

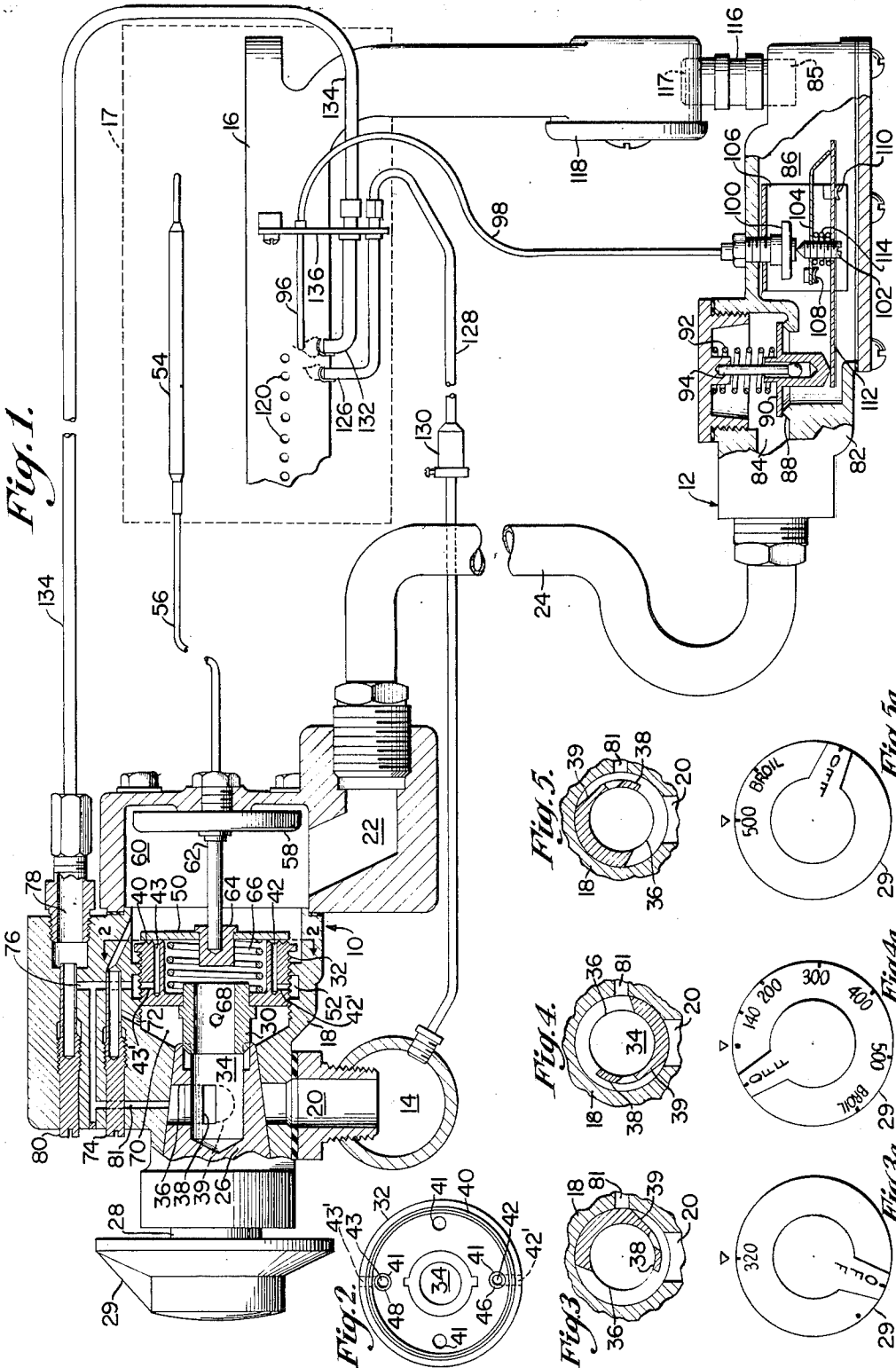
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OVEN TEMPERATURE CONTROL SYSTEM

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OVEN TEMPERATURE CONTROL SYSTEM

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15 Claims. (Cl. 236-15)

This application is a continuation application of its copending patent application, Serial Number 58,762, filed September 27, 1960, now abandoned.

This invention relates to systems for controlling the flow of fuel to burners and more particularly to systems especially adapted for automatic control of the flow of fuel in order to maintain a preselected temperature within an oven or the like.

In thermostatically controlling the flow of fuel to an oven burner, a minimum flow of fuel is arranged to bypass the thermostatic valve in order to supply the burner at the minimum flow rate necessary for ignition of the fuel as it flows from the burner. The insulated enclosures of ovens make it difficult to control temperatures in the lower range because the minimum bypass flame maintained at the burner for re-ignition during thermostatic action places a lower limit on the minimum flow rate. The use of a safety valve adjacent the main burner causes a cycling of the flow of fuel to the main burner in order to obtain temperatures in the lower range but such cycling operation makes it difficult to maintain the oven temperatures within a higher range. Furthermore, adjustment of the minimum flow of fuel could heretofore only be accomplished during the "on" part of the cycle.

An object of this invention is to control the cycling means utilized in a temperature controlling apparatus.

Another object of this invention is to utilize thermostatic valve means and cycling valve means for maintaining low temperatures in an oven and to prevent cycling of the cycling valve means to maintain high temperatures in the oven.

Another object of this invention is to bypass the thermostatic control of a temperature regulating system for a fuel burning control system.

A further object of this invention is to control the flow of fuel so that a single oven burner may be used alternately in a low temperature range or in a high temperature range.

Another object of this invention is to prevent cycling of a safety control valve during adjustment of a minimum flow bypass in a thermostatic control system.

This invention is characterized by utilizing a main burner and a pilot burner with thermostatically operated valve means simultaneously controlling the flow of fuel to the pilot burner and to a safety valve positioned upstream of the main burner. A minimum flow bypass communicates with the safety valve for maintaining a minimum flame at the main burner when the safety valve is open. A pilot flow bypass supplies a flow of fuel to the pilot burner independently of the thermostatically operated valve means; the pilot flow bypass is selectively controlled by a main control valve through a predetermined range of temperature settings whereby a flame at the pilot burner is maintained in order to retain a safety valve in its open position.

Other objects and advantages of this invention will be apparent from the following description taken in connection with the accompanying drawings wherein:

FIG. 1 is a schematic view, with portions broken away and other portions in longitudinal section, of the preferred embodiment of this invention;

FIG. 2 is a front elevation of an element shown in FIG. 1 and is taken on line 2-2 of FIG. 1;

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FIG. 3 is a partial section of a schematic arrangement of flow passages showing one controlling position of the main valve of FIG. 1;

FIG. 4 is a view similar to FIG. 3 showing another controlling position of the main valve of FIG. 1;

FIG. 5 is a view similar to FIGS. 3 and 4 of still another controlling position of the main control valve; and

FIGS. 3a, 4a, and 5a show the corresponding dial positions for the valve controlling positions of FIGS. 3, 4, and 5, respectively.

Referring now to the drawing and more particularly to FIG. 1, a valve means 10 is connected to a valve means 12 for controlling a flow of fuel from a gas supply manifold 14 to an oven burner 16 which is suitably mounted in an oven 17 as represented in dashed lines. Valve means 10 is preferably of the combined thermostatic valve and gas cock type and comprises a composite casing 18 formed with an inlet 20 and an outlet 22 connected respectively to manifold 14 and to one end of a conduit 24 which has its other end connected to valve means 12. A gas cock in the form of a hollow tapered valve plug 26 is connected to a manually operated shaft 28, the outer end of which is connected to a control knob dial 29 provided with suitable indicia corresponding to the temperatures to be maintained within the oven. The inner end of plug 26 is slotted to receive the cooperating portion of a hollow drive connector 30 which transmits rotation of the valve plug 26 to a movable valve seat member 32. A flow passage 34 extends through a portion of plug 26 and communicates with inlet 20 by means of an arcuate port 36 formed in plug 26 about a portion of approximately 260° of its tapered periphery. Counterclockwise rotation of the dial 29 from the "off" position brings the port 36 into registry with the inlet 20 to permit flow into passage 34. Corresponding to the low temperature range of dial 29, the arcuate port 36 is intersected by a strengthening web 38 and terminates in a semicircular tapering portion 39, which are formed as integral parts of the valve plug 26.

Valve seat member 32 is exteriorly threaded and is screwed into an interiorly threaded portion of casing 18. Rotation of plug 26 by dial 29 causes drive connector and valve seat member 32 to rotate whereby the valve seat member 32 is moved axially in the threaded portion of casing 18. The valve seat member 32 is provided with a substantially cup-shaped body formed at its open end with an outer annular valve seat 40. As is illustrated in FIG. 2, four lugs 41 are cast integral with the seat body and are spaced 90° apart about the periphery thereof. Two of these lugs are drilled to provide a pair of flow passages 42 and 43 and a pair of inner valve seats 46 and 48 at the exposed end of the two drilled lugs.

Valve seats 46 and 48 lie in the same plane as valve seat 40 and are simultaneously engageable with a disc-type valve member 50. Passages 42 and 43 cooperate with a pair of radially extending passages 42' and 43' communicating with an annular groove 52 formed in the interiorly threaded portion of casing 18. The valve seats 46 and 48 are so dimensioned that they are at all times supplied with pressure equal to that applied to valve seat 40. As a result, opening and closing of valve means 12 does not affect the pressure supplied to valve seats 46 and 48 to cause a regenerative pressure cycling of the system. It will be obvious that the number of inner valve seats is purely a matter of design, depending upon the particular installation.

Thermostatic actuation of the valve member 50 is accomplished by temperature responsive means comprising a temperature sensing bulb 54 connected by a capillary tube 56 to a contractible and expansible power element 58 which is disposed in a chamber 60 formed in casing 18 downstream from the valve seat 32. The bulb 54, tube

56, and power element 58 constitute a closed system which is filled with a temperature sensitive fluid that causes expansion and contraction of power element 58 in response to temperature variations of the oven 17 as sensed by the bulb 54. A valve stem 62 is connected to the movable end wall of element 58 and is provided with a hub member 64 on which the valve member 50 is mounted. The valve stem 62 may be provided with suitable overrun means (not shown) to prevent damage to the valve member 50. A coil spring 66 is mounted in compression between the bottom wall of the cup-shaped valve seat and the valve member 50 for biasing the valve member 50 away from the valve seat 32.

The hollow drive connector 30 is provided with passage means 68 through which an annular chamber 70 formed in casing 18 upstream of valve seat member 32 communicates with passage 34. A bypass passage 72 extends between chambers 70 and 60 and is provided with an adjusting screw 74 for adjusting the minimum bypass flow to chamber 60. Another passage 76 extends from the groove 52 to a pilot flow outlet 78 and is also provided with an adjusting screw 80, passage 76 being out of alignment with passage 72 and being disposed behind the same in FIG. 1. Casing 18 is also provided with a second pilot flow bypass passage 81 located upstream of chamber 70 for registry with plug port 39 and extending to the passageway 76 so as to be subject to the pilot flow adjusting screw 80.

The valve means 12 comprises a casing 82 formed with an inlet 84 connected to conduit 24 and an outlet 85 which communicates with a central flow chamber 86. An internal wall portion of casing 82 is formed with an annular valve seat 88 which is cooperable with a valve member 90 for controlling flow of gas through the valve means 12. A helical compression spring 92 biases the valve member 90 towards engagement with the valve seat 88. Movement of the valve member 90 is restricted to a plane perpendicular to the plane of the valve seat 88 by a guide pin 94. Temperature or flame responsive means actuate the valve member 90 from a closed position to an open position and comprises a temperature sensing bulb 96 connected by a capillary tube 98 to a contractible and expandable power element 100 disposed in chamber 86.

The bulb 96, tube 98, and power element 100 constitute a closed system which is filled with a quickly responding temperature sensitive fluid, such as mercury, that causes expansion and contraction of the power element 100 in response to the presence or absence of a flame at the bulb 96. The movable end wall of power element 100 abuts an adjusting screw 102 carried by a lever 104. An L-shaped stationary bracket 106 is mounted in the chamber 86 between a wall of the casing 82 and the power element 100 and is formed with a pair of pivots 108 and 110, about which lever 104 and a lever 112 respectively pivot. The adjusting screw 102 passes through an aperture suitably formed in lever 112 and is threadedly mounted in a threaded aperture in the lever 104. A coil spring 114 encircles the adjusting screw 102 and is mounted in compression between the levers 104 and 112 to maintain the adjusting screw 102 against the power element 100 and to maintain the levers against their respective pivots. The adjusting screw 102 allows the temperature at which the valve member 90 opens and closes to be varied, the lift of the valve member 90 to be varied, and permits compensation to be made for varying dimensions due to manufacturing tolerances of the elements.

An adjustable orifice hood 116 is connected to the outlet 85 of the valve means 12 and is formed with an orifice 117 which serves to increase the velocity of the gas so that a quantity of primary air is entrained through an adjustable air shutter 118 prior to the resultant combustible mixture flowing from a plurality of burner ports 120.

Ignition means in the form of a constantly burning pilot 126 is connected by a conduit 128 to the manifold 14. A combined gas cock and filter 130 is positioned in con-

duit 128 for adjusting and filtering the flow of fuel to the constantly burning pilot 126. A heater pilot 132 is positioned adjacent the mercury bulb 96 for controlling the same and is connected by conduit 135 to the pilot flow outlet 78. The ignition pilot 126, the heater pilot 132, and the mercury bulb 96 are all mounted on a stationary bracket 136 in proper relationship to the main burner 16. The igniter pilot 126 is so positioned to ignite the heater pilot 132 which in turn ignites the gas flowing from the main burner ports 120. Ignition pilot 126 may also be utilized to ignite main burner ports 120 in accordance with the design of a particular installation.

The valve means 12 acts to prevent the flow of gas to burner 16 in the event the flame is extinguished at the heater pilot burner 132. Valve means 12 is automatically operated inasmuch as it is not necessary to manually reset it to the open position. With the flame from pilot burner 132 directed upon the bulb 96, the resultant vaporization of the mercury therein expels the liquid mercury from the bulb 96 causing power element 100 to expand and rotate levers 104 and 112 in a clockwise direction whereby the valve member 90 is raised from the valve seat 88 to permit gas to flow therethrough. When the flame at the heater pilot 132 is extinguished in response to thermostatic action of the valve member 50, the subsequent cooling of bulb 96 causes the vapor contained therein to condense so that the power element 100 contracts allowing the biasing spring 92 to move valve member 90 into engagement with valve seat 88 and shut off the flow through valve means 12.

The normal temperatures encountered in an oven are relatively high but, since the boiling temperature of mercury is even higher, the ambient temperature of the oven does not affect the opening and closing of the valve means 12. A rapid movement is imparted to valve member 90 because of the vaporization and condensation of the mercury within the bulb 96 and because of the lever system between the power element 100 and the valve member 90. Furthermore, the closing action is aided by the pressure at inlet 84 so that as the valve member 90 approaches the valve seat 88, the pressure drop thereacross creates a force which further speeds the closing action.

The relative positions of the elements schematically shown in FIG. 1 are in a non-operating condition. To initiate operation, the control knob 29 is rotated counterclockwise to position valve seat 32 with respect to the valve member 50 at some particular temperature setting to be maintained within the oven 17. When the control knob 29 has been rotated to some temperature in the low temperature range shown as 140° F. to 320° F. in FIG. 3a, the thermostat will call for heat by effecting an opening between the seat 32 and valve disc 50. Main gas flow will be stopped at the valve means 12 but a pilot gas flow will be permitted through the valve seats 46 and 48 to the heater pilot burner 132 where it will be ignited by the constantly burning pilot 126.

The heater pilot 132 will effect an opening of the valve means 12 permitting a flow of gas to the main burner 16 where it will be ignited to increase the temperature in the oven 17. As the oven temperature approaches the preselected setting of control dial 29, the thermostatic valve disc 50 will close against the seat 32 to interrupt a flow of gas to the heater pilot burner 132 and a main flow of gas to the main burner 16. However, a minimum flow of gas bypasses the thermostatic valve member 50 through the passageway 72 to supply a minimum flow of gas to the main burner 16 through the valve 12. As soon as the mercury bulb 96 cools sufficiently due to the extinguishment of the flame at the heater pilot burner 132, the valve means 12 will close and cause a complete interruption of flow to the main burner 16.

The resulting decrease in oven temperature will cause the valve disc 50 to move away from the seat 32 permitting gas to flow to the heater pilot burner 132 whereupon

the valve means 12 will again open to permit gas flow to the main burner 16. Since the valve disc 50 is separated from the seat 32, there is a pilot flow to the heater pilot burner 132 and the flow of gas to the main burner 16 at ignition time will be the minimum flow bypass gas through passageway 72 plus the gas flowing past the valve disc 50. This extra gas flow at such time assures rapid ignition without raw gas escape. It should be noted that with the control valve 26 rotated to a controlling position as illustrated in FIGS. 3 and 3a, there is continuous cycling of the valve means 12 because there is no bypass pilot flow through the passageway 81 inasmuch as the arcuate port 36 is not in registry with the passageway 81.

When it is desired to adjust the minimum flow through the passageway 72 to correspond to a particular flame height at the burner 16, the control dial 29 is rotated to an adjustment position as indicated by a "dot" shown in FIG. 4a. The temperature at the adjustment position is low enough so that a short preheat period will keep the thermostatic disc valve 50 closed against the seat 32 as is illustrated in the position shown in FIG. 4. The main control valve plug 26 has its port 36 in registry with the passageway 81 whereby the heater pilot burner 132 receives a steady supply of gas and the valve means 12 is maintained in an open position. Inasmuch as the bypass pilot flow of gas places the valve means 12 in a non-cycling position, it is possible to adjust both the minimum flow bypass passage 72 and the pilot flow bypass passage 81 by means of the adjusting screw valves 74 and 80, respectively.

When the control dial 29 has been rotated to some temperature in the high temperature range as shown as higher than 320° F. in FIG. 5a, the concurrent rotation of the valve plug 26 will bring the arcuate port 36 into registry with the pilot bypass flow passageway 81 whereby the heater pilot burner 132 receives a steady supply of gas independently of the thermostatic valve member 50. As described above, the valve means 12 now functions with a non-cycling operation so that the main flow of fuel to the burner 16 is under the thermostatic control of the valve disc member 50.

Inasmuch as many changes and modifications may be made in the details and arrangement of parts of this invention, it is intended that the foregoing description of the drawing be interpreted as illustrative and not in a limiting sense.

While the form of the invention now preferred has been disclosed as required by the statutes, other forms may be used, all coming within the scope of the claims which follow.

What is claimed is:

1. In a fuel control system, a main burner means, a first valve means for directing fuel to said main burner means, pilot burner means for controlling said first valve means, and control means having two ranges of position, said control means including a valve member which when closed prevents the flow of fuel to said first valve means and said pilot burner means and when open permits the flow of fuel to said first valve means and said pilot burner means, said control means when in one range thereof causing cyclic action of said pilot burner means by said opening and closing of said valve member to cycle said first valve means between its opened and closed positions and cause on-off action of said main burner means, said control means when in the other range thereof causing continuous on operation of said pilot burner means to hold said first valve means in the open position thereof and cause continuous operation of said main burner means by by-passing the flow of fuel to said pilot burner means independently of said valve member.

2. In a fuel control system as set forth in claim 1, said control means thermostatically controlling said on-off action of said main burner means when said control means is in said one range thereof.

3. In a fuel control system as set forth in claim 1, said control means thermostatically controlling said continuous on operation of said main burner means when said control means is in said other range thereof.

4. A method for controlling the operation of a main burner comprising the steps of providing a first valve means for directing fuel to said main burner means, providing pilot burner means for controlling said first valve means, and providing control means having two ranges of positions, said control means including a valve member which when closed prevents the flow of fuel to said first valve means and said pilot burner means and when opened permits the flow of fuel to said first valve means and said pilot burner means, setting said control means in one range thereof to cause cyclic action of said pilot burner means by said opening and closing of said valve member to cycle said first valve means between its opened and closed positions and cause on-off action of said main burner means, and setting said control means in the other range thereof to cause continuous on operation of said pilot burner means to hold said first valve means in the open position thereof and cause continuous operation of said main burner means by by-passing the flow of fuel to said pilot burner means independently of the operation of said valve member.

5. A method as set forth in claim 4 and including the step of thermostatically controlling said on-off action of said main burner means when said control means is set in said one range thereof.

6. A method as set forth in claim 4 and including the step of thermostatically controlling said continuous on operation of said main burner means when said control means is set in said other range thereof.

7. In a control system for fuel burning apparatus having main and pilot burners, thermostatically operated valve means for regulating a flow of fuel to said main and pilot burners, minimum flow means bypassing said valve means for supplying a minimum flow of fuel to said main burner, an automatic control device operative in response to a flame at said pilot burner and cycling the minimum flow of fuel in accordance with cyclic operation of said pilot burner, and selectively controlled pilot flow bypass means bypassing said valve means for selectively supplying a bypass pilot flow to said pilot burner.

8. In a control system for fuel burning apparatus having main and pilot burners, the combination comprising valve means operative in response to a flame at the pilot burner for controlling a flow of fuel to the main burner, thermostatically operated valve means simultaneously controlling a flow of fuel to the pilot burner and to the first said valve means, first bypass means for supplying fuel to said first valve means independently of said thermostatically operated valve means, second bypass means for supplying fuel to said pilot burner independently of said thermostatically operated valve means, and main control valve means controlling flow of fuel to said thermostatically operated valve means and to said first and second bypass means.

9. In a control system for fuel burning apparatus having main and pilot burners, thermostatically operated valve means for regulating a flow of fuel to said main and pilot burners, minimum flow means bypassing said valve means for supplying a minimum flow of fuel to said main burner, flame actuated valve means movable between open and closed positions in response to a flame at said pilot burner and cycling the minimum flow of fuel in accordance with cyclic operation of said pilot burner, pilot flow bypass means bypassing said valve means for supplying a bypass pilot flow to said pilot burner for a non-cyclic operation thereof, and selection control means controlling said pilot flow bypass means for preventing the bypass pilot flow whereby said pilot burner is cyclically operated in accordance with thermostatic operation of said thermostatically operated valve means.

10. In a control system for fuel burning apparatus,

the combination comprising main and pilot burner means, ignition means for said burner means, valve means operable for controlling a flow of fuel to said main burner means, thermostatically operated valve means controlling a flow of fuel to said pilot burner means and to said valve means, means responsive to a flame at said pilot burner means to cycle the first said valve means when said thermostatically operated valve means cycles the flow of fuel to said pilot burner means, first means bypassing said thermostatically operated valve means to supply a bypass flow of fuel to said main burner means when said first valve means is in an open position, second means bypassing said thermostatically operated valve means to supply a bypass flow of fuel to said pilot burner means to maintain a flame thereat for retaining said first valve means in an open position, and selection control means for said second bypassing means whereby the bypass flow of fuel to said pilot burner means is selectively controlled.

11. In a control system for fuel burning apparatus, the combination comprising main and pilot burners, ignition means for said burner, valve means operable for controlling a flow of fuel to said main burner, thermostatically operated valve means controlling a flow of fuel to said pilot burner and to the first said valve means, means responsive to a flame at said pilot burner to cycle said first valve means between open and closed positions when said thermostatic valve means thermostatically cycles the flow of fuel to said pilot burner, first means bypassing said thermostatic valve means to supply a bypass flow of fuel to said main burner when said first valve means is in an open position, second means bypassing said thermostatic valve means and supplying a bypass flow of fuel to said pilot burner for maintaining a flame thereat to prevent cycling of said first valve means, selection control means for said second bypassing means whereby the bypass flow of fuel to said pilot burner is selectively controlled, and adjusting means for said first bypassing means to adjust the bypass flow of fuel to said main burner when said first valve means is in an open position and said thermostatic valve means is in a closed position.

12. In apparatus for controlling the temperature of an oven or the like having main and pilot burners and ignition means therefor, the combination comprising a valve controlling a flow of fuel to said main burner, means responsive to a flame at said pilot burner for actuating said valve, regulating valve means positioned ahead of said valve for regulating a flow of fuel to said pilot burner and to said valve, thermally responsive means for actuating said regulating valve means in accordance with oven temperature variations, control valve means positioned ahead of said regulating valve means for controlling a flow of fuel thereto and being operative for moving said regulating valve means to a regulating position, minimum flow means between said control valve means and said regulating valve means and bypassing said regulating valve means to supply a minimum flow of fuel to said valve, pilot flow means bypassing said regulating valve means to supply a bypass pilot flow of fuel to said pilot burner, said control valve means being movable through one range of controlling positions permitting a flow of fuel to said pilot flow bypassing means, to said minimum flow means, and to said regulating valve means, and through another range of controlling positions preventing a flow of fuel to said pilot flow bypassing means but permitting a flow of fuel to said minimum flow means and to said regulating valve means.

13. In control apparatus for maintaining set temperatures within an oven having main and pilot burners and ignition means therefor, the combination comprising a valve controlling a flow of fuel to said main burner, means responsive to a flame at said pilot burner for actuating

said valve, regulating valve means positioned ahead of said valve for regulating a flow of fuel to said pilot burner and to said valve, thermally responsive means for actuating said regulating valve means in accordance with oven temperature variations, temperature setting control valve means positioned ahead of said regulating valve means for controlling a flow of fuel thereto and being operative for moving said regulating valve means to a regulating position, minimum flow means between said temperature setting control valve means and said regulating valve means and bypassing said regulating valve means to supply a minimum flow of fuel to said valve, pilot flow means bypassing said regulating valve means to supply a bypass pilot flow of fuel to said pilot burner, said temperature setting control valve means being movable through a first range of controlling positions corresponding to low temperature settings in which positions a flow of fuel to said pilot flow bypassing means is prevented and a flow of fuel to said minimum flow means and said regulating valve means is permitted and through a second range of controlling positions corresponding to high temperature settings in which positions a flow of fuel to said pilot flow bypassing means, to said minimum flow means and to said regulating valve means is permitted.

14. In apparatus for controlling the temperature of an oven or the like, the combination comprising main and pilot burners, ignition means for said burners, a valve controlling a flow of fuel to said main burner, thermostatically operated valve means for controlling a flow of fuel to said valve and to said pilot burner whereby said pilot burner is provided with a cycling operation, means responsive to a flame at said pilot burner for actuating said valve whereby said valve is provided with a cycling operation, minimum flow means bypassing said valve means for supplying a minimum flow of fuel to said valve, adjusting means cooperating with said minimum flow means to adjust the minimum flow of fuel, pilot flow means bypassing said valve means for supplying a bypass pilot flow of fuel to said pilot burner whereby said pilot burner is provided with a non-cycling operation, and control valve means having a first controlling position permitting a flow of fuel to said pilot flow means whereby said pilot burner provides said valve with a non-cycling operation, said first controlling position also permitting a flow of fuel to said minimum flow means whereby the minimum flow of fuel through said valve may be adjusted when said thermostatically operated valve means is in a closed position, said control valve means having a second controlling position preventing a flow of fuel to said pilot flow means whereby said pilot burner provides said valve with a cycling operation, said second controlling position permitting a flow of fuel to said minimum flow means and to said thermostatically operated valve means for maintaining the oven at predetermined low temperatures, said control valve means having a third controlling position permitting a fluid flow to said pilot flow means, to said minimum flow means and to said thermostatically operated valve means for maintaining the oven at predetermined high temperatures.

15. A fuel control system comprising a main burner, a pilot burner, first valve means for controlling the flow of fuel to said main burner, means responsive to the existence of a flame at said pilot burner to open said first valve means, thermostatically operated valve means controlling the flow of fuel to said first valve means and to said pilot burner, means for bypassing said thermostatically operated valve means to supply a flow of fuel to said pilot burner independently of said thermostatically operated valve means, and a second valve means for controlling the flow of fuel to said thermostatically operated valve means, said second valve means selectively opening and closing said bypass means.

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ALDEN D. STEWART, *Primary Examiner.*

Dedication

3,255,965.—*James R. Willson*, Greensburg, Pa. OVEN TEMPERATURE CONTROL SYSTEM. Patent dated June 14, 1966. Dedication filed June 13, 1972, by the assignee, *Robertshaw Controls Company*.

Hereby dedicates the remaining term of said patent to the Public.

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