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SYSTEM OF CONTROL FOR BURNERS

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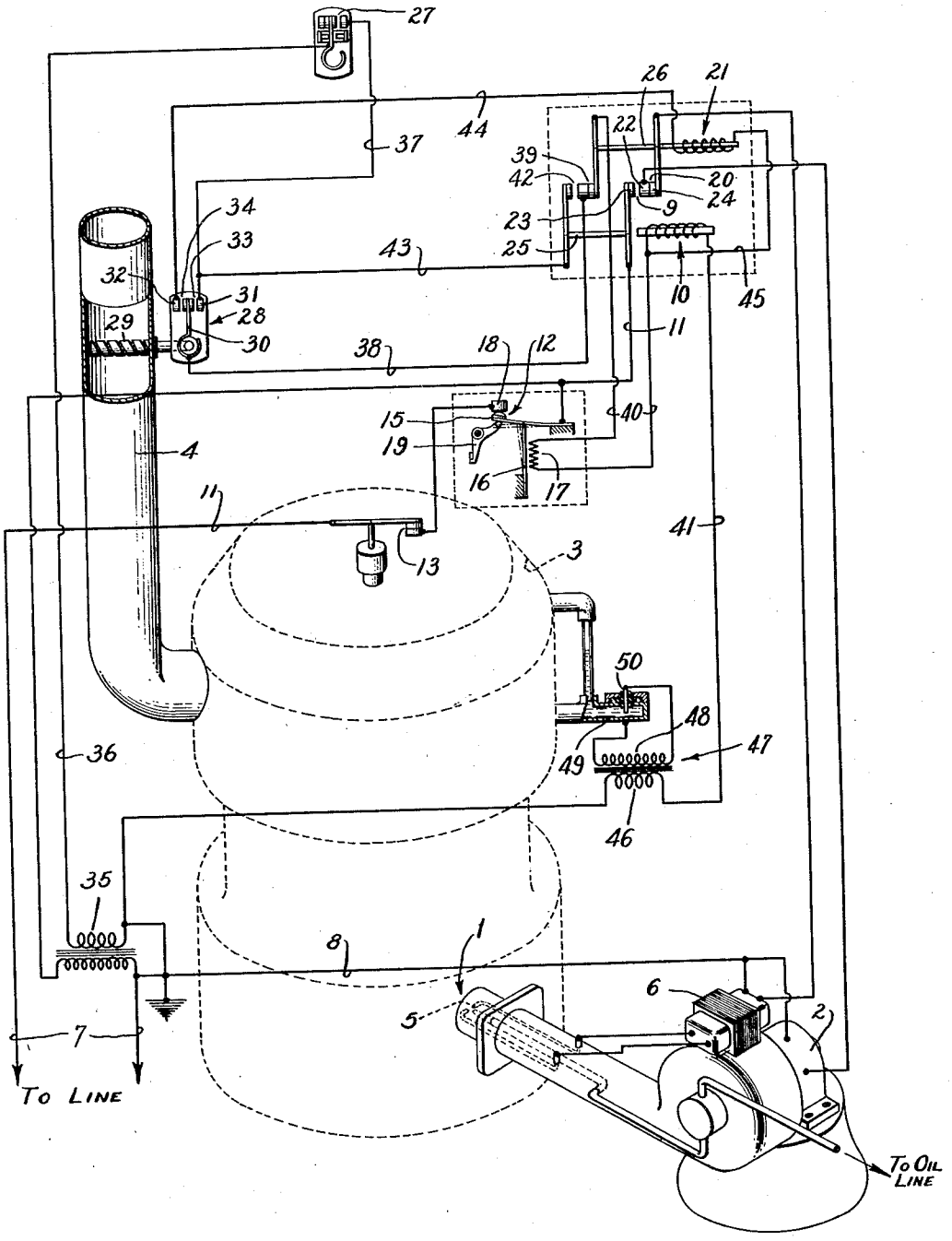

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SYSTEM OF CONTROL FOR BURNERS

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2 Claims. (Cl. 158—28)

This invention relates generally to control equipment for governing the cyclic operation of burners of the so-called intermittent type.

The general object is to provide a novel oil burner control system which is simple and inexpensive in construction, which is reliable in operation, which embodies all of the features necessary for safe operation of the burner under all abnormal conditions ordinarily occurring in service use, and which effects automatic recycling of the burner at the time and under the conditions when such recycling may safely occur.

The invention also resides in the novel character of the construction employed for carrying out the foregoing object.

Other objects and advantages of the invention will be apparent from the following detailed description taken in conjunction with the accompanying drawing which shows the improved control system as applied to the control of the liquid fuel burner 1 of a conventional type adapted upon operation of an electric motor 2 to discharge atomized fuel into the combustion chamber within a boiler 3 indicated in dotted outline and having an outlet flue 4 through which the products of combustion are discharged. While any preferred form of ignition means may be employed, a spark igniter 5 is illustrated and arranged to be rendered operative upon energization of the primary winding of a step-up transformer 6.

The motor 2 is arranged to be energized through a circuit which extends from a high voltage power source 7 through a conductor 8, the motor 2, a normally open switch 9 of an electromagnetic relay 10, and a conductor 11 having interposed therein a normally closed safety switch 12 and a normally closed switch 13 arranged to be opened in response to an abnormally high pressure or temperature of the boiler fluid. Thus, with the switches 12 and 13 closed as they normally are, the motor will be started and stopped and the supply of fuel to the combustion chamber will be initiated and interrupted in response to energization and deenergization of the magnet 10.

The safety switch 12 is maintained closed under normal operating conditions and is arranged to be opened after the lapse of an interval determined by the period during which a suitable slow-acting device remains electrically energized. After being opened, the switch remains in this position until reset manually. The slow-acting device comprises a strip 16 of bimetallic material normally acting as a latch to hold a movable contact 15 of the safety switch in closed position and arranged to warp, when heated by a resistance element 17, in a direction to release the contact and permit movement thereof away from the fixed contact 18. After opening of the switch, the motor circuit remains broken until the latch is reset by manual operation of a lever 19.

The primary winding of the ignition transformer 6 is connected in series with a control switch 20, and the two are arranged in parallel with the motor 2 so that the spark igniter 5 will be rendered effective when both of the switches 9 and 20 are closed, but may be rendered ineffective by opening of the switch 20 alone. The latter is arranged to be opened upon energization of a second relay 21. Preferably the switches 9 and 20 are formed by a common stationary contact 22 cooperating with movable contacts 23 and 24 carried respectively by the armatures 25 and 26 of the magnets 10 and 21.

The energizing circuits for the relays are preferably operated at low voltage under the control of a room thermostat having a switch 27, and a combustion responsive device 28. In the present instance, the latter device comprises a thermostatic element 29 disposed within the flue 4 with its movable end connected through a slip clutch or well known equivalent mechanism (not shown) to an arm 30 carrying a contact which cooperates with two relatively stationary contacts 31 and 32 to form switches 33 and 34. Stack switches of this character operate to detect predetermined rises and falls in the stack temperature, so that upon heating of the element 29 as the burner is started, the closed-when-cold switch 33 will be opened, and after the lapse of a predetermined interval the closed-when-hot switch 34 will be closed, slippage of the driving clutch occurring as the stack temperature continues to rise. When the stack temperature falls in response to stopping of the burner, the switch 34 will open, and after the lapse of a predetermined interval, the switch 33 will be again closed. The parts of the stack switch are so constructed and the contacts 31 and 32 so spaced that the interval of time between the opening of the switch 34 and closure of the switch 33 upon initial cooling of the element 29 following stopping of the burner is of sufficient duration to enable the combustion chamber to be properly purged of combustible gases. Also the arrangement is such that the interval between the opening of the switch 33 and the closing of the switch

34 during starting of the burner is shorter than the interval during which the resistance 17 must be energized and the thermostatic element 16 heated in order to effect opening of the safety switch 12.

The circuit for effecting initial energization of the relay 10 extends from the source of low voltage current such as the secondary of a transformer 35 through a conductor 36, the room thermostat switch 27, a conductor 37, the closed-when-cold stack switch 33, a conductor 38, a switch 39 operated by the armature 26 and normally closed when the relay 21 is deenergized, a conductor 40 in which the resistance 17 is interposed, the winding of the relay 10, and a conductor 41. When the relay 10 is thus energized, the switch 9 is closed thereby completing the high voltage circuits for the burner motor 2 and the circuit through the then closed switch 20 and the ignition transformer. The igniter 5 is thus rendered operative, and fuel is sprayed into the combustion chamber. Energization of the relay 10 also closes a normally open switch 42 interposed in a conductor 43 in parallel with the closed-when-cold stack switch 33 so that continued energization of the heater 17 and the relay 10 is maintained under the control of the room thermostat switch independently of the combustion switch.

If the fuel is ignited properly, the resulting rise in the stack temperature will cause the switch 33 to be opened, and after the lapse of the allotted interval, the closed-when-hot switch 34 will be closed. During this interval, energization of the relay 10 is continued under the control of the switch 42. Closure of the switch 34 results in energization of the second relay 21 in series with the first relay 10 through a circuit which extends from the current source 35 through the conductor 36, the room thermostat switch 27, the conductors 37 and 43, the switch 42, the conductor 38, the closed-when-hot switch 34, a conductor 44, the winding of the relay 21, a conductor 45, the winding of the relay 10, and the conductor 41. Attraction of the relay armature 26 opens the switch 20 thereby interrupting the operation of the igniter 5 and also opens the switch 39 which opens the circuit through the resistance 17, this occurring under normal conditions before the thermostatic element 16 has warped to a position permitting the safety switch 12 to open. Thus, if ignition is successful, operation of the burner motor, after the trial period, is continued under the control of the room thermostat switch 27, the closed-when-hot switch 34, and the switch 42.

When the room thermostat ceases to call for heat as evidenced by opening of the switch 27, the holding circuit through the windings of the relays 10 and 21 will be interrupted thereby stopping the motor. Reclosure of this circuit by the action of the thermostat and starting of the motor may again occur after the stack has cooled to a degree sufficient to permit closure of the closed-when-cold switch 33.

Failure of the voltage supply when the burner is operating will be accompanied by opening of the switch 42 as the relay 10 becomes deenergized. This results in opening of the holding circuit and stopping of the burner in the same manner as when the room thermostat switch is opened. Thus, in the event of a momentary voltage failure, the control system will effect recycling of the burner but only after the stack has cooled sufficiently to permit closure of the closed-when-cold switch 33 which requires an interval of time sufficient to enable the combustion chamber to be purged of combustible gases by natural circulation.

In the event of flame failure while the burner is operating, as might be occasioned by the presence of air or water in the fuel supply line, the stack temperature will fall, resulting in opening of the closed-when-hot switch 34 and therefore of the holding circuit causing the relay 10 to be deenergized and the burner motor to be stopped. Then, when the closed-when-cold switch 33 becomes closed as it will after the lapse of the purging interval, the starting circuit will, if the room thermostat is still calling for heat, again be completed and recycling of the control mechanism will occur.

With the arrangement above described, the room thermostat switch cannot be manipulated accidentally in a manner such as to effect momentary operation of the burner or momentary interruption of its operation without the desired purging interval being interposed between any two successive periods of motor operation. Thus, the present control effects recycling of the burner automatically in response to the occurrence of any abnormal condition where such recycling is permissible but only after the proper time for purging the combustion chamber has been allowed. Similarly, the control provides for locking the system against recycling in the event of initial failure of ignition upon starting of the burner motor. Such failure is evidenced by failure of the closed-when-cold switch 33 to open which continues the energization of the heater 17 until the latch 16 has warped to a position to allow the safety switch 12 to open.

Advantage is taken of the circuits above described to incorporate in the control system a simple and reliable mechanism for rendering the burner inoperative in the case of hot water or steam heating systems when the water in the boiler 3 falls below a predetermined safe level. For this purpose, the primary winding 46 of a transformer 47 is interposed in the low voltage circuits in series with the winding of the motor relay 10. One terminal of the secondary winding 48 is connected to an electrode 49 which may be a pipe communicating with the boiler at the proper level. The other winding terminal is connected to an electrode 50 which is insulated and spaced from the electrode 49 and positioned at the minimum water level to be maintained. The transformer is so constructed that the primary winding 46 will act as a choke in the low voltage supply to the motor relay 10, so that when the electrode 50 is immersed in the boiler water, the impedance of the primary winding will be relatively low. But when the water level falls below the electrode when the burner is operating, the impedance of the primary will be increased to such an extent that the resulting reduction in the voltage applied to the winding of the motor relay will cause this relay to release its armature and permit the switches 9 and 42 to open. In the event that the room thermostat calls for heat following a fall in the water level below the desired point, the relay 10 cannot be energized to the degree necessary to close the motor switch. With this arrangement, electrodes of very small size may be used and the necessity of switches or other moving parts subject to deterioration is avoided.

I claim as my invention:

1. A control system for a motor operated fuel burner having high voltage motor and ignition circuits, a first relay adapted when energized to close the motor and ignition circuits, a second relay adapted when energized to open said ignition circuit, a first switch constituting a main control, a combustion responsive thermostat having closed-when-hot and closed-when-cold switches, an electrically operable safety switch adapted to render the control system inoperative upon prolonged energization of an operating element, a low voltage circuit for effecting initial energization of said first relay extending through said first switch, said closed-when-cold switch, a normally closed switch which is opened when said second relay is energized, said operating element and the winding of said first relay, a circuit for maintaining initial energization of said first relay independently of said closed-when-cold switch including the winding of the relay, said operating element, said normally closed switch, and a normally open switch which is closed when said first relay is energized, and a circuit for energizing said first and second relays in series relation upon the occurrence of combustion including said first switch, said normally open switch, said closed-when-hot switch and the windings of said relays.

2. A control system for a motor operated burner having high voltage motor and ignition circuits, a first relay adapted when energized to close the motor and ignition circuits, a second relay adapted when energized to open said ignition circuit, a main control switch, a combustion responsive thermostat having closed-when-hot and closed-when-cold switches, an electrically heated safety switch adapted to render the control system inoperative upon prolonged heating of a resistance element, means controlled by said control switch and closed-when-cold combustion switch for effecting initial energization of said first relay and said resistance element and maintaining such energization during a burner starting period, and a low voltage circuit including said control switch and said closed-when-hot switch and operating to energize said first and second relays in series relation independently of said resistance element whereby to interrupt said ignition circuit and maintain operation of said burner after successful ignition of the fuel.

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