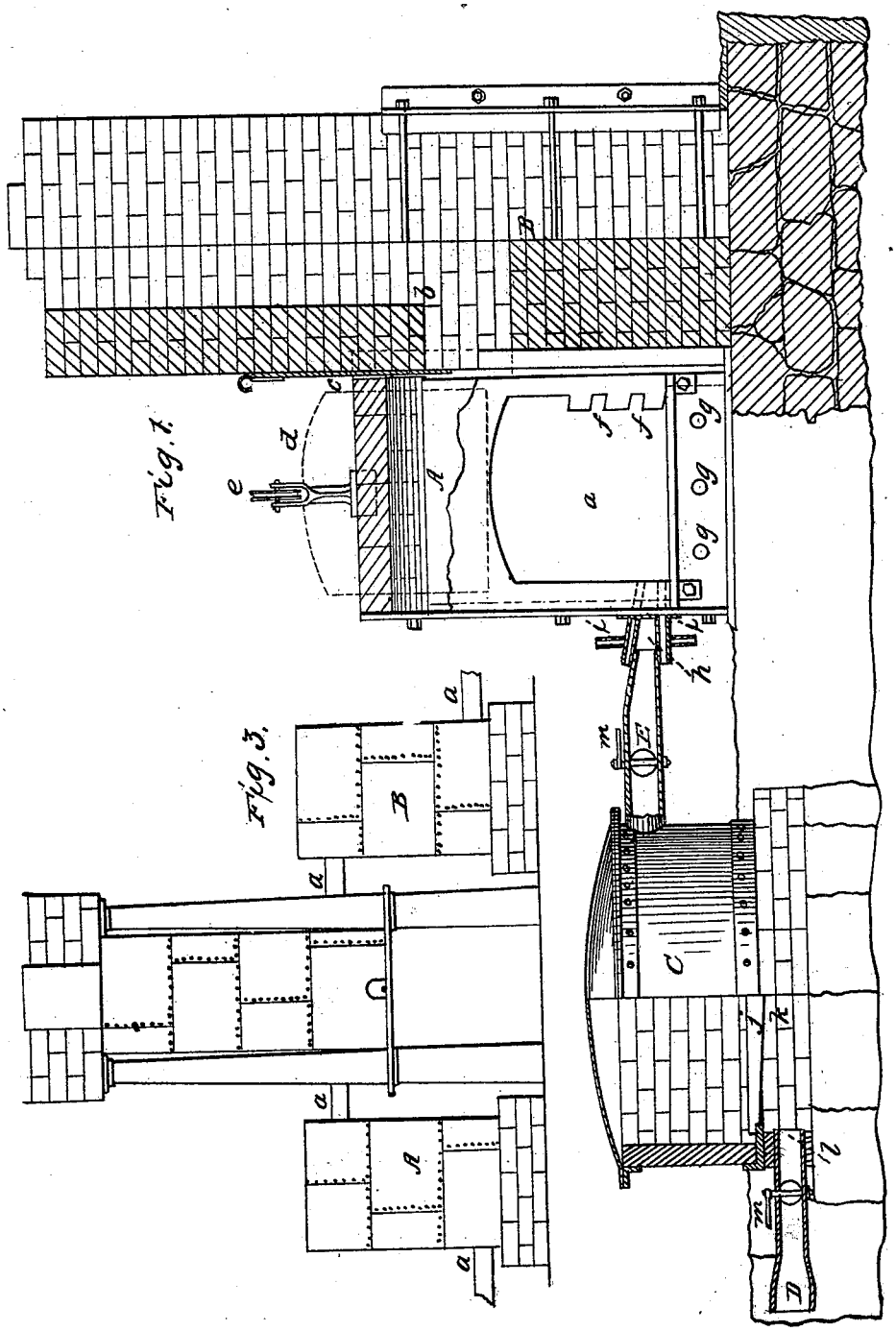
2 Sheets—Sheet 1

ISHAM & MARCY.

Manufacture of Steel from Iron.

No. 6,760.

Patented Oct. 2, 1849.



2 Sheets—Sheet 2.

ISHAM & MARCY.

Manufacture of Steel from Iron.

No. 6,760. Patented Oct. 2, 1849.

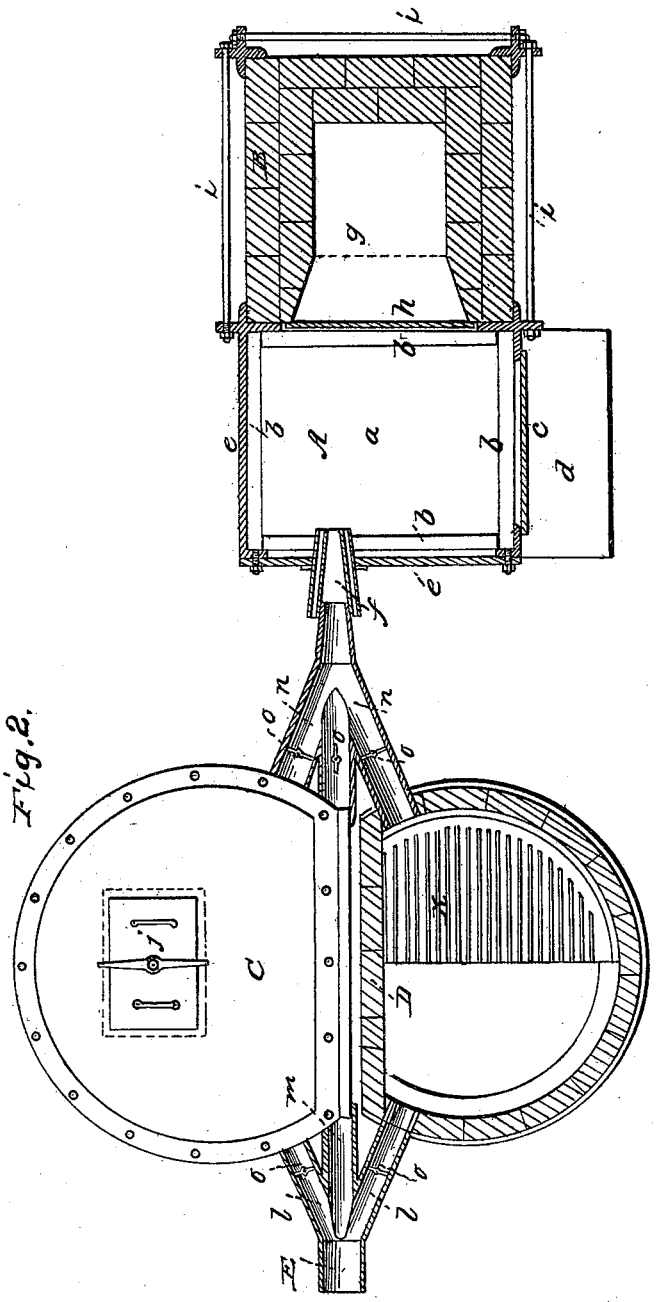


Fig. 2.

UNITED STATES PATENT OFFICE.

N. M. ISHAM AND E. E. MARCY, OF HARTFORD, CONNECTICUT.

PROCESS FOR MAKING STEEL.

Specification forming part of Letters Patent No. **6,760**, dated October 2, 1849; antedated November 2, 1848.

To all whom it may concern:

Be it known that we, NORMAN M. ISHAM and ERASTUS E. MARCY, joint inventors, of the city of Hartford and State of Connecticut, have invented a new and useful Improvement in the Art of Converting Iron Ores and Cast-Iron, Unmixed with any Malleable Iron, into Steel; and we do hereby declare that the nature of our invention and the method of operation are fully set forth in the following specification and accompanying drawings, making a part of this specification.

To enable others to make and use our said invention, we proceed to describe the apparatus, its construction, and mode of operation.

The first process in our manufacture of steel is to fuse either cast-iron or iron ore judiciously selected in a cupola-furnace charged after the ordinary method, but urged by blasts of hot carbonic-oxide gas. This is accomplished by attaching to a common cupola-furnace (charged in all respects after the ordinary method of melting pig-iron) two receptacles or reservoirs, A and B, Figure 3, similar to those represented by C in Fig. 1 and by C and D in Fig. 2, and of sufficient size to hold a quantity of charcoal, which shall not be all consumed until the iron is melted. The receptacles which are to be attached to the cupola-furnace in the manner as shown by Fig. 3 are to be charged with charcoal and ignited by the time the fuel in the cupola-furnace is ready for the blast. Now, instead of applying the air-blasts directly to the cupola-furnace, they are to be applied to the receptacles, as at *a a*, Fig. 3, and the iron is melted by the aid of the hot carbonic-oxide gas thus produced, and cast in chills. By this preparatory process the metal acquires some of the properties of steel, and becomes so modified in its character as to be more readily convertible into good steel by the process hereinafter described.

The process of refining steel is as follows: The metal, having been first prepared in the manner and by the apparatus above described, is placed in the bed of the furnace A, Fig. 1, and covered with charcoal. The receptacles or reservoirs C, Fig. 1, and C D, Fig. 2, are then filled with charcoal, and when thoroughly ignited the lids are put on and luted down to prevent an escape of gas. An air-blast, which must be regulated by the judgment of the operator, is then to be applied at the apertures D and E, Figs. 1 and 2. This blast by passing through the receptacles creates a gaseous oxide of carbon, which is driven upon the iron in the furnace through the tuyere *f*. In addition to this current of gaseous carbon there must be another air-blast passing into the furnace through branch *m* of the pipe *i*, regulated by the damper *o*, so as to admit atmospheric air sufficient to produce the combustion required to melt the metal. When melted, the metal is to be worked after the ordinary process adopted in refining iron. An important part of the process consists in graduating by means of the valves *o o o o o* the proportions of gaseous carbon and of atmospheric air thrown into the furnace, so as to bring the metal to nature, and at the same time to convert it into steel. No definite rules can be given to determine the exact proportions of gaseous carbon and atmospheric air requisite to produce this conversion, for much depends on the quality and quantity of the metal to be converted, and on the judgment and skill of the operator in conducting the process, which should be continued until the metal is properly brought to nature—that is, sufficiently refined to ball—when it should be taken out and carefully forged into blooms. Skill is required to enable the operator to treat the metal in the furnace, and to determine that precise degree of refinement and carbonization which is requisite to produce the best steel. This can be obtained by practical experience only.

Fig. 1 of the annexed drawings represents a transverse vertical section of the apparatus, and Fig. 2 a transverse horizontal section of the same.

In Fig. 1, A is the furnace; *a*, the front opening for same; B, the stack or chimney; *b*, the flue in same; *c*, the valve or damper for regulating draft of flue; *d*, an iron door for closing front of furnace, regulated by weight and chain passing over pulley *e*; *f f*, notches in front plate of furnace to support the bars when working the metal; *g g g*, holes in front plate for dipping out the cinder; *h*, tuyere surrounded by water conveyed through pipes *i i*, and entering the furnace near the

bottom; C, receptacle or reservoir, cylinder shape, made of iron, and lined with fire-brick; *j*, grate in bottom of same; K, ash-pit; D, blast-pipe entering ash-pit of receptacle C at *l;* E, branch of blast-pipe passing from near top of receptable C into furnace A through tuyere *h; m m*, valves in the blast-pipe.

In Fig. 2, A represents interior of furnace, *a* bottom plate, and *b b b b* side plates of cast-iron inclosing the fire, on which the metal is worked; *c*, door of iron for closing front of furnace; *d*, cast-iron hearth; *e e*, cast-iron plates inclosing the furnace; *f*, tuyere; B, stack or chimney; *g*, flue; *h*, valve or damper in flue for regulating draft; *i i i*, bolts for securing chimney in place; C, charcoal-receptacle, closed; *j*, door for charging same, which may be either in the top, as in the drawings, or in the sides; D, another receptacle, with cover removed, showing grate *k k* at bottom; E, blast-pipe; *l l*, branches entering receptacle at bottom; *m*, branch of same entering tuyere at *f; n n*, branches of same passing from near top of receptacle C and D and joining branch *m* at tuyere *f; o o o o o*, valves or dampers for regulating blasts. To reduce the blooms into bars they should be heated in a suitable heating-furnace and subjected to the tilt-hammer. During the working of the metal in the furnace A, Fig. 1, it should be carefully covered with charcoal, and the external air excluded as much as possible by means of the door D, Fig. 1.

The above is a general description of the process necessary to produce steel by our method, and the apparatus used therein. There are, however, some particulars relating to the working of our plans of the highest consequence and absolutely necessary to perfect success. The great importance of the first process is the effect thus produced on the metal, which seems to be a chemical union of a sufficient quantity of carbon equally throughout the whole mass of iron, by which it attains the properties of impure steel, and particularly fit it for the second process, for which it was never before discovered to be adapted, and without obtaining metal in the state in which the first process leaves it we find it impossible to make a perfect steel without the use of malleable iron, which has always heretofore been used in whole or in part in the conversion of iron into steel. In the second process we are obliged to confine ourselves within very narrow limits as to proportion, position, and direction of the blast, or the result will be entirely marred or spoiled, as has been proved by numerous experiments. The tuyere must enter the furnace in a horizontal position. It should be about five and three-fourths inches in circumference at the orifice and seven inches and three-fourths above the bottom plate, where the latter is eighteen by twenty inches, for making loops of eighty or one hundred pounds. In larger furnaces the tuyere should be a little higher.

We find that the apparatus heretofore used for refining steel by any of the known modes is wholly insufficient for our purposes. This we desire to call particular attention to, as it is very important to secure our particular apparatus, as clearly illustrated in the drawings. The peculiarities of our process may therefore be thus concisely summed up: First, we use no malleable iron, but melt the pig-iron or ore by the aid of the hot carbonic-oxide blast thown directly upon the iron in the cupola-furnace through a tuyere entering the furnace at or near the bottom. This very essentially modifies the character of the metal, as before stated, by which it is prepared to be submitted to the second process, in which it is placed in a refining-furnace, covered with charcoal, and subjected to a horizontal blast of hot carbonic-oxide gas and atmospheric air, commingled and in requisite proportions, properly regulated by valves, as described, till the metal is worked into a ball of malleable steel, ready to be forged into bars.

We take occasion here to observe that since our invention the hot carbonic-oxide blast has been applied to some extent in the manufacture of iron both in Europe and America; but we have priority and originality in the mode of application, as herein described, of this important gas to the manufacture of steel.

We do not claim to have been the first who have melted iron in a common cupola-furnace charged in the usual manner and urged by blasts of hot carbonic-oxide gas; but

What we do claim as our invention, and desire to secure by Letters Patent, is—

1. The process herein described of manufacturing steel by producing, first, a metal imperfectly converted in the cupola-furnace, in the manner described, and then submitting said metal to the refinery, constructed as herein described, where the article is perfected by the means above made known.

2. The horizontal blast in the refining-furnace, as above more particularly stated, for blowing a blast of carbonic oxide, as herein set forth.

NORMAN M. ISHAM.
ERASTUS E. MARCY.

Witnesses:
RICHARD D. HUBBARD,
HORATIO W. SHIPMAN.