

March 17, 1959

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2,877,835

CONTROL APPARATUS

Filed April 12, 1957

2 Sheets-Sheet 1

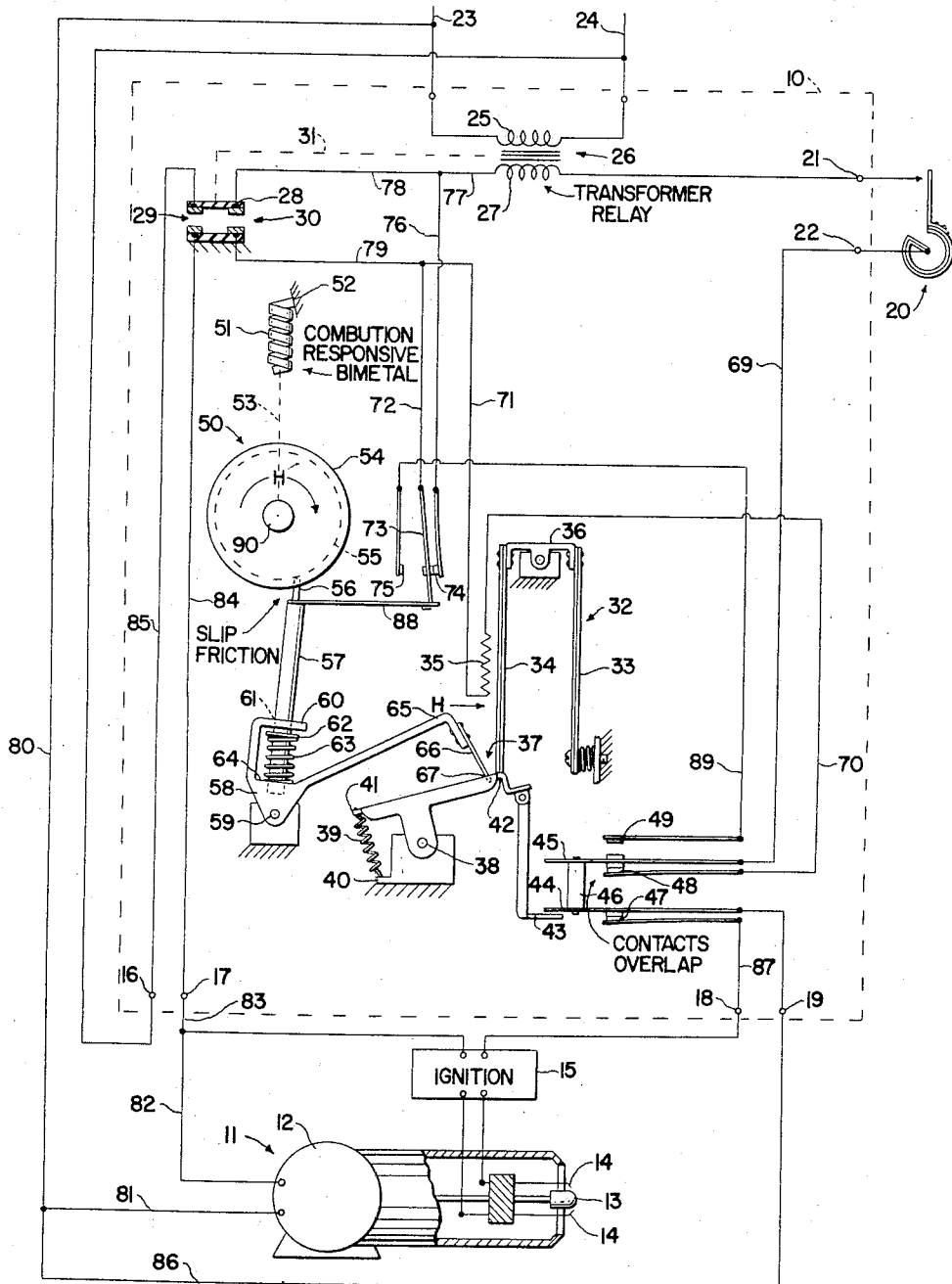


FIG. 1

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FIG. 3

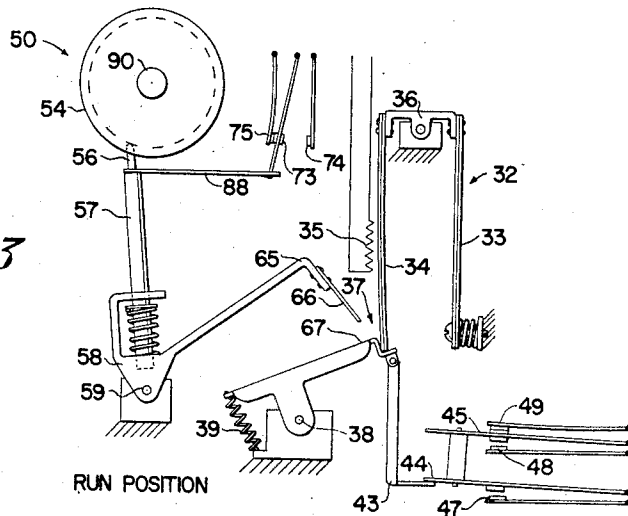


FIG. 4

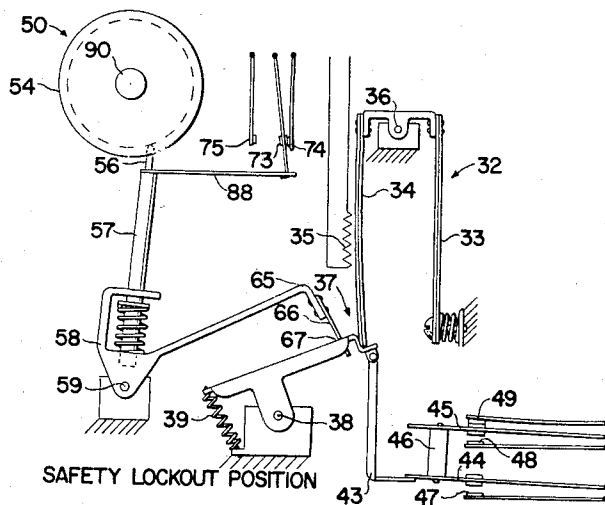
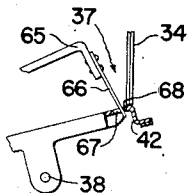


FIG. 2



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2,877,835

CONTROL APPARATUS

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5 Claims. (Cl. 158—28)

The present invention is concerned with an improved control apparatus and more specifically with an improved burner control apparatus.

Present day requirements necessitate that an acceptable burner control device provide safety switch action such that the burner is turned off in the event that combustion is not established at the burner. This is accomplished by inter-relating a flame detecting means and a timing means to provide a given trial period during which flame may be established. In the event that flame is not established at the end of this trial period, the safety switch opens to de-energize the burner. It is also desirable to provide intermittent ignition, with an ignition means timed by a timer to provide a trial ignition period.

It is an object of the present invention to provide an improved burner control apparatus having a combined safety switch mechanism and ignition timing mechanism so inter-related both electrically and mechanically with a flame detection mechanism that safe operation of the burner is accomplished.

It is a further object of the present invention to provide an improved burner control apparatus having a bimetal timer which is latched in a first position by means of a movable latch, the bimetal timer moving to a hot position to release the latch, and having further means controlled by the combustion responsive means which resets the latch to thereby reset the timer, this resetting action taking place only in the event that the combustion responsive means first senses the presence of combustion and later senses the absence of combustion.

More specifically, it is an object of the present invention to provide an improved burner control apparatus having a single bimetal timer which functions in one phase of its operation as a safety switch and in a second phase of its operation as an ignition timer, the electrical circuitry being such that in the event combustion is established, the operation of the timer turns off ignition and the timer is reset by the combustion responsive means upon the subsequent absence of combustion at the fuel burner, and in the event combustion is not established the operation of the timer actuates its switches to place the burner control in the safety lockout condition.

These and other objects of the present invention will be apparent to those skilled in the art upon reference to the following specification, claims, and drawings, of which

Figure 1 is a schematic representation of the electrical portion of the improved burner control apparatus along with a diagrammatic showing of the mechanical cooperation between the combustion responsive means and the timer.

Figure 2 is a view, partially in section, of the latch member, the bimetal member and the movable member positioned by the combustion responsive means, showing the position of these elements as shown in Figure 1.

Figure 3 is a showing of a portion of the apparatus in Figure 1 in the run position, and

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Figure 4 is a showing of a portion of the apparatus of Figure 1 in the safety lockout position.

Referring specifically to Figure 1, the improved burner control apparatus is shown within the broken line 10.

This burner control apparatus is connected to control the operation of a burner unit designated generally by the reference numeral 11 having a burner motor 12 which controls the flow of fuel to a fuel nozzle 13. The fuel at the nozzle 13 is ignited by a pair of ignition electrodes 14 connected to an ignition transformer 15. Electrical power is supplied to the burner unit 11 by means including terminals 16, 17, 18 and 19 of a burner control apparatus 10.

The need for operation of the burner unit 11 is sensed by means of a thermostat 20 which is connected to terminals 21 and 22 of the control apparatus 10 and functions to close its switch upon such a need.

Electrical power for both the burner control apparatus 10 and the burner unit 11 is received from power line conductors 23 and 24 which conductors are connected to a source of alternating voltage, not shown. The power supply conductors 23 and 24 are connected to the primary winding 25 of a transformer relay 26 having a secondary winding 27 and a movable armature 28 which controls the operation of switches 29 and 30. The secondary winding 27 of the transformer relay functions to both supply electrical energy to components within the burner control unit 10 and to control the position of armature 28. In other words, upon an electrical circuit being completed through the secondary winding 27, the armature 28 is moved from the position shown in Figure 1 to a position wherein the switches 29 and 30 of the relay are closed. This cooperation has been shown diagrammatically by means of the broken line connection designated by the reference numeral 31.

The reference numeral 32 designates a timing means. This timing means is in the form of a bimetal timer having an ambient temperature compensating bimetal 33 and an active bimetal 34. A timer actuator, in the form of a heater 35, is closely associated with the active bimetal 34 and causes the lower end of this bimetal to move to the right when the heater is energized. The movement of the lower end of the active bimetal 34 has been indicated in Figure 1 by provision of an arrow and the letter H.

The lower end of compensating bimetal 33 is relatively fixed in position while its upper end is mounted on one side of the pivot of a pivoted yoke 36. The upper end of the active bimetal 34 is mounted on this yoke 36 on the other side of the pivot from member 33.

The reference numeral 37 designates generally a movable operating member, or a latch member. Member 37 is pivoted at pivot 38 and is biased for counter-clockwise rotation about this pivot by means of a spring 39 having one end fixed in position at 40 and having the other end connected to member 37 at 41.

Member 37 is also provided with a knee portion 42 which engages the lower end of the active bimetal 34 when the bimetal 34 is in its cold position, as shown in Figure 1. The member 37 has an extension portion 43 which cooperates with switch blades 44 and 45 to control the operation thereof. Switch blades 44 and 45 are biased, by means not shown, in a downward direction and are separated by an insulating spacer 46. In the position shown, that is the first position of member 37, the switch blade 44 engages contact 47, and switch blade 45 engages contact 48 and is disengaged from contact 49. As will be described, upon energization of heater 35, which in turn causes active bimetal 34 to move to the right, member 37 rotates counter-clockwise about its pivot 38 and causes switch blades 44 and 45 to move in an upward

direction, switch blades 44 and 45 thereby disengaging contacts 47 and 48 respectively, and switch blade 45 engaging contact 49.

As will be apparent, the operation of the switches including switch blade 45 and contacts 48 and 49 must have an overlapping action. That is, switch blade 45 is so constructed and arranged with respect to contacts 48 and 49 that it engages one of the contacts before disengaging the other as the switch blade 45 moves in an upward or a downward direction.

The combustion responsive means of the burner control apparatus 10 is designated generally by the reference numeral 50. This combustion responsive means includes a spiral shaped bimetal operator 51 which has one end thereof fixed in position at 52 and has the other end thereof connected by means of the shaft designated by the broken line 53 to the center of a wheel 54. The operation of the combustion responsive means thus far described is such that the spiral shaped bimetal 51 causes rotation of the wheel 54 in a clockwise direction upon a temperature rise, as shown by the arrow in Figure 1, and likewise causes rotation of the wheel 54 in a counterclockwise direction upon a temperature fall. The wheel 54 is provided with a recessed portion, or valley, around the circumference thereof. The bottom of this recessed portion is shown in Figure 1 by means of the broken line designated by the reference numeral 55.

This recessed portion of the wheel 54 is engaged in a slip friction manner by a finger-like extension 56 of a spring biased member or rod 57. This rod 57 is carried in a harness 58 which is pivoted at 59. The harness 58 is provided with an upper extension 60, which extension is provided with a hole designated by the reference numeral 61. This hole receives the rod 57 and once the rod 57 is placed in position, a pin, or lock washer of some sort is placed in position as indicated by the reference numeral 62. The washer 62 provides an upper abutment for a coil spring 63 and the surface of the member 58 designated by the reference numeral 64 provides the lower abutment. In this manner, the rod 57 may move through the holes provided in the harness 58 under the bias of the spring 63 and limited by 62—61.

Member 88 couples the rod 57 to a combustion responsive switch means including switch blades 73, 74, and 75. In the absence of combustion, switch 73—74 is closed while switch 73—75 is opened. Upon combustion being established, switch 73—90 opens and switch 73—75 closes.

Explaining the operation of the wheel 54 and the manner in which it cooperates with the spring biased rod 57, upon the combustion responsive bimetal 51 being subjected to a temperature rise, wheel 54 moves in a clockwise direction. Due to the friction between the portions 56 of spring biased rod 57 and the groove provided in the circumference of wheel 54, the harness 58 pivots about pivot 59, moving from right to left in Figure 1. This movement continues until the rod 57 has moved substantially up to the left of the center of rotation of the wheel 54, see Figure 3. Upon a subsequent temperature fall as experienced by bimetal 51, wheel 54 moves in a counterclockwise direction and thereby causes the spring biased rod 57 and its harness 58 to move about pivot 59 in a clockwise direction that is to return to the position shown in Figure 1. This movement continues until the extension 56 of spring biased rod 57 is substantially to the right of the center of the rotation of wheel 54. In this position, member 88 has followed movement of rod 57 and thereby opens switch 73—75 and closes switch 73—74.

The support harness 58 of spring biased rod 57 is provided with an extending arm 65. This extending arm has a spring blade 66 fixed to the end thereof. As can be seen more clearly in Figure 2, this spring 66 extends through an opening 67 provided in the latching member 37.

In Figure 2, portions of the spring blade 66, the member 65, the bimetal 34, and the latch 37 have been shown in section. From this view it can be seen that with the elements of the burner control apparatus 10 in the position shown in Figure 1, the spring blade 66 does not engage the latch member 37.

However, upon operation of the timer 32 to cause the bimetal 34 to move to the right and thereby release the latch 37, and upon the combustion responsive bimetal 51 experiencing a temperature rise which is followed by a temperature fall, the spring blade 66 is operative to engage the upper right hand surface of the opening 67, this surface designated by the reference numeral 68, and as movement of the spring biased rod 57 and its harness 58 continues in a clockwise direction the latch 37 is caused to rotate in a clockwise direction against the bias of spring 39 to move to a position wherein the bimetal 34 may once again assume its cold position, that is the position shown in Figures 1 and 2.

Considering this phase of the operation of the device in greater detail, and with reference to Figure 2, upon wheel 54 rotating in a counterclockwise direction, spring 66 first engages latch member 37 at the surface 68. As wheel 54 continues to rotate, spring 66 is bowed, the lower end bowing concave upward to the right. This bowing occurs due to the increasing force which is building up in spring 39 as latch member 37 rotates about its pivot 38. When latch member 37 has rotated a sufficient amount to allow bimetal 34 to again assume its cold position, the force exerted by spring 39 is sufficiently great to cause spring 66 to bow to the extent that spring 66 snaps through the opening 67 provided in latch member 37.

The elements making up the combustion responsive means 50 and the timing means 32 are so proportioned and arranged so that upon wheel 54 first rotating in a clockwise direction and then returning by rotation in a counterclockwise direction, the spring 66 first engages latch member 37 to reset switch 45—48 to the position shown in Fig. 1. The spring 66 then snaps through the opening 67 provided in latch member 37 and latch member 37 remains in position due to bimetal 34, as shown in Figures 1 and 2. The last event in point of time is the resetting of switch 73—74 to the position shown in Figure 1. Such a construction insures that the burner unit 11 may not be re-energized until spring 66 has moved to the position shown in Figure 2 wherein the latch member 37 is under the sole control of bimetal 34, to thereby insure that the device is capable of assuming the safety lockout position as shown in Figure 2.

Operation

The operation of the improved burner control apparatus 10 will now be described. The apparatus of Figure 1 is shown in its standby condition, that is electrical power is supplied to the power line conductors 23 and 24, the circuit for the secondary winding 27 of transformer relay 26 is open, the switch of thermostat 20 is open indicating there is no need for the operation of the burner unit 11, the bimetal timer 32 is in its cold position with heater 35 de-energized, and the combustion responsive means 50 is sensing the absence of flame at the burner unit 11.

Assume now that the thermostat 20 closes its switch to indicate the need for operation of the burner unit 11. This completes an energizing circuit for the secondary winding 27 of transformer relay 26. This energizing circuit can be traced from the right hand terminal of secondary winding 27 through thermostat 20, conductor 69, switch blade 45, and contact 48, conductor 70, heater 35, conductors 71 and 72, switch blade 73 and contact 74, and conductors 76 and 77 to the left hand terminal of secondary winding 27. From the above traced circuit it can be seen that the secondary winding 27 of the transformer relay cannot be initially energized unless the start contacts 45—48 are closed, unless there is electrical

continuity in the heater 35, and unless the combustion responsive means switch 73—74 is in the position indicating the absence of flame at the burner unit 11.

Energization of the secondary winding 27 causes the armature 28 of transformer relay 26 to move in a downward direction thereby closing switches 29 and 30. The closing of switch 30 completes an intermediate energizing circuit which shunts the switch 73—74 controlled by combustion responsive means 50. This shunt circuit can be seen by tracing a circuit from contact 74 through conductors 76 and 78, switch 30, and conductors 79 and 72 to switch blade 73. Therefore, the intermediate energizing circuit for secondary winding 27 is not dependent upon the combustion responsive switch means 73—74 being in its closed condition.

The closing of switch 29 by transformer relay 26 completes an energizing circuit for both the burner motor 12 and the ignition transformer 15 of the burner unit 11. The energizing circuit for motor 12 can be traced from power line conductor 23 through conductors 80 and 81 to the burner motor 12 and then by means of conductors 82, 83 and 84, switch 29 and conductor 85 to the other power line conductor 24. The energizing circuit for the ignition transformer 15 includes in part conductor 86, switch blade 44 and contact 47, and conductor 87. From these circuits it can be seen that energization of the burner motor 12 depends solely upon the switch 29 of the transformer relay being closed. However, energization of the ignition transformer 15 not only depends upon switch 29 being closed but also upon the switch 44—47 being closed.

A flame is now normally established at the burner unit 11. The heat from this flame causes the combustion responsive bimetal 51 to experience a temperature rise. This in turn causes wheel 54 to move in a clockwise direction. As has been above described, this causes the spring biased member 57 and its harness 58 to rotate in a counter-clockwise direction about the pivot 59, thereby causing switch 73—74 to open and switch 73—75 to close through movement of the member 88.

As has been described, since the relay operated switch 30 is now in the closed condition, the energizing circuit for the secondary winding 27 no longer depends upon switch 73—74 being in the closed condition. The closing of the switch 73—75 completes a portion of a holding circuit for the secondary winding 27. The operation of this holding circuit will now be more completely described.

It will be remembered that the initial energization of the secondary winding 27 of the transformer relay included the actuating heater 35 of the bimetal timer 32. Therefore, the active bimetal 34 immediately starts to warp and causes its lower end to move to the right. Referring now to Figure 3, a portion of the burner control apparatus of Figure 1 is shown with the combustion responsive means 50 in the position sensing the presence of flame at the burner unit 10 and with the timer 32 in its actuated position. In this position the wheel 54 has rotated in a clockwise direction and has caused rotation of the spring biased rod 57 and its harness 58 in a counter-clockwise direction about the pivot 59. This causes the switch 73—74 to assume its open condition, and the switch 73—75 to assume its closed condition. This has also caused the spring blade 66 to move up and out of the opening 67 provided in the latch member 37. The active bimetal 34 of the bimetal timer 32 has been heated to an extent by the heater 35 such that it has released the latch member 37 and this latch member has rotated in a counter-clockwise direction about pivot 38 to thereby cause switch 44—47 to assume an open circuit condition and has caused switch 45—49 to assume a closed circuit condition. Referring again to Figure 1, it will be remembered that the operation of switches 45—48 and 45—49 is an overlapping action. In other words, the switch 45—49 is first closed before switch

45—48 opens. This completes the above mentioned holding circuit for the secondary winding 27 of the transformer relay. This holding circuit can be traced from the right hand terminal of secondary winding 27 through thermostat 20, conductor 69, switch blade 45 and contact 49, conductor 89, contact 75 and switch blade 73, conductors 72 and 79, switch 30, and conductors 78 and 77 to the left hand terminal of secondary 27.

A very short period of time thereafter, the switch 45—48 opens. This is the starting interlock switch of the timer 32 and this switch opens the initial energizing circuit of the secondary winding 27, previously traced. Since the running circuit, above described, is now complete the secondary winding 27 remains energized and electrical power is supplied to the burner unit 11. However, this electrical power is supplied only to the motor 12 since the ignition transformer 15 is now de-energized. As the bimetal 34 of timer 32 moved to the right, the latch member 37 was released and moved in an upward direction, such as shown in Figure 3. This caused spring blade 44 to disengage contact 47 and thereby open the energizing circuit for ignition transformer 15.

Assume now that there is no longer a need for operation of the burner unit 11; this is evidenced by thermostat 20 opening its switch. This in turn deenergizes the secondary winding 27 of transformer relay 26 and thereupon causes the switches 29 and 30 to assume their open condition, such as shown in Figure 1. The opening of switch 29 de-energizes burner motor 12 and causes the flame at the burner unit 11 to be extinguished. Considering the burner control apparatus at this instant, the relay operated switches 29 and 30 are open, the flame responsive switch 73—74 is open and the switch 73—75 is closed, the timer operated switches 44—47 and 45—48 are open, and the timer operated switch 45—49 is closed. Therefore, should there be an immediate recall for operation of the burner unit 11, such as evidenced by closing of the switch of thermostat 20, the secondary winding 27 of the transformer relay cannot be energized since both the initial energizing circuit and the running circuit are open. The initial energizing circuit is open at both the start switch 45—48 of timer 32 and at the switch 73—74 controlled by combustion responsive means 50. The running circuit is open at the relay operated switch 30. Therefore not only must the bimetal 51 of the combustion responsive means 50 return to its cold position to close the switch 73—74 but also, the latch member 37 must be returned to its latched position as shown in Figure 1, this being accomplished by movement of spring blade 66 as the combustion responsive means wheel 54 rotates in a counter-clockwise direction and thereby causes clockwise rotation of spring bias rod 57 and its harness 58.

Upon rod 57 returning to its cold position, the spring 66 first engages latch member 37 to close starting switch 45—48. The spring 66 then passes through the opening 67 in latch member 37 so that the latch member is now maintained in position by bimetal 34. Then combustion switch 73—74 closes. The secondary winding 27 of transformer relay 26 may now be energized in the event that the switch of thermostat 20 is closed at this time.

Assume now that there has been such an additional need for operation of the burner unit 11. As above described, this causes transformer relay 26 to be energized, motor 12 and ignition transformer 15 to be energized, and heater 35 of timer 32 to be energized. Further assume, that, due to malfunction of the burner unit 11, flame has not established at the burner unit. In this event, the combustion responsive means 50 remains in the condition shown in Figure 1 and the burner control apparatus 10 assumes the safety lockout position as shown in Figure 4.

Referring to Figure 4, this figure shows the bimetal timer 32 in its actuated condition. In other words, the heater 35 has been energized for a sufficient time period to cause the bimetal 34 to move to the right and release

latch member 37. Latch member 37 thereby rotates in a counter-clockwise direction about the pivot 38 and under the bias of spring 39. This movement of member 37 causes the starting switch 45—48 to be opened and causes the switch 45—49 to be closed. However, since the combustion responsive means 50 has not detected the presence of flame, the combustion responsive switch 73—75 remains in its open position and a running circuit cannot be established for the secondary winding 27 of the transformer relay. Therefore, the secondary winding 27 is de-energized. This in turn de-energizes the heater 35 of bimetal timer 32. After a time period, the bimetal 34 cools but cannot return to its cold position due to latching member 37, shown in Figure 4, engaging the lower end of bimetal 34 to prevent movement to the left.

The apparatus is now in its safety lockout position in which the thermostat 20 no longer controls operation of the burner unit 11. In order to reset the burner control apparatus, a raised portion or reset knob 90 is provided to cause rotation of the wheel 54. It will be remembered that the combustion responsive bimetal 51 has not experienced a temperature rise due to the lack of the establishment of flame at the burner unit 11. However, by rotation of the knob 90 in the clockwise direction, thereby simulating the temperature rise at the bimetal 51, the spring biased rod 57 and its harness 58 are moved in a counter-clockwise direction about pivot 59. This causes the spring member 66 to move to the position shown in Figure 3. The operator now releases the knob 90 and the wheel 54 rotates in a counter-clockwise direction under bias of the bimetal 51 which has been stressed by manually twisting it in the clockwise direction as above described. This causes the spring blade 66 to move in a downward direction and to engage the surface 68 of the latch member 37, which surface can be seen in Figure 2. This causes the latch member 37 to move in a downward direction, rotating clockwise about pivot 38 and thereby resets the timer 32 to its cold position as shown in Figure 1. Therefore, the burner control apparatus has been manually reset from the safety lockout position in Figure 4 to the standby position of Figure 1 and upon a subsequent call for operation of the burner unit 11 the burner unit 11 is again controlled in the normal manner as above described.

From the above description it can be seen that we have provided an improved burner control apparatus providing ignition timing and safety switch timing with a minimum number of components and therefore the resultant minimum cost.

We claim as our invention:

1. Burner control apparatus for use with a fuel burner comprising: a temperature responsive element adapted to be positioned to be heated by flame at the fuel burner, a switch arranged to be controlled by said temperature responsive element to be actuated from an open to a closed condition upon flame being detected at the fuel burner, a movable member controlled by said temperature responsive element and movable from a first to a second position upon said temperature responsive element sensing the presence of flame at the fuel burner, said movable member moving from said second to said first position upon said flame detector subsequently sensing the absence of flame at the fuel burner, a timer having an electrically energizable actuator and a timer member movable thereby after a time period of energization of said timer actuator, a starting switch, said starting switch being normally in the closed condition, a latch member jointly controlled by said timer member and said movable member and arranged initially to maintain said starting switch in the closed condition and to latch said starting switch in open position after a predetermined time period of energization of said timer actuator, said movable member being arranged to control said latch member and thereby cause said starting switch to again assume its closed condition upon said movable member moving from said

second to said first position in response to said temperature responsive element first sensing the flame at the fuel burner and then subsequently sensing the absence of flame at the fuel burner, a relay having an electrically energizable actuator and a switch controlled thereby, energizing circuit means for said relay actuator including terminals adapted to be connected to means responsive to the need for operation of the fuel burner and including said timer actuator and said starting switch, circuit means including terminals adapted to be connected to the fuel burner controlled by said relay switch and adapted to energize said fuel burner upon said relay actuator being energized, and running circuit means for said relay actuator including said switch controlled by said temperature responsive element, said running circuit being completed upon said temperature responsive element detecting flame at the fuel burner.

2. Burner control apparatus for use with a fuel burner having means responsive to the need for operation of the fuel burner, comprising: a flame detector arranged to be located to sense the presence or absence of flame at the fuel burner, a normally open switch controlled by said flame detector and movable to a closed position upon a flame being detected at the fuel burner, a movable member controlled by said flame detector and movable from a first to a second position upon said flame detector detecting flame at the fuel burner, said movable member moving from said second to said first position upon said flame detector subsequently detecting the absence of flame at the fuel burner; a timer having an electrically energizable actuator and timer means movable thereby after a time period of energization of said timer actuator, a first normally closed switch, a second normally open switch, a latch member controlled jointly by said timer means and said flame-detector-controlled movable member and arranged to latch said first and second switches in the open and closed conditions respectively after a time period of energization of said timer actuator, said flame detector movable member being arranged to move said latch member as said movable member moves from said second to said first position to thereby cause said first and second switches to assume the closed and open positions respectively upon said flame detector detecting the absence of flame at the fuel burner subsequent to the detection of the presence of flame at the fuel burner; relay means having an electrically energizable actuator and a normally open switch controlled thereby, initial energizing circuit means for said relay actuator including terminals adapted to be connected to the means responsive to the need for operation of the fuel burner and including said first switch and said timer actuator, and a running energizing circuit for said relay actuator including said second switch and said flame detector switch.

3. Burner control apparatus for use with a fuel burner having ignition means and means responsive to the need for operation of the fuel burner, comprising: flame detecting means responsive to flame at the fuel burner unit, a first and a second switch controlled by said flame detecting means, said first switch being closed in the presence of flame and being open in the absence of flame and said second being closed in the absence of flame and open in the presence of flame, a movable member controlled by said flame detecting means and movable from a first to a second position in response to the establishment of flame at the fuel burner, said movable member being moved from said second to said first position in response to the subsequent absence of flame at the fuel burner; timer means having a movable member and an electrically energizable actuator therefor, said timer movable member being movable from a first to a second position after a predetermined time period of energization of said actuator; latch means arranged under the control of said flame detecting means movable member and said timer movable member, said latch means moving from a first to a second position upon said timer movable member mov-

ing from said first to said second position after a timer period of energization of said timer actuator, said flame detecting means movable member controlling said latch means to reset said latch means to its first position upon said flame detecting means movable member moving from its second to its first position; a first normally closed switch, a second normally open switch, and a third normally closed switch controlled by said latch means and moved from the normal condition when said latch means moves to said second position; a relay having an actuating winding and a switch controlled thereby, said relay switch moving to a circuit closing position upon energization of said relay winding, initial energizing circuit means for said relay winding including terminals adapted to be connected to the means responsive to the need for operation of the fuel burner and including said first normally closed switch, said timer actuator and said second flame detecting means switch, a holding energizing circuit for said relay winding including said second normally closed switch and said first flame detecting means switch, and energizing circuit means for the fuel burner including said relay switch and including an energizing circuit for the burner ignition means under the control of said third normally closed switch.

4. Burner control apparatus for use with a fuel burner having ignition means and means responsive to the need for operation of the fuel burner, comprising: flame sensing means in the form of a spiral bimetal element arranged to be positioned to be heated by flame at the fuel burner unit, a wheel fixed to said bimetal and arranged to be rotated in a first direction upon a flame being established at the fuel burner unit and to be rotated in an opposite direction upon the subsequent absence of flame at the fuel burner unit; a spring biased member positioned to engage the outer circumference of said wheel in a slip friction engagement, said spring biased member being pivoted such that said spring biased member moves from a first side of said wheel to a second side of said wheel upon flame being established at the fuel burner, said spring biased member subsequently returning to said first side upon the subsequent absence of flame at the fuel burner; a first and second switch controlled by said spring biased member, said first and second switches being opened and closed respectively when said spring biased member is on the first side of said wheel and being closed and opened respectively when said spring biased member is on the second side of said wheel; a timer having a bimetal operating member and an operating heater therefor, latching means including a movable member arranged to be held in a first position by said bimetal when said bimetal is in its cold condition, said bimetal moving to its hot position after a predetermined time period of energization of said heater and allowing said movable

member to move to a second position; switch means including a first, second and third switch controlled by said movable member, said first and third switches being closed when said movable member is in said first position and said second switch being closed when said movable member is in said second position; further means controlled by said spring biased member arranged to reset said movable member to said first position upon said spring biased member moving from said second to said first side of said wheel upon a flame being established at the fuel burner and subsequently becoming extinguished; a relay having an energizing winding, energizing circuit means for said relay winding including terminals adapted to be connected to the means responsive to the need for operation of the fuel burner unit and including the first switch controlled by said movable member, said bimetal heater, and the second switch controlled by said spring biased means; a first and second switch controlled by said relay, energizing circuit means for the fuel burner including the first of said relay switches to energize the fuel burner and to energize the fuel burner ignition means through said third switch controlled by said movable member; and a running circuit for said relay winding including the second switch controlled by said movable member, the first switch controlled by said spring biased means, and said second relay switch.

5. In combination, a spiral shaped bimetal element having one end rigidly fixed in position, a wheel having its center fixed to the other end of said bimetal element so that upon heating or cooling of said bimetal said wheel rotates about its center, a spring biased member being pivoted at one end thereof and positioned such that the other end thereof bears against the outer circumference of said wheel, said spring biased member thereby being caused to move about its pivot as said other end thereof follows movement of said wheel in accordance with the condition to which said bimetal is subjected, a timer having a bimetal and a heater fixed in close proximity thereto, a latch member arranged to engage an end of said bimetal, said bimetal restricting the movement of said latch member in the cold position and in the hot position releasing said latch member for movement thereof, a further member positioned by said spring biased member and cooperating with said latch member to reset said latch member to its latched position, the relatching being accomplished upon said spiral shaped bimetal element being subjected to a temperature rise and a subsequent temperature fall, and means controlled by said latch member.

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