Aug. 6, 1946. J. H. SPROW 2,405,461

BLAST FURNACE TUYERE

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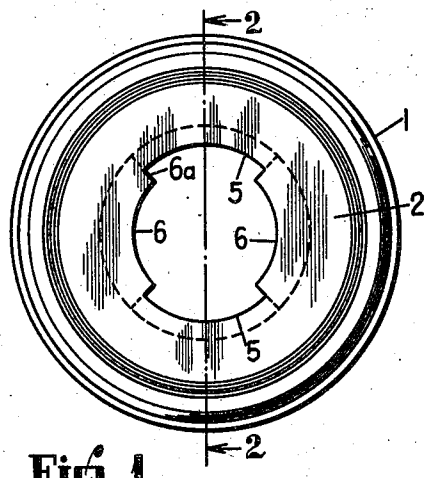


Fig. 1

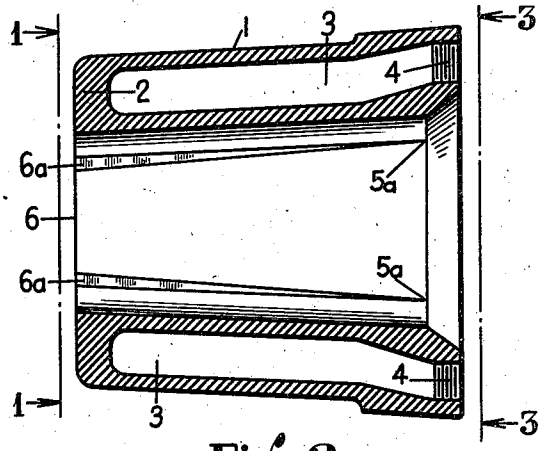


Fig. 2

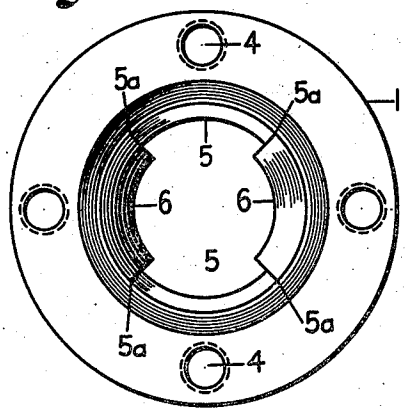


Fig. 3

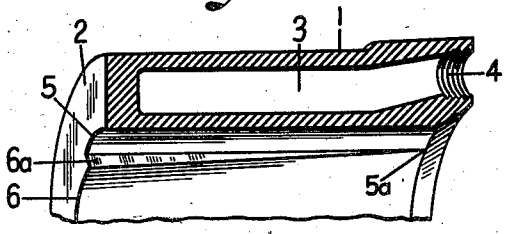


Fig. 4

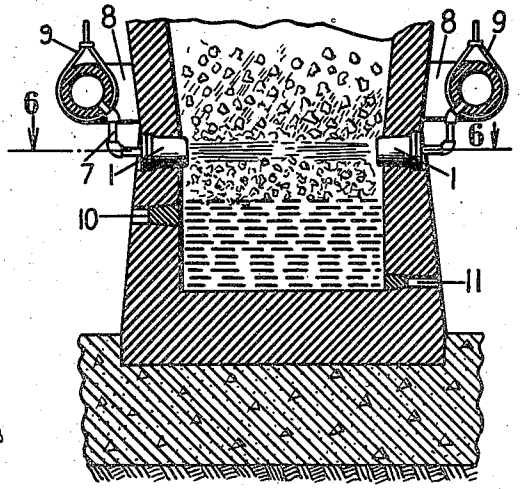


Fig. 5

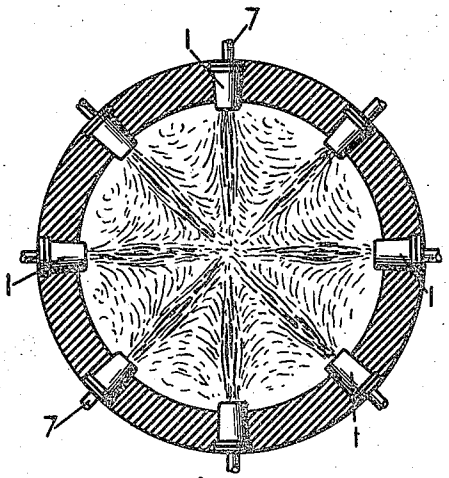


Fig. 6

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BLAST FURNACE TUYÈRE

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5 Claims. (Cl. 266—41)

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My invention relates to blast furnace tuyères. It has to do, more particularly, with a tuyère for inserting a combination concentrated stream of air, as well as a stream of air which has a spreading effect, into a blast furnace.

In the past, many attempts have been made to provide a blast furnace with a tuyère having a blast of air which will penetrate to the center of the furnace and, at the same time, will permit the spreading of air around the sides of the furnace in order to aid in the reduction of the ore and fuel at that point as well as at the center. In other words, a tuyère which furnishes a penetrating blast of air that does not have a spreading flow. To overcome this difficulty, it has been necessary to make and position tuyères of two sizes in the furnace in order to accomplish this uniform reduction of materials placed in the blast furnace. The main difficulty in using two sizes of tuyères is that it cuts down the overall blast into the furnace and thus reduces the efficiency of the furnace. Various devices have been inserted in tuyères for varying cross-sectional size, but they have quite generally resulted in the formation of back pressure and inefficient blasting. At the present time, narrow tuyères are placed along side of wide-nosed tuyères in the bosh of the blast furnace. The narrow tuyères give the penetrating blast while the wide-nosed tuyères give a fan-like spreading action for aiding in the reduction of the materal at the sides of the furnace. Even with the great number of tuyères now positioned in the furnace, there is still an uneven distribution, and where the narrow tuyères appear in the furnace, pilasters or slag deposits form around the sides of the furnace adjacent the narrow-nosed tuyère. This formation of the pilasters greatly reduces the life of the individual tuyère, therefore, necessitating replacements sooner than ordinarily expected. Furthermore, as indicated above, the use of the narrow or small-nosed tuyère reduces the amount of air forced into the furnace and this reduction is noticeable in the resulting product. All blast furnaces have certain capacities, and if any element, either fuel, ore or air, is varied, it vitally affects the operation of the furnace. To overcome the above difficulties, applicant has devised a tuyère having the following advantages over present-day tuyères.

One of the objects of my invention is to provide a tuyère which is capable of furnishing both a penetrating and spreading blast in a furnace.

Another object of my invention is to provide a tuyère of varying cross section at the nose end

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which will permit furnishing of a certain quantity of air but in varied velocities to the material in the furnace.

Another object of my invention is to provide a tuyère which has two dimensions in cross-sectional diameter which provides for a penetrating blast and a spreading blast while at the same time maintaining the same total quantity of air inserted in the furnace.

Another object of my invention is to provide a tuyère having its inner side wall surface divided into four sectional units, two of said units being spaced closer together than the other two units yet forming no obstruction to the blast of air inserted from the blast main.

Another object of my invention is to provide a tuyère which will more efficiently reduce the material in the furnace by a uniform distribution of air blast to the center of the furnace as well as around the sides thereof.

Another object of my invention is to provide a tuyère which will have a penetrating blast action and at the same time substantially reduce the formation of pilasters around the sides of the bosh portion of the furnace.

Another object of my invention is to provide a tuyèere having at least two diameters in cross section which will facilitate a reduction of the ore uniformly throughout the furnace.

Various other objects and advantages will be apparent from the following detailed description and the drawing wherein similar characters of reference designate corresponding parts and wherein

Figure 1 is a front end view of the tuyère, constructed according to my invention, taken along line 1—1 of Figure 2.

Figure 2 is a vertical sectional view of the tuyère taken along line 2—2 of Figure 1.

Figure 3 is a rear end view of the tuyère taken along line 3—3 of Figure 2 and showing the plugged opening for water cooling the tuyère.

Figure 4 is a fragmentary perspective view of the tuyère, partly in section, illustrating the marked taper of one of the sections of the inside surface.

Figure 5 is a side elevational view of the lower end of the blast furnace showing the location of the tuyères with reference to the bosh and hearth.

Figure 6 is a top plan view of the tuyères in place in the blast furnace taken along line 6—6 of Figure 5 and showing the two-fold distribution of the air blast.

Referring to the drawing, more particularly to

Figure 2, I illustrate a hollow tuyère 1 of frustro-conical shape. The tuyère 1 is tapered toward the nose end 2.

The tuyère 1 is provided with a conventional water jacket 3 for keeping the inner wall surfaces cool and said water jacket is supplied with a steady stream of water through a plurality of orifices 4 shown at the rear end thereof of the tuyère in Figure 3.

The inner wall surface of the tuyère is so formed as to provide four longitudinally extending wall segments each of which varies in width throughout its length. These segments constitute the diametrically opposed pair of walls 5 and the diametrically opposed pair of walls 6 which pairs are located at right angles to each other. Along the longitudinal edges of the walls 6 there are provided the shoulders 6a that taper rearwardly from the nose 2 to a point where they converge with the walls 5, as at 5a. Thus, as shown in Figure 1, the walls 6 converge towards each other at the nose resulting in a reduction of the diameter of the nose at this area. Consequently, there results a tuyère which has a narrow nose portion and a wide nose portion at right angles to each other. The diameter of the rear end of the tuyère, however, is uniform. This wall arrangement in a single tuyère produces a combination tuyère blast which will have both a penetrating and a spreading action which must usually be accomplished by having both a wide-nose and a narrow-nose tuyère.

In other words, the tuyère I illustrate in the figures of the drawing will permit a blast of air into the furnace of the type shown in Figure 6 which has a concentrated stream to the center and also a spreading stream which allows a uniform distribution of the charge of air over the entire interior area of the furnace. As will be seen from Figure 2, the tapered wall segment 6 varies in cross-sectional diameters of the tuyère and the air passing through the tuyère will be concentrated by the narrower diameter along the horizontal axis due to the narrow nosed portioned formed by the tapered wall segment 6 and the air passing along the regular tapered wall portion 5 will produce a spreading action. I thus provide a tuyère which is in effect equivalent of two tuyères of varying sizes.

I have found that tapering the two equal segments of the wall portion of a tuyère in this manner does not form back pressures upon the blast main 8 shown in Figure 5. Pipes 7 are connected to the rear ends of the tuyères 1 and to the blast main 8 which is suspended about the furnace by means of the hangers 9.

In Figure 5 of the drawing, I show the location of the tuyères 1 at the bottom of the bosh of the furnace just above the hearth. I also provide openings 10 and 11 which are of the conventional type taps for flowing the slag and the molten metal out of the furnace at intervals. Figure 6 illustrates the spread of air as well as the concentrated blast which reaches to the center of the furnace. The tapered wall segments 6 of the tuyère furnish the means for the concentrated blast while the wall segments 5 furnish the spreading blast.

With this arrangement, I am able to vary the blast in velocity and still maintain the same cross-sectional area of the tuyère by making the diameter of the wall portions, indicated by the segments 5, one-half inch larger than the usual tuyère size and by reducing the diameter of the wall 6, one-half inch. This enables me to produce the proper blast of air required within the furnace.

For example, if the particular furnace requirements call for a more penetrating blast, the tapered segment 6 can be made 4-inches in diameter, and the wider portion 5, 6-inches in diameter. It will be seen that this area will be of the same ratio as that of a 5-inch tuyère and still retain the velocities and penetration characteristics of the tuyère.

While I show in Figure 1 the vertical diameter the widest, it is understood that the tapered diameter 6 can be positioned along the vertical axis and have the widest diameter portion of the tuyère nose along the horizontal axis. This type of tuyère may be rotated to different positions at intervals so that pilasters which form adjacent the narrow-nosed portion 6 of the tuyère can be burnt off by positioning the wide-nosed portion 5 of the tuyère and turning the narrow-nosed portion to the position where the wide-nosed portion had been. Furthermore, while I show the tuyère nose as being divided into quarter segments, it is understood that I also wish to use a tuyère wherein a plurality of varying diameters are present at the nose end and not necessarily limited to two, as shown in the drawing. It is understood that the tuyère can be divided into a number of other segments which may have characteristics similar to the present type of tuyère shown in the accompanying drawing. It is important that the degree of taper of the smaller diameter segment at the nose end be very slight along the wall of the tuyère so that it comes to a fine point at the back end of the tuyère. If the taper is too marked, back pressures will be created in the tuyère which are definitely undesiderable. It is my intention, therefore, that the tapered segments coincide with the circular surface of the side wall 5 at the point 5a at the rear end of the tuyère. At the nose end of the tuyère, I disclose a thickened portion shown best in Figure 4 by the numeral 6.

It will be apparent from the above description that I have provided a tuyère having many advantages over present-day tuyères in use in blast furnaces. This tuyère has the equivalent flow of air as both a wide or narrow-nosed tuyère and also retains the proper amount of air blast required for the type furnace in use. The variation of the cross-sectional area of my tuyère permits both a penetrating and a spreading blast of air into a furnace thus aiding the reduction of the ore in a more efficient manner. It will be seen that this tuyère is so designed that it is particularly adaptable to prevent the formation of pilasters around the nose of the tuyère and also maintain a concentrated blast of air into the center of the furnace. Another advantage of my tuyère is that it is simple in construction and does not form back pressure as do other tuyères having restricted nose end openings. Many other advantages will be apparent from the above description, the drawing and the following claims.

Having thus described my invention, what I claim is:

1. A blast furnace tuyère of frustro-conical shape having a circular rear end portion and a nose end portion having oppositely spaced circular arcs formed by tapering parts of the wall intermediate the rear end and the nose end thus forming the said concentric arcs of varying widths so as to vary the velocity and direction of the air inserted in the rear end of the tuyère to be forced into the blast furnace.

2. A tuyère of the type described comprising a tapered wall portion, a second wall portion tapered to a greater degree than said first-mentioned wall portion, said wall portions forming segments of a circle which vary the diameter of the nose end of the tuyère, said segments having similar segments oppositely disposed and tapered in the same degrees, respectively, as said first two-mentioned segments so that the diameter of the tuyère at the nose end presents two diameters for inserting air in varying velocities and directions.

3. A tuyère of the type described comprising a tapered wall portion, an additional wall portion tapered to a greater degree than said first-mentioned wall portion, said wall portions forming segments of a circle which vary the diameter of the nose end of the tuyère, said segments having similar segments oppositely disposed and tapered in the same degree, respectively, as said first-mentioned segments so that the nose end of the

tuyère presents two diameters for inserting air in varying velocities and directions.

4. A tuyère of the type described having a circular rear end portion and a nose portion including concentric arc segments of varying diameters, the inner wall of said tuyère including wall segments arranged in pairs of oppositely disposed walls, the walls of some of said pairs converging towards each other and towards the tuyère axis to a greater extent than other of said pairs.

5. A tuyère of the type described having a nose portion including sections which are relatively angularly disposed and are of varying widths so as to direct the tuyère blast differently, the inner wall of said tuyère including wall sections arranged in pairs of oppositely disposed walls, the walls of some of said pairs converging towards each other and towards the longitudinal center line of the tuyère to a greater extent than other of said pairs.

JOHN H. SPROW.