July 12, 1927. 1,635,939

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APPARATUS FOR REVERSING AND CONTROLLING REGENERATIVE FURNACES

Filed Feb. 15, 1923 2 Sheets-Sheet 1

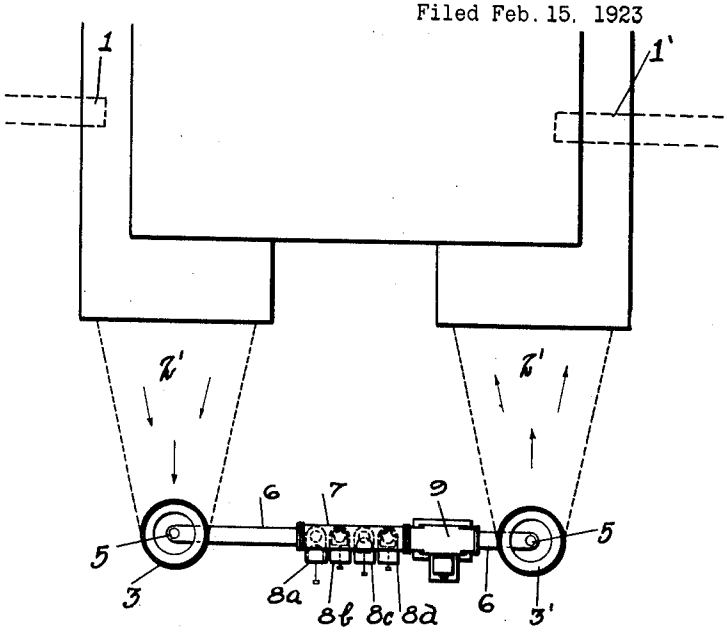


Fig. 1.

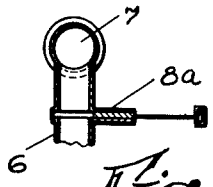


Fig. 3.

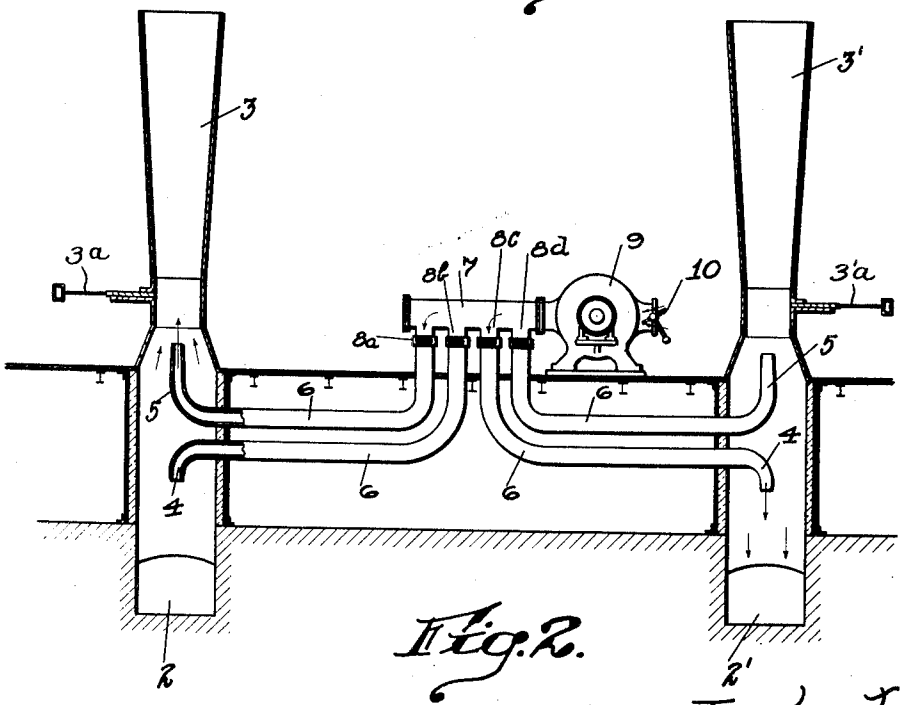


Fig. 2.

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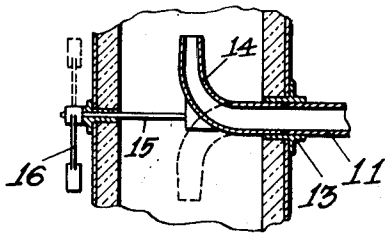


Fig. 5.

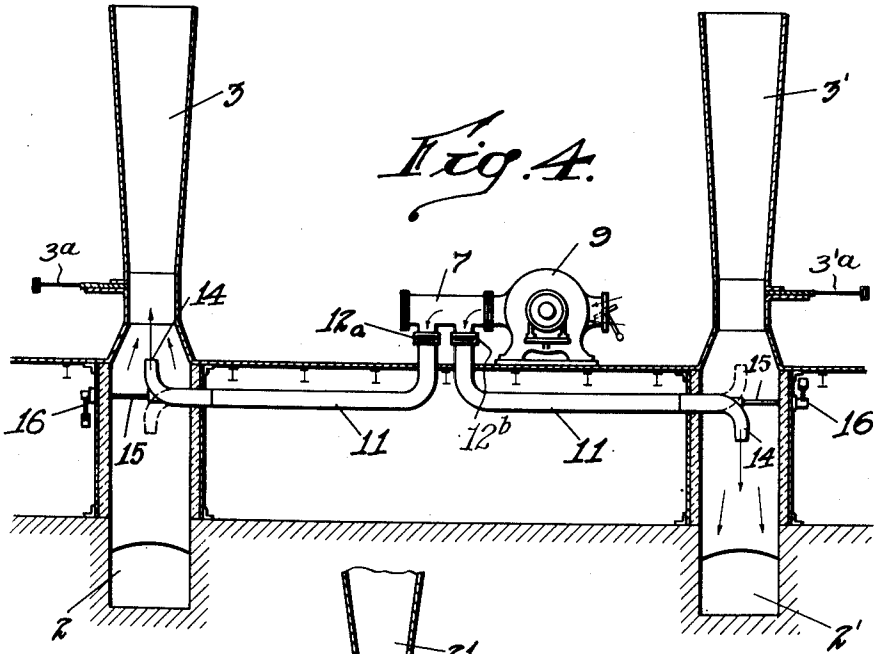


Fig. 4.

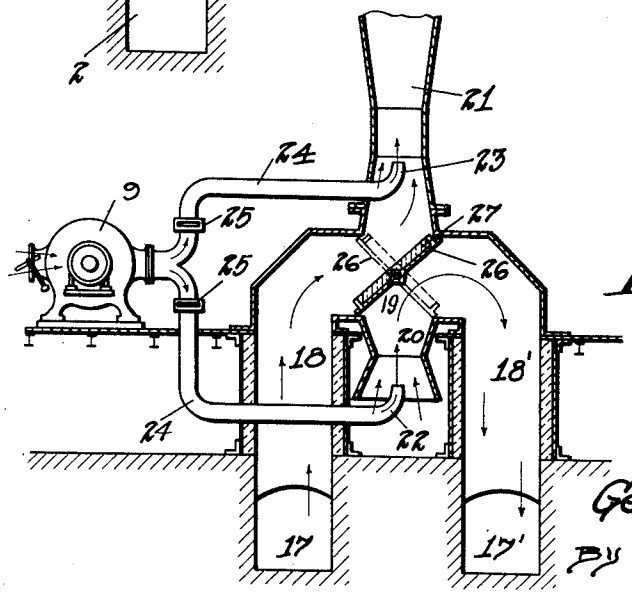


Fig. 6.

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UNITED STATES PATENT OFFICE.

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APPARATUS FOR REVERSING AND CONTROLLING REGENERATIVE FURNACES.

Application filed February 15, 1923. Serial No. 619,184.

The present invention relates to the reversal and control of regenerative furnaces, with particular reference to the regenerative heating of the air used for supporting combustion of the fuel employed, such as producer gas, oil, coke oven gas, powdered coal, and the like. The invention utilizes, in part, the principles of operation which characterize the apparatus shown and described in my United States Letters Patent No. 1,464,002, dated August 7, 1923,—all as more fully hereinafter described with reference to the accompanying drawings, wherein—

Fig. 1 is a diagrammatic plan view of the invention as applied to a conventional type of regenerative furnace.

Fig. 2 is a sectional view of the reversing apparatus shown in Fig. 1.

Fig. 3 is an enlarged sectional view illustrating a detail of construction.

Fig. 4 is a sectional view illustrating a modification of the reversing apparatus.

Fig. 5 is an enlarged detail sectional view of parts shown in Fig. 4.

Fig. 6 is a sectional view illustrating a further modification of the reversing apparatus.

Like reference characters refer to like parts in the different figures.

As shown in Figs. 1 and 2, the invention is applicable, in general, to any type of regenerative furnace, irrespective of the fuel used therein. In connection with the use of oil, coke oven gas, tar, powdered coal, and the like, as fuel, involving the employment of suitable burners 1, 1′ therefor at each end of the furnace, the invention is applicable to the regenerative heating of the air used to support combustion of such fuel, said air being admitted alternately to the furnace by way of suitable regenerator passages 2, 2′. In Fig. 1 the burner 1′ is shown in operative position, and the burner 1 in inoperative position; as will be well understood, upon reversal of the furnace, the burner 1 is moved into operative position and the burner 1′ into inoperative position.

As shown in Fig. 2, said air regenerator passages 2 and 2′ are connected respectively to open ended ducts 3 and 3′, each preferably in the form, substantially, of a Venturi tube, and equipped at or near its throat portion with a pair of oppositely directed entraining nozzles, designated 4 and 5, the former adapted to induce a gaseous flow through the associated duct 3 or 3′ into the furnace, and the latter adapted to induce a gaseous flow in the opposite direction from the furnace. The several nozzles 4 and 5 are all preferably connected by suitable pipes or ducts 6, 6 to a common air chamber 7, the connection in each case being controlled by suitable valves or dampers, designated 8^a, 8^b, 8^c and 8^d, of the construction, for example, shown in Fig. 3. The chamber 7 is supplied with air under pressure from a suitable blower 9, here shown as driven by a motor, or in any other suitable manner, and having an inlet control damper 10 to vary the air supply.

In connection with the passage of gases through the furnace from right to left, as shown in Fig. 1, (the left hand burner 1 being retracted or inoperative) the dampers 8^a and 8^c are left open and the dampers 8^b and 8^d are closed. This results in the operation of the ingoing nozzle 4 associated with right hand duct 3′, and the outgoing nozzle 5 associated with left hand duct 3, the other nozzles being inoperative. As a consequence, air is drawn in through the upper open end of duct 3′, and passes along with the air under pressure discharged by right hand nozzle 4 to the furnace, being regeneratively heated on its way in the passage 2′, while at the same time the burned gases pass from the other end of the furnace through the regenerator passage 2 under the influence of the entraining action of the jet or jets of air under pressure discharged by the left hand nozzle 5.

The reversal of the furnace is effected by simply closing the two dampers 8^a and 8^c and opening the two dampers 8^b and 8^d, and by causing the fuel supply to be furnished by burner 1 instead of burner 1′. Under these conditions, the left hand nozzle 4 and the right hand nozzle 5 become operative, the other two nozzles being rendered inoperative. The supply of air to the furnace is that drawn in or entrained through the upper open end of duct 3, in conjunction with the air under pressure discharged by left hand nozzle 4, said air being heated by passage through the regenerator passage 2, while the products of combustion drawn out through passage 2′, by the entraining action

of nozzle 5, are enabled to impart their heat to the walls of said passage preparatory to the subsequent introduction of air through said passage at the next reversal of the furnace.

It is to be noted that the apparatus as above described affords positive control both of ingoing and outgoing gases, owing to the fact that the draft in either case may be varied at will, by manipulation of any one or all of the dampers 8^a, 8^b, 8^c and 8^d and also the damper 10. This gives the apparatus the widest possible latitude and flexibility in meeting all of the various conditions of furnace operation. For instance, under normal conditions of operation, a greater volume of gases must be handled on the outgoing side than on the ingoing side, due to the increase in volume under high temperature; this is made possible by the independent control of the nozzles, which permits one to be operated so as to entrain a larger volume of gases than the other. If it be desired to cool the regenerator passages for repairs or otherwise, this can be accomplished in one-half the time ordinarily required by operating both nozzles 4, 4, so as to blow cool air into both passages at the same time; the effect of this is to hold the heat in the furnace chamber, away from the regenerator passages, while repairs are being made. To cool the furnace proper for purposes of repair, both nozzles 5, 5 may be operated, to draw out all the gaseous products through the regenerator passages 2 and 2'; the present invention permits of this cooling in much less time than that required when the usual types of reversing apparatus are employed.

In the apparatus shown in Figs. 4 and 5, the arrangement of the regenerator passages 2, 2' and associated open-ended ducts 3, 3' is the same as above described. The air under pressure is supplied by blower 9 to a supply chamber 7 as before, but in this instance there is but a single connection from said supply chamber to each duct 3 or 3', namely by way of pipes 11, 11. These pipes, provided with suitable dampers or valves 12^a and 12^b, each terminate, as shown in Fig. 5, in a thimble 13, the latter serving for the rotative support of nozzle elements 14, 14, in the respective ducts 3 and 3'. Said nozzle elements 14, 14 have spindles 15, 15 suitably journalled in the opposite walls of the ducts and provided exteriorly with operating handles 16, 16.

In connection with the passage of gases through the furnace from right to left, as indicated in Fig. 4, the right hand nozzle 14 is turned downwardly, so as to entrain air through the upper open end of duct 3' for passage, along with the air discharged by said nozzle, through the regenerator 2', while at the same time the burned gases from the other end of the furnace are drawn out through regenerator 2 by the entraining action of left hand nozzle 14 which is turned upwardly for this purpose. The reversal of the furnace is effected by simply reversing the positions of the two nozzles 14, 14, i. e., by turning up the right hand nozzle and turning down the left hand nozzle,—this being effected in conjunction, of course, with the reversal of the fuel supply. This arrangement of apparatus affords the same advantages and the same flexibility of furnace control as afforded by the arrangement of apparatus shown in Figs. 1, 2 and 3.

The reversal of the furnace shown in Fig. 4 can also be effected by means of dampers 3^a and $3'^a$ provided in the ducts 3 and 3' respectively, these dampers being similar in construction to the dampers 8^a, 8^b etc. When utilizing the duct dampers to obtain passage of the gases through the furnace from right to left, the right hand nozzle 14 is turned upwardly, as indicated in dotted lines, in the same direction as the left hand nozzle 14, and the duct damper $3'^a$ is closed. The blast from the right hand nozzle 14 is then deflected downwardly by the damper $3'^a$ through the regenerator passage 2', while at the same time the burned gases from the other end of the furnace are drawn out through the regenerator passage 2 by the action of the left hand nozzle 14. The reversal of the furnace may then be effected by simply opening the damper $3'^a$ and closing the damper 3^a, whereupon the blast from the left hand nozzle 14 is deflected downwardly by the damper 3^a into the regenerator passage 2, while the burned gases are drawn out through the regenerator passage 2' by the right hand nozzle 14.

Obviously, the furnace shown in Fig. 2 can also be controlled and reversed by employing the duct dampers 3^a and $3'^a$ in connection with only the upwardly extending nozzles 5, 5. With both of the dampers 8^a and 8^d open, and with the dampers 8^b and 8^c closed to prevent discharge through the nozzles 4, 4, the passage of gases through the furnace can be controlled by manipulating the duct dampers 3^a and $3'^a$ just as described with reference to Fig. 4.

In a third form of the invention, shown in Fig. 6, the opposite air regenerators 17 and 17' of the furnace terminate respectively in upwardly directed extensions 18 and 18', the latter merging into a common horizontal chamber 19, having a single air inlet 20, and a single discharge duct 21. Nozzles 22 and 23 are respectively disposed in said inlet 20 and in said discharge duct 21, these nozzles being supplied with air under pressure from a blower 9 by pipe connections 24, 24, equipped with the usual control valves or dampers 25, 25. A swinging butterfly valve 26 is disposed in the chamber 19 and, in the

full line position thereof, allows the passage of gases through the furnace from right to left, as shown by the arrows in Fig. 6, the nozzle 22 operating to entrain the air through inlet 20 to force it, along with the air discharged by said nozzle, into the right hand end of the furnace through regenerator passage 17′, and the nozzle 23 serving to entrain the waste gases from regenerator passage 17, and to cause their discharge through the upper open end of discharge duct 21. The reversal of the furnace is effected by shifting the butterfly valve 26 into the dotted line position, thereby causing the entering air, entrained by nozzle 22, to pass into regenerator 17, and the waste gases, entrained by nozzle 23 to be discharged from regenerator 17′ through the duct 21. It is to be noted in this connection that one side of the butterfly valve 26 is always exposed to the cool entering air; the other side, which is exposed to the hot gases discharged from the furnace, may be suitably protected by the use of a heat resisting surface of fire brick, or the like, as indicated at 27.

I claim,

1. Apparatus of the class described, comprising an outwardly opening duct leading from each end of a regenerative furnace, an air supply means having branches opening into both of said ducts and means selectively operable on said air supply means and its branches for discharging air into each of said ducts in an inwardly directed or in an outwardly directed jet, the first named jet of air with the air entrained by it constituting the air supply through one of said ducts for the support of combustion within the furnace, and the last named jet of air serving for the entrainment in the other of said ducts of the waste gases from the furnace, for discharge through the open end of said duct.

2. Apparatus of the class described, comprising an outwardly opening duct leading from each end of a regenerative furnace, an air nozzle in each of said ducts, and means for supplying air to said nozzles for the creation in one of said ducts of an inwardly directed air-entraining jet of air, and in the other of said ducts of an outwardly directed air jet for entraining and discharging waste gases from said furnace.

3. Apparatus of the class described, comprising an outwardly opening duct leading from each end of a regenerative furnace, an air nozzle for the delivery of air under pressure in each of said ducts, means for supplying air to each of said nozzles, and means for selectively procuring, in each duct, a jet discharge of air from said nozzles in an inward or an outward direction, said inward jet, with the air entrained by it, constituting the air supply for the support of combustion in the furnace, and said outward jet serving for the entrainment of the waste furnace gases and their discharge to the atmosphere.

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