

1

2,695,661

**COMPONENT CHECKING BURNER CONTROL
APPARATUS FOR STANDING PILOT SYS-
TEMS**

Lawrence E. Porter, Cleveland, Ohio, assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application January 12, 1951, Serial No. 205,632

8 Claims. (Cl. 158—28)

The present invention is concerned with a fuel burner control apparatus and more particularly with a control apparatus for a fuel burner requiring a standing pilot which is continuously supervised by an electronic flame detector.

In present day fuel burner controls and especially those utilizing electronic flame detection it is customary to provide for checking the operation of the components of the controls to insure that the components are operating properly. In the DuWayne J. Peterson Patent 2,537,293, for "Burner Control Apparatus," Serial No. 25,337, filed May 6, 1948, there is described a burner control apparatus wherein a flame electrode is positioned for flame detection purposes in a standing pilot flame and the flame electrode is connected in controlling relation to an electronic flame detection device. The burner control is operative when the main burner is not operating to open the flame electrode circuit and thereby prevent the flame detection device from detecting the pilot flame. The Peterson control apparatus also has a safety shut-down device which is operative to deenergize the control apparatus if the flame detection circuit continues to indicate a flame after the main burner is shut down and the flame electrode circuit is opened.

In certain types of systems where a standing pilot flame is required, it has been found desirable to provide a control by which the proper operation of the flame detection device is checked periodically and by which the flame detection device is conditioned to detect the presence of the standing pilot flame at all times other than when the operation of the detection device is being checked.

It is therefore an object of the present invention to provide a burner control apparatus which when associated with a burner having a standing pilot will check the operation of the flame detection device immediately before and after the operation of the main fuel burner.

A further object of the present invention is to provide a burner control apparatus having a flame detection device which will supervise the pilot flame at all times other than when the operation of the flame detection device is being checked.

A still further object of the present invention is to provide a burner control apparatus having a safety shutdown device which is operative to shut down the control apparatus upon the absence of flame at the pilot burner or upon faulty operation of flame detection device.

A further object of the present invention is to provide a control apparatus which has two conditions of operation and which is temporarily rendered in operative while changing from one condition of operation to the other.

A still further object of the present invention is to provide a control apparatus which has two conditions of operation and a condition indicating device such that the operation of the condition indicating device is checked as the control apparatus changes from one condition of operation to the other.

These and other objects of the present invention will be readily apparent upon considering the specification, claims and drawings.

Figure 1 is a showing of the invention wherein an automatic pilot lighting system is employed; and

Figure 2 is a showing of a modification of the invention wherein the apparatus is adapted for use with a pilot burner which is manually ignited.

Referring to Figure 1, the numeral 10 represents a main burner which receives its fuel through a conduit 11. Con-

2

duit 11 contains an electrically operated valve 12 which will permit fuel to flow to the burner 10 when the valve 12 is energized. A bleed conduit 13 is connected to the conduit 11 ahead of the valve 12 and provides a passage for the gas to flow to the pilot burner 14. An electrically operated valve 15 is located in the bleed line 13 and allows gas to pass to the pilot burner 14 when the valve 15 is energized. Associated with the pilot burner 14 is an ignition transformer 16 having ignition electrodes 17 positioned in the flame of the pilot burner 14. Also associated with the pilot burner 14 is a flame electrode 18 which is positioned in the flame of the pilot burner 14.

Operation of the main burner 10 is initiated by a thermostat 20. The thermostat 20 comprises a bimetal 21 which actuates the blades 22 and 23 into or out of contact with contacts 24 and 25 respectively depending upon whether there is or is not a need for burner operation.

Located within the housing 26 are the main components of the control apparatus. Conductors 27 and 28 are connected to an alternating current source of power and to these conductors are connected primaries 31, 41 and 51 of transformers 30, 40, and 50 respectively. The transformer 30 has a secondary 32 which is connected in an energizing circuit for a relay 33 by a conductor 34, the thermostat 20, and a conductor 35. The relay 33 has three movable switch blades 36, 37 and 38 which are normally biased out of engagement with associated switch contacts 60, 61 and 63 respectively. The blade 37 normally engages a contact 62 when the relay is deenergized.

The transformer 40 has a centertapped secondary 42 which is arranged to energize a relay 44 through a circuit which includes contacts 61 or 62 and the movable blade 37 of relay 33. Relay 44 operates three movable switch blades 80, 81 and 82 which are normally biased out of engagement with associated switch contacts 83, 84, and 86 respectively. The blade 81 normally engages contact 85 when the relay 41 is deenergized.

Also in a circuit with the transformer secondary 42 is a heater 43 for a safety switch 46. The safety switch 46 includes a bimetal 49 which normally holds the safety switch contacts 47 and 48 in contacting relation; however, when the heater 43 is energized the bimetal is warped out from under the contacts 47 and 48 so that after a predetermined length of time the contacts 47 and 48 are allowed to open. The opening of the contacts 47 and 48 opens the energizing circuit of relay 44 as will be shown later. When the bimetal 49 cools, the contacts 47 and 48 can be reset by depressing the reset button 39.

The transformer 50 has a secondary 52 which is connected to an electronic flame detector 53. This electronic flame detector preferably is of the type shown in the Vilynn O. Beam Patent 2,455,350, issued December 7, 1948. The flame detector 53 controls a relay 54 which has four movable switch blades 55, 56, 57 and 58. Switch blades 55 and 57 are normally biased out of engagement with associated switch contacts 70 and 72 respectively. The blades 56, 57 and 58 normally engage switch contacts 71, 73, and 74 when relay 54 is deenergized.

A relay 93 is also provided and this relay has a switch blade 92 normally biased out of engagement with a contact 91. The blade 92 and contact 91 are located in the controlling circuit of the flame detection device 53 and are operable to connect the flame electrode 18 in controlling relation to the flame detection device 53 when the relay 93 is energized.

Operation when main burner operation is not needed

In order to initiate operation of the control apparatus it is first necessary that the conductors 28 and 27 be energized by an alternating current power source. When so energized, the transformer 40 will be energized and the transformer secondary 42 will supply current to the relay 44 in a circuit traced from the right-hand terminal of secondary 42 through conductor 94, safety switch contacts 48 and 47, conductor 95, relay 44, contact 62 and movable blade 37 of relay 33, conductor 45, contact 71 and movable blade 56 of relay 54, conductor 96, movable blade 58 and contact 74 of relay 54, conductor 97, conductor 98, and safety switch heating element 43 back to

the left-hand terminal of the secondary 42 of transformer 40.

The relay 44 is now energized and opens or completes the circuits associated with its contacts. The relay 93 is energized by the contacts of relay 44 and its energizing circuit can be traced from the right-hand conductor 27 to conductor 102, movable blade 82 and contact 86 of relay 44, conductor 101, relay 93, and conductor 100 to the left-hand conductor 28. The electronic flame detector 53 thereby has its control circuit completed as before mentioned through fixed contact 91 and the movable blade 92 of relay 93. Also controlled by the operation of relay 44 is the energizing circuit for valve 15 located in the bleed line 13. This circuit is completed as follows: conductor 27, conductor 102, movable blade 82 and contact 86 of relay 44, conductor 101, conductor 104, valve 15, and conductor 103 to the conductor 28. The ignition circuit for the pilot valve is also completed as follows: conductor 27, conductor 102, movable blade 82 and contact 86 of relay 44, conductor 101, conductor 106, movable blade 57 and contact 73 of relay 54, conductor 105, ignition transformer 16, to conductor 28. The contact 83 and the movable blade 80 of relay 44 complete a holding circuit for relay 44 around the movable blade 56 and the contact 71 of relay 54.

It will be noted that the energizing circuit for relay 44 is completed through the safety switch heater 43. However, as soon as flame at the pilot burner 14 is established the electronic flame detector 53 operates to energize relay 54. The relay 54 will then open or complete the circuits associated with its contacts. The movable blade 57 opens the circuit associated with contact 73 and thereby deenergizes the ignition transformer 16. The movable blade 58 opens a circuit associated with the contact 74 and thereby deenergizes the safety switch heater 43 so that the bimetal 49 will not be warped to such a position that the contacts 47 and 48 would open. The opening of the contact 74 and blade 58 of relay 54 also opens the energizing circuit of the relay 44 since the relay 44 and the heater 43 are connected in series. However, another energizing circuit is simultaneously established as the movable blade 55 completes a circuit to contact 70 of relay 54. The energizing circuit for relay 44 can now be traced as follows: from the right-hand terminal of transformer secondary 42, to conductor 94, safety switch contacts 48 and 47, conductor 95, relay 44, contact 62 and movable blade 37 of relay 33, conductor 45, movable blade 80 and contact 83 of relay 44, contact 84 and movable blade 81 of relay 44, conductor 107, movable blade 55 and contact 70 of relay 54, and conductor 108 to the center tap of the transformer secondary 42. The control is now functioning to supervise the existence of a pilot flame at the pilot burner 14 while there is no need for operation of the main burner 10.

Operation upon a need for main burner operation

The need for burner operation is indicated by the operation of thermostat 20 which energizes the circuit containing the transformer secondary 32 and the relay 33 as aforementioned. The relay 33 is operable when energized to move its movable blades 36, 37, and 38 into their energized positions. The movable blade 36 completes a circuit to contact 60 and thereby establishes a holding circuit around the contact 25 and the blade 23 of the thermostat 20. The movable blade 37 opens its circuit with the contact 62 and completes a circuit with the contact 61 and since the contacts 61 and 62, which are connected in controlling relation to relay 44, are connected together relay 44 will be momentarily deenergized. The movable blade 38 completes a circuit to contact 63 which is located in the energizing circuit of the valve 12 in conduit 11 which supplies fuel to the main burner 10.

When the relay 44 is momentarily deenergized its movable blades return to their deenergized position. The movable blade 82 will therefore break its connection with the contact 86 and thereby deenergize the relay 93 and the valve 15 which is located in the bleed line 13 supplying fuel to the pilot burner 14. Since the relay 93 is deenergized the control circuit for the electronic flame detector 53 will be opened by the movable blade 92 and the contact 91 of the relay 93 and consequently the relay 54 will also become deenergized. Also the holding circuit for the relay 44 around the contact 71 and the movable blade 56 of relay 54 will be broken as the movable blade 80 of relay 44 returns to its deenergized position.

The energizing circuit for relay 44 will be reestablished when two conditions are satisfied. First, the movable blade 37 must complete a circuit to contact 61 of relay 33 and second, the movable blade 56 must complete a circuit to contact 71 of relay 54. Or in other words, relay 33 must move to its energized position and relay 54 must move to its deenergized position.

When the energizing circuit for relay 44 has been reestablished, contacts of relay 44 will again complete the energizing circuits for the ignition transformer 16, the relay 93, and the valve 15. The relay 93 is again operative to complete the control circuit to electronic flame detector 53. When a flame is re-established at the pilot burner 14 the electronic flame detector 53 is operative to energize relay 54 and the movable contact 57 of the relay 54 completes a circuit to the stationary contact 72. The electric valve 12 which controls the flow of fuel to the main burner 10 is now energized as follows: conductor 27, conductor 102, movable blade 82 and contact 86 of relay 44, conductor 101, conductor 106, movable blade 57 and contact 72 of relay 54, conductor 111, movable blade 38 and contact 63 of relay 33, conductor 110, valve 12, and conductor 115 to conductor 28. The control is now in its operating condition and will continue to operate in this condition as long as the thermostat 20 indicates a need for burner operation.

The thermostat 20 will operate, after the required period of main burner operation, to open the circuits associated with its contacts 24 and 25 and its blades 22 and 23 respectively. The relay 33 will therefore become deenergized and its movable blades will return to their deenergized position. This will deenergize the valve 12 and will momentarily deenergize the relay 44. The deenergization of relay 44 will cause the deenergization of valve 15 and relay 93. The flame detector 53 will now deenergize relay 54 and the movable blades of relay will return to their deenergized positions. This deenergization of relay 54 allows relay 44 to be again energized and the pilot flame will be once again established as aforementioned. However, as before, the relay 44 cannot be again energized until relay 54 returns to its deenergized position.

Operation on component failure

The present control is also capable of detecting faulty operation of the flame detector 53. As has been stated, the operation of the thermostat 20 in response to a need for burner operation causes the normally energized relay 44 to be momentarily deenergized. The contacts of relay 44 are operable to open the control circuit for the flame detector 53. This is accomplished by the opening of a fixed contact 86 and movable contact 82 as relay 44 becomes deenergized. These contacts are in the energizing circuit for relay 93 and therefore the control circuit for the flame detection device 53 is broken as switch blade 92 of the relay 93 returns to its deenergized position. The relay 54 should now return to its deenergized position; however, if the operation of the flame detector 53 is faulty relay 54 will remain energized. Referring again to the energizing circuit of relay 44, it can be seen that two conditions must exist before the relay 44 can be again energized. First, the relay 33 must be at its energized position and second, the relay 54 must be in its deenergized position. Assuming that the flame detector 53 is operating falsely, the relay 33 will not be reenergized since relay 54 does not return to its deenergized position.

However, with this component failure existing, the safety switch heater 43 is energized as follows: the center tap of transformer secondary 42, conductor 108, contact 70 and movable blade 55 of relay 54, conductor 107, movable blade 81 and contact 85 of relay 33, conductor 98, and safety switch heater 43 to the left-hand terminal of transformer secondary 42. The heater 43 remains in this energized condition as long as the relay 54 remains energized and after a predetermined length of time the safety switch contacts 47 and 48 will open. The safety switch contacts 47 and 48 cannot be reset by depressing the reset button 39 until the relay 54 returns to its deenergized position and the bimetal 49 has cooled.

Operation upon pilot flame failure

Assuming that the flame at the pilot burner 14 is extinguished or fails at a time other than immediately before or after operation of the main burner 10, the

5

flame detection device 53 will operate to deenergize relay 54. The movable blade 57 will complete a circuit to contact 73 of relay 54 and the ignition transformer 16 will be energized. The movable blade 55 will open the circuit to contact 70 and the movable blades 56 and 58 will complete a circuit to the contacts 71 and 74 respectively. This will establish a different energizing circuit for relay 44 which includes the safety switch heater 43. This circuit can be traced from the right-hand terminal of transformer secondary 42, to conductor 94, safety switch contacts 48 and 47, conductor 95, relay 44, contact 62 and movable blade 37 of relay 33, conductor 45, contact 71 and movable blade 56 of relay 54, conductor 96, movable blade 58 and contact 74 of relay 54, conductor 97, conductor 98, and heater 43 to the left-hand terminal of the transformer secondary 42.

The control is now operating to re-establish the flame at the pilot burner 14 and if the flame is not established in a predetermined length of time, as evidenced by the flame detector 53, the safety switch 46 will operate to deenergize the burner control. When the safety switch 46 operates its contacts 47 and 48 open and deenergize the relay 44. The movable blade 82 will then open the circuit to contact 86 of relay 44. This deenergizes the valve 15, the relay 93 and the ignition transformer 16. The flame detection device 54 will subsequently deenergize the relay 54 and the safety switch heater 43 will then be deenergized. In a period of time the bimetal 49 will have cooled and the burner control can be rendered operative again by means of the reset button 39.

Figure 2

In some fuel burner installations it is desirable to eliminate the ignition transformer of the control apparatus and to ignite the pilot burner manually. In this case, the pilot valve is normally continuously energized from the power source and is not deenergized during the component checking sequence. The control apparatus to be used in this manner must, however, be adapted to deenergize the pilot valve when the flame detection device of the control apparatus operates improperly or when the pilot flame inadvertently goes out. This is accomplished in the modification shown in Figure 2 wherein a thermal time delay switch is provided which maintains the pilot valve energized as the apparatus goes through the component checking sequence as pointed out before. The ignition transformer and its switching circuits are not present in this modification of the invention.

Figure 2 shows the modification of the invention wherein the pilot valve 15 is controlled by means of a thermal time delay switch 200. This switch contains a heater element 201 which is energized through the movable switch blade 82 and contact 86 of relay 44. The heat generated by the heater element 201 causes the bimetal 202 to move its contact 203 to engagement with the contact 204 as shown by the arrow which indicates the direction of movement when heat is applied. The contacts 203 and 204 are in the energizing circuit of the pilot valve 15.

When the control apparatus is used in this manner, the operator first connects an alternating current source of power (not shown) to the conductors 27 and 28. The heater element 201 is now energized through a circuit which includes the right hand conductor 27, conductor 102, movable blade 82 and contact 86 of relay 44, conductor 101, and the heater element 201 to the conductor 28. After a predetermined length of time the bimetal 202 causes the contact 203 to engage contact 204. The pilot valve 15 is then energized through a circuit which includes the right hand conductor 27, conductor 210, contacts 204 and 203 of the thermal time delay switch 200, conductor 211, pilot valve 15, and conductor 103 to the conductor 28. The pilot burner 14 is now supplied with fuel through the conduit 13 and the operator manually ignites the pilot burner 14.

As before mentioned, when the thermostat 20, shown in Figure 1, moves from one operating position to the other the control apparatus goes through a component checking sequence in which the operation of the electronic flame detector 53 is checked. The apparatus incorporating the modification shown in Figure 2 now operates on component failure to deenergize the heater element 201 since, as before mentioned, the movable blade 82 opens its circuit to the contact 86 of relay

6

44 when relay 44 remains deenergized in response to the faulty operation of the electronic flame detector 53. After a predetermined length of time the bimetal 202 will have cooled sufficiently to cause the contact 203 to break its engagement with contact 204. The pilot valve 15 is thereby deenergized. In this manner, the control apparatus causes the flame in the pilot burner 14 to be extinguished when the electronic flame detector 53 operates in a faulty manner.

If at some time the pilot flame should fail, the electronic flame detector 53 will deenergize the relay 54 and this causes the safety switch heater 43 to be energized as before mentioned. After a predetermined length of time the contacts of the safety switch 46 open their circuit and the relay 44 will be deenergized. This therefore deenergizes the heater element 201 and after a predetermined length of time the bimetal 202 will cool sufficiently to cause the contacts 203 and 204 to open circuit and the pilot valve 15 will be deenergized.

In the case of either component failure or failure of the pilot flame, the pilot burner 14 must be reignited manually. When the reset button 39 of the safety switch 46 is depressed so that the safety switch contacts 47 and 48 are reset, the heater element 201 will be again energized and after a predetermined length of time, the contacts 203 and 204 will complete the energizing circuit for the pilot valve 15. However, if the pilot flame is not ignited manually the electronic flame detector 53 will indicate the absence of flame and the safety switch heater 43 will remain energized and the safety switch 46 will again cause the relay 44 and the pilot valve 15 to be deenergized as before mentioned.

It may therefore be seen that I have provided a burner control apparatus for use with a burner having a standing pilot which will maintain the apparatus inoperative upon failure of the flame detection device to operate properly and also I have provided an apparatus which will supervise the pilot flame at all times other than immediately before and after operation of the main burner.

Although I have shown my invention in connection with a particular type of burner control, it will be obvious to those skilled in the art that my invention could be applied to any type of control apparatus to be associated with a burner having a standing pilot. Therefore, I intend to be limited solely by the scope of the appended claims in which I claim as my invention:

1. A control apparatus for use with a main fuel burner, a pilot burner, a valve for the pilot burner, ignition means for the pilot burner, and means indicative of the need for main fuel burner operation, comprising: safety cutout means including a time delayed actuator, said safety cutout means being connected to render the control apparatus inoperative upon a predetermined time period of energization of said actuator, electrically operated flame detecting means arranged to detect the presence of a flame at the pilot burner, first relay means including an electrical operator, a circuit adapted to be controlled by the means indicative of a need for main burner operation and including the operator of said first relay means, said first relay means assuming a first or a second condition of operation in accordance with the demand or no demand for burner operation, means including circuit means controlled by said first relay means in said first condition and adapted to energize the main fuel burner, means including circuit means controlled by said first relay means adapted to energize the pilot valve and said flame detecting means when said first relay means is in said first or second condition of operation and to open said energizing circuit and thereby deenergize the pilot valve and said flame detecting means when said first relay means is changing from one condition to the other, second relay means having an electrical operator controlled by said flame detecting means, means including said second relay means controlling a circuit adapted to be connected to the ignition means to deenergize the ignition means when pilot flame is detected and to energize the ignition means when pilot flame is not detected, and component checking circuit means controlled by said first and second relay means for energizing the actuator of said cutout means when said first relay means has changed from one condition of operation to the other and said second relay means has not been affected by the resulting absence of flame at the pilot burner.

2. In a burner control for use with a main fuel burner having a pilot burner normally supporting a standing pilot flame, comprising: means responsive to the need for operation of the main burner, main burner energizing circuit means controlled by said means responsive to the need for operation of the main burner and adapted to energize the main burner on such a need, relay means having an electrically energizable operator, energizing circuit means for the operator of said relay means controlled by said means responsive to the need for operation of the main burner, an electrically operable flame detection device adapted to be arranged to normally detect flame at the pilot burner only when said flame detection device is operative, means including means controlled by said relay means to temporarily render said flame detection device inoperative and thereby render said flame detection device unable to detect a pilot flame upon a need for operation of the main burner, and means controlled by said flame detection device arranged to render the burner control inoperative upon failure of said flame detection device to respond to its being rendered temporarily inoperative.

3. In a control apparatus for a main fuel burner having a normally operating pilot burner and a thermostat responsive to the need for operation of the main fuel burner, comprising: a first relay having an electrically energizable actuator and switch means controlled thereby, an energizing circuit for said actuator adapted to be controlled by the thermostat, said first relay switch means having a first portion which is in a first or a second circuit closing position when said actuator is energized or deenergized and having a second portion which is in circuit closing position only when said actuator is energized, a second relay having an electrically energizable actuator and switch means controlled thereby, a normally energized control circuit for energizing the actuator of said second relay and controlled by said first portion of said first relay switch means, said actuator of said second relay being energized when said first portion of first relay switch means is in said first or second position but being deenergized as said first portion of first relay switch means moves from one position to the other; an electrically operable flame detection device adapted to be arranged to detect the presence of flame at the pilot burner when said flame detection device is operative, a third relay having an actuator controlled by said flame detection device and having switch means, means controlled by said second relay switch means and connected to said flame detection device to render said flame detection device inoperative and thereby cause deenergization of said third relay as said second relay is deenergized, means connecting said third relay switch means in said control circuit to prevent re-energization of said second relay when said flame detection device fails to cause said third relay to become deenergized in response to said first portion of said first relay switch means moving from one position to the other, and an energizing circuit for the main fuel burner controlled by said second relay switch means when energized and by said second portion of first relay switch means when said first relay is energized.

4. In apparatus including a sensing device responsive to a condition, which apparatus is designed to prevent operation of a condition changing means if the sensing device is not effective; a condition changing means, a controller for sensing the need or no need for operation of the condition changing means and having a first and a second condition of operation corresponding thereto, circuit means controlled by said controller and adapted to control the condition changing means, safety cutout means having an electrically energizable actuator and having means connected in controlling relation to the condition changing means, an electrically energizable condition sensing device adapted when operative to sense the presence or absence of a normally existing safety condition which should exist before the condition changing means is placed in operation, further means controlled by said controller, a control circuit for said condition sensing device controlled by said further means and effective to render said condition sensing device operative when said controller is in one condition of operation or the other and render said condition sensing device inoperative as said controller changes from one condition of operation to the other, control means hav-

ing an electrically operable actuator controlled by said condition sensing device, said control means having a first condition of operation when said safety condition is absent or when said sensing device is inoperative and having a second condition of operation when said sensing device is operative and said safety condition is present, and energizing circuit means for the actuator of said cutout means controlled by said control means in said second condition of operation to render said safety cutout means operative to prevent operation of said condition changing means when said control means fails to assure said first condition of operation as said controller changes from one condition of operation to the other.

5. In apparatus including a checking means responsive to a condition, which apparatus is designed to prevent continued operation of a first control circuit if the checking means is not effective; a first control circuit normally energized, a condition responsive device responsive to a first controlling condition and having two conditions of operation, switching means having an electrically operable actuator controlled by said condition responsive device, means controlled by said switching means adapted to place a condition changing device in operation upon said condition responsive device changing from a first condition to a second condition of operation and upon the continued energization of said first control circuit, means connecting said switching means in controlling relation to said first control circuit to momentarily deenergize said first control circuit when said condition responsive device changes from one condition of operation to the other, a first relay having an electrically operable actuator connected in said first control circuit to be deenergized when said first control circuit is deenergized, switches controlled by said first relay, a checking means effective when operable to check the presence or absence of a second normally existing safety condition which should exist before said condition changing device is placed in operation, said checking means having an element assuming a first position either when said second condition is absent or when said checking means is inoperative and movable to a second position when said checking means is operative and said second condition is present, means including a second control circuit for controlling the operability of said checking means and rendering the latter inoperative when said circuit is deenergized, means including a switch of said first relay for controlling said second control circuit to normally deenergize said second control circuit when said first relay is deenergized, thus rendering said checking means inoperative, and means controlled by said checking means to prevent re-energization of said first control circuit if said element of said checking means fails to move from said second position to said first position when said first relay is momentarily deenergized as said condition responsive device changes from one condition of operation to the other.

6. A control apparatus for a fuel burner having a standing pilot, comprising: temperature responsive switching means responsive to the need for operation of the fuel burner, a first relay having an electrical actuator and a switch controlled thereby, means connecting said temperature responsive means in controlling relation to the actuator of said first relay; a second relay including an electrical actuator and a switch controlled thereby, a control circuit including the actuator of said second relay and said switch of said first relay, said switch of said first relay maintaining said control circuit and thereby said second relay actuator energized when said first relay switch is in its energized or deenergized position and deenergizing said control circuit and thereby said second relay actuator when said first relay switch is moving from one position to the other; a third relay having an electrical actuator and a switch controlled thereby, electrically operable flame responsive means normally operative to respond to the presence of the standing pilot flame and controlling the energization of the electrical actuator of said third relay, means controlled by said switch of said second relay for controlling the operativeness of said flame responsive means; said last named means rendering said flame responsive means inoperative when said second relay is deenergized in response to said switch of said first relay moving from one position to the other, thereby deenergizing said third relay; and means connecting said switch of said third relay to maintain said

control circuit open circuited when said third relay remains in energized position during the period in which said third relay is normally deenergized when said second relay is deenergized in response to said switch of said first relay moving from one position to the other.

7. Control apparatus for a main fuel burner having a normally continually operating pilot burner unit comprising; a first relay having an actuator and switch means controlled thereby and having an energized and a deenergized position, means responsive to a demand for operation of the main fuel burner for energizing said actuator upon such a need, means controlled by said first relay switch means adapted to energize the pilot burner unit when said switch means is at one or the other of said positions and to deenergize the pilot burner unit when said switch means is in changing from one position to the other, means controlled by said first relay switch means adapted to energize the main fuel burner only when said switch means is at said energized position; flame detecting means for detecting flame at the pilot burner unit, a second relay having switch means and an actuator controlled by said flame detecting means in accordance with the presence or absence of flame at the pilot burner unit; safety cutout means having an electrically energizable actuator and switching means, means connecting said safety cutout switching means in controlling relation to said first relay actuator; means controlled by said second relay switch means to energize the actuator of said safety cutout means upon failure to re-establish flame at the pilot burner unit upon operation of said first relay switch means from one position to the other, and further means controlled by said second relay switch means to energize the actuator of said safety cutout means upon failure of said flame detecting means to respond to the absence of flame at the pilot burner unit when said first relay switch means changes from one position to the other.

8. A control apparatus for use with a main fuel burner and a pilot burner having a valve therefor, comprising: condition responsive means having two conditions of operation in response to a need or no need for operation of the main fuel burner, energizing circuit means for the fuel burner including means controlled by said condition responsive means, first control means having an electrically energizable actuator controlled by said condition responsive means, a first control circuit controlled by said first control means, said first control circuit being nor-

mally energized when the condition responsive device is in one condition of operation or the other and deenergized when the condition responsive device changes from one condition of operation to the other, second control means having an electrically energizable actuator, means connecting said actuator of said second control means in said first control circuit to be energized thereby, time delayed control means having an electrically energizable actuator, an energizing circuit for the actuator of said time delayed control means controlled by said second control means, said energizing circuit being energized or deenergized as said first control circuit is energized or deenergized, a circuit controlled by said time delayed control means adapted to be connected to the pilot valve, said time delayed control means providing a time delay such that the pilot valve normally remains energized when the condition responsive means changes from one condition of operation to the other, an electrically operated flame detector normally responsive to flame at the pilot burner when said flame detector is operative, a second control circuit including means controlled by said second control means to render said flame detector operative or inoperative as said first control circuit is energized or deenergized, a cutout device having an electrically energizable actuator and having means arranged in over-all control of said first control circuit, and circuit means arranged to energize the actuator of said cutout device when said flame detector continues to respond to flame at the pilot burner after said first control circuit has been deenergized in response to the condition responsive means changing from one condition of operation to the other.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
2,081,091	Kuempel -----	May 18, 1937
2,084,880	Wotring -----	June 22, 1937
2,170,497	Gille -----	Aug. 22, 1939
2,299,501	Schneider -----	Oct. 20, 1942
2,484,008	Aubert -----	Oct. 11, 1949
2,537,293	Peterson -----	Jan. 9, 1951
2,610,677	Lange -----	Sept. 16, 1952
2,626,657	Wilson -----	Jan. 27, 1953