

[54] **OVEN CONTROL SYSTEM AND PARTS THEREFOR OR THE LIKE**

[75] Inventors: **Charles D. Branson**, Greensburg;
Francis S. Genbauffe, Irwin, both of Pa.

[73] Assignee: **Robertshaw Controls**, Richmond, Va.

[22] Filed: **Sept. 15, 1972**

[21] Appl. No.: **289,305**

Related U.S. Application Data

[62] Division of Ser. No. 93,540, Nov. 30, 1970, Pat. No. 3,703,988.

[52] U.S. Cl. **236/15 A, 126/39 C, 236/99**

[51] Int. Cl. **F23n 1/00**

[58] Field of Search **236/15 A, 46 D, 99; 126/39 C**

[56] **References Cited**

UNITED STATES PATENTS

3,123,298	3/1964	Wolfe	236/46
3,504,660	4/1970	McArthur, Jr. et al.	126/21
3,469,567	9/1969	Berquist	236/15 A

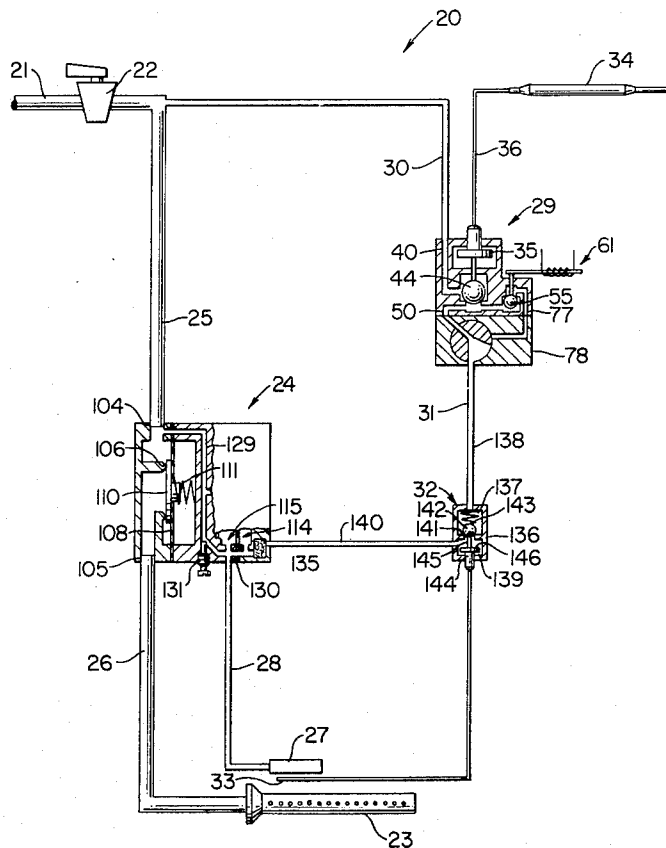
Primary Examiner—William E. Wayner

Attorney, Agent, or Firm—Candor, Candor & Tassone

[57] **ABSTRACT**

A fuel control system for an oven having a source of fuel and main burner means. A pneumatically operated main valve is utilized for interconnecting the source to the burner when the main valve is actuated and for disconnecting the source from the main burner when the main valve is deactuated. A manually settable and thermostatically operated valve is provided for interconnecting a pneumatic control signal to the main valve to actuate the same when a temperature effect of the burner is below a set temperature effect and for disconnecting the pneumatic control signal from the main valve to deactuate the same when the temperature effect of the burner is above the set temperature effect, the thermostatically operated valve having a manually settable construction for controlling the cooking temperature effect of the burner and having a modifying construction for modifying the manually settable construction for controlling a burn-off cleaning temperature effect of the burner.

15 Claims, 12 Drawing Figures



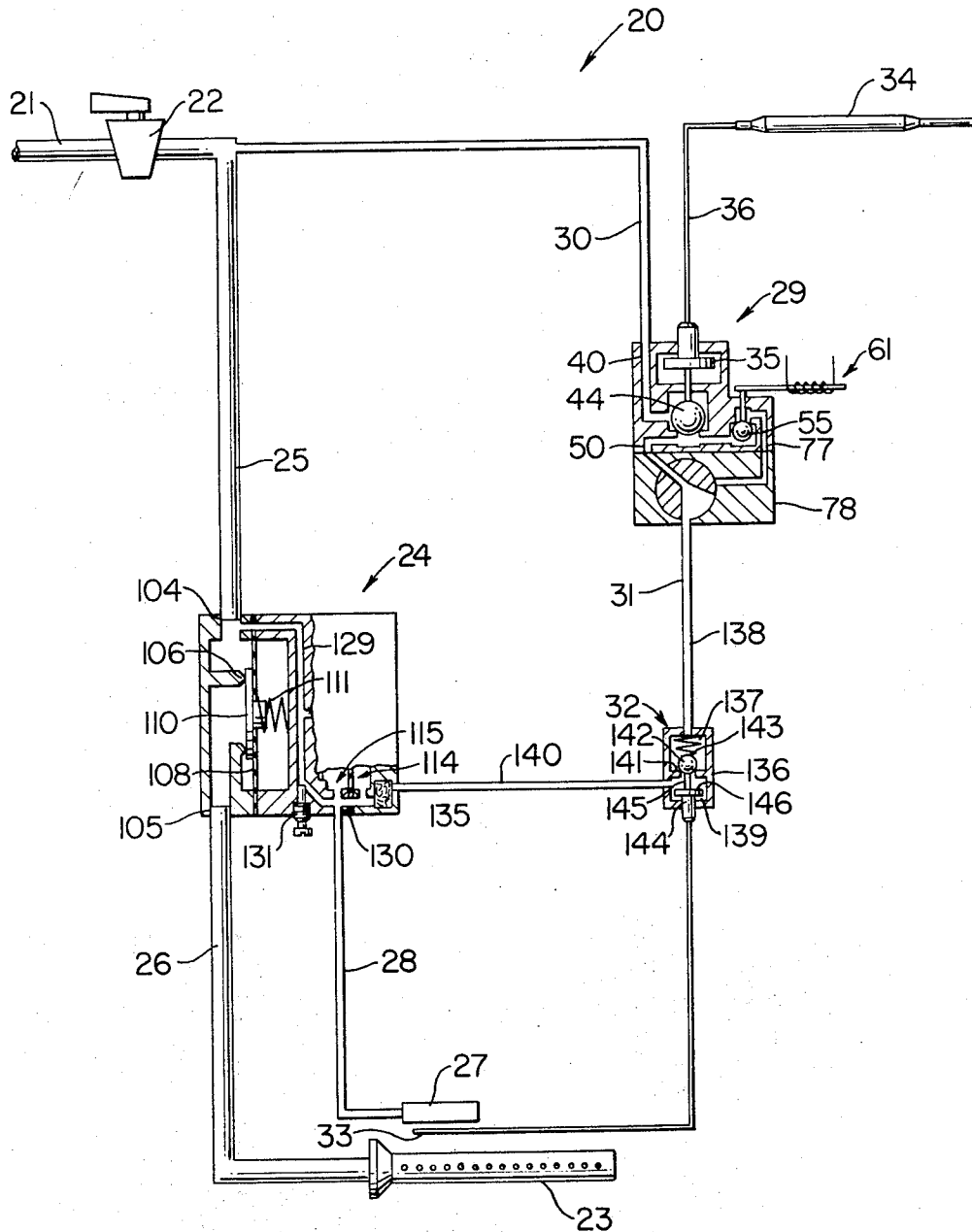


FIG. 1

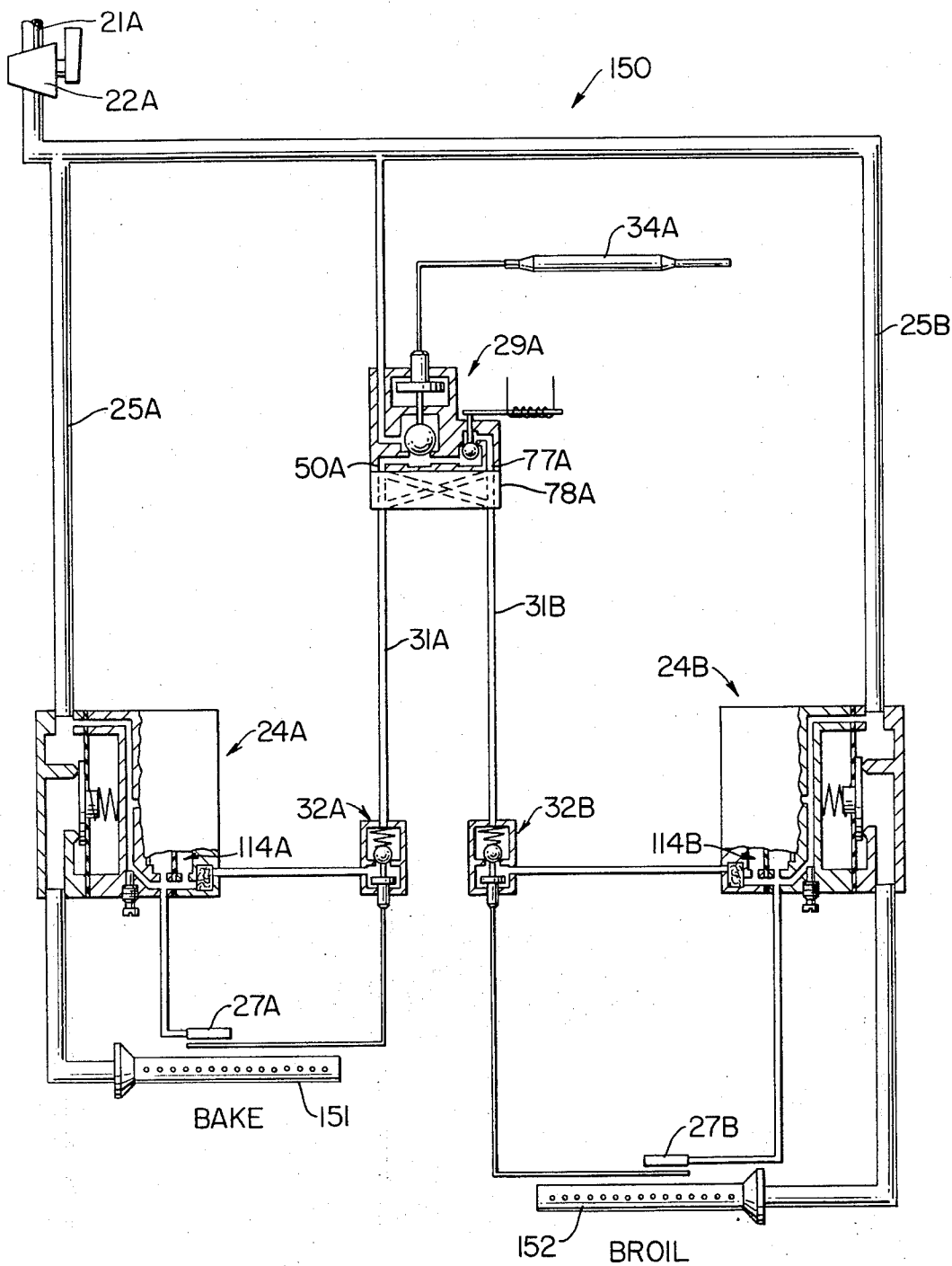


FIG. 2

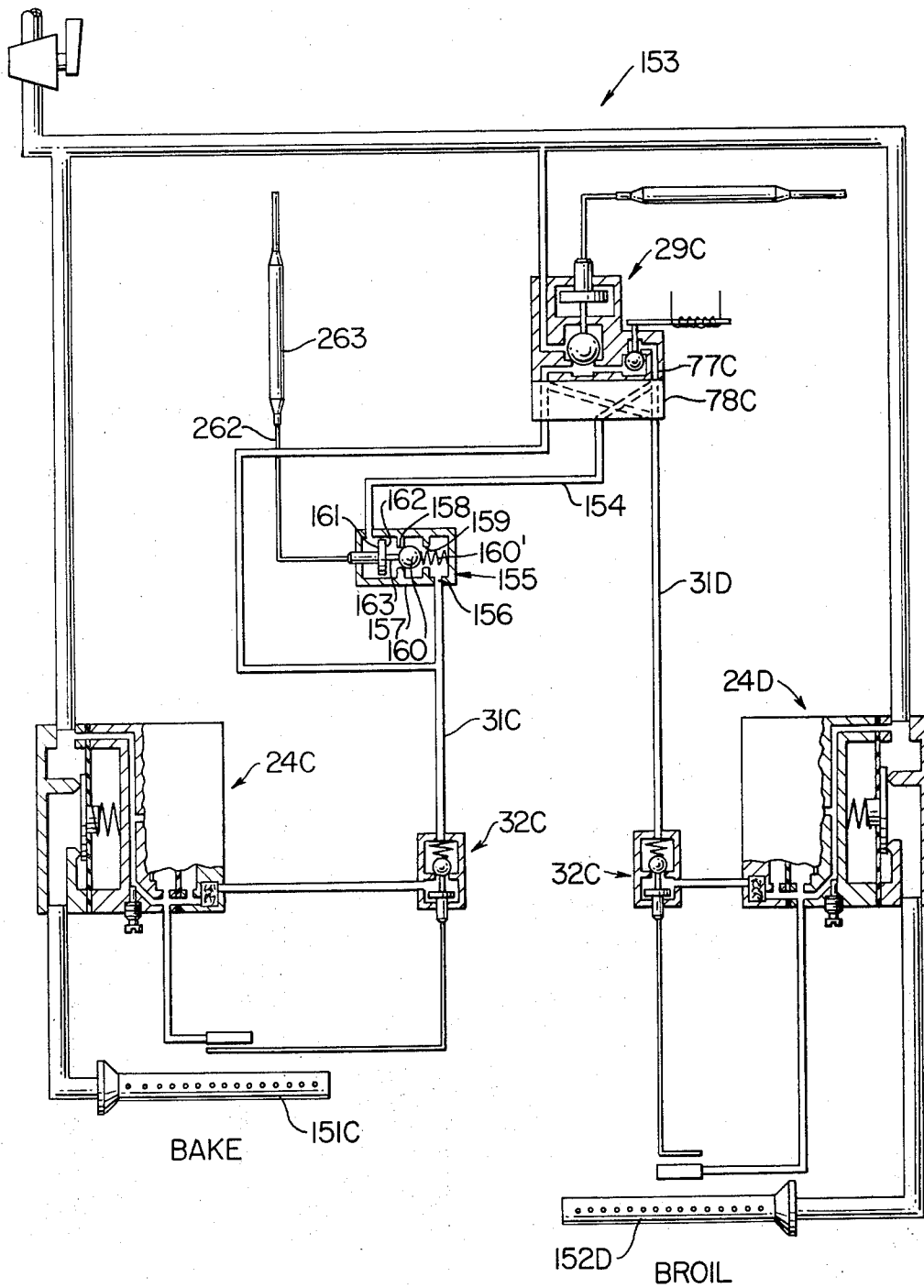


FIG.3

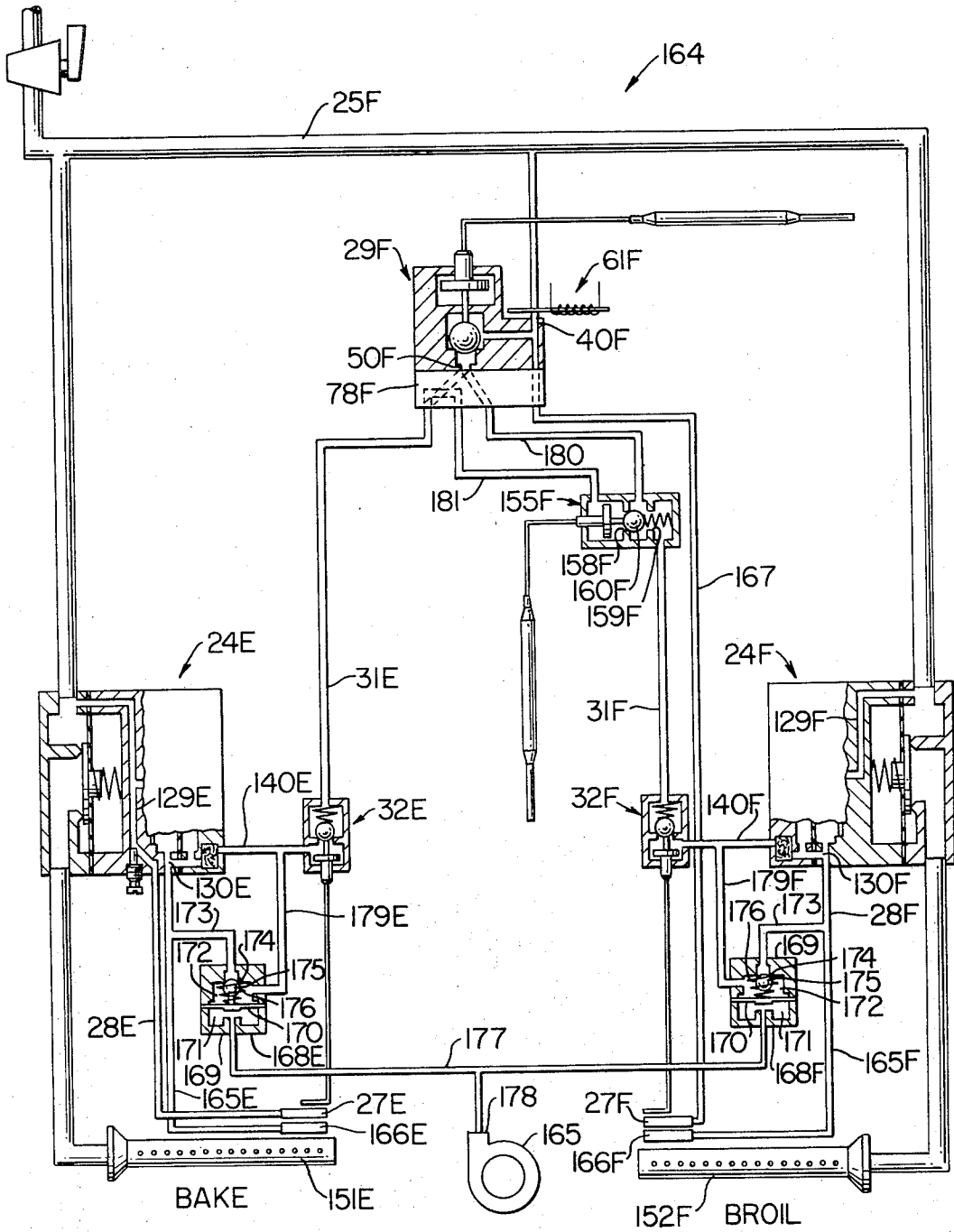
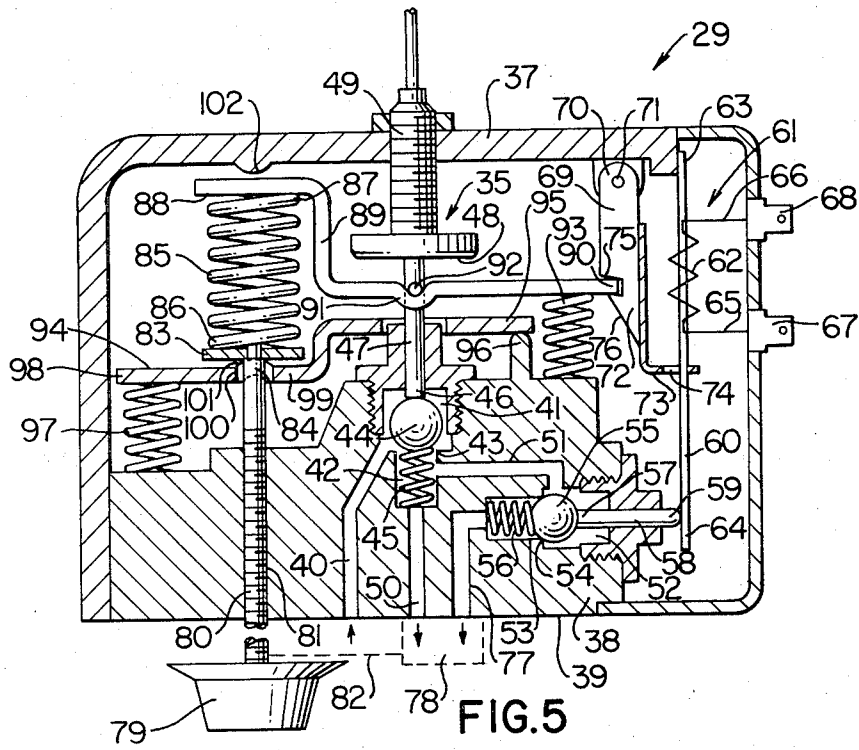
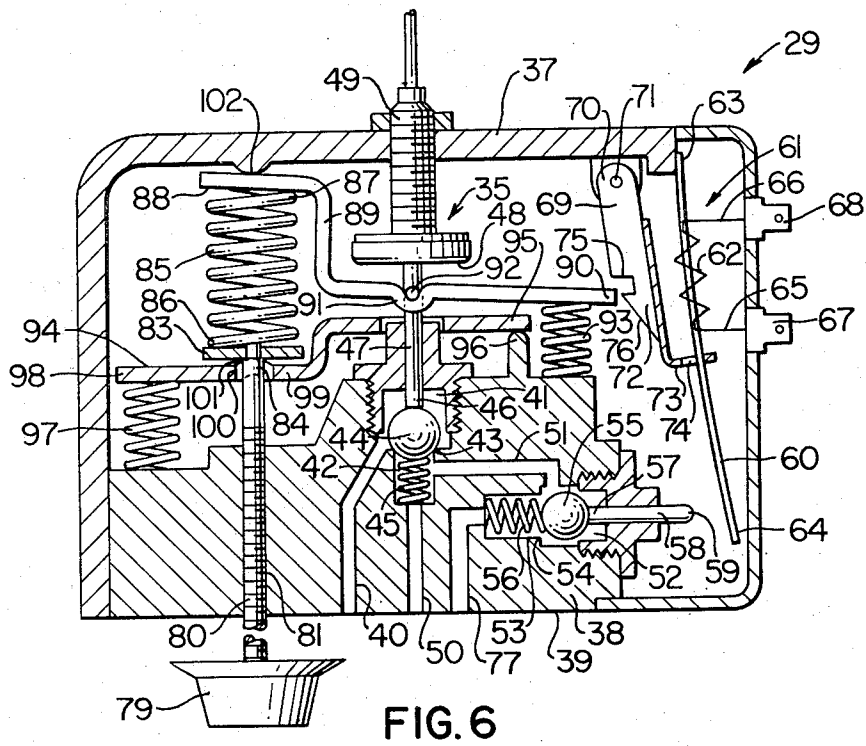
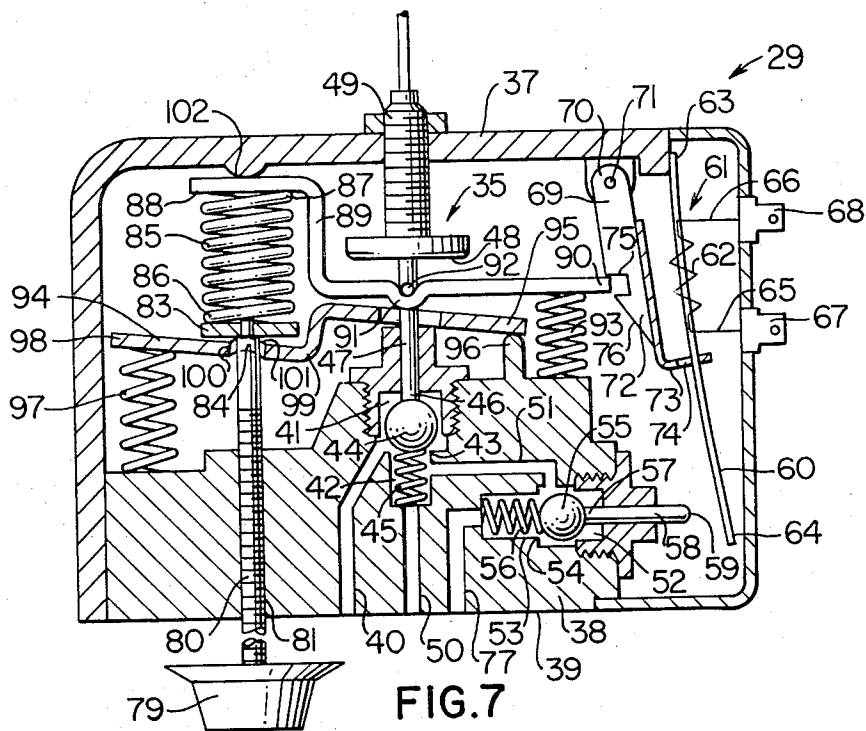
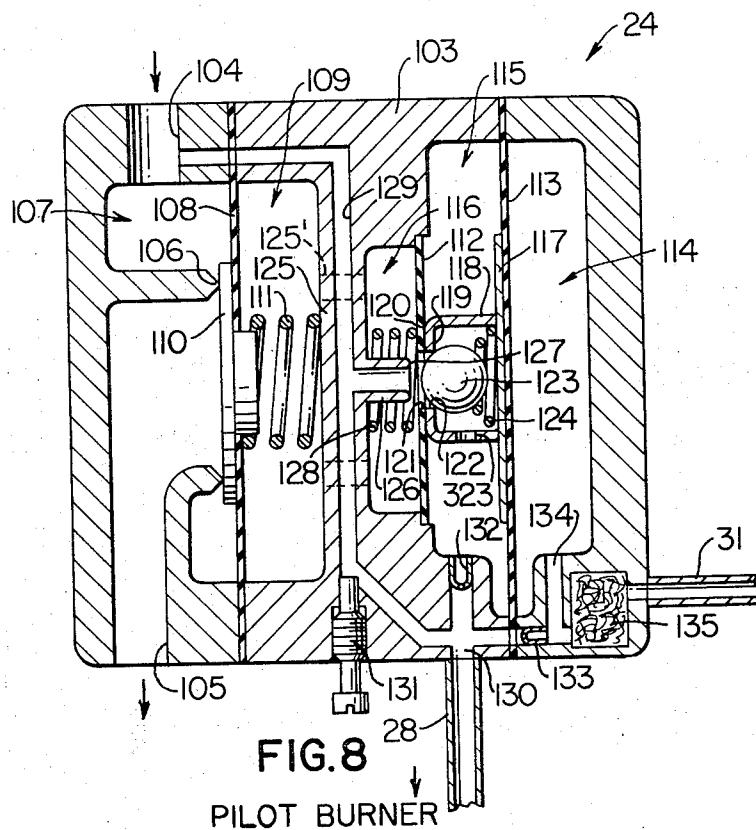


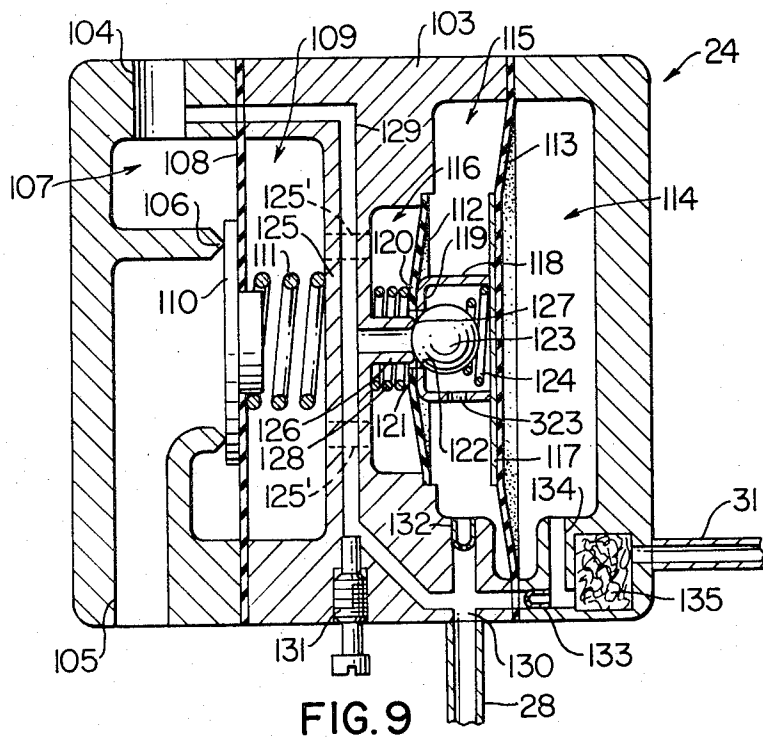
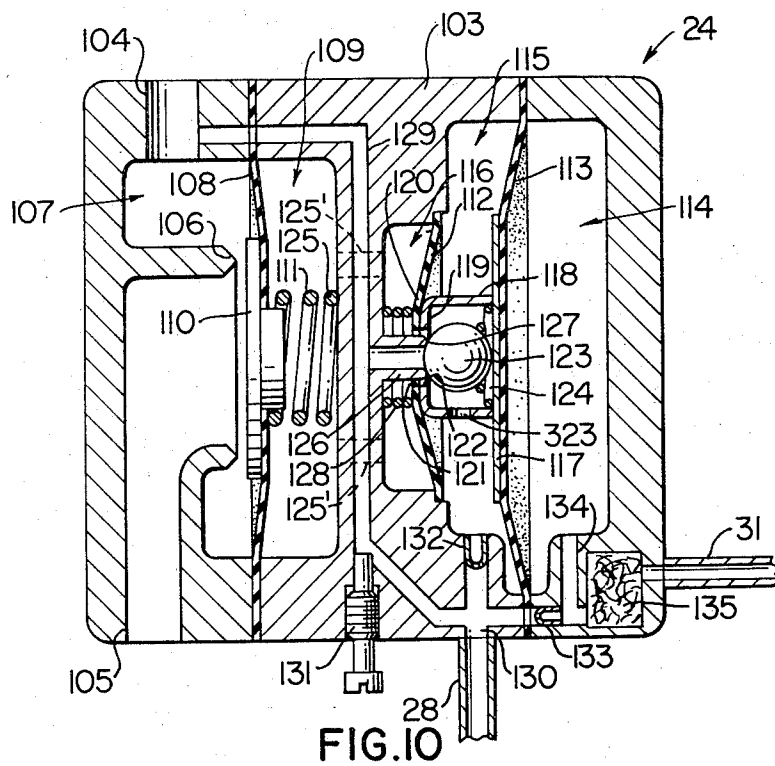
FIG. 4

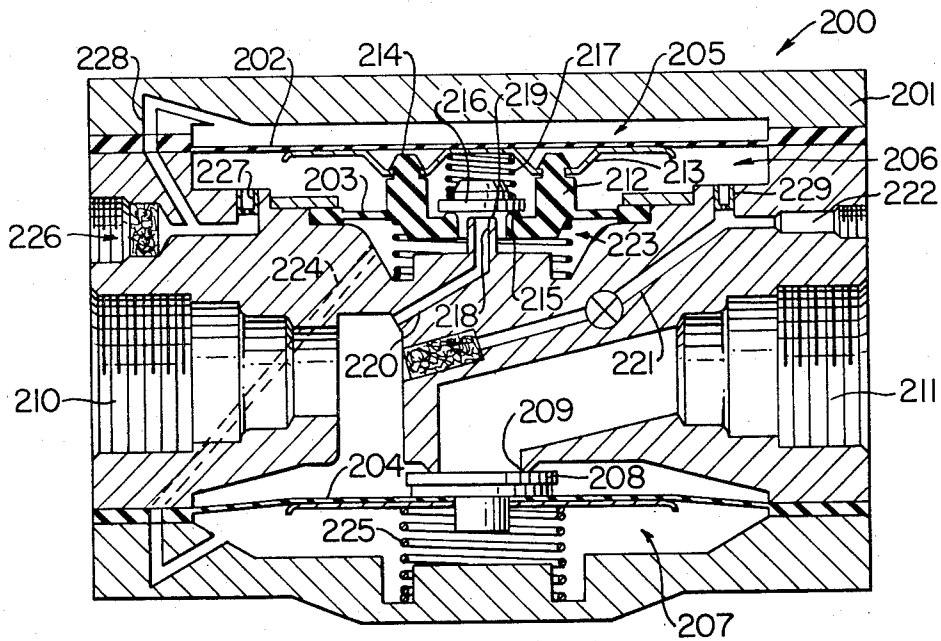
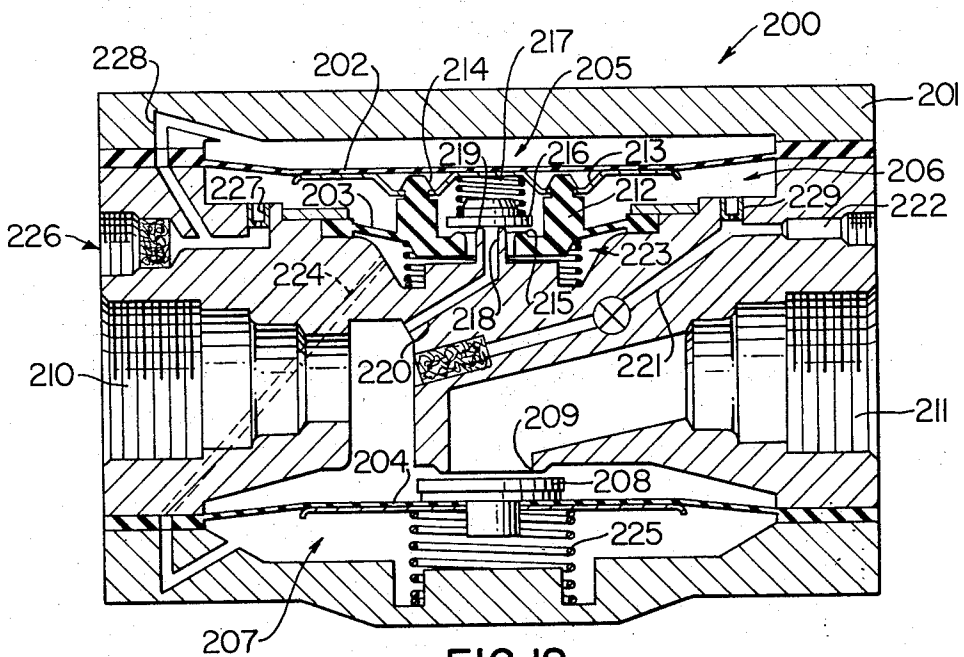


SHEET 6 OF 8



SHEET 7 OF 8





OVEN CONTROL SYSTEM AND PARTS THEREFOR OR THE LIKE

This is a division of application Ser. No. 093,540, filed Nov. 30, 1970, now U.S. Pat. No. 3,703,988.

This invention relates to a control system for an oven as well as to improved parts for such a control system or the like.

One of the features of this invention is to provide a fuel control system for an oven wherein the main control device is adapted to permit the operation of the fuel control system for normal cooking operations as well as for high temperature burn-off cleaning operations.

Another feature of this invention is to provide such a fuel control system wherein both a bake burner means and a broil burner means are disposed in the same oven cavity.

Another feature of this invention is to provide such a fuel control system wherein only one of the burners is initially operated during a burn-off cleaning operation until after the temperature effect in the oven reaches a predetermined temperature below the burn-off temperature at which predetermined temperature the other burner means is then operated simultaneously with the one burner means.

Another feature of this invention is to provide such a fuel control system wherein once the burn-off cleaning temperature effect is produced in the oven, the control system cycles on and off only one of the burner means while providing continuous operation of the other burner means to maintain the temperature in the oven at the burn-off cleaning temperature.

Another feature of this invention is to provide improved controls for such control systems or the like.

In particular, one embodiment of this invention provides a fuel control system for an oven that has a source of fuel and a main burner means, the control system including a pneumatically operated main valve means for interconnecting the source to the burner means when the main valve means is opened by the main valve means being actuated and for disconnecting the source from the burner means when the main valve means is closed by the main valve means being deactuated. A manually settable and thermostatically operated valve means is provided for interconnecting a pneumatic control signal to the main valve means to actuate the same when the thermostatically operated valve means senses a temperature effect of the burner means below a set temperature effect of the thermostatically operated valve means and for disconnecting the pneumatic control signal from the main valve means to deactuate the same when the thermostatically operated valve means senses a temperature effect of the burner means above the set temperature effect. The thermostatically operated valve means has manually settable means for controlling a cooking temperature effect of the burner means and has modifying means for modifying the manually settable means for controlling a burn-off cleaning temperature effect of the burner means. Such modifying means is also adapted to modify the manually settable means for controlling a warmth retaining and non-cooking temperature effect of the burner means. The modifying means can comprise a heat motor.

Accordingly, it is an object of this invention to provide an improved oven control system having one or

more of the novel features set forth above or hereinafter shown or described.

Another object of this invention is to provide an improved control device for such a control system or the like, the improved control device of this invention having one or more of the novel features set forth above or hereinafter shown or described.

Other objects, uses and advantages of this invention are apparent from a reading of this description which proceeds with reference to the accompanying drawings forming a part thereof and wherein:

FIG. 1 is a schematic view illustrating one embodiment of the oven control system of this invention.

FIG. 2 is a view similar to FIG. 1 and illustrates another embodiment of the fuel control system of this invention.

FIG. 3 is a view similar to FIG. 1 and illustrates another embodiment of the oven control system of this invention.

FIG. 4 is a view similar to FIG. 1 and illustrates another embodiment of the oven control system of this invention.

FIG. 5 is a schematic cross-sectional view illustrating an improved control device that is utilized in the oven control system of FIGS. 1-4.

FIG. 6 is a view similar to FIG. 5 and illustrates the control device in a keep warm setting position thereof.

FIG. 7 is a view similar to FIG. 5 and illustrates the control device in a burn-off oven cleaning position thereof.

FIG. 8 is a schematic cross-sectional view illustrating the main valve structure utilized in the oven control system of FIGS. 1-4.

FIG. 9 is a view similar to FIG. 8 and illustrates an intermediate operating position of the main valve means.

FIG. 10 is a view similar to FIG. 8 and illustrates the main valve means in an open condition thereof.

FIG. 11 is a view similar to FIG. 8 and illustrates another embodiment of the main valve means of this invention.

FIG. 12 is a view similar to FIG. 11 and illustrates the main valve means of FIG. 11 in an open condition thereof.

While the various features of this invention are hereinafter described and illustrated as being particularly adapted to provide control means for a fuel burning cooking apparatus, it is to be understood that the various features of this invention can be utilized singly or in any combination thereof to provide control means for other devices as desired.

Therefore, this invention is not to be limited to only the embodiments illustrated in the drawings, because the drawings are merely utilized to illustrate some of the wide variety of uses of this invention.

Referring now to FIG. 1, an improved oven control system of this invention is generally indicated by the reference numeral 20 and comprises a fuel source manifold 21 having the conventional on-off valve means 22 therein, a main burner means 23, a main valve means 24 for interconnecting the fuel source 21 by means of an inlet conduit means 25 to an outlet conduit means 26 that leads to the main burner 23, a pilot burner means 27 being adapted to be continuously supplied fuel from the inlet conduit 25 through the main valve means 24 and to a conduit means 28 leading to the pilot

burner 27 so that the pilot burner 27 can ignite fuel issuing from the main burner means 23, a main control device 29 for directing a control signal from the source conduit 25 by way of a conduit 30 to a conduit means 31 that leads to the main valve means 24 so as to actuate the main valve means 24 and interconnect the inlet conduit 25 with the outlet conduit 26 and for disconnecting that control signal from the main valve means 24 to cause the main valve means 24 to disconnect the inlet conduit 25 with the outlet conduit 26, a safety valve means 32 disposed in the control signal conduit 31 for preventing the passage of a control signal therethrough unless a detector portion 33 thereof detects the existence of flame means at the pilot burner 27, and a temperature sensing bulb 34 interconnected to an expandible and contractible power element 35 of the main control device 29 by a capillary tube 36 whereby the temperature sensing bulb 34 senses the output temperature effect of the burner means 23 in the oven (not shown) utilizing the same.

In general, the main control device 29 of the control system 20 can be manually set by the housewife or the like at any desired cooking temperature and the same will cause the opening and closing of the main valve means 24 so as to cycle the main burner means 23 off and on to maintain the temperature output effect of the oven at the selected output temperature. In addition, the main control device 29 can be set at a high temperature burn-off cleaning operation position thereof whereby the main control device 29 will cause the main valve means 24 to cycle on and off the main burner means 23 so as to produce a high temperature burn-off cleaning temperature effect in the oven, such as 900° F or the like.

The main control device 29 also includes means for automatically modifying the setting of the same to produce a warmth-retaining and non-cooking temperature in the oven by cycling the main valve means 24 to produce such warmth-retaining and non-cooking temperature in the oven as will be apparent hereinafter. Of course, the control device can be initially set for a warmth-retaining and non-cooking temperature, if desired.

Referring now to FIGS. 5, 6 and 7, the main control device 29 comprises a housing means 37 containing a valve block portion 38 provided with a valve surface 39 interrupted by an inlet passage 40 that is adapted to be interconnected to the conduit 30 of the control system 20 in any suitable manner and leads to a chamber 41 in the valve block 38 that is adapted to be interconnected to another chamber 42 therein by a valve seat 43. The valve seat 43 is adapted to be opened and closed by a ball valve 44 normally urged to an open position by a compression spring 45 disposed in the chamber 42 whereby the compression spring 45 tends to force the ball valve 44 against an end 46 of a stem 47 carried by a movable wall 48 of the power element 35 that has its threaded portion 49 adjustably fixed to the housing means 37 in a conventional manner.

The chamber 42 in the valve block 38 is interconnected to a pair of passages 50 and 51 with the passage 50 leading to and interrupting the valve surface 39 of the block 38 and with the passage 51 leading to another chamber 52 in the valve block 38.

The chamber 52 in the valve block 38 is adapted to be interconnected to another chamber 53 in the valve block 38 by a valve seat 54, the valve seat 54 being

adapted to be opened and closed by a ball valve 55 normally urged to an open position by a compression spring 56 disposed in the chamber 53 whereby the force of the compression spring 56 urges the ball valve 55 against an end 57 of a pin 58 having its other end 59 engageable by a bimetal blade 60 of a modifying means 61 of the control device 29 carried by the housing means 37 thereof and in the embodiment illustrated in FIGS. 5-7 comprising a heat motor arrangement.

In particular, the heat motor arrangement 61 includes a heating coil 62 for the bimetal blade 60 which has one end 63 thereof secured to the housing means 37 and the other end 64 thereof free from the housing means 37 and being adapted to engage against the end 59 of the pin 58. When the blade 60 is unheated, the natural warp thereof tends to urge the end 64 of the blade 60 to the left in FIG. 5 so as to continuously bear against the pin 58 and overcome the force of the compression spring 56 so as to maintain the ball 55 seated against the valve seat 54. However, when current is permitted to flow through the coil 62 which has its opposed ends 65 and 66 respectively interconnected to externally extending terminals 67 and 68, the heat produced by the coil 62 causes the blade 60 to warp to the right in the manner illustrated in FIGS. 6 and 7 to not only move the end 64 of the blade 60 away from the pin 58 so as to permit the compression spring 53 to open the ball valve 55 away from the valve seat 54, but also to carry therewith a latch member 69 having one end 70 thereof pivoted to the housing means 37 by a pivot pin 71 and the other end 72 thereof carrying a member 73 having an opening 74 passing therethrough and receiving the blade 60 therethrough. The latch member 69 has a notch 75 therein and a cam surface 76 adjacent the notch 75 for a purpose hereinafter described.

The chamber 53 in the valve block 38 is interconnected to a passage 77 that also interrupts the valve surface 39 of the valve block 38. A valve member 78 is disposed against the valve surface 39 and is illustrated in FIG. 5 as being a slide disc valve and schematically in FIG. 1 as being a cock or plug valve. However, it is to be understood that the valve member 78 can be of any desired configuration as the purpose thereof is merely to interconnect one of the passages 50 or 77 to the conduit 31 while blocking the other of the passages 50 and 77 from the conduit 31.

For example, the control device 29 includes a control knob 79 secured on a control shaft 80 threaded into a threaded bore 81 of the valve block 38 and being suitably interconnected to the valve member 78 by tying means 82 or the like so that when the control knob 79 is disposed in any on cooking position thereof, the passage 50 of the valve block 38 is interconnected to the conduit 31 while the passage 77 is completely blocked from the passage 31. However, when the control knob 79 is set in a burn-off cleaning temperature position thereof the tying means 82 causes the valve member 78 to block the passage 50 from the conduit 31 while interconnecting the passage 77 to the conduit 31 for a purpose hereinafter described.

The control shaft 80 of the control device 29 has a disc 83 fixed at the end 84 thereof so that the axial position of the disc 83 in the housing 37 is controlled by the threaded relation of the shaft 80 in the threaded bore 81. A compression spring 85 has one end 86 bearing against the disc 83 and the other end 87 thereof bearing

against an end 88 of a lever 89 having its other end 90 receivable in the notch 75 of the latch member 69 when the latch member 69 is disposed in the position illustrated in FIG. 5. An intermediate portion 91 of the lever 89 bears against a transverse pin 92 carried by the stem 47 of the power element 35 whereby the force of the compression spring 85 and the force of another compression spring 93 disposed between the valve block 38 and the end 90 of the lever 89, as well as the force provided by the valve spring 45, tend to pivot the lever 89 in a clockwise direction about its pivoted end 90 in opposition to any downward movement of the movable wall 48 of the power element 35 for a purpose hereinafter described.

Another lever 94 is carried in the housing means 37 and has an end 95 for pivoting on a fulcrum ledge 96 of the valve block 38 as a compression spring 97 is disposed between the valve block 38 and the other end 98 of the lever 94 to tend to pivot the same in a clockwise direction about the pivot point 96. However, an intermediate portion 99 of the lever 94 has an opening 100 passing therethrough and receiving the control shaft 80 whereby an embossment 101 of the intermediate portion 99 of the lever 94 bears against the disc 83 carried by the shaft 80 so that the disc 83 prevents the spring 97 from carrying the lever about the fulcrum point 96 until the disc 83 is moved upwardly a sufficient distance as illustrated in FIG. 7 to cause the lever 94 to act against the lever 89 in a manner hereinafter described.

The fill for the temperature sensing bulb 34, capillary tube 36 and power element 35 can be an inert gas, such as helium, since the control device 29 of this invention will respond to temperatures as high as 900°F and the like.

The lever 89 when freed from the notch 75 of the latch member 69 in the manner illustrated in FIGS. 6 and 7, is adapted to have end 88 engaged against a fulcrum embossment 102 on the housing means 37 by the force of the compression spring 85 so that the lever 89 will then pivot about the fulcrum point 102 for a purpose hereinafter described.

The main valve means 24 for the control system 20 previously described is illustrated in detail in FIGS. 8-10 and will now be described.

As illustrated in FIG. 8, the main valve means 24 includes a housing means 103 having an inlet 104 for interconnecting to the inlet conduit 25 and an outlet 105 for coupling to the outlet conduit 26 with the inlet 104 being separate from the outlet 105 by a valve seat 106 projecting into a chamber 107 of the housing means 103. A flexible diaphragm 108 is carried by the housing means 103 to define one side of the chamber 107 and separate the same from another chamber 109 of the housing means 103, the flexible diaphragm 108 carrying a rigid valve member or plate 110 for opening and closing the valve seat 106. A compression spring 111 is disposed in the chamber 109 to normally tend to urge the valve member 110 and its associated diaphragm 108 in a valve seat closing direction.

Two other flexible diaphragms 112 and 113 are carried by the housing means 103 with the diaphragm 113 cooperating with the housing means 103 to define a chamber 114 and in combination with the diaphragm 112 a chamber 115 therebetween while the diaphragm 112 cooperates with the housing 103 to define another chamber 116.

The flexible diaphragm 113 carries a rigid backing member 117 carrying a tubular extension 118 having an inwardly turned end 119 secured to an inner periphery 120 of the diaphragm 112 that defines an opening 121 passing centrally therethrough and being aligned with a resulting opening 122 at the turned end 119 of the tubular member 118. A ball valve 123 is carried in the tubular extension 118 and is normally urged by a compression spring 124 to seat against the opening 122 and close the same, the tubular extension 118 having opening means 323 passing therethrough to interconnect the interior of the tubular member 118 with the chamber 115.

The housing 103 has a wall portion 125 disposed between the chambers 109 and 116, the wall portion 125 having a tubular projection 126 extending into the chamber 116 and defining a valve seat 127 at the open end thereof adapted to be opened and closed by the ball 123 since the projection 126 is fully receivable into the openings 121 and 122 of the diaphragm 112 and extension 118 as fully illustrated in FIGS. 9 and 10.

A compression spring 128 is disposed in the chamber 116 to normally tend to urge the diaphragm 112 and, thus, the diaphragm 113 through the tubular extension 118 to the right in FIG. 8 so that the ball valve member 123 is held away from the valve seat 127.

The chambers 109 and 116 of the main valve means 24 are disposed in fluid communication with each other by openings 125' passing through the intermediate wall 125 of the housing 103.

The valve seat 127 of the tubular extension 126 of the wall 125 of the housing 103 is interconnected to a passage 129 formed in the housing means 103 and leading from the inlet 104 to an outlet passage 130 that is interconnected to the conduit 28 leading to the pilot burner 27 as illustrated in FIG. 1, the flow of fuel through the passage 129 to the outlet passage 130 being controlled by a suitable adjusting key 131 in a conventional manner.

The outlet passage 130 is also interconnected to the intermediate chamber 115 through an orifice cup 132. In addition, the outlet passage 130 is interconnected by another orifice cup 133 to a passage 134 that leads from a filter chamber 135 to the chamber 114. The filter chamber 135 is adapted to be interconnected to the conduit 31 from the control device 29 as illustrated in FIG. 1 downstream from the safety valve 32.

Therefore, it can be seen that the control device 29 and main valve means 24 can be formed of relatively few parts in a relatively simple manner to provide an oven control system 20 as illustrated in FIG. 1 as well as the oven control systems illustrated in FIGS. 2-4 as will be hereinafter described.

The safety valve 32 for the control system 20 illustrated in FIG. 1 comprises a housing means 136 having an inlet chamber 137 interconnected to the upstream part 138 of the conduit 31 while an outlet chamber 139 thereof is interconnected to the downstream part 140 of the conduit 31, the chambers 137 and 139 being separated by a valve seat 141 adapted to be opened and closed by a ball valve 142 normally urged to its closed position by a compression spring 143 in the inlet chamber 137. However, an expansible and contractible power element 144 is carried by the housing means 136 and has a stem 145 on the movable wall 146 thereof adapted to project through the valve seat 141 and engage against the ball valve 142 so that when certain

flames exist at the pilot burner means 27, the detector 33 causes the movable wall 146 of the power element 144 to move upwardly and thereby move the ball valve member 142 away from the valve seat 141 as long as flames exist at the pilot burner 27 so that the upstream part 138 of the conduit 31 will be interconnected with the downstream part 140 thereof.

The detailed operation of the control system 20 of FIG. 1 as well as the operation of the control device 29 and the main valve member 24 will now be described.

Referring now to FIG. 1, and assuming that the control device 29 is turned to an off position, fuel is supplied to the pilot burner 27 to maintain a flame at the pilot burner 27 since the conventional valve 22 in the supply manifold 21 is in an on condition and fuel can thereby flow through the inlet conduit 25 and passage means 129 and 130 of the main valve means 24 to the conduit 28 leading to the pilot burner 27. Thus, with flames at the pilot burner 27, the safety valve 32 has its ball valve member 142 maintained away from the valve seat 141 so that the conduit means 31 between the control device 29 and the main valve means 24 is in an open condition. However, since the control device 29 is in an off condition, the same is not directing any pneumatic signal through the conduit 30 to the main valve means 24 whereby the chamber 114 is at substantially atmospheric condition and the intermediate chamber 115 is also at substantially atmospheric condition whereby the compression spring 128 maintains the diaphragms 112 and 113 in the position illustrated in FIG. 8 where the ball valve member 123 closes the opening 122 of the tubular extension 118 and maintains the valve seat 127 of the projection 126 in an open condition for interconnecting the passage 129 with the chamber 116 and, thus, with the chamber 109 through the wall openings 125 so that the fuel pressure on both sides of the flexible diaphragm 108 are equal. In this manner, the force of the compression spring 111 maintains the valve member 110 against the valve seat 106 so that no fuel can flow from the inlet conduit 25 to the outlet conduit 26 and, thus, to the main burner means 23.

However, when the control knob 79 of the control device 29 is moved from its off position to any selected on cooking position thereof, the same causes the valve member 78 to unblock the passage 50 and interconnect the passage 50 to the upstream part 138 of the conduit 31 and at the same time axially adjust the control shaft 80 relative to the housing 37 so that the force of the compression spring 85 tending to pivot the lever 89 in a clockwise direction about the pivot point 92 is added to the force of the compression springs 93 and 45 against the transverse pin 92 of the stem 47 of the movable wall 48 of the power element 35 so that the temperature of the oven must increase to the set temperature of the selector knob 79 in order to cause the power element 35 to expand in opposition to the force setting of the spring 85 and move the ball member 44 against the valve seat 43.

However, since the temperature of the oven is normally below the temperature setting of the knob 79 when the same is first turned to an on cooking position thereof, the ball valve member 44 is in the open position as illustrated in FIG. 5 whereby a fuel source pneumatic signal is adapted to flow from the conduit 30, passage 40, open valve seat 43, and passage 50 into the

control signal conduit 31 and since the safety valve 32 is in an open position, into the chamber 114 of the main valve means 24 to pressurize the chamber 114 and thereby cause the diaphragm 113 to move to the left as illustrated in FIG. 9 carrying therewith the diaphragm 112 until the ball valve member engages against the valve seat 127. In this manner, further movement of the ball valve member 123 to the left is prevented even though the diaphragms 113 and 112 can further move to the left from the position illustrated in FIG. 9 to the position illustrated in FIG. 10. As the diaphragms 113 and 112 continue to move to the left from the position illustrated in FIG. 9 to the position illustrated in FIG. 10, it can be seen that the tubular extension 118 carried by the diaphragm 113 now moves away from the ball valve member 123 so that the intermediate chamber 116 and, thus, the chamber 109, through the wall openings 125', is now interconnected to the tubular extension 118 and through the openings 323 in the tubular extension 118 to the chamber 115 which is vented to the pilot burner outlet 130 through the orifice cup 132 which has an orifice therein larger than the orifice of the orifice cup 133. This reduction in pressure on the spring side of the diaphragm 108 causes the diaphragm 108 to move away from the valve seat 106 as illustrated in FIG. 10 and since the escape of gas pressure from the intermediate chamber 116 is increased as the opening between the ball valve member 123 and valve seat 122 becomes greater, the same results in the diaphragm 108 moving to an open position at a rapid rate to provide substantially a snap opening movement thereof whereby fuel is now permitted to flow from the inlet 104 to the outlet 105 of the main valve means 24 and, thus, to the burner 23 to be ignited by the pilot burner 27. Thus, as long as the temperature of the oven is below the temperature effect setting of the control knob 79, the ball valve 44 of the control device 29 is in an open position so that the pneumatic signal is continuously directed to the chamber 114 of the main valve means 24 to maintain the same in the open position as illustrated in FIG. 10.

However, when the temperature in the oven reaches or slightly exceeds the temperature setting of the control knob 79 of the control device 29, the expansion of the fluid in the temperature sensing bulb 34 is such that the same has caused the movable wall 48 of the power element 35 to move downwardly in FIG. 5 in opposition to the force of the compression springs 85, 93 and 45 a distance sufficient to seat the ball valve member 44 against the valve seat 43 and thereby terminate the flow of control signal fuel to the conduit 31 and, thus, to the chamber 114 of the main valve means 24. Since no more pressure is being directed to the chamber 114 of the main valve means 24, the pressure in the chamber 114 bleeds through the orifice cup 133 to the pilot burner 27. As the pressure in the chamber 114 is reduced, the diaphragm 113 moves to the right under the force of the compression spring 128 and subsequently the valve seat 122 makes contact with the ball valve 123 to carry the same to the right and thereby off of the valve seat 127. Movement of the ball valve 123 off of the valve seat 127 again permits the chambers 116 and 109 to have fuel under pressure directed therein by the passage 129 so that the pressure across the diaphragm 108 subsequently equalizes and the compression spring 111 can again move the diaphragm 108 to its valve

closing position as illustrated in FIG. 8 to terminate the flow of fuel to the main burner means 23.

Thus, the main control device 29 cycles the control signal to the main valve means 24 to cause the main valve means 24 to cycle the main burner means 23 between its off and on conditions to tend to maintain the temperature in the oven at the temperature selected by the control knob 79.

If the heat motor means 61 is interconnected to a meat probe or timer in such a manner that after the oven has been operating at the selected cooking temperature of the control knob 79 for a preselected time period or for a preselected meat probe condition of the food being cooked by the oven, the coil 62 can be automatically energized to heat the bimetal member 60 and cause the same to warp to the right as illustrated in FIG. 6 carrying the latch member 69 therewith which frees the end 90 of the lever 89 so that the force of the compression spring 85 can now pivot the lever 89 on the transverse pin 92 and engage the end 88 of the lever 89 against the fulcrum point 102 on the housing means 37 so that now the force of the compression spring 93 is imposed on a long moment arm of the lever 89 to oppose downward movement of the movable wall 48 of the power element 35 whereby the power element 35 will now tend to maintain the oven temperature at a warmth retaining and non-cooking temperature in the manner previously described by opening and closing the ball valve member 44.

Should the heat motor 61 only be momentarily energized to cause such rightward movement of the blade 60 and latch member 69 to provide the keep warm operation of the control device 29, a rewarping of the blade 60 back to the left even though causing a closing of the ball valve member 55 against the valve seat 54 will not effect the operation of the control device 29 as only the passage 50 is opened by the valve member 78 in any cooking position of the valve 79 or in the keep warm position thereof.

Of course, if a keep warm temperature is initially selected by the housewife or the like the heat motor 61 is immediately energized so that the control device 29 will initially assume the condition illustrated in FIG. 6.

When it is desired to utilize the oven control system 20 of this invention for an oven cleaning operation wherein the temperature effect is to be maintained at a relatively high temperature, such as 900°F. for burning off the soilage inside the oven, the control knob 79 of the control device 29 is set in an oven cleaning position thereof which not only causes the valve member 78 to block the passage 50 and open the passage 77 to the conduit 31, but also the control knob 79 has caused the control shaft 80 to be threaded into the valve block 38 a distance sufficient to cause the intermediate portion of the lever 90 to bear against the intermediate portion of the lever 89 as illustrated in FIG. 7 so that the force of the compression spring 97 will be added to the lever arrangement 89 in opposing downward movement of the movable wall 48 of the power element 35.

Also, through a suitable electric switch (not shown), the control knob 79 when set in an oven cleaning position and through suitable interlocks, such as the locking of the oven door, will cause the heat motor 61 to be engaged so that the bimetal member 60 warps to the right as illustrated in FIG. 7 to unlatch the end 90 of the

lever 89 from the latch member 69 whereby the end 88 of the lever 89 is now acting against the fulcrum point 102 of the housing means 37. In this manner, the force of the compression spring 93 and the compression spring 97 as well as the spring 45 is opposing downward movement of the movable part 48 of the power element 35. Thus, the heat motor 61 must remain energized during the entire oven cleaning operation so as to maintain the ball valve member 55 in the open condition as illustrated in FIG. 7 whereby the opening and closing of the ball valve member 44 by the power element 35 will control the main burner 23 in the manner previously described except that the same will be maintaining a burn-off cleaning temperature in the oven, the control signal from the control device 29 to the main valve means 24 being through the open valve seat 54 and passage 77 under the control of the ball valve member 44.

When the burn-off cleaning operation is terminated, the energizing of the heat motor 61 is also terminated and if the control knob 79 has not been turned back to the off position thereof, the lever 69 will tend to move back to the right but will be opposed by the end 90 of the lever 89. However, the bimetal member 60 can warp to the left to engage against the pin 58 and thereby close the ball valve member 55 against the seat 54 so that no more fuel can be delivered to the actuation chamber 114 of the main valve means 24. Thus, the operation of the main burner 23 is terminated. As the oven cools down, the end 90 of the lever 89 will cam down along the cam surface 76 of the latch member 69 to be subsequently received in the notch 75 thereof and thereby permit the latch member 69 to assume the position illustrated in FIG. 5 and thereby latch the end 90 of the lever 89 so that the control knob 79 can be utilized to subsequently set the control device 29 in a cooking position thereof without requiring a resetting action by the housewife after an oven cleaning operation.

Therefore, it can be seen that the control device 29 and the main valve means 24 of this invention can be utilized in the fuel control system 20 to not only control the burner means 23 for a cooking and/or keep warm operation thereof, but also for a burn-off cleaning operation in a simple and effective manner.

However, such control device 29 and main valve means 24 can also be used in other oven control systems of this invention.

For example, reference is now made to FIG. 2 wherein another control system of this invention is generally indicated by the reference numeral 150, the control system 150 including the control device 29A of this invention and two main valves 24A and 24B respectively for controlling the flow of fuel from inlet conduit means 25A and 25B leading from the source conduit 21A respectively to a bake burner 151 and a broil burner 152.

Thus, the control system 150 is being utilized for a double burner, single cavity oven and is adapted to operate either the bake burner, the broil burner or both the bake burner 151 and broil burner 152 for an oven clean off operation as will be apparent hereinafter.

Each main valve 24A and 24B continuously supplies the fuel in the manner previously described in the pilot burner means 27A and 27B respectively utilized for the burners 151 and 152, safety valves 32A and 32B being respectively provided in control signal conduits 31A

and 31B leading from the control device 29A to the operating chambers 114A and 114B of the main valve means 24A and 24B.

The valve member 78A for the control device 29A is so constructed and arranged that when the control knob (not shown) of the control device 29A is set for a baking operation, only the outlet 50A of the control device 29A is interconnected to the conduit 31A whereby the main valve means 24A will operate the bake burner 151 in the manner previously described to maintain a selected baking temperature effect in the oven. When the valve member 78A is set in a broil position, only the outlet 50A of the control device 29A is interconnected to the conduit 31B whereby the main valve means 24B controls the broil burner 152 in the manner previously described.

When the control knob of the control device 29A is set in an oven cleaning position, the valve member 78A is so constructed and arranged that the same only interconnects the outlet 77A to both conduits 31A and 31B so that both the bake burner 151 and broil burner 152 will be operated to produce the self cleaning temperature effect by the control device 29A as previously described.

Another oven control system of this invention is generally indicated by the reference numeral 153 in FIG. 3 and also comprises a single control device 29C and two main valve means 24C and 24D respectively controlling the flow of fuel to a bake burner 151C and to a broil burner 152D in a manner substantially similar to the control system 150 previously described when the control device 29C is being utilized for a baking or broiling operation.

However, for a cleaning operation of the control system 153, the valve member 78C is so constructed and arranged that when the same is set in an oven cleaning position thereof, the same interconnects the outlet 77C to the control signal conduit 31D for operating the broil burner 152D in the manner previously described and also interconnects the outlet 77C to a control signal conduit 154 that leads to a temperature responsive valve means 155 that has an outlet 156 interconnected to the control signal conduit 31C for the bake burner valve means 24C in advance of the safety valve 32C thereof.

The temperature responsive valve 155 comprises a housing 157 having two spaced valve seats 158 and 159 having a movable ball valve member 160 disposed therebetween and normally urged to the left in a closed position against the valve seat 158 by a compression spring 160'. A temperature responsive power element 161 is provided with a stem 163 adapted to project through the valve seat 158 and engage the ball valve member 160, the power element 161 being interconnected by a capillary tube 262 to a temperature sensing bulb 263 that senses the temperature in the oven.

The temperature responsive valve means 155 is so constructed and arranged that when the control device 29C is set for a burn off cleaning operation, the ball valve member 160 remains in its closed position against the valve seat 158 until the operation of the broil burner 152D under the control of the control device 29C has raised the temperature of the oven to a predetermined temperature that is below the desired burn off cleaning temperature. When the predetermined temperature is reached, the power element 161 has moved the ball valve member 160 intermediate the valve seats

158 and 159 so that the control signal from the control device 29C will now be directed to the valve means 24C for operating the bake burner 151C simultaneously with the broil burner 151D. However, when the temperature in the oven subsequently reaches the predetermined clean off temperature, the power element 161 of the valve means 155 has expanded in such a manner that the same will close the ball valve member 160 against the valve seat 159 and thereby terminate the operation of the bake burner 151C. Thus, the temperature responsive valve 155 will cycle the bake burner 151C between its off and on conditions to tend to maintain the oven at the burn off cleaning temperature as the broil burner 152D will be continuously operated during the oven cleaning cycle.

However, during a runaway condition of the oven above the cleaning temperature, the control device 29C will terminate the flow of fuel to the outlet 77C thereof by the ball valve member 55C in the manner previously described whereby the thermostatic device 29C will act as a high limit should the valve means 155 fail.

Another oven control system of this invention is generally indicated by the reference numeral 164 in FIG. 4 and is substantially identical to the control system 153 previously described except that such control system 164 is for a "muffle type" oven wherein an air supply means 165 must be continuously operating during the use of the bake burner 151E and/or use of the broil burner 152F.

The passage 129E of the main valve means 24E is directly interconnected to the conduit 28E leading to the pilot burner 27E for the bake burner 151E whereas the passage 130E of the valve means 24E is interconnected to a conduit 165E that leads to another small burner 166E adjacent the pilot burner 27E so that if any fuel issues from the burner 166E in the manner hereinafter described, the same will be ignited by the continuously burning pilot burner 27E.

Similarly, the main valve means 24F for the broil burner 152F has its passage 130F interconnected to a conduit 165F that leads to a small burner 166F disposed adjacent the pilot burner 27F for the broil burner 152F. However, the pilot burner 27F for the broil burner 152F is interconnected by a conduit 167 to the valve means 78F of the control device 29F.

The main control device 29F is similar to the control device 29 previously described except that the heat motor means 61F thereof is only utilized for modifying the lever arrangement therein when energized in the manner previously described as no ball valve equivalent to the ball valve 55 is provided in the thermostatic device 29F.

A pair of air sensing valves 168E and 168F are provided respectively for the burners 151E and 152F, each air sensing valve 168E and 168F comprising a housing means 169 having a flexible diaphragm 170 dividing the same into two chambers 171 and 172 with the chamber 172 being interconnected to a branch conduit 173 by a valve seat 174 adapted to be opened and closed by a ball valve member 175 carried by the diaphragm 170 and normally being urged in an open position by a compression spring 176. However, the chamber 171 of each air sensor 168E and 168F is interconnected to a conduit means 177 interconnected to the outlet 178 of the air supply 165 so that when the air supply is operating, the same pressurizes the chambers

171 to cause the diaphragms 170 to move the ball valve members 175 fully against the valve seats 174 in the manner illustrated in FIG. 4.

The pneumatic control signal conduits 31E and 31F respectively have the safety valves 32E and 32F therein except that the downstream parts 140E and 140F thereof have branch conduits 179E and 179F respectively leading to the chambers 172 of the air sensors 168E and 168F. The branch conduits 173 of the air sensors 168E and 168F are respectively interconnected to the conduits 165E and 165F that lead to the auxiliary burners 166E and 166F for a purpose now to be described.

Should pneumatic signals be directed through the conduits 31E and 31F toward the main valve means 24E and 24F and the air supply 165 not be operating, then the ball valve members 175 of the air sensors 168E and 168F will be in an open position so that the pneumatic signal passing through the open safety valves 32E and 32F will be diverted through the air sensors 168E and 168F to the burners 166E and 166F to be ignited and burn without causing opening of the main valves 24E and 24F. However, should the air supply 165 be operating, then the ball valve members 175 will be closed against the valve seats 174 in the air sensors 168E and 168F so that the control signal will only be directed to the main valves 24E and 24F to open the same in the manner previously described.

The outlet 50F of the control device 29F in combination with the valve member 78F is so constructed and arranged that when the valve member 78F is set in a broiling or oven cleaning position, the inlet 40F from the supply conduit 25F is directly connected to the conduit 167 leading to the pilot burner 27F for the broil burner 152F with the control device 29F operating suitable ignition means (not shown) for igniting the pilot burner 27F. Also, when the valve member 78F is set in a baking position, the outlet 50F is directly connected to the conduit 31E to operate the bake burner 151E in the manner previously described.

However, the valve member 78F also controls the interconnection to two conduit means 180 and 181 so that when the valve member 78F is set in a broiling or self cleaning position, the outlet 50F is interconnected to the conduit 180 and when the valve member 78F is set in an oven cleaning position, the valve member 78F interconnects the conduit 181 to the conduit 31E.

The conduits 180 and 181 are also interconnected to a temperature responsive valve 155F similar to the valve 155 of FIG. 3 except that the conduit 180 is interconnected to the spacing between the valve seats 158F and 159F with the conduit 181 being interconnected to the left of the valve seat 158F and the conduit 31F being interconnected to the right of the valve seat 159F.

Thus, it can be seen that when the valve member 78F of the control device 29F is set for a broiling operation, the control signal can be directed from the outlet 50F into the conduit 180 and pass through the open valve seat 159F of the valve 155F to control the broil burner 152F in the manner previously described because the ball valve member 160F is not moved against the valve seat 159F until the temperature in the oven exceeds an oven cleaning temperature.

When the valve member 78F of the device 29F is set for an oven cleaning operation, the pneumatic signal from the outlet 50F is directed to the conduit 180 to

operate the broil burner 152F in the manner previously described while the conduit 181 is interconnected to the conduit 31E for the bake burner 151E. However, initially the oven is below a predetermined high temperature in the oven so that the ball valve member 160F prevents any pneumatic signal from being directed to the conduit 181 and, thus, to the conduit 31E for the bake burner 151E so that the broil burner 152F is initially operated during the cleaning operation. However, when the temperature in the oven exceeds a predetermined high temperature therein, the ball valve member 160F is moved intermediate the valve seats 158F and 159F so as to continuously operate the broil burner 152F and to also now turn on the bake burner 151E so that both burners 151E and 152F are utilized to raise the temperature to the self cleaning temperature. However, as the temperature in the oven exceeds the self cleaning temperature, the ball valve member 160F can close the valve seat 159F and, thus, terminate the operation of the broil burner 152F so that the ball valve member 160F will cycle the broil burner 152F on and off while continuously maintaining the bake burner 151E on to maintain a self cleaning temperature in the oven, the control device 29F acting as a high limit for a runaway condition during the oven cleaning operation in the manner previously described for the control system 153.

Therefore, it can be seen that the control device 29 and main valve member 24 of this invention can be utilized in various combinations to provide different oven control systems as previously described.

While the valve means 24 previously described can have the configuration previously described in connection with FIG. 8, another embodiment thereof is generally indicated by the reference numeral 200 in FIGS. 11 and 12 and will now be described.

As illustrated in FIGS. 11 and 12, the valve means 200 comprises a housing means 201 carrying three flexible diaphragms 202, 203 and 204 respectively defining chambers 205, 206 and 207 with the housing means 201. The diaphragm 204 carries a valve member 208 for opening and closing a valve seat 209 which separates an inlet 210 from an outlet 211. The diaphragm 202 is interconnected to a tubular extension 212 of the diaphragm 203 by a spider-like member 213 which fluidly interconnects the open end 214 of the tubular extension 212 to the intermediate chamber 206. The diaphragm 203 carries a valve seat 215 inside the tubular extension 212 which is adapted to be opened and closed by a valve member 216 carried by the diaphragm 202 normally being urged to a closed position by a compression spring 217.

The housing 201 has a tubular extension 218 extending into the valve seat 215 and defining a valve seat 219 at the open end thereof with the valve seat 219 being interconnected to the inlet 210 by a passage 220. The inlet 210 is also interconnected by a passage 221 to an outlet 222 that is adapted to be directed to a pilot burner for supplying a continuous fuel flow thereto in the same manner as the passage 129 of the valve means 24.

The diaphragm 203 cooperates with the housing to define a chamber 223 that is interconnected by a passage 224 to the chamber 207 for the diaphragm 204. Thus, as long as the valve member 216 is held away from the valve seat 219 in the manner illustrated in FIG. 11, fuel from the inlet 210 is adapted to pass

through the passage 220, open valve seat 219, chamber 223 and passage 224 to the chamber 207 for the diaphragm 204 so that the diaphragm 204 in combination with a compression spring 225 will maintain the valve member 208 against the valve seat 209 in the same manner as provided by the diaphragm 108 of the valve means 24.

The control pneumatic signal for operating the valve means 200 is adapted to enter an inlet passage 226 that is interconnected to the intermediate chamber 206 by an orifice cup 227 and directly into the actuating chamber 205 by a branch passage 228. The intermediate chamber 206 is also interconnected to the pilot passage 221 by an orifice cup 229.

Therefore, it can be seen that the valve means 200 operates in the same manner as the valve means 24 previously described because when a pneumatic signal is directed to the inlet 226, the same pressurizes the chamber 205 to move the diaphragm 202 downwardly and carry the diaphragm 203 therewith so that the tubular extension 218 of the housing 201 will be engaged by the valve member 216 to close off the inlet 210 from the intermediate chamber 223 and further downward movement of the diaphragms 202 and 203 cause the valve seat 215 to move away from the valve member 216 in the manner illustrated in FIG. 12 so that the chamber 223 and, thus, the chamber 207 is vented to the chamber 206 which is interconnected to the pilot passage 221 by the orifice cup 229 whereby the pressure differential across the diaphragm 204 increases and the inlet pressure can cause the same to move to an open position as illustrated in FIG. 12 in the same manner as provided by the valve means 24.

Therefore, it can be seen that modifications, can be made in the various control devices of this invention with the operation thereof occurring in the same manner to accomplish the desired functions as previously described in connection with the oven control system.

Thus, not only does this invention provide improved oven control systems, but also this invention provides improved control devices for such control systems or the like.

While the form of the invention now preferred has been described as required by the statutes, variations can be made therein and all coming within the scope of the claims which follow.

What is claimed is:

1. A control system for an oven having an energy source and a heating means comprising a manually settable control device having thermostatically operated means for interconnecting said source to said heating means when said thermostatically operated means senses a temperature effect of said heating means below a set temperature effect of said control device and for disconnecting said source from said heating means when said thermostatically operated means senses a temperature effect of said heating means above said set temperature effect, said control device having manually settable means for setting said thermostatically operated means to provide a cooking temperature effect of said heating means, said manually settable means comprising a lever having multiple pivot points one of which is utilized during a cooking operation of said oven, said control device having modifying means for modifying said manually settable means for setting said thermostatically operated means to provide

a temperature effect other than a cooking temperature effect of said heating means by changing the pivot point of said lever from said one pivot point to another of said pivot points.

2. A control system as set forth in claim 1 wherein said other temperature effect of said heating means is one of a burn-off cleaning temperature effect and a warmth retaining and non-cooking temperature effect of said heating means.

3. A control system as set forth in claim 1 wherein said modifying means comprises a heat motor.

4. A control system as set forth in claim 1 wherein said energy source comprises a fuel source and said heating means comprises burner means.

5. A control system as set forth in claim 4 wherein said burner means comprise a bake burner and a broil burner.

6. A manually settable control device for an oven having an energy source and a heating means, said control device having thermostatically operated means for interconnecting said source to said heating means when said thermostatically operated means senses a temperature effect of said heating means below a set temperature effect of said control device and for disconnecting said source from said heating means when said thermostatically operated means senses a temperature effect of said heating means above said set temperature effect, said control device having manually settable means for setting said thermostatically operated means to provide a cooking temperature effect of said heating means, said manually settable means comprising a lever having multiple pivot points one of which is utilized during a cooking operation of said oven, said control device having modifying means for modifying said manually settable means for setting said thermostatically operated means to provide a temperature effect other than a cooking temperature effect of said heating means by changing the pivot point of said lever from said one pivot point to another of said pivot points.

7. A control device as set forth in claim 6 wherein said other temperature effect of said heating means is one of a burn-off cleaning temperature effect and a warmth retaining and non-cooking temperature effect of said heating means.

8. A control device as set forth in claim 6 wherein said modifying means comprises a heat motor.

9. A manually settable control device for an oven having an energy source and a heating means, said control device having thermostatically operated means for interconnecting said source to said heating means when said thermostatically operated means senses a temperature effect of said heating means below a set temperature effect of said control device and for disconnecting said source from said heating means when said thermostatically operated means senses a temperature effect of said heating means above said set temperature effect, said control device having manually settable means for setting said thermostatically operated means to provide a cooking temperature effect of said heating means, said control device having modifying means for modifying said manually settable means for setting said thermostatically operated means to provide a burn-off cleaning temperature effect of said heating means, said manually settable means comprising a lever having opposed ends, said thermostatically operated means having a movable part engageable with said lever intermediate said ends thereof, a pair of spring means carried

17

by said device and respectively associated with said ends of said lever to tend to pivot said lever in opposite directions, and a pivot member movably carried by said device and having a first position for pivoting said lever about one of said ends thereof whereby both springs act on said lever to tend to oppose movement of said movable part of said thermostatically operated means, said pivot member having a second position for releasing said one end of said lever from pivoting action therewith.

10. A control device as set forth in claim 9 wherein said modifying means comprises means for moving said pivot member from said first position thereof to said second position thereof.

11. A control device as set forth in claim 9 wherein the other end of said lever is moved against a pivot point of said device by its respective spring means when said pivot member is moved to its second position whereby the spring means of said one end opposes movement of said movable part of said thermostatically operated means.

18

12. A control device as set forth in claim 11 wherein said spring means for said other end of said lever is a range spring.

13. A control device as set forth in claim 12 wherein said manually settable means comprises an adjusting shaft carried by said device for adjusting the force of said range spring action on said other end of said lever.

14. A control device as set forth in claim 13 wherein a third spring means is carried by said device, said adjusting shaft being operatively associated with said third spring for adding the force thereof to said lever when said other end of said lever is against said pivot point and said adjusting shaft is set for a burn-off cleaning operation.

15. A control device as set forth in claim 14 wherein said device has a movable valve member for controlling fuel flow through said device, said movable part of said thermostatically operated means controlling opening and closing movement of said valve member.

* * * * *

25

30

35

40

45

50

55

60

65