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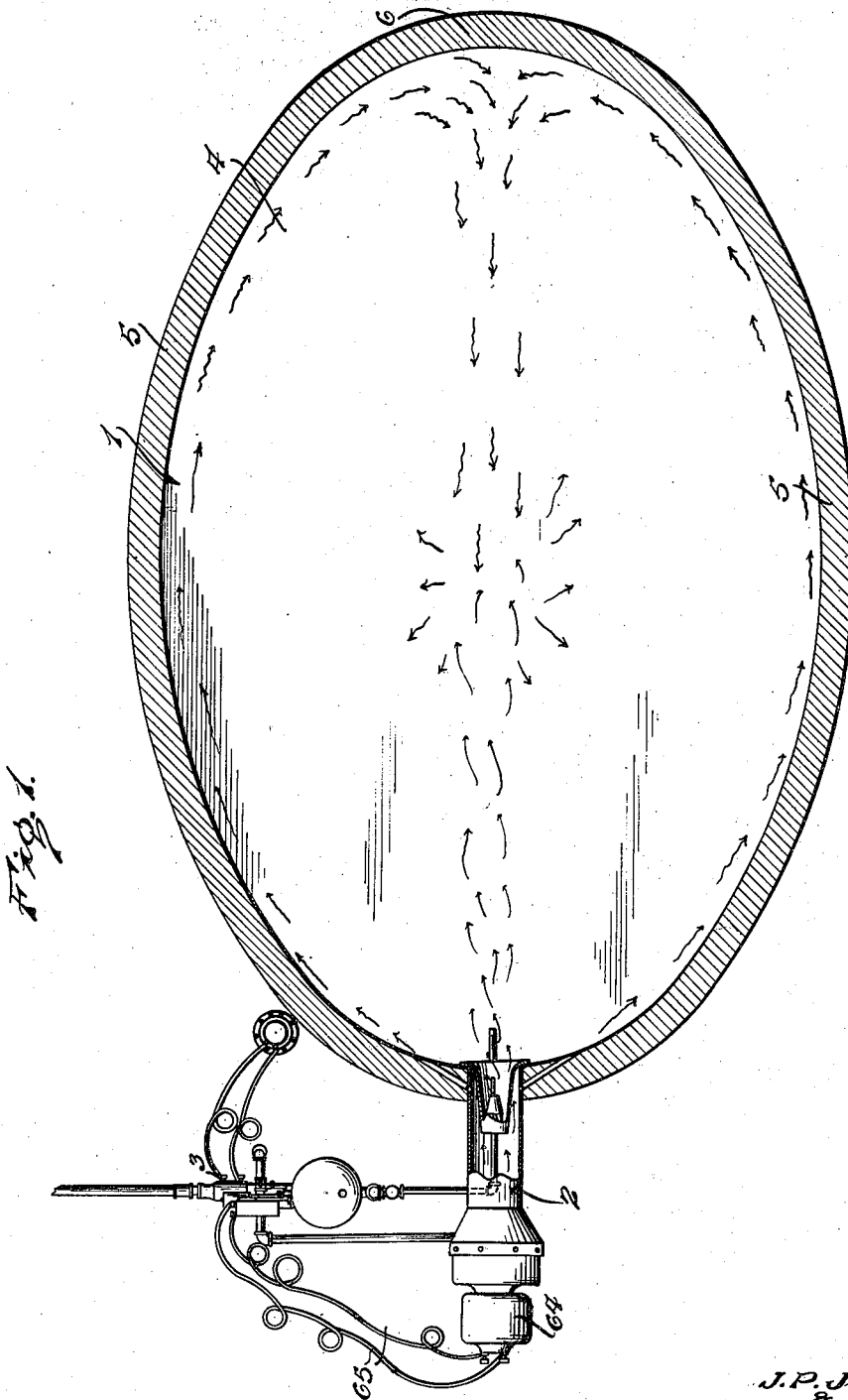
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J. P. JONES ET AL

LIQUID FUEL BURNER AND CONTROL MEANS THEREFOR

Filed Sept. 18, 1923

3 Sheets-Sheet 1



Inventor

J. P. Jones
&
G. Nembock

By

Lacy Tracy, Attorneys

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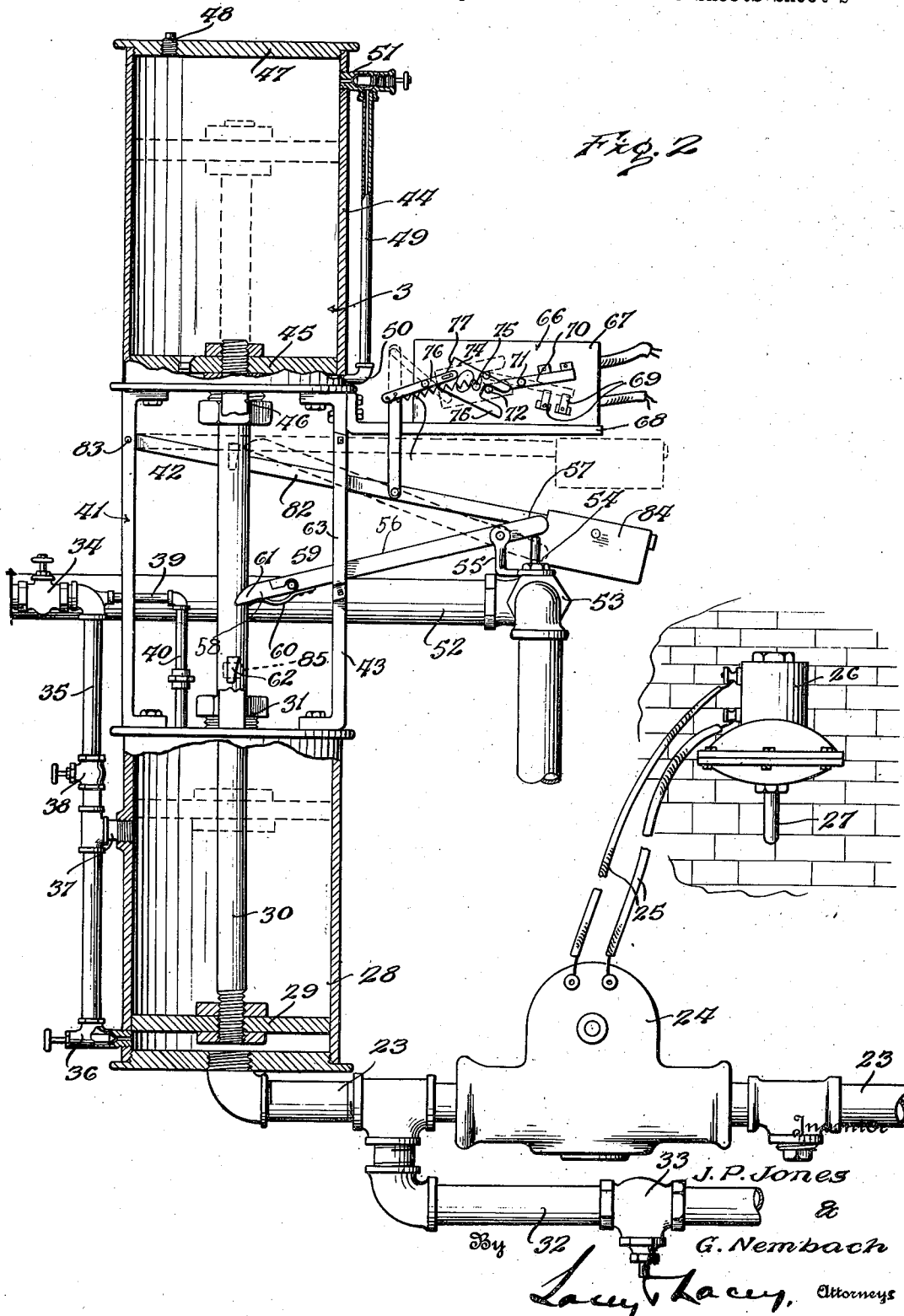
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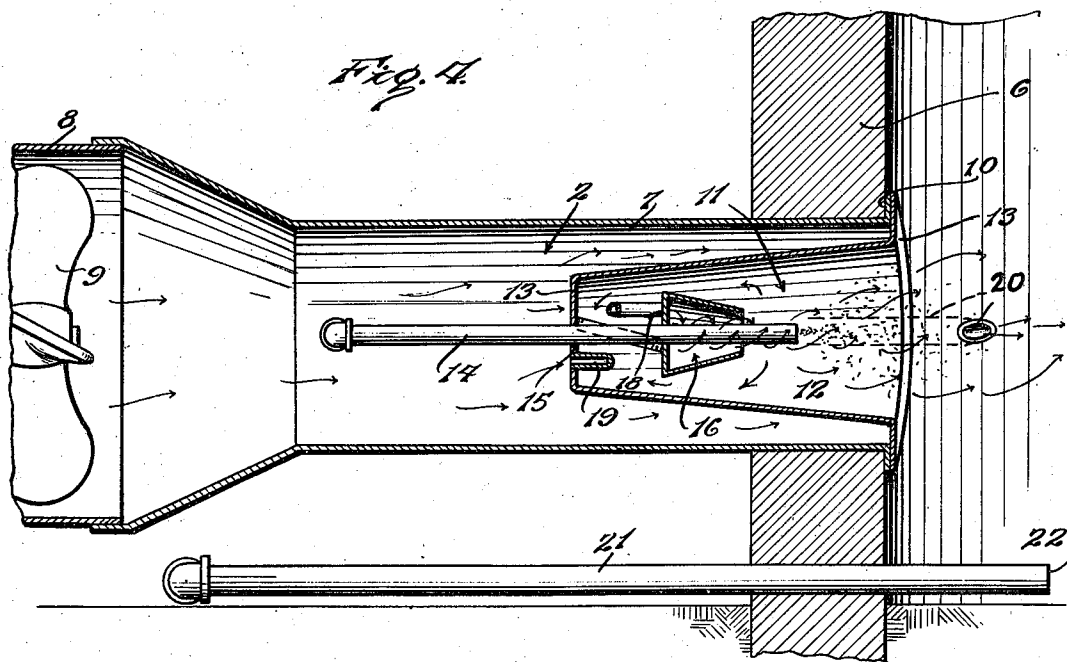
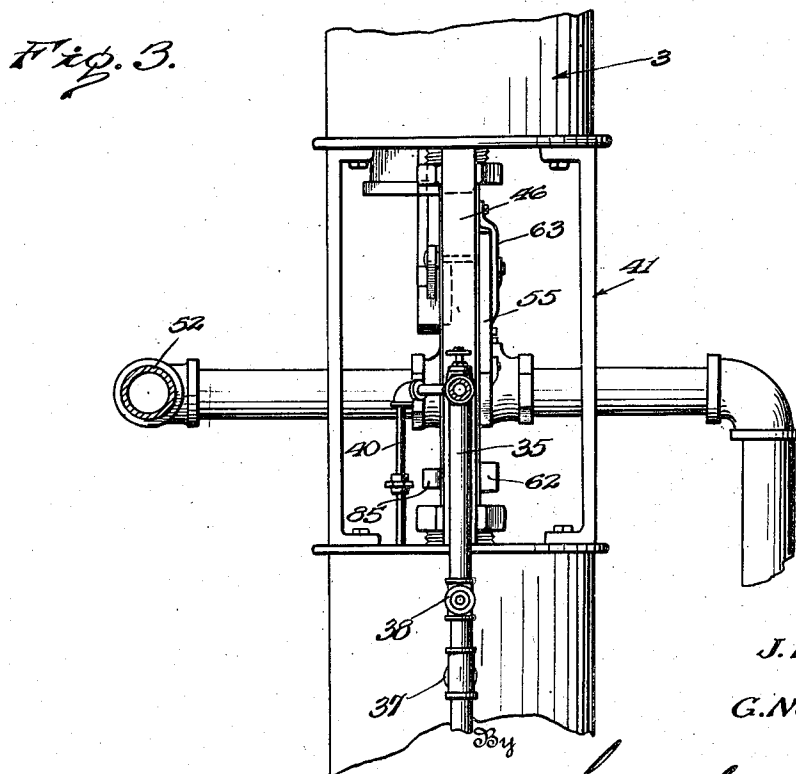
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J. P. JONES ET AL

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3 Sheets-Sheet 3



Inventor

J. P. Jones
&
G. Nemback

Lawrence Attorneys

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UNITED STATES PATENT OFFICE.

JOHN PAUL JONES, OF CINCINNATI, AND GEORGE NEMBACH, OF ST. BERNARD, OHIO.

LIQUID-FUEL BURNER AND CONTROL MEANS THEREFOR.

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This invention relates to liquid fuel burners and control means therefor.

A disadvantage presented by the majority of liquid fuel burners such as are employed in furnaces, is that electrically controlled means is employed for closing the valve to cut off the oil supply when a predetermined temperature is reached. If for any reason the current ceases to flow at the time it is required, the valves will of course remain open. Therefore, it is one of the objects of the present invention to provide a control for liquid fuel burners which will operate automatically to regulate the flow of liquid fuel to the burner and which will require little attention for its successful operation.

Another object of the invention is to provide, in combination with a burner to which both liquid and gaseous fuel are delivered, means for controlling both supplies, automatically, and without waste of fuel or the deposition of carbon in the burner or the conduit leading thereto.

Another object of the invention is to provide a control unit for a liquid fuel burner so constructed and operating in such a manner that when the operation of the burner is interrupted, the liquid fuel remaining in the liquid fuel supply pipe for the burner will be drawn back through the pipe for future use and thus prevent liquid fuel being discharged into the fire box of the furnace in an unconsumed condition, and likewise preventing, as stated, the accumulation of carbon in the liquid fuel supply pipe.

The invention has as a further object to provide a novel construction of liquid fuel burner in which the liquid fuel will be atomized and discharged into the fire box of the furnace in a manner to effect complete combustion of the fuel, thus economizing in fuel and obtaining the best results.

Another object of the invention is to so construct and so mount the burner that air to provide oxygen for supporting combustion will be supplied in the most effective manner.

Another object of the invention is to so arrange the parts of the burner that there will be an exchange of heat units between the hotter portion of the burner and the entering air thus effecting, on one hand, a cooling of the burner, and, on the other hand, a heating of the air before its delivery into the furnace. In this connection the invention also contemplates a pre-heating of the

liquid fuel at the time it is delivered to the burner.

In the accompanying drawings:

Figure 1 is a view in partly in plan and partly in horizontal section illustrating the burner and control unit embodying the present invention installed in the fire box of a furnace of special design;

Fig. 2 is a view partly in vertical section and partly in elevation illustrating the control unit in detail;

Fig. 3 is a side elevation of the control unit;

Fig. 4 is a longitudinal sectional view through the burner, installed.

In the drawings, the furnace fire box is indicated in general by the numeral 1, the burner by the numeral 2, and the control unit by the numeral 3. In order that the invention may be most effectually carried out, it is preferable that the burner and control be installed in connection with a furnace fire box of the elliptical form shown in Fig. 1 of the drawings, the bottom of the fire box being indicated by the numeral 4, and the side and end walls respectively by the numerals 5 and 6.

The burner comprises a cylindrical casing which is indicated by the numeral 7 and which at one end is connected to the discharge 8 of a blower indicated in general by the numeral 9. The blower may be of any of the standard types and in operation is intended to deliver a blast of air through the casing 7. The opposite end of the casing 7 is mounted within one end wall 6 of the fire box of the furnace, being preferably provided with an outstanding flange 10 seating against the inner surface of the said furnace wall. Arranged within the casing 7 is a mixing chamber which is indicated by the numeral 11. The mixing chamber 11 comprises a hollow frusto-conical body 12 preferably provided at its major end with an outstanding flange 13 abutting the flange 10 of the casing 7 and secured thereto in any appropriate manner whereby the said mixing chamber will be supported in axially aligned relation within and to the casing 7. At its said major end, which end opens into the fire box of the furnace, the mixing chamber is left entirely open, but its minor or opposite end is closed, as indicated by the numeral 13 except that openings are formed through this closed end for the fitting of certain pipes which will now be re-

ferred to. The numeral 14 indicates an oil supply pipe which is led into the casing 7 at any desired point and extends through an opening 15 located centrally of the closed end 13 of the mixing chamber, the pipe terminating at its discharge end somewhat short of the open discharge end of the said chamber. The numeral 16 indicates in general an air nozzle which is supported upon the pipe 14 and within the mixing chamber comprising the shell 12, and the said air nozzle comprises a hollow frusto-conical body 17 which is open at its forward or minor end and closed at its major end by an end wall 18 which is formed centrally with an opening adapting the nozzle to be fitted and secured upon the pipe 14, the discharge or minor end of the nozzle being located in rearwardly spaced relation to the discharge end of the said pipe 14. The nozzle 16 is arranged in concentric relation to the pipe as illustrated in Fig. 4 of the drawings. The numeral 19 indicates air supply pipes which are fitted each at one end through the closed end wall 13 of the mixing chamber and at its other end through the closed end wall 18 of the nozzle 16. These pipes therefore establish communication between the interior of the casing 7 and the interior of the nozzle so that when air is delivered under pressure to the casing 7, it will pass through the pipes and into the nozzle and finally be discharged from the nozzle at the open forward end thereof. In order that a vortical movement may be given the air currents delivered from the pipes 19 into the nozzle 16, the pipes are arranged obliquely with relation to the axis of the pipe 14 and in a series around said pipe. Consequently, the jets of air issuing from the pipes are delivered into the nozzle 16 at an angle and, striking the frusto-conical wall of the nozzle, are given a swirling or vortical motion and are so delivered from the discharge end of the nozzle. In consequence of the swirling motion given the air currents, the currents will swirl about and disintegrate or atomize the liquid fuel delivered from the pipe 14 so that the vaporized fuel and the air are thoroughly mixed by the time the two are discharged from the mixing chamber 11 into the furnace fire box.

It is evident that in order to insure perfect combustion of the fuel, it is necessary that an additional volume of air be supplied to the fire box of the furnace, and the present invention contemplates delivering this additional volume of air into the fire box in such a manner as to conserve fuel and insure of its most perfect combustion, and likewise prevent radiation of heat from the walls of the fire box with a consequent loss in efficiency. Air conducting pipes 20 are placed in communication at their rear ends with the

interior of the casing 7 by having their said ends fitted into the wall of the casing at opposite sides thereof and at points suitably spaced, inwardly with relation to the discharge end of the mixing chamber 11, and the other or forward ends of the pipes 20 open through the wall of the fire box and discharge into the interior of the said fire box, the pipes being extended forwardly in diverging relation to each other, or in other words, forwardly and laterally at an angle from the air chamber 7 as best shown in Fig. 1 of the drawings. As previously stated, the burner 2 is mounted in one of the end walls of the furnace fire box, and the fire box, in horizontal section, is of elliptical form. In consequence of this contour given the fire box walls and likewise in consequence of the angular disposition of the pipes 20, the air currents issuing from the pipes will travel around the inner surfaces of the side walls of the fire box and will meet at the other end walls 6 thereof. Where the air currents meet they will be of course deflected and will then flow inwardly toward the center of the fire box and will meet the blast of burning fuel delivered from the burner. By reason of this arrangement and because of the path taken by the air currents delivered from the pipe 20, the walls of the fire box are kept relatively cool, and, as a first consideration, the burning fuel is supplied with oxygen in ample volume to support combustion and insure of complete combustion of fuel, precisely at the point where this result should be effected, namely at the central portion of the fire box. At this point it will be evident that complete combustion of the fuel is insured and that the fuel is burned in the most economical and effective manner so that the greatest benefits will be obtained from the volume of fuel consumed. It will also be evident that there is little likelihood of the fire box walls requiring frequent repairs because of burning out, as is the case in furnaces where the liquid fuel is consumed in such a manner that the flames impinge against the walls of the fire box. In order that the furnace may be conveniently set in operation, a gas pipe 21 is led from a suitable source of supply as will presently be explained, and extends into the fire box of the furnace beneath the burner 2 and with its discharge end 22 located below and slightly in advance of the discharge end of the mixing chamber 11. The supply of gaseous fuel to the pipe as well as the supply of liquid fuel to the burner and likewise the supply of air to the burner, is effected by an automatic control unit which will now be described.

The control unit above referred to is best illustrated in Figs. 2 and 3 of the drawings wherein the numeral 23 indicates a liquid fuel supply main which leads from any suit-

able source of supply (not shown). Interposed in this main is an electrically operated pump 24 of any approved type which in its operation will maintain a flow of liquid fuel through the main 23. The electric motor for operating the pump is placed in circuit, by conductor wires 25, with an electrical switch 26 of any approved type which is controlled by a thermostatic element 27 mounted in the wall of the furnace fire box, the function of the electrical switch being to automatically cut the electric motor into and out of circuit respectively when the temperature reaches a pre-determined minimum and a predetermined maximum degree. The supply main 23 leads to the lower end of a fuel cylinder indicated by the numeral 28, and mounted for vertical reciprocation in this cylinder is a piston comprising a head 29 and a stem 30, the stem being led through a stuffing box 31 upon the upper head of the cylinder. As stated, the main 23 opens into the lower end of the cylinder, so that when the pump 24 is in operation, liquid fuel will be forced under pressure into the cylinder and the pressure exerted against the piston will effect an elevation of the piston, normally to substantially the dotted line position shown in Fig. 2 of the drawings. The numeral 32 indicates a return fuel pipe which leads from the supply main 23 at a point between the pump 24 and the fuel cylinder 28, and interposed in this pipe is a choke or pressure valve indicated by the numeral 33. The purpose of the pipe 32 is to conduct back to the source of supply any surplus fuel, under conditions where more than the required amount is being delivered by the pump 24 to the fuel cylinder 28. The oil supply pipe 14 is connected at its intake end to the casing of a cut-off valve 34, and a pipe 35 is led from this valve downwardly beside the fuel cylinder 28 and communicates at its lower end with the casing of a needle valve indicated by the numeral 36, the casing of the valve having its intake connected with the said cylinder 28 substantially at the lower end thereof. The pipe 35 is provided with a branch 37 which is placed in communication with the fuel cylinder 28 near the upper end of the said cylinder, and if desired a cut off valve 38 may be interposed in the pipe 35 above the said branch 37. A small branch pipe 39 leads from the upper end of the pipe 35 and has a downward branch 40 opening through the upper head of the cylinder 28, and this pipe constitutes a bleed for the fuel supply line under conditions which will presently be explained.

Mounted upon the top of the cylinder 28 is a frame structure indicated in general by the numeral 41 and including spaced uprights 42 and 43. This frame structure supports a dash pot cylinder 44 in which

works a piston head 45 supported at the upper end of the piston rod 30, the piston rod 30 extending through a stuffing box 46 upon the lower head of the cylinder 44. The upper end of the cylinder 44 is closed by a head 47 which may be provided with a removable plug or closure 48 to permit of the introduction into the cylinder of the fluid which is to offer resistance to movement of the piston 45. The by-pass for the resistance fluid comprises a pipe 49 having its lower end connected by an elbow 50 with the lower end of the cylinder 44 and its upper end placed in communication with the casing of a needle valve 51 which may be adjusted so as to more or less retard the flow of the resistance fluid through the by-pass.

The gas supply pipe 21 heretofore referred to is placed in communication with a gas main indicated by the numeral 52, and interposed in this main is a valve 53 which is normally held closed but which is provided with a stem 54 extending exteriorly of its casing and adapted, upon the exertion of pressure thereagainst, to effect opening of the valve. The numeral 55 indicates a bracket which is mounted upon the casing of the valve or upon any other appropriate fixed support, and mounted for rocking movement upon this bracket arm is a valve actuating lever 56 having a head at one side of its pivot indicated by the numeral 57 for co-action with the upper end of the valve 54. A dog 58 is pivoted as at 59 to the other end of the actuating lever 56 and in one position has shouldered engagement with the end of the said lever so that in this position the dog will be held fixed in alignment with the lever. A spring 60 is mounted upon the under side of the lever and bears against the dog to hold it in the position stated and it will be understood that the dog may be moved about its pivot against the tension of this spring. Preferably the end of the dog is provided with a rounded nose indicated by the numeral 61. The numeral 62 indicates a lug upon the piston rod 30 and it will be evident that the dog 58 is in the path of movement of this lug. The actuating lever 56 preferably works in a guide 63 upon the upright 43 of the frame structure 41, and at this point it will be evident that with the parts in the position shown in Fig. 2, when the piston 29 is forced upwardly under the pressure of the liquid fuel delivered to the cylinder 28 by the pump 24, the lug 62 will ride against the under side of the dog 58 and swing the corresponding end of the lever 56 in an upward direction thus causing the other end 57 to exert downward pressure upon the valve stem 54 to open the valve and permit flow of gaseous fuel through the conduit or main 52 and to the pilot tube 21. It will likewise be evident that at a point in the upward movement of the lug

62, the lug will ride past the rounded nose of the dog 58 thereby releasing the lever 56 and permitting the same to drop to the full line position shown in Fig. 2 of the drawings and permitting the valve 54 to return to its closed position. It will likewise be evident that upon return downward movement of the piston 29 and corresponding movement of the lug 62, the said lug will ride downwardly against the rounded nose of the dog 58, and sweep past the dog, moving the same upon its pivot 59, until it again assumes a position beneath the said dog. The conditions under which this operation takes place will presently be set forth.

The blower 9 which has heretofore been referred to, is preferably driven by an electric motor indicated in Fig. 1 of the drawings by the numeral 64. Conductor wires 65 lead to the motor and establish electrical connection between the same and a switch which is indicated in general by the numeral 66. The switch 66 is preferably mounted upon a panel 67 supported in turn upon a bracket 68 mounted upon the upright 43 or any other convenient fixed support. The said switch comprises fixed spaced contacts 69 which are mounted upon the panel and to which the conductor wires 65 are connected. The switch further comprises a switch blade 70 which is pivoted at a point intermediate its length, as at 71, upon the panel 67 and is provided at one end with a stud or roller 72 which works between spaced fingers 73 upon an oscillatory trip member 74 pivotally mounted as at 75 upon the panel. The other end of the switch blade 70 is designed to bridge the contacts 69, in one position of adjustment of the blade, and in another position of adjustment of the blade, namely the one illustrated in full lines in Fig. 2 of the drawings, is out of contact with the said contacts 69 so that the circuit is broken. A rocker 76 has pin and slot connection as at 77 with the oscillatory trip member 74 and is mounted for rocking movement as at 78 upon the said panel 67. A spring 79 is connected at one end to the outer end of the rocker 76 and at its other end to the pivot 75 for the oscillatory trip member 74. A link 80 is connected at its upper end to the rocker 76 and at its lower end as at 81 to an actuating lever 82 which is pivoted at one end as at 83 to the upright 42 of the frame structure 41 and extends transversely beside the piston rod 30 and is provided at its other end with a weight 84. A lug 85 is provided upon the piston rod 30 and rides beneath the lever 82.

The operation of the burner is as follows: The circuit is closed through the electric motor operating the pump 24 by a switch (not shown) and in the operation of the pump oil will be forced through the main 23 and into the lower end of the cylinder

28. The pressure of the oil will cause the piston 29 to rise in the cylinder and, the valves 34 and 38 being open, oil will flow into the pipe 35 and finally into the pipe 14. In the meantime the lug 62 will, in its upward movement, ride beneath the dog 58 and rock the valve actuating lever 56 so as to cause its end 57 to press downwardly upon the stem 54 of the valve 53 thus opening the valve and permitting flow of gaseous fuel through the main 52 and to the pilot tube 21. The fuel being ignited at the discharge end 22, of the tube 21, a pilot flame is established in the fire box of the furnace to ignite the fuel delivered to the burner 2. The piston 29 continues to rise, and it will be evident that the fuel oil will be admitted into the pipe 35 and to the burner tube 14 in regulated volume controlled by the adjustment of the needle valve 36. Finally the piston 29 will uncover the end of the pipe branch 37 whereupon the fuel oil in greater volume will be admitted into the pipe 35 and supplied in like volume to the tube 14. The oil initially supplied will at this time have been ignited at the burner, and at the time the branch 37 of the pipe 35 is uncovered by the piston 29, or substantially at such time, the lug 85 will have acted against the lever 82 to elevate the lever and actuate the rocker 76 to break the toggle formed by this rocker and the piston member 75 thus throwing the switch blade 70 to position to close the circuit through the motor 64 and set in operation the blower 9 so that air under pressure will be supplied to the burner and to the pipe 20 in the manner previously explained. Of course, in the normal operation of the burner, the several component parts thereof will maintain an equilibrium, but should the temperature rise above the maximum limit or should the pump 24 for any reason cease to operate, the thermostatic device 26 would in the first instance cut off the supply of current to the motor for the pump, and in the latter instance the pump would of course not function. Under these conditions, the flow of oil to the oil cylinder 28 would cease and the piston 29 would lower under the pressure exerted upon it by the weighted lever 82. In the lowering movement of the piston and likewise in the lowering movement of the lever 82, the switch 66 would be actuated in a manner the reverse of that above explained so as to cut off the supply of current to the motor 64 for the blower 9, and likewise the supply of fuel oil through the branch 37 would be discontinued or cut off. The downward movement of the piston 29 in the cylinder 28 creates a suction above the piston and as a consequence thereof any oil which may be present in the pipe 14 will be drawn out and delivered into the upper end of the cylinder 28 by way of the

said pipe 39 and its down branch 40. Of course, when the lug 62 rides past the nose of the dog 58 and the lever 56 is released, it will drop to its lowered position thus permitting the valve 54 to close and cut off the supply of gaseous fuel to the pilot tube 21.

Having thus described the invention, what is claimed as new is:

1. A liquid fuel control for liquid fuel burners, comprising a fuel cylinder, a piston therein, means for retarding the movement of the piston, a gaseous fuel supply main independent of the fuel cylinder, automatically controlled means for admitting fuel to the cylinder at one side of the piston, means for conducting fuel to the burner to be supplied and normally active for conducting fuel from the cylinder in regulated quantity, and active in a shifted position of the piston to conduct fuel from the cylinder in greater quantity, and means controlled through movement of the piston for regulating the supply of gaseous fuel through the said gaseous fuel supply main.

2. A liquid fuel control for liquid fuel burners, comprising a fuel cylinder, a piston therein, a fuel conducting pipe for conducting fuel to the burner to be supplied and having connection with the cylinder at one side of the piston to provide for the supply of fuel in regulated quantity under normal conditions, the pipe having a branch likewise communicating with the cylinder and arranged, in one position of shifting movement of the piston to be uncovered thereby whereby to permit the flow of fuel through the conducting pipe in greater quantity, and means automatically controlled for admitting fuel to the cylinder.

3. A liquid fuel control for liquid fuel burners, comprising a fuel cylinder, a piston therein, means for admitting fuel to the lower end of the cylinder beneath the piston, a fuel conducting pipe for conducting fuel to the burner to be supplied and having a branch in communication with the cylinder near the lower end thereof and below the piston in its lowered position, the said pipe having another branch of greater conducting area communicating with the cylinder at an elevated point and adapted to be uncovered in a shifted position of the piston whereby to admit fluid to the conducting pipe in greater quantity in said position of the piston, and means controlling the admission of fuel to the cylinder.

4. A liquid fuel control comprising a fuel cylinder, a piston therein, means for admitting fuel to the lower end of the cylinder beneath the piston, a fuel conducting pipe having a branch in communication with the cylinder near the lower end thereof and below the piston in its lowered position, the said pipe having another branch of greater

conducting area communicating with the cylinder at an elevated point and adapted to be uncovered in a shifted position of the piston whereby to admit fluid to the conducting pipe in greater quantity in said position of the piston, means controlling the admission of fuel to the cylinder, a gaseous fuel supply main independent of the fuel cylinder, and means actuated through movement of the piston for controlling the supply of gaseous fuel through said main.

5. A liquid fuel control for liquid fuel burners, comprising a fuel cylinder, a piston therein, means for admitting fuel to the lower end of the cylinder beneath the piston, a fuel conducting pipe for conducting fuel to the burner to be supplied and having a branch in communication with the cylinder near the lower end thereof and below the piston in its lowered position, the said pipe having another branch of greater conducting area communicating with the cylinder at an elevated point and adapted to be uncovered in a shifted position of the piston whereby to admit fluid to the conducting pipe in greater quantity in said position of the piston, means controlling the admission of fuel to the cylinder, and means establishing communication between the upper end of the cylinder and the said conducting pipe to provide for exhaustion of fuel from the said pipe upon downward movement of the piston and a creation of a partial vacuum in the upper end of the cylinder.

6. A liquid fuel control for liquid fuel burners, comprising a fuel cylinder, a piston therein, means for admitting fuel to the lower end of the cylinder beneath the piston, a fuel conducting pipe for conducting fuel to the burner to be supplied and having a branch in communication with the cylinder near the lower end thereof and below the piston in its lowered position, the said pipe having another branch of greater conducting area communicating with the cylinder at an elevated point and adapted to be uncovered in a shifted position of the piston whereby to admit fluid to the conducting pipe in greater quantity in said position of the piston, means controlling the admission of fuel to the cylinder, and means operable automatically upon downward movement of the piston for effecting exhaustion of the fuel from the said conducting pipe.

7. A liquid fuel control comprising a fuel cylinder, a piston therein including a rod extending exteriorly of the cylinder, automatically controlled means for admitting fuel to the cylinder at one side of the piston, means normally active for conducting fuel from the cylinder in restricted quantity, and active in a shifted position of the piston to conduct fuel from the cylinder in greater quantity, a gaseous fuel supply main,

a valve therein having a stem extending exteriorly, the valve being normally seated, and a lever arm engaged at one side of its pivot with the stem of the valve, the said
5 piston rod having means for coaction with the said lever arm at the other side of its pivot to effect rocking of the lever arm to actuate the valve and move the same to open position at a predetermined point in the shifting movement of the piston. 10

In testimony whereof we affix our signatures.

JOHN PAUL JONES. [L. S.]
GEORGE NEMBACH. [L. S.]