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H. F. TAPP

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CONTROL FOR OIL BURNERS

Filed Jan. 11, 1926

2 Sheets-Sheet 1

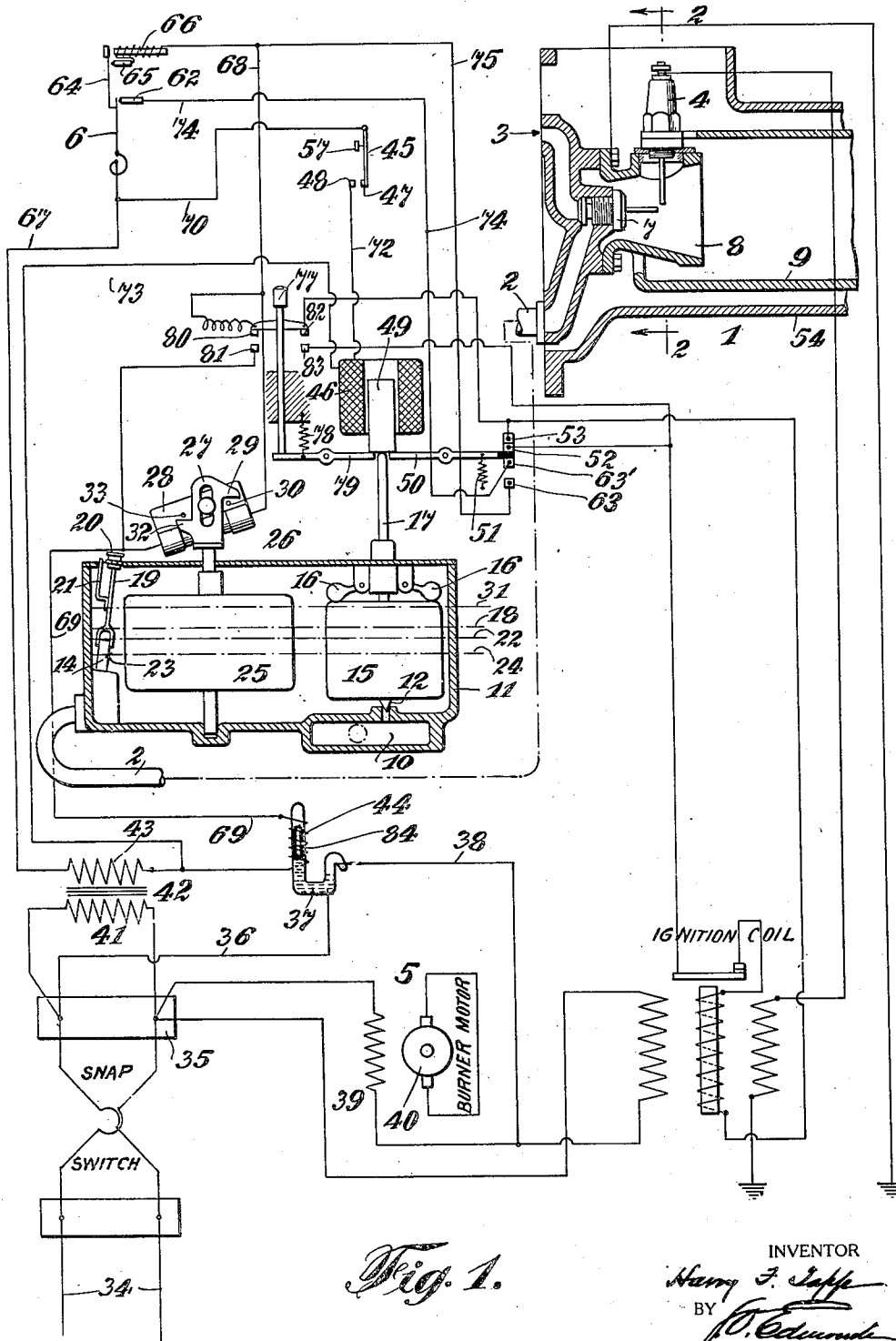


Fig. 1.

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Fig. 2.

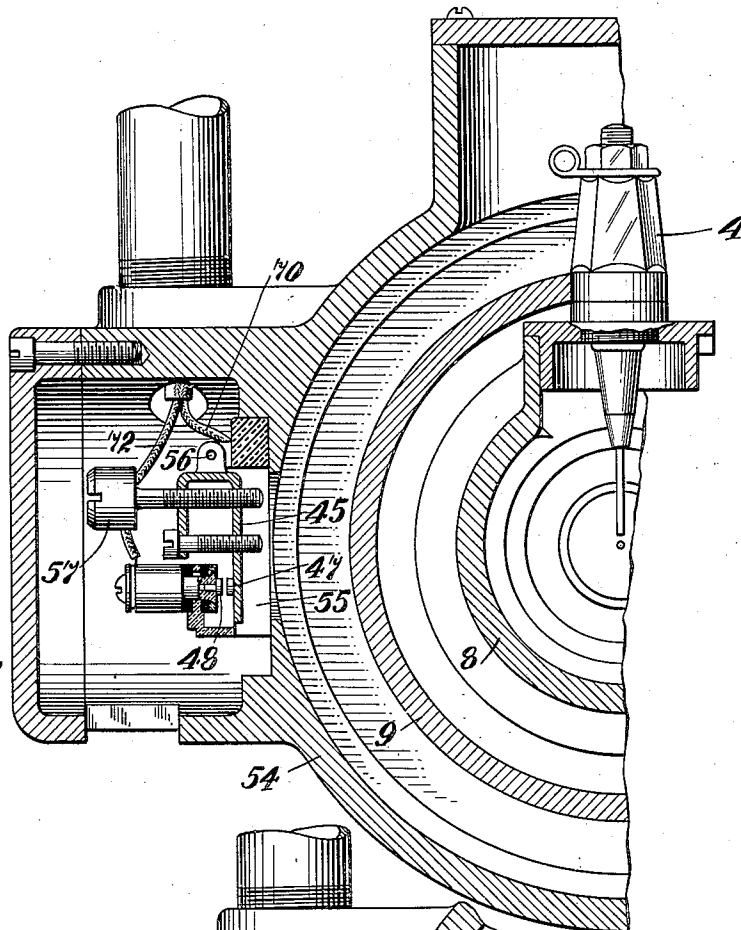
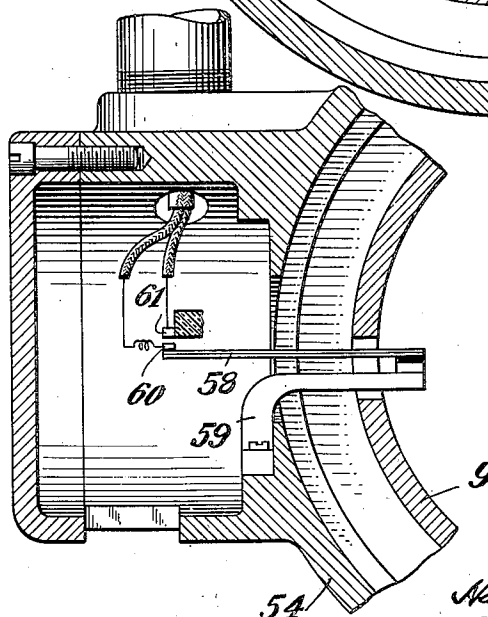


Fig. 3.



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CONTROL FOR OIL BURNERS

Application filed January 11, 1928. Serial No. 80,479.

This invention pertains to fuel burners, and more especially the invention relates to those burners which are semi-automatic or automatic in their operations.

5 The preferred apparatus, which has been selected for the purpose of illustrating and describing this invention, is a fuel burner adapted to burn oil. The particular burner selected is one that is especially adapted to
10 heat dwellings. While the invention will be disclosed as being incorporated in such a semi-automatic or automatic oil burner for heating the home, it is to be understood that the principles of operation thereof may be em-
15 ployed in burners used in the home for other purposes or in burners employed for other uses.

This invention is an improvement upon the invention set forth in application for Letters
20 Patent of Robert F. Metcalfe, filed November 3, 1925, S. N. 66,464, for improvements in fuel burners and method of control therefor.

It is well recognized that one of the main requisites of any control means for an auto-
25 matic or semi-automatic fuel burner, is to be operable as to prevent operation of the burner when fire hazards exist. Also, such control must be so designed as to prevent explosions which might result when there exists an im-
30 proper mixture of the fuel with the combustion supporting material. The herein disclosed improved form of automatic control gives a safe, efficient and successful operation of the fuel burner.

35 In general, the invention herein disclosed has particularly to do with safety control means which directly governs the feed of fuel to an oil burner. This improved successful and efficient control is preferably accomplish-
40 ed by feeding substantially all or a part of a preliminary or predetermined amount of fuel to the burner for the purposes of initiating combustion therein. After this initial combustion has been obtained, then part
45 of the control of the apparatus, or some other selected means, is brought into operation and opens or connects the main source of fuel supply to the burner for the purpose of continuing the combustion which has already been
50 established. This invention particularly has

to do with a desirable form of a novel and improved electrical control system having therein a portion that is responsive to combustion conditions in the burner, and another portion that is especially arranged to
55 control the feed of the fuel to the burner after initial ignition has been established.

An object of this invention is to provide in general an improved form of automatic control for liquid fuel burners and to design that
60 control so that the main fuel supply is connected to the burner only after ignition has been established therein.

It is a further object of the invention to provide a novel electrical means for control-
65 ling the connection of the fuel of an oil burner to the burner proper after predetermined conditions of operation have been completed.

Another object of the invention is to provide
70 an improved control means for liquid fuel burners and to so design such control that there is an immediate response to the conditions of combustion or of non-combustion to connect or disconnect respectively the
75 main fuel supply to the burner.

The particular object of the invention herein disclosed is to provide a novel and improved form of control means for a liquid
80 fuel burner wherein the main supply of fuel is normally closed until a quick acting electrical control means responds to conditions of combustion and automatically and immediately acts to open the supply of fuel to the
85 burner after some fuel has been fed to the burner for purposes of obtaining initial ignition thereof.

Other objects and advantages of this invention will become apparent upon the reading of the detailed description which fol-
90 lows.

The preferred form of disclosure of this invention is illustrated in the accompanying drawings wherein:—

Fig. 1 is a schematic wiring diagram of an
95 electrical system for fuel burner, and parts of the burner mechanism and a fuel feed system are shown in section;

Fig. 2 is a sectional view of a portion of
an oil burner showing the location, construc- 100

tion and electrical contacts of an improved form of switch; and

Fig. 3 is a modification in section of part of the apparatus shown in Fig. 2 and illustrates a thermostatically operated switch.

Referring now to these drawings, the skeleton part of an oil burning mechanism is illustrated as including a burner 1 which is provided with an oil inlet 2 and a suitable conduit 3 through which is supplied a combustion supporting material such as air or steam. In this installation the combustion supporting material is air. A suitable means for igniting the mixture of the oil and air is provided in the form of a spark-plug 4. A motor 5 is preferably provided for driving a blower or compressor for producing the air to be introduced through conduit 3. Whenever desired this motor may also drive a pump for moving the oil fuel from an oil supply to a point of use. Since this oil burner is particularly adapted to heat homes there is provided a thermostat 6 which is so placed as to be responsive to the heat in any one of the rooms of the dwelling. This thermostat normally operates to control the intermittent starting and stopping of the burner. In the event the burner is used for special or industrial purposes, the thermostat 6 may be located at a desired position in order to be responsive to the variations in heat to be governed, or it may be replaced by some other suitable heat responsive means.

In this fuel burner the compressed air in passing through conduit 3 draws the oil through conduit 2 and atomizes the same at nozzle 7 which is suitably located in a cone 8. The preferred construction of this oil burner includes a tube 9 in which there is a partial burning of the mixture of air and oil issuing from the cone 8. In order to obtain substantially complete burning of the mixture, there is provided an additional air supply which is introduced into the tube 9 preferably around the outside of the cone 8 and which in time is mixed with the burning mixture and finally is consumed in completing the combustion of the oil. While tube 9 is illustrated only in part it is to be understood that this tube may extend into a furnace or boiler, and that part of the burning of the oil mixture is accomplished within the tube 9 and part may be within the lower part of the furnace or boiler. For the purpose of this disclosure the tube 9 may be considered as a combustion chamber, although part of the combustion, as heretofore noted, may take place within the furnace. If desired all of the burning may be obtained within a single combustion chamber. The air which is supplied through conduit 3 and the air which is supplied around the nozzle 8, it will be noted, develop a substantially constant air pressure within the tube 9. By the use of this tube 9 it has been found that when igni-

tion of the oil mixture takes place within the tube an additional or higher pressure develops. This pressure due to combustion conditions is an additional pressure and it is preferred to employ it to aid in the proper control of the oil burner. The particular reason for this is that this additional pressure is present only when combustion conditions exist.

While an important part of this invention is directed to a desirable means and method of feeding the fuel to the burner, there has not been shown a definite source of fuel supply as any one of several kinds of supply tanks or pipes may be employed. It is to be considered, however, that fuel will pass from any suitable source of supply to a compartment 10 of a reservoir 11. This fuel may flow to the compartment 10 by reason of gravity or it may be forced thereto by a pump which, it is preferred shall be driven by the motor 5 as in this instance. The fuel passes from compartment 10 into the reservoir 11 through a suitable valve 12, and will flow from the reservoir through a weir 14 into the conduit 2 from which it will be drawn into nozzle 7 by the suction developed by the passing of air through the nozzle. Other means of supplying the fuel to the nozzle 7 may be employed if desired. It is also to be understood that a different type of nozzle may be used if desired.

This invention it is to be considered, provides a suitable fuel conduit system for supplying fuel to the burner under normal conditions. In addition the conduit system provides for the feeding of all or a portion of a predetermined amount of fuel to the burner whenever it is started under the control of the thermostat 6. This predetermined or preliminary quantity of fuel is fed for the purposes of establishing initial combustion in the combustion chamber. In the event combustion is initiated then the main supply of fuel will be connected to the burner proper so that combustion therein will be continued. In the event combustion does not take place then the burner will be automatically stopped as will be hereinafter more fully described. It is to be understood, however, that one of the main features of this invention consists in feeding some air and an immediately available amount of fuel for initiating combustion in the burner, and to thereafter, connect the main source of supply of fuel to the burner so that combustion may be satisfactorily continued.

The reservoir 11 contains a suitable float 15 which operates in the normal manner through weights 16 to control the movement of stem 17 which forms part of the valve 12 thereby opening or closing this valve to permit oil to flow from compartment 10 into reservoir 11. This stem 17, however, is not always responsive to the action of the float

15 as will later be described. The float 15, however, under normal running conditions functions to maintain fuel in the reservoir at a normal level such as level 18. The flow of the oil or fuel from the reservoir is through the weir 14 which may be adjusted so that its opening at the top thereof may be located at different positions below the normal fuel level 18 thereby varying the amount of fuel which is available to be fed to the nozzle 7 at the start of the burner. The position of this weir may be readily varied by moving shaft 19 in response to the turning of a thumb-screw 20. The shaft is prevented from turning by reason of a suitable extension 21. The preferred construction of this weir tube is illustrated in the application for Letters Patent above noted. It will be seen that the preliminary or predetermined quantity of oil which is available for feeding upon the start of the burner is that quantity of oil between level 18 and level 22 which is at the mouth of the weir and it will also be seen that this quantity may be varied.

In the event combustion takes place in burner 1 during the feeding of this preliminary amount of fuel, then valve 12 is opened, as will herein be fully described, and fuel will flow into the reservoir 11 and the normal fuel level 18 will be maintained by reason of the normal operation of float 15. Should combustion not take place when this preliminary amount of oil has been fed then air will be drawn through the weir 14 and pipe 2 into the nozzle 7 for the top of the weir will have been uncovered. Thus there will be no further supply of oil to the burner in such quantities as will support combustion.

It is desirable when ignition does not take place to close down the burner and for that purpose there is provided a leak opening 23 in the weir, and the oil will leak into the pipe 2 and will drop the level in reservoir 11 down to the level 24. This amount of oil leaking is not sufficient when combined with the atomizing air supplied by conduit 3 to support combustion. When the oil has reached the level 24 the motor 5 is stopped in the following manner. A suitable float 25 is located in the reservoir 11 and carries a plate 27. A suitable switch 28 connected in the electrical control circuit of the burner is operated when the fuel reaches level 24 by reason of an extension 29 engaging a suitable knob 30 on the switch and pulling it down to oscillate the switch to its open position thereby causing the opening of the main switch of motor 5 and stopping all operations of the burner. This float also operates to open switch 28 when a level of fuel in reservoir 11 rises and reaches level 31 as extension 32 engages knob 33 on the switch 28 and moves the same to open position.

It will be seen from the description thus far that a predetermined amount of fuel may be

fed to the burner at any start thereof for the purpose of initiating combustion and that after combustion has been initiated a normal level of fuel in reservoir 11 will be continued and fuel will be drawn to the nozzle 7 for continuing burning in the combustion chamber. It will also be seen that suitable means are provided for stopping the operating parts of the burner in the event ignition does not take place when this preliminary amount of fuel has been fed to the burner. It will also be seen that a safety means is provided for closing down the apparatus in the event the fuel level in reservoir 11 becomes too high. This high level 31 may be obtained for instance by the valve 12 becoming fouled and not tightly seating.

The electrical control system will now be described. A suitable supply of electrical current is provided through conduits 34 which pass through a snap switch to a connection board 35. This supply of current passes through conductor 36 to a mercury switch 37 and from there under certain operative conditions through conduits 38 to field 39 of the motor 5 and back to the other supply line. This switch 37 is to be considered as the main or burner motor switch. A branch of conduit 38 leads to the ignition coil which in turn operates the spark-plug 4. As the ignition coil does not form part of this invention it will not be described in detail. The rotor 40 of the motor is preferably of the closed circuit type so that when mercury switch 37 is closed the motor will operate. If desired, any other type of motor may be employed. A branch of the conductors 34 passes through a primary winding 41 of a suitable transformer 42 and forms the source of supply for the controlling apparatus of this particular type of oil burner. The secondary winding 43 of the transformer 42 gives a low potential upon which the control part of the burner operates. If desired the transformer may be eliminated and the potential of the electrical current as supplied through conductors 34 will be carried directly through the control apparatus. It will be noted that the thermostat 46 and a coil 44 and the transformer operate to control the action of burner motor switch 37 and are both in series with the secondary winding 43 of the transformer 42.

The preferred form of means for connecting the fuel from the source of supply to the burner after combustion has been initiated in the burner will now be described. This improvement relates particularly to an electrical control means for accomplishing this result and there is herein disclosed a switch 45 in series with a suitable magnet 46 and connected in a circuit which leads to the transformer 42. The switch 45 is located in the burner in such a manner as to be responsive to the additional pressure developed by reason of combustion, as hereinbefore stated

and therefore is responsive to conditions of combustion or non-combustion. The existence of such pressure closes switch 45 so that contact 47 will engage contact 48 and thereby energizing the magnet 46 raising its core 49 which in turn relieves the stem 17 upon which the core has been seated by reason of gravity maintaining valve 12 in its normal closed position. In the control herein disclosed it is desired to discontinue the operation of the spark-plug when combustion has been initiated in the tube 9 and a suitable means for accomplishing this result is provided in the form of a lever 50 which is held in its closed position against spring 51 as noted in the drawings so that contacts 52 and 53 are in engagement when the magnet 46 is not energized. When these contacts 52 and 53 are closed the ignition coil and consequently the spark-plug will operate when mercury switch 37 has been closed. When combustion takes place and core 49 is raised, contacts 52 and 53 are opened and the operation of the spark-plug or ignition means is discontinued.

The preferred type of switch 45 may be noted by reference to Fig. 2 wherein the cone 8 and the tube 9 are shown in section. It is preferred to locate this switch 45 so that it is not susceptible to the excessive heat of the burner but may still be responsive to the pressure developed by reason of the existence of combustion. The outer frame 54 is provided with an opening 55 in which the switch 45 normally hangs from a pivot point 56 carrying contact 47 as shown and having the stationary contact 48 held as illustrated. The pressure developed by combustion will throw the switch so that contacts 47 and 48 engage one another. When the pressure ceases due to cessation of combustion the switch becomes responsive to a weight 57 and separates contacts 47 and 48 for normally the switch hangs with these contacts open. The pressure to which this switch is responsive is regulated by any suitable means such as the weight 57 which may be adjusted to change its effective lever arm. In practice this switch has become known as the "flapper switch." It will be noted that this switch is immediately responsive to conditions of combustion or non-combustion and thus the electrical control for opening the valve 12 when ignition has been initiated in tube 9 is immediate. Likewise, when the combustion condition has been destroyed or ceases within tube 9 there is an immediate closing of valve 12 thereby stopping the supply of fuel to the burner. In Fig. 3 there is shown a suitable substitute for the switch 45 in the form of a thermostat rod 58 suitably mounted on a post 59 which preferably extends within the tube 9 and is controlled by the heat of combustion and operates in the normal manner to close contacts 60 and 61 which correspond respectively to contacts 47 and 48.

The operation of this improved control system will now be described. It is assumed that the burner is not operating and that the thermostat 6 is open. As the house becomes cool the thermostat 6 contracts and its arm closes across contact 62. There is no response by the burner as stationary contact 63 is not engaged by a movable contact 63' carried on the lever 50. A further cooling of the thermostat causes its extension 64 to engage contact 65. This engagement completes an electrical circuit and will start operation of the burner. When extension 64 engages the contact 65 an electro-magnet 66 becomes energized and immediately draws the thermostat extension 64 against contact 65 and maintains it in that closed position for a predetermined length of time thus eliminating the "fluttering" of the thermostat. With the closing of extension 64 into contact with 65 it will be seen that the current will be supplied from the secondary winding 43 of the transformer 42 through conductor 67, thermostat 6, extension 64, contact 65, magnet 66, conductor 68, switch 28, conductor 69 to coil 44 of the mercury switch 37 to the other side of the secondary winding 43. The closing of the mercury switch 37 closes the circuit through the field 39 of the burner motor which is then placed in operation for supplying compressed air through conduit 3 to nozzle 7 and thus drawing fuel from the fuel conduit system through pipe 2 and through nozzle 7. The contacts 52 and 53 are closed and the ignition coil and spark-plug are thus placed in operation.

Upon the initiation of combustion in the combustion chamber, or tube 9, the switch 45 is closed and electrical current is supplied from secondary winding 43, conductor 67, conductor 70, switch 45, contacts 47 and 48, conductor 72, electro-magnet 46 and conductor 73 back to the other side of the secondary winding. The core 49 is immediately raised upon the energization of the coil 46 and the spring 51 moves lever 50 so that contacts 52 and 53 are opened thereby stopping the operations of the spark-plug 4, and contacts 63 and 63' then become closed. The closing of these last two contacts operates to short circuit the magnet 66 and thus relieve the thermostat 6 from being positively held in its closed position. The electrical current will then pass from secondary winding 43, conductor 67, thermostat 6, contact 62, conductor 74, contacts 63 and 63', conductor 75 to conductor 68, switch 28, conductor 69, foil 44 back to the other side of the secondary winding 43.

The raising of the core 49 of the magnet 46 frees the stem 17 and float 15 then becomes operative to maintain the fuel level in reservoir 11 at lever 18. This condition of operation will continue until the room or the house has become sufficiently heated and the

thermostat 6 will open due to its expansion. The opening of the thermostat consequently opens mercury switch 37 and the burner motor stops its operation and, therefore the air and oil supplied the nozzle 7 are stopped and the flapper switch 45 will open due to the weight 57 thus deenergizing magnet 46 thereby permitting core 49 to drop and force stem 17 downward so that it closes fuel valve 12. The downward movement of the core 49 moves lever 50 opening contacts 63' and 63 and bringing contacts 52 and 53 into engagement thereby placing the ignition system back into condition to again be operated when mercury switch 37 is closed.

The description above in relation to the operation of the weir, the opening 23 therein and the float 25, fully describes the safety operations of the system in the event initial ignition is not established in the combustion chamber of the burner.

When the burner has been closed down by reason of the opening of switch 28 in response to the dropping of float 25, some suitable means is employed for reestablishing operating conditions in the burner. The preferred means for accomplishing this result provides a pushbutton 77 which is preferably manually moved downward against a spring 78. This movement mechanically raises core 49 by the oscillation of a suitable lever 79 and permits the stem 17 to rise thereby opening valve 12 and allowing oil to flow from compartment 10 into reservoir 11 to raise the fuel level from level 24 to level 18. At the same time that the valve 12 is opened the downward movement of pushbutton 77 closes suitable contacts 80 and 81 which short circuit the switch 28 which was opened when the float 25 was at its low point. By short circuiting this switch 28 the electrical control is completed through the mercury switch 37 and the motor 5 is started, and in case of the fuel pump is attached to motor 5, fuel is fed to the compartment 10 and into reservoir 11. The operation of push-button 77 in raising core 49 permits lever 50 to respond to the spring 51 and open the ignition contacts 52 and 53. In order to permit the operation of the spark-plug 4, which is desirable in order to ignite the mixture supplied from nozzle 7, the push-button apparatus provides for the closing of suitable contacts 82 and 83 which short circuit contacts 52 and 53 and permit the ignition coil and spark-plug to be brought into operation. The push-button 77 may be held down for a length of time thought to be proper. In the event combustion has taken place the switch 45 will be closed and the core 49 will be normally held within the magnet 46 by reason of the energization of the magnet winding.

In the particular type of mercury switch 37 herein shown there is provided a suitable core 84 responsive to magnetic conditions

developed by coil 44 and it operates to force the mercury so that it forms an electrical conducting path between conductors 36 and 38 thereby closing the switch 37.

It will be seen from the description herein that a preliminary amount of fuel is fed to the burner for initiating combustion therein and when such combustion is established the normal supply of fuel will be connected to the burner for purposes of continuing the combustion. It will also be seen that an electric control system is immediately placed in operation upon the establishment of combustion in the burner to connect the main supply of fuel to the burner. This control system operates to open a suitable valve in the fuel conduit system to thereby permit the fuel to flow from the supply to the burner. It will be seen that this immediate response to conditions of combustion is suitably obtained by reason of the pressure resulting from conditions of combustion within the burner. It will also be noted that this pressure due to combustion develops immediately and the control of the burner is advantageously based upon this phenomenon to immediately connect the fuel to the burner from the main source of supply, and to immediately disconnect the fuel in case combustion ceases for any reason. Thus the hazards of fire are eliminated and the means for this elimination it will be seen, act almost instantly to accomplish the desired results. It will also be seen that in the event combustion is not initiated in the burner that a suitable control system operates to close down the burner and it is to be noted that the means for closing down the burner under such conditions is positive and quick acting.

It will be understood that while I have herein described in detail a particular embodiment of my invention for purposes of fuel disclosures, and some detailed features which I am specifically claiming for a special advantage, many changes and modifications may be made in the particular construction and arrangement of parts without departing from the broad scope of my invention which is outlined in the sub-joined claims.

What I claim is:—

1. In a liquid-fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant-level supply chamber with a float for controlling the level thereof, a fuel cut off valve, a weighted member associated with said valve and acting when lowered to close the valve irrespective of the level of the fuel in the supply chamber, and means controlled by combustion conditions in the burner for lifting the weight while the burner flame persists but for causing its descent to close the valve when the burner flame fails.

2. In a liquid-fuel heating system, the com-

5 bination with a burner, of means for supplying fuel thereto comprising a constant-level supply chamber with a float for controlling the level thereof, a fuel cut off valve, a
10 weighted member associated with said valve and acting when lowered to close the valve irrespective of the level of the fuel in the supply chamber, a solenoid associated with
15 said weighted member and controlling movement thereof, and means controlled by combustion conditions in the burner for energizing the solenoid to lift the weight while the burner flame persists but for causing its descent to close the valve when the burner
15 flame fails.

3. In a liquid fuel heating system, the combination with a burner, of means for supplying fuel thereto comprising a constant-level supply chamber with a float for controlling
20 the level thereof, a fuel cut off valve, a solenoid having a core associated with said valve and acting when lowered to close the valve irrespective of the level of the fuel in the supply chamber, and means controlled by combustion conditions in the burner for energizing
25 the solenoid to lift its core while the burner flame persists but for causing the core to descend to close the valve when the burner flame fails.

30 This specification signed this 6th day of January, 1926.

HARRY F. TAPP.

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