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THERMOSTATIC CONTROL DEVICE AND BURNER SYSTEM

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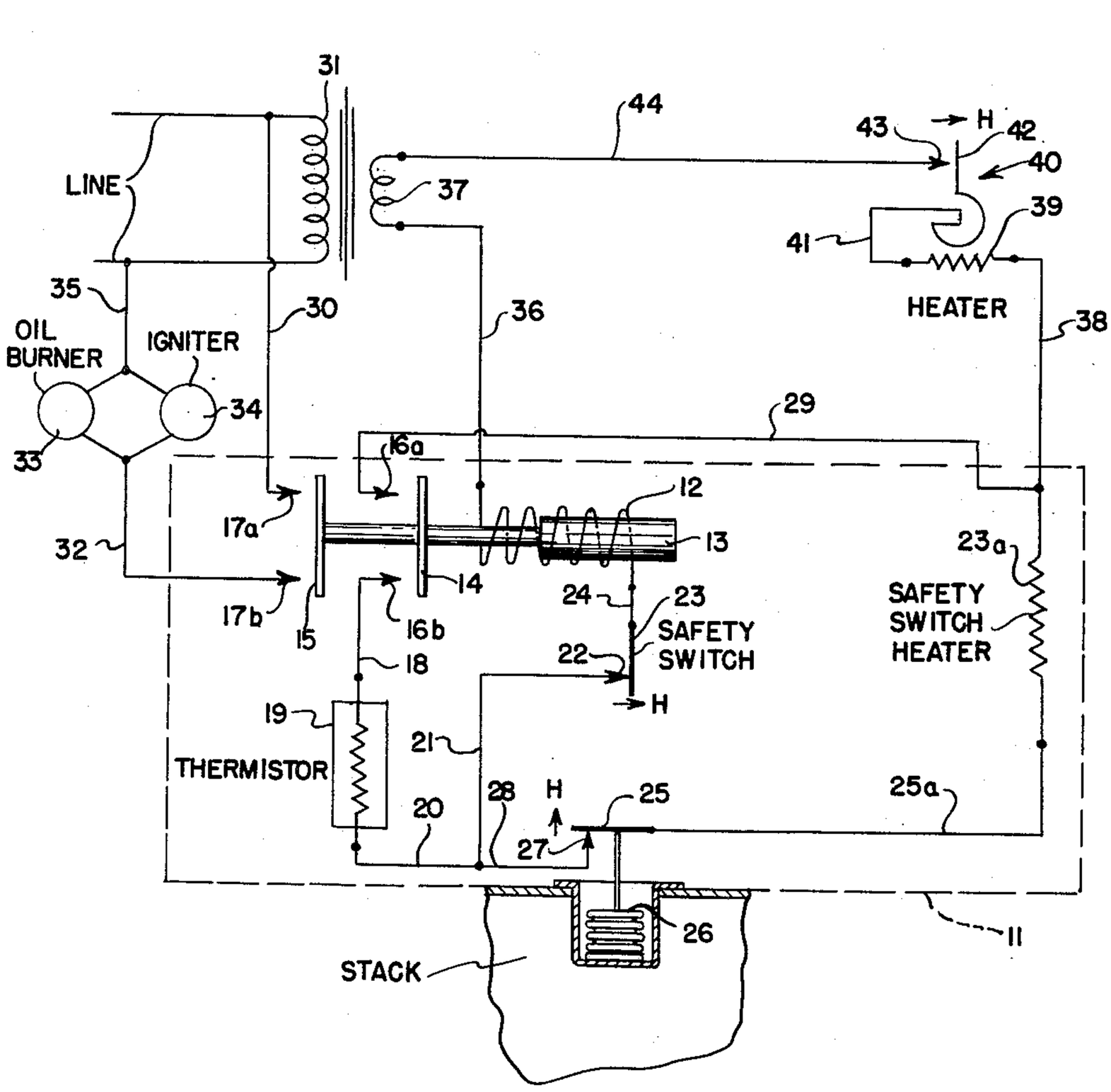


INVENTOR.
JAMES W. SMITH
BY
Georgell Fisher
ATTORNEY.

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## THERMOSTATIC CONTROL DEVICE AND BURNER SYSTEM

James W. Smith, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

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This invention relates to a control device for use in a fuel burning system and, more particularly, to a control device for use with a heat anticipating type of room thermostat to control the operation of a heating plant.

One of the objects of this invention is to provide a control device for a fuel burning system that is extremely simple and of inexpensive construction, yet sturdy in construction and reliable in operation.

Another object of the invention is to provide a fuel burner control device, that comprises a safety switch, a stack switch, a relay, and a thermistor in series with "holding contacts" of the relay, which are so arranged that the safety switch will open to break the circuit to the relay after a predetermined time, if the stack switch has not opened in response to heat in the heating plant, and wherein said holding circuit does not shunt out the safety switch heater until after a predetermined time.

Another object of the invention is to provide a control device that is particularly adapted for use with a heat anticipating type of room thermostat and which has a negative temperature coefficient of resistance in series with holding contacts of a relay and in shunt relationship with a safety switch heater and a stack switch, whereby the flow of current through the heater of the room thermostat is not substantially varied by the establishment of a holding circuit in parallel with the safety switch heater or, at least, not until a time delay after the establishment of said holding circuit and a short time prior to the opening of the stack switch.

Other objects of the invention will become apparent upon reading the following detailed description of the invention in conjunction with the accompanying drawing wherein:

A single figure of the drawing schematically shows the control device wired to other elements of a control system.

The control device is shown outlined by a broken line and designated by the reference numeral 11. The device comprises a conventional relay having a relay coil 12 of the solenoid type with a solenoid plunger 13 positioned therein. The plunger carries two bridging contact bars 14 and 15 which cooperate with two pairs of contacts 16*a*—16*b* and 17*a*—17*b*, respectively. One of the contacts 16*b* is connected through lead 18 to a resistor 19 having a negative temperature coefficient of resistance, which is generally known as a "thermistor." The other end of the thermistor is connected by lead 20

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and lead 21 to a fixed contact 22 of a conventional safety switch 23. The safety switch is preferably of the bimetal actuator type that is adapted to be heated by a heater 23*a*. One end of the safety switch is adapted to cooperate with the fixed contact 22 to break the circuit through lead 24 to the relay coil 12. The safety switch heater is obviously so related to the bimetal actuator of the safety switch that upon being energized, it supplies heat to the bimetal actuator to cause actuation thereof. One end of the safety switch heater is connected through lead 25*a* to the movable contact 25 of a stack temperature responsive member 26 and a fixed contact 27 which is cooperable therewith and is connected to the junction of leads 20 and 21 through lead 28. The other end of the heater 23*a* is connected by lead 29 to the other of the contacts 16*a*.

The control device is externally wired in the following manner: the fixed contact 17*a* is directly connected through line 30 to one side of a transformer primary coil 31 while the other other fixed contact 17*b* is connected through line 32 to the fuel burning means, illustrated as being an oil burner 33 and, if desired, an igniter 34, and through line 35 to the other end of the transformer primary coil 31. The other end of the relay or solenoid coil 12 is connected through line 36 to one side of the transformer secondary coil 37. The upper end of the safety switch heater, as viewed in the drawing, is also connected through line 38 to a heater 39 of the room thermostat, generally designated by the reference numeral 40. The other end of the heater 39 is connected through lead 41 to the movable contact arm 42 of the room thermostat. Fixed contact 43 of the room thermostat is connected to the other end of the transformer secondary coil 37. Obviously, if so desired, the transformer be mounted in or on the housing (not shown) of the control device.

### *Operation*

The control device and system is shown in its shut-down or off condition, that is, with the room thermostat in its satisfied condition, indicating that no heat is desired in the space surrounding the thermostat, and with the relay coil deenergized, which cause the plunger 13 to be biased outwardly of the coil 12, and with the contact bars 14 and 15 in open position with respect to their fixed cooperating contacts. If the furnace has been off for a time sufficient to permit the temperature responsive member 26 of the stack

switch to close movable contact 25 against fixed contact 27, the closing of the room thermostat upon a drop in room temperature below the control level, will initiate operation of the fuel burning means by completing a circuit from the upper end of the secondary of the transformer, as viewed in the drawing, through line 44, contact 43, movable contact 42, lead 41, heater 39, line 38, safety switch heater 23*a*, lead 25*a*, movable contact arm 25, fixed contact 27, lead 28, lead 21, fixed contact 22, movable contact 23, lead 24, coil 12, and line 36 back to the lower end of the secondary coil of the transformer. The closing of this circuit causes energization of the relay coil 12 to pull in solenoid plunger 13 to close contact bars 14 and 15 against their cooperating fixed contacts.

Upon the bridging of contacts 17*a* and 17*b*, a circuit will be completed from the power line at the upper end of the primary coil 31 through line 30, said contacts 17*a* and 17*b*, and line 32 to the oil burner 33 and igniter 34 and to the other power line at the lower end of the transformer primary coil through line 35.

Simultaneously with the starting of the oil burner, a holding circuit around the safety switch heater and the stack switch 25—27 will be established through lead 20, resistor 19, lead 18, fixed contact 16*b*, bridging contact bar 14, fixed contact 16*a*, lead 29 to the upper end of the safety switch heater. However, due to the fact that the resistance of the thermistor 19 is very high when current first starts to flow through it, the establishing of the holding circuit does not cause a material reduction in the overall resistance of the circuit through the heater 39 of the room thermostat so as to cause an extra flow of current therethrough and thus cause too rapid heating or "heat anticipation" action of the room thermostat. By the time that the thermistor has heated up sufficiently due to the current flowing therethrough to cause a slight increase in the current flowing through the room thermostat heater, the temperature of the stack will have risen to that required to open the contacts 25 and 27 and to break the circuit through the safety switch heater. This leaves the relay energized only through the holding circuit. If for some reason combustion is not established in the heating plant when the oil burner is started, or if ignition fails following the starting of the burner, the stack will not heat up and the stack switch 25—27 will remain closed causing continued heating of the safety switch heater which, in turn, causes actuation of the safety switch to its open position to break the circuit to the relay 12. This is a situation wherein the extra heating of the room thermostat heater 39 would not cause bad effects inasmuch as it is desired that the oil burner discontinue operating if ignition failed.

While I have disclosed above the preferred embodiment of the invention, it is to be understood that modifications may be made therein without departing from the spirit of the invention. Therefore, the scope of the invention is to be determined solely from the appended claims.

What is claimed is:

1. A heating system comprising fuel burning means, a thermostat having switching means and a first resistance heater in series therewith for artificially heating said thermostat in accordance with the electrical current flowing through said heater when said thermostat is calling for heat, a source of electrical power having one lead connected to said thermostat, a heat motor operated safety switch and a relay connected to a second lead from said source, a combustion responsive stack switch, a second resistance heater for said safety switch connected in series with said stack switch, said stack switch and second heater being electrically connected to said safety switch and said first heater to thereby complete an energizing circuit for said relay depending upon said thermostat calling for heat and upon said stack switch responding to the absence of combustion, said first heater thereby heating said thermostat in accordance with the electrical current flowing in said energizing circuit, a first relay switch for controlling the operation of said fuel burning means to energize said fuel burning means upon said relay being energized, a second relay switch, a resistor having a negative temperature coefficient of resistance, said resistor having a substantially high resistance value when cold and being heated by current flow therethrough with said resistance value lowering as said resistor is heated, and a circuit including said resistor in series with said second switch shunting said second resistance heater and said stack switch to thereby complete a further energizing circuit for said relay dependent upon said thermostat calling for heat and independent of said stack switch responding to the absence of combustion, said last named circuit being ineffective to operatively energize said relay when said resistor is cold and being effective to operatively energize said relay only after a time delay during which said resistor has been heated to lower its resistance value, the resistance value of said resistor when cold being such as to limit the current flow through said last named circuit to a low value to thereby maintain the current flow through said first resistance heater substantially constant during said time delay.

2. A heating system comprising fuel burning means, a thermostat having switching means and a first resistance heater for artificially heating said thermostat in accordance with the electrical current flowing through said heater when said thermostat is calling for heat, a source of electrical power having one lead connected to said thermostat, a heat motor operated safety switch and a relay connected to a second lead from said source, a combustion responsive stack switch having a first condition of operation indicative of the absence of combustion and a second condition of operation indicative of the presence of combustion, a second resistance heater for said safety switch connected in series with said stack switch, said stack switch and second heater being electrically connected to said safety switch and said first heater to thereby provide an energizing circuit for said relay, said energizing circuit arranged to be completed upon said thermostat calling for heat and upon said stack switch being in said first condition of operation, a first relay switch for controlling the operation of said fuel burning means, a second relay switch, a resistor having a negative temperature coefficient of resistance and a relatively high resistance value when cold, said resistor adapted to be heated by current flow therethrough to thereby lower said resistance value with a time delay, and a circuit including said resistor in series with said second switch in shunt relationship with said second resistance heater and said stack switch, said shunt circuit arranged to be completed by said second switch upon said relay being energized, said last named circuit being ineffective

to appreciably alter the current flow through said first heater when said resistor is cold and being effective to maintain said relay energized independent of said stack switch after said timed delay during which said resistor is being heated due to current flow therethrough.

3. A heating system comprising fuel burning means, a heat anticipating type thermostat having switching means, a source of electrical power having one lead connected to said thermostat, a heat motor operated safety switch and a relay connected to a second lead from said source, a combustion responsive closed-cold stack switch responsive to combustion at the fuel burning means to normally move to open position a time period after establishment of combustion, a resistance heater for said safety switch connected in series with said stack switch, said stack switch and resistance heater being electrically connected to said safety switch and said thermostat to thereby provide an energizing circuit connecting said relay to said first and second leads of said source, a first relay switch for controlling the operation of said fuel burning means upon said relay being energized, a second relay switch, a resistor having a negative temperature coefficient of resistance when cold and a high normal resistance, and a circuit including said resistor in series with said second switch connected in shunt relationhsip with said resistance heater and said stack switch, said normal resistance of said cold resistor being of sufficient magnitude compared to said heater to maintain said shunt circuit substantially ineffective to alter the electrical current flow through said thermostat for a given time interval during which said resistor heats to lower said normal resistance, said given time interval being somewhat shorter than said time period normally necessary for said stack switch to open.

4. In a control system for fuel burning means under the control of a heat anticipating type thermostat, the combination comprising a heat motor operated safety switch, a relay having a first load switch and a second circuit holding switch; a combustion responsive stack switch; a resistance heater for said safety switch; energizing circuit means for said relay and said resistance heater including said stack switch, said safety switch and means adapted to be connected to a thermostat; a resistor having a negative temperature coefficient of resistance and a relatively high resistance when cold; and holding circuit means including said resistor and said second switch connected in shunt relationship with said resistance heater and said stack switch to maintain said relay energized independent of said resistance heater being energized, the current flow through said holding circuit being limited by said relatively high resistance of said resistor when cold to thereby render said holding circuit ineffective as a holding circuit for a timed period after energization of said relay during which time period said resistor heats due to the current flow therethrough to lower said resistance value and thereby render said holding circuit effective.

5. A burner control device for a fuel burner under the control of a heat anticipating type thermostat, comprising, a burner control relay having sets of contacts that are opened and closed upon deenergization and energization of the relay, a heat motor operated safety switch, a combustion responsive stack switch, and a resistance heater for said heat motor all connected in series to provide an energizing circuit for said relay



under the control of means adapted to be connected to a thermostat, a resistor having a negative temperature coefficient of resistance and a relatively high cold resistance, said resistor being connected in series with one of said sets of contacts and therewith in shunt relationship with said stack switch and said safety switch heater to provide a holding circuit for said relay, said resistor while cold limiting the current flow through the last named circuit to render said circuit ineffective as a holding circuit for a timed period during which the current flow through said resistor heats said resistor, said last named circuit thereby maintaining the electrical current in said energizing circuit substantially constant for said timed period, said current remaining substantially constant after said timed period upon said stack switch responding to the presence of combustion.

6. A burner control device for a fuel burner and a thermostatic switch of the type requiring a constant current for proper operation, comprising, a relay having a set of holding contacts and a set of burner load contacts that are simultaneously opened and closed upon deenergization and energization of the relay; a heat motor operated safety switch; a closed-cold combustion responsive stack switch; and a resistance heater for said heat motor, said relay, stack switch, safety switch and heater being connected in series with means adapted to be connected to a thermostat to thereby provide an energizing circuit for said relay upon a call for heat; and a resistor having a negative temperature coefficient of resistance and a relatively high resistance value when cold, said resistor being connected in series with said set of holding contacts and therewith in shunt relationship with said stack switch and said safety switch heater to thereby provide a holding circuit for said relay independent of said stack switch, said resistor limiting the current flow in said holding circuit when said resistor is cold to render said holding circuit ineffective as a holding circuit for a time period during which said resistor heats and its resistance consequently lowers due to current flow therethrough, said holding circuit being effective after said time period to pass sufficient electrical current to maintain said relay energized, said stack switch normally opening after said time period in response to the establishment of combustion.

7. A burner control device for a fuel burner under the control of a heat anticipating type thermostat, comprising, a burner control relay having two sets of contacts that are opened and closed upon deenergization and energization of the relay, a heat motor operated safety switch, a combustion responsive stack switch, and a resistance heater for said heat motor all connected in series with means adapted to be connected to a thermostat to provide an energizing circuit for said relay upon a call for heat, and a resistor having a negative temperature coefficient of resistance and a high resistance when cold, said resistor being connected in series with one of said sets of contacts and therewith in shunt relationship with said stack switch and said safety switch heater to thereby provide a holding circuit for said relay, said resistor when cold limiting the current flow in said holding circuit to render said holding circuit substantially ineffective to alter the energizing current of said relay for a timed period and being effective after said timed period and after said stack switch normally responds to the presence of combustion to main-

tain said relay energized dependent upon a continued call for heat.

8. An oil burner control for use with thermostatic switching means requiring substantially constant current for proper operation, comprising, a burner control relay having contacts that are opened and closed upon deenergization and energization of the relay, a heat motor operated safety switch, a combustion responsive stack switch, and a resistance heater for said heat motor all connected in a series circuit, said series circuit including means adapted to be connected to the thermostat and being energized upon a call for heat, and a resistor having a negative temperature coefficient of resistance and a relatively high resistance when cold connected in series with contacts of said relay and therewith in shunt relationship with said stack switch and said safety switch heater, the resistance of said resistor when cold being so large that closing of said contacts will not substantially increase the current flow through the thermostat.

9. A fuel burner control under the control of a heat anticipating type thermostat, comprising, a relay having a set of burner load contacts and a set of holding contacts that are opened and closed upon deenergization and energization of the relay, a heat motor operated safety switch, a combustion responsive stack switch, and a resistance heater for said heat motor all connected in a series circuit, said series circuit including means adapted to be connected to the thermostat, and a resistor having a negative temperature coefficient of resistance and a high resistance when cold connected in series with said set of holding contacts and therewith in shunt relationship with said stack switch and said safety switch heater, said resistor when cold limiting the current flow in said shunt circuit to render said shunt circuit substantially ineffective to alter the current flow in said series circuit due to said high resistance when cold and being effective after a time delay during which said resistor heats due to current flow therethrough to maintain said relay energized after said stack switch normally responds to combustion.

10. A control apparatus for a fuel burner and a heat anticipating type thermostat responsive to the need for operation of the burner, comprising; a source of electrical power; a heat motor operated safety switch including a resistance heater to activate said safety switch after a predetermined period of operative energization of said resistance heater; a burner control relay including a first set of contacts and a second set of contacts, said first set of contacts, when said relay is energized, connecting said source of power to means adapted to be connected to a fuel burner, combustion responsive means including a closed-cold combustion responsive switch responsive to combustion to normally open said combustion responsive switch a period of time after the establishment of combustion; an initial energizing circuit connecting said relay to said source of power and including said safety switch, said combustion responsive switch, said resistance heater and means adapted to be connected to a thermostat; said initial energizing circuit when completed being effective to operatively energize said relay and said resistance heater; a resistor having a negative temperature coefficient of resistance and a relatively high resistance when cold, and further circuit means including said second set of contacts of said burner control relay connecting said resistor in shunt relationship to a portion of said initial energizing circuit which includes said combustion responsive switch and said resistance heater, said resistor when cold substantially limiting the current flow in said further circuit means for a timed period during which said resistance value of said resistor lowers due to current flow therethrough, the current flow of said initial energizing circuit being substantially unaffected by said further circuit means for said timed period which is somewhat shorter than said period of time to thereby maintain the current flow through said relay substantially constant and to maintain said resistance heater operatively energized dependent upon said combustion responsive switch opening.



JAMES W. SMITH.


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