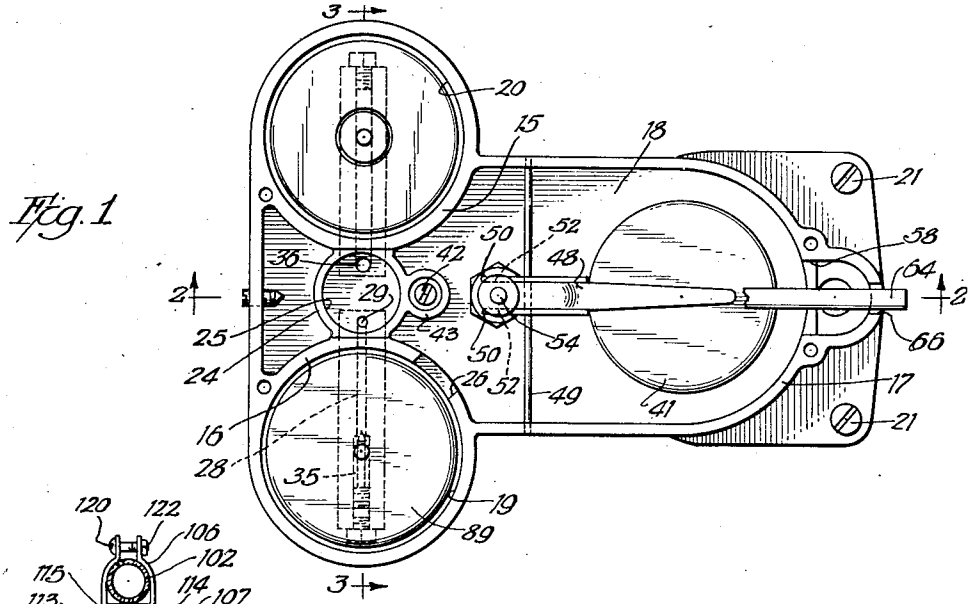
Dec. 23, 1941. O. L. BOCK 2,267,187

CONTROL APPARATUS

Filed March 25, 1940 2 Sheets-Sheet 1

Fig. 1



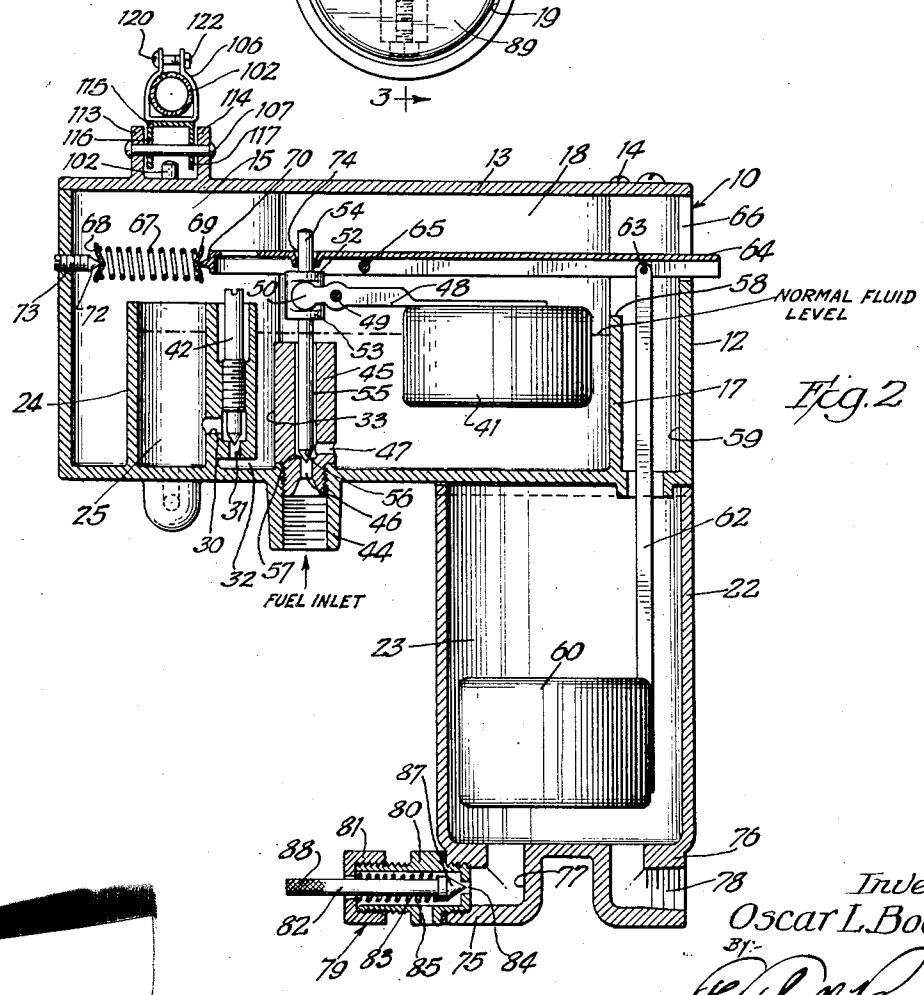


Fig. 2

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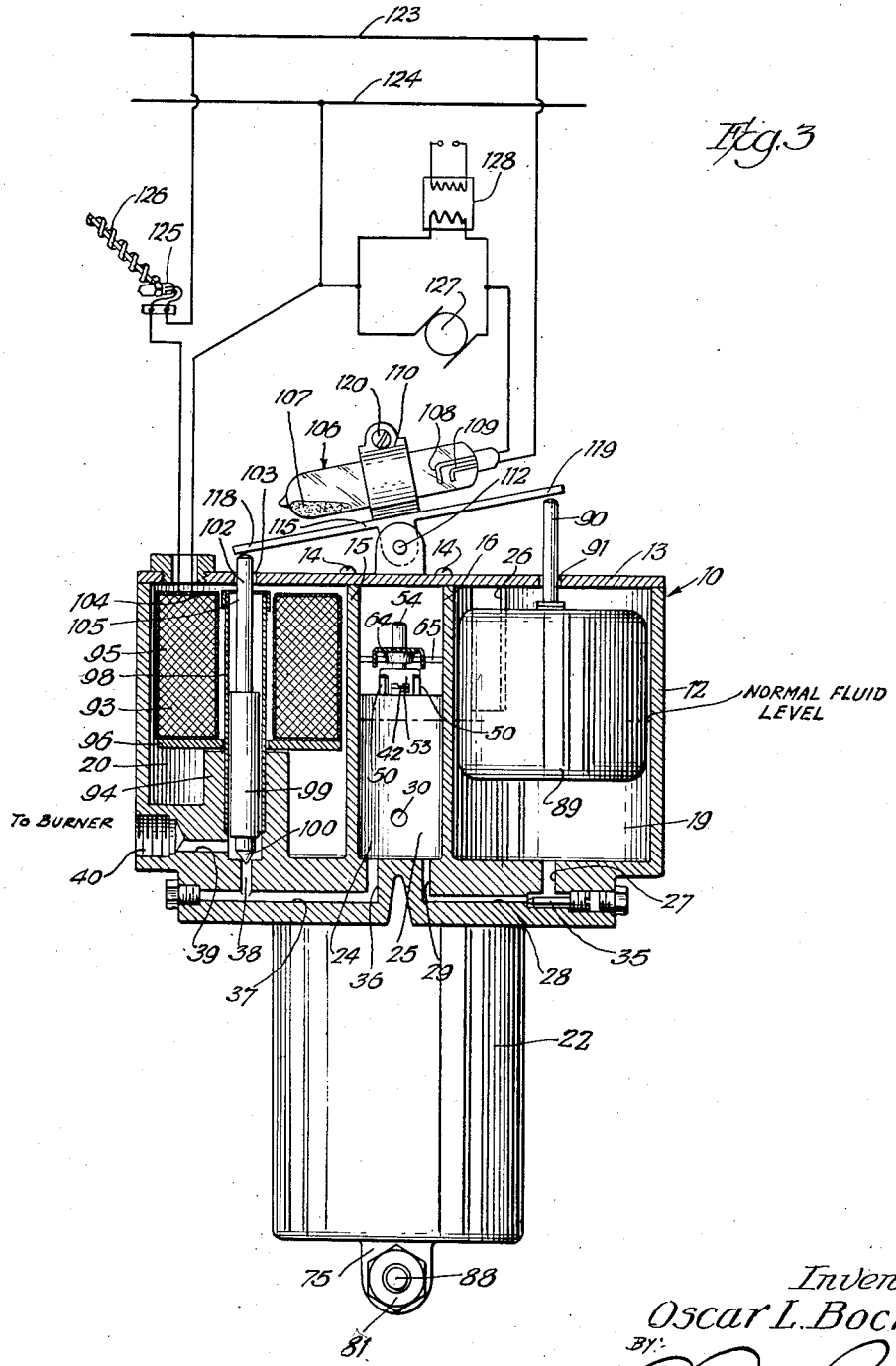
Fig. 3



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UNITED STATES PATENT OFFICE

2,267,187

CONTROL APPARATUS

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12 Claims. (Cl. 158—28)

This invention relates to control apparatus, and while all of the features of structure and arrangement of the disclosed embodiment of the invention are not limited thereto, the apparatus has been illustrated in its adaptation to the control of burners for liquid or hydrocarbon fuels.

As will be more particularly pointed out in the description of this invention, the apparatus herein disclosed is adapted to be utilized with, and to effect control of, a burner such as that shown in my United States Letters Patent No. 2,162,571; the controlled burner being utilized for heating water, air or any desired medium.

An object of this invention is to provide control apparatus which, in conjunction with a liquid or hydrocarbon fuel burner and its associated instrumentalities and temperature responsive control device, will effect accurate and dependable control of the operation of the burner. In the disclosed embodiment of this invention, accuracy and dependability are improved by the provision of independently adjustable control means and by effecting the control in response to different factors which are essential to the operation of the burner.

Another object of this invention is to provide control apparatus for controlling the operation of a liquid or hydrocarbon fuel burner which controls a plurality of incidents in connection with the burner operation, and in which the different controlling elements are independently adjustable to the extent that the proper sequence and order of operations of various instrumentalities is not disturbed by such adjustments. Although some of the adjustments of the disclosed embodiment are interdependent or influenced to a certain extent by others, the order and sequence of operations for proper burner control are independent of the individual adjustments.

Another object of this invention is to provide control apparatus which effects cooperative control of fluid flow and electrical control of one or more instrumentalities associated with the utilization of said fluid. In the disclosed embodiment of this invention valve means for controlling fluid flow are actuated by the fluid and electrical control means is cooperatively controlled by electrical means and means actuated by the fluid.

Another object of this invention is to provide unitary control apparatus for use in conjunction with a liquid or hydrocarbon fuel burner which is adapted effectively to control fuel flow and rate of fuel flow to the burner, as well as the timing and sequence of operation in relation to said flow, of instrumentalities associated with said burner.

Another object of this invention is to provide control apparatus in which a controlling element is jointly responsive to electrical actuated means and means actuated by fluid.

Other objects and advantages of the invention relate to features of construction and arrangement of parts which will be apparent from a consideration of the following specification and accompanying drawings, wherein

Figure 1 is a top elevation of a preferred embodiment of this invention with the cover of the apparatus removed to show the internal structure thereof;

Figure 2 is a side sectional view of a preferred embodiment of this invention with the cover in place and with the section taken substantially on a line 2—2 of Figure 1;

Figure 3 is a sectional view of the apparatus disclosed in Figures 1 and 2 with the section taken substantially on a line 3—3 of Figure 1 and includes a diagrammatic representation of associated instrumentalities, together with the electrical circuit connections therefor.

The apparatus herein disclosed for purposes of illustration has a housing 10 which includes a main or body portion 12 and a cover 13 secured to the main or body portion 12 by screws or fastening means 14. Partitions such as 15, 16 and 17, which are preferably integral with the main or body portion 12 of the housing, separate portions of the interior of the housing to provide a main or constant level float chamber 18, a timing float chamber 19 and a solenoid chamber or housing 20. An auxiliary housing 22 is secured to the main or body portion 12 of the housing 10 by screws or fastening means 21 and is disposed below the main or constant level float chamber 18 to provide a shut-off or safety float chamber 23. A wall 24 which is preferably integral with the main or body portion of the housing provides an auxiliary chamber 25.

An opening 26 in the wall 16 provides one communicating passage between the main or constant level float chamber 18 and the timing float chamber 19. A second communicating passage between the main or constant level float chamber 18 and the timing float chamber 19 is provided by connected passages 27, 28 and 29 between the timing float chamber 19 and the auxiliary chamber 25 and connected passages 30, 31, 32 and 33 between the auxiliary chamber 25 and the main or constant level float chamber

18. The opening 26 is above a predetermined level in the main or constant level float chamber 18 and also in the timing float chamber 19. The communicating passages provided by the connected openings 27, 28 and 29 and 30, 31, 32 and 33 are below the level of the opening 26 and below the normal fluid level in the main or constant level float chamber 18 so that the normal flow of fluid from the main or constant level float chamber to the timing float chamber is through the auxiliary chamber and the aforementioned connected passages. Needle valve 35 is threaded into the main or body portion 12 of the housing and extends into the passage 28 to provide an adjustable element for controlling the rate of fluid flow from the auxiliary chamber 25 to the timing float chamber 19. Connected passages 36, 37, 38 and 39 provide a fluid outlet opening from the auxiliary chamber 25 to a threaded coupling opening 40 which is adapted to be connected through a suitable pipe or supply line, such as the supply line 51 in the Patent No. 2,162,571 to a burner or other fluid utilizing device. An adjustable needle valve 42 is threaded into a projecting portion 43 on the wall 24 adjacent the auxiliary chamber 25 to control or meter the flow of fluid through the passage 31 from the constant level float chamber 18 to the auxiliary chamber 25. This adjustable needle valve 42 normally controls or meters the flow of fluid, such as fuel, from the constant level float chamber 18 to the burner or fluid utilizing device.

An integral threaded collar or coupling 44 on one wall of the constant level chamber 18 provides a means for making connection to a fuel inlet pipe which communicates with a suitable source of fluid, such as a liquid fuel supply tank. A detachable member 45 is threaded into the collar or coupling 44 from within the constant level float chamber 18 and has connected openings 46 and 47 therein which provide passages for the flow of fluid or liquid fuel from the supply to the constant level float chamber 18. A float or fluid level responsive means 41 is secured to an arm 48 which is pivotally supported at 49 so that the float is movable to a position within the constant level chamber 18, dependent upon the fluid level therein. Extending fingers 50 which are preferably integral with the arm 48 and which are on the opposite side of the pivotal support 49 from the float 41 are movably disposed in channels 52 on opposite sides of a coupling collar 53. The coupling collar 53 is secured to the stem of a needle valve 54 which needle valve extends through an opening 55 in the member 45 and into the passage 46 to control the flow of fluid or liquid fuel into the constant level chamber 18 from the fluid or fuel supply. A tapered end 56 on the needle valve 54 fits against a shoulder 57 in the passage 46 to shut off the flow of fluid to the constant level chamber when the float is raised to a predetermined position by the fluid in the chamber. When the fluid level in the chamber 18 drops the float moves downward a corresponding amount to raise the needle valve and permit the flow of fluid into the chamber to again raise the level. The resulting tendency is for the float 41 to keep the fluid level within the chamber 18 constant. This tends to keep a constant head for the flow of fuel through the metering passage 31 to the auxiliary chamber 25 and the outlet passage or coupling opening 40.

An opening 58 in the wall 17 is above the normal fluid level in the constant level chamber 18 and provides a passage through which overflow of fluid may flow from the constant level chamber 18 to the shut-off or safety float chamber 23 through a connecting opening or passage 59. A float or fluid level responsive means 60 is supported within the safety float chamber 23 by an arm 62 which is pivotally connected at 63 to a valve control arm 64. The valve control arm 64 is pivotally supported at 65 and has one end projecting through an opening 66 in an outer wall of the main or body portion 12 of the housing. A spring 67 having indented washers 68 and 69 at the ends thereof is compressed between a sharp end 70 on the other end of the valve control arm 64 and a sharp end 72 of an adjustable set screw 73 which is threaded into a suitable opening in an outer wall of the main or body portion 12 of the housing. The stem of the needle valve 54 extends through an opening 74 in the valve control arm 64 on the side of the pivotal support 65 opposite the arm 62, the valve control arm 64 being disposed adjacent the coupling collar 53. A sufficient rise in the level of the fluid in the shut-off or safety float chamber 23 moves the float 60 to a position such that the spring 67 biases the valve control arm 64 against the end of the coupling collar 53 to actuate the needle valve 54 and effect closure of the passage 46 independently of the control or position of the float 41. After such closure of the passage 46 which stops the flow of fluid to the constant level chamber 18, the control arm 64 must be manually reset as will be hereafter explained to reestablish the operation of the valve 54 in response to the float 41.

The auxiliary housing 22 is provided with a pair of threaded couplings 75 and 76 having openings 77 and 78 therein which communicate with the safety float chamber 23 and both of which couplings are preferably integral with the bottom or lower portion of the auxiliary housing. The coupling 76 is adapted to be connected to an overflow pipe line from the burner port or fluid utilizing device such as the pipe line 93 in Patent No. 2,162,571, so that the auxiliary chamber provides a sump for any overflow fuel from the burner or fluid utilizing device. As has been previously indicated, and in addition to providing a sump for overflow fuel from the burner or fluid utilizing device, the auxiliary chamber 23 also provides a sump for overflow fuel from the constant level chamber which may flow through the opening 58 under abnormal conditions. A drain valve 79 comprises a valve housing 80, a screw cap 81, a manually operable needle valve 82 and a spring 83 for biasing the needle valve element to closed position, is threaded into the opening 77 of the coupling 75 and has connected passages 84 and 85 through which fluid may be drained from the safety float chamber 23 when the drain valve 79 is manually opened. The manually operable needle valve element 82 has an enlarged end 87 which normally seats in the opening 84 to prevent the flow of fluid therethrough and provides a seat for one end of the spring 83. The other end of the spring 83 rests against the screw cap 81. The needle valve element 82 also preferably has a knurled handle 88 which projects outwardly from the screw cap 81. It is preferable that the drain valve 79 is opened by pulling the needle valve element 82 outwardly so that the purpose and operation of the valve will not be defeated by some object being in-

advertently placed against the end of the projecting handle 88. When the fluid in the safety float chamber 23 has risen to a level which effects closure of the needle valve 54, the fluid must be drained from the safety float chamber 23 through the drain valve 79 before normal operation of the control device can be restored. After draining the fluid from the safety float chamber 23, the end of the valve control arm 64 which projects through the opening 66 must be manually moved to restore the valve control arm 64 and float 60 to their normal positions which permits the needle valve 54 to be controlled by the fluid level responsive means or float 41. This manual movement restores the spring 67 to a position such that it no longer biases the valve control arm 64 toward the coupling collar 53.

A timing float or fluid level responsive means 89 is movably mounted within the timing float chamber 19 and is adapted normally to assume a position dependent upon the fluid level in the chamber 19. This float or fluid level responsive means 89 has a rod or actuating element 90 secured thereto and projecting outwardly from the housing 10 through an opening 91 in the cover 13. There is preferably sufficient space between the float or fluid level responsive means 89 and the wall of the timing float chamber 19 so that the float may be forced downwardly against the buoying force of the fluid in the chamber and the fluid will pass upwardly between the float and the chamber wall.

A solenoid or electromagnetic means 93 is mounted within the solenoid chamber 20 of the housing 10 and rests against a collar or spacer 94 which locates the solenoid within the chamber. This solenoid 93 has a winding 95 which is spaced and insulated from the collar or spacer 94 by means including a disc 96. The winding 95 surrounds a tubular member 98 in which a movable element or plunger 99 of magnetic material is slidably mounted and adapted to be actuated by the solenoid. The movable element or plunger 99 has a tapered valve portion 100 at one end thereof which normally rests in one end of the passage 38 to prevent fluid flow through that passage from the auxiliary chamber 25 to the fuel outlet opening 40. A portion 102 at the other end of the plunger 99 is preferably reduced in section and extends outwardly through an opening 103 in the cover 13 of the housing. A cap 104 is preferably provided on the end of the tubular member 98 adjacent the cover 13, which cap has an opening 105 through which the portion 102 of the plunger also extends.

A switch 106, which is preferably of the mercury tube type, having therein a quantity of mercury 107 adapted to bridge and electrically connect electrodes 108 and 109, is secured in a clamp 110 and rockably supported on a shaft 112 adjacent the cover 13 and in alignment with the projecting portion 102 of the plunger 99 and the rod or actuating element 90. The shaft 112 is preferably supported by and secured to lugs 113 and 114 which are preferably integral with the cover 13. Also, the clamp 110 is secured to a rocker 115 which has lugs 116 and 117 rotatably mounted on the shaft 107 between the lugs 113 and 114, and also has projecting arms 118 and 119 which extend outwardly from the lugs 116 and 117 to positions in alignment for engagement by the projecting portion 102 of the plunger 99 and the rod or actuating element 90. The switch 106 is clamped in position by a screw or fastening means 120 having a cooperating nut 122. The rocker 115 and switch 106 are preferably so balanced that the rocker and switch together are biased by gravity to the position to which they were last actuated. Energization of the solenoid 93 raises the plunger 99 to effect engagement of the projecting portion 102 thereof with the arm 118 to actuate the switch to a position in which the electrodes 108 and 109 are engaged and electrically connected by the mercury 107. When the solenoid is deenergized and the level of the fluid in the timing float chamber 19 increases to a sufficient extent, the switch is actuated to the position shown in Figure 3 by engagement of the rod or actuating element 90 with the arm 119.

In the illustrated electrical circuit with which the control apparatus is adapted to operate, the circuit from the power supply line wires 123 and 124 to the winding 95 of the solenoid is closed by and through a switch 125 which switch has been illustrated as one of the mercury tube type. The switch 125 may be actuated by a temperature responsive or bimetallic element 126, such as the one illustrated in Figure 2 of the Patent No. 2,162,571, in response to temperature variations of water, air, or a desired medium, or by other suitable means. The closing of the circuit to the winding 95 of the solenoid actuates the plunger 99 to effect actuation of the switch 106, which switch closes a circuit from the power supply lines 123 and 124 to a motor 127 which drives a blower such as the blower 36 shown in Figure 1 of the Patent No. 2,162,571, and also closes a circuit to an ignition transformer 128 which provides a spark for igniting the fuel of a burner.

Operation

In the operation of the control apparatus disclosed herein as a preferred embodiment of this invention, fuel flows into the main or constant level float chamber from a fuel supply tank and raises the level of the fluid level responsive means or float 41 to control the valve 54 and thereby effect control of the rate of fuel flow into the constant level float chamber 18. When the solenoid 95 is de-energized so that the fuel outlet passage is closed by the valve portion 100 of the plunger 99, fuel from the constant level float chamber 18 normally flows through the passage 30 and auxiliary chamber 25 and into the timing float chamber 19 to raise the level of the fluid level responsive means or timing float 89. This raises the level of the float 89 to a position such that the switch 106 is actuated to the "off" position thereby. Thus, when the solenoid is de-energized to close the fuel outlet passage the float 89 normally stays in a raised position, the switch 106 is in the "off" position and when a predetermined fluid level is reached in the constant level chamber 18 the valve 54 is closed by the action of the float 41 to prevent continued flow of fuel from the supply tank to the control apparatus.

With the apparatus in the normal "off" position described, the energization of the solenoid 93 by closure of the circuit through the switch 125, effects upward movement of the plunger 99 to actuate the switch 106 to the "on" position and force the float 89 downwardly against the buoyancy of the fluid in the timing chamber 19. This movement forces most of the liquid in chamber 19 out through opening 26 into chamber 18. The upward movement of the plunger 99 also opens the passage 38 for the flow of fuel or fluid

from the apparatus through the opening 40. After the opening of the passage 38 the remaining fluid or fuel from the timing chamber 19 flows therefrom through the connected passages 27, 28 and 29 and to the burner or fluid utilizing device with the fluid that flows thereto from the constant level float chamber through the auxiliary chamber 25. The closing of the switch 106 by the action of the plunger 99 starts the blower driving motor 127 and the fuel ignition discharge soon after the commencement of flow of fuel from the opening 40.

Since it is decidedly advantageous for the prevention of the formation of gum and soot in the burner to provide air for the complete combustion of all the fuel that remains in the burner after the closure of the passage 38, it is desirable that the switch 106 remain in the "on" or closed position after the de-energization of the solenoid 93 by the switch 125. This result is accomplished by the apparatus herein disclosed. When the action of the switch 125 de-energizes the solenoid 93 the plunger 99 drops to the position indicated in Figure 3 so that the valve portion 100 closes the passage 38. After such closure of the passage 38, the switch 106 remains in the "on" position until it is actuated to the "off" position by the action of the timing float 89. The closure of the passage 38 effects a flow of fuel through the connected passages 27, 28 and 29 to the timing float chamber 19 to raise the level of the timing float 89. Because of the restriction of the passages 27, 28 and 29 by the adjusted restricting action of the needle valve 35, a predetermined period of time is required for the timing float 89 to rise to a level at which the switch 106 is actuated to the "off" position. This predetermined period of time is adjusted by the needle valve 35 to a period such that the blower motor 127 is kept running for a sufficient time to effect complete combustion of the fuel remaining between the valve portion 100 and the burner at the time of the closure of the passage 38.

Under normal operating conditions the head for providing flow through the apparatus remains substantially constant through the action of the float 41 and its control of the valve 54. The adjustable needle valve 42 is provided to control and meter the flow of fluid or fuel from the chamber 18 to the burner or fluid utilizing device.

The opening 58, through which the constant level float chamber 18 is connected with the shut-off or safety float chamber 23, is also above the normal fluid level in the constant level float chamber 18. Overflow fluid from the constant level float chamber 18, which occurs under abnormal conditions, and the return flow of fluid from the burner or fluid utilizing device through the coupling opening 78 controls the level of the safety float 60. A sufficient rise in the level of the fluid in the chamber 23 effects movement of the valve control arm 64 with the snap action under the influence of the spring 67 to close the fluid inlet passage 46 by the needle valve 54 until the apparatus is again put in operating condition by manually draining the chamber 23 and resetting the valve control arm 64 as has been described.

It is pertinent to note in connection with the apparatus disclosed herein that the adjustment of the timing of the operation of the switch 106 is independent of the adjustment of the operation of the switch 125 and that the adjustment of the timing is effected without interference with the normal operation of the temperature control apparatus or other means which actuates the switch 125. It is also pertinent to note that the desired control is effected cooperatively by electrical and fluid responsive means. Another feature of this invention is that the apparatus herein disclosed provides control of fluid flow and timing.

While I have described a preferred embodiment of my invention, many modifications may be made without departing from the spirit of the invention, and I do not wish to be limited to the precise details of construction set forth, but desire to avail myself of all changes within the scope of the appended claims.

I claim:

1. In combination with a liquid fuel burner, fuel and air supply lines for said burner, a fan in said air line, a motor for said fan, a valve in said fuel supply line, and means normally maintaining said valve in a closed position, of control apparatus embodying a solenoid, a thermostatic switch, means operable upon the closing of said thermostatic switch to energize the solenoid and open said valve, a mercury switch operable upon the opening of said valve to energize the fan motor, means providing a float chamber having a movable float therein, means providing a communicating fuel flow passage from the fuel supply line to the float chamber, and means comprising said float for actuating said mercury switch to de-energize the fan motor in time delayed relation with respect to the de-energizing of the solenoid.

2. In combination with a liquid fuel burner, fuel and air supply lines for the burner, a motor driven blower for supplying air to the burner through the air supply line, and a control instrumentality, of control apparatus comprising a housing providing a fuel passage communicating with the fuel supply line and burner, said housing also providing a plurality of float chambers and passages connecting the chambers to the fuel passage, floats movable in each of said chambers in response to the liquid fuel level therein, electromagnetic means controlled by said control instrumentality, means actuated by the electromagnetic means for starting and stopping the flow of fuel through said fuel passage to the burner, means actuated by one of said floats for controlling the rate of fuel flow through the fuel passage to the burner when fuel is flowing through said fuel passage, a switch having "on" and "off" positions for starting and stopping the motor driven blower, means actuated by the electromagnetic means for actuating the switch to the "on" position for starting the blower when the flow of fuel through the fuel passage is started, a timing float in another of said chambers adapted to change position after the flow of fuel through the fuel passage is stopped, and means actuated by said change of position of the timing float to actuate said switch to the "off" position to stop the blower after the fuel flow has been stopped.

3. In combination, a liquid fuel burner, a fuel supply line for the burner, means for supplying air to the burner, a control instrumentality and control apparatus adapted to be utilized with the control instrumentality for controlling the flow of liquid fuel to the burner and the operation of the means for supplying air to the burner, said control apparatus comprising means for starting and stopping fuel flow through said supply line to the burner in response to control by the con-

trol instrumentality, means in addition to the control instrumentality and including a chamber connected to the fuel supply line and a float movable in said chamber by fuel flow into the chamber after the stopping of fuel flow through the supply line to control the means for supplying air to the burner and thereby stop the air supply to the burner a period of time after the fuel flow is stopped, means for controlling the rate of fuel flow to the burner, and means for stopping fuel flow to the burner under abnormal conditions of operation.

4. Control apparatus adapted to control the flow of liquid fuel to a burner and a motor driven air supply for the burner housing providing a chamber adapted to hold liquid, a main liquid fuel delivery passage and an auxiliary liquid fuel flow passage providing communication between the chamber and the main liquid fuel delivery passage, adjustable means for restricting the auxiliary liquid fuel flow passage, a switch having "on" and "off" positions for controlling the motor driven air supply fan, a solenoid adjacent said chamber, a linearly movable element actuated by the solenoid and having valve means integral therewith for stopping the flow of liquid fuel from the main liquid fuel delivery passage when the solenoid is deenergized, means comprising said movable element for actuating the switch to one of said positions when the solenoid is energized, and a float movable in said chamber for actuating the switch to the other of said positions when the solenoid is deenergized, the normal position of said float being dependent upon the fuel level in said chamber, and the fuel level in said chamber being dependent upon said valve means and the flow of liquid through the auxiliary liquid fuel flow passage, so that said switch is actuated to said other position a predetermined and controlled time after the flow of liquid fuel is stopped through the main fuel delivery passage.

5. In combination with a liquid fuel burner and a motor actuated blower, control apparatus comprising a housing including a chamber adapted to hold liquid fuel, a main liquid fuel delivery passage through which fuel flows to the burner, and an auxiliary liquid fuel flow passage providing a connecting passage for the flow of fuel between the main fuel delivery passage and the chamber, the position of said chamber with respect to the main fuel delivery passage being such that fuel flows from the chamber to the main fuel delivery passage when fuel is flowing through the main fuel delivery passage and flows from the main fuel delivery passage to the chamber when fuel flow through the main fuel delivery passage is stopped; a switch having two operating positions for controlling the operation of the motor actuated blower; a solenoid; a movable element actuated by the solenoid and having valve means integral therewith for controlling the flow of liquid fuel through the main fuel delivery passage to the burner; means comprising the solenoid for actuating the switch to one of said operating positions; and means including a float movable in said chamber in response to the fuel level therein for actuating the switch to the other of said operating positions, whereby the operation of said blower is timed with respect to the flow of fuel through the main fuel delivery passage to the burner.

6. Control apparatus adapted to control the operation of a liquid fuel burner and air supply means for the burner comprising, in combination, means providing a main liquid fuel delivery passage for the burner, and an auxiliary liquid fuel flow passage communicating with the main liquid flow passage; adjustable means for restricting the auxiliary liquid fuel flow passage; a switch having two operating positions for controlling the air supply means; a solenoid; a movable element actuated by the solenoid and having valve means integral therewith for controlling liquid fuel flow through the main liquid fuel delivery passage to the burner; means comprising the movable element for actuating the switch to one of said operating positions; and means controlled by liquid fuel flow through the auxiliary liquid flow passage for actuating the switch to the other of said operating positions to control the timing of the actuation of the switch to the said other of the operating positions.

7. In combination with an oil burner, a fuel supply line, air supply means for the burner, and a power circuit for the air supply means, means comprising a part of the fuel supply line and providing a main fuel supply passage, and an auxiliary passage communicating with the main fuel supply passage; a switch connected in the power circuit of the air supply means and having operating positions for controlling the supply of air to the burner; electromagnetic means; a movable element actuated by the electromagnetic means, said movable element effecting actuation of the switch to one of said operating positions to start the air supply to the burner and also effecting the starting and stopping of fuel flow through the main fuel supply passage; and means responsive to the quantity of fuel which flows through the auxiliary fuel flow passage for actuating the switch to another of said operating positions to stop the air supply to the burner in timed relation with respect to the stopping of fuel flow through the main fuel supply passage.

8. In combination with an oil burner, electrically operated air supply means for the burner and a power circuit for the air supply means, means providing connected main fuel supply and auxiliary fuel flow passages; a switch connected in the power circuit of the air supply means and having operating positions for starting and stopping the air supply means; electromagnetic means for controlling the operation of said switch to one of said operating positions to start the air supply to the burner, said electromagnetic means also effecting the commencement of fuel flow through the main fuel supply passage to the burner when the air supply is started; the direction of flow of fuel through the auxiliary fuel flow passage being dependent upon the flow of fuel through the main fuel supply passage, and means actuated by fuel flowing in one direction through the auxiliary fuel flow passage for actuating the switch to another of said operating positions to stop the air supply to the burner in timed relation with respect to the stopping of fuel flow through the main fuel supply passage.

9. In combination with an oil burner, a motor driven blower for supplying air to the burner and a power circuit for the motor driven blower, of means providing communicating fuel flow passages, a switch connected in the power circuit of the motor driven blower for controlling the starting and stopping of the blower, electromagnetic means providing primary control of the flow of fuel through said passages and the actuation of said switch for starting the blower, and means responsive to the quantity of fuel flow through one of the fuel flow passages for providing sec-

ondary control of the switch to stop the blower in timed relation to the stopping of fuel flow through the other of said fuel flow passages.

10. In combination with a liquid fuel burner, a fuel supply line, a motor driven blower for supplying air to the burner, and a power circuit for said motor, a mercury switch connected in said power circuit for controlling the supply of air to the burner and supported for rocking movement to "on" and "off" positions, said switch being normally biased to the position to which it was last operated, a solenoid having a movable armature and providing a primary control for moving the switch to the "on" position to start the motor when the solenoid is energized, means providing a float chamber having a passage communicating with the fuel supply line, a float movable within the chamber and providing a secondary control for actuating the switch to the "off" position to stop the motor when the solenoid is deenergized, and adjustable means restricting said passage.

11. In combination with a liquid fuel burner, a fuel supply line, electrically controlled air supply means for the burner, and a power circuit for said air supply means, a switch connected in said power circuit and having operating positions, said switch being normally biased to the position to which it was last operated, electromagnetic means providing a primary control for actuating the switch to one of said positions to start the air supply to the burner, means providing a float chamber having a fluid passage communicating with the fuel supply line, a float movable in said chamber and having its position determined by the fuel level in said chamber, means controlled by said electromagnetic means for controlling the fuel level in said chamber so that the chamber is emptied of fuel when the switch is actuated by the solenoid, said float providing a secondary control for actuating the switch to another of the operating positions to stop the air supply to the burner at a time after the switch is released by the electromagnetic means, which time is dependent upon the rate of flow of fuel into said chamber through said passage.

12. In combination with a liquid fuel burner, a fuel supply line, a motor operated air supply means for the burner, and a power circuit for the motor, control apparatus comprising a housing providing a float chamber and having a plurality of openings for fuel flow from the fuel supply line and from the chamber, a switch connected in the power circuit of said motor, for controlling the air supply to the burner, means responsive to the level of fuel in said chamber for effecting control of the switch, one of said openings being above a predetermined level in said chamber and having fuel flow therethrough under abnormal conditions of operation of the apparatus, another of said openings providing normal fuel flow to and from the chamber, and means metering fuel flow through the last mentioned opening to control timing of switch operations effected by said means responsive to the level of fuel in said chamber.

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