Jan. 26, 1954 M. J. CAPARONE 2,667,217

AUTOMATIC PILOT CONTROL AND IGNITION APPARATUS

Filed Oct. 21, 1949

2 Sheets-Sheet 1

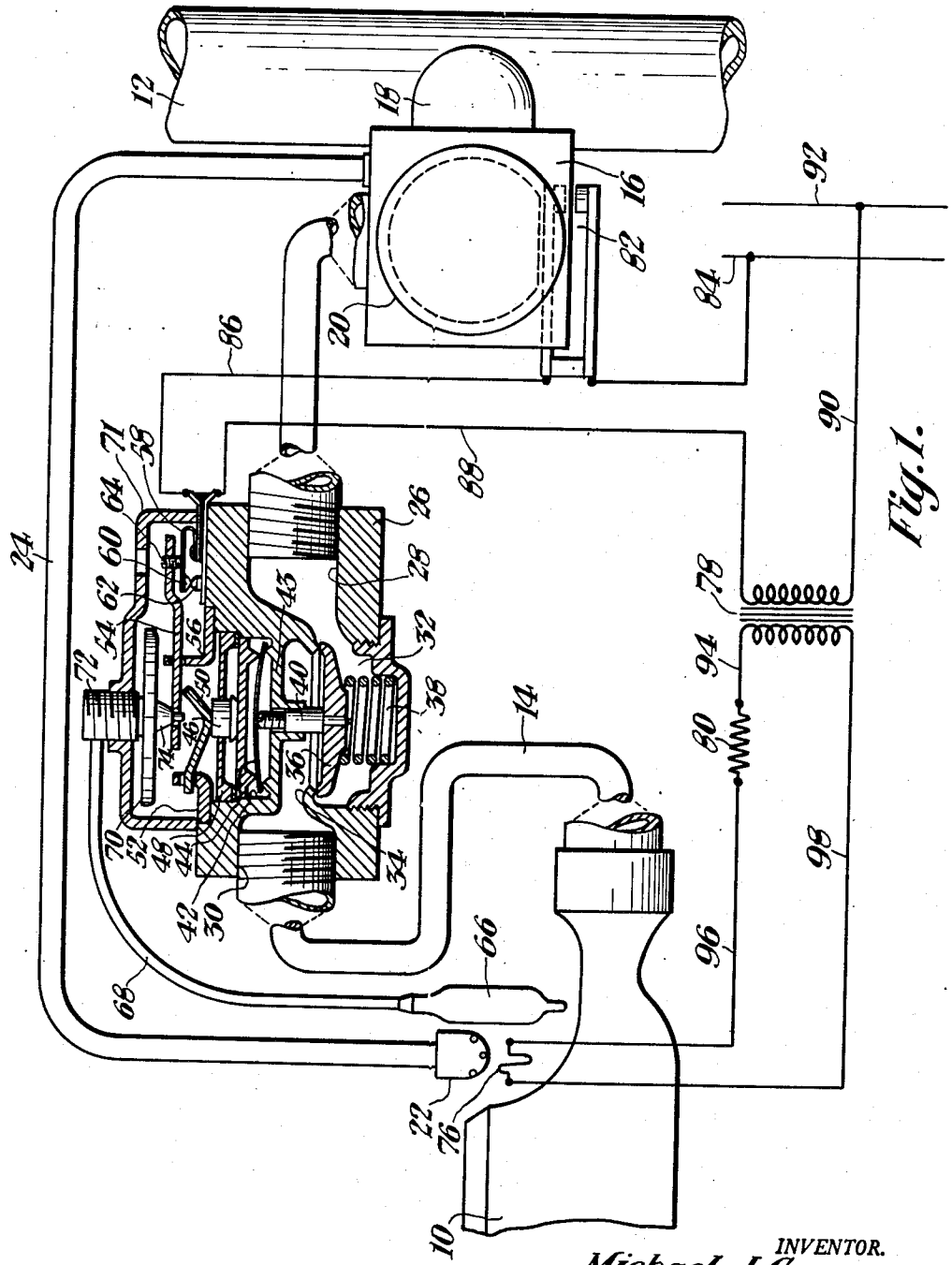



Fig. 1.

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2 Sheets-Sheet 2

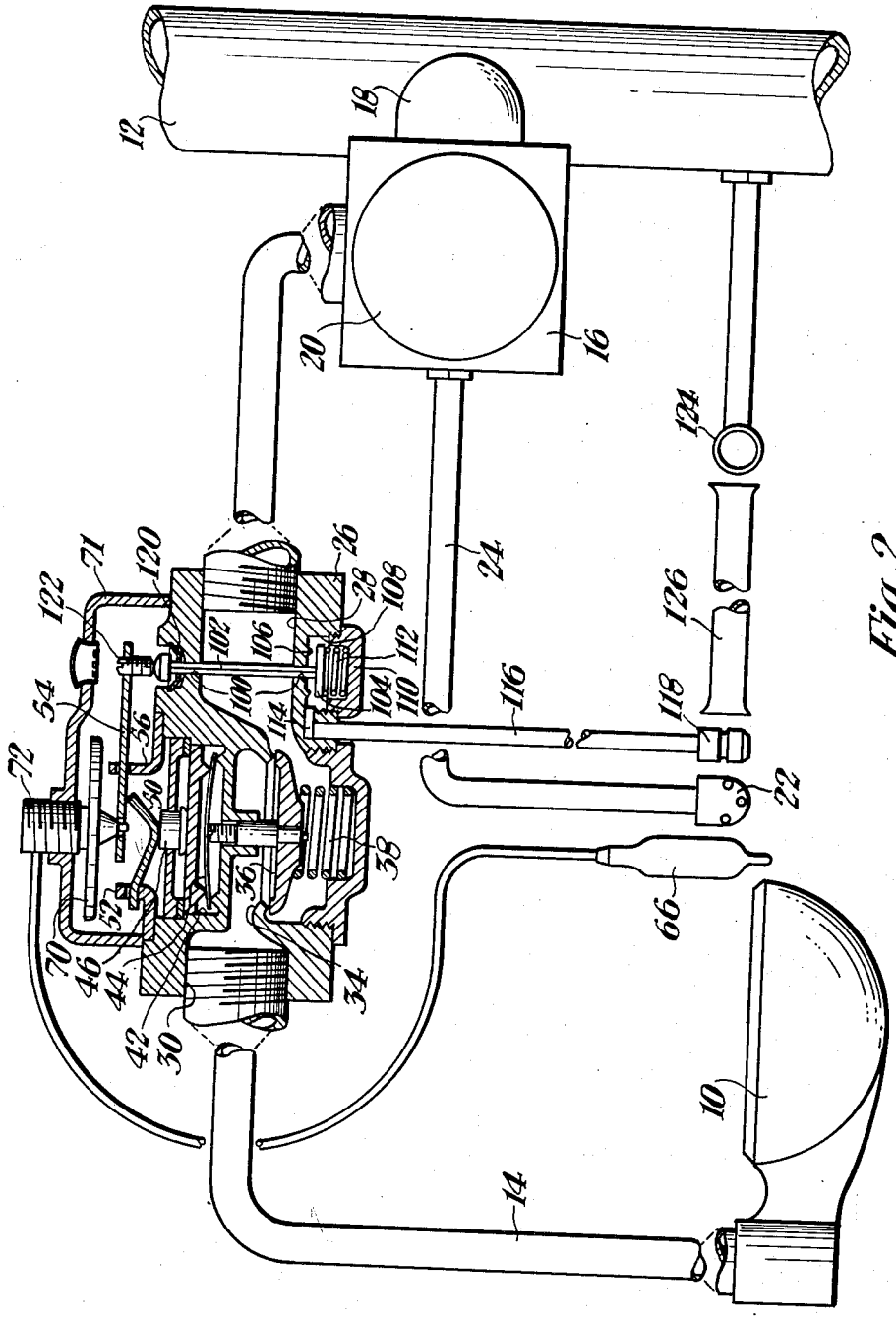



Fig. 2.

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2,667,217

# UNITED STATES PATENT OFFICE

2,667,217

## AUTOMATIC PILOT CONTROL AND IGNITION APPARATUS

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7 Claims. (Cl. 158—125)

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This invention relates to pilot controls combined with an igniting means for gaseous fuel burners and particularly adapted for first automatically igniting a main burner and thereafter causing the supply of fuel to be shut-off should a pilot flame become extinguished.

A relatively simple system for the foregoing purposes may employ a combustion responsive device associated with the pilot burner for opening the main burner valve during normal running conditions but causing this valve to close in the event of failure of the pilot flame. Such a system may be of the recycling type wherein the automatic closing of the valve is accompanied by another igniting operation of the pilot burner. However, during the time required for the combustion responsive device to cause closing of the valve there may be an escape of a considerable amount of unburned fuel into the burner chamber. An immediate reigniting operation would give rise to dangerous conditions due to this collection of unburned fuel becoming ignited.

The present invention seeks to avoid such conditions by providing a purge period in a recycling system so that no reignition can occur until a predetermined lapse of time following the valve closure. The apparatus requires no attention on the part of the operator to place it in operation beyond the customary turning "On" of the usual gas cock. The holding down of push buttons and the like is completely eliminated together with the waiting period prior to placing the system in operation. The apparatus requires a minimum number of parts which may be of simple design and should be economical to manufacture while requiring infrequent service when installed.

A single casing is preferably employed for housing the control valve and the igniter control means. These devices are disposed side-by-side and a pair of lever means extend between them. One lever means is pivoted on the casing and overlies the control valve. A second lever means is pivoted intermediate its ends in the casing independently of the first lever and has one arm operatively engaging the first lever and another arm operatively engaging the igniter control. The control valve is biased closed while the igniter control is biased to an inoperative position. However, due to the interposition of the levers the control valve bias serves to hold the igniter control in its operative position whenever the control valve is closed.

A thermally responsive device has an actuating element positioned in the casing and engageable with the one arm of the second lever. The

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actuating element is movable when the device responds to the heat of a pilot burner flame for reversing the positions of the control valve and the igniter control so that when the main burner becomes operative then the igniter is no longer in operation. As will be apparent from the detailed description which now ensues, the control valve and igniter control are operative in sequence in both directions for the purpose of providing a purge period as previously described.

In the drawings:

Fig. 1 is a schematic plan view, partly in section, of the automatic pilot control and ignition apparatus installed in a fuel burning system;

Fig. 2 is a similar schematic plan view, partly in section, of a modified form of automatic pilot control and ignition apparatus.

*Main shut-off cock and thermostat*

Referring more particularly to Fig. 1 of the drawings, a main burner **10** is shown as adapted to receive a supply of fuel from a manifold **12** by way of a main fuel pipe **14**. In one contemplated installation the main burner **10** is located in the oven burner compartment of a domestic gas range and the manifold **12** extends along the front of the range as is customary in such appliances. The usual main shut-off cock **16** has an inlet connected as by the elbow **18** to the manifold **12** and the outlet therefor is connected to one end of the main fuel pipe **14**. It will be understood that the main shut-off cock **16** may embody the usual oven thermostat operable by the single dial **20**, such devices being disclosed in Weber et al. Patent No. 2,303,011, for example.

A pilot burner **22** is located in lighting proximity to the oven burner **10** and receives a supply of fuel by way of a conduit **24** connected to the main shut-off cock **16**. Preferably, the flow of fuel in the conduit **24** should by-pass the thermostat control when such device is combined with the main fuel cock **16**. Otherwise the conduit **24** could well be connected to the main fuel pipe **14** at the outlet of the main shut-off cock. As such modifications are wellknown to those skilled in the art further description is deemed unnecessary, it being understood that rotation of the dial **20** to the "Off" position will serve to shut-off the flow of fuel in both the main fuel pipe **14** and the conduit **24**.

*Automatic pilot control and ignition device*

The automatic pilot control and ignition apparatus of this invention is embodied for the most part in a casing **26** which is interposed in

the main fuel supply pipe 14. Thus, the casing 26 is provided with an inlet 28 and an outlet 30 at opposite ends thereof to which the main fuel pipe 14 is connected. A valve chamber 32 is formed in the casing 26 intermediate the inlet 28 and outlet 30 and is provided with an annular valve seat 34 intersecting the passage between the inlet 28 and the outlet 30. A control valve member 36 is positioned in the chamber 32 and is movable between open and closed positions relative to the valve seat 34 for controlling the flow of fuel in the supply pipe 14. A coil spring 38 is operative between the casing 26 and the valve member 36 for biasing the latter towards the valve seat 34 and thus to its closed position.

The valve member 36 is provided with a valve stem 40 which projects into a recess 42 formed in the upper face of the casing 26 axially of the valve seat 34 and terminating at a partition 43 overlying the valve seat 34. The recess 42 contains a snap-action mechanism of well-known form including an overcenter snap or clicker disc 44 which engages the projecting end of the valve stem 40 and a thrust element 46 which projects through the usual sealing ring 48 for the snap-action mechanism. It will be understood that the contour of the snap disc 44 is reversed from that shown in the drawing upon sufficient pressure being applied to the thrust element 46. The conventional snap-action means thus briefly described is capable of overcoming the bias of the valve member 36 and moving the same to an open position relative to the valve seat 34.

The force required to move the thrust element 46 is applied through a first lever 50 which is pivoted at one end on a bracket 52 carried by the casing 26 and partly overlying the recess 42. The opposite end of the lever 50 forms an operating arm which overlies the thrust element 46 and then projects upwardly at an oblique angle therefrom for a purpose apparent hereinafter.

A second lever 54 is pivoted intermediate its ends in a bracket 56 which is carried by the casing 26 on the opposite side of the recess 42 from the first bracket 52 and also partly overlying the recess 42. One arm of the lever 54 projects into overlying engagement with the upturned angular arm of the lever 50 and extends therebeyond toward the bracket 52 but terminating short thereof. The other arm of the second lever 54 extends on the opposite side of the bracket 56 into overlying relation with a control switch 58 which is carried on the upper face of the casing 26 on one side of the recess 42.

A flexible arm carrying a contact 60 forms part of the control switch 58 and is normally biased out of operative engagement with a fixed contact 62 of the switch 58. An adjusting screw 64 projects from the lever 54 into operative engagement with the arm carrying contact 60 and serves to overcome the bias thereof when the parts are in the position shown in the drawing. Such position is due to the normal bias of the clicker disc 44 assisted by the bias of the valve spring 38 serving to rotate the lever 50 in a counterclockwise direction about its pivot on bracket 52 and in engagement with the lever 54 which thereupon rotates clockwise on its pivot on bracket 56 for the purpose described.

*Combustion responsive device*

Thermally responsive means having a bulb 66, capillary tube 68 and an actuating element 70 form the combustion responsive device of this invention. The bulb 66 is positioned in the path of a flame from the pilot burner 22 and will be responsive to the heat thereof. The actuating element 70 has one or more flexible sides and is positioned in a cover 71 for the casing 26 which also houses the levers 50, 54 and the control switch 58. The actuating element 70 is supported axially of the valve seat 34 and in overlying relation with the adjacent arm of the lever 54 by a hollow stud 72 interposed between the adjacent ends of the capillary tube 68 and the element 70 and secured to the cover 71. A button 74 projects from the actuating element 70 into operative engagement with the adjacent arm of the lever 54 for transmitting movement of the actuating element 70 thereto.

The thermally responsive means comprising bulb 66, capillary tube 68 and actuating element 70 are charged preferably with mercury which is adapted to be completely vaporized at about 1000° F. so that no appreciable deflection of the actuating element 70 can occur above this temperature. Upon the bulb 66 becoming sufficiently heated to cause such vaporization of the mercury charge, then the actuating element 70 will deflect and move toward the lever 54 sufficiently to operate the same. It will be apparent that this type of thermal element provides its own over-temperature safeguard due to the lack of movement beyond the set temperature. Furthermore, since the internal pressure must increase in order to cause movement of the actuating element 70 in a direction to open the valve member 36 then a leak or other failure of the thermal element is accompanied only by a safe-failure of the control apparatus.

*Igniting means*

The system disclosed in this embodiment is completed by the provision of an electric igniter 76 which is positioned to ignite the fuel flowing from the pilot burner 22. A step-down transformer 78 is preferably employed in the electrical circuit of the igniter 76 together with a current limiting resistor 80. The electrical circuit of the igniter 76 will be described in connection with the description of the operation of the apparatus which follows immediately. A main switch 82 is preferably included in this circuit for operation to closed position when the main shut-off cock 16 is opened by rotation of the dial 20.

*Operation*

The parts are shown in Fig. 1 of the drawings in the positions they assume prior to the starting operation. Upon rotating the dial 20 of the main fuel cock 16 to an open position, fuel is permitted to flow in the main fuel pipe 14 as far as the control valve 36 which is biased closed. Fuel also flows in the conduit 24 to the pilot burner 22. The rotation of the dial 20 also causes the main switch 82 to be closed establishing a circuit for the igniter 76 which may be traced as follows: line wire 84, main switch 82, wire 86, igniter switch 58, wire 88, primary of the transformer 78, wire 90, line wire 92. The transformer 78 being energized the circuit may further be traced from the upper terminal of the secondary of the transformer 78, line wire 94, resistor 80, wire 96, igniter 76 and wire 98 to the lower terminal of the secondary of transformer 78.

Since the igniter 76 is now energized in the circuit just traced, then fuel flowing from the pilot burner 22 becomes ignited and begins to heat the bulb 66 of the temperature responsive means. When the bulb 66 becomes heated to the temperature which will vaporize the mercury

contained therein then the vapor pressure so created moves the actuating element 70 to apply a force on the second lever 54. The resulting counterclockwise rotation of the lever 54 first causes the adjusting screw 64 carried thereby to become ineffective for overcoming the inherent bias of the flexible arm which carries contact 60 of the igniter switch 58 which thereupon moves out of engagement with the contact 62. Consequently, the igniter circuit is opened and the igniter 76 becomes deenergized.

Continued movement of the diaphragm 70 serves to further rotate the lever 54 in a counterclockwise direction causing corresponding clockwise movement of the first lever 50. When such movement has proceeded far enough, the thrust element 46 of the snap-action device exerts sufficient thrust to cause overcenter movement of the clicker disc 44 for overcoming the bias of the valve spring 38 and causing the valve member 36 to move to its open position. Fuel is thus permitted to flow to the main burner 10 where it is ignited by the pilot burner 22. The oven burner 10 continues in operation as long as the main fuel cock 16 remains in the open position. However, should a thermostatic device be incorporated in the main fuel cock 16 then an intermittent operation of the main burner 10 will occur due to the shutting-off of the flow of fuel in the fuel pipe 14 by the thermostat to maintain the set temperature.

It will be observed that the operation of the igniter switch 58 and the valve member 36 to open position occurs in sequence. The bias of the clicker disc 44 must necessarily be overcome before the valve member 36 can move to its open position and this bias is assisted by that of the valve spring 38 tending to maintain the valve member 36 closed. The adjustment of the screw 64 determines the time during the cycle of operation that the igniter switch 58 opens. The movement of the screw 64 resulting from the expansion of the actuating element 70 is amplified by means of the lever 54 so that the screw adjustment is less critical. Moreover, the lever system tends to reduce the force which the actuating element 70 must overcome to initiate the desired control movements. In the illustrative embodiment disclosed herein the force required to ensure overcenter snap-action of the clicker disc 44 is reduced from approximately 30 pounds to 10 pounds by operation of the levers 50, 54. While the described sequential operation occurs during both the starting operation described and an automatic shut-off, it has no significance in the procedure for bringing the main burner 10 into operation but does have considerable importance upon a reverse movement of the parts as will now be described.

In the event that the flame of the pilot burner 22 is extinguished then the bulb element 66 will cool causing the actuating element 70 to return toward its initial position. The bias of the clicker disc 44 and the valve spring 38 are now effective for causing a return overcenter operation of the clicker disc 44 and movement of the valve member 36 to its closed position. During such return movement the lever 50 is rotated counterclockwise by the thrust element 46 under the described bias and causes a corresponding clockwise movement of the lever 54. Upon sufficient movement of the actuating element 70 towards its initial position during further cooling of the bulb 66, then the lever 54 rotates sufficiently in a clockwise direction to effect reengagement of the switch contacts 60, 62 of the igniter switch 58 and consequent reenergization of the igniter 76.

It is apparent, therefore, that a definite period of time elapses after the control valve member 36 is closed before the igniter 76 is reenergized. This elapsed time is termed a purge period and permits any unburned fuel remaining in the burner chamber to flow away before the igniting operation occurs and thus prevents explosions. This safeguard is obtained in the apparatus herein described by a simple adjustment of the screw 64 so that the switch 58 operates at a desired time during the cycle of operation.

*Modified form Fig. 2*

Referring now more particularly to Fig. 2 of the drawings the apparatus previously shown and described has been modified to incorporate the so-called single point ignition. Thus, the electric ignition feature is eliminated and ignition of the main burner 10 is effected from a single central point such as from a constant burning pilot burner located on the top surface of a domestic gas range. As numerous parts embodied in the structure disclosed in Fig. 2 of the drawings merely duplicate those fully described and shown in connection with the Fig. 1 embodiment, similar reference numerals have been applied to these corresponding parts.

The casing 26 is substantially identical with that disclosed in the previous embodiment and is only slightly modified for the purposes of substituting a different control means for controlling the supply of operative energy to the igniter utilized in this alternative form. Thus, the inlet 28 is provided with a transverse passageway 100 extending through opposite walls thereof for the reception of a valve stem 102 carrying on one end thereof an auxiliary valve member 104. The valve member 104 is cooperable with an annular valve seat 106 forming part of the bottom wall of a recess 108 in the wall of the casing 26. The recess 108 is provided with a closure cap 110 which supports a valve spring 112 serving to bias the valve member 104 to a closed position relative to the seat 106.

An outlet 114 communicates with the chamber formed by the recess 108 and provides for flow of fuel to a conduit 116 secured to the wall of the casing 26 and terminating at the opposite end in an ignition burner 118 positioned in lighting proximity to the pilot burner 22. Flow of fuel from the inlet 28 to the outlet 114 occurs past the valve stem 102 which is conveniently made of noncircular form in cross-section for slidable engagement with the wall of the tranverse passage 100 which is substantially circular in cross section.

The end of the valve stem 102 opposite the valve member 104 projects from the casing 26 into the cover 71 and a suitable sealing ring 120 is provided at the projecting end to prevent leakage of fuel from the inlet 28. The operating means for the valve member 104 corresponding to the lever 54 of the previous embodiment is slightly modified to accommodate a longer adjusting screw 122 but is also pivoted intermediate its ends in the bracket 56.

As previously indicated, a constant burning pilot burner 124 which may be located on the top surface of a domestic gas range and supplied with fuel from the manifold 12 is relied upon as the original source for effecting ignition of the main burner 10 in this embodiment. To this end, a flash tube 126 is adapted to extend be-

tween the constant burner 124 and the ignition burner 118 for conducting a flame therebetween. Inasmuch as the electric igniting means has been eliminated in this embodiment the dial 20 of the main fuel cock 16 does not require the addition of any switch means such as embodied in the previously described form.

*Operation of Fig. 2 embodiment*

In the operation of the device disclosed in Fig. 2 of the drawings, the normal rotation of the dial 20 to an "on" position, or to set the oven temperature in the event that a combined thermostatic device is included therein, will serve to admit fuel to the pilot burner 22 and also in the main fuel pipe 14 as far as the control valve member 36 which is biased closed. Since the valve member 104 is at this time being held in an open position relative to its seat 106 fuel can flow past the valve stem 102 to the chamber formed by the recess 108 and thence through the outlet 114 and the conduit 116 to the ignition burner 118. This fuel enters the flash tube 126 and is ignited by the flame of the constant burner 124 whereupon a flash back occurs causing the ignition burner 118 to produce a flame. In this manner, the fuel issuing from the pilot burner 22 is ignited and serves to heat the bulb 66 of the temperature responsive means as in the previously described embodiment.

During the initial portion of the resulting movement of the actuating element 70, the force exerted by the lever 54 for holding the auxiliary valve member 104 in an open position is relieved and this valve member becomes closed under the bias of its spring 112. Thereafter, the position of the clicker disc 44 is reversed upon continued heating of the bulb 66 and the control valve member 36 is moved to an open position to permit flow of fuel to the main burner 10. As such fuel is immediately ignited by the flame from the pilot burner 22 the apparatus is placed in normal running condition under control of the main fuel cock 16 or the thermostatic device which may be associated therewith.

In the event that the flame at the pilot burner 22 is extinguished then the automatic pilot control comes into operation. The reverse movement of the actuating element 70 upon cooling of the bulb 66 first causes the clicker disc 44 to resume its initial position with consequent closure of the control valve member 36 under bias of the valve spring 38. After a sufficient lapse of time for any unburned fuel to flow away from the main burner 10, then the lever 54 is moved sufficiently in a clockwise direction by further contraction of the element 70 to reopen the auxiliary valve member 104 and admit fuel to the ignition burner 118 as described in connection with the starting operation. Thus, in this embodiment also a purge period is provided to prevent explosions caused by ignition of main burner fuel escaping during the time required for the bulb 66 to cool sufficiently to close the control valve member 36.

It will be apparent that both embodiments provide an igniter adapted to be positioned for igniting the pilot burner together with control means movable between positions for controlling the supply of operative medium to the igniter. As only minor changes are required to adapt the control casing 26 for either electric or single point ignition it is apparent that the selection can readily be made. Both modifications are illustrated in schematic form but it will be apparent that various changes can be made to adapt the apparatus for satisfactory commercial use. Furthermore, many changes 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. An automatic pilot control and ignition apparatus for fuel burners having main and pilot burners and a source of fuel supply, comprising a control valve member biased to a closed position and adapted for preventing said fuel supply to the main burner, an igniter adapted to be positioned for igniting the pilot burner, control means movable between positions for controlling the supply to said igniter of a medium for producing heat and being biased for preventing said medium supply, a pair of lever means cooperable for overcoming the bias of said control means when said valve member is in said closed position, one said lever means being operatively associated with said valve member, the other said lever means having operative connection with said one lever means and said control means, and thermally responsive means adapted for movement in response to the heat of a flame at the pilot burner and being operatively engageable with said other lever means for overcoming the bias of said valve member for moving the same to an open position and said control means to said biased position.

2. Apparatus as claimed in claim 1 wherein operative connection of said other lever means with said control means is adjustable with respect thereto for causing operation of said valve member and said control means in sequence.

3. An automatic pilot control and ignition apparatus for fuel burners having main and pilot burners and a source of fuel supply, comprising a control valve member biased to a closed position and adapted for preventing said fuel supply to the main burner, an igniter adapted to be positioned for igniting the pilot burner, control means movable between positions for controlling the supply to said igniter of a medium for producing heat and being biased for preventing said medium supply, said control means being axially offset from said valve member, a pair of lever means pivoted independently of each other, one said lever means having an operating arm operatively associated with said valve member, the other said lever means having operative connection with said one lever means adjacent said valve member and having an operating arm extending into operative engagement with said control means for overcoming the bias thereof when said valve member is in said closed position, and thermally responsive means having an actuating element movable axially of said valve member in response to the heat of a flame at the pilot burner and being operatively engageable with said other lever means, the arrangement being such that movement of said other lever means in one direction by said actuating element in the presence of said flame is effective first for causing movement of said control means under said bias to prevent said medium supply and thereafter for moving said valve member to an open position, said movement in an opposite direction in the absence of a flame being first ineffective for overcoming the bias of said valve member and thereafter for moving said control means to a medium supplying position.

4. An automatic pilot control and ignition apparatus for fuel burners having main and pilot burners and a source of fuel supply, comprising a control valve member biased to a closed posi-

tion and adapted for preventing said fuel supply to the main burner, an electric igniter adapted to be energized for igniting the pilot burner, switch means movable between open and closed positions for controlling the energization of said igniter and being biased to said open position, a pair of lever means cooperable for overcoming the bias of said switch means when said valve member is in said closed position, one said lever means being operatively associated with said valve member, the other said lever means having operative connection with said one lever means and said switch means, and thermally responsive means adapted for movement in response to the heat of a flame at the pilot burner and being operatively engageable with said other lever means for overcoming the bias of said valve member for moving the same to an open position and said switch means to said open position.

5. An automatic pilot control and ignition apparatus for fuel burners having main and pilot burners and a source of fuel supply, comprising in combination, a main shut-off cock adapted for controlling the supply of fuel to both the main and pilot burners, a source of electric energy, a main switch operatively associated with said shut-off cock, a fuel supply pipe extending from said shut-off cock and adapted for connection to the main burner, a combined valve and switch casing interposed in said supply pipe, a valve seat in said casing, a control valve member movable between open and closed positions relative to said seat for controlling flow of fuel in said supply pipe, and being biased to said closed position, snap-action means adapted for overcoming said bias and moving said valve member to open position, an electric igniter connected to said main switch and adapted to be energized for igniting the pilot burner, control switch means positioned in said casing laterally of said valve member and biased to an open position for preventing energization of said igniter, a first lever pivoted at one end on said casing and having an arm overlying said snap action means, a second lever pivoted intermediate the ends thereof on said casing and having one arm engageable with said first lever arm and having the other arm thereof engageable with said control switch for holding the same in closed position, and thermally responsive means adapted to respond to the heat of a flame at the pilot burner and having an actuating element in said casing engageable with said one arm of said second lever for moving the same toward said first lever thereby first causing said control switch to open under its bias and thereafter for operating said snap-action means to open said valve member.

6. An automatic pilot control and ignition apparatus for fuel burners having main and pilot burners and a source of fuel supply, comprising a control valve member biased to a closed position and adapted for preventing said fuel supply to the main burner, an ignition burner adapted for igniting the pilot burner, auxiliary valve means movable between open and closed positions for controlling the supply of fuel to said ignition burner and being biased to said closed position, a pair of lever means cooperable for overcoming the bias of said auxiliary valve means when said control valve member is in closed position, one said lever means being operatively associated with said control valve member, the other said lever means having operative connection with said one lever means and said auxiliary valve means, and thermally responsive means adapted for movement in response to the heat of a flame at the pilot burner and being operatively engageable with said other lever means for overcoming the bias of said control valve member for moving the same to an open position and said auxiliary valve means to said closed position.

7. An automatic pilot control and ignition apparatus for fuel burners having an oven burner, a pilot burner associated with said oven burner, and a constant burning burner remote therefrom, comprising a casing having an inlet and an outlet adapted for supplying fuel to the main burner, a valve seat in said casing, a control valve member movable between open and closed positions relative to said seat for controlling flow of fuel between said inlet and outlet and being biased to said closed position, snap-action means adapted for overcoming said bias and moving said valve member to open position, an ignition burner adapted to be positioned for igniting the pilot burner and connected to said casing for receiving fuel from said inlet, auxiliary valve means positioned in said casing laterally of said control valve member and biased to a closed position for preventing flow of fuel to said ignition burner, a pair of lever means pivoted independently of each other in said casing, one said lever means having an operating arm engageable with said control valve member, the other said lever means being engageable with said one lever means and said auxiliary valve means for overcoming the bias thereof when said control valve member is in said closed position, flash tube means adapted to extend between said constant burner and said ignition burner for conducting a flame therebetween for igniting said pilot burner, and thermally responsive means adapted to respond to the heat of a flame at the pilot burner and having an actuating element in said casing engageable with said other lever means for moving the same toward said one lever means thereby first causing said auxiliary valve means to close under its bias and thereafter for operating said snap-action means to open said control valve member.

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