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H. A. REECE
 APPARATUS AND METHOD FOR MODIFICATION OF CURRENTS
 OF AIR, GASES, AND THE LIKE
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2,197,948

FIG. 1

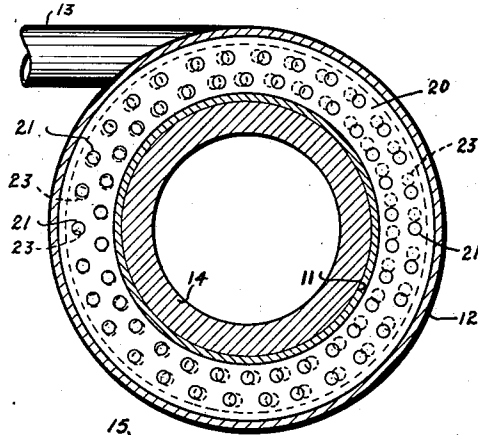


FIG. 2

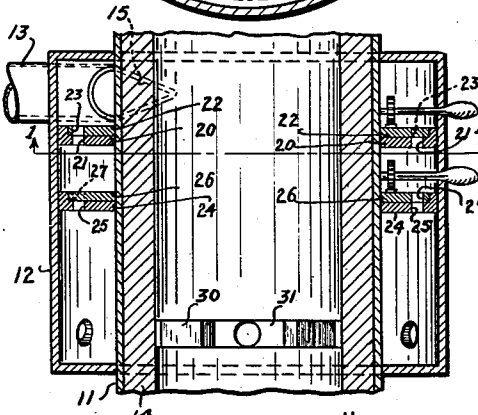
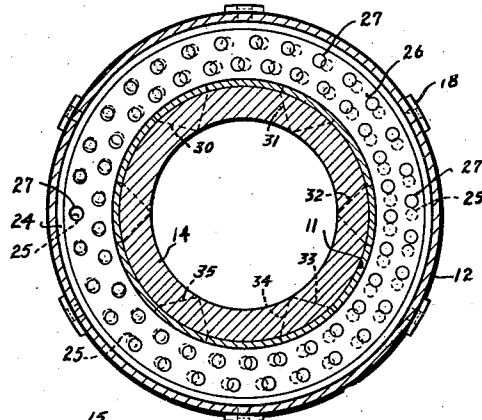


FIG. 3

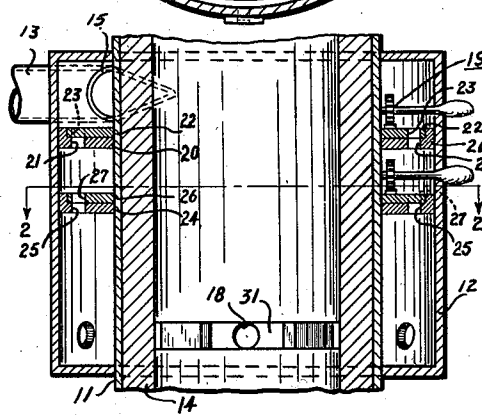


FIG. 4

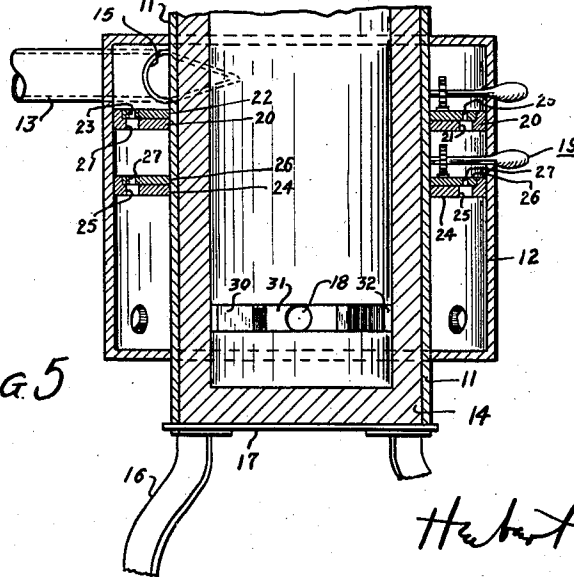


FIG. 5

INVENTOR.

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UNITED STATES PATENT OFFICE

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APPARATUS AND METHOD FOR MODIFICATION OF CURRENTS OF AIR, GASES, AND THE LIKE

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10 Claims. (Cl. 266—30)

My invention relates to supply apparatus for delivery of air and the like, such as wind boxes for metallurgical furnaces, and to the operation of the same. My present invention, herein described, is related in subject matter to my invention described in my co-pending United States patent application, Ser. No. 279,704, filed June 17, 1939, and is directed to the same and similar problem of furnace operation and control of air flow as is set forth in said co-pending application.

In the following discussion and description the operation and structure of a cupola for the remelting of metal will be referred to but it is to be understood that my invention includes the structure and operation of all furnaces or similar devices wherein a blast of air or other gases is supplied through a plurality of tuyères or like openings to the interior of the furnace or similar device.

The control of the air blast delivered to a plurality of tuyères of a furnace from a wind box is an object of my invention.

Another object is the modification of the current of an air blast moving through a wind box.

Another object is the modification of the direction of portions of an air blast passing through a wind box from an inlet to a plurality of outlets.

Another object is the provision for adjustably fixing the amount of restriction to an air blast at different locations in the wind box.

Another object is the provision for a variable limitation of the flow of air through a wind box at different local positions in the wind box.

Another object is the provision of a progressively varied amount of restriction to flow of air at varied locations in a wind box.

Another object is the provision of apparatus and method of modifying a flow of air through a common distributing chamber.

Another object is the provision of a device for improving the control of the air blast to a furnace.

Another object is the provision for control of velocity of air to a plurality of tuyères without disturbance of volume.

Another object is the provision for the control of the melting zone of a furnace.

Another object is the provision for the reversing, or changing the direction of, a current of air in an enclosed chamber.

Another object is to provide a method for improved operation of a furnace and the supplying of air thereto.

Other objects and a fuller understanding of my invention may be had by referring to the follow-

ing description and claims, taken in conjunction with the accompanying drawing, in which:

Figure 1 is a transverse cross-sectional view taken through a furnace and wind box utilizing my invention and looking in the direction of the arrows 1—1 of Figure 3.

Figure 2 is another transverse cross-sectional view of the furnace and wind box looking in the direction of the arrows 2—2 of Figure 4.

Figure 3 is a sectional view taken lengthwise of the furnace and wind box showing the transverse restricting plates in one relative position.

Figure 4 is a view similar to that of Figure 3 and shows the transverse restricting plates in an opposite relative position, and

Figure 5 is a view similar to that of Figures 3 and 4 and shows the transverse restricting plates in an intermediate relative position.

The furnace or cupola illustrated has a cupola body 11 which is supported upon the support 16. The cupola body or shell 11 is in the form of a cylindrical shaft, the inner walls of the cupola body 11 being lined by the fire brick lining 14. The body 11 and lining 14 are mounted upon the bottom plate 17.

For purposes of simplicity in illustration, the usual tap hole and slag hole are not shown. It has also been considered unnecessary to illustrate such other openings as a clean-out door, breast arch, or drop bottom doors. The cupola illustrated, however, may be considered as having all of the parts necessary for the usual operation of the same.

The wind box 12 of cylindrical outer shape is mounted upon the cupola body 11 by welding or other suitable means and in the embodiment shown, the outer wall of the cupola body forms one of the enclosing walls of the wind box 12. The wind box 12 forms an enclosed jacket surrounding the cupola body 11 in such a way that air introduced into the wind box may circulate entirely around the cupola body.

The inlet conduit 13 is in communication with an air blower or other source of an air blast and the inlet conduit 13 is connected to the wind box 12 at the upper portion of the wind box 12 so as to afford communication between the air blower and the inlet opening 15 of the wind box 12.

In the cupola illustrated there are six tuyères extending through the wall and lining of the cupola body 11 so as to establish communication between the interior of the shaft of the cupola and the wind box 12. The six tuyères 30, 31, 32, 33, 34, and 35 are shown in dotted lines in Figure 2. The interior side of three of the tuyères are

shown in Figures 3, 4 and 5. These tuyères are of substantially equal size and are uniformly spaced around the periphery of the cupola. The tuyères enter the cupola body at a low level in the cupola and communicate with the wind box in a lower portion thereof. In order that the operator may look into the tuyères from the outside of the furnace, peep holes are provided in the wind box opposite each of the tuyères and mica or other substance is sealed over the peep holes. Peep hole covers 18 hingedly connected to the wind box 12 keep the peep holes covered on the outside.

Positioned within the wind box below, and at a distance from, the inlet opening 15 is a fixed annular baffle plate 20 encircling the cupola body and which is secured to the walls of the wind box 12 and the cupola body 11 by welding or other suitable means. The baffle plate 20 extends transversely of the wind box 12 in the path of the flow of air from the inlet opening 15 to the tuyères 30, 31, 32, 33, 34, and 35. The baffle plate 20 has a shoulder portion extending around its outer periphery closely adjacent to the wall of the wind box 12. A movable annular baffle plate 22 rests upon the baffle plate 20 and is positioned between the shoulder of the fixed baffle plate and the wall of the cupola body 11. The engagement of the baffle plate 22 and the baffle plate 20 is such that the movable baffle plate 22 may be slidably moved relative to the fixed baffle plate 20. Since the cupola body 11 is circular in cross-section and the baffle plates are also annular in form the upper baffle plate 22 may revolve relative to the cupola body 11.

Positioned within the wind box below the baffle plate 20 and also intermediate of the inlet opening 15 and the plurality of tuyères is another fixed baffle plate 24. The lower baffle plate 24 is mounted in the wind box and is secured to the walls thereof in a manner similar to that described for baffle plate 20. The baffle plate 24 is similar to the baffle plate 20 in that it also has a shoulder portion extending around its peripheral edge. A lower movable baffle plate 26 is supported on, and slidably movable relative to, the baffle plate 24 in the same way as described for baffle plates 20 and 22. The lower baffle plates are intermediate of the upper baffle plates and the level of the tuyères. The lower baffle plates may be positioned immediately adjacent to the upper baffle plates and also other baffle plates may be added in other embodiments of my invention.

The baffle plate 20 is perforated over its surface and has uniformly distributed therein a plurality of openings or open spaces 21. The spacing between the open spaces 21 positioned at intervals around the baffle plate 20 and is regular and uniform all around the annular extent of the baffle plate 20. The baffle plate 22 is also perforate over its surface and has a plurality of openings or open spaces 23 distributed therein. The size of the openings 21 and the openings 23 are substantially the same. The spacing between the open spaces 23 of the baffle plates 22 is, however, different than the spacing between the open spaces 21 of the baffle plate 20. In the embodiment shown the spacing between the open spaces 23 is less than the spacing between the open spaces 21.

As a result of the differential spacing between the open spaces of the respective baffle plates there cannot be complete registration of all the open spaces 23 with all the open spaces 21. Upon registration of open spaces 23 and 21 at one

location there is a complete lack of registration at a location diametrically opposite from it. Between the location of full registration and the location of complete lack of registration the open spaces are arranged in progressive stages of partial registration.

The variable degree of registration of the open spaces 21 and 23 at different locations of the wind box at the mating baffle plates provide for variable restriction and limitation of the flow of air through the wind box. A turning mechanism denoted generally by the reference character 19 is provided for shifting the position of the baffle plates 22 relative to the baffle plates 20 and for thus changing the degree of registration of the open spaces 23 and 21 at the different local areas of the engaged baffle plates.

Other arrangements in the relative size, location, and spacing of the open spaces may be made for obtaining the differential restriction to the air flow at different localities of the cross-sectional area of the wind box at the baffle plate. The description of the particular arrangement in proportions here illustrated and described is only one example of an embodiment of my invention.

Spaced at a distance below the baffle plate 20, and intermediate the baffle plate 20 and the tuyères, there are positioned the fixed baffle plate 24 and the movable baffle plate 26. Open spaces 27 in the movable baffle plate 26 are spaced apart at different distances than are the open spaces 25 in the baffle plate 24. The operation of the lower baffle plate 24 and 26 by a turning mechanism 19 is similar to that described for the upper baffle plates 20 and 22. The same variance of registration of the open spaces 27 and 25 is obtainable as that described in connection with the upper baffle plate.

The operation of the lower baffle plate is independent of the operation of the upper baffle plate. In one location, the open spaces of the upper baffle plates may be in one condition of registration, for example completely unregistered, while immediately below, the open spaces of the lower baffle plates may be in a different condition of registration, for example, completely registered. In Figure 3 the baffle plates 22 and 26 are adjusted in a manner that on the left hand side the open spaces 21 and 23 of the upper baffles are completely registered while the open spaces 25 and 27 directly below in the lower baffles are completely out of registration. Upon the right hand side of Figure 3 the positions are in reverse condition in that the open spaces 23 and 21 are unregistered and the open spaces 27 and 25 are registered.

Figure 4 illustrates the position of the parts upon adjustment of the movable baffle plates 20 and 26 to an opposite condition of registration. Between the openings on the left hand side of Figures 3 and 4 and those on the right hand side of Figures 3 and 4, the openings are in progressively varied stages of registration. Figure 5 illustrates the position of the openings in an intermediate condition of registration.

Figures 1 and 2 better illustrate the spacing, positioning, and progressive stages of registration, of the open spaces in the respective sets of baffle plates.

The blast of air entering the wind box from the inlet opening travels at a rapid rate of speed. By reason of the arrangement and shape of the wind box, inlet, and outlets, the blast of air rapidly circles in unevenly propor-

tioned currents around the wind box. To properly control the blast of air and to modify the velocity of the faster moving portions of the air blast before supplying the air to the tuyères, it is desirable that the flow of air be properly restricted.

The apparatus here described provides for selective restriction of the air blast and permits a limitation of flow of the air blast as required by the conditions in different locations around the wind box. Where the velocity is excessive the parts may be adjusted to offer greater restriction to the flow of air than where the velocity is not excessive. It has been found, for example, that on one side of the wind box without any control means the velocity of the air entering a tuyère may be excessive while at the same time the velocity of the air entering another tuyère may be insufficient. By adjusting the baffle plates the proper amount of restriction at one location relative to the amount of restriction at another location may be obtained and the velocity of the air blast thus brought into equilibrium.

While one set of baffle plates are effective in modifying the velocity of the air blast, a plurality of sets, such as the two sets illustrated, permits the modifications to be made in gradual and successive steps without too abrupt a change and without undue restriction.

By thus selectively restricting the flow of the blast of air through the wind box to permit a limited flow of air in accordance with the conditions and requirements the velocity of the air blast is modified. By proper adjustment and making of the proper selective restriction the velocity of the air blast moving through the wind box is modified to provide for the supplying of air to the plurality of tuyères at substantially equal velocity. The provision of apparatus and method of control which provides for the supplying of air at equal velocity to a plurality of the tuyères of a furnace is of great consequence and utility in the successful operation of a furnace such as a metallurgical cupola.

The arrangement of the parts of the apparatus is such that the direction of the blast of air moving through the wind box or enlarged chamber may be changed. For example, the air blast entering the annular wind box may circle around through the wind box in a clock wise direction. By adjustably changing the degree and location of registration of the open spaces, the direction of the flow of the air blast passing through the mating baffle plates from one section of the wind box to another may be changed to move in a counter-clock wise direction. When two or more sets of registering baffle plates are utilized the direction of the air blast may be again reversed in passing through the open spaces of the next succeeding baffle plates. When two sets of plates are utilized to divide the wind box into three sections the air in the upper section may circle in one direction, the air in the intermediate section may circle in an opposite direction, and the air in the lower section may circle again in said one direction. This possibility in changing directions of the flow of air is a manifestation of the high degree of control which may be obtained by the use of my invention. By proper adjustment of registration the blast of air may be brought into an equilibrium of direction, that is, substantially all of the circling or tangential movement may be eliminated to cause the air to move substantially vertically downward toward

the outlets in a solid flow. Therefore by this means the air blast may be supplied to a plurality of tuyères of a cupola at substantially equal velocities.

Although I have described my invention with a certain degree of particularity it is understood that the present disclosure has been made only by way of example and that numerous changes in the details of construction and the combination and arrangement of parts may be resorted to without departing from the spirit and the scope of the invention as hereinafter claimed.

I claim as my invention:

1. In a furnace having a wind box forming a common distributing chamber for supplying blown air to the entrances of a plurality of tuyères communicating with said furnace, said wind box having an inlet adapted to communicate with a source of said blown air, a baffle plate mounted within the wind box intermediate of, and at a distance from, said inlet and said entrances, said baffle plate having a plurality of open spaces therein for permitting limited flow of air therethrough from one portion of the wind box to another portion of the wind box, a second plate adapted to slidably engage said baffle plate, said second plate also having a plurality of open spaces therein for permitting limited flow of air therethrough, the open spaces in said baffle plate being arranged in a relationship to each other different than the relationship of the open spaces to each other in said second plate to provide progressive stages of registration around the cross-section area of the wind box, and operating means for slidably moving said second plate relative to said baffle plate to vary the degree and locality of the registration of said open spaces for the control of the flow of air from said one portion of the wind box to said another portion of the wind box, the said air being delivered to the plurality of tuyères from said another portion of the wind box at velocities controlled by the variable registration of said open spaces.

2. In a furnace having a wind box forming a common distributing chamber for supplying blown air to the entrances of a plurality of tuyères communicating with said furnace, said wind box having an inlet adapted to communicate with a source of blown air, a plate positioned in said wind box to partition said wind box into a sub-chamber adjacent said inlet and a sub-chamber adjacent said entrances, said plate having a plurality of open spaces distributed therethrough for permitting a restricted flow of air through said plate from one sub-chamber to the other sub-chamber, valve means associated with said plate for varying the size of said open spaces, said valve means increasing the size of some of said open spaces and decreasing the size of other of said open spaces, and operating means for operating said valve means in unison, said plate, valve means and operating means being arranged to vary the size of said open spaces in inverse ratio at different areas of said plate to control the relative restriction presented to said flow of air at said different areas.

3. In a wind box for furnishing a blast of blown air from a common source to a plurality of tuyères in which the tuyères are substantially uniform in size and distribution to afford uniform volume delivery of blown air through the tuyères, a first plate positioned in the wind box to provide a restricting barrier to the flow of air in the wind box toward said tuyères, said plate having resisting surfaces and open spaces distributed therein to

permit a limited flow of air through said open spaces, a second plate adapted to engage said first plate and having resisting surfaces and open spaces distributed therein to permit a limited flow of air through said open spaces, and means for moving the second plate to vary the relative registration of the open spaces in the second plate and the open spaces in the first plate, said open spaces being arranged in different spaced relationships in said plates, respectively, to register in different degrees at different local areas of said plates, movement of said second plate adjusting the degree of registration of said open spaces at said different local areas to change the amount of restriction afforded by said plates so that the relative velocity of air moving through the wind box at said plates and toward the tuyères may be controlled.

4. In a furnace having a wind box and a perforate baffle positioned therein for modifying the velocity of an air blast passing through the wind box from an inlet to the entrances of a plurality of tuyères, a perforate plate adapted to slidably engage said baffle, said perforate plate having openings arranged in occurrences therein to register in progressively varied degrees with openings of other occurrences in the baffle at different locations of the baffle, and means for moving the perforate plate relative to the baffle to change the location of the said registration of varying degree, the adjustment of the relative registration of openings at different locations of the baffle providing for adjustable modification of the air blast moving through the wind box to said entrances.

5. In an enclosed system for distribution of air or other gases from a common source through a common distributing chamber to a plurality of outlets, a partition dividing said chamber into adjacent sections, said partition having open spaces distributed therein, said partition restricting the flow of air or other gases through the chamber and permitting limited flow of said air or other gases through said open spaces from one section to the next section toward said outlets, valve means for changing in varied degree the size of said open spaces and proportioning the limitation of the flow of air or other gases through each of said open spaces, and operating means connecting said valve means, the valve means and operating means being arranged that the valve means are operated in unison and that some of the valve means are moved toward closing position as other of the valve means are moved toward opening position, the variation in position of said valve means modifying the velocity of air or other gases moving through the chamber from one section to another at different local areas of the partition.

6. In an enclosed system for distribution of air or other gases from a common source through a common distributing chamber to a plurality of outlets, a plurality of partitions dividing said chamber into adjacent sections, said partitions having open spaces distributed therein, said partitions restricting the flow of air or other gases through the chamber and permitting limited flow of air through said open spaces from one section to the next succeeding section of the chamber toward said outlets, valve means for varying the proportional size relative to each other of said open spaces in each partition and the limitation of the flow of air or other gases therethrough, and operating means connecting, respectively, the valve means at each of said par-

titions, the valve means and operating means at each of said partitions being arranged that the valve means at each of said partitions are operated in unison and that some of the valve means are moved toward closing position as other of the valve means are moved toward opening position, the variation in position of said valve means modifying the velocity of air or other gases moving through the chamber from one section to the next succeeding section at different local areas of the respective partitions.

7. In a furnace having a wind box forming a common distributing chamber for supplying blown air to the entrances of a plurality of tuyères communicating with said furnace, said wind box having an inlet adapted to communicate with a source of said blown air, a plurality of spaced baffle plates mounted within the wind box intermediate of, and at a distance from, said inlet and said entrances, a plurality of supplemental plates positioned adjacent baffle plates, respectively, each of said supplemental plates having a lateral surface adapted to slidably engage a lateral surface of an adjacent baffle plate, said baffle plates and said supplemental plates having a plurality of open spaces extending through each of said plates, respectively, for permitting limited flow of air therethrough, the distance between the open spaces of one of the plates of each set of baffle plates and supplemental plate being greater than the distances between the open spaces of the other of said plates, and adjustable means operable from the exterior of the wind box for adjustably sliding each of said supplemental plates relative to an adjacent baffle plate to change the registration of the open spaces in the respective supplemental plate and adjacent baffle plate, the variable registration of said open spaces providing for the modification of velocity of said blown air in different portions of the wind box by said plates.

8. In a furnace having a wind box positioned around the body of the furnace for supplying air to a plurality of tuyères entering the furnace, said wind box having an inlet adapted to communicate with a source of an air blast and having outlets in communication with said tuyères, the arrangement of the wind box, inlet, and outlets being such that currents of air of unequal velocities circulate through the wind box, baffle plate means carried by the wall of the wind box and extending into the wind box in the path of the flow of air, said baffle plate means resisting the said flow of air to obstruct said currents of air, conduit means extending through said baffle plate means to permit limited flow of air therethrough, valve means for proportioning in inverse ratio the limitation of the flow of air through respective conduit means at different localities of the cross-section area of the wind box, adjustable control means for adjustably controlling said valve means, said control means and valve means being arranged to change the limitation of flow through the conduit means at one locality in inverse ratio to change in limitation of flow in the conduit means at another locality of the cross-section area of the wind box, the relative limitation to flow of air in said different localities providing for the modification of velocity of said currents of air.

9. The method of controlling the velocities of air supplied to a plurality of tuyères of a furnace from an enlarged air chamber through which blown air is passed, comprising: restricting the flow of air from one portion of the air

chamber to another, permitting a limited flow of air from said one portion of the air chamber to said another portion of the air chamber, proportioning the amount of the said limitation of a part of the flow of air at one location of the air chamber relative to the amount of the said limitation of another part of the flow of air at another location of the air chamber, and supplying the proportionately limited flow of air from said another portion of the wind box to said tuyères at velocities modified by the said proportioned limitation.

10. In the operation of a furnace, the method of furnishing an air blast to a plurality of

tuyères having predetermined volume capacities, comprising: supplying an air blast to a wind box, partially enclosing the air blast in one portion of the wind box, permitting a limited flow of the air blast to enter a second portion of the wind box, proportioning the partial enclosing and limitation of respective parts of the flow at different locations in the wind box in accordance with variance of velocities of the air blast, and supplying the air blast to said tuyères at velocities modified by said proportional partial enclosing and limitation of flow.

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