June 10, 1930. F. F. LINES 1,763,471

REVERBERATORY FURNACE

Filed July 11, 1921 3 Sheets-Sheet 1

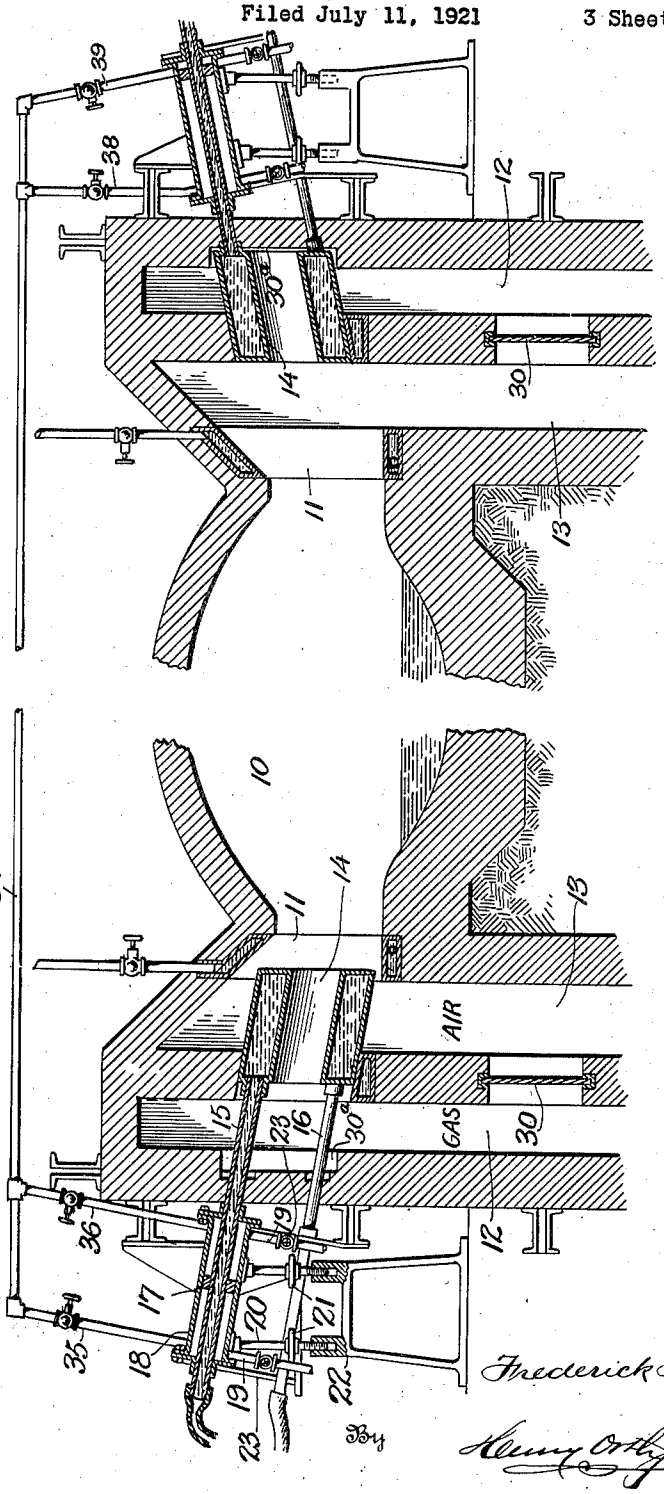


Fig. 1.

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REVERBERATORY FURNACE

Filed July 11, 1921 3 Sheets-Sheet 2

Fig. 3.

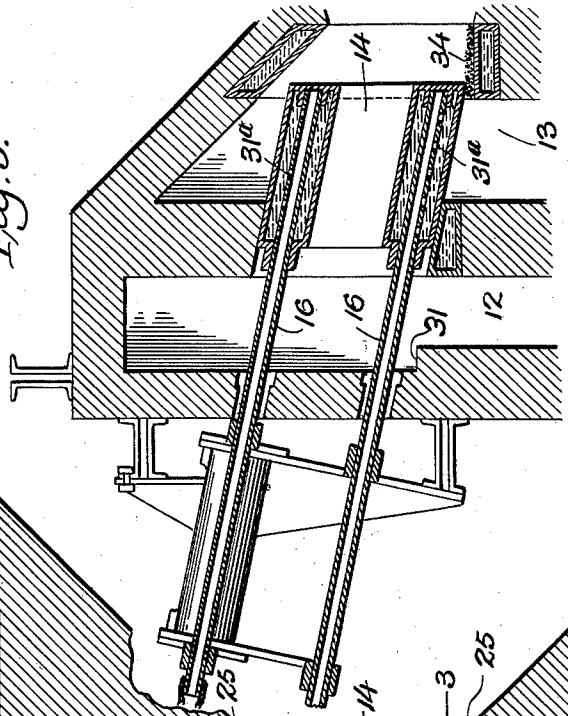
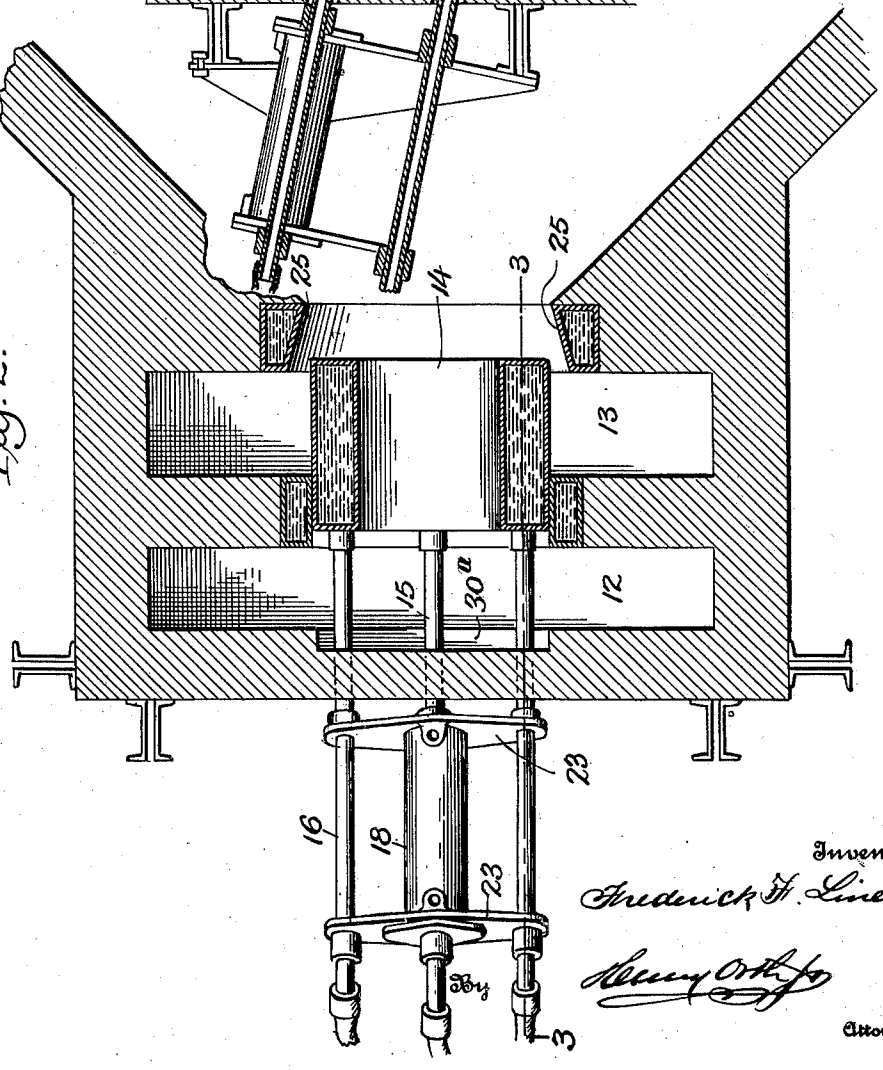


Fig. 2.



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Filed July 11, 1921 3 Sheets-Sheet 3

Fig. 5.

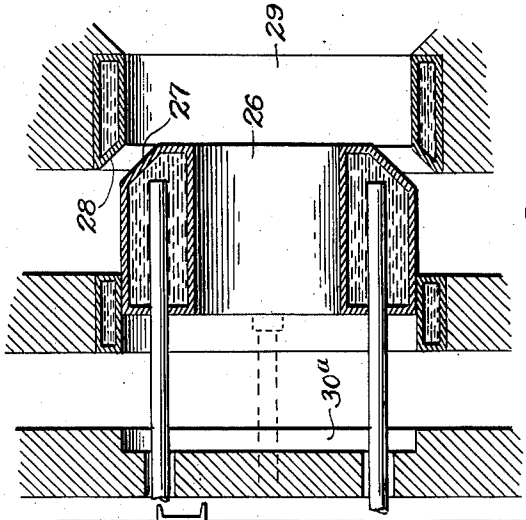


Fig. 6.

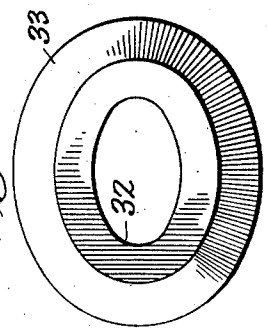
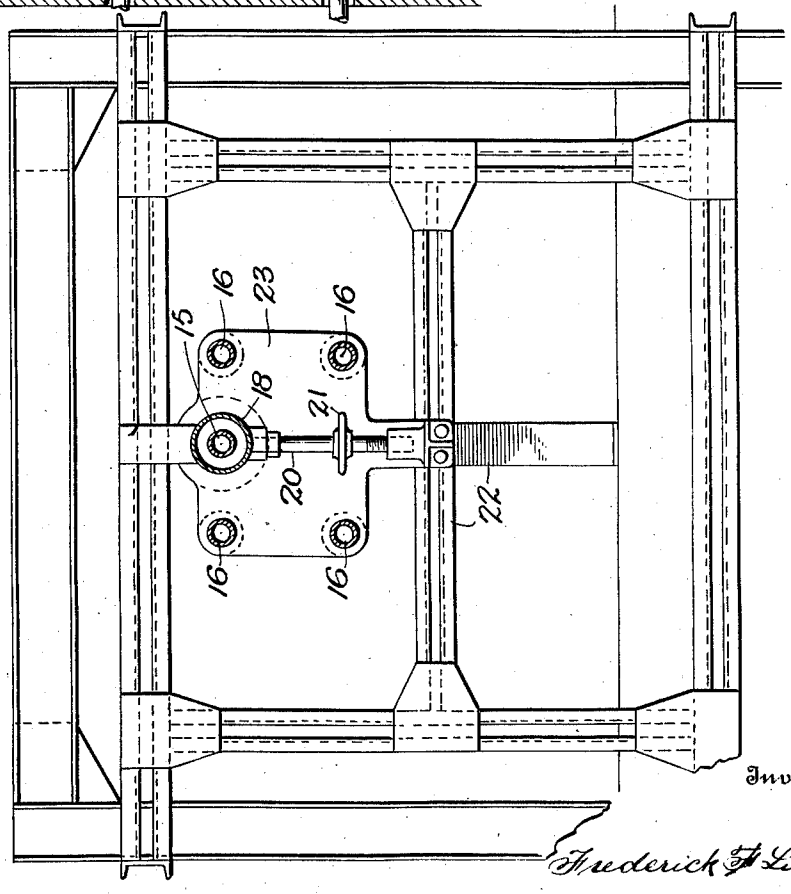


Fig. 4.



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UNITED STATES PATENT OFFICE

FREDERICK F. LINES, OF ANNAPOLIS, MARYLAND

REVERBERATORY FURNACE

Application filed July 11, 1921. Serial No. 483,792.

My invention relates to reverberatory furnaces and more particularly to that type of furnaces known as open hearth furnaces of the reversible type, where the hot products of combustion may or may not pass to regenerators to recuperate a portion of their heat, before passing to the furnace stack. Upon a reversal of the direction of movement of the gases across the hearth, these gases first pass through the regenerators previously heated.

My invention consists in the novel construction of the heads of such furnaces with particular reference to the ports for air and for gas.

The volume of air and gas supplied through one furnace head is less than the volume of the products of combustion, consequently, when the direction of flow of the gases is reversed the outgoing port opening should be the larger, and I provide a construction to accomplish this, and the construction may or may not include arrangements for varying the relative area of the ports in a furnace head. By such means the relative proportion of air and gas may be varied in the furnace head, instead of by distant valves controlling the gas supply from the regenerators, or by controlling the propulsion fan.

Preferably the enlargement of the port area is effected by moving one of the port ends with respect to the other, and specifically by withdrawing the gas port end or nozzle from the mouth of the air port.

The control of fluid supply is brought about by reason of the taper of the ports with respect to one another, or their relative positions to one another. These two features are not necessarily present together in the same structure or furnace head.

The movement of the movable nozzle preferably the gas port nozzle because it is the smaller, of one furnace head may or may not be independent of the like port in the opposite furnace head. However, I prefer to make one dependent upon the other and preferably so connected that they move simultaneously and to equal extents.

Details of construction and other features of invention will be described in the following description in which:

Figure 1 is a longitudinal vertical section through the hearth furnace and heads of an open hearth steel making furnace.

Fig. 2 is a longitudinal central cross section.

Fig. 3 is a section on line 3—3 of Fig. 2.

Fig. 4 is a front view.

Fig. 5 is a cross section of a modification.

Fig. 6 is a view of the discharge end of a gas port end of elliptical shape.

Referring more particularly to Fig. 1, the furnace chamber 10 has a port cooler 11 at each throat or head end as is customary with such furnaces. Each head is also provided with a gas uptake flue 12 and an air uptake flue 13 that is somewhat larger than the gas uptake. In each head I provide a tubular water cooled gas nozzle 14 that is provided with an intake cooling water pipe 15 and several water discharge pipes 16.

Pipe 15 which is preferably somewhat larger than the pipes 16 is provided with a piston 17 operating in a cylinder 18 that has at each end valved fluid pipes 19 for supplying operating fluid, air or water as the case may be, for operating the piston. The cylinder 18 is adjustably supported on screw rods 20 that are rotated by hand wheels 21 and that are supported in suitable brackets or frames 22.

The front and rear ends of the cylinder 18 are connected to plates 23 more clearly shown in the enlarged views Figs. 2 and 4.

The return water pipes 16 are also secured in these plates 23 so that the whole may be raised or lowered or the inclination varied slightly to vary the inclination of the nozzle.

The nozzle 14 can be withdrawn from or projected into the port cooler 11 and thereby control the quantity of air relatively to the quantity of gas supplied to the furnace chamber 10 and by operating the screws 20 the inclination of the nozzle may be varied to direct the flame either more toward the roof or toward the hearth or melt in the furnace.

The port cooler 11 may have only its top inclined downwardly as in Fig. 1 or it may have its sides inclined toward one another as

at 25, Fig. 2 or both, to give direction to the air and direct it onto the central gas stream through the nozzle.

The shape of the cross section of the nozzle may be varied as will be found most suitable, it may be round, square, or elliptical. In Fig. 5 I have shown a round nozzle 26, having ends bevelled at 27 that cooperate with the bevelled edge 28 of the port cooler 29.

In this construction the nozzle 26 does not pass entirely into the port cooler 29 as in Figures 1 and 2. When the nozzle is withdrawn by the piston 17 its rear end enters a recess 30ª, Figs. 1 and 2 or passes over a ledge 31, Fig. 3, and slides from over the air up-take 13 over the gas up-take 12 as shown at the right in Fig. 1.

This materially enlarges the passage or the effective area of the outgoing port cooler 11 as shown at the right of Fig. 1 and provides an enlarged passage for the gases down the air channels 13 to the customary heat exchanger not shown, because it is the effective area through the outgoing throat 11 that determines the rapidity of discharge of the products of combustion and this area must be calculated to pass the maximum volume of such products.

In case the air channel 13 at its lower portion is not large enough to carry all the products of combustion or where the gas passage is arranged to supply gas to the heat exchanger, I provide a damper or slide 30 between the two passages that is opened to permit combustion gases to pass down both passages 13 and 12.

When the gas is reversed the damper 30 is closed the nozzle 14 on one side of the furnace is projected and the nozzle on the other side of the furnace is retracted. This may be done simultaneously by connecting the cylinders 18 to operate their pistons simultaneously as is customarily done with pistons connected to operate simultaneously for other devices and such connections include the valved pipes 35 and 36, line pipe 37 and valved pipes 38 and 39.

The water cooler pipes 16 may advantageously extend to the front wall of the nozzle and are perforated as at 31ª Fig. 3.

In Fig. 6 the elliptical nozzle 32 has its front bevelled as at 33 and presents a broad narrow jet of air and gas at the throat.

It will thus be seen that in all of the constructions shown by moving the active gas port 14 more toward its cooperating throat cooler 11 the air supply is cut off accordingly so that the gas mixture becomes richer in gas while by withdrawing the nozzle 11 from its cooler 11 more air is admitted and the gas mixture becomes poorer in gas by reason of the larger quantity of air.

The inclined surfaces of the cooler or nozzle or both operate to give a nozzle effect to the air. The variation of the inclination of the gas nozzle changes the direction either more toward the roof or more toward the metal bath of the furnace.

In Figure 1 it will be noted that the space between the cooler 11 and top of nozzle 14 is greater than at the bottom, thus providing more air near the roof of the furnace. In case it be desired to close off the air entirely at the bottom of the nozzle, I place some loose insulating material on the cooler 11 at the bottom such as fine chrome ore, magnesite etc., as at 34 Fig. 3. Then the air will be supplied only on three sides of the gas stream.

I claim:—

1. In a reverberatory furnace, a furnace head having an air port and a gas port, means to vary the relative areas of the mouths of said ports and simultaneously control the quantity of fluid delivered to one of said ports.

2. In an open hearth regenerative furnace, a hearth, two uptake flues communicating with the hearth through a throat adapted to serve alternately as an outlet for gases of combustion and an inlet for fuel, and means for varying the effective area of the throat in such manner as to restrict the flow through one uptake without restricting the flow through the other uptake.

In testimony that I claim the foregoing as my invention, I have signed my name hereto.

FREDERICK F. LINES.