C. SHUNK.

Refining Iron.

No. 24,060. Patented May 17, 1859.

Fig. 1.

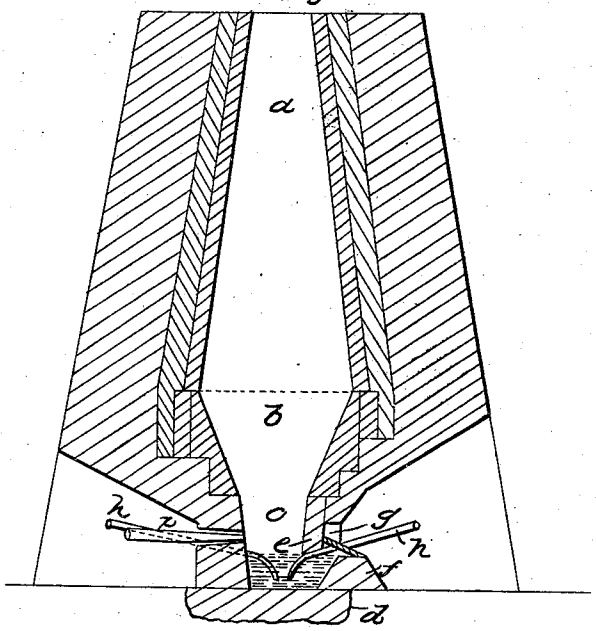
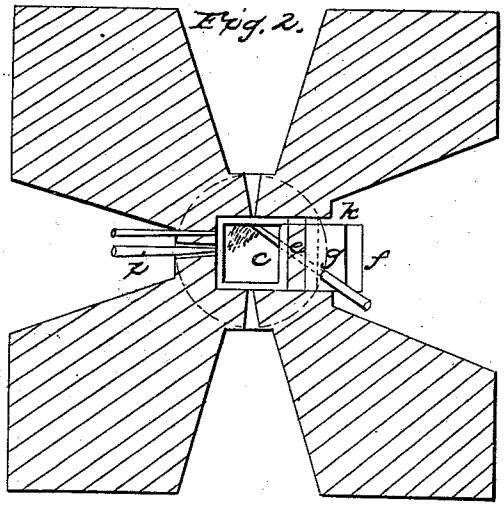


Fig. 2.



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UNITED STATES PATENT OFFICE.

CHRISTIAN SHUNK, OF CANTON, OHIO.

IMPROVEMENT IN REFINING IRON IN THE HEARTH OF A BLAST-FURNACE.

Specification forming part of Letters Patent No. **24,060**, dated May 17, 1859.

To all whom it may concern:

Be it known that I, CHRISTIAN SHUNK, of Canton, in the county of Stark and State of Ohio, (formerly of Slate Lick, Armstrong county, in the State of Pennsylvania,) have invented a new and useful improvement in in the process of refining and decarbonizing the melted metal in the hearth of the ordinary blast-furnace used in the manufacture of pig-metal; and I do hereby declare that the following is a full, clear, and exact description thereof.

My improvement consists in refining and decarbonizing the melted metal in the blast-furnace before it leaves the furnace-hearth by passing a blast or blasts of air through the body of the molten metal by means of an auxiliary tuyere pipe or pipes, so arranged as to discharge the blast under the surface of the melted metal, so as to secure the free admixture of the oxygen of the air used for blast with the particles of the iron, causing the union of the carbon of the iron with the oxygen thus supplied, and thus refining the metal before it is made into pig-iron. My invention supersedes entirely the use of the finery or run-out fire, the use of which arose from the manifest necessity of an intermediate process of refining or purification between the blast-furnace, where the ore is converted into metallic iron, and the puddling-furnace, this necessity being occasioned by the impurities in the iron and the presence of an excess of carbon. My invention thus not only avoids the trouble and delay of this intermediate process, but causes a great saving of iron, which is usually converted into slag, and wasted by the finery or the run-out process, as well as the fuel used in the remelting of the pig.

To enable others skilled in the art to make use of my invention, I will proceed to describe the mode in which I put it into practical operation, and in so doing shall describe the alterations which I make in the blast-furnace, as ordinarily constructed for smelting iron ore, to introduce my improvement.

In the drawings accompanying and forming part of this specification, and which represent a blast-furnace adapted to the use of my improvement, Figure 1 is a vertical sectional elevation of a blast-furnace, (through the tymp-arch and one of the tuyere-arches,) being the ordinary blast-furnace for the manufacture of pig-iron from the ore, constructed and arranged for the use of my improvement. Fig. 2 is a horizontal section through the tuyere-arches and hearth of the blast-furnace shown in Fig. 1.

The furnace itself is constructed like other blast-furnaces in the shape and position of the upper part or crucible, A, the middle portion or boshes, B, and the lowest part or hearth, C, the only alteration required being the formation of one or more additional tuyere-holes for the admission of the auxiliary tuyere-pipe or pipes used for introducing the blast into the iron. The ordinary tuyere-pipes used in the blast-furnaces are not dispensed with, nor is their position or mode of application varied, excepting that, when the refining process is being carried on, all the blast is caused to pass through auxiliary tuyere pipe or pipes, and is stopped from passing through the ordinary tuyere-pipes.

To introduce the blast for refining the iron by my process, I use a separate tuyere-pipe, which is introduced into the hearth of the furnace under the tymp-stone in front, or at any one of the other three sides, as may be desired. If it be introduced at one of the sides, it is inserted through a tuyere-arch, in a similar manner to the ordinary tuyere-pipes, excepting that the nozzle is much longer, and enters the hearth, (which the nozzle of the ordinary tuyere-pipe does not.) The nozzle of the auxiliary tuyere-pipe, after entering the cavity forming the hearth, dips downward to within a short distance of the hearth-stone D, so that its mouth is covered by the molten metal. It is preferable to set the nozzle of the auxiliary tuyere-pipe at such an angle as that the blast of air entering the iron may strike the circular wall of the hearth as nearly as possible at a tangent to its circumference, so as to cause the blast of air to pass around in the iron, and become as much diffused through it as possible, giving the metal in the hearth a spiral motion, which greatly relieves the pressure of the metal at the mouth of the tuyere-pipe. If the auxiliary tuyere-pipe is to be introduced in front of the furnace, it is done by inserting it through the small opening between the lower front edge of the tymp-stone E and the top of dam-stone F, in which case a movable tymp-plate, G, is placed over the dam, covering the aperture

between the tymp-stone and the dam-stone. The auxiliary tuyere-pipe is inserted in an opening of convenient size in said plate G, so as to penetrate the liquid metal near the bottom of the furnace-hearth. This plate may be swung out of the way when the refining process is over. It will thus be seen that my improvement, though very important in its results, requires so little alteration in the construction and arrangement of the blast-furnace as to be easy and cheaply introduced into practical operation; but I do not desire to confine myself in the application of my improvement to the precise manner of application herein described.

After the charge of iron has run down into the hearth of the blast-furnace, the smelting process being carried on in the usual way, and when the molten iron is ready, according to the ordinary process, to be run out into pigs my refining process is commenced. The whole blast of air used for the blast-furnace is now diverted from the ordinary tuyere-pipes, and caused to pass with great force and pressure through the auxiliary tuyere pipe or pipes H H′ used in my process. Cold air is much preferable as a blast for refining the iron, though either cold or hot may be used. Care must be taken to proportion the size of the auxiliary tuyere-pipes to the quantity of air to be forced through them by the blowing-cylinders, which must be very considerable in volume and pressure to cause a rapid motion and ebullition of the molten iron in the furnace-hearth, so as to expose all the particles of the iron to contact with the air, by means of which the iron is refined of its impurities, and decarbonized by the admixture of the oxygen of the air and the carbon of the iron before it is run into pig metal.

The process of refining requires but a few minutes for its accomplishment, and when finished the molten metal is drawn off through the tapping-hole K in the usual manner, and molded into pig-iron.

The use of a strong blast of cold air and in its intimate admixture with the melted iron has not the effect of chilling the iron in the furnace-hearth, but rather the reverse, as the chemical effect of the union of the oxygen and carbon is to produce an intense heat which preserves, and, if anything, increases the fluidity of the metal; but this cold blast must not be continued too long, for if so the iron will commence to granulate. The proper time is soon learned by the workman.

Having thus described my improved process for refining and purifying iron previous to its being cast into pig metal, I do not claim, broadly, the use of blasts of atmospheric air, either hot or cold, to refine and decarbonize iron, for that has been known before as applied to the surface of the iron; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

The employment of an auxiliary tuyere-pipe within the hearth of the common blast-furnace when charged with molten iron at such an angle as that the blast of the air entering the iron may strike the circular wall of the hearth as nearly as possible at a tangent to its circumference, so as to cause the blast of air to pass round in the metal, giving the whole mass in the hearth a spiral motion immediately before the tapping of the furnace for the manufacture of pig-iron from the ore.

CHRISTIAN SHUNK.

Witness:

DANIEL MCCOOK.