

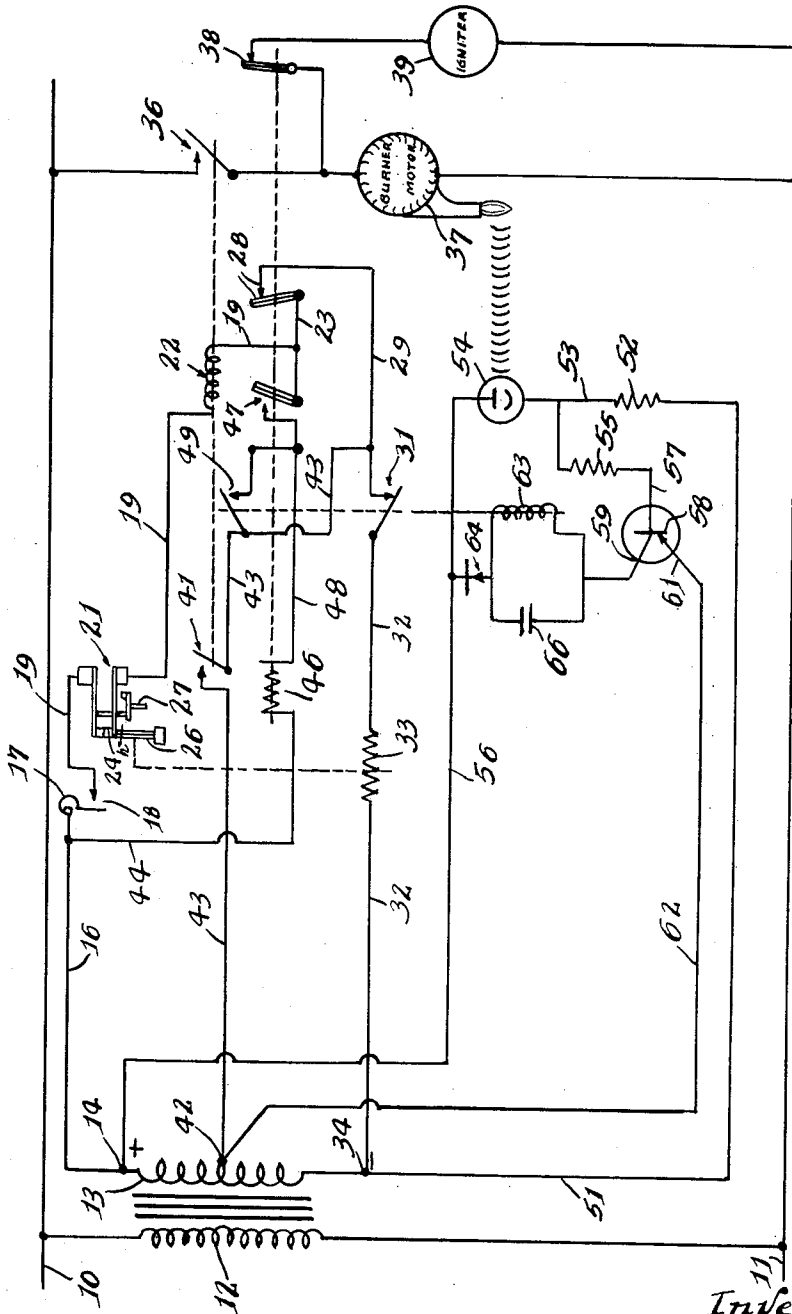
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FLAME DETECTOR CIRCUIT

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FLAME DETECTOR CIRCUIT

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2 Claims. (Cl. 317—148.5)

This invention relates generally to control circuits for oil burners, and in particular to a control circuit incorporating an electronic flame detector for instantaneously indicating the establishment of combustion at the burner. This application is a continuation of my now abandoned copending application Serial No. 718,005, filed February 27, 1958.

In oil burner controls of the character disclosed in Schell Patent No. 2,743,768, means are provided for switching the circuit in response to the heat of combustion. This combustion responsive switching means serves to set up a running circuit for subsequent completion by a warp switch and break a starting circuit when combustion occurs, and, additionally, serves to initiate the predetermined time interval during which the igniter remains energized.

The present invention relates to a modified and improved version of the circuit disclosed in the above-mentioned Schell patent. In the circuit of the present invention the switching from the setting up of the running circuit and the initiation of the ignition timing period is accomplished instantaneously by means of a transistor circuit triggered by the response of a photoelectric cell responsive to the presence of combustion at the burner.

Further objects and advantages of the present invention will become apparent as the description proceeds with reference to the accompanying drawing in which there is shown a schematic diagram of an oil burner control circuit embodying the present invention.

Referring to the drawing, wires 10 and 11 represent power input leads which may be connected to a suitable source of alternating current power (not shown). The primary coil 12 of a center-tapped transformer is connected across the input lines, the transformer having a secondary coil 13. One end 14 of the secondary coil is connected by means of a wire 16 to a conventional room thermostat 17 having switch contacts 18. The thermostat serves as the operating control and might, it will be understood, take the form of a pressure switch or similar condition responsive device. A wire 19 serially connects a safety switch 21 and an electromagnetically operable relay coil 22. Wire 19 further connects the safety switch and coil 22 to the thermostat contacts 18 and to a wire 23. The safety switch is of conventional type having contacts held closed by a bimetal operator 26. The contacts 24 are biased to open position so that once the operator 26 has moved out of engagement with them, the safety switch will be opened and must be reset to closed position by means of the push button 27.

Wire 23 on one side of its junction with wire 19 is connected to one side of a thermally operated warp switch 28. A wire 29 connects the circuits to a normally closed combustion responsive switch 31. Wire 32 serves to connect the switch 31 to a safety switch heater 33 and to the terminal 34 on the transformer secondary. As shown by broken lines in the drawing, the heater 33 cooperates with the bimetal 26 so that if the heater 33 remains energized for a predetermined period, the safety switch 24 will be opened.

The above-described circuit represents a starting circuit, and indicates the means whereby the relay coil 22 is initially energized upon the closure of the room thermostat contacts 18. Energization of relay coil 22 closes

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the main switch 36 which controls the burner motor 37 in conventional fashion. An electro-thermally operated warp switch 38 energizes the burner igniting means 39. Energization of the relay coil 22 additionally closes a switch 41 which completes a circuit from the intermediate tap 42 on the transformer secondary to wire 29 by means of a wire 43. The portion of the transformer secondary between terminals 14 and 42 thus serves to maintain the relay coil energized, and the portion of the transformer secondary between terminals 42 and 34 maintains the safety switch heater 33 energized through the combustion responsive switch 31.

A wire 44 connects the wire 16 to an electric heater 46 which, as indicated by broken lines in the drawing, operates the warp switches 38 and 28, previously mentioned, and in addition, operates the warp switch 47. A wire 48 connects the other side of the heater 46 to one side of the switch 47, the other side of switch 47 being connected to the wire 23. A normally open combustion responsive switch 49 connects wire 43 to wire 48.

The photoelectric circuit for instantaneously actuating switches 49 and 31 upon the presence of combustion at the burner will now be described. The wire 51 connects the secondary terminal 34 to one side of a resistor 52. The other side of the resistor is connected by means of a wire 53 to one side of a photoconductive cell 54. The photoconductive cell may be of the lead sulphide type, or may take any other suitable conventional form. A wire 56 connects the other side of the cell 54 to the secondary terminal 14. A wire 57 connects the wire 53 to the base 58 of a conventional PNP type junction transistor, a current limiting resistor 55 being interposed therebetween. The PNP type transistor is characterized by being conductive only when its base 58 and collector 59 are at a negative potential with respect to its emitter 61. The emitter 61 of the transistor is connected by means of a wire 62 to the transformer terminal 42.

The load circuit is connected between the collector 59 and the wire 56 and includes a relay coil 63 and in series therewith a diode 64. Connected in parallel with the relay coil 63 is a capacitor 66, which may be of the electrolytic type. The function of the capacitor is to prevent relay chattering on pulsating direct current.

The photoconductive cell 54 is mounted so as to view the burner flame. Thus, when there is no combustion at the burner, cell 54 will be non-conductive. With cell 54 non-conductive, when secondary terminal 14 is negative with respect to terminal 42 and terminal 34 is positive with respect to terminal 42, the base 58 of the transistor will be positive with respect to the emitter 61, and the transistor will be non-conductive. During those portions of the alternating cycle when terminal 14 is positive with respect to terminal 42 and terminal 34 is negative with respect to terminal 42, the transistor base will be negative with respect to the emitter. However, during this period the diode 64 will prevent the flow of current through the load circuit and coil 63 will remain de-energized.

Should cell 54 be rendered conductive by the presence of combustion at the burner, when the terminal 14 is negative with respect to the terminal 42 and the terminal 34 is positive with respect to terminal 42, the voltage drop across the photoconductive cell will be small, causing the base 58 of the transistor to be negative with respect to the emitter. The current then traversing the load circuit is passed by the diode 64 and relay 63 is consequently energized. During the alternate half cycle of the 60-cycle power, when all polarities are reversed, the relay will remain closed from energy stored in the capacitor 66.

In operation, when the room thermostat 17 closes its contacts, indicating a call for heat, the relay coil 22 will be energized through the starting circuit previously de-

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scribed. The closure of main switch 36 causes the burner motor and igniter to operate, resulting in combustion at the burner. Immediately upon the appearance of combustion at the burner, the relay coil 63 will be energized, opening switch 31 and closing switch 49. Opening switch 31 de-energizes the safety switch heater 33, so that, in normal operation the bimetal 26 is not deflected sufficiently to open the safety switch contacts 24. Closure of switch 49 provides an energization circuit for the warp switch heater 46 which may be traced as follows: from terminal 14, wire 16, wire 44, heater 46, wire 43, switch 49, and by means of wire 43 and switch 41 back to the transformer terminal 42. After a predetermined time, the heater 46 will provide sufficient total thermal output to open switch 38, shutting down the ignition means, open switch 28 and close switch 47. Switches 28 and 47 are arranged in conventional overlapping fashion so that switch 47 is closed before switch 28 is opened. Opening of switch 28 interrupts the starting circuit and closure of switch 47 establishes a running circuit for the relay coil 22 which may be traced as follows: from terminal 14, wire 16, thermostat contacts 18, wire 19, safety switch contacts 24, relay coil 22, snap switch 47, combustion responsive switch 49, via wire 43 and switch 41 back to the transformer terminal 42.

Should combustion fail to occur upon closure of switch 36, the relay coil 63 will not be energized and, consequently the safety switch heater 33 will remain energized and will, after a timed period, unlatch the safety switch contacts 24, shutting down the burner motor and igniter. The control system may be recycled by relatching the safety switch contacts 24 into closed position by means of the push button 27.

In the event of a momentary power failure during a running cycle of the burner, the relay 22 will be de-energized, shutting down the burner. Since the de-energization of relay coil 22 opens switch 41, the control cannot recycle until switches 31 and 49 have returned to their closed and open positions, respectively. Because of the electronic flame detecting circuit incorporated in the control, this return of the switches 31 and 49 occurs immediately upon the shutdown of the burner and recycling, upon a power failure, takes place immediately.

It will thus be evident that the present invention provides an improved flame detecting circuit for oil burners,

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which responds immediately to the presence or absence of combustion at the burner and recycles immediately upon the occurrence of a momentary power failure during a running cycle of the burner.

While the invention has been disclosed and described in some detail in the drawings and foregoing description, they are to be considered as illustrative and not restrictive in character, as other modifications may readily suggest themselves to persons skilled in this art and within the broad scope of the invention, reference being had to the appended claims.

I claim:

1. A control comprising a resistance type photocell, a sensing circuit including said photocell and a resistor adapted to be connected in series across a source of electrical alternating current, a relay having a coil, a rectifier and a transistor having an output circuit adapted to be connected in series with said coil and said rectifier across at least a portion of the source of electrical alternating current and having a control circuit connected with said sensing circuit.

2. A burner control comprising a resistance type photocell adapted to be responsive to a flame condition at a burner, a sensing circuit including said photocell and a resistor adapted to be connected in series across a source of electrical alternating current, a relay having a coil, a transistor having an emitter-collector output circuit adapted to be connected in series with said coil across at least a portion of the source of electrical alternating current, said transistor having a base connected with said photocell-resistor sensing circuit, and a diode connected in the output circuit of said transistor and phased to conduct current passed in the forward direction through the emitter of said transistor.

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