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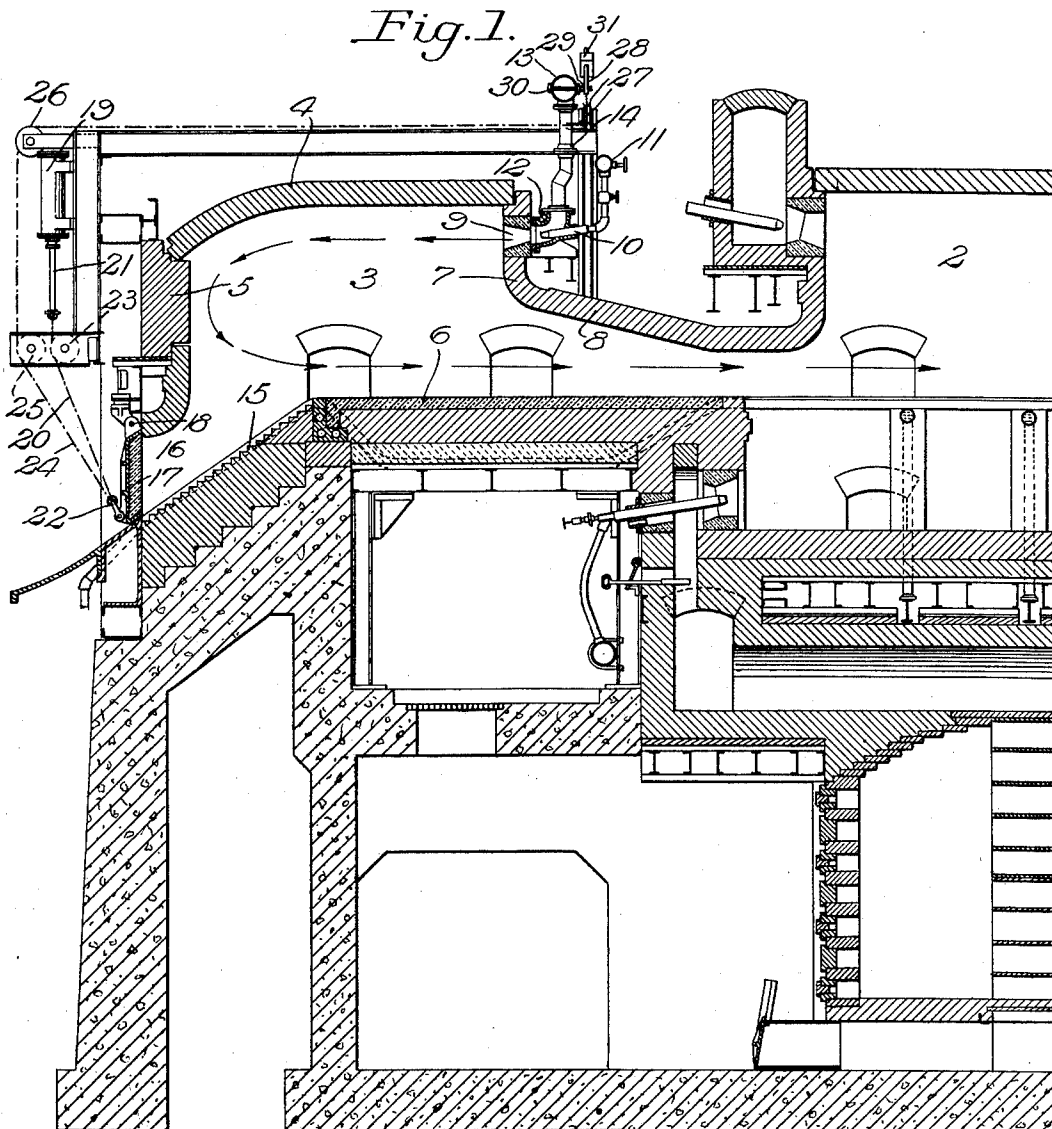
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1,937,812

HEATING FURNACE

Filed Aug. 29, 1931

3 Sheets-Sheet 1



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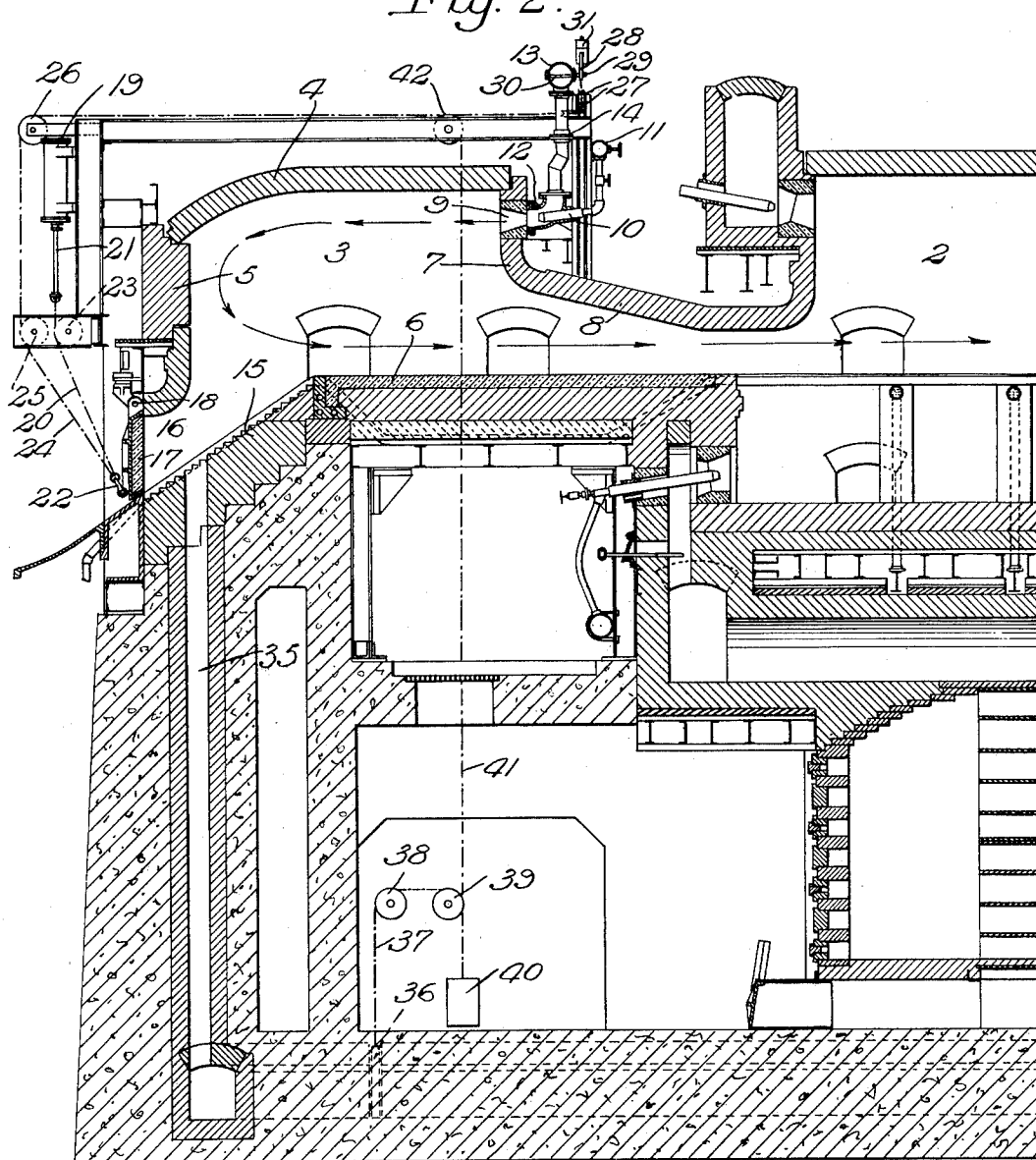
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Fig. 2



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Fig. 3.

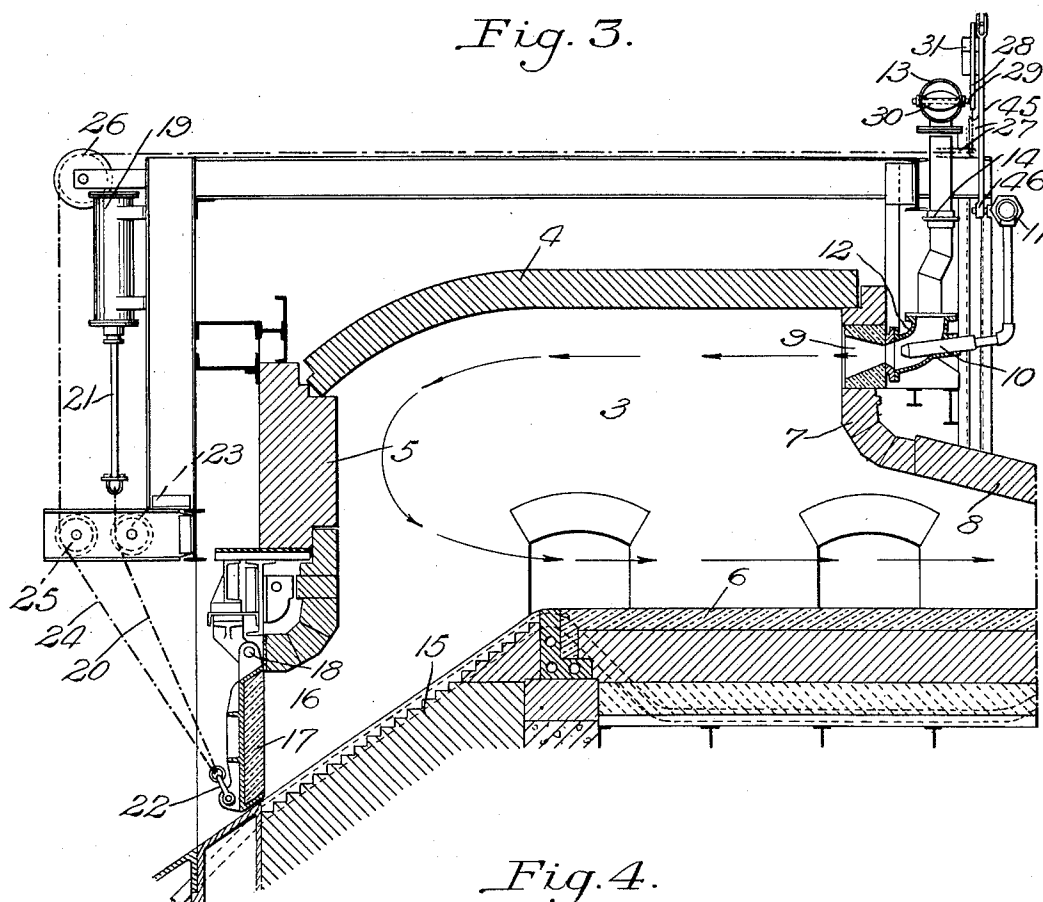
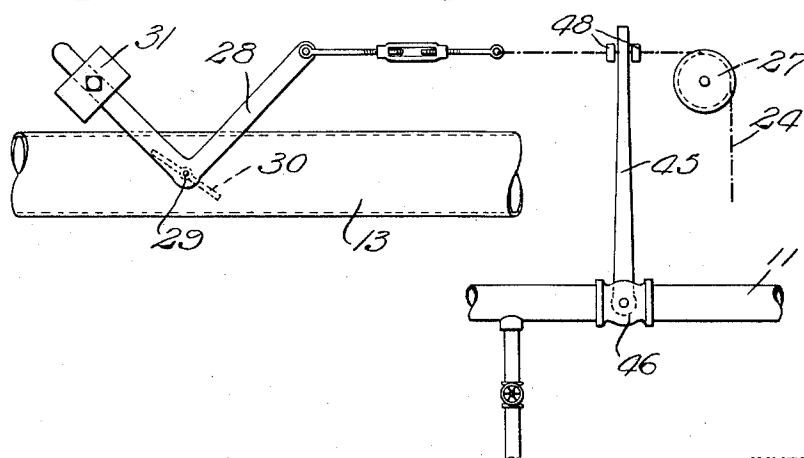


Fig. 4.



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UNITED STATES PATENT OFFICE

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HEATING FURNACE

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executors of said Albert L. Culbertson, deceased

Application August 29, 1931. Serial No. 560,100

9 Claims. (Cl. 263—8)

My invention relates generally to heating furnaces, and more particularly to the method and apparatus for preventing air entering the furnace through the discharge opening from contacting with the material being heated in the furnace and for reducing the amount of air which enters the furnace. By preventing the air entering the furnace through the discharge opening from contacting with the material being treated, and by reducing the amount of air entering the furnace, scaling or oxidation of the material will be materially reduced and the cooling effect of the cold air eliminated.

In the furnaces in use at the present time, and those heretofore used, and particularly those of the continuous type and those of the gravity discharge type, no suitable apparatus or method of operation has been provided for preventing air entering the furnace through the material discharge opening from contacting with the material and causing scaling or oxidation thereof, and cooling the material or reducing the temperature of the furnace chamber. By my invention I provide a method of operating such furnaces and apparatus for carrying out the method which obviates the above obviates the above objectionable features.

By my invention I provide a method for operating heating furnaces whereby the combustion conditions in the furnace chamber are varied during the period when material is being discharged from the furnace. The combustion conditions in the furnace chamber may be varied in such manner that the flame acts to prevent the air which enters the furnace chamber from contacting with the material and causing oxidation and cooling. By my invention I also provide apparatus suitable for carrying out the method of operation.

In the drawings, I have shown for purposes of illustration only a preferred embodiment of my invention and several modifications thereof. It is to be understood, however, that I do not intend to be limited thereby.

In the drawings:—

Figure 1 is a longitudinal sectional view of a portion of a furnace having incorporated therein apparatus suitable for carrying out my invention;

Figure 2 is a view similar to Figure 1, showing a modification thereof;

Figure 3 is a sectional view of a portion of a furnace showing a further modification; and

Figure 4 is a side elevational view of the apparatus for controlling the fuel and air supplied to the furnace.

In the drawings, there is shown a furnace having a principal heating chamber 2 and a soaking chamber 3. My invention is shown as being applied only to the soaking chamber of

the furnace shown in the drawings. It is to be understood, however, that the invention may be applied to any type furnace having therein an opening through which the material being treated is discharged from the furnace, and particularly to continuous heating furnaces and furnaces of the gravity discharge type. The furnace chamber 3 is made up of a top wall 4, a rear wall 5, a hearth 6 and a front wall 7. The front wall 7 of the furnace extends downwardly towards the hearth 6 and is curved forwardly toward the main heating chamber 2 as at 8.

A port 9 is provided in the front wall of the furnace through which fuel and air are supplied to the furnace chamber 3. The fuel may be supplied to the furnace chamber through the port 9 by means of a burner 10 adapted to be connected in any desirable manner to a fuel header 11. Air to support the combustion is supplied to the furnace chamber 3 through the port 9 by means of the elbow 12 which is connected to an air header 13 by suitable piping, indicated generally by the reference character 14.

The furnace shown is of the gravity discharge type. The hearth 6 of the furnace is sloped downwardly as at 15 toward the discharge opening 16. The rear wall of the furnace, indicated generally by the reference character 5, extends downwardly towards the discharge slope 15 to the discharge opening 16.

A door 17 is pivotally mounted as at 18 to the rear wall of the furnace chamber and is adapted to be swung outwardly so as to permit the material being heated to fall by gravity from the furnace. The door 17 is adapted to be opened by means of a fluid cylinder 19 which is connected to the door at the bottom thereof by means of a cable 20, one end of which is attached to the piston 21 of the cylinder and the other end thereof fastened to the door in any suitable manner as at 22. The cable 20 intermediate its ends may be passed over a pulley wheel 23.

One end of a cable 24 is attached to the lower portion of the door 17 and passes over pulley wheels 25, 26 and 27. The other end of the cable 24 is attached to one end of a lever 28 which is mounted on a shaft 29 of the butterfly valve 30. A counterweight 31 is mounted on the other end of the lever 28. The butterfly valve 30 is mounted in the air header 13, which supplies air to the furnace chamber for supporting combustion, and is adapted to control the amount of air supplied to the chamber.

Referring particularly to the embodiment shown in Figure 1, when the door 17 is opened so as to permit material to be discharged from the furnace, the butterfly valve 30, which is nor-

mally in neutral position, is operated through the cable 24 and the counterweight 31 attached to the lever 28. The butterfly valve operates to cut down the amount of air being supplied to the furnace. Consequently, an excess of fuel is supplied to the furnace chamber 3 during the period that the door or closure 17 is open.

The furnace shown in the drawings employs reverse firing on the chamber 3, that is, it fires towards the discharge end wall of the furnace. The flame and products of combustion, after traversing the length of the chamber, normally turn downwardly and pass above the material on the hearth and toward the heating chamber in the manner indicated by the arrows. When the furnace door is opened, air enters the furnace chamber through the discharge opening and travels up the discharge slope. The excess amount of fuel being supplied by virtue of the cutting down of the air supplied through the port 9 passes through the chamber in the manner indicated and joins with the air entering the furnace through the discharge opening 16. Additional combustion takes place then adjacent the upper portion of the discharge slope. This provides a flame at this point, which is additional to the flame extending from the port 9 around the furnace chamber in the manner above described. All the air entering the furnace chamber up the discharge slope is consumed by the excess of fuel in the flame before it comes in contact with the material on the hearth. No cold air, therefore, can come in contact with the material on the furnace hearth and cause oxidation or cooling thereof.

This same effect of a shielding flame to prevent the air entering the furnace through the discharge opening from contacting with the material being treated may be accomplished in the manner shown in Figure 2. In this figure, apparatus similar to that shown in Figure 1 is provided for regulating the amount of air supplied to the furnace through the port 9 for supporting combustion. In addition thereto, there is shown an auxiliary flue 35, the upper end of which opens into the discharge slope adjacent the discharge opening 16. The auxiliary flue is generally not utilized during the period when the discharge opening is closed by the door 16, a valve for damper 36 being provided in the flue which closes it off from the furnace stack during this period.

The auxiliary flue 35, as stated above, connects with a furnace stack, which is not shown in the drawings. The valve shown in the drawings comprises a damper adapted to be vertically moved in the horizontal portion of the flue 35. A cable 37, which passes over pulley wheels 38 and 39, is attached at one end thereof to the valve 36. The other end thereof is attached to a counterweight 40. Also attached to the counterweight 40 is a cable 41, which passes over a pulley wheel 42 and over pulley wheels 26 and 25 and is connected to the door 17 in the same manner that the cable 24 for operating the butterfly valve is attached to the door.

When the door 17 is opened, the counterweight 40 is lowered and the valve 36 in the flue 35 raised so as to permit the passage of products of combustion from the furnace chamber 3 down through the flue to the stack. The products of combustion are pulled downwardly through the flue 35 by means of the draft exerted thereon by the stack.

With the stack draft applied to the flue in the

discharge slope, the flame from the burners in the furnace chamber will traverse the length of the soaking chamber, turn down, and a portion of it will be drawn down the flues in the discharge slope, thereby forming a flame shield for preventing air entering the furnace chamber through the discharge opening from contacting with the material on the hearth. Not only will the stack draft draw down a portion of the flame, but it will also draw down the air entering the furnace chamber through the discharge opening. By virtue of the provision of this shielding flame and the escape for the incoming air, none of it contacts with the material on the hearth.

The use of the flue alone in the manner just described will effectually provide a shielding flame and prevent incoming air from contacting with the material. The combination of the flue and the valve therein with the apparatus for providing a reducing flame, described above with reference to Figure 1, and shown in both Figures 1 and 2, will be very effective in preventing air from contacting with the material being heated.

Another method of and apparatus for preventing the air from contacting with the material is shown in Figures 3 and 4. In these figures, the apparatus shown is substantially the same as that shown in Figure 1 for providing a reducing flame by controlling the amount of air supplied to the furnace chamber 3. In this embodiment, the butterfly valve 30 will not normally be maintained in neutral position. It will be maintained in a position similar to that shown in Figure 4. When the door is opened, the counterweight 31 will cause the valve to be opened wider and to supply more air to the furnace chamber for combustion. In this embodiment, there is also provided a lever 45, one end of which is connected to the valve 46 in the fuel header 11. The other end of the lever 45 is adapted to be moved by stops 48 carried by the cable 24.

When the discharge door 17 is opened, the counterweight 31 operates the butterfly valve 30 in the air header and opens the same so as to supply additional air to the furnace chamber. It also operates the lever 45 and the valve 46 through cable 24 so as to admit additional fuel to the furnace chamber. By the admission of additional fuel and air to the furnace chamber when the discharge door is open, a greater pressure is built up in the furnace, which pressure will tend to hold back and prevent any infiltration of air through the discharge opening. In this method, slightly more fuel than air should be turned on by the operation of the door so as to provide a reducing flame as well as an increased pressure. Any air then that comes up the discharge slope will be burned up by the excess fuel and a shielding flame provided adjacent the discharge opening.

By virtue of the varying of the combustion conditions in the furnace chamber in such manner that a shielding flame will be provided, or in such manner as to build up a greater pressure in the chamber, all air entering the furnace through the discharge opening may be prevented from contacting with the material. This reduces scaling or oxidation of the steel and eliminates the cooling effect of the cold air entering the furnace chamber.

While I have shown and described a preferred embodiment of my invention and several modifications thereof, it is to be understood that I do not intend to be limited thereby, and that

the invention may be otherwise practiced or embodied within the scope of the following claims. I claim:

1. In a heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber, a flue opening into the furnace chamber adjacent the material discharge opening, a valve in said flue, means operated by the movement of the closure relative to said opening for operating the valve, and means operated by the movement of the closure relative to said opening for regulating the amount of air supplied to the furnace chamber.

2. In a heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber, a flue opening into the furnace chamber adjacent the material discharge opening, a valve in said flue, means operated by the movement of the closure relative to said opening for operating the valve, and means operated by the movement of the closure relative to said opening for regulating the amount of fuel supplied to the furnace chamber.

3. In a heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber, a flue opening into the furnace chamber adjacent the material discharge opening, a valve in said flue, means operated by the movement of the closure relative to said opening for operating the valve, and means operated by the movement of the closure relative to said opening for regulating the amount of fuel and air supplied to the furnace chamber.

4. In a continuous heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber for combustion, said means being arranged to project the flame in the general direction of the discharge opening, and means operated by said closure for varying the relative quantities of fuel and air supplied to the furnace chamber for combustion.

5. In a continuous heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber for combustion, said means being arranged to project the flame in the general direction of the discharge opening, and means for varying the relative quantities of fuel and air supplied to the

furnace chamber for combustion in accordance with the movement of said closure relative to the discharge opening.

6. In a continuous heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber for combustion, said means being arranged to project the flame in the general direction of the discharge opening, and means controlled by the position of the closure for increasing the quantity of fuel supplied to the furnace chamber for combustion relative to the quantity of air fed by the aforesaid means, whereby a reducing flame is provided in the furnace adjacent the discharge opening.

7. In a continuous heating furnace, a furnace chamber having a material discharge opening therein, a closure for said opening, means for supplying fuel and air to the furnace chamber for combustion, said means being arranged to project the flame in the general direction of the discharge opening, and means controlled by the position of the closure for increasing the quantity of fuel supplied to the furnace chamber for combustion relative to the quantity of air fed by the aforesaid means during the time when the closure is in open position, whereby a reducing flame is provided and a flame curtain formed adjacent the discharge opening.

8. In the method of operating continuous heating furnaces having a discharge opening therein, the steps comprising supplying fuel and air to the furnace chamber for combustion for heating the material therein, the flame formed thereby extending adjacent the discharge opening, and varying the relative quantities of fuel and air supplied to the furnace for combustion to provide a reducing flame adjacent the discharge opening of the furnace during periods when the material is being discharged therefrom.

9. In the method of operating continuous heating furnaces having a discharge opening therein, the steps comprising supplying fuel and air to the furnace chamber for combustion for heating the material therein, the flame formed thereby extending adjacent the discharge opening, and varying the direction of the flame during the period when material is being discharged from the furnace chamber to provide a shield of flame across the discharge opening of the furnace for preventing air entering through said discharge opening from contacting the material being heated.

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