly screened there is very little likelihood of any impurities entering the mould. This gate may be made quite heavy, and engine beds weighing several tons are successfully poured with one block gate on each side of the main bearing.

Gating Through the Core.

The old-fashioned method of gating through the core commends itself in many instances, and has the advantage that the metal travels through dry sand continuously until it enters the casting. This is a splendid gate for large gas and air cylinders cast on end, the method being to cut the gate through the centre of the barrel, a vent being rammed in each half of the core.

The Runner Box Feature.

Even when the utmost care is exercised in gating, the effectiveness of the gate is often discounted by the sloping and spilling of the metal in the runner box when beginning to pour. To guard against this, some founders place a dry sand runner box on top of the mould. In this runner are placed one or two strainer cores, which collect all dirt or slag before it can reach the gate. This runner core is simple to make, and an ordinary coremaker can turn out a great number in the course of a day. One is surprised at the amount of dirt gathered by the strainer cores, a portion of which would almost of necessity enter the gate.

Some moulders make a practice of always gating a casting at its heaviest section. While this may be quite convenient, it is decidedly wrong, for the reason that the gate keeps the metal alive at this point so long that a spongy condition results. Unfortunately this is not detected until long after the casting leaves the foundry, and many weak castings are laid to faulty design where, with the proper arrangement of gates and risers, they would be sufficiently strong for the purpose intended.

TRADE WITH RUSSIA PROSPECTS.

GREAT possibilities for Canadian trade with Russia are revealed in the first report sent by Special Trade Commissioner Conrad F. Just to the Department of Trade and Commerce.

Mr. Just has concluded his investigations in the Petrograd district, and is now working south and east. He has had a number of conferences with members of the Russian Government and with leading bankers, having had considerable assistance from the British Commercial Attache and British Consul at Petrograd. He points out that at the outbreak of the war, Germany, after 25 years of effort, had to her credit 52 per cent. of the import trade of Russia. Since the war, the conventional tariff rates have been withdrawn, the general tariff increased by 10 per cent., and a surtax of 100 per cent. imposed against Germany and Austria. The war has not devastated any true Russian areas, but districts which constituted the base of the German economic penetration of Russia.

Russia, says Mr. Just, has great powers of recuperation, is internally rich and prosperous, and affords "great opportunities for industrial enterprise for which the consuming power is at hand." These factors, the report states, should make Russia a great market, "and if the conditions be rightly studied and understood, Canadian manufacturing industries, by the nature of the products, which are adapted in so many instances to the requirements of a developing country like Russia, may reasonably expect to participate in the trade with that market."

Agriculture is the occupation of 85 per cent. of the Russian people, and the manufacturing industry furnishes an insignificant output in relation to the country's needs.

Canadian Exports Confused.

Mr. Just says that Canadian machinery exports to Russia have been confounded with those from the United States. He advises Canadian traders to organize on the basis of a close study of the Russian requirements and to keep in touch with the consumer by means of local agents, who play a very prominent part in connection with the foreign trade of Russia. Firms seeking trade with Russia should enter the market in groups or syndicates, this being possible when the products of such firms do not compete, but are complementary to each other. It is also desirable to have assembling shops in Russia, particularly for machinery, thus saving on Customs duties and permitting tendering on Government works. A start should be made in Petrograd, where the Russian fashions are set.

"The successful participation of Canada in the contracts of the Russian Government for munitions of war, railway rolling stock, and it is believed for locomotives and other materials, has created lively interest in Russian official banking and commercial circles," says the report, "and should prove an excellent advertisement of the capabilities of the Canadian industrial system."

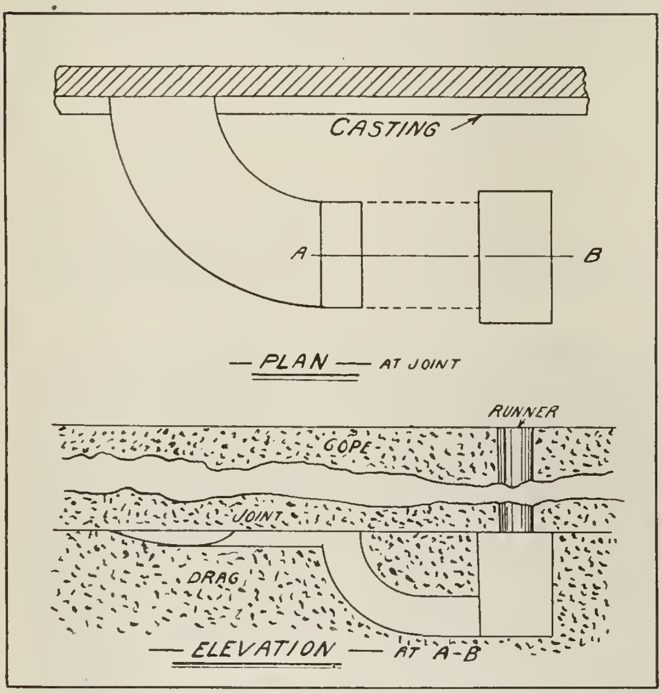
Canadian leather supplies, it is added, would be snapped up at high prices. "A pair of Russian army boots has a life of two months."

MARKET FOR WIRE RODS IN BRITAIN.

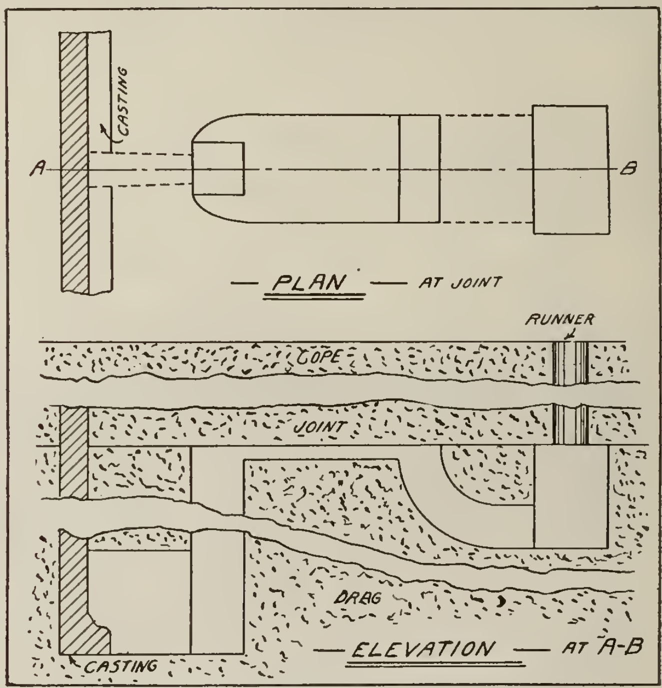
CONSIDERABLE quantities of wire rods have hitherto been sent to the United Kingdom from Germany, and as supplies have now ceased, consumers are experiencing much difficulty in obtaining adequate supplies from home sources. Another factor which is handicapping producers is the difficulty of securing labor, as so many skilled men have enlisted in the army.

If Canadian manufacturers are able to export these rods, the information ascertainable covering the following particulars may be of service. The rods required should be of soft and hard steel and in what is known to the trade as 4, 5 and 6 gauge. The soft steel rods should have 0.10 per cent. carbon, and the hard steel rods 0.40, 0.50 and 0.60 per cent. carbon. The soft rods are intended to be drawn into wire for the making of such articles as boot rivets and wire mattresses, while wire obtained from the hard rods is used among other purposes for card clothing and also for wire rope making.

The Toronto Structural Steel Co., Atlantic Avenue, has received a contract for shells.



BLOCK GATE ENTERING CASTING AT JOINT OF MOULD.



BLOCK GATE ENTERING CASTING AT BOTTOM.

CONTEMPORARY WAR ARTICLES

Embracing Information and Data Drawn from a Variety of Sources Relative to and Arising from the Prosecution of this Many-Sided European War

CAST IRON vs. STEEL SHELLS.

THE fact that fragments of presumably cast iron shell cases have recently been picked up on the battlefields in Flanders has had the natural result of raising the question as to why, if the Germans employ this material, then shouldn't we? The subject has been aired in the British House of Commons, and has formed the theme of more or less correspondence in the editorial columns of both the lay and technical press. Our contemporary, "The Engineer," has very opportunely investigated the matter, and additional point is given to its editorial pronouncement from the fact that it had for inspection a piece of a German cast iron projectile, received from a correspondent.

Referring, in the first instance, to the sample submitted, which was about 2 inches square and ¾-inch thick, the opinion is expressed that it belonged to a 6-inch diameter shell, that the internal surface had been cast on a chill, and that while the outside surface had been turned, the inside had not been so treated. The observations made and deductions drawn, which follow, will be found highly interesting and instructive as well.

Objections.

"There are several objections to such shells. In the first place, where shrapnel is concerned, the number of bullets is reduced because the walls of the projectile must be made much thicker. In the case of high-explosive shell, this does not apply in so great a degree, because the walls of the steel shell are then made thicker than is necessary for strength, but there is such danger of a cast iron shell developing cracks during manufacture that high explosives cannot safely be used in them. It must be remembered that no risk of a shell bursting in a gun must be run, and no one will doubt that there is more risk in cast iron than there is in forged steel.

"Another point against cast iron is connected with accuracy of fire. To ensure this, the projectile must be perfectly in balance. The walls must not only be of exactly the same thickness all round, but they must be homogeneous. At the very high speed of revolution set up by the rifling, a small difference of weight to one side of the centre line would be quite sufficient to cause irregular shooting. With forged steel there is little or no difficulty in securing this balance; with cast iron there is always some danger of local porosity, which, besides being a source of weakness, would destroy accuracy.

"Moreover, if the projectile were cast on a chill core and was not machined internally a risk of the core not being absolutely concentric would always have to be faced. Accurate fire would then be impossible. To remove a chill core, even if it were collapsible, it would be necessary to have a large hole in the base of a high explosive shell, of which the point is always solid, which subsequently would have to be plugged. If a sand core were used it might be removed through a smaller hole, but the machining of the interior would be difficult owing to the shape of the ogival head and the smallness of the hole through which the tool must be entered. In the case of shrapnel the boring would be much easier, because a large opening is left for filling purposes, but, owing to the small number of bullets that could be carried, cast iron shrapnel cannot be considered.

"All these facts have militated against cast iron shell, and although, of course, cast iron and cast steel were used at one time they have entirely given place to forged steel. Furthermore the methods of manufacture of steel shell have been so developed that such shell can actually be turned out more quickly than those of cast iron of equal reliability and accuracy. An 18-pounder shell for example, can be completely machined from the bar in about forty minutes. The case for the forged steel shell is, then, complete, and there is no case at all for the cast iron shell.

A Case of Necessity.

"The answer is fairly obvious, as to why Germans are using cast iron shells. In spite of the greatness of the supplies of their modern guns and projectiles, the Germans are beginning to find them not inexhaustible under the tremendous drain that is being put upon them. Hence, guns and projectiles have been drawn from stores many years' old to fill up the deficit in modern supplies. The guns use a lower powder pressure, which the cast iron is able to stand, and the shells are probably filled with black powder, so that less danger is to be feared from an accidental burst. We believe this to be the real reason for the fragment of a cast iron shell being found on the battlefield.

"Whether the Allies also are using old guns and shell we cannot say, but it is not inherently improbable. Every nation concerned has been surprised by the part artillery has been called upon to play, and it is not unlikely that all of them have drawn upon resources of every kind that can be turned to account. If the Germans are indeed using cast iron, it is a favorable sign, for it shows that even they, with all their preparation, were unable to collect enough material of a modern kind to meet the requirements of the war.

There are, of course, not wanting those who, while agreeing that for accurate fire or penetration the cast iron shell is non-serviceable, still believe that for scattering earthworks and breaking down wire entanglements, chunks of cast iron are just as effective as chunks of steel, and, of course, cost much less.

DEMAND FOR ANTIMONY.

IN each British 18-pounder shrapnel shell there is approximately one pound of antimony. The shrapnel bullet is composed of 87½ per cent. lead and 12½ per cent. antimony, and the total weight of the bullets in the shell is close to eight pounds.

The enormous production of shrapnel, including shells now in course of manufacture, already has reached a total that is far in excess of the U. S. imports of antimony for last year. Imports then were in excess of 14,000,000 pounds. However, there were produced close to 25,000,000 pounds of antimonial lead in that country in 1914. The antimony content was about 2,500,000 pounds.

"The situation in respect of supplies is less acute than early in May," says the Wall Street Journal, "when the tension in affairs between Japan and China threatened to shut off the only present foreign source of supply for the United States. The apparently more friendly relations between those two countries has reassured the American manufacturers, especially the type makers—the commercially big users of antimony.

German Field Gun.—The German field gun is a 15-pounder. It has a wedge breech action, that is to say, the breech is closed by a wedge and not by a screw, as with our field gun. It has three sights and a clinometer, but no independent line of fire. Each gun weighs about 2,000 pounds, and takes 378 rounds of ammunition into action.

THE COMING FOUNDRYMEN'S CONVENTION.

ACTIVE preparation is being made in every direction for the coming convention at Atlantic City, N.J., the American Foundrymen's Association and allied bodies, and there is little doubt that, when the week of September 27, 1915, arrives, everything will be in apple-pie order for this wide scope function.

The occasion will be marked by the annual meetings of the American Foundrymen's Association and the American Institute of Metals as well as the yearly exhibit of foundry supplies and equipment conducted under the auspices of the Foundry & Machine Exhibition Co. Heretofore, the Associated Foundry Foremen have held their meetings during this week, but since this organization has dissolved and its members have become affiliated as associates with the American Foundrymen's Association, they will take part in the deliberations of this society.

The program of the American Foundrymen's Association, while yet incomplete, has already assumed large proportions and to permit of full discussion of the many valuable papers that will be presented, two simultaneous sessions on malleable and steel castings will be held. The business meeting, which heretofore followed the close of the technical deliberations, will be held on Wednesday evening, Sept. 29, when the new officers will be elected and the business affairs of the association will be discussed.

A gratifying increase in membership has been recorded during the year, the enrollment now approximating 1,000, of which more than 150 are associates. The campaign for new members resulted in the addition of nearly 100 new names, and at the annual meeting it is believed a still further growth will be reported. Financially the society is in better condition than at any time in its history, and the balance in the treasury will permit of increasing the scope of the work that is now being carried on.

A partial list of papers that will be presented, follows:

"Resume of Advances in Foundry Practice," by Richard Moldenke.

"Application of Various Types of Molding Machines to Different Classes of Work," by I. J. Wilson and A. O. Backert.

"Time Studies on Molding Machines," by H. K. Hathaway, Philadelphia.

"Functions of Sand Binders," by H. M. Lane, Detroit.

"The Reclamation of Molding Sand," by W. M. Saunders and H. B. Hanley.

"Relation of the Foundry Foreman to the Manager," by S V. Blair.

"Manufacture and Constituents of Pig Iron and the Essentials in the Purchase of this Material," by O. J. Abell, Chicago.

"Pouring Systems for Gray Iron Shops," by H. Cole Estep.

"Fuel Oil Cupolas," by Bradley Stoughton, New York City.

"Thermal Reactions in Melting Gray Iron," by Dr. Joseph Richards, Lehigh, Pa.

"The Inspection of Automobile Castings," by C. B. Wilson, Pontiac, Mich.

"Defects in Gray Iron Castings and Remedies for Them," by Herbert Ramp, Cincinnati.

"The Value of the Vibratory Test in Steel Foundry Practice," by Lloyd Uhler, Pittsburgh.

"The Particular Application of the Converter in the Manufacture of Steel Castings," by C. S. Koch, McKeesport, Pa.

"Notes on Electric Furnace Construction and Operation in the Steel Foundry," by Mr. Gray, United States Steel Corporation, New York City.

"Correct Proportions and Essentials in Checker Design for Open Hearth Furnaces," by W. A. Janssen, Bettendorf, Ia.

"Causes for Shrinkage Cracks in Steel Castings," by William Bossinger, Marion, O.

In addition to the foregoing, reports will be presented by the committees on safety and sanitation, industrial education, costs, steel foundry standards, specifications for malleable castings, specifications for gray iron castings, specifications for steel castings, and specifications for foundry scrap.

Aside from the many attractions afforded by Atlantic City, the entertainment features will involve a theatre party and banquet, and a committee will be in charge of plant visitation, whose members will direct the visiting delegates to the many interesting foundries in Philadelphia and vicinity. It also is probable that numerous side trips will be arranged to enable visitors to inspect the shops in which they are interested, with the least amount of inconvenience.

Headquarters for the American Foundrymen's Association will be at the Marlborough-Blenheim Hotel. The meetings will be held on Young's Steel Pier, where the registration booth also will be located.

Foundry and Machine Exhibition.

C. E. Hoyt, secretary of the Foundry & Machine Exhibition Co., Lewis Institute, Chicago, reports that the space reservation already made, foreshadows one of the largest exhibitions ever held. Young's Steel Pier is admirably adapted for show purposes, and all facilities are provided for the rapid building and installation of machinery. The exhibition will be opened formally on Saturday, Sept. 25, and will close Friday, Oct. 1.

American Institute of Metals.

The headquarters of the American Institute of Metals will be at the Hotel Traymore, and the meetings will be held either there or on Young's Million Dollar Pier. The provisional programme is as follows:

D. H. Newland, Assistant State Geologist, New York—"Albany Sand."

A. D. Flinn, Board of Water Supply, New York—"Experience with Brass in Civil Engineering Work."

C. P. Karr, Bureau of Standards—"Molding Sand."

Charles Pack, Doehler Die Casting Company, New York—"Aluminum Die Casting Work."

Dr. Burgess and Dr. Merica, Bureau of Standards, Washington, D.C. — "Cracking of Wrought Brass from Overstrain."

William W. Clark, Seymour Manufacturing Company—"Manufacture and Use of Alumino-Vanadium."

C. V. Powell, British Aluminum Company, Toronto, Ont.—"Some Developments in Aluminum."

Russell R. Clarke, Pennsylvania Lines West—"The Advantage of a Standard Railroad Bearing Alloy (The Journal Bearing Shell, not the Lining)."

Dr. Weintraub, General Electric Company—"Silicon Resistance Furnaces for Melting Brass."

G. H. Clamer, The Ajax Metal Company—"Effect of Zinc on Copper, Tin and Lead Alloys."

W. M. Corse, The Titanium Alloy Manufacturing Company—"Copper-Aluminum Alloys."

Jesse L. Jones, Westinghouse Electric & Mfg. Company—"Forging Manganese Bronze."

S. L. Hoyt, University of Minnesota—"Amorphous State of Metals."

S. W. Parr, University of Illinois (Two Papers—"Method of Analysis for Complex Alloys," "Development of Acid Resistance Alloys."

Dr. Rawdon, Bureau of Standards, Washington—"Metallographical Examination of 88-10-2 Alloy."

F. A. J. FitzGerald, FitzGerald Laboratories—"Electric Furnaces for Brass Melting."

H. T. Kalmus, Kalmus, Comstock & Westcott, Inc.—"Cobalt in Non-Ferrous Metals."

Dr. S. Trood, U.S. Sherardizing Company—"The Electric Furnace for Sherardizing."

W. E. Barlow, Virginia Polytechnic Institute.

Thomas F. Wettstein, United Lead Company—"The Effect of the Present European War on the Metal Industries."

Elwood Haynes, Haynes Stellite Works—"Stellite."

Prof. D. J. Demarest, Ohio State University—"Analysis of Babbitt Metals."

Observations on Drop Forging Production Practice*

By A. B. Tilton**

The subject matter of this paper traces in a racy and general way the present day development of the drop forging industry. Particular prominence is given to the die feature, to the variety of forging material tonnage and the fact that in recent years many lines of forgings have been standardized as regards size and style by different manufacturers.

HAMMERING or forging hot bars of metal into shape is among the oldest of the crafts. The work for hundreds of years was entirely performed by hand, and, though a marvellous degree of skill was acquired, there appears to have been but slight change in methods; indeed, most of them are still in force where hand work alone is practised.

A departure from the old ways naturally could not occur until the need demanded it and a means for satisfying it appeared. These came during the middle of the last century when the swage of the blacksmith was developed into a form of forging die and the early type of drop hammer was devised. The history of the drop forging industry lies well within this period of about seventy-five years, though by far the greatest improvements both in the machinery and practices have been made during the last twenty-five years.

The making of forging dies is almost as much of an art as it is a trade, and, except for merely elementary features, no fixed rules can be laid down for the work. In the early days of the industry there were but few mechanics, however well skilled otherwise, who could make drop forging dies successfully without a considerable period of actual practice in the work. This condition operated somewhat to retard the development for a number of years.

The Die Feature.

The making of the dies is a feature of first importance in the production of drop forgings. Each design or piece has to be given individual attention in its construction to promote ease of operation, free motion in the metal while forging, and accuracy in forms and dimensions. To permit the easy removal of the forgings from the dies a draft of seven degrees is usually allowed on the sides or vertical dimensions, although in some shapes this may be more or less than seven degrees. Ordinarily this draft is added, but where the forging is not to be finished to any particular dimension, or if the metal could be spared at that point, it is sometimes taken off. The allowance for shrinking is usually three-sixteenths of an inch to the foot, but practices vary in different shops.

For economical reasons dies are sometimes made with only a single forging impression, which reduces the first cost of the tools to a moderate extent, but the forcing of the hot metal into its final shape without any preliminary operation may sometimes result most unsatisfactorily, since it is liable to create or add to any strains that may have existed in the bar and thereby establish a centre for crystallization when the forgings are in use. By making the dies with at least two impressions, one being merely auxiliary and the other to give a final shape to the piece, the liability of any additional strains is diminished; furthermore the life of the dies is increased.

For the making of plainer pieces one set of dies is usually sufficient, but in many of the more complicated forms, such as crank shafts having three or more throws set at other than straight angles, two or more sets of dies are required, one for each separate operation. Frequently the intermediate operations may be performed in the press, which is normally an auxiliary of the drop hammer, or it may be desirable to resort to first principles and require the assistance of the blacksmith, who is yet, and probably always will be, a very important factor in the working of wrought metals.

The variety of shapes which it is possible to make by this process is almost unlimited, although some would require so many operations as to make the cost prohibitive. Where such are required, however, in large quantities this difficulty may be overcome in a measure, even though three or more operations may be required to produce them. Very thin pieces or those that are thin with heavier sections at intervals, are among the difficult shapes to produce because of the rapid cooling of the thin parts in the dies which prevents the reduction to size without reheating. Such pieces would, therefore, be more expensive than those of equal weight, but more regular in outline and of greater thickness. By far the greater number of shapes in drop forgings are, however, of such thickness and general proportion as to be quite easily handled, and those just mentioned would perhaps be more properly regarded as exceptional.

Forging Temperature.

As nearly as possible it is desirable to make steel forgings at a uniform temperature, which is about 1,800 degrees, except for tool steel, where it should be much lower at the beginning of the operation, but, as the blows or strokes of the hammer are not ordinarily sufficiently rapid to maintain the heat, the finishing stroke is made at a slightly lower temperature, and, as this temperature varies at the finish, so will the shrinkage in the cooling process of the forging also vary, the allowance for this in the dies being constant. A further variation may be expected occasionally to a smaller extent, though hardly perceptible in the matching of the dies, which, however accurately set in the hammer will vary slightly in the fall, due to the necessary play in the hammer head between the ways. These are almost negligible; however, they should be considered in the construction of jigs for the finishing work. Where uniformity of contour is essential, it is customary to obtain this by re-striking the forgings after the trimming operation in sizing dies, especially on the smaller sizes of forgings. Generally this re-striking operation is done cold, though occasionally at a low heat.

Drop Forging Tonnage.

The greatest tonnage in drop forgings is in the carbon steels, and principally those below forty points in carbon content. The proportion of tool steel forgings used in the construction of various implements and tools is very slight, but may be properly classed among the carbon steels, though high-speed steels also form a feature of the drop forging product. The growth of the automobile industry has called into use a variety of alloy steels for parts where resistance to vibration is necessary, and forgings made of nickel steel, chrome nickel, and vanadium steel now form a very large part of the product of many drop forging plants. These alloys, besides resisting vibration to a great degree, also furnish when properly heat-treated the remarkable wearing qualities so highly desirable in gears and similar parts. Copper and bronze forgings are also a considerable feature of the drop forging product, though these are restricted chiefly to electrical work and where resistance to corrosion is necessary.

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*From a paper read at the National Machine Tool Builders' Association Convention, Atlantic City, May 20-21.

**President, Drop Forging Co. of New York.

Within recent years many lines of forgings have been standardized with respect to size and style, so that they may be obtained from manufacturers without the need or expense of special forging dies to produce them. The larger part, however, of the drop forging produce consists of forgings made to customers' individual designs. In most lines of manufacture methods are somewhat uniform, but in the drop forging industry there is much difference in methods, due perhaps to the latitude within which it is possible to work and accomplish the same results.

LARGE STEEL CASTINGS FROM SMALL CONVERTERS.

ARRANGEMENTS whereby large steel castings are secured from small converters is in operation at the Fonderia Milanesia di Acciaio at Milan, Italy. In 1894 several castings up to 6 tons in weight were made, a mixer being used, and since then the weight has been increased to 25 tons, a larger mixer having been built. Experience has shown that the quality of the steel is greatly improved by its long holding. Purification takes place similar to that noticed in the case of pig-iron mixers. Recently castings of 30 tons have been made weighing 45 tons with the casting heads. More steel than this must be made, due to a possible skulling in the mixers during the long wait.

The steel-making capacity consists of three 1-ton converters, two open-hearth furnaces of 3 to 4 tons, one open-hearth furnace of 6 tons (at the most 8 tons), and a Stassano electric furnace holding about 1 ton. Only one converter can be blown at a time, owing to insufficient blast, so that as fast as one is turned down another is turned up. Also, only two open-hearths can be run together. There are two mixers, one holding 15 and the other 20 tons. The converters were blown for four hours, and in that time made 40 tons; one open-hearth furnace 8 tons, another 5 tons, and the electric furnace 1 ton—altogether 53 tons. This large excess of 8 tons was to counterbalance skulls in the mixers, which amounted to 6 tons. The steel, nevertheless, cast all right. We are informed, says Page's Weekly, that 34 tons of steel were blown and 4 and 7 tons respectively were obtained from two open-hearth furnaces. No skull was left in the mixers.

The cupola charge for the converters consisted of 50 per cent. hematite with very high silicon, and 50 per cent. steel scrap with 0.2 per cent. silicon. The castings were annealed by building a furnace around them in which a coke fire was used.

THE LATE THOMAS D. WEST.

THOMAS D. WEST, for many years one of the most widely known men in the foundry trade in the United States and a high authority on foundry practice, died at Glenville Hospital, Cleveland, Ohio, June 18, from injuries received by being struck by an automobile on the previous day. He was 64 years of age. As chairman of the board of directors of the West Steel Casting Company, Cleveland, he actively co-operated with his son, Ralph D. West, president of the company, but for several years had spent much of his time in promoting safety work in foundries and in other efforts for the benefit of foundrymen and their employees.

Mr. West was born in Manchester, England. At the age of 12 he started to

THE LATE THOMAS DYSON WEST.

learn iron founding at the plant of the Portland Locomotive Company, Portland, Maine. In 1887 he organized the Thomas D. West Foundry Company, Sharpsville, Pa., now known as the Valley Mold & Iron Company, maker of ingot molds. He was vice-president and shop manager from its organization until 1909. He organized the West Steel Casting Company, Cleveland, in 1907.

Mr. West was president of the American Foundrymen's Association in 1905 and 1906, and was an honorary member of that association as well as of the Pittsburg, Philadelphia, and other associations of foundrymen. He was also a member of the American Society of Mechanical Engineers, the American Society for Testing Materials, and several other mechanical and scientific societies. He was author of "American Foundry Practice," "Molders' Text Book," "Metallurgy of Cast Iron," "The Competent Life," "Accidents: Their Cause and Remedies," and a large number of technical papers for engineering and foundrymen's associations. Two of his works have been translated into French and German.

"TNT." PRODUCTION IN CANADA.

THE report that the Minister of Militia has inspected the plant for the manufacture of trinitrotoluol, erected for the Dominion Steel Corporation, and the statement by the president of the corporation, J. H. Plummer, that the first lot of "TNT" has been completed to the satisfaction of the War Office representatives, mark an important step in the Canadian manufacture of munitions of war.

That "TNT" should be made in Canada is due to the persistent efforts of Mr. Plummer, and the soundness of his judgment in entrusting the contract for the nitration of the company's toluol to a Canadian concern is justified by the fact that, while the best English houses asked for five to six months to put up the necessary plant, the Canadian firm completed the work in two months. The benzol plant at Sydney, at which the first step in the process is taken, was erected in less than two months, and, taking the two plants together, the enterprise shows what can be accomplished in Canada when the need exists. It is a little over three months since the first contract was given to the Steel Company for toluol, and not over two months since the contract was extended to cover trinitrotoluol, and the delivery of finished "TNT" already by the Steel Company is creditable to all concerned.

It is due to Mr. Plummer that the supply of toluol available at the Algoma Steel Corporation by-product plant at Sault Ste. Marie is also to be utilized. The plant has been erected under his auspices, and, through his efforts it will be ready during the present month.

Canada's Metal Production.—Last year Canada produced metal and metallic ores valued at $58,870,000. Copper contributed 75,000,000 pounds at an average price of 13½ cents; gold, 770,000 ounces, valued at $15,925,000; lead, 36,000,000 pounds at 4½ cents; nickel, 45,000,000 at 30 cents a pound; silver, 27,500,000 ounces at 54.8 cents; and zinc ore, 13,000 tons, valued at $310,000. The war has affected metals in various ways. Copper is now selling at 20 cents a pound, nickel about 50 cents a pound, while lead and zinc also show advances in price. The only exception to the general increase is silver, which is now selling about 5 cents an ounce less than last year. It is estimated, however, that the heavy demand for munitions means $20,000,000 to Canada's mine owners.

EDITORIAL CORRESPONDENCE

Embracing the Further Discussion of Previously Published Articles, Inquiries for General Information, Observations and Suggestions. Your Co-operation is Invited

THE USE OF FLUX IN THE BRASS FOUNDRY.

By R. Micks.

THE intelligent use of flux in melting brass and other alloys has been proven beyond doubt to be a great help to foundrymen in producing sound castings from the different alloys, and, while in some foundries the flux question is overdone, there are still some brass founders who do not seem to see the advantage of using a flux when melting their metals. The experience of experts along these lines has shown very clearly that the right flux for the right metal when it is used at the proper time in the melting will not only produce better castings, but will also save metal.

Copper.

Good sound castings cannot be produced from copper when it is melted alone, and more chemicals have been tried and more different fluxes proposed for this metal than for any other used in making alloys. The difficulties of securing sound copper castings are due to oxygen-nitrogen and oxygen containing gases, and to overcome this trouble, it is necessary to use a flux or deoxidizing agent.

The flux now generally acknowledged as the best for copper is boron sub-oxide. This flux has a high affinity for these gases, but no affinity for copper. Potassium-ferro-cyanide has also been found to give good results as a flux for copper. Many foundrymen prefer, however, to use deoxidizing agents, such as silicon-copper-magnesium, phosphorus, etc.

Brass and Bronze.

For brass and bronze, common salt is almost universally used as a flux, and some founders claim to have got the best results with rock salt. The action of salt on these metals is that it forms a protective coating and prevents oxide of copper from forming. To obtain the best results from salt as a flux, it should be added when the first metal in the crucible begins to melt, a handful to the ordinary crucible being sufficient. The brass founder will find that, although cheap, salt will improve the quality of his castings whether he is using new metal or scrap. The metals should be kept well covered with charcoal during the melting process.

Aluminum.

For years, aluminum was melted without a flux or covering, as charcoal, on account of the lightness of aluminum, was almost sure to become mixed with the metal and cause black spots in the castings. Chloride of zinc has proved to be the most valuable flux for aluminum. The action of this flux when used on aluminum is that the zinc combines with the oxygen, which is taken up from the aluminum oxide, and forms zinc oxide. This is then skimmed off, together with the aluminum chloride, which is also formed in the reaction, when the flux is added. A piece of chloride of zinc the size of a walnut is sufficient for 50 lbs. of melted aluminum, and when dropped on the thick mass of dross, covering the surface of the melted aluminum, it will be quickly cleared. The metal should next be stirred, after which its surface will be found perfectly clear. Good, clean castings will be produced, but care should be taken not to raise the temperature any higher than is necessary, as melted aluminum should be protected from the air as much as possible.

Nickel.

The flux used for nickel, and the one that has given the best results, is a mixture of lime and fluor-spar, composed of 3 parts lime and 1 part fluor-spar. The lime should be slake, and it should be mixed with the fluor-spar and then be allowed to become solid, when it can be broken into small pieces for use. While fluor-spar alone acts all right as a flux for nickel, it attacks the crucible, affecting the clay in the crucible mixture in such a manner as to dissolve it, then as nothing but the graphite remains, the crucible goes to pieces when grasped by the tongs. Although the lime counteracts the action of the fluor-spar on the crucibles to a certain extent, they very seldom last more than five or six heats in melting nickel.

Turnings, Washings, Grindings, Etc.

As a flux for melting turnings, washing and grindings, nothing excels plaster of paris, it being not only a first-class flux for this purpose, but also having the advantage of being very cheap. Its main feature as a flux in melting these materials is that it dissolves all foreign matter that may be present in the form of sand, oxide, or slag. It melts quickly and forms a liquid slag, and has no bad effects on the crucible. About five pounds of Plaster of Paris mixed with a crucible full of turnings, washings, grindings, etc., should give desirable results. The metal should be allowed to melt in the usual manner, and if the slag is not fluid enough at the conclusion of the melt, more plaster of paris should be added. When the metal is ready to pour, do not attempt to skim, as the slag will rise to the top when the metal is poured into the ingot moulds, and when they are cool the slag of the plaster of paris can easily be detached by a few blows from a hammer.

FACULTY OF SPOTTING PLANT IMPROVEMENTS.

By James E. Cooley.

WE are spoken of as "creatures of habits." In repeating certain acts, in time we become sprinkled with a blindness, so that we do not realize when we are doing these things, and why we are doing them; we become unconscious of the real motive behind our efforts. This is plainly what is called "being in a rut." We cannot see and will not see until circumstances or someone points the way out for us.

Opportunity Always Present.

No person, no place, or institution escapes from this peculiar lethargic state, and the machine shop is included in the list. Where so much depends on saving time and reducing costs, it is hardly believable, until we are shown the facts, how many foolish and wasteful acts are done in the course of one's daily labor. A stranger looking in at the shop windows will see many things, and wonder why they are done. The fact of the matter is that while one can see easily enough from without, none apparently can see from within. It is only as we step outside that we can see inside a circle.

Repitition, doing the same things over and over, has the effect of deadening the brain's activity, and lessening the power of being able to think along new lines. If we study rut-making conditions we will become gradually enlightened and see the necessity of periodically changing the regular order of the things we do, for the mere sake of keeping clear of getting in a rut.

Being Alert to Opportunity.

There is no known method of advancing except by watching for opportunities to improve things. The reason why we do not go ahead and do things is because the impressions we receive do not go in deep enough to affect us, to stir us up to act; even having started something, we soon lose sight of the object we strive for. We adopt means for certain ends, then reverse the order so to speak, shift the thing around and preserve and uphold the means regardless of what the ends are. We become sprinkled with a blindness or what is the same thing, we enter into a state of "forgetfulness." The trouble is as before stated, our impressions do not get in deep enough, so that we wont' forget, so that we will remember what we are doing and why we are doing it. If we can get this fact strongly enough imbedded in our minds we seldom will get into a rut, or getting there, will know when is the opportune time to jump out.

Typical Examples.

A few cases are here cited to show what this rut-evil really is. A machine for grinding was bought and installed in a corner of a room by itself. In order to keep the machine clean and free from dust when not in use, a few yards of cloth were bought to cover it entirely. When workmen desired to use the machine they would pull off the cloth, double it up any old way and toss it on the bench, regardless of whether the bench was clean or not. When their job was finished they would throw back the cloth on the machine, without noting which was the top or dirt-covered side of the cloth. In time the cloth became soiled on both sides, and as much dirt was placed on the machine as was kept off. This repetition of removing and replacing the cloth was kept up for years.

If a "notice" had been put up stating what the cloth was for, which side was to be placed over the machine, and that it was to be taken off carefully and folded, the machine-users might have received a deep enough impression of their duties. One would think, however, that common sense was sufficient to indicate the proper thing to do in a matter of this kind without the aid of printed instructions. No, we can never depend on suppositions. While no great amount of profit was lost in this practice, it was a foolish action each time it was repeated.

A certain section of a factory was set apart for making up small shipments. Under a work-bench was placed several kegs of nails, one behind the other. Each time the packer wanted nails he had to reach down and rummage in the several kegs before he could find the size nails required. It would seem that the waste of this time, and constantly running into this inconvenience would have brought some enlightenment to the workman to the end that it would have led him to have the kegs placed on a bench purposely made, and have each size or sample of nail placed on the outside of each keg. This idea failed to materialize, however, as similar ideas fail to come to us. This inconvenience would never be discovered, and this and other wasteful methods of doing things would never be found out, unless a systematic study of each detail connected with machine-shop work was carried out.

A sweeper was given a long handle brush to sweep the floor of a room containing special machinery, so as not to raise too much dust. When he was through with it he stood it up against a post in the room. The sweeper left, other sweepers came after him, and each one who used that brush placed it back in the same identical place against the post. Workmen walking near it knocked the brush down, then picked it up again, and as many times as that long handle brush was used, and, as many times as it was knocked to the floor, it never occured to anyone to plug a hole in the end of the handle, loop a string through it and hang it to a peg.

Criticism Beneficial.

The reason why we act, why we make changes, is because someone suggests the idea to us to do so, otherwise we never make the effort. We need criticisms as well as suggestions, we need a lot of them, but we are dependent on one another for them, we have got to "see" for each other. Throughout each factory there are useless and wasteful practices blindly and thoughtlessly followed. Each detail needs to be carefully looked into. Disorder is found in the way some things are kept, and things are done that should never be done as they are. For example, crowbars and skid-rolls are kept in a corner or behind a door where they tumble down and workmen stumble over them. An upright-bin, sectioned off, should be built, and these materials placed in it. Again, a helper shovels up the cast-iron chips from under machines and pans into an open box, causing clouds of dust to fly upward, which gets into the belts and bearings and settles on everything. The box should be covered over, having an opening sufficient for the shovel to enter and thus keep the dust down.

Systematic Study of Detail.

Several changes such as these are required in many factories. The need only, is to develop the faculty to see them. This is best acquired by systematically studying each detail and improving it.

HABIT.

SOURCE of about three-quarters of all human actions, time saver and thought saver, best of slaves and worst of masters—that is Habit. The strength of it is beyond the realization of the people who are the most dependent upon it, and its danger is as great as its value, according to the character of the habits themselves.

A reflective friend of ours has occasion to pass through a certain street every evening at seven o'clock. He says that every night he meets the same people, four or five of them, doing the regular things, so that he looks forward to seeing them, and he is never disappointed.

There is a man who always runs for the seven o'clock car, when he might as easily catch it if he changed his habit of leaving at the last minute to one of leaving the moment before. Then there is the man who drops in regularly at the corner saloon, not because he particularly needs a drink, but because he has done it regularly for some time, and it's easier to do it than stop it. Again, there is a family at dinner he sees as he passes, and the boss is always in his shirt-sleeves, although it is no longer hot weather. You see. he is simply dining with his wife, and he has the habit of doing it this way, and she never gets used to it. She knows better, however, than to try to change his lordship.

Those are some of the habits our reflective friend runs into as he walks through the street nightly. It leads him to make up his mind that if habits are so infernally powerful, how much easier life is to a man who forms them along the right lines. "For," says our friend, "you might as well get the habit of doing it right as of doing it wrong—it's exactly as easy once you get it going. It pays—it's good business, and the habits of punctuality, neatness, courtesy, patience, and a hundred or so more, are so important to life that men call them virtues. However, they are habits, just the same."—Drill Chips.

A RESULT OF SHELL-MAKING IN CANADA.

APART from the immediate benefits accruing, the growth of the shell business is regarded by many business men as one of the most important developments of its kind that has yet taken place in industrial Canada. Their view is this—that it has shaken a big industry, steel and its allied branches, out of a rut; stimulated inventive qualities in the mills and compelled the development of adaptability to changing conditions.

When the shell business ceases with the end of the war, it is argued that manufacturers will be less ready to throw up their hands, because business along the old lines had ceased, as they did in many cases last summer, and will be alert for new opportunities. The high praise that has been bestowed on the Canadian shell makers by the Imperial Government is proof that adaptability and efficiency of a high order existed, but that initiative was to some extent lacking.

PROGRESS IN NEW EQUIPMENT

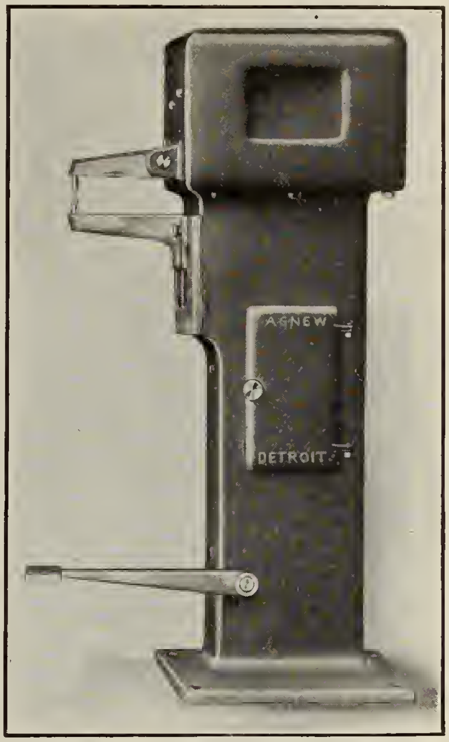
A Record of New and Improved Machinery and Accessories for the Pattern, Boiler and Blacksmith Shops, Planing Mill, Foundry and Power Plant

MULTIPLE BAR SAW.

THE manufacture of shrapnel and high explosive shells has been responsible for an extraordinary display of ingenuity in the matter of production methods and devices applicable to standard equipment. No less true is it that relative to special purpose machine tools, there has been an equivalent degree of achievement. In the operation of sawing the shell billets to length from the steel bars as received from the mill, the illustration shows one of seven Espen-Lucas Machine Works, Philadelphia, saws installed at the plants of the Steel Co., of Canada, Hamilton, Ont.

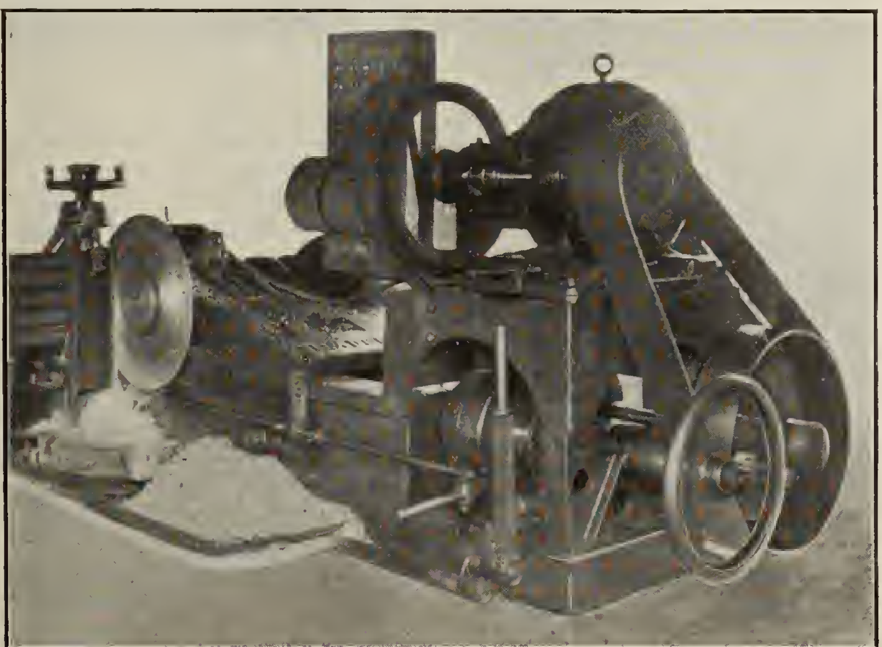
These machines are very heavily constructed, and with a Westinghouse back geared motor drive, a periphery speed of 30 feet per minute is got at the saw, as well as sufficient power to carry any reasonable feed per minute. This combination is a very desirable one from the standpoint of the life of saws. The machine is equipped with multi-bar holding jigs, holding five bars at one time, the bars beng jigged in circular form, so that the time of cutting one piece really covers the time of cutting all of the five.

The saw blades are of vanadium steel, and the saw teeth of the best high speed steel. All the bearings on the machine are bushed with bronze, while all steel parts are made of high carbon forgings. The feeds are variable and automatic, and are furnished with automatic throwout, which disengages the feed at any predetermined point. Automatic quick



NO. 10-D SPOT WELDER.

return withdraws the saw blade on completion of cut, and all operating levers are located conveniently at one point. The saws range from 30 in to 34 in.



MOTOR DRIVEN MULTIPLE BAR SAW.

diameter according to the size of the work, and the weight of the machine shown runs to about 16,000 pounds.

ELECTRIC SPOT AND BUTT WELDING MACHINES.

IN the new line of electric welders recently brought out by the Agnew Electric Welder Co., Detroit, Mich., the most important are two spot welders and a butt welding machine. A feature of both spot welding machines is that the worknig points are water cooled by hose and pipe inside the machine underneath the transformer. The high-tension wires are also housed inside the frame so that accidental contact with them is impossible. The regulating panel is inside the frame, access to it being through the door on the side of the frame. All working parts of both types are accessible and designed for hard service.

The 10-D Spot Welder.

The smaller or 10-D machine is of the pivoted type, and is equipped with a foot lever which automatically applies the current, the operator having free use of both hands. A regulating switch for welding any thickness of metal within its capacity of No. 18 or 14 gauge steel is provided. The depth of the throat is $10\frac{1}{2}$ in.; the adjustment of the lower horn, 6 in.; height from floor to work points, 41 in., and transformer capacity, $12\frac{1}{2}$ kw. This machine will make 500 welds on No. 18 gauge; 900 on No. 22 gauge; 1,500 on No. 26 gauge, and 3,000 on No. 30 gauge steel with a current consumption of 1 kw.-hr.

The 20-D Spot Welder.

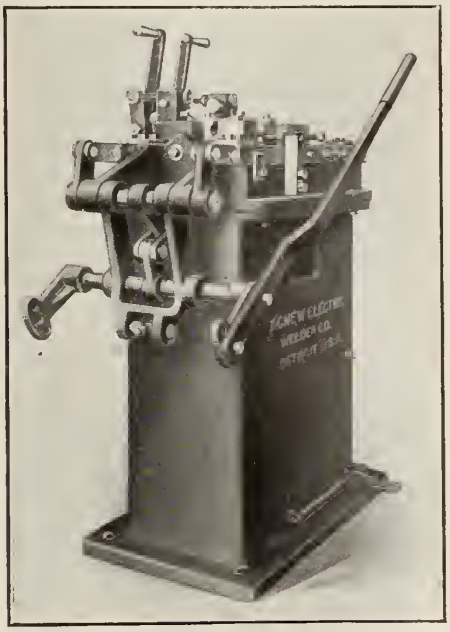
The larger type of spot welding machine, the 20-D, has an adjustable horn, so that, with the use of a long point, welds can be made at the bottom of deep cylinders, battery and tool boxes, etc., and the horn is arranged so that any kind of attachment can be put on it for welding on the inside of odd shaped pieces. In this machine the up and down movement of the upper electrode is secured by toggle joints. It is regularly equipped with a foot lever which automatically applies the current, but a hand lever may be attached if desired. Regulation is provided so that metal of light thickness may be welded without danger of burning. The transformer is designed for continuous and rapid service up to its capacity without overheating. Its welding capacity is No. 10 gauge steel and lighter. It is made in four sizes with depths of throat of 18, 24, 36 and 48 in. The adjustment of the horn is 10 in. and the height from the floor to the

NO. 20-D SPOT WELDER.

working points is 40 in. The transformer capacity is 20 kw. The machine will make 160 welds on No. 10 gauge steel; 350 on No. 16 gauge; 900 in No. 22 and 2,250 welds on No. 28 gauge steel with a 1-kw.-hr. current consumption.

The 20-C Butt Welder.

The butt welding machine, designated as the 20-C, has a number of special features including an extended movable rear carriage which is pulled against the work instead of being pushed, to prevent any tendency of the work to buckle under heavy pressure. The carriage slides in ways located at the front and rear of the opening. The extended movable carriage adds to the rigidity and allows the bearings to be located so that particles of chilled metal cannot get to them and cut the bearings. The movable carriage is gibbed to take up the wear. The forward carriage is adjustable vertically and crosswise, making it unnecessary to shim or remachine this to correct alignment. The necessary pressure is applied by a vertical lever operating a compound toggle movement that is adjustable to secure the greatest leverage at any desired position of the carriage.



NO. 20-C BUTT WELDER.

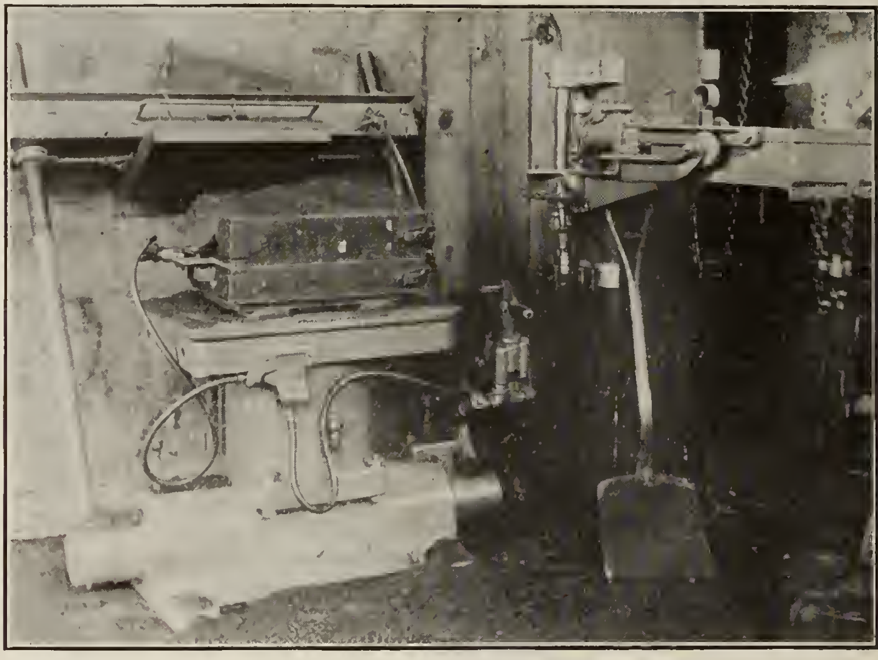
A second lever is attached on the rear, and the machine is operated by two men, avoiding the necessity of using a hydraulic ram on heavy work. It is equipped with clamps for welding either rounds or flats. A current regulator and water-cooled dies form a part of the equipment. The machine illustrated has a welding capacity of ½ to 1¼ in. rounds or ⅛ x 7-in. flats. The stroke of the carriage is 4 in. and the carriage opens 4½ in. The height from the floor to centre of work is 42 in.; the floor space is 22 x 34 in., and the transformer capacity is 30 kw. This machine will make 11 welds on 1¼-in.; 18 welds on 1-in.; 38 welds on ¾-in., and 135 welds on ½ in. round bars with a current consumption of 1 kw.-hr. It is also built on three other sizes, two smaller and one larger.

PNEUMATIC SIFTER FOR MOLDING MACHINES.

MOLDING machine users will doubtless be interested in this latest type of pneumatic sifter. It swings on a vertical shaft, which is held in brackets fastened to a wall or post, and is furnished with an automatic valve which admits air to the cylinder for starting the machine as it swings into place over the flask, and cuts off the air when swung back out of the way, this operation being almost involuntary on the part of the molder.

The screen box is rectangular in shape and arranged so that screens of different meshes can be used. The wire cloth is slipped into a space between two angles and securely held in place by a cap screw and washer in front of the screen box, thus providing an easy means for changing the screen. It can be dumped and cleared of the coarse material by lifting one end off the frame, while the other end swings on two bolts. When in operation, the loose end of the box is held in place by a spring catch.

This shaker will be found convenient for applying facing sand, the screen box containing enough sand for several molds, thereby avoiding the fatigue incident to lifting the full riddle above the flask for each mold when riddling by hand. The machine is furnished with screen box, either 9 in. wide by 12 in. long, 12 in. wide by 14 in. long, or with screen holder to accommodate an 18-in. riddle. The Hanna Engineering Works, Chicago, Illinois, are the manufacturers.



PNEUMATIC SIFTER SHOWN DRAWN BACK, READY TO SQUEEZE MOLD.

HARDNESS TEST OF SHRAPNEL SHELLS.

NOT the least important of the many operations which have to be performed in order to produce high quality shrapnel shells is that of "testing for hardness." A narrow strip round the body of the shell near the band groove is first polished, after which the shell is taken to the scleroscope. This apparatus consists of a vertical glass tube with an arrangement at the top for drawing up the steel hammer in the tube and a catch for holding the hammer until released. This part of the apparatus is operated by a rubber air bulb. At the back of the tube is a scale on which are figures which bear relation to the hardness of specific metals.

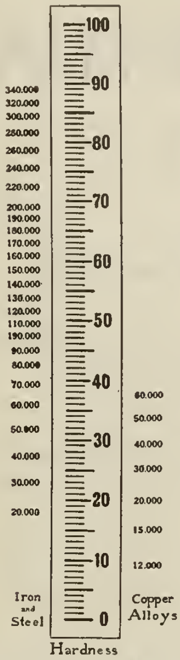
The shell is placed in a grooved block under the scleroscope and the diamond pointed steel hammer allowed to drop on the polished part of shell. The hammer rebounds and the figure at which it stops is noted by the operator. This is repeated several times, the shell being moved round each time. The hardness required of shrapnel shells must be around 45, a slight variation above or below being allowable.

TESTING SHELLS FOR HARDNESS WITH "SHORE" SCLEROSCOPE.

The shell must not rupture at the point tested when its contained charge is exploded nor when the charge in the case is set off. Should the shell upset near the rifling band groove when being propelled out of the gun, it would of course destroy the rifling of the latter.

Experience with the scleroscope has disclosed the existence of a definite relation between the hardness and strength of metal. In determining the strength of metal, two stages are recognized: First, the elastic limit, yield point or load required to start a permanent set; second, the ultimate strength or load required to terminate permanent elongation and reduction of area in rupture.

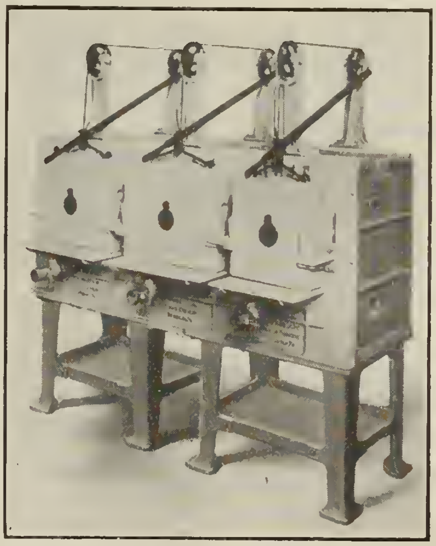
The hardness indicated by the scleroscope is intimately related to the elastic limit, as shown by the scale cut. The elastic limit increases more rapidly than the hardness from 43 to 45, this being the minimum index of the strength value required. As an elongation of 8 per cent. in 2 inches is also called for, there must necessarily be an upper limit to the hardness. On the steel used for shrapnel which is generally about 50-point carbon, 70-point manganese, the maximum hardness should not be over 60 on the scleroscope.



ELASTIC LIMITS (TENSILE) SYMBOLIZED BY THE SCLEROSCOPE HARDNESS UNITS.

THREE-CHAMBER DIE-HARDENING FURNACE.

THE description and illustration refer to a three-chamber die-hardening furnace manufactured by Tate-Jones & Co., Pittsburg, Pa. It consists of three distinct separate chambers, two of which are 18 in. wide, 18 in. deep, and 10 in. high. The third chamber is 12 in. wide, 18 in. deep, and 10 in. high. Each has a separate combustion chamber located underneath and separated by a fire brick slab, the heat passing from the combustion chamber through long narrow slots at the sides of this slab into the heating chamber, giving a furnace of semi-muffle construction. Each chamber is fired independently by natural gas or fuel oil burner. Compactness is a feature of the arrangement, and for die work, where long soaking preheating heats are desired before bringing up to the final hardening temperature, special usefulness is claimed.



THREE-CHAMBER DIE-HARDENING FURNACE.

With this furnace, two chambers can be used for preheating and one chamber for hardening, or the three chambers can be used independently for entirely different work. A lever arm is fastened to the rear sheave bracket, and is attached with a suitable sliding arrangement to the lifting links on the door, so that the door can be readily raised and lowered by the movement of this lever. The counterweights for each door drop in the rear of the furnace.

SHRAPNEL SHELL EXPLOSIVES.

THE main propelling charge is invariably of smokeless powder; this is relatively difficult to ignite and a completely satisfactory primer has yet to be found. In every respect save that of smoke, black powder makes the best primer; Krupps use a special cloth woven from guncotton yarn. Most of the smoke produced by modern ammunition is due to combustion of particles abraded from copper driving band and is thus hardly avoidable. The mechanical form of the explosive differs in shells of various nationalities.

In American shrapnel, perforated cylindrical grains of nitro-cellulose (about ⅜ in. long by 3-16 diameter) are used. The advantage of perforation lies in greater burning area and more constant surface than that of interstices between cords or strips, so that regular ignition and complete combustion are obtained. On the other hand, unless pressed hard, perforated granules are liable to crush under the gas pressure developed.

German ammunition uses bundles of stick nitro-cellulose about 9 inches long. Cordite has been much used in our shells in the past, but now a crystalline explosive, similar to that in Russian shells, is generally employed. French strip powder (about ½ in. by 1-64 in.) is used in 6-inch lengths. For the bursting charge, black powder is always used, since it gives the right sort of impulse to the bullets and is not affected by the shock of firing the shell.—Engineering Review.

Concerning Shell Orders.—The Canadian Shell Committee have, we understand, advised all those engaged in making shells not to wait for formal orders in the future, but to go ahead and manufacture to capacity.

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A Monthly Technical Journal devoted to the Foundry and Metal Industries.

PETER BAIN, M.E., Editor.
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Vol. VI. JULY, 1915 No. 7

PRINCIPAL CONTENTS.

SHELLS AND GENERAL SUPPLIES FOR BRITAIN.

If we might judge by the activities of our engineering and metal-working plant managements relative to the further development of the manufacture of shrapnel and high explosive shells in their every and complete feature, there is abundant evidence that if someone has not blundered, at least dissatisfaction over the paucity and scope of the orders placed exists. It has long since been proved that we can produce shells of first quality and in quantity ad lib, but, being now informed that our efforts lack all merit because only "empty" shells have been made, we naturally get up in arms to defend ourselves and at the same time give indication of both claiming and demanding the opportunity to produce shells with "fixed ammunition" and of earning the accruing merit by our handiwork.

Little compliment has been paid our engineering establishments during all these months of war in that no notice seems to have been taken in official circles of how they grasped and made a huge success of this shell forging and machining business. What was accomplished in this respect many months ago is as yet being only partly realized—much less appreciated officially, and little wonder is it that being fully aware of the call and necessity for "Shells, and Shells, Then More Shells," our leading metal-working plant managements have banded themselves together to "press their suit" without the official aid which was their right to expect, but their misfortune to lean too implicitly upon.

The concentration of effort indicated gives but concrete expression to a gradually developed necessity relative to shell manufacture in our Dominion. The steps already taken to establish and equip plants for the supply of "fixed ammunition" may be taken as a result of the initiative of our plant managements and their staffs. Arrangements are, we understand, now proceeding smoothly and satisfactorily with respect to the provision of fixed ammunition for the various sizes and types of shells being manufactured in Canada, and within the next two months it is expected that the various plants devoted to this feature will be in a position to cope with the output of what are known as "empty shells."

Some half dozen concerns are either equipping or are getting close to production stage relative to the manufacture of brass cartridge cases, and in the matter of the explosive charges, time fuses and detonators, the necessary arrangements have also been made. Much of course is expected from the coming interviews between Mr. Thomas—the accredited representative of Britain's Minister of Munitions, and our Shell Committee, and not the least important movement in the direction of fuller shell making opportunity is that which seeks to have our manufacturers' committee form a unit at the various conference sessions.

Further to the purchase of supplies for the British forces at home and on the European continent, it may be stated that a department for the purpose is now organized and operative in room 114, the Windsor Street Station Block, Montreal. Edward FitzGerald, assistant general purchasing agent of the C.P.R., has been deputed by Sir Thomas Shaughnessy to take charge of this special work. The supplies requirements will, of course, be both varied and numerous, and will in many instances reach to considerable proportions. Manufacturers of such commodities as are being used both on service and for consumption are invited to furnish particulars of their products, which should include prices, degrees of quality, quantities available, procurable and produceable on short notice. Shells, remounts and fodder do not come within the scope of the departmental activities.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

ECONOMY AND EFFICIENCY OF COPPER CYANIDE.*

By C. H. Proctor.

IN the past, copper solutions have been prepared with various materials. The majority of platers used so-called copper carbonate, which is in reality a sub-sulphate of copper, the metal contents of which vary from 45 to 52 per cent. Some platers are still preparing solutions with copper acetate, which tests in the neighborhood of 30 per cent. copper, and others are using cupri-cupro sulphite of copper, which is known in the market as red copper compound, testing about 40 per cent. copper.

Expensive Procedure.

Although the plater knew that of these materials the metal was the only ingredient of value to him, still he was forced to use such impure salts. He, of necessity, had to add about 50 per cent. of inert matter when using the so-called copper carbonate, 60 per cent. when using cupri-cupro sulphite of copper, and 69 per cent. when introducing acetate of copper. You can readily appreciate that, after a few additions of metal salts, the bath became filled with these inert salts and impurities, increasing the density of the bath to such an alarming proportion as to necessitate the dilution of the solution and finally the discarding of the plating bath. The plater realized that this was a most expensive operation, and has therefore looked for a material free from impurities which would make this waste unnecessary.

The silver plating industry first realized the enormity of this waste and silver cyanide has been used in the large silver plating establishments for the past generation or two, having displaced silver chloride and silver nitrate. The platers of copper, brass and bronze who had to deal with base metals have not given this wasteful practice the consideration it deserved, but as the plating of brass and copper is assuming such large proportions, the plater has been forced to give this matter his attention.

Every plater knows that no matter what copper salt is used in a cyanide solution, it must first be converted into a copper cyanide and then cut down with sodium cyanide to form the double sodium copper cyanide. He has endeavored to secure a chemically pure copper cyanide, as with such a material he would introduce into his bath only the active ingredients necessary for results, that is, metal and cyanide, and at the same time eliminate one operation—the conversion of the carbonates, etc., into copper cyanide.

Copper Cyanide Not New.

Copper cyanide is nothing new. It has been available for years, but unfortunately it could only be obtained at a price which made its use prohibitive. The plater has had to continue the use of impure salts. He has had to continue clogging up his solutions with dead salts, which, while they gave results for the time being, forced him to discard, or at least partially discard, the baths when they became too dense. Every plater knows that a dense solution is harder to manipulate and control, and that it requires more current to get a satisfactory deposit. He has had to contend with an unknown factor, the nature of which he had no way of determining. Recently, however, copper cyanide has been put on the market at a price which not only makes its use possible, but which actually results in a decided saving in chemical costs.

Copper Cyanide Chemically Pure.

Chemically pure copper cyanide, testing 70 per cent. copper, the balance of 30 per cent. being pure cyanogen, is now at the disposal of the plater. He knows that with such a chemically pure salt a solution can be made up which will contain only that which is necessary for results, and knowing this, the solution can be controlled with absolute certainty. As the plater is constantly striving to better his conditions and put his plating department on a sounder basis, it will only be a matter of a comparatively short time when this high grade metal salt will entirely displace the copper salts heretofore used in cyanide solutions.

Why should a plater continue using so-called copper carbonate, which contains about 50 per cent. impurities and which must first be converted into a copper cyanide, when he can introduce chemically pure copper cyanide into his bath direct, especially when a solution made up with chemically pure materials can be controlled with absolute certainty? When the bath needs metal, the plater adds it in the form of copper cyanide, and when it requires cyanide, he adds it in the form of sodium cyanide. In other words he is now able to make up a solution which will give the best possible results in the shortest time and remain constant and well balanced.

Chemically Pure Material Solutions.

In the solutions which I will prepare, I will confine myself strictly to chemically pure materials. The copper bath will be prepared as follows:—

Water	5 ounces
Copper cyanide	15 ounces
Zinc cyanide	5 ounces
Sodium cyanide	15 ounces

I will prepare the brass solution according to the following recipe:

Water	5 ounces
Copper cyanide	15 ounces
Zinc cyanide	5 ounces
Sodium cyanide	20 ounces

Of course, by the elimination of the inert salts, the solution will be less dense, the copper solution standing about 3½ deg. Baume. In making up a copper bath I have only used 6 ounces of chemicals per gallon, while to make up a solution of the same metal contents with copper carbonate, I would have to use over 12½ ounces of material per gallon, thus increasing the density over 100 per cent. To make up a copper bath of five gallons to contain the same amount of metal as this solution contains, it would be necessary to use 21 ounces of copper carbonate. To put this in solution so as to obtain sufficient free cyanide for results it would require about 42 ounces of sodium cyanide.

Baume Scale Solution Test.

It is time that the practical electroplater discarded the Baume scale as a test for solutions, as any material that is soluble in water adds to the density of the bath and the Baume scale, therefore, does not give the plater any idea of the condition of his solution. With the constant addition of metal salts which contain large proportions of inert matter, the density will rapidly increase, while the solution may be practically void of metal. The plater must use chemically pure materials or else discard the Baume scale as an index to the condition of his bath.

*From the Bulletin published by Lewis Institute, Chicago.

AMERICAN ELECTRO-PLATERS' SOCIETY. TORONTO BRANCH.

Officers:

President—John A. Magill, 591 St. Clarens Ave., Toronto.

Vice-President—William Salmon, 48 Oak Street, Toronto.

Secretary—Ernest Coles, P.O. Box 5, Coleman, Ont.

Treasurer — Walter S. Barrows, 628 Dovercourt Road, Toronto.

PLACE AND DATES OF MEETING.

The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

Relative Cost.

The cost of the copper solution is 12 cents per gallon, while to make up a solution with the same metal content, using so-called copper carbonate, would cost the plater about 25 per cent. more. When we take into consideration that many plants operate thousands of gallons of solution, this economy is a considerable item. On the face of it the metal cyanides appear more expensive. The market price of copper cyanide is from 42 to 45 cents per pound, while the so-called copper carbonate is quoted at 14 cents per pound.

The plater must not lose track of the fact that copper carbonate or copper cyanide either, for that matter, has absolutely no value as such. It only becomes of value to him when put in solution with cyanide. It is here that the plater saves. He requires only about one-third the quantity of cyanide to put in solution a given amount of copper in the form of copper cyanide as compared with copper carbonate. For instance, the cost of one pound of copper cyanide (70 per cent. metallic copper) put in solution with sufficient free cyanide to obtain an immediate deposit is—

1 lb. copper cyanide, at 42c per lb. .	42c
1 lb. sodium cyanide, 29 per cent., at 22c. per lb.	22c
	.64c.

To put in solution the equivalent amount of metal in the form of so-called carbonate of copper, 50 per cent., you require—

1 lb. 6 ozs. copper carbonate at 14c. per lb.	19¼c.
2 lb. 12 ozs. sodium cyanide, 29 per cent., at 22c. per lb.	60½c
	79¾c

Current Density.

Another factor which must be considered is the current density. It is a well known fact that a dense solution requires a higher electrical pressure, as the inert matter from the metal salts acts as a retarding agent. Of course, the rapidity of the deposit is governed by the ampere law, which teaches us that the more amperes which can be carried upon a given surface the more rapid will be the deposit. The inert matter being eliminated by the use of the metal cyanides, the plater is able to increase the amperage about 25 per cent., and this enables him to reduce the time necessary for results, increasing the output accordingly. He, therefore, is able to turn out more work in a given time without increasing his tank area, which is another decided economy.

Neither copper carbonate nor copper cyanide as a single factor must be taken then as a basis of calculating their relative costs in the plating solution, but when we take the solution complete, ready for operation, as a basis, there can be no doubt that with chemically pure materials the plater not only obtains a solution of maximum efficiency, but is able to materially reduce the plating costs. Once this fact is brought home, it will be a comparatively short time when chemically pure metal cyanides will entirely displace the materials of doubtful purity formerly used.

Standard Solution.

The fact that all copper salts in a cyanide solution must first be changed to a copper cyanide simplifies matters greatly, as copper cyanide can be added to any copper cyanide solution, no matter what salt was originally used to install the bath in question. The plater has obtained results with materials which were at his disposal, but it was always with a degree of uncertainty as to how the bath would behave. This uncertainty is entirely removed once a plating solution is standardized, and this ideal condition can only be reached with the use of metal salts which are correct from a theoretical and practical standpoint, and it cannot be disputed that the only metal salts which answer these purposes are the metal cyanides.

CANADIAN GOVERNMENT PURCHASING COMMISSION.

The following gentlemen constitute the Commission appointed to make all purchases under the Dominion $100,000,000 war appropriation:—George Gault, Winnipeg; Henry Laporte, Montreal; A. E. Kemp, Toronto. Thomas Hilliard is secretary, and the commission headquarters are at Ottawa.

BRASS MELTING QUERY.

HAVING seen a few copies of your publication and noticing some questions and answers in same, I am taking the privilege of asking a question re some metal I am having trouble with. This metal (brass) has been put through a fireclay-lined gas retort with a view to obtaining it in large quantities, the composition being: copper 85, lead 10, tin 5. We lose a lot of metal due to its sticking to the lining and also to its coming out mixed with same. Could you suggest a way of getting this metal free of slag or lining? We have put it through crucibles, and some of the metal goes to the bottom all right; still the top of the crucible has a very tough and spongy material, hard to make an opening into to get our melted metal free to pour, and leaving a lot of it still in this mixture. We have a great quantity of this material on hand, and are anxious to get the trouble solved.

We have tried charcoal as a flux, also salt, but get no better results, and were thinking of smelting it same as iron, having rolled a shell 6 ft. long by 30 in., and have brick-lined it. Would you advise this process, and could you give us a dimensioned sketch for its development? We are supplying air by electric fan, and, for air passage around shell, make a recess in the brick lining, so as to not be bothered cleaning out air holes in a circular pipe. These few points are mentioned so that they can be enlarged upon.

Questions and Answers

Question.—Will you please furnish me with a formula for a Verde green, which may be produced easily with chemicals usually found in average plating room?

Answer.—Scratch brush the parts with brass wire brush and pumice, clean, and immerse for a moment in a solution consisting of 16 oz. of ammonia chloride and an equal amount of sulphate of copper dissolved in 1 gal. of hot water. Remove the parts and allow to dry without rinsing. When dry, stipple the surface of parts with a solution of ammonium sulphate, 1 oz. to 1 pint of water, by using a small round brush or sash tool. When nearly dry, pass rapidly through clean cold water, and a fine green verde will be produced. Allow to dry in the air. The finished article may be either lacquered or waxed, the latter coating being particularly suitable when polished with Canton flannel buff wheel.

* * *

Question.—What portion of the actual cleaning is effected by hydrogen gas during treatment of metal articles in an electrolytic cleaning bath containing alkaline solution?

Answer.—The action of hydrogen is purely mechanical. It loosens the solidified matter from the work being treated and floats it to the surface of the solution. The caustic metallic elements such as potassium and sodium saponify or reduce such matter as may be susceptible to the action of these caustics. The combination accounts for the splendid efficiency of the electro-cleaning process.

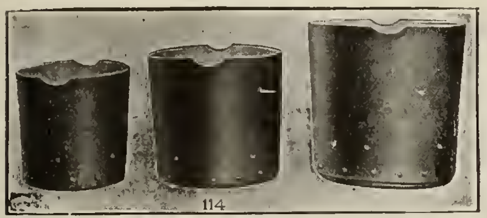
* * *

Question.—We wish a cheap method for blackening the backgrounds of nameplates, also a brown-black finish for yellow brass.

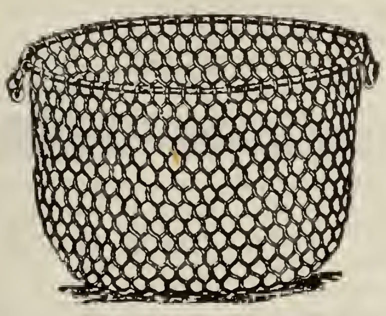
Answer.—The smoke finish, produced by passing the plates over a fish tail gas flame or oil flame, is very good and decidedly cheap. Lacquer the plates with

FOUNDRY

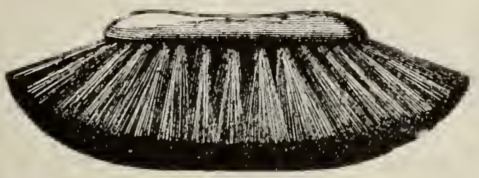
Necessities

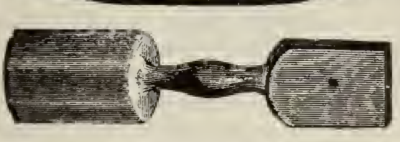


Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.



Coke or Charcoal Basket—Made of galvanized steel wire.





Bench Rammers—Made from Maple Hardwood well oiled.

It doesn't matter whether you are in need of Plumbago, Stoveplate Facing, Core Wash, Core Compound, either Powder or Liquid form, Partine, Fire Brick and Clay, Charcoal, Riddles, Brushes, or other requisites for the Foundry we can supply you. And what is more your requirements will be filled promptly, as they are in our supply house *READY FOR IMMEDIATE SHIPMENT.*

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MADE IN CANADA

The Hamilton Facing Mill Company, Limited

HAMILTON, CANADA

a thin dip lacquer. A brown-black on yellow brass may be obtained by cleaning the brass, then immersing in a clean hot solution of potash, and directly into a solution consisting of caustic potash, 8 oz.; potassium sulphurette, 2 oz.; and water, 1 gal. If one immersion does not give results, add a few drops of liquid ammonia.

* * *

Question.—Owing to the present high price of pure copper, we desire to economize a little. Could ingot copper or copper wire be used as anodes without producing future difficulties in plating?

Answer.—Copper ingots may be used as anodes with perfect safety. If your bath is large enough to accommodate the entire ingot as an anode, then simply bright dip the ingot and suspend in same manner as regular anode. Copper wire of reasonable size could also be used. The ingot copper and wire could be cast into convenient shaped slabs if your firm operate a brass foundry. Either form would be preferable to sheet copper.

* * *

Question.—Can you suggest a possible remedy for pitting in nickel deposits? Our solutions are proving extremely troublesome in this respect.

Answer.—Of the many sure cures for pitting which we have tried, the following proved most certain in greatest number of cases. Nickel pitting is a trouble experienced by all platers, more or less, and may be caused by several different conditions of the electrolytic. The most prevalent source of the difficulty, however, is a solution depleted of metal, or one which has not the property of sustaining a constant uniform metallic concentration in the immediate vicinity of the cathode during electro deposition, the result being an excess of liberated hydrogen. To remedy this condition, use only single nickel salts when replenishing, and to every 100 gallons of solution add 5 pounds of ammonioum chloride and 1 pound of pulverized boracic acid, which have previously been dissolved in one and one-half gallons of boiling water. Do not force the bath for a day or so after making the addition. It is also advisable to test the solution occasionally for metallic content. Do not depend on hydrometer readings, as they invariably mislead the plater when used to ascertain the metallic strength of working solutions.

* * *

Question.—We have read a great deal of late respecting cobalt as a substitute for nickel for electro-plating purposes, and wish to ask if formulæ for cobalt plating solutions are obtainable, and where we could purchase the material?

Answer.—Considerable progress has been made with cobalt plating solutions during the past year, and the metal is now in great demand by the plating craft. We have completed arrangements with W. S. Barrows, of Toronto, who has experimented largely with cobalt, whereby we will be able to publish an account of his work and the formulæ used next issue. The material may be obtained from W. W. Wells, Toronto. The metal is at present more expensive than nickel, but as the demand increases the price will naturally be reduced.

* * *

Question.—Can you furnish a formula for black nickel solution which does not contain zinc or arsenic? We wish a good lustrous black.

Answer.—The following will give you excellent results and is easily maintained in good condition:—Sulphate of nickel, 5 oz.; ammonium chloride, 3 oz.; sodium bisulphite, ½ oz.; sulpho-cyanide of potash, 2½ oz.; water, 1 gallon. Dissolve the salts in a small amount of hot water, then make up to required volume with cold water, and add 2 oz. of 26 per cent. ammonia to each gallon of the solution. Operate with same current as is usual for ordinary nickel plating. If the deposit be too dense or dead, all sulphate of nickel, and, if light, add sulpho-cyanide. Use brass anodes, and pass current through solution for several hours before attempting regular operation. The beauty of black coatings from this solution is not equaled by either zinc or arsenic baths.

* * *

Question.—Is it possible to prepare and operate a brass solution so that known colors may be produced repeatedly with a reasonable degree of certainty?

Answer.—It is a practical impossibility to make a brass solution from any known formula and maintain it in a condition that will invariably produce certain colors repeatedly, because the copper and zinc will not deposit in the same proportion as added to the solution in the form of copper and zinc salts. The presence of free cyanide and ammonia changes the proportion of copper and zinc in the deposit. Copper, 64 per cent., and zinc, 36 per cent., are the quantities used for yellow brass anodes, while 75 per cent. copper and 25 per cent. zinc salts are used in the solution to produce yellow brass deposits.

* * *

Question.—Kindly publish a formula for a good tin plating solution?

Answer.—Dissolve 1 pound caustic soda in 1 gallon of water, then add ¼ pound stanuous chloride (tin chloride). Stir until solution is clear, then add ½ pound sodium hyposulphite. The solution will deposit when used cold, but much better results are obtained from the hot solution. The deposit forms rapidly, is firm and adherent, is of good color and less spongy than most tin deposits.

* * *

Question.—Would potassium nitrate be beneficial to a double sulphate nickel solution, or would sodium nitrate be preferable?

Answer.—Avoid using nitrates of sodium, potassium or any other nitrate in a nickel solution. Deposits from nickel solutions containing nitrates are dark and liable to peel. Successful commercial nickel plating became a possibility only after nitrates were eliminated from the salts, etc.

* * *

Question. — We are nickel-plating stampings made from cold-rolled steel, but quite a large percentage of these pieces are partially defective because of a scale which is on the steel, and which does not finish properly in the plating bath. Can we remove this scale by any inexpensive process, so that the parts may be saved?

Answer.—Prepare a solution of ammonium sulphate and water—¾-lb. of the sulphate per gallon of water. Use this solution with strong current and the steel parts as anodes. When the scale is loosened, reverse the current for a few seconds, rinse and plate as usual.

* * *

Question.—My nickel solution does not show any evidence of poor working condition, but the nickel deposits peel badly. What are the usual causes of this trouble?

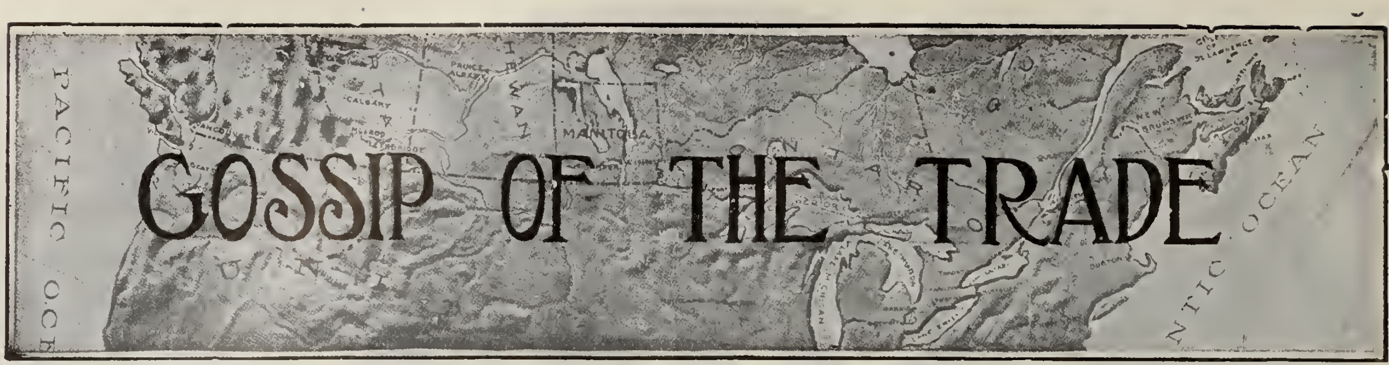
Answer.—The information regarding condition of your solution is very vague. Peeling frequently results when a nickel solution becomes low in metallic strength owing to an excessive evolution of hydrogen. Two or three oz. of sulphate of nickel per gallon of solution will usually correct the difficulty. Unclean surfaces will not permit of adherent coatings, though only a mere film. Over-pickeled iron or steel gives same results and excessive current during plating often causes deposits to peel or crack. An excessive alkalinity or acidity of the solution is also productive of peeling deposits.

* * *

Question.—We desire to produce a black non-oxidizable coating on steel motorcycle accessories.

Answer.—Use a solution as follows: Chloride of copper, 1 oz.; bichloride of mercury, 2 oz.; chloride of bismuth, 1 oz.; hydrochloric acid, 6 oz.; denatured alcohol, 5 oz.; water, 1 gallon. Operate the solution quite warm and repeat the dip if color is not black enough. If parts are subsequently allowed to remain in clean boiling water a few minutes, the results are considerably improved.


HINTS TO BUYERS



GOSSIP OF THE TRADE

Lindsay, Ont.—Arrangements are being made at John McCrae's foundry to install machinery for making shells.

Toronto, Ont.—Dominion Wheel and Foundry Co. will build a one-storey frame and galvanized addition to their foundry, 131 Eastern Avenue, to cost $5,000.

D. R. Hanna has retired from the firm of M. A. Hanna & Co., Cleveland, Ohio, sales agents for "Victoria" pig iron produced at Port Colborne, Ont. Mr. Hanna was admitted to the firm in 1891.

A. W. Mace has resigned his position with the Factory Products, Ltd., Toronto, Ont., temporarily, to give assistance in the war munitions department of the United States Steel Products Co., New York City.

Windsor, Ont.—The City Council are in the market for a quantity of cast iron pipe and specials, geared valves, fire hydrants, pig lead and valve boxes. W. A. Hanrahan is secretary of the Water Commission.

J. C. Rockwell, manager of the Lunenburg Foundry Co., Lunenburg, N.S., died at that place on June 29. Mr. Rockwell, who was born in Cornwallis, N.S., 50 years ago, had been manager of the Lunenburg Foundry Co. since 1899.

Douglas J. Peake, until recently with the United States Cast Iron Pipe & Foundry Co., Burlington, N.J., has been appointed foundry engineer and assistant to the general superintendent of foundries of the Canada Iron Corporation. Two years ago, Mr. Peake was connected with the Three Rivers, Que., plant of the latter concern.

Calgary, Alta.—One of the largest industrial mergers of recent years in the West was consummated on June 10, with the merging of the Western Foundry and Metal Co., Ltd., and the Canadian Equipment and Supply Co., both of Calgary, and the International Supply Co., Ltd., of Medicine Hat, into the Canadian Western Foundry and Supply Co., Ltd., capitalized at $1,000,000, with head offices in this city.

Dominion Steel Production.—The Dominion Steel Corporation production for the month of June, with comparisons, was as follows:

	1915, tons.	1914, tons.
Pig iron	22,552	21,111
Steel ingots	28,680	26,629
Rails	13,044	16,998
Rods	6,435	1,981
Bars	797	2,347
Wire and wire products	3,167	1,541
Coal mined	481,820	485,449

Halifax, N.S.—At a Board of Control meeting on June 30, the directors of the Nova Scotia Car Works, Ltd., asked the city for an additional $125,000, as further capital is declared by directors to be absolutely required to successfully carry on its business. The city originally advanced $125,000 and a portion of this loan has been paid off by instalments. The additional amount asked for will bring the company's liability to the city up to $250,000, and the amount will be secured by mortgage in same manner as previous advance.

Customs Receipts Show Increase.—For the first time in a considerable period, Customs receipts for the month just closed, June, show an increase over the same period last year. This is an indication that the new war taxes are beginning to take effect. Customs receipts for June were $7,315,638.74, as compared with $7,274,763.32 in June, 1914, an increase of $40,875.42. For the three months ending June 30 the total Customs receipts were $20,907,939.88, or $772,530.66 less than during the corresponding period last year.

Herbert M. Ewan has resigned from the position of sales manager of the Canadian Steel Foundries, Ltd., Montreal, and will join the firm of Taylor & Arnold, Ltd., dealers in railway supplies and locomotive specialties, Montreal and Winnipeg, as vice-president; the change to take effect on July 1. Mr. Ewan who was born in Montreal, has been connected with the Montreal Steel Works and Canadian Steel Foundries for over eleven years, latterly in the capacity of sales manager. He has had considerable experience in England and the United States as well as in Canada of the steel and railway supply business.

Canadian Trade.—The possibilities of increased trade between Russia and Canada are now being seriously considered. Until a short time ago Canada did no business direct with Russia. In 1913, out of our $2,145,000 of exports to Russia no less than $2,017,000 passed through the United States. Similarly Russian products were brought to Canada in foreign ships. Now the Canadian Pacific Railway are establishing a line of steamers between Vancouver and Vladivostock, and it is expected that an increased and direct trade will be built up between the two countries.

The Canadian Car & Foundry Co., Montreal, has received an order from the Railway Executive Committee of the British War Office for 1,200 four-wheel, continental type, 22-ton, steel frame box cars. The value of the order was placed at $1,200,000 by W. W. Butler, senior vice-president, who states that the cars will be manufactured at the company's local plants. Manufacturing operations will be started immediately. Mr. Butler explained that the cars were to be used in connection with military operations of the British army in northern France. The specifications of the equipment conformed in every respect to the standards of the French railways.

Canadian Car Co. Shell Contract.—It is understood that the loading of shrapnel and high explosive shells by the Canadian Car & Foundry Co. in its $83,000,000 contract with the Russian Government was not included in the original contract, but that it was arranged for later at the request of the Russian Government. Construction of the factory for assembling and loading of the shells near Lyndhurst, N.J., is not expected to be completed for about a month. No exports of shells by the Canadian Car Co. are looked for before the early part of August, although shipments of parts to assembling points by American manufacturers to whom the contract was sub-let will be well under way before then.

Large Equipment Orders.—Further equipment orders have been placed recently. The Federal Government has ordered 15 locomotives, to cost $22,000 each, from the Canadian Locomotive Co. of Kingston. An order has also been placed for 1,000 box cars for the National Transcontinental Railway. This contract has been placed among three concerns—the Canadian Car and Foundry Co., the National Steel Car Co., and the Nova Scotia Car Co. The Canadian Locomotive Co. is already working on a Russian Government order for 50 locomotives, while the Eastern Car Co. has an order for 2,000 cars also from the Russian Government. Canadian Car & Foundry Co. have a Dominion Government order for 600 standard freight cars for the Intercolonial Railway.

Catalogues

Arc Welding Apparatus is the subject of Bulletin No. 48,905 being distributed by the Canadian General Electric Co., Toronto, Ont. The bulletin, which describes fully both stationary and portable outfits relative to construction and operation, is fully illustrated, and includes diagrams, with a table giving the principal dimensions.

Power Transmission Appliances.—The new "Oneida" line of power transmission appliances is dealt with in bulletin 03, issued by the Oneida Steel Pulley Co., Oneida, N.Y. The principal lines described include drop and post hangers, pillow blocks, couplings, etc. Their principal features are dealt with in detail and price lists give the code words and other useful information for the various sizes of each appliance. The bulletin is fully illustrated.

Monarch Furnaces.—A catalogue being distributed by the Monarch Engineering & Mfg. Co., Baltimore, Mo., features at length several types of furnace for mines, smelters, refiners, etc. Among those described are the double chamber, tilting, non-tilting and pit furnaces. Other descriptive matter deals with muffle furnaces, cyanide ovens, blowers, fuel oil burners, etc. A number of tables give the principal sizes and general information covering the various types, all of which are illustrated.

Centrifugal Compressors for blast furnaces, is the title of bulletin No. 48601, just off the press, and being distributed by the Canadian General Electric Co., Toronto. The advantages claimed for this type of blower over the reciprocating blowing engine are described in detail and the illustrations give a general idea of the design. These latter are supplemented by a description of the compressor including, of course, its principal features and method of operation.

AETNA EXPLOSIVES.

ALMOST coincident with the New York report that the Canadian Car & Foundry Co. had placed an order with the Aetna Explosives Co. amounting to about $6,000,000, comes the announcement from Sydney, C.B., that the explosives company was planning to establish a new industry at that place. The details are to the effect that the project has just been organized in New York, and that letters patent have been granted at Ottawa.

This is just another instance of the widespread effect of the shell-making industry in Canada, and there would appear to be every reason to expect that it would be good business for the Aetna Co., after getting an order amounting to $6,000,000, to establish a plant at a point where the business could be expeditiously handled. If Canadian Car & Foundry Co. is going to load shells at Sydney, it would certainly be reasonable that the explosives be made close at hand.

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Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

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Hamilton Facing Co., Ltd., Hamilton, Ont.
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Dom. Iron & Steel Co., Sydney, N.S.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Talc.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Taps.

Geometric Tool Co., New Haven, Conn.

Teeming Crucibles and Funnels.

McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.

Geometric Tool Co., New Haven, Conn.

Track, Overhead.

Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tripoli.

W. W. Wells, Toronto.

Trolleys and Trolley Systems.

Can. Fairbanks-Morse Co., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks, Dryer and Factory.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tumblers.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.

Turntables.

H. S. Carter & Co., Toronto.
Northern Crane Works, Walkerville.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Vent Wax.

H. S. Carter & Co., Toronto.
United Compound Co., Buffalo, N.Y.
Wobster & Sons, Ltd., Montreal.

Vibrators.

Berkshire Mfg. Co., Cleveland, O.
Canadian Ingersoll-Rand Co., Ltd., Montreal.

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Dom. Iron & Steel Co., Sydney, N.S.

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Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.

Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Wire Wheels.

Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
W. W. Wells, Toronto.

Wire, Wire Rods and Nails.

Dom. Iron & Steel Co., Sydney, N.S.

ADVERTISING INDEX

CIRCULATES IN EVERY PROVINCE IN CANADA

CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited Toronto, Montreal, Winnipeg, and London, England

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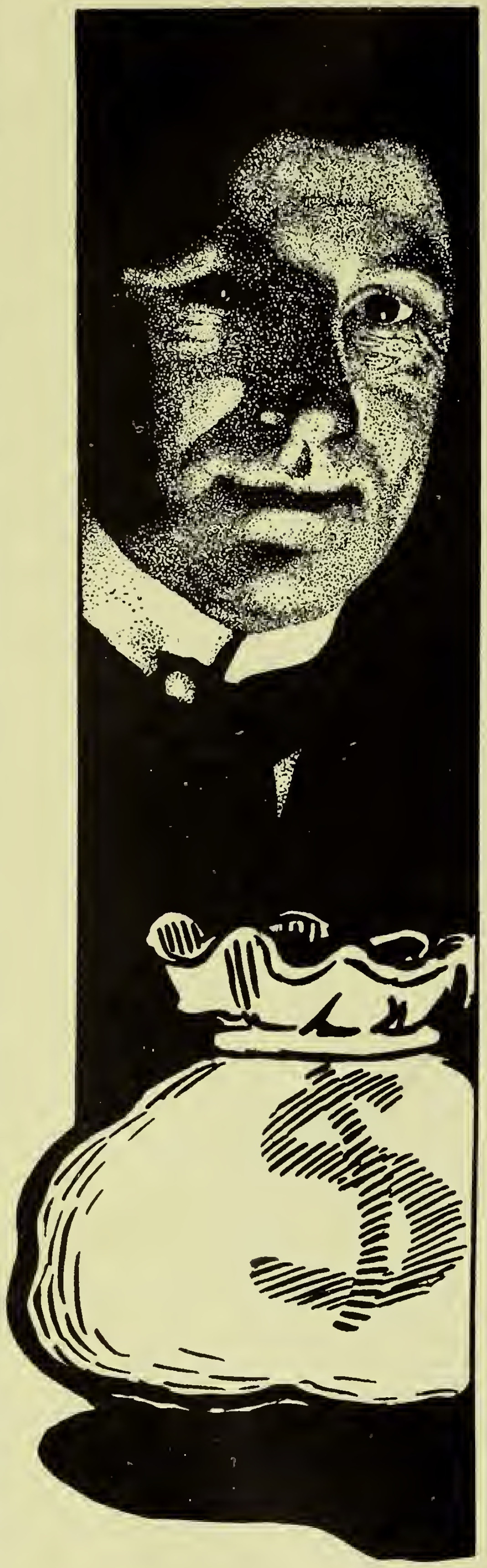

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Your foundry can be put on a better paying basis by

KAWIN SERVICE

We take all the Chances You take the Profits

Our proposition to you cannot be regarded as a game of chance.

It costs you absolutely nothing to try your luck with us, and you are assured bountiful returns for your trouble.

For instance :

One day we received a communication from owners of a certain foundry stating that, tired of seeing our advertisements and reading our claims, they had decided to "call our bluff."

In other words they told us to "go to it," seeing that it would cost them nothing if we failed.

These foundrymen had prided themselves that their plant was in such a condition that without the least bit of trouble they could get the most fashionably designed "O.K." imprinted on it by any *efficiency expert.*

And to be perfectly just to them, we will state that their foundry *was* in a remarkably good condition.

However,

We Went! We Saw We Conquered!

Our foundry experts, trained not to be misled by surface conditions, started in with their coats off and their sleeves rolled up, and they *did* things.

To say that they opened these foundrymen's eyes good and wide does not even begin to explain the situation.

They left no room for argument—but they left a *lasting impression.*

WHAT OUR EXPERTS DID IN THIS FOUNDRY THEY CAN DO IN YOURS!

Tell us to "go to it."

Charles C. KAWIN Company Limited

CHEMISTS FOUNDRY ADVISERS METALLURGISTS

Established in 1903 and now doing business, on yearly contract, with several hundred foundries.

307 KENT BUILDING, TORONTO

Chicago, Ill. San Francisco, California Dayton, Ohio

The Publisher's Page

By B.G.N.

"When Nations Advertise for Armies"

JOHN H. Fahey, president of the Chamber of Commerce of the United States, at the recent meeting of the Associated Advertising Clubs of the World, said in part:

"If there are still extant men who ask the question, 'Does it pay to advertise?' I know their thinking is of the kind which would lead them to light factories with candles and insist upon the advantages which would accrue if the residents of modern cities still drew their water supply by bucket from the town well.

"When nations in the greatest struggle of history advertise for armies; when kings and emperors and sultans come down from their thrones to seek the attention of the world and present their pleas and defenses through the press; when it has become the daily bread of a large part of the world's business, it is indeed a man of limited mentality who still questions the power of publicity. Its value to society has in fact so impressed itself that to-day publicity is the light of the world. It may be said, with little element of speculation in the assertion, that if publicity had characterized dealings between the nations of Europe during the last fifty years, and secret diplomacy had been eliminated, the present world war, with its terrorism and threat to all civilization, would not now be raging.

"The power by which hundreds of thousands of minds, yes, millions of minds, may be turned to consideration of the same thing at the same time is a wonderfully useful influence. Whether that power is employed to make millions think of the policies of the government or the homely comforts and economies affecting their daily lives, the underlying value of this power is the same; the advantages to be gained from its use are identical.

"It is often contended that you cannot advertise successfully when business is bad, but the extent to which confidence may be restored and enthusiasm reawakened by enterprising advertisers under adverse conditions was demonstrated again and in remarkable ways during the period of uncertainty which prevailed in our own country immediately after the first of last August. Once more it has been shown that the public demand for commodities always exists in greater or less degree. It is simply a question of brains and ingenuity in securing response under conditions a little harder than usual."

CANADIAN FOUNDRYMAN
143-153 UNIVERSITY AVE. ∴ TORONTO, ONTARIO

John L. Hammer

a practical foundryman, designed the "Hammer Core Machine."

Ira E. Burtis

a practical foundryman, designed the "Duplex Sand Shaker."

Each of these men built their machines and tested them thoroughly in *their own foundries.*

Each knew the weak points to be *overcome.*

Each started with the idea of building a *better* machine.

Both Succeeded!

Either of these machines will be sent to you on *trial.* This is your opportunity to prove our assertions.

Write to-day.

Brown Specialty Machinery Co.

2448 West 22nd Street

CHICAGO

Don't go along and merely THINK your Practice is O.K.— Let us show you whether it is or not.

We often save enough in one month to repay the losses of several months previous.

We make no claim of being know-it-alls, but do guarantee that our information is FULL of MONEY-SAVING IDEAS and COST-REDUCING formulas worth many times their price in every foundry.

Give us the chance and we will prove this.

It is easy for a man to say he knows all we teach—over half of our 2,000 clients thought likewise. But after they took a chance with us, we taught them some points that revolutionized their shops.

They no longer merely thought—They knew. They got rid of guesswork and followed science.

Nothing that you can buy will save you as much money and as many castings as McLain's System. NO CHARGE for full information. Return coupon below.

McLAIN'S SYSTEM, 703 Goldsmith Bldg.
Milwaukee, Wisconsin, U.S.A.

Send full particulars FREE.

NAME ....
POSITION ....
FIRM ....
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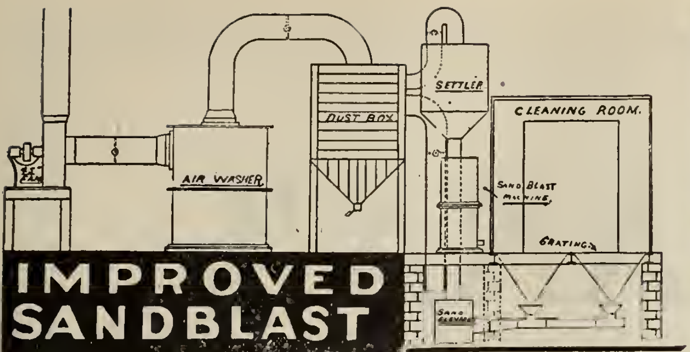
8-15



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Established 1869. First in business and leaders ever since.

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Study them carefully:

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5. Simple in design;
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9. The room is absolutely clear of all obstruction;
10. There is no shoveling of sand or shot back into the machine;
11. Entirely automatic;
12. These machines will increase your output.

WRITE FOR FULL PARTICULARS AND REFERENCES.

We specialize in
SANDBLAST MACHINERY, HELMETS, GLOVES, RESPIRATORS, OPERATORS' COATS, GOGGLES AND AIR COMPRESSORS.
Also Special Machines for Special Work.

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Canadian Office: McLean & Barker, 301 Unity Bldg., Montreal

GLUTRIN.
REG. U. S. PAT. OFF

Glutrin has been the standard sand-binder for years, and needs no introduction to those wide-awake foundrymen who, realizing "It's the pennies that make the dollars," are quick to avail themselves of any opportunity to reduce costs without lowering efficiency.

ROBESON PROCESS COMPANY
GRAND MERE, P. Q.

Selling Agents:
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Montreal, P. Q. and Toronto, Ontario.

VENT WAX AND PATTERN WAX

Two Essential Requirements.

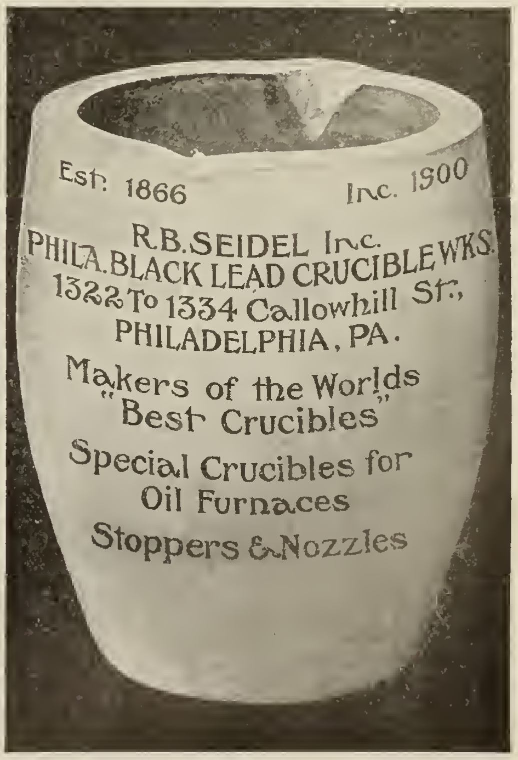
You will find the VENT WAX an important factor for venting complicated cores.

The PATTERN WAX is something original.

A sample of either will prove their merits.

Ask your supply house.

United Compound Company
178 Ohio St. Buffalo, N. Y.



The Successful Production of Large Steel Castings

Staff Article

The development of certain branches of mechanical and electrical engineering during the last decade has compelled foundrymen to strain every effort in order to keep pace with the ever-increasing demands of machine builders. A careful perusal of the following article will show that Canada is maintaining a satisfactory position in the production of large steel castings, such as are required to meet the most exacting conditions both in size and quality.

THE difficulties of making steel castings increase very rapidly after the weight and size pass a certain limit. Extra heavy castings such as are described in this article call for more than ordinary shop equipment, special shipping facilities and very often great ingenuity on the part of the foundry staff.

Castings such as are described in this article are being continually produced at the plant of The Canadian Steel Foundries, Longue Pointe, Montreal. Fig. 1 shows a large cast steel roughing roll of about eight tons and similar to those used in the largest steel mills. Let us follow the different stages of manufacture through which this piece passes beginning at the pattern shop, the various processes encountered in the foundry, until it leaves the finishing lathe and is ready for shipment.

Moulding a Large Roll.

For a more ready understanding of the method of forming the mould it is better to give first a description of the flask.

In this case the latter consists of two halves of a cylinder made of cast steel, two inch wall thickness, reinforced by circumferential flanges and longitudinal ribs of the same dimension. Each half of the flask is built up in short sections bolted together which make them adaptable to the making of long or short rolls as the occasion demands. On one end of each half is bolted a semi-circular steel plate forming the bottom; the metal is poured in at the other end with the flask standing in an upright position. The lower half of flask, known as the drag, consists of a quarter of a circle plus a square, the side of which is equal to the radius of the cylinder. This is done in order to give a bearing to the flask on the floor. In the corner of this square is also placed the riser or aperture through which the metal rises and enables the operator to tell when the mould is filled, it being impossible to detect same through the filling gate.

Specially Prepared Sand.

The next consideration is the sand. It is not to our purpose to enter into an analysis of the sand, so called, which consists of a mixture of special earth, gluten, fire clay, molasses, and other ingredients, furthermore than to say that the object sought after is to obtain a homogeneous and compact mass in the mould. Each foundry has its own practice which amounts almost to a trade secret. The prepared sand is then shovelled into the lower half of the flask and we now come to the most important part of the operation, that is, the forming of the mould proper. For the fashioning of the shape of the roll in the sand no pattern is used; instead a long one inch board, shaped out very much like a ratchet, is employed. There are two hinges on this board, which swings on a horizontal shaft, which has its bearing at either end of the flask. This board, commonly called a sweep, is revolved on its axis in the sand, the teeth on the board forming the ridges on the roll and the spaces between the teeth giving shape to the hollowed out sections on the casting. This method is rapid, and does away with the making of an expensive pattern, which in this case would not only prove unwieldy in handling, but also very liable to breakage. The upper half of the flask or cope, as it is called, is made in the same manner as the drag.

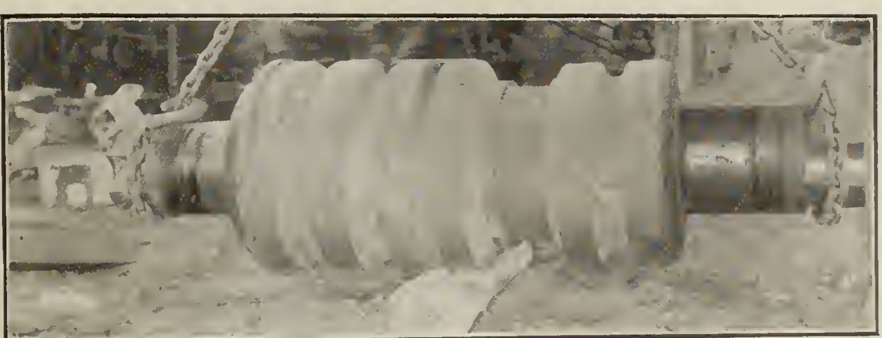


FIG. 1.—CAST STEEL ROLL. WEIGHT 8 TONS.

The flask with contained mould is lifted by a crane and carried across to an oven car, on which it is subjected to a

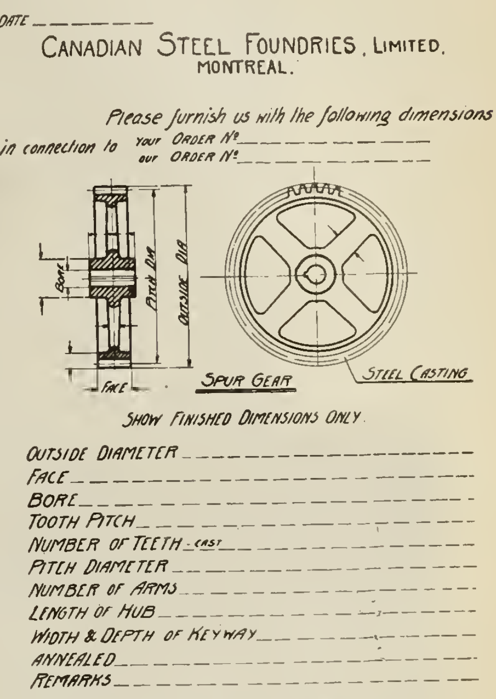


FIG. 2.—PARTICULARS REQUIRED FOR MACHINE MOULDED GEARS.

surface treatment before it is baked. This treatment consists in painting the mould with a heavy solution of molasses and water. The two halves are then placed in the oven for a thorough baking. The resultant mould must be much harder and more solid than for cast iron. The time taken for the baking process is twelve hours, after which twenty-four hours are allowed for cooling off. The drag and cope are now firmly bolted together and stood on end ready for the pouring of the molten metal. The foundry is equipped with two 30-ton furnaces of the acid open-hearth type. For firing purposes ordinary fuel oil, under a pressure of 80 lbs. per sq. in. and air at 100 lbs. per sq. in. are fed into the furnaces. Five hours are required to melt a charge with a consumption of about 35 gallons of fuel oil per ton of metal. A 40-ton bottom pouring ladle is used, into which the entire charge from the furnace is run.

Pouring the Metal.

The ladle, of the bottom pouring type, is made from heavy boiler plate lined with fire-brick. A graphite plug of truncated conical shape is used as a stopper for the pouring hole; this plug is connected to a rod which runs through the molten metal, and is insulated from the latter by means of fire-brick discs. The opening and closing is operated by means of a lever attached to the side of the ladle. The life of a graphite plug is considerable, one lasting sometimes for a week. The mould is now poured by one of the foundry cranes carrying the 40-ton bottom pouring ladle, spoken of above, and slowly filled from one end. This operation takes about four minutes. The three or four feet of the roll, which is excess metal, causes a uniform liquid pressure to be exerted full length of the casting and tends to counteract the contraction of the metal while setting. This extra metal is technically known as the crop and runs about 40 per cent. of the total weight of the casting.

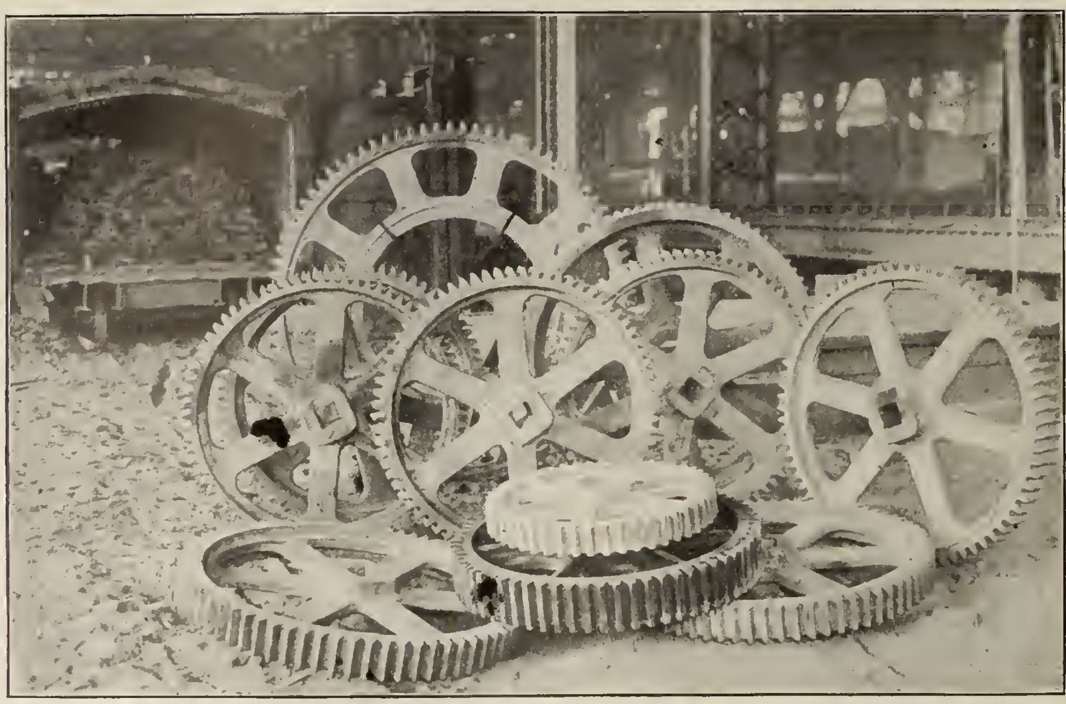


FIG. 3.—MACHINE MOULDED GEARS.

The casting is allowed to remain 24 hours in the mould, after which it is removed to the annealing oven. The latter is a long shallow pit, temporarily arched over with brickwork during heats. The rolls are here subjected to a temperature of 900° F. for about 12 hours. They are then allowed 24 hours in which to cool off. This annealing process produces a uniformly soft casting, at the same

FIG. 5.—LARGE STEEL CASTING FOR ELECTRICAL MACHINERY. WEIGHT 19 TONS.

time removing the chill strains set up by unequal rates of cooling. In Fig. 1 it will be noticed that the ends of the roll just outside the bearings are grooved; there are three of these circular slots on each end, their purpose being to engage with three internal teeth of a short sleeve, and act as a flexible coupling or universal joint. The wobbler is moulded only on one end, and has to be machined on the other after the riser or crop, spoken of above, has been cut off. The cutting off process is rapidly performed by means of the oxy-acetylene blow torch. The roll is finally turned down to size on a lathe, and is ready for use.

Machine-Moulded Gears.

In the past few years there have been great strides made in the moulding of steel gears without the necessity of expensive patterns. This is a fact that is not as widely known to the manufacturer as it might be, and one that will often obviate the necessity of a long and tiresome shut-down. The only information required is such as is specified on the form shown in Fig. 2. To such perfection has the machine moulding gear machine been brought that very often a gear can be made and shipped before a pattern could be completed.

Fig. 3 shows a few gears made by the machine-moulding process, and Fig. 4 shows the method of moulding. When sufficient care is exercised in making up the tooth block, the gears will be found to be remarkably true and machining will not be required. The tooth-block usually contains two teeth of the same pitch and dimensions as those on the gear to be moulded. Sometimes more than two teeth are used, but as the time is mostly taken up in the ramming and scarcely any in drawing the tooth-block and revolving the machine, it is not of any material advantage to employ more than two teeth. Moreover, when using a block of two teeth only, a slight alteration in the diameter of the gear can be made, since the "tooth space" only is used, so that the same block can be employed to make a pitch full or bare, which is decidedly convenient in jobbing and repair work. Gears can also be made having one or two teeth, more or less, than the number in the gear for

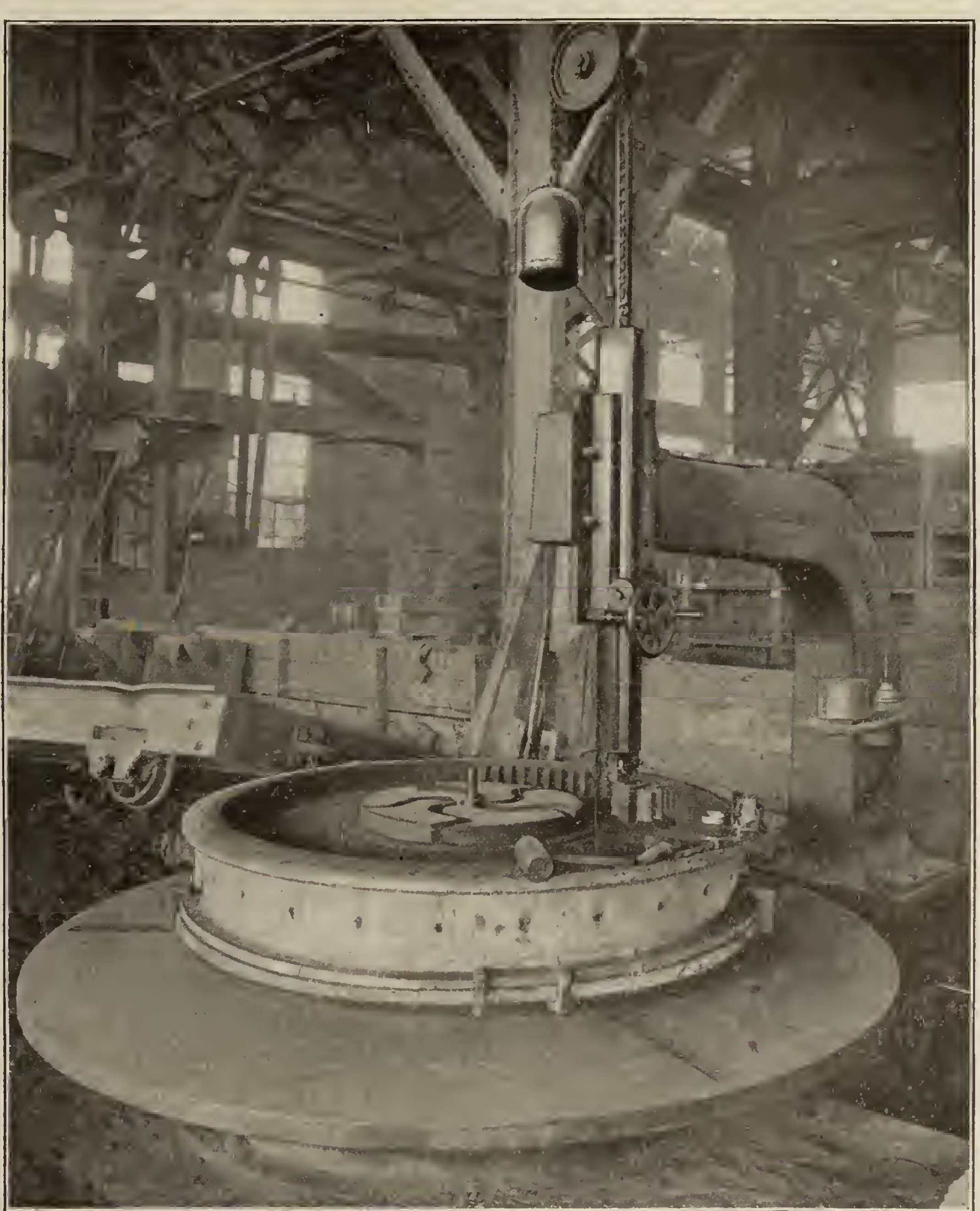


FIG. 4.—MOULDING MACHINE PRODUCING MOULD FOR LARGE GEAR WHEEL.

which the block was originally made. Fig. 5 shows a good example of a large steel spider intended for high speed, heavy duty, electrical equipment, which must necessarily be free from defects of all kinds. An idea of the size of the spider may be gained by comparing the bore (in which one of the men is resting) with the height. It is 16 ft. 6 in. diameter, with a 42-in. face, and weighs 37,930 lbs. There is a clearance of just six inches between the bottom of the spider and the railroad track. Note the clearly-defined bolt bosses and clean outlines of arms and rim. The forming of the mould is somewhat similar to that employed in the case of the roughing roll. In that case a sweep was employed, which revolved in a vertical plane around a horizontal axis, whereas in the case of the spider the sweep is revolved in a horizontal plane around a vertical axis pivoted at the centre or hub. The spaces between the arms are cored out and a riser placed on each arm. The molten metal is poured at the hub. The mould baking and annealing processes are somewhat similar to those employed as described above. Fig. 6 shows an extra heavy steel casting, as used in the piers of the Quebec Bridge. This piece was made from what is known as a skeleton pattern, merely a rough box, the main difficulty being the coring of the holes shown in the photograph.

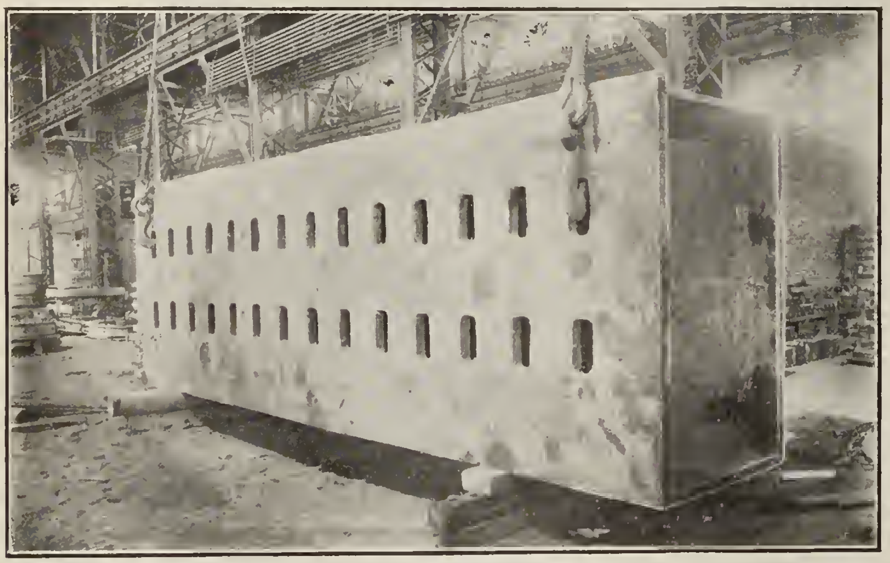


FIG. 6.—STEEL CASTING TO FORM PART OF BRIDGE PIER.

NEW FACTORY INSPECTION REGULATIONS.

THE twenty-seventh annual report of the Factories Inspection Branch of the Ontario Department of Agriculture has been issued. It shows that 10,059 inspections of factories and shops were made during the year in 410 cities, towns and villages. The number of accidents reported are 1,270 of which 52 were fatal.

Regulations regarding specifications for fire escapes are given with illustrations, together with a most practical article on how to lessen fire dangers. There are also helpful suggestions regarding ventilation and general sanitation, guarding of machinery, child labor, seats for females in shops, and wearing of girls' hair in mills and factories. Results are also given of the inspection of bake shops, canning factories and evaporators. Special emphasis is placed upon eye protection in certain occupations. In fact "safety first" is urged upon every possible occasion. A most suggestive feature of the report is a series of danger signs in which warnings are given in nearly every foreign language.

HASTE AND WASTE.

IT is hurry in the morning, hurry at noon-time, and hurry at night. Nervous bodies, wrought up to a certain speed, fret away pleasure and good nature just to keep up the pace. Relaxation becomes almost painful—rest a farce. To be in any measure content one feels it necessary to be rushing along "breakneck." No more is accomplished, homes are not the brighter, children the happier, or lives made more useful by all this rush. Yet we keep it up.

One has only to watch the crowds in the cities going to trains or cars to see the working out of the speed mania. Rights of others are forgotten, personal safety seems naught, just crowd, push and get ahead. Strange to say, however, we do not get ahead as quickly as we would if we were to move in a more leisurely manner.

Haste makes waste, and waste is expensive in the extreme. Some persons are too busy to attend to that which insures themselves good health. They expect to mend a broken auto tire hastily and with no skill.

This is an impossibility, but that is not taken into consideration; and so the haste and waste go on, and every day comparatively young men and women let slip from their hands all that is useful and happy in life. Their grasp has grown weak and nothing can be held longer. All due to the daily rush of eating, of working, of walking—everything done hastily, with only a thought for saving an hour or two. Think it over!—Dodge Idea.

ABOUT SEVERAL THINGS.

By N. Edwards.

SOME years ago I noticed a fine spray blowing out through the rear head of one of our boilers. Upon examination, however, the material appeared to be all right, being neither pitted nor grooved. We had a hole drilled and threaded at the spot, which had been carefully marked while the boiler was under pressure, and had an iron plug screwed in. My idea is that, in some way or other, a small piece of foreign matter got into the plate at that point while in process of manufacture at the mill.

Value of Technical Journals.

Did you ever notice this peculiarity among mechanics that, whether in the shop, engine-room, boiler-room or elsewhere, as a rule, the "chiefs," foremen, advanced or well paid mechanics, or other reliable work's stand-bys, are all readers of technical journals, many of them being subscribers to several of these? On the other hand, it is equally evident that the mechanic who is not a reader is kept on year after year at the one class of work, on the same old "hand-to-mouth" salary. His services are also the first to be dispensed with should a slack time occur.

With all the evidence proving the great educational value of mechanical literature, and the fact that this literature can be secured for a few cents a month, it is not surprising that a great many—yes, the majority, I believe—of the men engaged in mechanical lines neglect the opportunity and prefer to spend their spare cash on something which will neither increase their knowledge or general well-being? They never get very far up the ladder of success, are continually "cursing their luck," and when some student mechanic succeeds where they failed, they are always ready to credit his advance to "pull" or "fool luck."

At the present time neither "fool luck" nor "pull" will advance engineers or mechanics. Ability, assisted by perseverance, determination, mechanical, technical and practical knowledge is what counts. The words look big, but every man who tries can make some progress forward and upward.

Grinding Wheels : Their Material and Manufacture

The adoption of grinding as a commercial operation in machine shops has been very marked in connection with shell making. While most users are familiar with the suitabiliy of different abrasives for certain classes of work, the principal features regarding the manufacture of grinding wheels have always remained more or less unknown.

GRINDING as a means of removing metal has been brought to a state of such perfection and applied to such a broad field of manufacture that grinding machines excite no more comment than engine lathes or other manufacturing tools. The great advances made in the production of high-speed steel have monopolized the attention of manufacturers to so great an extent that the degree of perfection attained by the makers of grinding wheels has not been proportionately recognized.

The subject of grinding has received considerable attention from Mr. John Davey, of Glasgow, who recently read a paper before the Keighley Association of Engineers. The subject of materials and processes involved in the successful production of grinding wheels is treated by him in a most interesting way, and the information conveyed is certain to be appreciated by many users of abrasive products.

Abrasives: Natural and Artificial.

The principal natural abrasives are emery and corundum. The artificial abrasives are becoming increasingly numerous, and include carbolite, carborundum, crystolon, and alundum. These substances are all products of the electric furnace.

Emery.

Emery is simply corundum with a number of impurities present, which frequently accompany it in its natural state. Several years ago practically all grinding wheels were made from emery obtained from the vicinity of Smyrna and Chester, Mass., U.S.A. The value of emery as an abrasive depends upon the proportion of crystalline alumina oxide which it contains. This is the only element in emery which is hard enough to have any appreciable cutting action on metals.

Corundum.

Pure corundum was adopted in preference to emery. Being harder, the grains held their sharp points longer, while the absence of impurities, which caused increased friction without removing any metal, reduced the heat generated, thus allowing output to be increased.

Corundum has been obtained in India, and also in the States of Georgia and North Carolina, but nearly always in small deposits of varying quality. It would contain crystalline alumina to about 77 per cent. Due to its superiority over emery, it was eagerly sought after by the makers of grinding wheels. The supply from the sources mentioned was limited and uncertain, so that it did not come into general use until the discovery in 1896 of the now well-known Canadian mines. Not only do their deposits contain an unlimited supply of corundum, but the quality is far superior to any previously mined. It is found to contain 90 per cent. crystalline alumina and will often analyse much higher. Sharpness combined with just the right temper, has made Canadian corundum an ideal abrasive for most kinds of grinding. The Canadian corundum is mined in Eastern Ontario, the known deposits covering an area of about 32 miles long and 5 miles wide.

Carborundum.

Carbolite, carborundum and crystolon are different formations of the same substance; i.e., carbide of silicon.

Carborundum is distinct from anything found in nature. It is the product of the electric furnace, and being under human control, its freedom from impurities is assured. Carborundum is the trade name for carbide of silicon. It is the crystalline formation of the elements of carbon and silicon, brought about by subjecting a mixture of coke and sand to the inconceivable heat of 7,000° Fahr. The mixture is placed in the electric furnace, a fire brick structure 50 ft. long by 8 ft. wide, through which is built a core or resistance path. Leading to the core are the carbon rods attached to a set of power electric cables. To the mixture of sand and coke is added a quantity of sawdust which makes the mixture porous, so as to allow for the free escapement of gases which are formed during the operation. When the furnace has been filled the electric current is turned on and travels along the core, generating a heat that really is beyond human comprehension. It is a temperature at which steel, marble, granite or the highest refractory substances would not only melt, but would vaporize. In this tremendous heat the element of carbon and the element of silicon fly together and form crystal masses of the most beautiful hues. It takes 36 hours for the crystal to form. At the end of 36 hours the outer crusts of the mixture are broken into, the crystal masses removed and taken to the crushing department. The grains are then carefully washed free from dirt, dried and separated into the different sizes of grains.

Carborundum is particularly suited for foundry work and grinding cast iron in the cylindrical and surface grinding machines.

Alundum.

Alundum is oxide of alumina in crystalline formation. It is made by fusing the mineral bauxite to an intense heat in the electric furnace by the arc process. Chemically, bauxite is the purest form of aluminum oxide found in nature. The best bauxite mines are those found in the southern part of U.S.A., and only the best from these mines are used in the manufacture of alundum. Bauxite was considered infusible until the invention of the alundum electric furnace.

The furnaces used for the manufacture of alundum are different from the electric furnace used for the making of carborundum. They are conical-shaped pots, which stand on a car, and are heated by two vertical electrodes, which are gradually raised as the molten bauxite fills the furnace. The bauxite, as it is prepared for the furnace, is in the form of coarse gravel, that is, the bauxite as it comes from the mine is in a wet, clayey state. It is dried by means of a rotary calciner. The cylinder of this machine is 60 ft. in length, and is heated by two gas producers, the material being fed in at the farthest from the fire. Platforms are erected upon which the dried bauxite is placed, and it is fed into the electric furnace through the top.

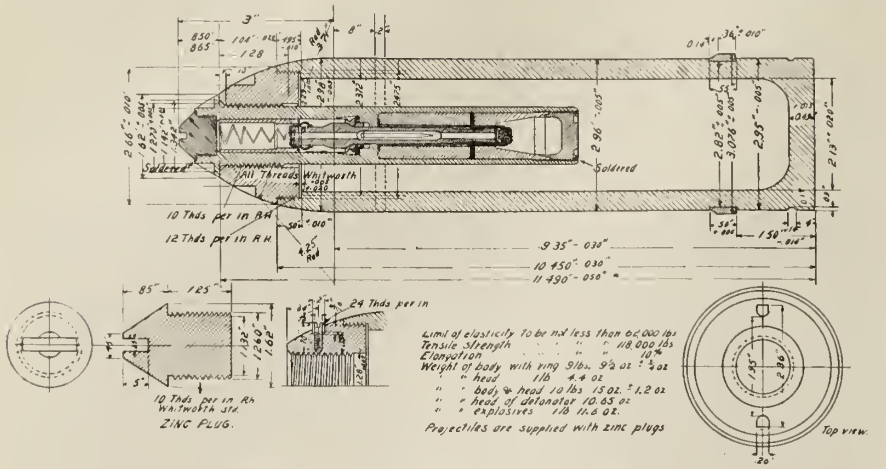
Alundum is very suitable for use in the cylindrical and surface grinding machines for grinding hardened and soft steel, brass, bronze, etc.; in fact, it covers the same field as corundum.

Three distinct processes are now widely employed for binding together abrasive grains to make grinding wheels. These are the vitrified, silicate and elastic, and each produces wheels specially suited for certain kinds of grinding.

Vitrified Process.

More grinding wheels are made by the vitrified process than any other. It consists in mixing suitable clays and fluxes in certain proportions with the grains of abrasive. This is generally done by the wet process, when a large amount of water is added and the mixture stirred in mixing kettles, until it is quite fluid. In preparing the mixture before the water is added, great care is taken to get the correct proportion of abrasive and the different clays, and in the case of combination wheels, where different size grains are used, the same precaution is used, so that wheels can be duplicated at any time. If an order is passed into the works for a wheel of a certain grit and grade it is made to the standard formula. Some years ago a great deal of trouble was caused by the wheels varying, but by the use of improved methods and care in weighing out the correct proportions of abrasives and clays this has been reduced to a minimum.

After the mixing, the mixture is drawn off into moulds and dried in drying rooms until it is hard enough to be handled. The wheels are moulded larger than the size wanted, and are shaved off on a machine resembling a potter's wheel. The hole is also put into the wheel on the machine while the wheel is in its semi-finished state. The next process is placing the wheel in the kiln. The kilns vary in size, some containing a chamber 18 ft. in diameter and 8 ft. high. The wheels are placed on fire-brick tiles, then surrounded by fire-clay rings, until the stand is complete. The kiln will hold several hundred wheels. The period of burning varies according to the size of kiln. In the larger kilns it takes nearly three weeks from the time the kiln is charged until it is drawn. During the baking or burning process the temperature is gradually raised until it is hot enough to vitrify or partially melt the clay, about 3,000° Fahr. The utmost skill and care are required to successfully burn a kiln, and every possible device is used to bring the operation under perfect control. If the temperature is allowed to change too quickly the wheels will be cracked. If they receive too much heat they will be harder than intended, and if not enough they will come out too soft. Wheels made by the vitrified process are those mostly in use on cylindrical and surface grinding machines, as they are free cutting.

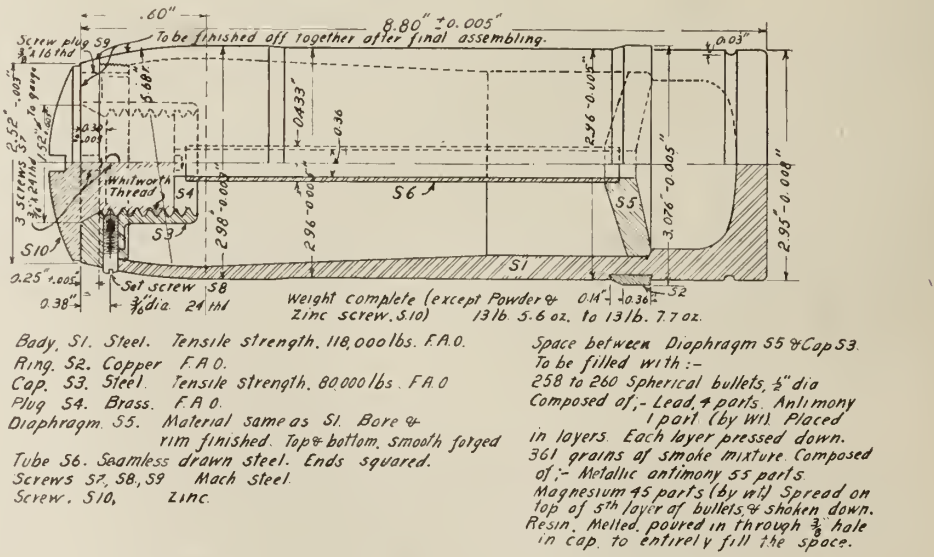


RUSSIAN 13½-PDR. HIGH EXPLOSIVE SHELL.

Silicate Process.

Silicate of soda or water glass is the principal ingredient in the bond of these wheels. After it has been thoroughly incorporated with the abrasive grains in special mixing machines, the whole mass has a thick adhesive quality. In this condition it is rammed into moulds. This part of the work requires considerable skill, and the uniformity and balance of the wheels depend largely upon the skill of the moulder. The wheels are then dried and afterwards baked in special ovens, from which all fire gases are carefully excluded. This causes a chemical reaction, which hardens or sets the bond, and after sufficient cooling, the wheels are ready to go to the finishing room. Some shapes of silicate wheels are moulded under hydraulic pressure, as, for instance, dish wheels, and all very hard silicate wheels are so moulded.

Water glass is the principal ingredient in the bond of silicate wheels, but other substances have to be added. Wheels made by this process are used for cutter sharpening, tool grinding, such as lathe and planer tools, etc. They can be furnished in a few days, and can be made up to 60 inches diameter or more, which is not possible in the vitrified process.



RUSSIAN 15-PDR. SHRAPNEL SHELL WITHOUT FUSE NOSE.

Elastic Wheels.

Shellac is the principal ingredient of the bond of elastic wheels. After the mixture has been suitably prepared, its consistency is such that if thin wheels are wanted it may be rolled into shallow moulds. Thicker wheels are moulded under hydraulic pressure or rammed into moulds the same as silicate wheels. They are then baked at a low temperature to set the shellac. By the elastic process very thin wheels may be made and used with safety. Wheels as thin as 1/32 inch are procurable, and are very useful for cutting of small bars of high-speed steel. Wheels made by this process can be supplied in a few days. All wheels require to be more or less finished after the baking or burning process. This work is done in special lathes, using a circular steel cutter and other types of wheel dressers. After finishing, the wheel is mounted on balancing ways. If not in balance, it is made so. It is then revolved at a speed 60 per cent. in excess of its working speed, producing a stress more than twice as great as that developed in use.

The wheels are tested for hardness by using a sharp-pointed instrument and comparing them with master discs that are kept as standards.

ONTARIO'S NICKEL COMMISSION.

FOLLOWING a prolonged controversy arising out of certain charges that nickel from Ontario mines was finding its way through various channels to Germany since the outbreak of hostilities in Europe, the Provincial Government a few days ago, through the Hon. Howard Ferguson, Minister of Forests and Mines, announced the appointment of the following Commission:

George T. Holloway, London, Eng., Chairman.

Willet G. Miller, Provincial Geologist, Toronto.

McGregor Young, K.C., Toronto.

Thomas W. Gibson, Deputy Minister of Mines, Toronto, Secretary.

The Commission is empowered to inquire into the whole nickel situation in Ontario with a view to establishing in the Province an industry that will have the material under observation from the time it leaves the mines to the time it is marketed.

While assurances have been given to the Imperial authorities and the Dominion and Provincial Governments that not an ounce of Ontario's nickel is finding its way into the enemy's hands, Hon. Mr. Ferguson states that the Provincial Government views the situation from a larger standpoint and has instructed the new Commission to ascertain whether it is not possible to complete the refining of nickel ore from the mines of Ontario entirely within the Province without having to ship it to American refineries.

The question of the province receiving an adequate return from its nickel deposits is regarded as of much importance, and on this point the Commission will also advise the Government.

HEALTH HAZARDS AND SAFETY PRECAUTIONS.

By J. M. W.

A STUDY of recent developments of applied science show that the first applications of many new inventions have been characterized by great indifference to their effect on operators. The complete success of oxy-acetylene welding and similar processes has been accompanied if not made possible by suitable precautions to safeguard the health and comfort of the men engaged on the work.

Oxy-Acetylene Welding.

The adoption of oxy-acetylene welding has been so rapid, and the different branches of industry which offered suitable opportunities for its use so numerous, that the trade obtained a wide field of activity before manufacturers obtained a true appreciation of its attendant hazards.

The type of apparatus varies considerably with the nature of the work. Small portable repair outfits are noteworthy principally because the gases are contained under pressure in storage cylinders. Fixed plants such as are used in shops specialising on welding consist of an acetylene gas generator which supplies this gas under a suitable pressure. The oxygen is usually obtained in cylinders from firms which specialize in the manufacture of this gas.

When using both gases from cylinders the cylinders are fitted with valves so as to maintain the supply of gases at the proper pressure. These valves are automatic in action and reduce to a minimium the risk and attention required from the operator.

Portable generators are not desirable on account of the necessity when traveling, for removing the water and carbide. Any carelessnes in this respect may allow sufficient quantities of carbide to come in contact with damp or moisture and generate enough gas to cause a severe explosion. Additional care and common sense must be exercised when handling generator plants as compared with storage cylinders.

Cleaning Out the Gas Generator.

The use of an open flame light when cleaning out a generator is a fruitful source of accident. When starting to clean a generator, the gas may be released through a suitable exit, until the pressure gauge falls to zero. But the fact that the gauge is at zero does not mean that there is no gas inside. It means that the gas which is inside is at zero pressure, and unless that remaining volume of gas has been displaced or allowed to pass out, so that the space which it occupied is filled with air, it will still be in the apparatus waiting for the first opportunty to ignite. When the generator has been safely opened, any remaining water which has not been completely drained off should be carefully mopped up and all traces of dampness removed before cleaning out the carbide. Especially is this the case where the construction of the generator is such that the carbide may cake and remain on the walls, as lumps of this caked carbide may be capable of generating a dangerous quantity of gas should they come in contact with unexpected moisture.

These considerations will make quite apparent the criminal negligence which accompanies the use of an open flame light around a generator at any time. A portable incandescent electric lamp is the only source of illumination which should be legally permitted.

Welding Apparatus Perfection.

The welding apparatus proper—blowpipe, torch, etc.—has been brought to a very high state of perfection by the various makers, and all the details such as control valves, flexible piping, etc., are capable of satisfactory service for long periods. In spite of care, couplings will become loose, careless workmen may burn holes in hose pipe, etc., and these defects are not readily detected because of the all pervading odor of acetylene gas which is an almost unavoidable feature of all plants. An accumulation of such small leakages may have disastrous consequences to the operator.

Hazards resulting from the foregoing conditions are of an active nature and their results are rapid and evident.

Hazards of a passive, but not less certain and detrimental nature are those which affect the operator physically and continually.

The most attractive feature of gas welding is the intensely strong light which is given off by the flame. While an ignorant and stubborn operator may spurn the use of protecting glasses, the effect on the sight soon makes itself felt, so that for self protection alone the adoption of glasses is a matter which soon adjusts itself. Recent experiments with tinted lenses in efforts to obviate the blinding effect of automobile headlights, have brought about the use of amber colored glass which effectually removes the glare without obstructing the vision so much as the ordinary smoked lenses do.

In addition to having them of the most suitable tint, the lenses should be of substantial dimensions and firmly secured in a strong frame. The presence of foreign substances may cause sparks of molten metal to be thrown off the work, and occasional moisture causes spurting of the job which should be properly guarded against.

Constitutional Feature.

Lastly the effect of the work generally may be such that occasionally a particularly expert operator, through some constitutional weakness, may be incapacitated much more quickly than another operator less expert but more robust. One has merely to consider the intense heat of the flame to realize that metallic vapors are being given off by the work in close proximity to the operator's face. The products of combustion from the flame itself may well be detrimental to the health without the addition of fumes from copper, aluminum, zinc, etc. The use of a helmet such as is used by sand-blasters is the least protection that can be taken and if used along with a respirator may delay but not permanently prevent the results of continued occupation on welding work.

Aetna Explosives Co.—The big plant of the Aetna Explosives Company, upon which operations are being rushed at Drummondville, Que., will stand as one of the important industries which the war business has brought to Canada. A subsidiary of the Aetna Explosives Co. of the United States, it will be backed entirely by American capital, but the business for the time being at least will be the outcome of the big contract which the company secured from the Canadian Car & Foundry Co. to supply explosives in connection with the Russian shell order. The company has secured a big site outside the town of Drummondville, and the plant will probably cost $500,000 and employ a large number of hands. The operation of the works is expected to commence in the course of a few months to fill contracts this fall.

PRACTICAL ARTICLES BY OUR READERS

Readers are invited to contribute to this Department with Short Articles and Personal Experiences—We pay for all Accepted Material.

CONCERNING SEMI-STEEL.

By "Melter."

MUCH has been said from time to time concerning the advantages and disadvantages to be derived from the addition of varying proportions of steel to cast iron, and melting in a cupola to produce commercial castings. Whether this can be done beneficially depends on local conditions involving size, shape and requirements of castings. The production of castings, soft or hard, irrespective of size or service conditions are also factors to be considered, although these ultimately resolve themselves into a question of cost. Generally speaking most castings require strength, so we shall consider this variety.

To appreciate why it is practical to use steel in the mixture or otherwise, something must be known of the factors influencing the strength of cast iron and the main differences effected by the use of steel. As the elastic limit is near the point of rupture in cast iron, it is necessary to get an iron having a high ultimate strength. That the elastic limit is near the ultimate strength is demonstrated by the fact that it is impossible to detect any difference other than that the deflection is proportionate to the load until just before failure.

The Strength Feature.

Strength depends on the size and percentage of graphite flakes, percentage of combined carbon, size of crystals of solid solution (iron, carbon, silicon), amount of oxide and impurities (sulphur, phosphorus, silicon and manganese).

Size of graphite depends on pouring temperature, rate of cooling, time iron has been molten before being poured, per centage of metalloids and total carbon. Graphite dissolves in the iron at temperatures below the melting point and therefore it is only the combined carbon on which the fusibility of cast iron depends. The fluidity is determined by the temperature of the metal, percentage of oxide, percentage of phosphorus and silicon, and the effect the metalloids have on the total carbon as well as the percentage of carbon.

Shrinkage.

Shrinkage is a great factor in using steel, and is dependent not only on the composition but on the size, shape, rate of cooling and whether the casting is made in dry or green sand. Anything that ultimately gives more combined carbon in the finished casting gives more shrinkage. If the iron be cooled quickly, the graphite carbon has not enough time to separate out, therefore the casting is hard and there is more contraction. Fluid contraction of course is quite another thing, as this is caused by bad design or in castings where one section solidifies before the other, the remaining fluid section having no molten iron to draw from its adjacent parts with a resultant cavity or shrink hole.

If, by the use of steel, the total carbon content is lowered, fluid contraction is increased. Fluid contraction can be overcome by the judicious use of chills, gates and risers. Shrinkage is not always uniform, in fact high total carbon, or low total carbon with high graphitic carbon expand before shrinkage, which expansion is due to the separation of graphite. During subsequent shrinkage there may be periods when expansion takes place due to the solidification of prosphide eutectic (Steadite), and another expansion may take place when the iron changes from the alpha to the gamma state which would be about 1,300 degs. Fah. By actual measurement a few curves have been made relative to the amount of first expansion and total shrinkage, the results being tabulated as follows:—

% steel	% scrap	Si.	Mn.	S.	P.	CC.	GC.	TC.	Relative Expansion	Contraction	Chill	T/S sq. ins.
0	92	2.18	.54	.162	.691	.94	2.41	3.35	1½	28	1–16	22,800
7	77	.68	.50	.12	.391	1.00	2.60	3.60	0	36	1–16	31,200
20	50	1.50	.60	.134	.474	.80	2.70	3.50	2	26	¼	27,000
25	50	2.26	.60	.104	.526	.80	2.46	3.26	1½	28	⅜	....
30	50	1.48	.59	.14	.415	.99	2.85	3.84	4	27	⅜	32,700
30	50	1.30	.55	.127	.454	.76	2.19	2.95	3½	22	¼	32,800

From my observations it was noted that the expansion depends on the graphitic carbon and the contraction on the amount of combined carbon irrespective of the quantity of steel in the mixture. I have obtained the same physical results with the air furnace, and with cupola melting without using steel, simply employing varied proportions and compositions of scrap.

Quantity of Steel.

The quantity of steel used depends on the section of the casting and whether machining be necessary or not. If the casting have light and heavy sections it is not easy to select an iron which will run well and be free from spongy spots, etc. Steel in cast iron is said to give greater strength which is true if the composition is arranged accordingly but where fluid hot iron and small sectioned castings are the requisite, the silicon and phosphorous has to be increased to such an extent that the strength is reduced correspondingly. We know silicon and phosphorus are detrimental to good castings as regards their strength, machining qualities and softness, therefore a happy medium in the percentage of steel added for light castings must be found. In very heavy work semi-steel is economical, as it gives a uniform fracture which it is not possible to get with ordinary cupola iron mixtures; the ultimate strength is also high.

For hydraulic work, machine bed ways or places where wear is a factor, when superheated steam is in contact with fittings, for grate bars and furnace parts, semi-steel, when used in the right chemical proportion, is efficient. The table gives suggested analyses and proportions of steel in various mixtures.

Service.	Si.	M.	S.	P.	% Steel
Loco. cylinders and piston rings	1.0 to 1.3	.8	.06	.50	20
Corliss engine cylinders	1.6	.85	.06	.72	20
Automobile cylinders	2–2.25	.75	.07	.40	12½
Hydraulic press beds	1.6	.80	.06	.5	30
Grate bars and heat resisting castings.....	2.0	.80	.07	.30	40
Auto. piston rings	1.8	.35	.08	1.0	10
Auto. castings (fairly heavy)	1.8	.80	.07	.40	20

HARDENING AND WELDING COPPER.

AN invention is announced for a process of hardening and welding copper. It is said to provide a simple, reliable, and efficient method together with a compound, by which the metal can be quickly hardened, or rapidly welded while being hardened, so as to make a strong union. The composition is of acidified hyposulphite of soda with acetic acid and alum. The powdered composition is successively applied to various portions of the copper to be treated and at a low heat. The operation is repeated, at which stage the metal is soft enough to be hammered or welded into the shape desired. Copper so treated, it is claimed, will take an edge and be sufficiently hardened for cutting purposes without any tempering.

JOBBING PULLEY PRACTICE.

By J. H. Eastham.

WHILE ordinary pulley moulding is so simple as to call for no special explanation, circumstances occasionally arise in millwright and repair shops that require a little

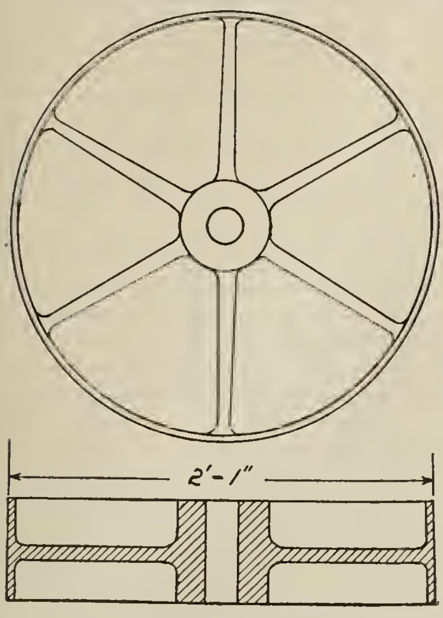


FIG. 1. PULLEY TO BE MOLDED.

study in order to keep cost of production low enough to cope with competitive selling prices. The foundryman owning a set of pulley patterns of loose rim, separate hub and arm types possesses a valuable asset if he be located in a manufacturing centre, as he is then able to handle rush orders to customer's satisfaction.

The casting 2 ft. 1 in. diameter by 6 in. face, indicated in plan and sectional views of Fig. 1, was ordered to replace

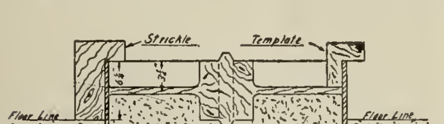


FIG. 2. JOBBING PULLEY PRACTICE.

a breakdown at short notice. The order was received at ten a.m., and was accompanied with the request that the finished pulley be shipped not later than the evening of the following day. The pattern, nearest to size of casting required, measured 25⅝ in. outside diameter, by 10 in. deep, and was used regularly for the production of 24 in. diameter pulleys. The method of molding employed was as follows:—

The rim pattern was bedded into the foundry floor to a depth of four inches, dead level (a most important factor in large pulley moulding), the correct depth being gauged by means of the strickle shown to left of sketch in Fig. 2. Following this operation, the inside of the rim was rammed up to within six inches of the upper edge, the arms and lower half of hub being next bedded to place correctly by using the small L shaped template shown to right of the same drawing.

A cheek or midpart approximately 2 ft. 8 in. square by 6¼ in. deep was now placed on the parting left by the strickle

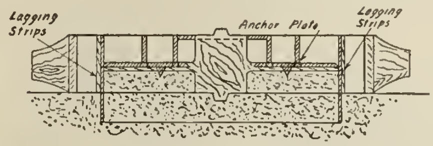


FIG. 3. JOBBING PULLEY PRACTICE.

above mentioned, and an anchor plate used regularly for the production of 2 ft. 0 in. pulleys lowered on the parting between the arms. Lagging strips 6¼ in. deep by 1¼ in. wide and ½ in. thick were next placed around the outside circumference of the rim pattern to bring up to required diameter, plus contraction and machining allowances; the mould at this stage being shown in cross section and plan by Figs. 3 and 4 respectively.

The cheek and anchor plate were next rammed up to lip of rim in the ordinary way, the upper parting made, the cope rammed up, and guide stakes driven in

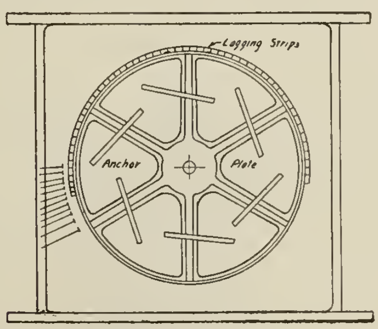


FIG. 4. JOBBING PULLEY PRACTICE.

handle corners. Following this the cope was lifted off and the rim pattern drawn.

The anchor plate with upper half of hub was next removed, the hub pattern drawn downwards, and the plate placed temporarily on a board as indicated at Fig. 5. The cheek was then lifted off, arms and lower half of hub drawn out and finished, and the lower four inches

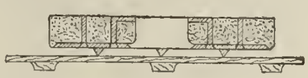


FIG. 5. ANCHOR PLATE ON BOARD.

of rim filled in with sand to lower parting level. This operation is shown partly completed at Fig. 6.

The hub core was next placed in position, and the mould closed and made ready for pouring, being so shown in cross section at Fig. 7. With the object of removing surplus weight thrown on the rim owing to the increased diameter, as well as to secure perfect balance, a cut was taken off the inside of

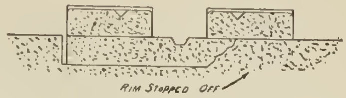


FIG. 6. JOBBING PULLEY PRACTICE.

the pulley whilst machining. The finished casting was delivered several hours ahead of schedule.

SAFETY FIRST — THE SHEET METAL PUNCH PRESS.

By J. H. Rodgers.

ONE of the greatest opportunities for the demonstration of "safety first" is in the protection of the operator on the

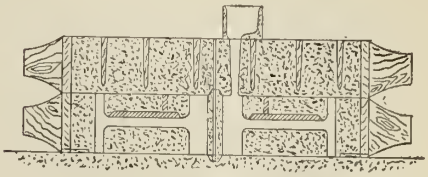


FIG. 7. FINISHED MOLD.

ordinary sheet metal-working punch press.

A very large percentage of accidents to hands and fingers of men and boys in the metal working industries can be traced back to the stamping press, and in many cases when an accident happens, the operator will say that the press "repeated." This may or may not have been the case, but, if the press did "repeat," it was due largely, if not entirely, to neglect on the part of the operator in not allowing the latch to engage the clutch pin and thereby release the press.

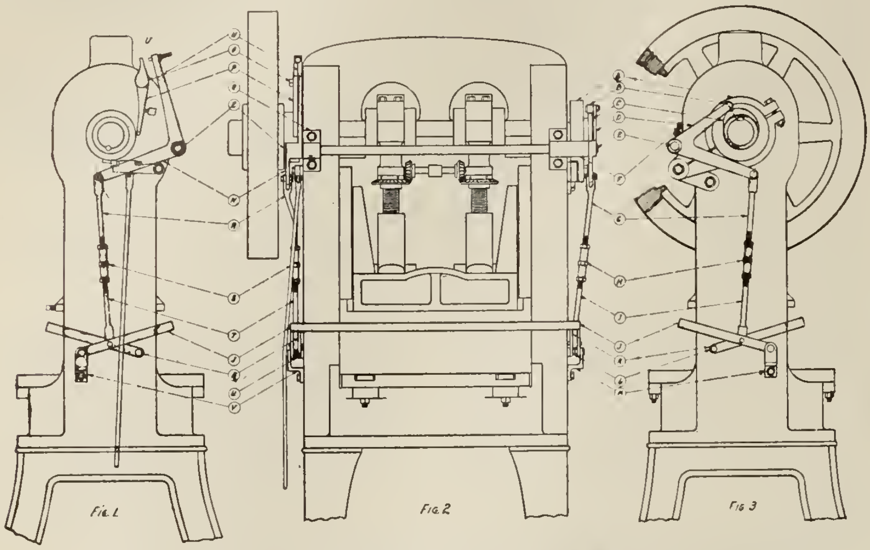
In the operation of most punch presses the foot is pressed down on a treadle, which pulls the stop latch away from the clutch pin. This clutch pin, by action of a spring, is forced in contact with the clutch which revolves the crank shaft. Removing the foot from the treadle, the latch returns to its former position and engages the clutch pin, thereby releasing the clutch when the shaft has made one revolution.

In many cases the operator, instead of removing his foot, will allow it to return to its former position with the treadle, and it is just at this point that the primary cause of many accidents becomes evident. Many operators, when keeping their foot upon the treadle, do not allow it to raise to its proper position, and instead of the latch engaging with the clutch pin the full amount, in a large number of instances, the contact is scarcely one-sixteenth of an inch.

Now this condition of affairs neither facilitates the operation of the press nor increases the output, while, on the other hand, an opening is left whereby any unforeseen incident, as his chair being jarred, a noise attracting his attention, etc., might cause the attendant to depress his foot before the proper time, and allow the press to operate or "repeat."

Many different styles of guards are now in service to reduce the possibility of accident, and these have had varying degrees of success. To produce a device that will protect (to the maximum) the operator in the performance of his duties, has been for years the desire of many an enterprising mechanic.

The object of this article is to place before the readers of **Canadian Machinery** a safety device for power presses and analogous machines, which has been developed and patented by Wright & Stacey, of Hamilton, Ont., and is manufactured by The Brown, Boggs Co., of that city.



SAFETY DEVICE FOR POWER PRESSES AND ANALAGOUS MACHINES.

Safety Device Features.

The accompanying drawing shows the device applied to a double crank arch press, and protecting both the front and rear of the press. Fig. 1 shows a view from the clutch end of the press; Fig. 2, a rear view; and Fig. 3, a view from the brake end.

Secured to the brake end of the crank shaft is the cam C, which engages with the roller B carried on the upper arm of the bell crank D, which is secured to one end of the shaft E. Connected to the lower arm of the bell crank D are the rods G and I (adjustable with the right and left hand nut H). Rod I supports one end of the guard bars J and K.

Attached to the opposite end of shaft E is the bell crank N, which supports the other end of the guard bars J and K by means of the rods R and T and the adjusting nut S. The stud O carries the stop dog P, one end of which rests against the clutch hub of the press in such a position as to engage with the clutch pin when the crank shaft has moved through a portion of a revolution.

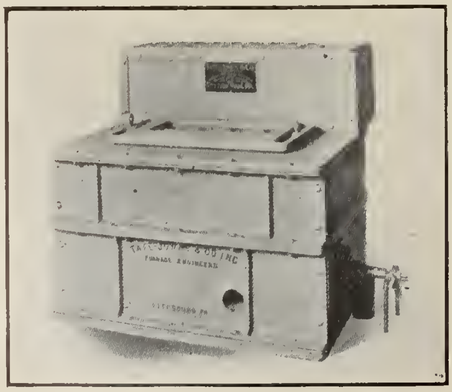
Operation.

The operation of the mechanism is as follows: The treadle of the press is lowered in the ordinary manner, allowing the ram to descend. Immediately the crank shaft—and also the cam C—revolve, the guard descends. If all is clear, the bars J and K will drop to their extreme position and allow the screw U to come in contact with the upper tail of the stop dog P, at the same time removing the opposite end sufficient to allow the press to complete one operation.

If, on the other hand, the operator's fingers, or hand, or any obstruction prevents the guard bars from reaching the safety position, the screw U does not reach the tail of the stop dog P. The opposite end will then engage with the clutch pin and disengage the clutch, stopping the press.

PREHEATED LEAD BATH FURNACE FOR SHELLS.

THE furnace here illustrated has a lead bath, 12 in. wide, 24 in. long, and 12 in. deep. At one end of the bath there is arranged a suitable pocket to accommodate the pyrometer couple. The lead bath proper is covered by a cast iron plate, through which are eight openings for inserting shells. The furnace is specially designed for Russian type shells, these being placed in the already mentioned holes open end up. Plugs in these open ends force the shell down into the lead, until each plug strikes the top plate.



PREHEATED LEAD BATH FURNACE FOR SHELLS.

There is sufficient bath in the pot, so that when eight shells are inserted the surface of the lead is up to the bottom of the plate covering the pot, and the shell is immersed to within about 1 in. of its top. As these shells are nosed after the heat-treating operation, this 1 in. receives heat treatment at that time.

In the preheating chamber to the rear of the furnace there is room for twenty shells. The hot gases from the combustion chamber of the furnace pass through this preheating chamber, heating up these shells, and thus taking advantage of considerable heat that would otherwise be wasted.

A distinctive feature of this furnace is the fact that the combustion chamber is entirely separated from the chamber in which the pot rests, the heat passing from one chamber to the other through suitable openings and being distributed evenly over the surface of the pot. The design eliminates excessive heating of the pot at any one point, thereby increasing the life of the pot itself and the furnace proper. Tate-Jones & Co., Pittsburg, Pa., manufacture this product.

BRASS MIXTURES FOR PLUMBERS AND STEAMFITTERS.

By P. W. Blair.

THE wide variety of its application in commercial and artistic lines gives to the making of brass a scope unequalled by few metals. A mixture or alloy designed for any given purpose may be useless for any other purpose. Therefore, the mixture of the metal for any purpose of manufacture is of the most importance. The compound must be so prepared that it will fully meet the conditions under which the article manufactured will be used. Owing to the hard usages and wear that plumbing and steam brass goods are subjected to, and the constant pressure on same, manufacturers of the above lines are improving the quality and alloys of metals they use in the manufacture of this line of goods.

The leading concerns employ a metallurgist in their foundry and know how to mix their metals by analysis and practice by scientific melting in place of the rule and thumb method previously employed, and get results.

The leading authorities on brass goods differ on the question of what really makes the best mixture, but they are agreed that copper in excess of zinc produces the best grade of brass. Copper, however, has inherent defects as a metal which must be overcome by the judicious use of alloys.

Mixture for Good Results.

The following compound is recognized by the leading metallurgists to produce the best results for plumbing and steam brass goods:

Copper	85
Zinc	6
Lead	4
Tin	5
	100

This produces what is known commercially as red brass, in contra-distinction to yellow brass, which contains less copper and more zinc, and is consequently a much less expensive metal, and which is also of more coarse grain metal and more brittle.

The mixture I have just given the above formula for, might with propriety be called a bronze composition, as it does not differ materially from the bronze formula given by Hirons, the English authority, which is:

Copper	84.0
Tin	2.9
Lead	4.8
Zinc	8.3
	100

Melting, Mixing and Casting.

The mode of melting, mixing and casting has an important bearing in the final result. In the manufacture of plumbing and steam brass goods from red brass, the constituent parts are, of course, of the utmost importance in forming the foundation of the goods, and play an important part in the final results. It must be taken into consideration, also that the mere mixing and casting of the metal would of itself fall short of producing a first-class metal, if it were not also for the particular process by which the metal is prepared in the furnace and the manner in which it is handled in the casting.

Red brass has many advantages compared to yellow brass in the manufacture of plumbing and steam brass goods.

It is much more pleasing to the eye.

There is an absence of the cheap brassy appearance of the goods which shows to a pronounced effect where zinc is used in large quantities.

It is more tenacious, closer grained, and tensile strength is far superior.

It is fibrous and more tenacious than yellow brass which by reason of the large percentage of zinc is a crystaline.

On this last point, Arthur H. Hirons, principal of the School of Metallurgy, Birmingham and Midland Institute says: "The pastiness of zinc manifests itself decidedly in alloys immediately below those which are fibrous, becoming more strongly marked as the alloys are rich in zinc. The fracture of these white alloys is for the most part vitreous, and glassy. Brass goods which contain a large proportion of zinc are much more susceptible to the action of water and other fluids, and more especially steam. The goods of this character become pitted because of the presence of zinc and are therefore rendered inefficient.

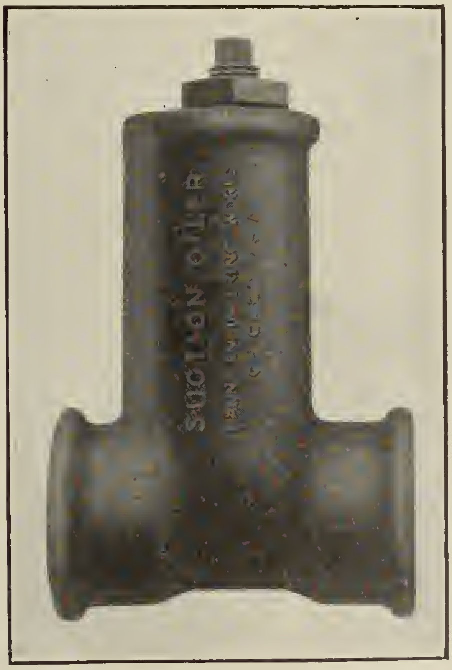
Brass Fittings Underground.

This is especially true of brass goods which are placed in the ground, for then they must resist not only the action of the water and fluids, but also the action of the earth as well.

In its strength and qualities red brass is like a piece of good oak, white yellow brass is like a pine board and its wearing qualities are therefore not comparable with red brass.

VERTICAL TYPE SUCTION OILER.

TO meet the demand for an oiler embodying the same principle as their universal type (a description of which appeared in these columns some time ago), the Hanna Engineering Works, Chicago, have developed the vertical type shown in the accompanying illustration. The operation of these oilers is entirely automatic, because suction action takes place immediately the air moves and ceases the instant the air is shut off. The necessary amount of lubricant at the proper place and time is, therefore, realized. A chamber containing an absorbent is kept saturated from another large oil storage chamber surrounding it, and air passing through the lubricator becomes sufficiently charged with oil to properly lubricate all surfaces with which it subsequently comes in contact.



VERTICAL TYPE SUCTION OILER.

The universal type oiler can be attached to air line in any position, operating equally well in any plane or angle, and can be filled in no matter what position. The vertical type, on the other hand, can be used only in the position shown. These oilers are made with ¾-inch, 1-inch and 1½-inch pipe connections.

TUNGSTEN.

TUNGSTEN is one of the many raw materials, the value of which has been greatly enhanced as a result of the war. It is a most important ingredient of high-speed steel, and the increased demand for that product itself, rendered necessary by shell manufacture, would be sufficient to cause a large advance in price. While most of the tungsten hitherto used in Britain has had to be imported, it is good to know that this metal is now being prepared from raw material obtained in the County of Cornwall, England.

Although most of the tungsten produced by different countries is used in steel making, considerable quantities are required in the manufacture of incandescent electric lamps. The material as received by the lamp makers is in a powdered state, and the Society of Engineers (London) recently had an opportunity of seeing it being made into the thread-like wire so familiar to all users of electricity. The tungsten powder is compressed into small bars by hydraulic pressure, and is afterwards purified at a very high temperature by a hydrogen flame.

After being treated with electricity to increase the solidity, it is gradually swaged down at a high heat, till it is small enough to be drawn through dies in the ordinary wire drawing manner.

It is not real steady service at work that wears out a belt, as a rule, but the overstrain and jerks incident to putting on belts and starting up idle machines. Properly used and cared for, any good belt will last a long time, but continued abuse will ruin the best belt made in a little while.

H. L. Gantt says scientific management will reduce costs, or, what is its equivalent, the time and effort necessary to do a certain amount of work, but it will not solve the labor problem; it will not in the long run tend to raise wages or increase profits. Scientific management is suffering more from the fact that too great claims are being made for it than from anything else. Far more fundamental reforms are necessary.

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Subscribers who are not receiving their paper regularly will confer a favor by letting us know. We should be notified at once of any change in address, giving both old and new.

Vol. VI. AUGUST, 1915 No. 8

PRINCIPAL CONTENTS.

THE "RETURNS" VALUE OF ADVERTISING.

IN the determination to take advertising space in a publication—domestic, trade or technical, what, we ask, are the considerations on which the decision usually depends? At first sight the query would not only seem to be unnecessary, but bear evidence as well of apparent lack of knowledge of human nature. Without, therefore, giving the slightest thought to the matter, a great majority of those appealed to would unhesitatingly reply that at the very least direct results equivalent to the money spent would be desired and ultimately expected.

There is little of sentiment, it would appear, in advertising, as a consequence there is generally little disposition on the part of the advertiser to either realize that he may or should be a benefactor even to a small extent. The general tendency is, as we have already said, towards direct and sufficient-in-value returns. Scant consideration, if any, is extended to what are known as indirect results, the smack of philanthrophy about these being considered altogether "unhealthy" from a business standpoint.

In spite, however, of the views so generally and tenaciously held, and the persistency with which we endeavor to put them into practice, isn't it true that in spite of what we achieve or otherwise in direct results from our advertising, we actually achieve more in the indirect sense, and become in very fact benefactors—even philanthropists in spite of ourselves

Most manufacturing concerns advertise because it pays them to do so; some don't, because they believe they can do equally well without advertising; others again may or may not advertise because of the fact that their particular product belongs to one of a few selective industries in which, although competition may be and is more or less keen, no possible monetary return is realizable.

Concerning the latter classification and specifically those who advertise—quite a few do so, the action taken may be meant to indicate simply a desire to keep the firm name before the public, a by-no-means unwise proceeding. There is, however, much more involved in such advertising than simply keeping one's name before the public, and just here it seems, that, were nothing else considered, some sensible percentage of every advertising appropriation should be excluded from direct results expectations and be ear-marked "the public eye only."

Advertising of any sort has an educative value, the latter being unrestricted to the mere bringing of buyer and seller together. It has made possible the placing in the hands of the public, at little cost, literature which aids them in every conceivable condition, circumstance and difficulty, and in no sphere is this so fully exemplified as in the arts, crafts and manufactures. Publications relative to each of these are recognized necessities, as only through their medium are the administrative and operative staffs of any particular industry kept in prompt, intimate touch with developments which may affect its welfare either way.

Through the opportunity of becoming a subscriber to a trade or technical journal the operative mechanic adds to his capabilities, and as a result enhances his earning capacity relative to his employer as well as to himself. Under such circumstances then, should not a further and quite husky percentage of every advertising appropriation be excised from the direct returns expectation column of the ledger and be esteemed as indirectly reflected in the increased efficiency and output of the shop. It seems to us that even the most progressive of our manufacturers realize in but small degree, if at all, that advertising appropriations are a most potent factor in the education and training of their employees.

Advertising, in that it places within easy reach of operatives of every class and grade a reputable trade or technical journal periodically and regularly, warrants expression of our conviction that whether systematically, intermittently or never practised, there is need for a complete change of viewpoint. The general attitude relative to it is that of an expenditure chargeable to profit and loss account, whereas, when properly considered and allocated, its service rendered belongs more truly to an expenditure on capital account, and is therefore an asset subject to a regular depreciation percentage only.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

ELECTRO-PLATING WITH COBALT.

By D. A. D.

EXPERIMENTS in the electro deposition of the metal cobalt were conducted many years ago by scientists, electro - chemists, electro platers and students in various institutes of learning throughout Europe and North America. Invariably these experiments were performed with solutions which were to a great extent analogous to the then existing nickel plating solutions in practical use, or were slightly modified or altered to meet the supposed requirements of the metal. To this fact may be attributed the lack of interest manifested by the practical plater or progressive manufacturer. The solution possessed no decided advantage over those of nickel. The deposit of cobalt obtained was harder than nickel deposits, but possessed other characteristics which failed to appeal to the lay mind as being permissible in commercial plating.

Recent Experiments and Commercial Tests.

The baths mentioned in this article are the results of extended experiments carried on at the research laboratories of electro-chemistry and metallurgy Queen's University, Kingston, Ontario, under the direction of Dr. Herbert T. Kalmus, and subsequently tested on a commercial scale at the Russell Motor Car Co's plant, West Toronto, by the writer. The cobalt baths in question have been designated Bath 1 B. and Bath XIII B. and are but two of sixteen different solutions studied at Kingston.

The cobalt plates produced by these two solutions are very similar in appearance and both possess several points of superiority as compared with nickel deposits from nickel solutions in general use. The plates are extremely hard and fine grained, resisting moisture and friction remarkably when the thinness of the deposit is considered. The metal may be deposited equally as ductile as nickel and is wonderfully adherent, in fact, the adherent qualities of cobalt deposits from these baths are such as to astonish the average plater Cathode surfaces must be perfectly clean to facilitate perfect plates, as the solution, like nickel is devoid of cleansing properties.

Cobalt Bath I B.

For ordinary plating purposes, or the plating of non-conducting surfaces, Bath I B is recommended. This consists of a nearly saturated solution of Cobalt ammonium sulphate, $CoSO_4\ (NH_4)_2\ SO_4,\ 6\ H_2O$. Two pounds of the crystals are dissolved to each gallon of solution required. The specific gravity at 15 degrees centigrade being 1.053. The bath thus prepared requires no additions to maintain neutrality, and may be immediately employed for coating brass or copper cathodes of small area. Ageing treatment is necessary to bring the bath up to its maximum efficiency and permit the coating of steel or iron cathodes whose areas approximate the anode area.

Ageing Treatment.

The ageing treatment required is of short duration as compared with nickel.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.

Officers:

President—John A. Magill, 591 St. Clarens Ave., Toronto.

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PLACE AND DATES OF MEETING.

The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

Bath I B is operated neutral and produces firm, smooth, white, extremely hard, adherent plates which color very easily to high lustre. An alkaline condition of the bath produces greyish plates which pit, peel and curl. When acid, the bath yields firm, smooth deposits which are quite adherent, but dark and freakish. The anodes remain free from slime and disintegrate very readily, while creeping salts are absent, the bath remaining clean and attractive in every respect. When properly aged and operated neutral with proper current density, the bath throws very satisfactorily into deep recesses and enables the treatment of very irregular pieces to be conducted without unusual care.

Current Densities.

Current densities, ranging from 20 amperes per square foot to 45 amperes per square foot, are recommended as being productive of best results, with bath at room temperature. Warm solutions will permit of much higher current densities; agitated cathodes also facilitate greater speed in plating. As will be seen, this bath yields perfect plates at current densities at least four times greater than the fastest nickel solution generally known, and the bath does not change appreciably in cobalt content or acidity when operated over long periods of time at the high current densities recommended.

The current efficiency of solution I B is as high at 27 amperes per square foot as is common for the best nickel solutions that are used in nickel-plating practice at very much lower current densities. The average of three current efficiency measurements made at Kingston, with solution I B at 27 amperes per square foot, which measurements agreed very well among themselves, was 90.5 per cent. A large proportion of rolled cobalt anodes may be used with either solution without causing the bath to become acid or depleted in metal.

In a double sulphate nickel solution containing 12 oz. of nickel-ammonium sulphate per gallon, there is present about 1.5 per cent. metallic nickel. Prepared nickel salts are sold under trade names and are used on the basis of 2 pounds to the gallon without danger of crystallization. These salts contain approximately 28 per cent. of N_1SO_4; therefore the bath contains about 2.6 per cent. metallic nickel in solution, thus rendering the production of very rapid deposits quite a simple process.

Nickel and Cobalt Bath Comparison.

If we compare cobalt bath I B with the above, we find the latter contains 200 grams of $CoSO_4\ (NH_4)_2\ SO_4\ 6H_2O$ to the litre, or approximately 2 pounds per gallon, which gives a concentration in metallic cobalt of practically 3.0 per cent. A very rapid plating solution should, therefore, be expected. The figures, however, do not account for the vast difference between the two solutions. The cobalt bath is free from any ingredients which are commonly regarded with suspicion by many platers, and which are present in varying quantities in all rapid nickel plating salts. The specific electrical conductivity of cobalt bath I B is very much higher than that of corresponding nickel solutions.

Cobalt Bath XIII B.

This is undoubtedly the most remarkable plating solution known. It has more points of merit which may be turned to economic commercial uses than any electro-plating solution we know of. The principal points of value about cobalt bath XIII B are its self-sustaining powers, its constant efficiency while depositing perfect plates at the extremely high current densities recommended, yielding as it does firm, smooth, hard, adherent plates of splendid color upon brass, iron or steel.

Cobalt bath XIII B does not yield the best deposits at low current densities, such as are used in ordinary nickel-plating practice, but, beginning with current densities in the neighborhood of 32 amperes per square foot, the densities may be increased to over 240 amperes per square foot with solution at ordinary temperature and still cathodes. Combining agitation and higher temperatures, the current densities attainable approach 1,000 amperes per square foot, yielding hard, adherent plates of perfect color, which are easily buffed to a mirror finish on a 6-inch cotton buffing wheel at 1,500 r.p.m.

Bath Speed.

Naturally we might expect such current densities to produce efficient coatings in a very short period of time, and this is true. Cobalt bath XIII B yields plates in from one to three minutes, which equal nickel deposits produced in rapid nickel solutions in one hour. The writer has plated a great variety of metals and alloys with this solution, and found that a one-minute deposit resisted the same tests imposed upon nickel deposits of one hour duration during the finishing of commercial wares. Corrosion tests extending over several months demonstrate the effectiveness of three-minute cobalt deposits as being in every respect equal to 1½-hour nickel deposits.

The speed of this bath is so great that it is practically impossible to operate a 100-gallon bath constantly at the recommended current densities by employing ordinary labor and usual cleaning processes during the operation of a similar volume of nickel solution. For this reason automatic mechanical devices are necessary to convey the work rapidly through the bath, and special cleaning processes are required to facilitate the rapid cleansing of the cathodes. It must also be remembered that the current densities necessary for the best results will necessitate the consumption of a tremendous volume of current in a comparatively small volume of solution.

For example, suppose we have ten plating tanks, each containing 200 gallons of nickel solution and operated at from 4 to 10 amperes per square foot, and, taking the higher density as a basis, we obtain the following:—Each tank has a capacity sufficient to treat 36 square feet of work, which at 10 amperes per square foot totals 360 amperes per tank, and ten tanks at 360 amperes each = 3,600 amperes to economically operate the plant. A dynamo furnishing 5,000 amperes at 5 volts is required. We conclude, therefore, to substitute cobalt solution XIII B for the nicked solutions. One square foot of cathode surface = 157 amperes. One tank of 200 gallons of cobalt solution, XIII B, will treat 36 square feet of work, and 36×157=5,652 amperes.

Our machine, which has previously operated 2,000 gallons of nickel solution, is found to be too small to efficiently operate 200 gallons of cobalt solution XIII B at 157 amperes per square foot treating the full capacity of the bath; therefore, we either reduce the amount of work treated or employ a lower current density. In either case, the total output for one hour will easily equal the total output of ten tanks of nickel solution for one hour, if we can prepare the work and pass it through the cobalt bath sufficiently rapid.

WELDED-UP SCRAP NICKEL ANODES.

Deposits from either bath I B or bath XIII B are ductile, extremely hard, smooth and adherent, and withstand severe bending and hammering tests equally as well as the best nickel-plate. Anodes of extreme purity are obtainable and should be used. The corrosion of the anode proceeds readily, and the bath remains free from precipitated matter such as characterizes the standard commercial nickel-plating solutions.

Cost Feature.

For many purposes, one-quarter the weight of cobalt as compared with nickel is required to do the same protective work. If nickel costs 50 cents per lb. in the anode form and cobalt costs $2 per lb. in the same form, the cost for metal, weight for weight, would be on the same basis. The cost of supplies, repairs, etc., would be less with cobalt, while the size of plant required for given amount of work would be smaller. The former consumption is also less for a given amount of work, while the voltage is not correspondingly greater. Highly-colored ornaments of brass or copper may be adequately coated in 30 seconds, and beautifully finished on a cotton buff without exposing the base metal. Three-minute deposits on steel, brass or copper were perfectly finished on 14-inch cotton buff revolving at 3,600 r.p.m. These same plates would color easily on very small buffs at lower speed, the severe treatment given them not being actually necessary, having been performed as a test of the friction resisting quantities and the hardness of the cobalt plates. Embossed brass pieces, which proved troublesome when plated one hour in nickel solution, were easily colored successfully when plated one minute with cobalt.

By using the solution XIII B, which consists of 4.5 lbs. of cobalt sulphate crystals and 2.5 oz. Na CL per gallon, and boric acid sufficient to nearly saturate the required volume of water, with nickel anodes of great purity, very satisfactory results may be obtained on stove parts or on work where very white backgrounds are necessary. Cobalt deposits on polished surfaces possess a slightly bluish tinge which renders the finish particularly rich and deep in appearance. This feature is the only marked difference in the appearance of cobalt as compared to nickel-plate.

Widespread Interest Aroused.

The above described solutions have attracted widespread interest during the past three months, and promise to revolutionize certain electro-plating processes and methods. The increasing demand for cobalt metal will permit the refiners to treat the ore in larger quantities, and consequently reduce the cost of material to the consumer. The metal is now produced in Canada, and the supply is ample to meet any possible demand. Platers and manufacturers who desire to keep in the front ranks should acquaint themselves with the possibilities of this truly wonderful metal and the remarkable electro-depositing solutions here described. The solutions are not patented; all the required material is easily obtainable, and the operation of the baths will prove instructive, pleasant and interesting.

WELDING UP SCRAP NICKEL ANODES.

SOME important experiments in the welding of nickel anodes by the oxy-acetylene process have just been concluded in the plating department of The Prest-O-Lite Co., Inc., at its Indianapolis plant. As a result of these experiments and tests, worn nickel anodes which have previously been scrapped and sold at less than half-price are now being reclaimed at a saving of more than 100 per cent.

The anodes used are castings of 90 per cent. nickel, 8 per cent. carbon and 2 per cent. iron. They are elliptical bars approximately 1½ in. by 3½ in. cross section, by 30 in. long, and weigh about 30 lbs. Their market value varies between 46c and 50c per lb. On the basis of the latter price, each 30 lb. anode has a value of $15.

By welding up old anodes which have been in the solution, and which have a junk value of between 22c and 25c per lb., this concern is now converting its entire pile of scrap nickel into what are practically new anodes at a total cost for gas and labor of less than 6 cents per lb. This estimate is based on a recent test at Indianapolis, in which 421 lbs. of scrap anodes were welded up at the following costs:

463 cu. ft. oxygen, at 2c.....	$9.26
480 cu. ft. acetylene, at 2c....	9.60
24 hours' labor, at 25c......	6.00
Total	$24.86

In view of the fact that this test was made before any experience in the operation had been gained, it is apparent that better results and greater savings are sure to be the result of practice. The method of handling this operation is about as follows:—

Operation Features.

As the anodes are eaten away by the solution, they are turned over to an oxy-acetylene welder, who "tacks" on scraps of old anodes by welding to increase the surface. One, two, three and sometimes four pieces of scrap are welded on, depending on the size and weight desired.

The welding flame is also employed to remove the brass hooks which are used to support the anodes while in solution. Under the intense heat of the oxy-acetylene flame (approximately 6,300° F.) the solder melts away rapidly, leaving a pure nickel bar, which is later welded up. Thus, by the addition of from, say, 5 to 15 lbs. or more of scrap nickel, a brand new anode, it is claimed, is manufactured at trifling cost, and every bit of scrap is utilized without the loss of a single pound of metal.

No flux is employed, as this has been found to be unnecessary. The pieces of scrap are simply melted-on or "fused" together, using another piece of nickel as a filling rod. The welding process is of great benefit in obtaining perfect fusion, which is essential, as all joints must have electrical conductivity equal to that of new anodes.

Another advantage is that no skill or experience in the art of oxy-acetylene welding is required to weld up scrap nickel anodes—in fact, any workman with average intelligence can do the work without previous knowledge of the process. The apparatus required to do the work is inexpensive.

Many previous attempts have been made to utilize scrap nickel anodes, the most common practice being to drill holes through several pieces and bind them together by means of lead rivets. This method depends upon the contact of the wire or rivet and the piece of scrap to conduct the current, and is, therefore, of uncertain value, and in many cases a flat failure.

COATING IRON OR STEEL WITH LEAD.

COATING the surfaces of iron or steel with lead or its alloys so that a continuous and uniform film is successfully and tenaciously applied is the subject of a recent U. S. patent. It has been granted to Jay C. Beneker, of Cincinnati, Ohio, and covers the coating of relatively corrosive metals with a protecting film. The patentee's efforts have been directed to finding a commercially satisfactory way of producing a better substitute for zinc, and one less costly than tin.

The patentee claims originality in a process based on certain metallurgical and physical discoveries. After the iron or steel surface has been cleaned of scale or oxide, it is subjected to a suitable flux, such as zinc chloride, and submerged in a melted bath of lead containing a little cadmium. Ordinary commercial lead possesses but little affinity for iron, but in the presence of metallic cadmium, even in very small quantities, it will amalgamate with the iron surface so as to cost it with a very thin film.

The inventor, under ordinary practical commercial conditions, preferably uses as small an amount as 0.17 per cent., but can use as high as 1 per cent. of cadmium. The smallest possible amount is recommended, as cadmium is expensive. Since it tends to oxidize and pass into the flux, causing a loss, the addition of about ½ per cent. of zinc to the lead bath prevents this, since the zinc oxidizes first and passes into the flux in preference to the cadmium. Cadmium, being more positive than iron, its presence in the lead tends to protect the iron the same as zinc. It also is claimed to promote and subsequently maintain the adherence of the film of lead.

ZINC SITUATION IN CANADA.

THAT there is a scarcity of zinc in Canada is evidenced by the price to which it has advanced, from six cents a pound at the outbreak of the war to from 22 to 25 cents a pound to-day. Copper, the other metal which forms one of the elements of brass, has advanced from only 15 cents a pound to 20 cents a pound. Yellow brass, although better for shell purposes, is not as high-grade as the red brass, and yet, owing to the advanced price of zinc, it is now dearer. Yellow brass contains about 60 per cent. copper and 40 per cent. zinc, with a trifle of lead, and the red brass about 80 to 90 per cent. copper and 10 to 20 per cent. zinc, with a small portion of tin.

The scarcity of zinc is attributed by the manager of one of the firms manufacturing shells as being due to speculation, and he is of the opinion that the supply is now becoming more plentiful. The war breaking out, he believed, caused to a great extent a cornering of the market.

"The high price of zinc has been caused by a scarcity," said the manager of another firm. "There is no denying that, because the United States has been exporting great quantities of it to Europe ever since the war broke out. Before the war Europe was a large exporter of zinc, and despite the duty, Belgium and Germany were able to place their zinc in the United States and compete with the manufactured product in that country."

Owing to the fact that it was never really a paying proposition to mine zinc in Canada, he was asked about mining it now in Canada in order to furnish a supply to meet the demand, but he said that the zinc ore in Canada was of a poor quality. It was coarse and contained many impurities so that he questioned if the establishment of refineries in Canada would produce the quality of zinc out of the ores needed for the manufacture of shells. It was his opinion that before six months zinc would go up to 50 cents a pound.

As an extinguisher of small fires of oil or grease, sawdust is considered to be much superior to either sand or water. Sawdust, wet or dry, thrown on a blazing liquid has a blanketing action, floating on the surface and keeping out the air, so that it actually smothers the flame. The efficiency of sawdust may be increased by mixing it with sodium bicarbonate, using 10 lb. per bushel of sawdust. The bicarbonate liberates carbon dioxide when heated, this gas smothering the flames. Sawdust is more suitable in cases of fires in an electric plant, as it is easier to handle and spreads more evenly than does sand.

If a man works for you, Mr. Employer, have confidence in him. If he be not deserving of your confidence discharge him at once. Suspicion and aloofness never helped any fellow in any situation.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products

PIG IRON.

Grey Forge, Pittsburgh	$13 20	$13 45
Lake Superior, charcoal, Chicago	.....	15 75
Ferro Nickel pig iron (Soo)	.....	25 00

	Montreal.	Toronto.
Middlesboro, No. 3	$21 00	.....
Carron, special	22 00	.....
Carron, soft	22 00	.....
Cleveland, No. 3	21 00	.....
Clarence, No. 3	21 00	.....
Glengarnock	25 00	.....
Summerlee, No. 1	25 00	.....
Summerlee, No. 3	25 00	.....
Michigan charcoal iron	25 00	.....
Victoria, No. 1	21 00	19 00
Victoria, No. 2X	21 00	19 00
Victoria, No. 2 plain	21 00	19 00
Hamilton, No. 1	20 00	19 00
Hamilton, No. 2	20 00	19 00

METALS.

Aluminum	$ .40
Antimony	.40
Cobalt 97% pure	2.00
Copper, lake	.21
Copper, electrolytic	.20¾
Copper, casting	.20½
Lead	.07¼
Mercury	100.00
Nickel, ingot	50.00
Silver	.48
Tin	.44
Zinc	.25

Prices Per Lb.

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$12 50	$12 50
Copper, crucible	14 50	14 50
Copper, unch-bled, heavy	14 00	14 00
Copper, wire, unch-bled	14 00	14 00
No. 1 machine, compos'n	11 50	12 50
No. 1 compos'n turnings	10 50	9 25
No. 1 wrought iron	6 00	6 00
Heavy melting steel	5 75	6 00
No. 1 machin'y cast iron	10 50	10 50
New brass clippings	12 00	12 00
No. 1 brass turnings	10 00	10 00
Heavy lead	4 50	4 75
Tea lead	3 50	3 50
Scrap zinc	12 00	13 00

COKE AND COAL.

Solvay foundry coke	$5.75
Connellsville foundry coke	4.85-5.15
Yough steam lump coal	3.83
Penn. steam lump coal	3.63
Best slack	2.99

net ton f.o.b. Toronto.

BILLETS.

	Per Gross Ton
Bessemer, billets, Pittsburgh	$22 00
Open-hearth billets, Pittsburgh	22 00
Forging billets, Pittsburgh	28 00
Wire rods, Pittsburgh	25 50

PROOF COIL CHAIN.

¼ inch	$8.00
5-16 inch	5.35
⅜ inch	4.60
7-16 inch	4.30
½ inch	4.05
9-16 inch	4.05
⅝ inch	3.90
¾ inch	3.85
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

MISCELLANEOUS.

Solder, half-and-half	0.26¾
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs, p. cwt.	9.67
Glue, French medal, per lb.	0.18
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.18
Benzine, single bbls., per gal.	0.18
Pure turpentine, single bbls.	0.66
Linseed oil, raw, single bbls.	0.67
Linseed oil, boiled, single bbls.	0.70
Plaster of Paris, per bbl.	2.50
Plumbers' oakum, per 100 lbs.	4.00
Lead wool, per lb.	0.10
Pure Manila rope	0.16
Transmission rope, Manila	0.19½
Drilling cables, Manila	0.17½
Lard oil, per gal.	0.60

SHEETS.

	Montreal.	Toronto.
Sheets, black, No. 28	$3 00	$2 90
Canada plates, dull, 52 sheets	3 25	3 50
Canada plates, all bright	4 40	4 60
Apollo brand, 10¾ oz. (galvanized)	6 40	5 95
Queen's Head, 28 B.W.G.	6 50	6 50
Fleur-de-Lis, 28 B.W.G.	5 75	5 75
Gorbal's best, No. 28	6 50	6 50
Viking metal, No. 28	6 00	6 00
Colborne Crown, No. 28	5 38	5 30

IRON PIPE FITTINGS.

Canadian malleable, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped unions, 65.

ELECTRIC WELD COIL CHAIN B.B.

3-16 in.	$9.00
¼ in.	6.25
5-16 in.	4.65
⅜ in.	4.00
7-16 in.	4.00
½ in.	4.00

Prices per 100 lbs.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium carbonate	.15
Ammonium chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cyanide of potassium (95 to 96%)	.35
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.20
Potassium carbonate	.40
Potassium sulphide	.30
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.08

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper	.25 to .28
Tin	.45 to .50
Silver	.55 to .60
Zinc	.30 to .33

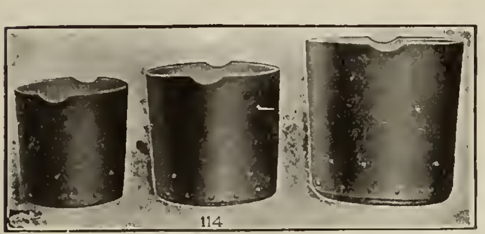
Prices Per Lb.

PLATING SUPPLIES.

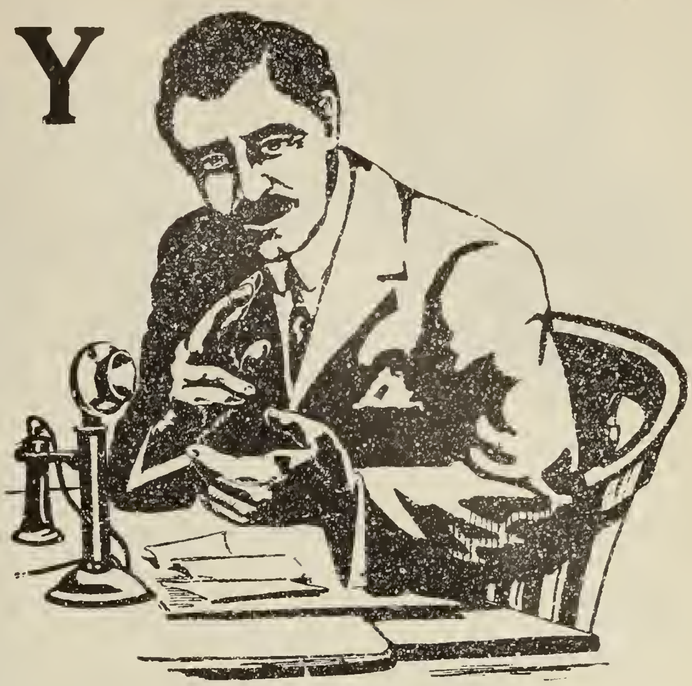
Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck	.80
Emery in kegs	.4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

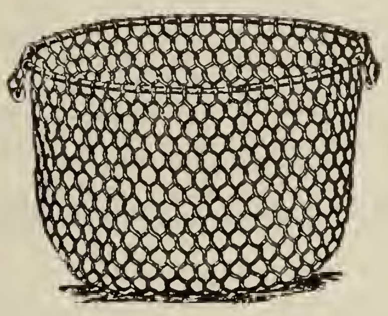
Prices Per Lb.

FOUNDRY
Necessities

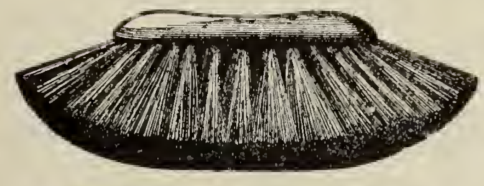


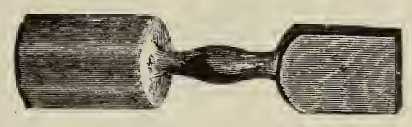
Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.





Coke or Charcoal Basket—Made of Galvanized steel wire.





Bench Rammers—Made from Maple Hardwood well oiled.

SATISFY YOURSELF

by a trial order. Just **one** will be sufficient to convince you that we really do supply **FOUNDRY NECESSITIES** of unrivalled quality, with promptness and at the minimum price.

These goods are

MADE IN CANADA

which is a good sign because it means a home-made product with the consequent advantage in shipping facilities over goods that have to be imported, which must, moreover, incur duty charges before entering Canada.

Plumbago, Stoveplate Facing, Core Wash, Core Compound, either Powder or Liquid form, **Partine Charcoal, Fire Brick and Clay** are included in our stock. We have other lines, and you can get to know all about them by writing for our catalog.

Let us prove our claims TO YOU.

The Hamilton Facing Mill Company, Limited

HAMILTON, CANADA

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Toronto, Ont., Aug. 10, 1915.—There is little change to note in the industrial situation, conditions being much the same as during the last few weeks. Compared with conditions prevailing one year ago, the business outlook is favorable, and the steady improvement in trade is distinctly encouraging. Perhaps the most interesting feature is the improvement in the steel trade. Twelve months ago, conditions in the steel trade were very quiet and production had fallen off considerably. Now the mills are very active, and working almost to capacity. Production is practically all on account of the war. The crop reports generally are very favorable, and if the yield is as good as is anticipated, it will be of the greatest benefit to the country.

The trade returns for the Dominion for the last fiscal year recently published by the Department of Trade and Commerce contain some interesting figures. The imports of merchandise fell off by nearly 163 million dollars, as compared with 1914, while the exports showed an increase of a little more than four millions. The encouraging feature, however, is the fact that for the first time in many years the balance of trade in regard to exports and imports is in Canada's favor. This condition is, of course, entirely as a result of the war. The increase in exports of manufactured goods being one of the principal reasons for the favorable trade balance.

Steel Market.

The outlook in the steel trade continues to improve, which is due almost entirely to war business. Canadian mills are operating almost to capacity, and, in addition to the output of forgings and bars for shells, are producing other steel products, both finished and semi-finished.

It is reported that negotiations are pending between the Dominion Steel Corporation and the French Government for a large order of finished shells. It is understood that, while nothing has been definitely settled, a contract will be signed at an early date. If this business is closed the outlook in the shell industry will improve considerably, as it may lead to other orders for shells being placed here in addition to those being handled by the Shell Committee. It is rumored that the Russian Government has awarded another large contract for shells to the Canadian Car and Foundry Co. In any case it is extremely probable that it will be distributed among the same concerns in the States as the previous contract, and so will not be of any particular interest to manufacturers on this side of the line.

Prices on bars, plates, and small shapes are holding very firm, and higher prices for Pittsburgh products may be expected any time. Boiler tubes have advanced approximately $1 per 100 feet. Wrought iron pipe is very firm and an advance is expected in the near future. Galvanized sheets are easier to obtain, and spelter has declined somewhat. Some makers are still out of the market, and are only filling up old contracts. Prices of galvanized sheets are unchanged but have an easier tendency. The black sheet market is steadily gaining strength and quotations are firm with an upward tendency.

ALLIES' PURCHASING AGENTS.

The Trade and Commerce Department, Ottawa, has published the following list of purchasing agents for military purposes for the allied Governments:—

International Purchasing Commission, India House, Kingsway, London, Eng.

French.—Hudson Bay Co., 56 McGill Street, Montreal; Captain Lafoulloux, Hotel Brevort, New York; Direction de l'Intendance Ministere de la Guerre, Bordeaux, France; M. De la Chaume, 28 Broadway, Westminster, London.

Russian.—Messrs. S. Ruperti and Alexsieff, care Military Attache, Russian Embassy, Washington, D.C.

The high-speed tool steel situation is acute, and fears are expressed that the shortage will be very serious, if it has not already become so.

The conditions in the steel trade in the States continue to improve, and big business is being done in rounds for shells. Mills are so well supplied with orders for bars that they are conservative about taking on any more tonnage, although large orders are offering from foreign countries. The market is well established at $1.30, Pittsburgh, and it is expected that $1.35 will soon prevail.

Pig Iron.

Furnaces connected with steel plants continue active, but the demand for foundry iron is light. The pig iron situation is improving in the States, and prices have a higher tendency.

Scrap Metals.

The market for heavy melting steel is active, and quotations firmer. Prices of copper and brass scrap are holding firm on good demand. Scrap lead is quiet, and prices have a weaker tendency. Zinc is quiet, and unchanged.

Metals.

Continued weakness characterizes the metal markets. There has been no sign of a recovery during the week, and the weakness has been further intensified in the London market by the depression following the fall of Warsaw. While this loss indicates that the war will be prolonged and therefore increases demand for munitions and their many dequirements, yet for the time being these facts have been offset by the psychological aspect of the situation. The metals principally affected are tin, copper, spelter and lead, which have all declined in London, and also locally, with the single exception of copper, which, although dull, is unchanged. The antimony spot market is easier, but quotations are unchanged. The volume of business continues good, and compares very favorably with conditions prevailing twelve months ago, altogether apart from the increase in the demand for metals for munitions.

Tin.—The market in London is depressed and has declined again. Conditions in the States are good, but the New York market has been affected in sympathy with London. There is some scarcity of spot tin, and if there were a better tone in the market, a recovery might be expected. Tin has declined 1c, and is quoted locally at 41c per pound.

Copper.—The depression caused by the fall of Warsaw has unsettled the market, but quotations have been maintained. The prospect of a war of longer duration improves the position of copper owing to the consequent larger demand for this metal. The market is dull and prices are unchanged at 21c per pound.

Spelter.—The market is weak, and lower with little buying. There is an entire absence of inquiry, and efforts to draw bids from buyers have met with little success. The scarcity of spot spelter has been largely overcome by the output of the smelters. Export orders have dropped off, and although these have been large over recent months, the shipments represent orders placed some time ago. Spelter has declined 2c and quotations are nominal at 23c per pound.

Lead.—There is practically no demand for lead, and the market is weak. It is extremely probable that the "Trust" will have to reduce their prices. Local

HINTS TO BUYERS

WINNING THE BUYER'S FAVOR

THE best possible buyer is not made an actual buyer at a single step. It is one thing to win the buyer's favor for an article and another to make adjustments incident to closing the sale. Winning the buyer's favor is the work of trade paper advertising. Under ordinary conditions it should not be expected to do more.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

prices have declined ¼c, and quotations are nominal at 7c per pound.

Antimony.—The spot market is easier, but there is a good inquiry for extended futures. Supplies of antimony are easier to obtain, but quotations are unchanged, and nominal at 40c per pound.

Aluminum.—There is no improvement in the situation as regards scarcity of aluminum. The market is firm and quotations nominal at 40c per pound.

BIG INCREASE IN EXPORTS.

THE anniversary of Great Britain's declaration of war directs attention to Canada's accomplishments and some of the more outstanding results of the conflict as affecting this country.

The initial step, taken before the formal declaration of war, was the offer by the Prime Minister of military assistance in the event of hostilities. Immediately after the war broke out, a complete Canadian division was accepted and hurried mobilization and equipment arranged for. It started on the 25th September, 1914, wintered at Salisbury, and in early spring went to France. The story of St. Julien, Ypres, Festubert, and Givenchy speaks of the character and the results.

70,000 Are Overseas.

Since then there has been more and steady recruiting, till about 140,000 men have been enlisted. Of this number upwards of seventy thousand are now overseas. Reinforcements are going ahead constantly. It is the intention to maintain in the field two complete divisions, and a third one may, quite possibly, be put there. In fact, there is no telling to what extent Canadian resources of men and munitions may be drawn on. A Russian retirement in the east and the return westward of German hordes might easily produce conditions calling for much greater assistance from this country than has heretofore been thought necessary.

Exports Have Increased.

The war has interfered with trade, and has completely changed the balance of it, so much so that last month the figures of export exceeded imports by thirty-five millions. Import trade has dwindled materially, while exports, raw and manufactured, have much increased. While many lines of business have been adversely affected, the war has stimulated industry connected with munitions and equipment for the forces.

An estimate of war orders in Canada places the total at approximately three hundred and fifty million dollars. This includes orders by the Canadian and allied governments. Orders for shells alone are estimated at one hundred and fifty-two million dollars. About 160 factories are turning them out.

Revenue Goes Up.

The revenues, which immediately started to decline after the war, were not very successfully arrested by the taxes imposed at the special session of Parliament in August. Those adopted by the last budget, however, have caused the revenue since then to equal and in most cases exceed what it was in the ante bellum months of last year. The war is being financed by British loans, while public works are being carried on by loans from Britain and the United States. The small jobs have been shut down, but the big undertakings are all going ahead. This policy has been followed from the start.

Canada has spent nearly a hundred millions on the war. It costs three hundred millions to run the country this year, and of this amount the war is costing half a million a day. The big item of outlay is the pay of officers and men. On equipment, about thirty millions has so far been spent. Speaking financially, while money is available for war purposes, municipal corporate or individual borrowings have been greatly restricted. There is no prospect of the flotation of a loan in Canada for the reason that all the money available is needed for commercial domestic purposes.

Just at present efforts are being concentrated upon recruiting of the new regiments and their equipment. The work has gone ahead splendidly, but the figures of enlistment in the past month admit of improvement. This applies to all military divisions, but it is quite probable that harvesting activities have much to do with the situation, and that when they are finished, enlistment will rapidly be augmented.

CANADIAN GOVERNMENT PURCHASING COMMISSION.

The following gentlemen constitute the Commission appointed to make all purchases under the Dominion $100,000,000 war appropriation:—George Gault, Winnipeg; Henry Laporte, Montreal; A. E. Kemp, Toronto. Thomas Hilliard is secretary, and the commission headquarters are at Ottawa.

Trade Gossip

The Hamilton Facing Mill Co., Hamilton, Ont., have increased their capital stock to $75,000.

Toronto, Ont.—The Canada Metal Co. are making extensions to their factory at a cost of $15,000.

Calgary, Alta.—The Canadian Pacific Railway is increasing its shell-making facilities at the shops here.

Welland, Ont.—The Canadian Billings & Spencer Co. will purchase forge and metal-working machinery to cost $30,000.

Lachine, Que.—The city council has awarded the contracts for the supply of cast-iron water pipe to the Dominion Bridge Co.

Lieut-Colonel Thomas Cantley has been elected president of the Nova Scotia Steel & Coal Co. He will also retain the position of general manager.

Windsor, Ont. — The city council awarded the contract for the supply of cast iron water pipe to the National Iron Works, Ltd., Toronto, at $30.25 per ton, and for specials, valves, hydrants, etc., to the Kerr Engine Works, Walkerville, Ont.

Canada's Trade Balance.—The effect of war munitions exports is being shown in the fact that Canada is now building up a favorable trade balance from month to month. In June the excess of exports over imports was $11,716,000, in May $7,689,678, and in April $300,000, a favorable balance for the quarter of $19,705,678. In the previous quarter there was an adverse balance against this country of about $5,000,000. With the prospect for a heavy balance on the right side this fall, owing to the record crop promised, the outlook in this respect is distinctly favorable.

Steel of Canada Outlook.—In circles close to the Steel Company of Canada, the greatest satisfaction is expressed over the outlook. The company had to take some losses in the first quarter of the calendar year, but these have long since been made up, and it is predicted that the results of this year will be fully up to those of 1913, when the company enjoyed a profitable period. The corporation is turning out 200 tons of finished steel product per day, and this presumably will be increased as soon as the new open hearth steel furnace is finished.

Catalogues

Steel Castings, the product of foundries at Windsor, Ont., and Detroit, Mich., are illustrated and described in a catalogue recently issued by the Swedish Crucible Co. The special "Pyro" brand steel castings are included among the others, and in this connection are a few suggestions for successful carbonizing practice.

Frankfort Furnaces made by the Strong, Carlisle & Hammond Co., Cleveland, Ohio. Catalogue No. 7 describes the various types of 'Frankfort' furnaces and states for what work each is specially adapted. Tables are included giving dimensions and other particulars for each size, while the concluding pages are devoted to various types of oil and gas burners, tanks, pyrometers, melting pots, etc.

Grinding and Polishing Machines made by J. G. Blount Co., Everett, Mass. A new catalogue, No. 17, describes at length a complete line of grinding and polishing machinery and speed lathes. Specifications giving the principal dimensions of each type of machine are included and numerous illustrations show the distinctive features embodied in the design of the various types. Copies may be had on application.

Electric Furnaces made by the Canadian Hoskins, Ltd., Walkerville, Ont., are described in bulletin No. 12. Full particulars are given covering the construction, temperatures, operation and uses of furnaces, together with dimensions and price of each size. Other lines dealt with include thermo-electric pyrometers, portable and wall meters, etc. Inserted leaflets illustrate and describe the "Stewart" combination furnace, gas and oil furnaces and a recalescent outfit. The catalogue is fully illustrated.

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WANTED—FOUNDRY FOREMAN WITH EXperience in Cupola management. Principal work, marine gasoline motors. A first-class position for a capable workman. State salary, and apply with recommendations to Bruce Stewart & Co., Limited, Charlottetown, P.E.I.

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Air Compressors.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
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Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
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Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
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Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
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Whiting Foundry Equipment Co., Harvey, Ill.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
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Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
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Cars, Core Oven.
H. S. Carter & Co., Toronto.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Pangborn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

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Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chemicals.
W. W. Wells, Toronto.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
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Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
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Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

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H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
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H. S. Carter & Co., Toronto.
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Monarch Eng. & Mfg. Co., Baltimore.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Walkerville, Ont.
Osborn Mfg. Co., Cleveland, O.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.

H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.

Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Graphite Products.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Grinders, Disc, Bench, Swing.

Ford-Smith Machine Co., Hamilton, Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.

Geometric Tool Co., New Haven, Conn.

Helmets.

Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.

Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.

A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.

Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.

Can. Niagara Device Co., Bridgeburg, Ont.

Ingot Metals.

Frankel Bros., Toronto.

Iron Cements.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.

Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).

J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

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Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.

Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.

H. S. Carter & Co., Toronto.

Mixers.

Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.

H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.

Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.

Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.

Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.

Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works,

Pattern Shop Equipment.

H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.

Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.

McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.

H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.

W. W. Wells, Toronto.

Pneumatic Paint Spray.

Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.

W. W. Wells, Toronto.

Ramming Plates and Machines.

Canadian Ingersoll-Rand Co., Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Retorts.

Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rosin.

Webster & Sons, Ltd., Montreal.

Rouge.

W. W. Wells, Toronto.

Sand Blast Machinery.

Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.

Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.

Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Molding.

H. S. Carter & Co., Toronto.
Hamilton Facing Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.

H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.

Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.

Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.

Pangborn Corporation, Hagerstown, Md.

Sieves.

Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Silica Wash.

Webster & Sons, Ltd., Montreal.

Small Angles.

Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Special Machinery.

Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Squeezers, Power.

Davenport Machine & Foundry Co., Iowa.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Steel Rails.

Dom. Iron & Steel Co., Sydney, N.S.

Steel Bars, all kinds.

Dom. Iron & Steel Co., Sydney, N.S.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Talc.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Taps.

Geometric Tool Co., New Haven, Conn.

Teeming Crucibles and Funnels.

McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.

Geometric Tool Co., New Haven, Conn.

Track, Overhead.

Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tripoli.

W. W. Wells, Toronto.

Trolleys and Trolley Systems.

Can. Fairbanks-Morse Co., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks, Dryer and Factory.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tumblers.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.

Turntables.

H. S. Carter & Co., Toronto.
Northern Crane Works, Walkerville.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Vent Wax.

H. S. Carter & Co., Toronto.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Vibrators.

Berkshire Mfg. Co., Cleveland, O.
Canadian Ingersoll-Rand Co., Ltd., Montreal.

Wall Channels.

Dom. Iron & Steel Co., Sydney, N.S.

Welding and Cutting.

Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.

Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Wire Wheels.

Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
W. W. Wells, Toronto.

Wire, Wire Rods and Nails.

Dom. Iron & Steel Co., Sydney, N.S.

ADVERTISING INDEX

A Real Service to Fit Your Foundry

OSBORN

The foundry equipment and service offered under the Osborn trade-mark are comprehensive.

We can help any foundry, at any stage of development in mold-making, to better profits.

Here are five typical kinds of foundries, say. The first is all hand-work, and each of the others goes beyond its predecessors in advanced methods.

One of these represents conditions in your foundry—or perhaps your conditions blend from those of one class into the other.

Whatever kind of foundry your foundry is, Osborn can help you to *more profits and to growth.*

How Foundries Grow with Osborn Service

A Statement of Typical Conditions

First Stage

Osborn furnishes the materials and accessories that are regularly used in hand-molding—riddles, shovels, core-ovens, malleable stars, ladles, etc., etc.

Second Stage

A step beyond the primitive methods of all-handwork come auxiliary machines for increasing output and lowering costs—automatic riddles, sand mixers and similar machines that represent the first steps toward labor-saving.

Third Stage.

After these come the simpler types of molding machines, semi-automatic in operation, multiplying production but depending less upon the molder's skill and making better use of it. This is the great field of small-lot work, and of the Osborn Plain-Jolt, Roll-Over and Squeezer machines.

Fourth Stage.

The next step provides automatic machines which depend little on the operator's skill, though he needs some knowledge of molding to gain a high output. This is the field of moderate to large quantities. The Osborn Stripper-Squeezer, Direct-Draw Roll-Over Jolt, Jolt-Stripper and similar machines are consistent profit-makers.

Fifth Stage.

Here the most advanced type of machine, specially built for one kind of work only is demanded, and here Osborn machines and the Osborn Engineering service have a world-wide reputation. No skill is required for the operation of such Osborn machines, and no more knowledge of molding than that of the foundry laborer. In this field are the biggest profits and the greatest opportunities for this is the field of rapid, economical, continuous production of certain types of work which are difficult, comparatively slow and attended by more or less waste under any other methods. Conspicuous instances of Osborn service and equipment of this nature will be gladly furnished you if you will write us.

OSBORN

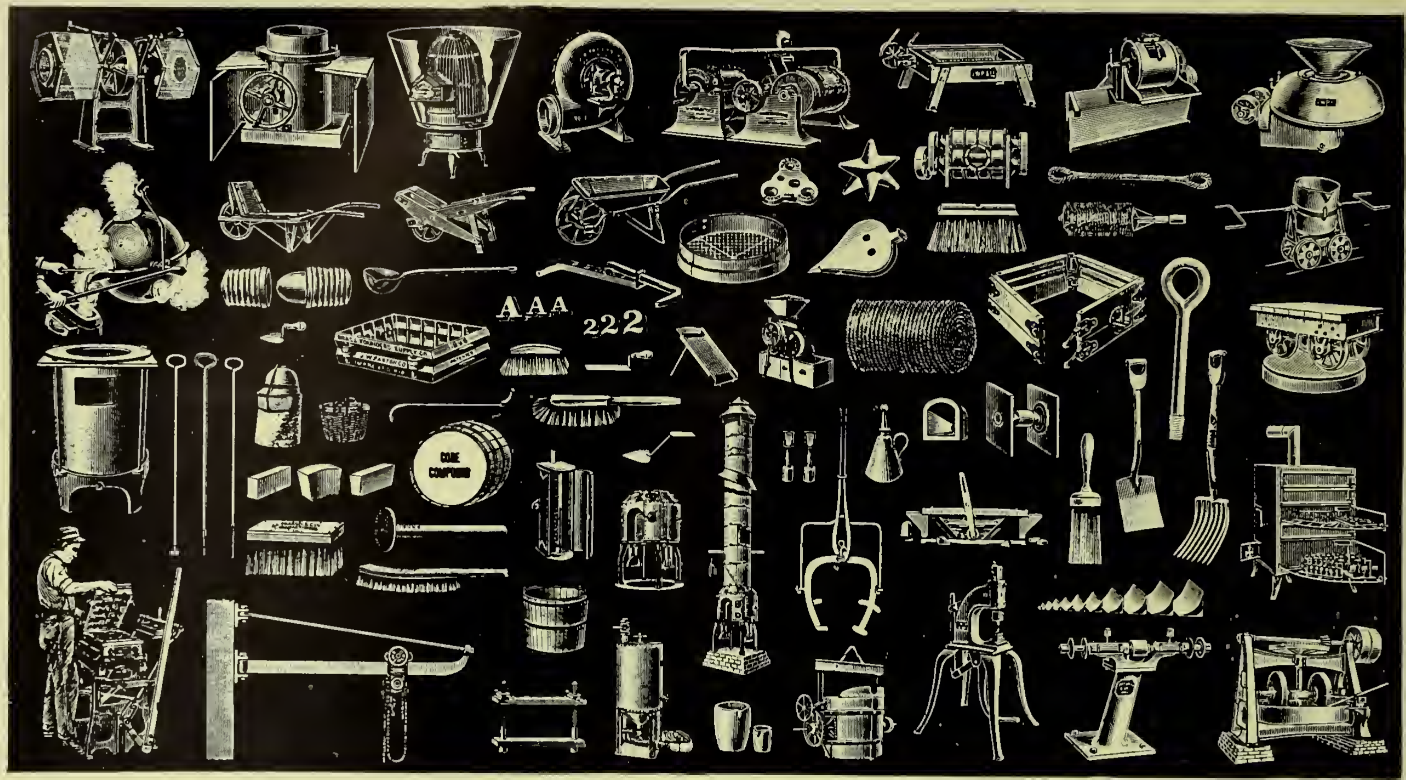
Learn to know this trade-mark for what it means as a guarantee of advanced methods. It is much more than a mere guarantee of the machine or article on which it appears.

DON'T be satisfied with your present production, or your present profits, until you *know* how they compare with what you *might have* under better methods. We will gladly help you to find out what your possibilities are, if we may—and that without obligation on your part.

THE OSBORN MANUFACTURING COMPANY

MOLDING MACHINES AND ACCESSORIES, FOUNDRY SUPPLIES

CLEVELAND	MILWAUKEE	SAN FRANCISCO	NEW YORK
5401 Hamilton Avenue	S Water and Ferry Sts.	61 First Street	204 Centre Street



Meritorious

Foundry Equipment and Supplies

and a distinctive kind of service

Our foundry and furnace equipment is made to fill the requirements of the largest and most progressive foundries, and its service and results show it.

Our stock of foundry supplies comprises what we believe (after many years of diligent search) to be the best that can be produced anywhere.

Our reputation stands back of every line that we sell to the trade—**we realize** that it's to our interest that our goods give a maximum of service and satisfaction.

Our service—the right goods at the right price, delivered on the dot.

May we prove ourselves by filling your next requirements?

Correspondence invited.

Webster & Sons, Limited

31 Wellington Street **MONTREAL, P.Q.**

Successors to F. HYDE & COMPANY

PRE-CONVENTION NUMBER

CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

VOL. VI. PUBLICATION OFFICE, TORONTO, SEPTEMBER, 1915 No. 9

THE MACLEAN PUBLISHING COMPANY, LIMITED

MONTREAL TORONTO WINNIPEG NEW YORK CHICAGO BOSTON LONDON, ENG.

The Publisher's Page

By B.G.N.

WATCH FOR IT!

¶ The October issue of CANADIAN FOUNDRYMAN will be our Annual Convention Number.

¶ It will prove unusually interesting and instructive, containing, as it will, a full report of the proceedings at the 1915 Annual Convention of the American Foundrymen's Association, which will be held in Atlantic City.

¶ Canadian foundrymen who are unable to attend the Convention, will have it brought to their doors in all the permanence and interest of the printed word. Our report will be liberally illustrated and some of the most important papers will be reproduced in our October Number.

THE EXHIBITS

¶ The tenth Annual Foundry and Machine Exhibition, with its interesting and instructive exhibits, will be perpetuated in word and picture, and buyers and probable buyers should preserve our Convention Number for reference purposes.

¶ The outlook for business is becoming better every day, and you may soon want to know what to buy, and where to buy it quickly. Let us suggest that you keep for reference purposes both this and our October number.

¶ The firms whose advertising you will find in these two issues, frankly solicit your orders, and are prepared to do business on a basis that will prove eminently satisfactory to the Canadian buyer.

CANADIAN FOUNDRYMAN

143-153 UNIVERSITY AVE. ∴ ∴ TORONTO, CANADA

The HEART of a MUMFORD JOLT RAMMER

DURABLE

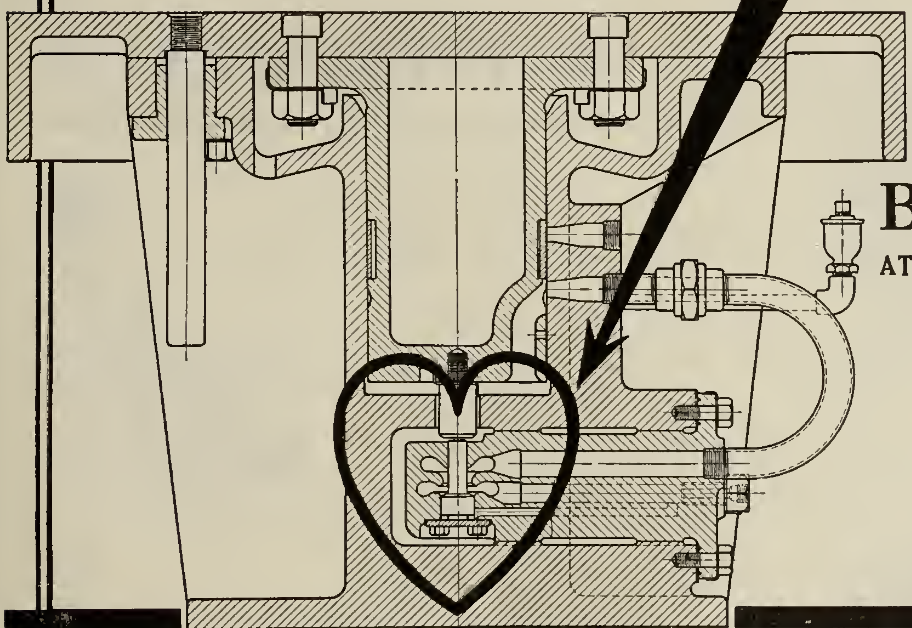
Because it is of one piece, hardened and ground, working vertically and entirely enclosed.

POSITIVE

Being air-operated in one direction to close—opens as table impacts on bumper frame.

SIMPLE

For it is without springs or complicated valve operating mechanism.



VISIT
BOOTH 170
ATLANTIC CITY, SEPT. 24-OCT. 1

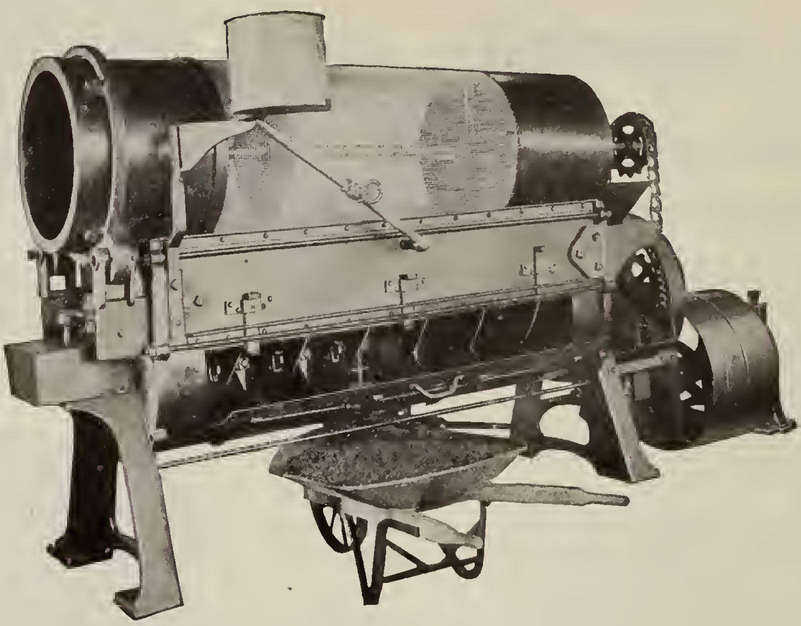
MUMFORD MOLDING MACHINE CO. **CHICAGO**

SALES AGENT:
VULCAN ENGINEERING SALES COMPANY
2067 Elston Avenue CHICAGO, U.S.A.
Foreign Agent: J. W. JACKMAN & CO., Caxton House, London

STANDARD BATCH MIXERS

LESSEN

- Labor
- Binder
- New Sand
- Bad Castings
- Bad Cores
- Gas
- Cleaning

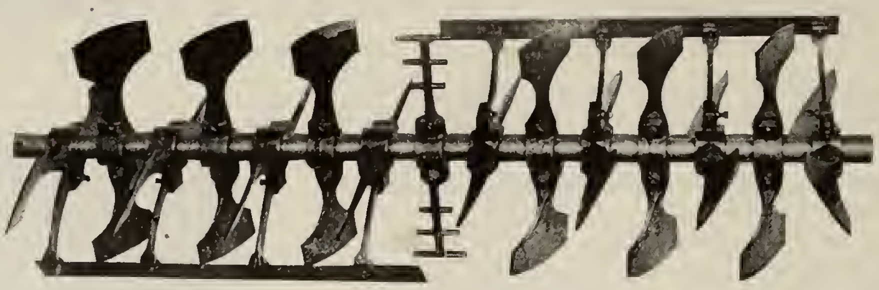


ADD

- Dividends
- Good Castings
- Good Cores
- Thorough Mixing
- Old Sand
- Strength
- Finish

No. 3 Standard Batch Mixer

You get the good things and eliminate the bad with a Standard.



These are the paddles used in a Standard, which *mix* the sand 100 times a minute and not merely turn it over as you would with a shovel. That is why foundries tell us they save from 5% to 50% of Binder.

Size.	Floor Space	Capacity Per Batch	H. P.	Size T & L Drive Pulleys	Speed Counter Shaft
No. 0-A	2′ x 6′ 9″	4 cu. ft.	3	20 x 4	150 R. P. M.
No. 1	2′7″x 8′ 7″	6 cu. ft.	4	26 x 6	95 R. P. M.
No. 2	2′7″x 9′ 9″	7½ cu. ft.	5	26 x 7	95 R. P. M.
No. 3	2′7″x10′11″	9 cu. ft.	6	26 x 8	95 R. P. M.
No. 4	4′9″x12′	27 cu. ft.	20	26 x 10	280 R. P. M.

There is a Standard for every size foundry. One to sixty tons per hour.

Write for new prices.

The E. J. WOODISON CO., Canadian Agents.

The Standard Sand & Machine Co., Cleveland, Ohio

Will Stand Up Under All Conditions

Particularly Adapted for Foundry Use

Thor

The Best Constructed Air Tools Ever Made

The Greatest Satisfaction Assured

Thor, God of Thunder, was the mightiest of all the Gods of Norse Mythology. No task was too difficult for him to perform.

"THOR" PNEUMATIC TOOLS like the original Thor, are undisputed leaders.

If another tool will do it, a "Thor" will do it easier and cheaper.

Size H—"Thor" Pneumatic Grinder

Speed 3,000 R.P.M. Made light for portable use. Equipped with wheel guard for safety. Fitted with *Roller Bearings* on each end of crank shaft, thus reducing friction and insuring greatest durability.

"Thor" Chipping Hammer
Type "L" Open Handle

Built especially for foundry service. Valve is so perfectly balanced that vibration is practically eliminated. Made in various sizes for chipping, calking and beading flues.

Type L Pistol Grip Pneumatic Hammer Chipping Casting

We wish to sell you Thor Pneumatic Tools, not on promises, but on actual results.

Therefore send at once for our latest Bulletin V. Look it over thoroughly, let us know in what you are interested.

We will be glad to send you what you desire on free trial—entirely at our expense.

Write Us Immediately

Independent Pneumatic Tool Company

334 St. James Street, MONTREAL, QUEBEC

W. H. Rosevear & Son, Winnipeg, Man.

The Coming Foundrymen's Convention and Exhibition

The privilege of spending a week in Atlantic City with its health-bracing and pleasure-giving opportunities may at any time be considered acceptable. There is, therefore, little doubt that, with the added features of a thoroughly installed and attractively displayed exhibition of foundry equipment and supplies, and an unusually high-grade programme of interesting and instructive work-a-day topics arranged for discourse and discussion, foundrymen from all over the United States and Canada will make their presence felt on this occasion in numbers greatly exceeding those of even the most successful of past similar functions.

THE selection of Atlantic City, N.J., as the meeting place for the 1915 Annual Convention of the American Foundrymen's Association and of the American Institute of Metals may justly be stated as a happy choice. The fact also that the Foundry & Machine Co. Exhibition is again found in co-operation leaves nothing to be desired by even the most fastidious or critical. It has been stated—and with more real truth than the mere words express—that the whole eastern section of the country have united as hosts to return the hospitality tendered at similar functions held in recent years in Toronto, Detroit, Cincinnati, Pittsburgh, Buffalo, and Chicago. This is clearly indicated by the fact that the local committee is formed of prominent foundrymen, chosen from the States of Pennsylvania, New Jersey, New York, Connecticut, Rhode Island and Massachusetts.

Its central location and excellent transportation facilities make Atlantic City easily accessible, while its proximity to Philadelphia and New York, in which districts are to be found many large and varied foundry establishments, gives unlimited scope and opportunity to such as may desire to visit and inspect lay-out and operation systems with which they may be unfamiliar, but by which they may profit. At the various sessions of the American Foundrymen's Association and the American Institute of Metals 63 papers and reports will be presented and discussed. In quality and variety the papers are fully equal to those presented at previous meetings and the programmes have been arranged to stimulate the fullest possible discussion.

Both societies will hear the reports of committees that have been at work throughout the year, and it is expected that an unusual volume of valuable foundry information and data will become available through this source. The exhibition will have the advantage of an ideal location which precludes the possibility of overcrowing and inconvenience and affords unusual facilities for the display of working equipment. The entertainment features of the week will be unique and of a character such as can only be found at Atlantic City.

The tenth annual foundry and machine exhibition, under the auspices of the Foundry & Machine Exhibition Co., will open Saturday morning, September 25, and close Friday evening, October 1. The convention proceedings will open at 10 a.m. Tuesday, September 28, with a joint meeting of the American Foundrymen's Association and the American Institute of Metals.

The registration bureaus for both associations, which will be located on the pier, will open Monday morning, September 27. The headquarters of the American Foundrymen's Association and the American Institute of Metals will be at the Hotel Traymore, the latest addition to Atlantic City's galaxy of hostelries. The headquarters for the Machine & Exhibition Co. will be at the Hotel Dennis.

Thursday, September 30, has been set aside as "Philadelphia Day" and an effort will be made to close all Philadelphia foundries on that day to enable the employees to attend the convention and exhibition. The annual joint banquet of the American Foundrymen's Association and the American Institute of Metals will be held Thursday evening, September 30, in order to give as many of the Philadelphia visitors as possible an opportunity to attend.

The American Foundrymen's Association will introduce an innovation by holding its annual business meeting on Wednesday evening, September 29, instead of on Friday morning as heretofore.

Exceptional facilities are, we understand, being provided for operating exhibits. Electric current, both direct and alternating, will be available at various voltages, while exhibitors of pneumatic machinery will have as usual an unlimited supply of compressed air. Steam as a motive power will also be on tap. The various convention programmes are as follows:—

YOUNG'S MILLION DOLLAR PIER WITH FOUNDRY AND MACHINE CO. AND FOUNDRYMEN'S CONVENTION HEADQUARTERS IN FOREGROUND.

American Foundrymen's Association

TUESDAY, Sept. 28, 10 a.m. CONVENTION HALL

Joint session, American Foundrymen's Association and American Institute of Metals.

Addresses of welcome and response.

Report of A. F. A. committee on safety, by A. W. Gregg, chairman, Bucyrus Co., South Milwaukee, Wis.

"Tests of Lenses for Foundry Goggles," by F. W. King, Julius King Optical Co., New York. This address will be accompanied by a demonstration of a lens testing machine and a colored spectroscopic test showing scientifically, colors of lenses used in dangerous conditions of light and glare.

Report of A. F. A. committee on industrial education, by Frank M. Leavitt, chairman, University of Chicago, Chicago.

"Functions of Sand Binders," by Henry M. Lane, consulting foundry engineer, Trussed Concrete Bldg., Detroit.

"Notes on Applications and Characteristics of Cores in Modern Molding," by R. A. Bull, Commonwealth Steel Co., Granite City, Ill.

"Molding Sands," by C. P. Karr, associate physicist, Bureau of Standards, Washington, D.C.

Appointments of nominating and resolutions committees.

TUESDAY, SEPT. 28, 2.30 p.m. CONVENTION HALL

Report of A. F. A. committee on specifications for foundry scrap, by S. D. Sleeth, chairman, Westinghouse Air Brake Co., Wilmerding, Pa.

"Patternmaking for Molding Machine Work," by E. I. Chase, Cadillac Motor Car Co., Detroit.

BEACH SCENE, ATLANTIC CITY.

"Foundations for Jar-Ramming Molding Machines," by E. S. Carman, Osborn Mfg. Co., Cleveland.

"The History and Development of the Molding Machine with Sidelights on Latter-Day Practice," by J. J. Wilson, Cadillac Motor Car Co., Detroit, and A. O. Backert, The Foundry, Cleveland.

"Scientific Management and Its Relation to the Foundry Industry," by H. K. Hathaway, Tabor Mfg. Co., Philadelphia.

"Reclaiming Molding Sand," by W. M. Saunders and H. B. Hanley, Saunders & Franklin, analytical and consulting chemists, Providence, R. I.

"The Relation of the Foundry Foreman to His Employer," by S. V. Blair, Rushville, Ind.

TUESDAY, SEPT. 28, 8 p.m.

Theatre party for members and ladies of the American Foundrymen's Association and the American Institute of Metals.

WEDNESDAY, SEPT. 29, 10 a.m. CONVENTION HALL

"The Modern Foundry Advance," by Dr. Richard Moldenke, consulting metallurgical engineer, Watchung, N.J.

"Manufacture, Constituents and Essentials in the Purchase of Pig Iron for Foundry Use," by Oliver J. Abell, The Iron Age, Chicago.

Report of the A. F. A. committee on costs, by B. D. Fuller, chairman, Westinghouse Electric & Mfg. Co., Cleveland.

Organization in the Foundry of the University of Illinois Shop Laboratories," by R. E. Kennedy and J. H. Hogue, instructors, University of Illinois, Urbana, Ill.

"The Structural or Mechanical Theory of the Effect of Rust on Cast Iron and Wrought Iron or Steel," by R. C. McWane, publisher of The Fire Engineer, and Harry Y. Carson, Central Foundry Co., New York.

WEDNESDAY, SEPT. 29, 2.30 p.m. CONVENTION HALL

Gray Iron Session

"Pouring Systems for Gray Iron Foundries," by H. Cole Estep, associate editor, The Foundry, Cleveland.

"Fuel Oil Cupolas," by Bradley Stoughton, consulting metallurgical engineer, New York City.

"Inspection of Automobile Castings," by C. B. Wilson, Wilson Foundry & Machine Co., Pontiac, Mich.

"Common Defects in Gray Iron Castings—Their Causes and Remedies Therefor," by Herbert M. Ramp, Elmwood Castings Co., Cincinnati.

Report of A. F. A. committee on specifications for gray iron castings, by W. D. Putnam, chairman, Detroit Testing Laboratory, Detroit.

Report of A. F. A. committee on standard methods for analyzing coke, by H. E. Diller, chairman, General Electric Co., Erie, Pa.

WEDNESDAY, SEPT. 29, 8 p.m., HOTEL TRAYMORE

Annual Business Session

Annual address of the president, R. A. Bull, Commonwealth Steel Co., Granite City, Ill.

Report of the secretary-treasurer, A. O. Backert, Cleveland.

Report of the auditor.

Report of the nominating committee.

Election of officers.

THURSDAY, SEPT. 30, 10 a.m. AND 2.30 p.m. CONVENTION HALL AND ANNEX

Steel Sessions

"Dynamic Properties of Steel Employed in the Manufacture of Castings of Various Types," by J. Lloyd Uhler, Union Steel Casting Co., Pittsburgh.

"The Particular Application of the Converter in the Manufacture of Steel Castings," by C. S. Koch, Fort Pitt Steel Casting Co., McKeesport, Pa.

"Notes on Electric Furnace Construction and Operation in the Steel Foundry," by James H. Gray, U. S. Steel Corporation, New York City.

"Open-Hearth Furnace Checker Design," by W. A. Janssen, Bettedorf Co., Davenport, Iowa.

"Causes of Shrinkage Cracks in Steel Castings," by William R. Bossinger, Marion Steam Shovel Co., Marion, O.

Report of A. F. A. committee on specifications for steel castings, by W. C. Hamilton, American Steel Foundries, Granite City, Ill.

Report of A. F. A. committee on steel foundry standards, by Dudley Shoemaker, American Steel Foundries, Indiana Harbor, Ind., and R. A. Bull, Commonwealth Steel Co., Granite City, Ill.

"Notes on Arc Welding," by Robert Kinkead, Lincoln Electric Co., Cleveland.

Malleable Sessions

"Some Remarks Regarding the Permissible Phosphorus Limit in Malleable Iron Castings," by Prof. Enrique Touceda, Rensselaer Polytechnic Institute, Albany, N.Y.

"Standardization of Air Furnace Practice," by A. L. Pollard, Johnston Harvester Co., Batavia, N.Y.

"An Outline to Illustrate the Interdependent Relationship of the Variable Factors in Malleable Iron Practice," by L. E. Gilmore, Baltimore Malleable & Steel Co., Baltimore.

Paper on malleable practice, by J. P. Pero and J. C. Nulsen, Missouri Malleable Iron Co., East St. Louis, Ill.

"Coal—Its Origin and Use in the Air Furnace," by F. Van O'Linda, Consolidation Coal Co., Chicago.

THURSDAY, SEPT. 30, 7 p.m., HOTEL TRAYMORE

Annual banquet.

FRIDAY, OCT. 1, 10 a.m. CONVENTION HALL

Introduction of new officers.

Report of committee on resolutions.

Appointment of standing committees.

Unfinished business.

American Institute of Metals

TUESDAY, SEPT. 28, 10 a.m. CONVENTION HALL

Joint meeting with the American Foundrymen's Association. (For details see A. F. A. program.)

TUESDAY, SEPT. 28, 2 p.m. HOTEL TRAYMORE

General Papers

Report of official chemist, by Arthur D. Little, Inc., Boston.

"An Investigation of Fusible Tin Boiler Plugs," by Dr. G. K. Burgess, Bureau of Standards, Washington, D.C.

"The Influence of the Impurities of Spelter on the Cracking of Slush Castings," by Gilbert Rigg, New Jersey Zinc Co., Newark, N.J.

"Cobalt in Non-Ferrous Metals," by H. T. Kalmus, Kalmus, Comstock & Westcott, Cambridge, Mass.

"Furnace Methods for Pure Castings," by F. L. Antisell, Raritan Copper Works, Perth Amboy, N.J.

"Standard Test Specimen of Zinc-Bronze: Cu. 88, Sn. 10, Zn. 2. Relation of the Mechanical Properties to the Microstructure," by Dr. H. S. Rawdon, Bureau of Standards, Washington, D.C.

"Notes on the Copper-Rich Kalchoids," by S. L. Hoyt, University of Minnesota, Minneapolis.

TUESDAY, SEPT. 28, 8 p.m.

Theatre party.

WEDNESDAY, SEPT. 29, 10 a.m. HOTEL TRAYMORE

"The Effect of the Present European War on the Metal Industries," by Thos. F. Wettstein, United Lead Co., New York.

"Sherardizing," by Dr. S. Trood, U. S. Sherardizing Co., New Castle, Pa.

"Electric Furnace for Brass Melting," by F. A. S. Fitzgerald, Fitzgerald Laboratories, Niagara Falls, N.Y.

"Substitutes and Alloys to Take the Place of Platinum," by W. E. Mowrey, St. Paul, Minn.

"Alloys of Nickel, Chromium and Copper," by David F. McFarland and O. E. Harder, University of Illinois, Uurbana, Ill.

WEDNESDAY, SEPT. 29, 2 p.m. HOTEL TRAYMORE

Aluminum and Aluminum Alloys

"Aluminum Die Castings," by Chas. Pack, Doehler Die Casting Co., Brooklyn, N.Y.

"The Manufacture and Use of Alumino-Vanadium," by Wm. W. Clark Seymour Mfg. Co., Seymour, Conn.

"Recent Advances in the Manufacture and Uses of Aluminum," by E. V. Pannell, British Aluminum Co., Toronto, Ont.

"The Welding of Aluminum," by E. V. Pannell, British Aluminum Co., Toronto, Ont.

"Aluminum Bronze Alloys," by W. M. Corse, Titanium Alloy Mfg. Co., Niagara Falls, N.Y.

THURSDAY, SEPT. 30, 10 a.m. HOTEL TRAYMORE

Acid Metals and Bearing Bronzes

"Development of an Acid-Resisting Alloy," by S. W. Parr, University of Illinois, Urbana, Ill.

"Methods of Analysis for Complex Alloys," by S. W. Parr, University of Illinois, Urbana, Ill.

"Effect of Zinc on Copper, Tin, Lead Alloys," by G. H. Clamer, Ajax Metal Co., Philadelphia.

"The Advantages of a Standard Railway Journal," by Russell R. Clark, Pennsylvania Railroad, Pittsburgh.

THURSDAY, SEPT. 30, 2 p.m. HOTEL TRAYMORE

Forging and Rolling Alloys

"Forging Manganese Bronze," by Jesse L. Jones, Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.

"The Failure of Structural Bronzes," by Dr. P. D. Merica, Bureau of Standards, Washington, D.C.

"Experiences with Brass in Civil Engineering Work," by A. D. Flinn, board of water supply, New York.

"Stellite," by Elwood Haynes, Haynes Stellite Works, Kokomo, Ind.

THURSDAY, SEPT. 30, 7 p.m. HOTEL TRAYMORE

Annual banquet.

Plant Visitation

A large number of important foundries have agreed to throw open their doors to the visitors. Among those may be mentioned the following:—

Southwark Foundry & Machine Co., Philadelphia.

American Engineering Co., Philadelphia.

Girard Iron Works, Philadelphia.

Sheeler-Hemsher Co., Philadelphia.

Eynon-Evans Mfg. Co., Philadelphia.

Baldwin Locomotive Works, Philadelphia.

J. W. Paxson Co., Philadelphia.

Tabor Mfg. Co., Philadelphia.

Isaac A. Shepherd & Co., Philadelphia.

R. D. Wood & Co., Philadelphia.

Wm. Sellers & Co., Inc., Philadelphia.

Ajax Metal Co., Philadelphia.

Thomas Devlin Mfg. Co., Philadelphia.

Niles-Bement-Pond Co., Philadelphia.

American Steel Foundries, Chester, Pa.

Seaboard Steel Casting Co., Chester, Pa.

Worth Bros. Co., Coatesville, Pa.

Baldt Steel Co., New Castle, Del.

The committee in charge of plant visitation is as follows:—

H. W. Brown, chairman, Tabor Mfg. Co., Philadelphia; Harry E. Asbury, Enterprise Mfg. Co., Philadelphia; W. J. Coane, Ajax Metal Co., Philadelphia; Geo. C. Davies, Pilling & Crane Co., Philadelphia; Harry Drinkhouse, Thos. Devlin Mfg. Co., Philadelphia; Thomas Evans, Eynon-Evans Mfg. Co., Philadelphia; Chas. H. Harrar, Midvale Steel Co., Philadelphia; J. S. Hibbs, J. W. Paxson Co., Philadelphia; Wilfred Lewis, Tabor Mfg. Co., Philadelphia; Geo. F. Pettinos, Pettinos Bros., Bethlehem, Pa.; Wm. H. Ridgway, Craig Ridgway & Son Co., Coatesville, Pa.; F. L. Shepherd, I. A. Shepherd Co., Philadelphia; A. G. Warren, J. W. Paxson Co., Philadelphia; and Robert Wetherill, Jr., Robert Wetherill & Co., Chester, Pa.

For the Devotees of Golf

To afford the visiting foundrymen an opportunity to indulge in the favorite pastime of golf, special arrangements have been made with the Country Club of Atlantic City for the use of its course at Northfield, N.J. This feature is in charge of a special committee, whose members will afford the golf devotees every assistance to indulge in this favorite sport. The committee is constituted as follows:—H. M. Bougher, chairman, J. W. Paxson Co., Philadelphia; Peter S. Brauscher, Philadelphia & Reading Railroad, Reading, Pa.; W. J. Coane, Ajax Metal Co., Philadelphia; Wm. J. Devlin, Thomas Devlin Mfg. Co., Philadelphia; Howard Evans, J. W. Paxson Co., Philadelphia; Howard C. Matlack, Marshall, Matlack Co., Philadelphia; H. P. Rebman, American Engineering Co., Philadelphia; Otto Schaum, Schaum & Uhlinger Co., Philadelphia; J. H. Sheeler, Sheeler, Hemsher Co., Philadelphia; W. P. Smith, Wm. Cramp Ship & Engine Building Co., Philadelphia; and E. P. Williams, Baldwin Locomotive Works, Philadelphia.

Local Convention Committee

The local convention committee includes the following:—

Thomas Devlin, chairman, president Thomas Devlin Mfg. Co., Philadelphia; W. H. Bassett, vice-president American Institute of Metals, American Brass Co., Waterbury, Conn.; Henry A. Carpenter, vice-president American Foundrymen's Association, General Fire Extinguisher Co., Providence, R.I.; A. F. Corbin, president New England Foundrymen's Association, Union Mfg. Co., New Britain, Conn.; Alex. T. Drysdale, vice-president American Foundrymen's Association, United States Cast Iron Pipe & Foundry Co., Burlington, N.J.; Stanley G. Flagg, Jr., past president American Foundrymen's Association, Stanley G. Flagg & Co., Philadelphia; H. W. Gillett, vice-president American Institute of Metals, Ithaca, N.Y.; Dr. Richard Moldenke, past secretary, American Foundrymen's Association, Watchung, N.J.; Geo. C. Stone, vice-president American Institute of Metals, New Jersey Zinc Co., New York; A. W. Walker, past president, American Foundrymen's Association, Walker & Pratt Mfg. Co., Boston, and Walter Wood, vice-president American Foundrymen's Association, R. D. Wood & Co., Philadelphia.

List of Exhibitors.

Ajax Metal Co., Philadelphia, Pa.
Arcade Mfg. Co., Freeport, Ill.
E. C. Atkins & Co., Indianapolis, Ind.
Ayer & Lord Tie Co., Chicago.
Berkshire Mfg. Co., Cleveland, O.
Chas. H. Besly & Co., Chicago.
S. Birkenstein & Sons, Chicago.
Blystone Mfg. Co., Cambridge Springs, Pa.
Brass World and Plater's Guide, New York City.
Brown Specialty Machinery Co., Chicago.
Buch Foundry Equipment Co., Bridgeport, Pa.
Buckeye Products Co., Cincinnati, O.
Carborundum Co., Niagara Falls, N.Y.
Cataract Refining & Mfg. Co., Buffalo, N.Y.
Charles J. Clark, Chicago.
Clark Foundry Co., Rumford, Me.
Clearfield Machine Shops, Clearfield, Pa.
Cleveland Automatic Machine Co., Cleveland, O.
Cleveland Pneumatic Tool Co., Cleveland, O.
Clipper Belt Lacer Co., Grand Rapids, Mich.
Geo. P. Clark Co., Windsor Locks, Conn.
Joseph Dixon Crucible Co., Jersey City, N.J.
Electric Controller & Mfg. Co., New York.
Felt & Tarrant Mfg. Co., Chicago.
Factory (A. W. Shaw Publishing Co.), Chicago.
Gardner Machine Co., Beloit, Wis.
General Electric Co., Schenectady, N.Y.
Goldschmidt Thermit Co., New York.
Graceton Coke Co., Graceton, Pa.
Great Western Mfg. Co., Leavenworth, Kansas.
F. A. Hardy & Co, New York.
Hayward Co., New York.
Herman Pneumatic Machine Co., Zelienople, Pa.
The Herold Bros. Co., Cleveland, O.
Hill & Griffith Co., Cincinnati, O.
Hunter Saw & Machine Co., Pittsburgh, Pa.
Ingersoll-Rand Co., New York.
International Molding Machine Co., Chicago.
International Steam Pump Co., New York.
The Iron Age, New York.
Iron Tradesman, Atlanta, Ga.
Jennison-Wright Co., Toledo, O.
Julius King Optical Co., Chicago.
Landis Tool Co., Waynesboro, Pa.
Lehigh Coke Co., South Bethlehem, Pa.
Lincoln Electric Co., Cleveland, O.
David Lupton's Sons Co., Philadelphia, Pa.
J. S. McCormick Co., Pittsburgh, Pa.
McCrosky-Reamer Co., Meadville, Pa.
MacLean Publishing Co., Toronto, Ont.
The Macleod Co., Cincinnati, O.
Mahr Mfg. Co., Minneapolis, Minn.
Malleable Iron Fittings Co., Branford, Conn.
Midland Machine Co., Detroit, Mich.
Monarch Engineering & Mfg. Co., Baltimore, Md.
Mott Sand Blast Mfg. Co., Chicago.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago.
Metal Record and Electro-Plater, Bridgeport, Conn.
National Engineering Co., Chicago.
New Haven Sand Blast Co., New Haven, Conn.
The Norma Company of America, New York
Norton Co., Worcester, Mass.
S. Obermayer Co., Chicago.
Osborn Mfg. Co., Cleveland, O.
Oxweld Acetylene Co., Chicago.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Penton Publishing Co., Cleveland, Ohio.
Pickands, Brown & Co., Chicago.
Henry E. Pridmore, Chicago.
Philadelphia Bourse, Exhibition Dept., Philadelphia, Pa.
Railway Age Gazette, Chicago.
Ready Tool Co., Bridgeport, Conn.
Richey, Brown & Donald, Inc., New York.
Robeson Process Co., New York.
Rogers, Brown & Co., Cincinnati, O.
Sand Mixing Machine Co., New York.
Shepard Electric Crane & Hoist Co., Montour Falls, N.Y.
W. W. Sly Mfg. Co., Cleveland, Ohio.
R. P. Smith & Sons, Chicago.
Snyder Electric Furnace Co., Chicago.
Standard Sand & Machine Co., Cleveland, O.
Sterling Wheelbarrow Co., West Allis, Wis.
W. F. Stodder, Syracuse, N.Y.
Strong, Kennard & Nutt Co., Cleveland, O.
Sullivan Machinery Co., Chicago.
Tabor Mfg. Co., Philadelphia, Pa.
Thomas Iron Co., Easton, Pa.
Titanium Alloy Mfg. Co., Niagara Falls, N.Y.
Union Steam Pump Co., Battle Creek, Mich.
U. S. Graphite Co., Saginaw, Mich.
Waterbury Welding Co., Waterbury, Conn.
Westinghouse Electric & Mfg. Co., East Pittsburgh, Pa.
White & Bro., Inc., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.
T. A. Willson Co., Reading, Pa.
E. J. Woodison Co., Detroit, Mich.
T. B. Wood's, Sons Co., Chambersburg, Pa
Wyoming Shovel Works, Wyoming, Pa.

Steel Ingots for Guns.—Prof. J. O. Arnold, of Sheffield University, at the Royal Institution, said that the managing director of Krupps told him that they were making steel ingots weighing 110 tons for guns by the crucible process evolved 175 years ago by an Englishman—Benjamin Huntsman. Neither the Germans nor the Americans could produce the Sheffield white crucible, however. That was a secret handed down from father to son in Sheffield. In the North of England they were making ingots weighing 150 tons, and there were 12,000-ton presses squeezing out armor plate like cheese.

Radiator and Boiler Manufacture in a Modern Foundry

Staff Article

The production of steam and hot water heating apparatus is a highly specialized development in modern iron founding. Systematic care and increasing attention are necessary for the continued production of satisfactory work.—In the following article a brief description is given of a visit to one of those plants which have earned for Canadian manufacturers in this line, an enviable reputation for quality of product, due to good workmanship and material.

THE No. 3 plant of Steel & Radiation, Ltd., is situated on the outskirts of the town of St. Catharines, Ont., a progressive and flourishing community of over 14,000 inhabitants. The Grand Trunk Railway System supplies convenient transportation facilities and the comparatively close proximity of such manufacturing centres as Toronto, Hamilton, Welland, Niagara Falls, and Buffalo, ensures a favorable market in which to secure labor, materials, etc. The plant, which is comparatively new specializes in apparatus for steam and hot water heating and full advantage has been taken of such methods and equipment as can be adopted where high class repetition work is required.

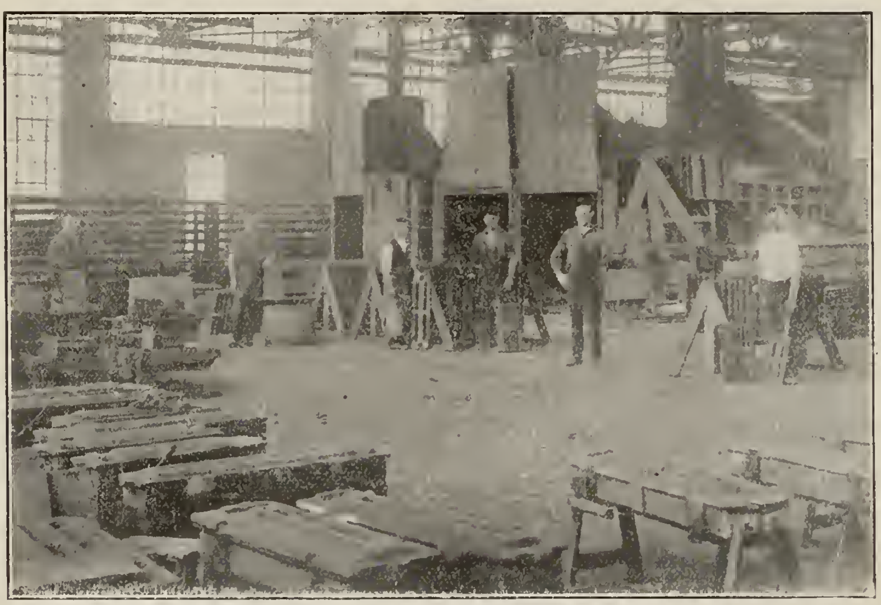


FIG. 1. FINISHED CORE AND CORE OVEN DEPARTMENT.

Buildings

The buildings consist of three principal bays running north and south and connected by a spacious cross aisle. The pattern shop, pattern store, and stock room are separately housed in detached buildings to the north of the main structure. All of the buildings are of modern design, an important constructional feature being the liberal use made of "Fenestra" steel sash, which is manufactured in Canada by this company. The efficiency of this product in providing light and ventilation is widely recognized, and its use, combined with ample height and floor space, provides ideal conditions for foundry operations. With the exception of the moulding department which is paved with brick, the shop has wooden floors throughout and in all respects is thoroughly representative of this particular sphere of modern foundry practice.

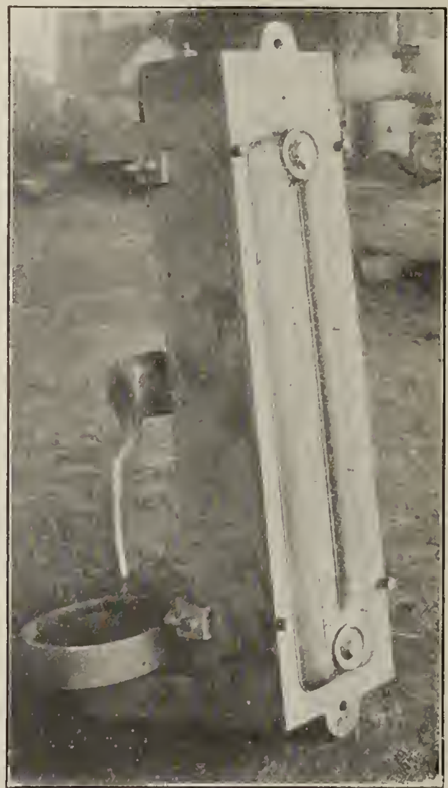


FIG. 2. MOLDING MACHINE FOR RADIATOR SECTIONS.

FIG. 3. RADIATOR MOLDING SHOP.

Raw material consisting of pig iron, coke, sand, scrap iron, etc., is delivered on the railway siding close to the cupola, a suitable covered storage space enabling a stock of material to be kept on hand should weather conditions interfere with its handling in the open.

Cupola Installation

The cupola is installed at the east end of the cross aisle and ample space is provided to allow of safe and rapid handling of the ladles. Close to the cupola is the blower room in which is a large "Connersville" blower of ample capacity, belt driven by a 50-horse power motor. Two belt driven air compressors supply compressed air for hoists, etc. The cupola elevator gear is conveniently situated in this room and is operated by a 15-horse power motor. Electrical energy is obtained from Niagara Falls, the shop equipment including a transformer set which supplies 3-phrase 25-cycle current at a pressure of 550 volts.

Owing to the high grade of work required, metal patterns are used almost exclusively. After the cores are formed of specially prepared sand, they are placed on trucks with suitable bodies and run into the drying ovens. A transfer truck runs on a track across each end of the core ovens thus allowing any rack to be put into any oven, and when dried, to be placed in any desired position, in the storage space, where the cores are arranged on frames for transference to the moulding department.

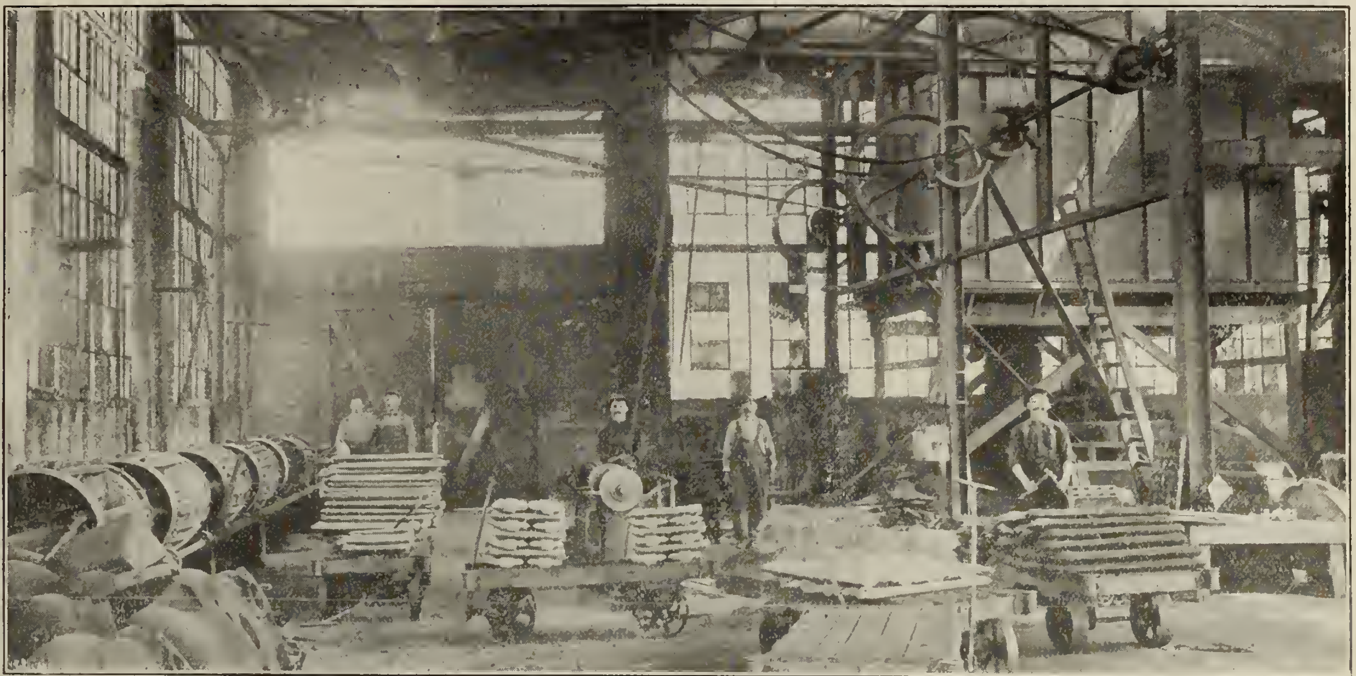


FIG. 5. GENERAL VIEW OF FETTLING SHOP.

Modern Methods

As would be expected in a plant of this description, moulding machines are largely used, Fig. 2 showing one type of machine which is simple, strong, accurate, and quick. Fig. 3 shows a view in the

FIG. 4. HEATING BOILER MOLDING SHOP.

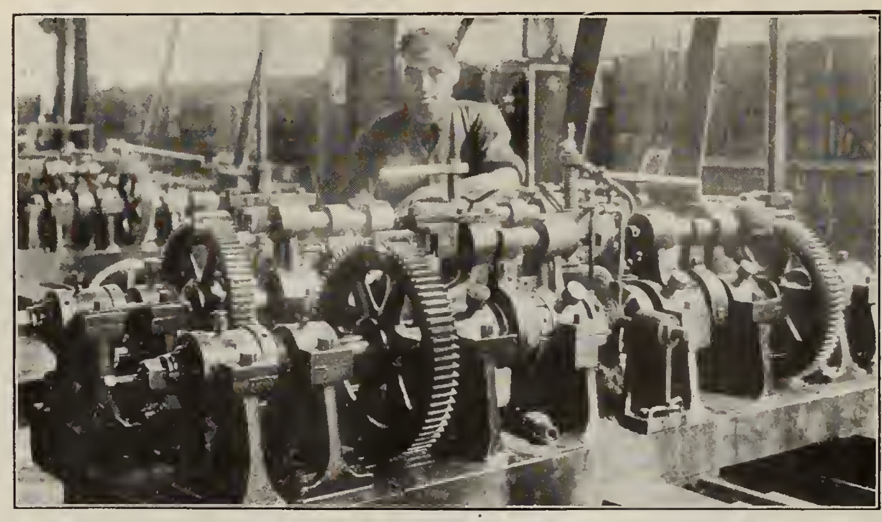


FIG. 6. TAPPING AND FACING MACHINE.

moulding shop, it being amply equipped with traveling air hoists, which save considerable time and labor in conveying the ladles of hot metal to the moulds. An overhead electric hoist travels on a track along the cross aisle and is used for transferring work from one bay to another.

A view of boiler moulds in course of preparation is shown in Fig. 4. The number of different pieces required in producing the boilers is greater than with radiators, in addition, the shape of the parts does not allow of the same moulding methods being pursued. As a result of this, the methods in use are similar to those generally adopted in the production of high grade foundry work, skilled labor and the best of materials and equipment being indispensable to the maintenance of the company's standard of excellence. A complete equipment of sand blasting and rumbling machinery is installed, and after being thoroughly cleaned the various parts are tested under hydraulic pressure. Specially designed fixtures enable this operation to be accomplished rapidly and satisfactorily.

Although the actual amount of machine work on radiators is not great, it has to be performed with a considerable degree of accuracy. The faces of the bosses which join each other must all be parallel; there must be exactly the same thickness from face to face, and the two faces on either side must be exactly in line. While slight inaccuracies do not appreciably affect a radiator composed of say six or less sections, the cumulative affect of bad machine work on 18 or 20 sections is quite apparent to a casual observer. Special machines which tap and face the four holes of a section simultaneously with the required

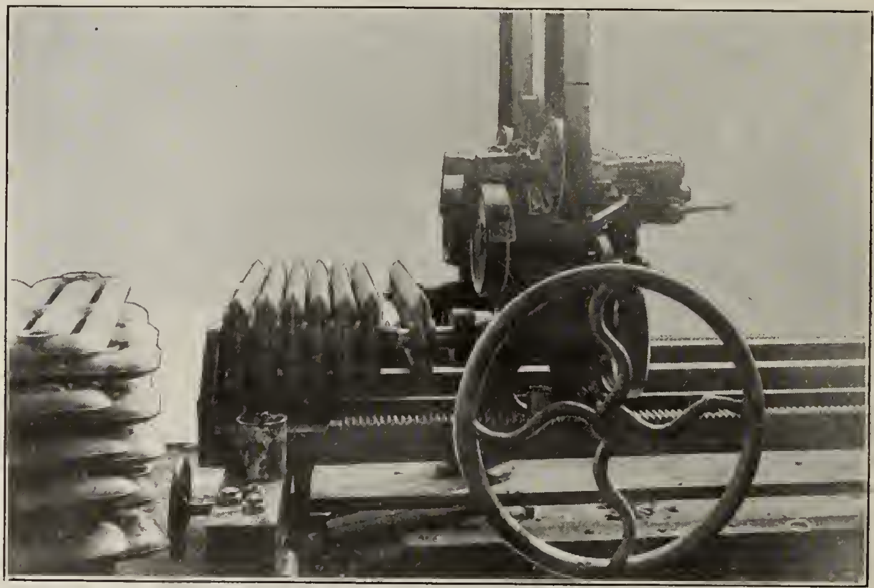


FIG. 7. RADIATOR ASSEMBLING MACHINE.

FIG. 8. HEATING BOILER ASSEMBLY DEPARTMENT.

degree of accuracy have been designed and built in the plant.

As can be observed in photograph, Fig. 5, the machine consists of two carriages, each of which carries two spindles. One of the carriages is rigid while the other is adjustable along the ways in the foreground of the picture. The machine shown has an adjustment of from 20 inches to 45 inches between centres of spindles, sufficient to handle all ordinary radiator sections.

Radiator Assembly

The threaded nipple system of construction is used exclusively in the company's radiators, making it thereby possible to produce tighter joints with less possibility of damage to the castings than when the push nipple joint is used. The latter method involves the use of tie rods or braces, which are unsightly when used externally, and interfere with the circulation when used internally. Furthermore, it is an easy matter to dissemble a threaded nipple for repairs, whereas a push nipple joint can only be separated at considerable risk of damage to sound parts of the radiator. As a result of this method of construction, few, if any, sections fail when the final hydraulic test is applied to the assembled unit.

Conditions render the use of push nipples desirable in the construction of steam and hot water boiler of which this firm has a large output. Push nipples of the spherical type as used by the company allow the component parts of a boiler to adjust themselves in use so that undue strains are avoided and all possibility of leakage is entirely prevented.

A well equipped machine shop and tool room are, as might be expected, a necessary adjunct of such a plant, and contribute to that quality of product for which the company have earned quite an enviable reputation.

REDUCED RAILROAD RATES—FOUNDRY CONVENTION AND EXHIBITION

THE railroads are offering a reduced rate to the members of the American Foundrymen's Association and the American Institute of Metals, covering the conventions of these two organizations, to be held at Atlantic City during the week of September 27. The rate is somewhat lower than the summer tourist rate which prevails until September 30, and it is suggested that each member, when purchasing his ticket should call attention of the passenger agent to this reduced rate in effect. The passenger rates which will be charged are as follows:

Two cents per mile in each direction, with a minimum of $1 for the round trip, going and returning via the same route only; tickets to be sold and good going September 25 to 27, and returning to reach original starting point not later than October 5.

The passenger associations which have granted this concession and the territories covered are as follows:

New England Passenger Association.—New England States.

Eastern Canadian Passenger Association.—Canada east of and including Port Arthur, Ont.; Sault Ste. Marie, Ont., and St. Clair and Detroit Rivers.

Central Passenger Association.—West of Buffalo, N.Y.; Pittsburgh, Pa.; Wheeling, Parkersburg and Huntington, W. Va., to and including Chicago, Ill., and St. Louis, Mo., and north of the Ohio River, including Cincinnati, O.; Louisville, Ky., and Cairo, Ill.

South-eastern Passenger Association.—South of the Ohio and Potomac and east of the Mississippi Rivers.

Western Passenger Association.—West of Chicago, Ill.; Peoria, Ill., and St. Louis, Mo., to and including Denver, Colo., and Cheyenne, Wyo.

South-western Passenger Association.—South-west of St. Louis, Mo., including Texas, Arkansas, Oklahoma, Missouri, south of the Missouri River, Louisiana, west of the Mississippi River, and Mexico.

Transcontinental Passenger Association.—Pacific Coast and other far Western territory not otherwise covered by the foregoing.

HARDNESS AND WEARING TESTS OF METALS

AT the suggestion of the Hardness Tests Research Committee of the Institution of Mechanical Engineers, some comparisons of the results of the different methods of testing the hardness and wearing properties of metals have been made, using specimens supplied by Sir Robert Hadfield. The comparisons made up to the present time have been between the results of the "Brinell" ball hardness test and the "Saniter" wear test.

For the purpose of making the latter test, the existing Wöhler fatigue testing machine was used with a 1-in. specimen rotating at 2,200 r.p.m. A hardened steel ring of 1½-in. internal diameter and 0.25 in. wide, was placed on the specimen and loaded with a weight of 210 lb. The wear was taken as the reduction in diameter of the specimen in ten-thousandths of an inch after 200,000 revolutions of the specimen. The results showed that the relation between the "Brinell" hardness number and the resistance to wear (as given by the reciprocal of the wear in ten-thousandths of an inch multiplied by 1,000), depends largely on the composition of the steel. In ordinary carbon steels a high resistance to wear (18 to 20) corresponded with a high hardness number (720), whereas, in manganese steels having a relatively low hardness number (241 to 286), the resistance to wear was extremely high (27 to 30).

In the wear test it was found that the effect of the vibrations of the wearing ring on the wear was very marked, so that it was difficult to repeat the tests. At the suggestion of the Committee, designs for a wear testing machine are being prepared, in which it is hoped that this difficulty will be overcome.—National Physical Laboratory Sectional Report.

GOLD OUTPUT INCREASES

THE Department of Mines reports that the total gold output in Ontario for the six months ending June 30, 1915, amounted to $3,570,072. Last year the value of the output was $2,011,069. Of the total yield for the half year, $3,267,620 was mined in Porcupine. This shows that the output from the Porcupine mines is growing, and if maintained will show a 50 per cent. increase over the yield for 1914.

The department reports progress in many of the mining districts, and says that the prospects for a large output of gold ore from these mines are very bright. Some of the mines mentioned are: The Huronia at Kirkland Lake, Goodfish Lake camps, Munro camps, Howard's Falls (Kow Kash).

The output of silver continues to diminish. There is a difference of $1,864,655 between the output of 1914 and the decreased output for the half year of 1915. Nickel has been mined more extensively. Compared with the previous year, the value of the nickel mined has increased 18 per cent., and that of copper 2 per cent.

The figures for the six months in 1915 and 1914 are, respectively: Gold—$3,570,072, $2,011,069; silver—$5,188,763, $7,053,418; copper—$1,229,894, $1,197,059; nickel—$3,393,528, $2,872,843; iron ore—$288,296, $118,119; pig iron—$2,856,040, $4,429,664; cobalt—$34,443, $22,581; cobalt oxide (including nickel oxide)—$56,812, $379,152.

COPPER PRODUCTION AT A MAXIMUM

REPORTS from New York indicate that copper production had about reached the maximum for the time being at least. Utah Copper and Chino Copper reported a falling off, while Nevada Consolidated and Ray Consolidated reported small increases.

As a result of development work, the Anaconda output for several months past has not been up to normal. There was an increase of 700,000 pounds in its output in August, but the company is still running two to three million pounds a month below normal.

The various copper companies are alive to the fact that present operations do not warrant a heavy increase in copper output, and should production run much above consumptive requirements, a curtailment would not be surprising.

Copper producers say that the situation is encouraging and that consumption can well take care of present production. There has been some unsettlement as a result of the violent drop in foreign exchange, but a readjustment is looked for by the trade within the next two or three weeks. Europe has not been buying much copper, on account of the lower exchange rates, but is expected to enter the market for large tonnages on any satisfactory adjustment of exchange.

DOMINION ROYAL COMMISSION

THE Dominion Royal Commission, of which Sir George E. Foster is a member, has just issued the last of its publications dealing with the trade conditions and resources of the Overseas Dominions. This report deals with the evidence taken by the Commission in the Maritime Provinces of Canada just before the outbreak of war last year. Prominence is given to the evidence taken in the Maritime Provinces relative to the need of a fast mail service between Halifax and the United Kingdom ports, and to the desirability of improved Imperial cable communications.

It was pointed out forcibly before the Commission that, although the Halifax route was much shorter, the New York ships were much faster, so that mails were distributed in Canada two days earlier by the New York route. One to two days could be saved with fast ships between Liverpool and Halifax, and mails for Australia and New Zealand could be carried on an all-red route across Canada. An Imperial subsidy was suggested, based on the speed of the steamers.

The proposal for improved cable facilities, as reported by the Commission, was that one of the existing cables across the Atlantic be leased and linked up with the Pacific cable by a Canadian land line.

DOMINION REVENUE

THE Department of Finance issued on September 10 the revised financial statement for the last fiscal year, together with the statement for August and the first five months of the current year.

The total revenue to the end of the fiscal year was $133,078,481. Consolidated fund expenditures were $135,523,206, and on capital account, $107,389,303. Under the heading of war outlays, $60,750,476 was spent up to the end of the fiscal year. On public works, including railways and canals, $41,447,320 was expended, and for railway subsidies $5,191,507.

The revenue was made up as follows: Customs, $75,941,219; excise, $21,479,730; post office, $13,046,664; public works, including railways and canals, $12,953,487; miscellaneous, $9,652,379.

The August financial statement places the revenue at $19,240,844, an increase of $44,000 over August, 1914. For the first five months of the present fiscal year, the aggregate receipts have been $60,089,196, a decrease of $200,000.

The August postal revenue doubles that of 1914 and amounts to $1,899,779. Likewise public works, railways and canals revenue increased in August.

A decrease is shown in expenditures on consolidated fund in the five months of the fiscal year of about four million dollars. This year's total under that head is $38,870,712.

On capital account, the five months' expenditure totals $13,898,659. The net debt on August 31 was $472,408,885, an increase of $140,000,000.

Temporary loans of $145,940,000 are largely for war purposes. The note circulation in the year was $152,065,684, an increase of $38,000,000.

CANADA'S GAS AND OIL RESOURCES.

THE Mines Department, under the direction of Dr. Eugene Haanel, has completed a comprehensive and exhaustive investigation of the oil and gas resources of the Dominion, and it will be issued shortly in book form. The work of investigation has been carried on for the past year or so by a field survey staff under Mr. Clapp, one of the ablest petroleum experts of the United States. The Alberta oil fields has been thoroughly gone over and, while no large producing wells have yet been developed, promising indications have been found of the existence of petroleum in several districts in the Province.

A considerable portion of the report deals with the commercial possibilities of the development of the extensive and rich oil shale deposits of New Brunswick. If these deposits are exploited it is believed that a great industry can be built up, and a substitute found in Canada for the large quantities of petroleum and its derivatives now annually imported from the United States.

So important are these deposits and so great is the market for petroleum products in Canada, that the Federal Government has provided for a bounty of 1½ cents per gallon on oil recovered from oil shales in Canada. The distillation of oil shales in Scotland has been for many years a successful and flourishing industry. New Brunswick shales are on the average richer than the Scotch shales.

The total domestic production of petroleum is now under eight million gallons, while last year imports of gasoline totalled 27,451,379 gallons, and of petroleum in other forms over 200,000,000 gallons.

MELTING FURNACE DATA

IN the course of a paper read before the British Foundrymen's Association, F. C. Barker referred to the various forms of tilting type coke-fired furnace, both those heated on the regenerative system and ordinary firing. He specified one of the former in which the furnace body consists of two light steel shells, one within the other, the grate-bars being carried within the inner body and a preheater being fitted above. The working results for this furnace are given for the 400 lb. size as follows:—Time of melting 8½ hours; average metal to coke 5 lb. or 6 lb. to 1 lb.; life of crucible 60 heats.

For another furnace of the same general construction, but without pre-heating for the air, the following results were attained from practical foundry working over a period of 12 months:—450 lb. size furnace, average life of crucible 50 heats, coke consumption 4 to 1; 250 lb. size furnace, average life of crucible 60 heats, coke consumption 6 to 1.

Compared with coke-fired pit furnaces, these tilting furnaces show a saving of 50 per cent. in crucibles, and 50 per cent. in coke, while the amount of ash, owing to the better combustion of the fuel, is less by 80 per cent. The first-mentioned of these furnaces can be adapted to burn crude oil.

Oil fuel has several distinct advantages. The furnace can be started up directly the oil and air jets are opened up. One man can look after several furnaces. There is no cleaning out of the furnace at the end of the day, and little storage room is required. The furnaces require no stoking or poking, and the melting can be conducted in a reducing atmosphere. A long life is assured to the crucibles, and a wide range of temperatures can be obtained.

If a good piece of work has been done by an individual or department, an expression of satisfaction will do a world of good. This requires a little giving on the part of the employer, but it is not an expense—it is merely placing credit where it is due.

Casting Steel Ingots for Production of 4.5 H.E. Shells

Staff Article

With a view to securing an increased output of 4.5 high explosive shells, cast steel billets are now being produced in our steel foundries through the medium of ingot moulds. Although in the earlier stages of the process considerable trouble and difficulty were met with, these have now been overcome and, in the particular plant under review, an output of over 4,000 shell blanks each 24-hour day is being achieved and continuously maintained.

WONDERFUL developments have been, and are still taking place in the iron and steel industry throughout the Dominion of Canada. While the manufacture of iron castings has for the most part in the past occupied the attention of foundrymen, that of steel castings is of comparatively recent date.

Prominent among Canadian concerns engaged in this production is to be noted the Canadian Steel Foundries, Ltd., of Montreal, etc. This company which was organized in 1910, have a large plant located at Longue Pointe on the outskirts of Montreal, for the express purpose of manufacturing steel castings of almost any size or shape, the meantime capacity being something over 3,000 tons per month.

The output had however been more or less restricted for some time owing to the generally prevailing industrial depression, but, on the advent of shell making, so great was the impetus imparted through the demand for shell steel billets, the plant is now running night and day to meet the new situation and at the same time do justice to its regular lines, among the latter of which may be mentioned locomotive frames, wheel centers, engine castings, high carbon rolls, dredge buckets, etc. A specialty is made of all kinds of steam and electric railway track work, such as frogs, switches, diamonds, intersections, etc. Vanadium steel is prominent in all products where great strength is desired.

The plant is located about a quarter of a mile from the St. Lawrence river and about a mile east of Montreal city boundary. The buildings are of structural steel and brick, erected on concrete foundations. A detail description of the constructional features was given in our October, 1912, issue of Canadian Foundryman.

The Steel Foundry.

This building is 436 feet long and has a width of 264 feet. It consists of five sections there being an aisle across one end of the shop.

The open hearth charging stock is brought into the shop and taken to the furnaces by a Morgan 5-ton, four motor high type charging machine. The two 25-ton acid furnaces, using oil fuel, are of the most modern design and construction, and should the oil fuel fail or be cut off a gas producer is arranged as a standby.

The first aisle on the east side is equipped with a 20-ton Dominion Bridge Co. crane and also a 30-ton "Morgan" crane, while jib cranes fitted with air hoists are on each side of every aisle for handling the flasks and moulds, all of the flasks being of heavy cast steel and in a variety of shapes and sizes.

Mould Drying and Pouring.

After the moulds are made they are taken on trucks to a battery of drying ovens equipped with "Kinnear" rolling doors. Following the drying, the moulds are removed to the casting floor and placed in readiness for pouring. Two 35-ton and three 24-ton steel ladles built by the John McDougall Caledonian Iron Works, are used in transferring the molten steel from the furnaces to the waiting moulds. One 20-ton Dominion Bridge Co., and two "Morgan" cranes of 30 and 40-ton capacity transport the above mentioned ladles.

Fettling Shop.

When the castings are sufficiently set they are shaken out and removed to the fettling shop which comprises the aisle at the end of the foundry. Here a variety of equipment prepares the casting for machining by removing all gates, fins, etc. This aisle is served by a 15-ton Dominion Bridge Co. and a 30-ton "Morgan" crane as well as by a "Whiting" electric travelling wall jib crane. A general view of this floor is shown in Fig. 1.

Billets for Shell Production.

Owing to the great difficulty on the part of many plants in obtaining rolled steel billets for the production of shrapnel and high explosive shells required

FIG. 1. GENERAL VIEW OF FETTLING SHOP FLOOR.

for the various European nations, our steel foundries have been scheming and experimenting with a varying amount of success so as to produce a grade of steel casting that would meet the requirements.

While the art of making steel in metal moulds dates back to the days when crucibles were first used in making small tool steel ingots, the more general adoption of metal moulds dates back only a few years.

On first thoughts it did not appear to be practicable to produce the desired grade of steel required for shells by the ingot moulding process, especially as the rough shell had to be forged from the cast ingot. However, after much time spent in experimenting, a stage has been reached at which almost every requirement is fulfilled. It was believed that the use of metal moulds would chill the steel and cause it to be unserviceable for shell making, but with moulds of proper proportions, results otherwise have been achieved. No annealing has been found necessary after the ingots are shaken from the moulds.

Government Specifications.

Government specification requirements for 4.5 shell steel call for the same standard of product as in the case of 15 and 18 pounder shrapnel shells. The steel must have a tensile strength of between 35 and 49 long tons, an elongation of about 20%, a percentage of carbon between 0.45 and 0.55; the quantity of nickel must not exceed 0.50, manganese to be between 0.40 and 1.00, and phosphorus not over 0.05 per cent.

A mixture that gives close results is composed of about 20 per cent. Chautaugua or a similar low phosphorus pig iron, 40 per cent. open hearth scrap steel and the balance of heavy melting steel scrap.

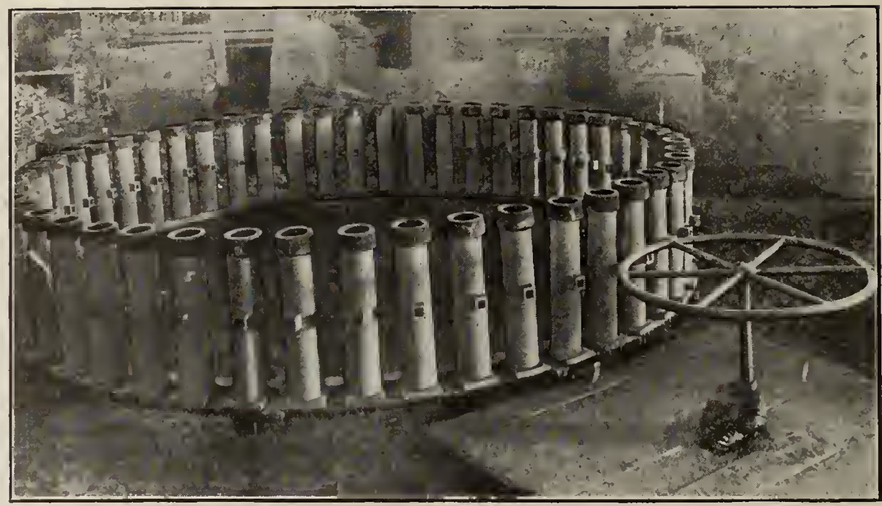


FIG. 4. BATTERY OF INGOT MOLDS READY TO BE POURED.

Melting the Mixture.

The steel is produced in two 30-ton furnaces by the open hearth process. They are fired with fuel oil at a pressure of 80 lbs. per sq. in. mixed with air at 100 lbs. per sq. in. The quantity of oil used is comparatively low, being about 3.3 or 3.4 gallons per ton of steel melted. One charge is melted in about 5 hours. The entire charge of about 25 tons is taken from the furnace by running it into a 40-ton bottom-pouring ladle shown in Fig. 2. This ladle, made by the John McDougall Caledonian Iron Works is built of heavy boiler plate lined throughout with fire-brick. The molten metal is poured from the ladle through an opening in the bottom which is stopped by a plug controlled by a series of rods and levers operated manually at some distance off. The stop plug which controls the flow of the metal from the ladle is made of graphite, the part entering the opening being conical in shape with the end somewhat rounded. This graphite plug is screwed on to a rod which extends down through the metal from the top of the ladle.

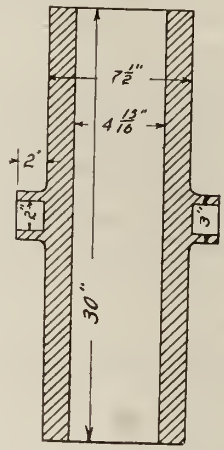


FIG. 3. INGOT MOLD.

To protect this rod from the action of the molten metal, it is covered with a series of fire-brick discs throughout its length. Owing to erosion the graphite plugs will only stand about 300 openings after which they are replaced by new ones.

Shell Ingot Moulds.

A rough sketch of the moulds used for making the shell ingots is shown Fig. 3. At first the moulds were made somewhat shorter but as it was desired to get two blanks from each ingot, it became necessary to increase the length in order to get sufficient sound steel at the bottom. The trunnions are placed a little above the centre to facilitate handling with the crane, while both ends are faced off to obtain a good level surface. The caps for these moulds are made of facing sand in a core box and oven-baked. The general construction is shown in Fig. 6, the bottom end being narrowed down to facilitate removal.

Preparing the Moulds.

When the ingots were being first produced, it was the custom to stand them

FIG. 2. FILLING BOTTOM POURING LADLE AT OPEN-HEARTH FURNACE.

in hit-and-miss fashion about the floor. This method was found unsatisfactory, however, as the crane operator had considerable difficulty in placing the opening of the ladle in the desired position. To overcome this trouble and also to facilitate the operations generally, the method shown in Fig. 4 was designed and is giving excellent results.

A rotary table with rack underneath is constructed to run on a track, and is operated by bevel gears and shafts leading to the large hand wheel shown in Figs. 4 and 5. These rotary tables are 16 ft. 8 ins. inside and 18 ft. 4 ins. outside diameter, and have flat surfaces upon which the moulds rest; the latter being held in position entirely by their own weight. At present there are four of these tables in use, each having a capacity of 50 moulds. There is also under consideration a new design which will involve a table to accommodate 2 concentric rows of 50 moulds each. This will do away with the handling of the crane after the first mould has been located.

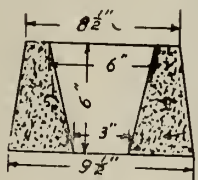


FIG. 6. INGOT MOLD CAP.

Pouring the Moulds.

After the charge has been taken from the furnace, the 40-ton ladle is picked up by the crane and taken to a position directly over the revolving table. When the proper location is found and the first mould poured, directions are given to the men at the controlling wheel and the table is revolved to the next mould. The man standing close to the ladle directs the movements of the crane operator and also the men at the wheel, his eyes being protected from the glare and heat by heavy blue glass goggles. The entire heat of around 25 tons is run off in about one hour.

FIG. 5. POURING A BATTERY OF INGOT MOLDS.

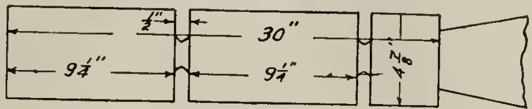


FIG. 8. SYSTEM OF CUTTING OFF BILLETS.

The magnitude of these operations can be best realized when it is known that an average of seven heats of 25 tons each, which is about 4,000 shell blanks, are run off every 24 hours.

Removing the Ingots.

When the ingots have properly set, although still quite hot, they are removed from the mould so that the latter can be prepared for the next pour. The ingots are raised by means of the crane and in most cases they drop out without any trouble, as the shrinkage, which

FIG. 7. SHAKING OUT THE INGOTS, SEVERAL OF WHICH MAY BE SEEN AGAINST THE TABLE.

is about 3-32 of an inch in the diameter of 5 inches, is usually sufficient to thoroughly free the ingot from the mould. Sometimes however, it is necessary to hit the ingot a blow with a sledge. If they do not come out with the sledge treatment they are taken to a "Bertram" horizontal hydraulic press and forced out.

Occasionally an ingot seizes in the mould, and when this happens the contraction will cause the metal of the mould to crack in one or more places; however, the loss in this respect is very slight, being less than 3 per cent. The walls are left thick enough to withstand the action of the heated metal, because, if too thin, the molten steel would tend to heat the mould so rapidly that the two surfaces would incline to weld together. After the ingots are shaken out, they are inspected for defects, such as fractures "piping," etc. The life of the average mould is about 200 heats. A view of the shaking out process is shown in Fig. 7.

Cutting Off the Billets.

After the ingots have passed the preliminary inspection they are cut into billets on several axle lathes; the length being 9¼ inches, and the width of cut being from ⅜ to ½ inch wide. The cutting off tools are of "Firth" high speed steel. Six lathes are employed in this operation, two of them being "Bridgeford" products and another two of "Bertram" make. The depth of cut is approximately 2 ins., the tools being fed in by hand. The average time for four cuts is twelve minutes, and about 200 billets are obtained in 10 hours. Each ingot weighs about 156 lbs. and is handled by means of a jib crane and air hoist. The Government inspection calls for a portion equal to about 1-6 of the cross sectional area to be left in the centre, so that, when broken apart it can be examined for fracture. A sketch of one of these ingots as it comes from the lathe is shown in Fig. 8.

Heat No.	Description	Dia.	Area	Elastic limit		Max Strength		Elongation		Reqd. dimension			Chemical Analysis					
				actual	per sq. in.	actual	per sq. in	in	per cent.	dia.	area	%	Car.	Phos	Man.	Sul.	Si.	Va.
	4.5 How.	.461			19.2		40.70		25.7				.42	.031	.72	.032	.28	
	,,	,,			21.9	long tons	41.8	on 1.635"	27.6				.41	.036	.85	.032	.30	
	,,	,,			22.3		42.0		26.3				.40	.036	.87	.034	.27	

FIG. 9. RECORD SHEET COVERING CHEMICAL TEST.

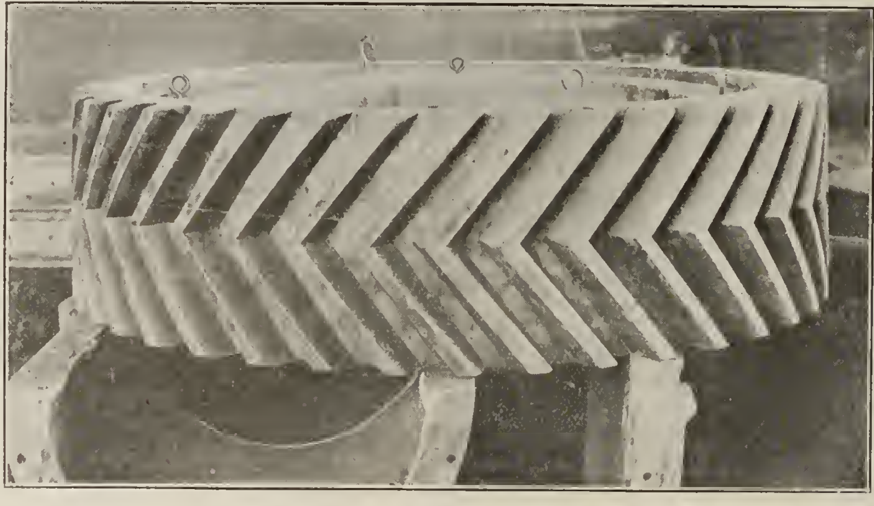


FIG. 10. PATTERN OF LARGE HERRING-BONE GEAR.

FIG. 11. PREPARING MOLD FOR LARGE STEEL HYDRAULIC CYLINDER.

Inspection.

The billets are broken apart by laying across a 3 x 4 block and striking with a sledge. The crop end is returned to the furnace for remelting and the billets again inspected for defects. If rejected at this stage they are stamped with the letter R. The buttons are removed by planing or shaping, or, if very shallow, by grinding. Two sample ingots are taken from each heat for analysis. Drillings are also taken for tests of carbon, sulphur, phosphorus and manganese. The carbon test is derived by combustion, as the color test gives only an approximation. Chemical and physical tests are made of each heat by the works chemist, also by the Government chemist, and records of these are preserved. One of these record slips is shown in Fig. 9.

General.

While this plant is busy at present supplying machine shops with steel billets for the manufacture of 4.5 high explosive shells a general line of heavy steel castings is also being turned out. An idea of these latter may be got from Fig. 10, in which is shown the pattern of a large herringbone gear of about 8 feet in diameter, and in Fig. 11, the mould for a large hydraulic press cylinder in course of preparation.

The first contingent of volunteer munitions workers left Johannesburg, South Africa, on August 5, for England.

Some Reasons for Locomotive Piston Ring Failures

By "Melter"

The writer discusses from a practical standpoint, the various factors which affect the life and service of locomotive piston rings. It is evident from the article that the entire responsibility cannot always be attributed to any one cause—either making or using. By the application of proper care in manufacture, and reasonable attention in service, the life of piston rings may be considerably prolonged, and efficiency in service greatly increased.

FROM time to time much has been written concerning various causes of piston ring failures in locomotives using superheated steam, some failures being due to one cause and some to another. Most cases of failure, however, are due rather to a combination of circumstances than to any one in particular.

Classification of Causes.

Causes of breakage, excessive wear, and loss of spring in piston rings may be divided into two main classes, viz.:

A.—Manufacture; consisting of (a) material and (b) workmanship.

B.—Service; consisting of (a), class of engine, i.e., passenger non-drifting, or freight drifting; (b), lubrication, and (c), superheat.

Proper Material Necessary.

Regarding Class A, the selection of suitable material is all important, no subsequent care in manufacture or service being able to prevent the development of defects due to improper composition. The American Foundryman's Association recommends the following analysis:

	Per Cent.
Silicon	1.50 to 2.00
Sulphur, under	.08
Phosphorus	0.30 to 0.50
Manganese	0.40 to 0.60
Total carbon	low.

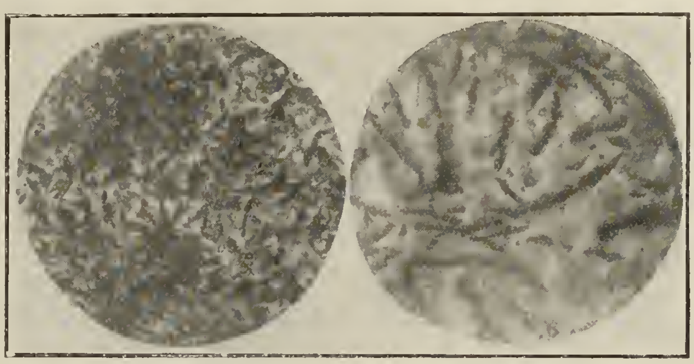
As far as general results are concerned, any close-grained iron comparatively free from oxides will do, but the best results can only be obtained from close-grained rings with the following composition:

	Per Cent.
Silicon from	1.20 to 1.30
Sulphur under	.08
Phosphorus under	.45
Manganese	.40
Graphitic carbon	2.30
Combined carbon	0.70
Total carbon	3.00

This analysis makes a satisfactory ring so long as the combined carbon does not exceed .80 per cent., otherwise the rings will be rather brittle and have a tendency to lose their spring or break. Samples of this mixture when etched with nitric acid should show a structure similar to A, Fig. 1. The dark portions indicating the graphite are small, close together and evenly distributed. The specimen shown at B, Fig. 1, shows the graphite in large bodies, widely separated and unevenly distributed. The comparative suitability of these two specimens is readily apparent to even the untrained eye.

Composition and Cost.

Some concerns use an air furnace to produce their piston ring iron and a good mixture is 33 per cent. pig iron, 10 per cent. steel and 57 per cent. selected scrap. Additions of ferro-manganese, which is used as a deoxidizer, say, 3 lbs. of 80 per cent. alloy to 1,100 lbs. of metal, may be put in the ladle to give greatest efficiency. A test bar from this mixture $1\frac{1}{4}$ in. diameter, cast vertically in dry sand and tested transversely on 12-inch centres, will give a load of about 3,800 lbs., and a deflection of 38 ins. The tensile strength would be about 29,000 to 32,000 lbs. per square inch, while the cost based on pig at $19.50 per ton, scrap at $17.50 per ton, ferro-manganese at $53.50 per ton, with low sulphur, and coal at $5, would be roughly about $1\frac{1}{2}$c per lb.



A — CLOSE EVEN GRAIN. FIG. 1. B — OPEN IRREGULAR GRAIN.

Making this iron in a railway foundry, where perhaps 50 tons of iron are melted per day in a 90-inch shell lined to, say, 72 in., is not a very easy matter, as it is difficult to produce a structure, or the analysis that is necessary for good service, but a fair iron may be produced by using 30 pig, 20 per cent. steel boiler plate, rails or spring steel (this is to reduce the total carbon and close the grain) and 50 per cent. cast scrap. The method of working out the analysis is shown in Fig. 2. Mixtures are given for air furnace and cupola iron.

Having obtained suitable material, the

Mixture for Air Furnace.

Mixture.	Charge lbs.	%	% Silicon	Silicon lbs.	% Mangau.	Mangan. lbs.	% Sulphur	Sulphur lbs.	% Phosp.	Phosp. lbs.
Pig iron ...	4,000	33.33	2.00	80.00	0.50	20.00	0.02	0.80	0.20	8.00
Scrap	8,000	66.66	1.75	140.00	0.40	32.00	0.12	9.60	0.60	48.00
Ferro Mang.	20	.....	....	.....	80.00	16.00	....	....	....	....
	12,000	100.00	....	220.00	....	68.00	....	10.40	....	56.00
Gross percentage					1.83		0.56	0.08		0.46
Estimated loss by oxidization					20%		30%	0.01 gain from fuel		....
Estimated net percentage					1.47		0.39	0.09		0.46
Net percentage analysis					1.30		0.42	0.078		0.42

By analysis—

Graphite carbon	2.44
Combined carbon	0.72
Total carbon	3.16

Mixture for Cupola.

Mixture.	Charge lbs.	%	% Silicon	Silicon lbs.	% Mangan.	Mangan. lbs.	% Sulphur	Sulphur lbs.	% Phosp.	Phosp. lbs.
Pig iron ...	1,500	30.00	2.25	33.75	0.50	7.50	0.02	0.30	0.18	2.70
Steel scrap..	1.000	20.00	0.02	0.20	0.40	4.00	0.04	0.40	0.04	0.40
Cast scrap..	2.500	50.00	1.75	43.75	0.40	10.00	0.12	3.00	0.60	15.00
Ferro Mang..	10	.....	....	.....	80.00	8.00	....	....	....	....
	5,000	100.00	....	77.70	....	29.50	....	3.70	....	18.10
Gross percentage					1.55		0.59	0.074		0.360
Estimated loss by oxidization					20%		30%	0.03 gain from fuel		.....
Estimated net percentage					1.24		0.41	0.104		0.360
Net percentage analysis					1.18		0.39	0.098		0.430

Graphitic carbon	2.80
Combined carbon	.72
Total carbon	3.52

FIG. 2. METHOD OF WORKING OUT ANALYSIS ON AIR FURNACE AND CUPOLA MIXTURES.

question of workmanship arises, as different methods of making the rings have a greater or less influence on the ultimate efficiency. The influence of workmanship commences right in the foundry, and begins with the manner of casting. Some makers cast their rings in the form of a tub or large pipe and cut them off with gang tools on a vertical turret

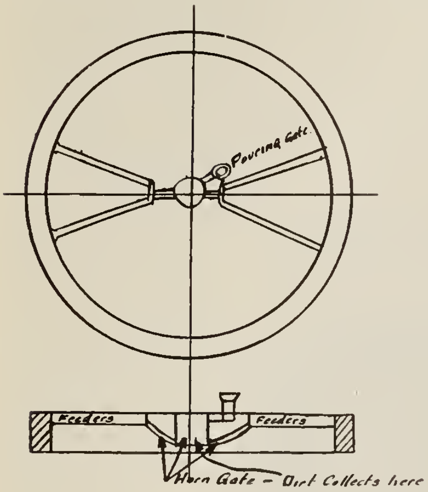


FIG. 3. ARRANGEMENT OF HORN GATE.

lathe or boring machine, while others increase the silicon content so that the rings may be cast singly and still not be too hard to machine. It might be well to state that iron with 1.30 per cent. of silicon is chilled when cast in single rings in a green sand mould, but if the percentage of silicon be increased to 1.60, and the total carbon slightly increased, a good ring will be obtained with correctly tempered sand. It is also best to use a metal pattern. In casting singly, a horn gate is used, as shown in sketch Fig. 3, which collects all the dirt accumulated during pouring.

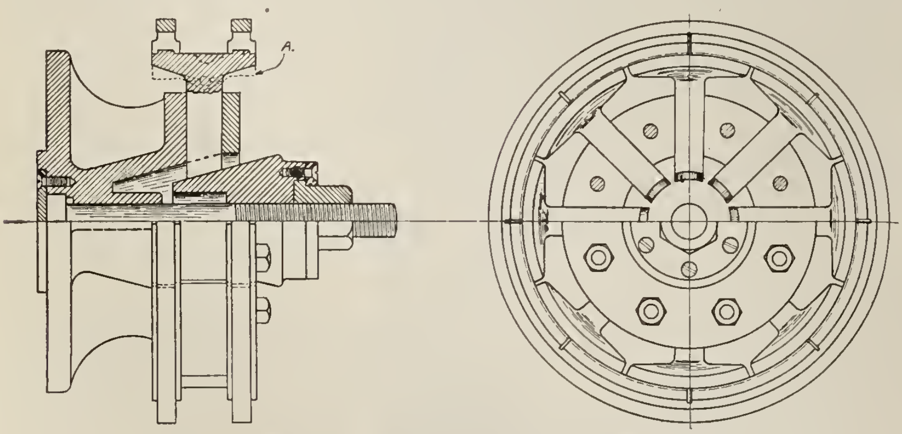


FIG. 4. IMPROVED DESIGN OF EXPANDING CHUCK.

The object in casting single rings is to obtain a denser and harder iron due to the chilling effect of the sand, and the small body of metal compared with a tub and lastly to reduce to a minimum the amount of metal to be machined off, so that the most benefit can be obtained from the superior state of the metal.

Machining.

In machining piston rings which are cast singly, an expanding chuck, Fig. 4, is used with a small modified turret tool holder, mounted on the tool slide, and using 3/8-inch square tool steel. Only three movements are necessary, a roughing and finishing cut on the sides and a roughing and finishing cut on the face in one movement of the carriage. Gauges are generally furnished, thus securing accurate machining.

The casting is made broad enough so that the edges extend 1/8 inch over each side of the mandrel, and previous to sending to the machine shop, each casting is thrown into the rumbler barrel and rumbled to remove the sand, after which all burrs or irregularities on the inside of the ring in particular are ground off by the foundry chipping room. The ring next the face plate is slipped on first and placed in position by eye, then the other ring is put in place and the nut tightened. The comparatively large travel of the wedge permits the rings to slip over the mandrels with ease.

The chuck shown in the sketch has been slightly improved as regards practical operation and first cost. Originally there were eight extra pieces, as shown dotted at (A), this piece swivelling on a little roller and the eight sections of the mandrel being held in place by a spring. The present method has proved more satisfactory.

The increased cost of the foundry practice (10 cents per ring, in the case of the single cast ring, as against 40 cents per tub making ten rings), in the one case is counter-balanced by the decreased cost of machining, and in the other case vice versa, whereas in the case of the single ring we have better material. In both instances a ring costs about 40 cents for labor.

Service.

The question of punctuality being of prime importance in passenger service, the opportunities for "drifting" on down grades cannot be taken advantage of to the same extent as with freight engines, where economy has to be maintained. Ordinarily, cylinders receive no oil when the engine is drifting, as the

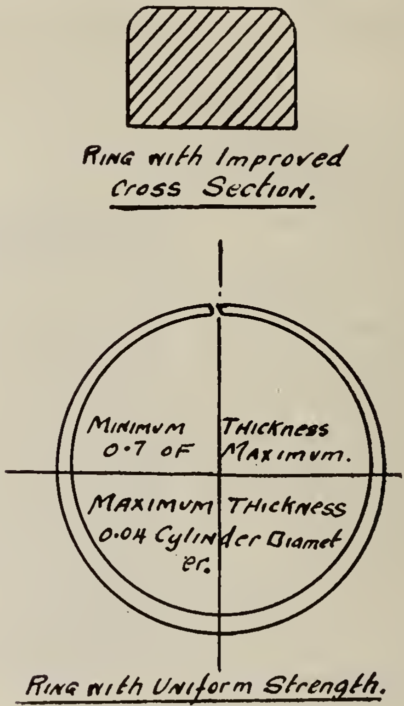


FIG. 5.

supply of oil is controlled by the steam pressure, consequently it is left to the engineer to "crack the throttle" on a down grade so as to maintain sufficient oil supply to the cylinder.

The methods of supplying oil to the cylinders vary. In some engines the oil is admitted to the steam pipes just previous to entering the valve, in others to the live steam valve passages themselves and in a few cases to the cylinders direct, at a point in the middle of the stroke and as near the top as possible. Some of the methods in use are:

(a)—One feed per steam chest, admitting the oil into the steam channel near the steam chest.

(b)—One feed per steam chest, admitting oil into the centre of the steam chamber.

(c)—Two feeds per steam chest, one near each admission point.

(d)—Three feeds per steam chest, one in the centre of the steam chamber, and one at each end near the admission ports, each point of delivery having an individual lubricator feed.

Methods of Lubrication.

The correct way would be directly to the top of the cylinders, as it has been found in three cases out of five that the most wear occurs at this point. It is all the more necessary to select the best method of lubrication, because the quality and quantity of oil supplied to railroad engineers is standardized and strictly limited to a minimum allowance, according to the type of engine and class of work.

In the case of an engine having cylinders 21 inches diameter by 28 inches stroke, with driving wheels 75 inches diameter, travelling at an average speed of 50 miles per hour, the allowance might be, say, one pint of oil for every 75 miles. The foregoing dimensions and speed figure out at a piston travel of fully 1,000 feet per minute, so that unless all factors which influence the life of a piston ring are properly taken care of, the life of the piston ring may easily be shortened to an unsatisfactory minimum.

The amount of wear in rings varies from .06 inch to .19 inch for 10,000 to 80,000 miles, and the greatest wear occurs opposite the split. Just what effect an eccentric ring, having uniform expansive pressure, would have on this wear has not been determined, as the other variables have been too great, but there is no doubt the wear would be much more uniform.

Effect of Superheat.

The effect of the high temperature of superheated steam is to weaken the cast iron, causing the rings to lose their spring. Experiments have shown that a superheat of 119 deg. F. is sufficient to decrease the strength 9 per cent., and when steel is heated to a maximum temperature of 400 to 650 deg. F. and stressed sufficient to create 1 per cent. distortion, its brittleness is increased about 33 per cent. Now, if we use a cast iron possessing characteristics somewhat resembling those of steel, which is stronger and therefore less liable to failure, are we not making an improvement in our piston rings?

The grade of oil used is necessarily important and with the moderate superheat used in this country, should show the following characteristics:

Flash point, 560 deg. F.
Burning point, 630 deg. F.
Cold test, 39 deg. F.
Spec. grav. at 60 deg. F., 25 degrees.
Saponifiable fats, 9.0.
Viscosity at 212 deg. F., 205 units.

With different degrees of superheat different oils must be used, i.e., for higher superheat, oil with a higher flash and burning point is required. A high superheat oil may be used for moderate and low superheat, but the cost would be a factor.

If the oil carbonizes, there is an excess of incrustation, which is equivalent to grit, as it causes abrasion. Then again, some tests have shown that excessive incrustation interferes with the ring springing up tight to the cylinder walls, and admits of a leakage of, some say, as much as 200 to 300 lbs. of water per hour.

Practical Points.

Some companies claim that they are getting their rings more uniformly lubricated by altering the section of the ring, as in sketch, Fig. 5, thus cutting off all sharp corners and allowing the oil to get under the ring instead of being scraped off ahead of the piston.

The best practice shows that the bushing must not vary out of round more than 1-16 inch, and the piston diameter must not vary more than ⅛ inch from the cylinder diameter. After the piston ring grooves in piston head have been worn 1-16 inch, a different sized ring is put in and, as the groove increases in size, the rings are increased by 1-16 in., until the original size has been exceeded by 3-16 inch, then the piston is scrapped.

Recently some engines were giving trouble with their rings making only about 300 miles before they had to be renewed. The pistons were changed and the rings made their average mileage.

BRASS MELTING QUERY ANSWER.

FROM the information given in the "Brass Melting Query" which appeared in a recent issue, it is somewhat difficult to give a very intelligent answer as it is not stated whether the metals are new or scrap. From the facts at hand, however, it would seem that some of the metals have an excess of dross or slag.

As regards using charcoal as a flux, I might say that charcoal is used as a covering only to protect the metal from the air, and has no other effect on the metal. Salt is a great help in melting brass, but should be used at the proper time, that is, just as the first metal begins to melt. A handful of salt to the ordinary crucible is sufficient.

The best means to overcome the stated difficulty is to melt metal in crucibles and pour it into ingot moulds, using plaster of Paris for a flux. This material when so used dissolves all the foreign matter that may be present in the metals in the form of sand, oxide or slag. It forms a very liquid slag and has no bad effect on the crucible like some fluxes but rather keeps it clean. About 5 lbs. of plaster of Paris to 50 lbs. of metal should give good results. It should be mixed with the metal as it is charged into your crucible.

Melt the metal in the usual manner, and, if the slag is not fluid enough at the conclusion of the melt, add more plaster of Paris. Do not attempt to skim metal when it is ready, but pour into ingot moulds. The slag will all rise to the top and when cool, the slag of the plaster of Paris can be easily detached by a few blows of a hammer. Remelting will produce good castings.

It is not practicable to melt metal as for iron as it would be too much exposed to the air and would be sure to absorb some injurious gases.

EFFICIENT USE OF LABOR IN THE FOUNDRY

By J. S.

SINCE the war began the writer has worked in four foundries, all of which have experienced the so-called shortage of labor. In such cases the employer's first thought should be as to whether he could increase the output of the men without overtaxing their strength, by supplying the materials to enable them to work quickly, but how many firms give their moulders or coremakers even all the tackle that should be regarded as necessary?

There are some, but very few founders who realize that a man cannot make his work safe and sound without the necessary tackle, and, moreover, they ignore the fact that tackle needs overhauling and repairing or replacing at times. There are few firms who keep a man to attend to the latter. The foreman or charge hand is perhaps supposed to do this, but the numerous other duties that keep him fully occupied, such as loading and unloading moulding boxes off the stove carriage, finding places to drop them so that they can be cored up and cast, giving jobs out, getting castings out, finding the defects and cause of bad ones, pouring metal when casting time comes round, and other items too numerous to mention that do not come under the heading of moulding or core-making, allow him little time for systematic attention to the men's tackle.

As an instance, two moulders were given employment in a certain foundry and were brought to the foreman or charge hand by a clerk from the office. They were given a pattern to mould, told to "get down here," and shown the box the casting had to be moulded in. The foreman then walked away.

Now, no doubt, these men were entire strangers to the place, and perhaps had not made a casting so heavy for five, ten or twenty years; or, on the other hand, they may have just come from a shop where they had been on that class of work for years. They rammed the bottom part, turned the box over and proceeded to ram the cores up in green sand. The pattern was for a bed plate of 3 to 4 tons weight, made as a shell pattern to leave its own cores. This system needs a good, strong cast-iron grid to carry the body of sand in the lift, but the men had to make shift with any old cast-iron grid that they could find or make suitable, and these were mostly in halves or with prods off, staples missing, etc., all of which entailed more loose wrought irons.

In cases like this, where the proper tackle is missing, the moulders often "risk it," and frequently there is a mishap, but who is to blame, the moulder for not using tackle which he had not, and although probably using his best endeavors to make the best of a bad job?

A moulder or core-maker who has acquired the methods of one firm is often not allowed to try them in another shop. In many jobs there is an alternative way that could well be adopted; but it makes a sensible man very cautious in following methods he considers best when the foreman, after the job is well started, pounces down upon him with "have you done this," or "don't do that," and finally orders the job to be started all over again on the customary methods of the firm (which, as a rule, are the foreman's methods) though there may perhaps be no better way than that followed by the new hand.—Foundry Trade Journal.

NEW PRACTICE IN UPSETTING.

THE Ford Motor Co. has placed orders for upsetting machines, the aggregate value of which will approximate $350,000, says the Iron Age. This equipment is to be installed in a new building to be erected at once, the extension of capacity being occasioned by the development of a new method of upsetting circular pieces having an open centre, such as gear blanks, collars and other forgings ordinarily made heretofore on hammers. It is not long since that it was impossible to secure such pieces with the central hole punched through, all of this metal having to be drilled out. More recently this practice has improved, and the machining required has been limited to drilling the hole to size, although even in this case considerable metal has had to be removed.

Process Features.

The practice which is being developed by the Ford Motor Co. for pieces of this character, not only provides for forging the hole in the centre within such limits of size as to require only a finishing cut in the machine shop, but results in the piece being formed without any waste of material. Even the flash is eliminated. While the process in general has not been sufficiently completed to warrant detailed description, it consists of upsetting pieces of the general form described, from bar stock of the same diameter as the central hole in the finished forging.

The work is done in two or three operations, depending upon the relation of the finished outside diameter of the forging to the diameter of the stock. The diameter of the stock may be safely increased $1\frac{1}{2}$ times. In the first operation, the end of the stock is pierced and spread; in the second operation the upset end of the stock is partly formed in a way which prepares for the third and finishing operation the exact amount of metal required, so that the piece finishes without any flash to be trimmed in a final operation. The third operation involves the simple stripping of the forging from the stock, the punching removed from the centre of the forging remaining on the bar and being worked up into the next piece, so that there is absolutely no waste of metal.

On some pieces it is possible to combine the first spreading operation with the stripping operation which finishes the preceding piece. At the Ford plant an interesting revision of machining operations will follow as a result of this new forging practice.

NOBLEMAN MUNITIONS' WORKER.

SLOWLY, but surely, Britain is coming to realize that she must exert every ounce of her strength if she hopes to win out decisively over Prussian military preparedness. The formation of the coalition war cabinet, with David Lloyd George as war munition secretary, charged with providing the forces at the front with the necessary equipment in required quality and quantity, has brought about a new spirit, and the Britishers are beginning to see that not only the soldiers on the firing line, but the whole nation must work and work hard. The picture shows Lord Norbury, one of England's wealthiest noblemen, who has taken a job in an aeroplane factory as a fitter, both to do his share and by his example encourage others to go to work to do their share. Lord Norbury earns 7d (14 cents) per hour, and is here shown ringing in on an "International" time recorder in his suit of overalls.

LORD NORBURY AS A MUNITION'S WORKER "RINGING-IN" ON AN INTERNATIONAL TIME RECORDER.

The Zinc Co. has been incorporated at Ottawa, with a capital of $100,000, to operate zinc mines and smelters at Sherbrooke, Que. Incorporators — Leland Drew Adams, Charles Herbert Maxey, of Oaklands, Cal., and John Perley Wells, of Sherbrooke, Que.

Why Steel is the Most Suitable Material for Shells

By J. M. W.

The exclusive use of steel for shell casings has occasioned inquiry by ironfounders into the possibility of cast iron being used as well. While the features of the case which have been brought to light by the discussion are so greatly in favor of steel, it must not be forgotten that steel is not perfect, and that any relaxation of stringent inspection, such as exists at present might be productive of results which must be avoided at any cost.

OCCASIONAL reports, chiefly from Belgium, that the Germans were using cast iron shells, have given rise to discussions on the merits of forged steel and cast iron as materials for shell bodies.

A momentary consideration of the requirements which must be met by either shrapnel or explosive shells is sufficient to make it obvious even to the lay mind why cast iron is quite unsuited for shell bodies except under extreme conditions such as now seem most unlikely to arise so far as the Allies are concerned. The purpose of shrapnel is to destroy men; the purpose of lyddite and other high explosive shells is to destroy the defences of the enemy so that infantry may attack. Entrenchments, fortifications, entanglements and other devices for defence are of such an effective nature that they must be literally blasted off the face of the earth before the opposing infantry can get into contact with each other. A hail of leaden bullets from shrapnel shell, no matter how fierce, has little or no effect on modern field works, consequently a copious stream of explosive shells must be distributed over the desired area so as to render the success of an infantry attack reasonably certain. Explosive shells which burst on contact may be used with delayed fuses, which allow a suitable space of time for the shell to sink into earth works to a desired depth, when the explosion of the charge resembles that of a mine. The immense hollows in the ground formed by the large siege guns firing half a ton of explosive are sufficient evidence of the power of high explosive ammunition. The disastrous results which would ensue from such an occurrence taking place in the barrel of a gun render necessary the absolute soundness of shell forgings, whether shrapnel or explosive.

Absolutely Safe Guns.

The absolute strength and safety of modern guns has been a wonder and mystery to the majority of laymen for many years; consequently the guns themselves have been discussed much more frequently than has the ammunition until the outbreak of hostilities.

Given good average material such as is procurable in the open market at the present moment, a good engineering education, and a high class engineering plant— and any resourceful man will produce a formidable gun with his personal experience and skill. The knowledge of ammunition manufacture, however, has for obvious reasons never been so widespread and available as that of guns. Even now with all their experience in shell work many producers have still to develop that patriotic interest in their product which is necessary to make them appreciate the strict inspection, and which would cause many so-called hardships to be viewed in their true light of precautions instead of being looked upon as hindrances to profit accumulation.

Rigid Inspection for Shells.

A true appreciation of the painstaking care and watchful economy which is necessary in producing shells at the present moment can only be obtained by a close study of the entire process from the time the iron ore enters the furnace until it leaves the muzzle of the gun as a shell. While the actual composition of the steel is decided on and controlled by a limited number of individuals, the mechanical and thermal treatment of the material is being performed by thousands of individuals, the majority of whom endeavor to effect every possible economy in time and material. That considerable economy in material has been accomplished is evident from published results obtained by a leading English metallurgist. Losses of 40 per cent. have been reduced to 15 per cent. with very little increase in cost, and no decrease in quality. The amount of labor lost on partly machined shrapnel forgings has been quite an item, but if shell makers calmly considered the matter from the steel makers point of view, they would not be so disposed to condemn offhand a product which represents the application of so much specialized knowledge and labor.

Steel Maker's Troubles.

The steel maker is not desirous of losing the profit as well as the actual cost of shell forgings which develop defects in course of machining. Government and personal inspection of material in all stages of manufacture is planned and carried out with the object of insuring perfect material and workmanship.

The results of Sir Robert Hadfield's investigations are of prime importance at this time. Steel which has been cast in ingots by ordinary methods may appear perfectly sound while not actually so—it may be rolled into billets—it may be forged into shells—and at all stages up to heat treating it may pass all physical tests satisfactorily with the one possible exception of an examination of the microstructure. After an ingot is cast, it is not again heated to a high enough temperature to cause the removal of piping defects, consequently the lack of what may be termed "cohesive density" persists in the metal till such time as it is finally heat treated.

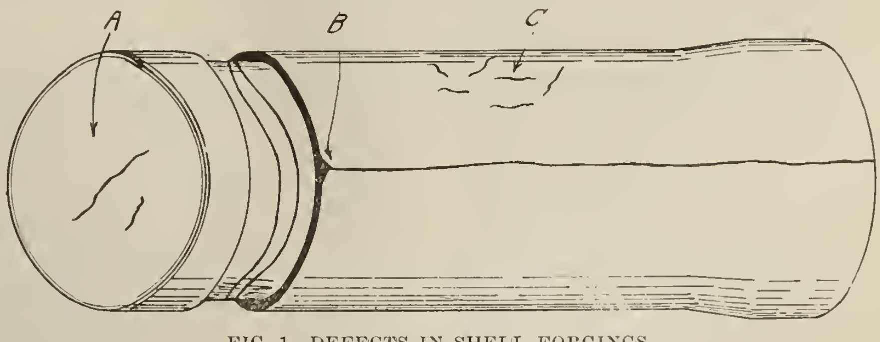


FIG. 1. DEFECTS IN SHELL FORGINGS.

When Defects Appear.

At this stage of manufacture hitherto unnoticed defects in shrapnel forgings, occasionally begin to appear. Flaws of various kinds become quite evident, although the most careful inspection before heat treating failed to reveal the slightest evidence. This trouble has caused considerable loss to both steel works and manufacturers, and the fact that it has occurred in spite of all inspection, etc., would indicate that the steel makers are continually confronted with a serious problem. The hypotheses which the writer advances in explanation of well-known and recognized defects in shell forgings are based on personal experience in producing many thousands of shells and the conclusions arrived at are offered to manufacturers in the hope that a clearer knowledge of their cause may assist in timely detection and, ultimately, their complete elimination.

In Fig. 1 is shown a shrapnel shell with three distinct flaws, which are due to three entirely different causes. At A is indicated what is perhaps the commonest flaw. One or more cracks may open up and become visible after the shell is hardened. They may be only one-eighth inch long, or they may be one inch and eight. They may be less than one sixty-fourth inch wide, or they may be one-sixteenth inch. While most parties who have experienced this trouble seem agreed that it is developed in forging, there has not been advanced, so far as the writer is aware, any definite theory which satisfactorily accounts for their occurrence.

A Crack Theory.

It would seem not improbable that these cracks are formed when a certain combination of circumstances occurs in the course of forging operations. In starting up forging after say a week-end stoppage, the drawing punch and dies would be well cooled down, while some pierced billets might be soaking at a high heat. The combination of the cold punch inside, and cold dies outside would chill the walls of the forgings much more quickly than after running steadily for some time. The probability of an extra long billet would call for extra power, causing excessive tension in the metal on the outer layers of the base, which as suggested might possibly be at a rather high heat. While a rupture might take place at this time, it would not weld together again, but the close contact of the surfaces due to shrinkage would conceal the defect until the tension induced in the outer layers by their sudden contraction when quenched, would open them sufficiently to make their presence noticeable.

Forgings, in which the thickness of the base was well oversize, would be more or less immune from this trouble, not only because the extra metal would provide increased resistance to rupture while passing through the drawing die, but also because the extra metal is removed from the outside of the bore more conveniently than from the inside. Even if there were any slight cracks, in spite of the thicker metal in the base, they would in all probability be removed in facing the base of the shell to the required thickness.

Other conditions under which they would occur would be when the forging shop was working too closely to the minimum thickness of base. This would be most likely to happen when the forge shop was getting low on material and endeavoring to work in billets which might be a trifle undersize.

Neglect to clean out the piercing die also causes trouble through scale remaining on the bottom and getting pressed into the base. Shells have been observed with quite large defects from this circumstance, the cavities caused by the scale or other foreign matter, sometimes extending completely through the base.

Flaws Due to Rolling.

At B, Fig. 1, is indicated a flaw which occurs previous to forging. In the particular shell referred to, this flaw extended from the nose to the driving band groove. About 1-64 inch in width it could be felt distinctly with the finger nail, and, where it terminated at the driving band groove, it had broken away on either side leaving a scaley surface exposed. While at first sight it might be considered due to piping, the fact that it was only 1-16 inch deep, and did not extend over the base, would indicate rather the presence of some foreign substance or material which got worked into the bar during rolling operations. the end of the affected part happening to terminate at the groove as described.

Flaws of this kind are not dangerous in the sense of being concealed or difficult of detection. Had there been a smaller amount of foreign matter rolled into the bar, it would have been entirely removed in machining, but an internal flaw due to lack of homogeneity in the ingot could quite well remain undetected at all stages of the work.

Fissures.

At C, Fig. 1, are indicated a number of minute hair-like cracks or fissures from one-quarter to three-quarters of an inch in length. In some particular makes of forgings these fissures would be quite numerous. Their behavior was similar to flaws A, with the difference that they were more noticeable when the shells were ground instead of turned. At one period in the business, considerable trouble was experienced with hard streaks which were attributed to segregation of manganese. While opportunity did not afford full investigation at the time, the conclusion was accepted as probable.

The matter of fissures in shrapnel shells has been the subject of recent discussion in England, the theory advanced being that regions of low carbon and high phosphorus resulted in layers of different hardness. The low carbon layers being more elastic would accommodate themselves to strains brought about by quenching, while the high phosphorus layers owing to their different behaviour, would be subject to local strains which might develop in the form of fissures such as have been observed.

The fact that defects such as these mentioned can, and do occur in the handling of steel forgings, renders it obvious even to the lay mind, that the use of any material which is less reliable than steel, can only be justified by the exigencies of the situation.

Regarding Cast Iron.

The most that can be said for cast iron is that it is better than nothing. The almost entire absence of elongation results in such brittleness that in order to be absolutely safe, a cast iron shell would have walls so thick that the number of bullets contained would be so greatly reduced that the killing powers of the shell would be negligible. The probability of blow holes in the walls would disturb the balance of the shell during flight so as to destroy all accuracy of fire. The presence of cast iron shells on a modern battlefield indicates two possible contingencies:—either the demand for shells is so abnormal that a sufficient amount of raw material can not be obtained, or else the supply of steel is so much below normal that the normal consumption of shells cannot be met.

The inference is largely a matter of degree, but the results cannot be other than favorable to the cause of the Allies.

MUNITIONS INVENTION COMMITTEE

THE Minister of Munitions has constituted a Munitions Inventions Branch of the Ministry, and has appointed as Comptroller E. W. Moir, M. Inst. C.E., M. Am. Soc. C. E. The branch, which for the present is located in Armament Buildings, Whitehall-place, will have the duty of considering projects for inventions relating to munitions for warfare on land, or matters appertaining thereto. The Comptroller and staff of the branch will be assisted in their work of examination, and, if thought necessary, in the investigation and development of any projects that may be considered worthy of being developed, by a panel of honorary scientific and other experts.

In order to prevent time fuses from turning whilst in transit, Krupps solder a wire across them sufficient to hold them in place, but yielding easily to the pressure of a key in the gunner's hand.

The Production of Sound Ingots for Shell Requirements*

By Sir Robert A. Hadfield, F.R.S.

It is shown by the following detail of the research work carried out by the author during recent years that there is no necessity for unsound material being produced for either rail or shell purposes, slight, but highly important changes in procedure reducing losses to zero.

FIG. 1 represents two 18-in. ingots made by the Hadfield system, weighing about 2¾ tons each. These ingots were cast with the small end up, as in ordinary practice. The photograph is interesting, as it gives an excellent view of the cavity produced by the sound steel in these ingots as it settles down into the body of the ingot proper; that is, below the feeding head. In these ingots it is not necessary, in order to determine whether they are sound or not, that machining or other observation by mechanical methods should be carried out, and at least 88 per cent. to 90 per cent. of sound usable and saleable material is obtained.

Fig. 2 shows an ingot made in the present and ordinary manner; not even the most experienced expert could say whether the exterior of the ingot was sound or unsound, whereas the ingot in Fig. 1 shows the steel to have settled or sunk down. When steel so sinks it is a definite proof that the material is sound and free from blow-holes. The following results further illustrate this important advance in the production of sound steel:—

Measuring the Cavity.

To show how considerable is the cavity which forms in piping steel, nine 15-in. ingots were taken (weighing about 3,600 lbs. each), each of which had the sand head and the writer's method of feeding carried out on them. After the ingots had cooled down, the hollows or cavities in the sand heads were filled with water, then the water was poured out and carefully measured. Table I. shows the results obtained.

*Abstract of paper communicated to the Franklin Institute.

Table I.

Ingot Number.	Cubic inches.	Lbs. of Steel.	Percentage of weight of ingot.
1	457	128	3.57
2	549	154	4.30
3	457	138	3.57
4	457	128	3.57
5	472	132	3.68
6	488	137	3.82
7	518	145	3.05
8	579	162	4.52
9	488	137	3.82
Average	496	139	3.88
Maximum	579	162	4.52
Minimum	457	128	3.57

Weight of ingot, 3, 600 lbs.

Fig. 1. 18-in. ingots of about 2¾ tons made by the "Hadfield" process. Fig. 2. 18-in. ingots of about 2¼ tons. A—Unsound ingot. B—Piped ingot.

The average weight for the nine 15-in. ingots showed that 139 lbs., with a minimum of 128 lbs. and a maximum of 162 lbs., passed from the head portion into the ingot itself. This percentage is represented by an average of 3.88 per cent. In other words, about 4 per cent., or 140 lbs. of of the total weight of the ingot or ingots cast passed from the upper or feeding head into the body of the ingot. Let it be assumed that the cubic capacity of each of the 15-in. ingots was approximately 12,500 cub. in. But for this feeding there would be a general want of solidity, chiefly at the upper portion of the ingot, to the extent of, say, 500 cub. in.—say, 4 per cent.—of the whole capacity. It is surely readily apparent why an ingot which is not fed must perforce be deficient in homogeneity.

There is, of course, a certain amount of feeding effect from the steel in the upper portion of the ordinary ingot, but this is not done efficiently, as the steel quickly freezes on the outside of the mould and on the surface of the liquid steel exposed to the air. Moreover, there is always an uncertainty as to how good or how bad is the resulting material. In any case, as the steel solidifies in an ingot of this size, the natural law of contraction demands that about 500 cub. in. have to be dealt with on an ingot of the weight and size mentioned.

While the results necessarily vary slightly, because the sizes of the head portion nearest the top of the mould formed in sand are not always uniform in length, as the steel shrinks down slightly more on the outside in some cases than others, on the whole the maximum and minimum figures of 4½ and 3½ per cent. of the total weight of the ingot having passed from the head into the ingot itself show very uniform working; if the heads were absolutely the same depth in each case, there would be practically no difference. If not treated, the piping would have probably run down the ingot itself, requiring a discard of probably 25 to 33 per cent. Although water cannot be poured into the cavity of a red-hot ingot, yet the cavity can be determined in each ingot by a cursory examination while at a red or yellow heat, involving only a few seconds of time.

Upper Portion Defective.

While in ingots made in the ordinary way as above mentioned a certain amount of fluid steel passes from the upper portion to the lower, still in doing so, it is robbing the quality of the upper portion of the ingot itself, which has no fluid metal above it to feed or take the place and supply the deficiency thus created. It will readily be understood, therefore, why the upper portion of ingots is so seriously affected as regards their soundness, also why segregation occurs. This is shown in a remarkably clear manner by ingot B (fig. 4). The steel in the "fed" ingots being maintained fluid in the head portion continues to exercise its ferro-static pressure, whereas with ingots made in the ordinary way the ferro-static pressure on the centre portion of the ingot is so slight that it produces very little beneficial effect. Further, without the feeding head above the ingot proper, the outside of the ingot in the ordinary ingot mould becomes rapidly chilled and frozen, so that it cannot contribute its proper share to the feeding of the remaining portion of the ingot. It is not, therefore, to be wondered at that rails rolled from the A and B portions of an ingot made in the ordinary way are liable to unsoundness or piping, or both, and are also often full of impure segregated material. There would probably be more dangerous ingots but for the fact that the steel maker tries to avoid this type of steel, and aims to make steel which will not pipe when poured into the ingot. Nevertheless, he is still fighting against a natural law. If piping steel is checked or avoided, he runs the risk of producing unsound steel, especially in the upper portion of the ingot, more or less permeated with blowholes. Thus, owing to lack of feeding from the upper portion, the centre, or that portion on the axis line of the ingot, must be of inferior nature, as the piping characteristics persist for quite a long way down the ingot.

Fig. 3. Ingot made by "Hadfield" process; perfectly sound, free from blow holes, piping and segregati n. Fig. 4. Ingot made in ordinary manner; unsound, having blow holes, piping and segregation. Fig. 5. Upper portions of three ingots made by the "Hadfield" process.

Ferro-Static Pressure Necessary.

This, as before mentioned, is for the reason that, owing to want of ferro-static pressure, the ingot lacks feeding from above, which, in the system of casting ingots now described, is maintained to a very late stage; that is, until or close upon actual solidification. There is always fluid steel in the upper portion of the ingot to feed the piping and shrinkage, both of which must occur, as they follow a natural law. Check or hinder ferro-static pressure, and segregation with its bad effects at once commences. In the case of "fed" ingots, the smaller amount of segregation which occurs takes place outside the ingot proper; that is, in the head.

Fig. 6. Etching on axis line to determine amount of segregation. Fig. 8. Shell forgings from blanks (1) and (2) of Fig. 7, split open for inspection.

The experiment, carried out by the writer some years ago, of pouring copper into the upper portion of an ingot 15 or 20 minutes after casting, showed how serious is this want of ferro-static pressure in the material situated on or near the centre or axis line of the ingot in ingots which have not been properly fed. The copper finds its way down to the bottom of the ingot, although added 15 minutes after casting. In any case, if there is no definite pipe at the bottom portion of such ingot, there is still material of loose or open structure, which means weak steel. Although this may not be apparent by fracture to the naked eye, nevertheless it exists, and can generally be detected by an examination of the micro-structure. In other words, notwithstanding that the product to be used may come from the lower half of the ingot, yet in unfed ingots it will be weak and not able to stand severe stresses.

It is true that some portions of the cavities in ingots have been measured, but probably not in the manner described by the writer. Although in the examination of the top of an ingot cast in the ordinary manner, and from steel which "settles" there is external evidence of some piping, this is irregular and varies considerably. Therefore, in the "best" ordinary ingot evidence is slight as to how much or how little the steel has piped.

Kinds of Piping.

Dr. Dudley has pointed out that such piping is divided into two kinds: the upper, or what may be termed the visible pipe, and the lower or hidden pipe, the extent and character of which can be determined only by cutting open the ingot. In the ingots cast under the writer's system, all the cavity or pipe is open and can be rapidly inspected from the top, its extent can be readily determined whether in the hot or cold condition. It is therefore not necessary to cut open the ingot.

Dr. G. K. Burgess, of the Bureau of Standards, Washington, is at present working with the writer on a joint research relating to this subject, and, though the full details of the work done cannot at the present time be given, it may be stated that ingots made under the writer's system were carefully cut up by the Bureau and compared with similar ingots produced at rail mills and made in the ordinary manner. The comparisons are shown in Figs. 3 and 4, in which A (Fig. 3) represents the ingot made under the writer's system, as described in the various papers, and B (Fig. 4) represents an average ingot made by one of the rail-makers.

Piping Defects Incurable.

While it is true that in unsound steel of very mild character the process of forging or rolling closes up the blowholes, and probably, if the heating temperature for rolling or forging is hot enough, the blowholes are welded together, even then it is doubtful whether such material can ever afterwards possess exactly the same tenacity and ductility as the same steel worked up from a sound ingot. In the case, however, of rail steel in which the carbon percentage is high, the same amount of welding does not take place; in fact, it is doubtful whether the blowholes are more than merely pressed together.

Sound Steel Imperative.

As large quantities of high-explosive steel shell are used by various governments, it is most necessary to obtain steel of the highest quality and yet at not too high cost. In other words, there is required steel of superior quality to that ordinarily used for rails, ship and boiler plates, angles, bars, etc. The system of manufacturing ingots of sound steel, described in the present paper, exactly meets these special requirements. Moreover, it can be used for making the comparatively lower quality of steel referred to. Several important governments, after making exhaustive tests, have been so satisfied with the Hadfield system of making sound ingots that, both for their land and sea services, they have now authorised explosive shell being made from ingots (afterwards forged into necessary billets) produced in the manner described in this paper.

As will be understood, an explosive shell, whether of small or large calibre, must be absolutely safe; that is, it must be (a) sound (that is, free from blowholes); (b) free from pipes; (c) free from segregation. Any flaw in the shell to its premature bursting would be most disastrous. In order to be absolutely certain of obtaining this combination of desirable qualities, it has been insisted upon by the user concerned that something like 40 per cent. to 50 per cent. of the ingot made in the ordinary manner—in fact sometimes more than this—must be discarded. Ingots made by the writer's method, however, are now allowed after discarding only 15 per cent.

It would also be quite possible under the system to give perfectly safe shell steel with only 10 per cent. to 12 per cent discard, and to ensure the qualities under the headings (a), (b) and (c) just referred to. This means a reduction in discard from 40 per cent. to 15 per cent. This decision has been arrived at after carefully cutting up and examining over one hundred ingots made by the Hadfield system, produced in the ordinary course of working. Each of these ingots on being cut up, was found to be perfectly sound.

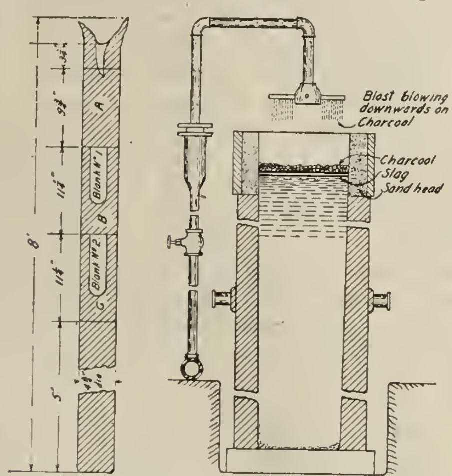


Fig. 7. Sketch showing upper portion of ingot forged and drawn out into a bar 4¾ in. diar. and about 8 ft. long. Fig. 9. Apparatus employed in producing sound ingots.

were not satisfactory the ingot would be rejected.

Ascertaining Soundness of Ingots.

The following demonstration was made to show the importance and efficiency of the system:—Fig. 5 shows the upper portion of three 15-in. ingots made under the Hadfield system. This place shows the soundness and freedom from piping of the ingots. If this is compared with the section of the ordinary rail ingot shown in B (Fig. 4), representing average and current practice, it will be seen how great is the difference. While sound material, whether rails or other articles, can be expected from ingots made as shown in Fig. 5, it can be well understood that if steel for explosive shell were made from an ordinary steel ingot cast in the usual manner, as shown in B (Fig. 4), there would have to be at least 50 per cent. discard in the ingot, and even then it is doubtful if the material could be safely used.

To further prove this, Fig. 6 shows an etching of the fractured portion of a 15-in. ingot (marked No. 3 in Fig. 5), on the centre or axis line, where segregation is usually met with to the greatest extent. This being so sound and free from segregation, it was necessary to continue the etching beyond the fractured portion. The analysis of this particular 15-in. ingot is shown in Table II. From this table it will be seen that there are no signs of segregation, unsoundness, or piping of any kind until the extraordinarily small discard of 7½ per cent. has been reached. Even in this case the difference in composition is very slight, whereas the composition of an ingot made in the ordinary manner and with only 7½ per cent. discard, to say nothing of the unsoundness, would show probably 0.60 to 0.70 per cent. carbon and 0.07 per cent. each of sulphur and phosphorus.

Table II.

	Analysis.				
	C.	Si.	S.	P.	Mn.
Original steel	0.36	0.19	0.031	0.031	0.96
A. Discard of 7½ per cent. (sand or feeding head of ingot)	0.54	—	0.056	0.031	—
B. Discard of 10 per cent.	0.46	—	0.040	0.031	—
C. Discard of 12½ per cent.	0.39	—	0.040	0.031	—
D. Discard of 15 per cent.	0.39	—	0.033	0.031	—
E. Bottom of ingot	0.38	0.19	0.031	0.031	0.96

It should be remembered that steel produce from the ingots to be used for the requirements of various governments is most critically examined by many inspectors supervising the material produced and the work done, not on the ingot only, but on each projectile, also including a considerable number of mechanical tests from each ingot, and from a certain number of projectiles made from each ingot. Moreover, each individual ingot is cut up and has to be passed on its own discard; if this

Table III. shows a number of analyses taken during the ordinary course of working) that is, they are not in any way special) from the centres of different ingots as above described, the drillings for analysis being taken exactly at the parting line where the 15-per cent. discard has been made. The figures obtained clearly show the important fact that the steel is as pure and free from segregation at this part as it is at the bottom or at any other portion of the ingot.

As a further test, the following interesting experiment was made:—The portion of one of the ingots representing the usual 40 per cent. of the discard hitherto demanded in the manufacture of high-explosive shell was taken from an 11-in. ingot having the following analysis:—C, 0.38 per cent.; Si., 0.18 per cent.; S, 0.024 per cent.; P, 0.035 per cent.; Mn., 0.85 per cent. This was forged into bar 4¾ in. in diameter and about 8 ft. in length, as shown by Fig. 7. Projectiles were forged from this bar as indicated.

The length marked A is the portion of the material from the top part of the ingot head which, in the writer's system is cast in sand; that is, above the ingot itself. This portion, about 13 in. in length, and representing 7.1 per cent. of the discard, was cut off. Below this the projectile forging known as "Blank No. 1" was prepared, as shown by the dotted lines in Fig. 7. Below this, "Blank No. 2" was taken after 10.4 per cent. discard had been allowed. In other words, "Blank No. 1" was made from the material now not used (that is, after 7.1 per cent. of the whole ingot was discarded) and "Blank No. 2" after discarding 10.4 per cent. This is also not now used. The further and following blanks, No. 3, 4, and upwards, are not shown, because this is unnecessary, as such blanks then formed part of the current work. As will be seen, even "Blank No. 2" could also have been safely used.

It is remarkable to find that the fracture from "Blank No. 1" (that is, at the discard of only 7.1 per cent.) was perfectly sound, free from piping, and showed no signs of segregation. In the interior of the blank, after forging, there were some slight skin cracks proceeding from the hollow portion of the ingot top. The projectile from "Blank No. 2" was perfectly sound in every way, whether as regards surface fracture, freedom from segregation, piping, or any other defects; the interior was also perfectly sound. In other words, from this "Blank No. 2" (that is, with only 10.4 per cent. discard) a perfectly sound projectile was obtained.

The two projectiles from "Blanks Nos. 1 and 2" after being split open, are shown in Fig. 8. It will be seen that the fractures are sound, and that in each case, even including the blank from the portion of the ingot with only 7.1 per cent. discard, the material would have etched quite sound and free from segregation. The writer has now produced close upon 40,000 tons of ingots by the plan referred to in this paper.

Description of the Hadfield Process.

The following is a description of the author's method of casting steel ingots, castings, etc. which ensures soundness, freedom from piping, and absence of segregation: The process is illustrated in Fig. 9. As will be seen, it consists in heating the fluid steel in the upper part of the ingot or other mould, and maintaining it in a liquid condition by the combustion, in contact therewith, or in close proximity thereto, during the cooling and shrinkage of the metal in the lower part of the mould, of solid fuel, for example charcoal, by means of a blast of compressed air which is caused to impinge on the fuel while this is directly or indirectly supported by the metal below; and the interposition of a layer of fusible material, such as cupola slag, which has little or no injurious action on the metal, between the metal and the fuel. This slag largely prevents radiation of heat, the loss of which is much greater than is ordinarily supposed to be the case.

Table III.

	Analysis made by Hadfield of drillings from the usual ladle ingot tests.					Analysis made by the inspector from drillings taken from the centre or axis line of each ingot after cutting off 15% discard.				
No.	C.	Si.	S.	P.	Mn.	C.	Si.	S.	P.	Mn.
1229	0.40	0.22	.030	0.033	0.89	0.37	0.24	0.031	0.035	0.87
1231	0.38	0.21	.031	0.037	0.88	0.40	0.21	0.029	0.036	0.88
1233	0.40	0.21	.033	0.035	0.90	0.39	0.20	0.035	0.036	0.88
1234	0.39	0.21	.032	0.033	0.89	0.39	0.21	0.036	0.038	0.88
1243	0.40	0.26	.034	0.029	0.91	0.39	0.23	0.026	0.034	0.88
1244	0.38	0.23	.031	0.032	0.93	0.43	0.22	0.038	0.034	0.91
1245	0.39	0.25	.030	0.030	0.99	0.38	0.24	0.030	0.032	0.91
1246	0.40	0.21	.029	0.029	0.95	0.39	0.19	0.025	0.030	0.87
1247	0.37	0.19	.030	0.032	0.89	0.39	0.18	0.025	0.033	0.81
1248	0.41	0.20	.026	0.036	0.87	0.45	0.20	0.027	0.029	0.81

MUNITION METALS.

A PREPONDERANCE of raw material from which to manufacture munitions of war is of vital importance to a belligerent, and if, as many persons hope, the allies can maintain the advantage in this respect at the expense of the enemy, the raw material assumes a doubled value. Professor H. C. H. Carpenter, writing to "Nature," compares the resources of the different countries in munition metals, and sums up the position as follows:—

Belligerent Resources.

Of the ten munition metals, the enemy countries can certainly produce five without having resource to imports—namely, iron (the basis of the various steels used for war purposes), manganese, chromium, zinc, and lead; on the other hand, it is doubtful whether they can produce sufficient nickel, copper, aluminium, tin, and antimony from domestic ores. In view of the fact, however, that they prepared for this war with extreme care and foresight, it may safely be concluded that large stocks, either of ores or the corresponding metals or both, will have been accumulated in those countries.

However confident the higher German command may ostensibly have been of a rapid victory, they will quite certainly have laid their plans to wage a prolonged war if it should prove to be necessary, and such plans will have included the accumulation of munition ores and metal of which their countries produced an insufficient amount. There is, accordingly, no adequate reason for concluding that the enemy countries are likely—in spite of the prodigious scale upon which the war is being conducted—to run short of metals which are essential for war purposes for some time to come. Moreover, it may safely be concluded that their technical metallurgists will have been mobilized in the direction of discovering substitutes for any of the above metals of which a shortage is liable to occur in a long war.

The allies for their part can produce from their own resources all the iron, manganese, nickel, chromium, tin, and most of the aluminium they require; their command of the seas enables them to obtain, principally from the United States, their deficiencies in aluminium, copper, and lead; China furnishes the requisite antimony. Zinc is the only important munition metal of which there is a shortage, in spite of the great speed with which the American furnaces are being operated. Wherever it is possible to substitute another metal for zinc, it is of national importance that it should be done.

EDITORIAL CORRESPONDENCE

Embracing the Further Discussion of Previously Published Articles, Inquiries for General Information, Observations and Suggestions. Your Co-operation is Invited

MOLDING A LARGE ACCUMULATOR BASE

By J. H. R.

THE St. Lawrence Iron Foundry Co., of Montreal, Que., who make a specialty of supplying all kinds of iron castings to the trade are at the present time remodelling a portion of their plant and equipping same for the machining of 4.5 high explosive shells. They will, however, continue to develop the foundry end of their business, and in order to give your readers an idea of the nature and scope of same, the molding features connected with the production of a large accumulator base casting are here detailed and illustrated.

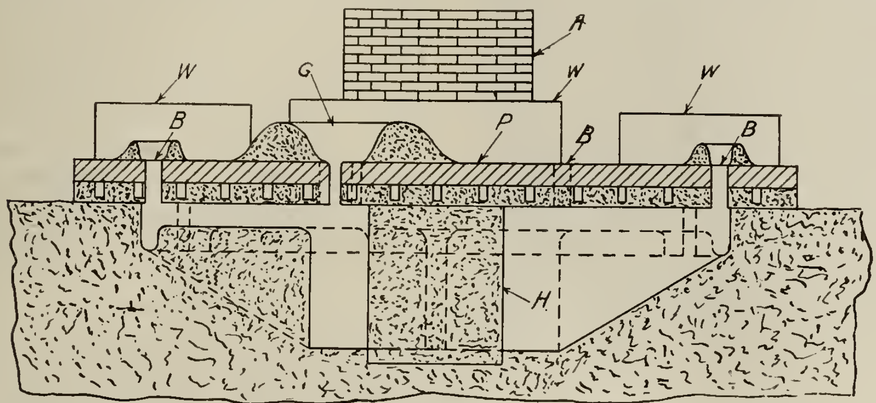


FIG. 1. SECTION THROUGH GREEN SAND MOLD FOR ACCUMULATOR BASE.

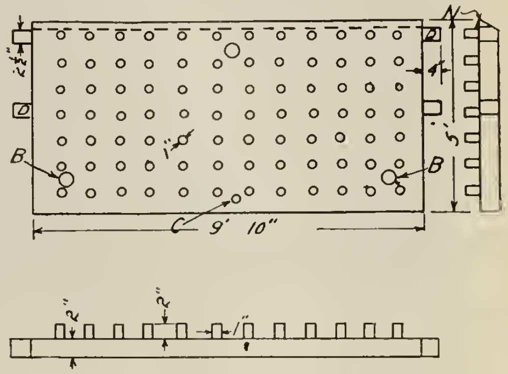


FIG. 3. COPE PLATES.

This casting, which will weigh in the neighborhood of 17,000 lbs., is for the base of one of the largest accumulators yet built in Canada, and which is being constructed for the Montreal Ammunition Co., by the Canadian Boomer & Boschert Press Co., of Montreal. The accumulator, when completed will furnish a pressure of 1,500 pounds per sq. inch to hydraulic presses engaged in the drawing of shell cartridge cases. The casting will consist of 25 per cent. steel, which is obtained from the use of the discarded shells and shell ends from shell making plants. The pattern for this base casting was of the skeleton type, being of course made of sufficient strength to retain its shape while being rammed up.

Preparing the Mould

The mould was prepared as shown in Fig. 1. A pit was dug in the floor and the pattern set into it, and levelled up. Green sand was shoveled in and thoroughly rammed, care being taken to have the sand of uniform density at all points. As there was no base to the pattern the openings between the ribs made it easy of access.

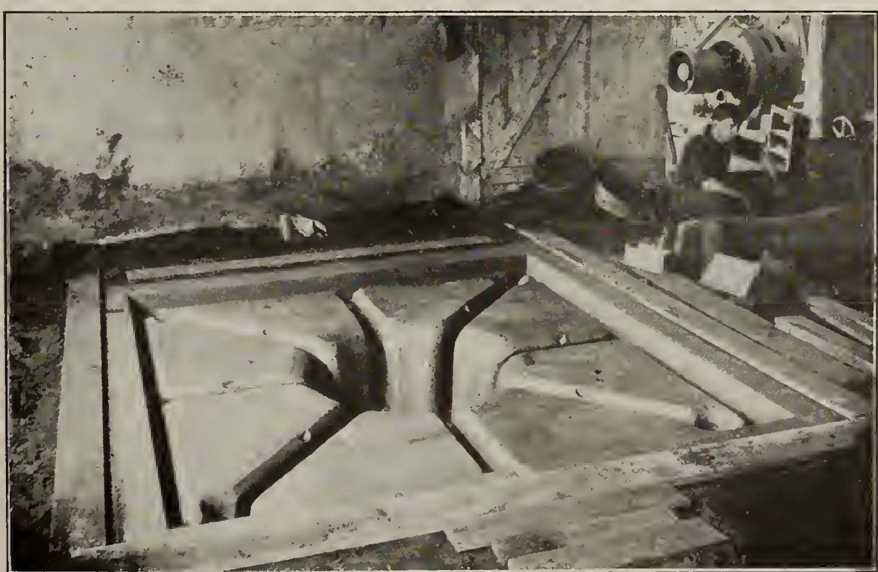


FIG. 2. COMPLETED GREEN SAND MOLD FOR ACCUMULATOR BASE.

When the spaces between the ribs were completely rammed, the surplus sand was removed by sweeping the surface above the ribs leaving the space for the metal at the base of the casting. The sand having been levelled off, the pattern was carefully removed, the moulder and his helper afterwards cleaning up and smooth facing the various surfaces. A view of the mould at this stage is seen in Fig. 2. As it was not thought advisable to construct a special cope the method shown in the figure was adopted as this had proved satisfactory in former cases.

Special Cope Plates

Two plates of cast iron weighing about 2 tons each and similar to that shown in Fig. 3 were cast. Pins A which protruded about two inches from

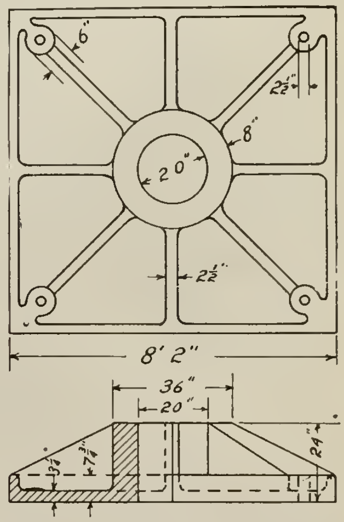


FIG. 4. ACCUMULATOR BASE.

the main plate and were about one inch in diameter were placed irregularly about the surface for the purpose of retaining a layer of sand spread over the surface and which was rammed up and surface levelled by placing the plate in the framework shown to the right is Fig. 6. This thickness of sand amounted to about 2½ inches. Cored holes B were put into the plate so as to come directly over the corners of the casting and be just outside of the boss as shown in Fig. 4. which is a sketch of the finished casting. The holes C were for inserting eye-bolts for convenience in handling, while the lugs D, were used for turning the plate over when the sand facing was in place.

Arrangement of Mould

The arrangement of the mould for producing these plates, two of them being used, is shown in Fig. 5. A space sufficiently large was cleared on the floor and the sand rammed to an even density. A skeleton frame was used to make the required plate dimensions which were about two inches thick by nine feet ten inch by five feet. When placed over the mould as shown in Fig. 1 there was a bearing of 10 inches all around the edge.

The object of making two plates in place of one was for convenience in handling. It will be noticed that the plate edges which come together in the centre of the mould as shown at N are bevelled. This is for the purpose of securing a good close joint with little labor. When the plates are butted, the trough formed by the two bevels is rammade with a little waste and sand thus securing a close joint and avoiding fins or burrs, which would be liable to appear if the plates were left the full thickness at their edges.

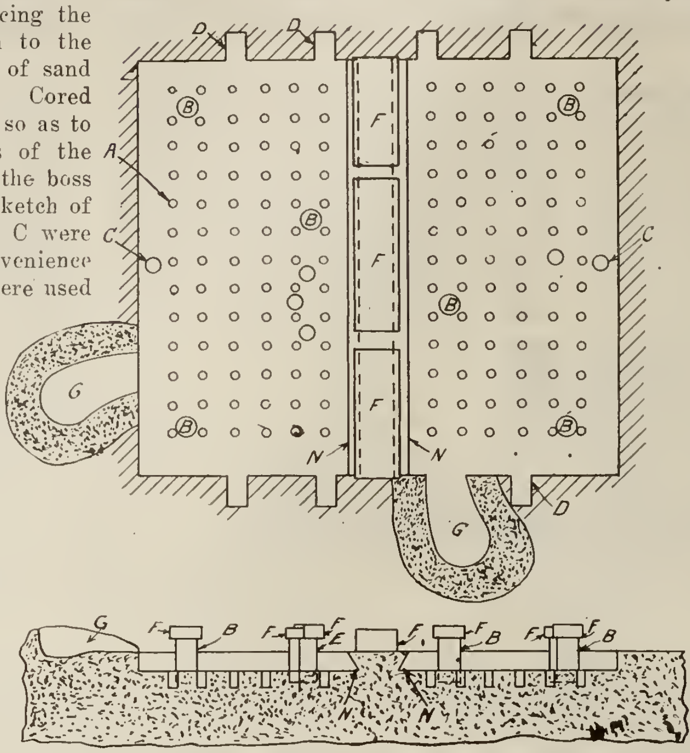


FIG. 5. GREEN SAND MOLD FOR COPE PLATES.

The layout of this mould is shown in Fig. 5. The cores B are for the risers while those at E were for the runners from the pouring basin when placed over the mould Fig. 1. The pouring basins G were placed to one side of the moulds. The cores were prevented from shifting by means of the weights F. A view of the mould in readiness for pouring is shown in Fig. 6.

Accumulator Base Casting Mould

A sketch of the mould for the accumulator base casting is seen in Fig. 1. After the mould is prepared as per Fig. 2, the plates with their facing of sand are placed in position and the basins for pouring and risers arranged. The weights W, together with that of the plates, amounted to about ten tons. The plates at the centre rested on the 20-inch cove H, which extended up level with the base of the cutting.

Pouring

The largest ladle in the shop which was handled by a 5-ton "Whiting" crane had a capacity of only 5 tons. It was, therefore, necessary to provide some means of continuous pouring. The brick bosh A shown at the rear of Fig. 1 was constructed of sufficient size to hold about 4 tons of iron and this was filled

(Continued on page 182.)

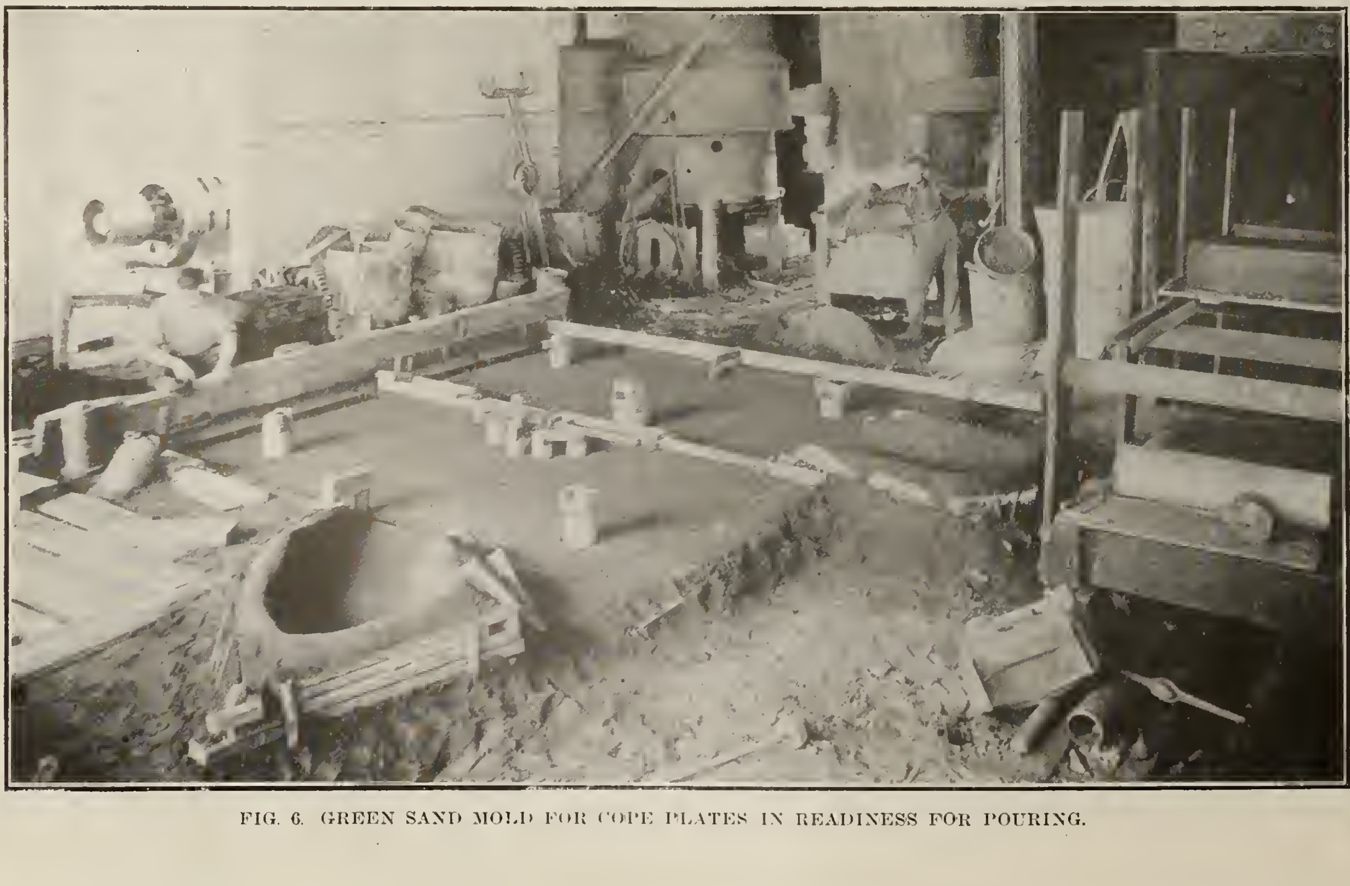


FIG. 6. GREEN SAND MOLD FOR COPE PLATES IN READINESS FOR POURING.

NEW AND IMPROVED EQUIPMENT

A Record of Machinery Development Tending Towards Higher Quality, Output and Efficiency in Foundry, Pattern and Metal Work Generally

CARTRIDGE CASE COOLING CONVEYORS.

THE accompanying cuts show two special conveyors of 33 feet centres furnished by the Stephens-Adamson Mfg. Co., Aurora, Illinois, to the Metal Drawing Co., St. Catharines, Ont., for carrying red hot cartridge cases for 18-pdr. shrapnel shells from the annealing ovens to the pickling tanks prior to being re-drawn. The function of these conveyors is to afford a means whereby the cartridge cases can be cooled gradually while travelling from ovens to tanks.

Fig. 1 shows a pan of cartridge cases which have just been discharged from the annealing furnaces. These are picked off the pan singly or in pairs by means of long hand pinchers or tongs, and placed in a wire basket, which holds forty cases. The pan when empty is trucked around to the receiving end of oven ready to receive another batch of cases to be annealed. The conveyor is then put in operation and moves for a distance of two feet bringing an empty basket ready to receive its load.

Fig. 2 shows the discharge end of conveyor with basket laying in horizontal position (same as receiving end) ready for cartridge cases to be removed by hand and placed in pickling tanks for treatment.

The conveyors are spaced 14 ft. centres in line with the annealing furnaces, and between the conveyors is installed an exhauster for cooling the cartridge cases while in transit, the conveyors being started and stopped at will at either end by means of a friction clutch pulley on line shaft driving the same.

The capacity of each conveyor is approximately 1,400 shells per hour, and the time consumed between receiving and discharge end is thirty minutes, the cartridge cases emerging from conveyor thoroughly cooled. Edwin J. Banfield, Toronto, is the Ontario representative of the Stephens-Adamson Co.

A NEW "GARDNER" GRINDER

IN bringing out this new machine, the manufacturers, the Gardner Machine Co., Beloit, Wisconsin, claim to have developed a disc grinder which has immeasurably broadened the possibilities of the disc wheel; a disc grinder which will not only handle with greater speed and accuracy all the work that their earlier types do, but a great number of additional operations which heretofore had been proven unsuited to this manner of machinery. It is a complete grinding unit, each machine being equipped with dust exhauster, water system and cast iron hood.

The machine is of unusual weight and rigidity. The total weight, without skids or crating, is 5,000 pounds. The spindle

FIG. 1. CARTRIDGE CASES BEING PICKED OFF PAN FROM ANNEALING FURNACE AND LOADED INTO WIRE BASKET ON CONVEYOR.

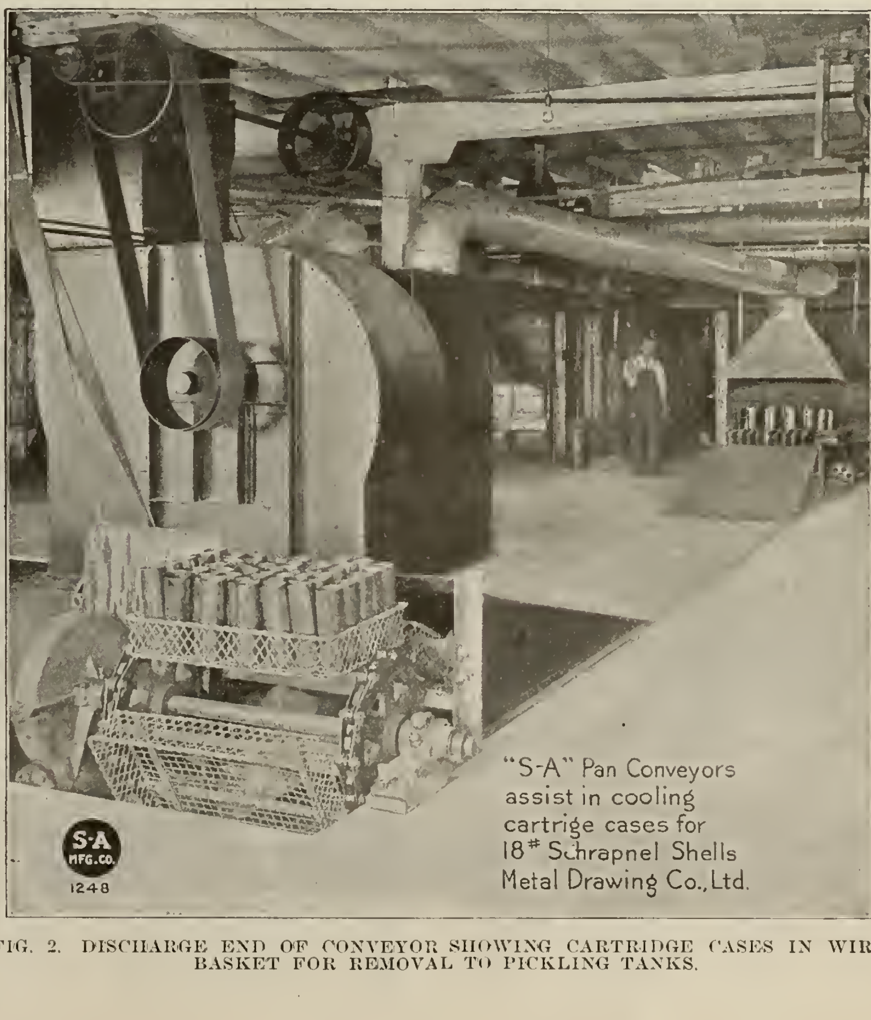
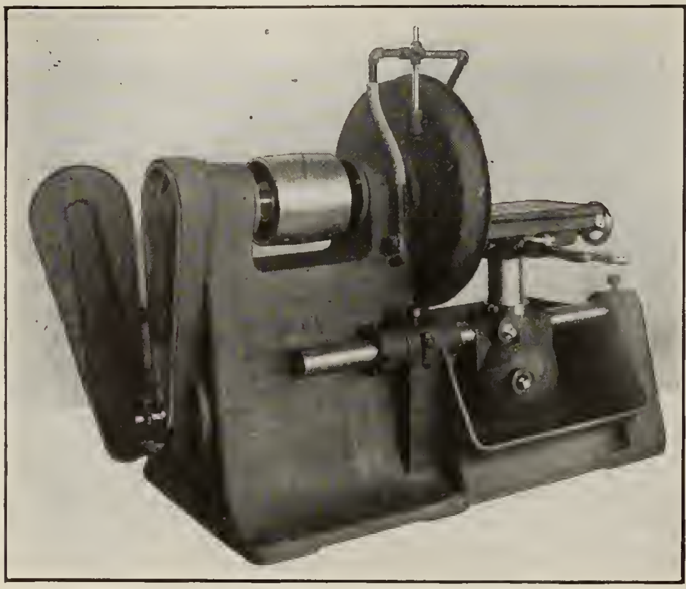


FIG. 2. DISCHARGE END OF CONVEYOR SHOWING CARTRIDGE CASES IN WIRE BASKET FOR REMOVAL TO PICKLING TANKS.

is made from the best crucible steel, turned and accurately ground to 3 inches in diameter. It is mounted in S.K.F. radial ball bearings of larger size than recommended by the manufacturers. The end play is also taken on thrust ball bearings of the same make. The spindle pulley is 12 inches in diameter, with a face for 10-inch double belt. The complete spindle is perfectly balanced and runs without sign of vibration.



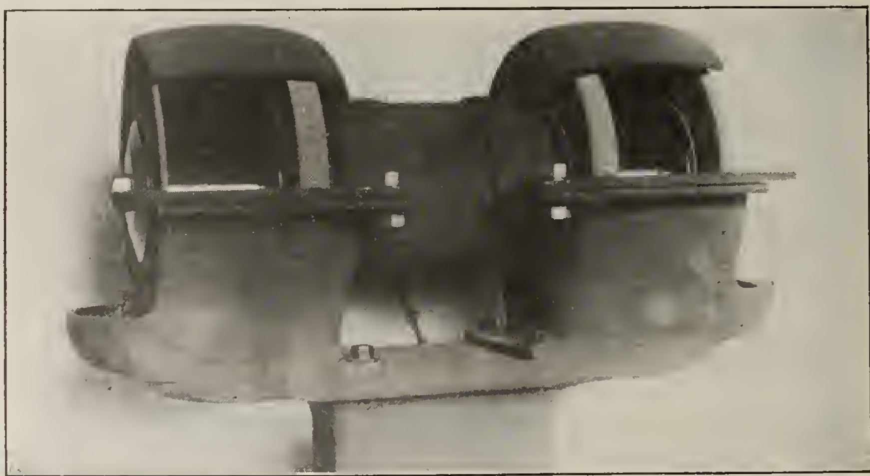
A NEW "GARDNER" GRINDER.

The 4-inch diameter rocker shaft and counter weight are a one-piece casting, and weigh in the rough approximately 500 pounds. It is of particular importance to note that the rocker shaft has a bearing at each end, and that it oscillates in the bearings when the table is rocked back and forth across the grinding wheel. This style of construction results in surpassing stiffness and rigidness, all of which make for greater accuracy and output. When the work being ground is forced against the grinding wheel, it will be understood there would be a tendency for the rocker shaft to move to right in its bearings. The heavy clamp collar just outside of the left bearing prevents this action. The other collar at the right serves two purposes: It is locked to the shaft against the end of the bearing, preventing the shaft from working to the left. The ledge on the under side of this collar and forming a part of it is provided with a curved, elongated slot, which acts around the stop screw. By adjusting this collar on the shaft and locking with the set screw, the limits of the oscillating motion of the table may be regulated.

The table column and top are solidly and rigidly constructed. The column is 5 inches in diameter, and when raised or lowered works within the counterweight, directly over the centre of the rocker shaft. When raised to the required height, it is held in position by the two locking screws passing through the left side of the counterweight. The graduated clamp collar, situated above the counterweight on the column, is employed when it is desired to set the table at an angle with the grinding wheel.

The finished top of the table has three ½-inch T-slots and measures 18 inches long by 10 inches wide. It is surrounded by a depressed channel, with the bottom cast on a down pitch, so that when wet grinding is done the water will rapidly drain into the basin below. The feed mechanism of the table—that is, the travel towards the grinding wheel, is a feature of this machine. Provision is made for either lever, screw or spring feed. When the lever feed is desired, the screw wheel is disengaged by removing a taper pin through its hub, and inner end of the lever shaft working in a rack attached to the under side of the table top. By lifting on the lever, a leverage of 56 to 5 is secured. The other handle mounted on the lever shaft, and which projects towards the front is used to assist in rocking the table. The positive screw feed is obtained by replacing the taper pin and turning the hand wheel to the right. A spring pressure of from 1 to 300 pounds can be had by turning up on the screw hand wheel when the latter is disengaged. When the spring feed is employed, the hand lever is used for giving any additional pressure wanted and for locking the table away from the grinding wheel. The micrometer stop screw in front accurately governs the forward movement of the table. The ways for the table top are formed by two heavy, flat gibs, and are thoroughly protected from grit or dust.

It should here be mentioned that this machine carries either a 30-inch diameter by 1¼-inch steel disc wheel or a 20-inch "Perfection" ring wheel chuck. The abrasive ring wheel is used when it is desired to do wet grinding and the disc wheel when dry grinding is done. The cast iron hood terminates at the extreme bottom with two openings, one for water and one for dust. When one of these openings is in use, the other is closed with hinged covers provided. When water is used, it falls into the main basin, from which it overflows into the removable reservoir shown at the rear of the machine. From here it is pumped up through the machine base and out at the adjustable nozzle directly on the work at the point of grinding contact. This water pump is of the gear type, and is driven from the machine spindle by sprockets and chain. The dust exhauster is contained within the machine base and is driven by belt. It is connected to the bottom of hood and discharges at the lower back of the machine. Here a thimble is provided for attaching to pipe. The front of the hood is enclosed with cast iron sections, one or more of which can be removed or inserted, making the opening adjustable for different sizes of work. The chain and belt driving the water pump and exhauster respectively are encased with a cast iron guard having a hinged door.



SPECIAL PATTERN SHOP GRINDING MACHINE.

PATTERN SHOP GRINDING MACHINE.

THIS new tool grinder, which is a product of the Forbes & Myers Co., Worcester, Mass., has been designed to meet the needs of pattern-making and other wood-working shops. It is made in both the bench and floor types, the photograph showing the grinder and top of stand of the floor type machine.

The regular equipment of wheels consists of one 10 in. x 1 in. with flat face for grinding chisels and other straight edge tools, also three round face wheels 10 in. in diameter by 1 in., ½ in., and ¼ in. respectively in thickness, for grinding gouges and special cutters. Other shapes of wheels can also be furnished.

The spindles are ¾ in. in diameter and ample space is allowed between the wheels. The guards are of heavy malleable iron, and the tool rests are adjustable in two directions. High grade ball bearings are used, these being thoroughly protected from dirt and grit by double grooved covers, and packed in grease.

The motor is of the squirrel cage induction type and can be supplied for two or three-phase alternating current circuits only. The capacity of the motor which is fully inclosed as a protection against dirt and mechanical injury, is ½ h.p. Frequencies of 25, 50 or 60 cycles can be used, the speed being 1.500 r.p.m. on the 25 and 50-cycle circuits, and 1,800 r.p.m. with the 60-cycle current.

MACHINE FOR SPRAYING SHRAPNEL SHELLS

TO coat the inside of shells, or for that matter any relatively inaccessible surface, with an asphaltum paint or anti-corrosion material, and to do the work rapidly, uniformly, and without waste of the coating compound, the Spray Engineering Co., Boston, Mass., has developed an interesting machine.

It looks not unlike a strongly built table with a circular recess in the top. The operator inverts a shell over the recess, pushes it down an inch or so into the latter, lifts it from the table, and the operation is completed, the shell having received its coating. He is then ready to repeat the operation with another shell. As the period covered in thus spraying a shell is 2 sec., or at the rate of 30 per minute, the capacity of the machine for coating is placed at 1,500 per hour.

SHRAPNEL SHELL SPRAYING APPARATUS.

The act of pushing the shell downward admits a supply of compressed air to a definite quantity of the protective liquid, which is driven through a spraying nozzle. The apparatus is supported under the table top. It includes what is substantially a three-way valve which holds the protective liquid, and which opens the channel between the compressed air supply and the nozzle when the shell is down, so to speak, and which receives the measured amount of liquid for the next shell when the pressure of the operator's hand is removed; that is, when the coated shell is removed. The fact that only the desired amount of liquid is admitted each time is a particular feature and application has been made for a patent covering the device. The working parts are counterbalanced as far as possible so that a minimum pressure will suffice to push the shell to the spraying position. It is obvious the machine is likely to find fields of usefulness outside of that for which it has been brought into being.

The height of the spray head is adjusted to coat the entire inner surface of the shell and the extent of this surface with the prescribed thickness of the paint film, sometimes 0.00025 in., gives some measure of the requirements. The amount of paint is regulated by what corresponds to a plunger which may be screwed in or out, decreasing or increasing the contents of the measuring chamber. For a given size of shell and a given paint and thickness of film, it is found that one setting of the measuring device suffices to insure that not only is sufficient paint sprayed upon the shell surface but there is no excess which has to be disposed of. The machine thus aims at a maximum economy of the protecting compound beside allowing for high working speed.

It is expected that the fundamental elements of the machine, the use of the spray head, and of the scheme for automatically measuring out the quantity of material to be sprayed, may have applications apart from war munitions. However, at this writing the company is engaged on working out details for utilizing the machine for spraying the small annular passage in the timing device or nose portion of the shell. This passage, which receives the time fuse, is small and somewhat inaccessible, and to swab the passage with a hand brush consumes too much time in view of the demands for high quantity production. It appears that in spite of the fact that the timing parts of the shell are of brass, the powder has a corroding influence, which fact makes it desirable to potect the brass work.

LAKE SUPERIOR CORPORATION

SURPLUS profits from operation of the subsidiary companies of the Lake Superior Corporation in the year ended June 30 last amounted to $1,366,210, a decrease of $1,145,125, or about 45 per cent. The return does not include any figures from the Algoma Central & Hudson Bay Railway, which went into a receivership during the year, and to that extent the comparison cannot be exact.

The return giving the output of the main company in the group, the Algoma Steel Corporation, reveals, however, the source of the great shrinkage in earnings. "The production of pig iron, rails and merchants' mill material," says the directors' report, "is less than for the previous year on account of the sharp falling off in demand which was experienced towards the end of the year." The output, in tons, compared with the preceding year, was as follows:

	1913-14	1914-15
Pig iron	311.904	212.917
Steel rails	325,680	174.536
Merchant mill material	15,575	8,903

The subsidiary companies, after paying interest on bonds amounting to $1,166,414, writing off $62.000, providing $134.423 for sinking funds, appropriating $54.209 for reserves and paying to the holding company $342,859 as interest on bonds, etc., showed a deficiency of $393,695 for the year. This wiped out the $61,930 carried as unappropriated profits and left a net deficiency of $331,765 at the end of the year.

The total income of the holding company, Lake Superior Corporation, was $369,032, against $448.054 the previous year. After paying interest and expenses the balance remaining as net income for the year was only $1,661.

"A nation cannot live without honor," was the reply of the Belgian Ambassador to the German Minister. To any enterprise, individual or corporate, the statement has an equal fitting application.

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Vol. VI. SEPTEMBER, 1915 No. 9

PRINCIPAL CONTENTS

THE EDUCATIONAL INFLUENCE OF CONVENTIONS

THE modern trade convention as exemplified by the coming meeting of the American Foundrymen's and Allied Associations at Atlantic City, N.J., is a development of our modern industrial system which is more or less peculiar to the North American Continent.

The wide field available in the United States and Canada possesses attractions for the energetic producer which vary considerably from those which obtain in other countries. Foundrymen as a group of producers form an important link in the world's industry, the processes under their control occupying the formative or foundational position on which much subsequent activity is accumulated. The stability of an industry such as rests on the successful conduct of foundry work is of importance to many more people than those immediately concerned in molding and ramming, but the man in the sand ought to know that much of our creature comfort and many of our luxuries are only available to the rest of the world as a result of productive activity which had its origin in the humble flask and sand heap.

The 1915 Annual Convention of the American Foundrymen's Association and of the American Institute of Metals is probably the finest example of trade co-operation extant. Coupled with the exhibition of foundry and machine equipment under the auspices of the Foundry & Machine Exhibition Co., it affords members and their employees opportunities of meeting professionally and socially which seldom or never occur in ordinary business intercourse.

A careful study of papers and reports submitted at such meetings as the present one, reveals a deep-rooted desire to get at the truth of many problems which perplex the trade. Reactions whose source is obscure, but whose influence is great are followed to a finish in order that others may be guided and advised. The skill and patience so characteristic of many of our investigators are only equalled by their disinterestedness in laying before the convention the results of their labors, and, be it said here, these results do not always represent success in the object set out to be accomplished. In many cases the original quest may be abandoned and activity developed in a line quite foreign to that intended.

The value of such conventions is not to be measured by the number of good fellows met or the business done. Conditions are not always conducive to sales, but the man in the sand keeps the work going ahead and any opportunity by which his interest can be stimulated, and the quality of his work improved should not be overlooked by his employers. The employee of to-day is frequently the competitor of to-morrow and many a master foundryman owes his position to just such influences as the present Convention.

There is not any real, live firm in the foundry business but what realizes and appreciates the advantages direct and indirect to be derived. Foremen who are invited as members' guests realize the importance of their duties, and when their appreciation takes the form of increased loyalty to their employers' interests, the expense of such a trip becomes more and more an efficiency investment from the employers viewpoint.

As in former years there will doubtless be a goodly representation of Canadian foundrymen who will journey to Atlantic City for the coming functions, and from the information to hand as to quantity and quality of the exhibits, and of the importance of the subjects to be discussed, it will certainly be worth the time spent and expense incurred.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

PROTECTIVE COATINGS FOR METAL*

By H. B. C. Allison**

THIS brief review of some of the processes at present in use for protecting metals from oxidation will be confined to two types: firstly, that in which the metal itself is made more resistant, usually by some chemical treatment; and secondly, that in which another metal is used as a surface coating.

In the first instance, a coating is formed which must possess the following properties, if it is to be successful: It must be homogeneous, continuous, resistant to attack by acids or alkali, firmly attached to the base metal and must have a similar expansion coefficient. The ideal metal coating should also be homogeneous and continuous, but should be strongly electropositive to the base metal and should form electropositive alloys with it, so that in case of oxidation the coating will be attacked and the base metal protected.

As iron is the metal most commonly used as the base, the processes chosen will be those used for its protection, although some may be applicable to other metals. It was known for a considerable time before any process was devised that the black or magnetic oxide formed on iron, under certain conditions, was a very fair protective coating. Attempts to control and improve this coating have led to a number of patented processes, of which two may be taken as typical.

Bower-Barff Process

The pieces to be treated are heated to a temperature of 900 deg. C. in a closed retort. When this temperature has been reached, superheated steam is admitted for 20 minutes and a coating consisting of a mixture of red and black oxides is formed. Producer gas is then substituted for the steam and allowed to act for the same length of time. After cooling somewhat, the pieces are oiled and a smooth, green-black coating is produced, which affords efficient protection from sea water, acid fumes, etc., and will stand a wide variation in temperature.

Gesner Process

This is a further development of the foregoing process. The pieces to be treated are maintained at 600 deg. C. for 20 minutes, after which steam at low pressure is let in at intervals for 30 minutes. The steam, on entering, passes through a red hot pipe at the base of the retort, and is thus partially decomposed into hydrogen and oxygen. After this treatment a small quantity of naphtha or hydrocarbon oil is introduced and allowed to act for 15 minutes to reduce any red oxide, and also to carbonize the surface. The coating is said to be a compound of iron, hydrogen and carbon, and analyses have shown that a minimum of 2 per cent. hydrogen is present. It is an improvement on the Bower-Barff process in that the danger of warping, due to high temperature, is removed, the size of the piece is practically unaltered, and the tendency to scale is much less.

Both processes are quite expensive, but users have usually found the protection afforded of sufficient benefit to warrant the added expense.

Protection by Chemical Means

There is one process which may be of interest in this connection, known after its inventor as "Coslettizing." The pieces to be coated are first cleaned as usual, either by pickling or sand blasting, and are then placed in a boiling water solution of phosphoric acid, in which iron or zinc filings are always present. The period of treatment is from one-half to three hours, depending on the thickness of the coating desired. After drying, the pieces are usually oiled. By this treatment a very slight amount of the surface of the article is converted into certain prosphates of iron, but most of the coating comes from the solution itself.

This coating has been found to be particularly useful in the tropics, and is employed in one instance for typewriters. It is not a complicated process or an expensive one and the finish is very durable. It is, however, subject to patent restrictions.

Protection by Another Metal

The agent used in the majority of cases for protecting iron is the metal zinc. Zinc is strongly electropositive to iron and so are its alloys, if free from impurities. It is also readily available and may be applied by a number of processes.

Hot Galvanizing

The oldest process is that of hot galvanizing, which consists simply of cleaning the piece, coating with a suitable flux and then dipping in the molten zinc. The piece is usually wiped after this to improve the coating. This process has the disadvantages of limiting the thickness of the coat, of plugging any small holes, of the composition of the coating being variable, and the possibility of including injurious and corrosive substances in the coating, which may cause early failure.

A modification of this process is known as the Lohman process. After cleaning, the article to be coated is dipped in the Lohman bath, which is a solution of hydrochloric acid, mercuric chloride and ammonium chloride; it is then dried before immersing in the molten metal, which may be any one or a mixture of a number of metals such as lead, zinc, and tin. The chief point in its favor seems to be that the junction between the iron and the protective alloy is kept free from all oxide, and, therefore, the alloy will fill all the pores and no corroding agent can be included.

It is claimed by its backers that a graduated alloy is formed so that the protective coating cannot be completely broken through except by breaking the sheet itself.

Cold Galvanizing

Another process being used more and more as it is improved is that of wet galvanizing or electroplating. In this case the article to be coated is suspended as a cathode in a suitable bath and is subject to easy control. It provides a coating of high purity and uniform thickness in general, but recesses and corners cause some trouble. It is liable to be more or less porous and may contain acid which will eventually cause failure. In both of these processes, hot or cold, the coating does not become intimately connected with the base metal through deep alloying.

Sherardizing

The latest process of this type is sherardizing, and it is undoubtedly the

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**Of Reserch Laboratory, General Electric Co.

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PLACE AND DATES OF MEETING.

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most perfect as a protection. The object to be sherardized is placed in an iron drum which is filled with a mixture of finely powdered zinc and zinc oxide in varying proportions, and is heated in a reducing or inert atmosphere for a period of time, the length of which depends on the thickness of coating desired.

The coating so obtained consists of four protective layers. Next to the pure iron is an alloy C, rich in iron, upon which is another definite alloy B, containing more zinc. Then there is a layer containing a number of more or less unknown alloys, and finally a layer of pure zinc. This makes a coating which is not easily broken down and which is continuous. The principal objections to its use are the high temperature to which the piece must be subjected and the increase in size which may be caused.

The theory which has been advanced to explain this process is interesting in that it may be considered as a distillation process. The zinc dust which is obtained from the zinc smelters is said to be in a state of unstable equilibrium, so that in contact with the hot iron it undergoes a change tending to restore it to the normal condition. During this change some of it alloys with the iron, thereby lowering the vapor pressure for zinc in that region. A slow distillation then begins from the zinc nearest the object itself. As the alloy becomes richer in zinc the difference in vapor pressure becomes less and less and then finally becomes zero. This is found to be the case in practice. The deposition becomes slower as the time is extended.

Calorizing

This recently developed process makes use of aluminum as the protective metal and is of particular advantage in preventing oxidation at high temperatures. The protective action is due to the oxide formed by the action of heat on the protecting metal, rather than to any electrolytic relations between the aluminum and the base.

It has been found very useful in the case of iron utensils subject to direct contact with flames at temperatures up to 1,000 deg. C., and also in the case of boiler tubes, for the life is increased many times by this treatment and the saving in the cost of replacements is much greater than the additional initial cost of calorizing.

Schoop Process

One of the most recent processes, and one of the most promising, is the Schoop process. This is applicable to the deposition of metals or alloys on any sort of an object. The apparatus consists of a pistol into which the coating metal is fed as a wire. It passes through a straightening and centreing device into the nozzle, where it is fed through a burner whose temperature may be regulated from 700 deg. to 2,000 deg. F. The molten metal is carried a short distance by the gas current and is suddenly caught by a powerful blast of compressed air which shoots it out of the nozzle with a velocity of 3,000 feet per second, directly on the object to be coated, which is held a short distance away. The coating is homogeneous, continuous, and of any desired depth, and is also exceedingly intimate.

The theory of the Schoop process as given by its inventor, is that the gaseous medium used is much larger in volume at any moment than the drop it has pulverized and is carrying, and the gas is expanding so rapidly that its temperature is far lower than that of the spray. A rapid exchange of heat, therefore, takes place between them, which consolidates the molten particles and gives them a temperature far below the melting point. If the particles arrived in a liquid state at the base with the observed velocity of 3,000 feet per second, they would simply splash on the surface and largely rebound. As a matter of fact they impact and inter-penetrate freely, and the later bombarding particles unite with the earlier ones to form homogeneous compact bodies.

In accounting for the observed action of the Schoop spray at the receiving base, it is supposed that the cooled particles of the metal just before impinging with great velocity on a hard surface, are in an abnormal physical condition. Due to the heat of collision they pass directly into a vapor which condenses and solidifies on the relatively cold receiving body, penetrating by osmotic pressure the superficial pores of the base when an affinity for the latter exists, and otherwise driven in by the pressure behind it. In either case it condenses and solidifies after penetration, and is effectively dovetailed into the base. The hammering and bombardment of the solidified first coat by the minute succeeding particles is practically a process of cold working. The entrained particles liquidify and solidify so rapidly that the metal has not time to return to its natural crystallized state."

There are many other processes in use, those outlined being chosen as representative of the various different means employed to obtain the desired protection because of their prominence, or of some new feature which they contain.

BOUNTY TO FOSTER ZINC PRODUCTION.

A SLIDING bounty not exceeding 2 cents per pound, and not payable until the end of the war has been granted by the Government on Canadian zinc production, with a view of obtaining supplies of this metal for the manufacture of munitions.

A committee of the Government under the chairmanship of the Minister of Finance, after full discussion with members of the Shell Committee, has thus satisfactorily solved the problem of ensuring at reasonable prices a Canadian supply of zinc suitable for use in the production of brass for the making of quick-firing cartridge cases for shells.

Before the outbreak of war, this quality of zinc sold at about eight cents per pound. Since that time the price has steadily risen as high as forty cents and grave fears were entertained that the supply might be entirely cut off. At present, the sources of supply are outside of Canada.

The Shell Committee, representing the British Government in the purchase of shells in Canada, regarded it is absolutely necessary that there should be supplies of this zinc within Canada. Canadian producers were unwilling to go to large expense of installing refineries unless insured against the fall in zinc prices which is inevitable after the close of the war. After considerable negotiation, the Government decided to offer a limited bounty for the production in Canada of zinc, the offer being as follows:—

Bounty Details.

Bounties on a sliding scale, not exceeding two cents per pound, will be granted upon production in Canada from Canadian ores of zinc, containing not more than 2 per cent. impurities, when the standard price of zinc in London, England, falls below £33 per ton of 2,000 pounds, provided that bounties shall not be payable on zinc produced before the expiration of the war or after the 31st day of July, 1917, or on zinc contracted for the Shell Committee at a price of 8 cents or over per pound, total amount of bounty to be paid not to exceed $400,000.

As a result of this action on the part of the Government the Shell Committee, on behalf of the Imperial War Office, has been able to contract for several thousand tons of zinc at very reasonable rates with a further reduced rate for further deliveries.

It will be observed that the object of the bounty is to insure the producers against too great a fall in price in the period between the end of the war and the 31st July, 1917. The bounty will give an impetus to the refinement of zinc in Canada and serve the purpose of ensuring a certain supply of brass to the Shell Committee.

Plating and Polishing Plant of the Russel Motor Car Co.

By Walter S. Barrows*

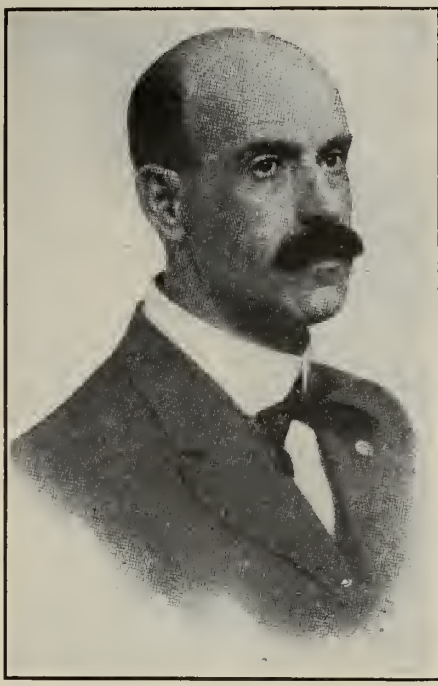
The product of this company at West Toronto, Ont., has always been characterized by its excellence of finish. Few people are aware of the scientific knowledge and practical skill necessary to insure continuous successful operation of a plating plant. Again when the actual quantity of work produced is taken in consideration, the necessity for efficient equipment and help becomes increasingly evident if required output is to be maintained.

THE plating and polishing departments of many industrial plants are usually the least interesting features shown the visitor. This fact is contrary to what one might expect. The plating and polishing department of the Russell Motor Car Co.'s Works at West Toronto is, however, an exception, and enjoys the distinction of being the finest in Canada. The cleanliness of this department has created considerable comment among men who know the existing conditions in similar departments throughout the North American continent.

Electrical Equipment

The equipment generally is very complete, the high quality of product required necessitating the installation of none but the most modern and efficient apparatus. The electrical units consist of two direct current dynamos, one supplying current at 10 and 5 volts with a three-wire system, and the other supplying a 6-volt current.

The latter is a shunt wound multipolar machine having a capacity of 2,500 amperes, and is operated in connection with a 3,500 gallon nickel solution. The copper plating tanks, brass plating baths, mechanical platers, etc.. are supplied with 5-volt. current from the first mentioned dynamo, while the 10-volt circuit from the same machine is employed in the operation of electro-cleaning solutions, and experimental baths. The capacity of this three-wire dynamo is 1,800 amperes. The entire power section of the department is separated from the plating section by glass partitions, the polished metal parts of the machines, and all connections, bus bars, etc., within the power section being kept scrupulously clean and bright.



WALTER S. BARROWS.

Each tank in the plating room is connected to a voltmeter, portable ammeters being used on all tanks, while the rheostats of the rectangular switch board type, are so wired as to permit the use of suitable current densities without undue heating.

Nickel and Copper Baths.

The nickel baths average 225 gallons per tank, and are nearly all of the double row type employing three rows of anodes. Uywards of 4,000,000 bicycle spokes are plated annually in still solutions, the result being a practically rust proof spoke the reputation of which has spread to all parts of the world.

A cyanide copper solution of 600 gallons is used in copper plating all steel parts previous to nickel plating. The copper plate is exceptionally heavy and durable, no competition or rush orders being allowed to interfere with the recognized standard of plating in this establishment. Exceptional care is taken in the preparation of all parts before treatment in the plating solutions, over 700 gallons of alkaline cleaning solutions being employed for this purpose. Electric cleaners with double throw switches are operated with a 10-volt current.

The famous "solid brass" plating produced by this company is the result of persistent efforts on the part of the foreman in charge. Copper and zinc anodes are used in the brass bath, and the electrolyte is a very simple and inexpensive solution.

Plating Small Parts

Bicycle spoke nipples, and parts of similar size are plated in mechanically operated cylinders, rotated while immersed in a concentrated nickel solution.

SHOWING ARRANGEMENT OF NICKEL BATHS. POWER SECTION IN BACKGROUND.

COPPER PLATING AND CLEANING SECTION SHOWING ACID JARS AND SWILLING TANKS.

*Foreman, Electro-plating Dept., Russell Motor Car Co., Ltd.

This treatment producing polished and plated parts in large quantities with a minimum of labor.

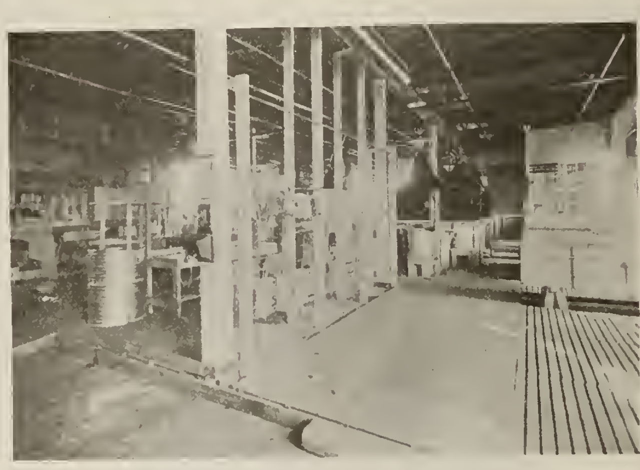
The plating room while located on the third floor is supplied with an excellent drainage and ventilation system. The floors are of concrete faced with asphalted tar paper, and protected by wooden slats. All water is conducted to a drain at the centre of the floor, and the department is well flushed and scoured once each week. Ventilation is effected by means of hoods placed above each tank containing solutions from which emanate strong fumes or steam during operation of the bath. The larger of these hoods are connected direct to outside draft, while the smaller hoods are connected to a rotary suction fan.

Parts for between 20,000 and 30,000 bicycles are plated annually, together with parts for 120,000 skates, and thousands of automobile parts. Special solutions are operated for special lines of work and the latest developments in electroplating are put to a severe test. The department is equipped with a chemical laboratory for the study of various solutions, and the perfecting of ideas which may be of commercial value to the business. The recent tests of cobalt plating solutions carried on at this plant have added a new and valuable chapter to modern electro-plating literature. Upon entering this very interesting department the visitor is impressed with the neat and clean appearance of everything, each employee being trained to do his share toward maintaining system, efficiency and cleanliness. A ball burnishing and wet tumbling section is included in the plating room. Here aluminum and steel parts are economically processed preparatory to plating. One of these tumbling barrels is the largest barrel operated in any plating department in Canada, it having a capacity of approximately 200 gallons.

Polishing and Buffing

The polishing, grinding and buffing department is located on the same floor with the plating room, but separated from the latter by a storage room. In the polishing room 35 men are employed, and the working conditions are as nearly ideal as modern ventilating machinery will permit. The blower system is worthy of particular attention as it is unusually large and efficient. The sanitary condition being well taken care of. The room is airy, well lighted and kept clean and neat in every detail. The polishing machinery is operated by separate motor power, and the entire department is being equipped to facilitate heating by exhaust steam.

In the manufacture of automobiles, bicycles and skates, the necessity for care and skilled workmanship exists in every department, but if the final finish of enamel or plating is not satisfactorily effected the product cannot become a leader in its respective line. All the products of this company are protected and finished "up to a standard not down to a price."

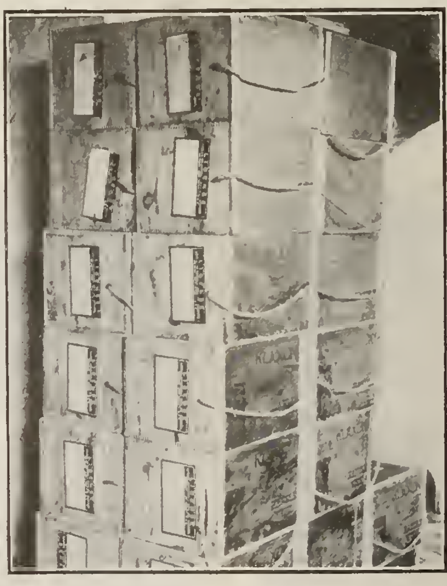


GENERAL VIEW OF PLATING ROOM FROM ENTRANCE. FINISHED WORK SECTION IN LEFT FOREGROUND.

A SHIPPING KINK.

By A. E. G.

THE Lovell-McConnell Mfg. Co., Newark, N. J., makers of Klaxon automobile signal horns, had considerable difficulty in packing the latter so that the bell of the horn would not be dented in transit. The trouble was principally caused by the handlers dropping the box in which the horn was packed with more or less force, and if the bell of the horn happened to be downward, the result was almost sure to be a dented or crushed bell.



A SHIPPING KINK.

Someone in the shipping department finally hit on the plan of putting rope handles on all the shipping boxes, so that a handler will naturally take hold of the rope when moving the box. This keeps the boxes top up in almost every instance, and as the horns are packed accordingly, the result has been very satisfactory.

GERMANS TRY TO GET SHEFFIELD STEEL

IT is reported that the Sheffield Chamer of Commerce has recently investigated some ingenious attempts to obtain high-speed steel and high-class tool steel from Sheffield manufacturers for the use of alien enemies. These special tool steels are necessary in all shops making munitions of war, and as Germany in peace time imported considerable quantities from Sheffield, it is probable that she is feeling the necessity of new supplies. The attempts to place orders have been made with great circumspection, and it was only the special knowledge of the president of the She eld Chamber that brought about the exposure in one case. The Chamber has issued a notice to manufacturers warning them that all inquiries should be carefully scrutinized "in view of attempts now being made to secure high-speed and high-class tool steels for the use of alien enemies. Manufacturers are asked to exercise the same caution even where orders are offered by London agents.

ACCUMULATOR CASTINGS

(Continued from page 174.)

with molten iron while the 5-ton ladle was being poured. When the 5-ton ladle was emptied, the bosh was tapped, and while the metal was running in the ladle was being refilled.

One of the problems which confronted the foundry foreman was the removal of the casting after cooling, as the 5-ton crane was not deemed capable of lifting a casting which was expected to weigh between 8 and 9 tons. One side was raised at a time by which process it was gradually turned over on to a track prepared with special rollers. It was then removed to the Canadian Boomer & Boschert Co. shops across the road in which the accumulator was to be erected and completed.

One of the problems the efficiency folks are working on is the standardization of man. It will prove a very complex problem for the simple reason that it is seldom there are two men exactly the same.

NON-RUSTING STEEL

THE fact was lately mentioned in a United States consular report from Sheffield, England, that a firm in that city had introduced a steel which is claimed to be non-rusting, unstainable and untarnishable. The steel is especially adapted for table cutlery, as the original polish is maintained after use, even when brought in contact with most acid foods. It is an interesting fact that the steel was not made with a view to producing cutlery, however. The investigator was endeavoring to produce a steel for pump rods used in collieries, where a damp atmosphere had to be resisted. The application of the steel to cutlery was but a natural sequence, and no doubt a multitude of other uses will be found for it. In a tempered condition the steel has a maximum strength of 50 to 55 tons per square inch, and elongation of 20 per cent., and a reduction of area approaching 60 per cent. In the hardened condition the tensile strength is raised to about 100 tons. It is claimed that the steel retains a keen edge, much the same as the best double-shear steel. This stainless steel is made by Messrs. Thomas Firth & Son, Ltd., of Sheffield, England.

PRODUCE AND REFINE ZINC AND COPPER FOR ALLIES

AS a result of arrangements now completed, it has been announced by General Bertram, that Canada will not only manufacture shells for the Allies, but will produce and refine for the first time in this country the zinc and copper required for the ammunition.

These arrangements represent the fruition of the desire and efforts of General Hughes, minister of militia. It was not long after Canada had commenced the manufacture of shells for Great Britain before the securing of copper and zinc for their production became a problem. Although Canada produces both these metals she has not hitherto had facilities for refining them. Consequently every ton of such ore produced in the Dominion had to be sent to the United States, and there refined before being bought back again by Canadians.

United States refiners took advantage of this situation shortly after Canada commenced the manufacture of shells by raising the price of refined copper and zinc to exorbitant levels. It is understood that by forming a combination among some Canadian capitalists and bucking the monopoly General Hughes succeeded in getting the price reduced somewhat. However, it became apparent that if the Dominion were to enter seriously into the manufacture of munitions it must have refineries of its own and efforts toward that end were initiated.

Several conferences have been held between the Shell Committee and the Cabinet. The result is contained in the statement of General Bertram that agreements had been made and were closed up for the refining at Trail, B.C., and other points, of both copper and zinc.

POLISHING SHRAPNEL SHELLS.

IN a recent article in the Brass World, James Haslip makes some pertinent remarks regarding the care and preparation of wheels which are at present being widely used by shrapnel makers to polish the spots where the hardness of the shell has to be tested:—

"The glue room should be separate and especially arranged, drafts from windows and doors being avoided so that the thin layer of glue will not chill on application to the wheels. Glue of any kind should be soaked in cold water several hours before heating. Being of animal matter, it is quickly decomposed by heat if soaked in hot water, and its strength impaired. Glue should never be boiled after being soaked and heated; no further melting is necessary It should be kept constantly at a temperature not exceeding 160 deg. Fahr. The glue pots should be thoroughly cleaned before refitting, no scum being allowed to accumulate. . . . . No glue should be used the second day as the strength will be impaired about 50 per cent. by standing over night, and thickened glue diluted, never has its original strength.

ELECTRO-PLATING STUDIES

THE recent completion of the new Toronto Technical School imparts added interest to the approaching opening of the winter classes. As is well known the tuition offered covers a very wide field, and along with other leading trades, electro-deposition of metals receives full attention.

While the schedule of studies has not been definitely settled yet, it is expected to be largely along the following lines:

Analysis of nickel plating solutions.

Analysis of nickel salts and anodes.

Study of the various phases of electro-deposition of nickel.

Study of the various nickel plating solutions and their adaptability to commercial uses.

Experiments with modern nickel and cobalt solutions.

Analysis of silver solutions.

Study of silver solutions used for various purposes, such as strike solutions, bright solutions, etc.

Study of electro-deposition of silver.

Experiments with silver deposits on commercial wares.

Questions and Answers

Question.—Do nickel anodes ordinarily contain copper? Will the copper introduced into the nickel bath from the anode have a detrimental effect upon the nickel deposit? We are having trouble with our nickel, the deposit is dark and streaked. Our plater is of the opinion that the nickel anodes contain copper. Kindly give us your opinion as the results now obtained are very annoying.

Answer.—Nickel anodes cast from scrap purchased by the anode manufacturer are liable to contain a larger percentage of copper than anodes cast from pure grain or shot nickel. While all nickel anodes known as commercial nickel contain very small percentages of copper, the amount is so small that it has no injurious effect upon the nickel deposit. Quantities ranging from 0.05 per cent. to 0.18 per cent. copper may be expected in low grade nickel anodes. A large percentage of copper would produce the streaked effect you mention, but the same effect may be the result of other causes, such as poor conductivity or a depleted solution. To test the nickel solution for copper, measure out about 10 c.c. of the bath and acidify with dilute hydrochloric acid. Warm the solution and pass sulphuretted hydrogen through it. If copper is present in even the smallest quantities, a black precipitate will be produced.

The copper may have entered the bath in the form of copper sulphate which may have become mixed with the double nickel salt while in storage. For this reason these two chemicals should be kept stored in receptacles distantly removed from one another. Inexperienced workmen very often mistake the one salt for the other, and the consequent expense and difficulty usually is no small item. The nickel anodes in the bath sometimes become red as a result of copper in the solution. Cobalt in the anode will produce a similar result, but the color produced by the cobalt disappears when the bath is in operation. The use of pure nickel anodes and pure salts together with care in making additions is the best safeguard against difficulties such as you mention.

* * *

Question.—Is it customary or good practice to "strike" iron and steel parts before regular nickel plating treatment? Should a nickel strike be rich in metal or rather weak?

Answer.—It is not customary to strike the parts previous to immersion in regular nickel plating solution, but such practice would certainly be productive of good results and probably the only reason why it is not popular is the cost for extra labor and time required. Most nickel plating solutions are operated with sufficient current to cover the cathode with a film of nickel within a few seconds, and very little damage can result from exposed surfaces.

If, however, the solution does not conduct properly and the cathode remains exposed to the action of the solution for two or three minutes, the corrosive effect would be anything but beneficial, and the bath should be corrected or a stronger current employed. Some classes of work require slow deposits which will be soft and white, the bath may be large and the work constantly entering and being removed from the solution. In such cases a strike would be of special value, as it would facilitate the production of a firm adherent film of nickel upon the base metal and allow the soft white finish to be obtained in the regular plating bath by weaker current. The nickel strike should be rich in metal and kept neutral or only slightly acid and never allowed to become alkaline. The practice is a commendable one if cost of operation will permit.

* * *

Question.—My nickel solution becomes alkaline at almost regular periods, can you tell me why, and how I can prevent it.

Answer.—Your difficulty is unusual, theoretically it is impossible for a double sulphate nickel solution to become alkaline. If the anodes disintegrate properly and feed the solution in proportion to the amount of metal deposited, the solution will remain neutral. This, however, is seldom the case, the nickel is deposited faster than it is taken from the anodes and the solution becomes acid. The alkaline reaction is usually the result of contamination by cleaning solutions which have not been properly removed from the recesses or surfaces of the work by rinsing before the parts enter the plating solution. This may be the direct result of careless rinsing or rinsing in water which is foul with potash or soda solution. Where only one rinse tank or compartment is employed, a double compartment rinsing tank would overcome the trouble in the later instance. The final rinse being given in the compartment receiving the fresh water.

Nickel solutions which are badly contaminated by potash or lye often give evidence of trouble by the odor of ammonia. The alkali decomposes the sulphate of ammonia forming sulphate of potash or soda and ammonia gas is liberated. The remedy is to neutralize the alkali by addition of sulphuric acid, testing the solution with litmus paper. The acid must be cautiously added in small quantities and the solution stirred before each test to avoid introducing too much acid, in which case difficulties of an equally serious nature would result.

THE WORLD'S ZINC SUPPLIES.

THE Financial Times of July 26 contains the following notes on zinc, compiled by Rudolf Wolff Kreuger & Co.:—

"We compile statistics every year of the production of virgin and secondary spelters; the last available statistics that we have before us are those for 1913, because, naturally, for 1914, after five months of the great European war, no enemy returns were available. Examining our figures for 1913 we find the total European output was 661,325 tons. Australia gave us 3,666 tons and the United States 508,549 tons. Out of the European total we must now cancel the Belgian, Silesian, Rhenish, Northern French, Austrian and Polish productions; these amount together to 570,152 tons per annum. It, therefore, follows that the onus of supplying the allies with spelter falls upon the United Kingdom, Holland, Spain, Australia and the United States.

Our own producers have probably slightly increased their output during the present year, but owing to the shortage of labor and the lack of furnace capacity we have not made anything like the advance that we should have done. The Dutch production has certainly fallen off, owing to the extreme difficulty of getting the ores into Holland. (Holland itself produces no zinc ores.) The Spanish production most likely remains unchanged. Australia has undoubtedly developed, and may send us 1,000 to 1,500 tons more this year. To make up for the bulk of the shortage, we have to look to the United States of America. In this respect it is, therefore, interesting to study the figures compiled by the United States Geological Survey. These statistics have already been considered very reliable, and when it is intimated, therefore, that the United States of America during 1915 may be in a position to furnish about 560,000 tons of spelter, this is interesting, as it provides for an increase on their 1913 total of something like 250,000 tons.

War Consumption of Spelter.

"Were the consumption of spelter to take normal course, even this increase on the part of the United States of America would not be sufficient to meet all demands. The price of spelter, however, has risen now to a level, which practically precludes any consumption save that for war purposes. This is a state of affairs which we forecast in many of our previous reports; that it was distasteful to those consumers, who were going to be squeezed out of business, we fully understand, but it was a situation that had to be faced. The requirements of the European war upon spelter are monthly increasing, and it is to be anticipated that consumption for war purposes will grow larger and larger. We think, however, that the smelting capacity among the allies and neutral countries will also increase, and with all normal peace trade suppressed, the equilibrium between supply and demand will be found again.

"Much has also been written about the German control of the vast zinciferous resources of our colonies. Most of the observations made upon this subject we entirely concur with; we have often made allusion to the same thing before, and we think it is pitiable to find a situation created like the present one, owing to the fact that German houses have been always able to contract for our output of colonial concentrates to the detriment of the British buyer.

Present Situation Summary.

"Our summary of the whole position is this: The spelter market may have been, and probably has been to a certain extent, exploited, but the situation at which we have arrived was inevitable, when German houses established the control of the British zinciferous reserves, and made full arrangements for treating the same. We consume alone in the United Kingdom something between 170,000 and 200,000 tons of spelter per annum, and we actually produce about 60,000 tons. At all events, it is satisfactory to know that Lloyd George's recent action has removed any likelihood of a shortage in the large supply needed for munitions."

CANADIAN LIGNITE INVESTIGATION.

LIGNITE obtained from the Province of Alberta has been under investigation by the Department of Mines, Ottawa, and a report of over 100 pages has been issued covering the results. This report, which is made by B. F. Haanel, chief of the Fuels and Fuel Testing Division of the Department, and John Blizard, states that in an extended number of trials in gas producers the fuel was found eminently suited for such gas production. In fact, it is suggested that the nitrogen content is sufficiently high to make recovery of ammonia or ammonium sulphate profitable. It is added that no trouble was experienced in utilizing the gas in a gas engine.

The tests cover also the use of the lignite under steam boilers, and it was concluded that lignites with a moisture content up to 30 per cent. do not materially affect boiler efficiency. It is explained that fuels of this class require a specially large combustion chamber and a brick ignition arch arranged to burn the large percentage of volatile matter contained.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products

PIG IRON.

Grey Forge, Pittsburgh		14 75
Lake Superior, charcoal, Chicago		15 75
Ferro Nickel pig iron (Soo)		25 00

	Montreal.	Toronto.
Middleboro, No. 3	$22 00	.....
Carron, special	23 00	.....
Carron soft	23 00	.....
Cleveland, No. 3	22 00	.....
Clarence, No. 3	22 50	.....
Glenarnock	26 00	.....
Summeerlee, No. 1	28 00	.....
Summerlee, No. 3	27 00	.....
Michigan charcoal iron	26 00	.....
Victoria, No. 1	23 00	19 00
Victoria, No. 2X	22 00	19 00
Victoria, No. 2 plain	22 00	19 00
Hamilton, No. 1	22 00	19 00
Hamilton, No. 2	22 00	19 00

METALS.

Aluminum	$ .40
Antimony	.38
Cobalt 97% pure	2.00
Copper, lake	.19
Copper, electrolytic	.18¾
Copper, casting	.18½
Lead	.06¼
Mercury	100.00
Nickel, ingot	50.00
Silver	.48
Tin	.39
Zinc	.18

Prices Per Lb.

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$12 25	$12 25
Copper, crucible	13 25	13 25
Copper, unch-bled, heavy	13 25	13 25
Copper, wire, unch-bled.	14 00	14 00
No. 1 machine, compos'n	11 50	11 50
No. 1 compos'n turnings	9 00	9 00
No. 1 wrought iron	6 50	6 50
Heavy melting steel	7 00	7 00
No. 1 machin'y cast iron	10 50	10 50
New brass clippings	11 00	11 00
No. 1 brass turnings	9 00	9 00
Heavy lead	5 00	5 00
Tea lead	3 50	3 50
Scrap zinc	8 50	9 00

COKE AND COAL.

Solvay foundry coke	$5.75
Connellsville foundry coke	5.00
Yough steam lump coal	3.83
Penn. steam lump coal	3.63
Best slack	2.99

net ton f.o.b. Toronto.

BILLETS.

	Per Gross Ton
Bessemer, billets, Pittsburgh	$ 24 00
Open-hearth billets, Pittsburgh.	24 50
Forging billets, Pittsburgh	32 00
Wire rods, Pittsburgh	30 00

PROOF COIL CHAIN.

¼ inch	$8.00
5-16 inch	5.35
⅜ inch	4.60
7-16 inch	4.30
½ inch	4.05
9-16 inch	4.05
⅝ inch	3.90
¾ inch	3.85
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

MISCELLANEOUS.

Silder, half-and-half	0.24
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs, p. cwt.	9.67
Glue, French medal, per lb.	0.18
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.18
Benzine, single bbls., per gal.	0.18
Pure turpentine, single bbls.	0.62
Linseed oil, raw, single bbls.	0.63
Linseed oil, boiled, single bbls.	0.66
Plaster of Paris, per bbl.	2.50
Plumbers' oakum, per 100 lbs.	4.00
Lead wool, per lb.	0.10
Pure Manila rope	0.16
Transmission rope, Manila	0.20
Drilling cables, Manila	0.17
Lard oil, per gal.	0.73

SHEETS.

	Montreal.	Toronto.
Sheets, black, No. 28	$3 00	$2 90
Canada plates, dull, 52 sheets	3 25	3 50
Canada plates, all bright.	4 40	4 60
Apollo brand, 10¾ oz. (galvanized)	6 20	5 30
Queen's Head, 28 B.W.G.	6 00	6 00
Fleur-de-Lis, 28 B.W.G.	5 75	5 75
Gorbal's best, No. 28	6 00	6 00
Viking metal, No. 28	6 00	6 00
Colborne Crown, No. 28	5 30	5 30
Premier, No. 28 B.G.	5 60	5 50

IRON PIPE FITTINGS.

Canadian malleable, A, 25 per cent.; B and C, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped union, 65.

ELECTRIC WELD COIL CHAIN B.B.

3-16 in.	$9.00
¼ in.	6.25
5-16 in.	4.65
⅜ in.	4.00
7-16 in.	4.00
½ in.	4.00

Prices per 100 lb.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium, carbonate	.15
Ammonium, chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cobalt Sulphate	.50
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.17
Potassium carbonate	.40
Potassium sulphide	.30
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide, 129-130 per cent.	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.08

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper, 22-25	.22 to .25
Tin	.45 to .50
Silver	.55 to .60
Zinc	.22 to .25

Prices Per Lb.

PLATING SUPPLIES.

Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck.	.80
Emery in kegs	.4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

Prices Per Lb.

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Montreal, Que., Sept. 13, 1915.—The firm trend and noticeable improvement in the industrial situation is undoubtedly due to the steady demand from Britain and her allies for munitions and supplies, incidental and necessary to the maintenance of men and equipment for the successful prosecution of the war. That still greater activity is about to develop is shown by the meeting held in Ottawa to-day, at which a number of our leading financiers and executive heads of manufacturing establishments discussed ways and means whereby both sections may co-operate with the Government to increase production of war necessities.

It is expected that orders for shells in still larger quantities will soon be placed. One large firm in Montreal, in discussing this feature, said that they had received word from Ottawa, the tone of which was highly optimistic. Some manufacturers are now installing extra heavy tools for the production of 4.5 shells, the expectation heing that the near future may warrant them doing so when still larger size shells will be called for.

Many inquiries have been received, and in some cases orders have heen placed for lathes of 24 in., 26 in., and even larger sizes, for the production of 6-in. and 9-in. shells for the French and Russian War Offices.

Steel.

The abnormal demand for billets and bars used in the production of various types of shells and component parts keeps the steel mills constantly going at about 100 per cent. capacity, and with orders on their hooks which cannot he filled for many months to come. If a supply of larger shells is demanded, and this seems more than likely, it will call for increased activity on the part of our steel producers to keep up the required supply of raw material.

Pig Iron

The pig iron market shows little activity, hut quotations on the various grades remain firm.

Machine Tools and Supplies

Inquiries for machine tools continue to come in, hut in a great number of cases it is almost impossible to have delivery within a period of six or eight months, especially on machines employed in the production of 3.3 and 4.5 shells. The feeling is growing that machine tool huilders will soon have to meet the demand for a larger and heavier product to meet the requirements of a correspondingly larger and heavier type of shell.

The demand for supplies, hoth for the smaller and larger tools, is daily growing greater, and there is little doubt that the near future will see further development in that direction.

Metals.

Very little change is shown in the metal quotations for the week, and as many of the leading manufacturers of brass and copper products are withholding their price lists, it leaves the tone of the market a little uncertain.

Scrap.

The tendency is upward in scrap metals, a slight increase being noticeable in the majority of quotations.

Toronto, Ont., Sept. 14.—Industrial conditions are much the same as last week, but a better feeling prevails in business circles due to the splendid crops in the West, a large yield heing now assured. This will stimulate domestic trade, which has heen comparatively quiet for several months, but has lately heen showing distinct signs of improving. The expansion in the export trade of the country has had much to do with this, as has also the return of a more confident spirit in business circles. There is every reason to expect further heavy orders for war supplies heing placed with Canadian manufacturers. It is understood that Premier Borden has been given the fullest assurance by the British Government that for all supplies that have to be procured outside the United Kingdom Canada's resources would be utilized to the fullest extent.

CANADIAN GOVERNMENT PURCHASING COMMISSION

The following gentlemen constitute the Commission appointed to make all purchases under the Dominion $100,000,000 war appropriation:—George F. Galt, Winnipeg; Hormidas Laporte, Montreal; A. E. Kemp, Toronto. Thomas Hilliard is secretary, and the commission headquarters are at Ottawa.

Steel Market.

Reports of the financial condition of the principal steel companies in Canada are exceedingly satisfactory. Conditions in the trade continue to improve, due principally to increasing export business and demand for rounds and forgings for shells. In this regard it is announced that as a result of Mr. Thomas' visit further orders approximating fifty million dollars will he placed in Canada for making munitions. It is further stated that it is the desire of the authorities to place such orders where they can he most speedily and economically filled. Prices on bars, plates, and shapes are very firm, but unchanged. Billets have again advanced, "Bessemer" being now quoted at $24, open hearth $24.50, and forging billets $32, all f.o.b. Pittsburgh. Wire rods have also advanced, and are now quoted at $30 Pittsburgh. With regard to semi-finished steel, it is reported from Philadelphia that competition has appeared in that market from Canadian mills for various sizes of hillets and blooms. No sales, however, have heen heard of.

There is no ahatement in the demand in the United States for open-hearth steel products, much of it being for war munitions. Pittsburgh mills report that they are operating to capacity, and unable to catch up with deliveries. The new demand for plates, shapes, and bars, particularly the latter, is very urgent, and the mills are filled up for weeks ahead. The scarcity of steel-making metal, particularly ferro-manganese, is gradually becoming more acute, and prices for ferro-alloys are advancing. Ferro-manganese is now being quoted at $100 to $110 per ton f.o.b. seaboard. Prices of steel hars have advanced to $1.35 Pittsburgh.

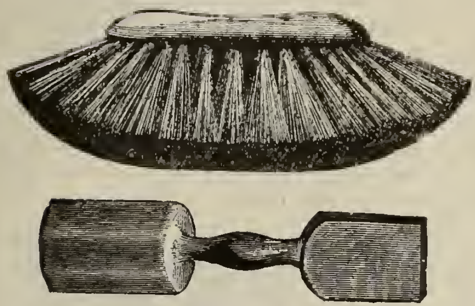
The galvanized sheet market is firming up slightly because of the uncertainty in the price of spelter. The advancing tendency in price of spelter has reduced production of sheets somewhat, as makers do not want to accumulate stocks until the spelter situation clears up. The high-speed tool steel situation does not improve, and prices have an advancing tendency.

Pig Iron

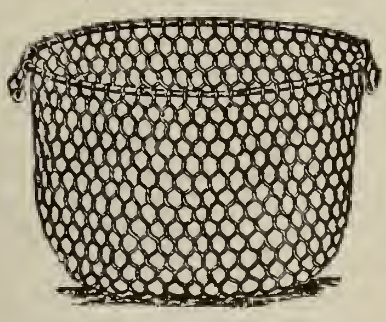
The situation is much the same as last week, and there is a good demand for steel-making pig iron. Prices for American hrands are firmer, and grey forge has advanced to $14.70 Pittsburgh. Domestic pig irons are unchanged.

Machine Tools

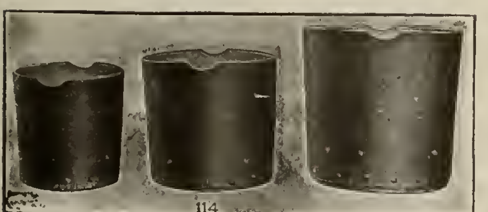
There is practically no change in the situation as regards machine tools, and no developments have as yet to be noted. The report that further large orders for shells will be distributed may result in further buying of machine tools, although it is highly probable that plants already well equipped will be favored with the greater part of this business. There is every possibility, however, that even these concerns will have to install



Bench Rammers—Made from Maple Hardwood well oiled.



Coke or Charcoal Basket—Made of Galvanized steel wire.



Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.

QUALITY, SERVICE and PRICE IN FOUNDRY Necessities

that will command your utmost satisfaction

It is the same old story suited to modern requirements. We have been endeavoring, with a good measure of success, to convince you that the service we speak of has "passed the censor." In other words, those dubious qualities in business which creep in during hard times were to our methods like an "Incompatible liquid" is to chemistry. They wouldn't mix. We can't afford to lose our reputation by selling you anything that would make us afraid of losing your custom.

Our Plumbago, Stoveplate Facing, Core Wash, Core Compound, either powder or liquid form, Partine, Charcoal, Fire Brick and Clay, answer the purpose of good foundrymen everywhere. Some of our lines are shown here on this page; there are still others about which we shall be glad to let you have prices and full particulars.

Write.

The Hamilton Facing Mill Company, Limited

HAMILTON, CANADA

If what you want is not advertised in th is issue consult the Buyers' Directory at the back.

more equipment. Inquiries for new machines have fallen off, but there is still a good demand for second-hand equipment. Deliveries in new tools are still very backward and prices have a higher tendency.

Supplies.

Business in machine shop supplies continues brisk, and prices all round are very firm. All American lathe chucks have advanced. "Independent" chucks, which were 20 per cent. off, are now net list, and 12 per cent., has been added to geared scroll chucks. Prices of leather belting are very firm, as there is a great scarcity of hides and a big demand for leather. Half-and-half solder is a little lower, and is now quoted at 24c per pound. The linseed oil market is steadier, but business is very dull. Prices have declined 2c, and oil is now quoted at 63c for raw and 66c for boiled oil per gallon.

Scrap Metals

The scrap metal is firmer, particularly for copper and brass scrap, which have advanced. Heavy lead is also little higher, being quoted at 5c per pound, but tea lead is unchanged. Revised prices are given in the selected market quotations.

Metals.

The metal markets all round are dull and weaker, with lower levels for all, with the exception of tin. The tin market is firm, but dull on account of buyers staying out of the market. There is also little interest being shown in copper, and the market is entirely a nominal one. Spelter has reacted after the advance recorded last week, and lead has also declined slightly. Antimony and aluminum have both declined, and quotations are nominal.

Tin.—The market is stagnant and void of all interest. Buyers have continued to stay out, and the extreme dullness is reflected in the tone being easier. Tin is unchanged at 39c per pound.

Spelter.—The market is dull and lower, with business very dull. Outside of a fair demand for prompt shipments there is nothing doing, futures being entirely neglected. Spelter has declined 1c, and is quoted at 18c per pound.

Copper.—The market is dull, and little interest is being shown by consumers. Quotations have declined ½c, and are nominal at 19c per pound.

Lead.—The market is unsettled and stagnant. The "Trust" has reduced the price to 4.70c, New York. Lead locally had declined ¼c, and is being quoted at 6¼ per pound.

Antimony.—The market is dull and weaker on light demand. Antimony has declined 2c, and is being quoted at 38c per pound.

Aluminum.—The market is entirely nominal. Supplies are so scarce that it is almost impossible to get any aluminum for spot delivery. Quotations are nominal at 40c per pound.

CANADIAN IRON AND STEEL IN 1914.

THE statistics gathered by the American Iron and Steel Institute show that the output of pig iron in Canada in 1914 was 705,972 tons, against 1,015,118 tons in 1913. In 1912 Canada's pig iron production was 912,878 tons and in 1911 it was 824,368 tons. Of the 1914 total, 690,880 tons was coke iron and 15,092 tons charcoal iron. The number of furnaces in blast in Canada at the end of 1914 was 6; the number out of blast, 16. The production of pig iron by grades in 1914 was as follows, comparison being made with 1913:

	1914	1913
Basic	331,456	558,524
Bessemer	184,053	227,662
Foundry	174,346	225,231
All other	16,117	3,701
Total	705,972	1,015,118

Steel Ingots and Castings.

The production of steel ingots and castings in Canada in 1914 was 694,447 tons, of which 675,691 tons was ingots and 18,756 tons castings. The production of open-hearth steel was 549,716 tons, of Bessemer steel 144,447 tons, and of other kinds 284 tons. The total of 694,447 tons includes about 4,800 tons of alloy treated steel ingots and castings, against about 1852 tons in 1913.

Finished Rolled Products.

The production of finished rolled products in Canada in 1914 was 659,519 tons, against 967,097 in 1913. The production of rails last year was 382,344 tons, against 506,709 tons; of structural shapes and wire rods, 59,050 tons, against 68,048 tons; of plates and sheets, nail plate, merchant bars, tie plate bars, etc., 218,125 tons, against 392,340 tons. The production of rolled iron products in 1914 was 47,309 tons, while the production of rolled steel products was 612,210 tons.

Cut and Wire Nails.

The production of iron and steel cut and wire nails in Canada in 1914 is estimated at 1,144,000 kegs, as compared with an estimated production of 1,520,000 kegs in 1913.

CANADIAN GOODS NEEDED IN RUSSIA.

RUSSIAN banks are interested greatly in Canada's determination to enter the Russian market, according to a further report received by the Department of Trade and Commerce, Ottawa, from C. F. Just, special Canadian Trade Commissioner. Mr. Just gives an extended list of articles which could be made the basis of a large trade between this country and Russia. He again emphasizes the desirability of the establishment of agencies in Russia, especially in regard to the trade in agricultural and other machinery, the United States manufacturers having erected works which, when in full working order, will take care of one-sixth of the total annual requirements of the country. Russia needs the light type of agricultural machinery, and the trade, says the commissioner, is capable of indefinite extension. A Canadian forwarding agency in Russia is recommended.

Trade Gossip

Frank Morgan, for 29 years with the Cowan Co., Galt., has been appointed manager of the Dominion Bronze Co., Preston, Ont.

The Canadian Iron Foundries, Ltd., Montreal, have been awarded a contract for the supply of cast iron pipe to the city of Hull, Que.

Fort William, Ont.—It is reported that the old Zenith zinc mine at Nipigon Bay will be opened again for active mining operations.

E. W. Knight, until recently with Frankel Bros., Toronto, has opened an office in the Stair Building, Bay street, Toronto, and will carry on a metal business.

St, John's, Nfld.—W. F. Mackay has made application to the City Commissioners for permission to erect a small smelting plant near the west end water front.

John McMillan, formerly manager of the Ontario factory of L'Air Liquide Society, Paris, France, is now handling the oxygen department of Lever Brothers, Ltd., Toronto.

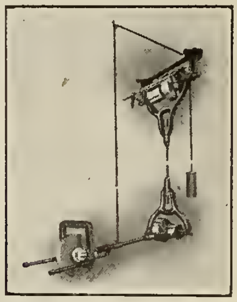
Welland, Ont.—A by-law will be voted on by the ratepayers on Sept. 20 to fix an assessment of $5,000 for ten years to the Weedon Mining Co., who propose establishing a zinc smelter here.

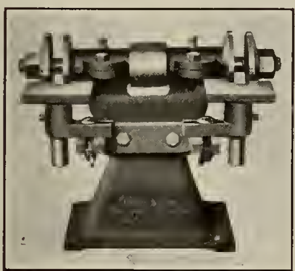
Brighton, Ont.—Thos. Garnet & Son contractors, of Port Hope, have commenced the construction of the building for the D. J. Barker Foundry Co. The main structure will be of brick, 220 by 100 feet. Jas. Hickey is manager.

Welland, Ont.—Preparations are being made to re-open the local plant of the Canadian Steel Foundries, Ltd. Operations will first begin in the foundry on shell billets and the rolling mill may open later. Mr. Gilmore is the manager.

The Steel Company of Canada, Hamilton, Ont., has made arrangements to in-

Ford-Smith Grinders





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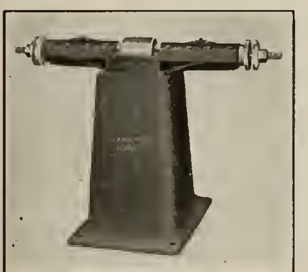
Our line of machines marks a new notch in Grinder Service.

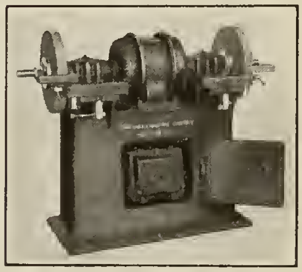
We build all types and sizes for Foundries and they are standards in the most conservative and up-to-date foundries.

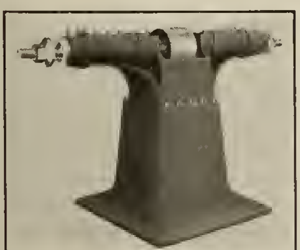
Prices are comparatively low and deliveries can generally be made from stock.

Now is the time to put your shop in the best shape to turn your castings out well finished.

Let us send you our catalog at once and quote on your present requirements.







Ford-Smith Machine Co., Limited

Hamilton, Canada

crease its open-hearth steel capacity to take care of the large orders it has received from England and from the Canadian Car & Foundry Co.

A. M. Mosley, who for the past few years has been manager of the National Tube Works at Fort William, Ont., has left for Guelph, Ont., where he will assume a similar executive position with the Page-Hersey Co., an affiliated concern.

American Foundrymen's Association.—The headquarters of the American Foundrymen's Association during Convention Week in Atlantic City will be the Hotel Traymore, instead of the Marlborough-Blenheim, as first announced.

New Hamburg, Ont.—On August 20 a fire broke out in the plant of the Electric Meteor and Stamping Metal Co., and the entire building and contents were destroyed. The factory was managed by John Messner and employed about 75 hands. The loss is estimated between $30,000 and $40,000, partly covered by insurance.

Steel Billets Higher.—It is reported from Pittsburgh, Pa., that the constantly increasing demand for shrapnel bar is causing the price of steel billets to jump, until a maximum limit has been reached, and buyers in the open market are declaring quotations to be prohibitive.

Nickel Commission at Work.—The Ontario Nickel Commission got down to business on September 10, when it paid a visit to the smelters at Deloro, Ontario. The commission will form its own itinerary, having been given almost carte blanche by the Hon. G. Howard Ferguson, Minister of Lands, Forests, and Mines.

Canada Iron Corporation—It is announced authoritatively that the affairs of the Canada Iron Corporation, which went into liquidation about two years ago, and the assets of which were taken over by the Canada Iron Foundries, Ltd., will be wound up about the end of the present month.

Hon. T. W. Crothers, Minister of Labor, has left Ottawa on a trip to Western Canada. He will go through to the coast and up as far as Prince Rupert. The Minister of Labor will stop off at all the principal cities and inquire into industrial conditions. At Vancouver he wll attend the Dominion Trades and Labor Congress.

Canada Asked to Tender.—The growing importance of Canada in the eyes of the other great portions of the Empire is indicated in the fact that Canadian manufacturers are being invited to tender for large supplies of materials required for the equipment of the North-western Railway of India. Copies of the forms of tender, etc., have been received by the Government at Ottawa. Thousands of brass and steel boiler tubes are called for.

The Spelter Outlook.—A large United States producing interest quotes spelter deliveries around the end of the year at 16½ to 17 cents, and spot metal 18 to 18½ cents. The scarcity of spot spelter has been largely overcome by the output of the smelters. Export orders have dropped off, and although exports have been large over recent months, these shipments represent orders placed some time ago.

Nickel Output of Canada.—The output of copper-nickel matte in Canada in 1914 was 46,396 gross tons, valued by the producers at the smelter at $7,189,031. It contained 28,895,825 lb. of copper and 45,517,937 lb. of nickel. The ore tonnage smelted was 947,053 The production in 1913 was 47,150 tons of matte containing 25,875,546 lb. of copper and 49,676,772 lb. of nickel. An increase was thus shown in copper content and a decrease in nickel. The world's production of fine nickel in 1913 approximated 34,000 tons, of which the Canadian ore contained 24,838 tons.

Steel Co. of Canada.—Figures of earnings of the Steel Co. of Canada, for July, are not yet available, but it is learned that they were well in excess of the June figures, which indicated profits at the annual rate of 21 per cent. on the common stock. In the first half of 1915, the company did a gross business of about $6,400,000. Its best year's gross was 1912, when orders totalling nearly $16,000,000 were filled. Gross in the second half of 1915 should be at least $10,000,000, which would make the year a record one. Net earnings for 1915 are conservatively estimated at about $3,200,000, this estimate being based on suppositious earnings of $400,000 monthly for the second half.

Canadian Car & Foundry Co.—Advices from New York state that negotiations for the purchase by the Russian Government from the Canadian Car & Foundry Co. of 3,000,000 sharpnel and high explosive shells at a cost of $52,000,000 have been virtually completed. The information was given out at the New York office of the company. Canadian Car & Foundry have already received contracts from the Russian Government valued at nearly $100,000,000. The contract calls for the delivery of the ammunition by April of next year and part of the work will be sublet. Russian funds, it is understood, in Wall Street, have been sent to New York and Canada to cover payment. The contract, it was announced, covers orders for additional shells just as soon as the present ones are turned out.

Tenders for Scrap.—Sealed tenders for the purchase of a quantity of scrap metal at the Dominion Arsenal, Quebec, will be received up to noon of Thursday, the 23rd day of September, 1915. The quantities are approximately as follows:

	Lbs.
Brass, etc.	16,000
Charger steel	81,120
Steel, tool, lumps	13,950
Steel, mild, lumps	129,232
Turnings	72,074
Cast iron	183,848

The prices should be for delivery, ex stores, Dominion Arsenal, Quebec, material to be removed within 30 days after acceptance of tender. All the scrap is loose, and information required may be obtained from the Superintendent, Dominion Arsenal, Quebec; or Department of Militia and Defence, Ottawa.

Catalogues

The Mott Sand Blast Mfg. Co., New York, N.Y., have had prepared for distribution four write-ups of different sand blast machines which they manufacture. Copies may be obtained upon application to the company.

Forcing Presses.—Catalogue No. 92 deals with the line of hydraulic forcing presses made by the Watson-Stillman Co., New York. A number of presses for various purposes are described and illustrated, making altogether a very complete line. Included is a copper hand-press for shell work.

"**Wrought Iron Railing,** Entrance Gates and Wire Fencing" is the title of a 64-page handsomely illustrated catalogue issued by the J. W. Fiske Iron Works, 78-80 Park Place, New York. This catalogue also includes outside lighting fixtures, mesh wire work for tool and stock room enclosures, and ornamental iron grille work.

Exhausters.—The Oneida Steel Pulley Co., Chicago, Ill., have issued a bulletin describing steel plate exhausters and cast iron blowers. The bulletin contains a speed, horse-power and pressure table, and also a price list for the exhausters. Another useful table gives the velocity and volume, etc., at given pressures. Among the illustrations are included an efficiency curve and diagrams with dimensions for the various sizes.

Shop Furnaces is the title of a bulletin recently issued by the American Shop Equipment Co., Chicago, Ill. The bulletin contains particulars covering a line of rivet forges, welding and forge furnaces, hardening and tempering furnaces, etc. The principal features of each type are described, while tables

Canadian Hart

GRESOLITE WHEELS

for Cast or Chilled Iron Grinding

GRESOLITE (carbide of silicon) wheels are manufactured at *HAMILTON, CANADA,* by the silicate process, and the success users have had with these wheels proves without a doubt that the product is not an experiment.

If you prefer we can supply you with *VITRIFIED EMERY* for your foundry grinding, but if first cost of wheel is not an important factor we strongly recommend *GRESOLITE* for productivity.

The *LARGEST STEEL FOUNDRIES* in Canada are using *CANADIAN HART* vitrified *EMERY* wheels.

We maintain a Service Department for your benefit. Have you taken advantage of it?

Canadian Hart Wheels, Limited

Manufacturers of Corundum, Emery and Gresolite Wheels. Also Grinding Machinery

HAMILTON, CANADA

give the principal dimensions and shipping weights of each size. The bulletin has been gotten up particularly with a view to furnishing information for exporters, as the weights are given in both pounds and kilogrammes, and the shipping measurements in both cubic feet and meters. The bulletin is fully illustrated.

FOR SALE—PATTERNS, JIGS, BLUEPRINTS, and some stock for manufacturing the "Hunter" Gasoline Engine, 1 H.P. to 40 H.P., both stationary and marine. Thousands in use. Names of users supplied. Splendid chance to own a business, going at a bargain—Address Geo. Minorgan & Sons, Beaverton, Ont.

A want ad. in this paper will bring replies from all parts of Canada.

VENT WAX

—SIX— REASONS WHY
we know it will save you money

By Far the Cheapest—
QUALITY CONSIDERED

FIRST—It is hard, but pliable, and WILL NOT stick together at any ordinary temperature.

SECOND—It is absorbed by the core, at the time of drying, thereby leaving a good, clean vent hole, just the size of the wax used. And you know what that means to YOU.

THIRD—It is guaranteed NOT to injure the most delicate core made.

FOURTH—It is guaranteed to work in unison with any kind of core made.

FIFTH—It is guaranteed to IMPROVE the core instead of making it soft around the vent.

SIXTH—It overcomes most bad castings—because they usually result from blowing of the cores caused by poor venting.

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ASK YOUR SUPPLY HOUSE OR WRITE US FOR SAMPLES AND PRICES, AND LET IT PROVE OUR CLAIMS.

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Quality Guaranteed

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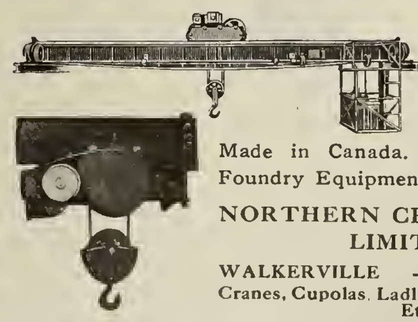

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Cranes, Cupolas, Ladles, Hoists, Tumblers Etc.

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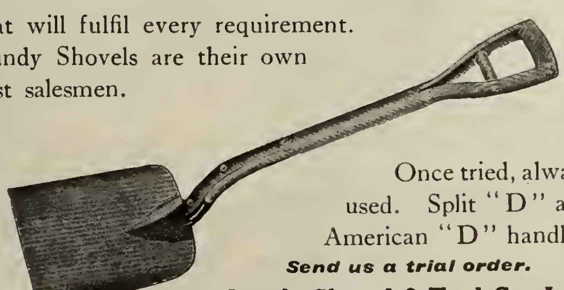
that will fulfil every requirement. Lundy Shovels are their own best salesmen.



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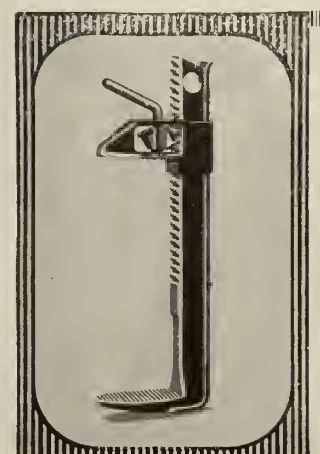

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The castings and time you can save by using these cla surprise you.

They can be instantly adjusted to any size flasks without the use of blocks and wedges.

They do not cause sand to fall from mold while being clamped, as no pounding is necessary.

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Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Ajax Metal Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
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Ammeters.
Chas. J. Menzemer, Niagara Falls.

Babbitt Metal
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H. S. Carter & Co., Toronto.
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Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
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Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

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Sterling Wheelbarrow Co., Milwaukee, Wis.

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Joseph Dixon Crucible Co., Jersey City, N.J.
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J. S. McCormick Co., Pittsburg, Pa.
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J. W. Paxson Co., Philadelphia, Pa.
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Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
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Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Boxes, Tote
Sterling Wheelbarrow Co., Milwaukee, Wis.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
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Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
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Manufacturers' Brush Co., Cleveland, Ohio.
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Webster & Sons, Ltd., Montreal.
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H. S. Carter & Co., Toronto.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Pangborn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
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Chemists.
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Chippers, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Clamps, Core Box
National Clamp Co., Chicago, Ill.

Clamps, Flask
National Clamp Co., Chicago, Ill.

Copper, Phosphorized
Ajax Metal Co., Philadelphia, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes
Pawling & Harnischfeger Co., Milwaukee, Wis.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Pangborn Corporation, Hagerstown, Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Northern Crane Works, Walkerville, Ont.
Osborn Mfg. Co., Cleveland, O.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Grinders, Disc, Bench, Swing.
Ford-Smith Machine Co., Hamilton Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.
Geometric Tool Co., New Haven, Conn.

Grinders, Electric
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Pneumatic, Portable.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Hammers, Chipping
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Helmets.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Pawling & Harnischfeger Co., Milwaukee, Wis.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Melting Pots.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.
Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works,

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rosin.
Webster & Sons, Ltd., Montreal.

Rouge.
W. W. Wells, Toronto.

Sand Blast Machinery.
Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Conveying Machinery
Standard Sand & Mach. Co., Cleveland, O.

Sand Mixing Machinery
Standard Sand & Mach. Co., Cleveland, O.
Vulcan Engineering Sales Co., Chicago, Ill.

Sand Molding.
H. S. Carter & Co., Toronto.
Hamilton Facing Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Standard Sand & Mach. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.
Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.
Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.
Pangborn Corporation, Hagerstown, Md.

Sieves.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Silica Wash.
Webster & Sons, Ltd., Montreal.

Small Angles.
Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Special Machinery.
Osborn Mfg. Co., Cleveland, O.
Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
Vulcan Engineering Sales Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.

Squeezer Molding Machines
Mumford Molding Machine Co., Chicago, Ill.

Squeezers, Power.
Davenport Machine & Foundry Co., Iowa.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.

Steel Rails.
Dom. Iron & Steel Co., Sydney, N.S.

Steel Bars, all kinds.
Dom. Iron & Steel Co., Sydney, N.S.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Talc.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Taps.

Geometric Tool Co., New Haven, Conn.

Teeming Crucibles and Funnels.

McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.

Geometric Tool Co., New Haven, Conn.

Tools, Pneumatic

Independent Pneumatic Tool Co., Chicago, Ill.

Track, Overhead.

Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tripoli.

W. W. Wells, Toronto.

Trolleys and Trolley Systems.

Can. Fairbanks-Morse Co., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks

Sterling Wheelbarrow Co., Milwaukee, Wis.

Trucks, Dryer and Factory.

Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tumblers.

H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.

Turntables.

H. S. Carter & Co., Toronto.
Northern Crane Works, Walkerville.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Vent Wax.

H. S. Carter & Co., Toronto.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Vibrators.

Berkshire Mfg. Co., Cleveland, O.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.

Wall Channels.

Dom. Iron & Steel Co., Sydney, N.S.

Wedges, Foundry

Sterling Wheelbarrow Co., Milwaukee, Wis.

Welding and Cutting.

Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.

Canadian Hart Wheels.
Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

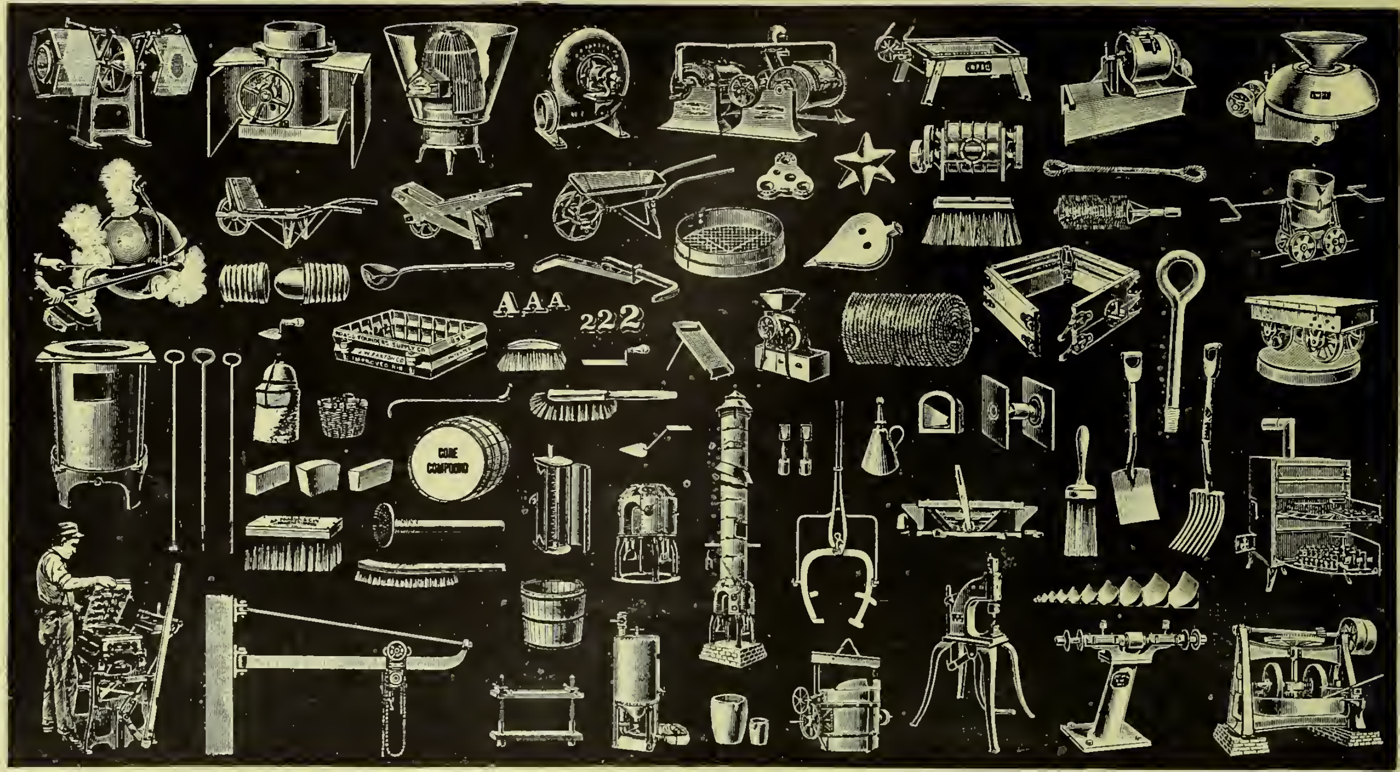
Wire Wheels.

Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
W. W. Wells, Toronto.

Wire, Wire Rods and Nails.

Dom. Iron & Steel Co., Sydney, N.S.
Osborn Mfg. Co., Cleveland, O.

ADVERTISING INDEX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SPECIAL FEATURE—CONVENTION NEWS

CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited. Toronto. Montreal. Winnipeg. and London. England

VOL. VI. | PUBLICATION OFFICE, TORONTO, OCTOBER, 1915 | No. 10

Our organization consists of practical, expert foundrymen who devote entire time and knowledge to turning losses into profit. When we enter your foundry every department undergoes the unerring judgment of carefully trained men and our report and recommendations cover the source of loss and practical remedies are suggested to eliminate such loss.

Kawin Service is not a game of chance. You take no chances whatever, for Kawin asks no recompense until you have been assured to your entire satisfaction that you are much better off for having called him to your assistance.

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WE POSITIVELY GUARANTEE 100 PER CENT. ON YOUR INVESTMENT WITH US, without the necessity of new equipment.

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Charles C. KAWIN Company, Limited

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Established in 1903 and now doing business, on yearly contract, with several hundred foundries

Chicago, Ill. **307 KENT BUILDING, TORONTO** **Dayton, Ohio**

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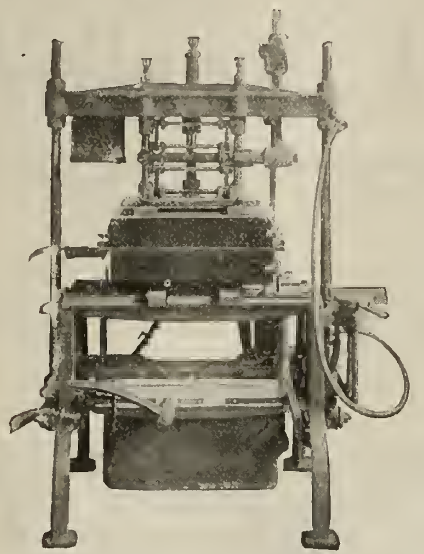
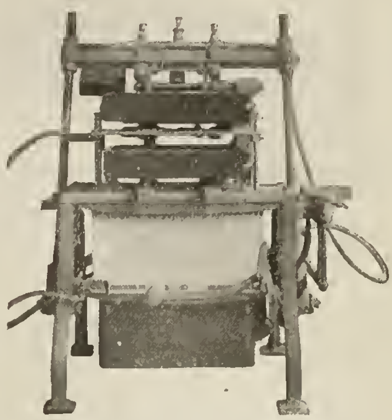


Berkshire Air Squeezer Squeezing Mold

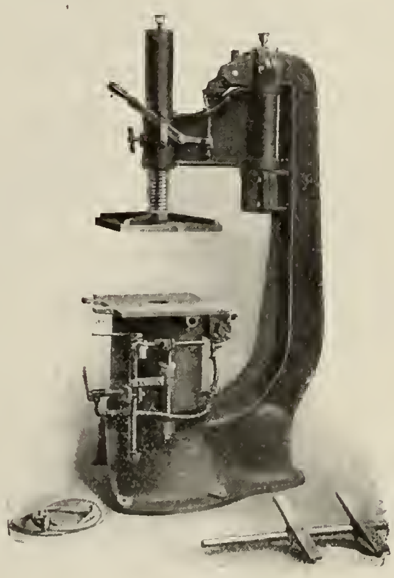
Berkshire Air Squeezers

The machine you are looking for. It has no equal. This is a plain statement of facts. Hundreds of users are proving this every day in the most progressive foundries in the world.

All the features which have made the Berkshire Squeezer famous are embodied in this machine.



Berkshire Air Squeezer Lifting Cope and Pattern Plate



The Berkshire Universal

Universal power molding machine for Malleable, Gray Iron or Brass foundries. Split patterns, match plates or plain gates. All molds exactly alike. Anyone can operate it. A powerful, convenient, well-built power molding machine.

The Berkshire-Acme Core Machine

No screws to wear or grind out. Uses multiple dies. Three cores at same time on all sizes up to and including 1". Two cores from 1" to 1½". Makes any shape core that will pass through a die. The faces of the plungers are cupped, so that they fill with sand which becomes the ramming face.

Berkshire Vibrators, ½" to 2"

The right workmanship and material, based on years of experience, go into our vibrators, insuring satisfactory service and durability; absolutely guaranteed, and all parts interchangeable.

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The Publisher's Page

By B.G.N.

Do You Use It?

¶ Although we have definite proof that scores of our readers consult CANADIAN FOUNDRYMAN Buyers' Directory, it has occurred to us that possibly a word of explanation and introduction concerning this important department of our paper will not be unwelcome to our many new subscribers.

¶ At the back of this, and every issue, you will find two pages known as our "Buyers' Directory." You will find listed here practically every foundry requisite that you might be in need of.

¶ Under each heading will be found the names of many of the leading manufacturers or dealers making and selling the line mentioned.

¶ In the majority of cases you can secure further particulars by consulting the advertising in the same or a preceding issue. Should you find that further information is necessary, as is usually the case, you can ask for catalogues and full particulars.

¶ Our Buyers' Directory is published solely for our readers' convenience, and you are invited to take advantage of it. If the information you desire is not given, write us, and we will gladly give you special service.

¶ Mind you, we do not claim that all firms making a particular line are listed in our Directory, but those who are can be relied on as being progressive, reliable, and as prepared to handle your inquiries in an eminently satisfactory manner. If their selling methods are up-to-date, you can safely assume that their products are also.

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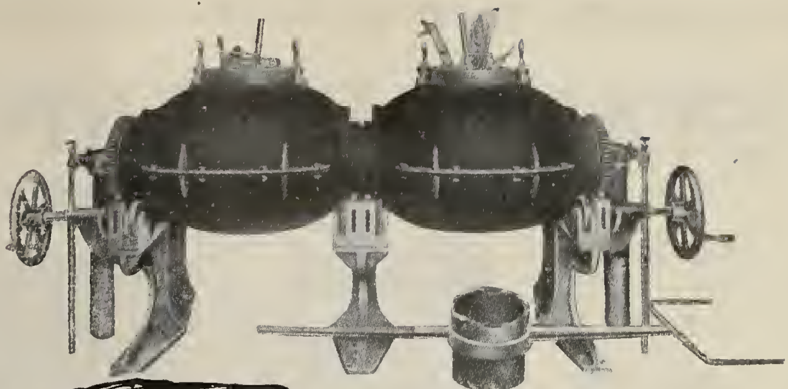

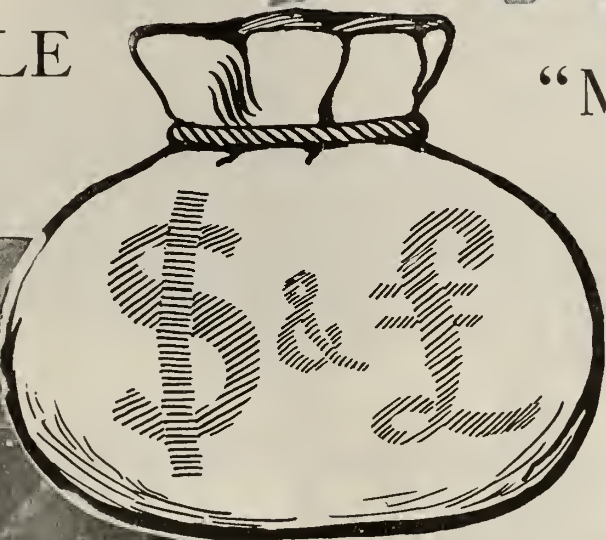

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Double Chamber Metal Furnace

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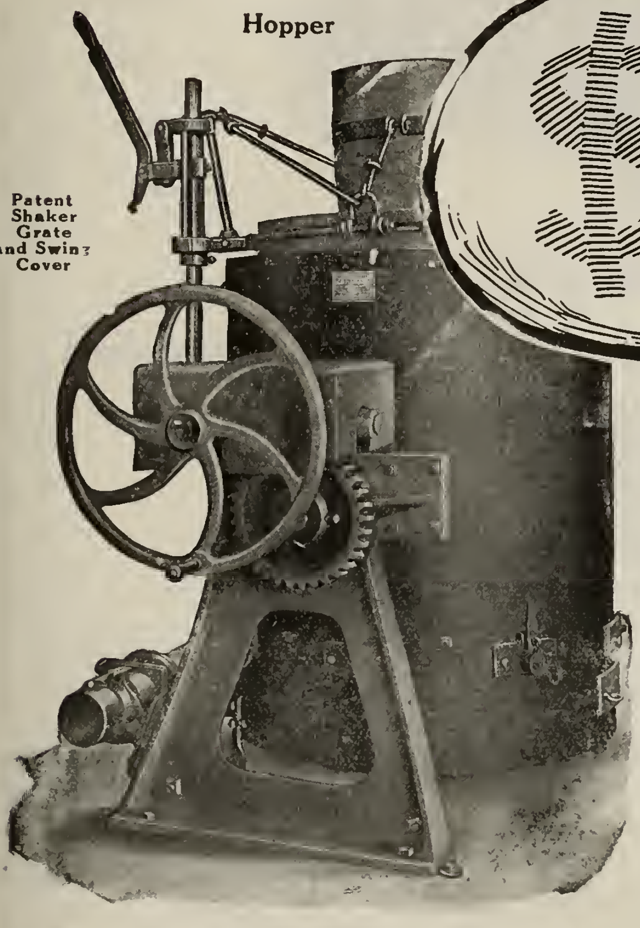
The two chambers can be used alternately. The exhaust heat from the active or primary chamber flows into the other chamber, thereby simultaneously melting in one chamber and heating the metal in the other chamber to very near the melting point with one burner and at no additional cost.

Makes melting practically continuous, permitting melts of various mixtures of metals to follow one another in rapid succession.

Cuts melting costs nearly in two.



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THE "MONARCH - Crown"

Tilting Coke-Coal Furnace

Brass, Copper, Bronze, Aluminum, Nickel, Silver, Gold, etc.

Designed for those who do not desire to use oil or gas fuels.

Monarch Metal Melting Furnaces have, by their great success in hundreds of American plants, demonstrated what they will do the world over.

They are built for all metals and fuel, and all conditions, any unit of heat and daily tonnage, with crucibles or without, with iron pots—"Stationary or Tilting." "IRON POT" for soft metals—"Tilting and Stationary" for aluminum, lead, tin, spelter, babbitt, dross, etc.

REVERBERATORY, both "Tilting and Stationary," from 500 to 10,000 lb. capacity. All Fuels. "Rockwell" Simplex and Double Chamber Brass Melting Furnaces, formerly made by Rockwell Furnace Co., New York (We own and manufacture), SPECIAL FURNACES FOR HIGH HEATS, boron, iron, steel alloys, etc.

PORTABLE HEATERS for moulds, ladles and lighting purposes, dispensing with wood in Cupola.

CORE OVENS, all sizes, all fuels; the "Acme" Double Overhead Trolley or "Arundel" Dropdown Front—the best sheet asbestos—heavy sheet steel—built like a rock.

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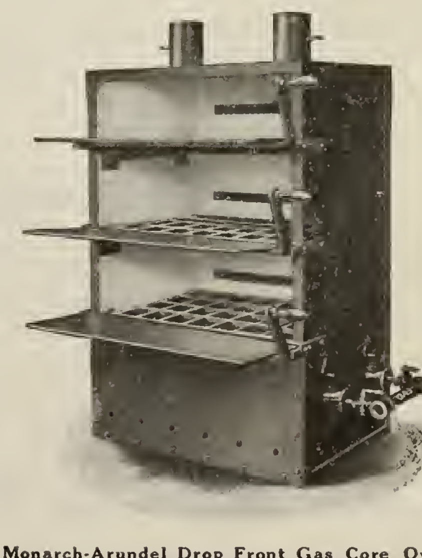

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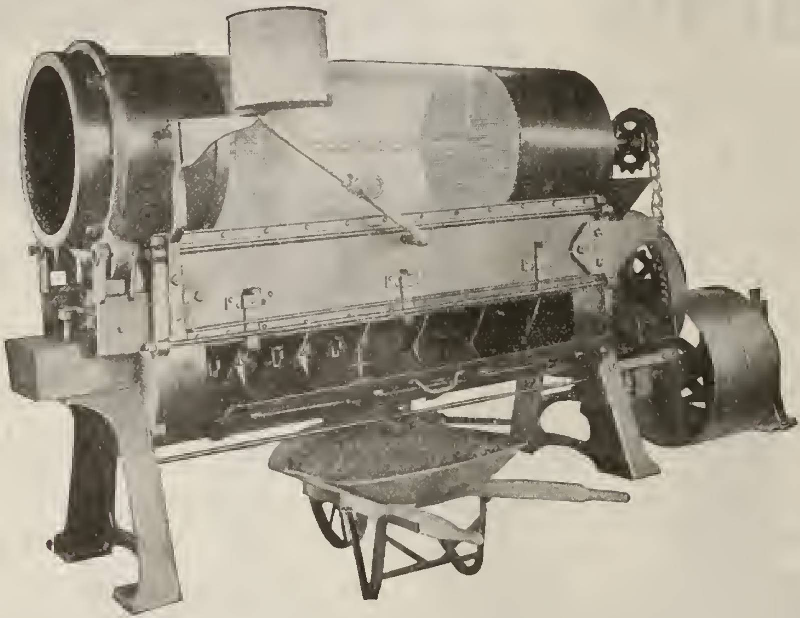

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These are the paddles used in a Standard, which **mix** the sand 100 times a minute and not merely turn it over as you would with a shovel. That is why foundries tell us they save from 5% to 50% of Binder.

Size.	Floor Space	Capacity Per Batch	H. P.	Size T & L Drive Pulleys	Speed Counter Shaft
No. 0-A	2′ x 6′ 9″	4 cu. ft.	3	20 x 4	150 R. P. M.
No. 1	2′7″x 8′ 7″	6 cu. ft.	4	26 x 6	95 R. P. M.
No. 2	2′7″x 9′ 9″	7½ cu. ft.	5	26 x 7	95 R. P. M.
No. 3	2′7″x10′11″	9 cu. ft.	6	26 x 8	95 R. P. M.
No. 4	4′9″x12′	27 cu. ft.	20	26 x 10	280 R. P. M.

There is a Standard for every size foundry. One to sixty tons per hour.

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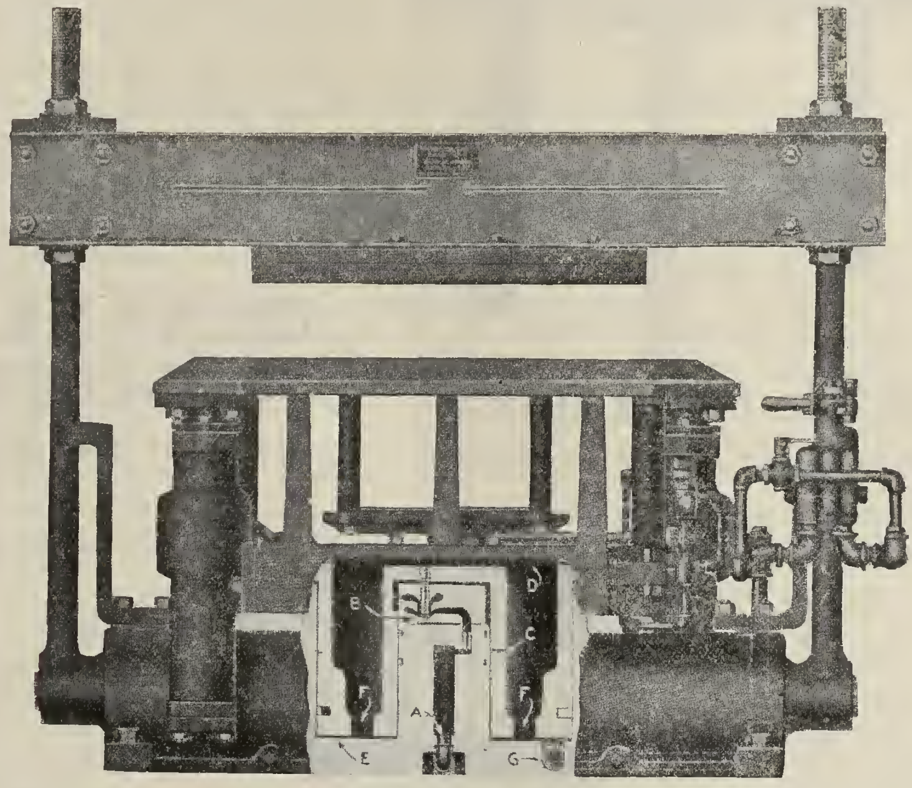
Mumford Jolt and Squeeze Ramming Split Pattern Machine

Power Jolt—Power Squeeze—Hand Starting.
Power Pattern Draft Adjustable up to ten inches.



A—Air for Jolt Ramming. **B**—Automatic Single-piece Valve for Jolt Ramming. **C**—Exhaust from Jolt Rammer. **D**—Open joint between plunger and ramming head of machine through which exhaust escapes. **E**—¼″ leather sheet serving as impact surface during jolting and valve closing surge ports FF during squeezing. **F**—Surge ports to prevent suction and cushion under squeeze plunger during Jolt Ramming. **G**—Air inlet port for squeezing.

A new Mumford invention with exclusive features that prevent any approach to its advantages in any other machine.

Saving of time, labor and expense make a cold and inadequate description of its value after you have used or beheld this machine in operation.

Valves are Necessary in Jolt Ramming Machines

A single-piece valve, for example, allows a small internal cylinder to take the place of the entire squeezing area for the work of Jolt ramming On a 14″ x 16″ machine you use a 4½″ jolt cylinder instead of 12″ squeezing cylinder and save six-sevenths of the area.

The action of our valve is to automatically gauge the air used to the load.

We can equip your plain squeezer or split pattern machine of our make with the jolt feature.

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If what you want is not advertised in this issue consult the Buyers' Directory at the back.

The Foundrymen's Convention and Equipment Exhibition

Every real, live firm in the foundry or other manufacturing business realizes and appreciates the benefits to be derived from presence at such a function as the recent American Foundrymens' Association Convention and its affiliated Exhibition, held recently in Atlantic City, N.J. On the particular occasion there was perhaps a more than usual tribute paid the benefit feature, large representative attendances and keen interest being expressive of it.

THE 20th Annual Convention of the American Foundrymen's Association was held at Atlantic City, N. J., during the week of September 25. As in former years, the American Institute of Metals annual sessions, and the Foundry and Machine Exhibition Co. display of foundry equipment and supplies ran concurrently with the first named. The official registration of members and guests of the A.F.A. and of the A.I.M. achieved, we understand, a new high record, the actual figures being 884. Attendance figures at the exhibition were also largely in excess of any previous year. A fairly comprehensive programme of what might aptly be termed the triple function was given in our September issue, and, in this and succeeding issues we will reproduce papers read, and describe in more minute detail equipment shown. The convention of 1916 has been tentatively planned to be held in Cleveland, Ohio.

A total of 64 reports and papers was presented, 39 of these being credited to the American Foundrymen's Association, and 25 to the American Institute of Metals. In the A. F. A. committee reports much interest was apparent, and quite naturally so because of the subjects considered and their bearing on foundry development work in the future. "Safety First." "Industrial Education," "Costs," "Gray Iron Castings Specifications," "Coke Analysis Standards," "Steel Castings Specifications," "Steel Foundry Standards," etc., are each and all live problems entering into the work-a-day activities of foundrymen, whether officer or operator, and no more effective way to have them individually and satisfactorily solved, can, we imagine, be suggested than through their systematic investigation by just such a body as the American Foundrymen's Association.

A.F.A. Papers

The subject matter of the papers read at the various sessions of the American Foundrymen's Association covered the widest possible range, and may be said to have embraced within its scope every department of foundry work. In number of presentations, as already indicated, in quality of matter discussed, and in the reception accorded the authors, little doubt may be said to remain as to the widespread benefits immediately derivable and to the influences set in motion towards still higher achievement. Grey iron, steel, malleable iron, their constitution and process of manufacture, were considered from a variety viewpoint, involving consideration of cupola practice, molding sands, the reclaiming of same, molding machines, etc.

A. I. M. Papers

The sessions of the American Institute of Metals were quite on a par with those of the A. F. A., both in the matter of high quality and wide scope of subjects discussed, and as regards attendance and interest displayed. Metals are entering largely into the manufacture of munitions of war at the present time; therefore, their production, maintenance and conservation against the most urgent requirements is a consideration of supreme moment. Furnaces, electric and oil, for

MACHINERY HALL EXTENSION, FROM UPPER END, FOUNDRY AND MACHINE CO. EXHIBITION, ATLANTIC CITY, N.J.

the production of castings, development of alloys and the growing use of aluminum on its own account and as a constituent of the latter may be said to indicate in a general way the field covered. Attention was directed, however, to the fact that the scientific side of many of the subjects was given undue prominence, it being in many cases almost impossible for the ordinary brass foundryman to follow the detail intelligently. That the criticism was both given and taken in the proper spirit became evident when the chairman of the Papers Committee intimated his intention to have included in next year's programme one or more papers of a quite elementary and nontechnical nature.

Foundry and Machine Co. Exhibition

The Foundry and Machine Co. exhibition of foundry equipment and supplies was held on "Young's Million Dollar Pier," and, while the most possible was made of the space available as regards layout, it cannot be said that the same facilities for setting off to advantage either still or operating machinery—the latter particularly—were available as in more recent years. The consensus of opinion among exhibitors expressed, however, satisfaction with the interest displayed and the inquiries received. Although nothing startlingly new was in evidence, it was quite apparent that quiet, progressive development work had been going on during the past year. Equipment exhibits were in many cases brought to a higher degree of perfection, modification of design and constructional details, together with ease of operation, having been carefully considered. As already stated, the more prominent exhibits will be described and detailed at length in succeeding issues. The machine tool exhibit for obvious reasons was almost wholly absent, at least in comparison with the display at Chicago in 1913 and 1914.

The usual banquets and entertainments for ladies accompanying the representatives were provided, and these, added to the amusement and healthful facilities for which Atlantic City alone on this continent bears the palm, contributed to make Foundrymen's Week both profitable and enjoyable.

Fitting references were made and resolutions adopted with regard to the losses sustained by the American Foundrymen's Association through the deaths since last convention of Thomas D. West and Edgar H. Mumford.

New Officers, A. F. A.

The following officers were elected for the ensuing year: President, R. A. Bull, Commonwealth Steel Co., Granite City, Ill.; senior vice-president, J. P. Pero, Missouri Malleable Iron Co., East St. Louis, Ill.; vice-presidents: Henry A. Carpenter, General Fire Extinguisher Co., Providence, R.I.; S. B. Chadsey, Massey-Harris Co., Toronto, Ont.; Alex. T. Drysdale, United States Cast Iron Pipe & Foundry Co., Burlington, N. J.; H. E. Field, Wheeling Mold & Foundry Co., Wheeling, W. Va.; Benjamin D. Fuller, Westinghouse Electric & Mfg. Co.. Cleveland; W. A. Janssen, Bettendorf Co., Davenport, Ia.; H. B. Swan, Cadillac Motor Car Co., Detroit; A. H. Thomas, Buckeye Steel Castings Co., Columbus, O., and Walter Wood, R. D. Wood Co., Philadelphia. Secretary-treasurer A. O. Backert was re-elected.

New Officers, A. I. M.

Jesse L. Jones, of the Westinghouse Electric & Mfg. Co., East Pittsburgh, was elected president for the ensuing year, while W. M. Corse, of the Titanium Alloy Mfg. Co., Niagara Falls, N. Y., was re-elected to the joint office of secretary and treasurer. Vice-presidents were elected as follows: R. S. B. Wallace, National Cash Register Co., Dayton, O.; Geo. C. Stone, New Jersey Zinc Co., New York; W. G. Harris, Canada Metal Co., Toronto; C. B. Horne, Packard Motor Car Co., Detroit; W. B. Price, Scovill Mfg. Co., Waterbury, Conn.; E. A. Barnes, Ft. Wayne Electric Co., Ft. Wayne, Ind.; Dr. S. H. Burgess, bureau of standards, Washington, D. C.; F. H. Schutz, Mueller Mfg. Co., Decatur, Ill.; H. S. Gullick, More-James Brass & Metal Co., St. Louis, and D. B. Browne, Goldschmidt Thermit Co., New York.

MACHINERY HALL, LOWER END, FOUNDRY AND MACHINE CO. EXHIBITION, ATLANTIC CITY, N.J.

Strengthened Aluminum.—While aluminum is made more suitable for many mechanical purposes by alloying with 9 to 12 per cent. of cobalt, it is still too coarsely crystalline to be strong, but in remedying this by adding a little tungsten or molybdenum, alloys have been obtained three times the tensile strength of pure aluminum. The best results were obtained with 0.8 to 1.2 per cent. of tungsten and 8 to 10 of cobalt, or 0.6 to 1 per cent. of molybdenum and 9 to 10 of cobalt. Increasing the tungsten or molybdenum and cobalt adds to the tensile strength but makes forging and rolling more difficult, the tungsten alloys being somewhat harder than the molybdenum.

Papers Read at the Recent Foundrymen's Convention

Selected from the more important subjects presented for discussion before the Annual Convention of the American Foundrymen's Association and the American Institute of Metals at Atlantic City, N.J., during September, 1915. The papers cover a wide field of foundry and allied activity, the nature of the results and the completeness of the reports making them of particular interest to all who desire to keep in touch with metallurgical progress.

THE CONVERTER IN STEEL CASTINGS MANUFACTURE

By C. S. Koch*

A WRITER of a paper on the manufacture of steel castings, some four or five years ago, started with the following words: "This subject has already been discussed so thoroughly before this association, that not many points remain uncovered." Since then there have been numerous additional papers. Consequently, it has been difficult for the writer to dig up something not yet touched upon, which would still be of general interest. There have been refinements in many ways, but they are generally too detailed to go into. If one looks over the Transactions of the Association, he will find a large amount of good matter on the converter. He will find papers on its construction, its lining, its manipulation, and its chemistry, and all the details pertaining thereto, all of which is of interest to those who are in close touch with the subject. However, little is found in regard to the various factors which have tended to make the converter a successful means for making steel in many cases and equally as disastrous in as many more; little material is available giving reasons why the converter is still being run in some foundries after 10 or 15 years, and why it was run six months or less in others. The writer proposes to discuss this subject.

Is the Converter Practical?

If, say 10 or 12 years ago, the following question were asked, "Is the converter a practical means for making steel for castings?", the total number of replies in the affirmative would have been less than 10. That is, replies from men whose experience would justify their endeavoring to answer the question. The number of negative replies would have been almost too great to record. The proportion would have been about nine negatives out of 10 answers. If the same question were asked to-day from the same class of individuals, the trend of replies would be just about the reverse. The converter process has about as large a proportion of adherents to-day as it had adverse critics 10 years ago.

Up until about 1905, the failures greatly exceeded the successes. For the next five years, the number each way was nearly equally divided and of late years, the successes have been, probably, in excess of the failures. But we must not lose sight of the fact that news of a success is published, while that of a failure is squelched. In the early days, the failures were not due, as we might suppose, to the crudity of the process, but rather, as a rule, to the fact that in a great number of cases the converter was being employed for purposes for which it was not adapted and was being wrongly applied. Better results have been obtained in recent years because the users have exhibited better judgment in the selection of the particular lines into which they have entered.

This can be demonstrated by an analysis of the history of the converter foundries of the United States. In making this analysis, trade conditions must be taken into consideration as they vary from one locality to another.

The conclusions from this examination seem to show that the following statements are approximately true:

1.—The application of the converter to the manufacture of a general line of railroad car castings has not, to date, been a success.

2.—The use of the converter in conjunction with an open-hearth furnace has not generally met with success. That is, the open-hearth foundries, which have endeavored to add the converter to their equipment, have nearly always given up this process after a short trial.

3.—Iron foundries which have endeavored to add the converter to their equipment, except in favored conditions, have been unsuccessful.

4.—Various manufacturing companies, having a fair consumption of steel castings, have not by any means been satisfied with the results of making a small tonnage for their own use.

Why Success Was Achieved

On the other hand, the resume of the history will show the companies that have been successful, and in almost every case it will be found that these companies have employed the following methods:

1.—They have made steel by no other process.

2.—They have adhered, as a rule, to a maximum metal line, or perhaps, we might say, weight of casting. This weight has varied somewhat in different localities, as competition and a few other conditions have varied.

Now all these causes for failure and success can be argued pro and con and exceptions can be cited. Nevertheless, if anyone is considering the application of the converter to the steel foundry business, he would do well to give due weight to the foregoing, because the statements given are not the result of theoretical considerations, but of a detailed analysis of the history of the converter business for the past 15 years.

It will be noted that in the writer's opinion, the reason for successful operation has been careful consideration of the maximum weight and the question naturally arises, what is this? It will vary in different localities, but is more or less dependent on the proximity, activity and attitude of open-hearth steel foundries.

Generally speaking, converter steel costs more than open-hearth steel. Consequently other things being equal, such plants can underbid the converter plant on all such castings as they can properly run. Therefore, if a converter foundry is in a locality where open-hearth competition is keen, the maximum weight of the castings which it ordinarily can take at a profit will be less than in the case where such competition is remote or less active. In considering this competition, there is another element that should not be overlooked. The manufacturer of large, heavy castings naturally has a lower average overhead per ton, and unfortunately in many cases, this small overhead expense is spread equally over the large and small work. In bidding, this naturally puts the converter plant at a disadvantage, with the logical tendency of restricting the converter plant to castings which the open-hearth cannot run; that is, restricting it to smaller and smaller castings.

Effect of Increased Skill in Molding

Again, the tendency in some localities is for the manufacturers of large castings to encroach more and more on the field of the converter shop owing to increased skill in molding. It is believed by the writer that owing to various conditions, greater skill in molding difficult, medium-size castings was formerly possessed by the converter plant. During every dull period, in their desire for work, the manufacturers of large castings have gone after more difficult jobs. This has developed their skill and given them confidence.

We have already stated that in the past, success was more or less dependent on restrictions to small work, and these latter considerations show that in the

*Fort Pitt Steel Casting Co., McKeesport, Pa.

future the converter plant will be compelled to carry this restriction further. There are, however, modifying features that should be given weight. There are converter plants strewn all over the country, located in districts where ordinary competition from the cheaper metal does not exist. These reap profits not possible to others. For example, the plant may be at such a distance from outside competition that the buyer is willing to pay a price sufficiently high to enable the converter plant to take the work with a reasonable profit. Proximity to user is always a valuable feature.

Most all converter plants, even the successful ones, handle some large work. This is obtained on the basis outlined previously, but it would not be safe to bank too much on this as being a particularly lucrative part of your business. From all of the foregoing it must not be concluded that the amount of work to be done by a converter plant is to grow less. On the contrary, new uses for steel are being found, which will give the industry more work than formerly. It is an adjustment of classes that will follow.

Shop Practice

To return more particularly to the application of the converter, there are a few fundamental principles of operation that it may be well to mention. These, again, are not theoretical considerations, but are brought to mind by a study of what has been accomplished and **not accomplished** by the converter plants of this country:

The points I wish to make are as follows:

GENERAL VIEW IN ANNEX, FOUNDRY AND MACHINE CO. EXHIBITION, ATLANTIC CITY, N.J.

MACHINERY HALL EXTENSION, FROM LOWER END, FOUNDRY AND MACHINE CO. EXHIBITION, ATLANTIC CITY, N.J.

1.—Uunusually good cupola practice is essential.

2.—The speed of the cupola should be regulated to the speed of the converter, that is, neither too slow nor too fast.

3.—Proper crane facilities are necessary.

The writer has endeavored to learn the causes, (a) of complete failures, (b) of the cases in which there was perhaps no real failure, but in which there was a discontinuance in the use of the converter, and (c) of mediocre success. As far as the steel-making end was concerned, these could be attributed to a bad combination of the three operations listed.

Holding the cupola back in any way whatever, to wait for the crane or the converter is not good practice, especially when the economical operation of the converter requires the use of a burden of perhaps 40 per cent. steel scrap. It should not be necessary to say much on this subject to foundrymen, but strange to say many converter foundries can be adversely criticized on this point. Quality and temperature of iron should be considered and if a large number of heats are to be taken off, the time element is essential. As is well known, a 2-ton converter will produce steel at the rate of two tons every 20 to 25 minutes. If 12 heats are produced daily, an unnecessary delay of only five minutes per heat will aggregate one hour. It is well not to be obliged to start pouring any earlier in the day than is necessary on account of fumes and heat, but at the end of the day overtime is not only costly, but has many other disadvantages. Consequently, quick operation, at a uniform rate, is helpful, and this can be obtained only by a well-run cupola that is not too slow for the converter, and by proper crane facilities, arranged to remove the steel from the converter as soon as it is blown and to immediately refill the converter with iron. The crane should not be busy pouring off, when it is wanted at the converter. A wait means holding back the cupola, which means not only loss in time, but bad iron later in the day. That the ideal relationship of cupola, converter and crane is not present in many foundries is not the fault of the foreman or superintendent, but is due to original faulty design.

Temperature of the Steel

Furthermore, the temperature of steel should be uniform from heat to heat and should be adapted to the class of work turned out and arrangement of the shop. The need of some shops is for steel much hotter than others. This is logical and correct and one might say that each shop has its own particular ideal temperature. This should not be higher than necessary, as heat is costly. Most shops do not seem to aim at any particular temperature. The result is changed temperature conditions daily. This puts the foreman at a disadvantage in guiding his molding practice.

If the ideal shop temperature is eventually attained, there still remains a difficulty. The steel will be too hot for some castings and too cold for others, and will burn in badly on some and not run others. To avoid this and many other foundry difficulties, the policy of the company should be toward a narrow range of sizes. It will be argued that this cannot be done in a jobbing shop, which must take whatever comes. The only answer to this is that such a statement is like many others emanating from foundrymen. We are in a rut and not until we get out, and break away from antiquated, preconceived principles, will we attain the highest degree of success. Establish your class and range of sizes and adhere to it. You will loose some work to the other fellow and at the same time take some from him. In time your plant will be operating on work for which it is best adapted, and your competitor will be doing likewise. You will have made the first step in specialization. In conclusion, let me say that the first step to take in the practical application of the converter to the steel foundry is to specialize, being sure that it is on that class of work to which the converter is best adapted.

GRAY IRON CASTINGS DEFECTS—THEIR CAUSES AND REMEDIES

By Herbert M. Ramp*

A COMPREHENSIVE discussion of the causes of defects common to gray iron castings and remedies for overcoming them would encompass the consideration of practically every foundry operation, but unfortunately the time at our disposal will permit only of a brief review of this interesting and complex problem. A discussion of the losses incurred by defective castings is one of the first things a man hears when he enters a foundry and it usually is the last thing that comes to his notice when he leaves it. Unfortunately, more attention is given to the losses incurred by defective castings than to making improvements that will eliminate practices that cause them. More consideration is given the pounds of bad castings a molder produces than to his output of good work. Also, more importance is attached to the bad castings reported than to the cost of productive labor per ton. The reason for this is not hard to find. The one is a tangible, direct loss that stares the foundryman in the face every day, while the others are intangible factors that can be corrected by the exercise of gray matter and the installation of proper equipment.

*Elmwood Casting Co., Cincinnati, Ohio.

It is estimated that defects common to gray iron castings are the direct cause of the rejection, or loss, of at least 5 per cent. of the iron castings produced. Some patterns may have a better record, although many, also, will show a higher percentage of loss. This estimate on the average, however, is low. If this loss were eliminated many foundries struggling for existence today could not make a profit on their operations. The reduction of the defective output is a problem of great importance and should command the earnest attention of every foundryman.

Ninety per cent. of all defects can be attributed to two causes, namely, incompetency and carelessness. However, since it is exceedingly difficult to obtain competent and careful labor, the operations involved in making castings to-day must be so safeguarded and simplified that a lesser degree of experience, intelligence and care is necessary to the successful operation of the casting plant than heretofore. Classifying casting losses in the order of their causes, it will be found that 50 per cent. can be attributed to the sand and its treatment, 20 per cent. to the cores, 10 per cent. to the patterns, five per cent. to equipment and five per cent. to the iron.

What constitutes defects in gray iron castings is another question of great importance. The standard of excellence for the different classes of castings varies and consumers using castings of a similar nature for the same purpose, frequently will have widely varying requirements. In other words, castings that will be accepted by one company will be rejected by another, and the line differentiating sound from defective castings is drawn at different points. In this respect every consumer is a law unto himself, and there really is no standard for casting quality. Each consumer fixes what he considers a standard for his own requirements which he believes is adequate to his needs.

Sand as a Cause for Defectives

No effort will be made to enumerate the many causes leading to the production of defective castings as the list will be entirely too long and, furthermore, in many instances the causes are so obvious that further comment is unnecessary. However, some practices are common to many shops which cause needless expense, and these are repeated day after day in one form or another without an intelligent effort being made to correct them. The sand, and its treatment, is probably one of the most prolific causes of defects, and to it can be attributed more losses than to all other causes combined. In three cases out of four, the sand is the cause of dirty castings; it causes the mold to cut and the castings to scab and blow. If a casting blows, it is generally attributed to the cores, the sand or its treatment, and its repetition is guarded against. However, the cause of the cut, scab or buckle is not investigated carefully, notwithstanding the fact that the losses thereby incurred are deadly to profits. It is the small defect that causes the foundryman to stop and wonder if the casting will pass the machine shop, but finally after it has been cleaned and shipped, it is returned with a caustic letter of complaint. It might be pointed out in this connection that the little foxes spoil the grapes. A casting that is defective beyond question usually points out its own remedy, but the casting which is questionably defective is the most elusive. The remedy is not sought as earnestly or intelligently as that causing the larger defect, neither are the molders instructed as carefully to prevent the causes of small defects as of those which are more apparent.

The foundryman usually becomes provoked and exceedingly angry when a molder has a run-out or breaks a casting hot. He views this in the light of exceedingly poor workmanship, but he considers in an entirely different spirit a casting that is slightly scabbed or dirty. The casting that is almost good enough offers the most difficult problem and the cause of its defect, as a rule, cannot be determined readily.

Scabs, Cuts and Buckles

Scabs, cuts and buckles come and go. They vary with the temperament of the man who wields the rammer and the vent wire and blossom forth with the use of too much water, too much finishing, too little venting and the use of improper sand. When the foundryman discovers a scabbed casting, he usually tells the molder to be more careful, or advises him that the mold was too hard or too wet, or whatever his judgment dictates, but how often does he examine the facing and the sand? How often does he employ every possible resource to secure better sand or to make mixtures of sand for his work that are more satisfactory? How often does the foundryman show the molder how to ram the mold, to vent or finish it? How many foremen to-day believe that they discharge their duty by merely telling the men in their employ what is patent to any one who has walked through a foundry a few times in place of personally instructing them how to avoid their troubles and to do their work right?

Poor or misused sand is the cause of more defective castings than any other factor. It has a decided influence on the cost of the product and may be the means of establishing a reputation for high grade or poor castings. It is the foundation upon which the entire foundry structure is built. Suitable sand means better and cheaper castings, lower losses and an easier shop to operate successfully. It is one of the great fundamentals of a happy business.

Preparation and Use of the Sand

Next in importance are the instructions regarding the preparations and use of the sand after its careful selection, consistent with its cost. However, cheap sand frequently is the most expensive raw material that a foundry can buy. The sand must be mixed and tempered for the particular work for which it is required and this must have the attention of the supervising force. The molder next must be instructed in its use and if defects develop in his work, he must be taught, regardless of the fact that he may have pounded sand for 40 years. It is futile to attempt to formulate fixed rules covering supervision and instruction, since every foundryman has individual ideas on this subject. However, not many realize that the cause of defective castings might be eliminated if they would start at the sand bin and see to it that the best possible sand is obtained and that the proper instructions are given regarding its use. Too frequently, also, this instruction partakes of the form of criticism, when the molder is called to the scrap pile where his defective castings are pointed out to him in no uncertain terms. In other words, in most instances, what should be well-intended instruction, is mere denunciation. Anyone can find fault, but a man must study his business if he wants to place himself in a position where he may be able to correct bad practice. The average molder does not lose a casting on purpose. He feels regretful over its failure, but the average molder does not always know the underlying cause of defects, nor how they may be overcome. He needs help, not hell, which he usually receives. He must be taught the rudiments of the business over and over again, since the conditions of the trade are changing constantly. This is the remedy that must be applied by the supervising force before the defective losses can be reduced. If the same energy is expended in instruction as in

MACHINERY HALL, LOWER MIDWAY VIEW, FOUNDRY AND MACHINE CO. EXHIBITION, ATLANTIC CITY, N.J.

condemnation, far more satisfactory results will be achieved.

Dirt Another Cause of Defects

Dirt ranks as the second of the prolific causes of defective castings. From a molding standpoint, the casting may be perfect, yet it is dirty in the rough, or it may display dirt spots in the finishing operations. The number of excuses attributed as the causes for dirty castings is legion, yet only two can be assigned for this defect. Either the iron does not lie quiet in the mold, or against the cores, or dirt has been permitted to enter the mold with the iron, or it was in the mold at the time when the metal was poured. Occasionally the blacking may wash; again the gates will cut, but more often the dirt can be attributed to the same cause as that of the scab or buckle, namely, improper sand, or its improper treatment. A casting will not be clean when the iron does not lie quietly in the mold. The metal may not boil or agitate sufficiently to cause a scab, yet its effect is apparent on the finished casting. If the slag which accumulates on top of the iron is permitted to enter the mold, the casting, of course, will be dirty and this is true also if the gates cut or scab, or if the gates or runners are improperly constructed, or are defective in any way. It is possible to make a perfect mold, yet if the gates are improperly made, the casting will be dirty and will prove defective. Here again the remedy is care and supervision.

Sources of Dirt

An excuse generally offered for defectives is dirty iron. This is the bulwark behind which the molder hides and is the shield which he employs to cover his shortcomings. First of all, it might be well to direct attention to the fact that iron and dirt are enemies and have nothing in common. The dirt referred to is the foreign substance that occurs or forms on the upper side of finished castings. Iron and dirt have no affinity and are of widely different specific gravities. Ninety per cent. of the so-called dirt in castings is composed of silica, alumina and magnesia and none of these is mixed with iron mechanically. They will not remain in solution by any known process, but they may unite to some extent chemically, in this event changing the chemical composition of the iron. This, of course, could be readily determined. However, the natures of these elements are not similar, repelling each other, which is indicated when such substance rises to the surface of the metal in the ladle. Some of the different oxides contain iron, being formed while the iron is in a liquid state and subjected to the action of the oxygen in the air. These oxides also are classed as dirt. However, this dirt, the same as any other refuse that rises to the surface of the metal in the ladle, must be skimmed-off before pouring and does not form a part of the iron. Oxides cannot, form, however, after the casting is poured.

Dirty Iron.

Iron is unlike most of the non-ferrous metals, in that it will form only a comparatively few combinations with the exception of those produced in the blast furnace. It repels all but a few elements that are taken up in almost constant proportions and these only at extreme temperatures. Regardless of the composition or the character of the iron, if it is melted and poured fairly hot, it will be clean. The sulphur may be 0.05 or 0.20 per cent. the manganese may be 0.20 or 2 per cent., the phosphorus may be 0.10 or 1.25 per cent., but none of these varying contents of these elements will make iron dirty in the castings. The iron may be too hard, too soft, too open; it may shrink, crack, draw or warp, but dirt is not its inheritance, nor its progeny.

During the past 25 years, the author has had direct charge of the mixing and melting of more than 500,000 tons of iron, but he has yet to find dirty iron in the sense assigned for it by the molder. Why does a molder make nine castings good and one bad? Why does a molder make a clean record for 30 days and then lose everything he makes? If a molder can produce 20 good castings why is he unable to make 21 or 200? These are the questions put up to the foundryman every day and he has yet to give a convincing answer. First of all, there are no standards or set regulations governing foundry work. The sand may be wet down more one day than another and this makes different the ramming, venting and finishing problem if the castings are to be good. The iron may be colder and duller one day than another, and this would necessitate the use of gates of different size, or different pouring arrangements and the cores may be swelled out of shape, which would require different methods of securing. The flasks may be worn out and finally give way and a hundred other conditions may arise which never are the same on subsequent days.

Inexplicable Foundry Problems

Little has been done in most shops to remove the many causes of defective castings, except in foundries specializing in a particular class of work. No effort has been made to catalog the ills of the foundry and no one has attempted to place the foundry business on a level with the machine shop. If this were done, many and marvelous changes would be made. The patterns, core boxes and flasks would be inspected daily, the sand would be prepared by machinery and the different grades and ingredients would be carefully measured; different rules would be laid down covering the pouring temperature of the metal, as well as the methods of gating. The foundryman would have a voice in the design of the patterns and he also would have the patterns made, not the cheapest way, but the most satisfactory way for foundry use. Every possible pattern would be mounted on a molding machine instead of placing so much dependence upon the skill of the individual operator. Either by lectures, by a school course, or through technical papers, would be imparted to the molders the knowledge gleaned by the employers as the result of the development of the business. Premiums would be paid for high grade service and efficiency.

The foregoing and many more factors would contribute as remedies for defective casting losses. Unfortunately, these needs cost money and the trail has to be blazed; some must be pioneers in elevating foundry practice to a class where definite standards exist and where definite practice will produce definite results.

The Personal Equation

In a large measure the personal equation will have to be limited and particular jobs will have to be so safeguarded that if Tom Jones lays off a day, his substitute won't make 50 per cent. scrap; that if Mike Murphy has been out the night before, he won't spoil his day's work; or, if a molder has sickness at home, he won't forget some minor detail and ruin his casting. More of the responsibility, judgment and skill must be taken away from the individual and the work must be placed upon a higher mechanical basis than it is to-day. Then, only, will the beginning be made for the elimination of defects in castings. An honest comparison of the defective work of the ordinary jobbing foundry with that of the shop equipped for a special line of work, proves conclusively that defectives can be reduced by placing operations on a higher mechanical plane.

Tellurium belongs to the same chemical group as sulphur and selenium, but unlike these two elements, tellurium is a metal, and resembles antimony in a general way. Tellurium fuses at 500 deg. Cent. and when heated above this point it burns with a fine blue flame to tellurium dioxide, at the same time evolving a very peculiar odor. Its combination with hydrogen forms the very poisonous and colorless gas hydrogen telluride.

NEW PROCESS DEVELOPMENTS

Inventive Genius and Research Operate to a Dual End — They Aim to Improve What We Now Possess and Bring to Our Service Commodities Before Unknown

ELECTRIC ARC WELDING*

By Lieut. C. S. McDowell, U.S.N.

WELDING is the joining of two pieces of metal of like or unlike characteristics by fusion, while in the plastic state. The old definition of welding was the process of uniting two pieces of metal by hammering them together while hot enough to be plastic. Modern methods, however, of obtaining high temperatures by means of gases and electricity, has broadened the definition of welding and brought in use additional processes, to which the term "welding" has been applied. It is the purpose in this article to describe only the Electric-Arc Welding process, which it is predicted will rapidly become the standard method of joining sheet metals of all thicknesses, reclaiming castings, repairing broken machinery of all kinds, building up of worn parts, welding seams in new boilers, tanks, etc., making of high-speed tools, repairing boilers, etc., and an arc-welding equipment will be a necessary adjunct to every properly-equipped machine shop.

Conditions for Successful Welding

The essential characteristics of a successful weld are:—That the metal in the welded joint shall be free from impurities, slag and defects of all sorts; that it shall possess a sufficient amount of elongation, flexibility and tensile strength; and that the process of welding shall be such as to reduce to a minimum disturbances in the texture of the surrounding metal. In certain classes of work, flexibility and elongation in the weld is of more importance than tensile strength. The quality of the weld obtained with electric welding is dependent on the following:—

1.—The furnishing of the correct amount of energy at the weld for obtaining of the proper working temperatures of the material to be welded.

2.—The quality of the metal electrodes (the welding wire).

3. The skill of the operator.

The Correct Amount of Energy

The material worked on, the anode, is heated by the impinging of the cathode stream, by the julean heat developed by the ohmic contact resistance and by the radiant heat given off the arc: the metallic pencil or cathode is heated by the julean heat due to its ohmic resistance to current flowing and by the slight contact resistance at the electrode surface. The greater proportion of the heat generated at the arc is at the anode, or material being welded (approximately 75 per cent. of the total heat), when the metallic arc is used. This is quite satisfactory due to the greater means of dissipation at the anode by radiation, convection and conduction.

Practically all the energy supplied to the arc is dissipated as heat, only a slight proportion being given off as light, and to regulate the amount of heat units and thereby the temperature of a particular shape and class of material, it is essential to regulate the amount of energy supplied to the arc as measured in watts. The maximum temperature of steel in the usual converter is approximately 1,800 degrees C., the melting being approximately 1,400 degrees C. The temperature of boiling steel at atmospheric pressure is approximately 2,450 degrees C., while the temperature of the arc stream may greatly exceed this. The result is that in electric-arc welding steel is being worked near a critical temperature.

The material to be welded should be in a plastic state sufficient for the proper intermixing of the metal and obtaining of perfect fusion; if the temperature be too low the added material will not adhere to the original metal and the weld will fall apart at the surface; on the other hand, if too high a temperature is obtained the metal will be burnt and the weld will be greatly weakened by slag thus formed and will be of coarse and irregular structures. The surfaces of the metals to be welded must tend to cohere to a marked extent, and the working temperature must be that at which the foregoing condition is most prominent.

Welding Condition Feature

The best welding condition for iron and steel exists within a limited range of temperature only. The safe working temperature depends somewhat on the material to be welded; an operator quickly obtains the necessary experience to tell if he has the proper temperature. The amount of energy necessary to obtain the proper temperature at the weld depends upon the size and shape of the piece worked on, it being the amount of energy necessary to supply the heat losses and keep the weld constantly at the proper welding temperature. The amount of energy required varies as the whole mass of the article becomes heated, a greater amount being required at first when the mass is cold; for this reason it is important in order to obtain consistent results to have a control of the energy at the operator's end of the line. This control should require very few changes in the supplied energy and is not to overcome the variation of energy due to changes in arc length. The temperature at the weld should remain practically constant; a momentary inrush of current will burn the metal at that point and cause a flaw with the chances of reducing the tensile strength of the weld 50 per cent., or even more.

Electrodes

There are two methods of electric-arc welding: one, the Benardes process, in which a carbon electrode is used; and the other, the Slavinoff process, in which the metallic electrode is used. As a result of the tests which have been conducted, and from the experience of others in electric-arc welding, it is believed that the carbon-electrode process is not suited for general work, some of the reasons being that much greater difficulty is experienced in maintaining the proper temperature, and there are more chances of getting an excess of carbon in the weld.

In the Slavinoff process, which is nearly universally employed at present, it is necessary to have the metal electrodes of such material that the deposited metal in the weld shall have practically the same characteristics as the rest of the metal of the object worked on. As certain of the constituents of the electrode are partially lost in the arc, it is usually necessary to have the electrode contain an excess of certain materials over what is desired in the finished weld. The amount of the loss of these constituents depends upon the temperature, and it is necessary in order to obtain desired and consistent characteristics in the finished weld to have a constant temperature at the weld. The steel companies will guarantee the results with the electrodes which they supply, only if the system of arc welding with which they are used can maintain a constant temperature at the weld.

The Operator

A certain amount of skill and experience is required of the operator, no matter what system of electric welding may be used; but some types of outfits require much more skill and closer attention than others, and it is considered essential that the ideal system should require a minimum of experience and only normal mechanical skill. A system which depends primarily on the skill

*From a paper read before the American Society of Naval Architects.

of the operator cannot turn out consistent work and is not suited to all services.

Fixtures

Certain companies claim that a flux is necessary to obtain good results, but in the tests conducted, all sorts of material and in all positions have been welded, and the best results have been obtained from system in which no flux is used. The claims in favor of the flux are that it blankets the weld by forming a gas around the material which prevents oxygen reaching it and thereby prevents oxidation. This has been proven not necessary, by making similar welds first where oxygen was entirely excluded, and then under normal conditions in the air; there being no difference in strength or structure of the weld.

Another claim is that the flux acts as a scavenger to remove impurities from the weld, but it cannot act in this way unless the metal actually boils, and this is a condition which, as previously shown, should be avoided. There are also certain users who believe a flux necessary for overhead work; but, in tests conducted, as good and consistent welds were obtained when welding overhead without a flux as in any other position. It is considered that in a good electrical welding system a flux is not necessary, and is simply an added expense and complication.

Automatic Control

While it is recognized that it is desirable to have as simple an equipment as possible, it is considered necessary to have an automatic control of the input energy to the weld, the reasons for which have been previously mentioned, so that when the proper amount of energy has been determined for a particular job it will remain constant regardless of the varying of the arc length.

A system with fixed resistances depends entirely on the skill of the operator in maintaining his arc length constant and thereby the energy constant. This system gives good results at times, but our tests showed that even with a skilled operator, furnished by the manufacturer, tensile strengths varying as much as 50 per cent. on the same class of material were obtained. It should be possible for the operator to set the current controlled at the desired amount as well as at the panel board; the controller should automatically keep the current approximately at the fixed value. A variation of less than 5 per cent. can be obtained with a well designed equipment.

Cutting

The electric arc has been found suitable for cutting, but a carbon electrode must be used; no automatic-current control is necessary, although a choke coil is advisable to prevent large inrushes of current. The amount of current varies with the size of the material to cut; from 250 to 400 amperes being required for burning off rivet heads and light section plates, while from 500 to 800 ampères may be required on plates 4 inches thick. This is a momentary load, however, and a 300-ampère continuous-duty machine is considered sufficient. It is necessary to cut away the edges of the cut and remove the burnt metal.

Preparation of Material to be Welded

The material to be welded should be cleaned with a scraper or wire brush to remove oxides and prevent forming of slag, and it is also necessary to bevel the edge sufficiently so that the distance from the electrode to bottom of the weld is less than that of the electrode to any other part of the article, so that the arc will not stray. In thick plates, where possible, and especially in castings, it is usual to weld from both sides, and in this case the original material is pointed by beveling on both sides.

Applications of Arc Welding

During the past year the New York Navy Yard has had contract electric welding done on boilers of various ships. Certain defective castings have been welded, blow holes filled in others, and miscellaneous repair work has been done while the various machines were under test. Additional uses are being developed as the advantages of the method became better known. A large saving in cost over other methods of repair have been made on boiler jobs, in addition to a saving in time, notwithstanding the large profit which the outside contractors have made on the jobs. A specific application of arc welding is in the making of high-speed tools, a piece of the tool being made of ordinary steel while high-speed tool steel is used for the cutting edge only. Some of the various applications are as follows:

Building-up of worn wearing parts, pins, rollers, bearings, etc.; welding of plates in lieu of riveting, or where seams are leaking; building up of rivets; building up of stripped gears; repair of cracked castings; making of high-speed tools; filling blow holes.

In manufacturing work: Welding of heads on tanks; welding of tubes in tube sheets; welding of feet and end frames, etc.

Brass, bronzes, and aluminum as well as steel, cast steel, wrought iron and cast iron can be welded, but none of the demonstrators have been able as yet to get very high tensile strength on naval brass.

Electric-arc welding is considered especially applicable for use on shipboard for emergency repairs of all sorts. In this connection it may be noted that the British cruiser Glasgow put into Rio de Janeiro after the battle off Chile with several holes below or near the water line, and was able, with the arc-welding set which happened to be in Rio de Janeiro, to weld plates over the holes inside of 24 hours and put to sea, taking with her the arc-welding set.

METALS USED IN MAKING SHELLS

THE metals needed to execute the war orders already placed are estimated at over 10 per cent. of the 1914 copper production of the United States, about 7 per cent. of the spelter output and nearly 20 per cent. of the lead production, says the London Iron and Coal Trades Review.

A British 18-pounder, or 3.3-in. shrapnel, requires 5 lb. 9⅛ oz. of brass containing 66 to 70 per cent. copper, or nearly 3¾ lb. A small copper band around the shell adds 4¾ oz., making the total copper 4.04 lb.

Spelter consumption for a shell of this size is about 1.87 lb.

Lead bullets weighing 7.92 lb. and composed of 7 parts lead to 1 part antimony, constitute the metal load of the projectile.

Estimating the total orders for shrapnel and other shells placed in the United States by Europe at 25,000,000 they would call for a total of 101,000,000 lb. of copper, 46,750,000 lb. of spelter and 173,250,000 lb. of lead. Actually the metal consumption is larger, as a fair proportion of the shells are 4.5-in. howitzer shells using more brass; some 6-in., 7½-in., and probably 9-in. shells are also being made.

Rifle cartridges are made of copper mainly, 1 lb. of it being used in making 24 Lebel cartridges, a type widely used by the French army. Every 125 of these take 1 lb. of spelter and a small amount of nickel.

Steel consumption per shell varies widely in different types. A finished 3.3-in. shell contains 6 lb. 15¼ oz. of steel, the shell weighing 6 lb. 5¾ oz, and the diaphragm 9½ oz. If the shell is made from a steel bar, the weight is about 17 lb., while a forging for the same purpose weighs approximately 14½ lb. and a bottle made by the seamless tube process somewhat less.

Value of Mica.—Mica has great physical properties which render it of much value in many industries, including the manufacture of electrical machinery and apparatus. These physical properties are flexibility, elasticity, transparency, cleavage, brilliancy of cleavage faces, and non-conductivity of heat.

NEW AND IMPROVED EQUIPMENT

A Record of Machinery Development Tending Towards Higher Quality, Output and Efficiency in Foundry, Pattern and Metal Work Generally

PNEUMATIC VIBRATOR

AMONG recent products of the Malleable Iron Fittings Company of Branford, Conn., the "Branford" vibrator is prominent. This device is made in all sizes from 3/8 inch to 2 inch. It is an instant starter and possesses the unusual feature of having all parts hardened and ground, which justify claims

"BRANFORD" VIBRATOR

to long life, economy in air consumption, and ample power capacity.

The makers guarantee this apparatus against defective workmanship or material.

SAND MACHINE

FOR castings that must be smooth, perfect, and regular, the preparation of the sand is of great importance. In addition to thoroughly mixing and tempering, the machine shown in Fig. 1 passes the material through a pair of rolls 12 to 18 times, thus pulverizing all small lumps and producing a sand which is smooth, velvety and tough, and possesses an even and regular vent. With the process as used here, one pair of rolls does the work of 12 to 18 pairs as usually set.

The Standard Sand & Machine Company, Cleveland, O., builds these machines in four sizes, equipping them regularly with floor hopper, revolving screen, elevator boot, bucket and chain elevator, and tempering gear. When desired, a three department proportioning hopper is supplied for controlling the amount of old sand, new sand, and dry binder; also a pump for liquid compounds. With the single hopper type, the materials are assembled in proper proportions before delivering to the hopper. With the three or more department hopper, the correct proportions are fed into the elevator boot from each hopper, and it is only necessary to keep the hoppers well supplied. The proportioned materials are delivered to the mixer by means of the bucket and chain elevator, and there the tempering liquids are introduced.

The mixture is carried forward by the worm conveyor to the feed end of the revolving drum which is provided with buckets inside to deliver the sand to the rolls within the drum. The pitch of the drum carries the mixture forward regularly, so that all the sand is treated alike, and is discharged after being thoroughly rolled and blended.

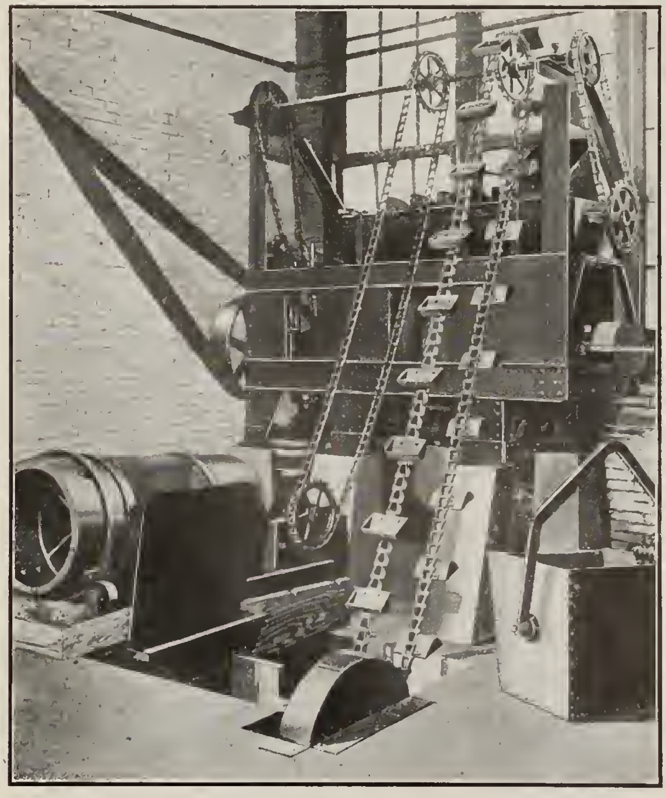

FIG. 1. MIXING, ROLLING AND BONDING MACHINE.

One roll is stationary, while the other is set against heavy compression springs, which are adjustable. Sand rolled in this way is not ground into dust, and retains its grain, thereby helping toward a perfect vent, which is so essential. The machine is modern in every respect, steel gears, bronze bushed bearings, and steel roller bearing chains being used.

The three larger sizes are particularly suited for steel foundries. Fig. 2 shows the arrangement of these, the compression springs back of the adjustable rolls being clearly seen. One pair of rolls arranged in this manner will do the work

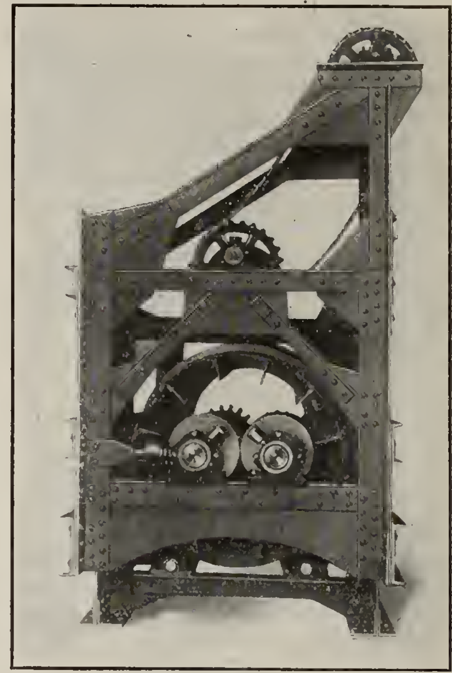

FIG. 2. SPECIAL SAND MACHINE FOR STEEL FOUNDRIES.

of tandem or multiple rolls, as the material can be passed through the same pair 9 to 36 times. These machines are designed to take the place of wet pan mills for core or facing sands.

The No. 1 machine has a capacity of 160 cu. ft. per hour, with 10 horse-power: rolls 8 in. dia. x 4 ft. long. The No. 4 machine has a capacity of 360 cu. ft .per hour, with 20 horse-power; rolls 16 in. dia. x 6 ft. long. Floor space required is 10 ft. x 14 ft. and 15 ft. x 17 ft. respectively.

Straw Wood.—Artificial wood has been made a subject of experiment at Lyons, France, for many years, and as now perfected is claimed to be of great value in place of the natural material, and an aid in conserving the supply of wood. The straw becomes transformed into a substance having the resistance of oak. It is first cut into small pieces, then reduced to a paste by boiling with certain chemicals. The pulpy mass is afterwards pressed into beams, planks, laths, mouldings, and other forms in which wood is used. Tested as fuel, the artificial wood burns with a bright flame and little smoke.

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PRINCIPAL CONTENTS

SCIENCE OR COMMON-SENSE?

THE beginning of the winter session of studies in the many technical schools throughout the country brings into increasing prominence every year, the subject of technical education. It is not very many years since discussions centered on the question, rather than the subject of technical education. People, especially employers, looked askance at the benefits which the rising generation of workers were supposed to be deriving from those institutions, and the practical value of the training, to the employer at any rate, was assessed at what, to the student, was a discouragingly low value.

The recent opening of the new Toronto Central Technical School marks what may well be regarded as a climax in the development of technical education. Quite apart from the magnificence and completeness of the institute as an educational plant, the significance of the event, as marking a further advance toward ultimate national efficiency, should make a deep and lasting impression on those manufacturers whose future prosperity and welfare will be largely dependent on the efficiency of the employees of the next generation.

By a peculiar coincidence, the recent meeting of the British Association for the Advancement of Science took place at Manchester almost simultaneously with the opening of the school in Toronto. As representing what might be turned the extremes of scientific knowledge the two events offer one of those contrasts which are characteristic of an age of advancement.

Knowledge feeds upon itself, and will not be suppressed. Ambition is the fruit of knowledge and a nation with no ambition is destined to ultimately sink into oblivion. Unguided ambition becomes recklessness, and when indulged in on a national scale induces catastrophe.

Professor Arthur Schuster, F.R.S., delivered his presidential address to the British Association on the subject of "The Common Aims of Science and Humanity." Although a man of German extraction, his deservedness of such a high honor was fully recognized by the authorities, and the subject matter of his address discloses a mind bereft of all traces of "kultur" and possessed of that receptive, analytical and constructive ability which is truly characteristic of the British scientist.

If it were possible to speak individually to the many thousands of young minds who at the present moment are digging into the rudiments of science with all the enthusiasm born of youth and novelty, advice for each one could be found in Dr. Schuster's Address.

In discussing the question of scientific success, he quotes a previous president who used these words regarding the qualifications necessary to make a man a great scientist: "But, I hear someone say, these qualities are not the particular attributes of the man of science, they may be recognized as belonging to almost everyone who has commanded or deserved success, whatever may have been his walk in life. That is so. That is exactly what I would desire to insist, that the men of science have no peculiar virtues, no special powers. They are ordinary men, their characters are common, even commonplace. Science, as Huxley said, is organized common-sense, and men of science are common men drilled in the ways of common-sense."

The student who wishes to attain success and all the happiness that accompanies the attainment of objects sought, will find his path smoothed, his interest sustained, and his accomplishments increased just so long as he remembers that his successes must be based on common-sense.

We commend a study of the Address to all thoughtful students at this time, and offer these few lines from it as representing sentiments which are worthy of assiduous cultivation:

. . . "the object of science is to economize thought, just as it is the object of a machine to economize effort. Logically, this definition is justified, and it may be the best that can be given, if we prefer using a technical expression to confessing an emotional feeling. But why should we do so? Is it not better to recognize that human intelligence is affected by sentiment as much as by reasoning? It is a mistake for scientific men to dissociate themselves from the rest of humanity by placing their motives on a different, and at the best only superficially higher level."

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

ESSENTIAL ELEMENTS OF SHERARDIZING*

By S. Trood

BEFORE going into the description of sherardizing, it is well to mention something about zinc.

Zinc is a peculiar metal of pronounced characteristics. It is relatively low in malleability, ductility, tenacity and fusibility when compared with other common metals. Zinc has a melting point of 419 deg. C. and under atmospheric pressure a boiling point of 918 deg. C. While under vacuum, the boiling point is reduced to 548 deg. C. On the basis of silver at 100, zinc has an electrical conductivity of 29, a heat conductivity of 36, and is practically non-corrosive in the atmosphere, a thin protecting coating of carbonate of zinc forming upon it. Zinc is one of the highest electropositive metals, having a potential of plus 0.493 volts.

Although many of the common metals date their discovery to prehistoric times, yet zinc was unknown as a metal until discovered by Paracelus in 1520. Previous to this, however, the action of zinc ores upon copper under action of heat was well known. Henchel in 1271 published an account of his discovery that metals when heated in calamine changed their properties, and in 1740, John Champion, of Bristol, England, obtained a patent for the process. Two of the processes of smelting zinc to-day date back to 1805 for the Belgian process and 1897 for the Sicilian process. In the United States, the Government was the first to use zinc, making the standard of weight and measure from brass.

It has only been within the last century that zinc has been used commercially as a protection against corrosion, and as a proof that the tendency of using zinc is toward the conservation of natural resources, it will be seen that by comparing the production of zinc and steel for the last four decades, the large increase in each has been running parallel for the corresponding years.

Process Features

In general, the process of sherardizing consists in treating in zinc dust, articles which it is desired to rust-proof. The zinc dust consists mainly of finely powdered metallic zinc with zinc oxide. After packing in a suitable container, the whole is heated for a certain period of time, cooled and articles then removed from the zinc dust. From everyday practice, we note that if we desire uniform results in a manufacturing proposition, we must have uniformly arranged details. So far as the sherardizing is concerned, the uniformity of each step in the process is very vital and necessary for success. In trying to explain what happens in the drum, the necessity of uniformity will explain itself.

Zinc dust is in a very finely divided state, and each particle covered with zinc oxide. In this condition, zinc could be heated above the melting point without fear of liquefying the mass, and because the zinc oxide is quite high fire-resisting material of inert nature, it prevents small particles of heated zinc uniting together and creating a solid liquid mass. It is also a well-established fact that under these conditions solid matter can be made to sublime; in other words, a solid can be brought to a vapor, overstepping the liquid form.

According to authorities, vapor tension for a small particle is greater than vapor tension for a big body, due to the difference in the ratio between surface and volume. Armstrong, Thompson, and other scientists have shown that a gas emanated from a solid has an electrical charge. From this, it follows that the microscopically small atmospheres of zinc vapor surrounding these dust particles are charged electrically, and due to their minute size, they may be considered to have all the properties of ions. Iron being heated, also emanates gases which produce ionic charges. Iron and zinc have different electrical potentials, and, therefore, the ionic charges of zinc and iron vapors will have a different potential. If this is a fact, then discharges must occur. Ionic discharges precipitate solids from gases, and in our case zinc and traces of iron would be precipitated.

Atmospheric Effect

Assuming once more that the theory is correct, the atmospheric pressure will have considerable effect on the process, as the vapor tension of gases will vary with the pressure, and the gases will be more readily emanated in vacuum. If we make use of a considerable vacuum, for instance, 28 ins. of mercury, the ionic discharge would be very effective. To prove this, I created a vacuum in a small sherardizing drum. In this case, the precipitation of zinc and iron took place at a much lower temperature and in considerably shorter time. Results were produced in ten minutes in a vacuum, which would require six hours at the same temperature, but under atmospheric pressure.

It is a well known fact that the electric potential is higher for pure gas than for a mixture of gases. Therefore it is quite advantageous to have pure zinc dust and the iron in as pure a state as possible. As before stated, zinc is one of the metals which has the lowest difference in temperature between melting and boiling point, and this difference is quite low under vacuum. This is another proof that, with pure zinc dust under vacuum, the vapors will be created much more readily, ionically charged and precipitate the solids upon the surface.

Zinc Dust and Heat Factors

From the above, we can draw the conclusion that uniformity of zinc dust is a very important factor. Uniformity of heat, however, is of just the same importance, since the higher the temperature, the greater is the emanation of gases and, therefore, precipitation of solids. This may be seen on sherardized metal in the typical "color lines."

With every increase of temperature, with all conditions the same, the precipitation of solids increases and creates a deposit of a different character, and the same is true with a decrease in temperature, which retards the process and creates a less dense coating. These differences, which produce the stratified appearance or lines of color, are quite distinct under a microscope and may explain the very fine microscopic checks. That the quality of iron to be sherardized has a similar effect on the process can also be readily understood, as emanation of gases from iron depends greatly upon its composition. Particles imbedded or stuck on the surface may also change the potential.

The last great factor in the process

*From a paper read at the American Institute of Metals Convention, held in Atlantic City, N.J.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.

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PLACE AND DATES OF MEETING.

The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

is time. It is self-evident that the effect of precipitation will continue so long as the conditions are favorable to create the effect. To repeat:—1st, composition and quality of the surface of the iron; 2nd, composition and uniformity of zinc dust; 3rd, proper uniform temperature; 4th, time, are the most essential factors in the process of sherardizing. The practical side of sherardizing depends solely upon the four factors just mentioned. Sherardizing is mostly applied to steel and iron in all its forms. Articles which could not be heated, should not be sherardized. All material should be examined and rejected if it is scaly, covered with silica or any other impurities.

Preparing Surfaces for Sherardizing

The best method of removing the impurities—in other words, preparing the surfaces to be sherardized—is shot air blasting. This method is fundamentally the best, because in sand blasting particles of sand or silica penetrate the pores of the iron and are very disadvantageous. Pickling requires great skill and must be done very carefully, as very often sulphates or phosphates are created on the surface, and if washed in alkalies, very often go into colloidal state. In other words, they become insoluble and very hard to remove. Another disadvantage of pickling is that the traces of salts, alkalies or acids when heated, may produce a retarding result so far as the ionic charges are concerned.

There are different zinc dusts on the market and those coming within the following limits would be the most advantageous:

Zinc between 85% and 90%.

Zinc oxide between 8% and 10%.

Lead between 1% and 1.5%.

Other impurities between .5% and 1%.

The three most important elements to be kept near the above percentages are:

Zinc which ought not to be below 85%.

Zinc oxide which ought not to be below 8%.

Lead which ought to be kept down to about 1.25%.

Although good sherardizing may be obtained if some variations from the above exist, the best results will be obtained if the percentages are kept within these limits. Lead must be kept down to the least practical amount, as experiments have shown that, when its percentage runs too high, lumpy deposits will appear on the sherardized plain surface and will also clog threads.

Free iron must be separated from the zinc dust as much as practice will allow, and in a well-established plant it is being done at least once in four weeks. This will remove surplus small particles of iron, which are liable to become lodged between the jaws or cotter pins, etc., and thus cause trouble in assembly. By cleaning the dust this way, the mechanical incorporation of small percentages of iron dust in the coating is also prevented. The weekly analysis of the working dust should show the iron content.

It was mentioned above that the size of particle has an effect on a vapor tension. Therefore, zinc dust must be kept uniform in size. When the zinc becomes caked or lumpy, it should be run through a tumbling barrel and sifted through at least 80-mesh screen. To keep practically the same metallic content, it is necessary to add to every charge, between 8% to 10% of virgin zinc dust. Weekly analysis of zinc dust should be made and the samples taken from the working zinc dust which has been sifted and well mixed together in one or several sherardizing drums.

In the question of temperature, it should be understood that there is practically no limitation. If a very long time for the process is allowed, low temperature could be used, but this is not practical and, therefore, a higher temperature will have to be reached. Also, the drums or containers are of metal and a working temperature must be of such a degree as not to destroy the working of the apparatus. In one case the temperature would be quite high and in another case it would be quite low.

Apparatus Feature

Any practical apparatus which would keep a uniform temperature throughout, would be advantageous, and, in this respect, the electrically heated drum would be the more suitable, as here the control of the heat as to uniformity, time and degree is ideal, and when electrical apparatus is used, 350 to 375° C. would be the most suitable temperature, as within this range a very practical and serviceable apparatus can be designed. There are some successful installations where gas as a means of heat is employed, and here the drums are passing through a continuous tunnel oven going gradually from the cold to the hottest zone and then to the cold.

The size of the container and construction have very much to do with uniformity of heat, as, if the dimensions are large, longer time is required to heat the apparatus. Zinc dust is a very poor conductor of heat and articles hardly touching each other do not offer a good path for heat.

Continuous rotation of the drums eliminates to a certain extent those disadvantages, since it produces a uniform mixing of the contents of the drum and allows the more heated particles on the outside to convect the heat to the centre. Packing the drum too tight will prevent a free flow of dust and heat, and consequently different temperature zones will occur with resulting different degrees of deposit.

Thickness of Deposit

After deposit of zinc begins, with all other factors well established, the thickness of the deposit depends solely upon the time. All other factors being constant, a good coating depends upon time, and if the process is continued too long, a brittle and easily chipped coating will result. This is due to the wide difference in co-efficient of expansion and contraction between the zinc and iron, which have co-efficients of .00002532 and .00001166 per degree centigrade, respectively.

The coating which is being deposited when the temperature is going up is the most dense and durable; next in quality will be the coating of the uniform temperature period and the least when the temperature is going down. If small articles are treated where sharp profiles and threads are present, the time element is most vital. It is very hard to establish any certainty in the time element, but in every case it has to be established in accordance with other factors.

The relation of these vital factors to the process of sherardizing is such that each one is dependent on the other, with the result that the variation of the one will require a variation of the others. Therefore, in order to simplify the process and make it practical on a manufacturing basis, it is found that uniformity is the essential element. This is practically all that need be said on sherardizing, although much could be written on sherardizing for special conditions.

I have come in contact with practically every large sherardizing plant in the United States, and, with very few exceptions, they still have some trouble with the process. After analyzing the troubles, I found that the uniformity and relation of these factors was not properly maintained.

I know at least one concern which—by using shot air blasting; very uniform and high metallic content zinc dust, which is periodically cleaned and magnetically separated and sifted; which uses electrically heated drums of proper design, giving a controllable uniform temperature—obtain very desirable results on sherardizing. The purpose of this paper, however, is not to describe the everyday methods of sherardizing, but to point out the essential elements of the process.

The next step in sherardizing will be a continuous method in vacuum, for by this method, the narrow margins of the atmospheric pressure process will be broadened and more uniform results with less effort will be obtained.

ELECTRO-PLATING WITH COBALT

THE results of recent tests in electroplating with cobalt are summarized as follows:—Cobalt plating has a beautiful bluish-white color. The deposit does not tarnish as readily as nickel; it is homogeneous, with a fine, close grain; it is smooth and not brittle, and will easily withstand bending tests. The time required in order to secure a satisfactory deposit is much less with cobalt than with nickel. Metallic cobalt costs more than nickel, but the cost of the salts is of small importance in a comparison of the two as to economy in results.

Because of the greater conductivity of cobalt as compared with nickel, a current of higher density may be used in combination with a solution of less concentration. The time required in the solution with cobalt is one-third that required for nickel, and there is a similar saving of time in the buffing-room.

PLATING BY IMPACT

A PROCESS of plating by impact has been in course of development by C. F. Jenkins ,of Washington, D.C., says the Journal of the Franklin Institute. This process can best be understood if it is remembered that, when an electric lamp bulb gives way, a discoloration of the inside of the bulb occurs, and also that when a fuse plug "blows" the mica cover is discolored. This color is black when the fuse is of lead, but it is a reddish color when a piece of copper wire is used.

This would seem to indicate some kind of deposit resulting from the blowing of the fuse, that it is not completely volatilized. Under a magnification of 300 diameters or more, minute particles of the copper wire are discovered adhering to the cover of the fuse plug, and, when a common visiting card is used for a cover instead of the mica, a decided deposit is attained. Repeated charges of such a fuse result in a complete coating of the card. When this surface is burnished with some smooth, hard object, a shiny polished metal surface results.

A fuse used in this manner is, in effect, a gun which throws out a shower of miniature shot so small as to be invisible to the naked eye, and this would operate successfully for covering almost any surface but for the annoyance of the frequent replacements with short pieces of copper wire. This led naturally to the development of a special "gun," into the barrel of which a copper wire is continuously fed. A pair of small rollers actuated by a motor pulls the wire off the supply spool and projects it across the barrel until the end touches the opposite surface. The inner lining of the barrel and the propelling rollers form a short circuit. The wire is immediately melted, and the heat causes it to be thrown out of the barrel against any object held in position for that purpose.

When a plurality of wires or a flat ribbon is used in order to cover a larger area in a given time, it is found desirable to add a propelling force, and this is done by introducing into the barrel behind the wire a small charge of explosive gas. The melting of the wire explodes the charge which projects the miniature metallic particles that are momentarily suspended in the gas against the object to be coated. It has been found that objects in great variety can be coated in this manner, and that any electrically conductive material can be used for the purpose.

Questions and Answers

Question.—We manufacture a novelty made of lead and antimony, and have trouble in copper plating the article. The deposit is not adherent, blisters form and the cost of re-finishing is greater than cost of the piece finished. We would appreciate some information regarding plating the alloy.

Answer.—When plating antimonial-lead use a cyanide copper solution, not very rich in metal, and particularly weak in cyanide. Very little, if any, free cyanide is recommended and a weak current is necessary. Use the solution at a temperature in the neighborhood of 120 degrees Fahr. The deposit must not be forced and very heavy coatings are not usually required.

Question—We recently learned that one competitive firm clean and plate their steel parts in the copper solutions with one operation. The parts are necessarily very oily when delivered to the plater and while the practice of cleaning in a cyanide copper solution may be practicable we are doubtful in regard to its commercial utility.

Answer.—The practice of combining the electro cleaning of steel parts with the copper plating is one quite prevalent among manufacturers in the United States, and is occasionally employed in Canada. When the operation is guarded by a watchful operator and the essential details of the bath carefully regulated, the process is capable of producing very satisfactory results, as is proven by some of the products of firms where the method is in practice.

Ordinarily the method is a failure. If the goods are polished and reach the plater coated with thick patches of emery paste, the copper-cleaning process is a decided failure, but, if the parts are free from polishing paste and are covered with oil of a vegetable or animal nature, the process is less difficult to use. Usually only a thin coating of copper is obtained and subsequent nickel deposit is also thin and soft. Hard heavy deposits which would increase the strain between the metals are to be avoided. The idea is not new, similar methods have been used in silver plating for many years. Caustic soda and cyanide form the bulk of the solution, only enough metallic salt being used to produce a very slow deposit, the principle of cleaning is identical with that of the ordinary electro-cleaning process.

Question.—I wish to obtain a formula for a tin plating solution which will produce a thick deposit which is not spongy. All tin solutions I have tried are practically the same in this respect, and therefore are of little value for high grade products.

Answer.—In one gallon of water dissolve 1 pound of caustic soda, then add 4 oz. of tin chloride. When the solution is clear, add 8 oz. of hypo-sulphite of soda and stir well. Use the solution hot for best results, but it will deposit while cold. Current densities ordinarily used on tin baths may easily be exceeded without danger of spongy deposits.

Question.—Is tin used in plating baths for bronze deposits? We have failed to find a formula specifying tin but naturally suppose it is required.

Answer—Ordinary bronze plating solutions contain copper and zinc. Tin is seldom used, and only for special work produced according to specifications, or contract. The copper-zinc solution is easier to manage, cheaper to maintain, and equally as good for all practical purposes. The usual proportions are about 9 per cent. copper and 1 per cent. zinc for steel or iron hardware.

Question.—Our product is of cast iron, we finish it in nickel, copper and brass. Preparatory to plating it is pickled in vitriol and then polished, the usual cleaning by boiling and scouring follows. Seventy-five per cent. of the pieces are often rebuffed to remove a stain or spot which forms after placing the product in stock. This is very expensive, and we would like to know if some method could be used to avoid the trouble.

Answer.—Your difficulty is encouraged by the pickling operation. Sand blast the part instead and less trouble will result. If the brass or copper plated articles continue to spot out use extra care in the rinsing and drying after plating and go over the entire surface rapidly with a strong blast of compressed air. This treatment will expel the chemical which is causing the stain and further treatment will be unnecessary.

MADE IN CANADA

Foundry Supplies and Equipment

When the wayfaring man thinks about a foundry, his mind goes out to belching flame and darkening clouds of smoke and steam, fiery furnaces and molten metals. That is the generally accepted summary of the man who gazes from the corridor of a passing railway train, upon this grim and grimy atmosphere of passing light and shadow.

The foundry business is, however, a highly organized affair, and we claim a fair share of its varied equipment. Take our FOUNDRY NECESSITIES, and the place they fill in the modern foundry. Without LADLES, FIRE BRICK, and CLAY, CORE COMPOUND, PLUMBAGO, CORE WASH, CHARCOAL, PARTINE, and other foundry requisites, foundries would come to a dead stop.

Since you need all these things, get the best. It is our guarantee NOW that the quality we supply can't be surpassed anywhere and there are other essentials to complete the transaction, such as delivery, and shipping facilities that we meet better than most others.

Place a trial order with us now and let the goods speak for themselves.

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THE HAMILTON FACING MILL COMPANY, LIMITED

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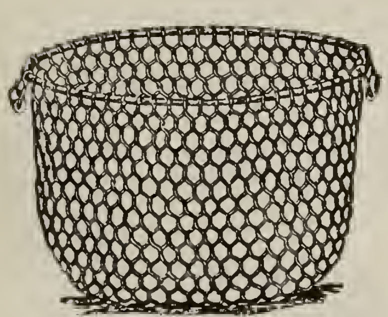
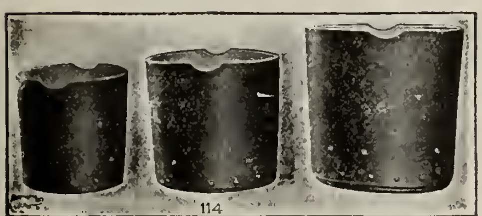


Coke or Charcoal Baskets—Made of galvanized steel wire.

Bench Rammers—Made from Maple Hardwood well oiled.



Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products

PIG IRON.

Grey Forge, Pittsburg		$14 70
Lake Superior, charcoal, Chicago		15 75
Ferro Nickel pig iron (Soo)		25 00
	Montreal.	Toronto.
Middleboro, No. 3	$22 00	.....
Carron, special	23 00	.....
Carron soft	23 00	.....
Cleveland, No. 3	22 00	.....
Clarence, No. 3	22 50	.....
Glenarnock	26 00	.....
Summerlee, No. 1	28 00	.....
Summerlee, No. 3	27 00	.....
Michigan charcoal iron	26 00	.....
Victoria, No. 1	23 00	20 15
Victoria, No. 2X	22 00	20 50
Victoria, No. 2 plain	22 00	20 50
Hamilton, No. 1	22 00	20 50
Hamilton, No. 2	22 00	20 50

METALS.

Aluminum	$ .60
Antimony	.38
Cobalt 97% pure	1.50
Copper, lake	19½
Copper, electrolytic	.19¼
Copper, casting	.19
Lead	.06¼
Mercury	100.00
Nickel	50.00
Silver	.48
Tin	.37
Zinc	.17

Prices Per Lb.

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$12 25	$12 00
Copper, crucible	14 25	13 50
Copper, unch-bled, heavy	14 25	13 25
Copper, wire, unch-bled	14 25	13 75
No. 1 machine, compos'n	11 50	11 50
No. 1 compos'n turnings	10 00	9 50
No. 1 wrought iron	10 00	9 50
Heavy melting steel	8 00	8 00
No. 1 machin'y cast iron	13 50	11 00
New brass clippings	11 00	11 00
No. 1 brass turnings	9 00	9 00
Heavy lead	4 50	4 50
Tea lead	3 50	3 50
Scrap zinc	10 50	9 50

COKE AND COAL.

Solvay foundry coke	$5.75
Connellsville foundry coke	5.00
Yough steam lump coal	3.83
Penn. steam lump coal	3.63
Best slack	2.99

net ton f.o.b. Toronto.

BILLETS.

	Per Gross Ton
Bessemer, billets, Pittsburg	$ 24 50
Open-hearth billets, Pittsburgh	25 00
Forging billets, Pittsburgh	34 00
Wire rods, Pittsburgh	31 00

PROOF COIL CHAIN.

¼ inch	$8.00
5-16 inch	5.35
⅜ inch	4.60
7-16 inch	4.30
½ inch	4.05
9-16 inch	4.05
⅝ inch	3.90
¾ inch	3.85
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

MISCELLANEOUS.

Solder, half-and-half	$0.22½
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs, p. cwt.	9.65
Glue, French medal, per lb.	0.18
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.18
Benzine, single bbls., per gal.	0.18
Pure turpentine, single bbls.	0.65
Linseed oil, raw, single bbls.	0.74
Linseed oil, boiled, single bbls.	0.77
Plaster of Paris, per bbl.	2.50
Plumbers' oakum, per 100 lbs.	4.00
Lead wool, per lb.	0.10
Pure Manila rope	0.16
Transmission rope, Manila	0.20
Drilling cables, Manila	0.17
Lard oil, per gal.	0.73

SHEETS.

	Montreal.	Toronto.
Sheets, black, No. 28	$3 00	$2 85
Canada plates, dull, 52 sheets	3 15	3 15
Canada plates, all bright	4 75	4 50
Apollo brand, 10¾ oz. (galvanized)	5 75	5 30
Queen's Head, 28 B.W.G.	6 00	5 95
Fleur-de-Lis, 28 B.W.G.	5 75	5 75
Gorbal's best, No. 28	6 00	6 00
Viking metal, No. 28	5 25	5 25
Colborne Crown, No. 28	5 70	5 80
Premier, No. 28 B.G.	5 10	5 00

IRON PIPE FITTINGS.

Canadian malleable, A, 25 per cent.; B and C, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped union, 65.

ELECTRIC WELD COIL CHAIN B.B.

3-16 in.	$9.00
¼ in.	6.25
5-16 in.	4.65
⅜ in.	4.00
7-16 in.	4.00
½ in.	4.00

Prices per 100 lbs.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium, carbonate	.15
Ammonium, chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cobalt Sulphate	.50
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.15
Potassium carbonate	.40
Potassium sulphide substitute	.20
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide, 129-130 per cent.	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.08

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper, 22-25	.22 to .25
Tin	.45 to .50
Silver	.55 to .60
Zinc	.22 to .25

Prices Per Lb.

PLATING SUPPLIES.

Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck.	.80
Emery in kegs	.4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

Prices Per Lb.

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Toronto, Ont., Oct. 19.—Indications point to a return of better trade conditions and a distinctly optimistic tone exists in business circles. The record harvest means prosperity in the West; war orders are keeping many factories fully employed, the adverse trade balance has been eliminated and railroad earnings now show an increase. The steel trade is generally considered to be the barometer of industrial conditions, and in its present state of great activity gives reasonable grounds for hoping that the improvement in business now taking place is something more than temporary. The influx of large sums of money resulting from war orders cannot help but stimulate manufacturing, and with the improvement in Canadian fiscal conditions will lead to a marked industrial development in the country.

The placing of orders for larger shells which is anticipated, and the repeat orders for 18-pdr. shells in considerable quantity indicates that the steel companies will be very busy for some time to come. It is understood that the Dominion Steel Corporation have decided to embark on the manufacture of shells and that a large order will be placed with them for those of large calibre. This concern has for some time been actively engaged in producing steel for shells but not turning out the complete product.

The galvanized sheet trade is somewhat unsettled. Although the price of spelter has declined, manufacturers of sheets are hesitating before making any further change since the revision announced recently.

Pig Iron

The chief interest in the market is in steel making grades, with low-phosphorous iron still the feature. Canadian buyers have taken considerable tonnage from the States. Among these is the Canadian Steel Foundries, who have bought 7,000 tons recently and have inquired for 5.000 tons additional, the price being $25 at the furnaces. Foundry grades are quiet at unchanged prices.

Metal Market

The metal market is dull and there is little of interest to note. Tin and spelter are lower, but aluminum has advanced. The copper market is steady as a result of good demand for war munitions which shows no signs of abatement. The lead market is unchanged, but the position of this metal is a good one. There is still some scarcity in supplies of antimony, but the demand has not improved and quotations are stationary. Prices of solders are unchanged, but have a weak tendency due to tin having declined. There is no change locally in the general situation. The general trend of business continues the same, metal for munitions constituting the principal demand.

Tin.—The market is quiet and lower, and comparatively little interest is being shown by consumers. The one influence dominating the tin market in New York is the expectation that the British Government will impose a 10 per cent. tax on its importation; there is as yet no official confirmation of any such intention. No large business is looked for until that question is settled, as consumers are content to wait. Tin has declined 1c locally and is quoted at 37c per pound.

Copper.—The market is very dull, but prices are holding firm. Buyers have fair stocks on hand, but are reaching a point where they will have to take on additional supplies. Producers are well stocked up, but are not inclined to offer any price concessions. Quotations are steady and unchanged at 19½c per pound.

Spelter.—The market for spot is weaker owing to the absence of interest on the part of consumers. Another influence lending weakness was a decline in the London market. Spelter has declined 1c locally, and is quoted at 17c per pound.

Lead.—The market is quiet and unchanged. It is reported that Canadian consumers have closed contracts for some good amounts of lead in addition to those recently placed. Quotations are firm at 6¼c per pound.

Antimony.—There is no change in the situation and the demand does not show much improvement. Quotations are unchanged at 35c per pound.

Aluminum.—Supplies are diminishing and the demand is increasing heavily, due to war orders. Quotations have reached a record level and are nominal at 60c per pound.

Plating Supplies

The situation with regard to plating materials shows no improvement and the scarcity of certain chemicals is being severely felt in the trade. Some lines have practically disappeared from the market, and a great effort is being made to find satisfactory substitutes. A case in point is potassium sulphide, which is practically unobtainable, but a substitute has been found at a considerably reduced price. Generally speaking, prices of chemicals are holding firm, except nickel sulphate, which is weaker, and is now quoted at 15c per pound.

The Canadian Furnace Co. report good business. They are shipping about 700 tons of pig iron every day.

Welland, Ont.—It is reported that preparations are being made to reopen the plant of the Canadian Steel Foundries.

Charles Stewart, one of the senior partners of Burrow, Stewart & Milne, founders, died at his home in Hamilton, Ont., on Oct. 8, at the age of 78.

Charles Partridge, at one time one of the proprietors of the North Sidney Foundry, North Sidney, C.B., died on Sept. 14, aged 74.

Bathurst, N.B.—It is announced that a brass and iron foundry will be established here. Messrs. Frank and Percy McCallum, formerly of Chatham, are at the head of it.

Lieut.Col. Frederic Nicholls has been appointed acting president of the Dominion Steel Corporation on account of the continued indisposition of the president, J. H. Plummer.

G. T. Hollaway, chairman of the Ontario Nickel Commission, has been making personal inspection of refining plants in Ontario. He was at Orillia and Welland recently.

The Dominion Brake Shoe & Foundry Co. has been incorporated at Ottawa, with a capital of $200,000, to manufacture all kinds of brake shoes at St. Thomas, Ont. Incorporators, James Stellar Lovell and William Bain, of Toronto, Ont.

The Electric Zinc Co., Ltd., has been incorporated at Ottawa with a capital of $24,000 to operate zinc smelters and refineries at Sherbrooke, Que. Incorporators: Leland Drew Adams and Charles Herbert May, of Oakland, Cal., and John P. Wells, of Sherbrooke, Que.

W. F. Angus, vice-president and managing director of Canadian Steel Foundries, has been appointed a director of the parent company, Canadian Car & Foundry, Montreal, to fill the vacancy caused by the death of M. E. Duncan. He has also been added to the executive.

Dominion Steel Foundry Co.—An addition, 100 x 160 feet, to the main foundry building of the Dominion Steel Foundry Co., Hamilton, Ont., is nearing completion. The company has installed in this addition one 25-ton acid open-hearth furnace and one 30-ton Shaw electric 4-motor crane. The company has also installed a complete outfit for machining 3-inch British shrapnel shells and machinery for finishing 4.5 howitzer shells.

The Sorel Steel Foundries Co., Ltd., has been incorporated at Ottawa with a capital of $100,000 to acquire and take over as a going concern the business now carried on at Sorel, Que., by Beauchemin & Fils, Ltd. Incorporators: Louis Phillippe Tremblay and Napoleon Latraverse of Sorel, Que.

Catalogues

The Westinghouse Electric & Manufacturing Co., Pittsburgh, Pa., has recently issued Leaflets 3,805, 3,806, and 3,807 on the application of automatic control apparatus to cranes and steel mills. They show the scheme of main connections and describe the method of operation of the magnetic unit switches, as arranged for the severe service of steel mill practice.

"Foundry Filosofy" is the title of a booklet published by the Hill & Griffith Co., Cincinnati, Ohio, manufacturers of foundry facings, supplies and equipment. The booklet is a combination of "Filosofy" for foundrymen and a brief description of the company's products. Polishing and plating supplies are included among the latter.

Furnaces.—The Monarch Engineering & Mfg. Co., Baltimore, Md., have issued a series of bulletins illustrating and describing some of their products, which include portable "Simplex" melting furnaces, tool room furnaces, core ovens, oil burners, etc. Full particulars are given of each type of equipment, and tables give the principal dimensions and capacities, etc., for each size. The bulletins are fully illustrated.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS--Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

Air Compressors.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Ajax Metal Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Babbitt Metal
Ajax Metal Co., Philadelphia, Pa.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Barrows, Foundry
Sterling Wheelbarrow Co., Milwaukee, Wis.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Boxes, Tote
Sterling Wheelbarrow Co., Milwaukee, Wis.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buckets, Grab
Pawling & Harnischfeger Co., Milwaukee, Wis.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Frederic B. Stevens, Detroit.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Panghorn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Millen & Son, Ltd., Montreal.

Chaplets.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Wells Pattern & Machine Works Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chemicals.
W. W. Wells, Toronto.

Chippers, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Clamps, Core Box
National Clamp Co., Chicago, Ill.

Clamps, Flask
National Clamp Co., Chicago, Ill.

Copper, Phosphorized
Ajax Metal Co., Philadelphia, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Holland Core Oil Co., Chicago, Ill.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes
Pawling & Harnischfeger Co., Milwaukee, Wis.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Panghorn Corporation, Hagerstown, Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Northern Crane Works, Walkerville, Ont.
Osborn Mfg. Co., Cleveland, O.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Grinders, Disc, Bench, Swing.
Ford-Smith Machine Co., Hamilton Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.
Geometric Tool Co., New Haven, Conn.

Grinders, Electric
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Pneumatic, Portable.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Hammers, Chipping
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Helmets.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Pawling & Harnischfeger Co., Milwaukee, Wis.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Melting Pots.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B. Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.
Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works.

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rosin.
Webster & Sons, Ltd., Montreal.

Rouge.
W. W. Wells, Toronto.

Sand Blast Machinery.
Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Conveying Machinery
Standard Sand & Mach. Co., Cleveland, O.

Sand Mixing Machinery
Standard Sand & Mach. Co., Cleveland, O.
Vulcan Engineering Sales Co., Chicago, Ill.

Sand Molding.
H. S. Carter & Co., Toronto.
Hamilton Facing Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Standard Sand & Mach. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.
Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.
Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.
Pangborn Corporation, Hagerstown, Md.

Sieves.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Silica Wash.
Webster & Sons, Ltd., Montreal.

Small Angles.
Dom. Iron & Steel Co., Sydney, N.S.

Soapstone.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Special Machinery.
Osborn Mfg. Co., Cleveland, O.
Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
Vulcan Engineering Sales Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.

Squeezer Molding Machines
Mumford Molding Machine Co., Chicago, Ill.

Squeezers, Power.
Davenport Machine & Foundry Co., Iowa.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.

Steel Rails.
Dom. Iron & Steel Co., Sydney, N.S.

Steel Bars, all kinds.
Dom. Iron & Steel Co., Sydney, N.S.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Talc.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. J. Woodison Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.

Taps.
Geometric Tool Co., New Haven, Conn.

Teeming Crucibles and Funnels.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.
Geometric Tool Co., New Haven, Conn.

Tools, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Track, Overhead.
Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tripoli.
W. W. Wells, Toronto.

Trolleys and Trolley Systems.
Can. Fairbanks-Morse Co., Montreal.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Trucks
Sterling Wheelbarrow Co., Milwaukee, Wis.

Trucks, Dryer and Factory.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Tumblers.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.

Turntables.
H. S. Carter & Co., Toronto.
Northern Crane Works, Walkerville.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Vent Wax.
H. S. Carter & Co., Toronto.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Vibrators.
Berkshire Mfg. Co., Cleveland, O.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.

Wall Channels.
Dom. Iron & Steel Co., Sydney, N.S.

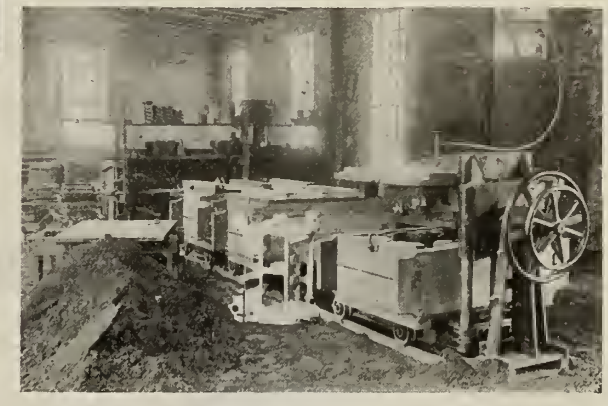
Wedges, Foundry
Sterling Wheelbarrow Co., Milwaukee, Wis.

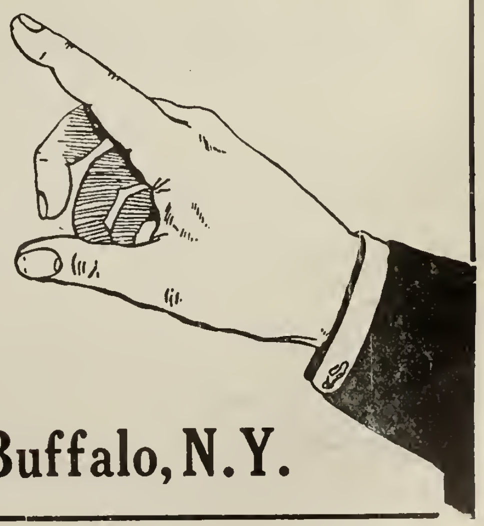
Welding and Cutting.
Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.
Canadian Hart Wheels.
Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Wire Wheels.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
W. W. Wells, Toronto.

Wire, Wire Rods and Nails.
Dom. Iron & Steel Co., Sydney, N.S.
Osborn Mfg. Co., Cleveland, O.



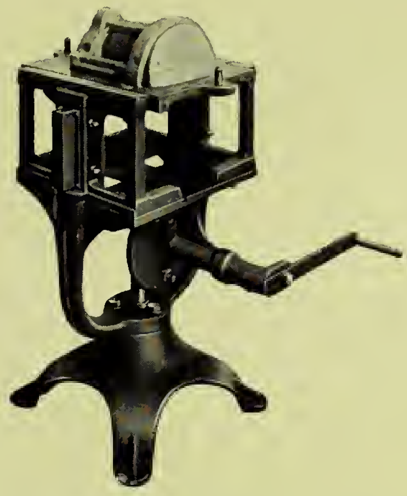


ADVERTISING INDEX

OSBORN

A Versatile, Speedy Pair

TWO of the most popular hand-operated machines of the Osborn line are shown below. Ask us for full information about either—or both—and what they are accomplishing in other foundries.



THIS is the Osborn Adjustable Drop-Plate Flask-Stripping Moulding Machine (No. 150). In many cases on record it has increased production 100% or more.

It is also an extremely accurate stripping-plate machine, but often saves the expense of stripping plates because the pattern can be mounted on a plate which strips directly from the flask.

It has a large usefulness on many classes of difficult work—such as automobile cylinders, crank-cases and pistons, fly-wheels, steering-gear cases, bushings, axles, caps, electric motor boxes.

Operation is very simple. A crank raises and lowers the pattern plate carrier between the sides of the frame; there are no links or other devices leading to lost motion. A half-turn gives maximum pattern-draw of 6 inches.

Sides are movable, making each size of the machine adjustable to 32 standard flask sizes. It is very accurate, very strong and very durable.

There are five sizes. No. 150 takes flasks from 9 x 10" to 12 x 26". We can furnish Round Stripping Plate Machines of corresponding diameters.

THIS machine is a combination of a powerful squeezer machine with the Adjustable Drop-Plate Flask-Stripper, and thus gives the user practically the advantages of three machines in one—drop-plate, stripping plate, and squeezer.

One machine in cost, maintenance and floor-space; three machines in usefulness on jobs of widely different character.

It can be kept busy without intermission, and there are no difficult adjustments, complicated pattern-drawing equipment or other causes of delay in changing from one job to another.

Being larger and more powerful than other hand squeezer types, it handles work that would otherwise have to be rammed up by the usual slower methods—and gives the added advantage of an accurate draw of the pattern.

The wheel-base makes it more valuable under average conditions, but it can be furnished either way.

You ought to have information about the complete Osborn line of molding machines. Write us, telling us something of your work; perhaps our Engineering Department can make suggestions that will help you to more profits. You incur no obligation by asking us.

THE OSBORN MANUFACTURING COMPANY

MOLDING MACHINES AND ACCESSORIES, FOUNDRY SUPPLIES

CLEVELAND	MILWAUKEE	SAN FRANCISCO	NEW YORK
5401 Hamilton Avenue	S. Water and Ferry Sts.	61 First Street	395 Broadway

Meritorious

Foundry Equipment and Supplies

and a distinctive kind of service

Our foundry and furnace equipment is made to fill the requirements of the largest and most progressive foundries, and its service and results show it.

Our stock of foundry supplies comprises what we believe (after many years of diligent search) to be the best that can be produced anywhere.

Our reputation stands back of every line that we sell to the trade—**we realize** that it's to our interest that our goods give a maximum of service and satisfaction.

Our service—the right goods at the right price, delivered on the dot.

May we prove ourselves by filling your next requirements?

Correspondence invited.

Webster & Sons, Limited

31 Wellington Street **MONTREAL, P.Q.**

Successors to F. HYDE & COMPANY

CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited, Toronto, Montreal, Winnipeg, and London, England

VOL. VI. PUBLICATION OFFICE, TORONTO, NOVEMBER, 1915 No. 11

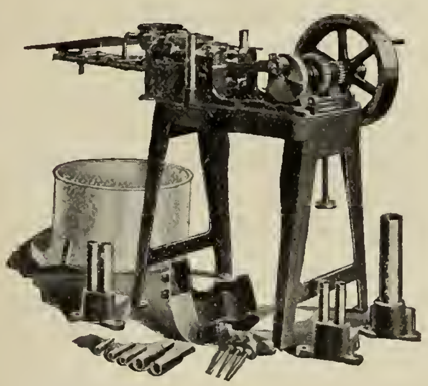
Berkshire Vibrators
½" to 2"

Berkshire Air Squeezers

The machine you are looking for. It has no equal. This is a plain statement of facts. Hundreds of users are proving this every day in the most progressive foundries in the world.

All the features which have made the Berkshire Squeezer famous are embodied in this machine.

Berkshire Air Squeezer Lifting Cope and Pattern Plate.

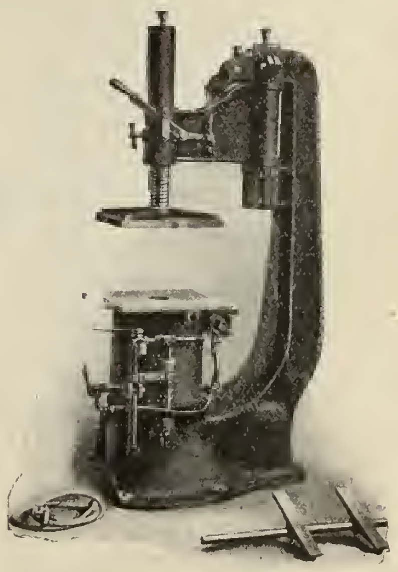


The Berkshire-Acme Core Machine

No screws to wear or grind out. Uses multiple dies. Three cores at same time on all sizes up to and including 1". Two cores from 1" to 1½". Makes any shape core that will pass through a die. The faces of the plungers are cupped, so that they fill with sand which becomes the ramming face.

The Berkshire Universal

Universal power molding machine for Malleable, Gray Iron or Brass foundries. Split patterns, match plates or plain gates. All molds exactly alike. Anyone can operate it. A powerful, convenient, well-built power molding machine.



The Berkshire Manufacturing Company Cleveland, Ohio

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

The Publisher's Page

By B.G.N.

The Coming of Prosperity

That the foundry trade will shortly show a marked improvement seems certain. The outlook for 1916 is much more promising than it was a year ago.

Canada has just marketed the richest crop in her history and our farmers will be the most independent in the world. Their millions of dollars will soon be in circulation and manufacturers have already felt the first zephyrs of the breeze of prosperity that has so recently swept across our fertile plains.

A few days ago Mr. D. A. Thomas was reported as having said that contracts totalling over $500,000,000 had been or would be placed in Canada! Study those figures for a moment and you cannot remain long in doubt about the outlook for trade during the next two years.

That the prospect of the industries that have been directly benefited by the war and the orders that have been placed as a consequence, will reach out and influence trade in all lines of business seems certain. The foundry trade already shows some improvement and this we believe will continue to become more and more marked.

Foundryman should look to their equipment and get it in shape, old and out-of-date machines should be repaired and remodelled or scrapped, and new and efficient equipment installed in its place.

The decks should be cleared for action so that when orders begin to flow in production will be carried on quietly, evenly, economically and profitably.

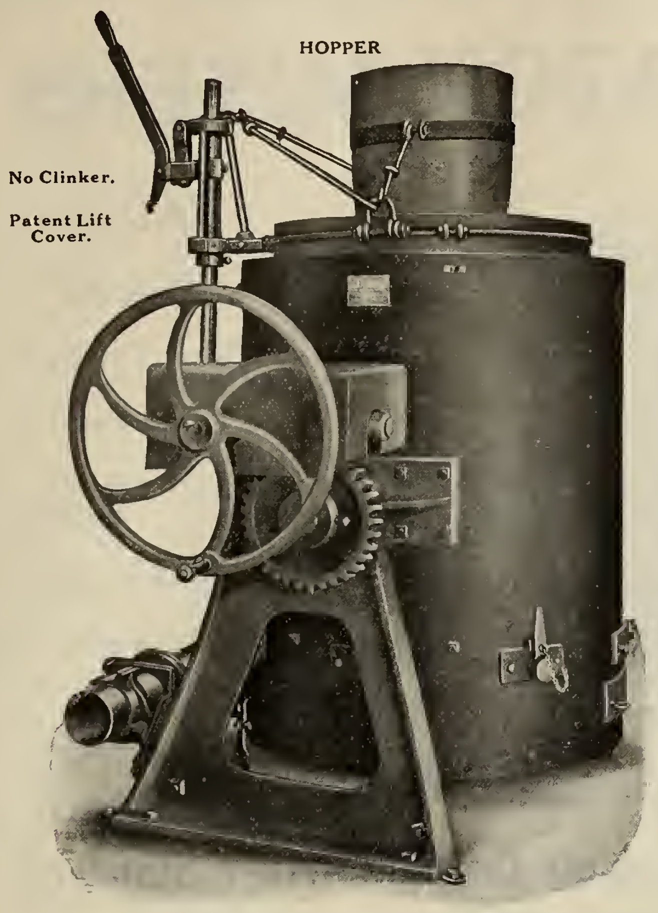
CANADIAN FOUNDRYMAN
143-153 University Avenue - - TORONTO

"Monarch" Furnaces

Bring us a steady flow of re-orders

What is better proof of merit than re-orders and re-orders from the largest manufacturers in Canada and the United States?

Monarch Furnaces are much sought after because it is our policy to make quality, service and economy our greatest salesmen.



Furnace in Melting Position, Hopper Feed, Shaker Grates.

Quality

For melting all metals high or low temperatures you'll find Monarch Melting Furnaces efficient and very economical—they will save 50% on your melting costs.

They are built for all fuel and all conditions with crucibles or without, with iron pots—"Stationary or Tilting."

IRON POTS for soft metals—"Tilting and Stationary," for aluminum, lead, tin, spelter, babbitt, dross, etc.

REVERBERATORY both "Tilting and Stationary," from 500 to 10,000 lbs. capacity. All Fuels. "Rockwell," Simplex and Double Chamber Brass Melting Furnaces, formerly made by Rockwell Furnace Co., New York. (We own and manufacture.)

SPECIAL FURNACES FOR HIGH HEATS, boron, iron, steel alloys, etc.

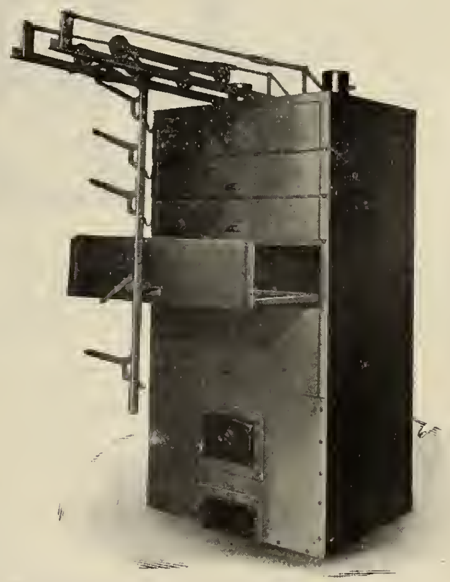
PORTABLE HEATERS for moulds, ladles and lighting purposes, dispensing with wood in cupola. **Positively guaranteed.**

Catalog C.M., 1915, on request.

The Monarch Engineering & Manufacturing Co.

1206 American Building, Baltimore, Md., U.S.A.

Shops: Curtis Bay, Md.



Monarch-Acme Double Track Core Oven, Coke Any Size. For All Fuels.

Monarch "Acme" Core Ovens

All Fuels—all sizes—all hand-made—sheet steel—asbestos insulation—built up to 6 feet square—Portable or bricked.

Our "Arundel" Core Oven is of the same quality construction—its drop-down front is the only difference.

THESE OVENS DEFY COMPETITION — THERE ARE NONE BETTER.

STANDARD BATCH MIXERS

LESSEN

Labor

Binder

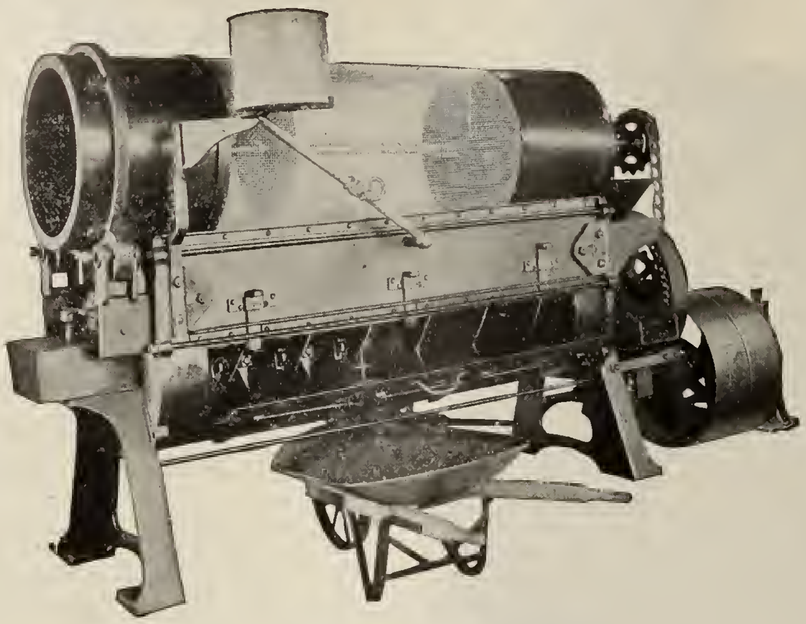
New Sand

Bad Castings

Bad Cores

Gas

Cleaning



ADD

Dividends

Good Castings

Good Cores

Thorough Mixing

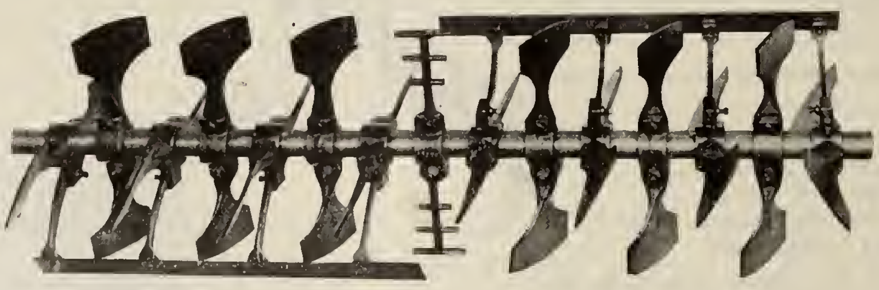
Old Sand

Strength

Finish

No. 3 Standard Batch Mixer

You Get the Good Things and Eliminate the Bad With a Standard



These are the paddles used in a Standard, which **mix** the sand 100 times a minute and not merely turn it over as you would with a shovel. That is why foundries tell us they save from 5% to 50% of Binder.

Size.	Floor Space	Capacity Per Batch	H. P.	Size T & L Drive Pulleys	Speed Counter Shaft
No. 0-A	2′ x 6′ 9″	4 cu. ft.	3	20 x 4	150 R. P. M.
No. 1	2′7″x 8′ 7″	6 cu. ft.	4	26 x 6	95 R. P. M.
No. 2	2′7″x 9′ 9″	7½ cu. ft.	5	26 x 7	95 R. P. M.
No. 3	2′7″x10′11″	9 cu. ft.	6	26 x 8	95 R. P. M.
No. 4	4′9″x12′	27 cu. ft.	20	26 x 10	280 R. P. M.

There is a Standard for every size foundry. One to sixty tons per hour.

Write for New Prices

The E. J. WOODISON CO., Canadian Agents

The Standard Sand & Machine Co., Cleveland, Ohio

Are You Melting Sand?

"WABANA"

Machine Cast Pig Iron

Cast in specially shaped moulds to permit of easy Handling, Piling and Breaking.

Chill Cast—*"SANDLESS"*—Pig Iron melts quicker or with lower fuel consumption than Sand Cast Iron. Machine Cast Iron is shipped 2240 pounds to the ton and it is *ALL METAL*—no sand.

We grade this iron according to the Silicon, as follows:

No. 1 Soft	Silicon	3.25% and over
1	"	2.50 to 3.24
2	"	2.00 to 2.49
3	"	1.75 to 1.99
4	"	1.30 to 1.74

An iron therefore for every Foundry purpose. Enquiries solicited. May we have the pleasure of quoting on your next requirements?

Dominion Iron & Steel Co., Limited

Head Office and Works, Sydney, N.S.

SALES OFFICES:

Sydney, N.S.; 112 St. James St., Montreal; 18 Wellington St. East, Toronto

THE STEEL COMPANY OF CANADA, Limited

Its Plant and Product at Hamilton, Ontario

Staff Article

From the ore mines of Mesabi to the fighting front in France is a long way to go, but not long enough to prevent a steady flow of shells and other munitions of war. The help which Canada is giving to the Empire, grows in volume and variety as it progresses Eastward and the valued assistance being rendered by establishments such as the one described in this article are a convincing evidence of Canada's present power and future potentiality.

THE entrance of Canada into the ranks of munitions producing nations was one of the unexpected events of a war, in which the unexpected has been more than once prominent. A year ago, when hostilities had been in progress for several months, there were few, if any, indeed, who foresaw the extent to which this country's resources would be relied upon for providing not only ammunition, but army stores of all descriptions in enormous quantities. Possessing an area of 3,817,000 square miles, equal to more than one-quarter of the land possessions of the Empire, with natural resources more varied and extensive than any other colony, and geographical location and political environment of the most favorable nature, Canada would have failed in her duty as a loyal colony had she exerted herself one whit less strenuously than she has done during the past year. Circumstances point to intensification and continuation of such efforts till the British Empire once more asserts itself as the chief factor in the world's peace, and in the attainment of such a state of affairs Canada will be looked to for increased help and support until the much desired consummation of events is attained.

The building of ordnance in the near future along with impending developments in munitions manufacture will tend more and more towards the consolidation of the Dominion as a self-contained and fully developed unit, and increase to a desirable extent the effective help so necessary in the terrible struggle for liberty and justice.

The Genesis of a Shell

While the successful production of guns will form the completion of Canada's military development, the demand for munitions has been most urgent, and so far the efforts of all parties have been so concentrated on actual production that few of us have realized that every step, every operation, every substance that enters into a finished shell, and last, but not least, the men and the guns to use them; in fact, each and every phase in the life of a shell from the ore mine to the battlefield is now in existence in this country.

The successful production of a modern artillery projectile is dependent on a degree of scientific knowledge, mechanical ability, and complexity of operations, of which the casual observer has only the faintest idea, and in devoting its efforts to the manufacture of munitions The Steel Company of Canada affords a splendid instance of that promptness, thoroughness, and wholeheartedness which has been so characteristic of our manufacturers.

Immediately it became apparent that the company's services would be needed, preparations for new, and alterations to operating plant and equipment were begun and carried out with such promptness and alacrity that in a very short time, shells were being produced at a highly creditable rate, and during the months which the plant has been engaged on this work the company has earned a lasting reputation as a producer of material for this purpose of the very highest order. In considering this performance one must remember that the metal is made from the ore, the forging is made from the metal, and the finished shell produced from the forging all under the one management. The life story of a shell as observed at the company's various plants is fascinating, instructive and highly stimulative of that industrial patriotism which is so characteristic of Canada's present efforts.

Mining the Iron Ore

Situated in the Mesabi range of hills in the northern part of the State of Minnesota, close to the Canadian border, and 800 miles from Hamilton, Ont., as the crow flies, are vast deposits of iron ore. From this locality, known as the Lake Superior district, about 40,000,000 tons of hematite iron ore are shipped annually to blast furnaces which yield more than three-quarters of the pig iron production on the North American continent. This red or brown hematite is one of the richest forms of iron ore, containing in some cases as much as 68 per cent. of iron, and in appearance resembles soft brownish earth. The deposits of the Mesabi range of hills lie near the surface, and are mined by means of immense steam shovels or excavators, such as are used for digging foundations, canals, railway cuttings, etc. These deposits are particularly adapted for handling by machinery, and the mining, transportation, and unloading of this material have resulted in the perfection of mechanical appliances of wonderful capacity and efficiency.

Lake Transportation

Ore boats carrying 10,000 or 12,000 tons of ore in one cargo, convey the ore to its destination. These boats are loaded from immense bins, into which the cars from the mines are emptied, the bins being elevated above the level of the boats, so that by means of ore chutes leading into each hatchway, the ore is rapidly conveyed by gravity into the hold of the vessel. In a few hours the ship has received its cargo and is ready to start on its long journey down the chain of inland lakes to its destination, where unloading of the boats is accomplished almost as rapidly as the loading.

LOADING ORE BOATS AT MESABA ORE DOCK, DULUTH.

The Production of Pig Iron

The plant of The Steel Company of Canada is complete in every detail, and is considered by many authorities to be of most modern design and construction. Here, in an extent of several acres, and in the course of a few hours may be seen steel in every stage of production from iron ore, barely distinguishable from common earth to the shrapnel and high-explosive shell, wanting only the addition of the explosive charge and propellant to make it ready for actual use in battle.

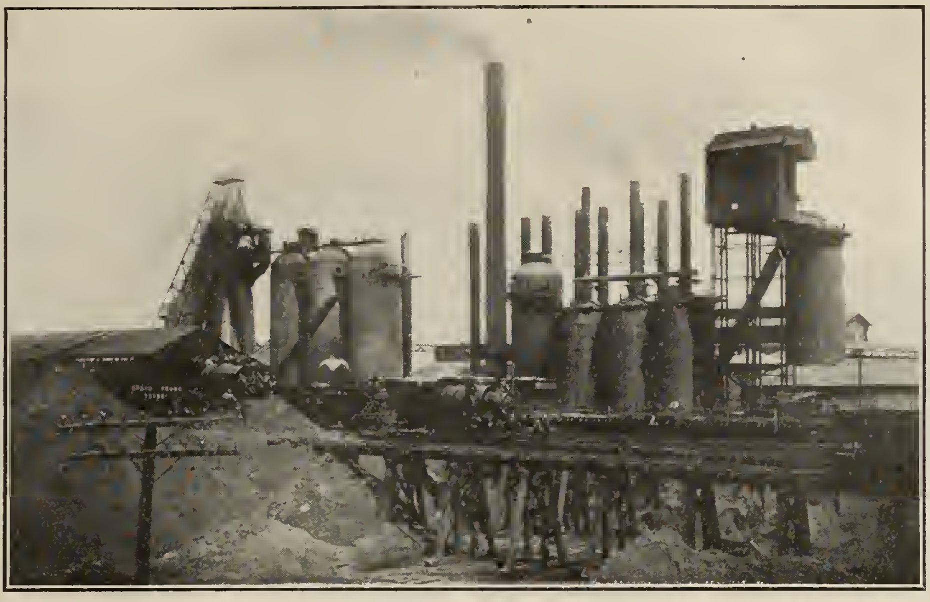
A short explanation of the reasons for and nature of the various processes through which the metal passes, may render clearer a description of the plant.

The first step in the manufacture of steel from iron ore is to separate the iron from the various substances associated with it in that form. This is accomplished by smelting the ore in a blast furnace with fuel and flux, whereby much of the impurities is removed, and a cast iron, commonly known as pig iron, is obtained. The pig iron thus produced is still an impure grade of

MALLET COMPOUND LOCOMOTIVE HAULING TRAIN OF iron, containing roughly 1.00 per cent. silicon, 0.1 per cent. sulphur, 1.50 per cent. phosphorus, 1.50 per cent. manganese, 3.50 per cent. carbon. A steel suitable for projectile manufacture would have a composition approximately thus: .15 silicon, 0.03 per cent. sulphur, 0.05 per cent. phosphorus, 0.70 per cent. manganese, 0.50 per cent. carbon. In order to obtain metal of this composition it is necessary to remove nearly all of the various impurities from the pig iron, and then add the necessary proportions of such ingredients as are desired.

This constitutes steel-making proper, and may be accomplished by various processes, all of which are similar in general principles, though differing widely in certain features which have important bearing on the finished produce.

After the desired chemical composition has been obtained, the steel is subjected to various mechanical treatments terminating with its appearance in the shape of the now familiar shell forging.



BLAST FURNACE PLANT OF THE STEEL COMPANY OF CANADA, LTD., HAMILTON, ONT.

The Blast Furnace

Returning now to the blast furnace—the iron ore arrives in hopper bottom cars, which are run out on elevated tracks and dumped in huge storage piles in close proximity to the blast furnace. Limestone and coke, which are necessary materials in steel-making, are similarly stored.

A sectional view of the blast furnace with skip hoist and charging bins is shown on page 205.

The charging bins are situated well above ground level, the discharge spouts being so arranged that the necessary amounts of ore, coke and limestone may be fed into a travelling dump car provided with scales, and running on a track below the bins. The car empties its load of material into the skip, two of which are used, one descending to be filled when the other ascends with the charge for the furnace. When the loaded skip nears the top of the hoist tracks, projections on the ends of the rear axle engage with suitable curved guide rails, and tip the skip over so that its contents are discharged into the hopper on top of the furnace. This hopper is of double construction, being fitted with two bells or cones A and B. Bell B is held against the bottom of the upper hopper by a counterweight, and is opened by hydraulic gear, thus allowing the charge to fall into the main hopper I, which in turn is closed by bell A. When hopper I has been charged with the proper quantities of ore, limestone and coke, bell A is opened, while bell B is kept tightly

LOADED CARS FROM ORE MINES TO LAKE SUPERIOR closed. The contents are now precipitated into the furnace, while the gas is prevented from escaping by bell B and going to waste as formerly, thus giving rise to the long flame which some years ago was such a prominent feature of blast furnace plants.

STORAGE PILES OF IRON ORE AWAITING TREATMENT IN BLAST FURNACE.

Design

As will be observed from the drawing, a blast furnace consists of a vertical brick-lined shaft, the internal shape being of a special outline, which has assumed its present form and proportions as the result of experience and scientific investigation. The lining of the furnace consists of acid (silicious) fire-brick, into the outer surface of which are built numerous water pipes for cooling purposes. These are easily seen in the photograph on page 206.

Encircling the lower part of the furnace is the blast pipe L, which supplies air to the furnace through the tuyeres N. The tuyeres, 12 in number, extend through the lining, the openings or "notches" as well as the tuyeres being cooled by water circulating through special pipes and hollow shields.

The hearth is the lower portion of the furnace, about 8 ft. in height, with vertical sides. Above that for a distance of 12 ft. is a portion of gradually increasing diameter, known as the bosh. From the top of the bosh, which is the largest diameter of the furnace, the walls close in gradually, forming the stack, which extends upwards to the throat where the charging hopper is located.

About three feet below the level of the tuyeres a hole is provided, known as the "cinder notch" or "monkey." This is protected by a water-cooled casting, and is closed by means of an iron plug. The purpose of this hole is to draw off the cinder and prevent it reaching the level of the tuyeres. On a level with the bottom of the crucible, on the front side of the furnace, is the iron tap-hole through which the liquid metal is drawn off from the furnace. This is simply a large hole in the brick work, which is stopped with clay balls. In tapping the furnace, these balls are broken up with a bar, and in order to stop the hole again a mud gun is employed, which shoots the balls of clay into the hole. This gun is seen lying at the base of the furnace in photograph on page 206.

ELECTRICALLY DRIVEN CHARGING CAR WHICH WEIGHS THE ORE, COKE, ETC., AS DELIVERED BY OVERHEAD CHUTES FROM CHARGING BINS.

Blowing Engines

The air which is necessary to operate the furnace is supplied at a pressure of from 15 to 30 lb. per sq. in., according to furnace conditions. The blowing engines for supplying this air are of a type which is more or less peculiar to blast furnace plants, and one of these is shown in a photograph on page 205. They are what are known as disconnected compound, long cross-head blowing engines. The steam cylinders are 44 in. and 84 in. diameter by 60 in. stroke, and are placed above the blowing cylinders, which are located between the flywheels.

Before entering the furnaces the air is heated to a temperature of 900 to 1,250 deg. Fahr. by passing through the hot blast stoves. These stoves, of which there are three, are distinctive features in the appearance of blast furnace plants. They are upwards of 100 ft. high and 20 ft. in diameter.

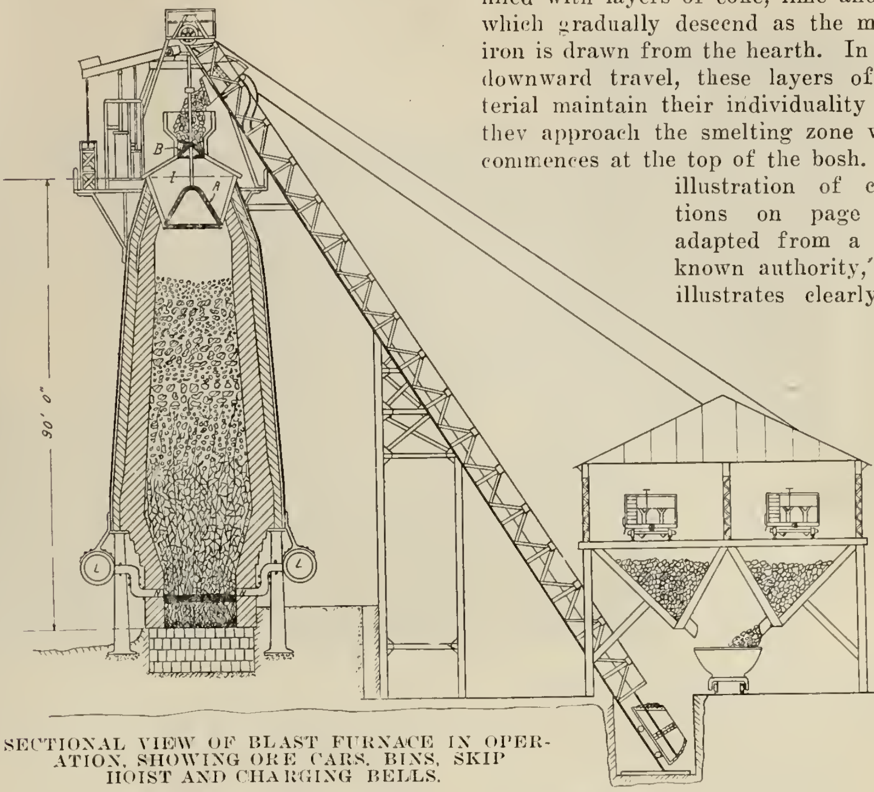
The hot gas from the top of the blast furnace is conveyed through large pipes to the base of the stoves, where it is mixed with air and burned. The products of combustion pass upwards through the central passage and then downward through the surrounding space, which is constructed of suitably arranged fire-brick chambers, after which the gases escape through the chimney. After running for a certain period, the stove has absorbed a maximum amount of heat from the gases, and the process is then reversed. The air from the blowing engines is received through a valve at the base of the chimney, and, passing upwards through the hot fire-brick, is raised to a high temperature before passing out at the bottom of the central passage and thence to the tuyeres. When this reversal takes place, the hot gases from the furnace are switched into that stove, which was previously heating the air. While one stove is heating the air, the remaining stoves are being warmed up by the hot gases. In order to maintain a fairly regular temperature in the blast furnace, the stoves are changed over about once an hour.

Utilizing the Waste Gases

Only one-third of the waste gases from the blast furnace is necessary to keep the stoves hot, and the remaining two-thirds are available for use in various ways. In the case of this plant, the gas is burned under a battery of boilers, producing the steam required to operate the blowing engines and refrigerating plant which is required for drying the air before entering the stoves.

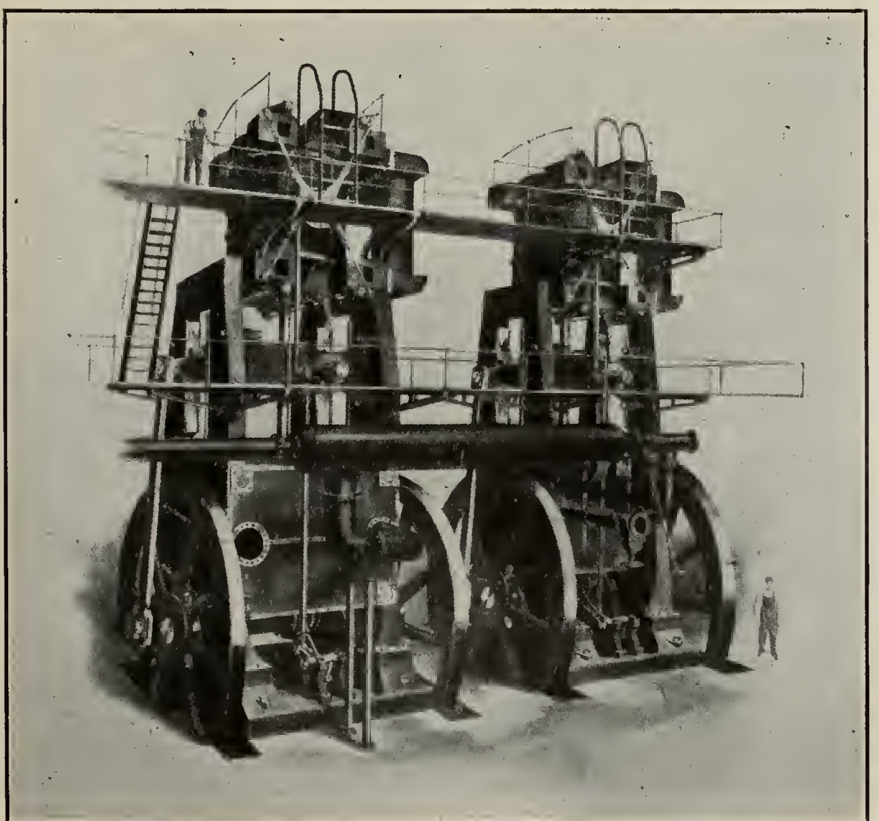
Undried air, if blown directly into the furnace, would carry with it water vapor equivalent to from 1 1/3 to 8 gallons per minute, according to the humidity of the air, materially cooling the smelting zone of the furnace. The process of drying the air by refrigeration was originated by James Gayley, a prominent American steel maker, and the saving in fuel and increased regularity of working due to the absence of moisture have resulted in its adoption by the leading plants in various countries.

The air-drying plant consists of three



SECTIONAL VIEW OF BLAST FURNACE IN OPERATION, SHOWING ORE CARS, BINS, SKIP HOIST AND CHARGING BELLS.

150-ton compound steam-driven ammonia compressors, which supply the necessary refrigeration for cooling the brine which is circulated by three steam-driven flywheel type brine pumps.



DISCONNECTED COMPOUND LONG CROSSHEAD BLOWING ENGINE.

Operation of the Blast Furnace

When in operation, the furnace is filled with layers of coke, lime and ore, which gradually descend as the molten iron is drawn from the hearth. In their downward travel, these layers of material maintain their individuality until they approach the smelting zone which commences at the top of the bosh. The illustration of conditions on page — is adapted from a well-known authority,' and illustrates clearly the action of the various materials. The exact location of the smelting zone is dependent upon the volume and pressure of blast, size of furnace, character of slag made, etc., but will extend from the level of the tuyeres to a few feet above them, or about to the top of the bosh. It will require perhaps fifteen hours for the material to descend from the top of the furnace to the smelting zone. During this descent, it is upheld partly by the resistance of the uprushing column of hot gases, partly by its friction on the walls of the furnace, and partly by the loose column of coke which extends through the smelting zone and to the bottom of the furnace, and which alone resists melting in the intense heat of this zone. The oxygen of the air blast attacks all the coke in the smelting zone and as much of it below the level of the tuyeres as is not covered by accumulations of iron and slag in the hearth, producing a large volume of carbon monoxide gas (CO), and a temperature which may exceed 3,000 deg. Fahr. This CO along with the nitrogen of the blast passes up between the particles of solid material, which takes up the greater part of their heat. The CO also performs certain chemical reactions, and thus in both ways the rising column of gases prepares the charge for its final reduction in the smelting zone.

Smelting the Iron

When the charge has travelled about half-way down the furnace, the increased temperature breaks up the limestone, and from this point down to the smelting zone the ore is gradually re-

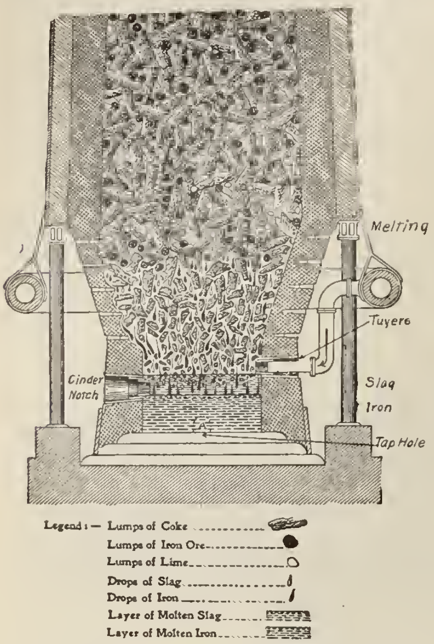


DIAGRAM SHOWING VARIOUS STAGES IN PROCESS OF SMELTING IRON ORE.
From Howe, "Iron, Steel and other Alloys."

duced to metallic iron. This spongy iron is impregnated with deposited carbon, which is absorbed in a similar manner to the process known as carbonizing. This reduces the melting point of the iron, and causes it to become liquid at a higher point above the tuyeres than it otherwise would.

On reaching the smelting zone, the iron melts and trickles quickly down over the columns of coke, from which it completes its saturation with carbon. At a corresponding point the lime unites with the coke ash and impurities in the iron ore, forming a fusible slag, which also trickles down and collects on the hearth. It is during this transit that the different impurities are reduced by the carbon, and the extent of this reduction determines the characteristics of the pig iron, for in this operation as in all smelting, reduced elements are dissolved by the metal, while those in the oxidized form are dissolved by the slag.

The slag is drawn off through the cinder notch four or five times, between each tapping of the furnace, which takes place about every six hours. This is run through channels in the sand floor to ladle cars at the side of the cast house, whence it is taken to the water front and dumped into the bay, making an ideal foundation for the reclaimed land which is being gradually brought into existence on the company's lake front.

Tapping the Furnace

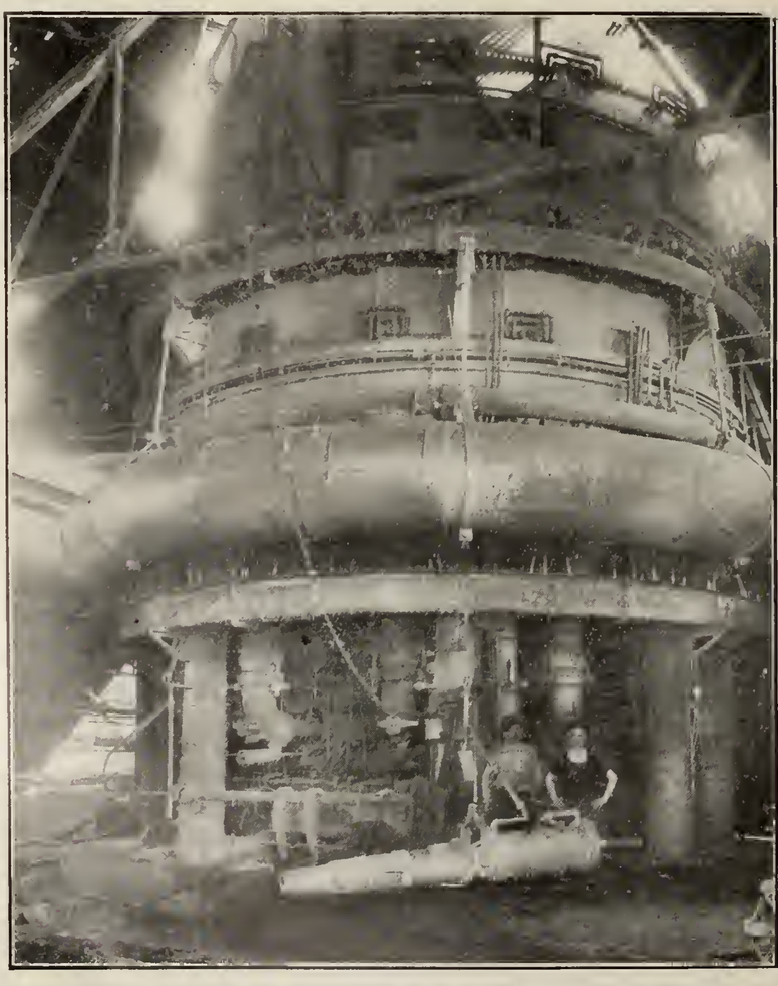
The scene in the cast house when the furnace is tapped is one which impresses even the most passive observers. The tap hole is opened by breaking up the clay balls which were forced into it, forming a solid plug. The molten iron flows underneath a skimmer, which deflects the floating slag into its own runner, while the iron flows into brick-lined ladles at the end of the cast house, which are immediately transferred to the open-hearth department and deposited in a large cylindrical vessel known as the mixer, where it is kept hot until it is time to charge it into the open-hearth furnace, where further changes in its composition are affected, which finally transform it into that indispensable metal—steel.

Manufacture of Steel

The physical properties possessed by iron as produced in the blast furnace are such as to render it unshuited for shells. The large proportion of carbon and other impurities present impart a brittleness and absence of ductility which are entirely absent when these substances are wholly or partially eliminated. This elimination or purification is performed by various processes, but the chemical action of oxidation is common to all.

The particular process of purification adopted by the Steel Company of Canada is that known as the basic open-hearth process, and differs sufficiently from other processes to demand a brief description. In all cases of purification, i.e., steelmaking, the impurities are removed from the pig iron by means of oxidation—that is to say, the molten metal is subjected to the action of oxygen either in the form of air or iron oxide or both. The name of Bessemer naturally occurs to many people in connection with steelmaking; and in the pro-

EXTERIOR VIEW OF BLAST FURNACE. SHOWING PIPES FOR CONVEYING WASTE GASES TO STOVES. DUST SEPARATOR IN FOREGROUND.

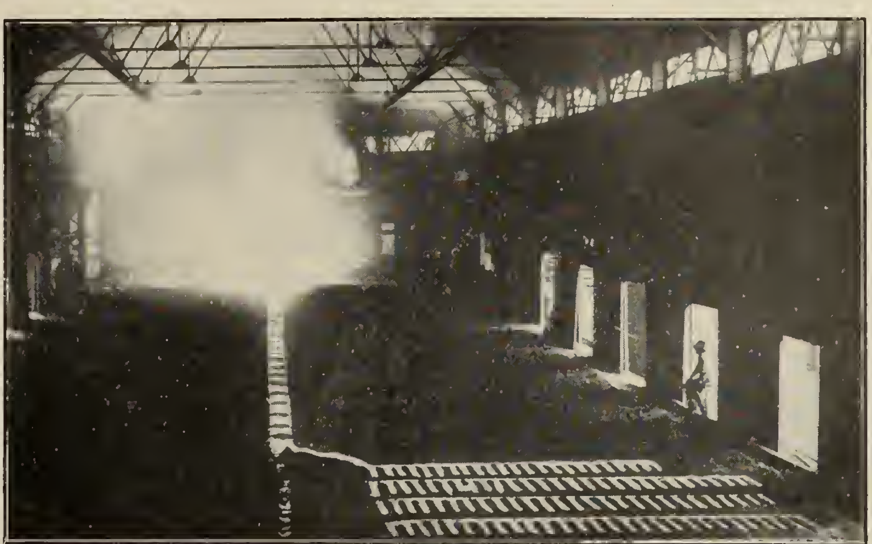


BASE OF STACK SHOWING LARGE BLAST PIPE SUPPLYING AIR TO THE TUYERES. STEAM OPERATED MUD GUN IN FOREGROUND USED FOR PLUGGING TAP HOLE BEHIND THE MUZZLE.

cess invented by the late Sir Henry Bessemer, air alone is used to remove the impurities from the molten iron.

Bessemer Process

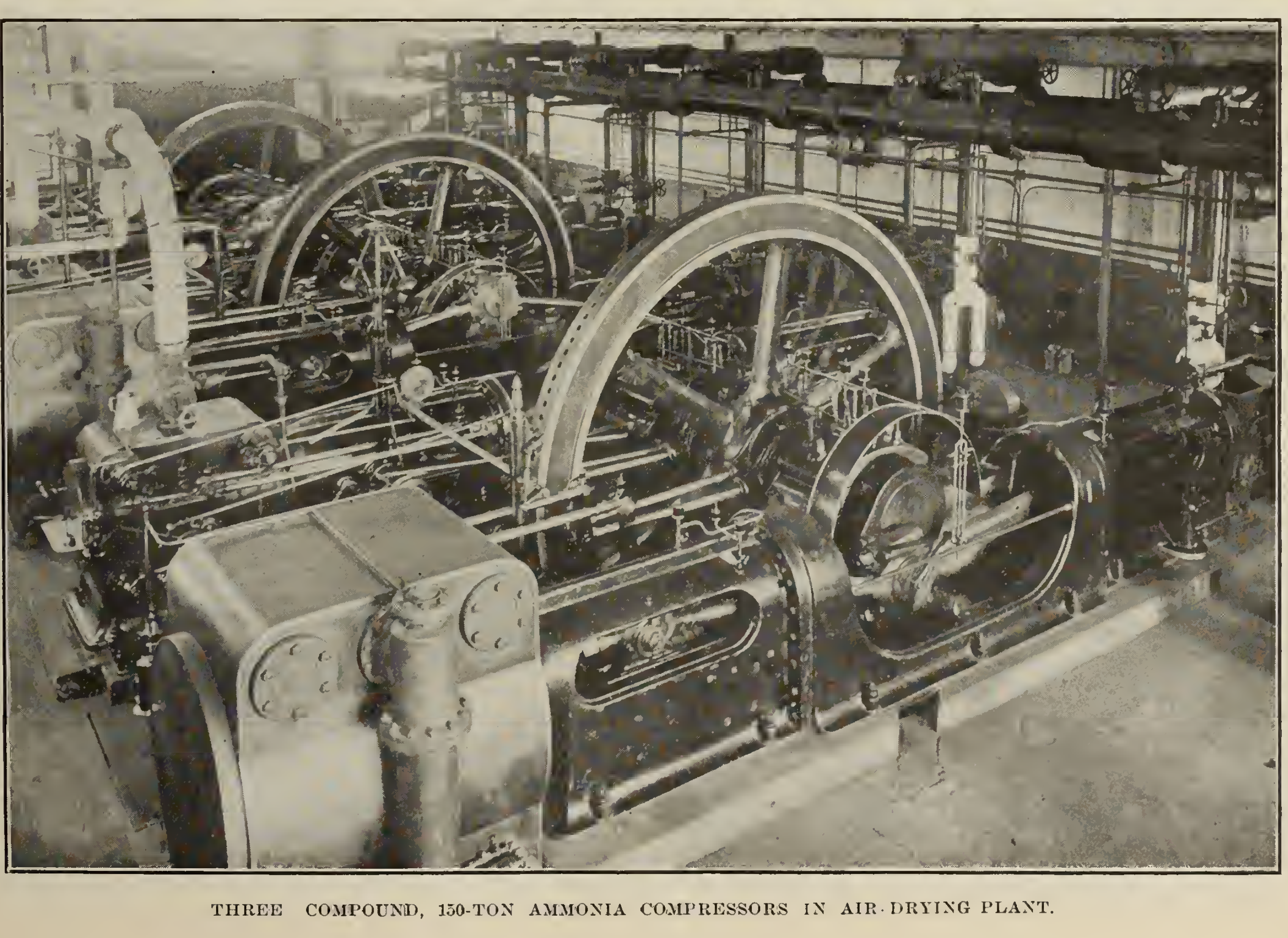
A large pear-shaped vessel known as a converter is lined with suitable protective material and provided with means whereby air can be forced upwards from the bottom with sufficient force to bubble through the molten metal. A converter, as the receptacle is termed, with a capacity of 15 tons, would require 30,000 cu. ft. of cold air per minute. The effect of such treatment on the iron impresses the lay mind chiefly by reason of its peculiar physical aspect, but no matter how wonderful its behaviour and appearance during this treatment, the resulting changes in the physical properties of the metal are little short of marvellous. A concise description of a "blow" or "heat" is given by Bradley Stoughton. "In about four minutes the silicon and manganese are all oxidized by the oxygen of the air and have formed a slag. The carbon then begins to oxidize to carbon monoxide, CO, and this boils up through the metal and pours out of the mouth of the vessel in a long brilliant flame. After another six minutes the flame shortens or 'drops' the operator knows that the carbon has been eliminated to the lowest practicable limit (say 0.04 per cent.), and the operation is stopped. So great has been the heat evolved by the oxidation of the impurities that the temperature is now higher than it was at the start, and we have a white-hot liquid mass of relatively pure metal. To this is added a carefully calculated amount of carbon to produce the desired degree of strength or hardness, or both; also about 1.0 per cent. of manganese and 0.15 per cent. of silicon. The manganese is added to remove from the bath the oxygen with which it has become charged during the operation, and which would render the steel unfit for use. The silicon is added to get rid of the gases which are contained in the bath. After adding these materials, or 'recarburning' as it is called, the metal is poured into ingots, which are allowed to solidify, and are then rolled, while hot, into the desired size and form."



CAST HOUSE, SHOWING THE MOLTEN IRON BEING RUN INTO MOULDS OR PIGS

Basic Open-Hearth Process

The open-hearth process in operation at this plant differs considerably from



THREE COMPOUND, 150-TON AMMONIA COMPRESSORS IN AIR-DRYING PLANT.

the Bessemer process, and its use in preference to the other is due to a complexity of circumstances, such as nature of ores available, quality of product desired, demands of customers, etc. The basic open-hearth differs from the acid open-hearth in the nature of the lining and the composition of the slag produced, the effect of which is to aid greatly in the removal of phosphorus and sulphur, thus permitting the use of high phosphorus ores as distinguished from low phosphorus ores, which are necessary for both Bessemer and acid open-hearth practice.

HOW METAL COOLS FROM LIQUID TO SOLID

IN the course of a lecture before the Sheffield branch of the British Foundrymen's Association recently, Dr. W. Rosenhain, F.R.S. (Head of the Metallurgical Department of the National Physical Laboratory), advanced an interesting theory, the consideration of which might enable one to understand some of the things which happen during the cooling of metals.

Special attention was given to the consideration of the existence of non crystalline or amorphous layers in metal bodies which have been cooled from a liquid condition. The "change of state" which took place during solidification involved something more than the formation of mere crystals commonly understood. Crystals invariably form at right angles to surfaces which happen to be at uniform temperatures, the growth of these crystals beginning at different points of centres termed nuclei where the temperature of the metal first reaches the freezing point. Each of these nuclei or centres then extended in all directions, meeting the arms of other nuclei and causing the crystal growth to permeate the whole body as quickly as the various parts reached the state of solidification, on freezing point.

By a crystalline body was meant one in which the particles, of which the body was composed were arranged in some regular manner. The absence of such a crystalline formation was termed an amorphous state, and science had enabled a very considerable insight to be obtained regarding the manner in which these particles were formed, as well as their absence. The growth of a crystalline structure did not result from the building up of successive layers, but by shooting out branches until these met other branches and the intervening spaces were filled up. What was it that made the atoms of the metal arrange themselves in this way? Clearly there was some directing force which made the atoms turn and arrange themselves. and determined whether a given atom should adhere to one crystal or to another. It would appear that the attractive force acting on the atom from one crystal was greater than those acting upon it from another.

The Amorphous Theory

But ultimately a point must be reached between two growing crystals where the opposing forces of the crystal growths were nearly balanced and the atom was not impelled very strongly one way or the other, and therefore did not range itself definitely on either side. The effect of the two such opposing forces was very clearly illustrated in the attraction of iron filings by the two similar poles of a magnet (as shown by means of a slide) between which there was a distinct neutral ground where the two opposing sets of forces were so nearly balanced that the particles of iron arranged themselves in a completely indifferent manner. So in the case of a cooling mass of metal, there would be a neutral zone between any two crystals where the atoms would go on cooling down without arranging themselves in crystalline order. This amorphous or non-crystalline layer between the crystals of metal would have the hardness characteristic of all under-cooled materials. The behaviour of pure iron which would consist of crystals of iron, with amorphous layers between, was considered. The amorphous layers would be stronger and harder than the crystals themselves, and if strained or deformed there should be very little movement at the boundaries of the crystals, all the movement taking place within the crystals themselves. Slides were exhibited which showed that deformation of the body as a whole was accomplished by deformation of the crystals themselves.

A temperature of 900 deg. Cent., however, approached somewhat to the softening point of the amorphous layers, while the crystals melted suddenly and changed from the solid to the completely liquid at a much higher temperature. At such a temperature as 900 Cent., nearly all movement took place by the sliding over one another of the boundaries. Thus the flow of these metals at high temperatures obeyed the law of the flow of various liquids. To carry the process a little further, the deformation might be continued until rupture took place; in the cold metal the crystals broke across but at a suitable high temperature the crystals could be pulled apart from one another quite easily, so that the fracture followed the crystal boundaries. Several slides were shown illustrating the varying course of the fractures at different temperatures, with various metals, including purest gold, to show that the action was not attributable to the presence of impurities, as was sometimes suggested by opponents of the theory which was also confirmed by experiments in vacuum.

Experiments in latent heat also, in the opinion of the lecturer, clearly indicated differences which would be very hard to explain on any other physical ground. He was quite prepared to admit that there was no definite proof of the existence of this "amorphous cement," but some people would never be convinced until one could hit them with a piece of amorphous metal. At the same time he thought there was enough evidence to indicate that there must be something in the theory. It explained the difference in the mechanical properties of metals, which depended upon the size of their crystal structure; and the curious difference in their elastic limit was very readily explained by it. It also served to give a reasonable explanation to that most puzzling of all facts, that a very small proportion of impurities produced such enormously disproportionately large mechanical, electrical and other effects; these added bodies would always tend to concentrate themselves in this amorphous cement, and might account for the large effect of vanadium on steel. This, he thought, was one of the most fruitful applications which the theory offered, but a good deal remained to be done in working out these applications; it showed why other things injured steel, because they spoiled the binding power of this amorphous cement. Dr. Rosenhain also discussed the separation of the various constituents of alloys, the formation of solid solutions, and the formation of cores. Cores were due to the rate of cooling; only by a slow cooling could completely homogeneous crystalline aggregate be obtained. The limitation of phosphorus in steel was considered, fissures in shrapnel shells being due in his opinion to regions of low carbon and high phosphorus, resulting in layers of different hardness. The remedy was to eliminate the phosphorus as far as possible, or to render its distribution uniform. One way was to decrease the speed of solidification of the steel, and if that was impracticable, the next best thing was to anneal the steel very drastically at a certain stage in the working.

THERE are men of patience, persistence, power. They invent, devise, originate, economize, and always and forever they work. And it is this capacity for work—the ability to bear burdens—that has brought about their promotion.—The Philistine.

NEW AND IMPROVED EQUIPMENT

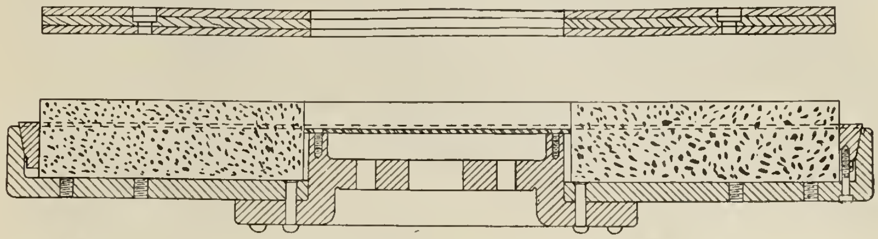
A Record of Machinery Development Tending Towards Higher Quality, Output and Efficiency in Foundry, Pattern and Metal Work Generally

WIDE FACE RING WHEEL GRINDER

An improved flat surface grinder of the ring wheel type has just been placed on the market by Charles H. Besly & Co., 120 North Clinton St., Chicago. This machine is called a Besly Wide Face Ring Wheel Grinder, and as shown in Fig. 1, is similar to the single spindle lever feed Besly disc grinder except that for roughing off scale and excess stock one end of the spindle is equipped with a pressed steel chuck holding a wide face vitrified ring wheel. This grinding wheel has 8 inches to 10 inches width of grinding face, so that work may be allowed to "float" on this broad face, while grinding; same as is done on the usual steel disc wheels covered with cloth abrasive discs.

These vitrified grinding wheels are more efficient and economical than cloth back abrasive discs for heavy rough grinding on scale; in fact, large rough work may be accomplished on the wide face ring wheel grinder which cannot be done at all on the ordinary disc grinder.

Besly grinders have, heretofore, been equipped with ring wheel chucks for rough grinding, but with comparatively narrow-faced ring wheels which made it necessary to rigidly clamp any work which was to be ground. The advantage of the wide face ring wheel as compared with the original narrow face ring wheel is that much work may be "floated" against the wide face wheel as in disc grinding and ground without clamping. This saves time in chucking. There is a further saving in the time of grinding because with the wide face ring wheel more cutting points are in action, as it grinds all over the face of the work at once—side swiping. The opposite end of spindle is equipped with the usual steel disc wheel set up with cloth back abrasive discs for finish grinding.



PRESSED STEEL CHUCK WITH CLAMP RING AND LAMINATED PACKING PLATE.

Chuck body is pressed steel, double riveted to a cast iron centre. Construction of this centre is such that spindle bearing projects into the chuck, thereby minimizing overhang. Chuck body is drilled and tapped from the back to receive headless threaded plugs for balancing. Grinding wheel is held in the chuck by pressure over its periphery. This pressure is applied by means of a wrought steel tapered clamp ring, passing around the grinding wheel. This ring is drawn into the tapered chuck body by means of clamp screws operated from the back of the chuck body. A suitable steel plate is provided to fit the centre hole of the grinding wheel and guard the heads of the screws which hold the chuck on the grinder spindle; so there are no external projections. This makes the chuck especially safe. As grinding wheel wears away, it may be set out in the chuck by means of a laminated wood plate supplied with the chuck.

The Besly wide face ring wheel grinder is built in two sizes: No. 17 carrying vitrified grinding wheel 24-inch diameter, 8-inch hole, 8-inch width of grinding face, illustrated in Fig. 1, and No. 16 carrying vitrified grinding wheel 30-inch diameter, 10-inch hole, 10-inch width of grinding face. All ring wheels are 3-inch thick when new and may be worn down to 1 inch in thickness.

Examples of economical surfacing are shown in Figs. 2 and 3, the former showing grinding of pillow blocks and caps. The 6 in. x 13 in. bottom surface of the cast iron pillow block was formerly done on a variable speed, motor driven shaper, using high speed tools to the limit of their capacity. In order to make this suitable for grinding instead of shaping, the pattern was changed. Very little stock was left for finish, and surface

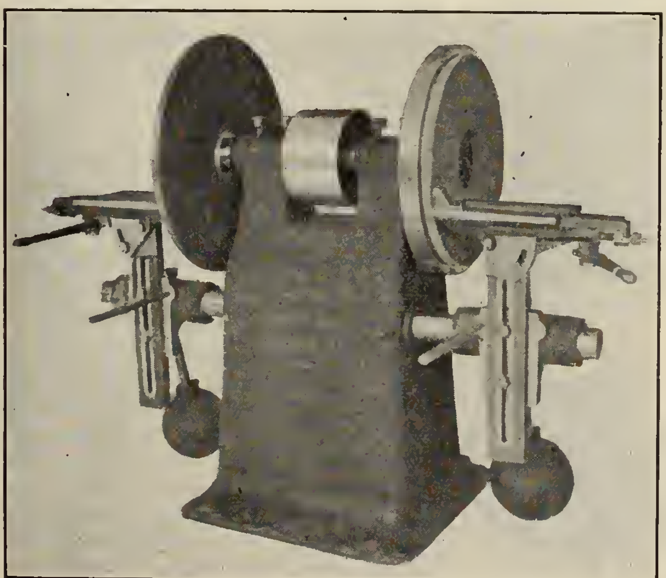


FIG. 1. NO. 17 GRINDER WITH 24-INCH DIAMETER WHEEL.

FIG. 2. GRINDING CAST IRON PILLOW BLOCKS AND CAPS.

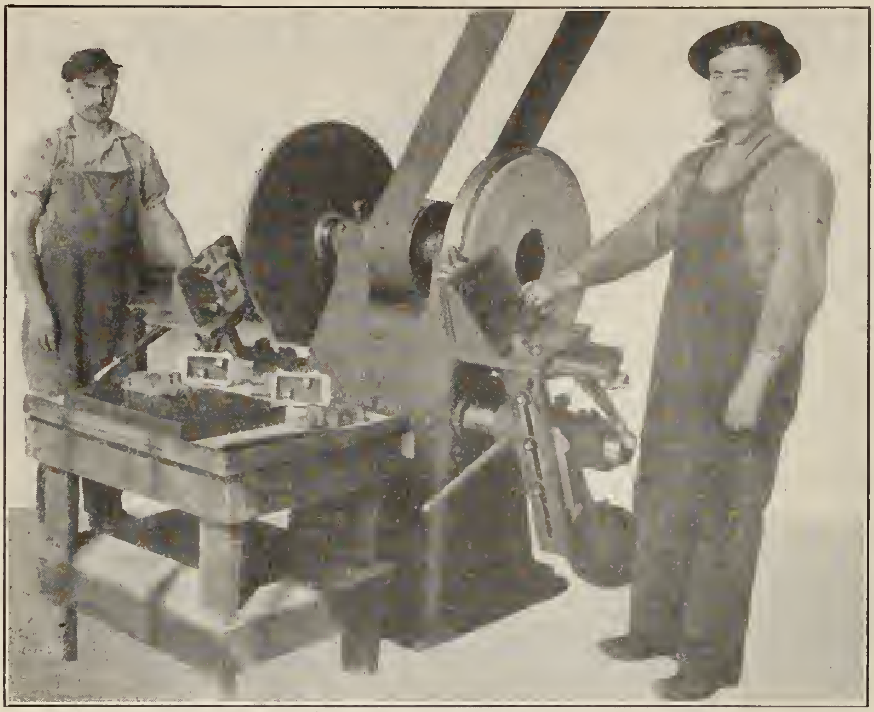


FIG. 3. GRINDING SMALL MALLEABLE IRON CASTINGS.

was recessed in molding to facilitate grinding. By a little care on the part of the moulder, these castings came to the grinder with a maximum of 1/16 in. stock for finish.

The No. 17 Besly wide face ring wheel grinder roughed and finished these surfaces, to size and flat—tested on surface plate, in less than two minutes. Former time on shaper was about twenty minutes. Allowing for careless moulding, necessitating the removal of ⅛ in. of stock, the grinder accomplishes the work in three minutes as against 20 minutes for the shaper, this time covering all work, floor to floor, including surface plate test. It will be noted that these heavy pillow blocks and caps are ground without rigid chucking—the work "floats" against the grinding wheel both in roughing and finishing operations.

Referring to Fig. 3 which shows grinding of automobile gear shifter covers; these castings are malleable iron and rather frail. As they are ground without rigid chucking, there is no chance to distort the casting as when rigidly clamped for milling.

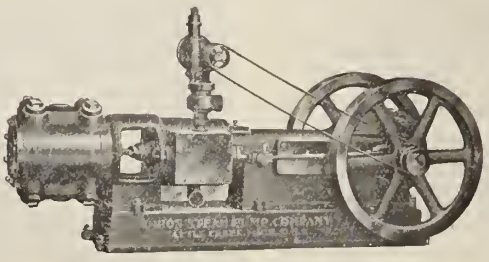
The grinder workholder is very simple. The work rests loosely on three studs projecting from the face of the angle plate. The work is located and supported on this three-point bearing by means of four studs projecting from the angle plate. The time on this job is 200 grinding operations per hour, per operator, or 100 castings roughed and finished per hour, per operator. As machine accommodates two operators, the production per machine is double that above mentioned. The geared lever feed work table used on this Besly grinder gives the operator a leverage of 20 to 1, so that with a very slight pressure of the operator's hand, the work is forced against the grinding wheel with sufficient pressure to secure maximum grinding efficiency.

To secure the best results. it is necessary to use care in designing patternmaking and moulding, so that the work may come to the grinder with the minimum amount of stock for finish, and large surfaces should be relieved to facilitate grinding.

ENCLOSED AIR COMPRESSORS

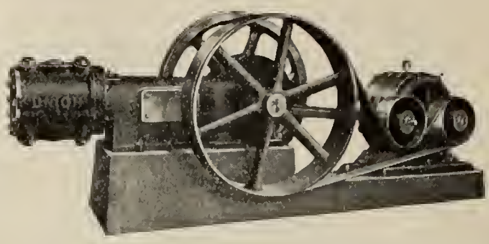
THE constant demand for increased efficiency in plant equipment of all kinds has been met with corresponding effort on the part of builders. Air compressors are one line of manufacture which has been the object of consistent effort.

The Union Steam Pump Co. of Battle Creek, Mich., build a full line of compressors which embody all that is desirable in modern air compressor design. These machines are of both vertical and horizontal types, and are adaptable to all drives. They are built with open frames as well as enclosed, and also duplex single-stage, and two-stage.



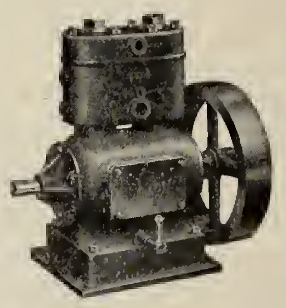
STEAM DRIVEN FLYWHEEL COMPRESSOR

Enclosed construction, as shown in the illustrations, completely protects all running parts from grit or dirt, and enables the splash system of lubrication to be adopted. Access to the various parts is obtained through suitably placed cover plates.



COMPRESSOR WITH MOTOR BELT DRIVE

Air valve design has received all the attention which this important feature deserves, and the flat steel-disc valve as developed by the makers is the result of many years' experience. This valve has a very small lift accompanied by freedom from noise, and its period of service is indefinitely lengthened by the use of special heat-treated steel in its construction.



VERTICAL DUPLEX COMPRESSOR

In addition to the types illustrated, there is also manufactured a line of single cylinder vertical compressors from 3 x 3 inch to 6 x 6 inch, all of the water cool type.

H. V. Armstrong, B.A.Sc., for several years town engineer of Estevan, Sask., has resigned.

H. T. Jackson, of Montreal, has been appointed to the position of manager of the Record Foundry & Machine Co., Moncton, N.B.

Capt. Leon H. Curry of the 42nd Royal Highlanders, of Montreal, was killed in action recently in Northern France. Capt. Curry was born at Amherst, N.S., 30 years ago. About three years ago he was appointed assistant to the vice-president and general manager of the Canadian Steel Foundries, Montreal, Que.

CAUSES OF SHRINKAGE CRACKS IN STEEL CASTINGS

By William R. Bossinger*

SHRINKAGE cracks in steel castings constitute a common defect of steel foundry operations. The cause of shrinkage cracks is the same for all castings, but their locations are never identical, owing to the varying forms of different sections. It is not unusual to make castings from one pattern for a period of several months without being troubled by this defect, yet suddenly all of the castings from one heat will develop these cracks. If it were possible to prevent steel from expanding or contracting, this difficulty would be overcome, but since this is beyond control, the alternative must be accepted and this phenomenon must be contended with, namely, the contraction of the steel after the mold is filled. To reduce these defects or to eliminate them entirely, every effort should be made to prevent setting up solid walls that will cause the metal either to stretch or crack when the force of contraction is brought to bear on the walls of the molds.

Numerous appliances, devices, etc., are resorted to to overcome this defect, including the use of brackets, chills, tie bars, the use of sawdust or cinders in the cores, maintaining the metal at a minimum temperature when pouring and keeping it as low in sulphur as possible, as too high a percentage of the latter element is one of the common causes leading to shrinkage cracks. Long castings with attached ribs, flanges or lugs will crack if the sulphur is not well under 0.05 per cent. in basic steel, regardless of the fact that other properties and conditions may be favorable to the elimination of this defect. While the various causes leading to shrinkage cracks are well-known to the management of steel foundries, nevertheless this will not eliminate losses from this cause until a knowledge of the cause of shrinkage cracks is imparted to all of the men constituting the organization. The success in keeping down shrinkage cracks is based upon the training of the men who are directly responsible for the development of this defect. Each casting presents a different problem, as the thickness of metal and the lack of uniformity in section will change the location of these cracks in one casting as compared with another of an entirely different form. To train the shop force in eliminating difficulties from this cause, the common sense of the employees is a contributing factor of no little importance. Theory and practice combined, as well as previous experience, likewise should be taken into consideration. It is not unusual to stop cracking in one part of a casting, only to have this defect develop in another part of the same piece. This, however, should not prove discouraging, as it indicates that proper methods are being taken to prevent these defects. The law of the segregation of metals should be recognized as being closely allied to the causes underlying the formation of shrinkage cracks. Segregation will cause the formation of shrinkage cracks on the outside surface of many castings.

*Marion Steam Shovel Co., Marion, O.

The Use of Chills

The free use of chills is recommended, as they will reduce this default by controlling the cooling to a greater extent than the use of brackets. Unless efforts are made to prevent the employment of chills that are too large or heavy, or which extend over onto the junction of heavy and light sections, the chills will increase the tendency to crack. If the chill is too large, it will cause shrinkage cracks at the point of the chilled face. This is caused by the too rapid contraction of the casting directly underneath the face of the chill. When the chill is of the proper thickness, it causes the heavy part of the casting to pass through the first stage of contraction, imparting to the metal sufficient strength to meet the stresses caused by passing through the first cooling stage. Stresses in the chilled parts of steel castings are eliminated when the proper chills are employed. The chills will absorb heat from the casting until they reach a temperature of 1,400 degrees Fahr., and on cooling with the casting all stresses should be relieved as the casting strains are released by what practically constitutes annealing at this temperature. The use of chills is resorted to for the purpose of reducing the size of feeders on many castings. The chills are inserted in the molds over lugs and flanges that have light, thin sections on top. A chill should be of sufficient size to set the heavy section of metal before the metal in the lighter section has left its fluid state. In this way fluid steel will be carried to the chilled part and other fluid steel will be drawn from the feeder to replace metal taken from the lighter section. Another reason why the chill is to be favored in place of the use of brackets is that the chill will fall out of the mold when the casting is shaken-out, whereas the brackets have to be chipped off.

Improper Gating

Improper gating also is frequently the cause of shrinkage cracks, forming hot spots in line with the flow of metal. If a flat casting is gated in the centre and the metal is forced in one direction, causing the sand to absorb and retain heat in this section of the mold, thereby causing a hot spot in the casting resulting in a shrinkage crack, it can be attributed to the remainder of the casting cooling and contracting in advance of the centre of the hot section. To further illustrate this point, an I-beam section will be considered which is gated in the centre of the web. If poured in this way, the casting will be liable to crack, as the flanges will resist contraction and the centre will be weakened by the higher temperature of the metal due to the method of gating in the web and this part of the section would not have sufficient strength to withstand contraction and the crushing of the sand walls on the flanges.

Catalogues

Murphy, Stearman & Co., 180 Gray's Inn Road, London, England, have sent us a copy of their new catalogue. The goods dealt with are all British made and embrace complete equipment for foundries and machine shops, and many other lines for engineers and contractors.

Foundry Equipment.—The National Engineering Co. of Chicago, Ill., have issued a bulletin dealing with the "Simpson" intensive foundry mixer and "Simpson" national screen separator. The construction of the mixer and methods of handling various materials are fully described, while illustrations give a general idea of the machine. The screen separator is also described and illustrated.

Grinders.—Bulletin No. 17 illustrates and describes the new model wide face ring wheel grinder made by the Charles H. Besley & Co., Chicago, Ill. Specifications and shipping weights, etc., are given for the different sizes of grinder which are illustrated both in operation and otherwise, showing clearly the general construction. Other matter includes the geared motion lever feed and pressed steel chuck which are illustrated and described.

Shop Furnaces.—The American Shop Equipment Co., Chicago, Ill., have issued a catalogue showing several standard types of furnace for a variety of purposes. Some of the types shown include portable and stationary rivet forges, flue welding furnaces, heat forge furnaces, single and double door hammer furnaces, single and double chamber bulldozer furnaces, annealing and melting furnaces, etc. Each type is illustrated and accompanied by a brief description and dimensions. In addition to the furnaces, an interesting line of auxiliary equipment is illustrated and described. Several pages are devoted to a discussion of equipment and methods employed in the heat treatment of steel and include some valuable information on the subject.

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CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Technical Journal devoted to the Foundry and Metal Industries.

PETER BAIN, M.E., Editor.

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Vol. VI. NOVEMBER, 1915 No. 11

PRINCIPAL CONTENTS

THE VALUE OF MANUFACTURING RECIPROCITY

JUST how much and just how little of a man's business should be known by his competitors is and always will be a moot question, and though at first sight anyone might be prepared to give a conclusive reply one way or the other, there are many qualifying features which prevent the average manufacturer from giving a definite reply offhand.

Apart from its desirability, which is questionable, or its efficiency which is still more questionable, the regime of quasi-secrecy inaugurated in connection with munitions manufacture may have a more or less permanent influence on many of our industrial organizations which must ultimately react to their disadvantage.

The advent of Government work has been characterized in the majority of cases by an absence of that spectacular display of industrial accomplishment which in ante-bellum days had been developed to a high degree. One result of this suppressed publicity has been to generate a feeling of mysterious importance in many enterprises whose pretensions were previously of a modest nature.

Without in any way detracting from the beneficial influence on the campaign which is to be obtained by keeping the enemy in complete ignorance of the extent of our munitions supply, it might be asked whether our own efficiency as munitions producers is not reduced as a result of excessive reticence regarding methods of production.

There are some persons who, in war time as in peace, look upon all journalists as necessary evils, to be borne with when necessary, and avoided when possible. Such individuals fail to realize that in standing in other people's light they also stand in their own.

No man is a hero to his valet, and few firms indeed are so highly regarded by all of their employees that they can afford to set themselves up as sphinx-like oracles. That liberty of employment which the North American workman cherishes as his inalienable birthright is one of the greatest factors in nullifying any attempts to form an Industrial Secrets Trust.

Ever since the munitions industry began to assume national proportions, we have consistently advocated, and devoted our efforts to the judicious dissemination of such technical and manufacturing information as could be of greatest immediate value to the numerous entrants into the ranks of producers. The knowledge that these efforts have not been valueless to many firms is our reward, and the manner in which nearly every concern has placed their experience at the disposal of others is proof of the soundness of our policy.

On frequent occasions we have been privileged to place on record a few examples of extreme resourcefulness and development in specialized manufacturing, these being probably only some of many instances of improvised equipment throughout the country. Although the intrinsic value of such efforts may be confined to the originators, the ultimate suggestive value to manufacturers as a body may be very great, and wonderful possibilities may await designers and mechanics as the result of being thus jolted out of the rut of conventional design.

Reference might here be made to an instance in shell manufacture which emphasizes the service rendered by technical journals. In machining 3.3 inch shrapnel forgings, it was found necessary to make the wall of increasing thickness for a short distance near the mouth so as to provide ample metal for the internal thread after nosing in. When the making of 4.5 inch shells was being started, many makers spent a great deal of valuable time in ascertaining the proper taper to allow for the same operation. Meantime a new producer who was not bound by precedent, went ahead and dispensed with the taper, getting satisfactory results with one operation less. The fact that others were experiencing trouble by a too strict adherence to existing methods, did not increase the value of his own method to himself personally, while the lack of just such information delayed their progress perceptibly, besides giving rise to a feeling of disappointment, due to the absence of prompt and successful results.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

Question.—In the manufacture of high explosive shells we wash the shell after machining, when dry a coat of varnish is applied to the interior of the shell. The surface of the interior must be free from specks, or marks which in any way may indicate or appear to indicate an imperfect shell. We have found quite a number of shells which show a mark on the inside base, resembling a crack corroded with iron rust. These marks may be removed by polishing with emery cloth in a lathe, but we desire to remove the cause if possible. After washing in a solution of soda ash, the shells are dried by passing through boiling water and suspending in the air.

Answer.—This trouble has been experienced by several firms and has been overcome by using the crystallized sodium carbonate in place of the soda ash, the latter being an inferior quality of soda. Others have attributed the marks to the chlorine used in the purification of city water supply and have succeeded in avoiding further trouble by adding 3 to 4 oz. of sodium silicate to the hot water used for final rinsing. In any case the wash waters should be kept clean and the drying effected as quickly as possible. The cleaning solutions must be kept strong and solutions free from caustics are preferred. The final rinse must be thorough in order to remove all traces of corroding substances from the pores of the metal. When the shell is immersed the open end should be uppermost to allow escape of air and permit the entire inner surface to be rinsed.

* * *

Question.—Since the price of cyanides used in plating baths has increased. I have been cautioned by my employer to economize on the sodium cyanide in copper solutions. Can you inform me whether there is any substitute for the sodium cyanide which would give good results in plating.

Answer.—Potassium and sodium cyanides are the only solvents for the copper salts, which can be used for plating purposes. The use of sodium carbonate crystals in the copper bath is claimed by some to reduce the amount of cyanide required. The crystals are dissolved in a portion of the copper solution or in water before adding to the bath. You will find that the use of copper cyanide as prepared specially for plating baths will reduce your operating expense to a great extent.

If you are using an excess of cyanide for the purpose of securing a bright deposit you may eliminate some expense by using hyposulphite of soda in very small quantities. In hot copper solutions ½ oz. per gallon will suffice. Baths operated cold will require larger quanties. We favor the cyanide in preference to soda in any form. Copper and brass baths containing sodas are invariably quite freakish, and require frequent attention and additions. If you require a heavy copper deposit, strike the work in the cyanide bath and finish in a duplex or acid copper bath, the latter is much cheaper than the cyanide solution and yields a splendid deposit.

* * *

Question.—We make a grey iron casting which we polish, plate and buff. Until recently we copper plated the casting previous to brass plating. We did this to facilitate a more rapid coating of brass as the grey iron did not cover well when brass plated directly on the iron. Now we have dispensed with our copper bath owing to increased cost of operating and have met with serious failures in the brass bath. Kindly advise us of a method or remedy which will eliminate defective deposits.

Answer.—Be specially careful in cleaning, take no chances, do not depend upon the plating solution to remove the slight film of anything. Avoid a strong current and maintain a well balanced solution by judicious additions of copper and zinc salts. Above all avoid any excess of free cyanide, the amount of free cyanide must be kept very small. No free cyanide causes a deposit that is granular and devoid of toughness. Use from 2 to 4 oz. of crystallized sodium carbonate to each gallon of solution. Keep this solution below 10 degrees Beaume, use warm if possible, and operate the solution without additions of ammonia or arsenic, ammonia is unnecessary and white stick caustic potash is superior to arsenic for producing bright clean deposits.

* * *

Question.—We use a nickel solution made from the double sulphates, the density of the solution being about 5½ degrees Beaume. We understand that a more rapid deposit may be produced from a denser bath, but that a denser double sulphate bath is liable to crystallize out in winter. As we have always been under the impression that a single sulphate solution was impracticable for commercial nickel plating, we are writing to inquire if a practical bath is possible which may be operated at a greater density than 5½ or 6 degrees Beaume.

Answer.—Nickel solutions prepared from the double sulphate of nickel and ammonium do crystallize out if too dense, say about 7 or 8 degrees Beaume, in winter when used as a still solution. Single salts alone produce a solution which yields brittle plates. The addition of boric acid and either sodium chloride or magnesium sulphate to the nickel sulphate solution renders it possible to utilize the bath at densities approaching 15 degrees Beaume, and operate at current densities in the neighborhood of 20 amperes for square foot. It is obvious that this bath will produce a deposit in about one-fourth the time required by the double sulphate bath, the plates are firm, adherent, tough and of splendid color. When equipped with high grade anodes the single sulphate bath is self sustaining and very economical. The reactions result in an automatic replenishing of the bath thereby reducing the attention required to a minimum amount.

AMERICAN ELECTRO-PLATERS' SOCIETY, TORONTO BRANCH.
Officers:

President—John A. Magill, 591 St. Clarens Ave., Toronto.

Vice-President—William Salmon, 48 Oak Street, Toronto.

Secretary—Ernest Coles, P.O. Box 5, Coleman, Ont.

Treasurer — Walter S. Barrows, 628 Dovercourt Road, Toronto.

PLACE AND DATES OF MEETING.

The Occident Hall, corner of Queen and Bathurst Streets. Fourth Thursday of each month, at 8 p.m.

Welland, Ont.—It is reported that preparations are being made to reopen the plant of the Canadian Steel Foundries.

Leamington, Ont.—The town council have decided to call for tenders for two 110 h.p. boilers for the waterworks. A new boiler house will be built.

Merritt, B.C.—The British Columbia Copper Co. proposes to spend in the neighborhood of $500.000 in the erection of a concentrating plant at their Copper Mountain properties. This is to be operated by an electric power plant to be erected either at Princeton or Tulameen, according to reports, it being estimated that it will take at least $300,000 to erect and equip same.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products

PIG IRON.

Grey Forge, Pittsburgh	$15 20	
Lake Superior, charcoal, Chicago	16 75	
Ferro Nickel pig iron (Soo)	25 00	

	Montreal.	Toronto.
Middleboro, No. 3	$24 00	.....
Carron, special	25 00	.....
Carron, soft	25 00	.....
Cleveland, No. 3	24 00	.....
Clarence, No. 3	24 50	.....
Glenarnock	28 00	.....
Summerlee, No. 1	30 00	.....
Summerlee, No. 3	29 00	.....
Michigan charcoal iron	28 00	.....
Victoria, No. 1	24 00	21 00
Victoria, No. 2X	23 00	21 00
Victoria, No. 2 plain	23 00	21 00
Hamilton, No. 1	23 00	21 00
Hamilton, No. 2	23 00	21 00

METALS.

Aluminum	$ .60
Antimony	.40
Cobalt 97% pure	1.50
Copper, lake	19½
Copper, electrolytic	.19¼
Copper, casting	.19
Lead	.06¾
Mercury	100.00
Nickel	50.00
Silver	.48
Tin	.40
Zinc	.19

Prices Per Lb.

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$12 25	$12 25
Copper, crucible	14 25	14 00
Copper, unch-bled, heavy	14 25	13 50
Copper, wire, unch-bled.	14 25	13 75
No. 1 machine, compos'n	11 50	11 50
No. 1 compos'n turnings	10 25	9 50
No. 1 wrought iron	10 00	9 50
Heavy melting steel	8 50	8 00
No. 1 machin'y cast iron	13 50	11 00
New brass clippings	11 00	11 00
No. 1 brass turnings	9 00	9 00
Heavy lead	4 60	4 50
Tea lead	3 75	3 50
Scrap Zinc	11 50	9 50

COKE AND COAL.

Solvay foundry coke	$5.75
Connellsville foundry coke	5.00
Yough steam lump coal	3.83
Penn. steam lump coal	3.63
Best slack	2.99

net ton f.o.b. Toronto.

BILLETS.

	Per Gross Ton
Bessemer billts, Pittsburgh	$26 00
Open-hearth billets, Pittsburgh	28 00
Forging billets, Pittsburgh	45 00
Wire rods, Pittsburgh	33 00

PROOF COIL CHAIN.

¼ inch	$9.00
5-16 inch	5.90
⅜ inch	4.95
7-16 inch	4.6
½ inch	4.40
9-16 inch	4.35
⅝ inch	4.30
¾ inch	4.15
⅞ inch	3.65
1 inch	3.45

Above quotations are per 100 lbs.

MISCELLANEOUS.

Solder, half-and-half	$0.23
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs. p. cwt.	9.65
Glue, French medal, per lb.	0.15
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.23½
Benzine, single bbls., per gal.	0.23
Pure turpentine, single bbls.	0.85
Linseed oil, raw, single bbls.	0.85
Linseed oil, boiled, single bbls.	0.88
Plaster of Paris, per bbl.	2.50
Plumbers' oakum, per 100 lbs.	4.50
Lead wool, per lb.	0.11
Pure Manila rope	0.16
Transmission rope, Manila	0.20
Drilling cables, Manila	0.17
Lard oil, per gal.	0.73

SHEETS.

	Montreal.	Toronto.
Sheets, black, No. 28	$3 10	$2 95
Canada plates, dull, 52 sheets	3 15	3 15
Canada plates, all bright.	4 60	4 75
Apollo brand, 10¾ oz. (galvanized)	5 50	4 80
Queen's Head, 28 B.W.G.	6 00	5 95
Fleur-de-Lis, 28 B.W.G.	5 75	5 75
Gorbal's best, No. 28	6 00	6 00
Viking metal, No. 28	5 25	5 25
Colborne Crown, No. 28	5 70	5 80
Premier, No. 28 B.G.	5 40	5 20

ELECTRIC WELD COIL CHAIN B.B.

⅛ in.	$12.75
3-16 in.	9.00
¼ in.	6.00
5-16 in.	4.75
⅜ in.	3.75
7-16 in.	3.75
½ in.	3.75
⅝ in.	3.60
¾ in.	3.60

Prices per 100 lbs.

IRON PIPE FITTINGS.

Canadian malleable, A, 25 per cent.; B and C, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped union, 65.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium, carbonate	.15
Ammonium, chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cobalt Sulphate	.50
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.15
Potassium carbonate	.40
Potassium sulphide substitute	.20
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide, 129-130 per cent.	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.07

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper, 22-25	.22 to .25
Tin	.45 to .50
Silver	.55 to .60
Zinc	.22 to .25

Prices Per Lb.

PLATING SUPPLIES.

Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck.	.80
Emery in kegs	4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

Prices Per Lb.

MADE IN CANADA

Every dollar you spend for

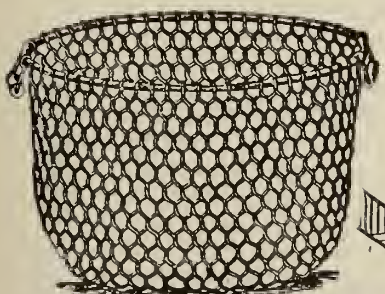
Hamilton Facings

is a dollar kept in Canada and every shipment you receive is of uniform unexcelled quality through and through.

The combination of quality and price in Hamilton Facings means **maximum results and practical economy for every user.**

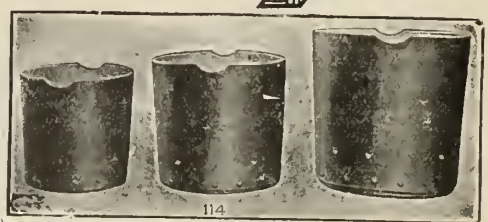
Hamilton Facings will save the trouble and delays in the customs which come hand in hand with imported makes.

We have every facility for making immediate deliveries.



Coke or Charcoal Baskets—Made of galvanized steel wire.

WRITE FOR PRICES, SAMPLES AND REFERENCES



Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.

Foundry Supplies and Equipment

The quality of our Foundry Supplies and Equipment is sure to meet your complete approval.

We believe we make the best goods that brains, skilled mechanics and good material can produce.

Place a trial order with us now and let the goods speak for themselves. They always make good.

The Hamilton Facing Mill Company, Ltd.

HAMILTON, CANADA

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Toronto, Ont., Nov. 9.—The industrial situation continues favorable and there is an increase of confidence for the future in business circles. In addition to heavy increases in exports the Dominion revenue is steadily growing. The customs returns for October were about four million dollars more than for the corresponding month of 1914, while for the first seven months of the present fiscal year the revenues were seven millions more than for the corresponding period of last year. The high ocean freight rates at present prevailing are a serious handicap to ordinary trade other than war business. The rates which are very much higher than at normal times, add considerably to the cost of the product and so have a tendency to restrict business.

Developments in the shell industry are being followed with the greatest interest; this is to be expected, considering the large amount of money involved. Contracts for the 6-in., 8-in. and 9.2-in. shells are being allotted gradually, and it is pretty well understood who are the recipients, although the amounts and values have not been given out officially. A large number of tenders for shells and shell parts have been submitted and their consideration requires considerable time and attention. The reorganization of the Shell Committee will probably not take place until the awarding of the various contracts has been completed. Sir Frederick Donaldson has left for England, where he will report to the War Office as to conditions in Canada and the feasibility of establishing ordnance works here.

Steel Market

The most important development in the steel market this week and one which indicates the trend of business is the withdrawal of prices on steel bars. The mills have taken this action on account of the unsettled condition of the market due to the heavy demand for steel and the difficulty in promising delivery. The mills will until further notice quote on application only for prompt acceptance. Canadian steel companies have advanced steel bars 10c, to $2.45 per 100 lbs., which price is really nominal. Iron bars are unchanged at $2.35. Pittsburgh bars for Canadian consumption are quoted nominally at 1.50c, but higher prices are more general. The steel market is very active and the demand for steel for munitions is steadily increasing. The placing of orders for the large-calibre shells will mean a considerable increase in tonnage, and will tax the capacity of the mills. This business will be additional to the requirements for the 18-pdr. shells, which are still being produced in large quantities. The steel trade is in an exceedingly prosperous condition and the present activity will no doubt be a permanent benefit to the industry.

Prices of electric weld coil chain have been reduced, but in all probability will only be effective a short time. With a higher tendency on all steel products, chain cannot help but be effected. Proof coil chain, fire welded, is unchanged but an advance is looked for in the near future. Seamless boiler tubes are very firm at last week's advance and may go still higher. Prices of boiler plates have been readjusted in an upward direction. Galvanized sheets are strong, some brands having been advanced. The tendency is decidedly in an upward direction on account of the high prices of spelter, acid and black sheets. There is only a fair demand for galvanized sheets in Canada, although in the States there is a large volume of export business. Bessemer black sheets No. 28 gauge are being quoted at 2.10c to 2.20c; open hearth; No. 28, 2.20c to 2.24c, and blue annealed No. 10 at 1.70c to 1.80c, Pittsburgh. "Premier" galvanized sheets are now being quoted at $5.20 per 100 lb. Toronto.

The high-speed tool steel situation may fairly be said to be acute. The scarcity, especially under present conditions, is very serious and is causing considerable anxiety to makers of munitions. Although prices are advancing all the time, these ranging from $2.50 to $3.50 per lb., the makers are unable to promise either a definite delivery date or the amount specified. Stocks in Canada are very low and supplies are difficult to obtain from Sheffield, England, on account of the restrictions placed on exports of tool steel by the British Government because of the enormous demand and the necessity of conserving supplies. The heavy demand in the States also makes it exceedingly difficult to obtain supplies from the mills in that country.

The extraordinary demand in the States for steel, particularly for munitions, continues and the mills are overwhelmed with orders. The output is expanding rapidly and prices are steadily advancing. For domestic delivery all makers are quoting bars at 1.50c Pittsburgh, but export business is being booked at considerably higher figures. The heavy demand for billets continues and prices are still advancing. Bessemer billets are now being quoted at $26, open-hearth billets at $28, and forging billets range from $35 to $45 f.o.b. Pittsburgh.

Pig Iron

There is an increased demand for low-phosphorus pig iron and there appears to be some scarcity of this grade. It is reported that Canadian buyers are unable to satisfy their requirements, one interest being in the market for several thousand tons monthly. Foundry grades are in better demand, but the tonnage is comparatively light.

Old Metals

The metal for scrap iron and steel is weaker, Canadian mills having covered their requirements meantime. No. 1 wrought iron and heavy melting steel are both lower, having dropped 50c a ton. Machinery cast iron is stronger and has advanced 50c per ton. The market for scrap copper, brass, zinc, and lead is reasonably active. The United States market is said to be over-supplied and a reaction may be expected. Quotations on the above-mentioned metals are unchanged with the exception of zinc, which has advanced, and is quoted at 10c per pound.

Metals

The general situation in the metal market is much the same as last week. The upward movement in tin continues and lead has also advanced slightly. There is no change in the copper market, but the position of this metal is a good one, and higher prices are more likely than otherwise. The spelter market is much firmer and indications point to higher prices in the near future. There is nothing of particular importance to note with regard to antimony and aluminum, except that supplies of the last-named metal are practically unobtainable. Solders are firmer and higher prices may develop shortly.

Tin.—Considerable activity has developed in the tin market and the upward movement continues. The market is in a sound position, but there is a possibility of a revival in speculation. Tin has advanced 1c and is quoted at 40c per pound.

Copper.—The market is steady and firm. Production is going on at a rapid rate, but at the same time consumption exceeds the output. The position of this metal is a strong one, as consumption will increase rather than decrease. Local quotations are firm at 19½c per pound.

Spelter.—The market is firm with a higher tendency. There is an improvement in demand in New York, both domestic and export. Spelter has advanced ½c, and is quoted locally at 18c per pound.

Lead.—The New York market is firm at the "Trust" price which is 5c per pound, while the London market has al-

so advanced. The advance is attributed to increased demand. Lead has advanced 1/4c and is now quoted at 6 1/4c per pound.

Antimony.—The market is fairly active, but the general situation is unchanged. Antimony is quoted locally at 35c per pound.

Aluminum. — The situation is unchanged and supplies locally are almost unobtainable. Quotations are nominal at 60c per pound.

Plating Chemicals and Supplies

The potash situation is becoming increasingly serious; supplies are very scarce and are, in fact, almost unobtainable. The soda situation is much the same, supplies being very difficult to obtain, consequently prices continue at a high level. Prices on most plating chemicals are very firm except zinc sulphate, which has declined 1c per pound due to the zinc market being weaker. Sulphuric acid is high and makers practically control the market. A new feature in the plating trade is the plating of cast iron nose plugs for shells, which are being used instead of brass.

RECORD COPPER PRODUCTION

IT IS announced from New York that the present output of copper by smelters as well as by refiners, is record-breaking, just as it is in steel; but the entire production of copper is not being taken up, as is the case with crude and rolled steel.

During September, it is conservatively estimated that there was a surplus of 30,000,000 pounds in producers' stock in this country. This is based upon an estimated total consumption of 125,000,000 pounds. As the exports were approximately 35,000,000 pounds, this would leave 90,000,000 pounds for domestic consumption. Estimates of melting by domestic consumers range from 80,000,000 to 100,000,000 pounds, but it is doubtful that there is capacity enough to consume 100,000,000 pounds per month, even with the recent extensions made to manufacturing plants.

The total production of blister copper in September is estimated at 165,000,000 pounds, but the refined output is said to have been 5,000,000 to 10,000,000 pounds less; thus it is indicated that there was an increase in smelters stocks of about 10,000,000 pounds, as well as an increase of 30,000,000 pounds in stocks at the refineries.

1916 FOUNDRY EXHIBIT AT CLEVELAND

AT a recent meeting of the executive committee of the American Foundrymen's Association at Cleveland it was decided to receive bids for the conduct of the exhibition of foundry machinery and supplies which will be held in connection with the convention at Cleveland next year. For several years the exhibition has been under the control of the Foundry & Machine Exhibition Company. It is understood that bids are to be opened Nov. 13 at Cleveland, and that the successful bidder will manage the exhibition for the foundrymen, the net profits to go to the associations and the exhibitors.

MOLYBDENITE SAMPLES FROM NORTHERN QUE.

G. R. E. KENNEDY, of Sherbrooke, has returned from a trip into Northern Quebec, with some 50 lbs. of molybdenite specimens which have been sent to the Assay office for analysis. They were obtained by him and J. D. Kennedy, who investigated and successfully relocated claims formerly taken up and prospected by Capt. K. E. Kennedy, who had to abandon them on going to the front.

Remarkable rich samples were secured with nothing but a prospector's pick, in a granite and pegmatite formation, of which there is a large area, and covered by their claims.

There are only a few places in Canada where this somewhat rare mineral, molybdenite (sulphite of molybdenum) is found, and the world's production is very limited.

It is used in the manufacture of high speed steels armor plates, rifle and big gun barrels, etc., to which around 10 per cent. imparts the quality of taking a great heat without loss of temper. It is now in great demand by Great Britain and France. Before the war, it was worth around $400 per ton, for 90 per cent. concentrates. Late quotations are $3,300 up. It is substituted for and superior to tungsten.

The Kennedy Claims are splendidly situated for shipping and can be worked to great advantage by tunnel, which, with the fine showing of ore, give the property all the earmarks of a very valuable mine, despite the usual pockety nature of the few known deposits of molybdenum.

ECONOMICAL VANADIUM IRON CASTINGS

THE problem of cheapening production without impairing quality is one that is always with us, and it will be of greater importance than ever in the years of industrial rivalry following the war. The use of the cheapest suitable materials is by no means the least fruitful of the many possible fields of economy, and in this connection it is interesting to note the results of a series of tests recently conducted by Prof. Fitch on vanadium castings. It appears that a pig iron containing silicon 2.00; sulphur, 0.02; phosphorus, 0.58; manganese, 0.69; carbon, 3.62 (0.55 combined); titanium, 0.022; and vanadium, 0.04 per cent., has unusually high scrap-carrying abilities and that nothing is to be gained from using a mixture of pig iron and scrap containing a large proportion of pig iron, even for automobile cylinders, or other work requiring soft, dense, machinable metal.

A series of tests was conducted on castings containing from zero to 80 per cent. scrap of the following composition: Silicon, 1.74; sulphur, 0.09; phosphorus, 0.49; manganese, 0.36; carbon, 3.30 (0.75 combined); titanium, 0.04; vanadium, 0.01 per cent. It was found that the test data lay between the following limits for specimens with from 20 to 80 per cent. scrap, the bracketed figures referring to pure pig specimens: Tensile, 22,000-26,500 (25,200) lb.; modulus of transverse rupture, 48,000-55,000 (50,600) lb. per sq. in.; deflection (12-in. centres), 0.086-0.116 (0.097) in.; shrinkage per foot, .11-.125 in. (.11 in.) in green sand and .125-.15 in. (.13.) against a chill; scleroscope reading (tool steel 100) 35.3-36.1 (36.3); pouring temperature, 2,125-2,475 deg. F. (2,280 deg.). These figures give a good indication of the scrap-carrying capacity of the pig and of the strength and resiliency of vanadium castings.

Using pig of the composition stated and scrap not differing much from the above analysis, it is recommended that a 50 per cent. mixture be used for all but heavy castings (wherein no part is less than 2 in. thick). Sixty per cent. gray iron machinery scrap gives good medium castings, and no less than 80 per cent. scrap can be used for heavy casting. Castings of these compositions are claimed to be easy to machine, soft and close grained, and easily susceptible to high polish. The possibilities of high-scrap, vanadium castings are distinctly worth bearing in mind for practically all classes of work.

ANTIMONY AND THE WAR

The consumption of antimony in the United States and Canada is estimated to amount at present to 600 to 700 tons per month, which is about the consumption in this country alone in peace times. Regular domestic consumption is now probably not over 50 per cent. of normal, owing to the high price of the metal.

Imports of the metal and regulus for July, 1915, were 2,439,601 lb., as against only 856,653 lb. in July, 1914. Before the war about half the antimony was imported from Europe, but now it all comes from Japan and China, indicating the tremendous expansion there. These countries are also exporting to England.

American antimony is now appearing on the domestic market, the production being estimated at the rate of 100 to 150 tons per month, and it is claimed to be superior to the Chinese or Japanese.

LOOKING FOR NICKEL

VICKERS, LTD., the well-known armament manufacturers, are financing an exploration expedition to the Fond du Lac region lying northeast of Lake Athabasca, in northern Alberta, in search of nickel deposits which are believed to occur extensively in that country.

Some months ago H. V. Dardier, a prospector, returned from Fond du Lac with rich specimens of nickel ore and went to England in order to interest British capitalists. He has been placed in charge of the expedition, which is on a large scale, comprising 25 engineers, assayers and mineralogists in addition to a large force of laborers.

They take with them machinery valued at $50,000 and supplies costing $10,000, being prepared for a long stay in order to thoroughly prospect the region. The total cost of the enterprise will amount to fully $100,000.

U.S. Production of Spelter.—The production of spelter in the United States for the first six months of the present year amounted to 207,634 tons, made from domestic ores, and 8,898 tons from foreign ores, making a total of 216,532 tons, as compared with 177,991 tons for the preceding six months and 175,058 tons for the first six months in 1914, according to Mr. C. E. Siebenthal, of the U.S. Geological Survey.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

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Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Ajax Metal Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Babbitt Metal
Ajax Metal Co., Philadelphia, Pa.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
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Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Barrows, Foundry
Sterling Wheelbarrow Co., Milwaukee, Wis.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Boxes, Tote
Sterling Wheelbarrow Co., Milwaukee, Wis.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buckets, Grab
Pawling & Harnischfeger Co., Milwaukee, Wis.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Frederic B. Stevens, Detroit.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Pangborn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Millen & Son, Ltd., Montreal.

Chaplets.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Wells Pattern & Machine Works Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chemicals.
W. W. Wells, Toronto.

Chippers, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Clay Lined Crucibles.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Clamps, Core Box
National Clamp Co., Chicago, Ill.

Clamps, Flask
National Clamp Co., Chicago, Ill.

Copper, Phosphorized
Ajax Metal Co., Philadelphia, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Holland Core Oil Co., Chicago, Ill.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes
Northern Crane Works, Ltd., Walkerville, Ont.
Pawling & Harnischfeger Co., Milwaukee, Wis.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

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Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Drying Ovens for Cores.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Pangborn Corporation, Hagerstown, Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

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H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Northern Crane Works, Walkerville, Ont.
Osborn Mfg. Co., Cleveland, O.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

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Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Grinders, Disc, Bench, Swing.
Ford-Smith Machine Co., Hamilton Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.
Geometric Tool Co., New Haven. Conn.

Grinders, Electric
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Pneumatic, Portable.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Hammers, Chipping
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Helmets.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Pawling & Harnischfeger Co., Milwaukee, Wis.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd. Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
J. W. Paxson Co., Philadelphia, Pa.
Seidel, R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Melting Pots.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.
Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works,

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Polishing Wheels.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Retorts.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
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J. W. Paxson Co., Philadelphia, Pa.
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Webster & Sons, Ltd., Montreal.

Rosin.
Webster & Sons, Ltd., Montreal.

Rouge.
W. W. Wells, Toronto.

Sand Blast Machinery.
Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brooksbank Sand Blast Co., Philadelphia, Pa.

Sand Conveying Machinery
Standard Sand & Mach. Co., Cleveland, O.

Sand Mixing Machinery
Standard Sand & Mach. Co., Cleveland, O.
Vulcan Engineering Sales Co., Chicago, Ill.

Sand Molding.
H. S. Carter & Co., Toronto.
Hamilton Facing Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Standard Sand & Mach. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.
Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.
Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.
Pangborn Corporation, Hagerstown, Md.

Sieves.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

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Webster & Sons, Ltd., Montreal.

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Squeezer Molding Machines
Mumford Molding Machine Co., Chicago, Ill.

Squeezers, Power.
Davenport Machine & Foundry Co., Iowa.
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Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
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H. S. Carter & Co., Toronto.
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Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

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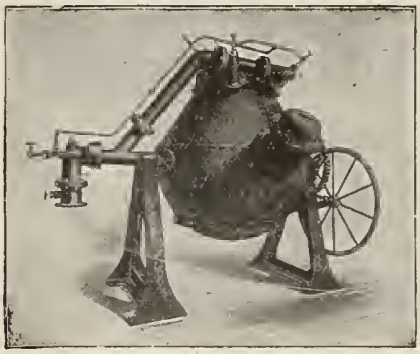
Wire, Wire Rods and Nails.
Dom. Iron & Steel Co., Sydney, N.S.
Osborn Mfg. Co., Cleveland, O.



ADVERTISING INDEX

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CANADIAN FOUNDRYMAN AND METAL INDUSTRY NEWS

A Monthly Newspaper Devoted to the Foundry, Patternmaking, Plating and Polishing Fields. Published by The MacLean Publishing Company Limited, Toronto, Montreal, Winnipeg, and London, England

VOL. VI. PUBLICATION OFFICE, TORONTO, DECEMBER, 1915 No. 12

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

The Publisher's Page

By B.G.N.

"The Passing of Narrow Gauge"

A MESSAGE TO MANUFACTURERS AND SUPPLY MEN

IN the Saturday Evening Post a short time ago, there appeared an article entitled "The Passing of Narrow Gauge." It certainly was worth reading. It would encourage even the rankest and most confirmed pessimist. Let us quote:

> "The broad-gauge man was speaking of the fall in exchange between pounds and dollars. Some big wheat contracts had been cancelled to save exchange. Canada had placed her forty-million dollar loan in New York instead of London, and by so doing had saved over a million in exchange.
>
> " 'Do you care to give any views as to how exchange will be righted?' I asked. He did not care to have his name given, but here is what he said:
>
> " 'England will restore exchange by shipping gold to the United States, and we'll borrow it back from them.'
>
> "Do you appreciate just what that answer meant? Canada is to-day the king-pin of the triangle between London and New York banks. London cannot afford to have gold go permanently out of the Empire. New York cannot afford to have half a billion of gold lying idle in her vaults. Canada will need to borrow, and she will be unable to borrow in England. The present financial movement from London to New York, from New York to Canada, is one of the most significant things that has happened since Confederation. Canada must play the financial game henceforth with Uncle Sam and John Bull as her partners, and she holds the pivotal place in the game. Will she be broad-minded enough to play it? Yes, for the narrow-gauge man will pass off the boards.
>
> "For a hundred years Canada and the United States have existed side by side without a fortress. For the next hundred years they will exist side by side, bound together by gold strands."

¶ A day or so before this issue of Canadian Foundryman went to press the sales manager of one of our leading steel companies told us that inquiries and orders for pig iron were being received every day from all over the country. He expressed the opinion that business is showing a vast improvement.

¶ Similar reports are being received from various other sources, and it looks as though the promised wave of prosperity is already breaking on our shore.

¶ Improved business conditions means new foundry equipment and supplies immediately. The scarcity of labor will naturally result in a big demand for labor-saving machinery.

¶ If we were to advise you to commence now to advertise your line in Canada's only Foundry paper, do you think you could go very far wrong?

Canadian Foundryman
143-153 University Ave., TORONTO

MONARCH Furnaces

The Moon rises,
The Sun sets,
but
The light of "MONARCH"
"never fades"

We guarantee Monarch Melting Furnaces to save you 50% on your melting costs—they are very efficient and economical.

Built for all metals, all fuels and all conditions, with crucibles or without, with iron pots ''Stationary or Tilting.''

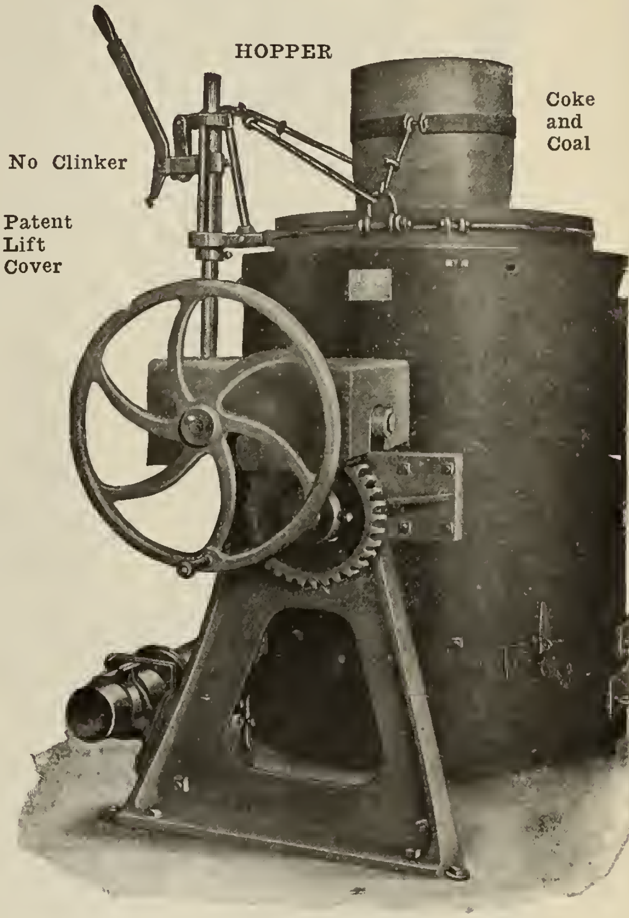
IRON POTS for soft metals—''Tilting and Stationary'' for aluminum, lead, tin, spelter, babbitt, dross, etc.

REVERBERATORY both ''Tilting and Stationary,'' from 500 to 10,000 lbs. capacity. All Fuels. ''Rockwell'' Simplex and Double-Chamber Brass Melting Furnaces, formerly made by Rockwell Furnace Co., New York (We own and manufacture).

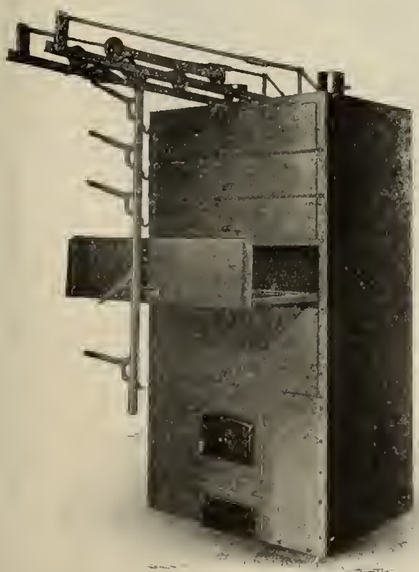
SPECIAL FURNACES FOR HIGH HEATS, boron, iron, steel, alloys, etc.

PORTABLE HEATERS for moulds, ladles and lighting purposes, dispensing with wood in cupola.

MONARCH FURNACES HAVE INVARIABLY BROUGHT US RE-ORDERS FROM THOSE GIVING THEM A TRIAL—Could they do this without distinctive merit?



Furnace in Belting Position, Hopper Feed, Shaker Grates.



Monarch-Acme Double Track Core Oven, Coke Any Size. For All Fuels.

—MONARCH "ACME" CORE OVENS

All Fuels—all sizes—all hand-made—sheet steel—asbestos insulation—built up to 6 feet square—portable or bricked.

Our ''Arundel'' Core Oven is of the same quality construction—its drop-down front is the only difference.

THESE OVENS DEFY COMPETITION—THERE ARE NONE BETTER.

Be sure to drop us a card for catalog C.M., 1915.

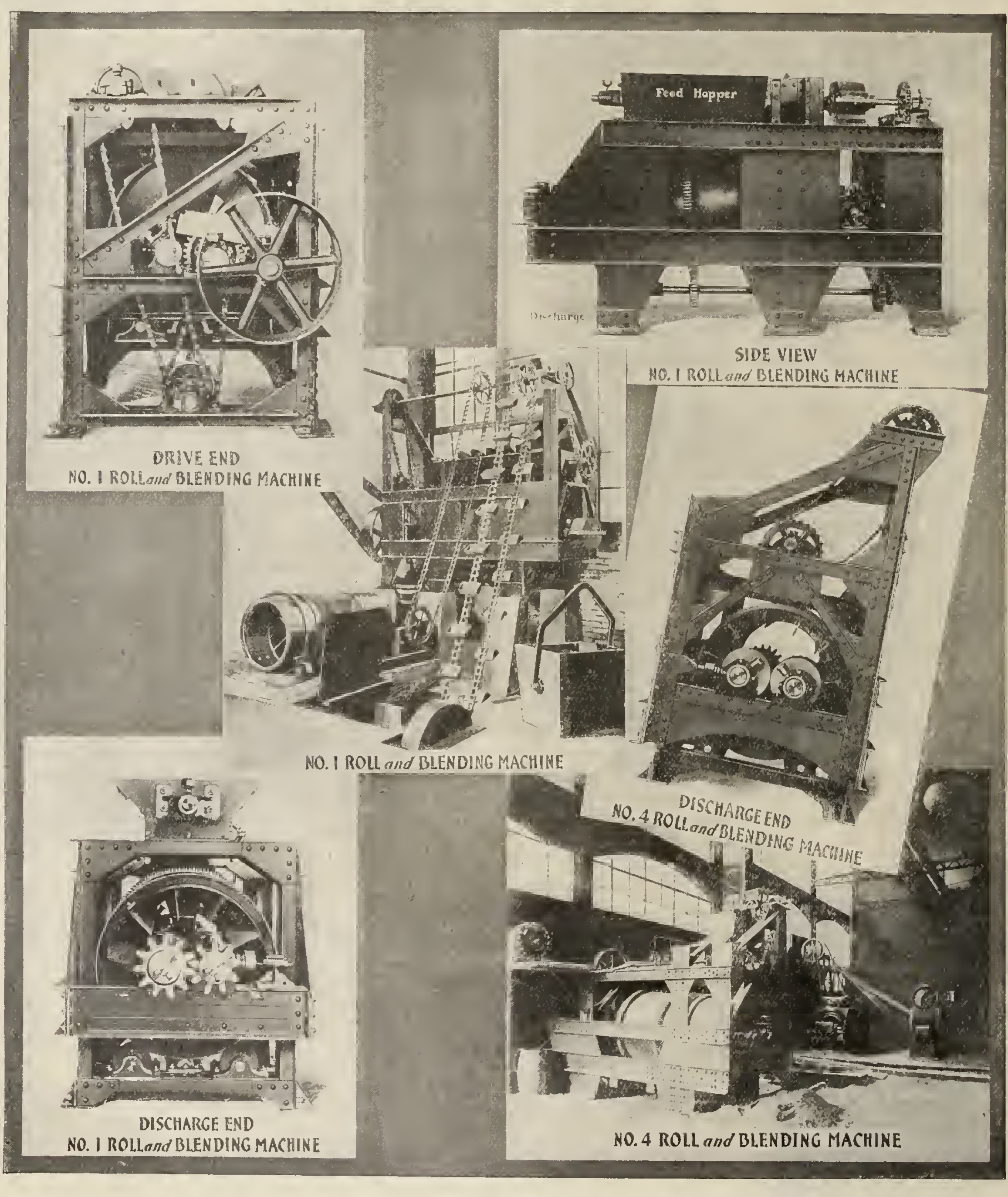
The Monarch Engineering & Manufacturing Co.

1206 American Building, Baltimore, Md., U. S. A.
Shops: Curtis Bay, Md.

STANDARD

SAND MIXING and CONVEYING MACHINERY

Is being widely copied, which proves its established record of fifteen years in the foundries.



Don't worry about the scarcity of labor to handle your raw and finished material. DO IT MECHANICALLY. Our Engineering Department will gladly show you how.

The E. J. WOODISON CO., Canadian Agents

The Standard Sand & Machine Co., Cleveland, Ohio

Plant of the Steel Company of Canada, Hamilton, Ont.--II.

Staff Article

From the ore mines of Mesabi to the fighting front in France is a long way to go, but not long enough to prevent a steady flow of shells and other munitions of war. The help which Canada is giving to the Empire, grows in volume and variety as it progresses Eastward and the valued assistance being rendered by establishments such as the one described in this article are a convincing evidence of Canada's present power and future potentiality.

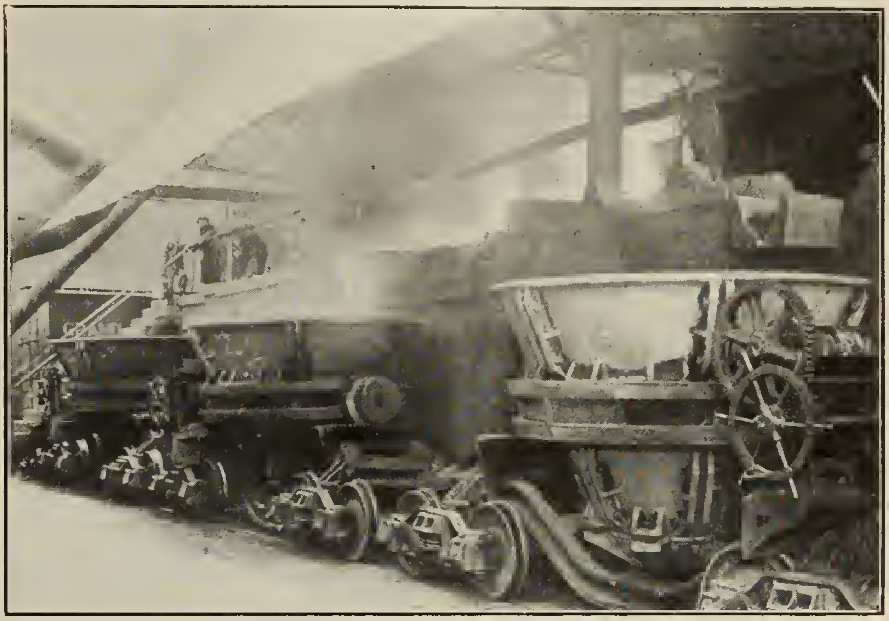
THE operations connected with the smelting of iron ore are of more than passing interest to foundrymen, not only because of their similarity in general features, but also from the fact that the work of the iron founder is very largely influenced, favorably or otherwise, by the care taken by the blast furnace plant in the production of proper grades of foundry pig iron.

In our previous issue the production of pig iron in a modern plant was described in considerable detail. With the subsequent refining operations and furnace work our readers are perhaps not so familiar. The general similarity of plant, however, and the handling and manipulating of molten metal and kindred operations possess added interest to foundrymen.

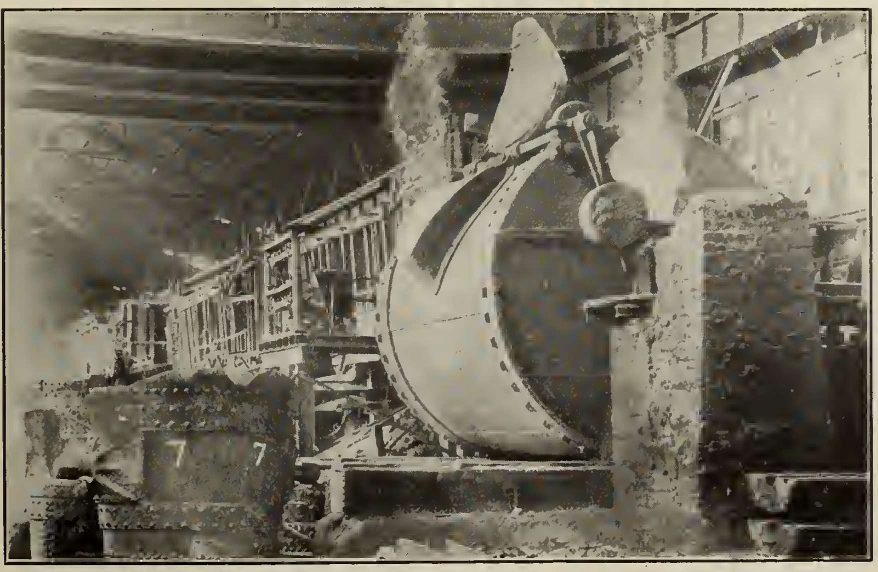
A sectional view of the furnace plant is given on page 216, while the accompanying views of the melting platform, charging machine, casting pit and ingot teeming give a good idea of the actual conditions under which the work of steel making is carried on.

The furnaces, which are in continuous operation, are of the stationary type, in which the metal is drawn off through a tap hole in the sides (see photo of casting pit). The melting platform or charging floor is on the other side of the furnaces and on the same level as the hearth. Two charging machines travel along this floor on rails, while directly in front of the furnaces is a standard gauge track on which trucks convey the scrap metal and limestone which are deposited in the furnaces through the various doors shown. Spanning the casting pit, which is situated on actual ground level, are two traveling cranes for handling the ladles in charging, teeming, etc. The mixer, which is at one end of the casting pit, is also served by these cranes.

Situated on the opposite side of the charging floor and at a lower level are the gas producers, which supply the necessary fuel for the furnaces. Regenerators or preheating chambers are built beneath the charging floor, and perform a similar function to that of the hot blast stoves in connection with the blast furnace.



RUNNING SLAG FROM THE BLAST FURNACE INTO LADLE-CARS.

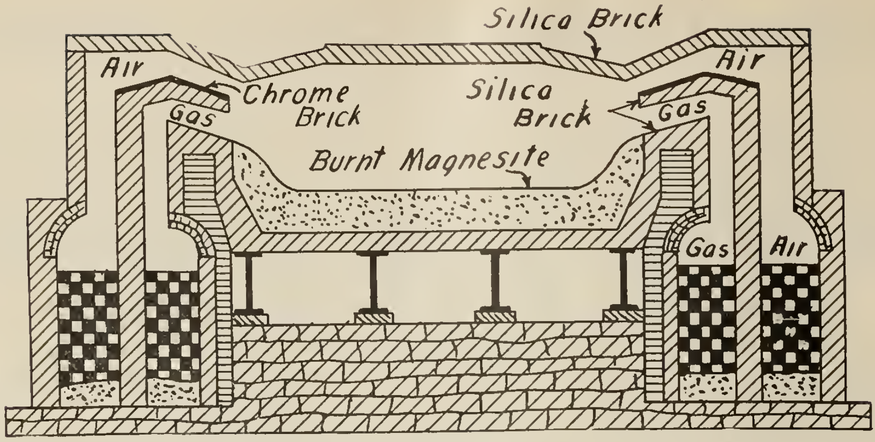


THE MIXER WHICH RECEIVES THE MOLTEN IRON TO PREPARE IT FOR TREATMENT IN OPEN-HEARTH FURNACE.

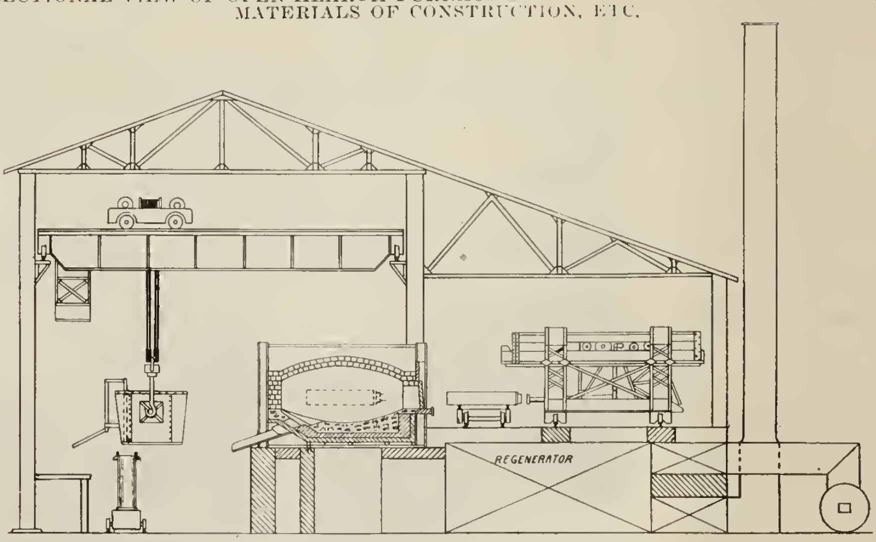
Construction of Furnaces

A longitudinal section of one of the furnaces is given on page 216, from which the principle of construction can be understood. The hearth in which the metal lies is formed of a shallow dish-like depression, which in the case of a 50-ton furnace is about 24 inches deep. The bottom is composed of a magnesite brick shell on which is built up a special lining of calcined magnesite with a small proportion of anhydrous tar, which acts as a binder. This magnesite and tar is deposited on the surface, where the tar is immediately incinerated, forming a strong frame work, which holds the magnesite securely in place. By means of successive layers this protective coating is built up to a thickness of 18 inches.

The fuel and air enter the furnace through separate ports at the same end of the furnace. Ports are provided at



SECTIONAL VIEW OF OPEN-HEARTH FURNACE SHOWING GAS AND AIR PASSAGES, MATERIALS OF CONSTRUCTION, ETC.



SECTION OF OPEN-HEARTH FURNACE BUILDING.

both ends, however, so that each pair of ports alternately acts as exit for the products of combination, which are conveyed through the regenerators to the chimney flue. After a suitable lapse of time the ports are reversed, so that the incoming gas and air is heated by the regenerators which were previously being heated by the waste gases, the ports which formerly supplied the fuel and air now acting as exits and allowing the regenerators in their flues to be heated again.

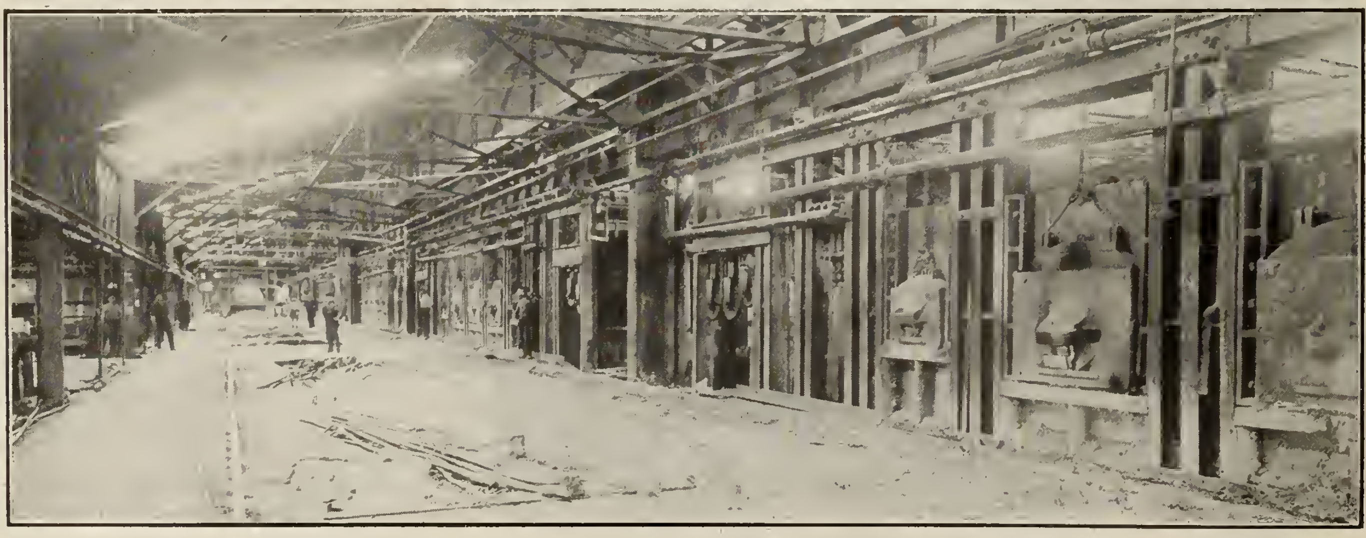
Charging the Furnace

In charging the furnace, the charging machine is placed opposite the furnace door. Between the machine and the door is a truck with a number of long buckets containing limestone. One end of each bucket is specially formed so that the arm of the machine is able to pick it up and carry it forward into the furnace and then revolve it, so that the contents are distributed equally over the bottom. Steel scrap and other cold metal is then added, and lastly, the molten iron from the blast furnace, which has been held over in the mixer till the furnace is ready to receive it. This molten iron is charged through a special door on the casting pit side of the furnace. The object in charging this last is to avoid damage to the furnace lining, which would result from dropping solid lumps of stone and metal into the liquid iron.

The charge melts down in about five hours or so. When this is complete, the melter takes a sample and continues to do so at stated intervals, until the laboratory tests show the desired composition. The charge is now run off through the tap hole, which was securely closed by forcing material into it from the inside of the furnace. As will be observed in the illustration of the casting pit, a gallery extends round the furnace close to the tap hole, and the hole is pierced by a man from this position. The metal pours out in a state of great fluidity, its appearance being like white hot water. After 35 or 40 tons are in the huge ladle, the surface ripples and waves, due to the pouring, continue to travel back and forth across the surface, and indicate in a most impressive manner the wonderful nature of the operations incidental to the production of steel.

The results of the various reactions which take place in the open-hearth furnace are these.

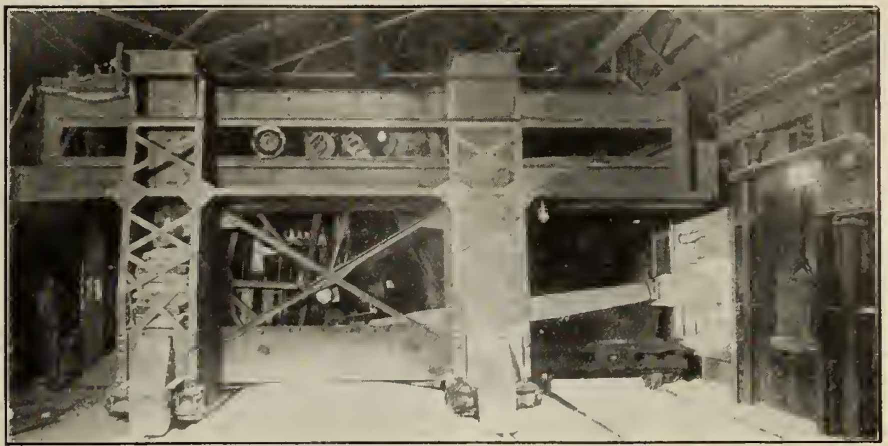
The molten lime absorbs the silicon, manganese and phosphorus with a proportion of sulphur, after which it floats on the surface of the metal and protects it from being oxidized by the furnace gases. The carbon content is brought down by introducing iron ore at a suitable time, the



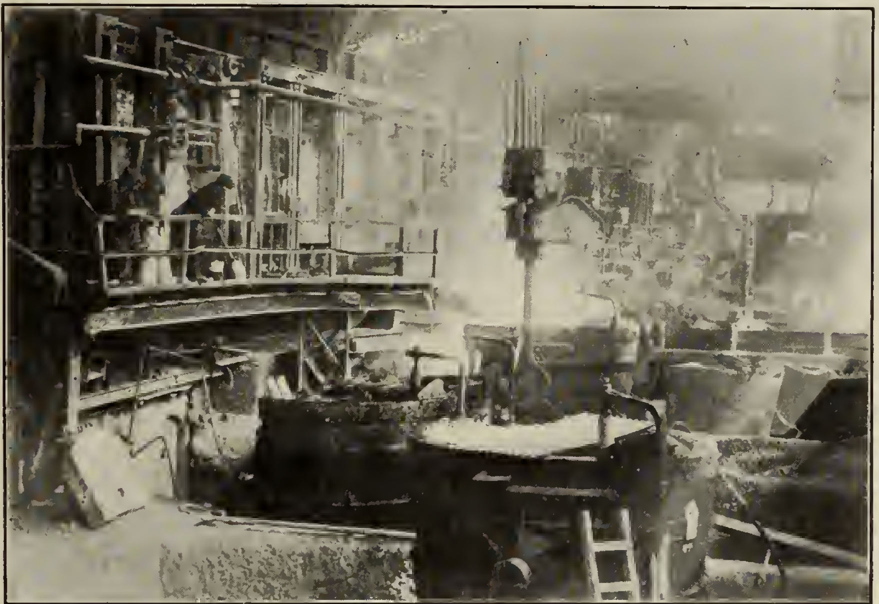
CHARGING FLOOR IN OPEN-HEARTH BUILDING. FURNACES ON RIGHT.

oxygen of which combines with the carbon, boiling off and escaping as gas.

While the metal is running off into the teeming ladle it is recarburized by adding to it the necessary quantity of ferromanganese and charcoal or coke. These materials are prepared in suitable size, and at a given time during the filling of the ladle, two large paper bags containing the mixture are thrown in from the gallery. About half of the carbon content of the materials is absorbed by the steel, and if all calculations and operations have been correctly made and carried out, the steel has now a composition roughly as follows: Silicon, 0.15 per cent.; sulphur, 0.03 per cent.; phosphorus, 0.05 per cent.; manganese, 0.70 per cent.; carbon, 0.50 per cent.



CHARGING MACHINE DEPOSITING MATERIAL IN FURNACE.

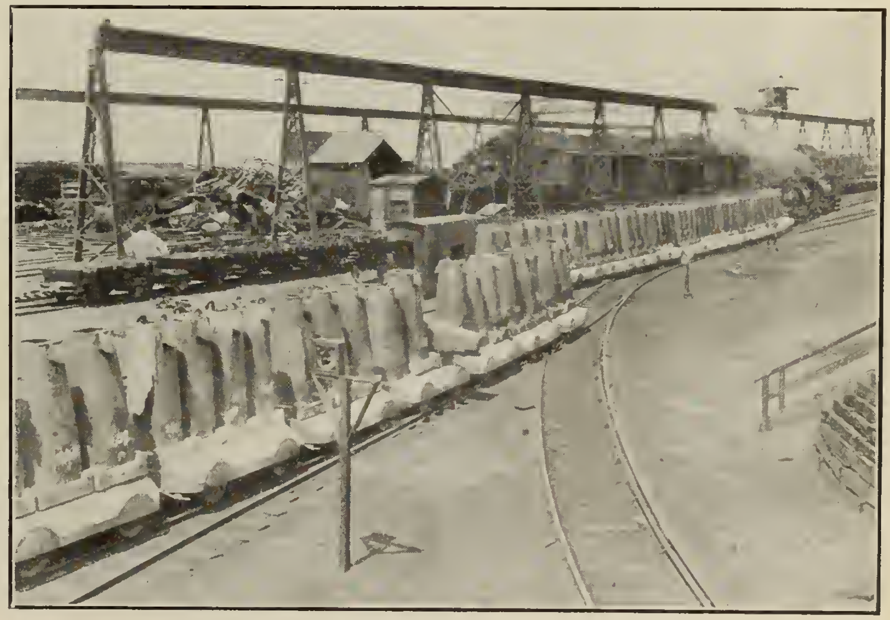


CASTING PIT. RUNNING CHARGE FROM FURNACE INTO TEEMING LADLE

Teeming

The pouring of the molten steel into moulds is known as teeming. The teeming ladle is made of heavy sheet steel lined with fire-brick and provided with a stopper or plug which fits into a hole in the bottom. The stopper is controlled by a handle which allows the operator to control the flow of metal into the ingot moulds, the ladle being moved over each mould by the overhead crane from which it is suspended. These moulds are of very massive cast iron construction and rest on stools carried by the cars. After the ingot moulds are filled, the train of cars is taken to the rolling mill, by which time the metal is sufficiently solidified to allow the mould to be drawn off or stripped, as shown in photograph. This is done by a 75-ton Alliance crane, which has a pair of links which grip the mould under the lugs and pull it up clear of the ingot. Another crane immediately grips the ingot and deposits it in a section of the soaking pit, where it is maintained in an upright position at a steady temperature for about one hour. This treatment is necessary to allow the ingot to attain an even temperature throughout, and also to confine the pipe or segregation core to the centre.

Each soaking pit furnace supplies heat to four holes, 5 ft. x 8 ft. 6 in., capable of holding eight ingots each, and served by a 10-ton soaking pit crane installed by the Morgan Engineering Co. These furnaces are fired by producer gas generated by four Morgan gas producers. They are provided with regenerating chambers similar to the open-hearth furnaces, suitable chambers and passages being provided for reversing the flow of the gases in order to utilize all of the heat. A photograph on page 218 gives a view of the top, showing the hydraulic cylinders which operate the doors. These doors are made of fire-brick tiles, supported in a suitable frame and run on wheels giving easy access to the various pits. The actual manufacture of the steel is now completed, as all subsequent operations are of a more



TRAIN OF INGOT MOULDS EN ROUTE TO ROLLING MILL.

or less mechanical nature, and exercise no decisive influence on the chemical composition or quality of the steel.

The Mechanical Treatment of Steel

Steel which is cast, i.e., poured into moulds after being drawn from the furnace, is subject to certain defects, the prevention and removal of which can be accomplished by suitable means. Ingotism, piping and segregation are three of the defects liable to occur in steel. The former consists of the formation of excessively large crystals which form when molten steel is cooled too slowly, and also when it is not poured at the correct temperature. This crystalline structure when allowed to take place may persist throughout the entire ingot, whereas piping and segregation are more of a localized nature.

"TEEMING" THE MOLTEN STEEL INTO INGOT MOULDS.

Piping, the term applied to the central porous core at the upper end of the ingot, is due to the shrinkage of the outer layers which induces an outward flow of the still liquid metal in the centre. This reduction in internal pressure also facilitates the evolution of contained gases which fill up the spaces left by the solidifying metal, resulting finally in the peculiar structure known as a "pipe."

Segregation is a partial separation of the various ingredients from the iron during solidification, due to the difference in fusibility of the various impurities and the iron itself. As the presence of some of the impurities lowers the melting point of the iron without increasing their own solubility, the result is that when the lower layers of steel solidify, a small portion of the impurities is rejected and passes upward into the still molten metal. This action proceeds upward through the ingot until when the topmost metal reaches the point of solidification, the percentage of impurities present is considerably greater than in the bulk of the ingot.

Segregation and piping cannot be entirely eliminated, but by suitable treatment and the use of deoxidizers, such as aluminum, etc., the trouble can be not only greatly reduced, but localized, so that the cropping of a comparatively small portion of the upper end of the ingot removes completely all possibility of harm from these causes. The progress made in this direction will be realized from the fact that although specifications for shell steel called for the discard of 40 per cent. of the ingot when operations were commenced, the thoroughness of manufacture and the resulting high quality of material have enabled this loss to be reduced below 15 per cent. with a large margin of safety.

Rolling the Steel

Having now been in the soaking pit

REMOVING HOT INGOT FROM SOAKING PIT TO BE ROLLED INTO BLOOMS IN THE BLOOMING MILL.

STRIPPING THE MOULD FROM THE HOT INGOT.

long enough to attain the necessary condition as regards solidification and temperature, the ingot is withdrawn from the pit by the crane and deposited on the approach table of the blooming mill. The ingot, which is 15 in. x 17 in. x 7 ft. long, is passed back and forth between massive steel rollers, which while reducing its cross-sectional area, increases its length until, when reduced to about 6 inches square, the bloom, as it is now termed, is 50 ft. in length.

ELECTRICALLY-DRIVEN REVERSING BLOOMING MILL.

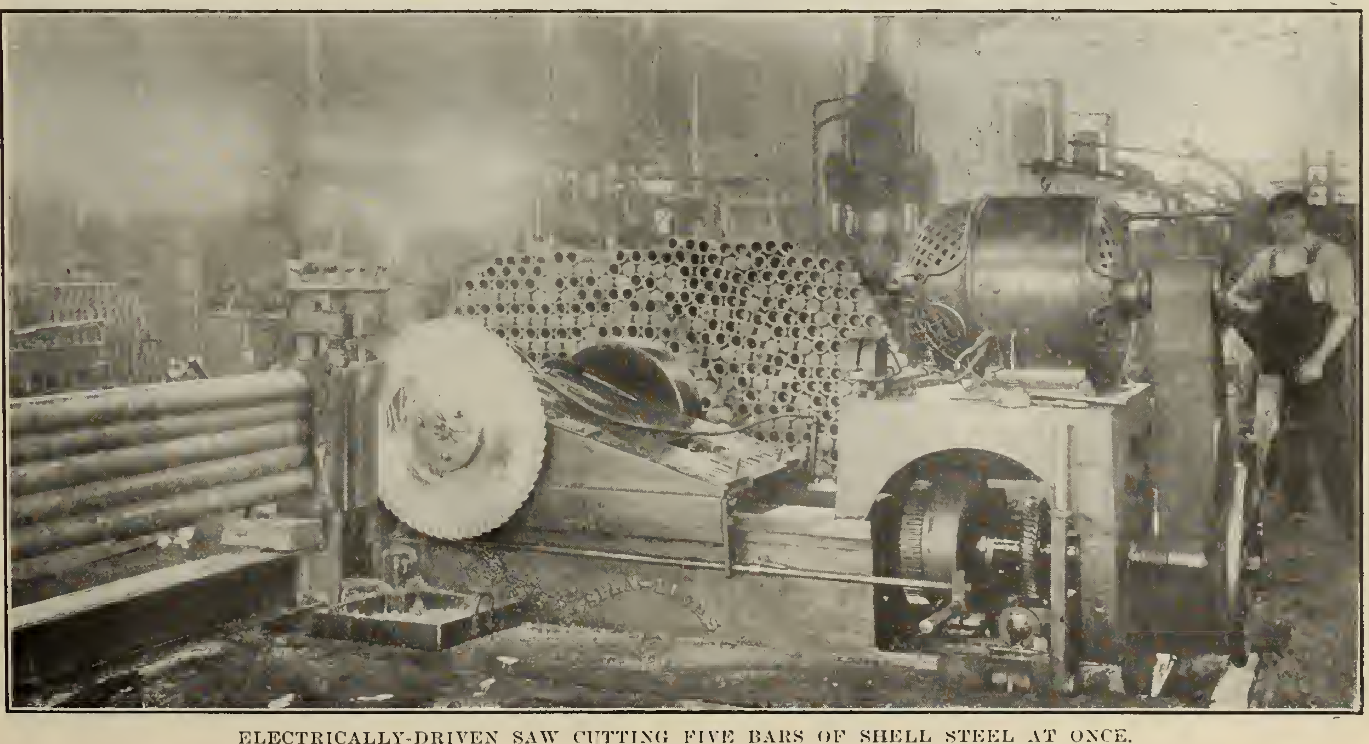
A photograph on this page shows a semi-finished bloom entering between the rollers of this mill, which is very complete in design and construction and along with its power plant is one of the best examples of modern steel working machinery on this continent.

The installation consists of a two-high 34-inch reversing motor-driven blooming mill designed by the Morgan Construction Company and built at the Lloyd-Booth plant of the United Engineering and Foundry Co., Pittsburgh, and is served by a Shaw 20-ton crane. The approach table in the immediate foreground is operated by a 30 horse-power direct-current motor, while the tables on either side of the mill are driven by 100-horse-power motors. The side guards for handling the bloom from one part of the rolls to another, are operated by hydraulic gear to the right of the tables. Here are also located the pinion housings. The lower pinion is directly coupled to the motor shaft, which passes through the wall into the power house; the other end of the pinion shaft is coupled to the lower roll of the mill.

The spindle or shaft which connects the upper pinion with the upper roll is provided at either end with a flexible coupling or wobbler, so that the spindle may assume an inclined position as the upper roller is raised or lowered to suit the thickness of metal passing between the rolls. The traveling crane is provided with special tackle to facilitate changing rolls and replacing pinions, etc., in case of accident. The entire operation of the mill is controlled from a platform or pulpit located above the table, affording a clear view of the rolls and the work.

After being reduced to the desired size, which is accomplished in 15 to 18 passes, the bloom is cut to suitable lengths in a 10 x 10-inch vertical bloom shear, which then go to the finishing mill, which reduces them still further to a round section of suitable diameter according to the size of shell to be made.

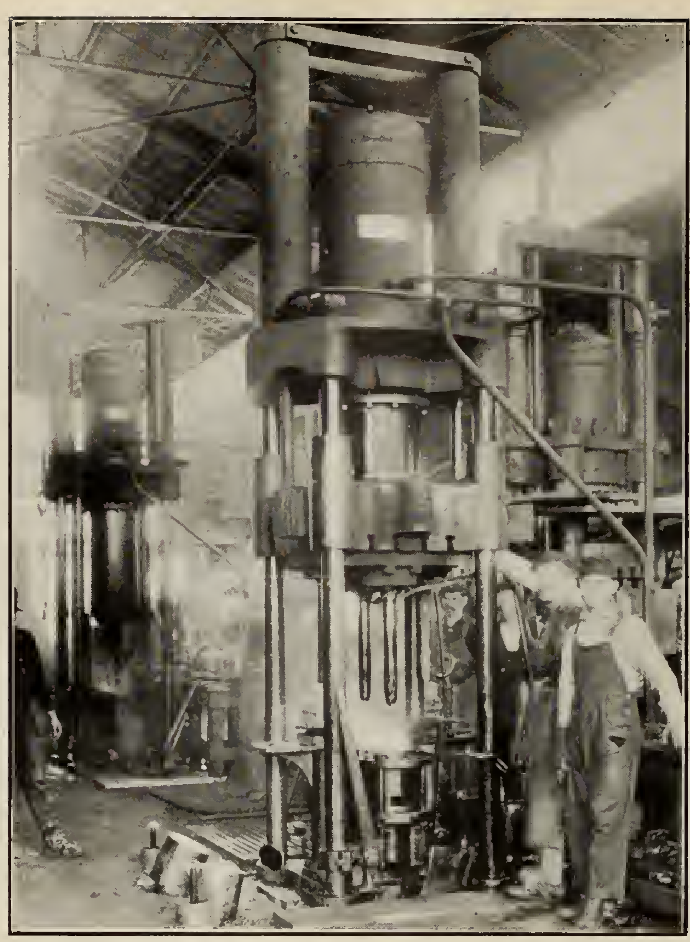
The blooming mill is driven by a 3,000 horse-power normal rating twin armature reversing motor, constructed by the Canadian Westinghouse Co., Hamilton, Ont., operated by electric power purchased from the Dominion Power & Transmission Co., which operates a 42,000 h.p. hydro-electric plant near St. Catharines, Ont., about 40 miles distant. The current, which is received at 44,000 volts, 66 2/3 cycles, is stepped down to 2,200 volts three-phase for the large motors and to 220 volts, two-phase, for several smaller motors and for lighting



ELECTRICALLY-DRIVEN SAW CUTTING FIVE BARS OF SHELL STEEL AT ONCE.

and all other purposes throughout the plant.

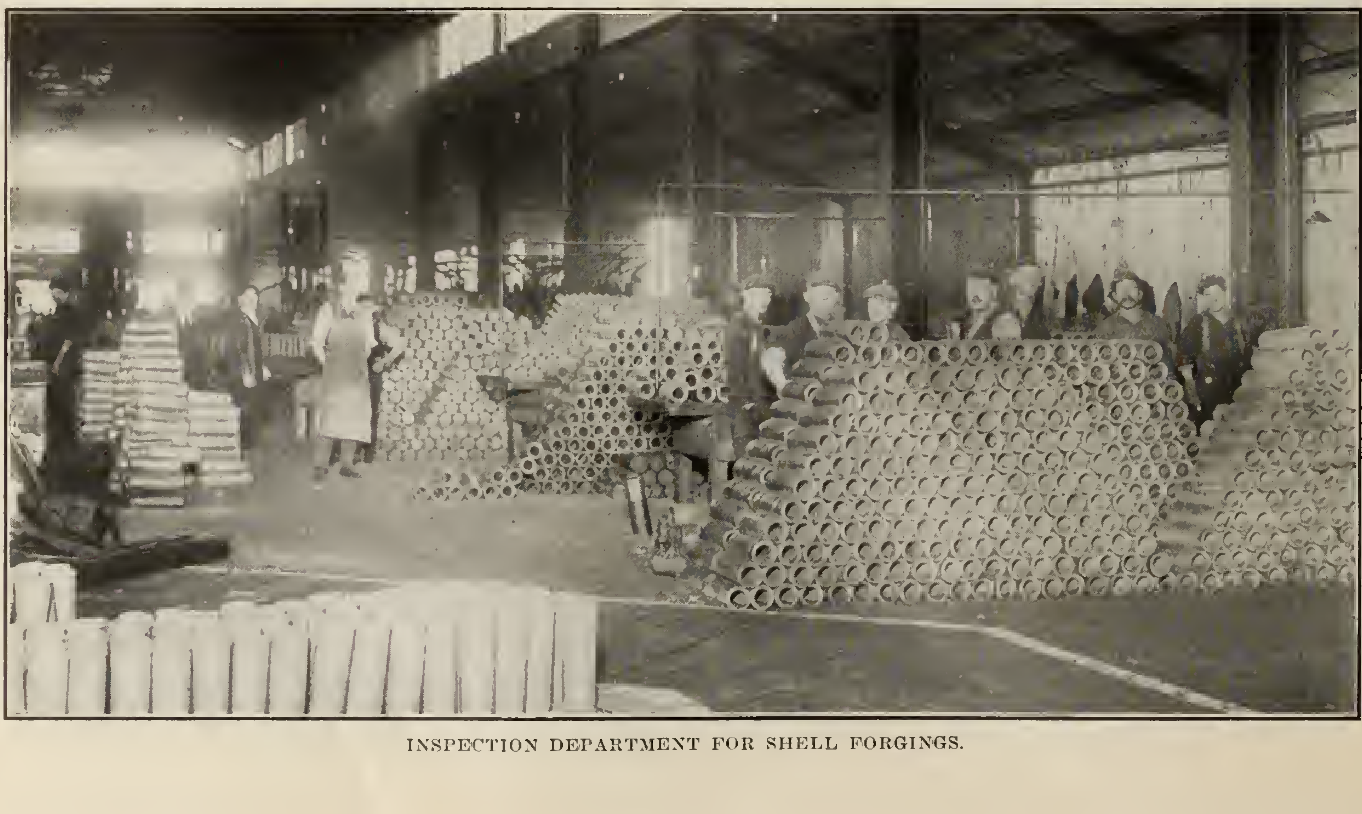
When breaking down ingots into blooms for the billet mill, the steel is given 18 passes through the rolls, but when breaking down for 6 x 6-inch blooms, the number of passes is reduced to 15. It is apparent, therefore, that the loads on the motor-generator set which supplies power to the reversing motor will vary rapidly over a wide range, the rate of change at times aggregating 4,000 to 5,000 horse-power per second during acceleration and approximately the same when braking. A load of this kind from the standpoint of power supply would be exceedingly undesirable and the cost of the current necessarily would be excessive. The twin armature reversing motor, while rated at 3,000 horse-power is, therefore, designed to carry a momentary peak load of 8,000 horse-power, receiving the necessary electrical energy through the medium of a motor-generator flywheel set consisting of one 1,800 horse-power alternating current, 2,200-volt, three-phase motor mounted on a common shaft with a 50-ton flywheel and two 1,200 kilowatt generators. This set is located in a power house on the other side of the wall from the blooming mill. Under light loads the fly-wheel has a speed of 500 r.p.m., while under the heaviest loads its speed does not fall below 400 revolutions per minute. The flywheel stores up energy during the period of light load and attains its maximum speed. When the heavy momentary loads comes on, the speed of the flywheel is allowed to drop, thus enabling it to deliver some of its stored-up energy in order to help the generators supply sufficient power to the reversing motor without making excessive demands on the external supply of electrical power.



VIEW OF SHRAPNEL FORGING PRESS SHOWING PUNCHES FOR PIERCING THE SHELL BLANKS.

To enable the flywheel to assist the 1,800 horse-power motor to drive the two 1,200 kilowatt generators, during maximum demand periods, an automatic slip regulator has been installed, which introduces resistance in the rotor circuit as the output to the set increases, the speed thereby being reduced and a portion of the flywheel energy utilized for driving the two generators. Reducing the load on the generators automatically cuts out the resistance, and as the speed increases, energy is again stored in the flywheel.

The speed and direction of the rotation of the 3,000 horse-power motor are controlled by changing the polarity of the generators and varying their field strength, thereby varying the voltage applied to the armatures of the mill motor. This eliminates rheostatic losses except in the field circuit and permits any desired speed to be obtained independent of the load. As a result of this arrangement, no peak loads are taken off the line and the current input to the motor-generator set is maintained practically constant. The blooming



INSPECTION DEPARTMENT FOR SHELL FORGINGS.

mill motor complete weighs 429,000 pounds, and the rotating part, which operates at a maximum speed of 100 revolutions per minute, weighs 164,000 pounds. This motor is provided with a thrust bearing on its shaft and a braking coupling is installed between the bearing and the pinion housing. The flywheel set weighs 367,130 pounds, and the rotating part weighs 240,000 pounds.

Ventilation is provided by a Sirocco fan installed by the American Blower Co., Detroit, which has a capacity of 24,000 cubic feet of free air per minute.

Forging the Shell

The round bars, from which the shell forgings are made, are of considerable length and must be cut to an exact size so that excess material or waste is reduced to a minimum. The bars or "rounds" as they are termed by the trade are cut off by electrically driven cold saws as illustrated on page 219. This photograph shows one of several machines which are engaged continuously on this work. The long bars are clamped in a frame or rest which holds them in a curved position corresponding to the curve of the circular saw so that all five bars are cut through simultaneously, and no time is lost waiting for the last bar to be finished by itself as happens in some cases.

All forgings for shrapnel and 4.5-inch shells are produced by hydraulic presses, the two-operation method being adopted as the most satisfactory. In order to handle the immense volume of work involved, an entirely new forging shop with complete equipment was installed and has already produced innumerable forgings for both shrapnel and 4.5-inch high explosive shells.

From the cold-sawing machines, the billets, as the pieces are called, now proceed to the heating furnaces where they are carefully brought up to the necessary temperature. The shrapnel billet is 6½ inches in length by 3 5/16 inches diameter and is forged at a temperature between 1,900 to 2,100 degs. F.

The process of forging as performed here consists of two operations, viz., piercing the solid billet, and then drawing the pierced billet out to length, this second operation including cupping or forming the pocket for powder cup. The north portion of the building is devoted to shrapnel forgings exclusively while the south end houses the 4.5 department. Each installation is complete with numerous hydraulic presses, heating furnaces, etc., the hydraulic power being supplied from a central station on one side of the building at the centre. Views of these departments are shown on pages 220-222, also the stock of finished forgings undergoing inspection by government officials. When piercing, the hot billet is placed in a cup-shaped die, and a round nose punch is forced into it causing it to fill out and extrude upwards around the punch. Suitable stripping gear removes the pierced billet from the die, and it is immediately transferred to an adjoining press for cupping and drawing.

In order to form the interior to the desired shape, the point of the drawing punch is made to the proper outline and the press is moved downward forcing the punch into the bottom of the billet which rests in a cupping die placed in position temporarily. Solid stops are arranged to arrest the travel of the punch at the required point after which the punch with the forging on it is raised slightly to allow the cupping die to be removed. The punch is now forced down through the drawing dies which draw the hot metal up around the punch giving the proper outside diameter to the forging which now has the form of a tube with one end closed.

The finished forgings are now deposited on end in large groups on a cinder floor which retards the cooling sufficiently to avoid any trouble due to air hardening, etc. As each forging leaves the drawing press, it is stamped with a number indicating the heat or melt of metal from which it is made, and is gauged for depth of bore and thickness of wall. After cooling it is finally inspected and marked after which it is transferred to the machine shop for completion, or forms one of the great number of forgings supplied by the company to numerous machine shops throughout the Dominion, engaged in machining and assembling shells and components.

VIEW IN SHRAPNEL FORGING DEPARTMENT.

The Spirit of the Plant

The vagaries of fate are well illustrated by the fact that while "doing their bit" in producing the much-needed material required by the Empire, the company, adhering to the most modern business policy, is an admirable exponent of the humane principles of "safety first." The mutual consideration for each other's interests which exists between the company and its army of employees is well evidenced by the environment of harmony which permeates the atmosphere of the entire organization.

In the midst of industry and activity, heat, smoke, grime, and other inseparable features of steel manufacture, the company has not failed to realize its moral duty to those whose toil and effort, both of brain and muscle, have helped to establish and maintain the position of the company in the foremost ranks of Canadian industry.

Firm believers in that old adage, "a sound mind in a sound body," the company's sentiments received concrete expression in the form of an athletic field, which is the home ground of a ball club of no small ability. Situated in front of the main offices, club room and library buildings, this expanse of green contrasts pleasantly with, and forms a welcome oasis in the midst of furnaces, mills, forges, machine shops, and railroad tracks.

The creature needs and comforts of all members of the staff are most carefully attended to in the staff building. A club restaurant, library, rest room, accident ward and hospital for sick and injured, are a few of many evidences of the reciprocal spirit of the plant, and in maintaining the surroundings in a high state of artistic excellence — well-kept grounds, vine-clad buildings, expert landscape gardening, etc.—the company betrays that attention and consideration for every detail, which has been an all-important factor in placing it in the enviable position which it now occupies as one of Canada's leading industrial establishments.

GUNMETAL: ITS COMPOSITION AND APPLICATIONS

THE following is a short summary of an article recently published in the "Foundry Trades' Journal":

The compositions which come under the heading of gunmetal include chiefly the following:

Copper	Tin	Zinc
88	11	2
88	11	1
87	8	5
87.5	6.25	6.25
84	12	4

The first of these is the recognized Admiralty steam metal, the second is used for general admiralty work, the third is for propellers, the fourth for bolts, and the fifth is a well-known metal for bearings. In making gun-metal, the copper should be melted first at a fairly rapid rate in a good fire, a cover of broken glass or powdered charcoal being used to protect from the atmosphere or from furnace fumes. When the metal is molten, the tin should be added, and finally, just prior to pouring, the zinc, the temperature then being raised slightly to overcome the chilling effects of the addition. A small piece of phosphor-copper used as a deoxidiser adds fluidity and aids soundness. The great essential in Admiralty specifications is purity of raw materials; the copper used should not contain more than 0.25 per cent. of arsenic, nor the zinc more than 0.25 per cent. of lead. Care must be taken not to overheat the metal in the furnace, nor to keep it at full heat for any longer time than is necessary; the molds must be ready when the metal is ready. The maximum temperature of pouring may be taken as 1,300 deg. Cent., and the aim should be to bring out the metal at this heat in order that it may enter the mold at not less that 1,100 deg. Cent. The rate of pouring should be more rapid than with iron; in fact, the metal should be poured as rapidly and fully as possible. Gun-metal being a somewhat sluggish metal, it is well to flush the mold by pouring extra metal through to clears away any gases which are liable to be entrapped.

The molds may be either green-sand or dry-sand. Much small work can be cast in green-sand, but if difficulty is experienced with blow-holes, it is advisable to dry the molds, and this is frequently done in larger work, as the trouble may be due to gases created in the molding blowing through the metal to escape. These gases are, of course, practically removed during the drying process, and there is only the contained air in the mold to be attended to. An open-grained sand usually obviates this trouble. Holes due to the liberation of dissolved gases are only dealt with by more careful melting or by changing the copper for a purer brand. In order to allow rapid pouring, the gates should be ample. Parts to be machined should be cast down; as any oxide present works to the top. The sand used in moulding should be of open texture and drier than is used for iron. The molds should be well rammed and well vented.

PORTABLE CHANNEL IRON PUNCH

AN addition to their existing line of portable hand metal punches, has just been made by the W. A. Whitney Mfg. Co., Rockford, Ill., in the shape of a punch for handling channel iron.

The tool as can be observed from the illustration is designed principally for use on channel or other similar flanged work, the gap on the end of frame lever being so shaped that the tool can be slipped over the end of the section and moved along to the desired part.

"WHITNEY" PORTABLE CHANNEL IRON PUNCH.

The portable channel iron punch has a capacity of a 1/4 inch hole through 1/4 inch iron, and can punch to the centre of 4 inch channel iron having 1 1/2 inch flange. It uses the same punches and dies as the makers' No. 2 punch, all the small parts of each being interchangeable. The sizes of punches and dies are from 1/8 inch to 1/2 inch, advancing by 1-32 rds.

4.5 IN. SHELL FORGING DEPARTMENT.

Papers Read at the Recent Foundrymen's Convention

Selected from the more important subjects presented for discussion before the Annual Convention of the American Foundrymen's Association and the American Institute of Metals at Atlantic City, N.J., during September, 1915. The papers cover a wide field of foundry and allied activity, the nature of the results and the completeness of the reports making them of particular interest to all who desire to keep in touch with metallurgical progress.

CONCERNING "STELLITE"

By Elwood Haynes.*

THE name STELLITE was coined from the Latin word "Stella," a star. This name was first applied to a binary alloy consisting of cobalt and chromium, which the writer discovered and produced as early as 1899. It was not until some years later that its properties were fully investigated, when it was found to possess the following properties:

1. A considerable amount of hardness, as alloys containing 10 per cent. or more of chromium could not be successfully filed, though the file could slowly wear away the suface of the metal.
2. Considerable toughness. Alloys containing as high as 25 per cent. chronium showing elongation of 10 per cent. or more.
3. Comparatively high tensile strength and elastic limit. A bar of forged metal showing elastic limit of 85,000 pounds and tensile strength of 110,000 pounds.
4. Fine color and lustre. The color of the alloy lies between that of steel and silver.
5. Absolute resistance to oxidation or other changes when exposed to either dry or moist atmosphere at all temperatures under a dull red heat.

In 1911 the writer succeeded in producing very hard alloys (consisting essentially of cobalt and chronium) by adding tungsten or molybdenum or both. The hard alloys thus formed could not be scratched with the file, but in turn would scratch any steel that could be produced. Some of these alloys were extremely brittle, and those used for lathe tools require very careful handling. Some of them that showed excellent cutting qualities when used for turning cast iron or steel would break very easily if subjected to any abnormal stress.

In order to determine the stress required to break a ⅜-in. sq. tool, for example, a small clamp was made in the form of a slot precisely similar to the slot used in the tool holder.

A short piece or bar of Stellite was placed in this slot and pressure applied vertically near the end of the bar at a distance of 1 in. from the clamp. Some of the weaker bars broke at from 100 to 300 pounds pressure under this test. Gradually the strength of the bars was increased until they would readily withstand 1000 pounds, and at this time bars are produced for turning steel which readily withstand from 1,200 to 1,500 pounds under the same test. The very hard bars used for turning cast iron usually stand from 800 to 1,200 pounds under this test. Bars that would stand as high as 1,850 pounds have been produced, but were not found to be equal in cutting qualities to some other compositions of slightly less strength. It should be remarked at this point that the cutting qualities of any steel do not depend primarily upon its strength, but upon the suitable combination of strength, hardness, resistance to wear, etc. The strength of a tool is in reality a question of elastic limit. Steels possessing this quality to the highest degree are nickel steels, nickel chrome steels and vanadium chrome steels. For turning steel and iron, however, they are of little or no value, since they lack in hardness and resistance to abrasion, particularly at high temperature.

*Haynes Stellite Works, Kokomo, Ind.

Maintaining the Cutting Edge

The virtue of the Stellite tool lies in its ability to maintain its cutting edge at a high rate of speed at temperatures which would immediately cause the failure of any known tools containing any notable quantity of iron. Its great hardness and resistance to abrasion at all working temperatures are likewise valuable properties.

Owing to the fact that Stellite retains its hardness even at a full red heat, it cannot be forged. This fact, however, is rather a virtue than a detriment so far as use is concerned, because if the alloy would soften sufficiently for forging when heated it would, of course, immediately lose its cutting edge at the same temperature and this would limit its usefulness to a marked degree.

A Recent Performance

From the above fact Stellite can only be reduced to the desired form by casting it in dies in the form of bars which are afterward ground to a cutting edge. Its capabilities as a lathe tool are now universally acknowledged, though in certain cases failures have resulted, due to improper knowledge of the alloy and its peculiarities. It should be remembered that it is not a steel and therefore requires special handling, which enables the operator to utilize its valuable properties to the best advantage.

Without going into the method of handling the alloy, some results obtained by its use may not be out of place. It was recently ascertained that a ⅜-in. sq. x 2½-in. long piece of Stellite, ground to the form of a grooving tool, cut 14,000 grooves in cast iron pistons ranging from 3½ in. to 4⅜ in. in diameter before it became too much worn off for further use. This work was performed in regular practice and not as a test. A still more remarkable and more recent performance has just come to light in the same factory. A Stellite tool of the same dimensions as that mentioned above, but which was ground to the round nose form and used for turning pistons, turned off more than 8,000 pounds of cast iron before becoming too short for use. Considering only the portion of the tool which was actually ground away, the tool turned off 1,000 times its weight of cast iron before becoming too short for service.

Both of the above tools were made especially for turning cast iron. Another combination is used for turning steel, which has also shown equally remarkable results. These tools are now being used extensively for turning shrapnel shells at high speed for the European war.

While long wear is an important property in a lathe tool, it is not the essential or most valuable property. The value of the tool, even at the comparatively high price of Stellite sinks into insignificance when compared with the value of the time saved. For example, in the cast iron performance mentioned above, the Stellite cost only about 1c per day, while it effected a net saving of from $2 to $3 per day. In other words, it is the value of the output which counts and not the cost of the tool.

FOUNDRY EXHIBITION OF 1916

A. O. BACKERT, secretary American Foundrymen's Association, has issued the following statement in his capacity as secretary of a special committee of the American Foundrymen's Association and the American Institute of Metals. Details of the new arrangement for the annual exhibition of foundry equipment and supplies are given in the following letter addressed to the members of the American Foundrymen's Association:

As a result of several conferences, held recently at Cleveland and Pittsburgh, by the special committee empowered by the American Foundrymen's Association and the American Institute of Metals to select the time and place for the 1916 foundrymen's convention, it has been decided to meet in Cleveland during the week of September 11.

At Atlantic City the executive board of the American Foundrymen's Association authorized the appointment of a committee of five to decide upon next year's meeting place, and this committee was instructed by the American Institute of Metals to serve also in its behalf. This special committee is constituted as follows: R. A. Bull, Commonwealth Steel Company, Granite City, Ill., president of the American Foundrymen's Association, chairman; Joseph T. Speer, Pittsburgh Valve, Foundry & Construction Company, Pittsburgh, and Alfred E. Howell, Phillips & Buttorff Mfg. Company, Nashville, Tenn., past presidents; J. P. Pero, Missouri Malleable Iron Company, East St. Louis, Ill., senior vice-president, and A. O. Backert, Cleveland, secretary American Foundrymen's Association.

The annual exhibition of foundry equipment and supplies, to be held concurrently with the meetings of these organizations, will be conducted under the auspices of the American Foundrymen's Association and the American Institute of Metals. This decision was reached after mature deliberation and represents the unanimous action of the members of this special committee. It also has been approved heartily by J. S. Seaman, Seaman-Sleeth Company, Pittsburgh, past president of the American Foundrymen's Association, and Jesse L. Jones, Westinghouse Electric & Mfg. Company, East Pittsburgh, Pa., president of the American Institute of Metals, with whom the members of the special committee met for counsel.

Since the interests of manufacturers of foundry equipment and supplies, who make exhibits at these annual shows, and the members of the American Foundrymen's Association and the American Institute of Metals are mutual, it is the sentiment of this special committee that the exhibitors should share in the profits, to be paid in the form of rebates on the cost of their space.

The exhibition will be held in the Cleveland Coliseum, located on Thirteenth Street, in the centre of Cleveland's business district. The Coliseum is within one block of the Hotel Statler, three blocks from the Hollenden, and is only a short walking distance from the other Cleveland hotels. It contains 60,000 sq. ft. of floor space on one level and is admirably adapted for a foundry show.

Sealed proposals have been invited from corporations and individuals capable of conducting exhibits, which are to be submitted to the secretary of this special committee, A. O. Backert, Twelfth and Chestnut Streets, Cleveland, Ohio, on or before 12 o'clock noon, Eastern time, Saturday, November 13, 1915.

This communication has been authorized by this special committee, and its secretary has been instructed to notify you of the action taken.

SPECIAL WELDING METAL FOR IRON AND MILD STEELS

THE necessity for using welding metals specially made for the oxy-acetylene welding process should be recognized by all users of the process, says the Acetylene and Welding Journal.

Until recently no special welding metal for work on iron and mild steels existed. and it is well known that until the advent of such a metal, wires or rods of Swedish iron should be used in preference to all other welding metals. The French Welding Union have been carrying out a series of experiments with the object of obtaining a welding metal for iron and steel which would deoxidize the welds, increase their strength and more important still, increase their ductility. Such an investigation is naturally a slow process because each rod made to a new or corrected formula must be followed by a series of practical and mechanical tests. These important researches were nearing completion and were to have been published in due course when the war intervened and the labors of the Union were turned in other directions.

It is well to emphasize that, apart from the welding rod, there are other conditions which must be rigidly followed if good welds on iron and steels are desired. It is safe to say that in the majority of workshops using the process these conditions are unfulfilled and advice on, say, the preparation of the edges, the power of the blowpipe and its position, the regulation of the flame and the execution of the weld itself could be given. Thus defective welds would, in many cases, be obtained with a perfect welding metal.

The use of ordinary iron or mild steel wire or rods is not to be recommended where sound strong welds are required. The use of Swedish iron gives a distinct improvement, but the welds obtained are still imperfect. The presence of impurities in these metals exerts a bad influence on the welds. The chief impurities being sulphur and phosphorus. A special welding metal for the welding of iron and mild steels has recently been placed on the British market under the name of Ferrox, and this product is manufactured entirely in England by a British firm's patented process. The metal is obtained by subjecting ordinary iron, steel, or cast iron to a process whereby the metal becomes impregnated with extremely finely divided nickel. and also holds in a state of occlusion or chemical combination a considerable quantity of hydrogen gas. It is claimed, after considerable research, that the welding rods obtained by this process effectively eliminate and counteract the disadvantages of the welding process. An example of the method of carrying out the invention is as follows:—

Hydrogen gas is passed over powdered nickel, or nickel oxide so that nickel chemically combines with the gas. The gas, thus charged with nickel is passed into a closed vessel in which the material to be treated is contained. The temperature and time of treatment play an important part. The gas is continuously passed over the metal or rods under a pressure slightly above atmospheric pressure. The time of treatment and the temperature employed will necessarily vary with the degree of impregnation required, with the thickness of the iron treated and its quality. When the treatment has been effected the product is cooled down in an atmosphere of hydrogen, or other inert gas.

Among the principal results obtained by applying this patented process are:—

(a)—The elimination of all oxides from the original material from which the welding wire is manufactured.

(b)—The expulsion from the original material of occluded gases.

The increased cost of this scientifically manufactured product over ordinary welding wire is small, and it is claimed that in spite of its increased cost, its use is attended with real economy. Apart from the relative merits it is cheaper than Swedish iron. In fact, the welding rod forms a very small percentage of the total cost of a weld.

NOVA SCOTIA STEEL CO.

AT a meeting of the directors of the Nova Scotia Steel & Coal Co. at Halifax, N.S., on Nov. 11, the general manager reported that in October the shipments exceeded those of September by 30 per cent., and that unfilled orders on November 1 and material since actually booked would call for 180,000 tons of steel. This is quite apart from the car-building material requirements which are likely to be large. Estimates for the construction of a new open hearth and steel-melting furnace of the largest type were submitted. The management were directed to proceed with construction at once. The new furnace will be ready to produce two hundred tons of steel per day within twelve weeks

Vancouver, B.C.—The Eclipse Iron Works has been incorporated for $20.-000 to do a general iron manufacturing business.

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Vol. VI. DECEMBER, 1915 No. 12

PRINCIPAL CONTENTS

IS A STEEL FAMINE REALLY IMMINENT?

IF the unexpected always happens, it might reasonably be argued that the expected never happens. Present reports and future prospects, however, would seem to justify many of the assertions which are being made regarding the inability of steel makers to meet the present demand, although, whether the demand is liable to increase still further, is at the moment largely conjecture.

As the largest producer of steel in the world, the United States is enjoying a period of unprecedented activity. That this activity is directly due to the war there can be no doubt, for while many observers credit the scarcity of steel to a greatly increased home consumption, it is obvious that much, if not nearly all of this domestic activity in the States developed after the placing of war contracts by the belligerents.

Reports as to the actual rate at which munition and other contracts calling for steel are being filled are not available for obvious reasons, but, if judged by the experience of manufacturers in this country, production should be well on to the maximum. It is true that an increase in Canadian consumption may result from the recently placed contracts for large shells, but that such an increase will result in a state of affairs approaching a steel famine seems hardly probable.

The uncertainty regarding developments in the war during the next few months is sufficient to prevent accurate forecasting of the industrial situation. The success which has attended the organization of national arsenals and controlled munitions plants in Great Britain is reducing the tendency to distribute shell orders broadcast as has been done recently. Consequently, when the present high peak of production has been passed, the consumption on this account may be expected to decrease.

The recent arrival on this side of the ocean of French Government officials regarding the assistance which could be rendered by American firms in the ultimate period of construction points to a possible continuance of consumption which, under the circumstances, might be of extended duration rather than of excessive urgency. The fact that British steel makers are extending their plants with all possible haste should not be lost sight of in its bearing on the steel market in this country.

While many furnace companies are endeavoring to place further orders for ore, indicating the probability of a shortage on docks during the winter, British firms are able to procure a steady supply of ore from Spain with which to increase their output. The close contact of Belgian, French and British officials and manufacturers discounts the probability of reconstruction opportunities being overlooked or suffering from lack of preparation by European manufacturers. The recovery of the Minette ore mines and the Alsace deposits by France will stimulate manufacturing in many ways, but as by that time, the demand for munitions may have decreased somewhat, the present highly organized industry of France may well be expected to resume production promptly and largely.

The nature of financial relations between Europe and America may not be without a retarding effect on the future steel trade between the two continents. The necessity for observing every available financial and industrial economy is becoming more apparent every day, and even later, when the tide of events is undeniably set towards Allied triumph, the necessity for economy will not be any less urgent.

Under these circumstances, and in the absence of further immediate increases in domestic consumption, the supply of steel may not fall so far short of the demand as to assume the nature of an absolute famine.

The commercial activity throughout the country which results from and reacts upon the steel industry in times like the present creates demands which do not partake of the urgency of war orders. Additions to rolling stock, building operations, county and municipal improvements, and many other undertakings of a similar kind are limited in their rate of progress by the cost of construction. The dull times in Canada and the United States which preceded the war, prevented the placing of much business, which, had it been gone on with, would have caused the present situation to be much more acute.

The highest bidder does not always get the material, and just as some firms across the line have an eye to their own permanent customers, to the refusal of export business, so will Allied interests encourage the formation of connections which, while of more than urgent necessity at the present moment, will later assume an economic value out of all proportion to their present cost.

PLATING AND POLISHING DEPARTMENT

Practical Articles, Useful Data, Descriptions of Machinery, Equipment, etc., Used in the Plating and Polishing Industry.

GALVANIZING CONDUITS

THE manufacture of galvanized conduits at the plant of the Orpen Conduit Co., Toronto, Ont., presents several interesting features, the principal one being that the pipe is copper-plated before being galvanized. Copper-plating is a protective covering of great value in resisting corrosion, forming an ideal "couple" between the metal of the tube and the zinc. The zinc is, therefore, deposited on copper and not on iron by means of the electro-deposition process, thus its full value as a rust preventative is secured.

This conduit, which bears the trade name of "Xceladuct," is a high-grade mild steel butt-weld pipe of special quality, being heavier than ordinary tubing. The pipe for the straight conduit is received at the factory in 10-ft. lengths, and is made in Canada; the bends are, of course, shorter. The pipe is threaded at both ends, one end having a coupling when shipped. The conduit is made in sizes from ½ in. to 6 in. inclusive.

Pickling Process

The first process consists of pickling, which is done to remove the scale, etc., from the pipe. For this process there are installed a number of wood tanks, the first containing a potash solution for removing oil or grease from the pipe. The pipes are then dipped in a tank containing sulphuric acid, which removes the scale. They are then dipped in another tank containing muriatic acid, which gives a smooth surface to the pipe.

On the completion of the foregoing, the pipes are laid out on a flat table, where they are carefully inspected. A powerful light at one end enables an examination of the inside to be made. Any defective pipes are laid to one side, and the sound ones are taken over to the plating department.

Plating and Galvanizing

In the plating department are installed a series of five tanks in one row, each being 14 feet deep, and having a capacity of 4,000 gallons. The tanks sit in an asphalt pit, and are constructed of wood or steel, according to the character of solution which they contain. Before being dipped in the first tank, the pipes are assembled in a "basket," in which they are held until this process is completed. The basket is made of copper, and is constructed so as to hold the pipes vertically. It has a capacity for 175 lengths, each 10 ft. long, of ½-in. pipe, equivalent to 1,750 t. The larger sizes, being heavier, fewer pipes are dipped at one operation.

The basket is suspended from and carried along by means of an electrically-operated hoist on an overhead runway, extending the full length of the tank. At the end of the operation, when empty, the baskets are returned on an overhead runway at each side of the tank. The hoist has lifting and lowering motions for use when dipping the pipes.

The pipes are dipped in three different solutions before being copper-plated. After being in the copper-plating tank the prescribed length of time, they are taken out and dipped in the zinc tank, where they remain about 45 minutes. They are then taken out and put in the rinsing tank.

The electrical equipment for the zinc and copper tanks consists of two motor-driven plating dynamos. One unit consists of a Canadian Hanson & Van Winkle Co. plating dynamo, 8,000 amperes, 6 volts., direct-connected to an 85 h.p. C.G.E. motor running at 470 r.p.m. The other unit is of the same make and size, but belt-driven by an 80 h.p. C.G.E. motor. The wiring from the dynamo is taken under the floor, up the outside of the tank, and connected to the anodes.

Drying and Insulating

After the pipes have been rinsed, they are taken from the basket and placed vertically over a grating through which air is passing from a blower. The pipes are thus thoroughly dried before being insulated and again inspected. For the insulating or enameling process, the pipes are laid inclined on a table and the enamel flows from an overhead tank through them into a shallow tank, whence it is pumped back by means of a motor-driven rotary pump to the overhead tank. The pipes are then placed vertically over a grating to dry, a current of air passing through accomplishes this.

They next go to the labeling table, where they are laid flat and two labels affixed—one factory label and one for the Underwriters. At this stage the pipes are carefully examined by the Underwriters' inspector, who selects one from each batch to be tested. Before leaving the table, a coupling is screwed on one end of each pipe, after which they are tied in bundles ready for shipping. The test pipe is cut in two sections on a hack saw machine, and a length taken to the inspector's office, where it is tested to ascertain if the zinc coating and enamel are adhering in a satisfactory manner. The tests are very thorough, as the conduit must conform in all respects to Underwriters' rules.

Elbows

The above-mentioned processes cover the straight lengths of conduit only. The elbows are treated in a somewhat indifferent way, chiefly as regards handling. Short lengths of pipe are received at the factory, threaded at both ends. The first requirement is to bend them to the required angle and radius. For the larger pipes a belt-driven bending machine operated from the line shaft is used, while the smaller size pipes are bent in a steam-operated machine. In both cases different forms are used to suit the various sizes of pipe.

The elbows, as in the case of the straight pipes, undergo the pickling process and in the same set of tanks. The elbows are, however, scrubbed with sand after being pickled. They are then copper-plated in the same tank as the straight lengths, but have a separate tank for the galvanizing process. The current for the zinc tank is furnished by a plating dynamo, which is also connected to the zinc tumbling tank used for galvanizing the couplings. The dynamo supplies current at 6 volts, 400 amperes. After being galvanized, which takes about 30 minutes, the elbows are taken out and hung on a rack to dry, and then taken over to the insulating tank to be enameled inside. After being enameled, they are hung on racks to dry, and are then inspected and stamped the same as the straight conduit. The elbows are also inspected and tested between the various processes. All sizes are treated in the same way.

Couplings

As already stated, a coupling is supplied with each length of conduit. The first process consists of pickling, which is done in the same set of tanks as the pipe and elbows. They are also copper-plated in the same tank, and are held in wire baskets during the process. For galvanizing, there is a special tumbling tank installed, in which the couplings are revolved for three hours. When the galvanizing process is completed, the couplings are taken out and washed in cold water. They are then put in wire baskets, washed again in hot water, and afterwards laid on a wire screen to dry. They are afterwards taken to the store room to be used as required.

MADE IN CANADA

Foundry Supplies and Equipment

If you value High Quality, Prompt Delivery and Reasonable Price you'll appreciate the goods that we have to offer

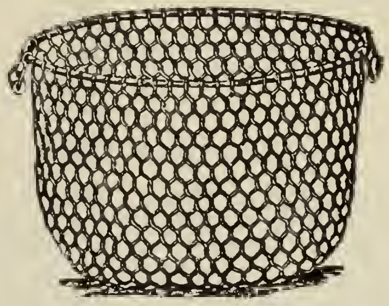
Fortunately we have all along retained an ample supply of Foundry Requisites in the shape of PURE CEYLON PLUMBAGO, IMPERIAL PLUMBAGO, FAULTLESS HEAVY STOVEPLATE FACING, CANADIAN RETURN FACING, CORE WASH, PARTING, LADLES, FIRE BRICK, FIRE CLAY, etc., and we are now in just the same good position to guarantee deliveries to any point desired, at the minimum cost and maximum despatch.

Business is improving. It was bound to do so, and that is why we kept on telling you about the unrivalled quality of our Foundry Supplies and Equipment.

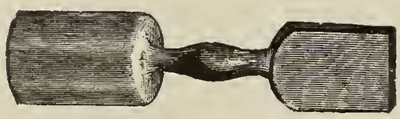
We have also been waiting for "THE DAY" when your stock would have to be replenished to make good the wastage that is perpetually going on, even in a period of semi-activity.

There are other details we can give if you will kindly let us know your requirements.

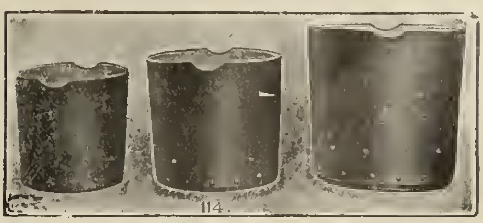
The Hamilton Facing Mill Company, Limited
Hamilton, Canada



Coke or Charcoal Baskets—Made of galvanized steel wire.



Bench Rammers—Made from Maple Hardwood well oiled.



Foundry Ladles—Flat bottom riveted steel bowls provided with forged lips and vent holes.

SELECTED MARKET QUOTATIONS

Being a record of prices current on raw and finished material entering into the manufacture of mechanical and general engineering products

PIG IRON.

Grey Forge, Pittsburgh	$16 45	
Lake Superior, charcoal, Chicago	17 25	
Ferro Nickel pig iron (Soo)	25 00	
	Montreal.	**Toronto.**
Middleboro, No. 3	$24 00	.....
Carron, special	25 00	.....
Carron, soft	25 00	.....
Cleveland, No. 3	24 00	.....
Clarence, No. 3	24 50	.....
Glenarnock	28 00	.....
Summerlee, No. 1	30 00	.....
Summerlee, No. 3	29 00	.....
Michigan charcoal iron	28 00	.....
Victoria, No. 1	24 00	23 00
Victoria, No. 2X	23 00	23 00
Victoria, No. 2 plain	23 00	23 00
Hamilton, No. 1	23 00	23 00
Hamilton, No. 2	23 00	23 00

METALS.

Aluminum	$ .65
Antimony	.40
Cobalt 97% pure	1.50
Copper, lake	.21
Copper, electrolytic	20.75
Copper, casting	20.50
Lead	.07
Mercury	100.00
Nickel	50.00
Silver	.48
Tin	.46
Zinc	.21

Prices Per Lb.

OLD MATERIAL.

Dealers' Buying Prices.	Montreal.	Toronto.
Copper, light	$13 75	$12 75
Copper, crucible	16 25	15 00
Copper, unch-bled, heavy	15 75	14 50
Copper wire, unch-bled.	15 75	14 50
No. 1 machine, compos'n	12 00	11 75
No. 1 compos'n turnings	11 00	10 00
No. 1 wrought iron	10 00	9 50
Heavy melting steel	9 00	9 00
No. 1 machin'y cast iron	13 50	13 00
New brass clippings	11 50	11 00
No. 1 brass turnings	9 50	9 00
Heavy lead	5 25	5 00
Tea lead	4 25	4 00
Scrap Zinc	13 50	12 00

COKE AND COAL.

Solvay foundry coke	$5.75
Connellsville foundry coke	5.00
Yough steam lump coal	3.83
Penn. steam lump coal	3.63
Best slack	2.99

net ton f.o.b. Toronto.

BILLETS.

	Per Gross Ton
Bessemer billets, Pittsburgh	$28 00
Open-hearth billets, Pittsburgh	29 00
Forging billets, Pittsburgh	50 00
Wire rods, Pittsburgh	38 00

PROOF COIL CHAIN.

1/4 inch	$9.00
5-16 inch	5.90
3/8 inch	4.95
7-16 inch	4.55
1/2 inch	4.30
9-16 inch	4.20
5/8 inch	4.10
3/4 inch	3.95
7/8 inch	3.80
1 inch	3.70

Above quotations are per 100 lbs.

MISCELLANEOUS.

Solder, half-and-half	$0.25
Putty, 100-lb. drums	2.70
Red dry lead, 100-lb. kegs, p. cwt.	9.65
Glue, French medal, per lb.	0.15
Tarred slaters' paper, per roll	0.95
Motor gasoline, single bbls., gal.	0.25½
Benzine, single bbls., per gal.	0.25
Pure turpentine, single bbls.	0.85
Linseed oil, raw, single bbls.	0.85
Linseed oil, boiled, single bbls.	0.88
Plaster of Paris, per bbl.	2.50
Plumbers' oakum, per 100 lbs.	4.50
Lead wool, per lb.	0.11
Pure Manila rope	0.16
Transmission rope, Manila	0.20
Drilling cables, Manila	0.17
Lard oil, per gal.	0.73

SHEETS.

	Montreal.	Toronto.
Sheets, black, No. 28	$3 20	$3 20
Canada plates, dull, 52 sheets	3 25	3 25
Canada plates, all bright	4 60	4 75
Apollo brand, 10¾ oz. galvanized)	5 50	5 75
Queen's Head, 28 B.W.G.	6 00	5 95
Fleur-de-Lis, 28 B.W.G.	5 75	5 75
Gorbal's best, No. 28	6 00	6 00
Viking metal, No. 28	5 25	5 25
Colborne Crown, No. 28	5 70	5 80
Premier, No. 28 B.G	5 40	5 50

ELECTRIC WELD COIL CHAIN B.B.

1/8 in.	$12.75
3-16 in.	8.85
1/4 in.	6.15
5-16 in.	4.90
3/8 in.	4.05
7-16 in.	3.85
1/2 in.	3.75
5/8 in.	3.60
3/4 in.	3.60

Prices per 100 lbs.

IRON PIPE FITTINGS.

Canadian malleable, A, 25 per cent.; B and C, 35 per cent.; cast iron, 60; standard bushings, 60; headers, 60; flanged unions, 60; malleable bushings, 60; nipples, 75; malleable, lipped union, 65.

PLATING CHEMICALS.

Acid, boracic	$ .15
Acid, hydrochloric	.05
Acid, hydrofluoric	.06
Acid, Nitric	.10
Acid, sulphuric	.05
Ammonia, aqua	.08
Ammonium, carbonate	.15
Ammonium, chloride	.11
Ammonium hydrosulphuret	.35
Ammonium sulphate	.07
Arsenic, white	.10
Copper sulphate	.10
Cobalt Sulphate	.50
Iron perchloride	.20
Lead acetate	.16
Nickel ammonium sulphate	.10
Nickel carbonate	.50
Nickel sulphate	.15
Potassium carbonate	.40
Potassium sulphide substitute	.20
Silver chloride (per oz.)	.65
Silver nitrate (per oz.)	.45
Sodium bisulphite	.10
Sodium carbonate crystals	.04
Sodium cyanide, 129-130 per cent.	.35
Sodium hydrate	.04
Sodium hyposulphite (per 100 lbs.)	3.00
Sodium phosphate	.14
Tin chloride	.45
Zinc chloride	.20
Zinc sulphate	.07

Prices Per Lb. Unless Otherwise Stated.

ANODES.

Nickel	.47 to .52
Cobalt	1.75 to 2.00
Copper, 22-25	.22 to .25
Tin	.45 to .50
Silver	.55 to .60
Zinc	.22 to .25

Prices Per Lb.

PLATING SUPPLIES.

Polishing wheels, felt	1.50 to 1.75
Polishing wheels, bullneck.	.80
Emery in kegs	.4½ to .06
Pumice, ground	.05
Emery glue	.15 to .20
Tripoli composition	.04 to .06
Crocus composition	.04 to .06
Emery composition	.05 to .07
Rouge, silver	.25 to .50
Rouge, nickel and brass	.15 to .25

Prices Per Lb.

The General Market Conditions and Tendencies

This section sets forth the views and observations of men qualified to judge the outlook and with whom we are in close touch through provincial correspondents

Toronto, Ont., Nov. 30.—An interesting development affecting the steel industry is the announcement that plans are being worked out for extending the scope of the Munitions Committee to include the distribution of orders for shells from all the Allies. Another interesting feature is a proposal for Canadian banks to assist factories in financing orders for shells. An arrangement such as this will permit of larger orders being handled and greatly simplify the financial aspect of the business. Hitherto all payments have been made in British funds. No very definite information is available with regard to the 8-in. and 9.2-in. shells, but it is understood that orders for 60-pdr. and 6-in. shells are being placed first.

The reorganization of the Shell Committee has been completed and the new body will be known as the Imperial Munitions Board. J. W. Flavelle of this city has been appointed chairman, and General Alex. Bertram deputy-chairman. A Commission has been appointed to enquire into the supply of raw materials for the production of munitions. Col. Thomas Cantley will be Chairman of the Commission.

Industrial conditions continue to steadily improve and a more optimistic feeling prevails in business circles with regard to the outlook for the future. Money is circulating more freely, railway earnings are increasing, and the volume of business is growing notwithstanding a steady advance in prices of many lines. The volume of exports is also increasing each month, thus improving the financial condition of the country.

Steel Market

The market continues very active and prices are holding very firm with a decided upward tendency. The demand for steel, particularly for shells, is on the increase, and mills are getting behind on deliveries, notwithstanding plant extensions which have been made to cope with the business. Steel bars are firm at 2.75c and iron bars are unchanged at 2.50c, but an advance is looked for in the near future. Wire nails have advanced again and are now quoted at $2.75 base, per keg. Boiler plates and lapwelded boiler tubes are higher. A new list for bolts and nuts has been issued, the prices showing a slight increase over the previous list. A new discount of 25 per cent. for cold drawn steel shafting is announced. Prices of proof coil chain and electric weld chain have been revised. The new discount on iron rivets 7-16-in. and less is 67½ per cent., and copper wire is now 30 per cent. off list. Smooth steel wire has advanced and is now quoted at $2.85 base.

The galvanized sheet market is extremely irregular. There is an increasing scarcity of steel and black sheets are therefore rising in price. Spelter is being maintained at a level too high to be attractive to the makers of galvanized sheets; in addition there is a shortage of sulphuric acid. This combination of circumstances is affecting the market and prices of sheets cannot help but advance. "Apollo," 10¾ oz., are now quoted at $5.75, and "Premier" No. 28, at $5.50. In some cases, sellers have done away with the regular differentials and are basing prices for each gauge on its cost. Some mills are said to be refusing to quote on galvanized sheets on account of operations having been cut down due to the acid and spelter situations. Black sheets are quoted at 2.40c to 2.75c Pittsburgh, and blue annealed 2.10c to 2.25c Pittsburgh.

In the States there is no cessation in the demand, which on nearly all lines of steel products, is beyond the capacity of the mills to supply. The majority of steel companies have sold their output for the first quarter of 1916 and have enquiries extending into the second quarter. Some authorities believe that prices have reached a danger point and any further advances should be prevented if possible. There is little indication, however, that prices have reached the top level. It is reported from London that the Allies can now manufacture all the munitions they require. Even if this is the case they will still need steel, as the output of steel has not increased in the same proportion as munitions. Heavy tonnages of steel will be required for other purposes. Prices continue to advance in many steel products: steel bars, however, are unchanged at 1.70c. Beams are higher at 1.70c, Bessemer billets $28, open-hearth billets $29, and forging billets $50 base, Pittsburgh. Prices of billets are nominal owing to the shortage in Bessemer and open-hearth steel.

Pig Iron

The market is very active and prices of domestic brands of pig iron have again been advanced; Hamilton and Victoria brands are $1.25 higher than last week and are now quoted at $23 ton. Grey forge, Pittsburgh, has advanced and is quoted at $16.45. There is a heavy demand for steel-making grades of iron, but foundry iron is less active.

Old Materials

Conditions in the market for old materials are much the same as last month, and prices are practically unchanged, although firmer for some scraps. Copper and zinc scrap are both very firm and have a higher tendency. Heavy melting steel is strong but No. 1 wrought iron is weaker, and is now quoted at $9. Copper and heavy melting steel are in good demand but other lines are quiet.

Metals

The situation in the metal market shows no appreciable change from last month. Copper continues strong and has advanced slightly. The tin market has reacted and is lower, following a decline in London. The spelter market is quiet and unchanged. Zinc ore is very high, being quoted $100 to $115 at Joplin, Mo. The lead market is very strong both in London and New York. The antimony market is strong and scarcity of supplies is being felt. Aluminum is also scarce and quotations are nominal.

Tin.—The market is dull and featureless with prices lower. There continues to be little interest shown by buyers for any deliveries, at the same time sellers are inclined to be indifferent. Tin has declined 2c and is being quoted at 46c per pound.

Copper.—The market is strong and higher and the position of copper is a decidedly strong one. Consumption is increasing and is, if anything, in excess of the current output. Lake copper is now quoted at 20¾c and electrolytic at 20½c per pound.

Spelter. — The market advanced in London, but this did not stimulate the New York market. The situation is practically unchanged and indications point to higher prices rather than otherwise. Spelter is unchanged at 21c per pound.

Lead.—Both London and New York markets are very strong. The "Trust" price of 5.25c New York is being firmly held with a possibility of an advance. Lead is unchanged locally at 7c per pound.

Antimony.—The market is in a stronger position than it has been and is feeling the full effects of the scarcity of supplies. Quotations locally are firm but unchanged at 40c per pound.

Aluminum.—There is no improvement in the situation with regard to supplies, which are very difficult to obtain. Quotations are nominal at 65c per pound.

Plating Chemicals and Supplies

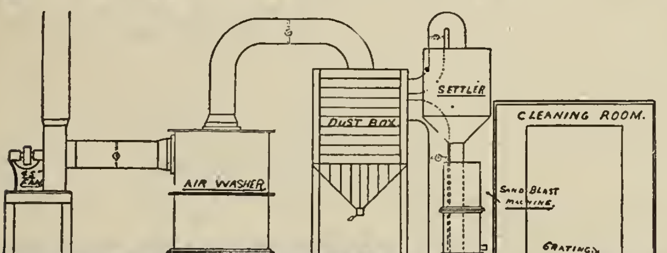
The situation with regard to certain lines of plating chemicals does not improve, and prices are very high. Some chemicals are quite scarce, particularly potash, which is practically unobtainable. Sulphuric acid is also difficult to procure owing to the heavy demand on

GLUTRIN.
REG. U. S. PAT. OFF.

It is like saying the sun shines, or the wind blows, to say that glutrin is the strongest sand binder known to the founder, for this fact is attested by thousands of successful users in various parts of the world.

ROBESON PROCESS COMPANY
GRAND MERE, P. Q.

Selling Agents:
The Dominion Foundry Supply Co., Limited
Montreal, P. Q. and Toronto, Ontario.



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Established 1869. First in business and leaders ever since.

TWELVE REASONS why Tilghman-Brooksbank New Sandblast Room Plants and Systems are the BEST

Study them carefully:

1. These machines insure better working conditions for the operator;
2. The initial cost is very small;
3. Only a very shallow pit is required;
4. The air in the room is changed from five to seven times every minute, at very little cost;
5. Simple in design;
6. Guaranteed to give first-class service;
7. There are no wearable parts;
8. There is plenty of light for operator to work by;
9. The room is absolutely clear of all obstruction;
10. There is no shoveling of sand or shot back into the machine;
11. Entirely automatic;
12. These machines will increase your output.

WRITE FOR FULL PARTICULARS AND REFERENCES.

We specialize in
SANDBLAST MACHINERY, HELMETS, GLOVES, RESPIRATORS, OPERATORS' COATS, GOGGLES AND AIR COMPRESSORS.
Also Special Machines for Special Work.

TILGHMAN-BROOKSBANK SAND BLAST CO.
1126 South 11th St., Philadelphia, Pa.
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Canadian Office: McLean & Barker, 301 Unity Bldg., Montreal

"Buffalo Brand"

VENT WAX

"True to the Core"

If we go back far enough, and down deep enough, we find that most of the happy little phrases such as "True to the Core" have their foundation in fact.

We don't know whether the old saw had any acquaintance with VENT WAX and its use in the making of good cores, but at any rate, he knew how important it was to have good cores. So do we, and "Buffalo Brand" supplies the need — your need.

Buffalo Brand Vent Wax will eliminate your core troubles, and thus reduce these costs to a minimum.

It is hard but pliable, and will not stick together at any ordinary temperature. Is absorbed by the core at the time of drying, thereby leaving a good clean vent hole, just the size of the wax used.

It will improve the core instead of making it soft around the vent. Works in unison with any kind of core binder. Guaranteed not to injure the most delicate core made.

Write your supply house for samples and prices, or write us, as we are convinced that a trial will prove it to be the easiest and best way to vent any core.

United Compound Co.
178 Ohio St. - Buffalo, N.Y.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

account of the war. There are no price changes to note, and in some cases quotations are more or less nominal.

The plating of nose plugs for shells, referred to in the last issue of Canadian Foundryman, is becoming more general, and several plants have been installed recently for this purpose. The operation is passing from the experimental stage, and being less costly than all brass plugs, nickel-plated cast iron plugs will no doubt be adopted exclusively. Steel nose sockets are also being nickel-plated, making another development in the trade, which will be followed with interest, and will help to stimulate business, which has been quiet of late.

Trade Gossip

New Liskeard, Ont.—The Wabi Iron Works have recently installed an electric furnace.

Vancouver, B.C.—The molding shops of the Vancouver Engineering Works, were damaged in a recent fire.

Welland, Ont.—The Electric Steel & Metals Co. will install a 6-ton Heroult furnace for making steel castings.

Montreal, Que.—The Castings Co. of Canada, which was recently incorporated, will build a foundry at Valleyfield, near here.

The Eclipse Iron Works, Ltd., Vancouver, B.C., has been incorporated with a capital stock of $20,000 to manufacture iron, steel, machinery, etc.

St. Thomas, Ont.—The local plant of the Canada Iron Corporation has received an order for a large number of iron plugs for shells.

The Morgan Engineering Co., Alliance, Ohio, have sold a 60-ton double trolley ladle crane to the Algoma Steel Corporation, Sault Ste. Marie, Ont.

The Northern Crane Works, of Walkerville, Ont., report the sale of several electric traveling cranes to the Consolidated Mining & Smelting Co., at Trail, British Columbia.

The Castings Co. of Canada, Ltd., has been incorporated with a capital of $40,000. Head office at Montreal and works at Valleyfield, Que. Incorporators: H. Cohen, A. Ellison and S. G. Metcalfe, of Montreal.

The Ideal Foundry & Hardware Co. has been incorporated at Toronto, with a capital of $50,000, to take over as a going concern the Imperial Foundry Co. of Toronto. Provisional directors—A. E. Furniss, R. M. Yeomans and B. MacDonald.

The Algoma Nickel Mining Co. has been incorporated at Toronto with a capital of $10,000 to acquire and develop mines and mineral lands. Head office at Toronto. Incorporators: George Hugh Baird and Henry Nicol Baird, of Toronto.

Montreal, P. Q.—The Standard Steel Co., which has recently been incorporated, has taken over an existing foundry on Atlantic avenue. The plant will be equipped and operated as a steel foundry. An extension to the plant is contemplated.

The Standard Steel Co., has been incorporated at Ottawa, with a capital of $200,000, to manufacture corrugated steel pipes, culverts, etc., at Montreal, Que. Incorporators: Louis Athanse David, Louis D'Argy Mailhiot and H. R. Bush, all of Montreal.

The Canadian Chadwick Metal Co. has been incorporated at Toronto with a capital of $40,000, to carry on the business of brass founders, iron founders, mechanical engineers, at Dundas, Ont. Incorporators, Arthur Burgess Turner and George Alexander Young, of Hamilton, Ont.

Welland, Ont.—The Canada Forge Co. will build an extension to their plant. The new building will have a ground area of 180 x 80 feet, and will be of structural steel. The cost is estimated at $20,000, and the equipment to be installed will cost $100,000. The building will be used for four additional hydraulic presses for making six-inch high-explosive shells. T. J. Dillon is manager.

Vancouver, B.C.—The recently organized Port Moody Steel Works, Ltd., are now busy clearing their site at Port Moody and anticipate within a short time starting construction work on their buildings, being far enough advanced early in the new year to start operations. The company has a 100-acre site at Port Moody and the council of that place have guaranteed bonds to the extent of $100,000.

Chippawa, Ont.—The Norton Co. will erect a new electric furnace abrasive plant for the manufacture of alundum adjacent to their crystolon plant. The plant will consist of an office building, a building for housing the electric furnaces, mixing and storage bins, etc., and a reinforced concrete storage building. Six electric furnaces will be installed at once with a 15-ton overhead travelling crane, motors and other electrical equipment.

The Dominion Steel Corporation is devoting particular attention to the production of shell steel, which is in such active demand, and is leaving the turning out of shells to the other companies. The management went into the matter of shell output with the old shell committee, but did not see its way clear to take on the heavy capital outlay incident to taking on shell production as well. It is stated in steel circles that further foreign orders, particularly Russian, are now available, if the Canadian mills can give any guarantee of being able to make deliveries as required.

Imported Shell Forgings.—A duty of 32¼ per cent. is imposed on shell forgings entering Canada from the United States. Up to the present it has been deemed wise by the Canadian Government not to remove the tariff, as some twelve Canadian companies have been turning out forgings at a rate sufficient to supply the needs of other manufacturers who merely finish shells. Since the recent further distribution of shell orders by the Munitions Committee at Ottawa it is, however considered advisable in some quarters to have the duty removed, on the ground that the output of shells in Canada would be increased by the importation of forgings from the United States. It is announced from Ottawa that the Munitions Committee has fixed the price of steel for ammunition to be made in Canada. It must not exceed 3½c per pound.

Catalogues

Sand Mixers.—The Sand Mixing Machine Co., New York, have issued a booklet containing reproductions of 30 advertisements from customers who have purchased their auto sand cutter. In addition to the above, the machine is fully described and illustrated.

Shop Furnaces made by the American Shop Equipment Co., Chicago, Ill., are the subject of a supplementary bulletin recently issued. The lines briefly described include portable and stationary rivet forges, welding and forge furnaces, annealing, tempering and hardening furnaces, etc. The bulletin contains complete export shipping data for each product listed.

Book Review

Forging of Iron and Steel, by William Allyn Richards, B.S. in M.E., 219 pages 8 in. x 5 in., 337 illustrations. Published by the D. Van Nostrand Co., New York. Price $1.50 net. This is a new text book for the use of students in colleges, secondary schools and the shop. The author as stated in the preface, has endeavored to treat the forging of iron and steel and the hardening and tempering of tool steel simply enough for the high school boy, and at the same time thoroughly and systematically enough for the veteran smith. An endeavor has been made to bring out principles, and all methods used toward this end have been thoroughly tried out during ten years of experience of teaching and supervising manual training. The book contains sixteen chapters, including one devoted to a series of calculations, and the introduction. Chapter one is an historical sketch, while chapter two deals with the characteristics of iron and steel and methods of production treated simply. Equipment used in the forge is described in chapter three and chapter four deals with fuel and fires. The next four chapters describe the different smith shop operations and tools. Chapters nine, ten and eleven describe various methods of welding and brazing. The two succeeding chapters contain some interesting matter on carbon and high-speed tool steel, describing methods of annealing, hardening and tempering steel for various purposes. Chapter fourteen treats on art ironwork, and chapter fifteen describes the operation of steam and power hammers. The chapter on calculations contains the information necessary to know in order to obtain the exact size of stock to be used to make a forging. The appendix contains a course of exercises consisting of 42 examples which help to demonstrate the principles of forge work and the application of the methods described in the preceding pages. At the end of each chapter is a series of questions for review, a useful feature in helping to draw the attention of the student to the main contents in the chapter. This book is written in a comprehensive style and will be a great help to the student or smith, used in conjunction with the work in the forge. The book is printed in clear type, is fully illustrated and bound in substantial cloth covers.

If what you want is not advertised in this issue consult the Buyers' Directory at the back.

CANADIAN FOUNDRYMAN BUYERS' DIRECTORY

TO OUR READERS--Use this Directory when seeking to buy any foundry or pattern-shop equipment. You will often get information that will save you money.
TO OUR ADVERTISERS—Send in your name for insertion under the headings of the lines you make or sell.
TO NON-ADVERTISERS—A nominal rate of $5.00 per line a year is charged to non-advertisers.

Air Compressors.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co. of Canada, Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Independent Pneumatic Tool Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Smart-Turner Machine Co., Hamilton, Ont.
A. R. Williams Machy. Co., Toronto.

Alloys.
Ajax Metal Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Anodes, Brass, Copper, Nickel, Zinc.
Tallman Brass & Metal Co., Hamilton, Ont.
W. W. Wells, Toronto.

Ammeters.
Chas. J. Menzemer, Niagara Falls.

Babbitt Metal
Ajax Metal Co., Philadelphia, Pa.

Barrels, Tumbling.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Barrows, Foundry
Sterling Wheelbarrow Co., Milwaukee, Wis.

Boiler Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Limited, Montreal.

Blowers.
Can. Buffalo Forge Co., Montreal.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. S. McCormick Co., Pittsburg, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
P. H. & F. M. Roots Co., Connersville, Ind.
Sheldons, Limited, Galt, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Blast Gauges—Cupola.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
H. S. Carter & Co., Toronto.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Boxes, Tote
Sterling Wheelbarrow Co., Milwaukee, Wis.

Brass Melting Furnaces.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Bricks, Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.

Brushes, Foundry and Core.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.

Brushes, all Kinds.
Manufacturers' Brush Co., Cleveland, Ohio.
Osborn Mfg. Co., Cleveland, O.
Sleeper & Hartley, Worcester, Mass.
Ford-Smith Machine Co., Hamilton.

Buckets, Grab
Pawling & Harnischfeger Co., Milwaukee, Wis.

Buffing and Polishing Machinery.
W. W. Wells, Toronto.

Buffing and Polishing Compositions.
W. W. Wells, Toronto.

Buffs.
W. W. Wells, Toronto.

Burners, Core Oven.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Frederic B. Stevens, Detroit.

Cars, Core Oven.
H. S. Carter & Co., Toronto.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.

Cars, Sand Blasts.
Pangborn Corporation, Hagerstown, Md.

Castings, Brass, Aluminum and Bronze.
Tallman Brass & Metal Co., Hamilton, Ont.

Cast Iron.
Frankel Bros., Toronto.

Castings, Aluminum and Brass.
Tallman Brass & Metal Co., Hamilton, Ont.
F. W. Quinn, Hamilton, Ont.

Castings, Nickel.
W. W. Wells, Toronto.

Cars, Foundry.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Chain Blocks.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
John Millen & Son, Ltd., Montreal.

Chaplets.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Wells Pattern & Machine Works Limited, Toronto.

Charcoal.
Webster & Sons, Ltd., Montreal.
Frederic B. Stevens, Detroit.

Chemists.
Toronto Testing Laboratory, Ltd., Toronto.

Chemicals.
W. W. Wells, Toronto.

Chippers, Pneumatic
Independent Pneumatic Tool Co., Chicago, Ill.

Clay Lined Crucibles.
Joseph Dixon Crucible Co., Jersey City, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Clamps, Core Box
National Clamp Co., Chicago, Ill.

Clamps, Flask
National Clamp Co., Chicago, Ill.

Copper, Phosphorized
Ajax Metal Co., Philadelphia, Pa.

Core Binders.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.

Core Box Machines.
Webster & Sons, Ltd., Montreal.
J. S. McCormick, Pittsburg, Pa.
J. W. Paxson Co., Philadelphia, Pa.

Core Cutting-off and Coning Machine.
Brown Specialty Machinery Co., Chicago, Ill.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Core Compounds.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Robeson Process Co., New York City.
Frederic B. Stevens, Detroit.

Core Machines, Hammer.
H. S. Carter & Co., Toronto.
Brown Specialty Machinery Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Core-making Machines.
Berkshire Mfg. Co., Cleveland, O.
H. S. Carter & Co., Toronto.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Frederic B. Stevens, Detroit.
Webster & Sons, Ltd., Montreal.

Core Oils.
Cataract Refining Co., Buffalo, N.Y.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Holland Core Oil Co., Chicago, Ill.

Core Ovens.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
Oven Equipment & Mfg. Co., New Haven, Conn.
Sheldons, Limited, Galt, Ont.
Frederic B. Stevens, Detroit.
Whiting Foundry Equipment Co., Harvey, Ill.

Core Wash.
Joseph Dixon Crucible Co., Jersey City, N.J.
Webster & Sons, Ltd., Montreal.

Core Wax.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
United Compound Co., Buffalo, N.Y.

Cranes
Northern Crane Works, Ltd., Walkerville, Ont.
Pawling & Harnischfeger Co., Milwaukee, Wis.

Cranes, Travelling and Jib.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Electric and Hand Power.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Dominion Bridge Co., Montreal.
Webster & Sons, Ltd., Montreal.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Ltd., Walkerville, Ont.
Smart-Turner Machine Co., Hamilton, Ont.
Whiting Foundry Equipment Co., Harvey, Ill.

Cranes, Hydraulic.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Crucibles, Reservoir, Tilting Furnace, Bottom Pour, Etc.
Dixon Crucible Co., Joseph, Jersey City, N.J.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Seidel, R. B., Philadelphia.
Stevens, F. B., Detroit, Mich.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Cupolas.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Northern Crane Works, Ltd., Walkerville, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blast Gauges.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Whiting Foundry Equipment Co., Harvey, Ill.

Cupola Blocks.
R. Bailey & Son, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Blowers.
Can. Buffalo Forge Co., Montreal.
Can Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Monarch Eng. & Mfg. Co., Baltimore.
Sheldons, Limited, Galt, Ont.
Stevens, F. B., Detroit, Mich.

Cupola Linings.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cupola Twyers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.

Cutting-off Machines.
Webster & Sons, Ltd., Montreal.

Cyanide of Potassium.
W. W. Wells, Toronto.

Dippers, Graphite.
Joseph Dixon Crucible Co., Jersey City, N.J.

Drying Ovens for Cores.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Dynamos.
W. W. Wells, Toronto.

Dust Arresters and Exhausters.
Pangborn Corporation, Hagerstown, Md.

Dryers, Sand.
Pangborn Corporation, Hagerstown, Md.

Elevators, Foundry, Hydraulic, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Pangborn Corporation, Hagerstown, Md.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Emery Stands.
Ford-Smith Machine Co., Hamilton.

Fans, Exhaust.
Can. Buffalo Forge Co., Montreal.
Can. Fairbanks-Morse Co., Montreal.
Can. Sirocco Co., Ltd., Windsor, Ont.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Sheldons, Limited, Galt, Ont.

Fillers (Metallic).
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Stevens, F. B., Detroit, Mich.
Shelton Metallic Filler Co., Derby, Conn.

Fillets, Leather and Wooden.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.

Fire Brick and Clay.
R. Bailey & Son, Toronto.
H. S. Carter & Co., Toronto.
Gibb, Alexander, Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Fire Sand.
Webster & Sons, Ltd., Montreal.
Whitehead Bros Co., Buffalo, N.Y.

Flasks, Snap, Etc.
Berkshire Mfg. Co., Cleveland, O.
Guelph Pattern Works, Guelph, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Sterling Wheelbarrow Co., Milwaukee, Wis.
Webster & Sons, Ltd., Montreal.

Foundry Coke.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Foundry Equipment.
H. S. Carter & Co., Toronto.
A. R. Williams Mach. Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Northern Crane Works, Walkerville, Ont.
Osborn Mfg. Co., Cleveland, O.
Pangborn Corporation, Hagerstown, Md.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Foundry Parting.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Foundry Facings.
Joseph Dixon Crucible Co., Jersey City, N.J.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.

Furnace Lining.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Furnaces, Brass.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Hawley Down Draft Furnace Co., Easton, Pa.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Goggles.
Tilghman-Brookshank Sand Blast Co., Philadelphia, Pa.

Graphite Products.
Joseph Dixon Crucible Co., Jersey City, N.J.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Jonathan Bartley Crucible Co., Trenton, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Graphite, Anti-Flux Brazing.
Joseph Dixon Crucible Co., Jersey City, N.J.

Grinders, Disc, Bench, Swing.
Ford-Smith Machine Co., Hamilton, Ont.
Perfect Machinery Co., Galt, Ont.

Grinders, Chaser or Die.
Geometric Tool Co., New Haven, Conn.

Grinders, Electric
Independent Pneumatic Tool Co., Chicago, Ill.

Grinders, Pneumatic, Portable.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Hammers, Chipping
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Helmets.
Tilghman-Brookshank Sand Blast Co., Philadelphia, Pa.

Hoisting and Conveying Machinery.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
A. R. Williams Machy. Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hoists, Electric, Pneumatic.
A. R. Williams Mach. Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Northern Crane Works, Walkerville.
Pawling & Harnischfeger Co., Milwaukee, Wis.
E. J. Woodison Co., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Hoists, Hand, Trolley.
Webster & Sons, Ltd., Montreal.
Northern Crane Works, Walkerville.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
Whiting Foundry Equipment Co., Harvey, Ill.

Hose and Couplings.
Can. Niagara Device Co., Bridgeburg, Ont.
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Ingot Metals.
Frankel Bros., Toronto.

Iron Cements.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Iron Filler.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.
Smooth-On Mfg. Co., Jersey City.
Stevens, F. B., Detroit, Mich.

Ladles, Foundry.
Joseph Dixon Crucible Co., Jersey City, N.J.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Northern Crane Works, Walkerville, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whiting Foundry Equipment Co., Harvey, Ill.

Ladle Heaters.
Hawley Down Draft Furnace Co., Easton, Pa.
Webster & Sons, Ltd., Montreal.

Ladle Stoppers, Ladle Nozzles, and Sleeves (Graphite).
Joseph Dixon Crucible Co., Jersey City, N.J.
J. W. Paxson Co., Philadelphia, Pa.
Seidel R. B., Philadelphia.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Webster & Sons, Ltd., Montreal.

Melting Pots.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
Stevens, F. B., Detroit, Mich.
E. J. Woodison Co., Toronto.
Webster & Sons, Ltd., Montreal.

Metallurgists.
Canadian Laboratories, Toronto.
Charles C. Kawin Co., Toronto.
Frankel Bros., Toronto.
Toronto Testing Laboratories, Toronto.

Millville Gravel.
H. S. Carter & Co., Toronto.

Mixers.
Webster & Sons, Ltd., Montreal.
J. W. Paxson Co., Philadelphia, Pa.

Molders' Tools.
H. S. Carter & Co., Toronto.
Wm. Dobson, Canastota, N.Y.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Molding Machines.
Berkshire Mfg. Co., Cleveland, O.
Cleveland Pneumatic Tool Co., of Canada, Toronto.
Webster & Sons, Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
E. H. Mumford Co., Elizabeth, N.J.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Midland Machine Co., Detroit.
Tabor Mfg. Co., Philadelphia.

Molding Sand.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Whitehead Bros. Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Molding Sifters.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.
Whitehead Bros. Co., Buffalo, N.Y.

Ovens for Core-baking and Drying.
Osborn Mfg. Co., Cleveland, O.
Whiting Foundry Equipment Co., Harvey, Ill.
Webster & Sons, Ltd., Montreal.

Oil and Gas Furnaces.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Monarch Eng. & Mfg. Co., Baltimore.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Patterns, Metal and Wood.
Limited, Toronto.
Guelph Pattern Works, Guelph, Ont.
F. W. Quinn, Hamilton, Ont.
Wells Pattern & Machine Works,

Pattern Shop Equipment.
H. S. Carter & Co., Toronto.
Hamilton Pattern Works, Hamilton.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
F. W. Quinn, Hamilton, Ont.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Pig Iron.
Dom. Iron & Steel Co., Sydney, N.S.
Frankel Bros., Toronto.

Phosphorizers.
Joseph Dixon Crucible Co., Jersey City, N.J.
McCulloch-Dalzell Crucible Company, Pittsburg, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Plumbago.
Joseph Dixon Crucible Co., Jersey City, N.J.
H. S. Carter & Co., Toronto.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Plating and Polishing Supplies.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Pneumatic Paint Spray.
Can. Niagara Device Co., Bridgeburg, Ont.

Pyrometer Shields.
Joseph Dixon Crucible Co., Jersey City, N.J.

Polishing Wheels.
Osborn Mfg. Co., Cleveland, O.
W. W. Wells, Toronto.

Ramming Plates and Machines.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rammers, Pneumatic
Cleveland Pneumatic Tool Co., Cleveland, O.
Independent Pneumatic Tool Co., Chicago, Ill.

Retorts.
Joseph Dixon Crucible Co., Jersey City, N.J.
Jonathan Bartley Crucible Co., Trenton, N.J.

Riddles.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Rosin.
Webster & Sons, Ltd., Montreal.

Rouge.
W. W. Wells, Toronto.

Sand Blast Machinery.
Brown Specialty Machinery Co., Chicago, Ill.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Can. Niagara Device Co., Bridgeburg, Ont.
Curtis Pneumatic Machinery Co., St. Louis, Mo.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brookshank Sand Blast Co., Philadelphia, Pa.
J. W. Paxson Co., Philadelphia, Pa.
Stevens F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Blast Rolling Barrels.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brookshank Sand Blast Co., Philadelphia, Pa.
Whitehead Bros. Co., Buffalo, N.Y.

Sand Blast Devices.
Brown Specialty Machinery Co., Chicago, Ill.
Can. Niagara Device Co., Bridgeburg.
Pangborn Corporation, Hagerstown, Md.
Tilghman-Brookshank Sand Blast Co., Philadelphia, Pa.

Sand Conveying Machinery
Standard Sand & Mach. Co., Cleveland, O.

Sand Mixing Machinery
Standard Sand & Mach. Co., Cleveland, O.
Vulcan Engineering Sales Co., Chicago, Ill.

Sand Molding.
H. S. Carter & Co., Toronto.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
J. W. Paxson Co., Philadelphia, Pa.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.

Sand Sifters.
H. S. Carter & Co., Toronto.
Canadian Ingersoll-Rand Co., Ltd., Montreal.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
Standard Sand & Mach. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
Webster & Sons, Ltd., Montreal.
Whiting Foundry Equipment Co., Harvey, Ill.

Sand Shakers.
Brown Specialty Machinery Co., Chicago, Ill.

Saws, Hack.
Ford-Smith Machine Co., Hamilton, Ont.

Separators, Moisture, Oil and Sand.
Pangborn Corporation, Hagerstown, Md.

Sieves.
Osborn Mfg. Co., Cleveland, O.
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Webster & Sons, Ltd., Montreal.

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Joseph Dixon Crucible Co., Jersey City, N.J.

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Soapstone.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.

Spelter Bowls.
Joseph Dixon Crucible Co., Jersey City, N.J.

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Wells Pattern & Machine Works, Limited, Toronto.

Sprue Cutters.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
J. W. Paxson Co., Philadelphia, Pa.
F. B. Shuster Co., New Haven, Conn.
Stevens, F. B., Detroit, Mich.
Vulcan Engineering Sales Co., Chicago, Ill.
Webster & Sons, Ltd., Montreal.

Squeezer Molding Machines
Mumford Molding Machine Co., Chicago, Ill.

Squeezers, Power.
Davenport Machine & Foundry Co., Iowa.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.
Webster & Sons, Ltd., Montreal.

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Dom. Iron & Steel Co., Sydney, N.S.

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Dom. Iron & Steel Co., Sydney, N.S.
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Geometric Tool Co., New Haven, Conn.

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McCulloch-Dalzell Crucible Company, Pittsburg, Pa.

Threading Machines.
Geometric Tool Co., New Haven, Conn.

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Independent Pneumatic Tool Co., Chicago, Ill.

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Northern Crane Works, Walkerville, Ont.
Herbert Morris Crane & Hoist Co., Ltd., Toronto.
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W. W. Wells, Toronto.

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Sterling Wheelbarrow Co., Milwaukee, Wis.

Trucks, Dryer and Factory.
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Webster & Sons, Ltd., Montreal.
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Tumblers.
H. S. Carter & Co., Toronto.
Webster & Sons, Ltd., Montreal.

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Webster & Sons, Ltd., Montreal.
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H. S. Carter & Co., Toronto.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

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Canadian Ingersoll-Rand Co., Ltd., Montreal.
Mumford Molding Machine Co., Chicago, Ill.
Osborn Mfg. Co., Cleveland, O.

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Dom. Iron & Steel Co., Sydney, N.S.

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Metals Welding Co., Cleveland, O.

Wheels, Polishing, Abrasive.
Canadian Hart Wheels,
Ford-Smith Machine Co., Hamilton, Ont.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Osborn Mfg. Co., Cleveland, O.
Stevens, F. B., Detroit, Mich.
United Compound Co., Buffalo, N.Y.
Webster & Sons, Ltd., Montreal.

Wire Wheels.
Stevens, F. B., Detroit, Mich.
Hamilton Facing Mill Co., Ltd., Hamilton, Ont.
Webster & Sons, Ltd., Montreal.
W. W. Wells, Toronto.

Wire, Wire Rods and Nails.
Dom. Iron & Steel Co., Sydney, N.S.
Osborn Mfg. Co., Cleveland, O.

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