Open-hearth furnace and method of operating the same, U.S. Patent 2,494,415

Jan. 10, 1950

R. B. SOSMAN

OPEN-HEARTH FURNACE AND METHOD OF OPERATING THE SAME

2,494,415

Filed June 6, 1947

2 Sheets-Sheet 1

Fig. 1.

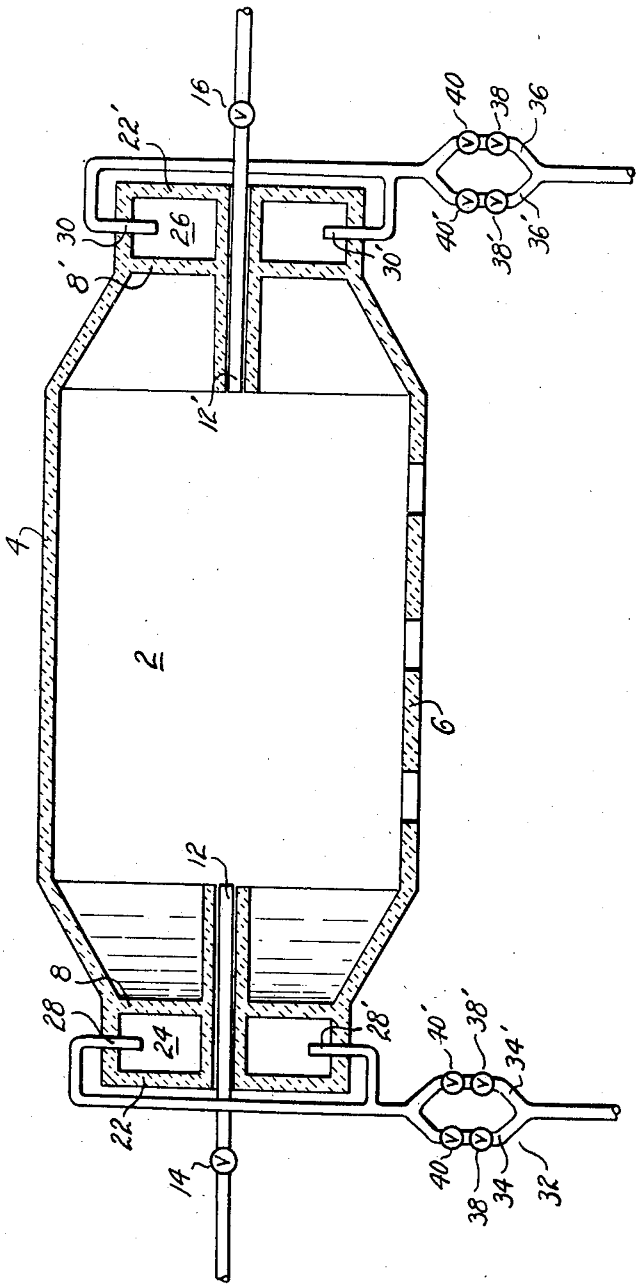

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Fig. 2.

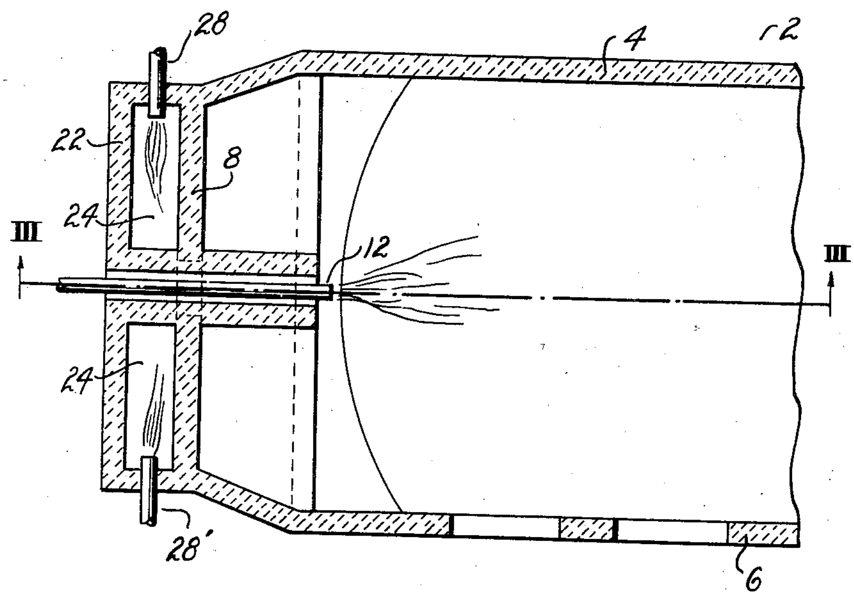
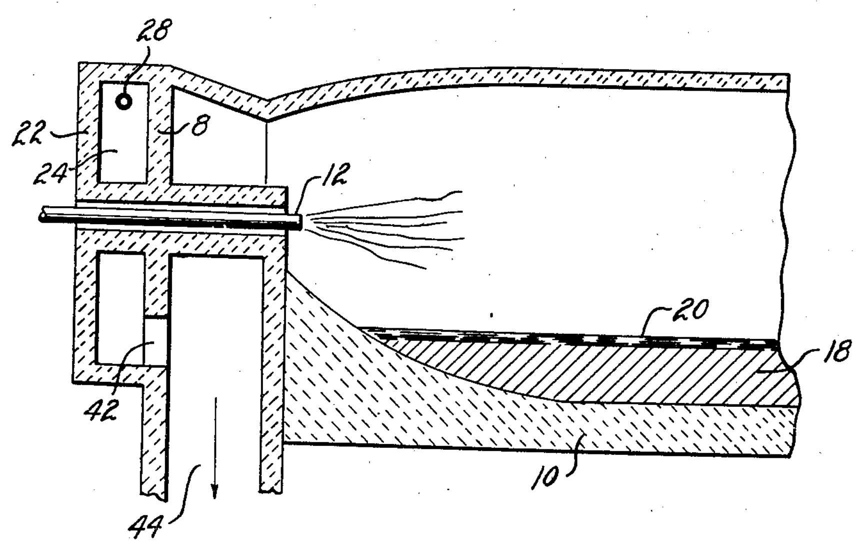


Fig. 3.



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OPEN-HEARTH FURNACE AND METHOD OF OPERATING THE SAME

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2 Claims. (Cl. 263—15)

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This invention relates to improvements in basic open hearth furnaces composed of basic brick and method of operating the same and more particularly to basic open hearth furnaces having basic brick walls.

In my copending case, Serial No. 733,151, filed March 7, 1947, now abandoned, I have described generally some of the problems relating to the operation of all-basic open hearths, particularly with respect to the roofs thereof.

Despite the disadvantages of using silica brick for the walls of open hearth furnaces employing the basic process of steel-making, silica brick have heretofore been generally used because magnesia (magnesite) brick do not have sufficient strength at operating temperatures. Recent improvements in basic brick, whereby they are made of mixtures of chrome ore and magnesia, have overcome this weakness. However, they are subject to severe spalling or peeling, which is believed due to abrupt changes in volume of liquid collecting on the face of the brick when the liquid crystallizes owing to lowering of the furnace temperature at the time cold scrap is introduced therein. This liquid results from iron and iron oxide in vaporous form combining with one or more constituents of the brick, forming a liquid which is drawn into the brick by capillarity. At the same time some of the iron oxide dissolves in magnesia to form highly refractory crystalline solutions. Chromite is subject to attack by liquid Fe_3O_4 which causes swelling of the chromite grains; this adds to the damage done by crystallizing of the liquid when the temperature changes.

It is proposed to overcome this difficulty and increase the life of chrome-magnesia brick in open hearth walls and end walls by maintaining them and particularly the inner surfaces thereof at a temperature above that of the slag and the metal bath, instead of letting such temperature drop lower than that of the slag and the bath due to reversals of the burners. By so doing, the iron oxide vapor pressure of the magnesia-saturated film on the brick is raised sufficiently to dry up the liquid and leave only the crystalline solution, whose rate of formation is then such that it is relatively harmless as a destructive factor in the basic brick. Even though it does not stay perfectly dry, the interior surface of the basic bricks should be maintained hot to prevent sudden crystallization of the liquid layer with a sharp change in volume. Damage due to peeling can be prevented by maintaining the

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temperature of the brick at at least 2400° F. or higher at all times including charging periods.

A contributing factor in preventing such damage is to use bricks having very little and preferably less than 1% silica as its presence causes a liquid of relatively low iron oxide vapor pressure to form which becomes concentrated with respect to iron oxide and thereupon attacks the chromite grains. Also there is a tendency for capillary attraction to cause the layer adjacent to the surface of the brick to become saturated and such parts peel off upon crystallization.

In order to maintain the inner surface of the end walls above the temperature of the bath and slag, I make the walls double with a space therebetween in which I provide burners. By keeping the burners in constant operation, the high temperature desired at the inner surfaces (i. e. the surfaces inside the furnace) are maintained at the high temperature desired to prolong the life of the basic brick work. Such construction is shown on the end walls of a basic open hearth in the accompanying drawings, wherein:

Figure 1 is a diagrammatic plan of an open hearth embodying my invention;

Figure 2 is an enlarged horizontal section of one end of the furnace taken through the main burner; and

Figure 3 is a vertical section along the line III—III of Figure 2.

Referring more particularly to the drawings, the numeral 2 designates an open hearth furnace having a back wall 4, a front wall 6, end walls 8, 8' and a hearth 10, all composed of basic brick. Disposed at opposite ends of the hearth and extending through the end walls are conventional burners 12, 12' having reversing control valves 14 and 16. Shown disposed on the hearth is a bath of steel 18 being refined, covered by a layer of slag 20.

In accordance with the teachings of my invention, supplementary end walls 22, 22' are provided outside of the regular end walls providing chambers 24 and 26 in which are disposed supplementary burners 28, 28' and 30, 30'. Fuel is supplied to these burners through a supply line having a double-loop 32 or by pass therein providing two branches, outer branch 34 and inner branch 34' in the line supplying burners 28, 28' and outer branch 36 and inner branch 36' in the line supplying burners 30, 30'. Each of the outer branches 34 and 36 has an adjustable valve 38 and a shut-off valve 40. Likewise, each of the inner branches 34', 36' has a similar adjustable valve 38' and shut-off valve 40'. The chambers

24 and 26 can be connected to the regenerators (not shown) through ports 42 opening into the downtakes 44.

In the arrangement shown, the valves 38 in the outer branches are adjusted to permit a larger supply of fuel to pass their respective burners than the valves 38' in the inner legs 34', 36'. The shut-off valves 40, 40' may be connected to the automatic reversing means for operating valves 14 and 16. Thus, when valve 16 is open and 14 closed, valve 40 in the outer branch 36 will be open and valve 40' in inner branch 36' will be closed. At the same time, valve 40 in outer branch 34 is closed and valve 40' in inner branch 34' is open. Thus, with this arrangement valve 16 being open, the flame from burner 12' is playing on end wall 8 which tends to heat it whereby a reduced supply of fuel to burners 28, 28' is indicated. At the same time, the draft from burner 12' tends to cool wall 8' so that a maximum flow of gas to burners 30, 30' will maintain a high temperature in chamber 26 and thereby maintain the inner surfaces of the end wall 8' above the temperature of the bath and slag. Moreover, these burners 28, 28' and 30, 30' are kept in operation at all times including charging so as to maintain the inner surfaces thereof at high temperatures at all times. As before stated, the valves 40 and 40' can be automatically operated by the conventional control equipment for reversing burners 14 and 16. Thus, the chambers 24 and 26 will always be supplied additional heat when burners 12 and 12', respectively, are firing the furnace. The chambers can thus be held to a relatively constant temperature of 3300° F. whereby the inner furnace faces thereof can be maintained above the bath temperature 2900 to 3100° F. and above at least 2400° F. during charging.

While I have shown and described one specific embodiment of my invention, it will be understood that this embodiment is merely for the purpose of illustration and description and that various other forms may be devised within the scope of my invention, as defined in the appended claims.

I claim:

1. In an open hearth furnace having main burners at both ends thereof adapted to be alternately fired, said furnace having basic end walls, supplementary end walls outside of said basic end walls, said supplementary walls and said basic walls defining heating chambers adjacent the outer ends of said furnace, heating means in said chambers, means for supplying fuel to said heating means, and means for adjusting the supply of fuel to said heating means whereby the chamber at the end of the furnace wherein the main burner is being fired can be supplied with more heat than the chamber at the end not being fired.

2. In an open hearth furnace having main burners at both ends thereof adapted to be alternately fired, said furnace having basic end walls, supplementary end walls outside of said basic end walls, said supplementary end walls and said basic walls defining a heating chamber at both ends of said furnace, heating means in said chambers, means for supplying fuel to said heating means and means for adjusting the supply of fuel to said heating means, said means comprising a by-pass in said fuel supplying means and a shut-off valve and an adjustable valve in the fuel supplying means and said by-pass whereby the amount of fuel supplied to said heating means can be varied as said main burners are reversed.

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