

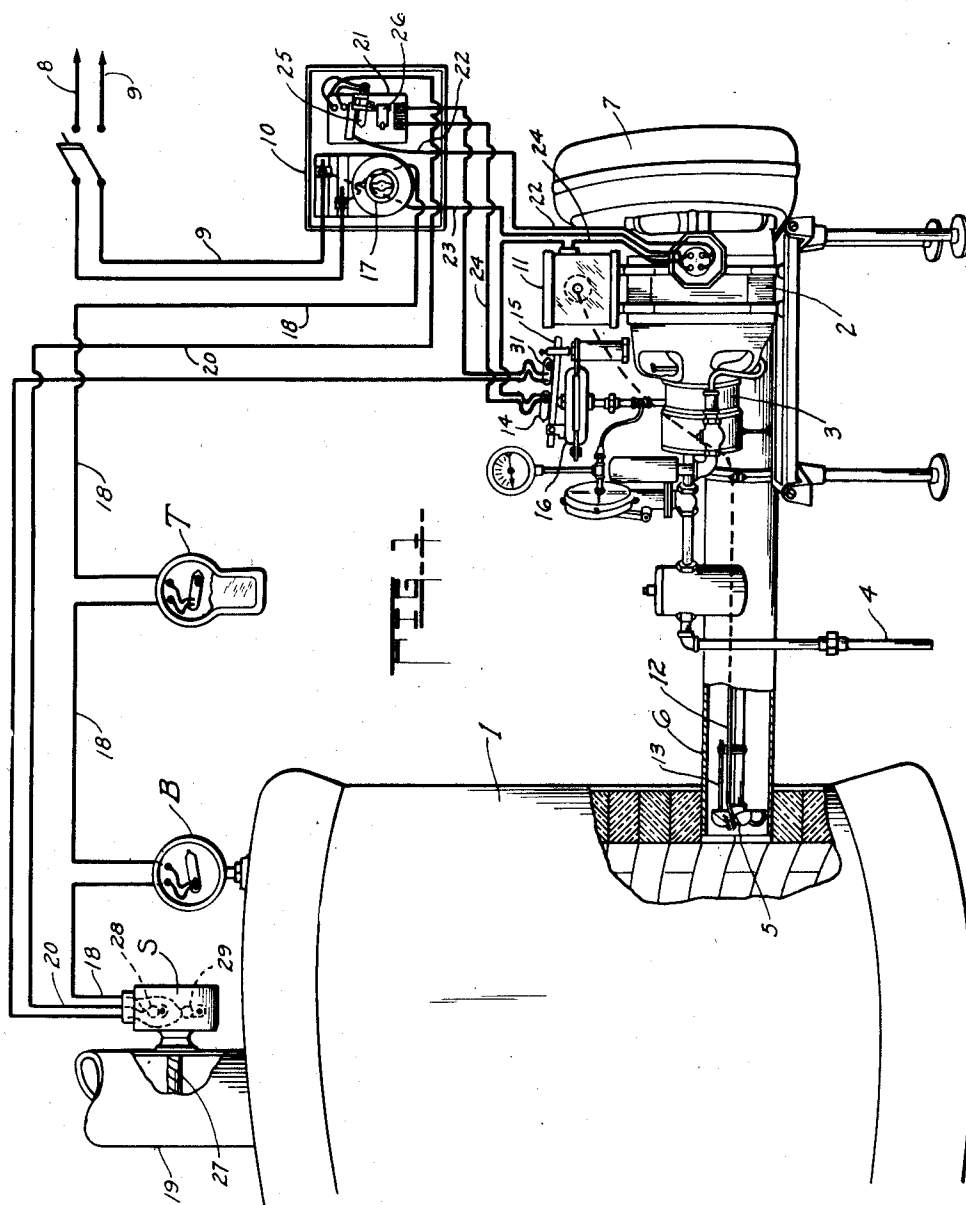
June 10, 1930.

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ELECTRIC CIRCUIT CONTROL

1,763,575

Filed Oct. 28, 1927

2 Sheets-Sheet 1



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2 Sheets-Sheet 2

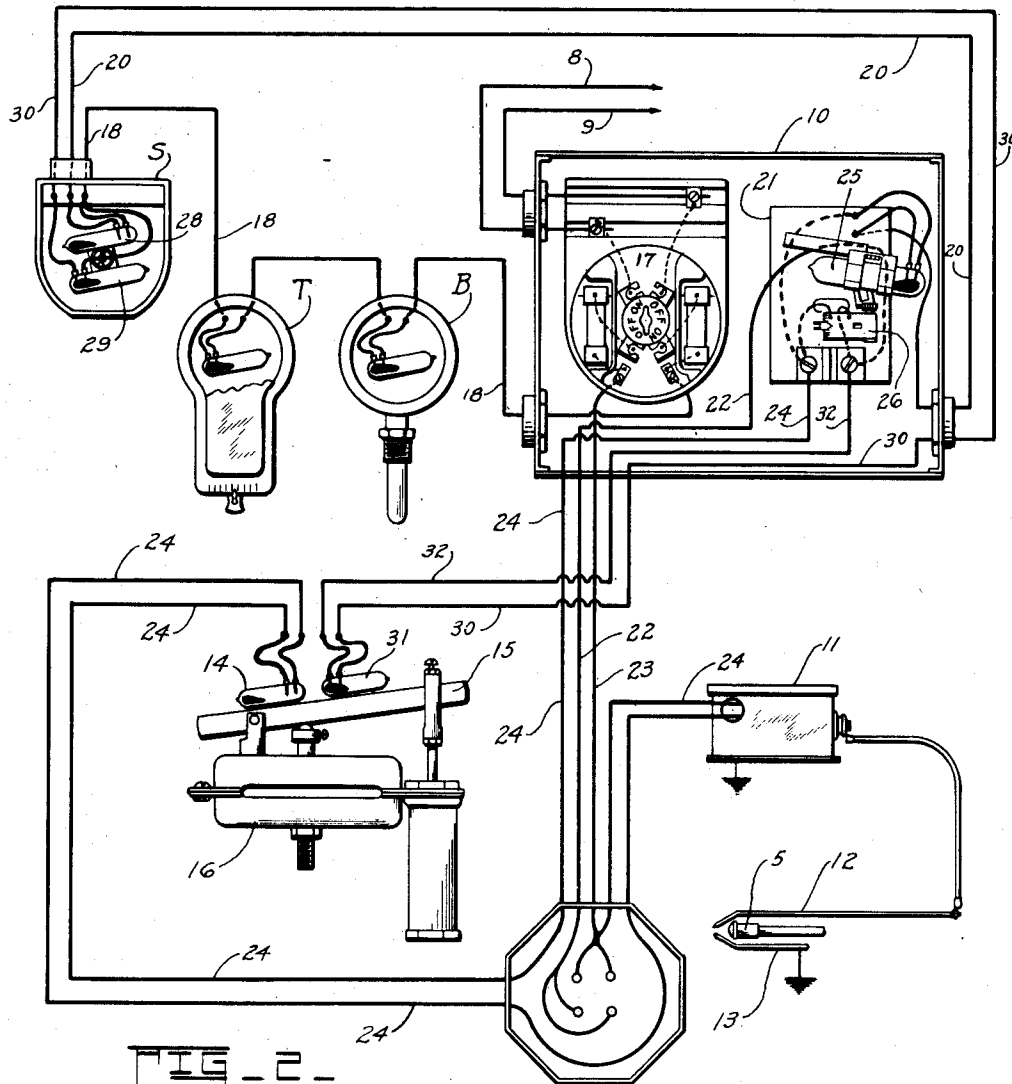


FIG. 2

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ELECTRIC-CIRCUIT CONTROL

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This invention relates to improvements in electric circuit controls and more particularly to a safety control for an electrically-operated domestic liquid fuel burner.

5 One type of electrically-operated domestic liquid fuel burners usually comprises a motor which operates a pump for supplying liquid fuel to the burner nozzle and a fan for providing air to produce the proper
10 combustible mixture. Such burners are usually controlled by a room thermostat located in that part of the building or dwelling the temperature of which is desired to be kept constant. The room thermostat is in
15 an electric circuit which starts and stops the motor of the burner mechanism. In addition to this control it is customary to employ a safety control in the circuit actuated by boiler or furnace conditions so that when
20 the pressure within the boiler of a steam heating system or the temperature of the water or vapor in a hot water or air system approaches the danger point, the burner mechanism will be caused to discontinue
25 its operation. In addition to these two controls it is desirable to provide a safety control which upon failure of the burner flame to initially ignite or upon failure of the burner flame after ignition will operate to
30 break the motor circuit. This safety device prevents a delivery of the liquid fuel into the combustion chamber of the furnace when combustion has ceased to exist and thereby preventing a flood of the combustion chamber with the fuel and prevents accidents resulting therefrom should the burner mechanism properly function and ignite the same
35 thereafter. It is also customary in domestic liquid fuel burners to provide an electrical ignition for the fuel at the nozzle which will spark a sufficient length of time at the initial starting of the burner mechanism to ignite the flame at the burner nozzle and then be discontinued.

45 It is an object of this invention to provide an electric control which normally will be in position when the room thermostat calls for heat to place the motor and electrical ignition device in circuit so that the burner
50 mechanism can be started and thereafter cut

out the electrical ignition and cause the control to immediately discontinue the operation of the motor should the burner flame fail to ignite or fail after ignition.

With these objects in view reference is
55 had to the accompanying sheets of drawing which illustrate a preferred form of this invention with an understanding that minor detail changes may be made without departing from the scope thereof.
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In the drawings:

Figure 1 is a perspective view of a commercial type of domestic liquid fuel burner as installed with a commercial type of furnace or heater, partly in section and illustrating the wiring of the controls in diagram.
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Figure 2 is an enlarged detail wiring diagram illustrating the connections between the various controls and motor.
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A commercial type of furnace 1 is diagrammatically illustrated in Figure 1 with parts broken away to illustrate the application of a domestic liquid fuel burner thereto. The type of burner illustrated is operated by an electric motor 2 which actuates an atomizing pump contained in chamber 3 for delivering the liquid fuel supplied through the pipe 4 from a tank or other source, not shown, to the burner nozzle 5 extending through a draft pipe 6 into the combustion chamber of the furnace. The motor also operates a fan blower contained in the casing 7 for supplying air through the draft pipe 6 to the discharged liquid fuel.
75

The commercial line is connected by leads 8 and 9 to a switch box 10 and through the various controls and safety devices to the motor 2. A transformer, spark coil or other ignition device 11 is preferably placed
80 in circuit between the motor and control box, the secondary circuit of which is connected to the ignition device for igniting the liquid fuel at the nozzle. In this particular type, the ignition device comprises an electrode 12 connected to one side of the secondary coil of the transformer 11 which electrode extends in front of the discharge orifice of the nozzle with the other side of the transformer grounded to the burner mechanism.
85

nism and an electrode 13 also grounded to the burner mechanism arranged in operative position adjacent the burner nozzle for creating a jump spark between electrodes 12 and 13 when the transformer is energized. The timing of the operation of the ignition device in this particular type of burner is actuated by the pressure built up within the atomizing chamber 3 as the atomizing pump begins to initially operate and is illustrated herein as comprising an electric switch 14 in the circuit between the transformer 11 and switch box 10 carried upon a pivoted arm 15 in such a position as to normally close the ignition circuit. This arm is associated with a pressure device 16 communicating with the interior of the atomizing chamber 3 so that as the pressure increases, the arm will be caused to rotate about its pivot and break the ignition circuit.

The commercial line entering the switch box 10 through leads 8 and 9 passes through a manually-operated switch 17 and the incoming current travels through the lead 18 to a room thermostat T of commercial design and from thence to a boiler or pressure control device B of commercial form associated with the interior of the boiler or heater and passing through this control is continued to one terminal of a thermostatically-operated safety device S preferably mounted upon the stack 19 through which the products of combustion pass in leaving the furnace on their way to the smoke stack or chimney. When this safety device is in normal position before the motor starts operating, the commercial current then passes therefrom through the lead 20 to a safety switch 21 of commercial design located in the switch box 10. The commercial current then passes from the safety switch 21 through the lead 22 to the motor 2 and returns through lead 23 to the switch 17 through which it is connected to the return lead 9 of the commercial line. The commercial current to the motor at switch 21 in the switch box is diverted so that part of it passes through lead 24, through the ignition switch 14 and then passing through the primary winding of the transformer or spark coil 11, is connected to the return lead 23 to the switch 17, as shown in Figure 2.

The particular commercial type of safety switch illustrated at 21 comprises a mercury tube switch 25 releasably held in the closed position by a thermostatically-operated element 26 which will be heated by a continuance of the passage of the line circuit there-through to release after a predetermined time the mercury tube 25 to be automatically tilted into open position. As seen in Figure 2, the incoming current from line 20 passes through the mercury tube 25 and thence through the thermostatic control 26

on its way to the motor so that when the element 26 remains in circuit, the motor circuit will be broken after a predetermined time. It is therefore necessary to provide a safety device which will close a circuit on the incoming side of the thermostatic element to the motor, whereby the circuit will be broken through the element 26 to maintain the motor circuit closed through the switch 25. This is accomplished in the following manner. The thermostatically-operated safety device S is a commercial instrument known in the trade as a stack safety and includes a bi-metallic spiral 27 introduced within the stack 19 which expands and contracts in accordance with the stack temperature to operate a mercury tube switch 28 to open and close the circuit between the leads 18 and 20, normally with the circuit closed. A second mercury tube switch 29 is operated by the same mechanism with its terminals arranged in reverse relation to the upper switch in that when 28 is closed 29 is open and when the products of combustion from the ignited burner flame pass through the stack the thermostatic coil operates to open switch 28 and close switch 29. One terminal of switch 29 is connected to the incoming line 18 and the other by a lead 30 to one terminal of another mercury tube switch 31 mounted on the pressure actuated lever 15 carrying the ignition switch 14 in such a manner that the circuit therethrough is broken when the lever is in its normal depressed position. The other terminal of this switch 31 is connected by a lead 32 to the binding post of the safety switch 21 which is connected to the motor through lead 22.

In the normal cold position when the motor is idle switch 28 of the stack safety is in the closed position and under these conditions, the lever 15 is in the depressed position with ignition switch 14 closed, switch 31 in the shunt motor circuit open, and the room thermostat T in the open position, as shown in Figure 1. When heat is required, the thermostat T closes whereby the circuit through lead 18, switch 28, lead 20, safety switch 21, lead 22 to motor and from motor to switch 17 and at the same time the ignition circuit through lead 24, transformer 11 and ignition switch 14 is closed. If the burner flame is not ignited by electrodes 12 and 13, the temperature of the stack 19 does not change and the continued passage of the current through the element 26 of the safety switch 21 releases the automatic switch 25 to break the motor circuit there-through. If the burner flame is ignited, the products of combustion passing through the stack 19 operate the stack safety S to open switch 28 and close switch 29. While the stack safety thermostatic element is being heated, the pressure in the atomizing chamber is tilting the lever 15 to break the igni-

tion circuit through switch 14 and close switch 31. These operations are so timed in relation to the thermostatic element 26 of the safety switch 21 that the stack safety switch S will deenergize the element 26 before the same releases the line switch 25 and by the time the stack safety operates sufficient time has passed since the energizing of the ignition device to cause the burner flame to be ignited and then the pressure device acts upon the switch carrying lever 15 to open the ignition switch 14 and close the switch 31 to shunt the commercial current about the thermal element 26 to the motor.

From the above construction it is seen that continued operation of the motor when the room thermostat is closed depends upon the normal co-operation of two elements of the burner mechanism, namely, the operation of the fuel supplying means and the operation of the ignition means to ignite the fuel so supplied. Should for any reason the thermostatic element of the stack safety fail to initially operate the switches thereof upon initial ignition of the fuel, the safety switch 21 will be actuated to break the motor circuit. Switches of this type were designed and are used in controls of this character for this purpose, the additional switch tube 29 in connection to the pressure operated switch 31 produces an additional and novel result, namely, should, during normal operation of the burner in producing heat, the thermostatic member 27 become deformed or otherwise fail to operate the tube switches 28 and 29 and combustion cease by operation of the room thermostat, the circuit to the motor cannot be again closed by the room thermostat until the stack safety has been repaired or replaced because as soon as the motor circuit is broken the pressure in the device 16 falls causing switch 31 to break the circuit from the stack safety to the motor and thereafter the motor cannot be initially started. If during the normal operation of the burner mechanism and stack safety should the pressure device 16 become inoperative on the next operation of the room thermostat, the burner cannot be again operated until the trouble has been repaired or removed because in the running position the ignition circuit is broken and because should the pressure device fail to operate upon the initial starting of the motor the shunt circuit through pressure operated switch 31 is broken. Therefore, it is necessary for the continuous operation of the burner mechanism to intermittently furnish heat, which is the function of the domestic liquid fuel burner, there must be the co-operation as first described between the stack safety and pressure device at all times. Furthermore, this control system depending upon the co-operation of the operation of the motor and the establishment of com-

bustion, should the motor become inoperative in any way either while idle or during operation, the line circuit thereto will be broken either through safety switch 21 or pressure operated switch 31 and prevent further damage thereto by the passage of the line circuit.

What I claim is:

1. In an electrically-operated liquid fuel burner mechanism including an electrical ignition device, an electric control therefor included in the burner circuit comprising an electrically-actuated safety switch, a room thermostat and a stack safety switch normally adapted upon closing of the room thermostat to operate the burner mechanism for a time predetermined by the electrically-actuated safety switch, an ignition switch normally closing a circuit through an ignition device from the safety switch to the return circuit from the burner mechanism, a normally open burner switch connected on one side to the burner circuit, a second switch in the stack safety normally open, connected on one side to the burner switch and on the other to the burner circuit and adapted upon establishment of combustion to close the circuit through the burner switch and at the same time open the first switch to exclude the safety switch, and means actuated by operation of the burner mechanism to actuate the ignition switch to break the ignition circuit and to close the burner switch, the normal burner circuit having been broken through the first mentioned stack safety switch upon establishing of combustion.

2. In an electrically-operated liquid fuel burner mechanism including an electrical ignition device, an electric control therefor included in the burner circuit comprising an electrically-actuated safety switch, a room thermostat and a stack safety switch normally adapted upon closing of the room thermostat to operate the burner mechanism for a time predetermined by the electrically-actuated safety switch, an ignition switch normally closing a circuit through an ignition device from the safety switch to the return circuit from the burner mechanism, a normally open burner switch connected on one side to the burner circuit, a second switch in the stack safety normally open, connected on one side to the burner switch and on the other side to the burner circuit and adapted upon establishment of combustion to close the circuit through the burner switch and at the same time open the first switch to exclude the safety switch, and means actuated by the fuel pressure created by the operation of the burner mechanism to actuate the ignition switch to break the ignition circuit and to close the burner switch, the normal burner circuit having been broken through the first mentioned

stack safety switch upon establishment of combustion.

3. In an electrically-operated liquid fuel burner mechanism, an electrically actuated safety switch normally in the burner circuit, two oppositely connected thermostatically-actuated switches one of which is normally open and the other normally closed in the burner circuit to initiate operation of the burner mechanism, a normally open pressure-actuated burner switch connected on one side to one side of the said normally open switch, the other side of said open switch and said pressure switch both connected in the burner circuit, means actuated by operation of the burner mechanism to close said pressure switch and means actuated upon establishment of combustion to close said open thermostatically-operated switch and at the same time open said other thermostatically-operated switch to exclude said safety switch.

4. In an electrically-operated liquid fuel burner mechanism including an operating motor, an electrical ignition device and a control circuit therefor including an electrically operated closed safety switch, a normally closed ignition switch and a thermostatically actuated switch mechanism having one switch normally closed all connected in the control circuit to the motor in combination with a normally open second switch in the thermostatically-actuated mechanism connected on one side to the control circuit, a normally open burner switch connected on one side to said second switch and on the other side to the motor and said normally closed switch of the thermostatically actuated switch mechanism, safety switch and ignition switch acting upon closing the control circuit to initiate operation of the burner mechanism and ignition device and means actuated by said operation of the burner mechanism to close the burner switch, the establishment of combustion actuating the thermostatically-actuated mechanism to open the first switch and close the second switch to close the circuit to the motor and open the circuit to the safety switch.

5. In a control system for an electrically-operated liquid fuel burning mechanism, a starting circuit therefor including a normally closed electrically actuated safety switch and a normally closed switch in a thermostatically-operated stack safety mechanism to initiate operation, in combination with a running circuit exclusive of said starting circuit and including a normally open second switch in said stack safety mechanism and a normally open pressure actuated burner switch, and means actuated by initiation of operation of said mechanism to close said burner switch, said thermostatically operated stack safety mechanism operating when combustion is established to open

the first stack safety switch and close the second stack safety switch, whereby failure of initial operation of the burner will operate the electrically actuated safety switch to break the starting circuit and failure of combustion after initial operation will operate the second stack safety switch to break the running circuit.

Signed at Bloomington, Illinois, this 26th day of October, 1927.

WALTER W. WILLIAMS.