

# STEWART, CHRISTOPHER & FORWARD.

Refining Iron and Steel.

No. 23,123.

Patented March 1, 1859.

Fig. 3.

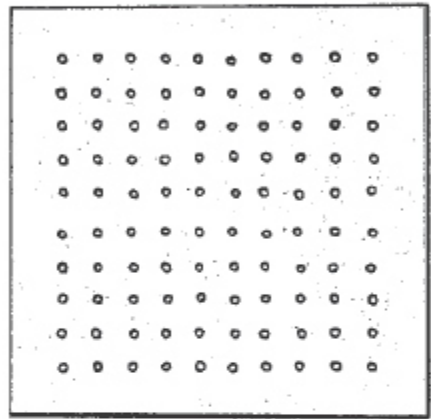


Fig. 5.



Fig. 4.



Fig. 6.

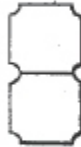


Fig. 1.

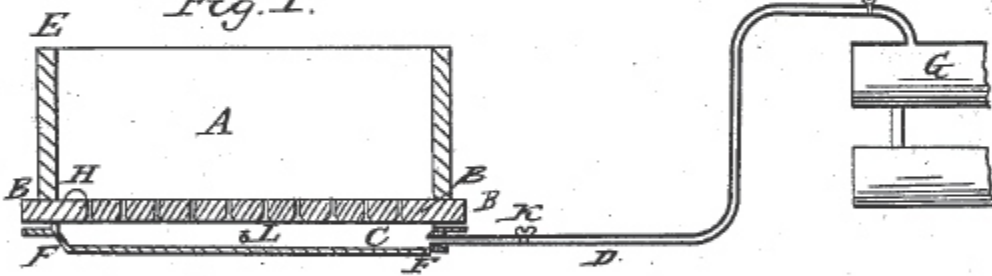
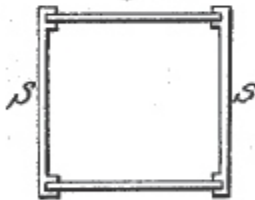


Fig. 7.



Witnesses:

*R. J. Forward*  
*Michael Zimmerman*

Inventors:

*R. L. Stewart*  
*John Christopher*  
*Ross Forward*

# UNITED STATES PATENT OFFICE.

R. L. STEWART, J. CHRISTOPHER, AND R. FORWARD, OF LIGONIER, PA.

## IMPROVED HEARTH FOR WORKING AND REFINING IRON.

Specification forming part of Letters Patent No. 23,123, dated March 1, 1859.

*To all whom it may concern:*

Be it known that we, R. L. STEWART, J. CHRISTOPHER, and R. FORWARD, of Ligonier, Pennsylvania, have discovered a new and Improved Method of Refining Iron, of which the following is a specification.

The nature of our invention consists in exposing the molten metal to the action of a blast of steam operating by the pressure of its confinement through perforations in the bottom of a furnace pan or vessel, in which the fluid iron is placed, whereby the steam, being forced in a number of jets through the molten iron, is decomposed, its oxygen and hydrogen combining with the impurities of the metal consuming and carrying them off through the gases evolved, leaving the iron pure and in such state as saves much time and labor in the puddling of the same and converting it into wrought-iron.

We are aware that steam has been thought of and to some extent attempted to be used in the refining of iron; but the manner of its application, on account of the mechanical and other difficulties attending it, so far as we know, has produced no practical results. This impracticability we claim to have completely overcome, although it is not readily to be believed that, to pour a vessel full of molten metal, the bottom of which is full of perforations, the metal would not run through in spite of the jets of steam issuing through them, or that the further expansion of the steam would not blow the whole mass into the air. Nevertheless, in the practice of the method hereinafter described, these apparent difficulties vanish, for the pressure of the jet of steam upholds the iron until it has passed into it, where it is decomposed, the oxygen and hydrogen combining with the carbon and other impurities consuming them. This action of steam we believe far preferable to blasts of air because of the greater amount of oxygen it contains, and because of the greater affinity of hydrogen than nitrogen for sulphur and other deleterious ingredients usual in iron; also, because the superior pressure of the steam-blast, operating through so many apertures, insures its perfect contact with the whole contents of the furnace-pan or crucible, converting it into a homogeneous mass.

In order that our process may be fully un-

derstood, we will proceed to describe the same as conducted on the refining-hearth or in the crucible or chilling-pan represented in the accompanying drawings.

Figure 1 is a vertical section and view of the furnace-pan or crucible, into which the metal is conducted from the furnace or cupola.

B is the hearth, which is made by taking a plain slab of cast metal a number of inches in thickness, according to its size, the amount of metal to be run upon it, and the heat to which it is to be exposed, and drilling small holes of the proper dimensions at regular intervals through the same, as shown at Fig. 3. It may also be cast of the shape, Fig. 4, showing indentations, having a less thickness of the metal to be subsequently drilled through. Another method may be by first casting an inch and half plate and then screwing into it, at the points where the perforations are desired, inch or inch and half wrought bars, so as to project three or four inches above the surface of the plate. The perforations are then made through these wrought-iron projections, as in Fig. 5, and the spaces between the same filled with fire-clay to the depth of the tubes, and then baked, or fire-brick of the shape as shown at Fig. 6 made to fit around the tubes, and of the proper thickness to make a level hearth, even with the tops or ends of the same. The hearth being then ready, is bolted fast to the lower box or pan, F, which must then be packed around the edges with iron filings and acid, or some other suitable material to make it steam-tight. The whole is then placed on a proper foundation at the place it is designed to stand. When intended as the bottom of a common puddling-furnace, the surrounding structure is walled up as usual, or in any desired manner. If designed for a chilling-pan or casting-bed in connection with a smelting-furnace, the chamber A is then formed on top of the same by taking four thick plates of iron of the height sufficient to hold the amount of metal desired to be cast from the smelting-furnace or refined at one time. Two of the side pieces, S S, as shown at Fig. 7, are provided with flanges, in which or against which the end pieces are stood, so as to prevent them from falling in. These sides are then backed up with sand to hold them in position. It is designed that the level

of the top of this receptacle for the iron should be below the level of the tap-hole of the furnace or cupola, so that the metal can run directly into it at E. These sides and the bottom, if only a plain slab of metal, may have a thin coating of clay rubbed over them before using, so as to prevent the metal from adhering too closely to them. This, however, is not essential. The pipe D conducts the steam from the boilers at G into the steam-chamber C, from which it presses through the perforations into the liquid metal. When the chamber A is intended to be used for the refining of the metal, the same to be afterward run out into a chill made to receive it, a hole is left in one of the side pieces, as at H, for letting out the metal when the process is finished. But we think the preferable way is to construct the pan, or a number of pans, of sufficient size and breadth to hold the whole casting of the furnace without having a greater depth than four or five inches upon the bottom hearth, and let it chill while in the pan, as it can readily be broken up, before too cold, into pieces of proper size for handling.

L is a faucet for letting out water of condensed steam which may at any time collect in chamber C.

The whole being ready to operate, the steam is first turned on at the faucet K and allowed to pass into the chamber C and through the perforations. The furnace or cupola is tapped simultaneously, and the metal conducted into the chamber A at E, and, falling upon the hearth, begins to fill it up and cover over the perforations through which the steam is es-

caping, and, coming in contact therewith, the process begins and is continued until the metal, if in the puddling-furnace, is ready to be worked into balls for the rolls, if in the refining-crucible in connection with a blast-furnace, till it shows that sandy or granulated appearance which the puddlers term "coming to nature," when it must be immediately tapped and run into the chill prepared to receive it. But when the pan itself or chamber A is used as a chill or casting bed, the blowing is continued until the metal thickens so far that the steam can no longer penetrate the mass. The steam is then cut off and the sides removed, when, with a long bar the mass is broken up before it has sufficiently cooled to prevent it from readily separating.

We do not wish to be understood as claiming the steam-chamber and perforated hearth herein described of any particular shape or dimensions, as applied in the various ways set forth, but claim its application in any shape or size required for the purposes mentioned; and

What we specifically claim, and desire to secure by Letters Patent, is—

The steam-chamber C and perforated hearth B, as in the specifications and drawings described, for the uses and purposes therein set forth.

R. L. STEWART.  
JOHN CHRISTOPHER.  
ROSS FORWARD.

Witnesses:

C. FORWARD,  
MICHAEL ZIMMERMAN.

Here, below, is an entry from pages 247-248 of the U.S. Senate's 1860 book "The Executive Documents" that indicates that Ross Forward was living in Somerset, PA at some point during the patent application process:

**No. 23,123.—ROBERT L. STEWART and JOHN CHRISTOPHER, of Ligonier, and ROSS FORWARD, of Somerset, Pa.—Improved Hearth for Working and Refining Iron.—Patent dated March 1, 1859.—The pipe D conducts the steam from the boilers at G into the steam chamber C, from which it presses through the perforations into the liquid metal. A hole H is left in one of the side pieces S S for letting out the metal when the process is finished.**

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ANNUAL REPORT OF THE

*Claim.*—The steam chamber C, and perforated hearth B, as in the specifications and drawings described, for the uses and purposes set forth.