Dec. 23, 1958 F. T. DEZIEL 2,865,444

CONTROL APPARATUS

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FIG. 1

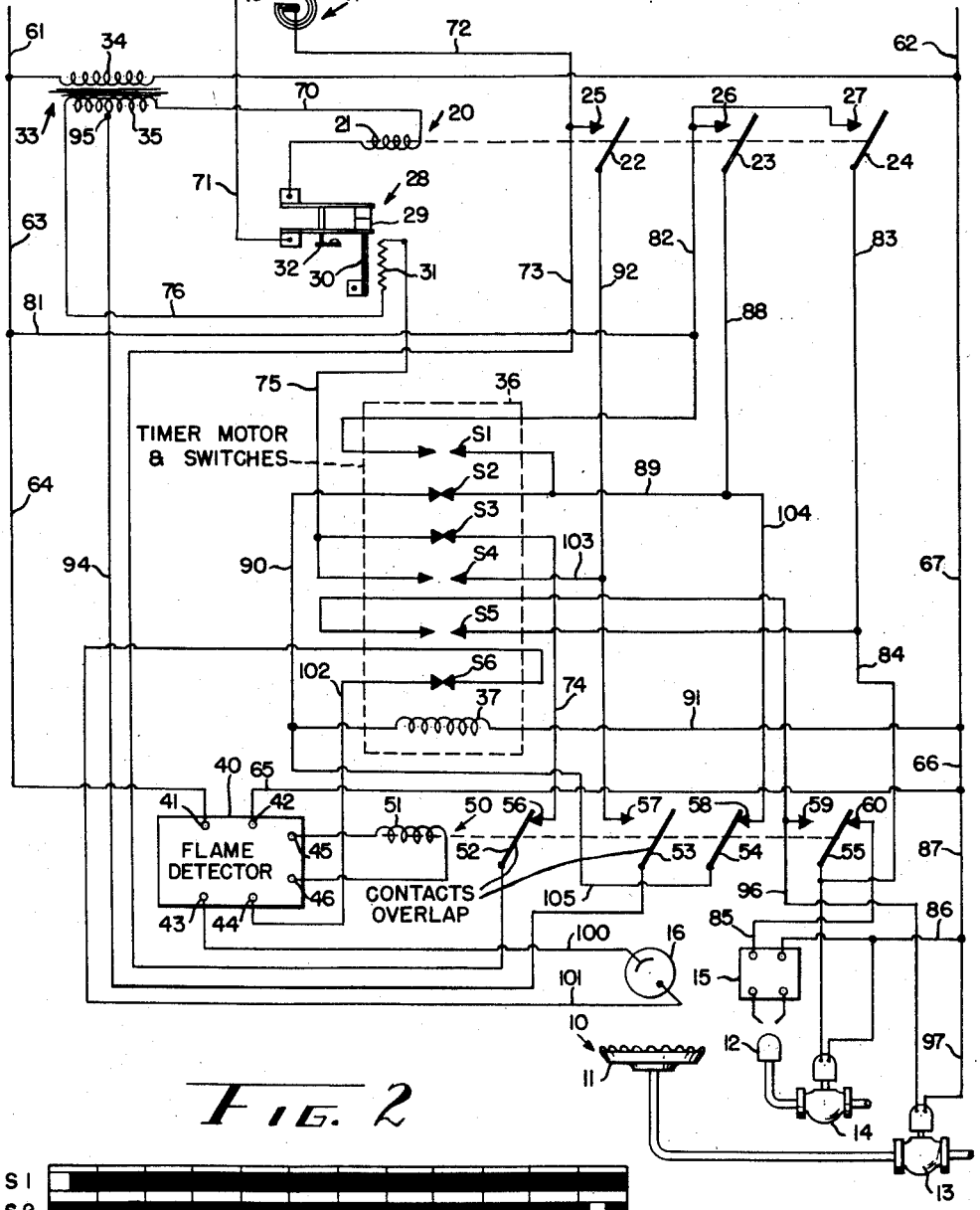

FIG. 2

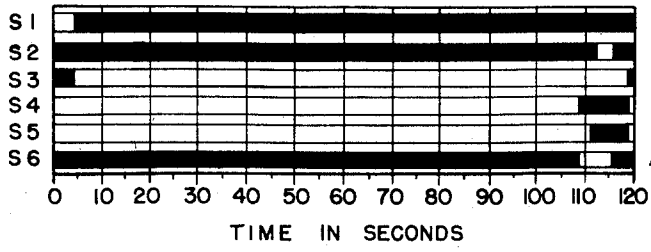

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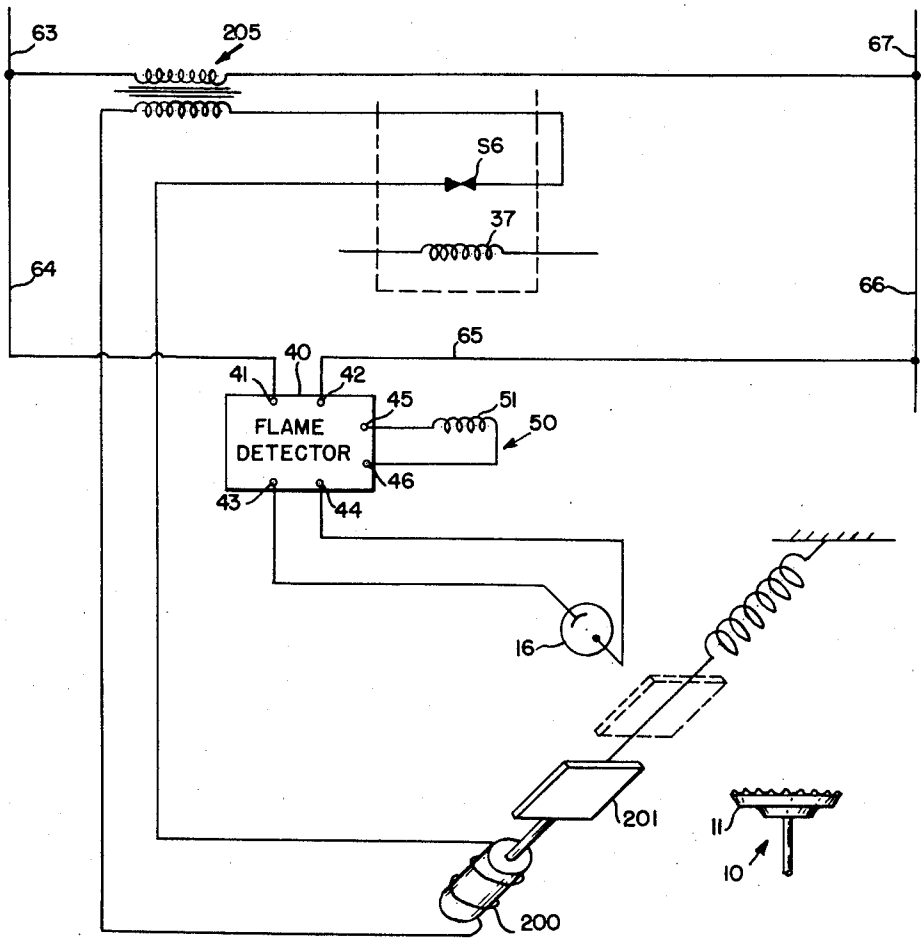
FIG. 3



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2,865,444

CONTROL APPARATUS

Fred T. Deziel, Bloomington, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application December 20, 1954, Serial No. 476,311

10 Claims. (Cl. 158—128)

The present invention is concerned with a control apparatus and more particularly with a fuel burner control apparatus wherein means are provided to periodically check the proper operation of a flame detecting means.

This invention is a continuation in part of the copending application of Fred T. Deziel, Serial No. 425,657, filed April 26, 1954 now abandoned.

In present day control systems the trend has been toward electronic flame detectors. This is particularly necessary in large burner installations where a very large amount of fuel is consumed per unit time since in this case it is very essential that a flame failure be detected in a very short time. Electronic flame detectors are capable of sensing the presence or absence of flame in a matter of only a few seconds.

However, electronic flame detectors sometimes fail due to deterioration of the electron discharge devices or due to changes in values of the circuit components. These failures may be either an unsafe or a safe type of failure. An unsafe type of failure is a failure wherein the electronic flame detector continues to sense the presence of flame when in fact the flame is not present at the burner. A safe failure is a failure wherein the electronic flame detector senses the absence of the flame at all times when in fact there may be a flame present at the burner.

Prior art burner control devices have provided means for actuating a safety switch upon a safe failure of the electronic flame detector and have also provided means for actuating the safety switch if an unsafe failure of electronic flame detector occurs during a standby condition when there is no need for operation of the burner unit being controlled.

The present invention is concerned with an improved control apparatus wherein a timer is provided to periodically check the ability of the flame detector to sense both the presence and absence of flame.

It is a further object of the present invention to provide a control apparatus wherein a timer is provided to control a plurality of switches in a predetermined reoccurring cycle to render the flame detector inoperative to detect the presence of flame once each cycle, with the timer cycling so long as there is a need for operation of the burner unit being controlled.

It is still a further object of the present invention to provide an improved burner control apparatus having a flame detector and a timing means connected to the flame detector to periodically simulate the absence of flame and having safety cutout means energized upon failure of the flame detector to respond to the simulation of the absence of flame.

These and further objects of the present invention will become apparent to those skilled in the art upon reference to the specification, claims, and drawings, of which:

Figure 1 is a schematic representation of the improved burner control apparatus,

Figure 2 is a graphic representation of the action of the timer switches, and

Figure 3 is a showing of a modification of a portion of Figure 1.

Referring now to Figure 1, the numeral **10** designates a burner unit having a main burner **11**, a pilot burner **12**, a main valve **13**, and a pilot valve **14**. The valves **13** and **14** control the flow of fuel to the burners **11** and **12** and allow fuel to flow to these burners upon energization of the valves. Associated with the pilot burner **12** is an ignition transformer **15** which upon energization thereof is arranged to provide a spark to ignite the fuel emitting from the pilot burner **12**.

A flame sensing element, or photocell, **16** is provided and arranged to sense or view the flame at either of the burners **11** or **12**. The flame sensing element **16** is connected to and becomes a part of the improved burner control apparatus to be described.

A thermostat **17** is provided and is responsive to the need for operation of the burner unit **10** to cause the blade **18** to engage contact **19** upon such a need. Thermostat **17** controls a main burner control relay or control means **20** having a winding **21**, movable switch blades **22**, **23**, and **24**, and stationary contacts **25**, **26**, and **27**. The deenergized position of relay **20** is shown and in this position the movable switch blades **23** and **24** are biased, by means not shown, to disengage stationary contacts **26** and **27** respectively.

Also connected in circuit with the winding **21** of relay **20** is a safety cutout device **28**. Safety cutout device includes the normally closed switch **29**, a bimetal actuator **30**, a bimetal heater **31**, and a reset actuator **32**. The operation of the safety cutout device **28** is such that upon heating of the bimetal **30** by a predetermined time period of energization of the heater **31** the bimetal is effective to warp to the right out from under the normally closed switch **29** and the switch opens. Upon cooling of bimetal **30**, the reset actuator **32** can be manually depressed to reset the safety cutout device to the condition shown in Figure 1.

The energizing voltage for relay **20** is supplied by a transformer **33** having a primary **34** and a tapped secondary **35**.

Shown within broken lines **36** is a program timer or electrical timing means. This timer may take a variety of forms and for example may be an electrical motor having a plurality of cams which control a plurality of switches, the switches being represented as S1 through S6. The motor is represented by a coil **37** and it is to be understood that energization of the coil **37** causes the switches S1 through S6 to be actuated through a cycle of operation shown in Figure 2.

Referring to Figure 2, each switch has a bar associated therewith and by means of the bar the closed position of the switch is shown. For example, in Figure 1 the switches are shown in the standby condition of the burner control, that is, the condition when the thermostat **17** is not calling for operation of the burner unit **10**. In this condition the switches S2, S3, and S6 are closed and this is shown in Figure 2 wherein at the zero time interval the bars associated with the switches S2, S3, and S6 show that these switches are closed. The operation of timer **36** will be explained in detail later.

The numeral **40** designates a flame detector or condition responsive means which may take one of many forms, for example such as shown in the Richard S. Feigal Patent 2,556,961. Flame detector **40** has power input terminals **41** and **42**, signal input terminals **43** and **44**, and output terminals **45** and **46**. Connected to the output terminals **45** and **46** is a flame relay **50** having a winding **51**, movable switch blades **52**, **53**, **54**, and **55**, and stationary contacts **56**, **57**, **58**, **59**, and **60**. In Figure 1, flame relay **50** is shown in a deenergized condition and in this condition the movable switch blades **52** and **54** are

biased by means not shown to engage stationary contacts 56 and 58 respectively, movable switch blade 53 is biased to disengage stationary contact 57, and movable switch blade 55 is biased to disengage stationary contact 59 and to engage stationary contact 60. Contacts 56 and 57 are overlapping. That is, switch blade 53 engages contact 57 before switch blade 52 disengages contact 56.

Power lines 61 and 62 are provided and are adapted to be connected to a source of alternating current power, not shown. With conductors 61 and 62 connected to an alternating current source of power the primary 34 of transformer 33 is energized. However, relay 20 is not energized at this time since thermostat 17 is not calling for operation of the burner unit 10. Also, timer 36 is not energized but flame detector 40 is energized. The energizing circuit for flame detector 40 can be traced from power line conductor 61 through conductor 63, conductor 64, flame detector 40, conductor 65, conductor 66, and conductor 67 to power line conductor 62.

This is the standby condition of the control apparatus wherein main relay 20 is deenergized, timer 36 is deenergized, flame detector 40 is energized, flame relay 50 is deenergized and the fuel valves 13 and 14 are deenergized.

If it is now assumed that thermostat 17 indicates that there is a need for operation of the burner unit 10, a circuit is completed from blade 18 to contact 19 of thermostat 17. An energizing circuit is now completed for winding 21 of relay 20. This energizing circuit can be traced from the right hand terminal of secondary 35 through conductor 70, winding 21, switch 29, conductor 71, thermostat 17, conductor 72, conductor 73, movable switch blade 52 and stationary contact 56 of flame relay 50, conductor 74, timer switch S3, conductor 75, heater 31, and conductor 76 to the left hand terminal of secondary 35. Certain conditions must exist for this initial energizing circuit to be completed. The flame relay 50 must be in the deenergized or no flame position, the timer 36 must be at the start position where switch S3 is closed, and the heater 31 of safety cutout device 28 must have electrical continuity. The timer switch S3 can therefore be characterized as a start switch. If any of these conditions do not exist, the main relay 20 cannot be energized.

Energization of main relay 20 causes movable switch blades 22, 23, and 24 to move into engagement with stationary contacts 25, 26, and 27 respectively. Movement of switch blade 22 to engage stationary contact 25 completes a portion of a holding energizing circuit for relay 20, to be later described and switch 22—25 can therefore be characterized as a holding switch.

Movement of switch blade 24 into engagement with stationary contact 27 completes an energizing circuit for ignition transformer 15 and for valve 14 associated with the pilot burner 12. This energizing circuit can be traced from power line conductor 61 through conductor 63, conductor 81, conductor 82, stationary contact 27 and movable switch blade 24 of relay 20, conductor 83, conductor 84, parallel connector transformer 15 and valve 14, with transformer 15 being connected through movable switch blade 55, stationary contact 60 of flame relay 50 and conductor 85, conductor 86, conductor 87, conductor 66, and conductor 67 to power line conductor 61. Fuel is then admitted to the pilot burner 12 and normally ignited to establish flame. Relay switch 24—27 can therefore be called a burner switch.

Movement of switch blade 23 into engagement with stationary contact 26 completes an energizing circuit for the timer 36. This energizing circuit can be traced from power line conductor 61 through conductor 63, conductor 81, conductor 82, stationary contact 26 and movable switch blade 23 of relay 20, conductor 88, conductor 89, timer switch S2, conductor 90, timer motor 37, conductor 91, and conductor 67 to power line conductor 62. Relay switch 23—26 and timer switch S2 can therefore be called the timer energizing switches of the relay and the timer

respectively. It will be noted that in parallel with timer switch S2 is a circuit which includes the movable switch blade 54 of flame relay 50 engaging stationary contact 58.

The timer 36 is now energized and motor 37 runs to actuate the switches as shown in Figure 2. Also, flame is established at pilot burner 12 and is sensed by photocell 16 which, through flame detector 40, causes flame relay 50 to be energized.

Energization of flame relay 50 causes movable switch blade 53 to move into engagement with stationary contact 57. This completes the above mentioned holding energizing circuit for relay 20. Since contacts 56 and 57 overlap, this holding circuit is completed before the energizing circuit for relay 20 is broken. This circuit can be traced from the right hand terminal of secondary 35 through conductor 70, winding 21, switch 29, conductor 71, thermostat 17, conductor 72, stationary contact 25 and movable switch blade 22 of relay 20, conductor 92, stationary contact 57 and movable switch blade 53 of flame relay 50, and conductor 94 to center tap 95 of secondary 35.

Energization of flame relay 50 also causes movable switch blade 52 to disengage stationary contact 56 and this breaks the initial energizing circuit for relay 20 and thereby deenergizes heater 31 of safety cutout device 28. From the explanation thus far it can be seen that in order for main control relay 20 to be initially energized electrical continuity of heater 31 must exist. This is accomplished by initially energizing the heater 31 through the initial energizing circuit for relay 20. However, as soon as flame is detected the heater 31 is deenergized.

Energization of flame relay 50 also causes movable switch blade 55 to disengage stationary contact 60 and to move into engagement with stationary contact 59. When movable switch blade 55 engages stationary contact 59 an energizing circuit is completed for the main valve 13 to admit fuel to the main burner 11 to thereby establish flame at this burner and provide a flame to be continuously sensed by photocell 16. Disengagement of stationary contact 60 deenergizes the ignition transformer 15. The energizing circuit for valve 13 can be traced from power line conductor 61 through conductor 63, conductor 81, conductor 82, stationary contact 27 and movable switch blade 24 of relay 20, conductor 83, conductor 84, switch blade 55 and stationary contact 59 of flame relay 50, conductor 96, valve 13, conductor 97, conductor 87, conductor 66, and conductor 67 to power line conductor 62.

After approximately five seconds of operation of timer 36, switch S1 closes and switch S3 opens. The closing of switch S1 completes a shunt circuit around switch blade 23 and stationary contact 26 of relay 20. As shown above, switch blade 23 and stationary contacts 26 of relay 20 are in the energizing circuit from motor 37 of timer 36 and therefore closing of switch S1 completes a holding circuit from motor 37 which is independent of the condition of relay 20.

The opening of switch S3 opens the initial energizing circuit for relay 20. This initial energizing circuit is broken at this time also at switch blade 52 and stationary contact 56 of flame relay 50. The timer switch S3 can be called an interlock switch since it is in the initial energizing circuit for main relay 20 and this relay cannot be initially energized unless the timer is in the start position, that is, the zero time position shown in Figure 2.

The apparatus continues to operate in this manner until the 109 second interval is reached. At this time, the timer switch S6 is opened and the timer switch S4 is closed. Timer switch S6 is in series with photocell 16 and connects photocell 16 to signal input terminals 43 and 44 of flame detector 40 so long as switch S6 is closed. The opening of switch S6 simulates the no-flame condition and therefore switch S6 can be characterized as the no-flame or condition simulating switch. This can be seen by tracing a circuit from signal input terminal

43 through conductor 100, photocell 16, conductor 101, timer switch S6, and conductor 102 to signal input terminal 44. When timer switch S6 opens, photocell 16 is disconnected from signal input terminals 43 and 44 and causes the absence of flame to be simulated at flame detector 40. With a flame detector such as in the above mentioned Richard S. Feigal patent, a time delay is provided such that flame relay 50 is not deenergized immediately upon the absence of flame being simulated. For example, a delay of five seconds may be provided or, in other words, flame relay 50 normally becomes deenergized five seconds after switch S6 opens.

Closing of switch S4 completes an energizing circuit for heater 31 of safety cutout device 28. This energizing circuit can be seen by tracing a circuit from the left-hand terminal of secondary 35 through conductor 76, heater 31, conductor 75, timer switch S4, conductor 103, contact 57 and switch blade 53 of relay 50, and conductor 94 to tap 95 on secondary 35. This last traced circuit operatively energizes heater 31 and initiates the timing period necessary for bimetal 30 to warp to the right to cause switch 29 to open.

Operation of timer motor 37 continues and at the 111 second interval; or two seconds latter, timer switch S5 is closed. Timer switch S5 is connected in parallel with movable switch blade 55 and stationary contact 59 of flame relay 50. It will be remembered that switch blade 55 and contact 59 of flame relay 50 are connected in the energizing circuit for the main valve 13. Therefore, closing of timer switch S5 completes a holding circuit for valve 13 which is independent of the condition of flame relay 50.

Operation of timer motor 37 continues until the 112 second interval, or one more second, at which time timer switch S2 is opened. As above described, timer switch S2 is in parallel with switch blade 54 and stationary contact 58 of relay 50, now disengaged, and is in the energizing circuit for timer motor 37. At this time the five second dropout timing of flame detector 40 has not expired and flame relay 50 is still energized. Therefore opening of timer switch S2 at this time causes the timer motor 37 to be deenergized and operation of the timer switches is stopped.

At this time the timer switch S1, S4, and S5 are closed while the timer switches S2, S3, and S6 are open, The main valve 13 is maintained energized through the closed contact S5. The absence of flame is simulated at flame detector 40 by timer switch S6 being in the open condition and the heater 31 of safety cutout device 28 is energized through the above traced circuit including switch 54. This circuit is a checking circuit which checks the ability of flame detector 40 to respond to the simulated no-flame condition. Switch S4 can therefore be characterized as a checking switch.

It will now be assumed that an abnormal condition exists in flame detector 40 and that a component has failed in the flame detector such that the flame detector is unable to respond to simulated absence of flame to deenergized flame relay 50. With flame relay 50 maintained energized the conditions as above described will continue to exist until heater 31 has been heated for a predetermined period of time and switch 29 of safety cutout device 28 is open. Opening of switch 29 deenergizes main relay 20 and causes the main fuel valve 13 to be deenergized. This is the safety shutdown condition of the control apparatus and it is necessary for the fault within the flame detector 40 to be corrected before operation and control of the burner unit 10 can again be affected.

Normally however the flame detector 40 will respond to the simulated absence of flame to deenergize the flame relay 50. Deenergization of flame relay 50 causes heater 31 to be deenergized and also completes an energizing circuit for timer motor 37. This energizing circuit for motor 37 can be seen by tracing a circuit from power line conductor 61 through conductor 63, conductor 81, conductor 82, stationary contact 26 and switch blade 23 of main relay 20, conductor 88, conductor 104, stationary contact 58 and movable switch blade 54 of flame relay 50, conductor 105, timer motor 37, conductor 91, and conductor 67 to power line 62. This above traced circuit causes continued operation of timer switches S1 through S6 in the normal cycle.

When the timer motor has operated to the 117 second interval, as shown in Figure 2, timer switch S6 is closed and timer switch S2 is closed. Timer switch S6 in closing again connects photocell 16 to signal input terminals 43 and 44 and therefore the simulated condition of the absence of flame is discontinued and photocell 16 and flame detector 40 again monitor the actual conditions at the burner unit 10, or in other words, the flame at the burners.

Closing of timer switch S2 again completes an energizing circuit for timer motor 37 which is independent of the condition of flame relay 50. Since photocell 16 is again connected to signal input terminals 43 and 44 of flame detector 40, flame detector 40 will respond to the presence of flame at the main burner 11 and will again energize flame relay 50. However, with the closing of timer switch S2 energization of timer motor 37 is no longer conditioned upon the deenergized condition of flame relay 50.

Operation of timer motor 37 continues until the 118 second time interval is reached. At this time timer switches S4 and S5 are opened and timer switch S3 is closed.

The opening of switch S5 breaks the above traced energizing circuit for main valve 13 which is independent of the condition of flame relay 50 and once again places control of main valve 13 under the control of flame relay 50 wherein continued energization of valve 13 is dependent upon blade 55 engaging stationary contact 59.

A complete cycle of the improved burner control apparatus has now been described. However, the above described cycle will continue to reoccur and once every cycle when timer switch S6 opens to simulate the absence of flame and when timer contact S2 opens to deenergize timer 37 the proper operation of flame detector 40 is checked. It is noted from Figure 2 that a cycle of 120 seconds duration has been selected. However, by simply extending the time period in the middle of the cycle wherein only switches S1, S2, and S6 are closed, a cycle of any time duration can be provided.

As above described, if during any one of the reoccurring cycles the electronic flame detector 40 is unable to detect the simulated absence of flame the safety cutout device 28 is actuated to deenergize the main relay 20 and thereby deenergize main valve 13. However, in the absence of such a failure in flame detector 40, operation of valve 13 continues until thermostat 17 indicates that there is no longer a need for operation of the burner unit 10. Upon the end of such a need, blade 18 disengages contact 19. This breaks the energizing circuit for relay 20 and causes main valve 13 to be deenergized. In all probability, the thermostat 17 will not indicate the end of such a need at the zero time position of timer motor 37. However, timer motor 37 will continue to run cycling its contacts until timer switch S1 is opened. Since relay 20 is now deenergized and therefore switch blade 23 disengages contact 26 the timer motor 37 is deenergized and the control apparatus is once again in the condition shown in Figure 1, which is the standby condition awaiting a further need for operation of the burner unit 10 as indicated by thermostat 17.

Figure 3 shows an alternate method of simulating the absence of flame. In Figure 1, the circuit connecting photocell 16 to signal input terminals 43 and 44 of flame detector 40 is opened by timer switch S6. In the modification of Figure 3 the timer switch S6 is utilized to control an electrically energizable means in the form of a

solenoid 200 which when energized positions a shield 201 so that photocell 16 can view the flame at the burner unit 10. However, when the 109 second time interval is reached, referring to Figure 2, timer switch S6 is opened and solenoid 200 is deenergized to allow shield 201 to assume the dotted line position to restrict the view of photocell 16 such that photocell 16 cannot respond or sense the presence of flame at burner unit 10. This causes a simulation of the absence of flame at the burner 11 and flame detector 40 normally responds to this simulated condition to deenergize the flame relay 50.

For purposes of simplicity the complete control apparatus was not repeated in Figure 3, however, like reference numerals are used for like elements. It will be noted that a transformer 205 must also be provided in the modification of Figure 3 to provide an energizing voltage source for solenoid 200.

While these and other modifications of the present invention will be apparent to those skilled in the art it is intended that the present invention be limited solely by the scope of the appended claims.

I claim as my invention:

1. Burner control apparatus for use with a fuel burner, comprising; electrical control means arranged to be energized upon a need for fuel burner operation and having means adapted to be connected to energize the fuel burner to establish a flame, a flame detector adapted to be associated with the fuel burner to detect flame at the fuel burner, electrical timing means connected to be energized upon a need for fuel burner operation and having means associated with said flame detector to periodically simulate the absence of flame, electrically energizable safety cutout means for terminating operation of the burner, and means for causing said safety cutout means to be energized upon failure of said flame detector to respond to the simulation of the absence of flame.

2. Control apparatus for use with a fuel burner unit comprising; an electrical program timer having a no-flame simulating switch controlled in a predetermined cycle of operation when said timer is energized, electrical flame detecting means having a switch controlled thereby and having flame sensing means connected in a circuit controlled by said no-flame simulating switch, said flame sensing means being adapted to be positioned to sense the presence or absence of flame at the fuel burner unit and cause the switch of said flame detecting means to assume a flame or a no flame condition, electrical control means arranged to be energized upon a need for operation of the fuel burner and having a timer energizing switch and a burner switch, means including said timer energizing switch for energizing said program timer, means including said burner switch adapted to be connected to energize the fuel burner unit to thereby establish flame at the fuel burner unit, said program timer after a time period of energization thereof actuating said no-flame simulating switch to momentarily render said flame detecting means incapable of detecting flame at the fuel burner unit, means including the switch of said flame detecting means to deenergize said program timer so long as the switch of said flame detecting means remains in said flame condition and to continue energization of said program timer when the switch of said flame detecting means is actuated to said no flame condition, and means responsive to failure of the switch of said flame detecting means being actuated to said no flame condition to deenergize the fuel burner unit.

3. Control apparatus comprising, condition responsive means, a switch controlled thereby, said condition responsive means being operative to actuate said switch from a first position to a second position upon said condition responsive means responding to a given condition, electrical programming timer means having a condition simulating switch and a timer means energizing switch actuated in a predetermined cycle of operation, means for energizing said programming timer means, means including said condition simulating switch arranged to render said condition responsive means inoperative to respond to said given condition at a given point in said predetermined cycle of operation at which said condition simulating switch is actuated, means including said timer means energizing switch arranged to deenergize said programming timer means, and means including the switch of said condition responsive means in said first position maintaining said programming timer means energized upon the switch of said condition responsive means assuming said first position due to actuation of said condition simulating switch.

4. Control apparatus comprising, condition responsive means, a switch controlled thereby, said condition responsive means, being operative to actuate said switch from a first position to a second position upon said condition responsive means responding to a given condition, electrical timer means having a condition simulating switch, a timer means energizing switch, and a checking switch actuated in a predetermined cycle of operation, control means for energizing said timer means, means including said condition simulating switch arranged to render said condition responsive means inoperative to respond to said given condition at a given point in said predetermined cycle of operation at which said condition simulating switch is actuated, means including said timer means energizing switch arranged to deenergize said timer means, means including said switch controlled by said condition responsive means in said first position maintaining said timer means energized upon said switch controlled by said condition responsive means assuming said first position due to actuation of said condition simulating switch, electrical cutout means arranged in controlling relation to said control means and having a time delayed actuator, and means including said checking switch to energize said actuator and thereby cause cutout means to be actuated upon said timer means being deenergized for a given period of time.

5. Control apparatus for use with a fuel burner comprising; electrical timing means having a no-flame simulating switch and a timing means energizing switch which are controlled in a predetermined cycle of operation so long as said timing means is energized, electrical control means arranged to be energized upon a need for operation of the fuel burner, flame detecting means having means arranged to be positioned to detect the presence or absence of flame at the fuel burner, means controlled by said control means arranged to be connected to energize the fuel burner to thereby establish flame at the fuel burner upon a need for operation of the fuel burner, means controlled by said control means to energize said timing means, means including said no-flame simulating switch for rendering said flame detecting means incapable of detecting the presence of flame when said no-flame simulating switch is actuated from a first to a second condition to thereby cause said flame detecting means to assure a simulated no-flame condition independent of the presence or absence of flame at the fuel burner, means including said timing means energizing switch when actuated from a first to a second condition to deenergize said timing means after said flame detecting means has been rendered inoperative, and means controlled by said flame detecting means in said simulated no-flame condition to energize said timing means to continue operation thereof and cause said no-flame simulating switch and said timing means energizing switch to be actuated back to said first condition to thereby again render said flame detecting means capable of detecting flame at the fuel burner.

6. Control apparatus for use with a fuel burner unit comprising; an electrical program timer having a no-flame simulating switch and a checking switch controlled in a predetermined cycle of operation when said timer is energized, electrical flame detecting means having a

switch controlled thereby and having flame sensing means connected in a circuit controlled by said no-flame simulating switch, said flame sensing means being adapted to be positioned to sense the presence or absence of flame at the fuel burner unit and cause the switch of said flame detecting means to assume a flame or a no-flame condition, electrical control means arranged to be energized upon a need for operation of the fuel burner and having a timer energizing switch and a burner switch, means including said timer energizing switch for energizing said program timer, means including said burner switch adapted to be connected to energize the fuel burner unit to thereby establish flame at the fuel burner unit, said program timer after a time period of energization thereof actuating said no-flame simulating switch to momentarily render said flame detecting means incapable of detecting flame at the fuel burner unit, means including the switch of said flame detecting means to de-energize said program timer so long as the switch of said flame detecting means remains in said flame condition and to continue energization of said program timer when the switch of said flame detecting means is actuated to said no-flame condition, electrical safety cutout means connected in controlling relation to said control means and having a time delayed actuator, and means including said checking switch arranged to operatively energize said actuator if said program timer remains de-energized after actuation of said no-flame simulating switch.

7. Burner control system comprising, a fuel burner unit, a control relay having a plurality of switches, a flame detector having a plurality of switches and a flame sensing element located at said burner unit to sense the presence or absence of flame at said burner unit, a timer having an actuator and a plurality of switches controlled thereby in a predetermined cycle of operation from a start position, means responsive to a need for operation of said burner unit, means for energizing said control relay including said means responsive to a need for operation of said burner unit and a start switch of said timer which is closed when said timer is at start position, means including a burner switch controlled by said relay for energizing said burner unit, means including a timer energizing switch controlled by said relay for energizing said timer, means connected to said flame detector and including a no-flame simulating switch of said timer to momentarily simulate the absence of flame at said burner unit at periodic intervals so long as there is a need for operation of said burner unit, safety cutout means having a switch connected in controlling relation to said relay and having an actuator, and means for energizing said actuator upon failure of said flame detector to respond to the simulated absence of flame at said burner unit.

8. Control apparatus for use with a fuel burner comprising; a main burner control relay having a plurality of switches including a burner switch adapted to be connected to control energization of the fuel burner, a flame detector having a photocell adapted to be positioned to sense the presence or absence of flame at the fuel burner, electrical timing means having a plurality of switches which are controlled in a predetermined sequence upon energization of said timing means, electrically energizable means including a shield arranged to prevent said photocell from sensing flame when said electrically energizable means is de-energized, circuit means controlled by a no-flame simulating switch of said timing means for controlling said electrically energizable means, said no-flame simulating switch of said timing means being momentarily opened to de-energize said electrically energizable means after a time period of energization of said timing means, a checking switch of said timing means which is closed during the time period that said no-flame simulating switch is opened, time delayed safety cutout means connected in controlling relation to said relay and having an electrical actuator, energizing circuit means for said actuator including said checking switch to continuously energize said actuator so long as said checking switch is closed, energizing circuit means for said timing means including a timing means energizing switch of said relay and a timing means energizing switch of said timing means, said timing means energizing switch of said timing means being opened during the time period that said no-flame simulating switch is opened to thereby de-energize said timing means, a switch controlled by said flame detector and closed in the absence of flame, and circuit means including said switch controlled by said flame detector connected to energize said timing means after said timing means energizing switch of said timing means has opened.

9. Control apparatus for use with a fuel burner comprising; a main burner control relay having a plurality of switches including a burner switch arranged to be connected to control energization of the fuel burner, an electrical flame detector having a flame sensing element arranged to be positioned to sense the presence or absence of flame at the fuel burner, electrical timing means having a plurality of switches which are controlled in a predetermined sequence upon energization of said timing means, means controlled by a no-flame simulating switch of said timing means connecting said flame sensing element to said flame detector when said no-flame simulating switch is closed, said no-flame simulating switch being momentarily opened after a time period of energization of said timing means, a checking switch of said timing means which is closed during the time period that said no-flame simulating switch is opened, safety cutout means arranged to control said main burner control relay and having an electrical actuator, energizing means for said actuator including said checking switch to continuously energize said actuator so long as said checking switch is closed, energizing means for said timing means controlled by a timing means energizing switch of said relay and a timing means energizing switch of said timing means to energize said timing means when both of said switches are closed, said timing means energizing switch of said timing means being opened during the time period that said no-flame simulating switch is opened to thereby de-energize said timing means, a switch controlled by said flame detector and closed in the absence of flame, and means controlled by said flame detector switch in closed position to energize said timing means after said timing means energizing switch of said timing means has opened.

10. Control apparatus for use with a fuel burner comprising; electrical timing means having a no-flame simulating switch, a timing means energizing switch, and a checking switch which are controlled in a predetermined cycle of operation so long as said timing means is energized, electrical control means arranged to be energized upon a need for operation of the fuel burner, flame detecting means having means arranged to be positioned to detect the presence or absence of flame at the fuel burner, means controlled by said control means arranged to be connected to energize the fuel burner to thereby establish flame at the fuel burner upon a need for operation of the fuel burner, means controlled by said control means to energize said timing means, means including said no-flame simulating switch for rendering said flame detecting means incapable of detecting the presence of flame when said no-flame simulating switch is actuated from a first to a second condition, means including said timing means energizing switch when actuated from a first to a second condition to de-energize said timing means after said flame detecting means has been rendered incapable of detecting the presence of flame, and means controlled by said flame detecting means in said no-flame condition to energize said timing means to continue operation thereof and cause said no-flame simulating switch and said timing means energizing switch to be actuated back to said first condition, electrical safety cutout means

having means connected in controlling relation to said control means, means including said checking switch to operatively energize said safety cutout means if said timing means remains de-energized by said means including said timing means energizing switch.

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