May 31, 1949. H. A. REECE 2,471,776

AIR SUPPLY APPARATUS FOR CUPOLA FURNACES

Filed March 24, 1947 2 Sheets-Sheet 1

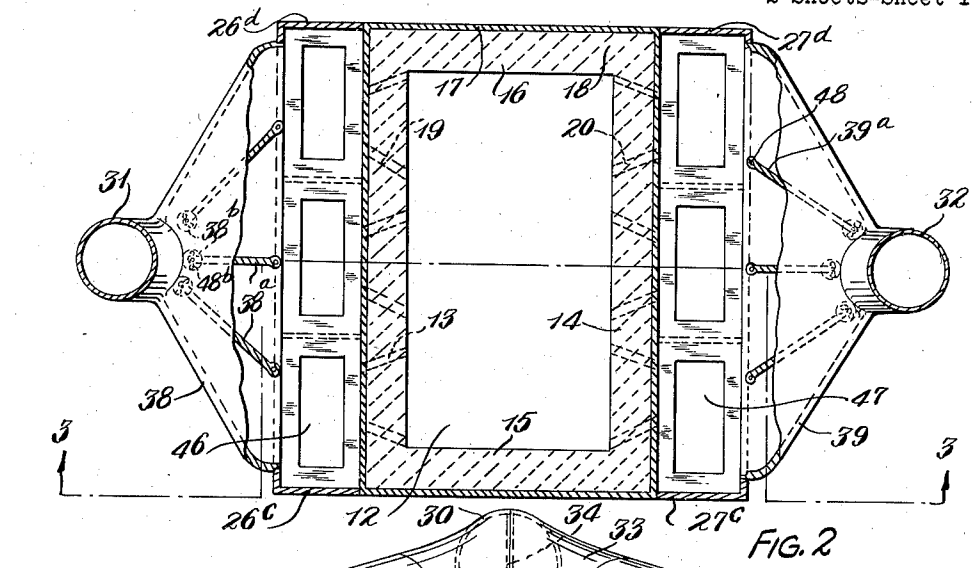


FIG. 2

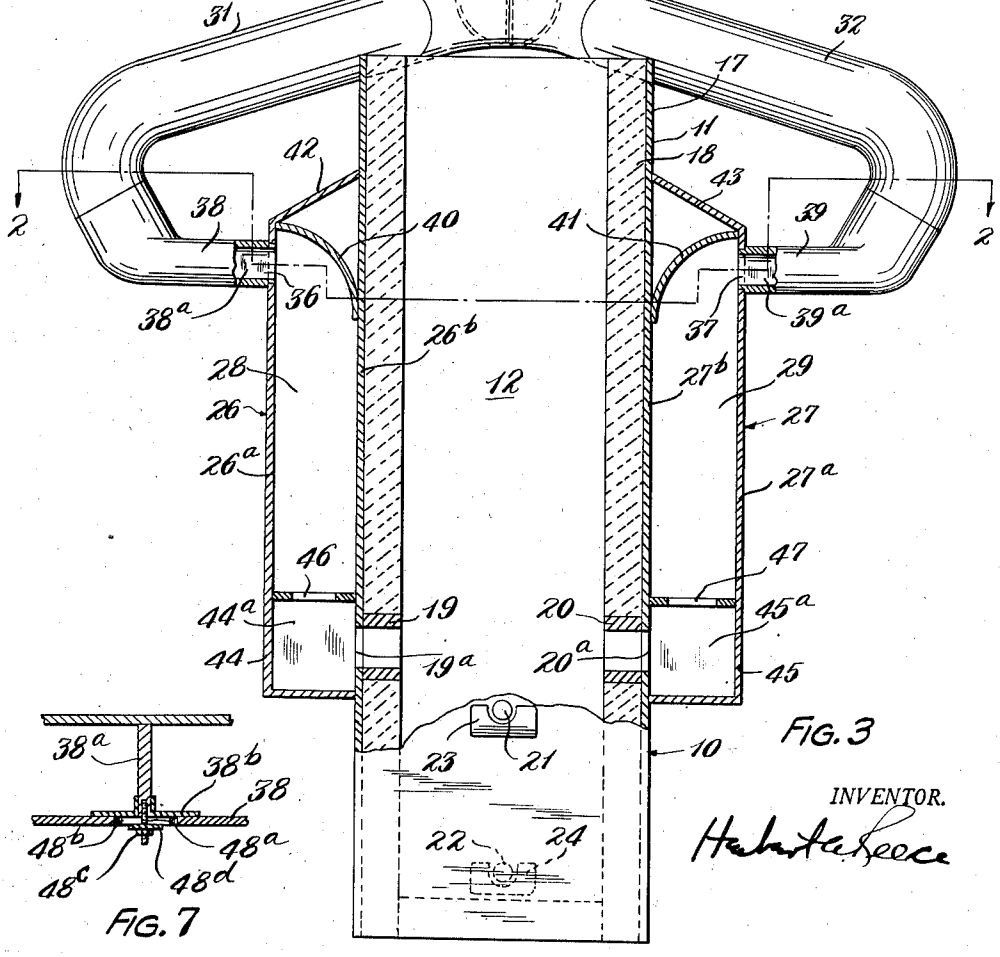


FIG. 3

FIG. 7

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AIR SUPPLY APPARATUS FOR CUPOLA FURNACES

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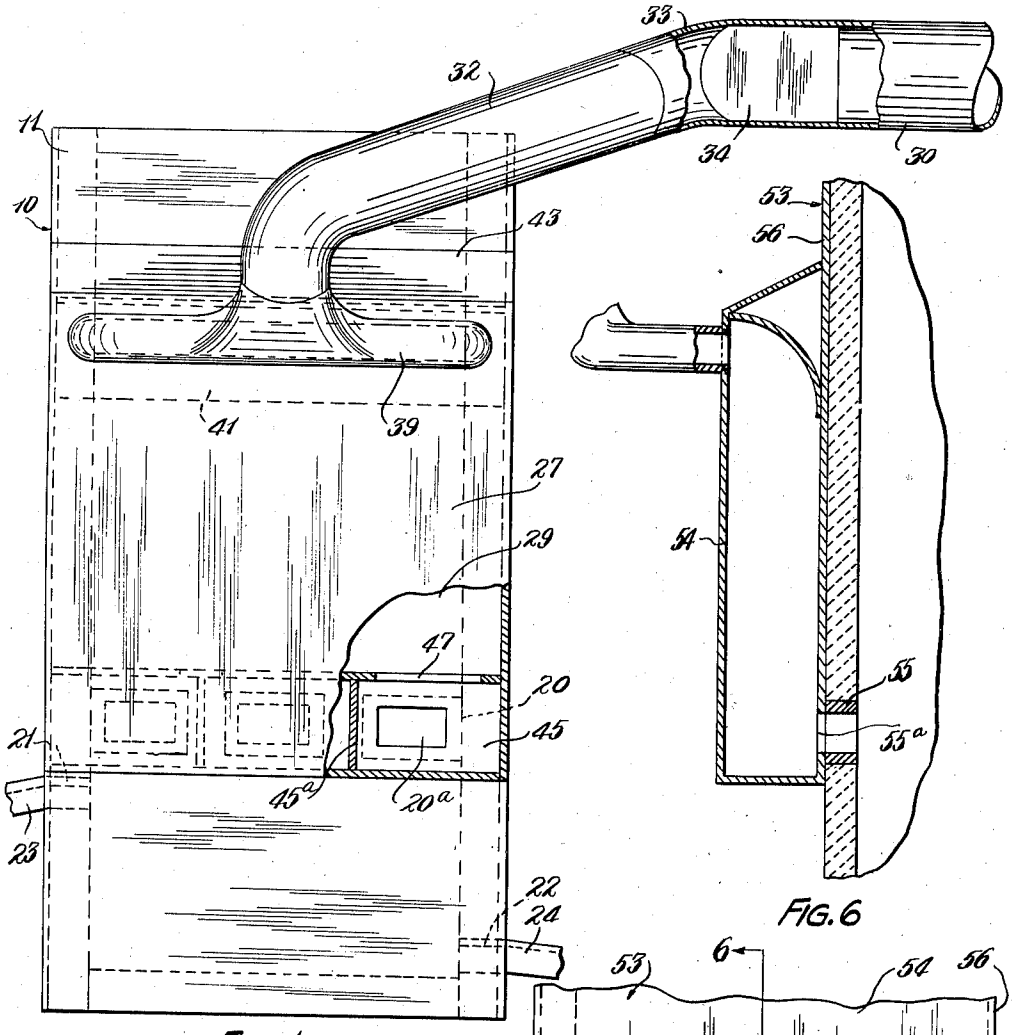


FIG. 1

FIG. 6

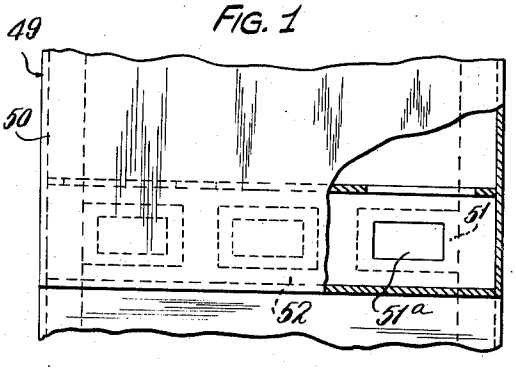


FIG. 4

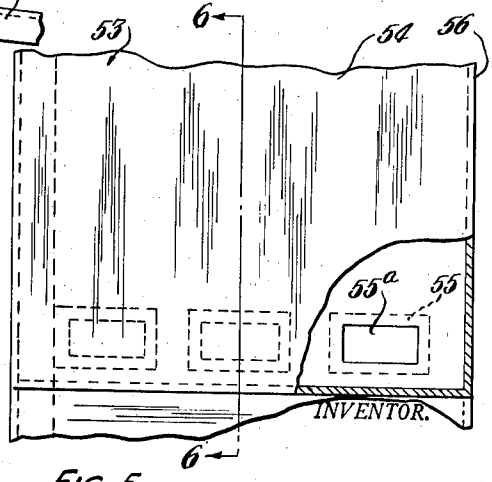


FIG. 5

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AIR SUPPLY APPARATUS FOR CUPOLA FURNACES

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2 Claims. (Cl. 266—30)

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This invention has to do with the supplying of air to metallurgical furnaces and relates more particularly to furnaces of the cupola type having a group or series of spaced tuyères and windbox means for supplying air to the tuyères.

In the operation of furnaces of this kind the quality of the melt and the characteristics of the castings obtained therefrom are dependent upon the attainment of a uniform condition in the combustion zone and this, in turn, is dependent upon the attainment of a substantially equal distribution of the air supply to the individual tuyères of the tuyère group or groups. Heretofore various means and methods have been employed in endeavoring to achieve such an equal distribution of air and, so far as I am aware, all such attempts have sought to eliminate disturbance in the air stream and to obtain a flow which is relatively smooth and substantially devoid of abrupt directional changes.

The present invention represents a radical departure from such prior practice and obtains the desired substantially equal distribution of air to the tuyères by deliberately producing additional disturbance in the air stream by making abrupt directional changes in advance of its delivery to the tuyères. As further explained hereinafter, the disturbance is created in the air stream while it is passing through the windbox and is produced by using, in a novel manner, a velocity discharge of the air supply into the windbox. By creating such a disturbance in the air stream as it enters the windbox the air being supplied distributes itself therein so that substantially the same pressure and velocity factors will exist in the windbox for all points of a given cross section and this will substantially eliminate high and low pressure areas, dead spots, and the like, and will result in a substantially equal flow of air to all of the tuyères being supplied by that particular windbox.

It is therefore an object of this invention to provide a novel air supply means for a furnace of this character in which a substantially equal distribution of air to the individual tuyères of a group is obtained by creating a disturbance in the stream of air being supplied to such group.

A further object is to provide an air supply for a group of furnace tuyères in which a windbox serving such group embodies novel means for using the velocity, or a portion of the velocity, of the air supply for obtaining substantially equal distribution of the air to all portions of the windbox and the delivery of substantially equal volumes to the individual tuyères of the group.

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Still another object is to provide air supply means of this character in which the air is delivered to the tuyères of the group from the lower end of the windbox and additional disturbance is created in the air stream by directing the supply of air into the upper end of the windbox in a direction crosswise thereof.

This invention also provides the feature of a deflecting means at or adjacent the upper end of the windbox and against which the incoming air stream impinges.

Yet another object is to provide the windbox with an elongated air inlet opening which has a length approximately equal to the width of the windbox.

As another of its objects this invention provides a cupola of the rectangular type having rows of tuyères in opposed walls served by separate windboxes.

Other objects and advantages of the invention will be apparent from the following description and the accompanying sheets of drawings in which

Fig. 1 is a side elevation of a furnace of the cupola type showing the same equipped with the equalizing air supply means of the present invention and with portions of one of the windboxes broken away;

Fig. 2 is a transverse sectional view of the cupola taken substantially at the plane of the air inlet openings as indicated by line 2—2 of Fig. 3;

Fig. 3 is a partial vertical sectional view taken substantially on line 3—3 of Fig. 2;

Fig. 4 is a partial side elevation similar to Fig. 1 but showing a modified construction;

Fig. 5 is another such partial side elevation showing another modifying construction;

Fig. 6 is a partial vertical sectional view taken on line 6—6 of Fig. 5, and

Fig. 7 is a sectional detail view showing the clamp adjustment provided on the distributing vanes of the air supply nozzles.

Proceeding now with a more detailed description of the invention, Figs. 1, 2 and 3 show a furnace 10 of the cupola type having an upright hollow cupola body 11 containing a furnace shaft 12. The cupola body 11 has opposed substantially flat side walls 13 and 14 and opposed end walls 15 and 16. The side and end walls are formed by an outer metal shell 17 and a refractory lining 18. The cupola body 11 is rectangular in cross-sectional shape and is provided with groups or rows of tuyères 19 and 20 located in the opposed side walls 13 and 14. A slag hole 21 can be provided in one of the end walls, in this instance

the end wall 15, and a tap hole 22 can be provided in the opposite end wall. The slag and tap holes are provided with appropriate spouts 23 and 24 as shown in Fig. 3.

As indicated above in a general way, it is important in the operation of a furnace of this type that air be supplied simultaneously for the two opposed groups of tuyères 19 and 20 and be supplied in streams having substantially equal volumes and velocities. It is also important that the individual tuyères of the two groups be supplied with air of substantially equal volumes and velocities. This is accomplished by the novel air supply means and method which will now be described.

Windboxes 26 and 27 which, as here shown, may be substantially flat structures mounted on the outside of the substantially flat side walls 13 and 14. These windboxes have upright substantially flat front or outer walls 26*a* and 27*a* and their upright rear or inner walls 26*b* and 27*b* may be formed by portions of the shell 17 of the cupola body. The windbox 26 has opposed upright side walls 26*c* and 26*d*, and the windbox 27 likewise has opposed upright side walls 27*c* and 27*d*. The walls of the air box 26 define an upright air chamber 28 which is of sufficient width to serve all of the tuyères 19 constituting one of the tuyère groups and may have a width approximately equal to the width of the side wall 13. The walls of the windbox 27 likewise define an upright air chamber 29 of a width approximately equal to the length of the side wall 14 and capable of serving all of the tuyères 20 of the other group. The inclined plates 42 and 43 form the tops of windboxes 26 and 27 respectively.

The air supply means also includes a main duct 30 extending from a blower or other suitable source of air under pressure and a pair of branch ducts 31 and 32 which extend respectively to the windboxes 26 and 27. The branch ducts 31 and 32 are connected with the main duct 30 by means of a Y-fitting 33 which is preferably provided with a division plate 34 for insuring a substantially equal division of the air supply between the two branch ducts.

The branch ducts 31 and 32 are connected with these inlet openings 36 and 37 by means of laterally elongated divergently tapered or flared nozzles 38 and 39. These nozzles are provided with distributing vanes 38*a* and 39*a* extending in diverging or radiating relation and which serve to distribute the flow of air over the entire width of the inlet openings.

In connection with the nozzles 38 and 39 it should be noted that these nozzles are disposed so that they extend in a direction substantially normal to the front walls 26*a* and 27*a* of the windbox 26 and 27. This position for the nozzles causes the velocity discharge of air into the windboxes to take place in a direction crosswise thereof, that is to say, in a direction substantially at right angles to the downward direction of flow which the air must subsequently follow in passing to the tuyères.

By reason of the divergent shape of the nozzles 38 and 39 and the use of the distributing vanes therein, the streams of air constituting the velocity discharges into the windboxes 26 and 27 will be laterally elongated substantially flat streams corresponding with the laterally elongated shape of the inlet openings 36 and 37. When these flat streams of air are directed into the windboxes in a direction crosswise thereof as just mentioned above, they will impinge against the inner or rear walls 26*b* and 27*b* of the windboxes, or against the deflector plates 40 and 41 as the case may be, and this will cause great disturbance in the air streams because they will be subjected to an abrupt directional change.

In the embodiment of the invention here illustrated the drawings show the tops of the windboxes 26 and 27 as being formed by the laterally elongated deflector plates 40 and 41 which are located opposite the laterally elongated inlet openings 36 and 37. When the air streams are directed into the windboxes by the nozzles 38 and 39 they impinge against these deflectors in a direction normal to the surface of the deflector. The deflectors 40 and 41 can be omitted, in which case the air streams impinge directly against the rear side walls 26*b* and 27*b* as mentioned above. When the upper ends of the windboxes embody the deflectors 40 and 41, inclined plates 42 and 43 may be located over the upper ends of the windboxes to serve as sheds for water, dust and the like so as to prevent an accumulation of such materials in the pockets existing behind the deflectors.

The tuyères 19 and 20 are connected with the lower ends of the windboxes 26 and 27 by providing tuyère boxes of the so-called "drop type" or by any other suitable tuyère construction which will provide the necessary air passages from the lower ends of the windboxes to the tuyère openings 19*a* and 20*a*. In Figs. 1–3, inclusive, individual tuyère boxes 44 and 45 are shown which are separated by upright partitions 44*a* and 45*a* and which are connected with the windboxes through air delivery openings 46 and 47.

Because of the novel way in which the air stream is supplied to each windbox, the straight line flow is disturbed and broken up so that pockets of unequal pressure are avoided and the pressure over the entire cross sectional area of the windbox is substantially the same. When the downwardly moving air stream strikes the bottom of the windbox some of the remaining velocity of the stream will be converted into pressure but the pressure factor will have substantially the same value for all points in a given transverse plane or cross-section of the windbox. The air then flows from the windbox through the delivery openings to the tuyère group 19 and 20 and, since the air stream has equalized pressure values as just explained, the air passed through each individual tuyère of a group will be substantially the same in volume and velocity.

Reverting to the distributing vanes 38*a* and 39*a* of the air supply nozzles 38 and 39 it should be explained that these vanes can be in fixed relation in the nozzles or, if desired, can be laterally adjustable so as to permit them to be located in the proper position to obtain the equalized distribution of the air being delivered to the air inlet openings 36 and 37 of the windboxes. For the purpose of this adjustment some or all of the vanes have a pivot 48 which permits lateral swinging. The adjustable vanes are adapted to be clamped in the selected position by a clamping means such as that shown in Fig. 7 and which comprises a screw or stud 48*a* projecting through a slot 48*b* in the wall of the nozzle and having a nut 48*c* thereon bearing against a washer 48*d* which spans the slot. Members 38*b* connected to the vane form a cover for the slot and prevent the loss of air therethrough.

Fig. 4 shows a furnace 49 of the cupola type similar to the furnace 10 above described but in

which a modified construction is employed for connecting the lower ends of the windboxes **50** with the passages **51***a* of the tuyères **51**. In this modified construction the upright partitions **44***a* and **45***a* have been omitted and laterally continuous tuyère boxes **52** are provided for the groups of tuyères.

Figs. 5 and 6 show another furnace **53** of the cupola type which is similar to the furnace **10** above described but in which the windboxes **54** are extended downwardly to a point below the tuyères **55** and the air inlet openings **55***a* of the tuyères extend through the shell **56** forming the rear wall of the windbox.

From the foregoing description and the accompanying drawings it will now be readily understood that this invention provides a novel construction for supplying air to a furnace of the cupola type and particularly for a cupola of quadrangular cross-section having groups of tuyères in opposed walls. It will now also be understood that the division plate **34** in the Y fitting **33** can be set so that equal volumes of air will be supplied to the separate windboxes through their respective nozzles with the result that all the tuyères leading into the furnace shaft will supply substantially equal volumes of air at substantially the same velocity. Also, if it is desired the division plate can be set so that the tuyères of one windbox will supply more air to the shaft than those of the other windbox, and any desired ratio of quantities of air can be obtained.

Although the improved air supply means of my invention have been illustrated and described herein to a detailed extent, it will be understood

of course that the invention is not to be regarded as being limited correspondingly but includes all changes and modifications coming within the scope of the appended claims.

Having thus described my invention, I claim:

1. A cupola having a rectangular shaped shaft having a separate windbox on each of two opposite sides, each windbox having a set of tuyères, a common main blast line for supplying air to said windboxes, a proportioning valve in the main blast line to permit selective proportioning of air to each of the windbox inlets so that the tuyères of one windbox may supply an equal, greater or less volume of air to the cupola shaft than the tuyères of the diametrically opposite windbox, the portion of each windbox opposite the inlet being provided with a curved deflector plate facing the inlet deflecting the air toward the tuyères to obtain substantially equal air velocities in the tuyères of either tuyère set.

2. The furnace as described in claim 1 wherein the deflector plate is of parabolic shape.

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