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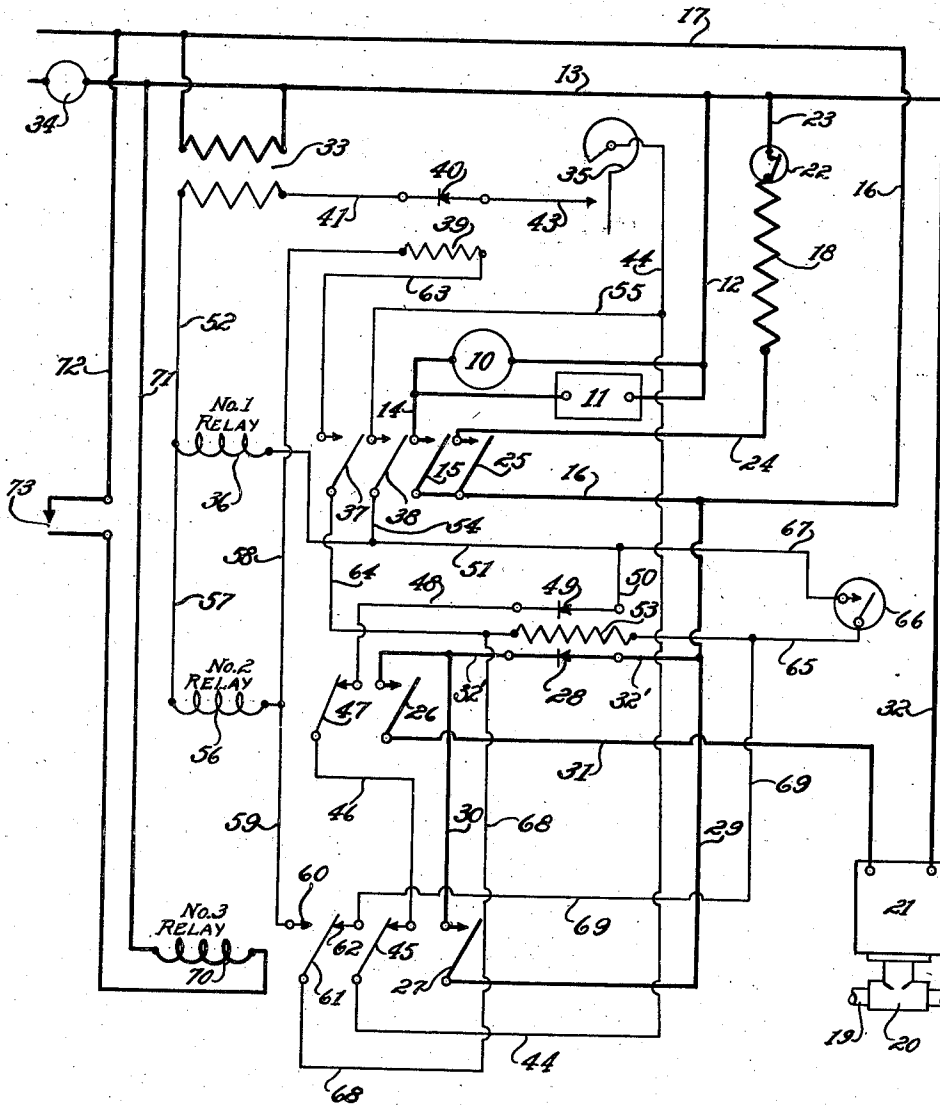
H. F. TAPP ET AL
CONTROL FOR OIL BURNERS

2,230,732

Filed Jan. 16, 1940

4 Sheets-Sheet 1

Fig. 1.



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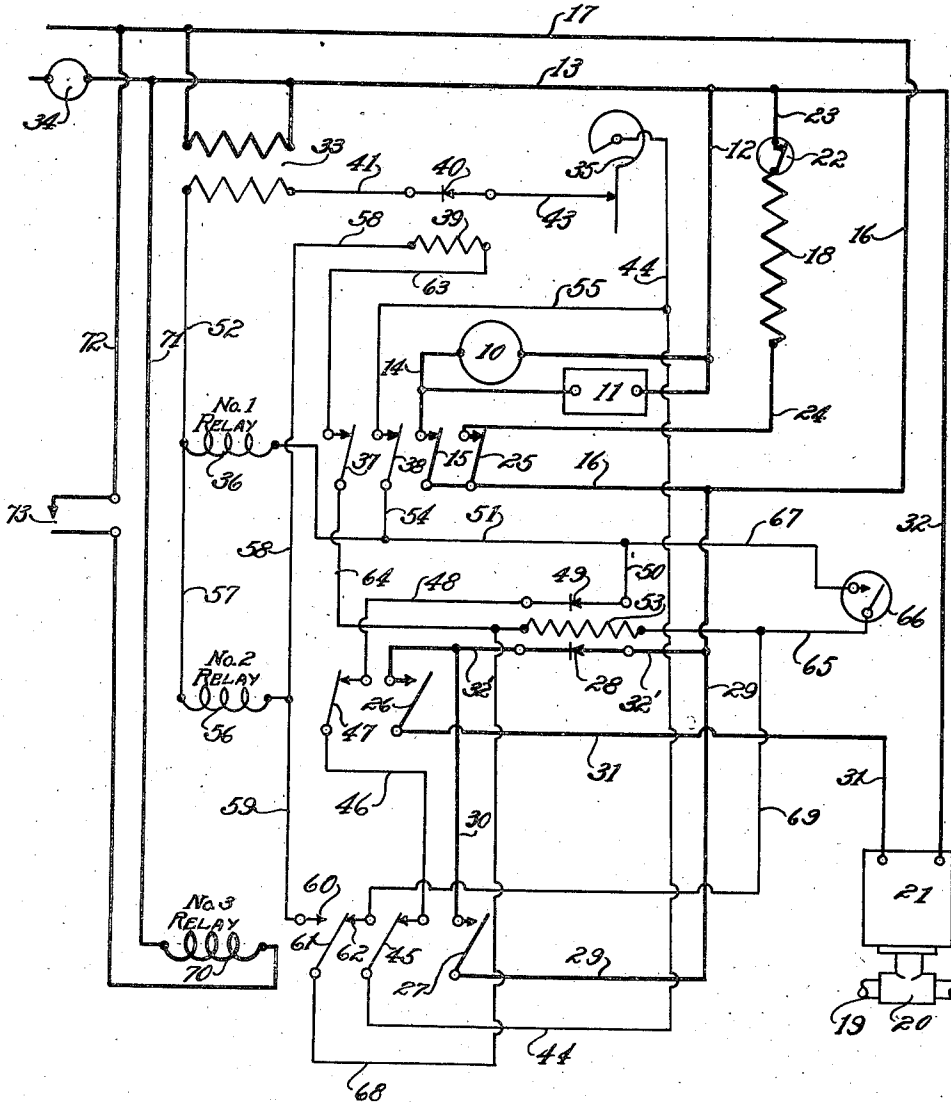
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Fig. 2.



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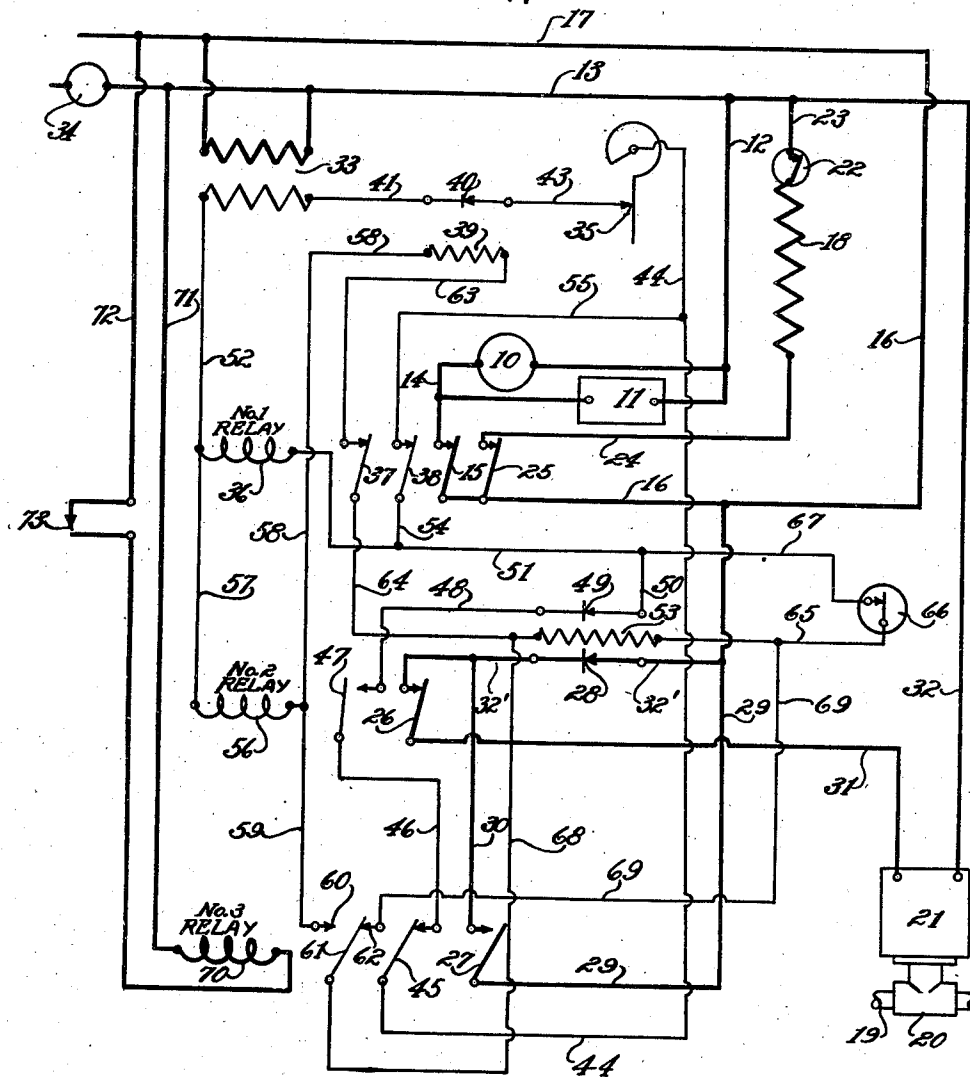
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Fig. 3.



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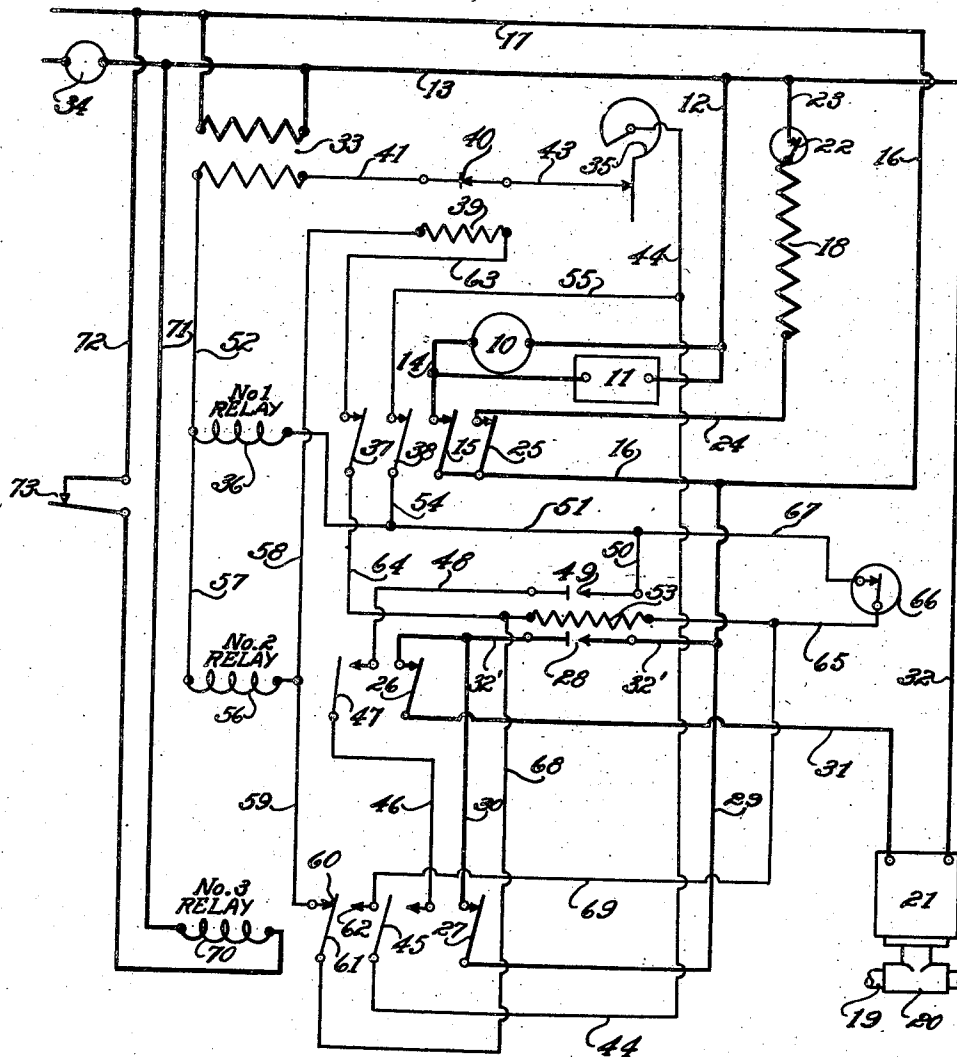
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4 Sheets-Sheet 4

Fig. 4.



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UNITED STATES PATENT OFFICE

2,230,732

CONTROL FOR OIL BURNERS

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Application January 16, 1940, Serial No. 314,102

9 Claims. (Cl. 158—28)

This invention relates to an improved control system for an oil burner of that type in which the oil is heated to a predetermined temperature before flow of oil to the nozzle of the burner is permitted.

The invention has for one object the provision of a control system which will enable a motor-operated oil pump, or other oil-circulating means, and an oil-heating means such for example as an electric heater to be started up simultaneously when a demand for heat occurs and to run as long as may be necessary to bring the oil up to the desired temperature and which, when such temperature is attained, will enable flow of oil to the burner and, at the same time, place in action a safety switch for shutting down the burner after the lapse of a predetermined time interval in the event of failure of combustion—the system providing a control responsive to combustion for rendering the safety switch inoperative in the event that combustion occurs within said time interval.

The invention has for another object the provision of a control for accomplishing the above described functions in an extremely safe and substantially fool-proof manner.

The invention has for another object the provision of a joint control for the oil-flow controlling means, comprising two switches in series, one of which switches closes on rise of temperature of the oil to a predetermined degree and the other of which switches closes in the event that combustion of the oil occurs, together with a shunt across the terminals of the second switch which is closed until combustion occurs and thereafter opens but only after the lapse of a predetermined time interval after the closing of the second switch.

The invention has for another object the provision of a control system including relay-operated switches for effecting the functions above set forth, one relay responding to a demand for heat and serving to start the oil-heating and oil-circulating means, a second relay responding to rise in temperature of the oil to a predetermined degree and serving to open a valve enabling flow of oil to the nozzle and also place in action a safety switch, and a third relay responding to combustion of the oil and serving to shunt out the safety switch and to cause the oil valve to be placed under the joint control of the oil-temperature responsive means and combustion-responsive means.

These and other features of the invention will

best be understood as the detailed description proceeds and they will be pointed out in the appended claims.

The invention will be disclosed with reference to the accompanying drawings, in which:

Fig. 1 is a diagrammatical view of a control system embodying the invention and showing the parts as they are positioned when the burner is not in operation;

Fig. 2 is a similar view showing the parts as they are positioned after a demand for heat has caused actuation of the first relay;

Fig. 3 is a similar view showing the parts as they are positioned after the oil has attained the desired temperature and causes the actuation of the second relay; and

Fig. 4 is a similar view showing the parts as they are positioned after the third relay has been actuated in response to combustion and after certain thermal switches have opened.

Referring to the diagram of Fig. 1, the burner motor, which as is usual drives a pump and a fan for supplying oil and air, respectively, to the burner, is indicated at 10. A transformer 11 for supplying current for ignition of the oil is joined in parallel with motor 10 and connected by a wire 12 to one wire 13 of the supply circuit, and by a wire 14 to one terminal of a switch 15. The other terminal of switch 15 is connected by a wire 16 to the other wire 17 of the supply circuit. 18 represents an electric heater for heating the oil supplied by the motor-driven pump to the nozzle, such oil being delivered through a pipe shown in part at 19. Emission of oil from this pipe to the nozzle is controlled by a valve 20 actuated by a solenoid 21. The valve opens when the solenoid is energized and closes when the solenoid is deenergized. The heater 18 may, and preferably does, have a thermostat switch such as 22 which opens responsive to temperature of the heater, or the oil heated thereby, to open the circuit in which the heater is included. This circuit includes a wire 23, connecting supply wire 13 to one terminal of switch 22. The other terminal of the latter is connected to one terminal of heater 18. The other terminal of heater 18 is connected by a wire 24 to one terminal of a switch 25—the other terminal of which is connected to wire 16. The solenoid 21 is included in a circuit 50 which includes two switches 26 and 27 arranged in series and a shunt which is controlled by some means—such as an electrically-heated thermostatic switch 28—for bridging across the terminals of switch 27 at certain times and render-

ing the same ineffective to control the solenoid. This circuit includes part of wire 16 and a wire 29 connected thereto and extending to one terminal of switch 27; a wire 30 connecting the other terminal of switch 27 to one terminal of switch 26; a wire 31 connecting the other terminal of switch 26 to one terminal of solenoid 21; and a wire 32 connecting the other terminal of solenoid 21 to the supply wire 13. The shunt which includes wires 32' and the thermostat switch 28 is connected across wires 29 and 30 and then across the terminals of switch 27. The contacts of switch 28 open on the application of heat after a predetermined time interval, say for example, twenty seconds.

The elements, thus far described, are usually included in high voltage circuits, indicated herein by relatively heavy lines. Most of the remaining elements are usually included in low voltage circuits supplied from the secondary of a transformer 33, the primary of which is connected across the supply wires 13 and 17. All low voltage circuits are shown herein by relatively light lines. It is to be understood, however, that the invention in no sense is dependent on the use of high and low voltage circuits, as in the arrangement herein illustrated. Controls for low voltage use and controls for high voltage use are well known to those skilled in the art and either kind may be used as desired or both kinds may be utilized conjointly.

The control for initiating the cycle of burner operation may be of any kind desired. As examples, there are shown a limit switch 34, included in series directly in the high voltage supply wire 13, and a thermostat switch 35 included in a low voltage circuit from the secondary of the transformer 33. The switch 34 may respond to pressure or temperature of the heating medium while the switch 35 may respond to room temperature. Usually, both controls are used but either could be used alone or any other suitable means, even a hand-operated switch, could be used to close the switches 15 and 25 and start the cycle of operation.

In the particular form herein shown an electromagnetic means, such as a relay, is utilized to actuate simultaneously the switches 15 and 25, together with two low-voltage switches 37 and 38. This relay will be hereinafter referred to as "No. 1 relay" and its coil is designated 36. The switch 37 is one of the controls for the electric heating coil 39 of a thermostatic safety switch 40, which opens on application of heat after a predetermined time interval, say for example 30 seconds. The switch 38 controls a holding circuit for No. 1 relay.

The starting circuit for No. 1 relay includes in series the following elements and wire connections. A wire 41 connecting one terminal of the secondary of transformer 33 to the safety switch 40, a wire 43, room thermostat switch 35, wire 44, switch 45, wire 46, switch 47, wire 48, a thermostatic switch 49, wires 50 and 51, relay coil 36, and a wire 52 connecting the coil 36 to the other terminal of the secondary of the transformer. The thermostatic switch 49 opens on the application of heat from the same electric heating coil 53, which heats switch 28—opening after a predetermined time interval has elapsed. This interval may be about the same as that for switch 28, viz., twenty seconds. All the switches of the starting circuit, except switch 35, are normally closed during periods of rest of the burner. The condition of the various circuits is as shown

in Fig. 1. The switch 35 ordinarily initiates the cycle of operation unless, of course, the limit control 34 happens to be open when switch 35 closes, in which case the subsequent closing of switch 34 will start the cycle. Usually then, on a demand for heat as manifested by the closing of switch 35, the described starting circuit will be closed and No. 1 relay will pull in, closing all four switches 15, 25, 37, and 38. The closing of switch 15 will start the motor 10 and the oil pump driven thereby, together with the ignition means 11. The closing of switch 25 will start the heater 18 in operation to heat the oil. The closing of switch 38 closes a holding circuit for No. 1 relay. This circuit includes wires 54 and 55 which, when switch 38 is closed, interconnect wires 44 and 51 and thus shunt out switches 45, 47 and thermal switch 49. No. 1 relay stays energized subject for the time being to control by thermostat switch 35 only. The safety switch 40 cannot yet function, as will later appear. The conditions of the various circuits as they then exist are as shown in Fig. 2.

The switches 26 and 47 are electromagnetically operated simultaneously as by a relay herein-after referred to as "No. 2 relay" and the coil of which is designated 56. One terminal of coil 56 is connected by a wire 57 to wire 52. The other terminal of coil 56 is connected by a wire 58 to one terminal of heat coil 39 and by a wire 59 to one contact 60 of a switch, having a blade 61 and a second contact 62. The other terminal of heat coil 39 is connected by a wire 63 to one terminal of switch 37, and the other terminal of the latter is connected by a wire 64 to one terminal of heat coil 53. The other terminal of coil 53 is connected by a wire 65 to one terminal of a thermostat switch 66, which closes on heat and responds to the temperature of the oil. The other terminal of switch 66 is connected by a wire 67 to wire 51. When the oil reaches a predetermined temperature, switch 66 closes, thereby energizing No. 2 relay and causing switch 47 to open and switch 26 to close. The condition of the various circuits is then as shown in Fig. 3. The circuit, closed by thermostat 66, is as follows: from the secondary of transformer 33 by wires 52 and 57 to relay 56, thence by wire 58 to heat coil 39, wire 63, switch 37, wires 64 and 65, switch 66, wires 67, 51 and 54, switch 38, wires 55 and 44, switch 35, wire 43 safety switch 40, and wire 41, back to the secondary of the transformer. It is to be noted that this circuit also includes a shunt around heat coil 53—such shunt comprising wires 68 and 69 connected to opposite ends of the heat coil 53 and connecting one with contact 62 and the other with the blade 61 of a switch. The shunt is now closed and no effective current passes through coil 53. The heat coil 39 is, however, energized.

The switches 27, 45, and 61 are simultaneously actuated by electro-magnetic means, such as a relay hereinafter referred to as "No. 3 relay" and the coil of which is designated 70. This coil 70 is included in a high voltage circuit comprising wires 71 and 72, connected to supply wires 13 and 17, respectively, and a control 73. This control is a thermostatic switch or any other kind of switch which will respond to the occurrence of combustion and close the circuit to relay coil 70. When No. 3 relay pulls in, it closes switch 27, opens switch 45 and moves switch 61 from contact 62 to contact 60. Switch 61 shunts out heat coil 39 of the safety switch 40 and, at the same time, opens the shunt of heat coil 53. Thus, the

thermal switches 28 and 49 will be actuated and opened after the selected predetermined time interval. The opening of switch 28 opens the shunt across switch 27, whereby this switch is placed in series with switch 26 to control solenoid 21. The condition of the circuits is now as shown in Fig. 4.

The operation of the apparatus will next be described. When the burner is at rest, the condition of the various circuits is as shown in Fig. 1. When there is a demand for heat, the room thermostat closes the starting circuit to No. 1 relay which pulls in, closing switches 15, 25, 37 and 38. A holding circuit is closed through switch 38 and this circuit shunts out the thermal switch 49 and the switches 47 and 45, respectively, operated by No. 2 and No. 3 relays. No. 1 relay is thus placed wholly under the control of room thermostat 35 and the safety switch 40. This safety switch, which is the usual one relied on to shut down the burner in the event that combustion does not occur, and which, when once actuated, holds the circuit open until the safety switch has been manually reset, is not yet capable of performing its intended function, because the circuit of its heat coil 39 is open at the hot-closing oil thermostat 66. Thus, the holding circuit for No. 1 relay will remain closed at least until the oil has been brought to the desired temperature. No. 1 relay sets in operation the motor 10 and the fuel pump driven thereby; the ignition means (herein exemplified only in part by transformer 11); and the electric heater 18. The latter heats the oil and, when the desired temperature has been attained, the thermostat switch 66 closes, thereby completing the circuit No. 2 relay and heat coil 39. No. 2 relay pulls in, opening switch 47 and closing switch 26, thereby energizing solenoid 21 which opens valve 20 and allows heated oil to flow to the burner to be ignited by the usual ignition means supplied by transformer 11. In its present condition, the burner will now operate only for the predetermined time permitted by the setting of the safety switch. That is, the heat coil 39 of safety switch 40 is energized and will cause this switch to open in a short time, say 30 seconds, unless combustion occurs. The burner will thus be shut down and further operation thereof prevented unless and until the open safety switch 40 has been closed by the usual manually-operated reset means. Assuming that ignition does occur, combustion-responsive switch 73 closes and causes No. 3 relay to pull in, actuating switches 27, 45 and 61. Switch 61 moves to engage contact 60, thereby shunting out the heat coil 39 of safety switch 40 so that No. 1 relay is now controlled by the room thermostat or limit control 34, which will eventually open, when the demand for heat is satisfied, or the predetermined limiting condition for which switch 34 is set, is reached, and thereby stop the burner. Switch 27 closes, preparatory to being placed in control jointly with switch 26 of solenoid 21. Switch 45 opens the shunt of heat coil 53 and in a short time, say twenty seconds, thermal switch 28 will open to accomplish the act of placing of the solenoid 21 under the joint control of switches 26 and 27 and thus of No. 2 and No. 3 relays. No. 2 relay will drop out if the oil temperature falls too low and No. 3 relay will drop out if combustion fails for any reason. If the fire goes out, switch 73 will open, causing No. 3 relay to drop out, thereby opening the shunt of the heat coil 39 of safety switch 40. Thus, the

burner is again placed on safety and will be stopped by the opening of switch 40 in a few seconds. However, if combustion is maintained, the burner will not be placed on safety by the dropping of the temperature of the oil below the predetermined figure. No. 2 relay only will drop out under such circumstances, resulting in deenergizing the solenoid 21 and closing of the oil valve 20. The motor, oil pump, heater and ignition means will continue in operation 10 and when the oil temperature again reaches the desired degree, No. 2 relay will again close and allow oil to flow to the burner.

It is to be noted that the electric heater 18 may stop under the action of its own thermostat switch 22. If there are other oil heating means used and heater 18 is relied on primarily for preliminary heating, the switch 22 will be desirable in order to automatically cut out heater 18 after it is no longer needed. If heater 18 alone were used for the purpose of heating of the oil, the switch 22 might be omitted.

When the demand for heat has been satisfied, thermostat switch 35 opens and No. 1 relay drops out, thereby opening the circuits to the motor 10, ignition means 11, and heater 18. The opening of switch 35 also opens the circuit of No. 2 relay which then drops out, thus deenergizing solenoid 21 and causing the oil valve to close. With the stopping of the flow of oil to the burner, combustion ceases and switch 73 opens, causing No. 3 relay to drop out. The parts are then as in Fig. 1 except that the thermal switches 28 and 49 are still open. These begin to cool when the circuit to their heat coil 53 is broken 35 by the opening of switch 37 and eventually these two switches will close. The closing of these two switches usually occurs in a minute or a minute and a half. The closing of switch 28 bridges across the open terminals of switch 27 40 and thus makes possible the opening of the oil valve by the pulling in of No. 2 relay alone. The closing of thermal switch 49 makes the starting circuit to No. 1 relay effective on closing of the room thermostat switch 35. The purpose of switch 49 is to prevent immediate operation of the burner after it has been stopped in any normal manner or to prevent recycling on flame failure. For example, if the thermostat 35 is moved to "off" position and immediately moved 50 back on "on" position; if the current supply fails and is restored almost immediately; and if the oil supply fails momentarily, the switch 49 will prevent operation of the burner until it is safe to do so. If the burner is stopped in any normal manner, the open thermal switch 49 insures that the burner will not again be started until after the lapse of an interval sufficient to allow scavenging of the burnt gases from the burner and a sufficient cooling down of certain parts, 60 such as the switch 73, switch 40, and switch 28. The arrangement is preferably such that switch 28 will close just a few seconds before switch 49 closes.

The invention affords a fool-proof control 65 which insures that the various functions occur in the desired sequence and which insures safety in that the burner cannot be operated in the event that faulty conditions exist. For example, No. 2 relay cannot pull in until after No. 1 pulls in because the switch 37 is open. No. 1 relay cannot pull in until after both No. 2 and No. 3 relays have dropped out. The switches 47 and 45, respectively actuated by the No. 2 and No. 3 relays, are in the starting circuit of No. 1 relay and 75

will not close until No. 2 and No. 3 relays have dropped out. So also, if the heat coil 39 of safety switch 40 is burned out, No. 2 relay cannot pull in because such coil is placed in the starting circuit of this relay. If heat coil 53 burns out, No. 2 relay will drop out after No. 3 relay has pulled in and opened the shunt 68, 69, thus closing the solenoid valve and stopping combustion, whereupon No. 3 relay drops out. If No. 1 relay is burned out, the cycle cannot be initiated at all. If No. 2 relay is burned out, no oil can flow to the burner and the heater 18, although in circuit, will cut in and out under the action of its own thermostat 22. If No. 3 relay is burned out, the safety switch 40 will stop the burner. If the contacts of any of the thermostats 35, 66 or 73 are dirty and fail to close properly, operation of the burner is prevented and, in general, the control requires good closing of circuits as a prerequisite to continued operation. The thermostat 73 must cool sufficiently after stopping of the burner and this is insured by the then open thermal switch 49 which also prevents immediate subsequent operation as above described.

25 The arrangement also guards against a low voltage condition by inserting in the circuit of No. 2 relay—the one which controls the flow of oil to the burner—a resistance (being that of heat coil 39), whereby substantially full voltage is required to secure the necessary current flow through the relay to cause it to pull in. Even though No. 1 relay pulls in on an abnormally low voltage, no harm is done because no oil can flow to the burner nozzle, and such flow cannot occur unless and until No. 2 relay pulls in and to accomplish this substantially full voltage is required.

The invention thus offers an improved control system for a burner of the oil-preheating type and provides for the desired sequence of operations with certainty and at the same time affords adequate safeguards which make the system exceptionally safe and substantially fool-proof.

What we claim is:

45 1. In a control system for a burner, having a motor-operated oil pump, atomizing means, a valve controlling flow of oil to said means and initially closed to prevent such flow, and means for heating the oil prior to its passage through said valve, means for starting said motor and pump and oil-heating means, electrical means for opening said valve, a circuit for said last-named means, a first switch and a second switch arranged in series in said circuit, a shunt initially bridging the terminals of the second switch, a thermostat responsive to the temperature of the heated oil to close the first switch when the oil attains a predetermined temperature, whereby said circuit will be closed to cause opening of the oil valve, means responsive to combustion of oil at said atomizing means to close the second switch, and means automatically operable after the closing of the second switch for opening said shunt, whereby said valve may be closed either by a drop in oil temperature or failure of combustion.

2. In a control system for a burner, having a motor-operated oil pump, atomizing means, a valve controlling flow of oil to said means and initially closed to prevent such flow, and means for heating the oil prior to its passage through said valve, means for starting said motor and pump and oil-heating means, electrical means for opening said valve, a circuit for said last-named means, a first switch and a second switch

arranged in series in said circuit, a shunt initially bridging the terminals of the second switch, a thermostat responsive to the temperature of the heated oil to close the first switch when the oil attains a predetermined temperature, whereby said circuit will be closed to cause opening of the oil valve, means responsive to combustion of the oil at said atomizing means to close the second switch, a thermal switch in said shunt operable when heated to open the shunt, an electric heater for the thermal switch, and means for energizing said heater including a control switch closed simultaneously with the closing of the second switch.

3. In a control system for a burner, having a motor-operated oil pump, atomizing means, a valve controlling flow of oil to said means and initially closed to prevent such flow, and means for heating the oil prior to its passage through said valve, means for starting said motor and pump and oil-heating means, electrical means for opening said valve, a circuit for said last-named means, a first switch and a second switch arranged in series in said circuit, a shunt initially bridging the terminals of the second switch, electrical means operable when energized to close the first switch, an energizing circuit for said last-named means, a thermostat switch closing when the oil reaches a predetermined temperature for controlling said energizing circuit, a thermal safety switch effective when opened to stop the burner, an electrical heater operable when energized for a predetermined time to open said safety switch, said heater included in said energizing circuit, whereby the oil valve will be opened when the oil is sufficiently heated and whereby the safety switch will commence to be heated, means responsive to combustion of the oil at the atomizing means to close the second switch, means automatically operable after the closing of the second switch for opening said shunt, whereby said valve may be closed either by a drop in oil temperature or failure of combustion, and means operable on closure of the second switch to shunt out the heater of said safety switch.

4. In a control system for a burner, having a motor-operated oil pump, atomizing means, a valve controlling flow of oil to said means and initially closed to prevent such flow, and means for heating the oil prior to its passage through said valve, means for starting said motor and pump and oil-heating means, electrical means for opening said valve, a circuit for said last-named means, a first switch and a second switch arranged in series in said circuit, a shunt initially bridging the terminals of the second switch, electrical means operable when energized to close the first switch, an energizing circuit for said last-named means, a thermostat switch closing when the oil reaches a predetermined temperature for controlling said energizing circuit, a thermal safety switch effective when opened to stop the burner, an electrical heater operable when energized for a predetermined time to open said safety switch, said heater included in said energizing circuit, whereby the oil valve will be opened when the oil is sufficiently heated and whereby the safety switch will commence to be heated, means responsive to combustion of the oil at said atomizing means to close the second switch and simultaneously shunt out the heater of said safety switch, a thermal switch in said shunt operable when sufficiently heated to open the same, an electrical heater for said last-named thermal

switch, and an energizing circuit for the last-named heater closed simultaneously with the closing of said second switch.

5. In a control system for a burner, having a motor-operated oil pump, atomizing means, an initially-closed valve preventing flow of oil to said atomizing means, electrical means for opening said valve, and means for heating the oil, means for actuating said motor and pump and oil-heating means including a control closing on demand for heat, a circuit including said flow-controlling means, a first switch controlling said circuit, a thermostat operable on rise in temperature of the heated oil to a predetermined degree to close the first switch and thus the circuit to said valve actuating means thereby allowing flow of oil to said atomizing means, a thermal safety switch operable when sufficiently heated to stop said motor and pump and oil heating means, an electrical heater operable when energized to heat said safety switch, means for energizing said heater rendered effective by the closing of said first switch, a second switch closing in response to combustion of the oil, means operable on the closing of the second switch to shunt out the heater of said safety switch, and means also operable after closure of the second switch to place said valve-actuating means under the joint control of the first and second switches, whereby the flow of oil may be stopped in the event of failure of combustion or in the event that the temperature of the oil falls below said predetermined degree.

6. In a control system for a burner, having a motor-operated oil pump, atomizing means, an initially-closed valve preventing flow of oil to said atomizing means, electrical means for opening said valve, and means for heating the oil, means for actuating said motor and pump and oil heating means including a control closing on a demand for heat, a circuit including said flow-controlling means, a first switch controlling said circuit, a thermostat operable on rise in temperature of the heated oil to a predetermined degree to close the first switch and thus the circuit to said valve-actuating means thereby allowing flow of oil to said atomizing means, a thermal safety switch operable when sufficiently heated to stop said motor and oil-heating means, an electrical heater operable when energized to heat said safety switch, means for energizing said heater rendered effective by the closing of said first switch, a second switch closing in response to combustion of the oil, means operable on the closing of the second switch to shunt out the heater of said safety switch, and means also operable after closure of the second switch to place said valve-actuating means under the joint control of the first and second switches, whereby the flow of oil may be stopped in the event of failure of combustion or in the event that the temperature of the oil falls below said predetermined degree.

7. In a control system for a burner, having a motor-operated oil pump, atomizing means, an initially-closed valve preventing flow of oil to said atomizing means, electrical means for opening said valve, ignition means and electrical means for heating the oil, means for simultaneously actuating said motor and pump and ignition means and oil-heating means including a control closing on demand for heat, a circuit including said flow-controlling means, a first switch controlling said circuit, a thermostat operable on rise in temperature of the heated oil to a predetermined degree to close the first switch and

thus the circuit to said valve-actuating means thereby allowing flow of oil to said atomizing means, a thermal safety switch operable when sufficiently heated to stop said motor and pump and oil heating means, an electrical heater operable when energized to heat said safety switch, means for energizing said heater rendered effective by the closing of said first switch, a second switch closing in response to combustion of the oil, means operable on the closing of the second switch to shunt out the heater of said safety switch, and means also operable after closure of the second switch to place said valve-actuating means under the joint control of the first and second switches, whereby the flow of oil may be stopped in the event of failure of combustion or in the event that the temperature of the oil falls below said predetermined degree.

8. In a control system for a burner, having a motor-driven oil pump, atomizing means, electrical means for controlling the flow of oil to said atomizing means, and means for heating the oil; first, second and third relays; a starting switch closable on a demand for heat, initially-closed switches actuated to open position one by the second and one by the third relays, a starting circuit for the first relay including said starting switch and said initially-closed switches, circuits closed by the pulling in of the first relay to actuate the pump and motor and oil-heating means, a thermal safety switch, an electric heater therefor operable to cause opening of the safety switch in a predetermined time, a holding circuit for the first relay including said starting and safety switches, a thermostat switch closing on rise of temperature of the heated oil to a predetermined degree, a circuit to the second relay including said heater and thermostat switch, whereby the second relay pulls in when the oil is heated to the desired temperature and at the same time the safety switch is rendered operative to open in a predetermined time, a circuit to said flow-controlling means, a switch closed by the pulling in of the second relay to close the last-named circuit and enable flow of oil to said atomizing means, ignition means for the oil, a combustion responsive switch, a circuit including the latter and the third relay, a shunt for said heater closed by the pulling in of the third relay, an initially-closed thermal switch in the circuit to said flow-controlling means energized to open in a predetermined time by the pulling in of the third relay, a circuit including a switch closed by the third relay for bridging across said thermal switch, whereby on opening of the latter the switches closed one by the second and the other by the third relay are placed in series to enable the opening of either to actuate said flow-controlling means to stop the flow of oil to said atomizing means.

9. In a control system for a burner, having a motor-driven oil pump, atomizing means, electrical means for controlling the flow of oil to said atomizing means, and means for heating the oil; first, second and third relays; a starting switch closable on a demand for heat, initially-closed switches actuated to open position one by the second and one by the third relays, a starting circuit for the first relay including said starting switch and said initially-closed switches, circuits closed by the pulling in of the first relay to actuate the pump and motor and oil-heating means, a thermal safety switch, an electric heater therefor operable to cause opening of the safety switch in a predetermined time, a holding circuit for

the first relay including said starting and safety switches, a thermostat switch closing on rise of temperature of the heated oil to a predetermined degree, a circuit to the second relay including
5 said heater and thermostat switch, whereby the second relay pulls in when the oil is heated to the desired temperature and at the same time the safety switch is rendered operative to open in a predetermined time, a circuit to said flow-con-
10 trolling means, a switch closed by the pulling in of the second relay to close the last-named circuit and enable flow of oil to said atomizing means, ignition means for the oil, a combustion responsive switch, a circuit including the latter
15 and the third relay, a shunt for said heater closed by the pulling in of the third relay, an initially-closed thermal switch in the circuit to said flow-

controlling means energized to open in a predetermined time by the pulling in of the third relay, a circuit including a switch closed by the third relay for bridging across said thermal switch,
5 whereby on opening of the latter the switches closed one by the second and the other by the third relay are placed in series to enable the opening of either to actuate said flow-controlling means to stop the flow of oil to said atomizing means, and an initially-closed thermal switch in
10 the starting circuit of the first relay and energized to open in a predetermined time by the pulling in of the third relay, whereby to break said starting circuit and prevent immediate subsequent closing thereof.

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