July 8, 1958 R. S. PENN 2,842,192

OIL BURNER CONTROL

Filed Aug. 22, 1955 2 Sheets-Sheet 1

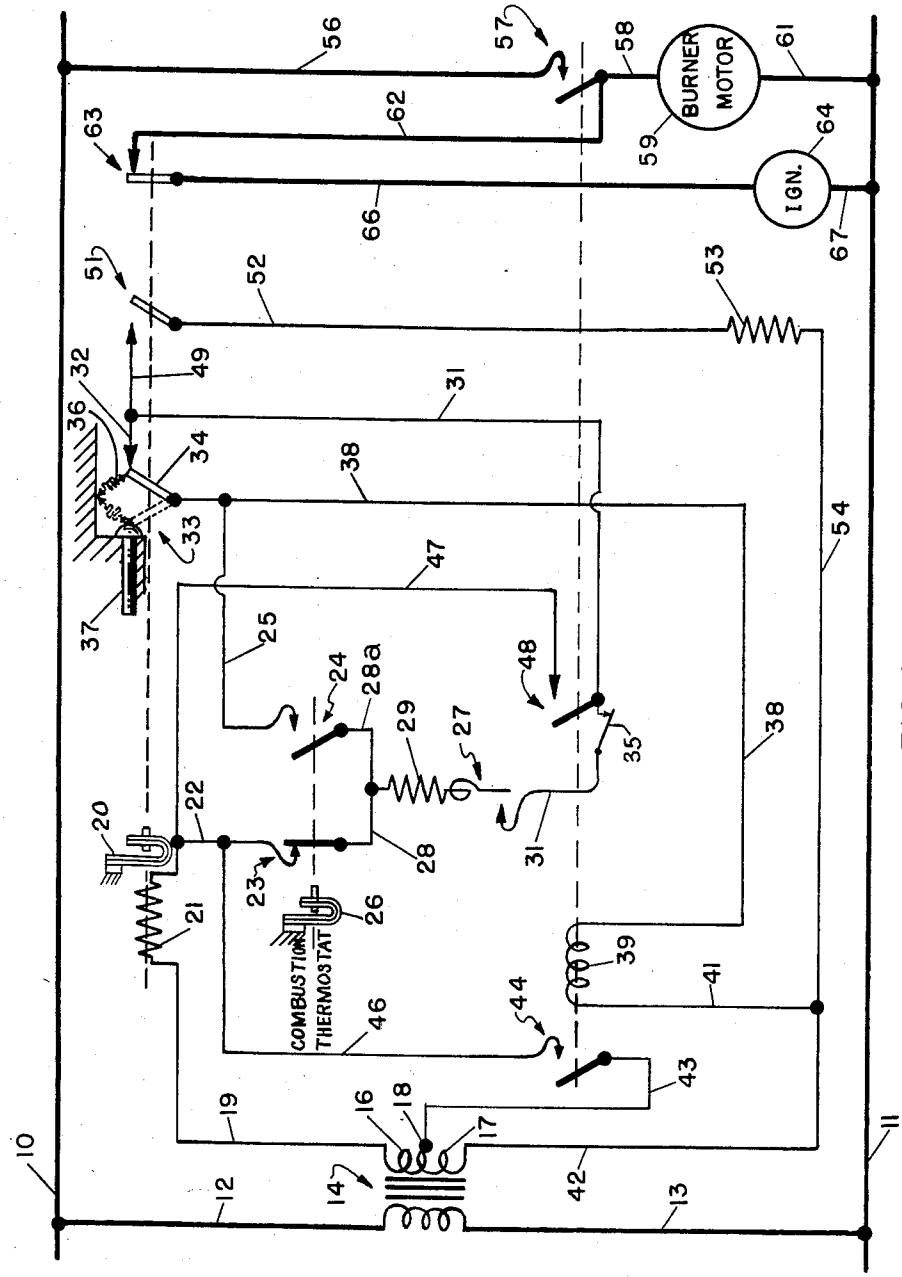


FIG. 1

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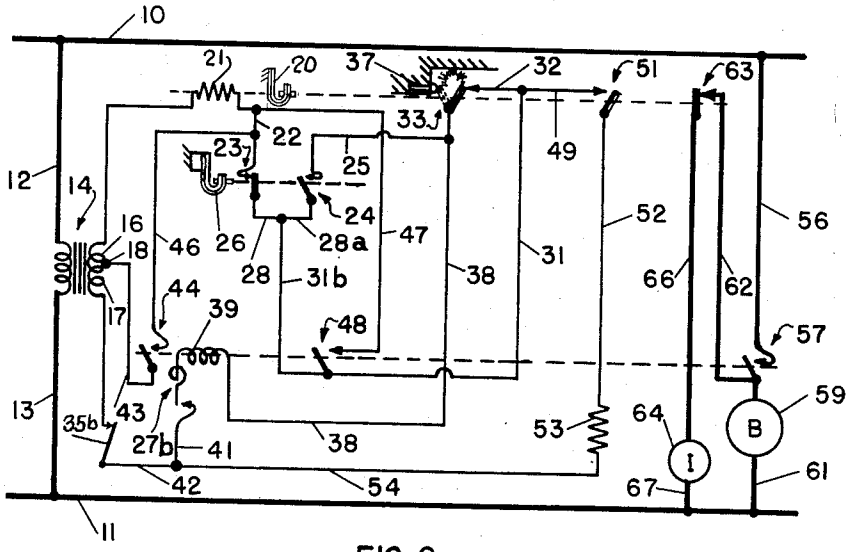


FIG. 2

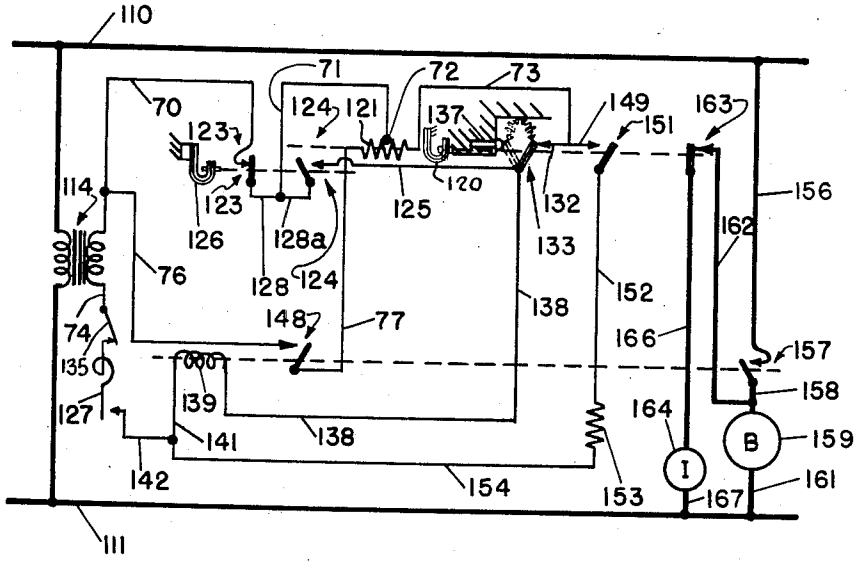


FIG. 3

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OIL BURNER CONTROL

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Application August 22, 1955, Serial No. 529,825

5 Claims. (Cl. 158—28)

This invention relates generally to control circuits for temperature changing apparatus and in particular to an improved arrangement of circuits components for an oil burner control.

The required operational sequence of modern oil burners has, customarily, been accomplished by a primary control which includes a relay to operate a power circuit to the burner motor, an electrothermally operated safety switch, and, in types for controlling burners with intermittent ignition, a second electrothermally operated switch for terminating the operation of the igniter. This second thermally operated switch may, in addition, serve to operate additional switches in the control circuit to provide proper sequencing of the circuit operations.

The safety switch, referred to above, is usually of the warp switch lockout type and, once moved to its open position is there locked, by a suitable mechanism, until it is manually reclosed or reset by actuation of a push-button, or similar operation, which is located at the primary control, which, in turn, is usually located adjacent the oil burner itself.

The safety switches heretofore used in oil burner primary controls have been as previously pointed out, of the lockout type, its contact never being opened by its electrothermal operator except when a malfunction has occurred in the burner operating sequence. Under such conditions the safety switch is subject to a defect, which can be highly dangerous. This defect in safety switches and their operating circuits is common to most safety devices, including high temperature cut-outs and high pressure relief valves on domestic water heaters, safety pilot valves for gas appliances, automatic fire extinguisher systems, anywhere a safety device is called upon to operate only when a defect or malfunction occurs. The inherent defect referred to results from the mode of operation wherein the safety device, since it goes through its operational cycle only when a malfunction occurs, may rest in its deactuated, or safe, position for six months or six years or a much longer period before it is called on to perform a safety shut-down of the controlled apparatus, and in the interim the safety device may physically deteriorate, because of rust, corrosion, accumulate dust, etc., so that after what may be years of inactivity, the safety device may be incapable of performing the safety function for which it was designed. As the design of the controlled equipment, such as oil burners, has improved over the years, the occurrence of a malfunction, such as ignition failure, is less frequent and the period of inactivity of the safety switch is prolonged thereby aggravating the difficulty. When ignition failure, or other malfunction of the burners equipment does occur, however, the importance of a safety shut-down of the burner is not diminished by the fact that the malfunction occurs only rarely.

An object of the present invention is to provide an oil burner control circuit in which is integrated a safety switch which goes through its operative cycle every time the burner itself cycles, thereby avoiding the deteriorating effect of long periods of inactivity.

A further object of the present invention is to provide an oil burner control in which the safety switch, which is operated at each cycling of the burner, and the ignition timing contacts are all operated by a single electrothermal operator.

A further object of the invention is to provide an oil burner control in which, after initial closure of the room thermostat, energization of the burner motor relay, and of the combined safety switch and ignition timing operator, is independent of the position (open or closed) of the room thermostat until that point in the switching sequence is reached when the safety switch opens.

A further object of the present invention is to provide an oil burner control having the previously mentioned features and which additionally recycles on flame failure at the burner and shuts down the burner upon an ignition failure.

A further object is to provide an oil burner control which after it has put the oil burner on safety shut-down, may be reset or restarted at the room thermostat or some other point remote from the burner and its adjacent primary control, or can be reset mechanically at the primary control itself.

These and other objects will be made apparent by the detailed description hereafter set out and the drawings in which:

Figure 1 is a schematic wiring drawing of an oil burner control circuit embodying the invention.

Figure 2 is a schematic drawing of a modification of the circuit shown in Figure 1.

Figure 3 is a schematic drawing of a further modification of the circuit shown in Figure 1.

Referring to Figure 1, reference numerals **10** and **11** identify line voltage power input lines across which is connected by means of wires **12** and **13** a stepdown transformer **14**. Transformer **14** has a low-voltage, secondary winding which is divided into two segments **16** and **17** by an intermediate tap **18**, providing the advantages disclosed in Burton E. Shaw Patent 2,080,580.

A wire **19** connects one end of transformer secondary segment **16** with an electrothermal operator or warp switch heater **21**. Heater **21** operates the bimetal warp bar **20** and is, in turn, connected by wire **22** to one side of a closed when cold thermally operated switch **23**. Switch **23** and a corresponding, closed when hot thermally operated switch **24** are of a conventional type operated by a thermally responsive element, shown schematically at **26**, which responds to the temperature of the oil burner flame and is usually located in the stack passage of the furnace. The connection between element **26** and switches **23** and **24** may be of the conventional slip-friction type permitting element **26** to operate switches **23** and **24** from their cold to their hot positions, and vice versa, upon a predetermined temperature change, rather than at any fixed temperature. This conventional connection also delays somewhat the reclosure of switch **23** as element **26** cools at the end of a burner on-period. The other side of switch **23** is connected to a conventional room thermostat **27** by means of a wire **28**, one side of switch **24** also being connected to a thermostat **27** by a wire **28***a*. Room thermostat **27** may be of the conventional anticipating type, and in such case, will accommodate an anticipating heater, shown schematically at **29**.

Room thermostat **27** is in turn connected, by wire **31** to a wire **32**, one end of wire **32** being connected to a safety switch **33**, operated under conditions hereafter described, by the heater **21**. Interposed in wire **31** may be an auxiliary manual switch **35** which is normally closed but may be manually moved to open position.

Safety switch **33**, as schematically shown in Figure 1,

comprises a blade 34 which, in its cold position (the solid line position of Figure 1) closes a circuit to wire 32. Input of a predetermined amount of thermal energy to bar 20 from the heater 21 will cause blade 34 to move from its cold position to its hot position (the broken line position of Figure 1), thereby breaking the circuit through its contacts. The amount of heat input to bar 20 from heater 21 required to move blade 34 to its hot (open) position is determined by the force exerted by an over-center compression spring 36. The time required for switch 33 to open its contacts may be of the order of one minute after the initial energization of heater 21. After the system comprising blade 34 and spring 36 have moved over center to the hot position of blade 34, any subsequent partial reduction in the heat output of heater 21 will permit blade 34 to remain in its hot position, but will enable it to be reset manually to its cold (closed) position by any suitable means, such as a push-button operator shown schematically at 37.

When safety switch 33 is in its cold position it maintains a circuit between wire 32 and wire 38 which is connected to one side of an electromagnetic switch operator or relay coil 39. The other side of relay coil 39 is connected by wire 41 to wire 42 which completes the circuit back to segment 17 of the secondary of transformer 14. A wire 25 connects wire 38 to one side of combustion switch 24.

Wire 43 connects the intermediate tap 18 of the secondary of transformer 14 with a normally open switch 44, which is moved to closed position upon energization of relay coil 39. A wire 46 connects the switch 44 to wire 22.

The warp switch heater 21 is connected by a wire 47 to a second relay coil operated, normally open switch 48, the other side of which is connected to wire 31. A wire 49 is connected to the junction of wires 31 and 32 and thence to one side of a normally open switch 51. This switch is similar to safety switch 33 in that it comprises a blade which, upon being moved by the warp bar 20 moves from its normally open position to a closed position. It differs from switch 33 in that no over-center spring is used to determine the amount of thermal energy input required to operate the switch 51. The other side of switch 51 is connected by a wire 52 to a resistance 53. A wire 54 connects the other end of resistance 53 to the junction of wires 41 and 42.

A wire 56 connects the line voltage bus 10 to one side of a third normally open, relay coil operated switch 57. The other side of switch 57 is connected, by a wire 58, to the burner motor of an oil burner which may be of a conventional type, the burner motor being represented on the drawing by the circle marked with reference character 59. A wire 61 connects the burner 59 to line voltage bus 11.

Wire 58 is connected by a wire 62 to one side of a normally closed switch 63 which, similar to switch 51, has a blade which, when moved by bar 20, moves in a direction to open its contacts. Switch 63 controls the igniter for the oil burner, the igniter being represented on the drawing by the circle marked with reference character 64. A wire 66 connects switch 63 to igniter 64. A wire 67 connects igniter 64 to the line voltage bus 11. It will be understood that warp switches 33, 51 and 63, all operated by the heater 21 and bar 20, may move from their cold to their hot positions, and vice versa, simultaneously; their timing being subject only to the limitation that safety switch 33 be delayed in moving to open position a time sufficient for switch 24 to reach its closed (hot) position and that, at the end of a burner on-period, warp switch 51 be moved to its closed (cold) position prior to the combustion responsive switch 23 reaching its closed (cold) position.

OPERATION

With the switches and room thermostat in their positions shown in Figure 1, the burner and its controlling apparatus are in a stand-by condition. Upon closure of the room thermostat, an initiating circuit is completed which initially energizes both electrothermal operator 21 and relay coil 39. This circuit may be traced from segment 16 of transformer 14, wire 19, heater 21, wire 22, combustion responsive switch 23, wire 28, room thermostat 27, wire 31, wire 32, safety switch 33, wire 38, relay coil 39, wire 41 and by wire 42 back to segment 17 of transformer 14. It will be noted that this initiating circuit has impressed across it the total of the voltage available at the transformer secondary segments 16 and 17.

Energization of relay 39 closes switch 44 which establishes an independent circuit for heater 21 through transformer secondary segment 16, wire 19, heater 21, wire 22, wire 46, switch 44, wire 43, and intermediate tap 18 on the transformer secondary. Switch 48 is also closed by relay coil 39 thereby establishing a starting circuit for relay 39 which is independent of combustion switch 23 and room thermostat 27. This circuit can be traced from transformer segment 16, wire 19, heater 21, wire 47, through switch 48 to wire 31, safety switch 33, wire 38, relay coil 39, wire 41, and, via wire 42, back to transformer secondary segment 17. Closure of switch 57 by relay coil 39 starts the burner motor 59 and, via wire 62, switch 63 and wire 66, simultaneously energizes the igniter 64.

It will be apparent that initial energization of relay coil 39 established starting circuits for the relay 39 and the heater 21 making the continued energization of these two components independent of the room thermostat 27 and combusion switch 23 until safety switch 33 opens.

A short time interval after the initial energization of burner 59 and igniter 64, combustion will normally be established at the burner and the increase in stack temperature thereby occasioned will cause element 26 to move switches 23 and 24 to their open and closed positions respectively. This shift in position of combustion responsive switches 23 and 24 has no immediate effect on either relay 39 or heater 21 since both remain energized through holding circuits controlled by relay switches 48 and 44, respectively.

A short time interval, which may be of the order of one minute, after heater 21 is initially energized, warp switch 51 will be moved to its closed position, placing resistance 53 in parallel to relay coil 39 via switch 51, wire 52, resistance 53, and wire 54. Simultaneously with the closing of switch 51, ignition switch 63 will be moved to its open position thereby breaking the circuit to, and deenergizing, igniter 64.

At the same time as switches 51 and 63 are moved to their closed and open positions respectively, safety switch 33 will be moved to its open position. Since combustion has been established and combustion responsive switch 24 has previously moved to its closed position, relay coil 39 will remain energized through its running circuit, as distinguished from the previously described starting circuit, the running circuit being traceable from intermediate tap 18, wire 43, switch 44, wire 46, wire 22, wire 47, switch 48, wire 31, room thermostat 27, wire 28*a*, switch 24, wires 25 and 38, relay coil 39, wire 41, and by wire 42 to segment 17 of transformer 14.

It will be noted that the establishment of the running circuit by the opening of safety switch 33 makes continued energization of relay coil 39 dependent on the position of thermostat 27, and that although combustion was established at the burner, the safety switch 33 has moved through its cycle of operation, shut down of the burner being prevented by the circuit arrangement whereby combustion switch 24, when closed within the correct time interval, establishes a relay hold-in circuit around the safety switch 33.

When the room thermostat 27 opens, ending the burner

on-period, relay coil 39 is deenergized opening switches 44, 48, and 57, shutting down the burner 59 and deenergizing heater 21. After a short time switches 63, 51, and 33 will simultaneously assume their cold positions, and, a short time thereafter, element 26 will have cooled sufficiently to reopen switch 24 and reclose switch 23. Reclosure of switch 23 conditions the starting circuit for a new operating cycle which will start when thermostat 27 again closes.

In the event of ignition failure at the burner, element 26 will not move the combustion switches 23 and 24 into their hot positions and the circuit around safety switch 33 will not therefore be established by combustion switch 24. Safety switch 33 will remain in the energizing circuit of relay coil 39, and relay 39 will be deenergized and the burner shut down when safety switch 33 opens. Thereafter heater 21 will remain energized, holding safety switch 33 in open (safety shut down) position, by a circuit which may be traced from transformer segment 16, wire 19, heater 21, combustion switch 23, wire 28, thermostat 27, wire 31, wire 49, switch 51, wire 52, resistance 53, wire 54, and wire 42 back to transformer segment 17.

Insertion of resistance 53 in series with the heater 21 in the circuit last described diminishes somewhat the thermal output of heater 21 so that safety switch 33 can be manually reset to closed position by means of push button operator 37, this resetting taking place after the defect which caused the ignition failure has been repaired.

Additionally, safety switch 33 can be reset to its closed position remotely by opening the circuit to heater 21 by any suitable means such as manually opening the auxiliary switch 35 or by manually opening the contacts of room thermostat 27 for a short time permitting heater 21 to cool and safety switch 33 to thereby move back to its cold position.

On flame failure (which may occur during a burner on-period and after the burner has been running for some time) with all the switches in their running position, the initial reaction will be the opening of combustion switch 24, because of the cooling of element 26. This breaks the circuit to relay coil 39 and thereby immediately shuts down the oil burner 59. Deenergization of relay coil 39 also opens switch 44 which breaks the circuit to heater 21, permitting it to cool and thereby open switch 51, ignition switch 63, and reclose safety switch 33. Subsequent to this operation, particularly the opening of switch 51, the element 26 will have further cooled sufficiently to reclose combustion responsive switch 23. When this occurs, assuming the room thermostat 27 has remained closed, the control will proceed through its normal starting period bringing on the burner and igniter. If the defect which originally caused the flame failure now prevents ignition at the burner the control will proceed to safety shut-down as previously described with reference to ignition failure.

Since the running circuit for relay coil 39 is through relay operated switches 44 and 48, a momentary power failure will immediately open switches 44, 48 and 57, shutting down the burner. Though electric power is immediately restored the relay coil 39 cannot be reenergized and the burner restarted until the switches 33, 51, and 63 have reached their cold positions and combustion switches 23 and 24 have assumed their cold positions, thus assuring that the burner cannot be restarted without ignition.

Figure 2 modification

In Figure 2 is disclosed a slightly modified form of the circuit disclosed in Figure 1. In this figure components which are displaced from their Figure 1 position are given the suffix *b*; those occupying the same position as in Figure 1 carry the same reference numeral as in Figure 1. The room thermostat 27*b* is located in circuit between the relay coil 39 and the junction of wires 41 and 42. A wire 316 extends from the junction of wires 28 and 28*a* to the switch 48.

The sequence of operation of the circuit of Figure 2 is identical to the operation of the circuit of Figure 1 in normal starting, running, and shutdown. It performs the same as the circuit of Figure 1 on ignition failure, flame failure, or momentary power failure. During a safety shut-down period, however, the heater 21 is maintained energized, and safety switch 33 thereby maintained open, by a circuit which is independent of room thermostat 27*b*, this circuit being traceable from transformer segment 16, wire 19, heater 21, wire 22, combustion switch 23, wire 28, wire 31*b*, wire 31, switch 51, wire 52, resistance 53, wire 54, and wire 42 to transformer segment 17. Resetting of safety switch 33 cannot therefore be accomplished by opening thermostat 27*b* for a short time, as in the case of the Figure 1 circuit. Resetting can, however, be accomplished by manual operator 37, or, remotely, by using any suitable means such as manually operated auxiliary switch 35*b* to temporarily open either the low voltage circuit last traced, or the line voltage power input to the circuit at wires 12 or 13.

Figure 3 modification

At Figure 3 is shown a further modified form of the circuit disclosed in Figure 1. Components of the modified circuit, which have counterparts in the circuit of Figure 1, are given the reference numeral of Figure 1 with the digital prefix 1.

The circuit comprises a stepdown transformer 114 (not of the intermediate tap type) which is connected across line voltage supply wires 110 and 111. The secondary of transformer 114 is connected by means of a wire 70 to the closed-when-cold contacts 123 of a combustion switch. Switch 123 is connected, by wires 128 and 71 to an intermediate tap 72 on the heater 121. One end of heater 121 is connected by wire 73 to a wire 132 which in turn is connected to one side of the safety switch 133. Safety switch 133 has a manual operator illustrated as the push-button 137 and operates identically as the safety switch 37 described with reference to Figure 1. The other side of safety switch 133 is connected, by means of wire 138, to relay coil 139, which, in turn, is connected to one side of the room thermostat 127 by wires 141 and 142. The other side of thermostat 127 is connected by wire 74 to the secondary of transformer 114.

A wire 76 connects the wire 70 to one side of a normally open, relay coil operated switch 148, the other side of switch 148 being connected by a wire 77 to the left-hand end (as viewed in Figure 3) of the heater 121.

The junction of wire 128 and 71 is connected, by means of a wire 128*a* to one side of the closed-when-hot combustion switch 124, the other side of switch 124 being connected by a wire 125 to the wire 138.

A wire 149 connects the junction of wires 73 and 132 to one side of the switch 151, which is operated to its closed position upon energization of heater 121 (the operation of switch 151 being identical to that of switch 51 described with reference to Figure 1). The other side of switch 151 is connected by a wire 152 to a resistance 153, which, in turn, is connected to the junction of wires 141 and 142 by a wire 154.

Line bus 110 is connected by a wire 156 to a relay operated switch 157 the other side of which is connected by a wire 158 to the burner motor 159. A wire 161 connects the burner motor to line wire 111. A wire 162 connects wire 158 and an ignition switch 163, operated to its open position by heater 121 (operation of switch 163 being identical to the operation of switch 63 of Figure 1). The other side of switch 163 is connected, by a wire 166 to the igniter 164, which is connected to line wire 111 by a wire 167.

OPERATION OF FIG. 3

With the switches and room thermostat in their posi-

tions shown in Figure 3, the burner and its controlling apparatus are in a stand-by condition. Upon closure of the room thermostat, a starting circuit is completed which initially energizes both electrothermal operator or heater **121** and relay coil **139**. This circuit may be traced from the secondary of transformer **114**, by wire **70** to combustion switch **123**, wire **128**, wire **71**, the right hand segment (as viewed in Figure 3) of heater **121**, wire **73**, wire **132**, safety switch **133**, wire **138**, relay coil **139**, wire **141**, wire **142**, thermostat **127**, and, via wire **74**, back to the secondary of transformer **114**. Energization of relay coil **139** immediately closes switches **148** and **157**, which energizes the remaining segment of heater **121**, and starts the burner motor and igniter, respectively.

With the starting of the burner motor and energization of the igniter, combustion will be established at the burner. Combustion switches **123** and **124** will thereupon be moved from their cold to their hot positions. This shift in position of combustion switches **123** and **124** has no immediate effect upon either relay coil **139** or heater **121** since they remain energized through the holding circuit established by relay operated switch **148** through wires **77** and **76**.

A time interval after the inital energization of heater **121**, ignition switch **163** will be moved to its open position, deenergizing igniter **164** and switch **151** will be closed, placing resistance **153** in parallel with relay **139**. Simultaneously safety switch **133** will be moved over center, to its open position. Since combustion has previously been established and combustion switch **124** has moved to its closed position, relay coil **139** will remain energized through its running circuit, which may be traced as follows: secondary of transformer **114**, wire **76**, switch **148**, wire **77**, the left-hand segment of heater **121**, wire **71**, wire **128***a*, switch **124**, wire **125**, wire **138**, relay coil **139**, wire **141**, wire **142**, thermostat **127** and via wire **74**, back to the secondary of transformer **114**.

When the demand for heat from the burner has been satisfied, the room thermostat **127** will open, deenergizing relay coil **139**, and thereby opening switches **148** and **157**. This shuts down burner **159**, and deenergizes heater **121**. After a short time switches **151**, **163**, and **133** will move to their cold positions. A short time thereafter combustion switch **123** will reclose. Reclosure of switch **123** conditions the starting circuit for a new operating cycle which will start when thermostat **127** again closes.

In the event of ignition failure the reaction will be the same as described with reference to the circuit of Figure 1. If combustion switch **124** has not moved to its closed (hot) position prior to the opening of safety switch **133**, the relay coil **139** will be deenergized and the burner will be shut-down. The right-hand segment (as viewed in Figure 3) will remain energized and in series with resistance **153**, until the safety switch is remotely reset by manually opening the thermostat **127** or by the auxiliary reset switch **135**, or manually reset by means of the push button **137**.

Upon flame failure the burner will be recycled and then shut down if the defect producing the flame failure also produces an ignition failure, this operation being identical with that described with reference to Figure 1. Upon a momentary power failure, the burner will be immediately shut-down, and the burner cannot be placed back into operation until switches **151**, **163**, and **133** have reached their cold positions and combustions switches **123** and **124** have assumed their cold positions, this operation also being identical to that disclosed with reference to Figure 1.

The modified form of the circuit, just described, is simpler, in some respects, than the circuit of Figure 1 in that it uses a transformer which does not have an intermediately tapped secondary and would therefore permit use of a conventional transformer-relay, which combines the transformer secondary and the relay coil into one electromagnetic unit. Additionally one relay switch (switch **44** of Figure 1) is eliminated. In its functional aspect, however, the circuits of Figures 1 and 3 perform alike.

From the foregoing it will be apparent that the circuit described with reference to Figure 1, and the modified forms of Figures 2 and 3, all utilize a safety switch which goes through its closed to open cycle of operation each time the burner is cycled, additionally, the circuits permit the safety switch to be reset, after a safety shut-down, remotely, at a location which may be much more convenient than at the burner or its stack flue, and, further, though a single electrothermal operator (**21**) operates safety switch **33**, switch **51** and switch **63**, the circuit does not require that these switches be operated other than simultaneously, the complications inherent in constructing a sequence operated warp switch assembly thereby being avoided.

Alterations might be made in the present invention without departing from its scope, the invention is, therefore, to be limited only by the appended claims.

What is claimed is:

1. In a burner control for controlling a burner motor and ignition mechanism for the burner, said burner control comprising a control switch, a motor circuit having a motor switch therein, a circuit for connecting the ignition mechanism in shunting relation to the motor and having a normally closed ignition switch therein, a transformer having a pair of secondary coils connected in series with each other, a relay circuit across said coils controlled by the control switch and including a relay coil, normally closed combustion and safety switches in said relay circuit, said motor switch being operatively associated with and controlled by said relay coil, a combustion switch actuator for said combustion switch, a relay holding switch connected in parallel with said normally closed combustion switch and said control switch and adapted to be closed by energization of said relay coil, normally open combustion and resistor switches, a delayed action actuator operatively associated with said resistor switch, ignition switch and safety switch, to close said resistor and open said ignition and safety switches upon energization of said delayed action actuator for a predetermined time, said safety switch de-energizing said relay coil upon said normally open combustion switch failing to close due to initial combustion failure or reopening after closing due to subsequent combustion failure, and a resistor adapted to be connected in series with said delayed action actuator across said pair of secondary coils through said resistor switch, said control switch and said normally closed combustion switch when it closes due to combustion failure, the reduced level of energization of said delayed action actuator thereby achieved permitting manual reclosing of said safety switch.

2. In a burner control system, a starting circuit for controlling the operation of the burner for a starting interval and a running circuit for controlling operation of the burner thereafter, a thermostat switch adapted to initially complete said starting circuit and to control said running circuit, safety means including an electrically energizable operator and a safety switch in said starting circuit, said safety switch being movable by said operator between a first position permitting completion of said starting circuit and a second position breaking said starting circuit, an independent energizing circuit for said operator completed upon completion of said starting circuit, said safety switch being adapted to be moved by said operator to said second position independently of the condition of said thermostat switch thereby terminating said starting interval, and combustion responsive means including a switch in said running circuit adapted to be moved in response to the establishment of combustion at the burner to complete said running circuit prior to the termination of the starting interval, said safety

switch being moved to its second position by its operator whether or not combustion is established.

3. In a control means of the type in which a source of power is connected to a burner motor and igniter by means of a main switch, said control means comprising: an electrically energizable operator for the main switch, an initiating circuit for initially energizing said operator, a starting circuit for maintaining said operator energized while combustion is being established at the burner, and a runnning circuit for maintaining said operator energized thereafter, safety means including an electrically energizable safety operator and a safety switch operated thereby in both said initiating circuit and said starting circuit and adapted to open said circuits a predetermined time after completion of said initiating circuit, combustion responsive means, a switching mechanism operated by said combustion responsive means adapted to break said initiating circuit and complete said running circuit upon the establishment of combustion and prior to the opening of said initiating and starting circuit by said safety switch, an independent energizing circuit for said safety operator completed upon completion of said initiating circuit, said safety switch being thereby operated by said operator to open said initiating and starting circuits whether or not combustion is established.

4. A control means of the type claimed in claim 3 having a room thermostat switch in the said initiating circuit and running circuit, a switching means in parallel with said thermostat switch and the combustion responsive switching mechanism, said switching means being adapted to complete said starting circuit, said starting circuit being thereby independent of said room thermostat switch.

5. In a control means of the type in which a source of power is connected to a burner motor and igniter by means of a main switch and the igniter is additionally controlled by an igniter switch, said control means comprising: an electromagnetic operator for said main switch, an electrothermal operator for said ignition switch, combustion responsive means, a switching mechanism operated thereby from a cold position to a hot position upon the establishment of combustion at said burner, and a

thermostat switch, an initiating circuit for initially energizing said electromagnetic operator including said electrothermal operator, said switching mechanism in its cold position, and said thermostat switch, a starting circuit for maintaining energization of said electromagnetic operator while combustion is being established, a switch operable by said electromagnetic operator and connected in parallel with said thermostat switch and said switching mechanism in its cold position, said switching means being adapted to complete said starting circuit when operated, said starting circuit being thereby independent of said thermostat switch and said combustion responsive switching mechanism, a running circuit for maintaining energization of said electromagnetic operator subsequent to the establishment of combustion at the burner, said running circuit including said thermostat switch and said combustion responsive switching mechanism in its hot position, and a safety switch operated from closed to open position by said electrothermal operator a predetermined time after completion of the initiating circuit, said safety switch controlling both said initiating and starting circuits and adapted to transfer control of said electromagnetic operator from the starting circuit to the running circuit upon its operation to open position by said electrothermal operator whether or not combustion has been established.

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