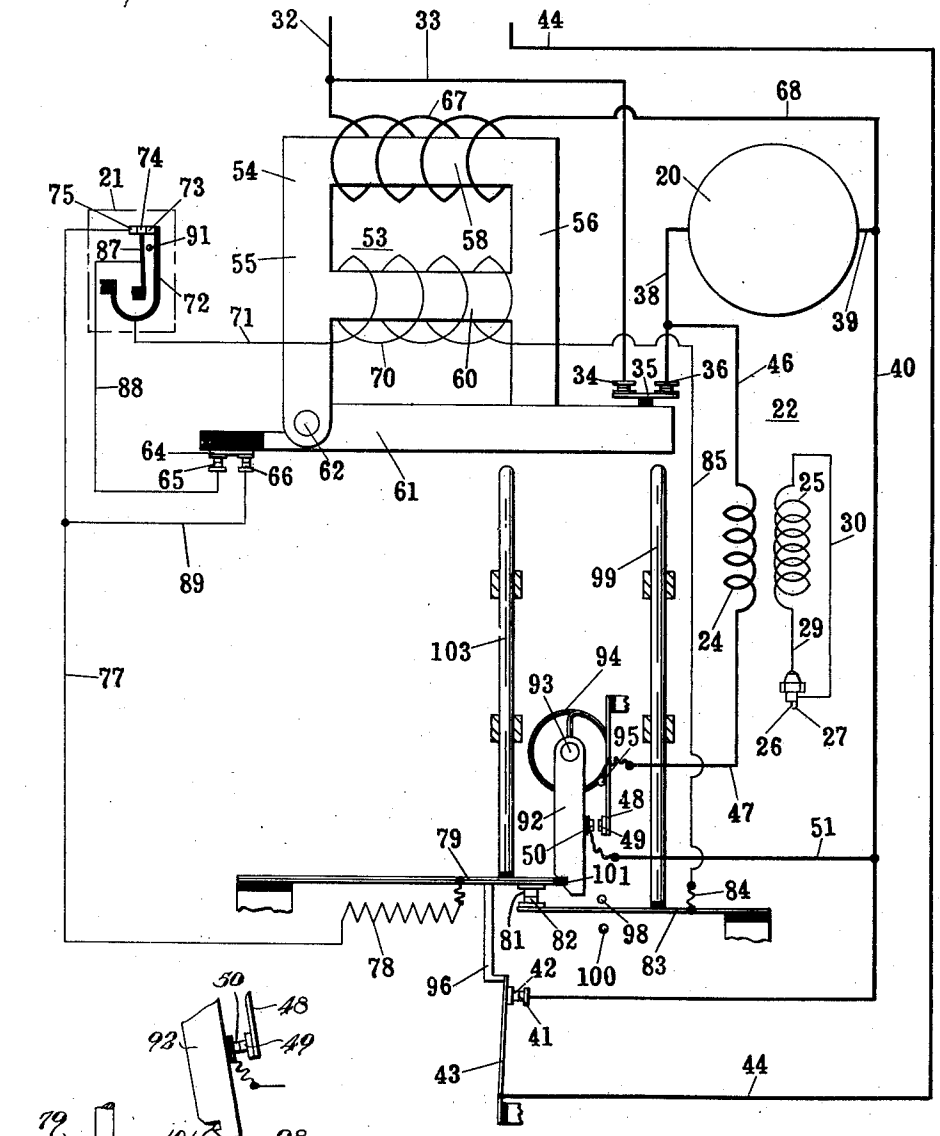
Jan. 2, 1940. W. H. F. SCHMIEDING 2,185,318

CONTROL APPARATUS

Filed Nov. 16, 1937

Fig. 1.



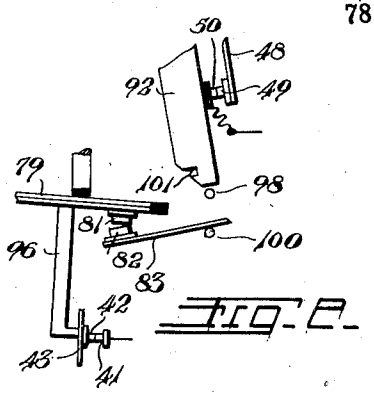


Fig. 2.

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CONTROL APPARATUS

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5 Claims. (Cl. 158—28)

The present invention relates to control apparatus and particularly to a control system for a fuel burning device.

A control system for a fuel burning device usually employs a safety controller for the purpose of automatically preventing the flow of fuel to the furnace upon the failure of the fuel to ignite or upon the cessation of combustion of the fuel. Usually such safety controller is a thermostatic device responsive to heat generated by electricity.

One of the objects of the present invention is to maintain the thermostatic device at operating temperature, so that it is in condition for immediate operation in the event of flame failure. It is desirable under certain conditions to provide for rendering an ignition device ineffective after combustion has been established and it is a further object of the invention to utilize an apparatus which is responsive to combustion for interrupting the operation of the ignition device after the fuel is ignited and for preventing the safety controller from stopping the operation of the system during normal operating conditions.

Another object of the present invention is to utilize the combustion responsive apparatus for the purpose of delaying the restarting of the system for a period sufficient for purging the furnace of gases and to arrange for the reclosing of the ignition circuit prior to the closing of the starting circuit for the fuel burning device.

A still further object of the present invention is to provide a system in which the control circuit, including the electrically heated thermostat, is maintained operative during the entire period of operation of the fuel burning device and to provide for opening this control circuit in the event of electric power failure, and to utilize the combustion responsive device for delaying the reclosing of this control circuit for a time sufficient to purge the furnace.

Further objects and advantages will be apparent from the following description, reference being had to the accompanying drawing wherein a preferred form of embodiment of the present invention is clearly shown.

In the drawing:

Fig. 1 is a diagrammatic view of the improved control system, the switches being shown in the position which they assume during normal operations of the system, and,

Fig. 2, is an enlarged view of a combustion responsive latch member.

Referring to Fig. 1, there is shown an electrically operated device 20, of any suitable type for controlling the flow of fuel, such as gas or oil, to a combustion chamber. In the specific embodiment the device 20 comprises a motor which is used for ejecting fuel and air into the combustion chamber. The combustion chamber may be of the type employed in furnaces for homes and need not be shown for the purposes of the present invention. The present control system is of the type for controlling intermittent operation of the motor 20, wherein a room thermostat 21 is utilized to start and stop the motor respectively in response to demand and cessation of demand for heat. An ignition device 22 is utilized for igniting the fuel and comprises a primary coil 24, a secondary coil 25 and spaced electrodes 26 and 27 connected in series with the secondary coil 25 by wires 29 and 30.

The circuit for the motor 20 includes line 32, wire 33, switch contacts 34, 35 and 36, wire 38, motor 20, wires 39 and 40, switch contacts 41 and 42, resilient blade 43 and line 44. The ignition circuit for the primary coil 24 includes line 32, wire 33, contacts 34, 35 and 36, wire 46, ignition coil 24, wire 47, resilient blade 48, contacts 49 and 50, which are closed during the starting operation, wires 51 and 40, contacts 41 and 42, blade 43 and line 44.

Thus it is seen that when contact 35 bridges contacts 34 and 36, current is supplied to the motor for injecting fuel mixture into the furnace, and, when contact 49 is in engagement with contact 50, ignition coil 24 is energized and ignition is supplied to the fuel mixture by the spark between electrodes 26 and 27.

A transformer relay 53 is utilized for moving contact 35 into and out of contacting position with contacts 34 and 36. This transformer relay 53 comprises a laminated core 54 having legs 55 and 56, which are joined at one end by a yoke 58 and intermediate the length thereof by a bridge 60. The lower parts of legs 55 and 56 are adapted to be bridged by an armature 61, which is pivoted at 62 and carries the contact 35. When the armature 61 is attracted it moves contact 35 into engagement with contacts 34 and 36. Armature 61 also carries a contact 64, which is arranged to bridge contacts 65 and 66 when the armature is attracted. The yoke 58 of core 54 carries a primary coil 67 which is energized normally continuously by line voltage for example, 110 volts. The circuit for coil 67 includes line 32, coil 67, wires 68 and 40, contacts 41 and 42, blade 43, and line 44. The bridge 60 of core 54 carries a low voltage coil 70 and when

the circuit for the coil 70 is interrupted, the major flux path for the circuit includes the upper part of legs 55 and 56, the yoke 58 and the bridge 60. Thus the bridge 60 shunts the path of the flux and the armature 61 will not be attracted. When the circuit for coil 70 is completed, current will be induced into said coil and the same is wound so as to oppose the flux created by primary coil 67. When this occurs, sufficient flux will flow through armature 61 to cause the same to be attracted toward leg 56.

The circuit for secondary coil 70 includes wire 71, bimetallic strip 72 of room thermostat 21, contacts 73, 74 and 75, wire 77, heating coil 78, bimetallic strip 79, contacts 81 and 82, resilient blade 83, pig tail 84, and wire 85. Thus when the bimetal 72 of room thermostat 71 moves contact 73 into engagement with contact 74 and contact 74 into engagement with contacts 75, a secondary low voltage or control circuit is completed, which causes armature 61 to be attracted whereby contact 35 bridges contacts 34 and 36 to complete the motor circuit. At this time contact 50 is in engagement with contact 49 whereby the ignition circuit is also completed. After combustion takes place and the room being heated is increased in temperature, bimetal 72 will move to the right, however, contact 74 is carried by resilient blade 87 and this blade is biased so that the contact 74 follows contact 73 to the right. When contacts 73 and 74 move to the right, contact 74 will separate from contact 75, however, a shunting circuit is established for the secondary circuit which includes wire 71, strip 72, contacts 73 and 74, blade 87, wire 88, contacts 65, 64 and 66, wires 89 and 77, heater 78, strip 79, contacts 81 and 82, blade 83, pig tail 84, and wire 85. This shunt circuit will be maintained as long as contact 74 engages contact 73. The right hand movement of the blade 87 is limited by a stop 91. When contact 73 separates from contact 74, secondary coil 70 will be deenergized permitting the armature 61 to fall, thus separating contact 35 from contacts 34 and 36 and thereby interrupting the circuit to motor 20.

The contact 50 is carried by a lever 92 which is pivoted at 93 and is actuated through the usual slipping clutch connection by a thermostat 94. This thermostat 94 is responsive to the combustion condition of the furnace, that is, when the furnace is cooled, the thermostat 94 moves lever 92 to the right in which position, contacts 50 and 49 are in engagement, and the blade 48 is biased slightly to the right. Consequently when the furnace is cold the ignition circuit is conditioned for operation by contacts 49 and 50 and when contact 35 is closed on contacts 34 and 36 ignition is present. When combustion of fuel takes place the thermostat 94 moves lever 92 and contact 50 to the left. Due to the biased condition of blade 48, contact 49 will follow contact 50 for a short distance. A stop 95 is interposed in the path of movement of blade 48. On continued leftwise movement of lever 92, contact 50 will be separated from contact 49 to interrupt the ignition. The fuel at this time is then ignited by the burning gas.

Often upon starting, the flame is extinguished but upon reignition, the fuel will continue to burn in the normal manner. Now if the thermostat is highly sensitive to slight changes in temperature, it would substantially immediately interrupt the ignition circuit prematurely. Therefore, it is desirable to delay the interruption of the ignition circuit until the period of time has elapsed in which the flame is apt to be extinguished. This delay interruption of the ignition circuit is accomplished by causing contact 49 to follow 50 during the initial heating of thermostat 94.

During the starting period the heater 78 causes bimetallic strip 79 to be moved upwardly, contact 82 being carried by the blade 83, which is biased to move upwardly, will follow the contact 81 to maintain the control circuit. The upward movement of blade 83 is limited by a stop 98 so that contact 81 can separate from contact 82 in the event that the strip 79 is not stopped in its upward movement during heating. Under normal conditions, that is, when combustion takes place the upward movement of the strip 79 is stopped because the lever 92 moves in the path thereof.

In the event that combustion does not take place, the lever 92 is not moved to the left and the strip 79 continues moving upwardly and carries with it an arm 96. When the arm 96 moves upward a predetermined distance, it will slide off the blade 43 and the blade 43 will then move to the left to separate contact 42 from contact 41 and in so doing interrupts the flow of current to the line. Blade 43 can be reset manually after the strip 79 is cooled. The heater 78 and thermostatic strip 79 are computed so that ample time elapses for starting the fuel burning device before the main line is interrupted.

If for any reason the armature 61 falls out, as for example during normal operation when room thermostat contact 73 separates from contact 74 or in the event of power failure, contact 82 will be separated from contact 81 and will remain separated for a predetermined length of time, which time is sufficient to permit purging of the combustion chamber of gases therein. In the diagrammatic showing I have illustrated a rod 99 which is pushed downwardly due to the weight of the armature 61 and this rod bears on resilient blade 83 to separate contact 82 from 81. The downward movement of this blade 83 is limited by a stop 100 so that the contact 82 is in a position to be reenergized by contact 81 when the thermostatic strip 79 is cool. In order to insure ignition upon the next starting operation of the system, a catch 101 is formed in the lower part of lever 92, which catch is arranged to be locked with the end of strip 79 to retain the strip 79 in a raised position until the combustion responsive thermostat 94 moves lever 92 to recondition the ignition circuit for operation. As previously stated the lever 92 is connected to the spiral thermostat 94 by the usual and well known type of slipping clutch, which clutch causes movement of the lever 92 from one of its extreme positions to the other upon slight increase or decrease in temperature and the clutch will slip upon continued spiral movement of the thermostat. When the thermostat 94 cools slightly due to cessation of combustion, lever 92 will be moved to condition the ignition circuit for operation.

If the combustion responsive apparatus should stick in the position shown, the motor cannot be restarted. In this manner I have insured the prevention of restarting of the fuel injector until ignition is present.

In view of the fact that lever 92 operates relatively soon after cessation of combustion and relatively faster than the downward movement of thermostatic strip 79, it is desirable to prevent upward snapping of thermostatic strip 79 when released by lever 92. For this purpose I have diagrammatically shown a rod 103 which is engaged by the falling armature 61 and the weight

of the armature assists in holding the strip 78 in position. The weight of armature and rod 103 on thermostatic strip 78 is insufficient to move the contact 81 into engagement with contact 82 when the strip 78 is hot. Strip 78 must cool to a predetermined temperature before it closes said contacts and the mechanism is computed with respect to time so that a desirable purging time is provided before the contacts 81 and 82 are closed. In this manner I have insured the prevention of conditioning the secondary circuit for operation until sufficient time has elapsed to purge the combustion chamber of explosive or spent gases as the case may be.

From the foregoing it is apparent that there has been provided a system in which the injection of fuel in to the combustion chamber is stopped relatively quickly after cessation of combustion. The thermostatic strip 78 is heated constantly during the operation of the system and is therefore under a tension and as soon as there is a slight lowering of temperature, due to cessation of combustion, thermostat 94 will operate to release lever 92, whereby strip 78 operates immediately to separate contact 81 from 82 and thereby interrupt the secondary or control circuit. Furthermore this control circuit cannot be reclosed until the ignition circuit is in condition for operation and until sufficient time has elapsed to permit the purging of the combustion chamber.

While the form of embodiment of the present invention as herein disclosed constitutes a prefererd form, it is to be understood that other forms might be adapted, all coming within the scope of the claims which follow:

I claim:

1. A control system for a fuel burning device comprising in combination electrically operated means for controlling the fuel burning device; an electric circuit for said means including a switch; electrically operated thermostatic means; a safety switch actuated by the thermostatic means for rendering the circuit inoperative after a predetermined time; combustion responsive means having a starting position and a second position wherein the last mentioned means prevent the operation of the safety switch, said combustion responsive means being moved to the second position in response to the establishment of combustion; means responsive to deenergization of the first mentioned electrically operated means for opening the first mentioned switch; said thermostatic means being timed to reclose the first mentioned switch after a predetermined time; and means operated by the combustion responsive means for preventing the thermostatic means from reclosing the first mentioned switch until said combustion responsive means returns to its starting position.

2. A control system for a fuel burning device comprising in combination electrically operated means for controlling the fuel burning device; an electric circuit for said means including a switch; a safety switch operable to deenergize the electrically operated means; a thermostatic timing means for actuating said safety switch after a predetermined period; a latch lever adapted to prevent the timing means from actuating the safety switch; means responsive to the establishment of combustion for actuating said latch lever from a starting position to a position wherein it prevents the timing means from operating the safety switch; means responsive to deenergization of the electrically operated means for opening the first mentioned switch; said thermostatic means operable after a predetermined time for closing the first mentioned switch and means associated with the latch lever for preventing the thermostatic means from closing the first mentioned switch until said latch lever is displaced to its starting position.

3. A control system for a fuel burning device, comprising in combination, electrically operated means for controlling the fuel burning device; a circuit for the electrically operated means; a controller including a safety switch for controlling the circuit; a control circuit for controlling the first circuit; switching means in the control circuit; said controller including an electrically energized thermal device connected in the control circuit and adapted to actuate the safety switch after a predetermined time period of operation of the burner device; an ignition device; a circuit for controlling the ignition device having a switch therein; means operated upon the cessation of flow of current in the first circuit for actuating the switching means to the open position whereby the electric thermal device is rendered ineffective, said controller being adapted to actuate said switching means to the closed position to condition the control circuit for operation upon cooling of the thermal device; and temperature responsive mechanism responsive to the establishment of combustion for opening the switch in the ignition device circuit and for preventing the controller from actuating the safety switch to interrupt the control circuit and operating due to cessation of combustion for closing the switch in the ignition circuit for conditioning the ignition devce for operation and for preventing the reclosing of the said switching means by the controller until the switch in the ignition circuit is closed.

4. A control system for a fuel burning device, comprising in combination, electrically operated means for controlling the fuel burning device; a circuit for the electrically operated means; a controller including a safety switch for controlling the circuit; a control circuit for controlling the first circuit; switching means in said control circuit; said controller including a resistance device connected in the control circuit and continuously tending to operate the safety switch to open the control circuit when the burner device is operating; an ignition device; a circuit for the ignition device having a switch therein; means operated upon the cessation of flow of current in the first circuit for opening said switching means whereby the resistance device is rendered ineffective, said controller being adapted to reclose said switching means to condition the control circuit for operation upon cooling of the resistance device; and means responsive to the establishment of combustion for opening the switch in the ignition device circuit and for preventing the controller from operating the safety switch to open the control circuit and operating due to cessation of combustion for closing the switch in the ignition device circuit and for delaying the reclosing of the said switching means by the controller until the switch in the ignition device circuit is closed.

5. A control system for a fuel burning device comprising in combination electrically operated means for controlling the fuel burning device; an electric circuit for said means including a switch; electrically operated thermostatic means; a safety switch actuated by the thermostatic means for rendering the circuit inoperative after a predetermined time; ignition means for ignit-

ing the fuel including a switch; combustion responsive means having a starting position in which the combustion responsive means operates to close the ignition switch and having a second position in which the combustion responsive means operates to prevent the opening of the safety switch, said combustion responsive means being moved to the second position in response to the establishment of combustion; means responsive to deenergization of the first mentioned electrically operated means for opening the first mentioned switch, said thermostatic means being timed to reclose the first mentioned switch after a predetermined time; and means operated by the combustion responsive means for preventing the thermostatic means from reclosing the first mentioned switch until said combustion responsive means returns to its starting position.

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