No. 689,585. Patented Dec. 24, 1901.

J. M. HARTMAN.

IRON NOTCH FOR BLAST FURNACES.

(Application filed May 27, 1901.)

(No Model.)

FIG. 1.

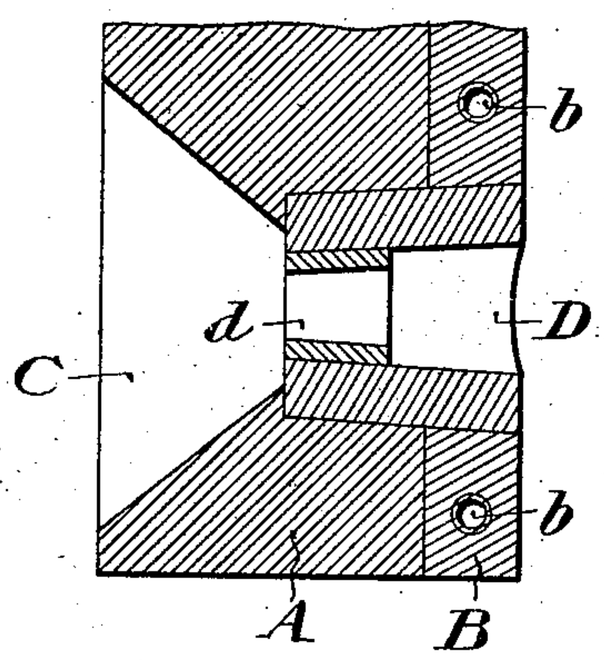


FIG. 2.

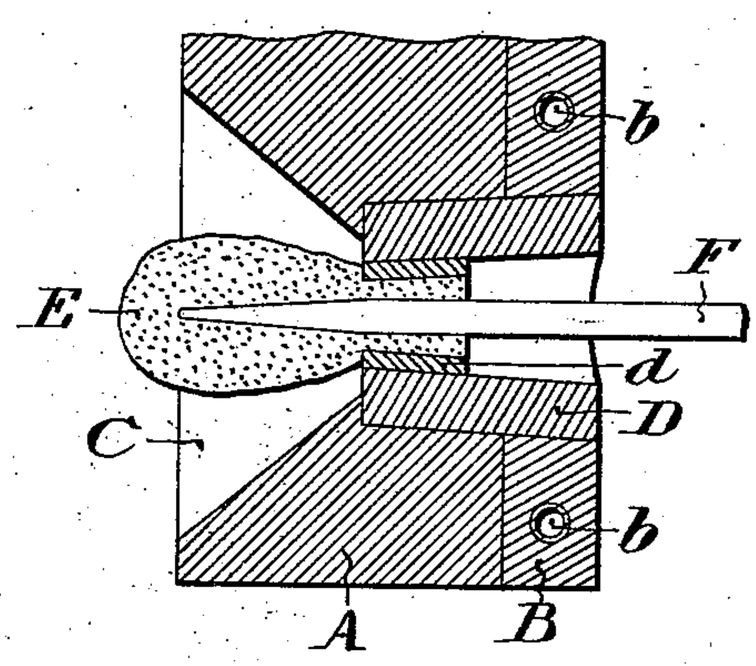


FIG. 3.

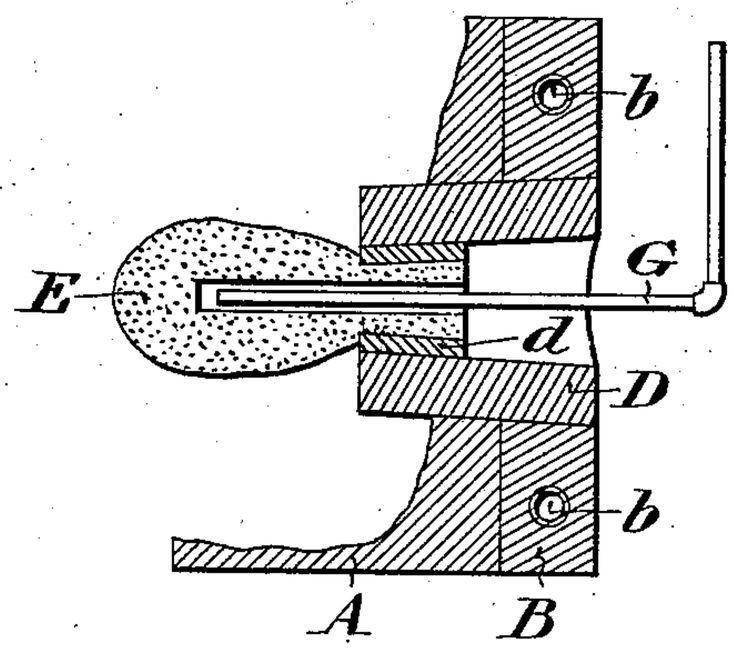
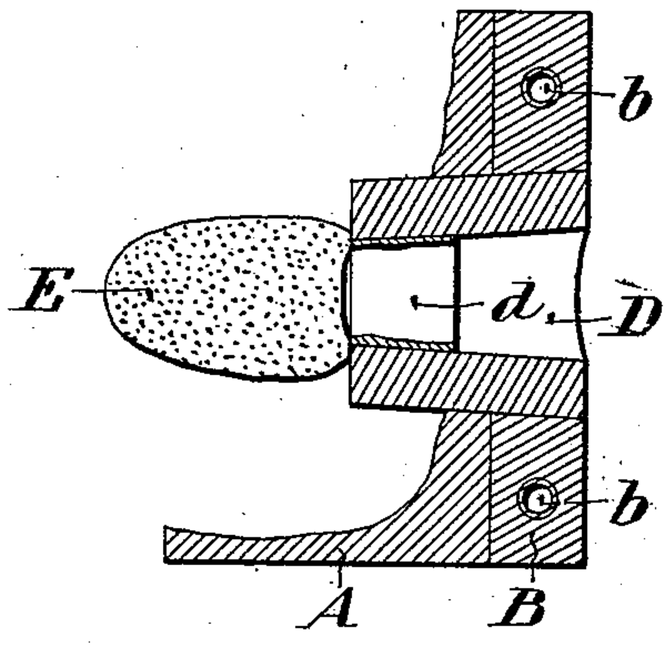


FIG. 4.



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IRON-NOTCH FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 689,585, dated December 24, 1901.

Application filed May 27, 1901. Serial No. 62,156. (No model.)

To all whom it may concern:

Be it known that I, JOHN M. HARTMAN, a citizen of the United States, residing on Gowen avenue, Mount Airy, in the city and county of Philadelphia and State of Pennsylvania, have invented certain new and useful Improvements in Iron-Notches for Blast-Furnaces, of which the following is a specification, reference being had to the accompanying drawings.

In the drawings, Figure 1 represents a vertical section of the crucible-wall of a blast-furnace, taken through the iron-notch. Fig. 2 is the same view showing the means employed for stopping the notch. Fig. 3 is a similar section with the crucible-wall worn away, showing other means employed for stopping the notch. Fig. 4 is the same view with the notch worn away.

It is of great importance to the proper operation of a blast-furnace that it be furnished with an iron-notch which is sufficiently refractory and strong to maintain a substantially constant aperture, notwithstanding the great heat to which it is subjected and the abrasive action of the escaping molten iron and basic cinder tending to wear it away. Otherwise the rate of flow of the molten metal becomes too rapid. Hitherto the effort to protect the notch has resulted in a construction in which the notch (or at least the narrowest part of the notch, where the abrasion of the outrushing metal exerts its most destructive tendency) is situated in or near the zone of the water-cooled jacket surrounding the crucible in order that by thus placing what may be termed the "critical" part of the notch within its cooling influence it might be sufficiently cooled to insure its protection and permanence. The same effort resulted in the construction which I described in United States Letters Patent No. 500,386, previously granted to me, in which the notch itself is provided with cooling devices of its own. These devices are partially successful. The cooling of the notch thus effected prolongs its life and keeps it from wearing away as rapidly as it otherwise would. They have, however, developed a countervailing disadvantage in that by placing the narrowest part of the notch so far toward the exterior edge of the crucible it results when the notch is cooled and stopped that a considerable mass of iron or cinder is hardened in or about the region of the notch, where the temperature is reduced by the influence of the cooling devices. When, therefore, the time comes to again tap the notch, it becomes necessary not merely to remove the clay stopping, but to drill through a stopping of iron. This is not only difficult, but is often more destructive to the notch than the action of the molten metal. In the course of drilling through the solid iron the workman is liable to crack and break and often destroy the notch. I have now discovered that it is possible to make an iron-notch of graphitic material sufficiently refractory to withstand, without cooling, the high temperatures to which it is subjected and the abrasive action of the flowing metal. By placing the narrowest point of such a notch quite at the other extreme from that hitherto adopted—that is to say, as near to the inner wall of the crucible as practicable—I prevent any freezing of the metal within or about the notch, thus obviating the difficulty which I have just spoken of.

In carrying out my invention I employ a refractory cylindrical breast running from the exterior wall of the furnace well back into the wall of the crucible and provided at its inner end with a removable interior sheathing or bushing forming the notch proper, which fits closely within the inner end of the breast and which may be easily replaced at intervals as required.

In Fig. 1, A represents the crucible-wall of the furnace before it has been used. B is the crucible-jacket, furnished with conduits *b b* for circulating a cooling medium. The crucible-wall is constructed of fire-brick and has a large flaring aperture C, leading to the iron-notch. D is the breast of the iron-notch, constructed in the form of a cylinder of the best plumbago and German fire-clay well mixed and burned. This breast runs through the crucible-jacket well back into the crucible-wall to a point quite remote from the influence of the cooling-jacket. The interior of this breast flares outwardly. Its inner end is fitted with a bushing *d*, of the same material as the breast which forms the notch itself. Its exterior corresponds in size and flare to the interior of the breast, so that it is socket-

ed tightly within the inner end of the same and yet is readily removable from the outside. The interior of the notch is shown slightly funneled; but it may be made with parallel sides. It should have an aperture of about three inches.

Fig. 2 shows the means of stopping the notch. A mass of soft clay E is forced (preferably by a gun) well through the notch, so as to form not only a plug within the notch, but a considerable stopper on the inside. An expanding-bar F is immediately driven into the mass of clay, causing the stopper to expand and form a shoulder against the inner edge of the notch. The stopper immediately hardens, baked by the heat, and effectually sustains the weight of molten metal on the inside. A considerable mass of molten metal rests all around the stopper and remains molten, being sufficiently removed from the cooler exterior of the crucible so that when it is again desired to tap the furnace it is only necessary to break the clay stopper and the metal at once rushes forth. After a blast-furnace has been used for several days the inner part of the crucible is entirely burned away, leaving it in about the shape indicated in Fig. 3. The further destruction of the crucible is prevented by the cooling influence of the jacket B, which soon causes the inner edge of the crucible to become coated with a highly-refractory graphitic material called "kish." This figure therefore really represents the permanent working condition of the invention.

It will be observed that the clay stopper is even more markedly projected into the main body of molten metal which fills the crucible. There is therefore no possibility of the metal in or near the notch freezing up and interfering with the tapping of the notch.

When a furnace is running on gray iron, requiring an exceedingly high temperature, it is sometimes necessary to prevent the melting of the clay stopper by inserting a small air-pipe G, through which a current of atmospheric air passes.

The breast D, as I have described, will last for a long time. It resists the heat and is not subjected to the more destructive abrasive action of the outrushing molten metal which is confined in the notch proper. After passing through the notch the stream of metal spreads out and its force is mostly lost.

After a few days the notch *d* wears out, being worn down to a shell, as shown in Fig. 4. It is then necessary to renew the notch, which is very readily done. The shoulder of the clay stopper when the notch is in this condition rests against the inner edge of the breast. The notch can therefore be safely extracted and a new one substituted for it.

Having thus described my invention, I claim—

1. In an iron-notch for a blast-furnace, the combination of the crucible-wall; the crucible-jacket surrounding the wall; a cylindrical graphitic breast extending through the crucible-jacket and well back into the crucible-wall; and a removable bushing of graphitic material fitted to the inner end of the breast, substantially as described.

2. In an iron-notch for a blast-furnace, the combination of the crucible-wall; the crucible-jacket surrounding the wall; a cylindrical graphitic breast extending through the crucible-jacket and well back into the crucible-wall, having an outwardly-flaring interior; and a bushing of graphitic material fitted to the inner end of the breast, which forms the notch proper, substantially as described.

3. In an iron-notch for a blast-furnace, the combination of the crucible-wall; the crucible-jacket surrounding the wall; a cylindrical graphitic breast extending through the crucible-jacket and well back into the crucible-wall; a removable bushing of graphitic material fitted to the inner end of the breast; a stopping of clay within and on the inner side of the bushing; and a tapered bar inserted into the midst of the clay, substantially as described.

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