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Nov. 2, 1926. 1,605,423

A. H. BALLARD

LIQUID FUEL BURNING APPARATUS

Filed Jan. 19. 1925 2 Sheets-Sheet 1

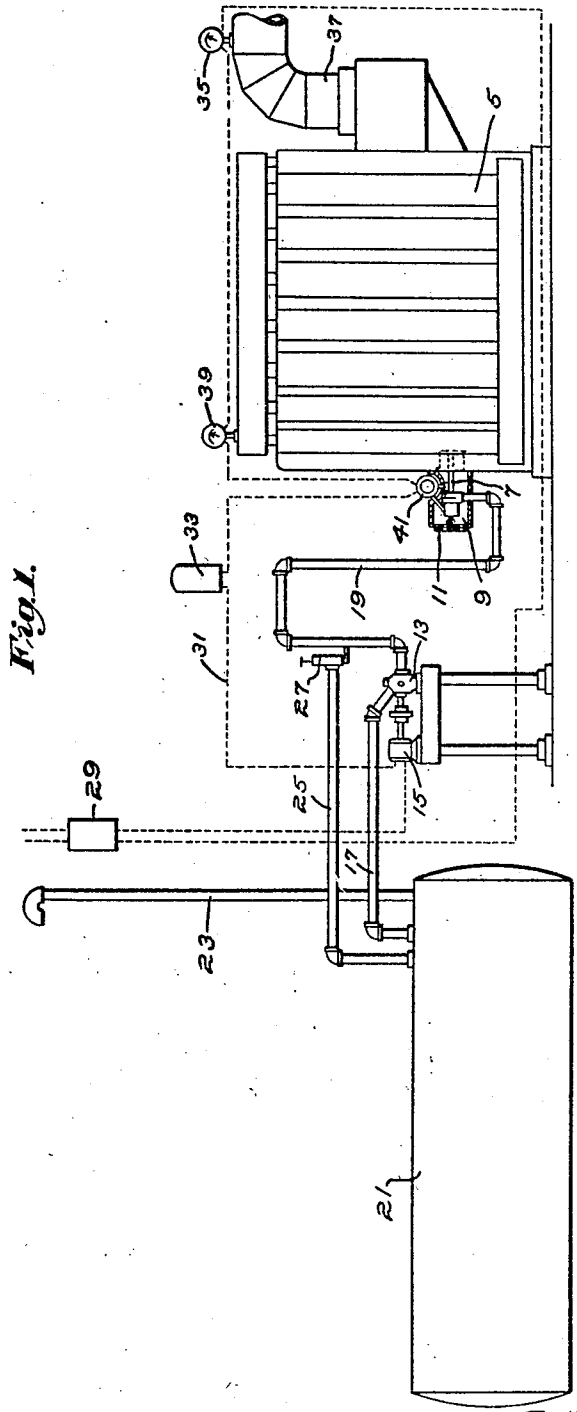


Fig. 1.

Inventor:
Arthur H. Ballard
By Emery Booth Janney & Varney
Attys.

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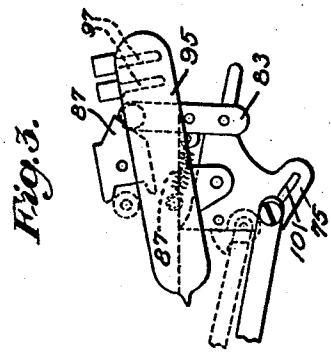
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Fig. 3.



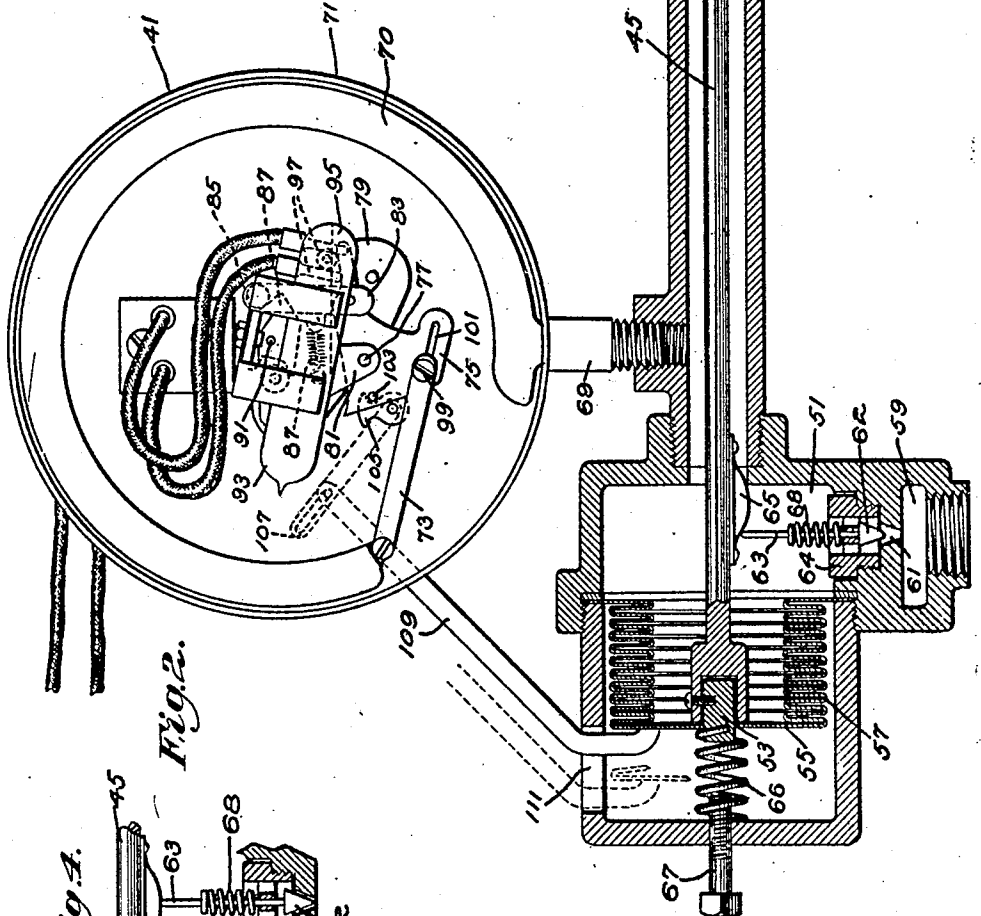


Fig. 2.

Fig. 4.

Inventor:
Arthur H. Ballard
By Emery Booth Janney Varney
Attys.

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UNITED STATES PATENT OFFICE.

ARTHUR H. BALLARD, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO BALLARD OIL BURNING EQUIPMENT COMPANY, OF BOSTON, MASSACHUSETTS, A CORPORATION OF MASSACHUSETTS.

LIQUID-FUEL-BURNING APPARATUS.

Application filed January 19, 1925. Serial No. 3,222.

This invention relates to liquid fuel burning apparatus and particularly to apparatus employing a nozzle having an orifice through which the fuel is discharged. The object of the invention is to provide means for maintaining the orifice open and preventing accumulations of carbon or other material which tend to obstruct the flow of the fuel and interfere with the proper functioning of the apparatus.

While the invention may have other useful application, it is of particular value in connection with oil burners where the oil is forced under pressure through a relatively small orifice into the combustion chamber, air being supplied exteriorly of the nozzle to comingle with the discharged oil. Under such conditions the intense heat to which the nozzle orifice is exposed tends to produce a carbonization which gradually builds up an encrustation cutting off or so reducing the supply of fuel that the flame may be extinguished or the normal function of the burner otherwise interfered with.

The invention will be best understood by reference to the following description when taken in connection with the accompanying illustration of one specific embodiment thereof, while the scope will be more particularly pointed out in the appended claims.

In the drawings,—

Fig. 1 illustrates diagrammatically the general arrangement of a liquid fuel burning apparatus embodying one form of the invention;

Fig. 2 is a detail in elevation and partial cross section on an enlarged scale showing the burner nozzle and automatically actuated cut-out switch for the oil feeding motor;

Fig. 3 is a diagrammatic detail showing the cut-out switch in its open position; and

Fig. 4 is a sectional detail in elevation showing the admission orifice and its valve when the clearing device is retracted in the normal operation of the burner.

Referring to the drawings and to the illustrative embodiment of the invention therein shown, the apparatus is shown applied to a suitable combustion chamber, herein embodied in the boiler 5, to which chamber oil or other liquid fuel is supplied through the nozzle 7, the fuel when discharged from the orifice of the nozzle being comingled with air delivered about the nozzle through the surrounding air-supply chamber 9 and regulated by the damper 11 or other suitable regulator.

To supply the fuel under the necessary pressure, there is provided the fuel pump 13 driven by the electric motor 15, the pump drawing its supply through the supply pipe 17 and delivering it to the nozzle through the delivery pipe 19. The fuel is withdrawn by the pump through the pipe 17 from the supply tank 21 provided with the vent pipe 23, there being also provided the bypass 25 above the pump and pressure regulating valve 27 such that a uniform predetermined pressure may be maintained at the nozzle.

The feed motor 15 is supplied with current from any suitable source through the control switch represented at 29. The motor circuit indicated at 31 may include a switch controlled by the room-thermostat 33 for opening the circuit on an excessive rise of temperature of the space to be heated and closing it on the lowering of such temperature, a similarly thermostatically controlled switch 35 responsive to the temperature in the stack or flue 37 leading from the combustion chamber, and the pressure responsive switch 39 for opening the circuit on excessive rise of boiler pressure and conversely closing the circuit on a drop in pressure. Additionally, there is also provided a switch 41 cooperatively related to the nozzle, the construction and function of which is hereinafter described.

Referring to the nozzle and the switch 41 (Figs. 2 and 3), the former is provided with a clearing device arranged to clear accumulated obstructions from the small oil discharge orifice 43, such clearing member comprising the reciprocatory plunger 45 having the small reduced end 47 of a size adapted to enter and clear the orifice of any accumulations. In the normal or inactive condition of the burner the plunger is in its forward position with its reduced end entering and protruding through the orifice 43. The reduced end of the plunger passes through a central perforation in the guide plate 49, the latter being suitably perforated to permit the free passage of oil therethrough, while the rear end of the plunger enters an enlarged chamber 51 and is connected to a stud 53 secured to the dia-

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phragm 55 attached to the corrugated or bellows-like metallic wall 57, the forward end of which is flanged and held between co-acting walls of the chamber 51.

The oil under pressure is supplied to the oil supply chamber 59 which opens into the chamber 51 through a passage 61. The latter is tapered or flared toward the interior and provided with a conical valve 62 which is so held (see Fig. 4) during the normal operation of the burner as to provide a supply orifice of restricted cross sectional area and of such relation to the size of the orifice 43 so that in the operation of the burner, with the orifice 43 unobstructed and the oil flowing freely therethrough, the normal working pressure of the oil within the chamber 51 is less than the supply pressure within the supply chamber 59. The valve 62 has a stem 63 mounted to slide vertically in the guide block 64, the top of the stem engaging with a cam plate 65 carried by the plunger 45.

When the burner is inactive the corrugated wall 57 is contracted and the clearing rod moves to its forward or protruding position under the constantly acting pressure of the spring 66 located between the head of the stud 53 and the threaded pin 67. In this position it brings the low part of the cam plate 65 against the valve stem 63 which latter is lifted by the spring 68 opening wide the orifice 61, as shown in Fig. 2.

When the feed motor is started up, however, and the oil enters the nozzle, pressure within the nozzle chamber 51 forces the diaphragm back (see dotted line position in Fig. 2), withdrawing the reduced end of the clearing rod from the orifice to a point where it offers no interference with the free passage of the oil therethrough and bringing the high part of the cam plate to bear on the valve stem 63 which thereupon moves to the position shown in Fig. 4 leaving a supply orifice having the restricted area mentioned.

Means are provided for availing of the differential pressure relation between the chambers 51 and 59 (due to the restricted orifice 61) automatically to move the clearing device forward to clear the passage and thereafter to retract it when the nozzle orifice 43 is cleared. For this purpose the switch 41 is arranged to be opened by a pressure responsive device connected to the nozzle chamber. In case the orifice 43 becomes obstructed during the operation of the burner the pressure in the nozzle chamber 51 will immediately build up, and if the orifice 43 becomes completely closed the pressure in the chambers 51 and 59 will become equalized or approximately so. The pressure in the nozzle chamber 51 during the unobstructed flow of oil in the operation of the burner is insufficient to actuate the pressure responsive device, but, with the equalization of pressure in the chambers 51 and 59 following the occurrence of an obstruction, this increase of pressure in the chamber 51 is availed of to open the motor control switch, thereby causing stoppage of the motor and cessation of the fuel supply. This is followed by the forward or clearing movement of the plunger under the compression spring 66, the end 47 of the clearing rod thereupon serving to remove the obstruction and clear the orifice. Forward movement of the clearing rod is further utilized to close the switch by a mechanical connection between the clearing member and the switch.

For this purpose the nozzle chamber is connected by means of the nipple 69 to a Bourdon pressure tube 70 carried within the casing 71, the free end of the tube having connection through the link 73 to an oscillating plate 75 pivoted at 77 between the fixed plates 79 and 81. The plate 75 is jointed to the link 83, the latter carrying at its upper end the roll 85 which is drawn by the spring 87 against a V-shaped piece 89, the latter mounted to rock about the fixed pivot 91. The piece 89 is secured to the glass tube 93 carrying a small amount of mercury 95. The tube and its carrier are so mounted as to be capable of tipping about the pivot 91 to either one of the two extreme positions represented in Figs. 2 and 3, so that in one position (Fig. 2) the terminals 97 of the motor circuit are immersed in the mercury and the circuit closed. In the opposite position represented in Fig. 3 the mercury has gravitated to the opposite end of the tube causing the opening of the circuit.

During the operation of the burner the normal working pressure in the nozzle chamber 51 is insufficient to actuate the Bourdon tube and the switch parts so far described remain in the position indicated in Fig. 2. In case pressure in the nozzle chamber rises, however, through the occurrence of an obstruction in the orifice, the tube segment will tend to straighten, rocking the oscillating plate 75 right-handedly, drawing down the link 83, causing the roll 85 to snap to the under side of the V-shaped piece 89 and throwing the glass tube to its oppositely inclined position represented in Fig. 3.

This opens the motor circuit, stops the feeding of oil, and the clearing member is thereupon thrown forward as described. Preferably lost motion is provided between the link 73 and the plate 75, as by means of the pin 99 working in the slot 101, so that the switch cannot be again thrown to its closed position by the drop in pressure, a mechanical attachment between the clearing member and the switch being herein relied upon for that purpose.

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To again close the switch and return the parts from the position indicated in Fig. 3 to that indicated in Fig. 2 the oscillating plate 75 is provided with a pin 103 adapted to be engaged by the pivoted dog 105, the latter being fixed to the actuating arm 107. To move the arm and throw the switch the back of the diaphragm 53 has fastened thereto an actuating member 109 which projects through a slot 111 in the nozzle chamber walls, the actuator being prolonged to engage the arm 107 through a pin and slot connection.

When the burner is started into operation the actuator moves to the dotted line position indicated in Fig. 2, withdrawing the dog from the pin 103. When the pressure responsive device operates, however, and the clearing member reaches its forward position, the actuator 109, which has been carried forwardly therewith, turns the dog right-handedly causing it to engage the pin 103 and throw the switch to the closed position (Fig. 2). The parts are so arranged therefore that in case of obstruction in the orifice a rise in pressure of the nozzle opens the switch and the switch is not again closed until the clearing member is moved forwardly to a position where it insures the clearing of the orifice.

The provision of the valve 62 which opens up the normally restricted supply orifice 61 when the clearing device moved forward serves also automatically to clear the orifice 61 of any dirt, dust or foreign matter accumulated therein and likely to interfere with the proper functioning of the apparatus. While the burner is in normal operation the passage 61 is restricted in size, and any particles of foreign matter lodging therein and likely to materially reduce its cross sectional area below a suitable point will be promptly washed out or cleared as soon as the valve lifts on the forward movement of the plunger 45.

While I have herein shown and described for the purposes of illustration one specific embodiment of the invention and one particular application thereof, it is to be understood that the same may be usefully applied to other purposes and that extensive deviations and changes may be made in the details and the form and relative arrangement of parts, all without departing from the spirit of the invention.

Having described my invention, what I claim as new and desire to secure by Letters Patent is:

1. In an apparatus for burning liquid fuel, the combination with a nozzle having an orifice, of a movable clearing device for said orifice, supply passages through which liquid fuel is fed under pressure to the nozzle, said passages being proportioned to provide for substantial increase in pressure in the nozzle on an occurrence of an obstruction in said orifice, a fuel pump, a feed motor, means for causing the retraction of the clearing device under pressure of the fuel fed to the nozzle, means for forcing the clearing device to a clearing position when the nozzle pressure drops, a motor switch, pressure responsive device responsive to pressure increase at the nozzle for opening said switch, and means responsive to clearing movement of the clearing device for again closing said switch.

2. In a liquid fuel burning apparatus, the combination with a nozzle having an orifice, of a movable clearing member with means tending to move the same to clear the orifice, means responsive to pressure of the fuel in the nozzle for retraction of the member, a fuel supply pump, a motor, a switch with means for moving the same to open the motor circuit following the occurrence of an obstruction in said orifice, and means for again closing said switch following the clearing movement of said member.

3. An apparatus for burning liquid fuel comprising a nozzle having a discharge orifice, means for supplying fuel under pressure to the nozzle, a clearing device comprising a plunger having an end adapted to enter and clear the orifice, and plunger moving means normally forcing said plunger to a clearing position but responsive to the pressure of liquid fuel to retract the clearing device from the orifice, said plunger moving means being automatically controlled in response to an obstruction in the orifice during the operation of the burner first to move said plunger to its clearing position and then to retract the same therefrom.

4. In an apparatus for burning liquid fuel, the combination with a nozzle having a discharge orifice, of a clearing device for the orifice retracted under the pressure of the fuel in the normal operation of the burner, devices responsive to the occurrence of an obstruction in the orifice for stopping the fuel supply and causing a clearing movement of the clearing member, and means for restoring the fuel supply and retracting said member following its clearing movement.

5. In an apparatus for burning liquid fuel, the combination with a nozzle having an orifice, of a movable clearing device for said orifice, a supply passage through which liquid fuel is fed under pressure to the nozzle, said passage being proportioned to provide for a substantial increase in pressure of the nozzle on an occurrence of an obstruction in said orifice, means responsive to pressure increase therein for moving the clearing member, and means automatically also to clear said passage, said means comprising a valve serving to restrict said passage in the normal operation of the burner and means to open said valve on the clearing movement of the clearing device.

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6. An apparatus for burning liquid fuel comprising a nozzle having an orifice and a movable clearing member, power-driven, pressure-creating means for feeding fuel under pressure to the nozzle, means for moving the clearing member including a diaphragm subject to the pressure of the fuel being fed and serving normally to withdraw the clearing member from the orifice during the operation of the burner, and a device responsive to the rise in pressure of the fuel in the nozzle on the occurrence of an obstruction in the orifice, said device serving to control the pressure creating means to reduce the pressure acting against said diaphragm and to cause the latter to project the clearing member through the orifice, but subsequently to increase said pressure to cause the diaphragm to withdraw the clearing member from the orifice.

7. An apparatus for burning liquid fuel comprising a nozzle having an orifice and a movable clearing member withdrawn from the orifice during the normal operation of the burner, pressure creating means comprising a motor driven pump for feeding fuel under pressure to the nozzle, a device for moving the clearing member responsive to pressure conditions at or adjacent the nozzle, means including a pressure responsive device responsive to an increase in working pressure at the nozzle following the occurrence of an obstruction in the orifice to control said pump and reduce the pressure at the nozzle, thereby to cause the moving means to move the clearing member to an orifice clearing position, and pump controlling devices also connected to the clearing member and adapted to be set in operation by the clearing movement thereof to restore working pressure conditions at the nozzle and to cause the clearing member to withdraw from the orifice.

8. An apparatus for burning liquid fuel comprising a nozzle having an orifice and a movable clearing member withdrawn from the orifice during the normal operation of the burner, means comprising a power-driven pump for feeding fuel under pressure to the nozzle, means including a pressure responsive device, responsive to an increase in working pressure at the nozzle following the occurrence of an obstruction in the orifice, to act on said fuel feeding means and change the pressure at said nozzle, thereby to cause the clearing member to move to an orifice clearing position, and devices, connected to the clearing member to be set in operation by the clearing movement thereof and acting on said fuel feeding means to restore working pressure conditions at the nozzle and cause the clearing member to withdraw from the orifice.

In testimony whereof, I have signed my name to this specification.

ARTHUR H. BALLARD.