May 22, 1928. 1,670,626

J. D. LALOR

FURNACE FIRING APPARATUS

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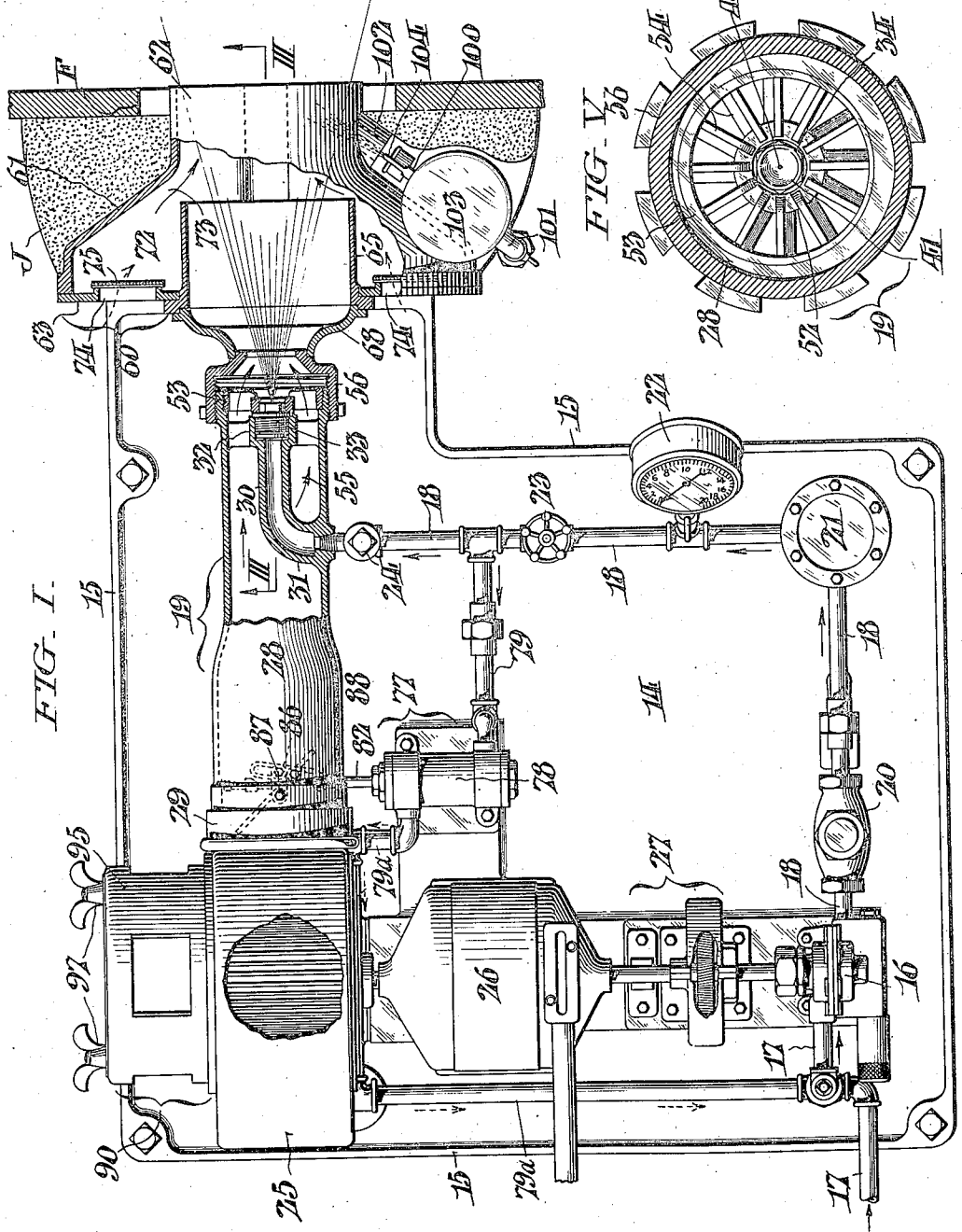


FIG. I.

FIG. V.

WITNESSES

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FURNACE FIRING APPARATUS

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FIG. II.

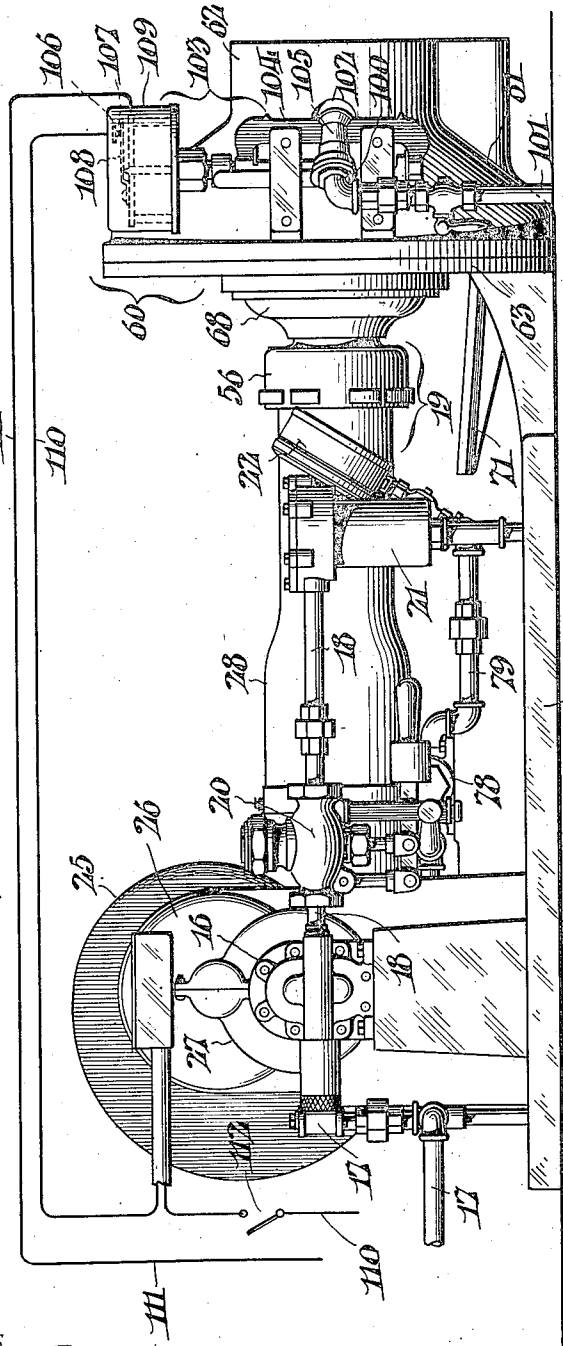


FIG. VIII.

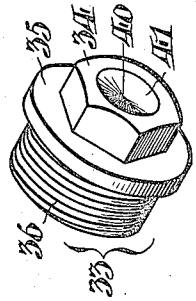


FIG. VII.

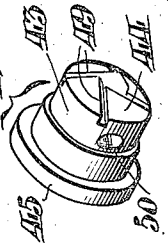
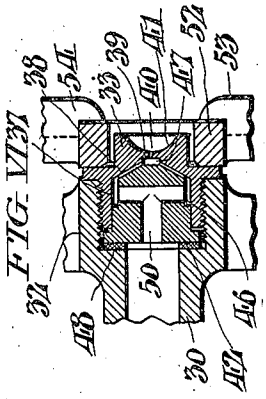


FIG. VIIA.



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FURNACE FIRING APPARATUS

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FIG. III.

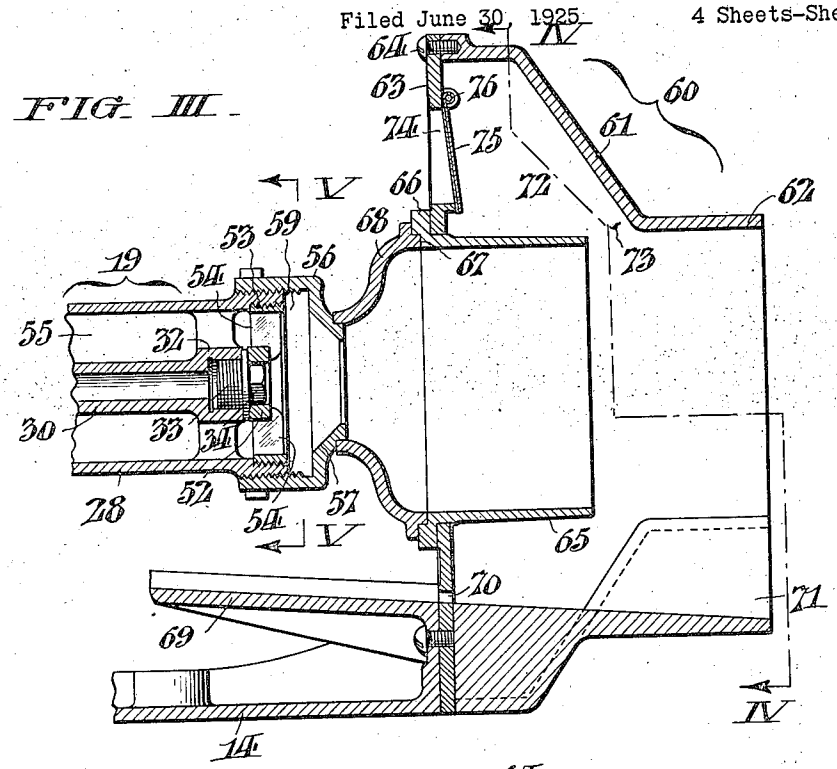
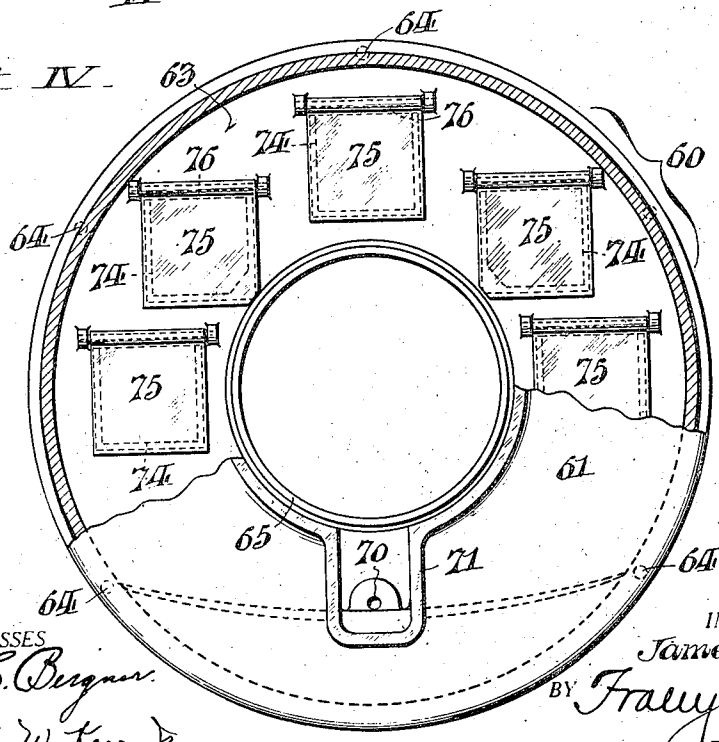


FIG. IV.



WITNESSES

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FURNACE FIRING APPARATUS

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FIG. IX.

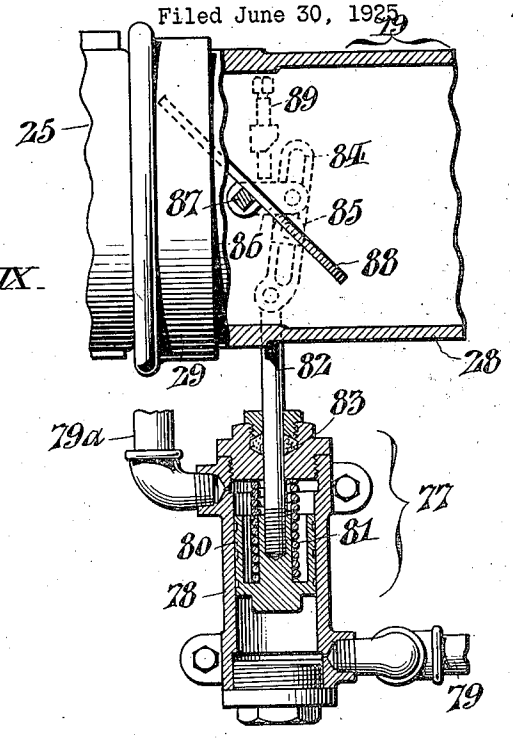


FIG. X.

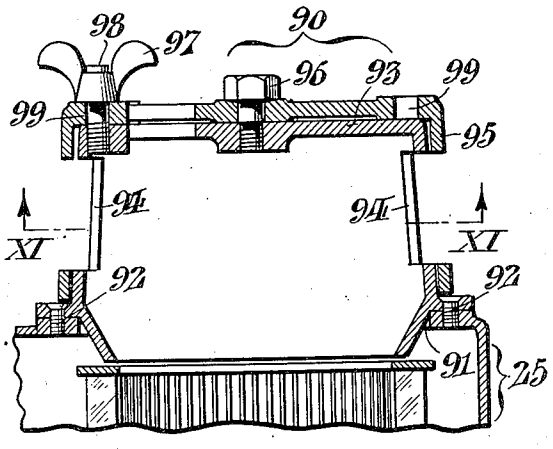
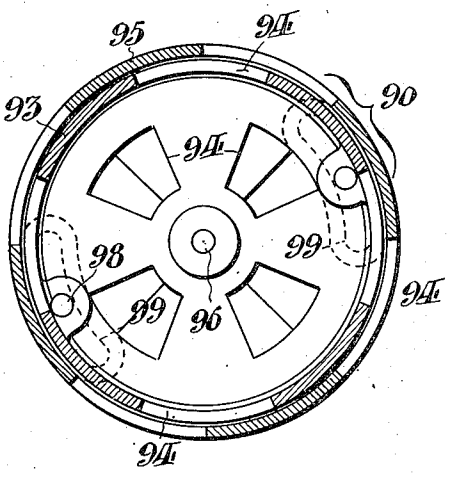


FIG. XI.



WITNESSES

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UNITED STATES PATENT OFFICE.

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FURNACE-FIRING APPARATUS.

Application filed June 30, 1925. Serial No. 40,501.

This invention relates to firing apparatus adapted for consumption of oils or other fluent combustibles, and of a type intended more particularly for domestic use in firing household furnaces and the like.

My invention is directed toward providing a firing apparatus of the above character which is extremely compact so as to occupy a minimum space; self-contained for ease of installation; reliable in operation; high in efficiency yet very low in fuel consumption; and free against flooding and against danger from explosion.

The foregoing and other advantages are readily attainable with the typical embodiment of my invention shown in the drawings, whereof Fig. I is a plan view of the furnace-firing apparatus with certain portions in section to expose details which would be otherwise hidden.

Fig. II is a side elevation of the organization as viewed from the bottom of Fig. I.

Fig. III is a fragmentary sectional view on a larger scale of the carbureting burner and associated parts taken as indicated by the arrows III—III in Fig. I.

Fig. IV is a cross sectional elevation in diversified planes as indicated by the dot-and-dash line IV—IV in Fig. III, and viewed in the direction of its terminal arrows.

Fig. V is a cross sectional view through the burner taken as indicated by the arrows V—V in Fig. III.

Fig. VI is an enlarged fragmentary sectional view, on a larger scale than Fig. III, showing the details of the atomizing nozzle of the burner to better advantage.

Figs. VII and VIII are perspective views showing component parts of the atomizing nozzle.

Fig. IX is a fragmentary sectional elevation showing the automatic means for maintaining the proper proportioning of the combustion-supporting air with regard to the fuel delivered to the burner.

Fig. X is a detail sectional view of the adjustable louver for controlling admission of air to the blower; and,

Fig. XI is a sectional view taken as indicated by the arows XI—XI in Fig. X.

Referring first to Figs. I and II, it will be observed that the various parts of the organization are mounted upon a bed plate 14, which is generally of rectangular configuration and characterized by an upstanding peripheral flange 15 to retain any drippings of the fuel oil. Occupying the lower left hand corner of this bed plate 14 (as considered in Fig. I), is a gear pump 16, of a suitable type, to which the fuel oil is conducted through a pipe line 17, leading from a convenient source of supply (not shown), and from which the oil is discharged under comparatively high pressure into piping 18 that connects with a burner comprehensively indicated 19. Interposed in the piping 18 are various necessary or desirable auxiliaries such as an automatic shut-off valve 20, a strainer or filter 21, a pressure gauge 22, and hand valves 23, 24. Combustion-supporting air is concurrently supplied to the burner 19 by a centrifugal blower 25, occupying the upper left hand (Fig. I) corner of the bed plate 14. This blower 25 is actuated in the present instance by an electric motor 26 which also drives the pump 16 through reduction gearing 27.

Referring now more in detail to the burner 19, the same will be observed to comprise a tubular body 28 which is directly coupled with the outlet 29 of the blower 25 and serves, for the most part, as a conduit for the combustion-supporting air. Adjacent the outer end however, the tubular burner body 28 has formed in it, a comparatively short axial duct 30 (see Figs. I, III and VI) which is turned laterally as shown at 31 for connection of the fuel pipe 18. An enlargement 32 at the opposite terminus of the duct 30 provides a cavity to take the screw tip 33, illustrated in perspective in Fig. VIII, said tip being distinguished by a polygonal head 34, a circumferential flange 35 and an externally-threaded shank 36 with a hollow 37 Fig. VI. The base of the hollow 37 is coned as indicated at 38, and counterbored at 39 for a purpose which will presently be explained, the counterbore 39 having outlet through a minute axial orifice 40 leading to a concavity 41 in the face of the head 34. The tip 33 just described, together with the core-piece 42 separately detailed in Fig. VII, constitute the atomizer for breaking up the oil. This core-piece 42, although generally cylindric in configuration, has its front end 43 somewhat reduced diametrically and provided with a cone face 44; while its opposite

end is circumferentially enlarged to the form of a flange 45. When the parts are assembled as shown in Fig. VI, the core-piece 42 is almost wholly accommodated in the hollow 37 of the screw tip 33, with consequent formation of an annular chamber 46 around the reduced portion 43 of said core-piece, and a small circular chamber 47 by closure of the counter recess 39. A compressible ring gasket 48, for example of asbestos sheathed in copper, interposed behind the flanged end of the core-piece 42, not only prevents displacement of the latter, but insures snug contact between the contiguous conical surfaces 38, 44 with the result that the chambers 46, 47 are isolated from one another except for communication by way of tangentially-disposed channels 49 in the sloping face of the core-piece 42. The annular chamber 37 also communicates with the fuel or axial duct 30 by way of branched passages 50 through the core-piece 42. As a consequence of this arrangement, the oil delivered under pressure by the duct 30, is conducted through the passages 50 of the core-piece 42 and into the annular chamber 46, wherein it is distributed to the tangential channels 49 for swirling within the small circular chamber 47, and expulsion through the restricted axial orifice 40 of the tip 33 as a finely-divided divergent spray.

As shown in Figs. I, III and VI, the head 34 of the tip 33 projects into the axially apertured hub 52 of a whorl 53 with radial vanes 54 which span the annular space 55 intervening between the fuel duct 30 and the wall of the burner 19. The whorl 53 is screwed into the end of the tubular burner body 28; and a cap piece 56, with a convergently-tapered axial opening 57, in turn screwed about the end of the burner 19 with provision of a clear space 59 which will hereinafter be referred to as the "mixing chamber". Incidental to the constant operation of the blower 25, and by virtue of enforced traverse through the whorl 53, the combustion-supporting air is gyrated as it enters the mixing chamber 59 wherein it encounters the spray of atomized fuel issuing from the tip 33 of the nozzle with the result that the two are intimately commingled through enforced gyration, the combustible mixture attenuating in passing through the flared axial opening 57 of the cap piece 56, and discharging at accelerated velocity from the burner 19.

Such gaseous combustible mixture is directed by the burner into an aligned element 60, which, from its function, may be conveniently termed an "inductor". As best shown in Fig. III, the body 61 of this inductor is of hollow frusto-conical configuration, and terminates in a co-axial neck 62 adapted to project into the fire box opening F of the furnace (Fig. I), the union between the body and the furnace being made air tight by a jacket J of cement or the like, as conventionally shown. The inductor body 61 is closed by a frontal plate 63 secured by screws or other convenient fastening means 64, said plate having a central opening to take a removable tube 65 with a stop flange 66 at one end to determine its position in the assemblage. At the outer end the removable tube 65 is recessed as at 67 for accurate fit with a bell-shaped expanding connector 68 provided for bridging the interval between the burner 19 and the inductor 60. The smaller end of the expanding connector 68 is machined for accurate fit with the cap piece 56 of the burner 19, said cap piece thus acting as a coupling to hold the several aligned parts in place. By screwing the cap piece 56 inward on the burner body 28 to release the connector 68, the tube 65 can be readily removed when access must be had to the interior of the inductor 60 for inspection and cleaning. Also, with the expanding connector 68 out of the way, the cap piece 56 in turn may be removed to enable withdrawal of the whorl 53 and the nozzle parts 33 and 42 as may be required occasionally to clean them of any clogging matter. Leakage of oil, likely to attend disassemblage of the nozzle parts 33 and 42 in the manner just explained, is caught by an underlying gutter 69 that is secured to the front of the inductor 60 (see Fig. III), with sufficient tilt to direct the collected oil through a hole 70 in the frontal plate 63 and into a continuation constituted by a downward offset 71 of the neck 62. The leakage oil is accordingly conducted through the inductor 60 and into the combustion zone within the furnace, thereby obviating exposure of oil accumulation at the exterior and reducing the danger of fire from this source.

Referring again to the inductor 60, attention is directed to the fact that the removable tube 65 sets apart a surrounding chamber 72 within the body 61 with provision of annular portage communication at 73 with the neck 62, whereby suction is created in said space concurrently with the passage of the combustible mixture at high velocity enroute to the furnace. Under such suction, an additional or auxiliary supply of air is drawn into the inductor 60 through a number of rectangular ports 74 in the frontal plate 63 under governance of gravity-fall members or flap valves 75 suspended on pivots 76. By virtue of being thus suspended, the flap valves 75 can freely respond to variations in the suction so that the quantity of air admitted is always proportionate to the velocity of the fuel mixture. This provision is made to prevent a so-called "minus" furnace such as likely to exist when the full proportionate quantity

of combustion-supporting air is directly mixed with the fuel initially, and has the further advantage of minimizing the noise of furnace operation with my apparatus as well as to render the combustion perfect. In the event of back pressure from within the furnace due to possible back fire at starting, the flap valves 75 will be instantaneously forced to closed position and thus prevent flame from escaping through the ports 74.

For the purpose of accurately maintaining a predetermined proportioning of air and fuel delivery to the burner 19, I make provisions as follows:

Referring to Figs. I and IX, 77 indicates a control device which is governed by the pressure of the fuel flowing in the pipe 18. This device comprises a cylinder 78 in communication with the pipe 18 through a branch 79. The fluid entering the cylinder 78 at the bottom, reacts against a piston 80 that is subject to the influence of a spring 81, and has a rod 82 extending to the exterior through a stuffing box 83. Adjustable along a slot 84 in the outer end of the rod 82, is a block 85 which engages a crank arm 86 on the pivot axis 87 of a butterfly vane 88 within the air conduit of the burner 19. The limit of movement of the butterfly vane 88 in one direction is determined by a set screw 89 that projects into the path of the crank arm 86. By adjusting the block 85 along the slot 84 of the piston rod 82, it will be seen that the said extent of lost motion between the piston rod and crank arm 86 may be regulated as required to permit a certain amount of flexibility in the operation of the butterfly vane 88 to offset any spasmodic actuations in the cylinder 78. By virtue of being connected to the fuel pipe 18, the control device 77 is at all times subject to the pressure of the oil, and therefore also directly to the flow thereof, such variations being transmitted to the piston 80, and by the latter, through the various instrumentalities described, to the butterfly vane 88 which accordingly changes its position to permit either an increased or decreased flow of air through the body of the burner 25 for commingling with the vaporized fuel discharged from the nozzle tip 33. A pipe connection 79a conducts any leakage which may pass the piston 80 to the suction side of the pump 16, see Fig. I.

As a means to regulate admission of air into the blower 25, a louver control, such as comprehensively designated 90 in Figs. I, X and XI is provided, the same being secured over the blower intake opening 91 by screws or other convenient fastening means 92. The fixed part 93 of the louver control 90 has at the front and also intervals circumferentially, inlets 94; while the companion part 95 is movable about the first under support of an axial screw stud 96 in adjusting the area of said inlets in an obvious manner. the adjustments being fixable by winged clamp nuts 97 engaging studs 98 which are anchored in the fixed part 93 and project through arcuate motion-limiting slots 99 in the movable part 95.

For convenience in starting combustion, the apparatus is equipped with a pilot burner 100 whereto gas is conducted by a valved pipe 101, the flame from the pilot being projected into the combustion zone within the furnace through an opening 102 in the neck 62 of the inductor 60. Associated with the pilot burner 100 is a thermostatic control device 103 which embodies a yoke 104 of expansible metal with an orifice 105 through which the pilot flame plays. Under the action of the heat, the yoke 104 is normally maintained in an expanded condition to hold contacts 106, 107 closed, this action being opposed by a leaf spring 108. The contacts 106, 107 are housed in a protective casing 109 and interposed in the conductors 110, 111 constituting the power line to the electric motor 26.

In the event of the pilot flame going out, attendant contraction of the yoke 104 will be followed by automatic opening of the contacts 106, 107, interruption of current to the motor 26 and stoppage of the apparatus so that flooding of the furnace with oil cannot possibly take place. A suitable switch 112 is also interposed in the motor circuit at a convenient point between the source of the power and the apparatus.

The operation of the apparatus as a whole is thought to be obvious from the foregoing without necessitating a detailed sequential description. In this connection it is however to be pointed out that, when once started, the apparatus needs but little attention since it is entirely fool proof under protection against flooding afforded by the thermostatic control 103 for stopping of the motor 26 in the event of failure of the pilot flame. Moreover, by virtue of being exceedingly compact and self contained the apparatus requires but very little space for its accommodation, and may be installed with minimum labor and expense.

Having thus described my invention, I claim:

1. In a furnace-firing apparatus of the character described, the combination of a carbureting burner, means supplying liquid fuel to said burner, a blower for concurrently supplying combustion-supporting air to the burner for commingling with said fuel, means adjustable to regulate admission of air to the blower, means automatically operated by the fuel delivery pressure to govern the passage of air from the blower to the burner, and separate gravity-influenced automatic means supplying an auxiliary

quantity of air proportionate with the velocity of the fuel mixture to the discharge from the burner while enroute to the furnace.

2. In furnace-firing apparatus of the character described, the combination of a carbureting nozzle burner, an aligned inductor comprising a hollow body with an axial outlet neck leading into the furnace, a frontal closure plate, and an axial tube setting apart a surrounding chamber within the hollow body with provisions of annular portage communication into the neck aforesaid for induction of an auxiliary supply of air under suction induced by the passing fuel mixture from the burner, flap-valves in the frontal closure plate that admit such auxiliary air proportionate with the velocity of the fuel mixture, a connector bridging an interval between the burner and the inductor while acting to hold the axial tube aforesaid in place, and a screw coupling in turn serving to hold the connector in place with capacity for ready removal for access to the nozzle of the burner, and withdrawal of the aforementioned axial tube for access to the interior of the inductor.

3. In furnace-firing apparatus of the character described, the combination of a carbureting oil burner, an aligned inductor including a co-axial removable insert for conducting the combustible mixture from the burner into the furnace, said inductor having a ported closure under governance of gravity-fall flap-valves adapted to admit auxiliary air proportionate with the velocity of the fuel mixture passing through the insert aforesaid, a removable coupling between the burner and the inductor insert, and an underlying gutter secured to the frontal closure to catch oil leakage from the region of the coupling aforesaid and conveying it through a hole in the inductor closure to the combustion zone within the furnace.

4. A self contained apparatus for firing furnaces with liquid fuel comprising a carbureting burner, a pump for continuously feeding fuel to the burner, a blower for concurrently supplying combustion-supporting air, means incorporated in the burner for individually gyrating the fuel and air, a driving motor common to the pump and blower, an inductor aligned with the burner to conduct the fuel mixture into the furnace, said inductor embodying a series of gravity-fall flap-valves automatically-actuated by the velocity of the fuel mixture to admit an auxiliary supply of air preventive of a "minus" furnace, and a bed plate by which the various parts aforesaid are supported in operative relation.

In testimony whereof I have hereunto signed my name at Philadelphia, Pennsylvania, this 25th day of June, 1925.

JAMES D. LALOR.