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HEAT TREATING FURNACE

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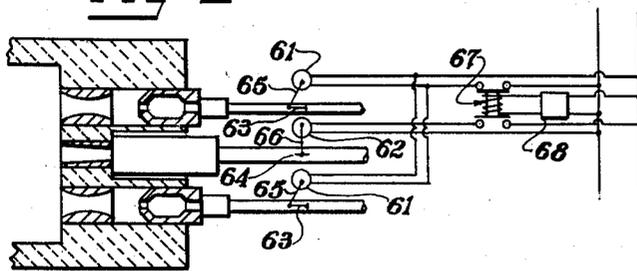
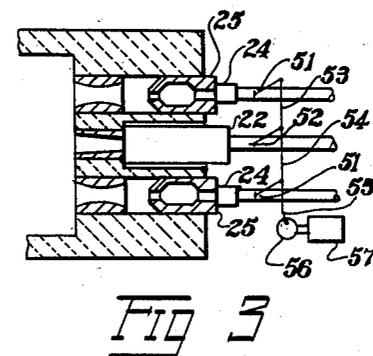
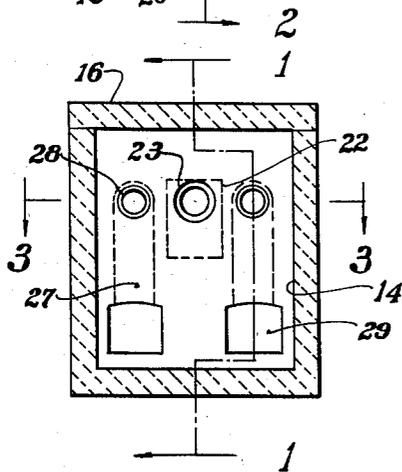
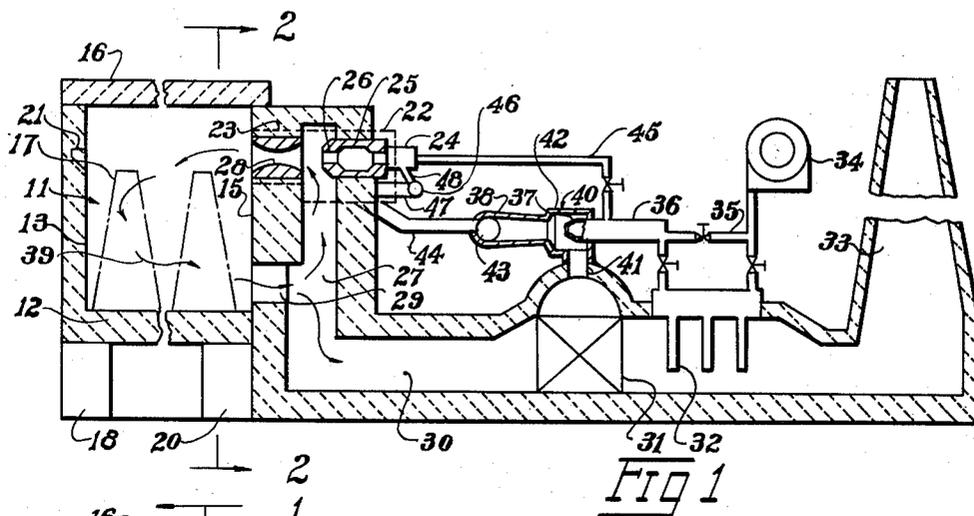


Fig 4

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## HEAT TREATING FURNACE

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10 Claims. (Cl. 263—43)

This invention pertains to the circulation of gases in a heat treating furnace and more particularly to recirculation of flue products in a one-way fired soaking pit furnace.

Soaking pit furnaces are used to reheat partially chilled or cold steel ingots to a uniform temperature for rolling. In operation, a number of ingots ordinarily are charged into the heating chamber and removed singly for rolling after they have attained proper temperature.

The burner in a one-way fired pit is generally located in the upper portion of an end wall and directs its flame toward the opposite end of the pit with its maximum heat concentration located near the opposite end when the burner is firing at its full rate. The combustion gases then travel back through the lower portion of the pit and out through exhaust ports located in the lower portion of the end wall containing the burner.

After placing the ingots in this heating chamber, or charging it, the burner is fired at its full rate until the desired maximum temperature is approached. The firing rate is gradually decreased as the maximum temperature is neared to avoid overshooting this temperature and to also enable more uniform heating to be attained by changing the area of heat concentration as the burner's firing rate decreases. When the desired temperature is reached, the burner will be shut off or adjusted to a minimum firing rate until the temperature controller again calls for further heating.

During the period in which the burner is off or at minimum fire, combustion gases in the chamber become stagnant and the colder gases settle toward the bottom of the chamber, thus establishing gaseous layers of varying temperatures. These conditions tend to cause uneven heating of the ingots.

To overcome this problem, a novel means of recirculating gases when the heating burner is off or at its minimum firing rate is proposed. By such means, gases will be circulated throughout the chamber to prevent stagnation and maintain uniformity of pit temperatures.

We propose a method of heating a one-way fired soaking pit furnace by firing a first burner until the soaking pit chamber reaches a control point temperature. The firing rate of this burner will then be substantially reduced and a second burner will be fired into an auxiliary combustion chamber. Flue gases will be emitted from a nozzle in this chamber through a duct and venturi tube to the soaking pit chamber, in a manner to induce recirculation of flue gases through the duct and soaking pit.

For further consideration of what we consider novel and our invention, refer to the accompanying drawings, description, and claims.

In the drawings:

Figure 1 represents a cross-section of a soaking pit

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furnace embodying the invention on line 1—1 of Figure 2;

Figure 2 illustrates a cross-section of the soaking pit heating chamber on line 2—2 of Figure 1;

5 Figure 3 shows a cross section on line 3—3 of the apparatus of Figure 2 showing a burner, recirculation apparatus, and mechanical control means therefor; and

Figure 4 represents a modification of Figure 3 showing electrical control means.

10 In Figure 1 and Figure 2, heating chamber 11 comprises hearth 12, walls 13, 14 and 15, and cover 16. Ingots 17 are placed in chamber 11 on hearth 12 to be heat treated. Supports 8 and 20 uphold the weight of the chamber 11 and ingots 17. Recess 21 accommodates

15 a thermocouple or similar temperature responsive means.

20 Heating burner 22, represented by dotted lines in Figure 1, fires through burner port 23. Recirculating burners 24 fire into combustion chambers 25. Combustion gases exit through nozzles 26, across ducts 27, and through venturi tubes 28. After circulating through chamber 11 in a horse-shoe shaped path, indicated by arrows 39, these gases leave through exhaust ports 29. Part of these gases is then carried through ducts 27 and back through tubes 28 by an inspiration effect produced

25 by the high velocity combustion gases from chambers 25 passing through tubes 28. The remaining gases travel through passage 30, tile recuperator 31, metal recuperator 32, and out stack 33. High pressure air is blown by blower 34 through metal recuperator 32 and by-pass 35, if desired, duct 36, nozzle 37, and into venturi 38. Low pressure air, induced from the inspirating effect of jet pump 40, enters through tile recuperator 31, passage 41, housing 42, and into venturi 38. The total air then enters manifold 43 which may supply combustion air to

30 a battery of several pits. Duct 44 leads from this manifold to the heating burner 22 on each pit. Air for the recirculating burners 24 is taken from the high pressure air in duct 36 and carried by pipes 45. Manifold 46 supplies fuel to heating burner 22 and recirculating burners 24 by pipes 47 and 48, respectively.

35 In Figure 3, a mechanical control means for controlling fuel or air to the burners 22 and 24 is shown. Here valves 51 control the volume to burners 24 and valve 52 controls the volume to burner 22. These three valves are operatively linked together by linkages 53 and 54. Another linkage 55 connects one of the linkages with a power means such as servo-motor 56. This is regulated by a temperature control device 57 responsive to a temperature responsive means such as a thermocouple (not shown) which may be placed in recess 21.

40 In operation the latter actuates servo-motor 56 which moves valves 51 and 52 by means of linkages 53, 54, and 55. When the soaking pit chamber temperature falls below that required, instrument 57 actuates servo-motor 56 which through the aforementioned linkages tends to open valve 52 and close valves 51. Likewise, when required temperature is again reached or exceeded, valves 51 are caused to open and valve 52 to close. If the heating burner 22 is operated in a graduated manner, as opposed to on-off, this control system can function as a proportioning method.

45 An electrical control means for accomplishing the same results is illustrated in Figure 4. With this method, valve control motors 61 and 62 actuate valves 63 and 64 through linkages 65 and 66. These motors 61 and 62 are operated by relay 67 which is regulated by temperature control device 68 responsive to a temperature

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responsive means. This control system operates on an on-off basis and does not function in a proportioning manner.

To those skilled in the art, other variations of this design will be apparent without changing the basic principles in our invention.

We claim:

1. The method of heating a soaking pit furnace which comprises: firing a first burner to produce flame in the heating chamber of said furnace until the temperature of said chamber rises to a control point temperature; then substantially reducing the firing rate of said burner and firing a second burner into an auxiliary combustion chamber and discharging therefrom a high velocity stream of combustion gas in inspirating relation to furnace gases venting from the furnace; and directing the resulting admixture into said heating chamber to supply thereto a recirculating stream of heating gas while the furnace is above the control point temperature.

2. In a soaking pit furnace, a means for recirculating furnace gases comprising: a tube opening into the heating chamber in said furnace; a duct connecting the other end of said tube to another portion of the furnace chamber; a combustion chamber located adjacent said tube and outside said furnace chamber whose flue products emit through a nozzle, said duct, and said tube; a first burner adjacent said combustion chamber and capable of firing thereinto; a tile recuperator and metal recuperator through which flue gases flow; means for creating a flow of high pressure air through said metal recuperator; a duct for carrying said high pressure air to a jet pump after passing through said metal recuperator, said jet pump inspirating low pressure air through said tile recuperator; a second burner located adjacent said furnace chamber and capable of firing thereinto for heating said furnace chamber; a duct for carrying the combined high pressure and low pressure air from said jet pump to said second burner; a pipe connecting the high pressure air duct to said first burner; and a fuel supply for said first burner and said second burner.

3. In a soaking pit furnace, means for recirculating furnace gas comprising: a tube connecting a portion of a heating chamber in said furnace to a duct, said duct connecting said tube to another portion of said heating chamber; a combustion chamber for directing products of combustion through said duct and said tube; a first burner for firing into said combustion chamber; a high pressure air source; a jet pump through which high pressure air flows, inspirating low pressure air from a low pressure air source; a second burner located adjacent said heating chamber and capable of firing thereinto for heating said heating chamber; a duct carrying the combined low and high pressure air mixture to said second burner; a pipe carrying said high pressure air to said first burner; a fuel supply source for supplying fuel to said first burner and said second burner; and control means for alternating air and fuel flow to said first burner and to said second burner.

4. In a soaking pit furnace, means for recirculating furnace gas comprising: a tube connecting a portion of a heating chamber in said furnace to a duct, said duct connecting said tube to another portion of said heating chamber; a combustion chamber for directing products of combustion through said duct and said tube; a first burner for firing into said combustion chamber; a high pressure air source; a jet pump through which high pressure air flows, inspirating low pressure air from a low pressure air source; a second burner located adjacent said heating chamber and capable of firing thereinto for heating said heating chamber; a duct carrying the combined low and high pressure air mixture to said second burner; a pipe carrying said high pressure air to said first burner; a fuel supply source for supplying fuel to said first burner and said second burner; and control means for proportioning the flow of air and fuel to said first burner and said second burner to de-

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crease the flow of said air and said fuel to one burner and to increase the flow of said air and said fuel to the other burner.

5. The combination according to claim 3 wherein said control means comprises: means responsive to temperature in said heating chamber; a temperature control device responsive to said responsive means; and electrically operated valves responsive to said control device through an electrical circuit for controlling flow of fuel to said burners.

6. The combination according to claim 4 wherein said control means comprises: means responsive to temperature in said heating chamber; a temperature control device responsive to said responsive means; a power means responsive to said control device; and a linked valve assembly operated by said power means for controlling flow of fuel to said burners.

7. In a soaking pit furnace, apparatus for maintaining movement of the gases therein comprising: a tube connecting a portion of a heating chamber in the furnace to a duct, said duct connecting said tube to another portion of said heating chamber; a recirculating burner located outside said chamber for directing a high velocity stream of gas through said tube whereby gas in said duct is inspirated through said tube by said stream; a heating burner; a source of air; a source of combustible gas; means responsive to the temperature in said chamber; a temperature control device responsive to said responsive means; and means responsive to said device for directing gas and air to said heating burner when the temperature of said chamber is below a predetermined point and to said recirculating burner when the temperature is above the predetermined point.

8. In a soaking pit furnace, apparatus for maintaining movement of the gases therein comprising: a tube connecting a portion of a heating chamber in the furnace to a duct, said duct connecting said tube to another portion of said heating chamber; a recirculating burner located outside said chamber for directing a high velocity stream of gas through said tube whereby gas in said duct is inspirated through said tube by said stream; a heating burner; a source of air; a source of combustible gas; means responsive to the temperature in said chamber; a temperature control device responsive to said responsive means; and means responsive to said device for proportioning air and gas to said recirculating burner and said heating burner in a manner tending to direct a major portion of the air and gas to said recirculating burner when the temperature of said chamber is above a predetermined point and to direct a major portion of the air and gas to said heating burner when the temperature of said chamber is below a predetermined point.

9. The method of heating a soaking pit furnace which comprises: firing a first burner to produce flame in the heating chamber of said furnace until the temperature of said chamber rises to a control point temperature; then substantially reducing the firing rate of said burner and firing a second burner into an auxiliary combustion chamber and discharging therefrom a high velocity stream of combustion gas in inspirating relation to furnace gases venting from the furnace; directing the resulting admixture into said heating chamber to supply thereto a recirculating stream of heating gas; and controlling the firing rate of said second burner to maintain the temperature of said chamber substantially at control point temperature.

10. The method of heating a soaking pit furnace which comprises: firing a first burner to produce flame in the heating chamber of said furnace until the temperature of said chamber rises to a control point temperature; then substantially reducing the firing rate of said burner and firing a second burner into an auxiliary combustion chamber and discharging therefrom a high velocity stream of combustion gas in inspirating relation to furnace gases venting from the furnace; directing the resulting admix-

ture into said heating chamber to supply thereto a recirculating stream of heating gas; and controlling the firing rate of said second burner to fire alternately at a rate greater than the furnace holding rate and at a rate less than the furnace holding rate.

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