Nov. 13, 1934. E. J. DILLMAN 1,980,789

CONTROL APPARATUS

Filed April 27, 1933 3 Sheets-Sheet 1

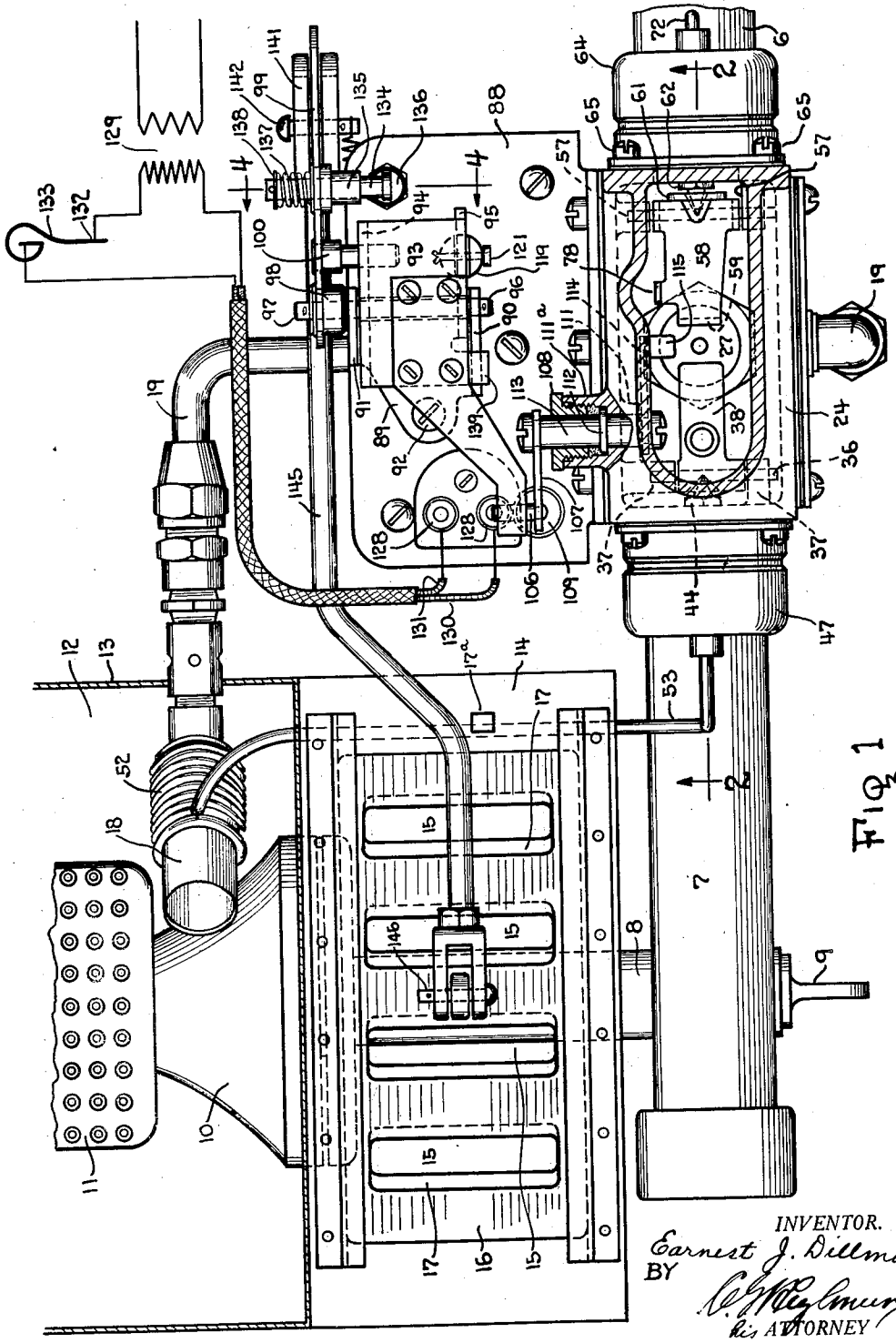


FIG 1

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Nov. 13, 1934. E. J. DILLMAN 1,980,789

CONTROL APPARATUS

Filed April 27, 1933 3 Sheets-Sheet 2

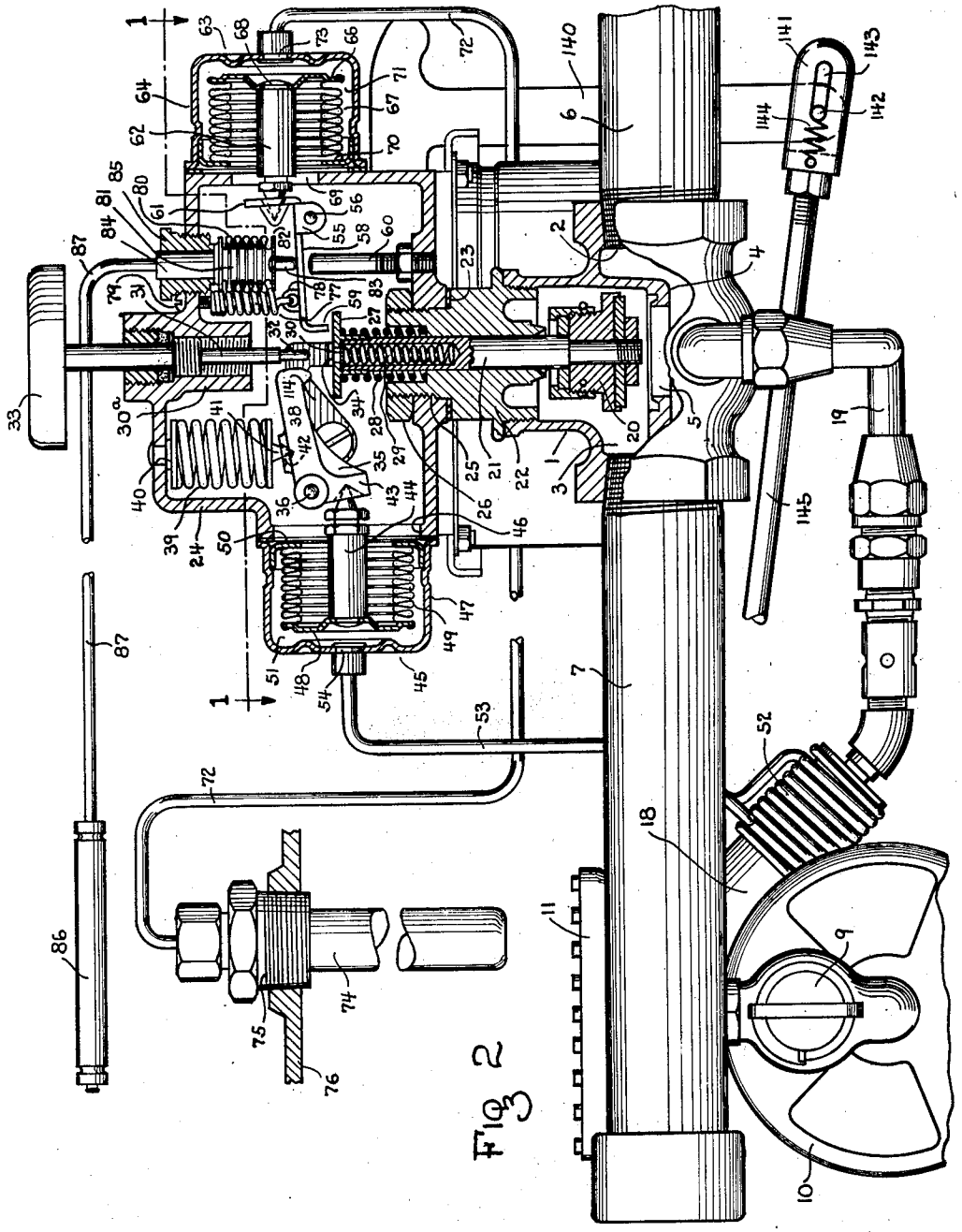


FIG 2

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Nov. 13, 1934. E. J. DILLMAN 1,980,789

CONTROL APPARATUS

Filed April 27, 1933 3 Sheets-Sheet 3

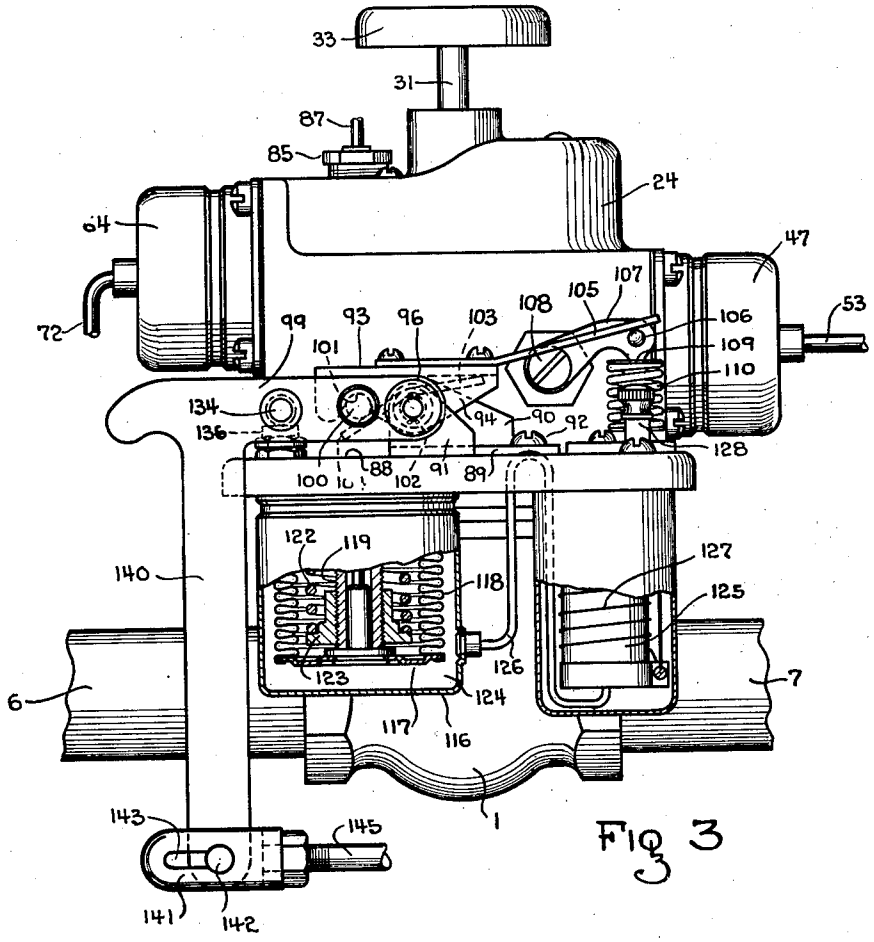


Fig 3

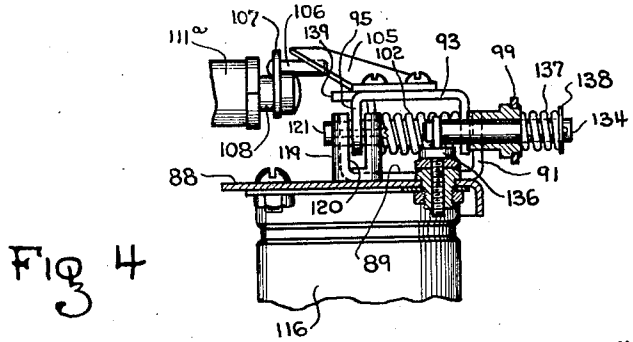


Fig 4

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UNITED STATES PATENT OFFICE

1,980,789

CONTROL APPARATUS

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Application April 27, 1933, Serial No. 668,160

20 Claims. (Cl. 236—1)

My invention relates to new and useful improvements in control apparatus, and more particularly to means for controlling the supply of gas or other fluid fuel to the burner or burners of a heating apparatus.

An object of my invention is to provide a valve control which is operable in response to the temperature of the space or room to be heated.

Another object is to provide means for limiting the operation of the fuel supply valve in accordance with outdoor temperatures.

Another object is to provide means for regulating the supply of fuel to the burner in accordance with a characteristic such as temperature of the fluid medium heated by the burner.

Another object is to provide a secondary air supply for the main burner and to control the supply relative to the supply of fuel to the burner.

The invention consists in the improved construction and combination of parts and their aggroupment in operative relation, to be more fully described hereinafter and the novelty of which will be particularly pointed out and distinctly claimed.

In the accompanying drawings, to be taken as a part of this specification, I have fully and clearly illustrated a preferred embodiment of my invention, in which drawings—

Figure 1 is a top plan view, partially diagrammatic and partially in section on the line 1—1 of Fig. 2, showing my control apparatus in cooperable relation with a main burner;

Fig. 2 is a view partially in section on the line 2—2 of Figure 1 but with the burner casing removed;

Fig. 3 is a detail view in rear elevation of the control apparatus and having certain parts broken away to show the internal construction, and

Fig. 4 is a detail view in section on the line 4—4 of Figure 1.

Referring to the drawings by characters of reference, 1 designates a valve casing having an inlet 2 and an outlet 3, which are separated by an internal partition 4 having a valve port 5 therethrough. The casing 1 is connected to a supply conduit 6 at the inlet 2 and has its outlet 3 opening into a burner supply pipe or manifold 7. The manifold 7 is connected by a duct or pipe 8 provided with a cock or control key 9 to the mixing chamber 10 of a main burner 11. The burner 11 is preferably positioned within a secondary air supply chamber 12 defined by a casing 13 having an air inlet casing 14 opening into the chamber 12. The casing 14 surrounds the duct 8 and is closed save for its inlet apertures 15 and its communication with the chamber 12. The apertures 15 are preferably formed in the top wall of the casing 14 and are controlled by a slide valve or damper plate 16 having apertures 17 therethrough registerable with the casing apertures 15 so as to regulate the admission of air to the casing 14 and the chamber 12. A stop member 17^a is provided to limit the opening movement of the damper plate and to stop further movement of the plate when the apertures 15 and 17 are in registry. Within the casing 13 and positioned adjacent the burner 11 there is a pilot burner 18 supplied with gas from the conduit 6 by a pipe or duct 19 which connects into the casing 1 on the inlet side of the partition 4.

The valve port 5 is controlled by a valve member 20 having a stem 21 reciprocably supported in the bore of the valve bonnet 22. Supported on the valve casing and seating upon an upward facing shoulder 23 on the bonnet 22, there is a housing 24 having an aperture 25 in its bottom wall which receives the upper end portion of the bonnet 21. The housing is rigidly secured to the casing 1 by a nut, or the like, 26 screw-threaded on the upper end of the bonnet which projects into the housing. The stem 21 extends into the interior of the housing and is provided with a head or end plate 27. The bonnet 22 is provided in its top face with an annular recess surrounding the stem 21 and in which is positioned a coil spring 28 held under compression between the bottom of the recess and the head 27 so that the spring normally acts to move the valve toward open position. The upper end portion of the stem 21 has an axial bore or recess in which is positioned a coil spring 29 capped by a disc 30. The head 27 is preferably in the form of a cap member having a depending cylindrical flange screw-threaded onto the upper end of the valve stem, such that the member 27 serves to retain the disc 30 and spring 29 within the stem bore. The top wall of the housing is provided directly above the stem 21 with a hollow guide sleeve member 30^a which is internally threaded. The sleeve member 30^a receives a valve actuating stem or rod 31 which is adjustably screw-threaded within the bore of the member 30^a and which is provided at its lower end with a reduced portion 32. The stem 31 projects out of the housing and is provided with an operating member or hand wheel 33. The head 27 is provided with a central aperture 34 in line with and adapted to receive the reduced stem portion 32 so that the portion 32 is movable into engagement with the disc 30. The stem 31

thus provides a manual means for closing the valve 20, the spring 29 serving as a safety take-up for over-travel of the stem 31 after the valve is seated.

A pilot safety means is provided for closing the valve 20 upon failure of the pilot flame at the burner 18. This means comprises a lever 35, preferably of the bell-crank type, carried by a shaft 36 supported at its ends in lugs or ears 37 rigid with the housing walls. The lever 35 has an arm 38 which extends into overlying relation with the valve stem head 27 and which is normally urged into engagement therewith to close the valve by a spring 39. The spring 39 seats at one end against an abutment member 40 rigidly fixed in the top wall of the housing 24, and at its other end seats upon a follower member 41 having a conical portion seating within a conical recess 42 in the top face of the arm 38, the spring 39 preferably being of the helical coil type and being held under compression between the abutment member 40 and the lever arm 38. The other arm 43 of the lever 35 is engaged by a plunger or push rod 44 of a temperature responsive means 45. The end wall of the housing is provided with an aperture 46 through which the plunger 44 extends, and secured to the housing about the aperture 46 there is a substantially cup-shaped casing or container 47 having a movable wall 48 to which the plunger 44 is rigidly secured. The wall 48 is preferably formed by a metal bellows 49 positioned within the container 47 and having its inner end closed and sealed by a head or end wall. The other end of the bellows 49 is rigidly secured and sealed to the casing 47 by an annular plate or ring member 50 so that the bellows and casing together provide therebetween a sealed expansible-contractible chamber 51. The chamber 51 is in communication with a thermostatic bulb element 52 by means of a tube 53 which opens through and is secured at one end in the wall of the casing 47, as at 54. The element 52 preferably comprises a plurality of turns of the free end of the tube 53, the turns of the tube preferably being coiled about the pilot jet tube. The bulb element 52 and the chamber 51 are charged with a suitable volatile liquid so that the heat of the pilot flame will drive the liquid from the bulb 52 into the tube 53 and chamber 51 to move the lever 35 to the position shown in Fig. 2.

Opening movement of the valve 20 by the spring 28 is limited by a lever 55 carried by a shaft 56 supported in the lugs or ears 57 rigid with the housing walls. The lever 55 is preferably of the bell-crank type having a substantially horizontally extending arm 58 provided at its free end with a downward extending portion or finger 59 which overlies and is movable into engagement with the top face of the valve stem head 27. It may be noted that the shafts 36 and 56 are substantially parallel and are positioned adjacent the opposite end walls of the housing 24 such that the lever arms 38 and 58 extend toward each other and the central portion of the housing. Movement of the arm 58 toward the head 27 is limited by a stop or abutment member 60 which is adjustably screw-threaded in the bottom wall of the housing 24. The other arm 61 of the lever 55 is engaged by the plunger or push rod 62 of a temperature responsive means 63. The means 63 preferably comprises a casing or container 64 secured by screws, or the like, to the outside face of the end wall of the housing 24. The casing 64 is provided with a movable wall 66, preferably formed by a metal bellows 67, having a head or end wall and positioned within the casing 64. The plunger 62 is rigidly secured and sealed in the wall 66, as at 68, and it extends through an aperture 69 in the end wall of the housing for engagement with the lever arm 61. The bellows is secured and sealed to the casing 64 by an annular plate 70 such that the bellows and casing provide therebetween an expansible and contractible chamber 71. The end wall of the casing 64 receives one end of a tube 72 which is secured and sealed therein, as at 73. The other end of the tube 72 communicates with the interior of a thermostatic bulb element 74 to which it is rigidly secured. The bulb element 74 and the chamber 71 are charged with an expansible-contractible liquid. The element 74 is provided with a supporting sleeve 75 which may be screw-threaded or otherwise secured in a wall 76 of the water containing space of a boiler or other heating apparatus heated by the burner 11 so that the element 74 will be subject to the temperature of the medium heated by the burner 11. Movement of the lever 55 by the plunger 62 is opposed by an adjustable spring 77 which is secured at one end in an eyelet 78 rigid with the lever arm 58. The other end of the spring 77 is supported from the top wall of the housing 24 by an adjustment screw 79 for varying the tension in the spring 77.

The lever arm 58 is also automatically adjusted by a temperature responsive means 80 which is responsive to outdoor temperature. The means 80 preferably comprises a bellows chamber 81 having a head or end wall 82 to which is secured a pin or plunger 83 engageable with the top face of the lever arm 58. The other end of the bellows chamber 81 is closed by a fitting 84 supported in a sleeve member 85 which is adjustably screw-threaded in an aperture in the top wall of the housing 24. The bellows chamber 81 is in communication with a bulb element 86 by means of a tube 87 which is secured and sealed in the fitting 84. The bulb element 86 and the chamber 81 are preferably charged solid with an expansible and contractible liquid such as kerosene.

The housing 24 has rigidly secured thereto a substantially horizontal supporting plate 88 which serves to support a heat motor operated means for actuating the valve 20. A substantially U-shaped bracket 89 having upwardly extending spaced arms 90, 91 is secured rigidly to the plate 88 by a screw, or the like, 92. Positioned between the arms 90, 91 is a lever member 93 having depending side flanges 94, 95. A shaft 96 extends through the arms 90, 91 and the flanges 94, 95 and serves to pivotally support the lever member 93. The shaft 96 extends beyond the edge of the plate member 88, as at 97, and supported on the shaft end 97 is a sleeve member 98 to which is rigidly secured an operating arm or member 99. The member 99 has a pin 100 rigidly secured thereto and projecting between the plate member 88 and the flange 94, the flange 94 preferably having a downward opened recess 101 to receive the pin 100. Surrounding the shaft 96 between the depending flanges 94, 95 there is a spring 102 having one end 103 engaging the underface of the lever member 93, and having its other end 104 underlying the pin 100, such that the spring normally tends to hold the pin 100 in engagement with the flange 94. The lever member 93 has a rigid extension or arm 105 which overlies and is movable into engagement with a lateral pin or arm 106 carried by a lever arm or crank 107. The crank 107 is rigidly secured to

and carried by a substantially horizontal shaft 108 journaled in the rear wall of the housing 24. The free end of the crank 107 seats upon a follower member 109 supported on the upper end of a coil spring 110 supported by the plate member 88. The shaft 108 is rotatably supported in the bore of a bearing member or sleeve 111 which projects into the housing. The outer end of shaft 108 is surrounded by a hollow extension 111[a] projecting from the rear housing wall and providing an outward facing annular shoulder. The shaft 108 has an annular flange 112 which seats and is held against the shoulder within the hollow extension by packing and a gland 113 to seal the bearing and prevent longitudinal movement of the shaft. The inner end of the shaft 108 which extends into the housing 24 has rigidly secured thereto an operating arm 114 provided with a lateral flange 115 which overlies the valve stem head 27. The spring 110 exerts sufficient force through the arms 107 and 114 to overcome the spring 28 and seat the valve 20. Supported by the plate member 88 and depending from the underside thereof, there is a casing member 116 having a movable wall 117, preferably formed by a metal bellows 118 secured and sealed at one end to the casing 116 and having its other end provided with a head or end wall. The movable wall 117 supports a plunger rod 119 which extends upwardly through the plate member 88 beneath the flange 95. The upper end of the plunger 119 is longitudinally slotted, as at 120, to receive the flange 95 which is secured to the plunger 119 by a cross pin 121. The supporting shaft 96 is positioned between the plunger 119 and the lever arm 105 so that upward movement of the plunger 119 will move the arm 105 downward against the pin 106 to lift the flange 115 upon compression of the spring 110 thereby to permit spring 28 to open the valve 20. Movement of the wall 117 is opposed by a spring 122 which surrounds the plunger 119 and which is held under compression between the plate member 88 and an adjustable abutment member 123 screw-threaded on the plunger 119. The chamber 124 formed between the bellows 118 and the casing 116 is in communication with the interior of a bulb element 125 by means of a tube 126. The bulb element 125 and the chamber 124 are charged with a suitable volatile liquid such that on heating of the bulb element 125 the liquid therein will be discharged through the tube 126 into the chamber 124 to expand the chamber and move the plunger 119 upward to permit opening of the valve 20. The bulb element 125 is provided with a heating means 127, which is preferably a coil of resistance wire wrapped around the element 125, the ends of the resistance wire being connected to terminal binding posts 128. The resistance coil 127 may be energized by a source of current supplied by a transformer 129, for example, connected to the posts 128 by lead wires 130, 131. The circuit through the lead wires 130, 131 is controlled by an electric switch 132 operated by a thermostat 133 shown diagrammatically, and which is responsive to the temperature of the space or room heated by the heating apparatus which includes the burner 11. The thermostat 133 acts when satisfied to break circuit at the switch 132 to permit the spring 122 to move the plunger 119 downward such that the spring 110 may act to overcome spring 28 and close the valve 20.

The operating member 99 serves as a manual means for opening the valve 20 and is provided with a locking means 134, preferably in the form of a plunger reciprocable in a sleeve 135 rigidly secured to the member 99, and which serves to hold the member 99 in raised position and the valve 20 partly open as in Fig. 2. When the member 99 has been lifted, the plunger 134 may be manually moved into overlying relation with an adjustable stop member 136 carried by the plate member 88 so that on release of member 99 the plunger will seat on the stop member 136. The plunger 134 is provided with a retracting means 137, such as a coil spring held under compression between the member 99 and an abutment 138 fixed on the end of the plunger 134, the spring 137 serving to move the plunger out of overlying abutting relation to the stop member 136 when the operating member 99 is lifted either manually or by the heat motor plunger 119. The lever member 93 is preferably provided with a stop 139 cooperable with the top face of the bracket arm 90 to limit upward movement of the plunger 119.

The operating member 99 has a depending arm 140 which at its free end extends between the arms of a yoke member 141 to which it is secured by a transverse pin 142. The arms of the yoke member 141 are provided with longitudinal slots 143 to permit relative movement of the arm 140 and the yoke member, but relative movement is normally prevented by a spring 144 fixed at one end to the pin 142 and at its other end to the yoke member 141. The yoke member 141 is carried by one end of an operating rod or link 145 which is pivotally secured at its other end by a pin 146 to the damper plate 16, so that movement of the operating member 99 on the shaft 96 will reciprocate the plate 16 to control the secondary air supply to the burner 11.

The operation of my control apparatus is as follows: In the position of the parts as shown in the drawings, the pilot 18 is burning and the heat of the flame has expanded the liquid in the bulb 52 to expand the chamber 51 to move the plunger 44 outward to rock the lever 35 against the force of spring 39 and lift the arm 38 out of engagement with the valve stem head 27 so that spring 28 is free except for spring 110 to open the valve 20. Assuming that there has been a current failure in the supply line to the transformer 129 and that the room thermostat 133 is unsatisfied and calling for heat so that circuit to the heating coil 127 is closed at the switch 132, then the burner 11 may be lighted as follows: The operating member 99 may be manually lifted and the locking means 134 be manually moved against the force of spring 137 to lie upon the stop 136 where it is frictionally held by the spring 122. Raising of the member 99 has acted through the pin 100 to rock the lever member 93, thereby compressing spring 110 and rotating the shaft 108 to lift the flange 115 and permit spring 28 to move valve 20 partially open to the position shown in Fig. 2. This open position of the valve 20 may be regulated by the adjustable stop 136. Prior to engagement of the arm 105 with pin 106, the lifting of the operating member 99 has acted through the operating arm 140 and the connecting rod 145 to partially open the secondary air valve 16, the valve 16 taking the position shown in Fig. 1 when the valve 20 is in the position of Fig. 2. The opening of the valve 20 by the operating member 99 will permit gas to flow to the main burner 11 to be ignited by the burning pilot 18. The quantity of gas thus supplied is not sufficient to create a high temperature in the heat-

ing apparatus. If current is now supplied to the transformer 129, the thermostat 133 being unsatisfied, and circuit being completed at the switch 132, the heating coil 127 will be energized. The heat applied to the bulb element 125 will discharge liquid therefrom through the tube 126 into the expansible chamber 124. The pressure of the liquid entering the chamber 124 will compress the bellows 118 against the force of spring 122 and move the plunger 119 upward. Upward movement of the plunger 119 will rock the lever member 93 about its shaft 96, lifting the locking means 134 out of abutting relation with the stop 136. As the plunger 134 leaves the stop 136, the spring 137 will retract the plunger 134 so that when the thermostat 133 becomes satisfied, the lever member 93 will be free to move to a position to permit closing of the valve 20. Upward movement of the plunger 119 will further depress the lever arm 105 thereby lifting the lever arm 114 to its maximum extent to permit the spring 28 to move the valve 20 to its wide or full open position against the bonnet 22. This further movement of the lever member 93 will carry the member 99 with it to move the secondary air valve 16 to full open position against the stop 17^a. The secondary air valve preferably reaches full open position prior to full opening of valve 20, which is permitted by the pin and slot engagement between the arm 140 and rod 145, the lost motion being taken up by spring 144. Should the temperature in the room rise to a point which will satisfy the thermostat 133, contact at the switch 132 will be broken, thereby deenergizing the heating coil 127 to permit the liquid in the bulb 125 to cool and contract. The spring 122 will move the plunger 119 downward as the liquid returns into the bulb 125 and the force opposing expansion of the spring 110 is relieved. The spring 110 acting through the arm 107 and shaft 108 will move the flange 115 into engagement with the valve stem head 27 to overcome spring 28 and close the valve 20. As the valve 20 moves toward closed position, the operating member 99, moving therewith, will act through arm 140 and rod 145 to close the valve 16. The extent to which the valve 20 may be opened by the spring 28 is determined by the finger 59 of the lever arm 58. The lever arm 58 is controlled by the temperature of the boiler water or other medium heated by the burner 11. If while the room thermostat is unsatisfied the temperature surrounding the bulb element 74 increases sufficiently to overcome the spring 77, the liquid discharged from the bulb element into the chamber 71 will move the lever arm 58 and the finger 59 toward the valve stem head 27. If the finger 59 is in engagement with the head 27, movement of the plunger 62 by liquid discharged into the chamber 71 will move the valve 20 toward closed position. The element 74 acts as a throttling means to regulate the gas supplied to the burner 11 and, therefore, the heat applied to the boiler water or other heating medium. The stop member 60, which cooperates with the lever arm 58, is adjusted to limit the extent to which the operating finger 59 can move the valve toward closed position, and is preferably adjusted to maintain sufficient gas flow through the port 5 to prevent popping back of the flame into the mixing chamber 10. The valve 20 is also throttled and its extent of opening is limited in response to outdoor temperature, which is accomplished by means of the thermostatic bulb 86. Expansion and contraction of the liquid in the bulb 86 will be transmitted through the tube 87 to the interior of the bellows chamber 81. The position of the operating pin or member 83 relative to the lever arm 58 may be adjusted by the sleeve 85 for any given outdoor temperature, so that when the outdoor temperature exceeds a predetermined desired degree the expansion of the liquid in the bulb 86 will act through the member 83 and lever arm 58 to move the valve 20 toward closed position. If the valve 20 happens to be closed when the lever arm 58 is moved by expansion of the chamber 81, then the operating finger 59 will serve to limit the extent to which the valve 20 can open under the force of spring 28. Should the flame of the pilot 18 fail at any time, the liquid in the bulb 52 will cool and contract, and the spring 39 acting through the lever 35 will force the plunger 44 rearward and the lever arm 38 downward upon the head 27. The force of spring 39 being sufficient to overcome the spring 28, the lever arm 38 will move the valve 20 to full closed position, thereby cutting off flow of gas through the port 5 to the burner 11. The valve 20 may be manually closed by the stem or plunger 31 which may be screwed downward by the hand wheel 33 into engagement with the spring follower disc 30 to act through spring 29 to close the valve.

The spring 103 serves also as a safety means to prevent injury to the heat motor in the event that the operating member 99 should be forced downward when the heating coil 127 is energized.

What I claim and desire to secure by Letters Patent of the United States is:

1. A control apparatus comprising a gas burner, a valve controlling the supply of gas to said burner, means to supply air to said burner, a valve controlling said air supply means, power means, means to transmit motion from said power means to said gas valve, means responsive to a condition remote from said gas valve for determining the extent of opening movement of said gas valve, and means operable by said power means to actuate said air valve.

2. A control apparatus comprising a gas burner, a valve controlling the supply of gas to said burner, secondary air supply means for said burner, a valve controlling said air supply means, temperature responsive means, means to transmit motion from said responsive means to said gas valve, means responsive to a condition remote from said gas valve for determining the extent of opening movement of said gas valve, and means operable upon opening movement of said gas valve to move said air valve toward open position.

3. A control apparatus comprising a burner, a valve controlling flow of fuel to said burner, means to supply secondary air to said burner, a valve controlling said secondary air supply means, means cooperable with and for actuating said first-named valve, means responsive to a condition remote from said first-named valve for determining the extent of opening movement thereof, a lever operatively connected to said second-named valve, and means interconnecting said valve actuating means and said lever.

4. A control apparatus comprising a burner, a valve operable to control flow of fuel to said burner, means to supply secondary air to said burner, a valve controlling said secondary air supply means, means cooperable with and for actuating said first-named valve, means responsive to a condition remote from said first-named valve for determining the extent of opening movement thereof, a lever, lost-motion means operatively

connecting said lever to said second-named valve, and means interconnecting said valve actuating means and said lever.

5. A control apparatus comprising a main fluid fuel burner, a valve controlling flow of fuel to said burner, means normally tending to open said valve, means operable in response to variation in room temperature to move said valve toward closed position, means responsive to outdoor temperature to limit opening movement of said valve, a pilot burner for igniting said main burner, and means operable on failure of said pilot burner to overcome said first-named means and close said valve.

6. A control apparatus comprising a main gas burner, a valve controlling flow of gas to said burner, means normally acting to move said valve toward open position, means responsive to a characteristic of a medium heated by said burner to move said valve toward closed position, means operable in response to variation in room temperature to move said valve toward closed position, and temperature responsive means to limit opening movement of said valve.

7. A control apparatus comprising a main gas burner, a valve controlling flow of gas to said burner, means normally acting to move said valve toward open position, means responsive to a characteristic of a medium heated by said burner to move said valve toward closed position, means operable in response to variation in room temperature to move said valve toward closed position, temperature responsive means to limit opening movement of said valve, and means to limit closing movement of said valve by said first-named means.

8. A control device comprising a reciprocable valve, a spring having one end fixed and tending irrespective of valve position to move said valve toward open position, a spring normally tending to close said valve and operable to overcome said first-named spring, means cooperable with said second-named spring, temperature responsive means for actuating said last-named means to overcome said second-named spring whereby said first-named spring can open said valve, and automatic means responsive to a fluid characteristic and cooperable with said valve to regulate the extent of opening movement thereof by said first-named spring.

9. A control device comprising a reciprocable valve, a spring normally tending to move said valve toward open position, a spring normally tending to close said valve and operable to overcome said first-named spring, means cooperable with said second-named spring, temperature responsive means for actuating said last-named means to overcome said second-named spring whereby said first-named spring can open said valve, and manual means for actuating said cooperable means.

10. A control apparatus comprising a reciprocable valve, a spring having one end fixed and tending irrespective of valve position to move said valve toward open position, a spring normally tending to close said valve and operable to overcome said first-named spring, a lever cooperable with said second-named spring, and a heat actuated motor having a movable wall cooperable with said lever, said lever acting upon movement of said wall to overcome said second-named spring whereby said first-named spring can open said valve.

11. A control apparatus comprising a valve, a casing having a movable wall, a bulb communicating with the interior of said casing, a volatile liquid in said casing and said bulb, heating means for said bulb operable to discharge liquid from said bulb into said casing to move said wall, a spring having one end fixed and acting irrespective of valve position to move said valve in one direction, a second spring opposing said first-named spring and normally acting to overcome said first-named spring to move said valve in the opposite direction, and a lever operable by said wall and acting on said second-named spring whereby movement of said lever by said wall will overcome said second-named spring.

12. A control device comprising a valve, means continuously acting to move said valve toward open position, means normally acting to overcome said first-named means and move said valve toward closed position, temperature responsive means operable to overcome said second-named means whereby said first-named means can open said valve, adjustable means to regulate the extent to which said valve is opened by said continuously acting means, means responsive to a fluid characteristic to adjust said regulating means, and means opposing operation of said last-named responsive means.

13. A control device comprising a valve, means continuously acting to move said valve toward open position, means normally acting to overcome said first-named means and move said valve toward closed position, temperature responsive means operable to overcome said second-named means whereby said first-named means can open said valve, adjustable means to regulate the opening movement of said valve, means responsive to a fluid characteristic to adjust said regulating means, a spring opposing operation of said regulating means by said last-named responsive means, and means to adjust the opposing force of said spring.

14. A control device comprising a valve, means normally tending to move said valve toward open position, means operable to overcome said means and acting to move said valve toward closed position, temperature responsive means operable to overcome said second-named means whereby said first-named means can move said valve toward open position, means responsive to a fluid characteristic to limit opening movement of said valve and operable to move said valve toward closed position, means resisting operation of said second-named responsive means, and means to limit closing movement of said valve by said second-named responsive means.

15. A control device comprising a valve having a stem, means acting on said stem and normally urging said valve toward open position, a lever having a fulcrum support and cooperable with said stem, a spring normally urging said lever into engagement with said stem and acting to overcome said first-named spring to close said valve, temperature responsive means cooperable with said lever and operable to move said lever out of engagement with said stem, a second lever engageable with said stem to limit opening movement of said valve and operable to move said valve toward closed position, means responsive to a fluid characteristic for actuating said second-named lever, and means opposing operation of said second-named lever by said second-named responsive means.

16. A control device comprising a valve having a stem, means acting on said stem and normally urging said valve toward open position, a lever having a fulcrum support and cooperable with

said stem, a spring normally urging said lever into engagement with said stem and acting to overcome said first-named spring to close said valve, temperature responsive means cooperable with said lever and operable to move said lever out of engagement with said stem, a second lever engageable with said stem to limit opening movement of said valve and operable to move said valve toward closed position, means responsive to a fluid characteristic for actuating said second-named lever, means opposing operation of said second-named lever by said second-named responsive means, and means to limit closing movement of said valve by said second-named lever.

17. A control device comprising a valve casing, a valve in said casing, a housing rigid with said casing, a stem on said valve projecting into said housing, a spring normally tending to move said valve toward open position, a lever fulcrumed in said housing, a spring normally urging said lever into engagement with said stem and acting to overcome said first-named spring to close said valve, power means carried by said housing, means operatively connecting said last-named means to said lever whereby operation of said power means will act on said lever to overcome said second-named spring, a second lever fulcrumed in said housing, said second-named lever cooperating with said stem to determine the opening movement of said valve, power means carried by said housing, and means operatively connecting said second-named power means and said second-named lever whereby said second-named power means is operable to adjust said second-named lever.

18. A control apparatus comprising a valve casing, a valve reciprocable in said casing, a housing rigid with said casing, said valve having a stem projecting into said housing, a shaft journaled in a wall of said housing and projecting therethrough, an arm fixed on said shaft within the housing and cooperable with said stem, a spring normally tending to move said valve to open position, power means external of said housing, means operatively connecting said power means to said shaft whereby said power means is operable to overcome said spring, a lever journaled in said housing and cooperable with said stem to limit operation of said valve by said spring, and means to actuate said second-named lever.

19. A control apparatus comprising a valve casing, a valve reciprocable in said casing, a housing rigid with said casing, said valve having a stem projecting into said housing, a shaft journaled in a wall of said housing and projecting therethrough, an arm fixed on said shaft within the housing and cooperable with said stem, a spring normally tending to move said valve to open position, power means external of said housing, means external of said housing and operatively connecting said power means to an external portion of said shaft whereby said power means is operable to overcome said spring, a lever journaled in said housing and cooperable with said stem to limit operation of said valve by said spring, and means to actuate said second-named lever.

20. A control apparatus comprising a valve casing, a valve reciprocable in said casing, a housing rigid with said casing, said valve having a stem projecting into said housing, a shaft journaled in a wall of said housing and projecting therethrough, an arm fixed on said shaft within the housing and cooperable with said stem, a spring normally tending to move said valve to open position, power means external of said housing, said power means being operatively connected to said shaft whereby to control said valve, a lever journaled in said housing and cooperable with said stem to limit operation of said valve by said spring, means to actuate said second-named lever, and temperature responsive means for controlling the operation of said power means.

EARNEST J. DILLMAN.