May 7, 1968 D. BEGGS 3,381,947

FURNACE VESTIBULE HAVING A MOVABLE CEILING

Filed Sept. 20, 1965 2 Sheets-Sheet 1

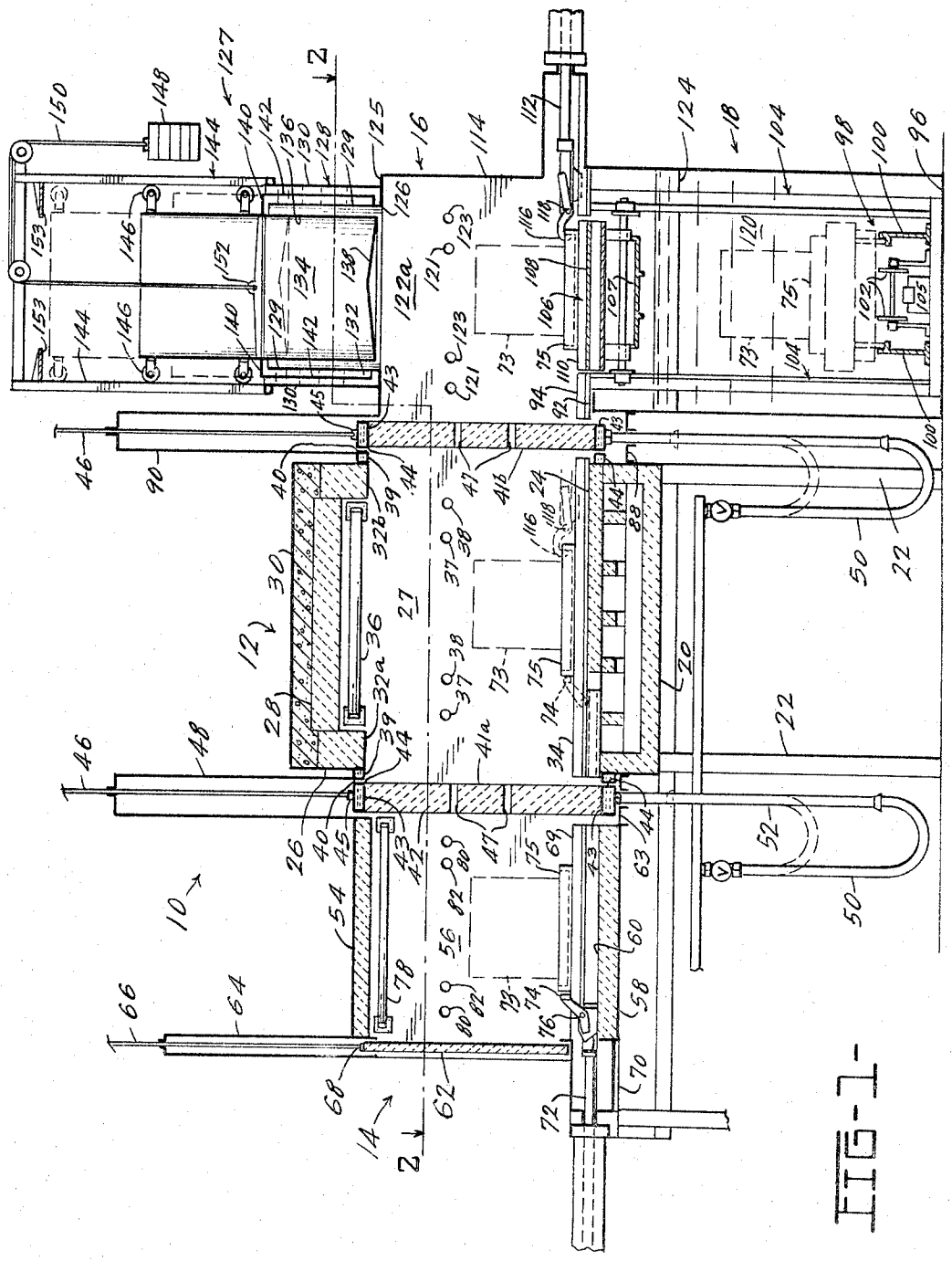


FIG-1-

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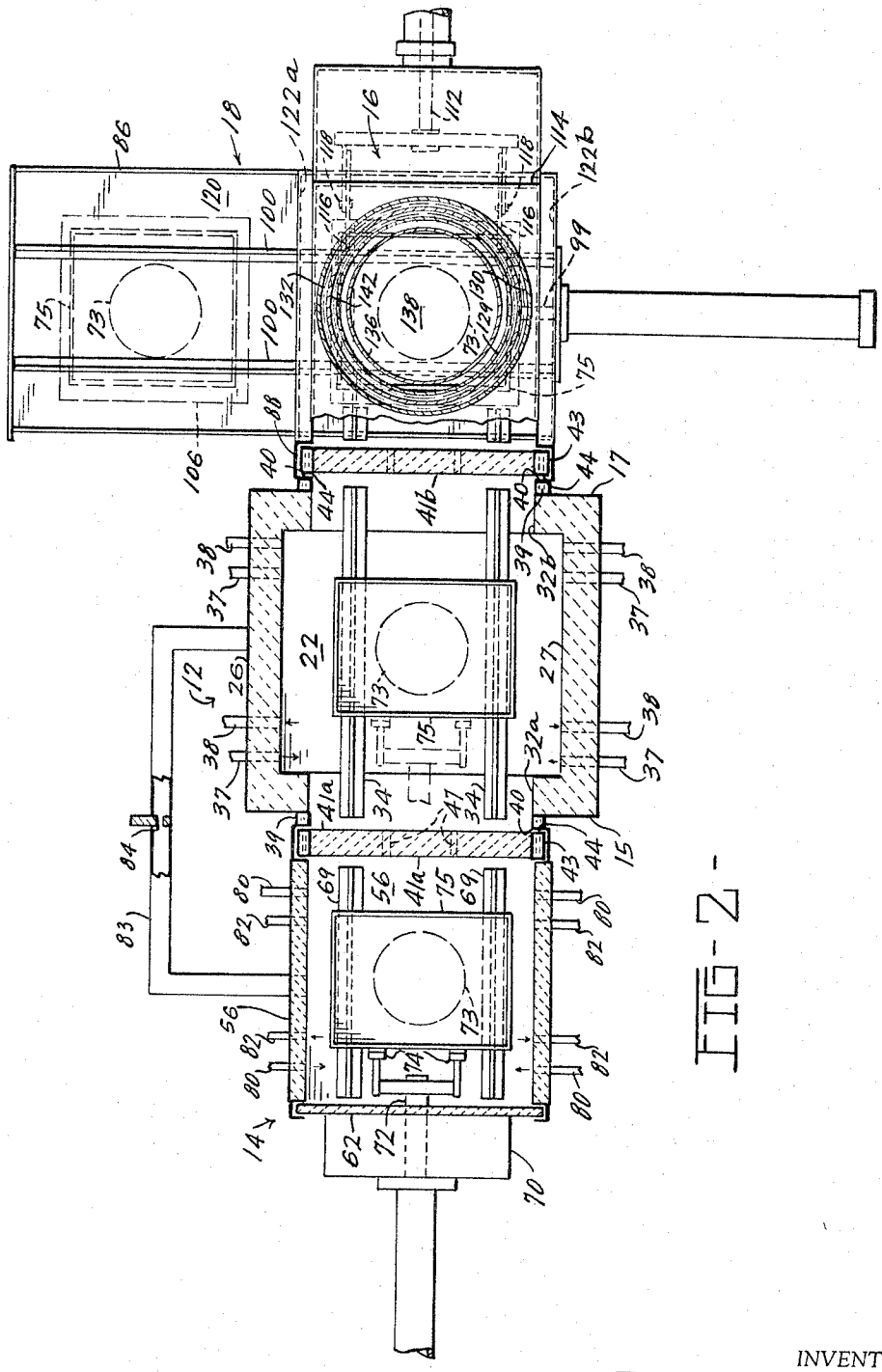


FIG-2-

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FURNACE VESTIBULE HAVING A MOVABLE CEILING

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ABSTRACT OF THE DISCLOSURE

This disclosure relates to furnace vestibules, and more particularly to furnace vestibules having means for maintaining a predetermined gas pressure therewithin, whereby inert gases contained within the vestibules can be subjected to a wide range of temperatures without such gases being lost to the atmosphere. In an embodiment disclosed herein a furnace vestibule is provided with a ceiling having a movable portion that is responsive to pressure changes. As the gases within a vestibule tend to expand when heated, the movable portion will respond to the change in pressure and increase the volume of the vestibule, until such time as an equilibrium is achieved. Conversely, when the gases tend to contract due to cooling, the movable portion will move in the opposite direction to decrease the volume of the vestibule and maintain a constant pressure therein. Thus, a means is provided to prevent loss of furnace atmosphere when gases expand in the vestibule and to prevent the drawing in of air when gases contract therein.

In most heat treating furnaces it is necessary to maintain a non-oxidizing atmosphere during the heat treating of a workpiece or load. Rather than charge the load directly into the furnace, or discharge the load directly into the atmosphere, means, such as a vestibule, is usually provided whereby the load may be in a non-oxidizing atmosphere before being placed into and after removal from the heating chamber of the furnace, so that when the chamber door separating the vestibule from the heating chamber is opened for charging or discharging of the load, no air enters the heating chamber. A non-oxidizing gas is usually supplied directly to the heating chamber and the door of the heating chamber may be provided with an aperture so that a portion of the non-oxidizing gas is diverted to the vestibule, or the gas may be supplied to the vestibule through a by-pass means connecting the vestibule to the heating chamber.

Throughout the heat treating cycle, the gas within the vestibule experiences pressure changes due to a variation in temperature. This is particularly true when the chamber door is opened and the gas in the vestibule is quickly heated. At this time, the gas in the vestibule expands and a portion of it escapes into the atmosphere either through cracks or small openings in the vestibule or through vent means provided for release of pressure build-up. After the aforementioned door is closed, the pressure in the vestibule drops, as a result of the decreased temperature, and air is drawn into the vestibule through the same cracks and small openings. Because of the presence of air in the vestibule, when a load is transferred from the same to the heating chamber, a small portion of air also enters the latter. In most heat treating processes, the presence of a small amount of air is not harmful and the atmosphere of the heating chamber can be controlled to accommodate this small amount of air; however, present day heat treating specifications are becoming increasingly stringent with respect to controlled atmosphere requirements so maximum physical properties in the final product may be attained. To meet these more stringent requirements, it is

sometimes necessary to utilize an inert atmosphere with a virtually complete absence of air during heat treating. In order to maintain a controlled atmosphere within the heating chamber, it is necessary to maintain a like atmosphere in the vestibule. If inert gas is lost from the vestibule each time the chamber door is opened, the cost of supplying the inert gas would be high, particularly if the inert atmosphere were argon. It would be desirable from an economics point of view to retain all the inert non-oxidizing gas within the vestibule no matter what temperature variation may occur therein.

It is, therefore, an object of this invention to provide a furnace with a vestibule wherein the atmosphere within the vestibule can be subjected to a wide range of temperatures without such gases being lost to the atmosphere.

It is another object of this invention to provide a furnace vestibule with a unique ceiling.

It is still another object of this invention to provide a ceiling which is responsive to pressure variation.

It is a further object of this invention to provide a vestibule for a furnace wherein at least one of the walls of the vestibule is pressure responsive so that the volume within the vestibule is variable.

It is a still further object of this invention to provide a furnace vestibule capable of increasing its volume as the temperature of the atmosphere therein increases, thereby maintaining a constant gas pressure therewithin.

In the drawing:

FIG. 1 is an elevated sectional view of a furnace embodying the principles of the invention.

FIG. 2 is a plane view of the furnace shown in FIG. 1 taken along the line 2—2.

In one embodiment of this invention, a furnace is provided with a vestibule so that a non-oxidizing atmosphere may be maintained within the heating chamber of the furnace as a load is charged into or out of the furnace. The vestibule is provided with a floating roof which is supported by liquid sealing means. When the temperature of the atmosphere within the vestibule rises as a consequence of a furnace door being opened, the roof rises in its seal, as a result of thermal expansion of the gases, to increase the volume of the vestibule and maintain a constant pressure therein. After the furnace door is closed, the temperature of the vestibule atmosphere decreases and the floating roof descends to decrease the volume, thus assuring that no leakage of air into the vestibule occurs and negating the necessity of having to supply additional gas.

Referring now to the drawing, a furnace embodying the principles of this invention is shown generally at **10** and comprises a heating chamber **12**, an entrance vestibule **14** attached to one longitudinal end **15** of the heating chamber, an exit vestibule **16** attached to the other longitudinal end **17** of the heating chamber, and a quench tank **18** disposed immediately below and extending laterally from the exit vestibule.

The heating chamber **12** has a refractory lining **20** supported by a base **22** upon which lining a refractory floor **24** is disposed. Extending upwardly from the base **22** and formed with the ends **15** and **17** are transversely extending side insulating walls **26** and **27**. The enclosure of the heating chamber **12** is completed by an arched roof **28** of refractory brick with a concrete covering **30** thereover. The end walls **15** and **17** have openings **32***a* and **32***b*, respectively, therein, which openings provide ingress and egress to the heating chamber **12**. Longitudinally extending on the chamber floor **24**, substantially between the openings **32***a* and **32***b*, is a pair of rails **34**, each rail being spaced and extending parallel to the other.

The means for supplying heat to the heating chamber consists of electrical heating elements **36** (only one ele-

ment being shown) which extend longitudinally along the inside surface of the side walls 26 and 27; however, any means for supplying heat may be employed as long as the atmosphere of the heating chamber is not contaminated by the type of heat source employed. The atmosphere of the heating chamber 12 is controlled by gas inlets 37 and gas outlets 38 extending through the side walls 26 and 27.

Attached to the outside of each end 15 and 17 and about each opening 32*a* and 32*b* is a hollow metal casing 39 having a smooth outwardly exposed surface 40. Disposed outwardly of openings 32*a* and 32*b* are vertically slidable doors 41*a* and 41*b*, which doors separate the heating chamber 12 from the entrance vestibule 14 and exit vestibule 16, respectively. The doors 41*a* and 41*b* are made of insulating bodies 42 having hollow metal frames 43 about the peripheries thereof. The inward facing 44 of the door frame 43 is smooth and adapted to engage the outside surface 40 of the metal casing 39 when the doors 41*a* and 41*b* are in their lowest vertical position, thereby sealing the openings 32*a* and 32*b*. Extending through the doors 41*a* and 41*b* are apertures 47 that provide means for gas to pass through the door.

Attached to the top of the door frames 43 are brackets 45 to which one end of lifting rods 46 are secured. The other end of the lifting rods 46 is engaged by means providing the necessary power to lift the door (the opposite end of the rods and the power means not being shown). The power means may be an electric motor, an air cylinder, or any other convenient means. Disposed above the door 41*a* and sealingly connecting the heating chamber 12 and the entrance vestibule 14 is a metal hood 48 which acts as a guide for the door 41*a* as it is raised or lowered, as well as contributing to the seal of the furnace 10. Attached to the lower ends of the door frames 43 are flexible water lines 50 which communicate with the hollow interior of the door frames. Each water line 50 is slidably received within a protective sheath 52 and is able to move with the doors 41*a* and 41*b* as the latter are raised or lowered. Thus, means is provided to circulate cooling water through the door frames 43 to maintain the same at a relatively uniform temperature and prevent warpage of the door frames which would be caused by temperature fluctuation and lead to the loss of seal between the door frame and the metal casing 39. Means (not shown) is also provided for water cooling the metal casing 39 for the same reason.

Sealingly attached to one longitudinal end 15 of the heating chamber 12 is the entrance vestibule 14, comprising an insulating roof 54, a pair of longitudinal insulating side walls 56, a base 58 having a refractory floor 60, and a vertically slidable outer door 62. Metal brackets 63 extend between the heating chamber 12 to the walls 56 and base 58 of the entrance vestibule 14 to sealingly connect the vestibule to the heating chamber. Sealingly attached to and supported by the vestibule roof 54 is a guideway 64 which is adapted to receive and guide the door 62 as it moves vertically. One end of a lifting rod 66 is secured to the top of the door 62 by means of a bracket 68 and the other end of the rod is attached to power means for lifting the door (the other end of the rod and the power means not being shown).

Secured to the floor 60 of the entrance vestibule 14 is a second pair of rails 69 which is longitudinally aligned with the first pair of rails 34 of the heating chamber 12 and extends from the vestibule door 62 to the heating chamber door 41*a*.

Extending outwardly from the base 58 is a member 70 adapted to sealingly support the vestibule door 62 and to receive a longitudinal slidable push rod 72 of sufficient length to extend substantially into the heating chamber 12 when the door 41*a* is open. The push rod 72 is disposed intermediate the rails 69 and has at its innermost end a load engaging member 74 rotatably supported by a pin 76. The member 74 is operative to approach a vertical position to extend above the rails 69 when the push rod is moved inwardly toward the heating chamber 12 and it is adapted to assume a horizontal position as the push rod is slid outwardly so as not to extend above the rails. Consequently, the member 74 will engage a load placed upon the rails 69 to charge the same into the heating chamber 12 as the push rod 72 is extended inwardly, but will not engage a load on the rails during an outward stroke of the push rod. As shown in FIG. 1, the load 73 to be processed normally is placed in a tray 75 and the member 74 engages the tray.

Attached to the side walls 56 of the entrance vestibule 14 are a plurality of electrical heating elements 78, and extending through the walls are gas inlet means 80 and gas outlet outlet means 82. In addition, a by-pass means 83 having an orifice 84 therein, provides communication between the heating chamber 12 and the entrance vestibule. Thus, when the vestibule door 62 is closed, the entrance vestibule is sealed from the air, and the temperature and atmosphere within the vestibule may be controlled through cooperation of aperatures 47, gas inlet means 80, gas outlet means 82, and by-pass 83.

At the other end 17 of the heating chamber 12 is the exit vestibule 16 and the quench tank 18. The quench tank 18 is immediately below and communicates with the exit vestibule 16. The quench tank 18 is supported by a base 96 and has a portion 86 which extends laterally, the top of which portion is open to the air. Metal sheeting 88 sealingly connects the exit vestibule 16 to the heating chamber 12, and a hood 90 is supported by the vestibule and the heating chamber to form part of the sealing means therebetween and to slidably receive the door 41*b*.

The exit vestibule 16 has a floor extension 92 having a pair of rails 94 which are aligned with the floor 24 and rails 34, respectively, of the heating chamber 12.

The base 96 of the quench tank 18 supports a laterally extending rail means 98 having a pair of laterally extending rails 100 and a plurality of wheels or rollers 102 extending laterally in a longitudinally paired relationship. A framework 104 extends from the base 96 to the bottom of the exit vestibule 16 and is adapted to receive an elevator car 106 which is operative, by means of a hydraulic motor 105, to move vertically within the framework and operative to be moved laterally upon the rail means 98 by means of a push rod 99. The elevator car 106 includes a carriage 107 adapted to rest upon the wheels 102 when the car is in its lowered position and a floor portion 108 having a pair of rails 110 thereupon, which floor portion and rails become aligned with the floor 24 and rails 34, respectively, of the heating chamber 12 when the elevator car is in its uppermost vertical position. The rails 100 are provided to guide the car 106 when the same is pushed on the wheels 102.

A puller rod 112 is sealingly received through the outside wall 114 of the exit vestibule 16 at a position a short distance above and intermediate the paired rails 110. The rod 112 is adapted to extend longitudinally into the heating chamber when the door 41*b* is open and has, depending vertically from its inside end, a load engaging member 116 rotatably supported by a pin 118. The engaging member 116 is operative so that it is able to rotate counterclockwise when met by an object, but it will not move from the horizontal position in a clockwise direction. Thus, as the rod 112 is extended into the furnace 10, it is high enough to clear a tray 75 placed on the rails 34 of the heating chamber 12, and the member 116 will engage the edge of the tray to be rotated counterclockwise so that it is able to hook over the edge. As the rod 112 is pulled away from the heating chamber 12, the engaging member 116 will engage the inside of the edge of the tray 75 and pull it therealong.

The quench tank 18 is filled with fluid 120 having low oxygen solubiiity. The longitudinal side wall 122*a* of the exit vestibule 16 adjacent the lateral extending portion 86 of the quench tank 18 extends into the quench tank im-

mediately below the level of the fluid, as indicated at 124, so that air is prevented from entering the exit vestibule. The other longitudinal side wall 122*b* extends downwardly to form a wall for the quench tank. Each wall 122*a* and 122*b* has gas inlet means 121 and gas outlet means 123.

The roof 125 of the exit vestibule 16 has a circular opening 126 therein. Attached to the roof 125 circumpositioned about the opening 126 is an annular vessel 128 comprising a cylindrical inside wall 129 and a cylindrical outside wall 130 which rise substantially above the vestibule roof. The vessel 128 is filled with a fluid 132 having low oxygen solubility, which fluid may be the same as used in the quench tank 18.

Disposed within the center of the annular vessel 128 is a drum shaped ceiling member 134 having a hollow cylindrical portion 136 and a disk portion 138, which disk portion forms part of the ceiling of the exit vestibule 16. A ring 140 is attached intermediate the ends of the cylindrical portion 136 and circumferentially exceeds intermediate the walls 129 and 130 of the vessel 128. Depending from the outside circumference of the ring 140 and into the fluid 132 is a cylinder 142 having a length slightly less than the height of the vessel walls 129 and 130. From the foregoing, it is apparent that the ceiling member 134 is vertically movable but will maintain the gastight integrity of the exit vestibule 16 regardless of the vertical position of the member. Although in this particular embodiment an annular vessel 128 and drum shaped ceiling member 134 are used, it is obvious that any convenient configuration, such as rectangular, may be used without departing from the scope of the invention.

To aid the mobility of the ceiling member 134, a frame 144 is provided to vertically guide the member and prevent it from becoming tilted against the inside vessel wall 129. The ceiling member 134 is provided with frame 144 engaging wheels or rollers 146 to facilitate vertical movement of the member, and a counterweight 148 is connected to the ceiling member through a line 150 attached to a bracket 152. An annular member 153 is secured near the top of the frame 144 to limit the vertical movement of the drum 134.

In the operation of the furnace 10, all the doors 41*a*, 41*b*, and 62 are closed and the heating chamber 12 is raised to the operating temperature through the use of the heating elements 36. When the proper temperature is obtained, an inert atmosphere, such as argon, helium, or the like, is introduced into the heating chamber 12 through the inlet pipes 37 and the chamber is purged in cooperation with the outlet pipes 38. A slight positive pressure is maintained within the chamber 12 and gas flows through apertures 47 into the vestibules 14 and 16.

After the heating chamber 12 is at the proper temperature and has an inert atmosphere, the entrance vestibule 14 is heated to a temperature intermediate room temperature and the temperature of the heating chamber 12. This intermediate temperature of the entrance vestibule is termed the preheat temperature and is used to increase the temperature of the load to be charged to an intermediate point so that it will not experience thermal shock when it is placed into the heating chamber 12. In addition, by maintaining a preheat temperature, a smaller quantity of gas is required to supply an inert atmosphere to the entrance vestibule 14. After the entrance vestibule 14 is raised to the proper temperature by the heating elements 78, the door 62 is opened and a tray 75 containing a first load 73 is placed upon the rails 69. The door 62 is then closed and an inert atmosphere is introduced into the entrance vestibule 14 through utilization of the outlet means 82, in cooperation with the apertures 47 and/or the inlet means 80. At this time an inert atmosphere can also be admitted to the exit vestibule through cooperation of the gas outlet means 123 with the apertures 47 and/or the gas inlet means 121. Sufficient inert gas is supplied to the exit vestibule 16 to provide enough pressure to barely support the ceiling member 134.

With an inert atmosphere in the entrance chamber, the door 41*a* may be opened preparatory to charging the load 73 into the heating chamber 12. With the raising of the door 41*a* and the fact that the temperature within the heating chamber 12 is substantially higher than the temperature of the entrance vestibule 14, there will be expansion of the gases within the vestibule and a portion of the gas may be vented out the outlet means 82. The load 73 is charged into the heating chamber 12 by pushing the push rod 72 inwardly until such time as the load engaging member 74 engages the tray 75 and pushes the same into the chamber. The push rod 72 is then removed from the heating chamber 12 to its outermost position, and the chamber door 41*a* is closed. At this time, the vestibule door 62 is opened and a second load is placed within the entrance vestibule. The vestibule is purged of air by means of the gas inlet 80 and gas outlet 82, after which a small positive pressure of approximately 0.5" W.C. gauge is maintained by means of the by-pass 82 communicating the vestibule 14 to the heating chamber 12. This small positive pressure prevents leakage of air into the entrance vestibule while the first load is being heat treated in the chamber 12.

The charge 73 remains in the heating chamber 12 sufficiently long to complete the heat treating cycle. At this time the elevator car 106 is moved to its uppermost position in the exit vestibule 16 and the ceiling member 134 is in a vertically downward position so that the ring 140 virtually rests on the upper edge of inner wall 129 of the vessel 129, and an inert atmosphere resides within exit vestibule 16. With the completion of the heat treating of the load, the second chamber door 41*b* is opened, and, as a consequence, the temperature of the inert gas within the exit vestibule 16 increases. With the increase in the temperature, the pressure of the inert gas tends to increase due to thermal expansion of the gas. As the gas pressure tends to increase, the sealing member 134 begins to rise to bring an equilibrium in the pressure of the gas within the vestibule 16. More particularly, when the gas is at a given pressure, it will have sufficient energy to overcome the weight of the ceiling member 134 and cause the same to be suspended within the vessel 128. As the temperature of the gas increases, thermal expansion causes the ceiling member to rise until equilibrium is attained between the weight of the member and the pressure of the gas. Thus, the gas pressure within the exit vestibule 16 remains constant as the temperature varies therewithin. The ceiling member 134 will rise in proportion to the change of temperature, but sufficient volume increase is provided within the space defined by the inside wall 129 so that the ceiling member would not be completely lifted out of the vessel 130. As a safety measure, the annular member 153 is provided to restrict the upward movement of the drum. It will be observed that the gases may flow between the ceiling member 134 and the inside wall 129 of the vessel 128 but the presence of the fluid 132 prevents the gas from escaping out of the exit vestibule 16 and into the atmosphere. This same fluid 132 prevents air from passing between the outside wall 130 and the cylinder 129 to enter into the exit vestibule 16.

After the door is opened, the puller rod 112 is extended into the furnace 10 until the engaging member 116 passes over the tray 75. The rod 112 is then pulled back and the engaging member 116 will engage the inside surface of the tray 75, thereby causing the tray to be pulled back along the rails 34 on the base 24. The tray 75 is pulled back along the rails 34, 94 and 110 until such time as it rests substantially in the center of the elevator car 106. At this point, the elevator car 106 with its load 73 is lowered through the framework 104 by the motor 105 until it rests upon the rail means 98 at the bottom of the quench tank 18. As the elevator car 106 is lowered, the tray 75 is disengaged automatically from the member 116, and the charge is quenched as it is lowered into

the fluid 132. The elevator car 106 is thus placed upon the rail means 98 and it can be pushed by the push rod 99 toward the extending portion 86 of the quench tank. From this position the trays 75 may be lifted out of the quench tank and into the atmosphere inasmuch as they have been reduced in temperature sufficiently so that the charge 73 will not be at a temperature where it would oxidize.

With the removal of the load 73 from the exit vestibule 16, the door 41*b* is closed. With the closing of the door 41*b* the temperature of the inert gas within the exit vestibule 16 will reduce substantially, causing a decrease in the pressure of the same. As a consequence, the ceiling member 134 will now fall within the vessel 128, and the ring 140 will approach the top of the inside wall 129. Thus, the exit vestibule 16 has gone through a complete cycle of providing egress means for a charging load from the heating chamber 12, whereby the atmosphere within such exit vestibule has been conserved, and no need has arisen for supplying new atmosphere or for venting any therefrom.

In the first embodiment, a liquid seal in the form of a vessel 128 was used as a means for providing gas expansion. It is obvious that other means may be used equally as well. For example, rather than having a liquid seal, the cylinder 142 and fluid 142 may be replaced by a collapsible and expanding member such as an accordion type structure. In this way the gasses overcome the weight of the ceiling member 136 through thermal expansion as in the example of the liquid seal. The member will provide expanding means for the ceiling member while still maintaining the seal within the vestibule.

Although gas saver 127 was provided in the exit vestibule 16 in the first embodiment, it is obvious that a gas saver of this type may be placed in another part of the furnace and still accomplish the objects of this invention. For example, the gas saver 127 may be placed on the hood 30 of the heating chamber 12 and still maintain a predetermined pressure. The presence of the apertures 47 in the door 41*b* render the heating chamber 12 and exit vestibule 16 confluent to one another, thereby equalizing the pressures therebetween. With this construction, the increase in pressure in the exit vestibule 16, when the chamber door 41*b* is open, would cause the ceiling member 134 to rise in the roof 28 of the heating chamber 12. After the door is closed and the gases within the exit vestibule 16 tend to contract, the gases within the heating chamber 12 would pass through apertures 47 to compensate for the loss in pressure and gas volume in the exit chamber 16. Although it is possible to place the gas saver within the heating chamber 12, this is not preferred because of the complex structure of the heating chamber roof 30 as compared to the ceiling of the exit vestibule 16.

It would also be possible to place the gas saver at a distance from the furnace. For example, an expandable chamber, built in accordance with the principle heretofore described, could be placed at a distance from the furnace and made confluent with the latter through means such as a pipe. In this way the expandable means may be introduced to any part of the furnace without materially interfering with the normal furnace construction.

I claim:

1. A furnace for heat treating a load, comprising first wall means defining a longitudinally extending heating chamber having first and second opening means each at a longitudinal end of said chamber, heating means disposed within said heating chamber, second wall means defining an entrance vestibule contiguous with a longitudinal end of said first wall means and having load access means, load moving means associated with said second wall means operative to move a load from said entrance vestibule through said first opening means and into said heating chamber, third wall means defining an exit vestibule contiguous with the other longitudinal end of said first wall means and having a ceiling with an opening therein, a quench tank contiguous with said exit vestibule and having a liquid therein, said liquid communicating with the atmosphere, load moving means associated with said third wall means and operative to remove a load from said heating chamber through said second opening and into said exit vestibule, means disposed within said quench tank for removing a load from said exit vestibule into said quench tank, receiving means disposed upon said ceiling and circumpositioned about said ceiling opening, a ceiling member slidably disposed within said receiving means in a sealing relationship and sealingly covering said ceiling opening, and means for supplying a nonoxidizing atmosphere to said chamber and to at least one of said vestibules, said ceiling member being operative to slide within said receiving means in response to temperature change of said non-oxidizing atmosphere within said exit vestibule.

2. A furnace for heat treating a load, comprising first wall means defining a longitudinally extending heating chamber having first and second opening means each at a longitudinal end of said chamber, heating means disposed within said heating chamber, second wall means defining an entrance vestibule contiguous with a longitudinal end of said first wall means and having load access means, load moving means associated with said second wall means operative to move a load from said entrance vestibule through said first opening means and into said heating chamber, third wall means defining an exit vestibule contiguous with the other longitudinal end of said first wall means and having a ceiling with an opening therein, a quench tank contiguous with said exit vestibule and having a liquid therein, said liquid communicating with the atmosphere, load moving means associated with said third wall means and operative to remove a load from said heating chamber through said second opening and into said exit vestibule, means disposed within said quench tank for removing a load from said exit vestibule into said quench tank, liquid containing vessel means disposed upon said ceiling and circumpositioned about said ceiling opening, a ceiling member slidably received within said vessel means in a sealing relationship and sealingly covering said ceiling opening, and means for supplying atmosphere to said heating chamber and to said vestibules, said ceiling member being operative to slide within said vessel means in response to temperature change of said atmosphere within said exit vestibule.

3. A vestibule for attachment to one end of a furnace, which end has access means therein, comprising a base attached to the furnace end, a pair of side walls spaced relative to one another and attached to the base and to the furnace end, a back wall spaced relative to the furnace end and attached to said side walls and to said base, vestibule access means associated with said base, a ceiling member attached to the furnace end and to said walls and having an opening therein; an annular vessel disposed upon said ceiling member circumpositioned about said opening and comprising an enclosure forming inner wall and outer wall extending normal to said ceiling member, a fluid contained within said vessel between said inner and outer walls, a drum member slidably disposed within the spaced defined by said inner wall; the bottom of said drum forming a portion of the ceiling of said vestibule, a ring secured to and top circumposing said drum member and extending intermediate said inner and outer walls, a cylinder depending from the perimeter of said ring into said fluid, whereby said drum member is responsive to change in gas pressure within said vestibule and operative to maintain said gas pressure constant.

4. In a furnace, the combination comprising first wall means defining a heating chamber, vestibule defining second wall means contiguous with said first wall means and having first access means thereto, second access means disposed between said first and second wall means, means for supplying a nonoxidizing atmosphere to said first

and second wall means, pressure responsive means associated with one of said wall means and operative to vary the volume of said wall means upon change in temperature of said non-oxidizing atmosphere, whereby said non-oxidizing atmosphere maintains a constant pressure.

5. The furnace of claim 4 wherein said second access means is provided with a movable door.

6. The furnace of claim 5 wherein said movable door has an aperture therein.

7. In a furnace, the combination comprising first wall means defining a heating chamber, vestibule defining second wall means contiguous with said first wall means, a quench tank contiguous with said second wall means and having a liquid therein, said liquid exposed to and sealing said second wall means from the atmosphere, access means disposed between said first and second wall means, means for supplying a non-oxidizing atmosphere to said first and second wall means, pressure responsive means associated with one of said wall means and operative to vary the volume of said one wall means upon change in temperature of said non-oxidizing atmosphere, whereby said non-oxidizing atmosphere maintains a constant pressure.

8. The furnace of claim 7 wherein said second access means is provided with a movable door having an aperture therein.

9. The combination of a furnace and expanding means, comprising first wall means defining a furnace, second wall means defining expanding means and having an opening therein, means creating a confluent relationship between said furnace and said expanding means, said expanding means comprising receiving means circumscribing said opening and movable means sealingly and movably engaging said receiving means to form a seal for said

opening, said movable means being suspended by a selected pressure within said expanding means and being operative to move upon change of pressure within said furnace, thereby changing the volume of said expanding means and restoring said selected pressure within said furnace.

10. The combination of a furnace and expanding means, comprising first wall means defining a furnace, second wall means defining expanding means, and means creating a confluent relationship between said furnace and said expanding means, said expanding means having a pressure sensitive portion operative to vary the volume of said expanding means upon a change in pressure within the latter.

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