

Jan. 28, 1930.

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1,745,178

LIQUID FUEL BURNER CONTROL

Filed Dec. 6, 1926

4 Sheets-Sheet 1

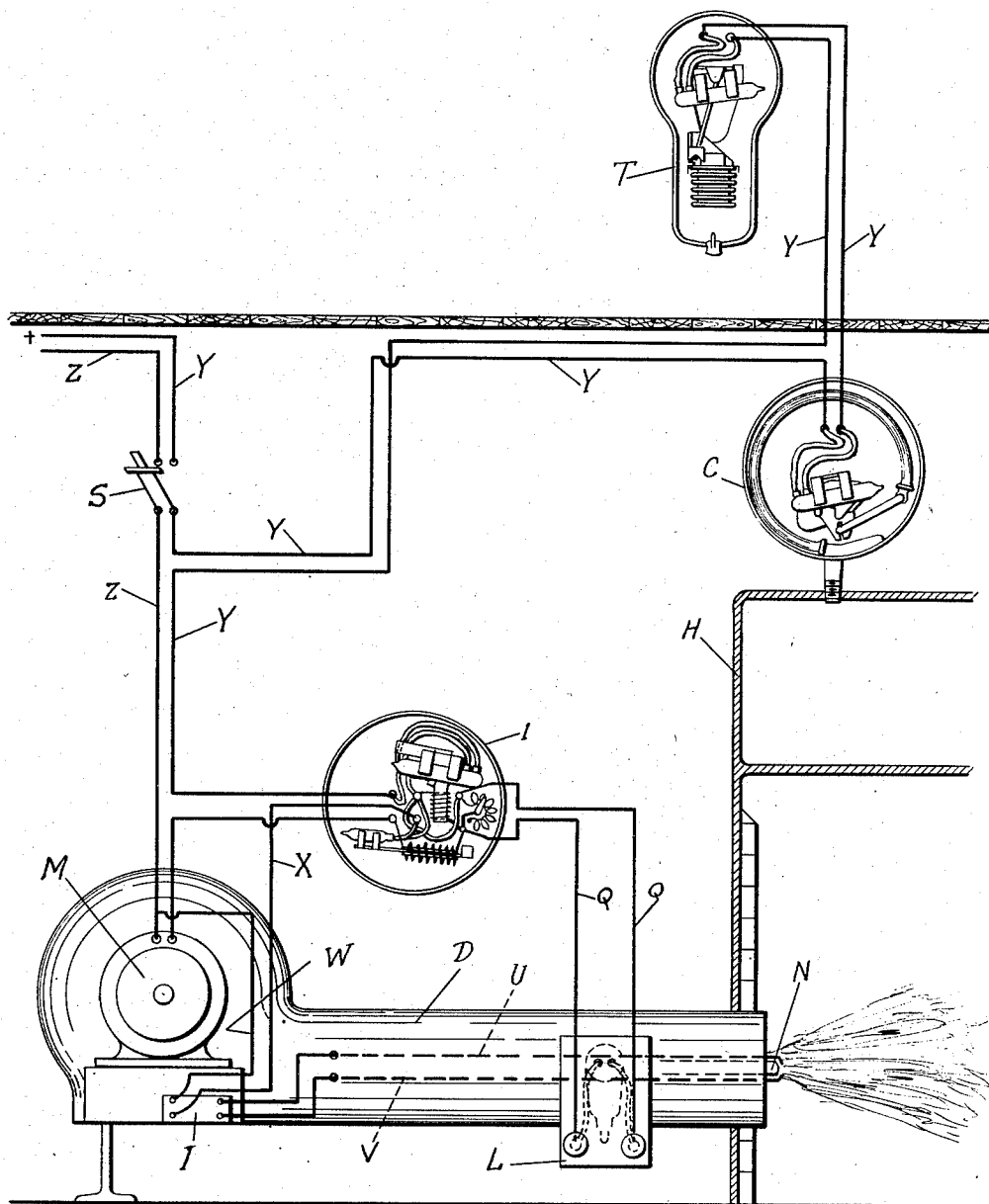


Fig. 1

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4 Sheets-Sheet 2

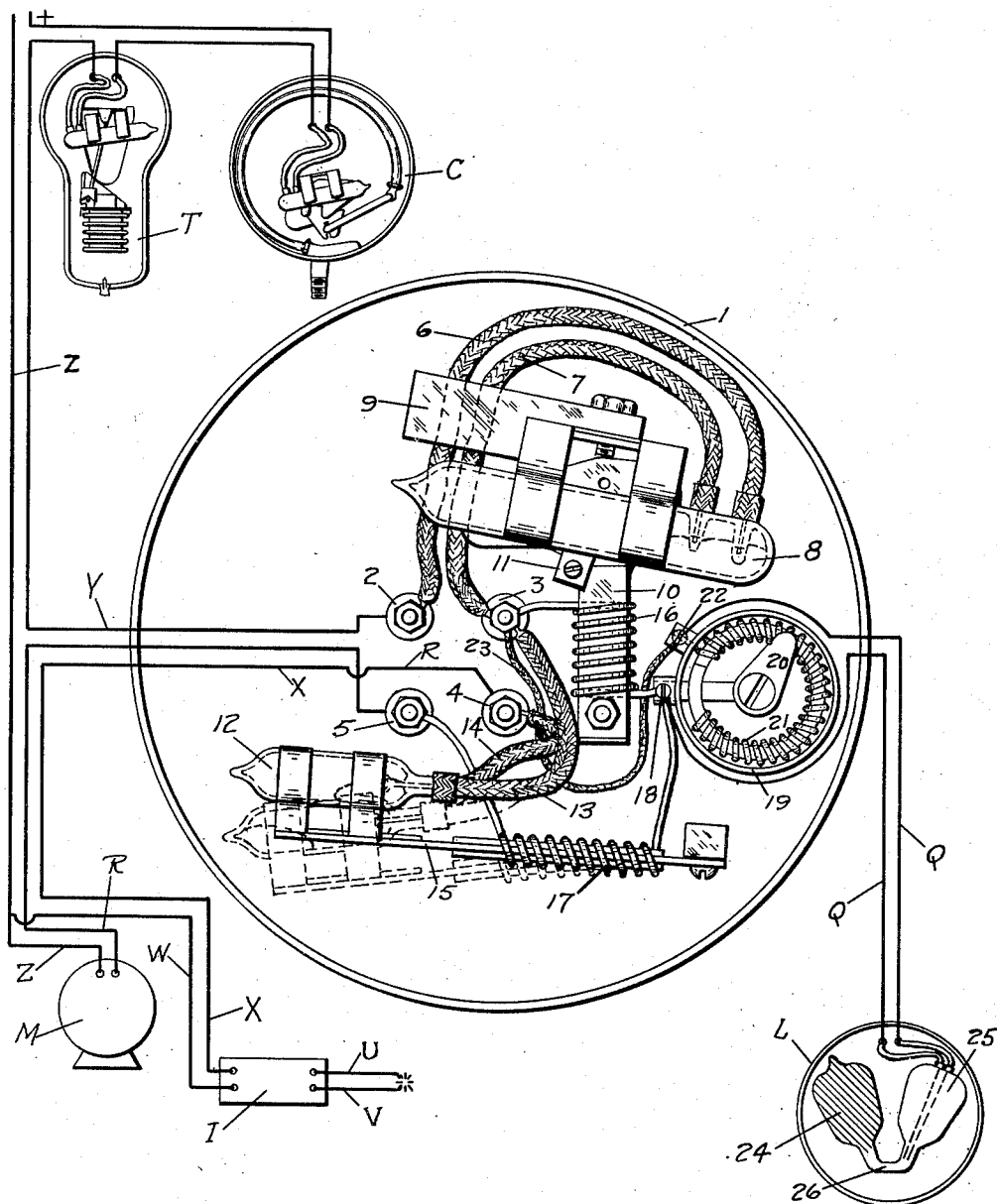


Fig. 2

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4 Sheets-Sheet 3

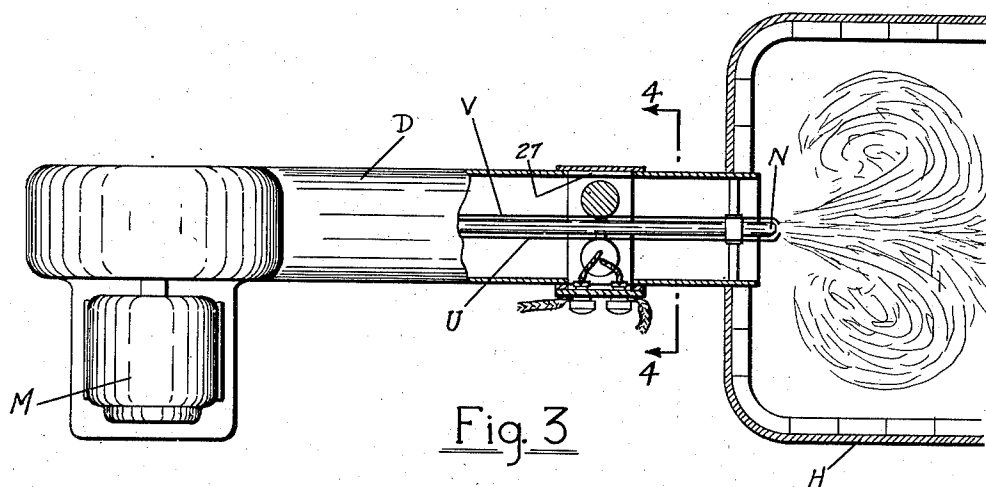


Fig. 3

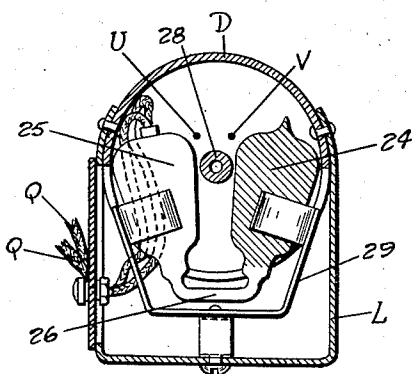


Fig. 4

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4 Sheets-Sheet 4

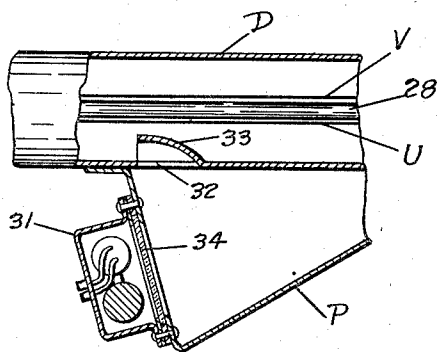
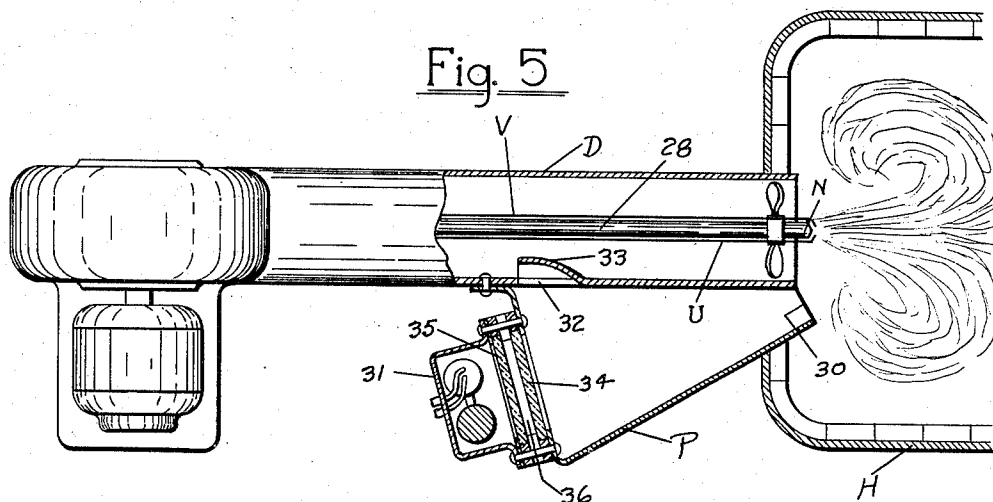


Fig. 6

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UNITED STATES PATENT OFFICE

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LIQUID-FUEL-BURNER CONTROL

Application filed December 6, 1926. Serial No. 153,022.

This invention relates to improvements in liquid fuel burning devices and more particular to a system designed to control the operation of such devices when applied to domestic heating, however, this invention may be applied as well to any electrically-operated fuel burner where its operation is to be controlled by predetermined temperatures resulting from the heat or lack of heat produced by the burner flame.

In electrically-operated liquid fuel burners installed in connection with a domestic heating plant it is not only desirable to have the operation controlled by the temperature of the building to be heated but to also provide certain safety devices which should the pressure or temperature of the heating medium become too great will operate to suspend the operation of the burner until such pressure or temperature decreases to a safe operating degree, also to prevent the liquid fuel being supplied to the burner nozzle should the initial ignition of the burner flame fail to occur or should the burner flame, after ignition, become extinguished, as well as to provide means which upon the initial operation of the burner mechanism will operate to ignite the burner flame and after having done so to cease operation.

It is an object of this invention to provide a control system of the above described type employing a safety device in the motor circuit controlled by the light produced by the ignition of the burner flame.

While the accompanying drawings illustrate a preferable embodiment of this invention in an electrically-operated liquid fuel burning device for domestic heating purposes, it is to be understood that minor detail changes may be made without departing from the scope thereof.

In the drawings:

Figure 1 illustrates an electrically-operated liquid fuel burning device in side elevation applied to a domestic heating unit shown in section, with the control device illustrated in outline and the wiring of the respective device illustrated in diagram.

Figure 2 is an enlarged detail view of the motor circuit safety and ignition control de-

vices with the motor and other controls illustrated in outline and the respective wiring illustrated in diagram.

Figure 3 is a top plan view of the burner mechanism, partly broken away, with the attaching heating unit in section, illustrating one form of installing the device controlled by the light from the burner flame.

Figure 4 is an enlarged detail view in section taken on the line 4-4 of Figure 3, looking in the direction of the arrows.

Figure 5 is a view similar to Figure 3 of another form of installing the light-controlled device.

Figure 6 is a fragmentary view of a modification of the form illustrated in Figure 5 for installing the device controlled by the light from the burner flame.

The embodiment of this invention illustrated in Figure 1 includes an electrically-operated liquid fuel burning device of a commercial type having an electric motor M for supplying liquid fuel and air to the nozzle N projecting within the fire box of a domestic heater H, here indicated as a commercial steam heater, with an ignition device I and draft pipe D leading from a fan blower operated by the motor for supplying air under pressure about the nozzle N. The wires Y and Z connect the motor M to the commercial source of electricity which enters through the wire Y and passes through a pressure or temperature control C upon the heater H and thence through a room thermostat T of commercial design which is placed in the room or hall of the building or in the compartment where the desired temperature is to be produced by the heating system, and thence through a safety switch mechanism contained in a casing 1 which, when, in proper position allows the current to pass therethrough to one pole of the motor M, the other pole being connected through wire Z to the commercial circuit. It is customary to provide a hand-operated switch S in the circuit between the controls C and T and the commercial line or source of electricity. The parts above described are all of known commercial forms and need no particular description.

This invention relates to the construction

and operation of the safety switch mechanism contained in the casing 1 and the light-operated switch contained in the casing L and their cooperation with the other parts of the system heretofore described.

The safety switch mechanism contained in the casing 1 is shown in the enlarged view in Figure 2 as including four binding posts 2, 3, 4, 5, with the wire Y of the commercial circuit connected to the post 2. The post 2 is connected by flexible leads 6 and 7 through the mercury tube switch 8 to the post 3. The mercury tube switch 8 is of commercial form having two terminals connected to the flexible leads 6 and 7 arranged near one end thereof and is rotatably mounted upon the casing 1 so that when the end carrying the terminals is depressed the mercury therein flows to that end and closes the circuit between said terminals, and when rotated to depress the other end, the mercury flows into the depressed end and breaks the circuit between said terminals. The switch mounting is provided with a counterweight 9, or other means, which normally acts to rotate the switch tube to its open circuit position. A bi-metal strip 10 is secured at its lower end to the casing 1 with its upper free end arranged in the path of a stud extending from a depending projection 11 from the switch tube mounting so constructed when the switch tube is in the open position to allow the switch tube to be rotated to the closed position with the stud wiping over the free end of the strip 10 and thereafter to be engaged by the edge of said strip to normally hold the switch tube in its closed position. This mercury tube switch 8 as long as held in engagement with the bi-metal strip 10 allows the commercial circuit to pass therethrough, but as soon as the bi-metal strip 10 is caused to move out of engagement therewith, the counterweight causes the switch tube to rotate and break the commercial circuit.

The casing 1 also contains an ignition control switch here shown in the form of a mercury switch tube 12 of commercial form having two terminals adjacent one end connected by lead 13 to binding post 3 and by lead 14 to binding post 4, which latter is connected by wire X to one pole of the ignition device I, here shown as a spark coil of commercial type, the other pole of which is connected by wire W to wire Z. The spark coil is so connected to cause a spark to jump across a spark gap by the wires U and V in front of the burner nozzle N. The ignition control switch tube 12 is carried on the free movable end of a bi-metal strip 15 secured at its upper end to the casing 1 in such a position that the mercury tube 12 will be held normally in a tilted position with the mercury therein closing the circuit between its terminals so that the commercial circuit will pass from binding post 3 through switch 12, post 4, wire X to

spark coil I, and thence through wire W to the commercial line Z. A section of heat-producing resistance wire 16 leading from binding post 3 is wrapped about the bi-metal safety holding strip 10 and a section of heat producing resistance wire 17 leading from binding post 5 is wrapped about the bi-metal ignition switch supporting strip 15. Binding post 5 is connected by wire R to one pole of the motor M, the other pole of which is in circuit with wire Z to the commercial line. Both sections of the heat-producing resistance wires 16 and 17 are connected to a binding post 18 connected to one pole of a rheostat or variable resistance coil 19 having a movable finger 20 in connection with said binding post 18 and with its free end adapted to wipe over and form a connection with a coil of resistance wire 21 to complete a circuit to a binding post 22 attached to the end of such coil. Lead 23 connects binding post 3 to binding post 22 of the rheostat.

With the commercial circuit open through the room thermostat and the safety switch 8 in closed position with the ignition switch 12 in closed position and the connections as above indicated made in the switch mechanism casing 1 and from there to the motor M and spark coil I, upon the closing of the circuit through the room thermostat T, the current will flow to binding post 2 through safety switch 8 to binding post 3, where it will divide, part passing through lead 23 to binding post 22 of the rheostat 19 and therethrough to the binding post 18 and the other part will pass through the heating coil 16 about the bi-metal strip 10 to binding post 18 where it will join the current passing the rheostat 19 and the full strength of the current will then pass through the heating coil 17 about the bi-metal strip 15, binding post 5 and from there to the motor M which will be energized and operate to supply fuel and air to the nozzle N. The heat generated in coils 16 and 17 will act upon the bi-metal strips 10 and 15 to depress them in various degrees depending upon the number of wraps about each, and the position of the arm 20 of the rheostat 19 further determines the amount of current passing through coil 16. The strip 15 normally holds the ignition switch 12 in position to close the ignition circuit so that as the motor M operates to supply fuel to the nozzle N, spark coil I will be energized at the same time to ignite the burner flame and then the heat of coil 17 will cause the bi-metal strip to bend downward and break the ignition circuit. The heat generated by coil 16 will normally cause the bi-metal strip 10 to release the safety switch 8 to break the motor circuit. To provide means to shunt out the heating coil 16 and the variable resistance rheostat 19 after the burner flame has become ignited, the switch in casing L actuated to close a circuit between

post 22 and 18 by the light from the burner flame is connected to the said binding posts by wires Q, and as long as the circuit through the light actuated switch in casing L remains closed, the majority of the current from binding post 3 will flow through lead 23, binding post 22, light-operated switch casing L, binding post 18, to heat coil 17 and thence to binding post 5 and to the motor M and upon breaking of the circuit through the light actuated switch in casing L, the safety switch 8 will be operated to break the motor circuit.

sition to readily receive the rays of light emanating from the nozzle N whenever the burner flame is ignited, and being in the conduit of the air supply to the nozzle N the draft therethrough, when the motor M is operating, precludes heat, smoke, or soot entering the switch housing which might delay the normal operation of the switch.

Another form of installation of the light switch is shown in Figures 5 and 6 in which a casing P is attached at one side to the draft pipe D having a restricted opening 30 entering the heater H adjacent the inner end of the draft pipe D through which light emanating from the burner flame when ignited at the nozzle N may pass and fall upon the light switch contained in a casing 31 closing the outer larger end of the casing P secured to the side of the draft pipe D. In the form shown it is preferable to provide the draft pipe D with an opening 32 in its side adjacent the light switch formed by striking inward a portion thereof to form a deflector 33 so that when the motor M is operated a portion of the air on its way to nozzle N will be deflected, pass through the opening 32 into casing P and then through orifice 30 into the heater H which will maintain a clear and cool atmosphere within the casing P during the operation of the burner mechanism.

In the form shown in Figures 3 and 4, should the burner flame become extinguished after it has been ignited and operate for sufficient time to cause the heat therefrom to be absorbed by the light of the heater H and then become extinguished, the absorbed heat of the walls radiating therefrom cannot enter the draft pipe D as long as the motor operates to force air therethrough which also passes over the bulbs of the light switch and upon extinguishing of the burner flame will act to carry away the heat radiating from the colored bulb causing the prompt actuation of the switch.

In Figures 5 and 6 air passes through the draft pipe and does not pass over the bulbs of the light switch and it is preferable form to present a removable screen 34 of a medium adapted to absorb radiant energy or rays of the invisible spectrum while allowing to pass therethrough or transmit rays of the visible spectrum so that the visible spectrum rays emanating from the burner flame when ignited at the nozzle will pass therethrough and fall upon the light switch and upon extinguishing of such burner flame any radiant energy which may enter the casing P from the interior of the heater H will be absorbed by the screen 34 and in falling upon the light switch in some cases it may be preferable to provide another screen 35 of similar or different material, arranged in spaced apart relation to screen 34, as shown in Figure 3, with orifices 36 provided in the casing leading to a space between said screens 34 and 35

The light-actuated switch in casing L comprises two sealed bulbs or enlarged containers 24 and 25, preferably similar to the commercial electric light bulbs, connected at their lower ends by a restricted passageway 26 containing a fluid seal of electric conducting material such as mercury. This light-actuated switch is fully disclosed and described in my prior pending application Serial Number 133,868, filed September 7, 1926. The circuit is closed and opened therethrough by forming one bulb 25 of a clear transparent medium and sealing two separated electrodes terminating in proximity to the surface of the mercury seal at their lower ends, the terminals of such electrodes being connected to the wires Q leading from binding posts 18 and 22, with the other bulb 24 formed of a medium adapted to absorb the rays of the visible spectrum falling thereon and transmute the energy thereof into heat which expands the contained gas and causes the mercury seal in the connecting portion 26 to ascend into the other bulb and close the circuit between the terminals therein, and upon the cessation of the rays of the visible spectrum falling thereon, the increased temperature of the walls of said bulb is radiated into the surrounding atmosphere and the equalizing of the internal pressure of the two bulbs 24 and 25 returns the mercury seal to its original position, breaking the electrical connection between the electrodes in bulb 25. As illustrated in Figures 2 and 4, bulb 25 is formed of clear glass while bulb 24 is of a green color. Referring to Figure 3 and the enlarged detail view in Figure 4, it is seen that the casing L is attached to the draft pipe D of the burner mechanism at a distance from the end which terminates within the heater H. As shown in these figures, the lower half of the draft pipe D is provided with a slot 27 through which the light switch is in circuit with the spaced-apart upper portion of the bulb 24 and 25 entering between the fuel discharge pipe 28 and the adjacent side walls of the draft pipe D and held in such a position by clips extending from a bracket 29 supported upon the bottom of the casing L which closes the slot 27 and is secured to the outer surfaces of the draft pipe D thereabove. In this arrangement the light switch is protected by the draft pipe D, is in a po-

to the atmosphere so that should the screen 34 absorb sufficient heat from the radiant energy fall thereupon to increase the temperature of the atmosphere between the two screens, the ventilating orifices 36 will allow the heated air to escape.

For the proper functioning of the safety switch mechanism in casing 1, a certain relationship must be established and maintained between the elements therein to allow the current from the commercial line, when the circuit is closed by the room thermostat T, to pass through both heat coils 16 and 17, a sufficient length of time to allow the ignition device to normally ignite the burner flame and close the circuit through the light switch before the bi-metal catch 10 releases the safety switch 8. This may differ in different instruments with the same strength of commercial current and does differ considerably with the different strengths of commercial current, as in different localities the commercial voltage differs, and to properly adjust each instrument the variable resistance or rheostat 19 is provided, which is normally so adjusted that upon the closing of the circuit through the room thermostat T, the ignition device will be allowed to ignite the burner flame to close the circuit through the light switch and shunt out coil 16 before the bi-metal catch would normally release the safety switch, and if the burner flame fails to ignite initially or becomes extinguished after ignition the light switch will operate to cause sufficient current to pass through coil 16 to actuate the bi-metal catch 10 to release the safety switch 8 and break the circuit to the motor.

What I claim is:

1. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, and a light actuated switch adapted upon receiving light from the burner flame to close a circuit to shunt out the safety switch control.

2. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, and a light actuated switch adapted upon receiving light from the burner flame to close a circuit to shunt out the safety switch control, and failure of the burner flame adapted to actuate said light switch, to open said circuit there-through, whereupon said safety switch control is operated to break the motor circuit.

3. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a normally closed switch for operating the ignition means, and a safety switch adapted upon re-

ceiving light from the burner flame to close a circuit to shunt out the safety switch control, and means actuated by a continued flow of current through the motor circuit to open the switch in the ignition circuit.

4. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a normally closed switch for operating the ignition means and a safety switch control in the motor circuit, a light actuated switch adapted upon receiving light from the burner flame to close a circuit to shunt out the safety switch control, means actuated by continued flow of current through the motor circuit to open the switch in the ignition circuit, said light switch upon failure of the burner flame adapted to break the circuit therethrough and release the safety switch control to break the motor circuit and allow said ignition switch to return to the closed position.

5. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, a normally closed switch for operating the ignition means, retarding means operable by the motor circuit to open said ignition switch and a light actuated switch arranged to receive light from the burner flame, whereupon said switch closes a circuit therethrough to the motor shunting out the safety switch control.

6. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, including an electrically controlled releasable catch adapted at a predetermined time after closing the motor circuit to release said safety switch to break the motor circuit, and a light actuated switch arranged to receive light at the burner flame and adapted thereupon to close a circuit to the motor and shunt out said safety switch control.

7. An electrically operated liquid fuel burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, including an electrically controlled releasable catch adapted at a predetermined time after closing the motor circuit to release said safety switch to break the motor circuit, and a light actuated switch arranged to receive light at the burner flame and adapted thereupon to close a circuit to the motor and shunt out said safety switch control, and upon cessation of the light from the burner flame said light switch breaks said circuit therethrough whereupon said safety switch control operates to break the motor circuit.

8. An electrically operated liquid fuel

burning device, including a motor for supplying fuel to the burner nozzle, means for igniting the fuel at the nozzle, a safety switch control in the motor circuit, a normally closed switch for operating the ignition means, retarding means operable by the motor circuit to open said ignition switch and a light actuated switch arranged to receive light from the burner flame, whereupon said switch closes a circuit therethrough to the motor, shunting out the safety switch control, and upon cessation of said light said switch breaks said circuit therethrough and allows the motor circuit to actuate the safety control to release the safety switch to break the motor circuit therethrough.

9. An electrically operated liquid fuel burning device, a motor for supplying fuel to the burner nozzle, means to ignite the fuel at the burner nozzle, a safety switch control in the motor circuit and a switch in a circuit to the motor adapted to shunt out the safety control arranged in the path of rays emanating from fuel when ignited at the nozzle, said switch before the ignition of the burner flame is in a position to break the circuit therethrough and is actuated by the light resulting from the ignition of the fuel to close said circuit and maintain it closed as long as said light continues and the closing of said switch shunts out the said safety switch in the control.

10. An electrically operated liquid fuel burning device, a motor for supplying fuel to the burner nozzle, means to ignite the fuel at the burner nozzle, a safety switch control in the motor circuit, a switch in a circuit to the motor adapted to shunt out the safety control arranged in the path of rays of light emanating from the fuel when ignited at the nozzle, said switch before the ignition of the burner flame is in a position to break the circuit therethrough and is actuated by the rays of the visible spectrum from the burner flame to close said circuit and maintain it closed as long as said light continues and the closing of said switch shunt out said safety switch control, and means obstructing rays of the invisible spectrum effecting the prompt actuation of said switch to break the circuit therethrough upon the cessation of light from the ignited fuel.

11. An electrically operated liquid fuel burning device, a motor for supplying fuel and air to the burner nozzle, means to ignite the fuel at the nozzle, a safety switch control in the motor circuit, a switch in a circuit to the motor adapted to shunt out a safety control, said switch arranged in the path of the air to the nozzle and actuated by the light emanating from the ignited fuel to close said circuit to shunt out said safety control.

12. An electrically operated liquid fuel burning device, a motor for supplying fuel

and air to the burner nozzle, means to ignite the fuel at the nozzle, a safety switch control in the motor circuit, a switch in a circuit to the motor adapted to shunt out a safety control, said switch arranged in the path of the air to the nozzle and actuated by the light emanating from the ignited fuel to close said circuit to shunt out said safety control, and upon cessation of said light to open said circuit and allow the current of the motor circuit to operate said safety control to break the motor circuit therethrough.

13. An electrically operated liquid fuel burning device, a motor for supplying fuel and air to the burner nozzle, means to ignite the fuel at the nozzle, a safety switch control in the motor circuit normally closing said circuit, a switch in a circuit to the motor adapted to shunt out the safety control, said switch arranged in the path of the air to the nozzle and actuated by the light emanating from the ignited fuel to close said circuit to shunt out said safety control, said burner mechanism having a draft pipe surrounding the fuel supply pipe for supplying air to the burner nozzle, said latter switch comprising two spaced apart connected bulbs having spaced apart terminals in one bulb and a mercury seal in the connecting portion said latter switch adapted upon receiving rays of light to operate to close the circuit between the terminals and upon cessation of light to break said circuit, said switch arranged in the draft pipe in the path of the light generated by ignition of the fuel at the nozzle.

14. An electrically operated liquid fuel burning device, a motor for supplying fuel and air to the burner nozzle, means to ignite the fuel at the nozzle, a safety switch control in the motor circuit, comprising an electrically actuated releasable catch in a shunt circuit to the motor, a variable resistance in the motor circuit between the connections of said shunt, and a light actuated switch adapted to shunt out the resistance element when subjected to light produced by the ignition of the burner flame.

15. The combination of a furnace with devices for supplying fuel thereto, a light sensitive mechanism exposed to the light rays from the furnace and means controlled by said light sensitive mechanism for maintaining the fuel supply devices in operation while the flame is going, but operable to shut off said fuel devices when the furnace flame goes out.

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