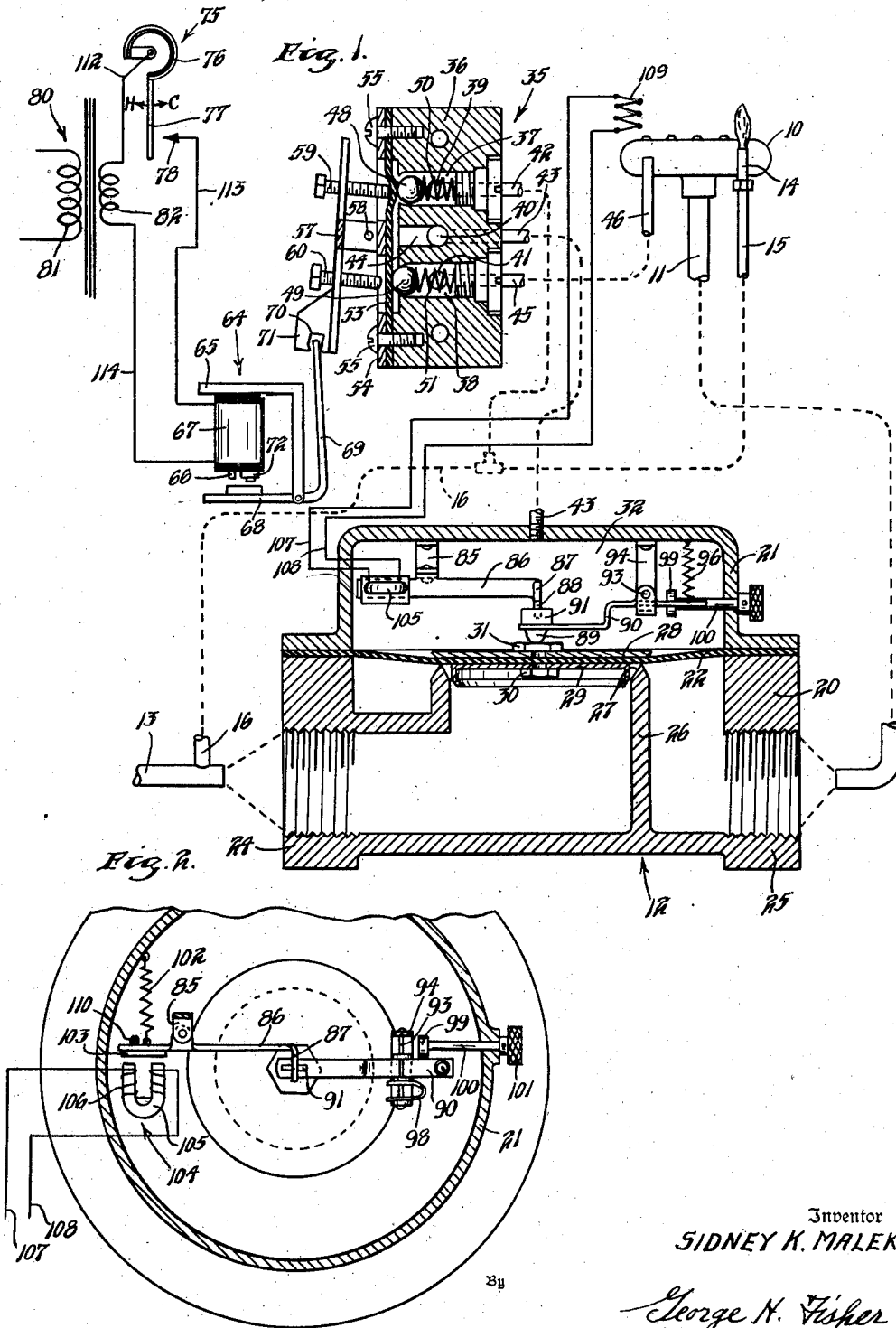


2,407,170

CONTROL MECHANISM

Filed Nov. 25, 1942

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Sept. 3, 1946.

S. K. MALEK

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CONTROL MECHANISM

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Fig. 3.

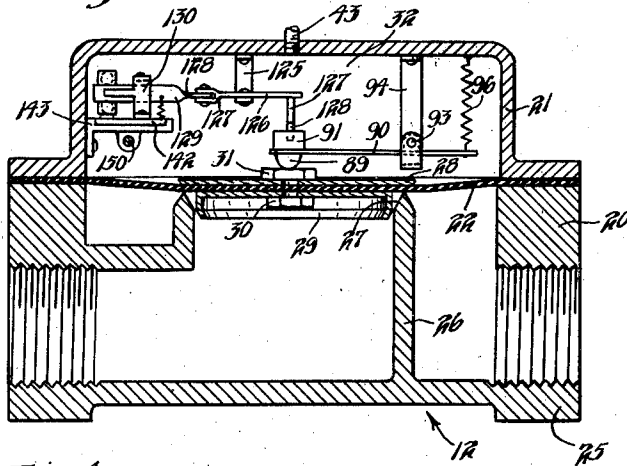


Fig. 4.

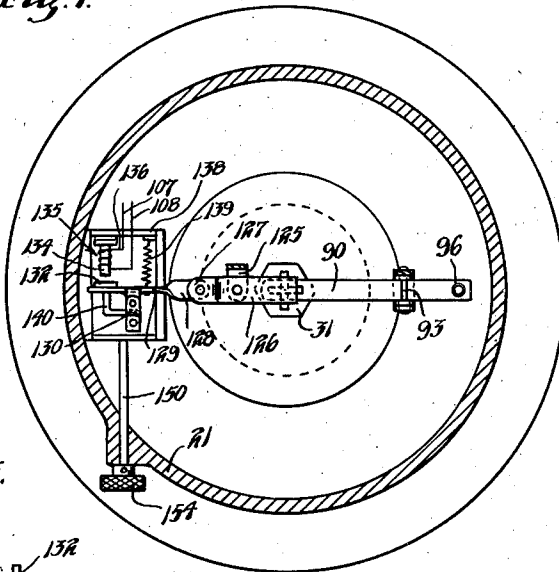
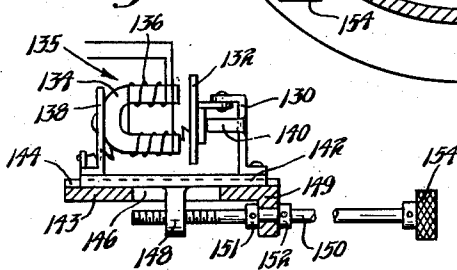


Fig. 5.



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2,407,170

CONTROL MECHANISM

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16 Claims. (Cl. 158—99)

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The present invention is concerned with a control mechanism and more particularly with one in which a control device is stopped temporarily at an intermediate position in moving between two extreme controlling positions.

An object of the present invention is to provide an arrangement including a control device movable between first and second positions in which an impeding means is present for temporarily impeding the movement of the control device from the first position, beyond an intermediate position with electromagnetic means for positioning this impeding means.

A still further object of the present invention is to provide such an arrangement in which the electromagnetic means is effective to move the impeding means from an impeding position to one in which the control device is free to move to its second position.

A still further object of the present invention is to provide an arrangement of the type set forth in which the electromagnetic means is energized an appreciable period of time subsequent to movement of the control device to the intermediate position.

A further object of the present invention is to provide such a control arrangement in which the impeding means is effective to interfere with the movement of the control device only when it is moved in one direction.

A still further object of the invention is to provide such an arrangement in which the control device is a valve which is interrupted in its movement from closed to open position.

A further object of the present invention is to provide such a controlling arrangement in which the controlling device is a diaphragm valve and the impeding means is a stop in the path of the valve.

A further object of the invention is to provide such an arrangement in which the stop is electromagnetically positioned and in which means are provided for adjusting the intermediate position without interfering with the spacing between the armature and the electromagnet.

A still further object of the invention is to provide a controlling arrangement of the type set forth in the previous objects in which the control device is employed to control the operation of a burner and in which the impeding means is moved from its impeding position under the control of means responsive to the establishment of combustion.

A still further object of the present invention is to provide a controlling arrangement employ-

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ing an electromagnet and an armature in which it is possible to adjust the position of the electromagnet and the armature simultaneously to vary the action of the electromagnet and armature on a controlling device without affecting the relative positions of the electromagnet and armature.

Still further objects of the invention will be apparent from a consideration of the accompanying specification, claims and drawings, of which:

Figure 1 is a schematic view of a burner control system employing my improved control mechanism, the burner control mechanism being shown in vertical section;

Figure 2 is a horizontal sectional view of my control mechanism;

Figure 3 is a vertical sectional view of a modified form of my control mechanism;

Figure 4 is a horizontal sectional view of the modification of Figure 3; and

Figure 5 is a detail view of a portion of the mechanism of the control device of Figures 3 and 4.

Referring to the drawings, my control device is shown as controlling the flow of fuel to a main burner 10 which is supplied with gas by a pipe 11 which connects with the outlet of my control valve 12. The inlet of the valve connects with a pipe 13 leading from any suitable source of gas (not shown).

Located adjacent to the main burner 10 is a pilot burner 14. The pilot burner 14 is connected by pipes 15 and 16 with the supply pipe 13 and is normally constantly burning.

Referring to my improved control mechanism 12, this comprises a housing having a lower housing section 20 and an upper housing section 21. A diaphragm 22 is secured between the two sections and the upper and lower housing sections and diaphragm 22 are clamped together by any suitable clamping means (not shown). The lower section 20 constitutes the valve casing and has the usual inlet connection 24 to which pipe 13 is connected and an outlet connection 25 to which pipe 11 is connected. Extending between the inlet and outlet connections 24 and 25 is a partition wall 26 having an opening therethrough to provide a valve seat 27. The central portion of the diaphragm 22 seats on this valve seat 23. A backing plate 28 and a throttling skirt 29 are clamped against this central portion of the diaphragm by a bolt 30 and nut 31. The backing plate 28 serves to re-enforce the portion of the diaphragm which acts as the valve disk. The

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throttling skirt serves to graduate the flow and make possible the establishment of an intermediate condition of flow.

The upper housing section 21 acts together with diaphragm 22 to enclose a pressure chamber 32. The pressure within this chamber 32 affects the pressure differential acting on diaphragm 22 and hence serves to control the movement of diaphragm 22 between its open and closed positions.

The gas pressure within the chamber 32 is controlled by means of a pilot valve generally indicated by the reference numeral 35. This pilot valve and its operating mechanism is illustrated in greater detail in the copending application of Daniel G. Taylor, Serial No. 390,553, filed April 26, 1941 and issued on May 16, 1944, as Patent No. 2,349,209. Reference is made to that application for a detailed understanding of the pilot valve. As shown in the drawings of this application, this pilot valve comprises a housing 36 having a pair of valve chambers 37 and 38. The valve housing 36 is provided with openings 39, 40 and 41. Opening 39 opens into the chamber 37 and connects at its outer end with a pipe 42 joining with a pipe 16 extending to the gas supply pipe 13. The chamber 37 thus constitutes the inlet chamber of the valve mechanism.

The passage 40 connects with a pipe 43 connected to the pressure chamber 32 within housing section 21. The inner end of opening 40 is connected to a chamber 44 which is adapted to be placed into communication with either chamber 37 or chamber 38.

Opening 41 which connects with chamber 38 is connected with a pipe 45 which leads to bleed burner 46 for burning the waste gas. Thus, the chamber 38 constitutes the outlet chamber of the valve mechanism.

Each of the chambers 37 and 38 has an inturned portion at its outer end to form a valve seat. A ball valve 48 is located within chamber 37 and a ball valve 49 in chamber 38. Springs 50 and 51 are located within chambers 37 and 38, respectively, and serve to bias the ball valves outwardly against their seats. When ball valve 48 is moved to open position, communication is established between opening 39 and opening 40 leading to the pressure chamber of the valve. When, on the other hand, valve 48 is against its seat and valve 49 is away from its seat, communication is established between opening 40 and opening 41 leading to the bleed burner 46.

The chamber 44 is sealed from the atmosphere by a diaphragm 53 which is suitably clamped to the pilot valve assembly by any suitable means such as a frame 54 and screws 55. A rocker 57 is tiltably secured to the frame 54 at 58. The rocker carries adjustable screws 59 and 60 whose stems extend inwardly towards the pilot valve assembly and engage the diaphragm 53 through openings in the frame 54 for actuating the ball valves 48 and 49. The rocker 57 and the actuating screws 59 and 60 are so arranged that when the rocker assumes the mid-position both of the valves 48 and 49 are closed so that the pressure within the pressure chamber 32 remains at a constant value. When the rocker 57 is rotated slightly in a clockwise direction from mid-position to the position shown in the drawings, actuating screw 59 forces the ball valve 48 away from its seat, at which time gas will pass from the inlet chamber 37 through chamber 44. When the rocker 57 is rotated in a counter-clockwise direction it permits the biasing spring

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50 to move ball valve 48 against its seat. At the same time, the ball valve 49 is forced away from its seat to establish communication between chambers 44 and 38.

The rocker 57 is adapted to be actuated automatically by means of an electromagnet 64. This electromagnet may be of any suitable type but is shown schematically as comprising an L shaped magnetic frame element 65. Secured to one leg of the L shaped frame member is a core post 66 around which a winding 67 is located. Pivotaly secured to the lower end of the other leg of the inverted L shaped element 65 is an armature member 68 which is designed to cooperate with the core post 66. Upon energization of the winding 67, the armature member 68 is rotated in clockwise direction into engagement with the end of the core post 66. As is common with A. C. operated devices, the end of the post 66 engaged by the armature 68 is provided with a shading ring 72 to shade a portion of the flux and hence decrease chattering of the relay. The right-hand end of armature 68 is provided with an upstanding arm 69 adapted to extend into a slot 70 of an ear 71 carried by the rocker 57. Upon energization of the winding 67 to rotate armature 68 in a clockwise direction, the resultant clockwise movement of arm 69 causes a counter-clockwise movement of rocker 57 to in turn cause closure of valve 48 and opening of valve 49, all as previously described.

A room thermostat 75 is employed to control the energization of winding 67 and hence the operation of pilot valve 35. This thermostat is of conventional form and is shown as comprising a bimetallic element 76 to which is secured a contact arm 77. The contact arm is designed to cooperate with a fixed contact 78. As shown by the legend adjacent the contact arm 77, the bimetallic element 76 is so arranged that upon a drop in temperature, the contact arm 77 is moved towards the right into engagement with the contact 78. Upon a rise in temperature on the other hand, the contact arm 77 is moved to the left away from contact 78.

A step-down transformer 80 is employed for supplying power to the electromagnet 64. This transformer comprises a line voltage primary 81 and a low voltage secondary 82. The line voltage primary 81 is connected to any suitable source of power (not shown).

The mechanism which has been described so far is not novel with the applicant. The novel features of my control device will now be described. Secured to the upper wall of the housing 21 is a bracket 85 which supports a lever 86 for pivotal movement in a horizontal plane. The extreme right-hand end of lever 86 is turned inwardly so as to overlie the center portion of valve backing disk 28. This inturned ear, designated in the drawings by the reference numeral 87, has a lower inclined surface 88. Interposed between the inclined surface 88 and the nut 31 is a button 89 carried by the left-hand end of a lever 90. The button 89 is rounded beneath the lever 90 for engagement with the nut 31. The upper portion of button 89 is in the form of a plate 91 which engages the inclined surface 88. The lever 90 is journaled on a pivot pin 93 supported by the bracket 94. A biasing spring 96 is secured at its upper end to the housing section 21 and at its lower end to the right-hand portion of lever 90. This biasing spring serves to bias lever 90 in a counter-clockwise direction (as viewed in Figure

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1) so as to maintain button 89 in engagement with the nut 31.

As best indicated in Figure 2, the length of the pivot pin 93 is several times as great as the width of lever 90. The lever 90 can thus be shifted along the pivot pin 93. A leaf spring 98 is interposed between one end of bracket 94 and the lever 90 and serves to bias lever 90 toward the rear (as viewed in Figure 1). This biasing movement is resisted by a cam 99 carried on a shaft 100. The shaft 100 extends through the wall of housing section 21. The outer end of shaft 100 has secured thereto a knurled knob 101. There is a close frictional fit between the shaft 100 and the wall of the opening in housing 21 through which the shaft 21 extends. Because of this frictional fit, the escape of gas around shaft 100 is minimized and furthermore, the cam 99 will remain in any position to which it is adjusted by knob 101. It will be obvious that as the knurled knob 101 is rotated, the position of lever 90 on the pivot pin 93 will be changed. When the position of lever 90 with respect to pivot pin 93 is adjusted, the position of the plate 91 with respect to the inclined surface 88 is similarly adjusted so that the distance through which lever 90 may move before the plate 91 engages the inclined surface 88 is varied.

The lever 86, which as previously explained, is mounted for pivotal movement in a horizontal plane, carries an armature 103 adjacent its left-hand end. This armature is adapted to cooperate with an electromagnet 104 comprising a core 105 and a winding 106. The armature 103 and core 105 are both of very high permeability material. The winding 106 is a relatively low resistance winding and is connected by low resistance conductors 107 to a thermopile 109 disposed adjacent the main burner 10. A spring 102 is fastened at one end to the housing section 21 and its other end to lever 86. It thus acts to bias armature 103 away from core 105. The movement of armature 103 by spring 102 is limited by a stop 110 in the path of movement of lever 86.

The thermopile 109 upon being exposed to the flame of the main burner 10, is capable of generating sufficient current to energize the electromagnet 104 adequately to cause the latter to attract armature 103 against the action of spring 102 and rotate the lever 86 in a counter-clockwise direction, as viewed in Figure 2. In this position of the lever 86, it is out of the path of movement of the plate portion 91 of button 89.

Operation

The various elements of the system are shown in the position which they assume when the thermostat 75 is satisfied. Under these conditions, the ball valve 48 is away from its seat so that gas may flow from pipe 13 through pipes 16 and 42, passage 39, chamber 37 to chamber 44, and through passage 40 and pipe 43 to the interior of chamber 32. As a result of the establishment of this communication between supply pipe 13 and chamber 32, chamber 32 is subjected to line pressure so that diaphragm 22 is held in engagement with valve seat 23. In this position, the flow of gas through the valve 12 to the main burner 10 is prevented so that the main burner is extinguished.

Also under these same conditions, the thermopile 109 is unheated. As a result, the spring 102 is effective to hold armature 103 out of engagement with the core 105 so that the ear 87 is disposed in a position in which the inclined surface

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88 is in the path of plate portion 91 of button 89.

Now let it be assumed that the temperature adjacent thermostat 75 drops sufficiently to cause the movement of contact arm 77 into engagement with contact 78. This results in the establishment of an energizing circuit to electromagnet 67 as follows: from the upper terminal of secondary 82 through conductor 112, bimetallic element 76, contact arm 77, contact 78, conductor 113, electromagnet 67, and conductor 114 to the lower terminal of secondary 82. The energization of electromagnet 67 causes arm 69 to be rocked in a clockwise direction. This in turn causes a counter-clockwise movement of rocker 57 to depress ball valve 49 from its seat and to permit spring 50 to move ball valve 48 into engagement with its seat. The closing of ball valve 48 interrupts the passage between supply line 13 and the pressure chamber 32. The opening of ball valve 49 results in the establishment of the following passage for gas: from the interior of chamber 32 through pipe 43, opening 40, chambers 44 and 38, passage 41 and pipe 45 to bleed burner 46. The establishment of this passage permits gas to pass from the interior of pressure chamber 32 to bleed burner 46 where it is burned. As a result, the pressure in chamber 32 is relieved so that the pressure above diaphragm 22 becomes substantially atmospheric pressure. The inlet pressure acting on the underside of the center portion of diaphragm 22 is now effective to raise the diaphragm. As soon as the diaphragm starts to move from the seat 27, the effective area of the underside thereof will be increased due to the fact that the gas is now able to act on the outer portion of the underside of diaphragm 22. As a result, the movement of diaphragm 22 towards valve opening position will be accelerated so that the diaphragm will move very quickly.

The upward movement of diaphragm 22 results in the lever 90 being rocked in a clockwise direction so as to move plate 91 towards the inclined surface 88 of the ear 87. As soon as sufficient movement of diaphragm 22 has occurred to cause the plate 91 of button 89 to engage inclined surface 88, further upward movement of diaphragm 22 is prevented. In other words, the diaphragm valve is permitted to move to some intermediate position. This position is adjusted by adjusting the cam 99 through the rotation of shaft 100. As previously explained, such rotation of cam 99 shifts the position of lever 90 and hence shifts the point of contact of the plate portion 91 of button 89 with the inclined surface 88. It will be obvious that as this point of contact is shifted, the amount of movement permitted diaphragm 22 is changed. Due to the skirt 29, the amount of gas flow taking place with the valve in intermediate position will be changed with a change in the intermediate position of the diaphragm.

With the diaphragm valve in this intermediate position, it is possible for gas to flow to the main burner 10, this gas being ignited by pilot burner 14. This intermediate position is so selected that the gas flow to burner 10 is sufficient to permit proper ignition of the burner. The main burner 10 is now effective to heat the thermopile 109.

After a predetermined period of time sufficient for the hot junctions of the thermopile to become adequately heated, the thermopile 109 is able to energize the electromagnetic winding 106 of electromagnet 104. When this happens, armature 103 is attracted to the electromagnetic core 105 with the result that the lever 86 is rotated in a counter-clockwise direction (as viewed in Figure

2). The rotation of lever 86 in this manner, as previously explained, causes the inclined surface 88 to be moved to a position in which it is out of the path of movement of the plate portion 91 of button 89. As a result, it is now possible for the diaphragm valve 22 to move to full open position. The moving of the valve to full open position permits a greater flow of gas to burner 10.

By permitting only a small flow of gas at first until combustion has been properly established and then permitting a larger flow of gas, it is possible to ignite relatively large burners without any danger of concussion such as often results when a large body of gas is suddenly admitted to the burner. Wherever the size of the ports of the burner is relatively large, it is desirable to admit the gas to the burner slowly to insure it being ignited as it is admitted.

The burner will continue in operation until the thermostat 75 is satisfied. When this happens, the electromagnet 67 will be deenergized so as to permit the elements of the pilot valve 35 to assume the position shown in the drawings and previously discussed. Under these conditions, the connection between the pressure chamber 32 and the bleed burner 46 is interrupted and a connection is again established between the supply pipe 13 and the pressure chamber 32. As a result, supply line pressure is admitted to chamber 32 with the result that the diaphragm 22 moves into engagement with the valve seat 27. As the diaphragm 22 approaches the valve seat 27, the portion of the underside of the diaphragm subjected to gas pressure tends to decrease with the result that movement of the diaphragm 22 into engagement with seat 27 is accelerated. The closing of the diaphragm valve 22 interrupts the flow of gas to the main burner 10 with the result that thermopile 109 is no longer heated. When the hot junctions of the thermopile 109 approach the temperature of the cold junctions, the electromotive force supplied by the thermopile to the electromagnet is sufficiently small that the spring 102 is capable of rotating the armature 86 in a clockwise direction back to the position shown in Figure 2, in which position the ear 87 is effective as a stop. It is to be noted that the stop is effective only during opening movement of the valve and is ineffective to interfere in any way with the closing movement of the valve.

It is furthermore to be noted that the means for adjusting the intermediate position does not in any way affect the spacing between the armature 103 and the core 105. The only member which is moved as a result of the adjustment process is lever 90. Lever 86 remains in the same position. This is extremely important since the spacing between the armature and the electromagnet is extremely critical when a limited source of power such as a thermopile is employed. While this spacing has been shown as greatly exaggerated for purposes of illustration, actually the spacing is extremely small.

It will be seen from the above description that I have provided an arrangement whereby the opening movement of the main valve is interrupted at the intermediate position of the valve, the valve being maintained in this position until a combustion responsive means has indicated the establishment of the proper conditions for movement of the valve to open position. Furthermore, it will be seen that this is accomplished with a relatively simple arrangement which does not provide for any connection with an external source of power.

Species of Figures 3 to 5

The species of Figures 3 to 5 differs from that of Figures 1 and 2 solely in the means for adjusting the intermediate position of the valve. In order to enable a comparison of the two species, elements in Figures 3 to 5 corresponding to elements in Figures 1 and 2, are referred to by the same reference numerals. The details of the valve housing 20 are exactly the same as in Figures 1 and 2, and it is believed unnecessary to again describe these details. The upper housing 21 similarly encloses a pressure chamber 32 to which is connected a pipe 43. The manner of controlling the pressure within the chamber 32 is identically the same as in Figures 1 and 2. Similarly, there is a bracket 94 which carries a pivot pin 93. Journalled on the pin 93 is a lever 90 which carries at its left-hand end a button 89 having a plate 91. A spring 96 biases the lever in a counter-clockwise direction as in the species of Figures 1 and 2. A U-shaped bracket 125 is secured to the upper wall of housing section 21. Pivoted to this bracket 125 is a lever 126, the lever being mounted for pivotal movement in a horizontal plane. Secured to the right-hand end of lever 126 is a downwardly extending flange 127 having an inclined surface 128 corresponding in shape and function to the inclined surface 88 in Figures 1 and 2. The left-hand end of lever 126 is provided with a yoke 127a which straddles the end 128 of a lever 129. The lever 129 is in turn journalled to a bracket 130. Secured to the extreme left-hand end of lever 129 is an armature 132. This armature cooperates with a core 134 of an electromagnet 135. Located on the core 134 is an electromagnetic winding 136. This winding is connected by conductors 107 and 108 to the thermopile 109. The core 134 of electromagnet 135 is secured to a bracket 138 (Figure 5). Also secured to this bracket 138 is a spring 139 which is connected to the lever 129 and which serves to bias lever 129 in a counter-clockwise direction (as viewed in Figure 4). The bracket 130 is provided with an ear 140 which extends into the path of movement of the left-hand end of lever 129 and acts as a stop for the lever to limit the movement thereof by the spring 139. This ear 140 determines the spacing of armature 132 from core 134 when the electromagnet 135 is deenergized, this spacing being exaggerated in the drawings.

The bracket 130 carrying the lever 129 and the bracket 138 carrying the core 134 are both secured to a carriage 142 which is mounted for sliding movement on a bracket 143 rigidly secured to the housing section 21. The bracket 143 is provided with a slot 144 within which the carriage 142 slides. If desired, the edges of this slot and the edge of carriage 142 may be slightly bevelled so as to retain the carriage 144 against vertical displacement. The central portion of bracket 143 is provided with an opening 145 and an ear 148 projects downwardly from carriage 142 through the opening 146. The bracket 143 is provided with an ear 149 displaced from ear 148. The ears 148 and 149 are provided with aligned apertures, the aperture through ear 148 being screw-threaded while the aperture through ear 149 is not. Journalled in the aperture 149 is a shank portion of a screw 150. Collars 151 and 152 are secured to the screw 150 on either side of the ear 149 to prevent longitudinal displacement of the screw 150. The outer portion of screw 150 extends through the housing section 21, as best

indicated in Figure 4. Secured to the outermost end of screw member 150 is a knurled knob 154 to facilitate rotation of the screw. The screw-threaded portion of screw 150 is screw-threadedly engaged with the screw-threaded opening in ear 148. Upon rotation of the screw in either direction, the carriage 142 is shifted in position. Thus, by suitable rotation of the screw 150, it is possible to adjust the carriage 142 to any desired position. Upon the carriage being so adjusted, both the armature 132 and the magnet 135 are simultaneously shifted. This causes the position of lever 129 to be shifted so as to cause the rotation of lever 126. This in turn causes the point of engagement of the plate portion 91 of button 89 with the inclined surface 128 to be likewise shifted so as to vary the intermediate position at which the diaphragm is stopped. Again, it is to be noted that the means for adjusting the intermediate position does not in any way affect the relative positions of the armature and the electromagnet.

The operation of the species of Figures 3 to 5 is believed to be sufficiently clear as to require no further explanation.

Upon the thermopile connected to winding 134 being energized, the armature 132 is drawn into engagement with the magnet to rotate the lever 136 in a counter-clockwise direction (as viewed in Figure 4). This movement has the same effect as the similar movement of lever 86 in the species of Figures 1 and 2. In other words, the stop is moved to a position where it is ineffective to impede the opening movement of the diaphragm valve.

Conclusion

It will be seen from the above that with the arrangement of the present invention, the delivery of fuel to the burner is in two definite steps. In the first step, only a minimum amount of fuel is provided. The full amount of fuel is not provided until combustion has been adequately established at the burner.

While I have described my invention specifically in connection with a diaphragm gas valve, it is to be understood that certain principles thereof are applicable where the control device is not a diaphragm valve. In general, while I have shown certain specific embodiments of my invention, it is to be understood that these are for purposes of illustration and that the invention is to be limited solely by the scope of the appended claims.

I claim as my invention:

1. In combination, a burner control device movable between a first position preventing burner operation and a second position permitting full burner operation, means for controlling the position of said control device, means for interrupting movement of said control device from said first position at an intermediate position in which said burner is operating at partial capacity, and thermoelectric means responsive to the establishment of combustion for causing said control device to continue to move toward said second position.

2. In combination, a burner control device movable between a first position preventing burner operation and a second position permitting full burner operation, means for controlling the position of said control device, means for interrupting movement of said control device from said first position at an intermediate position in which said burner is operating at partial ca-

capacity, means interposed between said interrupting means and said control device biasing said device toward closed position, electromagnetic means for moving said interrupting means to a position in which it is ineffective to interrupt movement of said control device to said second position, and thermoelectric means responsive to the establishment of combustion for energizing said electromagnetic means.

3. In combination, a fluid fuel controlling valve for a burner, means for controlling the position of said valve, means for interrupting opening movement of said valve at an intermediate position thereof, and thermoelectric actuated means responsive to the establishment of combustion for causing the removal of said interrupting means to permit said valve to move to full open position, said interrupting means being ineffective to impede closing movement of said valve.

4. In combination, a diaphragm valve, means for controlling the pressure differential acting on said diaphragm valve to cause said diaphragm valve to move between closed and full open positions, a stop movable independently of said valve between a first position in which it stops opening movement of said valve at an intermediate position and a second position in which said valve is free to move on to said open position, and electromagnetic means for moving said stop between said first and second positions.

5. In combination, a diaphragm valve, means for controlling the pressure differential acting on said diaphragm valve to cause said diaphragm valve to move between closed and full open positions, means for causing said valve to open in a plurality of steps and including a stop biased to a position in which it stops opening movement of said valve at an adjustable intermediate position to complete a first opening step, and electromagnetic means for moving said stop to a second position in which the valve is free to move to open position to complete the second step.

6. In combination, a diaphragm valve, means for controlling the pressure differential acting on said diaphragm valve to cause said diaphragm valve to move between closed and full open positions, a stop normally in a position in which it stops opening movement of said valve at an intermediate position, a member interposed between said stop and said diaphragm valve, means for altering the relative positions of said stop and said member transversely of the direction of travel of said valve to selectively adjust said intermediate position, electromagnetic means for moving said stop to a second position in which the valve is free to move to open position, and heat responsive means operable upon movement of said valve to intermediate position for controlling the energization of said electromagnetic means.

7. In combination, a diaphragm valve having a pressure chamber on one side of the valve, means for controlling the pressure within said chamber to cause said diaphragm valve to move between closed and full open positions, a stop within said pressure chamber and normally in a position in which it stops movement of said valve at a position intermediate its extreme of travel, and electromagnetic means for moving said stop independently of said valve to a second position in which the valve is free to move to its extreme position of travel.

8. In a control mechanism, a control device

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movable between first and second controlling positions, a stop normally assuming a position in which it prevents movement of said device beyond an intermediate position, a lever carrying said stop and an armature, an electromagnet for cooperating with said armature to move said lever and said stop to a position in which said device may move to said second position, and means for adjusting the normal relationship between said stop and said control device so as to adjust said intermediate position.

9. In a control mechanism, a control device movable between first and second controlling positions, a stop normally assuming a position in which it prevents movement of said device beyond an intermediate position, a lever carrying said stop and an armature, an electromagnet for cooperating with said armature to move said lever and said stop to a position in which said device may move to said second position, and means for adjusting the normal relationship between said stop and said control device without affecting the spacing of said armature and electromagnet.

10. In a control mechanism, a control device movable between first and second controlling positions, a stop, a first lever interposed between said stop and control device and movable in the direction of movement of said device, said first lever acting to connect said stop to said device so that said stop prevents movement of said device beyond an intermediate position, one of the cooperating faces of said stop and first lever being inclined, means for adjusting said first lever transversely of the direction of movement of said device to adjust said intermediate position, a second lever carrying said stop and an armature, and an electromagnet for cooperating with said armature to move said second lever and said stop to a position in which said device may move to said second position.

11. In a control mechanism, a control device movable between first and second controlling positions, a stop normally assuming a position in which it prevents movement of said device beyond an intermediate position, a lever carrying said stop and an armature, an electromagnet for cooperating with said lever to move said lever and said stop to a position in which said device may move to said second position, and means for simultaneously adjusting the position of said electromagnet and armature in relation to said control device so as to adjust said intermediate position without affecting the normal spacing of said electromagnet and armature.

12. In combination, a control device movable between first and second extreme positions, abutment means movable in a direction normal to the movement of said control device and having a first position in which it arrests the movement of said control device intermediate said extreme positions and a second position in which said control device is free to move on to said second extreme position, a member interposed between said abutment means and said control device, said interposed member being biased toward said control device and upon movement of said control device from

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its first extreme position to contact said abutment means, means for altering the relative positions of said abutment means and said interposed member to selectively alter their points of contact with each other and to determine the intermediate position at which the movement of said control device is arrested, and means for removing said abutment means from its arresting position.

13. In combination, a control device movable between first and second extreme positions, means for arresting the movement of said control device from said first position at a variable point intermediate said extreme positions, said means including an abutment member and an abutment engaging member, one of said members being adjustable relative to the other to engage different portions of the other to determine the point for arresting the movement of said control device, and means for moving said abutment member to release said control device for movement to said second extreme position.

14. In combination, a control device movable between first and second extreme positions, means for arresting the movement of said control device intermediate said extreme positions, said means comprising an abutment engaging member and an abutment member, said abutment member and said abutment engaging member being relatively adjustable to engage different portions of their engaging surfaces to selectively determine the intermediate position at which movement of said control device is arrested, and means for moving said abutment member to release said control device for continued movement to said second extreme position.

15. In combination, a control device movable between first and second controlling positions, abutment means for arresting the movement of said control device intermediate said first and said second positions, means interposed between said abutment means and said control device and operable to selectively determine the intermediate stopping position of said control device, electromagnetic means for moving said abutment means to a position in which said control device is free to move on to said second controlling position, and means operable as a result of the movement of said control device to said intermediate position to energize said electromagnetic means.

16. In combination, a flow control device movable between first, second, and third controlling positions, means for arresting the movement of said control device at said second position to establish a minimum flow condition, means for selectively adjusting said second position relative to said first and said third positions, said last named means including a member engageable with an inclined surface of said arresting means at a point determined by the relative adjustment of said engaging parts, means for moving said arresting means to a position in which said control device is free to move to said third position, and means brought into operation as a result of the movement of said control device to said second position for actuating said moving means.

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