

[54] **METHOD AND APPARATUS FOR
REDUCING AIR INFILTRATION INTO
ELECTRIC ARC FURNACE DURING
THE CHARGING AND MELTING
OPERATION**

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266/1 R

[51] Int. Cl. F27d 23/00

[58] Field of Search 13/1, 9, 35, 33, 31; 266/1 R;
263/50; 98/36

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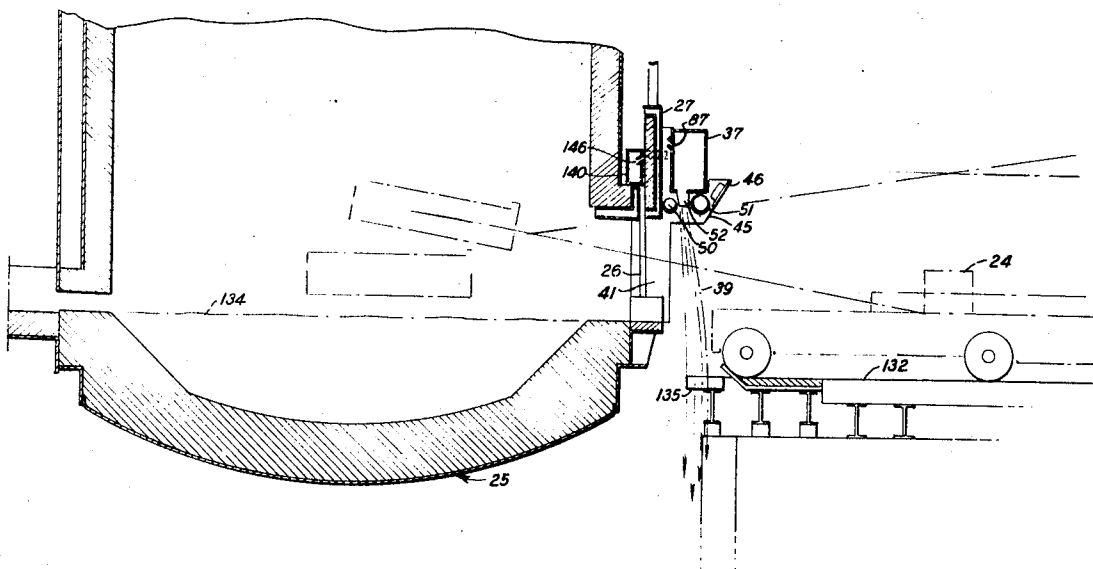
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ABSTRACT

An air curtain arrangement for the charging opening of an electric arc steelmaking furnace for restricting entry of air into the furnace, the air curtain apparatus being disposed above the opening and spaced sufficiently from the furnace wall to permit the door which normally covers the opening to be raised. An air screen is directed downwardly and a pair of side air flows are provided to screen the areas between the furnace wall and the air screen which is provided across the opening. Two further air flows are directed against the sides of the door, one on each side thereof for the purpose of screening these areas against incursion around the raised door of outside air into the furnace which is maintained at a pressure slightly less than atmospheric pressure during the door charging operation.

19 Claims, 20 Drawing Figures



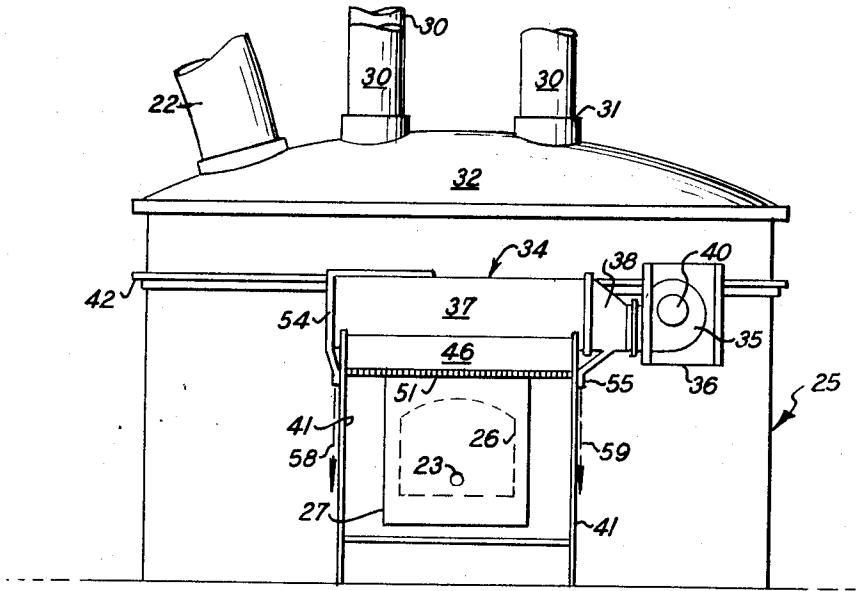


Fig. 1

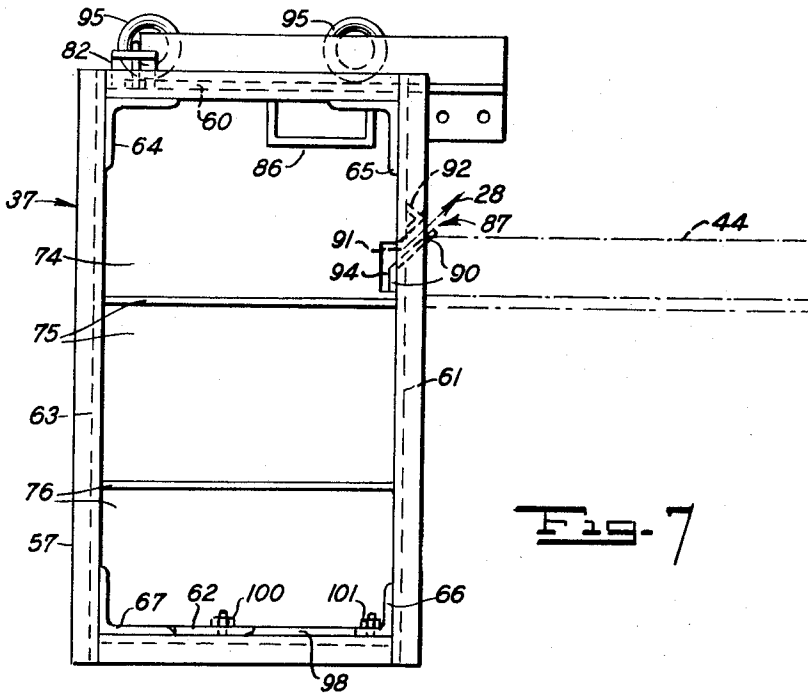


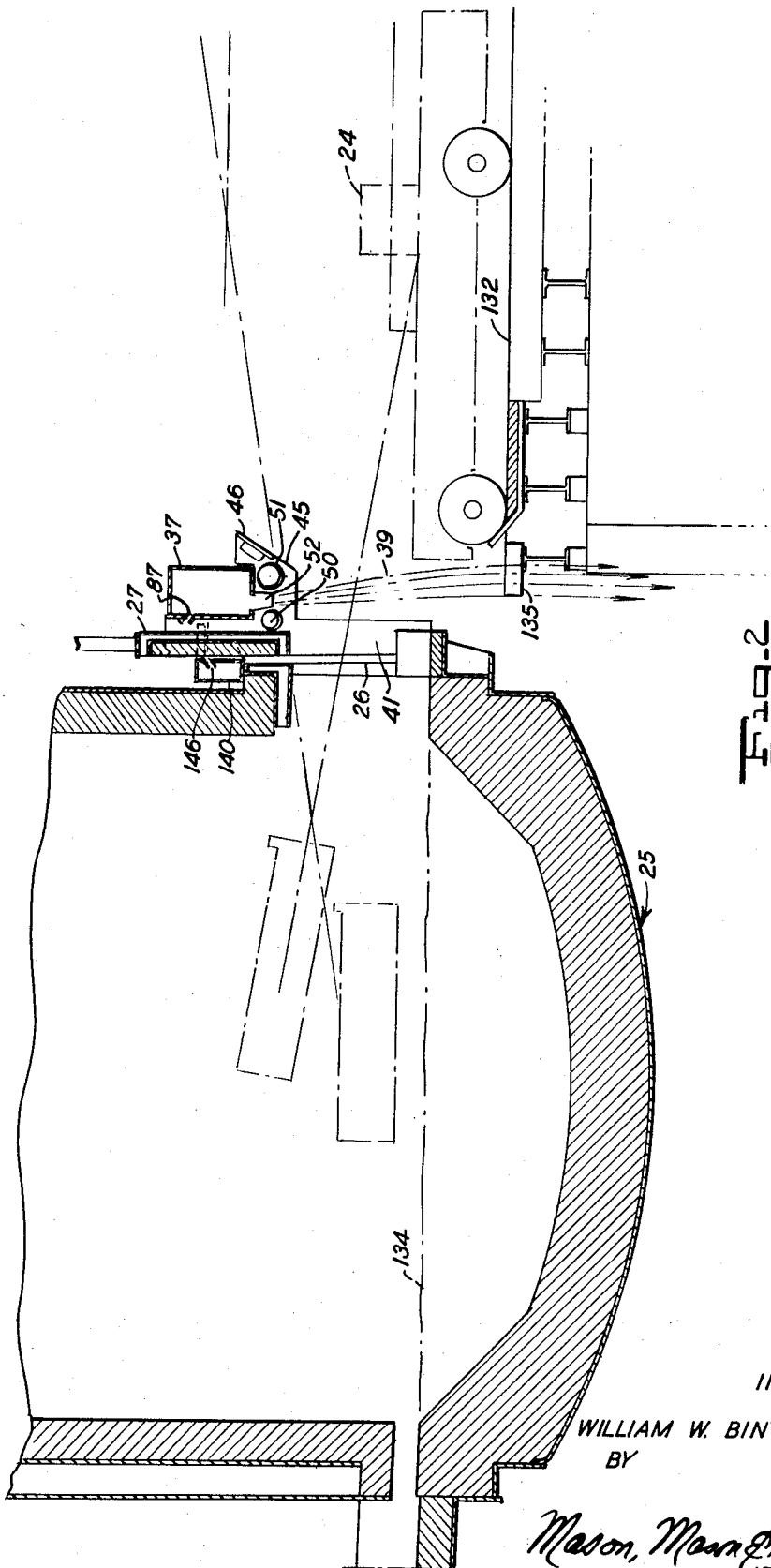
Fig. 7

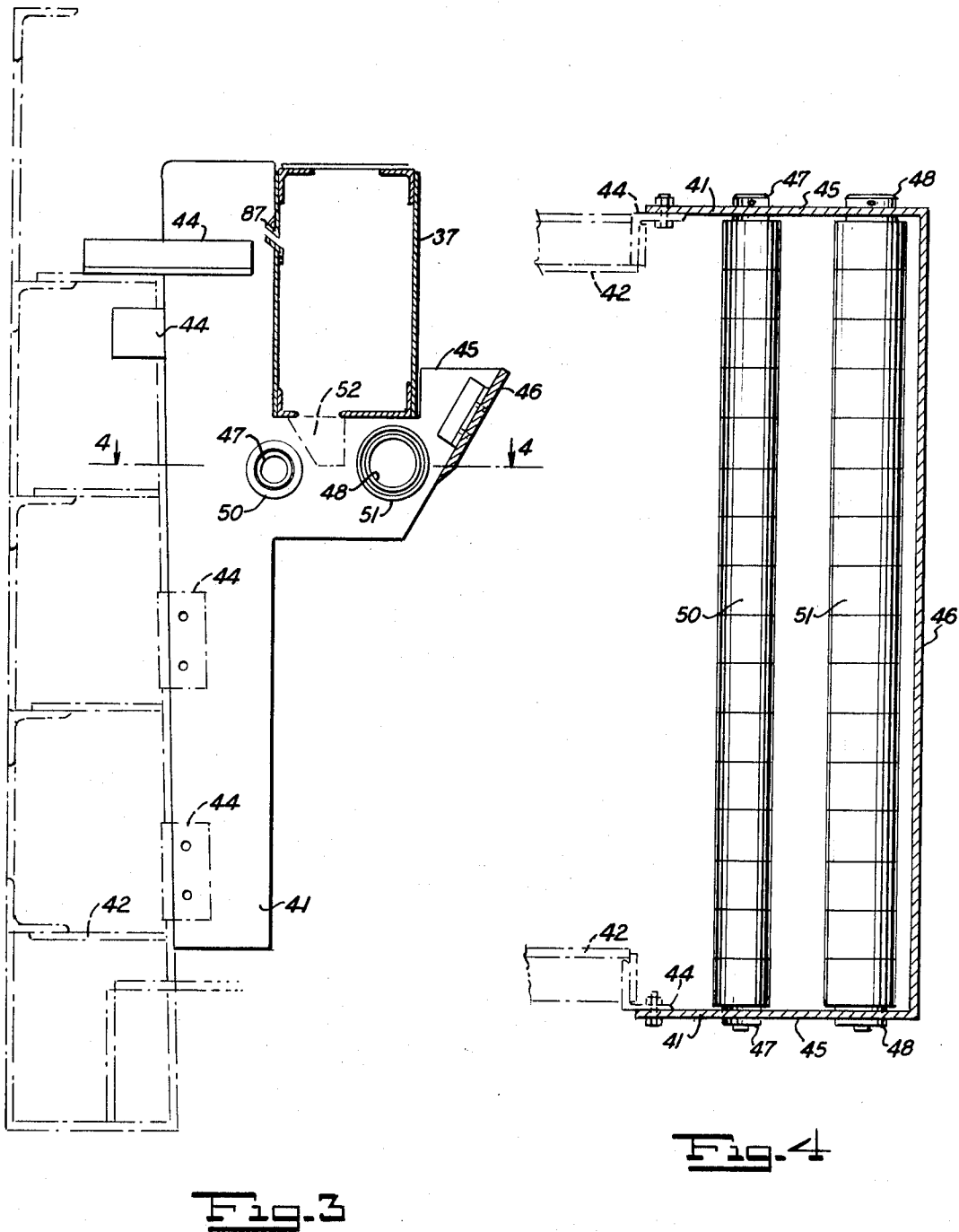
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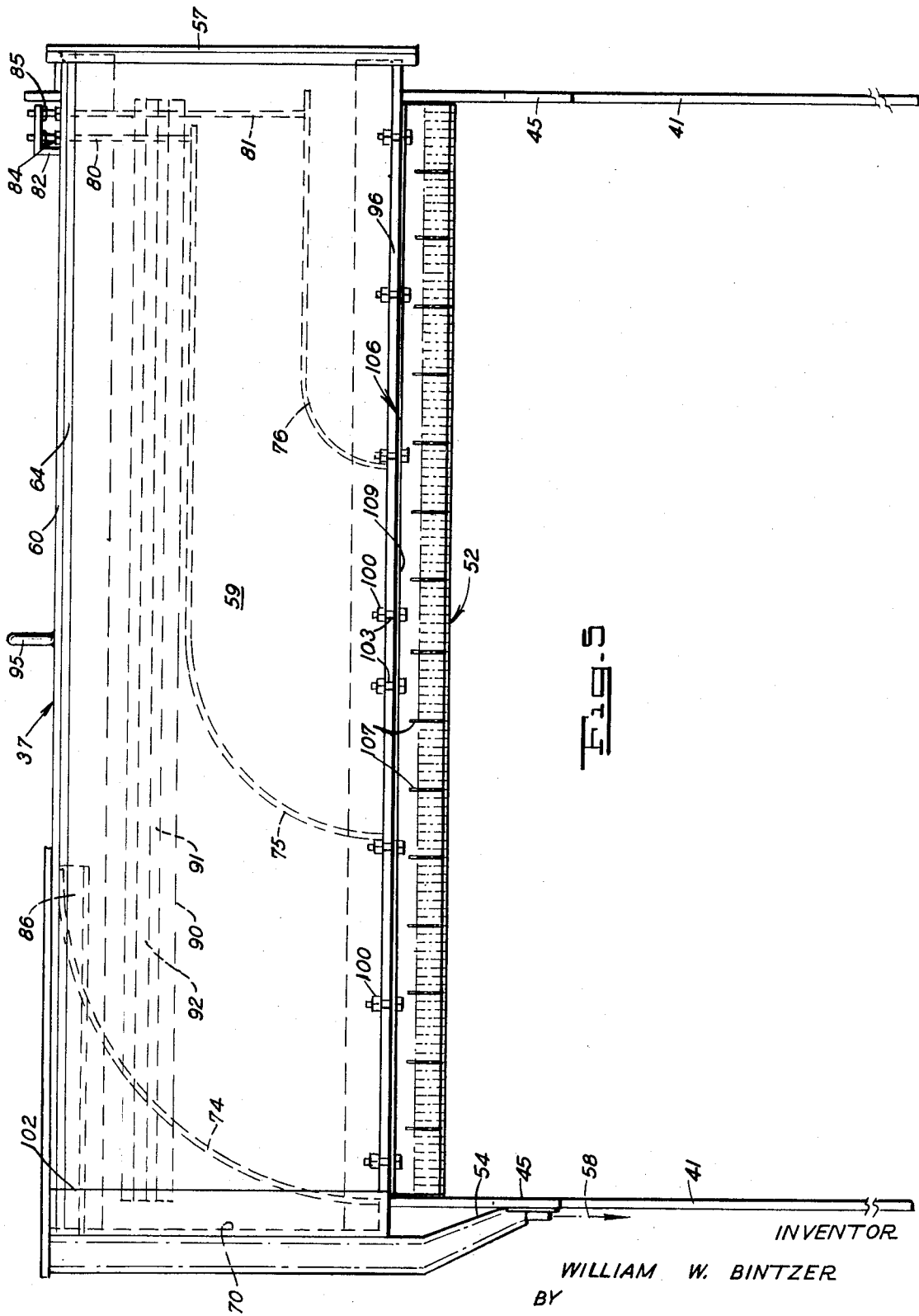


Fig. 5

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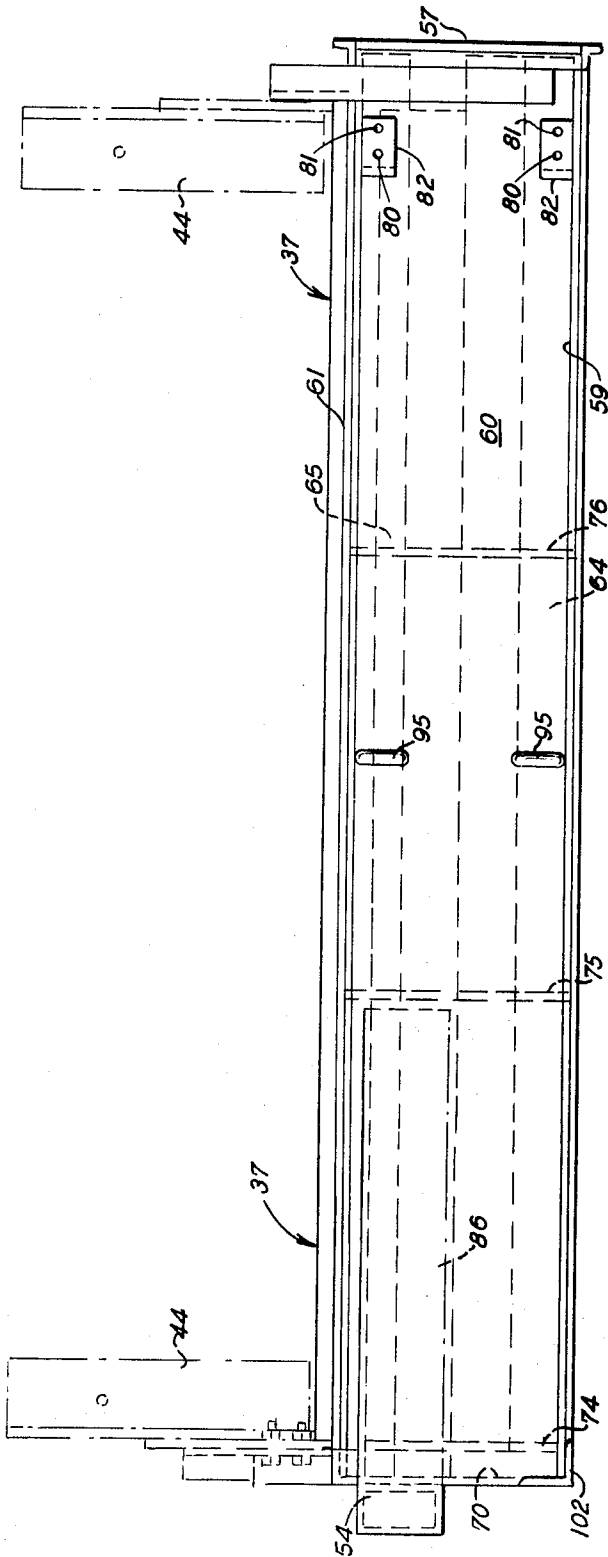


Fig. 6

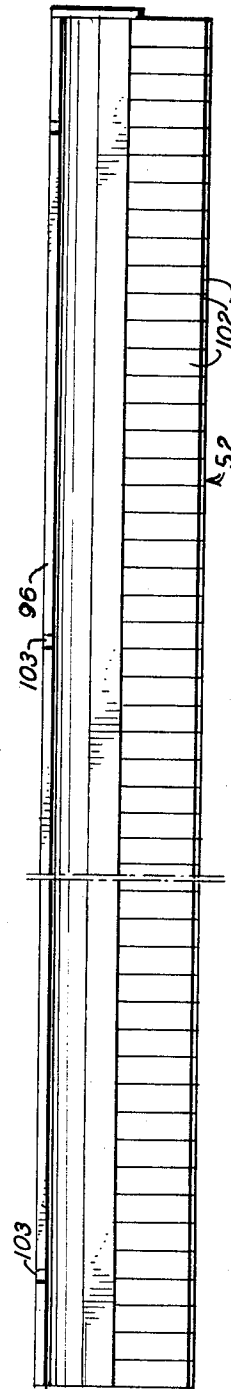


Fig. 7

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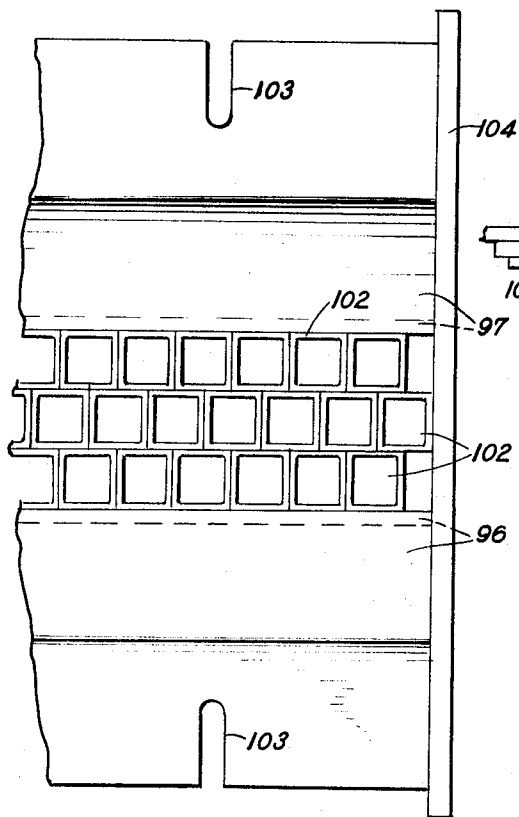


Fig. 9

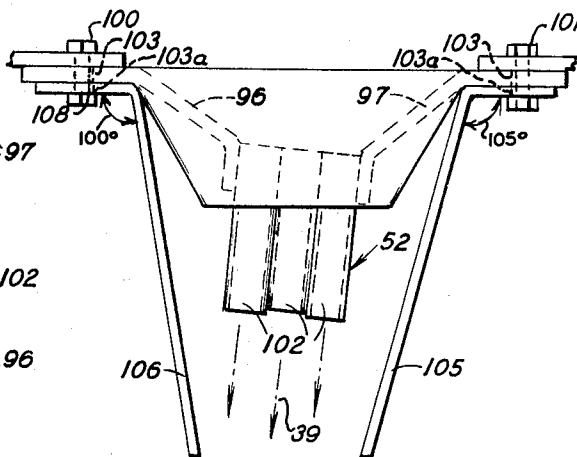


Fig. 10

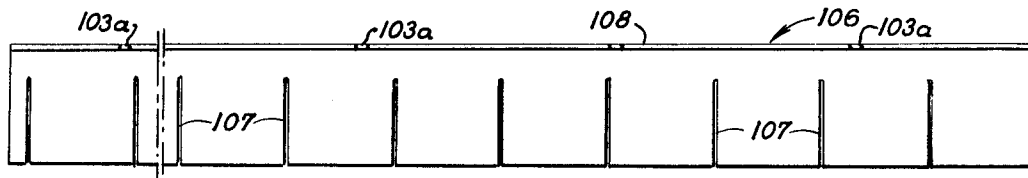


Fig. 11

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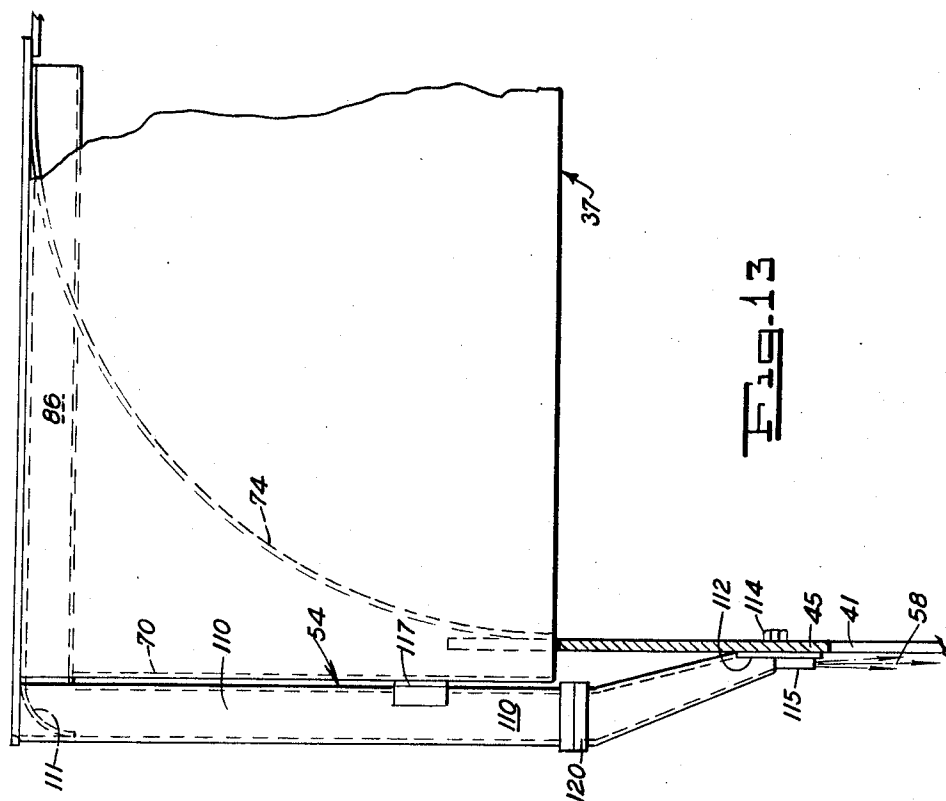


Fig. 13

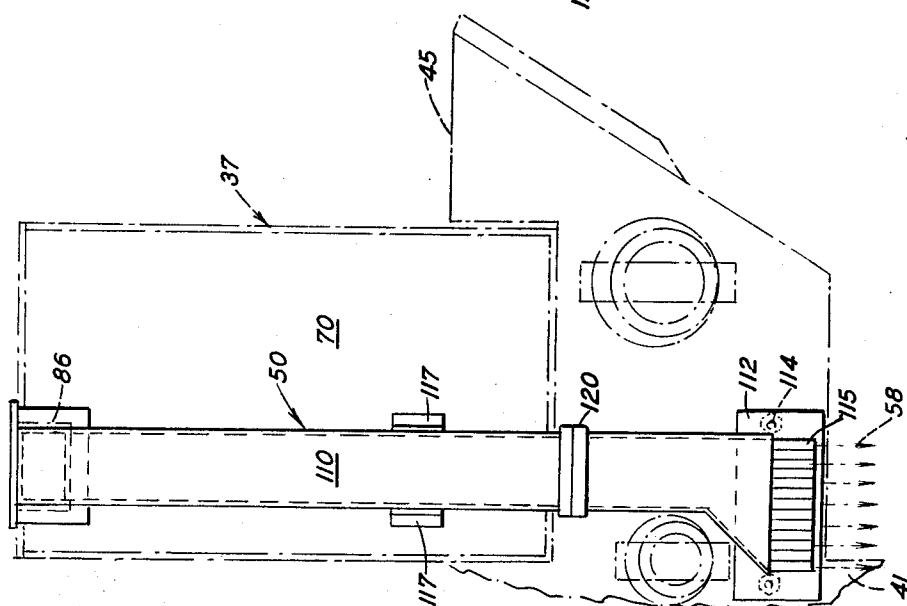
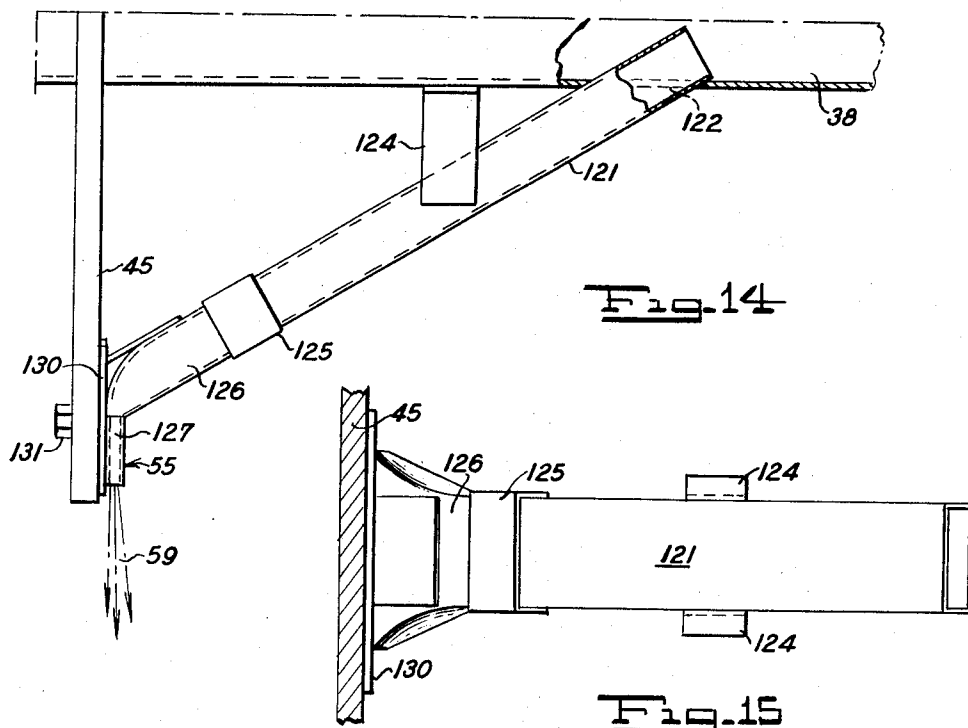
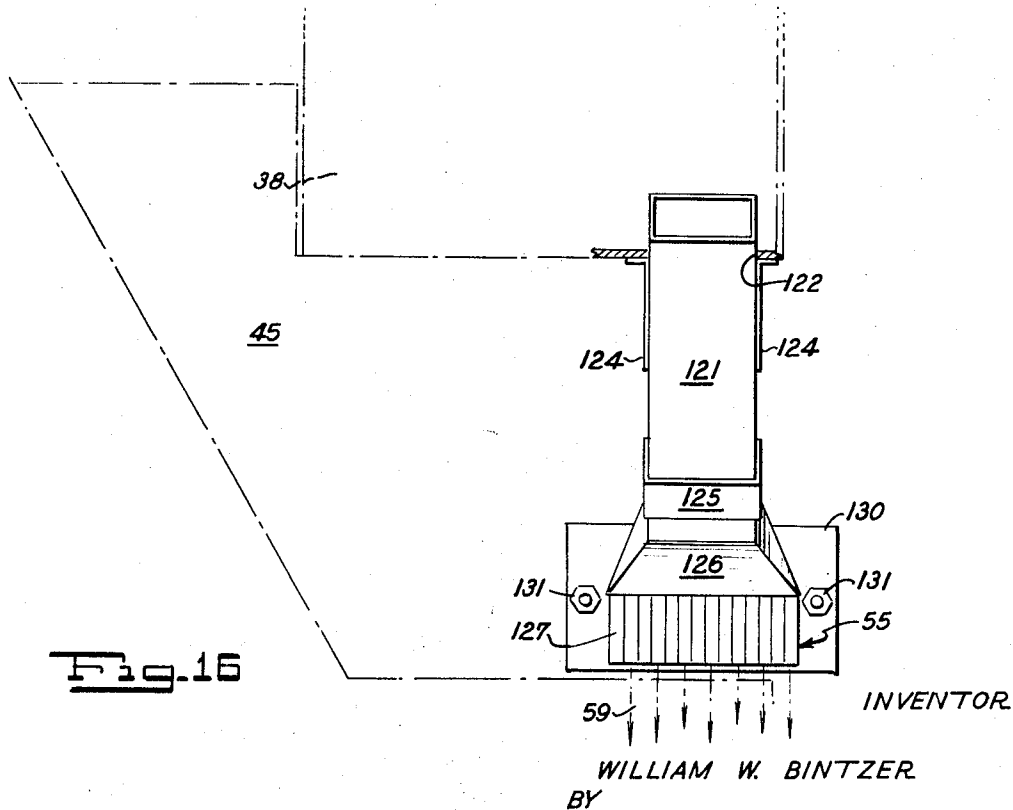


Fig. 12

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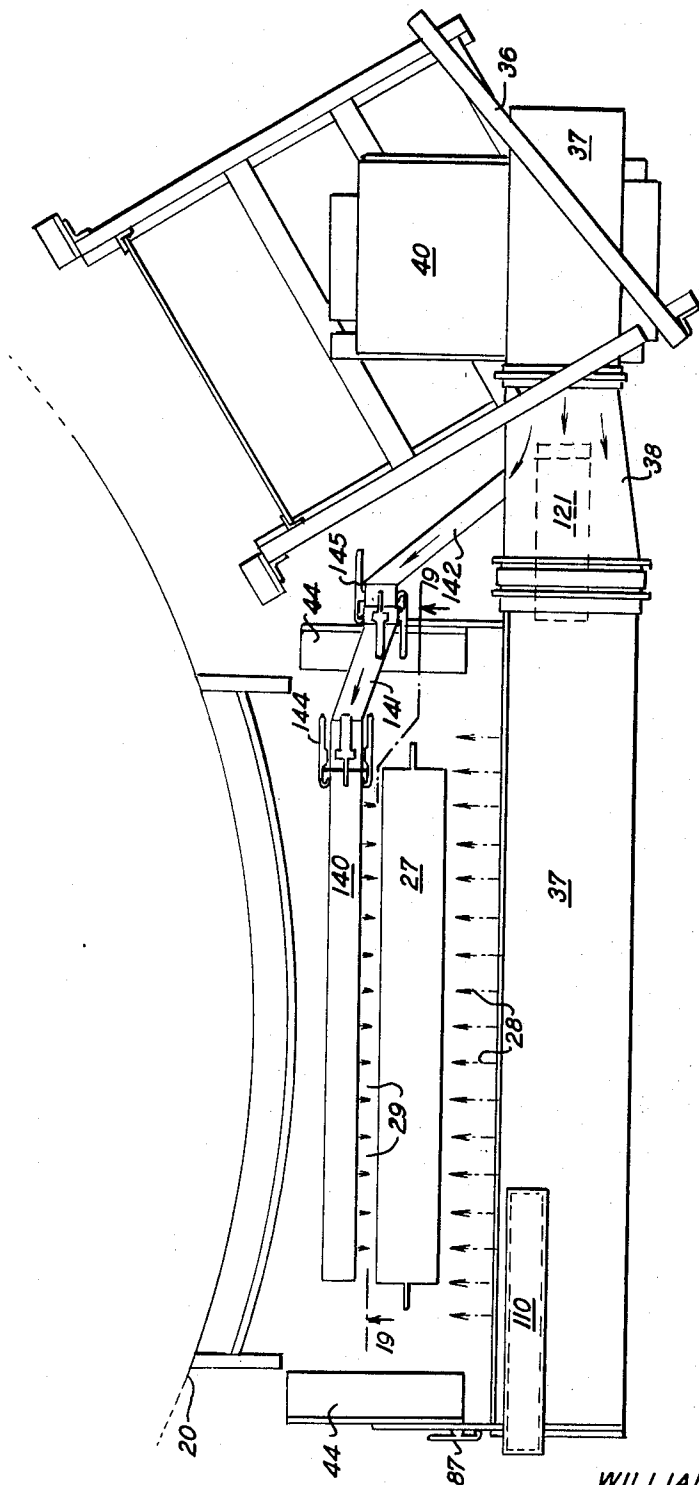


Fig. 17

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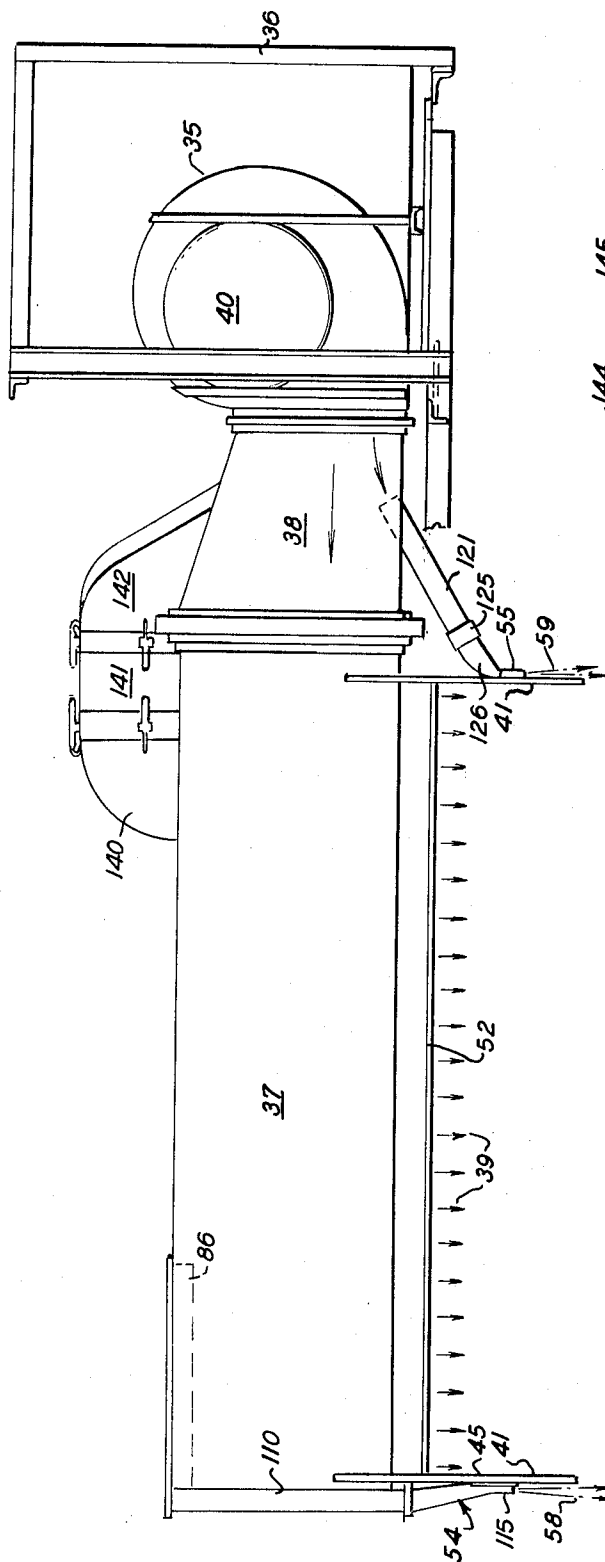
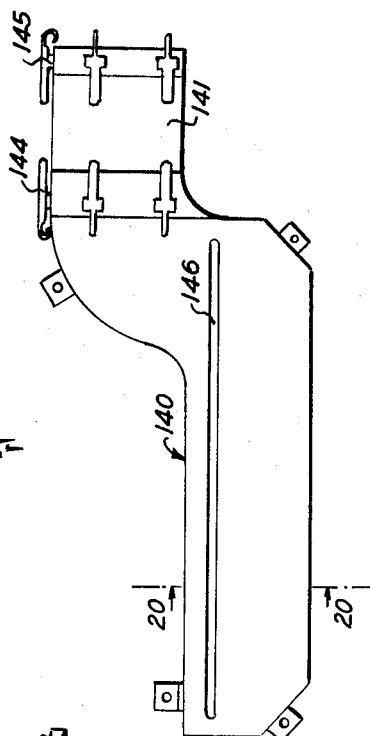


Fig. 18

Fig. 19

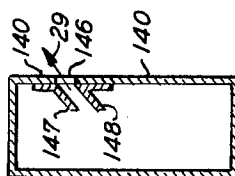


Fig. 20

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METHOD AND APPARATUS FOR REDUCING AIR INFILTRATION INTO ELECTRIC ARC FURNACE DURING THE CHARGING AND MELTING OPERATION

BACKGROUND OF THE INVENTION

The invention relates to a method and apparatus for restricting the entry of surrounding air into an electric arc furnace during the steelmaking process and, more particularly, whenever the door is open for furnace operations such as charging, taking tests, slag removal, etc.

In the process of making steel in an electric arc furnace, it is a routine practice to charge alloying metals, fluorspar, lime, coke, and other materials into the furnace for melting several times during the melting process until the desired volume of molten steel is obtained. Such charging is frequently accomplished through a side opening having a door or multiple doors which can be raised and lowered to expose or cover the opening. During this period a considerable amount of air enters through the charging opening into the furnace where it both mixes with and, in part, displaces the heat atmosphere therein. Such air so introduced into the furnace has a number of adverse effects. It invariably creates a large volume of fumes and smoke which in turn requires expensive air cleaning equipment. Moreover, a considerable amount of fumes escape through the electrode holes in the roof, and such fumes are not normally processed through the cleaning apparatus. The arc electrodes are oxidized in part by such air and their effective operating life is thereby reduced. The intense heat from the interior of the furnace renders the task of the steelworkers connected with the charging operation a difficult one. In addition, there is, of course, a significant heat loss due to the entry of the much colder outside air into the furnace and the temperature over the unmelted metal and molten bath is reduced and is less uniform than might be desired.

Although electric arc furnaces are not a new development and have been undergoing constant improvement, the above problems have not been successfully overcome. One method which has been tried, but which has not proved fully satisfactory, is known in the art as the "Russian cooler" wherein a circular conduit is provided around the electrodes which flows air into the roof holes. Another system is to provide a hood over the charging opening for collecting fumes and dust from the furnace when the charging door is open and from around the electrodes. Although these methods assist in preventing contamination of the surrounding air due to leakage around the electrodes and through the charging opening, the overall air and gas control of an electric arc furnace during charging operations has, for many years, left much to be desired.

SUMMARY OF THE INVENTION

It was conceived by the inventor that an improved air and gas control system for an electric arc furnace might be obtained by providing an air curtain over the charging opening when same was uncovered. However, theoretical considerations did not encourage experimentation along these lines. For example, although it is considered advantageous to incline an air flow towards the warmer air where an air curtain is used to divide cooler and warmer air, the structure of an electric arc furnace appeared impractical for this approach. Also it was noted that numerous problems arise with air screening where the temperature differentials are as little as 100° F. or less. The same is true where pressure differentials exist. But, with an electric arc furnace relative extremes exist both as to temperature and pressure differences. Still further, the intense radiation which emanates from an electric arc furnace through the charging opening would be likely to damage most known mechanisms for producing an air curtain. Perhaps, more importantly, in considering known formulas for heat transfer coefficients in this type of apparatus, it seemed that the depth of the curtain required would have to be much larger than practicable.

It occurred to the inventor that the foregoing problems might be overcome by providing a total screening system for

the charging opening which would include its upper and side exposures and, at the same time, maintaining the interior of the arc furnace at somewhat less than atmospheric pressure to restrict leakage to the surrounding atmosphere around the openings for the electric arc electrodes. By so doing, it has been learned that a number of important operational and mechanical advantages are obtained. Thus the volume of exhaust gases are substantially reduced. A decrease in volume of exhaust gases which must be cleaned means that the air cleaning equipment can be smaller than would be otherwise required. Also, the fumes and gases escaping through the electrode holes in the roof are greatly reduced in volume because with a subatmospheric pressure inside the furnace, the air flow being normally into the furnace through these holes. Due to the reduced volume of oxygen which enters the furnace atmosphere, oxidation losses to the arc electrodes are reduced, thus providing a savings in the electrode consumption rate per ton of steel produced. Also, it has been found that the air curtain acts as an efficient heat barrier, although of course not a total barrier, and this materially improves the working conditions for the melting crew at the furnace door. The air screen also reduces the draft conditions inside the furnace which creates a more balanced temperature over both the unmelted metal and molten bath and results in more uniform melting. Still further, the power consumption for any given melt is reduced and the efficiency of the furnace is thereby improved. The advantages of the system are substantially greater than anticipated and are considered to have important ramifications in the steel industry insofar as environmental control and steelmaking efficiency are concerned.

Other objects, adaptabilities and capabilities of the method and apparatus of the invention will be recognized by those skilled in the art as the description progresses, reference being had to the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a front elevational view of an electric arc furnace which has been provided with air curtain apparatus in accordance with the invention;

FIG. 2 is a fragmentary side sectional view showing an electric arc furnace provided with apparatus in accordance with the invention and with the charging door drawn upwardly to expose the charging opening into the furnace;

FIG. 3 is a side sectional view showing the support and nozzle guard mechanism for the air curtain box;

FIG. 4 is a top view taken on section lines 4—4 of FIG. 3 showing the nozzle guard components;

FIG. 5 is a front elevational view showing the principal air curtain housing;

FIG. 6 is a plan view of the apparatus shown in FIG. 5;

FIG. 7 is a side elevational view of the apparatus shown in FIGS. 5 and 6;

FIG. 8 is a front elevational view of the air curtain nozzle assembly;

FIG. 9 is a fragmentary plan view of the assembly shown in FIG. 8;

FIG. 10 is a side elevational view of the air curtain assembly which also includes the heat reflectors;

FIG. 11 is a front elevational view of a heat reflector for the nozzle assembly;

FIG. 12 is a side view showing the duct and nozzle arrangement producing one of the side air curtains;

FIG. 13 is a front elevational view of the apparatus shown in FIG. 12;

FIG. 14 is a front elevational view showing the arrangement of the duct and nozzle assembly for producing the other side air curtain;

FIG. 15 is a plan view of the apparatus shown in FIG. 14;

FIG. 16 is a side elevational view of the apparatus shown in FIGS. 14 and 15;

FIG. 17 is a top plan view showing the air curtain housings, and the duct and blower arrangement as mounted on the electric arc furnace;

FIG. 18 is a front view of the apparatus shown in FIG. 17;

FIG. 19 is a front sectional view of the rear housing for producing the air curtain taken on lines 19—19 of FIG. 17; and

FIG. 20 is a sectional view taken on lines 20—20 of FIG. 19.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to FIG. 1, an electric arc furnace 25 of, say, 150 ton capacity, has a charging opening 26 which is covered by a furnace door 27 adapted to be moved vertically for exposing opening 26. Three electric arc electrodes 30 are received in the furnace 25 through apertures 31 in roof 32. Apertures 31 are not completely filled by the electrodes 30. Thus, some leakage may occur into or out of furnace 25 around electrodes 30 where they enter the roof 32 through such apertures 31. In conventional furnace arrangements, such leakage occurs when the furnace door 27 is raised to expose opening 26 for charging and other purposes. A dust collection pickup port 22 is provided to vent furnace 25. It leads to a fume collection system which includes an exhaust fan. Furnace 25 together with the associated equipment mentioned above are conventional and generally widely known in the steel industry. Therefore, it is not considered necessary to describe them in greater detail to enable a person skilled in the art to understand and use the invention.

In accordance with the invention, an air curtain apparatus 34 is arranged to provide an air curtain 39 which, together with partitions and other cooperating air curtains, acts to preclude the substantial introduction of air into furnace 25 through opening 26 when door 27 has been raised as shown in FIG. 2. Also, as it is the usual practice to maintain apparatus 34 in operation during the steelmaking process, apparatus 34 prevents leakage around door 27 and through wicket hole 23 when door 27 is closed, such air leakage being significant. Apparatus 34 comprises a fan 35 supported by a framework 36 which moves air to the air curtain housing 37 and auxiliary ducts as will be describe hereinafter, via the main air duct 38. Fan 35 is preferably capable of generating 8,200 cubic feet per minute at 1,432 RPM. It is propelled by a 10-horsepower motor 40 connected thereto by belts or other appropriate drive means.

A pair of side support partitions 41 are connected to the framework 42 of furnace 25 by means of brackets 44. Each partition 41 includes a forward extension 45. A guard plate 46 and a pair of bars 47 and 48 extend between and connect extensions 45 of each partition 41. Bars 47 and 48 carry a plurality of cylindrical rollers 50 and 51 which function to protect air directing means comprising a nozzle 52, which leads from the air curtain housing 37, from damage from the charging of material into furnace 25 through opening 26 by means of the charging truck 24 as shown in dot-dash lines in FIG. 2.

Air curtain housing 37 is carried by extensions 45 and nozzle 52, extending downwardly therefrom, is surrounded by the partition portions which constitute extensions 45 on two sides and by the rollers 50 and 51 on the other two sides.

As may be seen in FIG. 1, a pair of further air directing means comprising side nozzles 54 and 55 are provided in the air curtain apparatus 34. Side nozzle 54 which produces a side air curtain 58 extends from air curtain housing 34, and side nozzle 55 which produces a side air curtain 59 extends from main air duct 38 which connects housing 37 with fan 35.

The construction of air curtain housing 37 is disclosed in more detail in FIG. 5, 6 and 7. Thus, it will be noted that a flange 57 is provided about the end of housing 37 which is adapted to receive the main air duct 38. Four side plates 60, 61, 62 and 63 are connected by four angle bars 64, 65, 66 and 67 and an end plate 70 to form the parallelepiped shaped housing 37. The bars 64, 65, 66 and 67 are secured directly to flange 57 by welding or other suitable means. Plate 62 is secured on one end to flange 57 and on the other to end plate 70. Three vanes 74, 75 and 76, function to guide air entering through the flange 57 into nozzle 52. Vanes 75 and 76 are each secured on their lower ends to bars 66 and 67, and at

their upper ends to pairs of threaded adjustable rods 80 and 81, respectively. On their upper ends, rods 80 and 81 are received by brackets 82 which are welded to plate 60. Proper adjustment of vanes 75 and 76 is provided by adjustment nuts 84 and 85, which are threadably received by rods 80 and 81 respectively. The purpose of such adjustment is to insure that an even uniform flow of air is provided throughout the length of nozzle 52. Vane 74 is connected on its lower end to the bars 66 and 67 and on its upper end to plate 60 and angle bars 64 and 65. A duct 86 leading to side nozzle 54 is received through vane 74. Additional or supplementary vanes may be used as desired.

On the rear of the side plate 61, an upwardly inclined nozzle 87 is provided which extends along the entire width of housing 37. Nozzle 87 comprises an inclined plate 90, which is secured to the interior of plate 61 and extends through a slot 91, and an angle bar 92 which is secured on the outside of side plate 61 and extends parallel to the inclined portion of plate 90. A small opening 94 is provided in vane 74 in the vicinity of slot 91 so that moving air is supplied to nozzle 87 to the windward of vane 74.

A pair of lifting eyes 95 are welded to the top of plate 60 in order to provide lifting means for the air curtain housing 37.

A continuous slot 98 is provided between plate 62 and bar 66 for the receipt of main nozzle 52.

As may be seen in FIG. 10, nozzle 52 comprises a pair of support plates 96 and 97 which are secured to plate 62 by bolts 100 and to bar 66 by bolts 101. As shown in FIG. 5, bolts 100 are spaced along the length of plate 62 and, together with bolts 101, are adjacent to slot 98 which receives nozzle 52. Bolts 100 are received in apertures or channels 103 spaced along support plate 96 and bolts 101 are received in like apertures or channels 103 spaced along support plate 97 so as to secure same in place whereby the downwardly inclined portions of support plates 96 and 97 extend through slot 98. Plates 96 and 97 carry between them a plurality of tubes having a square cross section as shown in FIG. 9, individual tubes being designated 102. Tubes 102 are also received between plates 104, only one of such plate 104 being shown in FIG. 9. Spaced from the sides of portions of tubes 102 extending below plates 96 and 97, are a pair of radiation shields or reflector parts 105 and 106. These parts are substantially identical except that part 105 is inclined at an angle of about 105° relative to its upper part 108. A side view of part 106 is shown in FIG. 11 and it will be noted that expansion means comprising expansion slits 107 to prevent warping of part 106 are provided approximately every six inches along part 106, such slits being approximately one-thirty-second of an inch in width. Also channels or apertures 103a which correspond to channels 103 are provided in part 106. The function of reflector parts 105 and 106 is to protect the nozzle 52 and particularly tubes 102 from the intense heat radiation which emanates from the charging opening 26 when furnace door 27 is opened and when molten slag or the like may be discharging through opening 26. It will be noted from FIG. 2 that air curtain 39 is inclined away from opening 26. Due to the pressure differential within and immediately outside of furnace 25, the curtain is slightly curved towards the opening 26.

Side nozzle 54 is shown in greater detail in FIGS. 12 and 13. Thus, it will be noted that horizontal duct 86 connects with a vertical duct 110, a curved vane 111 being provided at the junction of ducts 86 and 110. Vertical duct 110 extends downwardly along end plate 70 to the lower part of air curtain housing 37 where it is inclined inwardly towards extension 45 of partition 41. In this area the duct 101 becomes wider as seen from the side and at the same time narrows as seen from the front to the position where it is secured by a backing plate 112 to extension 45 of partition 41 by means of bolts 114. A vertical side nozzle comprising a plurality of rectangular tubes 115 are secured so as to extend from the interior of the lower portion of vertical duct 110 to provide the side air stream curtain 58 which departs from tubes 115 along the lower horizontal portion of extension 45. A pair of angle bars 117 secured to

plate 70 function to clamp and secure the vertical duct 110 to the plate 70. A rectangular flexible connection tube 120 is included in the vertical duct 110 for joining the upper and lower portions thereof. Nozzle 54 and particularly tubes 115 are so located as to provide a downwardly directed stream of air, side air curtain 58, which is adjacent to and at right angles with respect to the air curtain 39.

On the other side of housing 37, as seen in FIGS. 14-16, side nozzle 55 comprises a duct 121 which enters the main air duct 38 through an opening 122 and is supported in its inclined position by a hanger 124 connected to the bottom of duct 38. Duct 121 includes a flexible joint 125 and an enlarged curved portion 126. Portion 126 includes a plurality of vertically disposed tubes 127 which are rectangular in cross section and direct a side air curtain 39 and perpendicular to the width of air curtain 39. Portion 126 is secured to a plate 130 which in turn is fastened to extension 45 of partition 41 by means of bolts 13.

From FIG. 18, it will be appreciated that fan 35 moves air into duct 38 with a part of such air being intercepted by duct 121 and directed downwardly as side curtain 59 by nozzle 55 forward of and adjacent to partition 41. Air entering housing 37 is guided by vanes 74, 75 and 76 to where it is directed downwardly by nozzle 52 to create air curtain 39, with however, a small portion of such air being received into ducts 86 and 110 and directed downwardly by nozzle 54 forward of partition 41, whereby such partition 41 has a curtain of air 58 extending forwardly thereof approximately in the same plane of the partition.

Referring again to FIG. 2, a deck 132 is provided adjacent furnace 25 somewhat lower than 2 feet under the hearth line 134. Immediately adjacent furnace 25, deck 132 is open at a location 135 so that the air curtain 39 dissipates itself in the space under deck 132 and furnace 25. The same applies with respect to air curtains 58 and 59 directed forward of partitions 41 by side nozzles 54 and 55.

As previously indicated, nozzle 87 provides an air curtain or barrier 28 between the housing 37 and door 27 when it is in a raised position. A further air curtain or barrier 29 is obtained from a rear housing 140 which is connected to main duct 38 via an intermediate duct 142 and removable duct portion 141, the portion 141 being connected to housing 140 by connecting hooks 144 and to the intermediate duct 142 by further connecting hooks 145. As shown in FIGS. 17 and 19, housing 140 is disposed to the rear of door 27 and includes a slot 146 which includes along its length, interior guide vanes 147 and 148, as shown in FIG. 20, through which a curtain of air 29 is directed towards door 27 when it is in an opened position above opening 26. Intermediate duct 142 connects into the side of a duct 38 in a manner so as to receive a portion of the air stream generated from fan 35 and convey same to housing 140 from whence it is discharged through slot 146. Duct portion 141 is removable for the purpose of pipe line maintenance.

From the foregoing, it will be appreciated that a curtain or barrier of flowing air is created at five locations about the opening 26 in order to isolate from each other insofar as practical, the atmosphere inside and outside the furnace 25 when same is in operation. These consist of the main air curtain 39 and side air curtains 58 and 59 which together create a moving air barrier in front of the opening 26, and air curtains 28 and 29 on either side of door 27 (in raised position) so as to restrict the movement of relatively cold atmospheric air from entering the interior of furnace 25 through opening 26 along the sides of door 27. In the arrangement disclosed, these directed air streams effectively restrict any significant movement of air into or out of furnace 25 even though molten steel at above 2,800°F. is contained within furnace 25.

In operation, furnace 25 is charged with scrap metal. Door 27 is closed when the initial charging is taking place. Thereafter, electrodes 30 are lowered and the scrap is melted within furnace 25 bringing the temperature of the molten metal to above 2,800°F. Thereafter, further material is

charged into furnace 25 by truck 24. However, before raising door 27 to expose opening 26, motor 40 is energized and fan 35 delivers air into housing 37 via the main air duct 38, into the rear housing 140 via ducts 14 and 142 and to the side nozzles 54 and 55 via ducts 110 and 121. Accordingly, air curtains 28 and 29, 30, 58, 59 are created which, as indicated previously, provide in combination an effective barrier between the atmospheres inside and outside furnace 25. As a matter of practice, apparatus 34 is maintained in operation continuously. Among other things, this eliminates the need for a cover on wicket hole 23 and effectively seals any gaps around door 27. The interior of furnace 25 is vented through port 22 and maintained at an absolute pressure slightly less (about -0.05 inches watergauge) than that of the surrounding atmospheric pressure. In the absence of apparatus 34, this differential would not be maintained. Except for the operation of air curtain apparatus 34, the opening of door 27 would normally be followed by a substantial incursion of outside air into furnace 25 through opening 26. Such incursion increases the oxidizing capacity of the atmosphere within furnace 25 and, in addition, creates in practice a substantial amount of fumes and smoke which are vented to the atmosphere. Also, a certain cooling effect occurs which must be compensated by additional heating by arcs from electrodes 30. With the incursion of air into furnace 25 in conventional furnaces, the absolute pressure inside and outside the furnace are at first equalized, but as the now cooler air within furnace 25 is heated, pressure in furnace 25 may exceed that of the atmosphere and such situation is conducive to the escape of gas and fumes through apertures 31 around electrodes 30 which, in turn, tends to contaminate the air in the operating area around furnace 25. However, with the air barrier created by apparatus 34, not only is this local contamination absent, but also the air curtains in front of opening 26 tend to act as partial barriers to the intense heat from furnace 25 which improves the operating conditions around the furnace to a significant extent. Furnace 25 does not emit fumes when door 27 is opened as was previously the case when charging furnace 25. Thus, by utilization of apparatus 34, each opening of door 27 is accomplished without the contamination of the local area with smoke and fumes as before and without substantial incursion of the oxidizing surrounding atmosphere into furnace 25 and the attending heat losses. The reduction of oxidizing gas within the furnace extends the life of the electrodes and the entire operation is more efficient with the substantial reduction of contaminating exhaust gases which were produced prior to use of the invention.

It is believed that the instant invention provides the only economically practicable method to prevent air contamination from large electric arc furnaces of the surrounding atmosphere when the charging door is opened. Otherwise, the absolute pressure seems inevitably to increase within the furnace to above the surrounding atmospheric pressure immediately upon opening of the charging door.

In cooperation with port 22 and associated exhaust apparatus, the invention facilitates techniques of the feeding of iron bearing material through an opening in the furnace roof to the extent it assists in the maintenance of a subatmospheric pressure in the furnace and otherwise improves the steelmaking environment within the furnace.

It will be appreciated by those skilled in the steelmaking art, that through use of the instant invention, the carbon reduction rate is reduced. Also, the amount of hydrogen (which may be detrimental to the steel) within the furnace is reduced. The hydrogen enters the furnace as part of the water moisture with cold air, which entering the invention restricts to a substantial degree. Further, the melting rate of the steel making material in the furnace is substantially improved. Thus, the pollution effects of the furnace are materially reduced while at the same time the productivity of the furnace is improved by my invention.

Having thus described my invention, what I claim is new and desire to secure by letters patent of the United States is:

1. The combination of an air curtain for a steelmaking furnace which comprises an opening in said furnace; a door adapted to move vertically disposed in front of said opening; an air curtain housing mounted above said opening; lift means connected to said door for displacing it vertically in front of said opening to between said housing and said furnace above said door; a pair of air directing means included in said air curtain housing; a first of said air directing means directing a first curtain of air in front of said opening, the second of said air directing means directing a second curtain of air into the space between said housing and said door when said door is lifted to a position between said housing and said furnace; and blower means supplying air to said air directing means.

2. The combination of claim 1 where a further air curtain housing is provided, said further housing mounted above said opening between said furnace and said door when said door is lifted to a position between said first mentioned housing and said furnace, third air directing means included in said further housing directing a third curtain of air into the space between said furnace and said door when said door is lifted to a position between said first mentioned housing and said furnace.

3. A combination of claim 1 wherein further air directing means are provided to direct a pair of air curtains between the outer vertical edges of said first curtain of air and said furnace adjacent both sides of said opening.

4. The combination of claim 1 wherein said first air directing means comprising a nozzle extending below said first mentioned housing, the longer sides of said nozzle extending horizontally substantially parallel to said door.

5. The combination of claim 4 wherein a pair of radiation guards are provided on both of the longer sides of said nozzle.

6. The combination of claim 5 wherein said radiation guards are provided with heat expansion means whereby said guards are not warped by heat radiations from molten steel and molten slag.

7. The combination of claim 1 wherein said furnace contains molten steel having a temperature in excess of 2,800°F.

8. The combination of claim 7 wherein the gas contained in said furnace has a negative pressure relative to the concurrent atmospheric pressure surrounding said furnace.

9. A method of reducing air infiltration from the surrounding atmosphere into an operating electric arc furnace when the furnace door is opened which comprises screening said opening by directing a downward air flow across the entire width of said opening, and with said furnace door being raised above said opening and spaced between the source of said downward air flow and said furnace, screening both sides of said door in its raised position by directing a pair of air flows against said door, one of said air flows screening space

between said door and said furnace and the other of said air flows screening space between said door and the source of downward air flow.

10. The method of claim 9 wherein a further pair of downward air flows are directed adjacent the lateral limits of said first mentioned downward air flow and adjacent said furnace.

11. The method of claim 9 wherein said downward air flow is directed so as to be inclined outwardly relative to said furnace.

12. A method for reducing air pollution from exhaust gases of an electric arc furnace while charging steelmaking material through an opening into the furnace during the steelmaking process which comprises establishing and maintaining gases in the interior of said electric arc furnace at a pressure less than the surrounding atmospheric pressure and screening said charging opening by directing an air flow across the entire width of said opening whereby the introduction of air into said furnace is minimized and the generation of fumes and dust from air so introduced is substantially eliminated.

13. A method in accordance with claim 12 wherein said air flow is directed in a downwardly direction.

14. A method in accordance with claim 13 wherein said air flow is directed so as to be inclined outwardly relative to said opening.

15. A method in accordance with claim 13 wherein a pair of further air flows are directed downwardly between said furnace and said first mentioned air flow.

16. A method in accordance with claim 13 wherein the door for said opening is pulled upwardly relative to the position of said opening and two air flows are directed against the vertical sides of the door, one said air flow on each side of said sides being substantially parallel to the proximate furnace walls, whereby the introduction of air into the furnace from the vicinity of said wall is substantially restricted.

17. A method in accordance with claim 16 wherein the directions of said two air flows are inclined upwardly towards said sides.

18. A method of reducing air infiltration from the surrounding atmosphere into an operating electric arc furnace which comprises screening the charging door of said furnace with a curtain of air to prevent significant leakage of atmospheric air into said furnace around said door, and at the same time exhausting said furnace to maintain the absolute pressure of the gas within said furnace less than that of the atmosphere immediately outside said furnace.

19. The method of claim 18 wherein said difference is about 0.05 inches watergauge.

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