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**"Iron and Brass Foundries, Point St. Charles Works,
Grand Trunk Railway of Canada."**

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(Abstract.)

THESE foundries were specially designed to meet the requirements of two-thirds of the Company's entire system, and to supply castings to all departments, and not solely to the locomotive and wagon works.

The annual capacity of the iron foundry is 3,000 tons of castings, that of the brass foundry 200 tons. The main body of the foundry is cruciform, 200 feet from north to south, and 200 feet from east to west, with a span of 60 feet and height of 18 feet from the level of the floor to the top of the walls. The building is heated by steam-pipes capable of maintaining a uniform temperature of 54° in the coldest weather. The brass foundry occupies a space of 60 feet by 30 feet in the north end of the building. A line of rails of the standard gauge of 4 feet $8\frac{1}{2}$ inches leads from the main line into the building.

The cupola house is situated in the south-west angle of the main building. Its main dimensions are 31 feet $7\frac{1}{2}$ inches by 20 feet by 20 feet high. There is a light iron stair at one corner for the use of the furnace-men and a hoist for lifting up the charges of fuel and metal. The building is ventilated by annular ventilators passing through the roof round the cupola stacks, similar to those used round the funnels of steam-ships.

There are two cupolas, made of boiler-plate, $\frac{3}{8}$ inch thick, 5 feet in diameter, in five parallel courses, 13 feet 9 inches high to the top of the fifth course; the sixth course is conical, 3 feet 6 inches, contracting from 5 feet in diameter to 3 feet 3 inches at the base of the stack, which is also of boiler-plate, $\frac{1}{16}$ inch thick, built in thirteen parallel courses, 35 feet high, and 3 feet 3 inches in diameter. Each is fitted with a drop bottom. The lining is parallel from the sole-plate to the flare contracting into the stack, of double fire-brick. The course next to the shell, or

outside lining, is of plain fire-bricks, 9 inches by $4\frac{1}{2}$ inches by $2\frac{1}{2}$ inches thick, placed on edge, the small ends down, and backed with about $\frac{3}{4}$ inch of sand to keep them off the rivet-heads in the seams of the shell. The inner lining consists of segmental fire-bricks of a superior quality, 9 inches by $4\frac{1}{2}$ inches by $4\frac{1}{2}$ inches thick, and moulded to a radius of 1 foot $10\frac{3}{8}$ inches, the diameter of the cupola inside the lining being 44 inches. The flare is lined with one course of specially moulded segmental fire-bricks, 9 inches by $3\frac{1}{2}$ inches by $2\frac{1}{2}$ inches thick and 1 foot $8\frac{1}{8}$ inches radius, as is also the stack throughout its entire length with bricks 9 inches by $3\frac{1}{2}$ inches by $2\frac{1}{2}$ inches thick and of 1 foot 4 inches radius, the diameter of the stack inside the lining being 31 inches. The bricks are set in thin fire-clay mortar, consisting of refractory sand and Jersey fire-clay; great care being taken to break the joints of the inner and outer linings, and to make them as thin as possible. A lining, such as the one just described, will last ten months, used daily, before any of the inner lining bricks require renewing. The first to burn out are those in the zone of fusion about 20 inches above the tuyeres. The repairs are carried out without disturbing the rest of the lining; angle-iron rings riveted inside the shell support the lining at three points. The blast is delivered into an annular wind-chest 1 foot 8 inches by 9 inches. Sight-holes are provided in elbows fitted with covers glazed with thick glass and mica or talc, a $\frac{1}{2}$ -inch air space being left between the glass and mica, which is on the inside, preventing the glass from being cracked by heat. The tuyeres are five in number, circular, $5\frac{1}{2}$ inches in diameter in one belt, 1 foot $5\frac{1}{2}$ inches from the sole-plate to the centre of the tuyeres, and 3 feet apart. The charging hole is 2 feet 3 inches by 2 feet 8 inches, placed 10 feet 9 inches above the sole-plate. It is fitted with cast-iron doors, which are lined with fire-brick, and carried on a cast-iron frame bolted to the shell. The blast enters the wind-chest at two points directly opposite each other, placed between the tuyeres and not opposite to any one of them. The main blast-pipe leading from the cupola-house to the engine-room is 24 inches in diameter, made of galvanized iron No. 20 B. W. G.; all seams and joints are riveted and soldered to ensure their being air-tight. This pipe is provided with weighted valves opening outwards, which prevent the pressure in it exceeding 16 oz. per square inch.

The blast is supplied by two No. 8 Sturtevant fans. The pressure varies from $8\frac{1}{2}$ to 9 oz. The fans and other machinery are driven by an ordinary high-pressure engine; the cylinder has a bore of 12 inches and length of stroke of 30 inches, indicating

36 HP. The steam for the engine and for heating-purposes is supplied by two boilers of the locomotive type, 11 feet 7 inches in extreme length, and 4 feet 2 inches in diameter. The dimensions of the fire-boxes inside are 5 feet 4 inches by 5 feet 3 inches by 3 feet 9 inches. The main chimney is of $\frac{3}{8}$ -inch plate 3 feet in diameter at the base, tapering to 2 feet 6 inches at the top, and it is 62 feet high.

There are two core-ovens, with flues leading into the main boiler-house chimney. They are built of brick, air spaces being provided in the walls to prevent their cracking. The roofs are of iron plate, stiffened with old rails, and covered with a cement mixture of clay and asbestos fibre about 6 inches thick; this is found to keep the heat in well, and does not crack. The general core oven is 18 feet by 8 feet 6 inches by 8 feet high. The other core oven is 20 feet by 10 feet by 8 feet high. The entrance is 10 feet by 8 feet. The door is of iron plate, lifting upward between guides, and balanced. The space above the core ovens is used for storing iron patterns.

There are four cranes in the building, one 8-ton and one 4-ton of 25 feet radius, and one 2-ton and one 1-ton of 20 feet radius. Very light hand-work is moulded on benches. The moulds are made in movable or "snap" flasks, and do not require any flasks round them when being cast, the adhesion of the sand being in itself sufficient to resist the pressure of the molten metal. This method of moulding is very economical; a good bench moulder will turn out forty to fifty moulds per day. The charging hoist in the cupola house is capable of lifting 2 tons, and is run by simple worm and wheel gear with straight and crossed belts, one fast and two loose pulleys. The power to work it is transmitted from the main shafting running through the engine-house by an ordinary tarred $4\frac{1}{2}$ -inch hempen rope, running cast-iron V-pulleys 5 feet in diameter; the bottom of the groove in the pulleys is filled with india-rubber. This rope runs outside the building, exposed to all weather, and lasts on an average ten months. The rest of the machinery consists of: a sand-grinding and loam-mixing mill, two rattlers or fettling drums 56 inches long, one of them 48 inches, the other 24 inches, in diameter. The larger of these is mounted on friction rollers, and is built into a wooden chamber lined with sheet iron; the dust coming from the castings being cleaned in the mill is exhausted from this chamber, and blown out of the building. The smaller drum is placed outside the cupola-house, and is used exclusively for separating the iron from the cinders and slag dropped out of the cupolas, which often

amounts to 8 or 10 cwt. One vibratory sand-sifter; one hay-band making machine; a double-wheeled emery-grinder for dressing fins and gates; one small vertical and one small horizontal drill; a machine for breaking pig-iron; this machine enables the furnace-man to break pigs into pieces 8 or 10 inches long; large pieces of pig thrown into the cupola do serious injury to the lining, crushing and bruising the bricks, and they are also apt to scaffold or hang; it therefore pays to break the pigs into small pieces; a drop-weight and pole 30 feet high for breaking up large pieces of scrap, &c. The largest ladles used hold 6 tons of metal; all ladles from 40 cwt. and upwards are geared, and ladles over 1 cwt. capacity are fitted with malleable-iron removable lips.

The brass foundry is divided from the iron foundry by a brick wall 8 feet high, surrounded by an iron railing, 4 feet high. The moulding sand in this department is contained in large troughs over which the moulders work. These troughs are placed along the wall, under the large windows, and down the centre of the shop. The pot-holes or furnaces are placed along the west wall, occupying a space 19 feet 3 inches by 9 feet 3 inches; they are seven in number, six of the ordinary type, 1 foot 6 inches in diameter, and 2 feet 5 inches deep, lined with segmental fire-bricks, 1 foot 7 inches by $4\frac{1}{2}$ inches by $6\frac{1}{8}$ inches thick and 9 inches radius, and are large enough to admit 80-lb. crucibles. The seventh is Fletcher's patent furnace. All furnaces are provided with a forced blast of about 6 oz. pressure, as well as the natural draught from the chimney. The tops of the furnaces are level with the floor; there is an ash-pit in front of the furnaces, 3 feet wide, 4 feet 5 inches deep, covered with a strong wrought-iron grating. The flues all lead into one chimney of $\frac{3}{16}$ -inch plate, 3 feet 3 inches at the base, tapering to 2 feet 6 inches at the top, and 40 feet high, lined with fire-brick for about one-third of the way up. The hot gases, before entering the chimney, pass round and heat the core-ovens, which are of iron plate fitted with suitable shelves. At the side of the building opposite the furnaces is a coal bunker, capable of holding 7 tons of coal. The coal is carried from this bunker to the fires in a swing-bucket, travelling on a rail overhead. There is also a double emery wheel and rattler for dressing and cleaning castings. These and the fan are driven by a diagonal engine, having a cylinder 8 inches by 10 inches.

The cost of foundry-materials in Montreal, in 1885, was as follows:—

IRON FOUNDRY MATERIAL.

	£	s.	d.
Scrap iron per gross ton (2,240 lbs.)	2	6	8
Pig iron, "Langloan," No. 1 "	4	5	7
" " "Summerlee," "	4	4	7
" " "American," "	4	5	4½
Coke, Reading and Pittsburg Mining Co., per net ton (2,000 lbs.)	1	0	10
Coal, Lehigh anthracite lump per gross ton	1	10	2
" " "egg size "	1	4	2
" " Steam, Lower Province Canadian "	15	10	
Moulding sand, Canadian "	4	2½	
" " "American "	14	7	
River " " for core-making "	5	10	
Fire-clay, Scotch, ground, in bags per 100 lbs.	3	4	
" " "American, in lumps per net ton	2	1	8
Red clay per gross ton	7	3½	
Fire-brick, Scotch " 1,000	4	9	7
" " "American, No. 1 "	27	10	0
" " "No. 2 "	11	5	0
Lumber per 1,000 feet	3	2	6
Flour for core-making per lb.			1
Sea-coal facing per net ton	2	13	4
Carbonized lead facing "	9	7	0
Powdered charcoal "	10	10	5

BRASS FOUNDRY MATERIAL.

	£	s.	d.
Scrap brass per lb.	0	5	
Ingot copper "	0	6	
" tin "	0	10½	
Cake zinc "	0	1½	
Pig lead "	0	1½	
Antimony "	0	5½	
Crucibles, 60 lbs. capacity each	8	11½	

Cost of Labour.—Foreman, £177 1s. 8d. per annum; moulders, 10d. to 7d.; core makers, 8d. to 7½d.; furnaceman, 7¼d.; carpenter, 6¾d.; engine-man, 5½d.; fitters, 6¼d. to 5¼d.; labourers, 5½d. to 5d. per hour; apprentices, per hour, first year, 2d., second year, 2½d., third year, 3d., fourth year, 4d., fifth year, 5d. The total cost of production was £7,532 15s. 6d., being equal to £6 19s. 9d. per gross ton, or 0·74d. per lb. On further analysis it will be found that 46 per cent. of this amount was paid for labour, 41·3 per cent. for iron, 4·6 per cent. for fuel, and 8·1 per cent. for sundries. The cost of labour may at first sight appear to be high, but it must be borne in mind that a large portion of the castings turned out of a general railway foundry in Canada is light. The proportion of pig iron to scrap used is as one to three. It is expected that the price of castings may be reduced to £6 per ton.

The output of the Brass Foundry from the 1st of January
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to the 30th of October, 1885, was 140 tons 15 cwt. 1 qr. 6 lbs., and very nearly represents the full capacity of the foundry, of which the chief part consists of engine and wagon brasses. The cost of production was £8,073 2s. 8½d., equal to £57 6s. 11d. per gross ton, or 6·14d. per lb. The labour costs 9 per cent.; metals, 86 per cent.; fuel, 3 per cent.; and sundries, 2 per cent. From this it is evident that whereas the price of labour seriously affects the cost of iron-castings, it makes but little difference in the cost of brass-castings; although the cost per lb. of metal in the latter case, 0·505d., is nearly double that in the former, 0·32d., owing to the work being so much lighter. The cost of brass castings is controlled by the prices of the raw materials; it therefore depends more on the ability displayed in purchasing these than in the smaller economies resulting from the careful management of the brass foundry, whether the company pays dearly for brass castings or obtains them at a moderate price.

GENERAL STATEMENT SHOWING THE WORKING OF THE IRON FOUNDRY FROM
JULY, 1884, TO JUNE, 1885.

	lbs.	Per cent. of metals melted.
Total iron melted	3,066,977	
„ castings produced	2,414,913	78¾
„ mill scrap	300,404	9¾
„ defective castings	54,959	1¾
„ excess after filling moulds.	187,737	6¼
„ Waste	108,964	3½
Total amount of fuel used	411,548 lbs.	
Ratio of fuel to iron melted	1 to 7¼.	
Total number of melts	248	
„ time in melting charges	263 hours.	
Average weight of each melt	9,775 lbs.	
Ratio of pig iron to scrap.	1 to 3.	

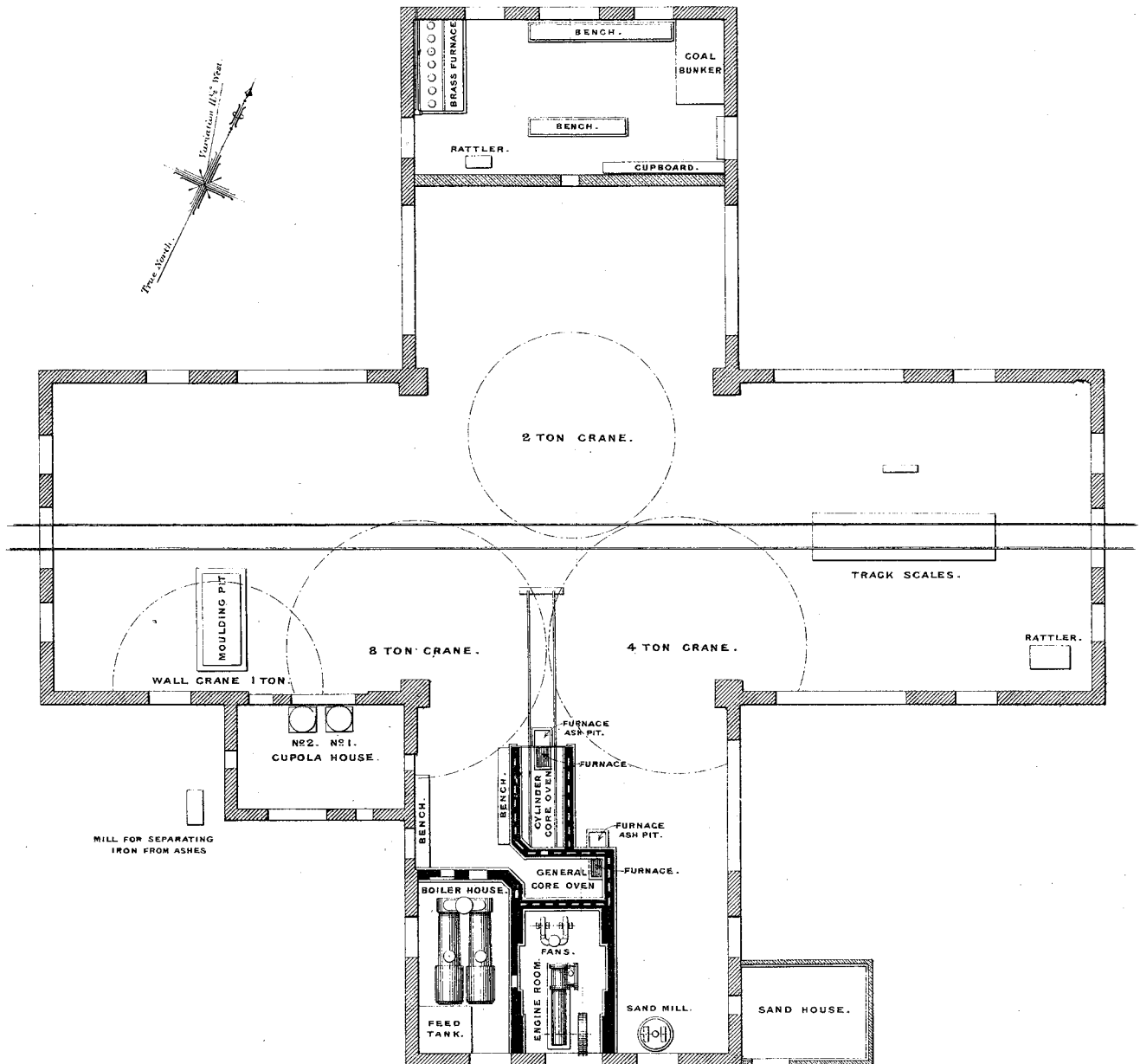
GENERAL STATEMENT SHOWING THE WORKING OF THE BRASS FOUNDRY FROM
JANUARY 1st to OCTOBER 30th, 1885:—

	lbs.	Per cent. of metals melted.
Total metals melted	358,419	..
„ castings produced	315,342	88
„ excess after filling moulds	18,162	5½
„ gates	21,557	6½
„ waste	3,358	¾
Total amount of fuel used	433,618 lbs.	
Ratio of fuel to metals melted	1½ to 1.	
Ratio of scrap metals to ingot metals	3½ to 1.	

The communication is illustrated by a general plan of the works, Plate 4.

IRON AND BRASS FOUNDRIES, POINT ST CHARLES WORKS, GRAND TRUNK RAILWAY OF CANADA.

PLATE 4.



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Scale: 32 Feet = 1 Inch.
0 10 20 30 40 50 60 70 80 90 100 Feet.

THOR KELL & SON, LITH. LONDON