

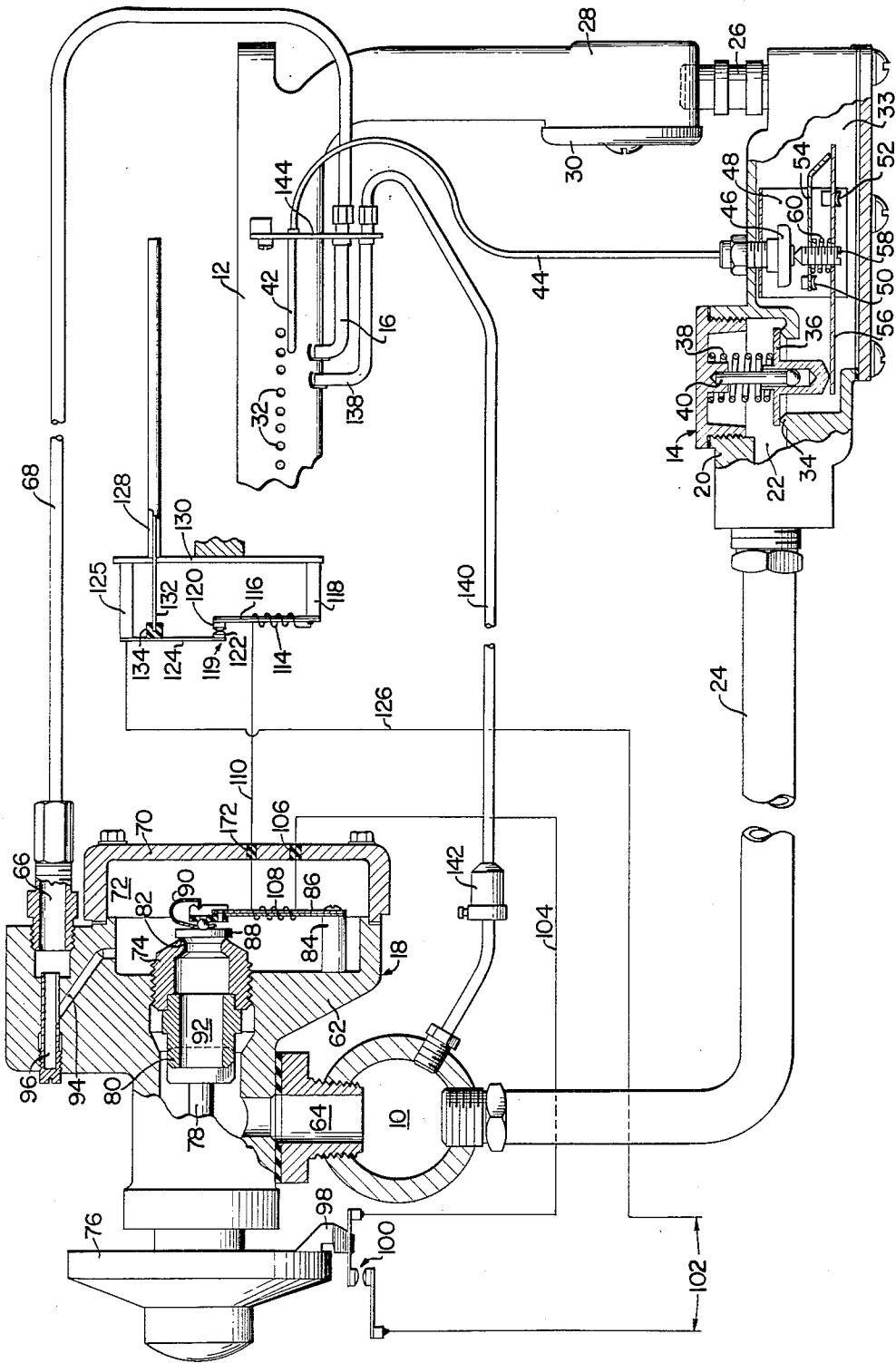
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BURNER FUEL CONTROL SYSTEM

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BURNER FUEL CONTROL SYSTEM

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This invention relates to burner fuel control systems and more particularly to systems adapted to control the flow of fuel to a burner in accordance with the temperature of the space being heated by the burner.

In burner control systems, especially domestic oven burner control systems, it is customary to use a thermostat responsive to the temperature of the space being heated for actuating a control device, such as a valve, to control the oven temperature. Many of the thermostats are filled with a thermally responsive fluid so that the maximum control temperature is limited to the "breakdown" temperature of the fluid being used, which temperature is in the range of 700° F.

Accordingly, it is an object of this invention to control the flow of fuel to a burner in such a manner that the maximum control temperature is higher than 700° F.

Another object of this invention is to control the temperature over a wide range of values by utilizing inexpensive components.

In the preferred embodiment of this invention, a pair of bimetals are heated by a corresponding pair of anticipatory heaters which are serially connected in a circuit which includes a thermally actuated switch responsive to the temperature of the space being heated. The bimetals and heaters are cycled to position a disc valve member proportional to the temperature of the space being heated. The disc valve member controls the flow of fuel to the burner of a controller pilot which actuates an automatic safety valve to control the flow of fuel to the main burner.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawing in which the single FIGURE is a somewhat schematic arrangement showing the preferred embodiment of this invention.

Referring now more particularly to the drawing, fuel is supplied from a gas supply manifold 10 to an oven burner 12 through an automatic safety valve 14 which is actuated by a flame burning at a controller pilot 16. The flow of gas from manifold 10 to controller pilot passes through and is controlled by a thermostatic control valve 18.

The safety valve 14 is provided with a casing 20 formed with an inlet 22 which is connected to one end of a conduit 24. The other end of conduit 24 is connected to manifold 10 to supply fuel to valve 14. Casing 20 is also formed with an outlet in which an adjustable orifice hood 26 is mounted for injecting a stream of high velocity gas into the mixing chamber 28 of burner 12 to entrain a flow of primary air through an adjustable air shutter 30 prior to delivery of the resultant combustible mixture to a plurality of burner ports 32.

Casing 20 embodies a central flow chamber 33 which extends between inlet 22 and the outlet to hood 28. A partition extends across a portion of chamber 33 and is formed with an annular valve seat 34. A valve member 36 is biased by a spring 38 towards engagement with valve seat 34 and cooperates with a guide pin 40 to move only in a plane perpendicular to the plane of valve seat 34.

Valve member 36 is actuated by thermally responsive means which includes a temperature sensing bulb 42 connected by a capillary tube 44 to an expansible power element 46 disposed within chamber 33 downstream from valve seat 34. Bulb 42, tube 44, and element 46 form a

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closed system which is preferably filled with mercury and in which bulb 42 is disposed in the path of the flame burning at controller pilot 16 so as to actuate power element 46 in response to the existence of a flame at the controller pilot 16.

A bracket 48 is mounted between power element 46 and casing 20 and is provided with a pair of pivots 50 and 52 about which a pair of levers 54 and 56, respectively, rotate. One end of lever 56 underlies valve member 36 and is adapted for operative engagement therewith. An adjusting screw 58 passes through an aperture in lever 56 and is threaded into lever 54 so as to abut power element 46 to transmit movement therefrom through levers 54 and 56 to valve member 36. A helical compression spring 60 extends between levers 54 and 56 to maintain adjusting screw 58 and lever 56 in engagement with power element 46 and valve member 36.

It will be obvious that safety valve 14 is either open or closed, dependent upon the existence of a flame at controller pilot 16. When fuel flowing from the pilot 16 is ignited, the heat of the flame vaporizes a portion of the mercury contained within bulb 42 and actuates power element 46 to rotate levers 54 and 56 with resultant clockwise movement of the end of lever 56 which engages valve member 36. This movement causes valve member 36 to open and allows gas to flow from manifold 10 to burner 12 so long as the flame continues to burn at pilot 16. When the flame at pilot 16 is extinguished, the mercury gas or vapor within bulb 42 condenses allowing spring 38 to move valve member 36 into engagement with valve seat 34 and rotate levers 56 and 54 counterclockwise.

Thermostatic valve 18 is provided with a casing 62 formed with an inlet 64, connected to manifold 10, and an outlet 66 connected to a conduit 68 which, in turn, is connected to controller pilot 16. Casing 62 is provided with an end cap 70 which partially defines a chamber 72 located downstream from the valve seat member 74. A manually rotatable control knob 76 is connected through a shaft 78 to a connector 80 which transmits rotation from knob 76 to valve seat member 74. Valve seat member 74 is exteriorly threaded and is screwed into an interiorly threaded portion of casing member 62 so that rotation of knob 76 causes axial movement of a valve seat 82, formed on valve seat member 74.

A support stud 84 is carried by a wall of chamber 72 and is connected to one end of a bimetal 86 which has a floating disc valve member 88 mounted on the other end through a floating disc, spring-clip and ball assembly 90. Bimetal 86 is biased so that when it is cool, it will hold the valve member 88 closed for all positions of valve seat 82.

Connector 80 is formed with an axial passage 92 which communicates with inlet 64 and which is adapted to communicate with chamber 72 through valve seat 82. A passage 94 extends from chamber 72 to outlet 66 for conducting fuel to controller pilot 16 through valve 18 and is provided with an adjusting screw 96 by means of which the flow rate to outlet 66 may be adjusted.

Control knob 76 may be provided with suitable indicia corresponding to the temperature to be maintained in the space being heated by burner 12. Knob 76 is also provided with a cam 98 which is adapted to close normally-open switch means 100 when control knob 76 is turned to an "on" position. Switch means 100 is operably connected to one side of a pair of electric power leads 102 and to one end of a wire 104 which extends through an insulation bushing 106 mounted within plate 70. The other end of wire 104 is connected to an anticipatory heater 108 which in this embodiment is shown as being wrapped around bimetal 86.

Heater 108 is connected to one end of a wire 110 which extends through an insulation bushing 172 mounted in

cap 70. The other end of wire 110 is connected to an anticipatory heater 114 which is also shown as being wound around a bimetal 116 in this embodiment. Bimetal 116 is held stationary at one end by a stud 118 and is connected to a switch 119 comprising a contact 120 which cooperates with another contact 122 carried on the movable end of a flexible contact blade 124. A wire 126 is connected at one end to contact blade 124 and is connected at the other end to the other side of the power leads 102. The other end of anticipatory heater 114 is connected to bimetal 116 to form a circuit which passes through switch 119. Contact blade 124 is connected at one end to a stationary support stud 125 and is positioned to bias contacts 120 and 122 towards one another when bimetal 116 is cool.

Thermostatic means are provided and are arranged to be responsive to the temperature of the space being heated by burner 12. This thermostatic means comprises an outer tube 128, held stationary by a bracket 130, and a rod 132 connected at one end to one end of tube 128 and connected at the other end to an insulation bushing 134 mounted on contact blade 124. Tube 128 and rod 132 are constructed from materials having different coefficients of expansion so that the free ends thereof are positioned relative to one another in an amount proportional to the temperature thereof. Since this thermostatic means is of the rod-and-tube type and thus does not include any fluid, it is adapted to control temperatures higher than 700° F., which is the accepted limit for known fluid-filled types.

A continuously burning standby pilot 138 is connected by a conduit 140 through a device 142 to manifold 10. Device 142 includes a conventional filter and gas cock for adjusting the flow rate to standby pilot 138. Controller pilot 16, standby pilot 138 and bulb 42 are mounted and are held stationary by a bracket 144. Standby pilot 138 is so arranged that the flame thereat ignites gas flowing from controller pilot 16 which in turn ignites gas flowing from burner ports 32.

As shown in the drawing, the system is in an "off" condition. To initiate operation, control knob 76 is turned to the desired temperature setting. This movement positions valve seat 82 an amount corresponding to the control temperature to be maintained. This movement also causes cam 98 to close switch means 100 so that current flows through heaters 108 and 114 and switch 119. Bimetal 86 is disposed with the material having the higher coefficient of expansion on the side adjacent to valve seat 82 so that upon an increase in temperature, disc valve member 88 is moved away from valve seat 82 allowing gas to flow from manifold 10 to chamber 72, passage 94, outlet 66, and to conduit 68 to controller pilot 16.

The gas flowing from controller pilot 16 is ignited thereby causing valve 14 to be opened by operation of lever 56 by power element 46 to admit gas from manifold 10 to burner 12. Bimetal 116 is arranged with the material having the higher coefficient of expansion on the side adjacent to contact 122 so that sufficient heating of heater 114 causes contact 120 to move away from contact 122 and open the electrical circuit. When the electrical circuit is open, heaters 108 and 114 cool and allow bimetal 116 and 86 to move towards their normal unheated positions. This causes contact 120 to move into engagement with contact 122 to close the electrical circuit and reenergize heaters 108 and 114. As the temperature of the space being heated increases, contact blade 124 moves contact 122 away from contact 120 to decrease the necessary time required for bimetal 116 to break the electrical circuit. Therefore, as the temperature of the space being heated increases, the periods of electrical impulses through the heaters become shorter. This results in bimetal 86 moving disc valve member 88 to an average position which is closer to valve seat 82.

For any heated position of contact arm 124, the pulse

rate of energization of the heaters causes disc valve member 88 to assume a position proportional to the temperature of the heated enclosure. Therefore, by adjusting valve seat member 74 in relation to disc valve member 88, the gas flow can be adjusted in relation to a predetermined temperature setting for the enclosure. When this temperature is satisfied, the gas flowing to controller pilot 16 is interrupted by disc valve member 88 closing against valve seat 82. Consequently, bulb 42 is cooled and valve 14 is closed to prevent the flow of fuel to burner 12. The flow of fuel to burner 12 subsequently occurs only when necessary to maintain the preselected control temperature.

It will be obvious that the temperature limitations of this system are determined by the material selected for constructing tube 128 and rod 132, and also upon the temperature of vaporization of the mercury within bulb 42. This temperature is ordinarily sufficiently high so that the ambient temperature of the oven or space being heated causes rapid closing and opening of valve 14.

It will be apparent to those skilled in the art that many changes and modifications may be made in the details of construction and arrangement of parts without departing from the scope of the invention as defined in the appended claims.

I claim:

1. In a heating system having a main burner, the combination comprising, a controller pilot disposed adjacent said main burner, thermostatic valve means adapted for controlling flow to the main burner and being responsive to the flame of said controller pilot, said valve means being operable when open to permit fuel to flow to said burner and being operable when closed to prevent fuel flow to said burner, thermostatic means responsive to the temperature of the space being heated, heater actuated bimetallic means operatively connected to said thermostatic means and adapted for regulating flow to said controller pilot, and control means adapted for setting an indicated temperature and for varying the regulation of said bimetallic means.

2. In a burner fuel control system, the combination comprising: a control valve means, a first bimetallic element being operatively connected to said control valve means and being adapted for controlling a flow of fuel through said control valve means, a thermal responsive device being adapted to move a first movable contact, a second bimetallic element including a second movable contact being adapted for cooperation with said first movable contact, serially connected heater means operatively associated with said first and second bimetallic elements respectively for heating said bimetallic elements and being operatively connected by a heater circuit to said first and second movable contacts for energization thereby, and control switch means being adapted for indicating a desired temperature of said thermal responsive device and for energizing said heater circuit whereby said heaters are energized to simultaneously regulate fuel flow through said control valve means and to intermittently separate said first and second contacts, said heater means thereby being energized in intermittent time intervals which time intervals are directly proportional to the difference in temperature recorded by said thermal responsive device and said indicated temperature.

3. In a burner fuel control system having a burner, the combination comprising: pilot means adapted to ignite fuel flowing from said burner, first valve means movable between an open position wherein the fuel flows to said burner and a closed position wherein fuel is prevented from flowing to said burner, thermally responsive means operatively connected to actuate said first valve means between positions in response to a flame burning at said pilot means, control valve means including a valve member adapted for setting the temperature to be maintained in the space being heated by said burner by regulating the flow of fuel to said pilot means, first bimetallic

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means operatively connected to said valve member and being adapted for displacing said valve member from said valve seat upon an increase in temperature, a thermal responsive device being disposed to respond to the temperature of the space being heated, a first movable contact actuated by said thermal responsive device, a second bimetallic means, a second movable contact mounted on said second bimetallic means and adapted for cooperation with said first movable contact upon a decrease in temperature of said second bimetallic means, serially connected first and second heater means operatively associated with said first and second bimetallic means, respectively, and being operatively connected to said first and second movable contacts for energization thereby, and control switch means operatively connected to said heaters for controlling the energization thereof, said heaters being simultaneously energized for intermittent time intervals upon engagement of said first and second contacts, which time intervals are directly proportional to the difference in temperature recorded by said thermal responsive device and said indicated temperature whereby fuel flow to said pilot means is substantially proportional to the time interval of engagement of said first and second contacts to thereby actuate said first valve means between control positions to control said burner at full fuel input.

4. The device of claim 3 in which a movable valve seat member cooperates with said valve member of said control means to regulate fluid flow to said burner pilot, said movable valve seat member operatively connected to said control switch means whereby said control switch means simultaneously energizes said heaters and moves said valve seat member to vary the distance between said valve member and said valve seat to increase fluid flow for obtaining an increase in temperature at said burner pilot means.

5. In a burner fuel control system, the combination comprising: a main conduit means for supplying fuel to a burner, a bypass conduit means for supplying fuel to a control pilot, a control valve means intersecting said bypass conduit means and being adapted for regulating fuel to said control pilot, a first thermally responsive device being responsive to the flame at said control pilot and being operatively connected to a first valve means for controlling fuel flow through said main conduit means, a first heater actuated bimetallic element being operatively connected to a movable valve member of said control valve means and being adapted for regulating flow therethrough upon energization of said heater, a second thermally responsive device being responsive to the space being heated by said burner and being operatively connected for moving the first of a pair of contacts, a second heater actuated bimetallic element having a second contact disposed thereon adapted to cooperate with said first contact, a series circuit operatively connecting the heaters of said first and second bimetallic elements and said first and second contacts, and a control valve means actuator for determining a desired temperature of the space being heated operatively connected to said control valve means and being adapted to simultaneously energize said series circuit, said second bimetallic element being adapted in its heated condition to deenergize said second contact from said first contact, said second thermally responsive device being adapted to bias said first contact away from said second contact upon an increase in temperature whereby said first and second contacts are intermittently engaged for decreasing increments of time to decrease the fuel flow to said control pilot whereby full fuel supply flow is intermittently interrupted as the space being heated reaches the desired temperature.

6. In a system for controlling the full flow of fuel to a burner for heating a space, the combination comprising, first valve means movable between an open and a closed position for respectively permitting and blocking the flow of fuel to the burner, pilot means supplied with

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fuel by a bypass conduit, means responsive to a flame burning at said pilot means for actuating said first valve means, a valve member being mounted on a bimetallic element and adapted for cooperation with a movable valve seat member in a reduced temperature condition to regulate fuel flow through said bypass conduit to said pilot means, a second bimetallic element having a first contact located thereon and being adapted for movement therewith, a thermally responsive device being adapted for moving a second contact relative to said first contact, said second bimetallic element and said thermally responsive device being adapted to tend to engage said first and second contacts in a reduced temperature condition, serially connected heaters being disposed adjacent said first and second bimetallic elements and being adapted for energization by said first and second contacts, control valve actuator means being adapted to simultaneously energize said serially connected circuit and to displace said movable valve seat member from said valve member an amount in proportion to the movement of said actuator, said first and second bimetallic elements being intermittently heated by said first and second heaters to cycle said valve member and said first contact relative to said movable valve seat and said second contact respectively, said second contact being displaced a greater distance by said thermally responsive device in response to an increase in temperature whereby intervals between cycles are increased for moving said valve member into closer proximity with said valve seat member to regulate fluid flow to said pilot means.

7. In a burner fuel control system, the combination comprising a controller pilot, a standby pilot operably disposed for igniting fuel flowing from said controller pilot and from the burner, automatic safety valve means responsive to a flame at said controller pilot for controlling the flow of fuel to the burner, valve means including a movable valve seat member for controlling the flow of fuel to said controller pilot and a bimetal carried valve member being movable relative to said valve seat member, said valve means and said bimetal valve member being disposed outside the space being heated by said burner, thermostatic means disposed in said space being heated by said burner to be responsive to the temperature of said space being heated, said thermostatic means being remotely located from and operatively interconnected to said bimetal of said valve member to vary the position of said valve member relative to said valve seat member in accordance with the temperature of said space being heated, and a temperature setting means operatively connected to move said valve seat member to a set point corresponding to the temperature to be maintained in the heated space by the burner whereby said temperature of the heated space modulates said valve member relative to said valve seat member to control fuel flow to said controller pilot, said movable valve seat member being displaced a greater distance from said valve member for obtaining high temperatures in the heated space.

8. In a burner fuel control system, the combination comprising: pilot means adapted to ignite fuel flowing from the burner; first valve means movable between an open position wherein fuel flows to the burner and a closed position wherein fuel is prevented from flowing to the burner, said first valve means including biasing means for moving said valve means from said open position to said closed position; thermally responsive means operatively connected to move said first valve means from said closed position to said open position upon ignition of fuel flowing from said pilot means, said thermally responsive means being operable to hold said valve means open so long as a predetermined flame continues to burn at said pilot means; second valve means including a valve seat member movable between positions for setting the temperature to be maintained in the space being heated by the burner, a valve member movable relative to said valve seat member for controlling the flow of fuel from

the fuel supply to said pilot means, a bimetallic element upon which said valve member is mounted for movement therewith in response to changes in temperature thereof, manually operable means being adapted for setting the temperature and being connected to move said valve seat member; first switch means adapted to be closed when said manually operable means is turned to an on position; second switch means including first and second contacts, said first contact being carried by a flexible contact blade and a second contact being carried by a second bimetallic element, a pair of anticipatory heaters operatively connected to heat said bimetallic elements, said heaters and said switch means being serially connected and being adapted to be connected to a source of power; and a high temperature sensing element being spaced adjacent said burner and being adapted to move said first contact and said contact blade between posi-

tions which movement is proportional to the temperature of said temperature sensing element whereby fuel flow to said pilot means is directly proportional to the difference between the indicated temperature and the actual temperature of the space being heated for controlling the pilot flame which pilot flame controls the actuation of said first valve means.

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