April 20, 1954 J. J. SEAVER 2,675,864

BURNER FOR OPEN-HEARTH FURNACES

Original Filed March 15, 1950 2 Sheets-Sheet 1

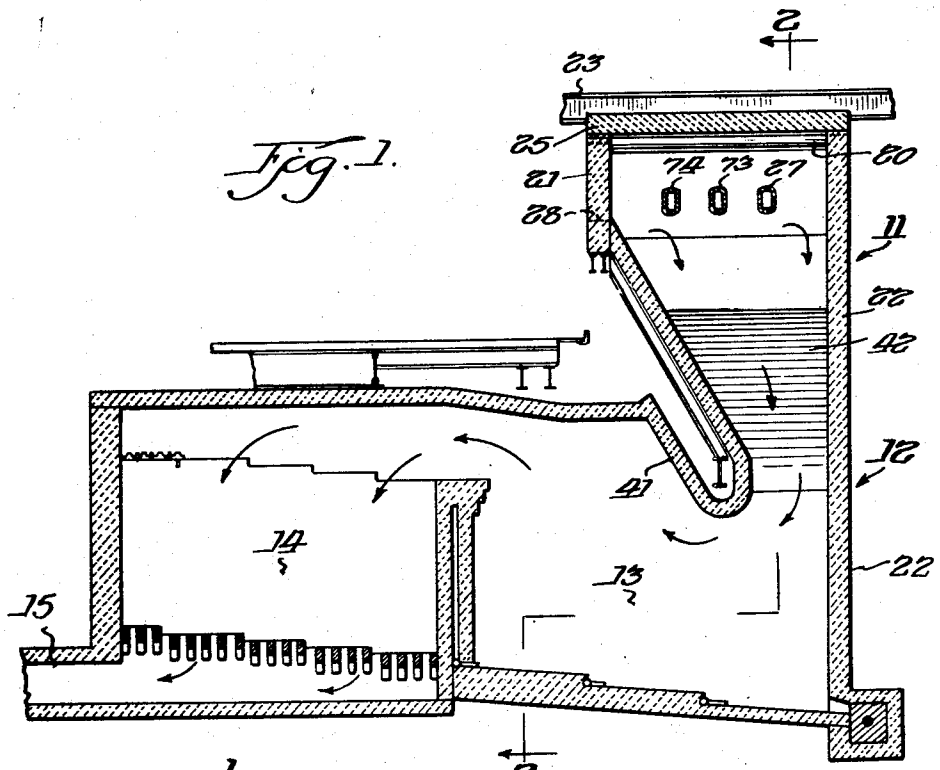


Fig. 1.

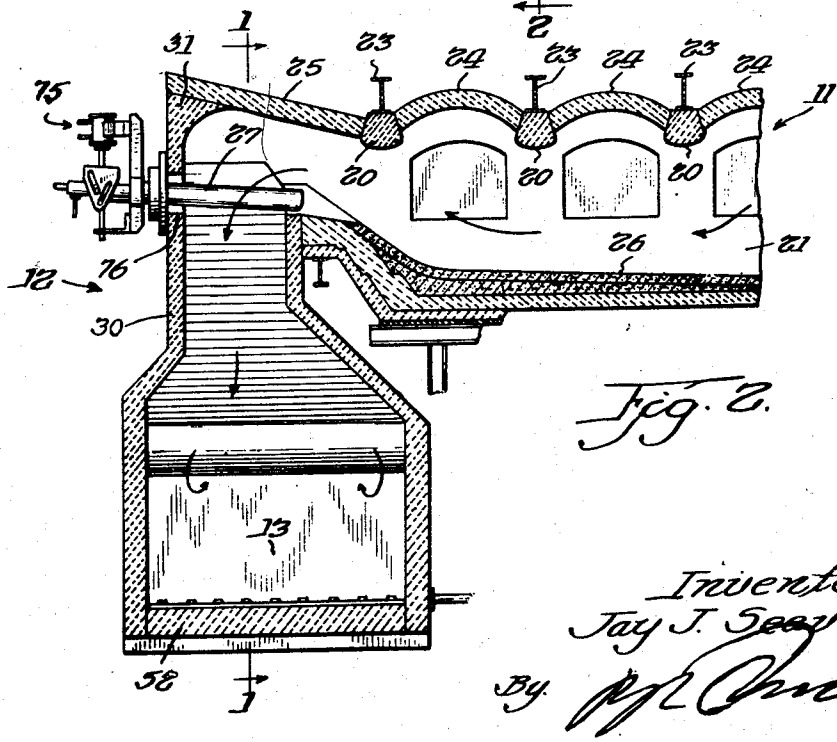


Fig. 2.

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Fig. 3.

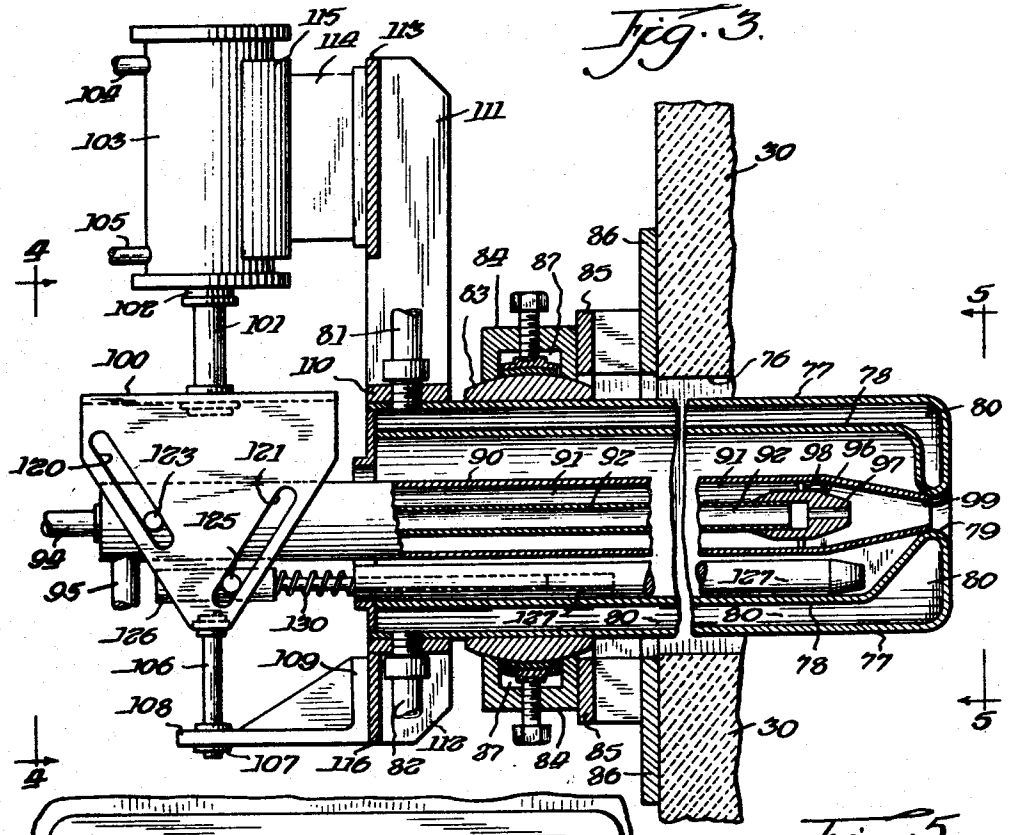


Fig. 5.

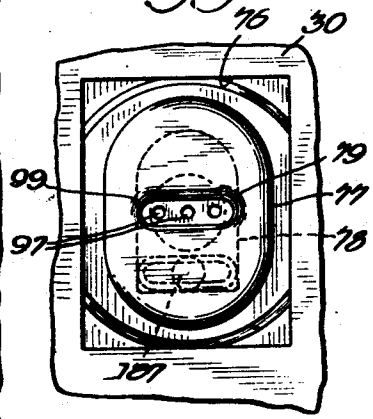
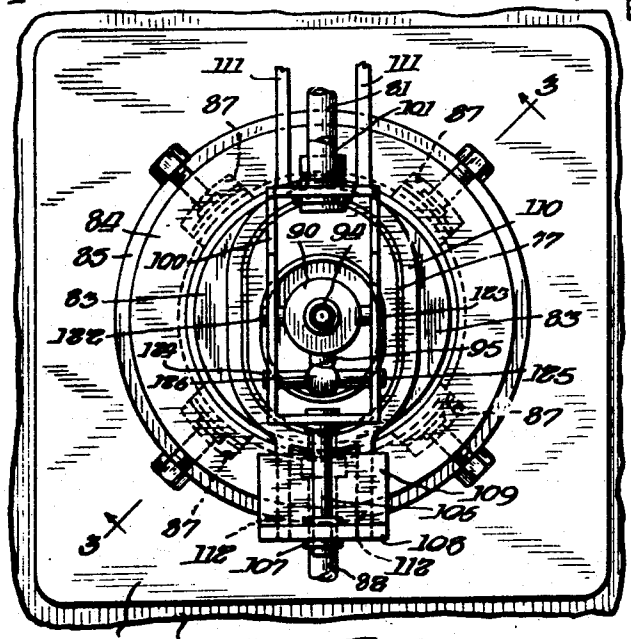


Fig. 4.



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BURNER FOR OPEN-HEARTH FURNACES

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6 Claims. (Cl. 158—1)

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The present invention relates to burners such as are utilized in firing furnace crucibles and is particularly concerned with open hearth furnace burners of the type used in multiples for directing combustion supporting gases in respect to a hearth bath.

This application is a division of copending application Serial No. 149,720, filed March 15, 1950, now Patent No. 2,640,692, dated June 2, 1953.

A principal object of the invention is to produce a directional flame projecting nozzle type of burner for open hearth furnaces which will issue a flat divergent flame, which may be positively secured in an infinite variety of aimed positions respecting a furnace crucible, and which may be expeditiously controlled to promptly retract its supply nozzle and generator apparatus from exposure in the burner tube housing during recycle firing intervals while simultaneously plugging the burner tube apparatus to prevent infiltration thereof by gas borne solids.

Additional objects and features of the invention will be brought out in the course of the detailed description of certain embodiments, which will presently be rendered with reference to the accompanying drawings. In these drawings,

Fig. 1 is a diagrammatic sectional view through portions of an open-hearth furnace taken approximately along line 1—1 in Fig. 2;

Fig. 2 illustrates in similar diagrammatic representation corresponding portions of the furnace in sectional view taken approximately along line 2—2 in Fig. 1;

Fig. 3 shows an embodiment of the novel burner structure partly in diagrammatic elevational and partly in diagrammatic sectional view, the sectional view being taken approximately along line 3—3 in Fig. 4;

Fig. 4 represents a diagrammatic end view of the burner structure and control therefor, as seen from the outside of the furnace, that is, as seen from the left of Fig. 3; and

Fig. 5 is a diagrammatic end view of the burner structure as seen from the inside of the furnace hearth, that is, as seen from the right of Fig. 3.

Like parts are indicated by like reference numerals throughout the drawings. Known elements and details will be discussed only to the extent required for explaining what is considered new.

The open-hearth furnace shown in Figs. 1 and 2 includes the usual principal sections comprising the furnace hearth structure proper, which is generally indicated by numeral 11, two conduit sections—one at either end of the hearth structure and downwardly extending therefrom—one of these conduit sections being indicated at 12, each conduit section terminating in a slag chamber or pocket 13 and each slag chamber being associated with a so-called checker or regeneration chamber 14 containing suitable bricks through which the exhaust gases pass for heat exchange purposes and finally for exhaust through the flue 15 to a suitable stack. Solids entrained in the exhaust gases are precipitated into and deposited on the floor of the slag chamber 13; the gases free of solids passing through the checker chamber 14 transmit the heat to the bricks in such chamber, the bricks retaining the heat for heat-conserving purposes. The current is periodically reversed, after removing the solids deposited in the slag chamber 13, and fresh air is injected into the flue 15 for passage through the heated bricks in the checker chamber 14 where the air is pre-heated, passing then through the slag chamber and upwardly through the conduit 12 to the furnace hearth to sweep over the hearth bath to the other end thereof for exhaust through the conduit at such other end, which corresponds to the conduit 12, and further passage from this conduit to the corresponding slag chamber and thence through the associated checker chamber to the exhaust flue.

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In the parlance of the art, the conduit 12 is referred to either as "downtake" or as "uptake," depending on the operation cycle during which the gases sweep either downwardly from the furnace hearth in the form of exhaust gases or upwardly as fresh pre-heated air to the furnace hearth to aid in the processing of the hearth bath.

As shown in Figs. 1 and 2, the roof of the furnace hearth comprises a number of transverse baffles 20 made of suitable high heat-resisting refractory material. These baffles extend between the hearth walls 21 and 22 on top thereof and may be suspended from beams 23. Disposed between each pair of baffles 20 is a transversely extending arch 24 made of suitable refractory material. At each end of the structure is disposed a roof portion 25 likewise made of refractory material joining with the wall 30 at the top 31 thereof.

The hot gases created by burners such as 27 and coming from the "uptake" 12 at the right end of the furnace hearth, as seen in Fig. 2, sweep over the hearth bath on the hearth floor 26 from right to left, as generally indicated by the arrows in Fig. 2.

The new burner structure diagrammatically

shown in Fig. 2 at 27, with its control means generally indicated at 75, will now be described more in detail with reference to Figs. 3–5.

Referring now to Figs. 3–5: Numeral 30 indicates the furnace wall shown in Fig. 2 by identical reference number. This wall is provided with openings 76, one for each burner. It has been assumed in the example shown in the drawings that there are three burners 27, 73, and 74, as shown diagrammatically in Fig. 1. More or fewer of such burners may of course be provided.

Each burner comprises a cross-sectionally generally oval or elliptic housing and cooling jacket having the walls 77, 78 which converge at the inner operating end to form a relatively wide nozzlelike opening 79. The walls 77, 78 form the chamber 80 for the flow of cooling water which may be circulated through the structure by way of the inlet 81 and outlet 82. The housing or jacket has been assumed to be of oval or generally elliptic structure, but can of course assume any desired form; for example, it may be cross-sectionally circular or square.

Suitably secured to the outside of the housing at a point near the outer end thereof, that is, where the burner projects to the outside of the furnace through the opening 76 in the furnace wall 30, is a circular bearing ring 83 which rides in a cage 84, the latter being fixedly mounted on the furnace wall 30 by means of a bracket 85 which in turn is carried on the plate 86. The cage 84 is provided with a suitable number of recesses 87, each containing pressure shims or shoes, as particularly shown in Figs. 3 and 4 for coaction with corresponding bolts, so as to fix the bearing ring 83 and therewith the corresponding burner in any position of angular adjustment with respect to the fixedly mounted cage. The bearing ring 83, riding in the cage 84, thus coacts with the cage in the nature of a universal joint, which permits adjustment of the corresponding burner angularly with respect to the hearth bath so as to focus the burner flame upon the hearth bath as desired.

Disposed within the cooling jacket or housing is the burner proper which comprises an outer tubular member 90 forming an annular space 91 with the inner tubular member 92 which is concentrically disposed therein, as particularly shown in Fig. 3. At the outer end is an inlet 94 for supplying to the inner tube 92 any suitable fuel, which may be oil, gas or tar, for example, and an inlet 95 for supplying to the annular space 91 a suitable atomizing fluid, which may be air or steam, for example. At the inner end of the tubular member 92 is provided a distributor element 96 consisting of a flat member which extends substantially across the inner clearance of the outer tube 90, and forms three nozzlelike openings 97 (see also Fig. 5) which communicate with the inside of the fuel-feed tube 92. The distributor 96 is held within the outer tubular member 90 by means of a spider 98. The inner end of the outer tube 90 is flattened as indicated at 99, to form a Venturi-like nozzle opening which is disposed within the elongated opening 79 formed in the inner face of the housing or cooling jacket.

The flame which will issue from the nozzle opening of the above described structure will be a flat, wide flame instead of a circular flame, which is in keeping with the intended operation of the burner, to produce a concentrated flame that can affect a relatively large area of the hearth bath. The angle at which this flat, wide flame strikes the hearth bath is adjustable, as previously described, and inasmuch as there are a plurality of such adjustable burners it is possible to produce a flat, wide flame of desired width and intensity, composed of the flames of the various burners, and properly angularly focused upon the hearth bath to obtain the best effect and the most efficient operation.

It may be mentioned in passing that this angularly adjusted, flat, wide, flame, which may thus be produced by each burner and by all burners combined, also contributes toward favorable conditions which promote the efficient utilization of the new roof structure discussed previously. It is clear that, if the flame is focused upon the hearth bath and concentrated thereon, like a fiery sheath which extends substantially in parallel to the transverse plane of the hearth bath, the flame and the heat are used where they are needed, keeping them away from direct contact with portions of the roof.

As indicated before, the furnace is operated in cycles, using first the burner or burners at one end of the hearth, for example, the burners disposed at the right end of the hearth as it is shown in Fig. 2. The gas stream, including preheated air, will then sweep over the hearth bath in the general direction indicated by the arrows in Fig. 2. After a while this particular burner or burners at the corresponding end of the hearth are shut off, the solids deposited in the corresponding slag chamber are removed, and fresh air is drawn through the checker chamber where it is preheated, to flow upwardly through the "uptake" shown in Fig. 2 to sweep over the hearth bath, and at the same time the burner or burners 27 shown in Fig. 2 are ignited to produce the angularly adjusted flat and wide flame which is focused on the hearth bath, as described before. At this particular time, while the cycle is in operation, the burners at the opposite end of the hearth must be protected against the ingress of slag and solid particles which are propelled across the hearth with the gas stream flowing for exhaust toward the corresponding "downtake," as already described.

The device for protecting an inactive burner against the ingress of solids entrained in the gas stream, which comes from the opposite end of the hearth, includes control means comprising a cam cage 100 which may be operated by the connecting rod 101 extending from the piston 102 which projects from a hydraulic or suitable compressed air cylinder 103. Any desired operating liquid or fluid may be circulated through the cylinder 103 by means of the inlet and outlet 104 and 105. Known control means such as valves and the like have been omitted to simplify the drawing. At the lower end the cage 100 carries a guide rod 106 which moves within a bearing bushing 107 carried by an arm 108 of a bracket having a mounting 109. On the housing or cooling jacket of the burner, that is, on the outer wall 77 at the outer end thereof, is mounted a ringlike member 110 which carries arms 111 projecting upwardly and arms 112 which project downwardly. The arms 111 form a mounting 113 which carries a bracket 114 having an extension 115 for supporting the cylinder 103, and the arms 112 carry a mounting 116 for securing the bracket member 109 from which extends the arm 108 carrying the bushing 107 for guiding the pin 106 secured to the lower end of the cam cage 100.

The cam cage 100 is provided with cam slots

120 and 121. In the cam slots 120 ride pins 122, 123 carried by the outer tubular member 90 of the burner proper, and in the cam slots 121 ride pins 124, 125 carried on the operating member 126 having a reduced rodlike portion which extends into a boring in the plug rod 127. The latter, at its inner end, is of flat configuration with its front end tapered as shown in Fig. 3, or carries a flat plug member for plugging the elongated opening 79 in the inner end of the housing or cooling jacket 77 into which extends the Venturi-like inner end 99 of the burner.

Now, when it is desired to plug the opening 79 of the housing or cooling jacket of a particular burner against ingress of solid particles, that is, when it is desired to make the particular burner inactive preparatory to igniting the burner at the opposite end of the hearth, operating fluid is injected into the cylinder 103 to drive down the cam cage 100, and during such operation the cam slots 120 cause the pins 122, 123 to displace the burner element comprising the fuel supply tubes 90, 92 within its housing or cooling jacket by moving it through a composite motion including a slight angular displacement in a counterclockwise direction and at the same time withdrawing it axially rearwardly, thus moving the flattened Venturi-like inner end 99 of the burner element to within its housing and disposing it in angular position in the upper portion thereof. At the same time the cam slots 121 operate against the pins 124, 125 of the actuating member 126, driving this member inwardly and causing the spring 130 to move the plug 127 inwardly, at the same time displacing it counter-clockwise until the inner tapered end of the plug 127 closes the opening 79. It is to be noted that the plug is actuated through the medium of the spring 130 to put its tapered inner end yieldingly in engagement with the inside walls of the jacket forming the opening 79. The ends of the spring 130 are suitably secured, one to the actuating member 126 and the other to the outer end of the plug 127 so as to effect the withdrawal of the plug 127 again in a yielding manner by the spring 130. This resilient or yielding operation of the plug protects against damage the inner end of the housing or cooling jacket forming the opening 79.

After the burner, or each of the burners, at the corresponding end of the hearth is put in inoperative position and its flame opening plugged, as described above, the next operating cycle can proceed after first putting the burner or burners at the respective end of the hearth in operative position. This is done by again injecting operating fluid into the cylinder 103 for moving the cage 100 in opposite direction, namely, upwardly, during which motion the burner element within its housing or cooling jacket is moved in a composite motion angularly clockwise and at the same time inwardly into the position shown in Fig. 3, while the associated plug 127 is moved in a composite motion angularly in clockwise direction and at the same time outwardly until it is in the position shown in Fig. 3. The corresponding burner is now again in operative position.

Changes may be made within the scope and spirit of this invention as described in the foregoing. Accordingly, what is believed to be new and desired to be protected by Letters Patent is that set forth in the hereunto appended claims.

I claim:

1. In an open-hearth furnace, a burner comprising a housing forming a cooling jacket which forms a nozzlelike opening at the inner end thereof, means for adjustably mounting said housing in a wall of said furnace with the inner end projecting into the hearth thereof, a flame-producing element disposed within said jacket and forming a Venturi-like inner end for alignment with the nozzlelike opening formed by said jacket, means for retracting said flame-producing element within said jacket, and means for plugging said nozzle-like opening of said jacket.

2. A burner for an open-hearth furnace comprising a double-walled casing forming a space for circulating a cooling liquid therethrough, a universal joint for angularly adjustably mounting said casing on a wall of said furnace, means for moving said casing for adjustment and for securing it in angularly adjusted position, a burner element within said casing having a tubular inner end for flame-throwing alignment with an opening formed at the inner end of said casing, mounting means carried by said casing at the outer end thereof, cam means movably carried by said mounting means, actuating means for said cam means, and means operable by said cam means for adjusting the position of said burner element within said casing.

3. A burner for an open-hearth furnace comprising a double-walled casing forming a space for circulating a cooling liquid therethrough, a universal joint for angularly adjustably mounting said casing on a wall of said furnace, means for moving said casing for adjustment and for securing it in angularly adjusted position, a burner element within said casing having a tubular inner end for flame-throwing alignment with an opening formed at the inner end of said casing, mounting means carried by said casing at the outer end thereof, cam means movably carried by said mounting means, actuating means for said cam means, means operable by said cam means for adjusting the position of said burner element within said casing, and means operable by said cam means for closing the opening formed at the inner end of said casing to make said burner inactive.

4. In a furnace, a plurality of burners disposed side by side and extending into the combustion space of said furnace through an end wall thereof, means for adjustably mounting each burner, means forming an elongated nozzlelike opening at the inner end of each burner which projects into said combustion space, fuel supply means in each burner for supplying a combustible fluid fuel to said nozzlelike opening through a plurality of individual relatively closely spaced orifices therein, means for supplying a fluid medium for intermixture with the fluid fuel supplied through said orifices to support ignition of said fuel so as to create upon ignition thereof a relatively flat and wide flame directed from said nozzlelike opening into said combustion space, means for adjusting said adjustably mounted burners to adjust said flames relative to the combustion space, means for retracting said fuel supply means of each burner, and means for plugging said nozzlelike opening of each burner while said fuel supply means is retracted.

5. A burner for a furnace comprising an outer cooling jacket extending into the combustion space of said furnace through an end wall thereof, means for adjustably mounting said burner, said cooling jacket forming an elongated nozzlelike opening at the inner end thereof which projects into said combustion space, fuel supply means in

said burner for supplying a combustible fluid fuel to said nozzlelike opening through a plurality of individual orifices therein, mixture means for supplying a fluid medium for intermixture with said fluid fuel supplied through said orifices to support ignition of said fuel so as to create upon ignition thereof a relatively flat and wide flame directed from said nozzlelike opening into said combustion space, means for adjusting said adjustably mounted burner to adjust said flame relative to the combustion space, means for retracting said fuel supply and said mixture means, and means for plugging said nozzlelike opening while said fuel supply and said mixture means are retracted.

6. In a furnace, a burner comprising an outer housing, means for adjustably mounting said housing in a wall of said furnace, the inner end of said housing projecting into the combustion space of said furnace, said housing forming at such inner end an elongated nozzlelike flame ejection opening, a tubular member in said housing for supplying at the inner end thereof a fluid combustible fuel to said nozzlelike opening to create thereat a flame upon ignition of said fuel which is directed into said combustion space, a control member disposed at the outer end of said tubular member, actuating means for displacing said control member to move said tubular member to adjust the position of the inner end thereof relative to said nozzlelike opening, a normally retracted plug disposed in said housing adjacent to and extending generally in parallel with said tubular member, and means controlled by said control member upon actuation thereof by said actuating means for displacing said plug to adjust the inner end thereof relative to said nozzlelike opening.

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