(No Model.) 2 Sheets—Sheet 1.

J. M. HARTMAN.

BLAST APPARATUS FOR BLAST FURNACES.

No. 399,262. Patented Mar. 12, 1889.

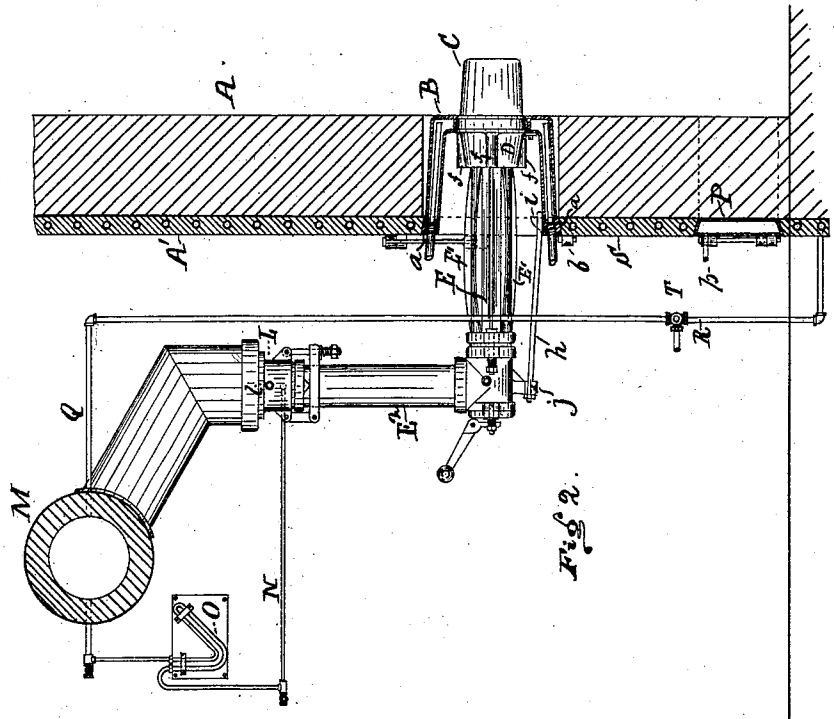


Fig. 2.

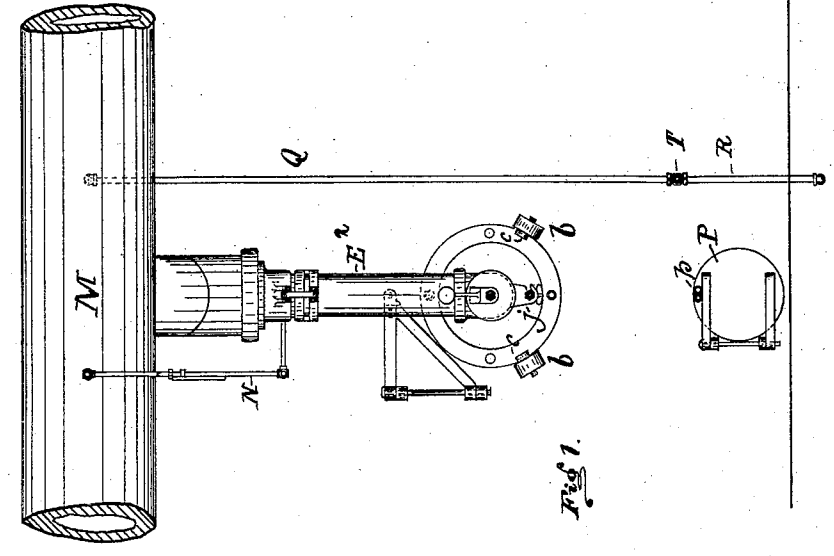


Fig. 1.

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(No Model.) 2 Sheets—Sheet 2.

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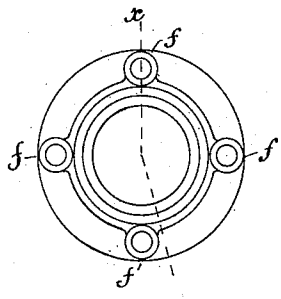


Fig. 3

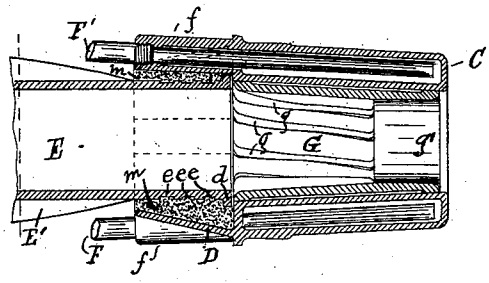


Fig. 4

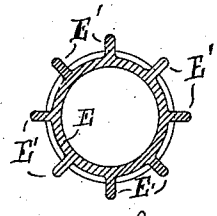


Fig. 5

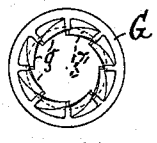


Fig. 6

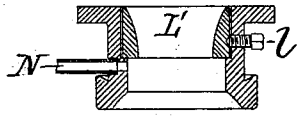


Fig. 7

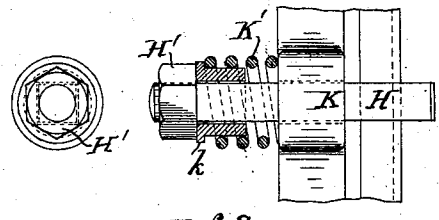


Fig. 8

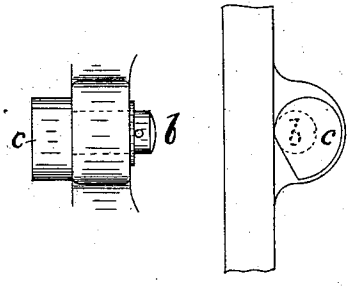


Fig. 9

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BLAST APPARATUS FOR BLAST-FURNACES.

SPECIFICATION forming part of Letters Patent No. 399,262, dated March 12, 1889.

Application filed March 20, 1885. Serial No. 159,549. (No model.)

To all whom it may concern:

Be it known that I, JOHN M. HARTMAN, of Philadelphia, in the State of Pennsylvania, have invented certain new and useful Improvements in Blast Apparatus for Blast-Furnaces.

The following is a specification of said improvements, reference being had to the accompanying drawings, wherein—

Figure 1 is a rear view of the tuyere of a blast-furnace and its attachments. Fig. 2 is a view, partly in side elevation and partly in longitudinal section, through the tuyere-breast and adjacent portions of the furnace-wall. Fig. 3 is a rear view, and Fig. 4 a longitudinal section, through the tuyere proper on the line of *x x* in Fig. 3, the scale of these figures being considerably enlarged; and Figs. 5, 6, 7, 8, and 9 are detail views upon differing scales of various minor features relating to the invention.

The several objects of the improvements will be mentioned in connection with the description of the parts specially relating thereto.

In the drawings, A is the furnace-wall, having the usual jacket, A′, with a circulating-coil cast therein.

B is the tuyere-breast, inserted through an opening in the said wall and jacket. Instead of being packed or rammed with clay, in the usual manner, a tight fitting for the breast is obtained by giving a quick taper to its rear periphery, as shown at *a*, and forming a correspondingly-tapered seat around the adjacent portion of the opening in the jacket A′. The tuyere-breast, or that portion which is in contact with the jacket, is constructed of bronze, the object of such method of construction and application being to avoid the adhesion of metal to metal, which would take place were the parts in contact both of iron. Where bronze is used I have found that no such adhesion takes place, and thus I am enabled to obtain a tight joint without the use of packing and free from any danger of adhesion, which would interfere with the quick renewal or replacing of a tuyere-breast.

To maintain the breast in position, I provide eyes upon the adjacent portion of the jacket A′, and, as the differences in size or adjustment of the breasts render it difficult to bring them up home by means of a pin, I provide the cam-head pins *c*, (see Fig. 9,) which are inserted through the eyes *b*, and by the rotation of which the cam-surface can be forced up against the rear end of the breast, so as to clamp it snugly in position from two or more points.

C is the tuyere, which has at its butt a rearwardly-projecting flange, D, of sufficient diameter to permit the insertion of the belly-pipe E and leave an annular space for packing, *m*, between the two.

To prevent the clay packing while in course of insertion from falling into the tuyere, or the space between it and the end of the belly-pipe, I provide the extreme end of the belly-pipe with an outwardly-projecting collar, *d*, which forms a stop to prevent the packing from being pushed over the end of the pipe E in case there is not a close contact between it and the adjacent portion of the tuyere, and to further assist in the retention of the packing I cast a series of small circumferential channels, *e*, upon the belly-pipe, near its end, into which channels the soft clay enters, and is thus firmly held.

To prevent the belly-pipe from yielding or sagging, as frequently happens from the softening of the metal under the high heats of blast at present used, I cast upon the exterior surface longitudinal ribs or flanges E′, which not only afford a more extended surface for radiation of the heat, but remain much cooler than the periphery of the pipe proper, and thus do not become softened, but maintain the stiffness of the pipe.

As the tuyere itself, the system of water-circulation, the nozzle-piece, &c., are claimed in another application filed by me under date of August 13, 1885, I do not deem it necessary to describe the details of their construction. The belly-pipe E is held closely up against the rear end of the tuyere by attachment to the leg E^2, which is clamped or held firmly in position by means of the rigid bar *h*, having an eye which fits over a lug, *i*, cast on the inner periphery of the tuyere-breast B. This tie-rod is attached to a downwardly-depending slotted lug, *j*, at the bottom of the leg E^2.

As much trouble has been experienced when absolutely rigid joints are used for the connections, I join them by means of the device

shown on a large scale in Fig. 8. A screw-bolt, H, having a nut, H′, and washer *k*, extends through eyes K on the adjacent end flanges, E^2, and pipe E. A strong spiral spring, K′, is arranged around the bolt H between the nut H′ and washer *k* and the eye K. This spring is of sufficient strength to enable the parts to be firmly clamped together and yet give sufficient yielding to compensate for the expansion of the pipes under the heat of the blast. In this way I avoid the adhesion of the contiguous ends of the pipe, which frequently occurs when they become slightly oxidized and are thrust or jammed together by the expansion referred to. I prefer to use a brass nut, H′, and washer *k*, as this metal is less liable to adhere.

In operating furnaces there is great difficulty in maintaining a uniformity of volume in the entering blast at all the tuyeres, and this difficulty increases with the size of the furnace. When the blast enters more upon one side, the heat at that point is correspondingly increased. The furnace works up in a large passage on that side and forms a scaffold on the opposite one. This tends to further increase the difference in the operation of the tuyeres, as the blast enters with more difficulty on the side where the contents of the furnace are more or less chilled. As soon as this state of affairs is found to exist, it is necessary at once to open the tuyere at which the blast is defective and force an entrance by means of a pricker-bar into the furnace.

To prevent the uneven flow of blast, reducers have been used for the tuyeres which were working too freely, such reducers being placed in the belly-pipes; but it is found that they are liable to destruction from the flowing back of the cinder into the pipe, and, furthermore, the blast is not delivered properly into the furnace when the reduction is effected at that point. If the reducer be placed in the tuyere, it is not only liable to get clogged with cinder, but, instead of obtaining a slackening of the blast or even distribution by friction, it often acts a nozzle-piece and produces too great a penetrating power in the blast, especially when soft fuel is used or the hearth is small.

I have found that it is desirable to maintain a system of reducers in permanent parts of the tuyere-pipe connections, and I therefore place it in the vertical portion of the pipe or leg E^2, preferably at the point L, Fig. 2. The reducer itself is shown at Fig. 7 at L′, being secured on the inside of the pipe by means of a set-screw, *l*.

To enable the furnace-man to detect any variation of the blast at the different tuyeres, and thus prevent one tuyere from robbing another, I provide the tuyere-pipe or its connections with a gage operated by the pressure from the current of blast within said pipe and indicating the velocity of the blast. This gage I prefer to construct and apply as follows: I connect the bustle-pipe M and the leg E^2 at a point below the reducer L′ by means of a small pipe, N, and place at some intermediate point in the pipe N a differential pressure-gage, O, formed, preferably, with one vertical leg and one inclined at an angle of forty-five degrees, as shown in Fig. 2. Each tuyere is provided with one of these gages, and if the tuyere is taking less air than it ought to do the fact will be indicated by the position of the mercury in the two legs of the gage O.

When the condition of affairs is normal, the mercury will stand higher in the leg of the gage which is connected with the leg E^2; but when the blast has been checked at the tuyere the mercury will stand at an even height in both legs. To facilitate the observation of this, the legs of the gage are inclined, as above stated. I do not, however, restrict myself to the particular differential gage above described, nor to the use of a removable reducer, as the diminution of the pipe's bore might be obtained by a permanent contraction of the pipe itself.

In the operation of a furnace the hearth often becomes chilled from an overburden or the leakage of water through a defective tuyere, and under these circumstances the crucible-walls also may become chilled; and as in these cases the water-circulation around them is actually detrimental, since it abstracts the much-needed heat, I provide a pipe, Q, which runs from the bustle-pipe M to the water-pipe R of the crucible-jacket S, and place the three-way cock T at a proper point, so that if the crucible-jacket is found to be chilled the water-supply can be cut off by turning the cock T and a supply of hot blast from the pipe Q admitted into the circulating-coil of the jacket S. Whatever water remains in the pipe R is at once expelled, either directly or in the form of steam, by the pressure of the hot blast. In this way I restore the jacket to its former temperature.

I find it convenient to place around the lower portion of the crucible a number of doors, P, each of which is provided with a proper interior pipe, *p*, for water-circulation. When it is found that the accumulation of mushy cinder has occurred in the crucible, (as sometimes happens when the hearth is chilled from overburden,) I open a door upon that side, dig through the wall of the furnace into the interior, and draw off the deposit of mushy cinder, preferably allowing it to flow on the ground around the crucible-jacket. In this way it aids in restoring the heat of the furnace-foundation, which, in proper running, should act as a reservoir of heat.

Having thus described my invention, I claim—

1. The combination, with the blast-furnace and the tuyere, of the belly-pipe E, having a series of radially-projecting ribs along its exterior, substantially as and for the purposes set forth.

2. The combination, with the tuyere and the blast-pipes connected therewith, of a reducer

and a gage operated by the pressure of the air-blast within said pipe, situated at a point between the reduced portion of the pipe and the tuyere, substantially as set forth.

3. The combination, with the tuyere and the blast-pipes connected therewith, of a reducer placed in a portion of the pipe, a small pipe communicating with the blast-pipes on opposite sides of the reducer, and a differential pressure-gage arranged in the said small pipe, substantially as set forth.

4. The combination of the circulating-coil for the crucible-jacket with branch pipes leading from the blast apparatus and suitable cocks whereby the water can be shut off from and the hot blast turned on the said coil, for the purposes set forth.

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