Sept. 11, 1951 W. E. EDELMAN 2,567,807

BURNER SAFETY CONTROL SYSTEM AND APPARATUS

Filed Oct. 2, 1947 2 Sheets-Sheet 1

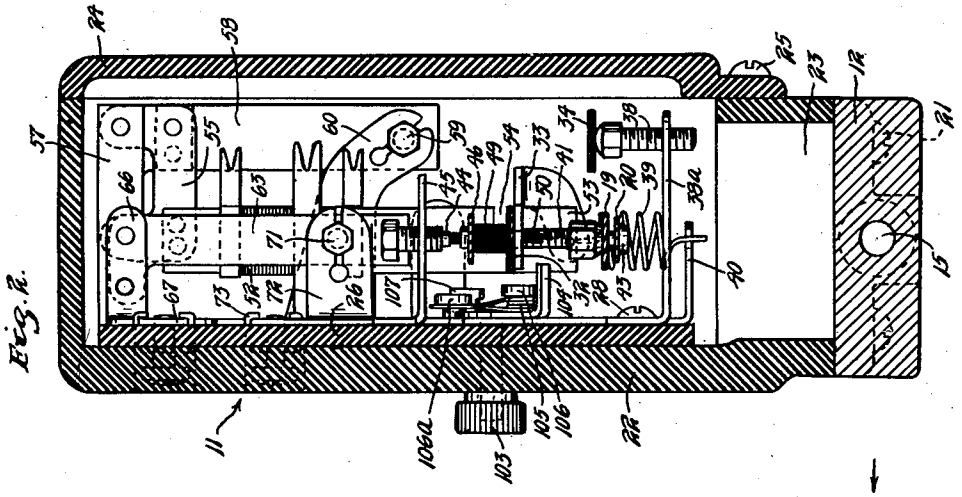


Fig. 2.

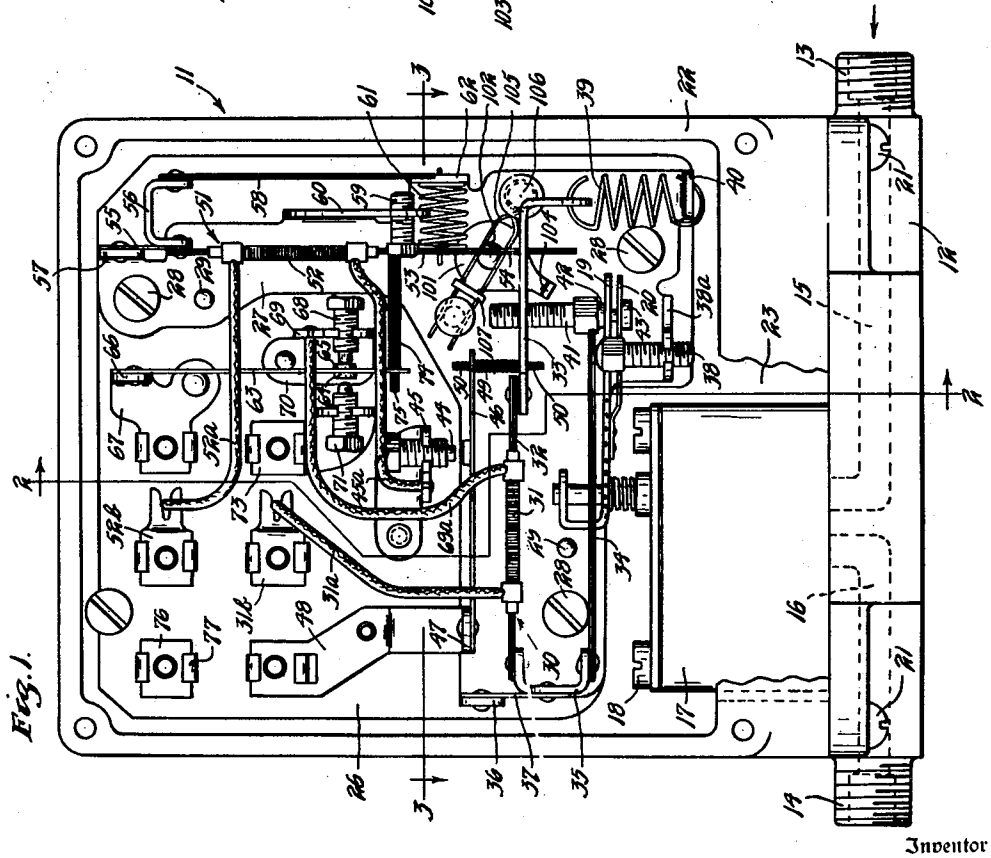


Fig. 1.

Inventor
WALTER E. EDELMAN

George N. Fisher
Attorney

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Filed Oct. 2, 1947 2 Sheets-Sheet 2

Fig. 4.

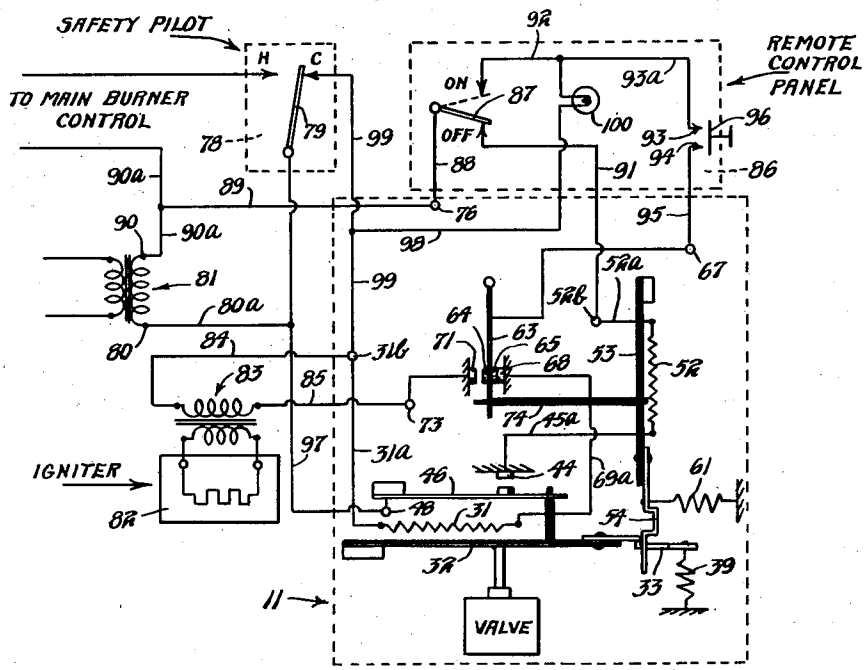
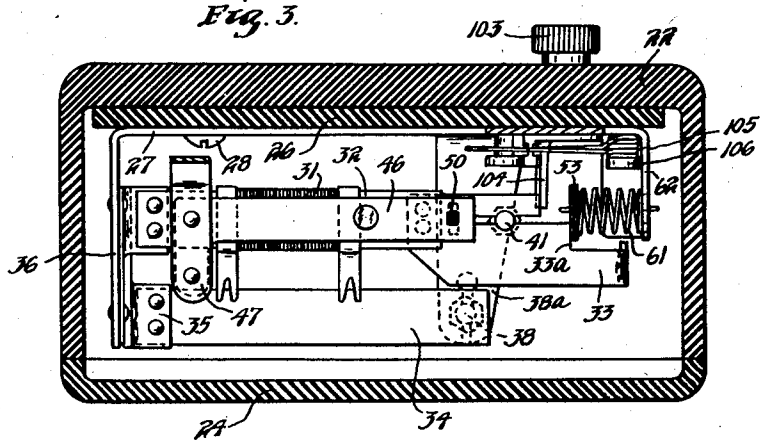


Fig. 3.



Inventor
WALTER E. EDELMAN

By

George H. Fisher
Attorney

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BURNER SAFETY CONTROL SYSTEM AND APPARATUS

Walter E. Edelman, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Application October 2, 1947, Serial No. 777,407

9 Claims. (Cl. 158—28)

1

This invention relates to a fuel burner control system and apparatus and, more particularly, to a system having a control station remote from the fuel burner.

One of the objects of the invention is to provide control apparatus whereby, for example, a householder may start operation of the heating system from a frequently occupied room remotely positioned from the heating plant.

Another object of the invention is to provide a remote control apparatus of such simple operation that a home owner need not require the gas company or service man to come out and light the pilot in the fall and turn off the system in the spring.

Another object of the invention is to provide fuel burner control apparatus which, when started manually, will automatically start and maintain the flow of fuel to a pilot burner, cause energization of an igniter, and then simultaneously deenergize the igniter upon the establishment of combustion at the pilot burner and complete a circuit to a main burner control system.

Another object of the invention is to provide a remote control instrument which is able to signal to an operator, such as a householder, that an undesirable operating condition exists in the controlled heating system.

Still another object of the invention is to provide a simple and inexpensive controller or control device that is adapted to cause ignition of a pilot burner either from a remote electrical control panel or manually at the control device.

A further object of the invention is to provide a controller or control device that is adapted to initiate and maintain a supply of fuel to a burner and then automatically energize an igniter for said fuel.

Still further objects of the invention will become apparent upon reading the following detailed description thereof in conjunction with the accompanying drawing wherein:

Figure 1 is an elevational view of the controller with its cover removed and a portion of its casing broken away;

Figure 2 is a cross sectional view of the controller taken along line 2—2 of Figure 1;

Figure 3 is a cross sectional view of the controller taken along line 3—3 of Figure 1; and

Figure 4 is a schematic view of the system and apparatus.

As seen in Figure 4 of the drawing, the control apparatus and system of this invention is adapted to be connected to most any conventional control apparatus for a main fuel burner. For example, the upper lead of the leads designated by the legend "to main burner control" could be connected to a room thermostat that is in turn connected to one terminal of a solenoid gas valve, while the other of said leads could be connected

2

to the other terminal of said solenoid valve through a limit switch or any other safety control.

The control device or controller, generally designated by the reference numeral 11, is shown in detail in Figures 1 to 3. It comprises a mounting plate 12 having an inlet 13 adapted to be connected to a source of fuel (not shown) and an outlet 14 adapted to be connected to a pilot burner (not shown). The mounting plate has passages 15 and 16 which lead respectively, to and from a control means or pilot valve 17 mounted thereon and secured thereto as by means of screws 18. The mounting plate itself is adapted to be secured to any suitable support (not shown) adjacent the burner apparatus or the fuel supply lines leading thereto.

The control means, which in the preferred embodiment of the invention is a pilot valve 17, the details of which form no part of this invention, has a bifurcated actuating arm 19 and a bifurcated strain release arm 20 secured to and in spaced relationship with said arm 19. The pilot valve is so designed that when the arm 19 is in its lowermost position, the valve is closed, and when the arm 19 is in its uppermost position, the pilot valve is opened.

Also mounted on the plate 12, by means of screws 21, is a housing 22, open at one side and having an opening 23 in the bottom thereof through which the pilot valve 17 extends upwardly into said housing. The housing also has a plurality of openings in the back or opposite side from the open side of the housing, which are adapted to receive the operating shaft of a manual controller and a plurality of terminal members to be described hereinafter. A cover member 24 is adapted to be secured to the housing 22 by means of screws 25 to close said open side.

A panel member 26, made of electrical insulating material, and a metallic frame member 27 are both secured to the back side of the housing 22 by means of screws 28, with the panel 26 positioned between the frame member 27 and the back side of the housing. The frame member 27 is additionally secured to the panel member 26 by means of rivets 29. It is thus seen that the members 26 and 27 form a detachable mounting base for the control elements now to be described.

A power means or power actuator, preferably a heat motor, generally designated by the reference numeral 30, comprises a resistance heater 31 coiled around a bimetal member 32, an actuating arm 33 secured to the relatively free end of the bimetal member 32 by means of a rivet or any other suitable means, a bimetal compensating arm 34, and a U-shaped bracket member 35, the legs of which are secured respectively to the left ends of the bimetal members 32 and 34

(as viewed in Figure 1) by means of rivets or other suitable fastening means. The heat motor 30 is pivotally secured to an arm 36 extending laterally from the frame member 27 by means of a spring hinge 37 riveted or otherwise secured at its ends to said arm and to the base of said U-shaped member 35. An adjustable abutment screw 38, which bears against the bottom of bimetal member 34 in its lowermost position, is screw threaded into a split arm 38a extending laterally from the frame member 27. A tension spring 39, extending between an arm 40 on the frame member 27 and the outer free end of the arm 33, constantly urges the heat motor in a clockwise direction about pivot 37. An adjustable connecting screw 41 having spaced abutment shoulders 42 and 43 at its lower end, is screw threaded through the actuating arm 33 and extends through the bifurcated arms 19 and 20 of the pilot valve with said arms 19 and 20 positioned between said abutments. It is thus seen that the motor 30 is operatively connected to the pilot valve in such a manner that spring 39 normally holds said valve closed, but is adapted to move the valve to its open position, upon energization of the resistance heater 31 by warping the outer free end of the bimetal member 32 upwardly against the action of spring 39, which carries with it the connecting screw 41 and the valve arms 20 and 19. The bracket 35 is prevented from pivoting in a clockwise direction, upon energization of the heater 31, due to the reactive force of the bimetal 34 against the adjustable abutment screw 38. The compensating bimetal is arranged so as to warp in the same direction as bimetal 32 so that any change that would normally take place in the position of the free end of the bimetal arm 32, due to changes in the ambient air temperature, will be offset by the bimetal 34, a compensation well known in the art.

A switch having an adjustable contact 44, threaded through an arm 45 which is riveted or otherwise secured to panel 26 and having a flexible, normally open arm 46 secured to an arm 47 extending laterally from a terminal member 48, is positioned above said heat motor 30 so as to be actuated thereby. An insulation member 49, having reduced end portions 50 extending through apertures in members 46 and 33, causes the arm 46 to move to a closed position against contact 44 upon upward movement of the arm 33. The contact supporting arm 45 is electrically connected by means of connector wire 45a to a second power means or heat motor, generally designated by the reference numeral 51.

The heat motor 51 has the same general construction as the heat motor 30 and is arranged with its longitudinal axis at right angles to the longitudinal axis of the heat motor 30. It comprises a resistance heater 52 surrounding a bimetal actuating arm 53 having a notch 54 spaced upwardly from the outer end thereof. The upper end of the bimetal arm 53 is riveted or otherwise secured to one end of a flexible pivot member 55 and one leg of a U-shaped bracket member 56. The other end of the flexible pivot member 55 is secured to a support arm 57 extending laterally from the frame member 27. The other leg of the U-shaped bracket member 56 is secured to a conventional bimetallic compensating arm 58 that is adapted to bear at its lower end against an adjustable abutment screw 59 threaded through an arm 60 extending from frame member 27. A compression spring 61 extends between the bimetal arm 53 and arm 62 extending laterally from frame member 27. One end of the heater 52 is connected to the above mentioned connector 45a while the other end of the heater is electrically connected to terminal member 52b by means of a connector wire 52a.

The relationship of the lower end of arm 53 and the right hand end of arm 33, as viewed in Figure 1, is such that when the arm 33 is moved upwardly against the bias of spring 39 upon energization of the heater 31, a portion of the arm 33 will slide through notch 54. This is due to the fact that when the shoulder formed by the notch 33a in the arm 33 is brought into alignment with the notch 54, the spring 61 is able to move the arm 53 toward the left. The spring 61 retains the arm 53 in this position and the arm 33 latched up and, consequently, the pilot valve 17 in its open position until the arm 53 is warped toward the right upon energization of the heater 52 or by other means to be described hereinafter. Energization of heater 52 causes the arm 53 to move toward the right thereby moving the lower edge of the notch 54 out from under the shoulder formed on the arm 33, thus permitting spring 39 to lower the arm 33 and close the pilot valve.

A single pole, double throw switch, having a flexible arm 63 carrying oppositely disposed contacts 64 and 65 near the lower end thereof, is pivotally connected to an arm 66 extending laterally from a terminal member 67 riveted to the panel member 26. An adjustable contact member 68 screw threaded through an arm 69 extending laterally from a plate 70 riveted to the panel 26 is normally in engagement with contact member 65. A second adjustable contact member 71, screw threaded through an arm 72 extending laterally from a terminal member 73 is secured to panel 26 and in spaced and opposed relationship with contact 64. The bias of the flexible arm 63 is such that it normally tends to move contact 65 into engagement with adjustable contact 68. The arm 63 is moved in the other direction by means of an insulation bar 74 having reduced end portions 75 extending through apertures in flexible arm 63 and bimetallic arm 53 of the heat motor 51. Arm 69, supporting contact member 68, is electrically connected to the right hand end of heater 31 by means of lead wire 69a. It is thus seen that when the arm 33 is in its lowermost position, the heater 52 cannot become energized due to the fact that contact 44 is separated from contact 46, and when the arm 33 is in its uppermost position, the contact 44 is in engagement with contact arm 46 but contact 65 is out of engagement with contact 68 breaking the circuit to heater 31. Therefore, it is apparent that only one of the heaters can be energized at one time.

Terminal member 76, as well as the other terminal members described before, is screw threaded to receive a lead clamping screw and is held against the inner side of the panel 26 by means of a split rivet 77 extending through an aperture in the panel 26 in alignment with one of the apertures in the back side of the housing 22, described above. This terminal 76 is not connected to any of the elements of the controller 11 but merely serves as a convenient means for electrically connecting other elements of the control apparatus, to be described hereinafter.

A safety pilot 78, shown schematically in Figure 4 of the drawing and the details of which form

no part of this invention, comprises a contact arm 79 adapted to be moved by a conventional flame sensing member into engagement with a "cold" contact C when no flame is present at the pilot burner, and into engagement with the "hot" contact H, when flame is present at the pilot burner. The conventional means for actuating the contact arm 79 is preferably the well known thermocouple-relay combination. The "hot" terminal of the safety pilot is connected by a suitable lead to one end of a break in the main burner control circuit. The "cold" contact is connected through terminal 31*b* to heater 31, to one side each of an igniter transformer 83 and a signal 100, to be described hereinafter. The contact arm 79 of the safety pilot is connected through line 97 and line 80*a* to terminal 80 of the secondary of transformer 81 and to the flexible contact arm 46 of the controller. It is thus seen that when contact arm 79 is in engagement with contact C, a circuit is completed to heater 31.

An igniter, such as a conventional hot wire igniter 82 suitably mounted to ignite the pilot burner, is adapted to be energized by a transformer 83. One terminal of the igniter transformer is connected through line 84 to terminal 31*b* of the controller and the other terminal is connected through line 85 to contact 71 through terminal 73. It is thus apparent that the igniter cannot be energized unless both the contact 79 is in engagement with contact C and contact arm 63 is in engagement with contact 71.

A remote control panel 86 is adapted to be secured by suitable means (not shown) to the wall of, or an object in a room remotely positioned from the burner apparatus. However, the panel may be positioned adjacent the burner apparatus if so desired. It comprises a manually operable double throw switch, preferably of the toggle type, wherein a movable contact member 87 is adapted to be selectively moved to engagement with an "on" contact or an "off" contact therein. The movable contact member 87 is connected through line 88, terminal 76 and lines 89 and 90*a* to the other end of the above mentioned break in the main burner circuit and the terminal 90 of the transformer 81. The "off" contact is connected through line 91 to terminal 52*b* of the controller. The "on" contact is connected to the other terminal of the conventional signal means 100, preferably a light, through line 92 and to one contact 93 of a push button switch through line 93*a*. Another contact 94 of the push button is connected through line 95 to terminal 67 of the controller. A push button bridging member 96 of the push button switch is normally biased to its contact open position by means of a spring not shown. Due to the fact that the push button is in series alternately with the igniter and the heater 31, depending upon the position of contact arm 63, the only time that the igniter or heater 31 can be energized is when the push button is manually held closed.

As it is often desirable to control the heating system manually, especially if there should be an electrical power failure that renders the above described control means inoperative, an additional control means is provided on the controller 11 which enables the pilot valve to be opened manually.

The manual control means comprises a lever 101 secured to rotatable shaft 102 which extends through the back of the housing, panel 26 and frame 27. The shaft has a manual actuating knob 103 secured to the outer end thereof. A transversely extending arm 104 on the lever 101 is positioned below the arm 33 and to the left of arm 53. It is thus seen that selective turning of the knob 103 in one direction or the other will move one or the other of said arms 33 and 53 to the position it would take if it were actuated by its heater. To provide for the return of arm 104 to an intermediate and inoperative position, a fork shaped spring 105 has its closed end around a headed pin 106 with its legs straddling a T-shaped arm 107 extending laterally from the lever 101 and a second headed pin 106*a*. At least one leg of the spring will always be in engagement with the second pin while the other leg may be flexed outwardly by the T-shaped arm to permit rotation of knob 103.

The operation of the rest of the control apparatus will be the same as if the arms 33 and 53 were actuated by their heat motors, except when ignition of the pilot burner is being attempted when no electrical power is available. In this case the igniter 82 will not operate and it will be necessary to ignite the pilot by other suitable means, such as a match or taper.

Operation

The system is shown in its shut down condition, that is, when the manually operable contact member 87 of the snap switch is in its "off" position, the pilot valve is in its closed position, and the safety pilot is in its "cold" position.

To initiate operation of the heating system, as in the fall, the operator first moves the contact member 87 into engagement with the "on" contact. This completes a circuit from the terminal 90 of the transformer 81, through part of line 90*a*, line 89, terminal 76, line 88, movable contact member 87, "on" contact, line 92, signal 100, line 98, part of line 99, contact C of the safety pilot, contact arm 79, part of line 97, and line 80*a* to the other terminal 80 of the transformer 81. This energization of the signal 100 indicates to the operator that the pilot burner is not lighted and that the system requires ignition of the pilot burner to put it into operation. The operator then presses on the push button switch to bridge contacts 93 and 94 to complete a circuit, in parallel with the signal 100, from line 92 through line 93*a* contact 93, bridge 96, contact 94, line 95, terminal 67, switch arm 63, contacts 65 and 68, connector 69*a*, heater 31, connector 31*a*, and terminal 31*b* to line 99. Energization of heater 31 causes the bimetallic actuating arm 32 to move upwardly opening the pilot valve and closing contacts 44 and 46. Slight additional movement of the arm 32 after contact arm 46 engages contact 44, brings the abutment shoulder 33*a* on arm 33 into alignment with notch 54 in bimetallic arm 53, thus permitting compression spring 61 to move arm 53, insulation bar 74 and contact arm 63 out of engagement with contact 68 and into engagement with contact 71.

Separation of contact 65 from 68 deenergizes heater 31 but the normal tendency of the bimetallic arm 32 to return to its valve closing position is checked by the lower portion of the notch 54 engaging under the shoulder 33*a*. With the push button still maintained in a closed position by the operator, a circuit in parallel with the signal 100 is now completed from line 92 through line 93*a*, contact 93, bridge 96, contact 94, terminal 67, contact arm 63, contacts 64 and 71, terminal 73, line 85, igniter transformer 83,

line 84, to line 99 through terminal 31b. Although contact 44 is now in engagement with contact arm 46, the heater 52 remains deenergized due to the fact that contact member 87 is disengaged from the "off" contact of the manual switch. Upon ignition taking place at the pilot burner, the safety pilot will be actuated to move the contact arm 79 from contact C to contact H thus breaking the circuit to the igniter and the signal. Deenergization of the signal 100 indicates to the operator that the pilot burner is lighted and the main burner system is in operation and that the igniter is deenergized.

The operator may then release the push button, which additionally breaks the circuit to the igniter so that, if for any reason the pilot burner should go out, and the contact arm 79 moves to its cold position, automatic re-ignition will not take place. In this way, unsafe re-ignition of the pilot burner is prevented.

Upon the pilot burner accidentally going out, the signal 100 becomes energized indicating to the operator that re-ignition of the pilot burner is necessary. However, the operator, knowing that the system has recently been in operation, is able to take care that a safe ignition condition exists in the furnace before closing the circuit to the igniter by means of the push button.

When it is desirable to shut down the heating system, as in the spring, all that the operator has to do is to move the contact member 87 of the snap switch from its "on" position to its "off" position. This completes a circuit from terminal 90 of the tranformer 81 through line 90a, line 89, terminal 76, line 88, contact arm 87, "off" contact, line 91, terminal 52b, connector 52a, heater 52 connector 45a, contact 44, contact arm 46, terminal 48, line 97, and line 80a to the other terminal 80 of the transformer 81. This causes energization of heater 52 which warps bimetallic arm 53 toward the right, causing contact 64 to leave contact 71 and contact 65 to engage contact 68. Upon the bottom portion of notch 54 moving out from under arm 33, such arm is released permitting tension spring 39 to lower bimetallic arm 32 to close the pilot valve and to permit contact arm 46 to separate from contact 44 thus breaking the circuit to the heater 52. Upon closing the pilot valve, cutting off the flow of gas to the pilot burner, the safety pilot will cease to be heated by the pilot burner, which will cause it to operate and move to its "cold" position with the contact arm 79 in engagement with contact C. The heating system has thus returned to its original shut down position as shown in the drawing.

In the event that it is desirable to start the heating system manually, as when there is no electrical power available, this may be accomplished by rotating the manual control knob 103 counterclockwise to lift the arm 33. This causes operation of the apparatus just as if the arm had been lifted by the heater 31. The switch 87 must also be moved to "on" position to prevent power resumption shutting down the system.

Similarly, when it is desirable to turn off the the system manually, it may be done by rotating the same manual control knob 103 clockwise to move the arm 53 outwardly to unlatch the valve control arm 33, permitting the valve 17 to close.

While I have described the preferred structure and operation of the invention, it is obvious that various modifications may be made therein without departing from the spirit of the invention. It is therefore to be understood that the scope of the invention is to be determined solely from the appended claims.

I claim as my invention:

1. A control mechanism, comprising, first and second electrically energized actuators each having a movable portion having energized and deenergized positions, said movable portions mechanically coacting with one another in such a manner that each when in its deenergized position holds the other in its energized position, and single manually operable means positioned between said actuators so that either one may be actuated thereby to its energized position.

2. A control mechanism, comprising, first and second electrically energized actuators each having a movable portion having energized and deenergized positions, said movable portions mechanically coacting with one another in such a manner that each when in its deenergized position holds the other in its energized position, and manually operable crank means positioned between said actuators so that rotation in one direction will move one actuator to its energized position while rotation thereof in the opposite direction will move the other actuator to its energized position.

3. Control apparatus comprising an igniter, a fuel control means having a fuel-flow position and a no-flow position, a first electrical power means for actuating said control means to its fuel-flow position, holding means normally biased to a position wherein it mechanically retains said power means in said fuel-flow position, a second electrical power means for actuating said holding means to a position wherein it releases the first power means to return to the no-flow position of said control means and wherein it is mechanically retained in said position by said first power means, a normally open switch adapted to be actuated to a closed position upon movement of the first power means to said fuel-flow position, said switch being in series with said second power means, and a single pole double throw switch having one contact connected to said ignitor and another contact in series with said first power means and adapted to be actuated by said second power means to open the circuit to said first power means and to simultaneously close the circuit to said igniter.

4. A control device comprising a fuel valve, a first bimetallic actuating arm for said fuel valve, said arm having a heater adjacent thereto and a notched member on one of its ends, a single pole double throw switch with one of its contacts in series with said heater and the other contact connected to a load terminal on said device, a second bimetallic arm for actuating said switch, said second arm having its longitudinal axis substantially at right angles to the longitudinal axis of said first arm and having a second heater adjacent thereto, said second arm also having a notch in an edge thereof spaced from one end thereof, said arms being so related to each other that each in its normal cooled position is adapted to hold the other in its heated position, and a second switch in series with said second heater and adapted to be actuated by said first arm.

5. A control device comprising a control means having a first position and a second position, a first power means for actuating said control means to its second position, holding means

adapted to cooperate with said power means and normally biased to a position wherein it retains said control means in its second position, a second power means including said holding means for actuating said holding means to a position wherein it releases said first power means to permit it to move said control means to its first position and wherein it is retained in said position by said first power means, and a manually rockable lever adapted to selectively engage and actuate said first or second power means, said lever being spring biased in each direction to normally hold it in an intermediate position between said first and second power means.

6. In a fuel control system, the combination comprising, a fuel control means, a first power means for moving said control means to a first fuel supplying position, a second power means for holding said first power means in said fuel supplying position and movable to release said first power means to return said control means to a second position wherein fuel flow is discontinued, connections including a first switch closable upon energization of said first power means to partially complete a power circuit to said second power means, an igniter, connections including a second single pole double throw switch selectively operable by said second power means to partially complete a circuit to said first power means when said second power means is in its energized position or to partially complete a circuit to said igniter when said first power means is in its energized position, connections including a third switch for selectively completing a circuit to either the movable contact of said second switch or to said second power means, a source of electrical power, and connections including a fourth combustion responsive switch adapted to complete either a circuit from said source to main burner control means when fuel passing through said control means is burning or to partially complete a circuit from said source to said first power means when no fuel is burning.

7. In a fuel control system, the combination comprising, a fuel control means, a first power means for moving said control means to a fuel-flow position, a second power means for latching said first power means in said position but movable when energized to permit the moving of said control means to a no-flow position, connections including a first switch closable upon energization of said first power means to partially complete a power circuit to said second power means, an igniter, connections including a second single pole double throw switch for partially completing a power circuit to said first power means when said second power means is in its energized position or for completing a power circuit to said igniter when said first power means is in its energized position, connections including a third switch adapted to selectively complete a power circuit to either the movable contact of said second switch or to said second power means, a source of electrical power, connections including a fourth condition responsive switch for selectively completing either a circuit from said source of power to main burner control means when fuel is burning or a circuit from said source to said first power means when no fuel is burning, and connections including a fifth biased-open switch in the circuit between said second switch and said third switch adapted to be held closed only manually.

8. In a fuel control system, the combination comprising, a fuel control means, a first power means for moving said control means to a fuel-flow position, a second power means positioned to hold said first power means in said fuel-flow position but movable when energized to release said first power means to enable it to return said control means to a no-flow position, connections including a first switch which is closed by said first power means upon energization thereof to partially complete a power circuit to said second power means, an igniter, connections including a second single pole double throw switch adapted to selectively and partially complete a power circuit to said first power means when said second power means is in its energized position or to said igniter when said first power means is in its energized position, connections including a third switch adapted to selectively complete a power circuit to either the movable contact of said second switch or to said second power means, a line between said second and third switches, a source of electrical power, connections including a fourth condition responsive switch for selectively completing either a circuit from said source to load terminals of said control system when fuel is burning or a circuit from said source to said first power means when no fuel is burning, a line between said fourth switch and said first power means, and connections including signal means mounted adjacent said third switch and connecting said line between said second and third switches to said line between said fourth switch and said first power means.

9. In a control system for a fuel burner, the combination comprising, connections including a single pole double throw switch having two pairs of contacts, an electrically operable fuel valve, a circuit including an igniter electrically connected to said switch, a combustion responsive means having a hot contact and a cold contact, said cold contact being electrically connected to said fuel valve and igniter, said hot contact being connectable to control means for said fuel burner and connections including a control switch for completing a power circuit to said fuel valve, said double throw switch being so arranged as to have one pair of its contacts normally closed and in series with said fuel valve but biased to move when said fuel valve is opened to separate said one pair of contacts and thus break the circuit to said fuel valve and to complete the circuit to said igniter through the other pair of contacts on said double throw switch.

WALTER E. EDELMAN.

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