Dec. 1, 1931. I. E. McCABE 1,834,287

LIQUID FUEL BURNER CONTROL

Filed Dec. 27, 1926 4 Sheets-Sheet 1

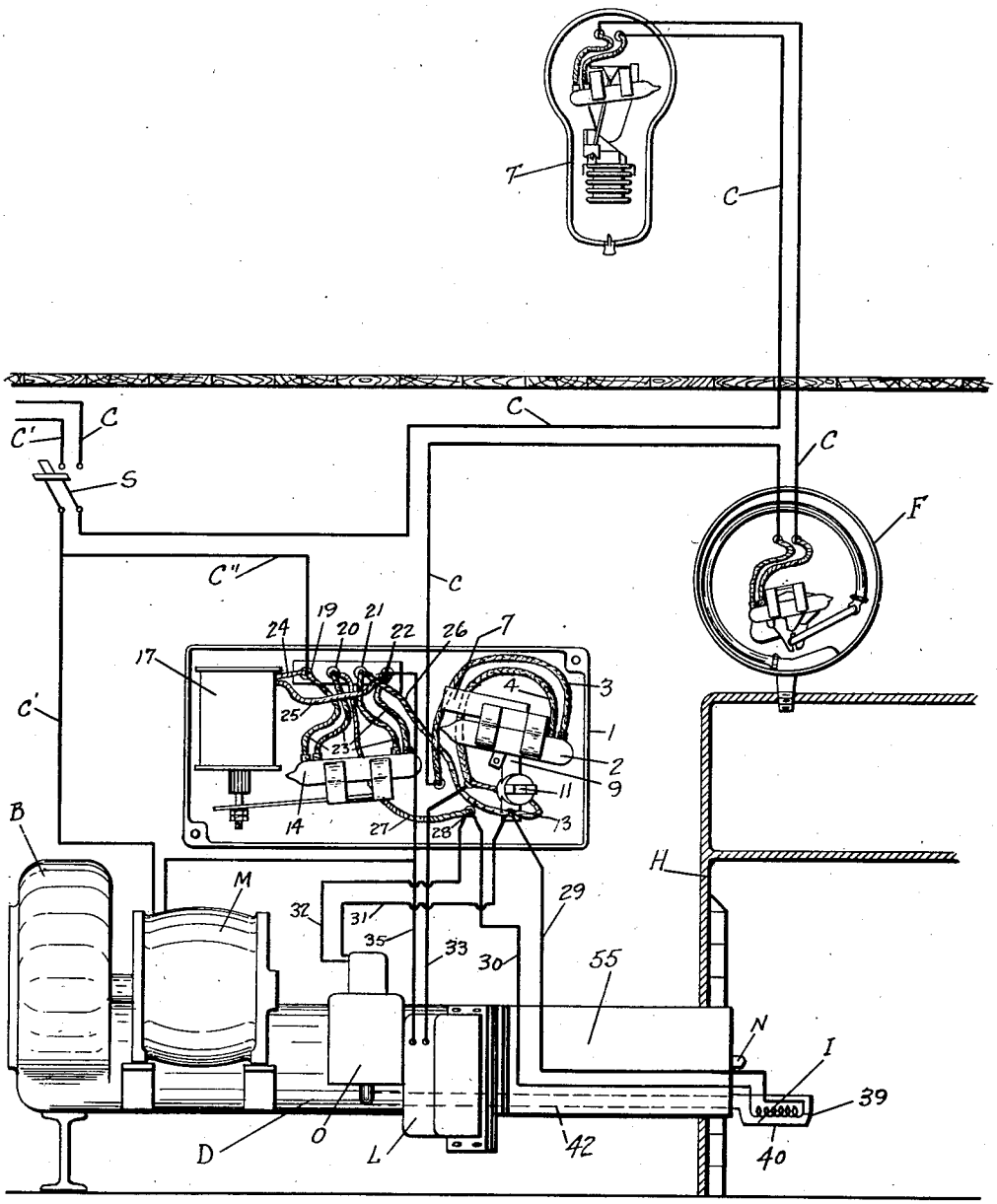


Fig 1

INVENTOR.
IRA E. McCABE
BY Langdon Moore
ATTORNEYS.

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LIQUID FUEL BURNER CONTROL

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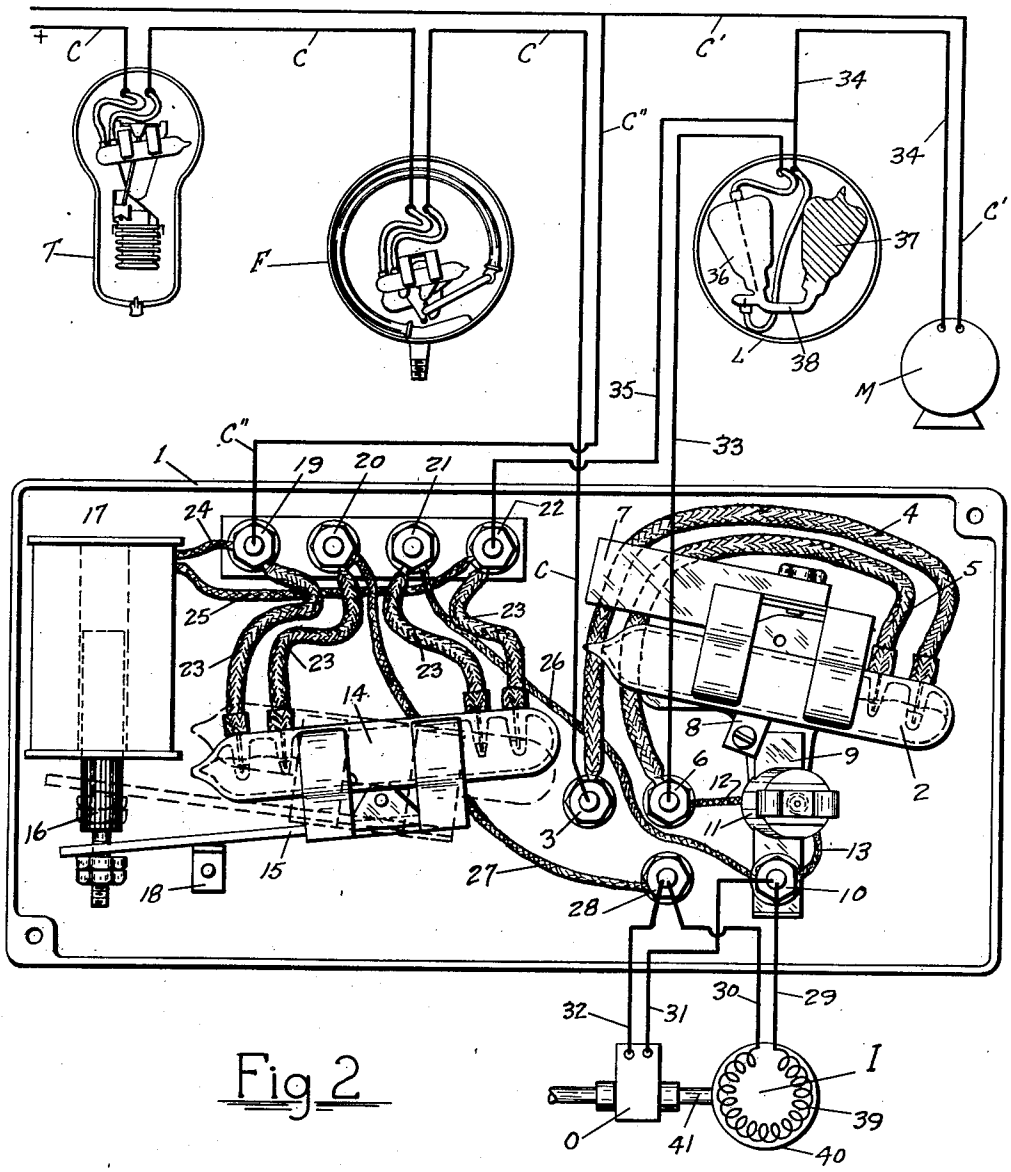


Fig 2

INVENTOR.
IRA E. McCABE
BY Langdon Thom
ATTORNEYS.

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LIQUID FUEL BURNER CONTROL

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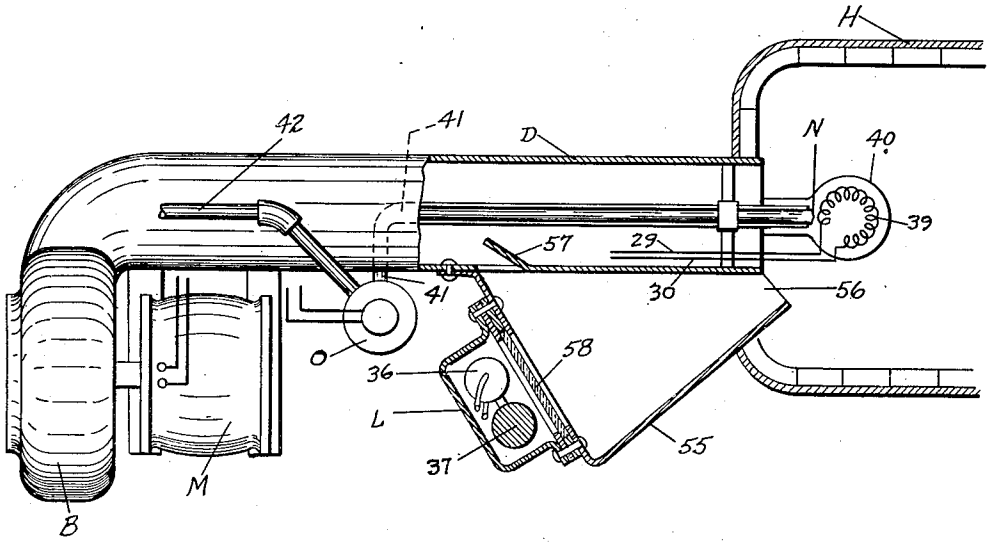


Fig. 3

INVENTOR.
IRA E. McCABE
BY Langdon Mann
ATTORNEYS.

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LIQUID FUEL BURNER CONTROL

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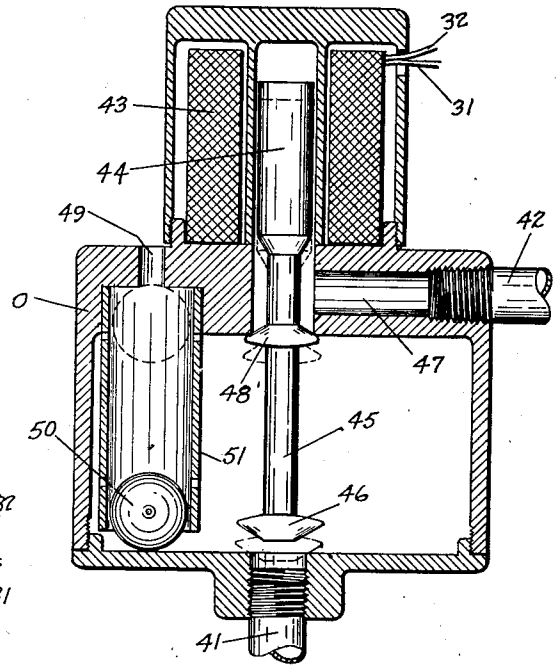


Fig. 4

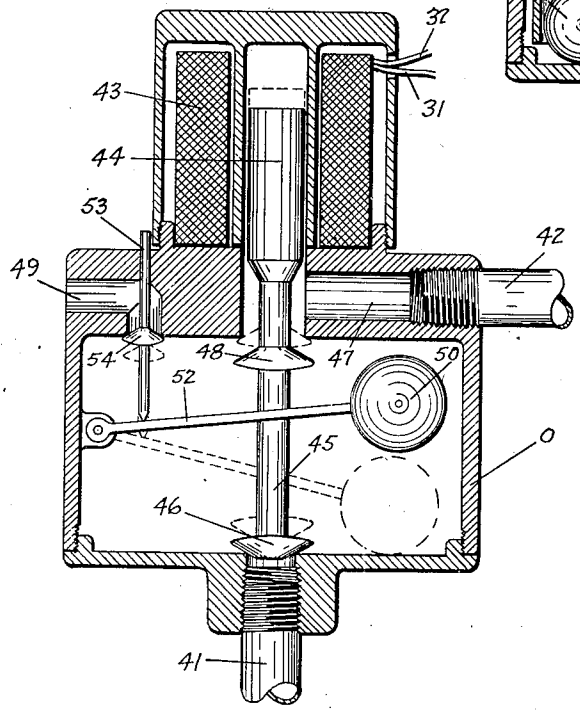


Fig. 5

INVENTOR.
IRA E. McCABE
BY Langdon Thom
ATTORNEYS.

Patented Dec. 1, 1931 1,834,287

UNITED STATES PATENT OFFICE

IRA E. McCABE, OF CHICAGO, ILLINOIS

LIQUID FUEL BURNER CONTROL

Application filed December 27, 1926. Serial No. 157,325.

This invention relates to improvements in controls and more particularly to a system for controlling an electrically-operated liquid fuel burning device when applied to domestic heating purposes.

When electrically-operated liquid fuel burning devices are applied to domestic heating purposes, the liquid fuel burning device is installed to deliver the flame of the burning fuel in the fire box of a commercial furnace or heater of the desired type in accordance with the heating system employed, that is, hot air, hot water or steam. A liquid fuel burning device of this character includes an electric motor for delivering the liquid fuel to the burner nozzle and air under pressure to the ignited fuel. The motor is connected in circuit to a commercial line or source of electricity, with a series of controls interposed between the motor and source of electricity. In domestic heating, the temperature of the building or dwelling is controlled by a room thermostat in the motor circuit which may be set at a desired predetermined degree and when the temperature of the building varies above or below the desired degree, the thermostat opens or closes the motor circuit, as the case may be. It is preferable to provide the burner with a safety control in the motor circuit which when the pressure or temperature within the domestic heater approaches the danger mark, the control will break the motor circuit and when the pressure or temperature decreases sufficiently will close the motor circuit. It is necessary to provide means when the burner mechanism supplies liquid fuel to the burner nozzle to ignite the fuel each time the room thermostat closes the motor circuit. A further safety device is required which will operate should the liquid fuel fail initially to be ignited at the nozzle or should the flame after ignition become extinguished during the operation of the burner mechanism to break the motor circuit, such a safety device is usually installed in the motor circuit between the motor and the room thermostat and heater or furnace control.

It is an object of this invention to provide an efficient and positive control of the type just described which may be termed a safety control and which is particularly adapted to domestic heating purposes although it may be applied as well to any form of electrically operated liquid fuel burning devices for other purposes where it is desirable to discontinue the operation of the burner mechanism upon initial failure of the liquid fuel to ignite or as the flame from the ignited liquid fuel becomes extinguished during the operation of the burner mechanism.

While a preferred form of this invention is illustrated upon the accompanying sheets of drawings, it is to be understood that minor detail changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 is a view illustrating an electrically-operated liquid fuel burning device of commercial type in side elevation as applied to a commercial type of domestic heater or furnace, such as employed in a steam heating system, illustrated in section with the room thermostat, furnace control, and safety control illustrated in outline and the wiring of the system shown in diagram.

Figure 2 is an enlarged detail view in side elevation of the safety control mechanism, with the cover of the casing removed, showing the motor and control devices in outline with the wiring of the system in diagram.

Figure 3 is a fragmentary top plan view of the burner mechanism as supplied to the domestic heater, with parts broken away.

Figure 4 is an enlarged detail view in transverse vertical section of a liquid fuel metering device employed in the ignition of the burner flame.

Figure 5 is a view similar to Figure 4 of a modified form of such device.

The embodiment of this invention shown in Figure 1, illustrates a commercial type of electrically-operated liquid fuel burner including a motor M for supplying liquid fuel to the burner nozzle N projecting within the fire box of a domestic heater H and having a housing B enclosing a blower fan on the motor shaft for delivering air under pressure through the draft pipe D about the nozzle N. The wires C and C^1 forming the commercial

source of electricity are shown entering the building with a hand-operated switch S to close or open the circuit to the heating device. The current from wire C passes through the room thermostat T and furnace control F to the safety control mechanism contained in the casing 1, while the wire C^1 is connected to one pole of the motor M.

The safety control mechanism in casing 1 includes a safety switch comprising a mercury tube switch 2 of commercial form, having two electrodes entering one end thereof held in a support rotatable mounted upon the back of the casing with the wire C connected through binding post 3 by a flexible lead 4 to the casing adjacent binding post 10. An electrode of which is connected by a flexible lead 5 to the binding post 6. The rotatable mercury tube support is provided with a counterweight 7 adapted to normally rotate the tube so that the mercury therein flows to the end opposite the electrodes, and is provided with a depending projection 8 having a stud adapted to be engaged by a catch 9 which allows the switch support to be manually rotated to tilt the mercury tube so that the mercury flows into the end with the electrodes and forms an electric connection between them, which catch 9 engages the stud of the projection 8 in the closing position and detachably holds the switch tube in closed position. The catch 9 is preferably formed of a strip of bi-metal secured to its lower end to the back of the casing by the binding post 10. The bi-metal catch 9 supports an electric heating element 11 thereon connected by lead 12 to binding post 6 and by lead 13 to binding post 10. While the heating element 11 may be a coil of resistance wire about the bi-metal strip or any other type of electric heat producer, it is shown here as composed of a plurality of carbon discs within the casing 11, such as fully described and disclosed in my pending application Serial No. 146,971, filed November 8, 1926.

A second mercury tube switch 14 having two sets of terminals arranged in series adjacent the respective ends of the tube is mounted on a support rotatably mounted on the back of the casing which support is provided with an operating arm 15 extending from one side thereof, the free end of which engages with the lower end of a solenoid core 16 slidably mounted in a solenoid 17 mounted thereabove upon the back of the casing. The weight of the core 16 and arm 15 act to tilt the switch support about its pivot causing the mercury to flow into the lower end making an electric connection between the pair of terminals adjacent the solenoid, and a stop 18 is secured upon the back of the casing to limit the amount of rotation of the support in that direction. Four binding posts 19, 20, 21 and 22 are mounted upon an insulated plate secured to the casing above the second mercury tube switch 14, flexible leads 23 connecting the left hand pair of posts 19 and 20 to the left hand pair of terminals in the switch tube 14 and similar leads connecting the right hand pair of posts 21 and 22 to the right hand pair of terminals in said switch tube 14. Binding post 19 is connected by a lead 24 to one end of the windings of the solenoid 17, the other end of which is connected by lead 25 to binding post 22. Binding post 21 is connected by lead 26 to binding post 10 and binding post 20 is connected by lead 27 to binding post 28 upon the back of the casing adjacent binding post 10. An electric ignition device I is connected by wires 29 and 30 to binding posts 10 and 28, respectively, and an electrically-operated oil valve in casing O is connected by wires 31 and 32 to binding post 10 and 28, respectively, and binding post 19 is connected by wire C^{11} to the wire C^1 from one pole of the motor M to the commercial line. Binding post 6 is connected by a wire 33 to one terminal of a light-actuated switch in the casing L, the other terminal of which is connected by wire 34 to the other pole of the motor M, and binding post 22 is connected by a wire 35 to wire 34 between the light switch and the motor. The light switch in casing L is of the type illustrated and described in my co-pending application Serial No. 133,868 filed September 7, 1926, and comprises two sealed bulbs 36 and 37 joined at their lower ends by a restricted connection portion 38 which contains a mercury seal. The bulb 36 is preferably of a clear transparent medium and which contains spaced-apart terminals to which wires 33 and 34 are connected, which terminals extend within the bulb and stop short of the surface of the mercury seal. The other bulb 37 is formed of a medium adapted to absorb rays of the visible spectrum falling thereon, transmute the rays thereof into heat and increase the internal pressure of that bulb to move the mercury of the seal into the other bulb and make an electrical connection between the terminals therein, and upon the failure of light to fall thereon, the absorbed heat is transmitted to the surrounding atmosphere, equalizes the internal pressure of the bulbs and causing the return of the seal to normal position breaking the electrical contact between the terminals in bulb 36.

The ignition device I may be of any type but is here shown as a coil of wire 39 adapted to be heated to incandescence by the electric current when it passes therethrough. This coil 39 is arranged in a cup 40 supported adjacent to and just below the burner nozzle N, and is adapted to receive oil or other liquid fuel from a pipe 41 leading from the valve casing O. The term "oil" is used herein in the sense of any desired liquid fuel, preferably that employed in the burner, although not necessarily so. The oil valve casing O, as

shown in the detail in Figure 4, is divided into four compartments. The lower compartment being an oil container into which oil is fed at the top through pipe 42 from any desired source, preferably of the same source as that supplying liquid fuel to the burner mechanism and the pipe 41 discharges oil from the bottom of the compartment into the cup 40. The upper compartment of the casing O contains a solenoid 43, the windings of which are connected by wires 31 and 32 to binding posts 10 and 28, respectively. The core 44 of the solenoid is prolonged into a valve stem 45 passing through an opening into the lower compartment with a valve head 46 carried on its lower end adapted to seat upon the orifice leading into the discharge pipe 41, which, when the solenoid is de-energized, it will close. Inlet pipe 42 communicates with a duct 47 in the walls of the casing O which opens into the valve stem passage way leading into the lower compartment and the valve stem is provided upon the interior of the lower compartment with a valve head 48 adapted when the solenoid is energized and the core 44 drawn upward thereby to set upon the walls surrounding said valve stem orifice and to close the inlet from pipe 42. In this position the valve head 46 opens the discharge orifice in the pipe 41. When the solenoid is de-energized the valve stem drops, closing the lower discharge orifice as the valve head 48 opens the inlet orifice. The lower compartment is provided with an air vent 49 in the upper wall adapted to be closed by a float valve 50 arranged in a cage 51.

When the inlet pipe 42 is first connected to the source of oil supply, the solenoid will be de-energized so that the discharge orifice will be closed and the inlet orifice opens and oil will flow from pipe 42 through duct 47 into the lower compartment until the float 52 closes the air vent in the tube therefor. Upon initial operation of the burner the solenoid 43 will be energized, drawing solenoid core 44 and more valve stem 45 upward which will open the discharge orifice and close the inlet orifice. The oil contained in the compartment will then flow through pipe 41 into the cup 40. The size of the oil compartment and the cup 40 is such that enough oil will flow into the cup which, when ignited, will be sufficient to operate the light switch and to ignite the burner flame. Upon the de-energization of the solenoid 43, the lower compartment will be replenished with oil. It is, therefore, seen that upon each initial operation of the oil burner mechanism, the oil in casing O will be automatically supplied to the ignition device and then be replenished and retained within the casing until the next operation of the burner mechanism, and for this reason it may be termed a metering device.

Figure 5 illustrates a supply modification in the opening and closing mechanism for the air vent 49. As shown, the float 50 is mounted upon an arm 52, pivoted to a bracket on the side of the compartment below and in line with the opening of the air vent 49. The air vent 49 is in the form of a duct bent at right angle to open into the atmosphere at one side of the casing with a valve stem 53 mounted in the slide through the top of the casing and rest at its lower end upon the float operated arm 52. The valve stem 53 is provided with a valve head 54, within the compartment adapted to open and close the air vent 49. The operation of this form is the same as that above described.

The casing L containing the light switch may be mounted in any desirable manner as long as the rays of light emanating from the burner flame when the liquid fuel at the nozzle is ignited will fall upon the bulb 37. Figures 1 and 3 illustrate another means of supporting the casing L. In this construction the casing L is arranged to close the exterior end of a casing 55 carried on the draft tube D and terminating therewith upon the interior of the heater H having an orifice 56 through which the light emanating from the burner flame may pass and fall upon the bulbs 36 and 37. In this form of light switch support, it is preferable to strike inwardly a portion of the draft tube D which will form a deflector 57 which will cause the air, under pressure from the fan blower passing therethrough, to be deflected into the chamber formed by the casing 55 and thence through the orifice 56 which will maintain a cool and clear atmosphere between the burner nozzle and light switch. In this type, it is also preferable to arrange a screen 58 between the burner flame and the bulbs of the light switch of a medium adapted to absorb the infra-red rays emanating and radiating from the heated walls of the heater H when the burner flame is extinguished.

With the thermostat T in open position and the safety switch 2 having been manually rotated to the position shown in Figures 1 and 2, the switch tube 14 will rest in the position shown in these figures with the arm 15 thereof in engagement with the stop 18. Upon closing of the circuit through the room thermostat T, the commercial current will pass therethrough and through the furnace control F by wire C to binding post 3 in the safety switch control casing 1, thence through safety switch tube 2 by way of leads 4 and 5 to binding post 6. Here the current will divide, part passing through wire 33 to the light switch, but the oil in cup 40, not being ignited, this switch is open and it cannot pass therethrough so it passes through lead 12, through heating element 11 upon the bi-metal safety switch catch 9 and by lead 13 to binding post 10. As the light switch is open, the full strength of the commercial current passes through binding post 10. As

the ignition device I and the oil valve operating means in casing O are connected in multiple to binding post 10 and 28, the current will pass through these devices and cause them to operate as it passes to binding post 28. It then passes through wire 27 to post 20 and, as the left hand end of the solenoid operated switch tube 14 is depressed, through leads 23 and switch 14 to binding post 19 and through wire C^{11} to the commercial return lead C^1.

The completion of the circuit just described energizes the resistance 39 of the ignition device and actuates the solenoid 43 to deliver oil from the metering chamber in casing "O" into the cup 40, the resistance wire becoming incandescent will ignite the oil in cup 40 and light from the flame thereof will actuate the light switch L to close the circuit therethrough from binding post 6 through wire 33 and wire 34 to the motor M and from the motor through wire C^1 to the commercial line. The closing of the circuit from binding post 6 through the light switch L and the motor M shunts out the heating element 11 of the safety switch tube 2. The current passing through the light switch divides, part passing through wire 34 to the motor and part passing through wire 35 to binding post 22 and from thence through lead 25 to the windings of the solenoid 17 and from there through lead 24 to binding post 19 and from thence by the wire C″ to the wire C′ back to the commercial line. The closing of the circuit through the solenoid windings energizes the solenoid to draw the core 16 upward which tilts the switch 14 into the position shown in dotted lines on Figure 2 of the drawings. This movement of the switch 14 breaks the circuit through the leads 23 in the left hand end of the switch and therefore breaks the circuit through the ignition device and solenoid 43 in the casing "O", and as the mercury flows to the right hand end of the tube 14 it closes the circuit between the leads 23 so that should there be any seepage of current from binding post 6 through heating element 11 to binding post 12, it may pass through the lead 26 to binding post 21 and by the way of leads 23 to the binding post 22 and from there through lead 25 back through binding post 19 to the wire C″ to the commercial line. This is the ordinary running circuit.

The flame from the oil burning in cup 40 ignites the fuel issuing from the nozzle N so that when the oil in the cup 40 has burned out the light from the flame of the fuel burning at the nozzle will maintain the light switch L in closed position. Should the oil in cup 40 fail to ignite, the light switch L will remain in open position and the full strength of the commercial current will continue to pass through the heating element 11 which in a predetermined time will trip the safety switch 2 and thereafter all operation will cease until the safety switch 2 is manually reset. Should the flame at the burner nozzle fail to ignite after the oil in the cup 40 has been ignited and has closed the circuit through the light switch L which has not only started the motor but has also actuated the solenoid to tilt the switch 14 to the position shown in dotted lines in Figure 2, the circuit from binding post 6 to the motor will be broken, however, full strength of the commercial circuit will pass from binding post 6 through lead 12 heating element 11 and lead 13 to binding post 10 and from thence through lead 26 to binding post 21 and by way of leads 23, the same being closed in switch 14, to binding post 22 and from thence through lead 25, solenoid 17, lead 24, to binding post 19, and thence by way of wires C″ and C′ to the commercial line until the heating element 11 trips the safety switch 2, whereupon the circuit to the solenoid is broken and switch 14 will assume the position shown in full lines in Figure 2 and the device cannot be operated until the safety switch 2 is manually reset. The same action will occur should for any reason the flame fail at the nozzle after it has been initially ignited, that is, should at any time the burner flame become extinguished, the motor circuit through light switch L will be broken so that the main strength of the commercial current will pass through the heating element 11 and solenoid 17 until the safety switch breaks the circuit therethrough.

What I claim is:

1. In combination, a source of electrical power, an electric motor operated fluid fuel burning mechanism and an electrical control system for said mechanism, said control system comprising a normally closed safety switch in said power source having a timed electrically operable release, an electrical ignition device and an electrically operable fluid fuel pilot for the burner ignited thereby, an electrically actuated switch mechanism and a light responsive switch positioned to be illuminated by both the burner and pilot, and means connecting the enumerated elements to so supply current thereto that on starting the electrically operable release, the ignition device and the electrically operable pilot are energized, the light switch is operated by light from the pilot to energize the motor, and to energize the electrically actuated switch mechanism, said switch mechanism being operable to deenergize the ignition device, pilot and electrically operable release.

2. In combination, a source of electric power, an electric motor operated fluid fuel burner mechanism, a control system for said mechanism, said system comprising a nor-

mally closed electrically operable fluid fuel pilot device for the burner, an electric ignition device for the pilot, a normally closed safety switch in one side of the power source having a timed electrically operable release, an electrically actuated switch mechanism including a plurality of switches and a solenoid for throwing said switches, a light responsive switch positioned to be illuminated by both the pilot and the burner, said light responsive switch being normally open and interposed in a circuit from the safety switch to the motor to the second side of the power source; a branch circuit from the motor side of the light responsive switch to the solenoid to the second side of the power source; a circuit from the safety switch through its electric release, the ignition device, pilot device, a switch of the switch mechanism which is closed when the solenoid is deenergized to the second side of the power source; and a switch which is open when the solenoid is deenergized interposed in a circuit from the electric release to the branch circuit from the motor side of the light switch to the solenoid.

IRA E. McCABE.