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CONTROLS FOR GAS-BURNING SYSTEMS

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3 Sheets-Sheet 1

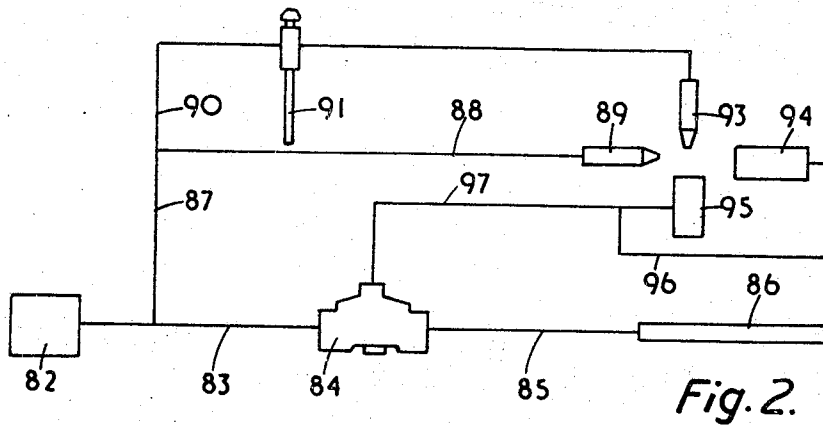


Fig. 2.

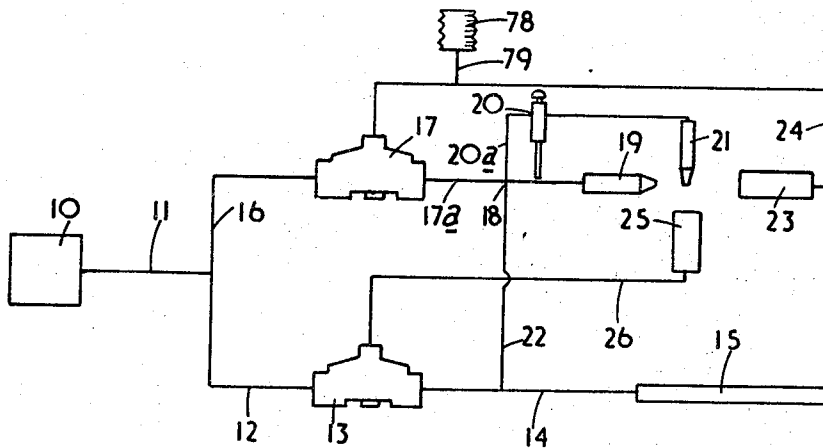


Fig. 1.

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3 Sheets-Sheet 2

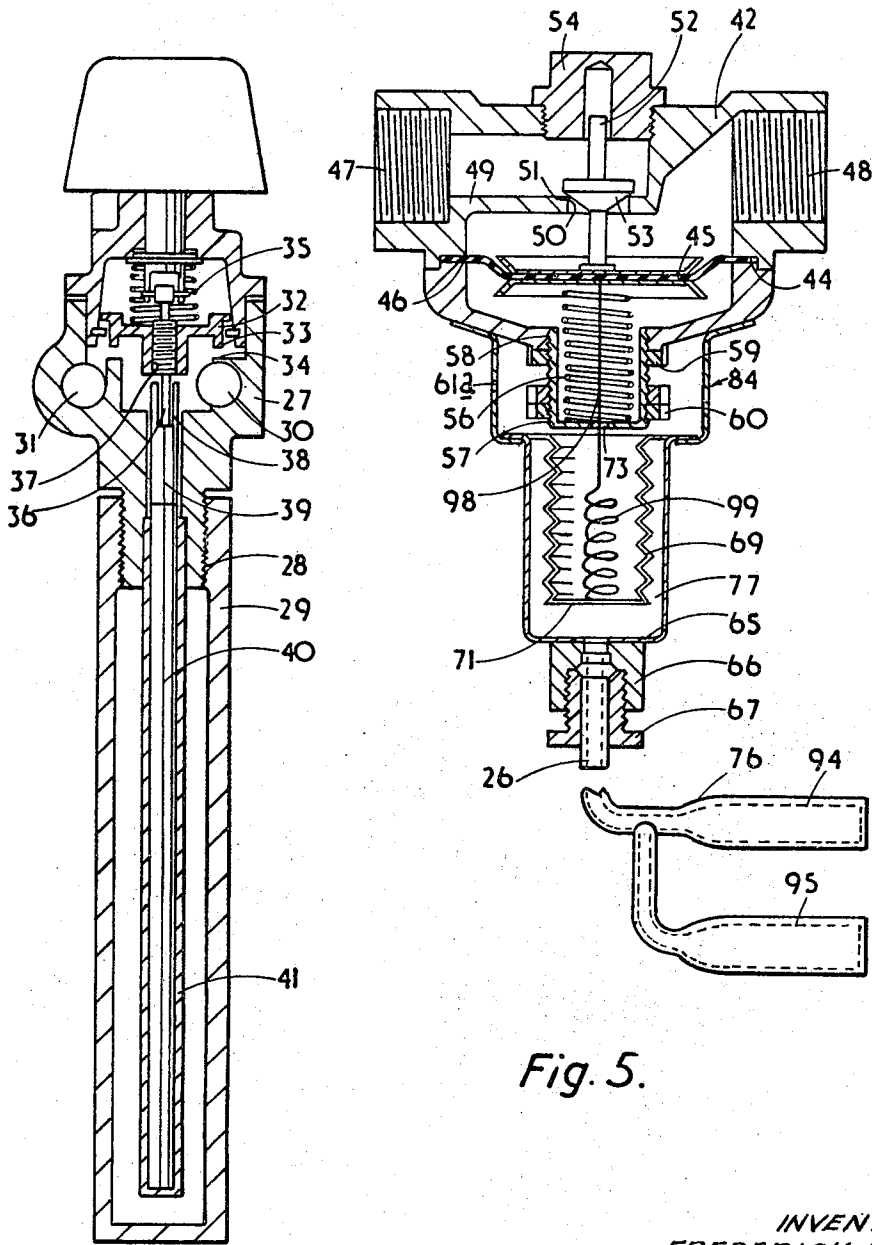


Fig. 3.

Fig. 5.

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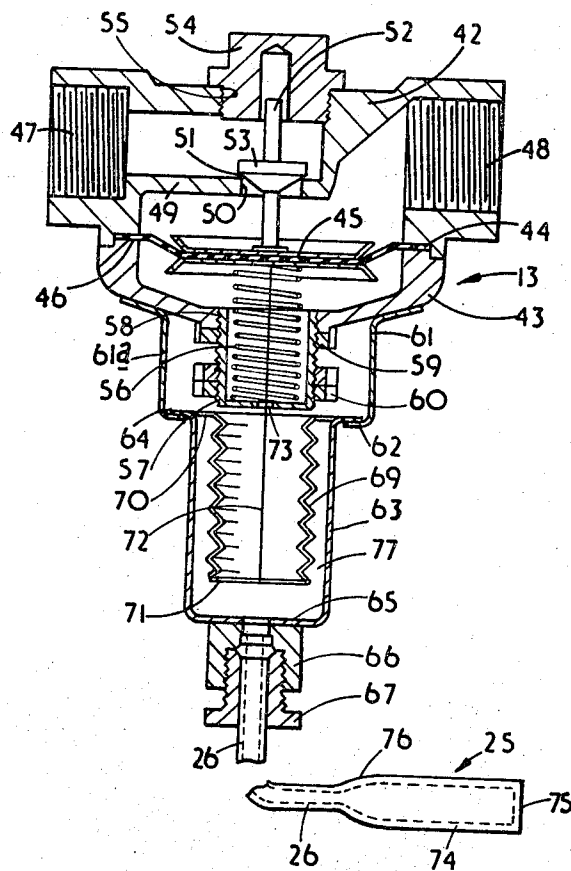


Fig. 4.

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CONTROLS FOR GAS-BURNING SYSTEMS

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ABSTRACT OF THE DISCLOSURE

The specification discloses a gas-burning system having a main burner, a pilot burner and an auxiliary burner. Operation of the auxiliary burner controls the gas supply to the main burner. The system includes a main-burner, gas-supply valve which acts both as a shut-off valve for the main burner and, when it is open, as a pressure governor for the gas supplied to the main burner. This valve is controlled in dependence on operation of the auxiliary burner. In one embodiment, the auxiliary burner can also be supplied from a gas control valve which operates as a shut-off valve and also as a pressure governor when open. In a second embodiment, the supply valve for the main burner is controlled in dependence on the operation both of the pilot burner and of the auxiliary burner.

In present gas-burning systems there are at least three sensing elements each of which may control a separate valve in the gas supply in dependence on the conditions sensed. Thus there is normally a pilot burner which, when alight, heats a first sensing element in the form of a thermocouple and holds open a gas valve, failure of the pilot flame causing closure of the gas valve and preventing the escape of gas. Secondly, there is a pressure governor which governs the pressure of the gas supplied to the main burner of the system during variations in the supply pressure. The governor may consist of a loaded diaphragm which is connected to a valve member, the diaphragm moving in response to sensed changes in supply pressure and opening and closing the valve to maintain the pressure of the gas supplied to the main burner substantially constant.

Thirdly, there is normally a thermostat which, in the case of a domestic central heating system, may be responsive either to the fluid being heated in the system or to the temperature of the ambient air or there may be two thermostats each responsive to one of these quantities. One known form of valve for use with a thermostat has a loaded diaphragm which has one side in a first chamber open to the gas supply pressure and the other side in a second chamber open to the gas supply pressure through a restriction. A weep pipe leads from the second chamber and the passage of gas along this weep pipe is controlled by the thermostat. If the weep pipe is closed then the pressure on both sides of the diaphragm is the same and the valve closes. If, however, the weep pipe is open, the pressure in the second chamber is less than that in the first chamber and the valve opens. The gas supplied to the weep pipe is usually fed to the main burner after it has passed through the thermostat.

Two embodiments of the invention will now be described in detail by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a schematic diagram of a gas-burning system constituting one embodiment of the invention;

FIGURE 2 is a schematic diagram of a gas-burning system constituting a second embodiment of the invention;

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FIGURE 3 is a cross-section through a thermostat of the type used in the system of FIGURES 1 and 2;

FIGURE 4 is a cross-section through the control means used in the system of FIGURE 1; and

FIGURE 5 is a view similar to FIGURE 4 of the control means used in the system of FIGURE 2.

Referring now to FIGURE 1, a gas supply is indicated at 10 and a main gas supply line at 11. The main gas supply line branches into a first branch 12 which is connected to main control means 13 which in turn is connected by a line 14 to a main burner 15 of the system to be controlled. The other branch 16 of the main gas supply line is connected to auxiliary control means 17, the outlet of which is connected by a line 17a to a junction 18. From the junction 18 one line feeds a pilot burner 19. Another line 20a passes through a thermostat 20 to an auxiliary burner 21. A third line 22 is connected from the junction 18 to the line 14.

As shown in the figure, the burners 19 and 21 are arranged adjacent to one another so that gas supplied to the auxiliary burner 21 will be ignited by the pilot burner 19. Moreover, the pilot burner 19 is arranged to heat a thermal bulb 23 which is connected by a capillary tube 24 to the auxiliary control means 17. As will be described hereinafter, the bulb 23 is filled with a liquid, preferably water, which vaporizes on being heated and displaces liquid along the capillary tube 24 to the auxiliary control means 17.

Similarly, the auxiliary burner 21 is arranged to heat a thermal bulb 25 which is connected by a capillary tube 26 to the main control means 13. The bulb 25 is filled with liquid, preferably water, which vaporizes when heated by the auxiliary burner 21 and displaces liquid to a part of the control means 13 as will hereinafter be described.

The thermostat 20 controls the supply of gas to the auxiliary burner 21 assuming that gas is being supplied to the junction 18.

Referring to FIGURE 3, the thermostat 20 comprises a housing 27 which is threadedly engaged at 28 in the upper end of a container 29 containing the liquid of, for example, a domestic central heating system. The body 27 is provided with a gas inlet 30 and a gas outlet 31 and these may be cut off from one another by means of a valve member 32 having a depending flange 33 coming into contact with a peripheral valve seat, parts of which are indicated at 34. The valve member 32 is acted upon by a spring 35 and is urged to a downward position to cut off the inlet from the outlet. The valve member also has secured thereto a rod 36 which is threadedly engaged in a bore 37 in the valve member so that it may be adjusted relative thereto. The rod 36 is received in a counter-bore 38 in the upper end of a rod member 39. The lower end of the rod member 39 rests on the upper end of an Invar rod 40 which is received in a brass tube 41 whose upper end is fixed in the housing 27, the lower end of the Invar rod resting on the bottom of the brass tube.

Referring now to FIGURE 4, this shows in detail the main control means 13 and its associated bulb 25. The control means 13 comprises a housing having a first part 42 which is connected to a second part 43, the edge portion 44 of a diaphragm 45 being trapped in a groove 46 between the parts 42 and 43. The part 42 is provided with a gas inlet 47 and a gas outlet 48. The part is also divided by an internal wall 49 which is provided with a central aperture 50, the upper edge 51 of which provides a valve seat.

Secured to the diaphragm 45 and extending upwardly therefrom is a valve stem 52 which carries an inverted conical valve member 53 which as shown in FIGURE 4, can engage the valve seat 51 to shut off communication between the gas inlet 47 and the gas outlet 48. The

upper end of the valve stem is guided in a valve guide 54 threadedly received in an aperture 55 in the part 42.

The lower side of the diaphragm is connected to a spring 56 which acts as the diaphragm loading and the spring is contained in a cup 57 which is threadedly engaged at 58 with the part 43 of the housing. A seal 59 seals the joint between the cup 57 and the housing part 43. The cup 57 is also provided with a knurled ring 60 whereby the cup can be rotated relative to the housing part 43 to vary the setting of the spring 56.

Secured to the housing part 43 is a first sheet metal casing member 61 the interior of which is open to atmosphere through a small aperture 61a, which at its lower end has an inturned flange 62 and which carries a second casing member 63 having an out-turned flange 64 at its upper end which is engaged within the inturned flange 62. At its lower end, the casing member 63 has an inturned flange 65 which carries a block 66 for a union nut 67 whereby the one end of the tube 26 can be connected to the casing part 63.

Mounted in the casing member 63 is a bellows 69 made of sheet metal and of known type, the mouth 70 of the bellows being out-turned and being secured to the flange 64 of the casing member 63. The bellows is shown in FIGURE 4 in its fully extended position (its first state) and is closed at its lower end by a plate 71 which is connected by a nylon thread 72 to the underside of a diaphragm 45, the nylon thread passing through an aperture 73 in the bottom of the cup 57. The casing part 63 comprises a chamber in which the bellows 69 are mounted.

The bulb 25 comprises a tube 74 closed at its one end 75 and being brazed at its other end 76 to the other end of the capillary tube 26. When the system is assembled it will be seen that the chamber 77 between the casing member 63 and the bellows 69 is in communication with the tube 26 which is in communication with the interior of the vessel 25. The vessel 25 contains liquid, preferably water, so that when the vessel 25 is heated as will hereinafter be described, there will be a displacement of water into the chamber 77 which will result in a compression of the bellows 69. The nylon thread 72 is of such a length that, when the bellows is in its fully extended position as shown in FIGURE 4, the bellows bias the valve member 53 in contact with the valve seat 51 so as to cut off communication between the gas inlet 47 and the gas outlet 48.

The auxiliary control means 17 is identical to that shown in FIGURE 4 except that it will be smaller in size. Moreover, the auxiliary control means has a manual over-ride comprising a liquid-filled bellows indicated at 78 in FIGURE 1 and connected by a capillary tube 79 to the tube 24. Manual compression of the bellows 78 displaces liquid along the tubes 79 and 24 and compresses the bellows 69 in the auxiliary control means 17 thus allowing the valve therein to open.

The operation of the system shown in FIGURE 1 will now be described assuming that all the flames are extinguished. It will first be necessary to light the pilot burner 19. The auxiliary control means 17 will, if the system is cold, as has been assumed, cut off the supply to the line 17a so it will be necessary manually to compress the bellows 78 to allow the valve member 53 in the auxiliary control means 17 to lift thus to permit gas to flow into the line 17a. It will then be possible to light the pilot burner 19. Similarly, assuming that the system is cold, the thermostat 20 will permit gas to flow from the line 20a to the auxiliary burner 21 so that the gas issuing from this burner will be ignited by the pilot burner.

The flame from the pilot burner 19 will then heat the bulb 23 with the result that the water therein will vaporize and water will be displaced along the tube 24 to the chamber 77 in the auxiliary control means 17. This will result in compressing the bellows 69 (moving it

to its second state) thus slackening the nylon thread 72 and allowing the valve member 53 to rise and permit gas to flow from the inlet to the outlet and thus to permit a flow of gas through the control means both to the pilot burner 19 and, through the thermostat 20, to the auxiliary burner 21. When this has occurred, the bellows 78 can be released and the valve will then operate under the action of the gas pressure. The diaphragm 45 controls the valve member 53 in such a manner that if the gas pressure in the line downstream of the valve increases, the diaphragm will tend to be depressed against the action of the spring and will tend to bring the valve member 53 closer towards the valve seat 51 thus reducing the supply of gas. Conversely, if the gas pressure decreases the diaphragm will tend to rise thus increasing the distance between the valve member 53 and the valve seat 51. The diaphragm thus acts to maintain the gas pressure in the line 17a substantially constant.

When the pilot flame is initially lit, the main control means 13 will be in the position shown in FIGURE 4 thus the gas supply to the main burner 15 will be cut off. When the auxiliary control means 17 is operated initially by the bellows 78, some gas will flow from the junction 18 and along the lines 22 and 14 to the burner 15. This gas flow will only be at a low rate but the burner 15 will be ignited by the flame from the pilot burner 19. As the auxiliary burner 21 heats up the bulb 25, liquid will be displaced into the chamber 77 in the main control means 13 thus compressing the bellows 69 (i.e. moving it to its second state) and allowing the diaphragm 45 to act in the manner described in relation to the auxiliary control means 17 and thus allowing a supply of gas to be fed to the main burner 15. Assuming that the control is applied to a domestic central heating system, the burner 15 will then heat the liquid in the system. Some of this liquid will be supplied to the container 29 of the thermostat. So long as the temperature of this liquid is below a predetermined value, the thermostat will allow gas to flow from the inlet 30 to the outlet 31 thereof and will thus maintain a supply of gas to the auxiliary burner 21. The thermostat is operated by virtue of the different rates of thermal expansion of the Invar rod 40 and the brass tube 41. As the brass tube is heated, it will expand by a greater amount than the Invar rod 40 so that the projection of the rod from the top of the tube becomes less. As a result, the rod member 39 moves downwardly and allows the spring 35 to push the valve member 32 so that its peripheral flange 33 seats against the seating 34 thus cutting off communication between the inlet and the outlet. It follows, therefore, that when the desired temperature is attained in the liquid, the thermostat will operate to cut off the supply of gas to the auxiliary burner. The auxiliary burner will thus be extinguished and the vapor in the bulb 25 will liquefy so that liquid will be displaced from the chamber 77 in the main control member 13 and this will assume the position shown in FIGURE 4 thus cutting off the supply of gas from the line 12 to the main burner 15. However, there will be a small supply of gas from the junction 18 along the line 22 to the main burner 15. This will ensure that the main burner 15 will not be entirely extinguished and the line 22 acts, as it were, as a by-pass to the main burner 15. The purpose of the by-pass is to avoid the noise of the main burner lighting up when the main control means 13 opens.

When the temperature of the liquid in the system falls below the predetermined value set on the thermostat, the brass tube 41 will contract and will thus cause the Invar rod 40 to extend further from the tube 41 and will thus lift the valve member 32 to the position shown in FIGURE 3 thus allowing gas to flow to the auxiliary burner 21 and this gas is ignited by the pilot burner 19. The flame from the auxiliary burner 21 heats the bulb 25 and thus brings into operation once more the main control

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means 13 thus increasing a supply of gas to the main burner 15 and causing the liquid to be heated once more.

It will be seen, therefore, that the gas supply to the main burner from the line 12, i.e. the main gas supply thereto, is controlled in dependence on the operation of the auxiliary burner 21. It is normal in controls of this type to provide some safety device so that, in the event of flame failure, all the gas supplies are cut off. It will be seen that if the auxiliary burner 21 is extinguished the main gas supply to the main burner 15 will be cut off by the main control means 13. If the pilot burner 19 is extinguished then the vapor in the bulb 23 will liquefy and the auxiliary control means 17 will move to the position shown in FIGURE 4 and will thus cut off the gas supply along the line 17a. If the thermostat 20 is closed at this time, the auxiliary burner will already have been extinguished and the main control means 13 will be closed so that the main burner will be extinguished since no gas can now flow along the line 22. If the thermostat at 20 is open when the pilot flame fails, the main burner will be alight since the main control means 13 will be open and gas will flow along the line 22 and through the thermostat 20 to the auxiliary burner 21. The main burner will thus be kept alight until the thermostat 20 closes whereupon the auxiliary burner 21 will be extinguished thus causing the main control means 13 to close and extinguishing the main burner 13 since the auxiliary control means 17 has already closed and no gas can thus flow along the by-pass 22 to the main burner. In order to start the system again, it will be necessary to operate the auxiliary control means 17 manually by the bellows 78 and light the pilot burner as described above.

Referring again to FIGURE 1, a second thermostat may be inserted in the line 20a in series with a thermostat 20. In a domestic central heating system, there may be two thermostats, one being a thermostat 20 to sense the temperature of the liquid in the system and the other thermostat to sense the temperature of the air in the space being heated. These thermostats are arranged in series so that if either is operated the gas supply to the auxiliary burner 21 is cut off with the result that only the reduced supply of gas is fed to the burner 15 through the by-pass 22.

Referring now to FIGURES 2 and 5, these illustrate a somewhat simplified system in which there is only a single control means. Referring to FIGURE 2, there is a main gas supply 82 which feeds along the line 83 to the control means 84. From the control means 84 a line 85 supplies gas to the main burner 86. From the line 83 there is a tapping 87 which divides into a line 88 which feeds a pilot burner 89 and a line 90 which passes through a thermostat 91, and if desired a second thermostat (not shown) to an auxiliary burner 93. The pilot burner 89 heats a bulb 94 and the auxiliary burner 93 heats a bulb 95. The bulbs 94 and 95 are connected by capillary tubes 96 and 97 to each other and to the main control means 84.

The main control means 84 is indicated in section in FIGURE 5 and it is basically similar to the control means shown in FIGURE 4 so that similar parts are indicated by the same reference numerals in both figures. The difference between the two controls is that the nylon thread 72 in the control of FIGURE 4 is replaced in that of FIGURE 5 by a nylon thread 98 which is secured to the underside of the diaphragm 45 and has its other end secured to one end of a tension spring 99. The other end of the spring 99 is secured to the plate 71 at the bottom of the bellows 69. When the system is cold the valve member 53 of the control 84 is held in its closed position by means of the tension in the spring 99. If only one of the bulbs 94 and 95 is heated by its appropriate burner then this will only displace sufficient liquid into the chamber 77 of the control 84 to move the bellows 69 to relieve the tension in the spring 99. The valve member 53 will still be held closed by the thread 98. If both

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bulbs 94, 95 are heated, however, there will be sufficient liquid displaced into the chamber 77 to cause the thread 98 to become slack and thus to enable the diaphragm 45 to act as a pressure governor as described in detail in relation to FIGURE 4.

Operation of the system of FIGURE 2 is therefore similar to that of FIGURE 1. The system is set into operation by first lighting the pilot burner 89. Assuming that the system is cold, gas will be supplied through the thermostat 91 to the auxiliary burner 93 and this will also light. Both bulbs 94 and 95 will thus be heated and will release the diaphragm in the control means 84 so that gas is supplied to the main burner 86. As the liquid in the system heats up, the thermostat 91 will be operated to cut off the gas supply to the auxiliary burner 93 which will thus be extinguished and the bulb 95 will cool with the result that the valve in the control means 84 will close thus cutting off the supply to the main burner 86. When the temperature of the liquid falls, the thermostat 91 will open thus supplying gas to the auxiliary burner 93 which in turn heats up the bulb 95 and frees the valve in the control member 84 to supply gas to the main burner 15, the gas being lit by the pilot burner 89. Should the pilot burner 89 fail then the control 84 will cut off the gas supply to the main burner even if the auxiliary burner 93 remains alight. It is to be noted that in the system of FIGURE 2, there is no by-pass supply to the main burner 86 as there is in FIGURE 1.

If desired the bulb 94 heated by the pilot burner may be omitted in the system shown in FIGURE 2 in which case the main control means 84 may be as shown in FIGURE 4 and controlled solely by displacement from the bulb 95. The provision of both bulbs 94 and 95 does have the added safety feature that gas is not supplied to the main burner if either the pilot or the auxiliary burner is extinguished.

If desired, in any of the control means described the bellows may be mounted above the diaphragm 45 and may operate it through a push rod.

It will be seen that the invention provides a simple and versatile gas control system which is simpler than those heretofore provided.

What I claim then is:

1. A gas-burning system including a gas supply; a main burner; a main burner, gas-supply valve interposed between and connected to the gas supply and the main burner and including a valve seat, a valve member cooperable with the valve seat to control the supply of gas to the main burner and movable between open and closed positions, a diaphragm communicating on one side with the main burner and on its other side with atmosphere, means connecting the diaphragm with the valve member so that the pressure of gas supplied to the main burner urges the valve member to a closed position, spring means acting on the diaphragm to urge the valve member towards an open position, the diaphragm, spring means and valve member acting as a pressure governor to control the pressure of gas supplied to the main burner; a chamber; a bellows of variable size mounted in the chamber and connected to the valve member so that when the bellows is in a first state it holds the valve member in its closed position against the action of said spring means and said diaphragm and when the bellows is in a second state it allows the valve member to assume its open position and to move under the influence of said spring means and said diaphragm; a pilot burner connected to the gas supply for igniting gas supplied to the main burner; an auxiliary burner connected to the gas supply and disposed so as to be ignited by the pilot burner; thermostatically-operated valve means interposed between the gas supply and the auxiliary burner to control the supply of gas to the latter; a thermal bulb disposed so as to be heated by the auxiliary burner when the latter is alight; a conduit connecting the thermal bulb with said chamber and a vaporizable liquid in the thermal bulb, conduit and

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chamber such that when the auxiliary burner is alight the liquid in the thermal bulb is vaporised thus displacing liquid along the conduit to the chamber to move the bellows to its second state and such that when the auxiliary burner is extinguished the liquid is not vaporised and the bellows is in its first state.

2. A system according to claim 1 including auxiliary control means interposed between the gas supply and the pilot burner to cut off the supply of gas to the pilot burner when the pilot burner, auxiliary burner and main burner are extinguished.

3. A system according to claim 2 including a by-pass interposed between the auxiliary control means and the main burner to supply the gas at a low rate to the main burner when the main burner, gas-supply valve is closed.

4. A system according to claim 2 wherein the thermostatically operated valve means is interposed between the auxiliary control means and the auxiliary burner.

5. A system according to claim 2 wherein the auxiliary control means comprises an auxiliary gas supply valve including a valve seat, a valve member cooperable with the valve seat and movable between open and closed positions, a diaphragm communicating on one side with said auxiliary burner and on its other side with atmosphere, means connecting the diaphragm with the valve member so that the pressure of the gas supplied to the auxiliary burner urges the valve member to a closed position, spring means acting on the diaphragm to urge the valve member towards an open position, the diaphragm, spring means and valve member acting as a pressure governor to control the pressure of gas supplied to the auxiliary burner; an auxiliary chamber; a bellows of variable size mounted in the auxiliary chamber and connected to the valve member of the auxiliary gas supply valve so that when the bellows is in a first state it holds said valve member in its closed position against the action of said spring means and said diaphragm and when the bellows

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is in a second state it allows said valve member to move under the influence of the spring means and said diaphragm; a second thermal bulb disposed so as to be heated by the pilot burner when the latter is alight; a second conduit connecting said second thermal bulb with said second chamber and a vaporisable liquid in the thermal bulb, conduit and chamber such that when the pilot burner is alight the liquid in the second thermal bulb is vaporised thus displacing liquid along the conduit to the second chamber to move the bellows therein to its second state and such that when the pilot burner is extinguished the liquid is not vaporised and the bellows in the second chamber is in its first state.

6. A system according to claim 1 including a second thermal bulb disposed so as to be heated by said pilot burner when the latter is alight, a second conduit connecting the second thermal bulb to said chamber and a spring forming part of said connecting means between the valve member and the diaphragm such that the liquid displaced from the thermal bulbs to said chamber with only one of the auxiliary and pilot burners alight is only sufficient to reduce the stress which occurs in said spring when both of said burners are extinguished, the liquid displaced to said chamber when both the auxiliary and pilot burners are alight moving the bellows to its second state.

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