June 10, 1930. G. H. ISLEY 1,762,300

REVERSING AND CONTROLLING APPARATUS FOR REGENERATIVE HEATING FURNACES

Filed Aug. 1, 1928 2 Sheets-Sheet 1

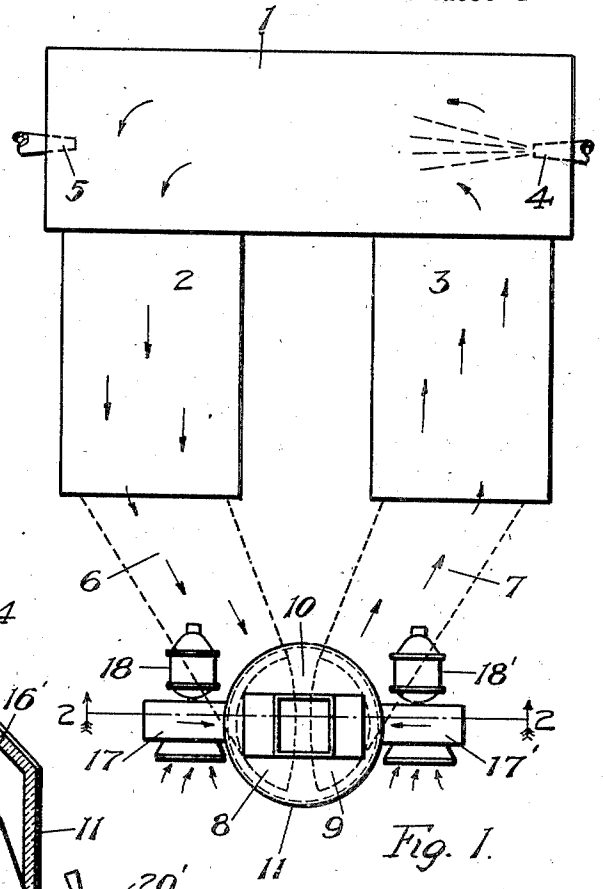



Fig. 1.

Fig. 2.

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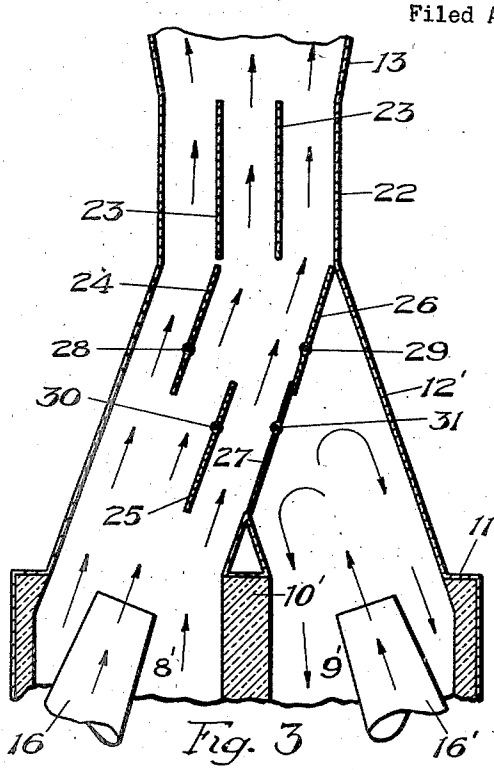



Fig. 3

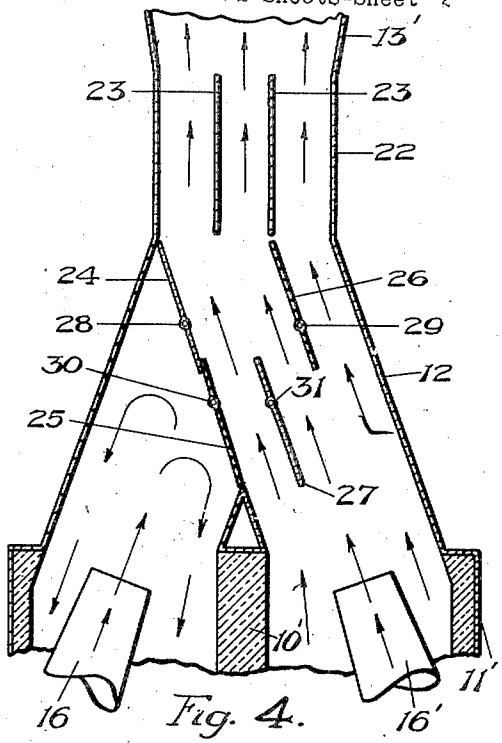



Fig. 4.

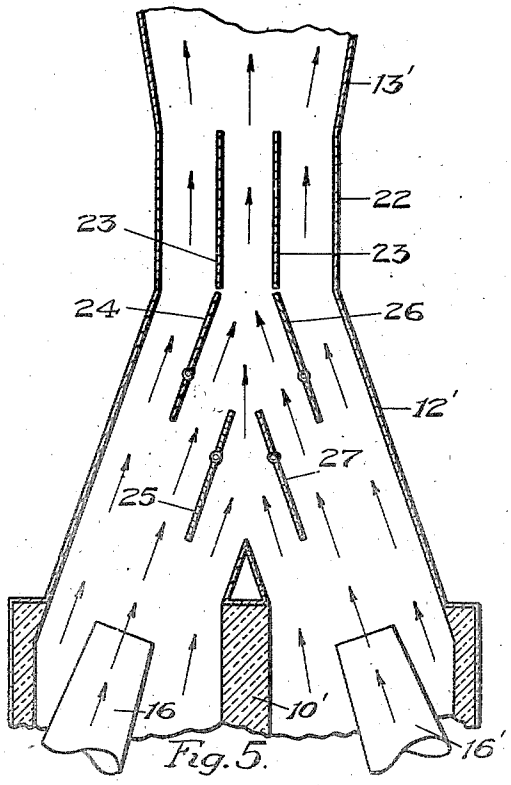



Fig. 5.

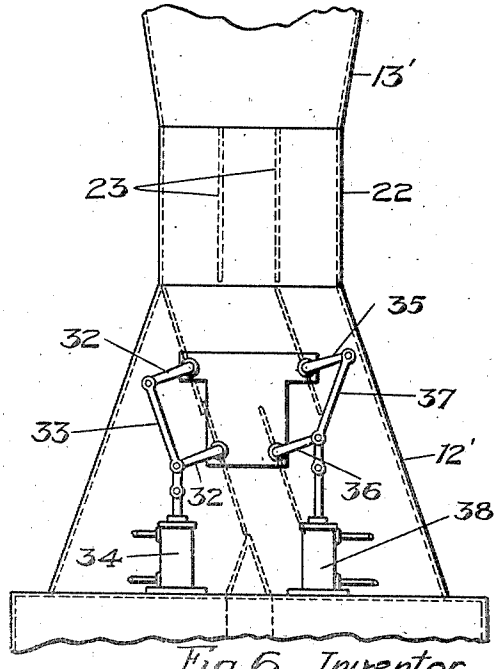



Fig. 6.

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# UNITED STATES PATENT OFFICE

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## REVERSING AND CONTROLLING APPARATUS FOR REGENERATIVE HEATING FURNACES

Application filed August 1, 1928. Serial No. 296,824.

The present invention relates to improvements in the apparatus which is used with a regenerative heating furnace for reversing and controlling the course of gaseous flow through such a furnace. The invention utilizes, in part, the principles of operation which characterize the apparatus shown and described in my United States Letters Patent No. 1,591,090, dated July 6, 1926, and also in my United States Letters Patent No. 1,721,735, dated July 23, 1929. The improvements and refinements which comprise the present invention are fully described hereinafter with reference to the accompanying drawings in which—

Fig. 1 is a diagrammatic plan view showing a conventional type of regenerative furnace, having the invention applied thereto.

Fig. 2 is a large scale view of the invention, shown partly in section, the section being taken on the line 2—2 of Fig. 1.

Fig. 3 is a fragmentary sectional view, similar to Fig. 2, showing a modified form of the invention.

Figs. 4 and 5 are views similar to Fig. 3, showing the parts in different positions.

Fig. 6 is an external view of the apparatus shown in Figs. 3, 4 and 5, and illustrating the operating means for the movement of the parts.

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

Referring to Fig. 1, the heating chamber 1 of the furnace is in communication, at opposite ends with the usual regenerator passages 2 and 3,—the latter adapted to serve, alternately, for the inflow of air for supporting combustion within the furnace, and for the outflow of waste burned gases from the furnace,—depending upon the direction of gaseous flow. As shown by the arrows in Fig. 1, the direction of gaseous flow is from right to left, and under these circumstances the regenerator passage 3, having previously absorbed heat from the outflow of waste gases therethrough, now gives up its heat to the inflowing air that is used to support the combustion of the fuel supplied the right hand burner 4, while the regenerator passage 2, at the other end of the furnace serves for the outflow of the burned waste gases, and absorbs the heat thereof. When the furnace is reversed, as hereinafter described, the right hand burner 4 is rendered inoperative and the left hand burner 5 is rendered operative; at the same time the regenerator passages 2 and 3 interchange their functions,—the air entering by way of passage 2 and the waste gases leaving by way of passage 3. The apparatus of the invention, for effecting this reversal and for drafting and controlling the furnace in a simplified and highly effective manner will now be described in detail.

As shown in Fig. 1, the regenerator passages 2 and 3 are in communication respectively with underground flues 6 and 7, the latter converging toward one another and finally terminating in up-turned extensions 8 and 9 that are separated by a partition 10 in a cylindrical casing 11, common to both extensions. Said casing 11 provides a contracting portion 12 at its upper end with which communicate both passage extensions 8 and 9, and in communication with this contracting portion 12 is an upwardly extending expanding duct 13 that serves, as hereinafter described for the discharge of waste furnace gases to the atmosphere. Mounted to swing in the contracting portion 12 is a damper or valve 14, pivoted at 15, and adapted, in the full line position shown in Fig. 2, to close off the communication of the passage extension 9 with the duct 13, while establishing communication between passage extension 8 and said duct 13; when valve 14 is rocked into its position shown by broken lines in Fig. 2 passage extension 8 is shut off, and the passage extension 9 is put in communication with duct 13.

In each of the passage extensions 8 and 9 is disposed an upwardly directed nozzle, 16 in the one case, and 16′ in the other, said nozzles being supplied with air from suitable blowing units 17, 17′ which are driven, for example, by motors 18, 18′ on opposite sides of the casing 11. The volume of air supplied to the nozzles 16, 16′ may be controlled by varying the speeds of the motors 18 and 18′, as will be readily understood, or

if desired, said motors may run at constant speed, and as here shown, the volume of air may be controlled by varying the size of the inlets 19, 19′ to the blowers 17 and 17′ respectively, as by the use of adjustable swinging shutters 20 and 20′.

In connection with the passage of gases through the furnace from right to left, as shown in Fig. 1 (with the left hand burner 5 inoperative and the right hand burner 4 furnishing the fuel) the valve 14 is disposed in the full line position of Fig. 2. Under these conditions the air for supporting combustion is drawn from the atmosphere into the blower 17′ and is discharged through nozzle 16′ into the closed passage extension 9, being deflected downwardly therethrough by valve 14 so as to flow through flue 7 and regenerator passage 3 to the furnace—absorbing on its way the heat left in the walls of said flue and passage by the previous outflow of combustion products therethrough. Such heated air, entering the furnace by way of regenerator passage 3 forms a combustible mixture with the fuel from burner 4, and it is obvious that by controlling the amount of fuel from said burner and the amount of air blown in by blower 17′, the proper combustion at all times may be maintained in the furnace. Products of this combustion, under the conditions assumed, leave the furnace by way of regenerator passage 2 and are drawn through the flue 6 and its extension 8 by the entraining action of the air discharged from nozzle 16,—said air and the entrained combustion products passing upwardly and outwardly through the contracter casing portion 12 and the discharge duct 13, as indicated by the arrows on Fig. 2. A portion of the heat of these waste furnace gases is, of course, absorbed by the walls of passage 2 and flue 6; therefore when the furnace is reversed (by shifting valve 14 into its broken line position and by rendering burner 5 operative) the air for the support of combustion within the furnace, blown in by blower 17 and passing to the furnace by way of flue extension 8, flue 6 and regenerator passage 2, will be heated as before described, by its absorption of the heat left in the passage walls by the previous outflow of combustion products therethrough. Under these conditions, with the furnace gases flowing from left to right, the products of combustion leave the furnace by way of regenerator passage 3, being entrained upwardly through flue extension 9 by the air discharged from nozzle 16′, said air and the entrained products passing to the atmosphere by way of duct 13.

It is obvious that by suitably varying the volume of air discharged from nozzle 16 or 16′, whichever is operating on the outgoing side, the proper draft for the furnace may be maintained, and that by suitably varying the volume of air blown in from nozzle 16 or 16′, whichever may be operating on the ingoing side, the proper amount of air for the support of combustion within the furnace will be supplied; this insures, regardless of atmospheric conditions, the complete control of the furnace operation at all times, to meet any condition or requirement that may arise. For example, if it be desired to cool the furnace quickly for purposes of repair, the valve 14 may be disposed in an intermediate position, so that both air nozzles 16 and 16′ will operate in the outgoing direction to draw the hot gases out of the furnace. Or, if it be desired to hold heat in the furnace, during a period of shutdown, a normally open damper 21 in the duct 13 may be moved into closed position, thereby to prevent the escape of hot gases to the atmosphere.

A modification of the invention, as disclosed in Figs. 3 to 6 inclusive, contemplates the same disposition of air blowing nozzles 16 and 16′ in the adjacent flue extensions 8′ and 9′, the latter being separated, as before in the casing 11′ by a partition 10′. Between the contracting portion 12′ and the upwardly opening duct 13′ is interposed a neck portion 22, equipped with a plurality of vanes 23, 23 that stand parallel to the axis of the discharge duct 13′, and hence operate to deflect the outgoing current into the direction of said axis, where otherwise, by reason of the inclination of the nozzle 16 and 16′, it would impinge, sidewise, against the inner wall of said duct 13′. In order to make the deflection of the outgoing current by these vanes 23, 23 more gradual, thus to secure a smoother flow through the contracting portion 12′, the single valve 14 is replaced, in this modification of the invention with two pairs of smaller valves 24, 25 and 26, 27. the first pair associated with the flue extension 8′ and the nozzle 16 and the second pair associated with the flue extension 9′ and the nozzle 16′. Each of said valves is pivoted off center, the upper valves 24 and 26 of each pair having their longer portions above their pivot points 28 and 29 respectively and the lower valves 25 and 27 of each pair having their longer portions below their pivot points 30 and 31 respectively. As shown in Fig. 6, the valve shafts or pivots 28 and 30 have parallel arms 32, 32, connected by a link 33 for operation in unison from any suitable means such as a reciprocating cylinder and piston unit 34, and similarly the pivotal shafts 29 and 31 of the other pair of valves 26, 27 have parallel arms 35, 36 connected by a link 37, for operation by an independent piston and cylinder unit 38.

Fig. 3 shows the pair of valves 26, 27 moved into the position where they cooperate to effect closure of flue extension 9′, for directing the air from nozzle 16′ downwardly, so that it will pass into the furnace. The other

pair of valves 24, 25 in this figure stand in open position, and serve as deflecting vanes, cooperating with the vanes 23, 23 to gradually turn the course of the upward current of air and entrained combustion products into line with the axis of duct 13′,—the upper end of valve 24 of this pair substantially meeting the lower end of one vane 23 and the same being true of the other valve 25, if extended, with respect to the other vane 23. To effect reversal of the furnace, the pair of valves 24, 25 are rocked counterclockwise into the position shown in Fig. 4, and this movement occurs with the minimum expenditure of power because said valves are so arranged as to practically counterbalance each other,—the longer portion of valve 25, in the open position shown by Fig. 3, having a counterclockwise tendency that substantially counteracts the clockwise tendency of the longer portion of the companion valve 24. At the same time, the other pair of valves 26, 27 are rocked counterclockwise from the closed position of Fig. 3 to the open position of Fig. 4, and this movement likewise occurs with a minimum of shock effort, because said connected valves counterbalance one another, the same as the valves 24, 25. Fig. 5 shows the two pairs of valves 24, 25 and 26, 27 both moved into open position, and both cooperating with the vanes 23, 23 to deflect the air discharged by both nozzles 16 and 16′ and the entrained combustion products from both flue extensions 8′ and 9′ into a direction corresponding substantially to the axis of duct 13′,—for the rapid removal of hot gases from the furnace.

I claim:

1. The combination, with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, and means for supplying air to each flue in jets discharging longitudinally of said flue and directed toward said common discharge duct, for the entrainment and discharge of the combustion products of the furnace through said discharge duct.

2. The combination with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, means for blowing air longitudinally through each flue toward said discharge duct, for the entrainment and discharge of the combustion products of the furnace through said duct, and means selectively operable to reverse the flow of air in either of said flues, for passage into the furnace to support combustion therein.

3. The combination, with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, means for supplying air to each flue in a jet discharging longitudinally of said flue and directed toward said common discharge duct, and valve means movable selectively to close the outlet of either one of said flues, while leaving the other flue in communication with said discharge duct, thereby to direct the air supplied to the closed flue into the furnace, for the support of combustion therein, and to procure, by the air supplied to the other flue, the entrainment and discharge of combustion products through said discharge duct.

4. The combination, with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, means for supplying air to each flue in a jet directed toward said common discharge duct, and valve means movable selectively to close the outlet of either one of said flues, while leaving the other flue in communication with said discharge duct, said valve means comprising a plurality of elements adapted in open position to deflect the outgoing air and combustion products into the axis of said discharge duct.

5. The combination, with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, deflecting vanes in said discharge duct, parallel to the axis of said duct, means for supplying air to each flue in a jet directed toward said common discharge duct, and valve means movable selectively to close the outlet of either one of said flues, while leaving the other flue in communication with said discharge duct, said valve means comprising a plurality of elements adapted in open position to cooperate with said deflecting vanes, in the deflection of the outgoing air and combustion products into the axis of said discharge duct.

6. The combination, with a pair of contiguous furnace flues, communicating respectively with the opposite air regenerator passages of a regenerative furnace, of a discharge duct common to the outlets of said flues, means for supplying air to each flue in a jet directed toward said common discharge duct, and valve means movable selectively to close the outlet of either one of said flues, while leaving the other flue in communication with said discharge duct, said valve means comprising for each flue outlet a pair of counter-weighted swinging dampers, movable in unison, with their counterweighted portions counteracting each other during said movements.

Dated this thirtieth day of July, 1928.

GEORGE H. ISLEY.