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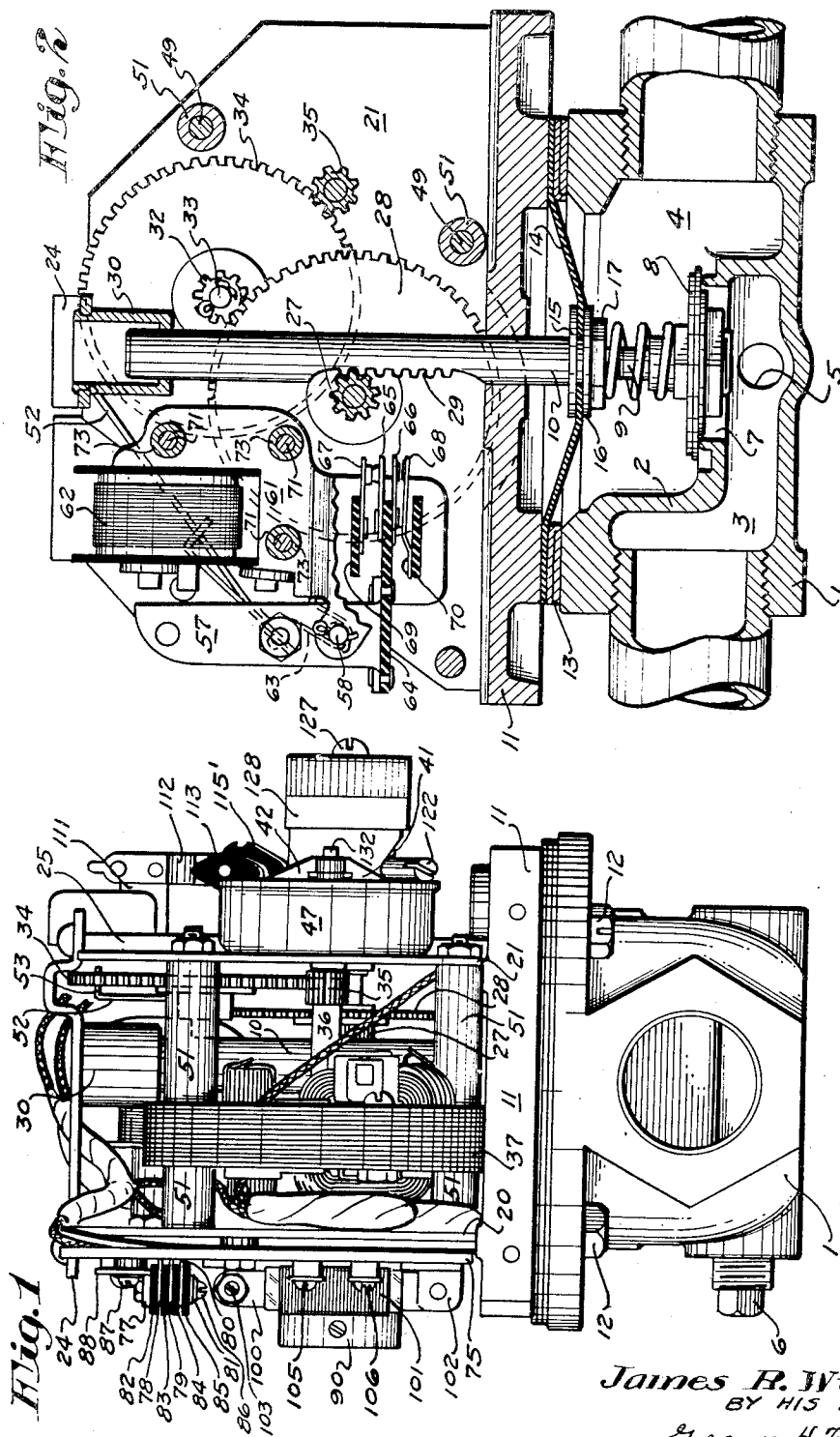
J. R. WILLIAMS

2,145,146

VALVE AND CONTROL SYSTEM THEREFOR

Filed Oct. 9, 1935

4 Sheets-Sheet 1



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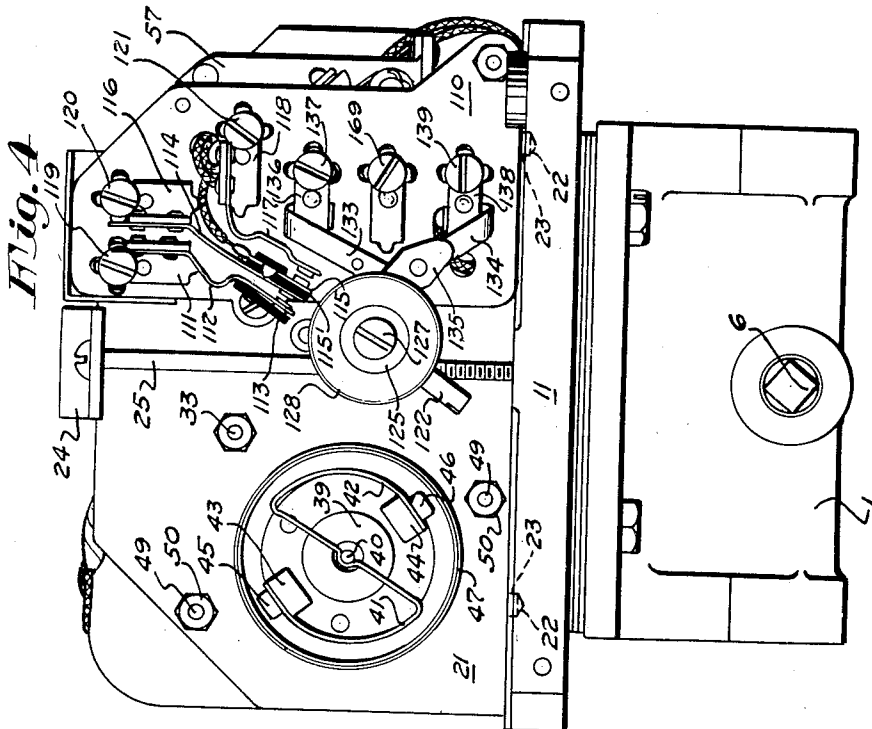
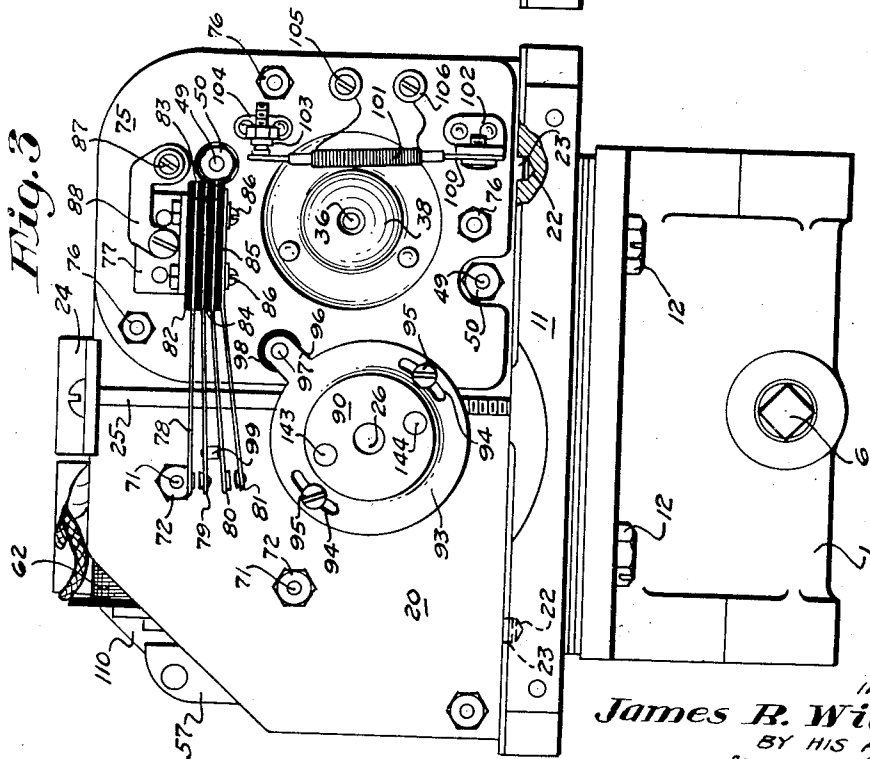
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VALVE AND CONTROL SYSTEM THEREFOR

Filed Oct. 9, 1935

4 Sheets-Sheet 2



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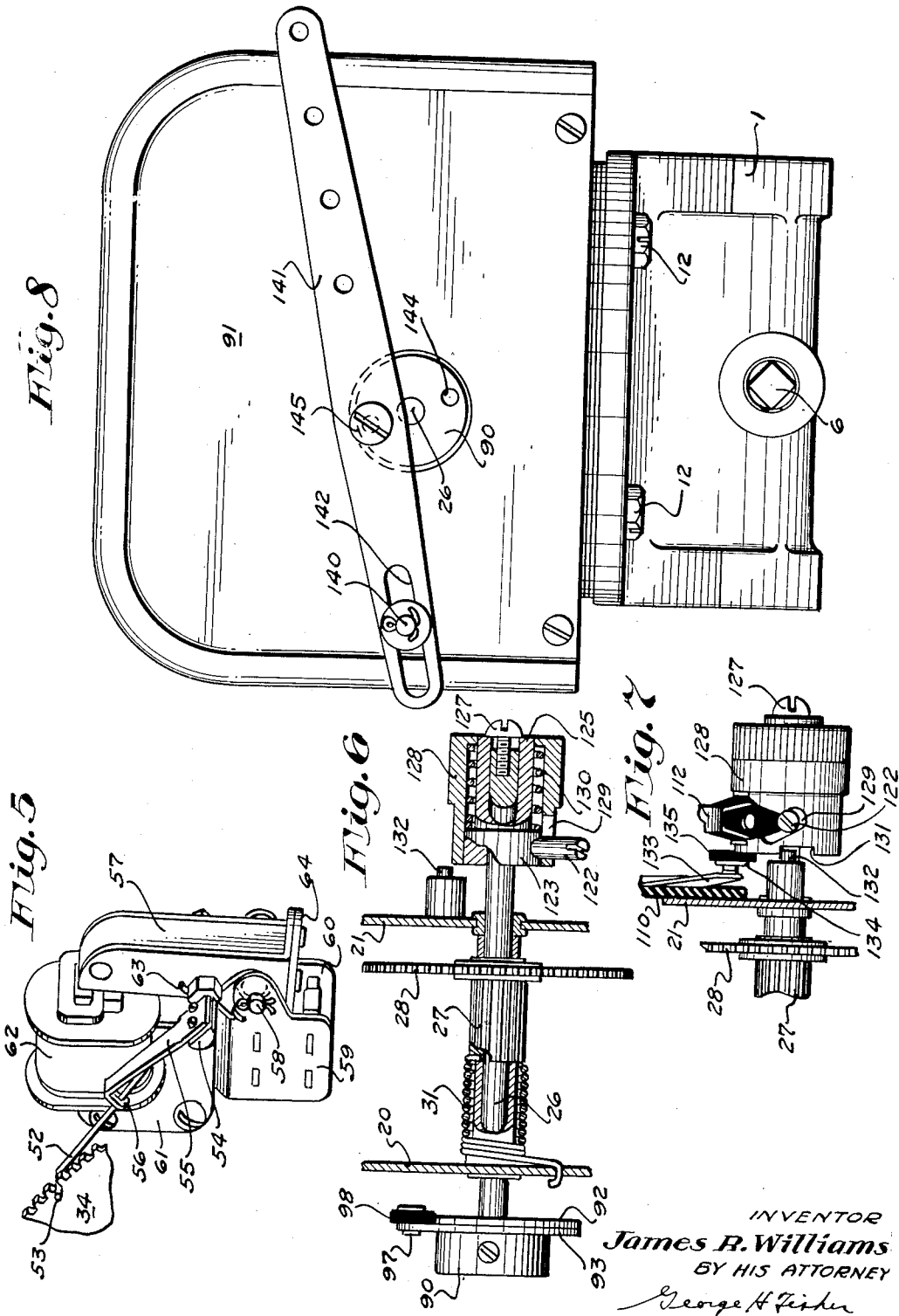
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VALVE AND CONTROL SYSTEM THEREFOR

Filed Oct. 9, 1935

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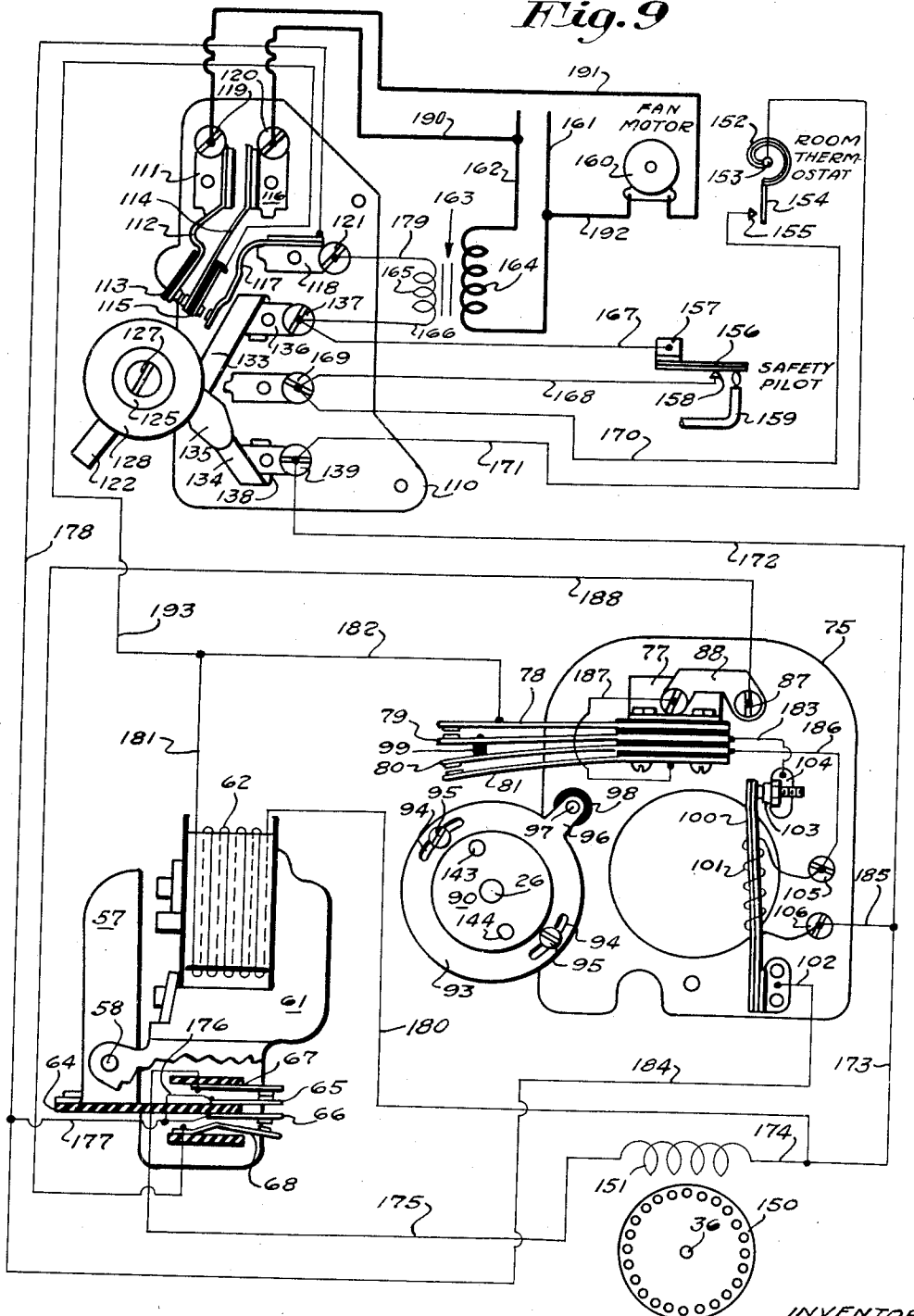
2,145,146

VALVE AND CONTROL SYSTEM THEREFOR

Filed Oct. 9, 1935

4 Sheets-Sheet 4

Fig. 9



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UNITED STATES PATENT OFFICE

2,145,146

VALVE AND CONTROL SYSTEM THEREFOR

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Application October 9, 1935, Serial No. 44,308

22 Claims. (Cl. 137—139)

The present invention relates to a novel design of electric motor operated valve, as well as to the manner of operating the valve.

In certain types of gas burners, if a full supply of gas is initially turned on to the burner, the gas often ignites with a pronounced "pop". While this minor explosion or "pop" may not be of such nature as to be particularly dangerous, it often results in blowing out the pilot light. If the burner is not equipped with a safety pilot, then the next time the gas is turned on it will not ignite, whereas if it is equipped with a safety pilot, extinguishment of the pilot will cause a shutdown of the apparatus. Also, where burners of large capacity are used, when the stack flue is cold, sufficient draft will not be created to provide enough combustion supporting air if the full supply of gas is immediately turned on to the burner. However, as the stack flue heats up, the draft is increased to such a point that sufficient air for supporting combustion is supplied to the burner even though the burner is receiving its maximum flow of gas.

In order to overcome these difficulties, it has been proposed in the past to open the gas valve at a relatively slow rate. This not only obviates the initial "pop" present in certain types of burners but also, in the larger capacity burners, gives the stack flue a time to heat up so as to increase the draft before a full supply of fuel is fed to the burner. However, many of these so-called "slow-opening" gas valves have their disadvantages. In one type, the electric motor which is utilized to open the valve is slowed down by a second electrical motor which acts in the nature of a governor. Obviously, this is an expensive and indirect way of accomplishing the desired results. Again, while it would offhand seem that a slow-opening valve could be easily provided by providing a sufficiently large gear reduction between the electrical motor and the gas valve, such a slowing down of the gas valve through the use of a large gear reduction opens up the very great possibility that the valve will not close under its spring-loading upon deenergization of the operating motor.

The present invention therefore contemplates controlling an electrically operated valve in such manner that upon an initial call for heat, the valve moves relatively rapidly to a partial open position and remains in this position for a timed period, after which it automatically moves relatively rapidly to full open position. This arrangement obviates the "pop" described above and also eliminates the difficulties experienced in large capacity burners when the stack flues thereof are cold. Also, this construction does

away with the necessity of having the valve itself move at a very slow rate so that the other difficulties specified above are also avoided.

One of the objects of the present invention is the provision of a valve control system in which a valve, upon a call for heat, moves to a partial open position, then remains in this partial open position for a timed-period and thereafter automatically moves to a larger or full open position.

Other objects of the invention include the specific manner in which this partial and then full opening of the gas valve is obtained and also include certain improved constructional features of the valve itself.

Further objects of the invention will be found in the description, the detailed drawings, and the appended claims.

For a more complete understanding of the invention, reference may be had to the following detailed description and the accompanying drawings, in which:

Fig. 1 is an end view of my novel valve with the cover removed,

Fig. 2 is a longitudinal sectional view through my valve with certain parts removed and others broken away in order to show the construction more clearly,

Fig. 3 is a side view of one side of my novel valve with the cover removed,

Fig. 4 is a similar view taken of the other side of my novel valve,

Fig. 5 is a perspective view showing the manner in which the electromagnet of my valve operates to latch one of the gears of the speed reducing mechanism so as to maintain the valve in any position to which it is moved,

Fig. 6 is a fragmentary showing of the main operating shaft of my valve with certain parts in section and others broken away in order to show the constructional details more clearly,

Fig. 7 is a fragmentary view looking downwardly upon the manual reset mechanism when the same has been moved to latched position,

Fig. 8 is a side view of my valve showing the novel manner in which the secondary air arm is mounted and controlled, and

Fig. 9 is a schematic wiring diagram illustrating the manner in which my valve is controlled.

Referring first to Figs. 1 to 8 inclusive of the drawings, the valve mechanism of the present invention includes a valve casing 1 provided with a partition 2 that forms an inlet chamber 3 and an outlet chamber 4. The valve casing 1 is further provided with a pair of tapped openings 5, one of which is shown as plugged by a plug 6, which tapped openings may be utilized to supply

gas to a pilot light or the like. The partition 2 is provided with the usual valve opening 7 with which the usual valve disc 8 cooperates in order to control the flow of gas from the inlet chamber 3 to the outlet chamber 4. This valve disc 8 is connected to a reduced portion 9 of the valve stem 10 in such manner that it is free to swivel thereon.

The valve casing 1 is secured to a suitable base 11 by screws 12, there being interposed between the base 11 and the casing 1, a circular gasket 13, and a sealing off diaphragm 14. This sealing off diaphragm 14 serves to seal off the outlet chamber 4 so that no gas can escape therefrom except through the usual threaded outlet opening. The valve stem 10 is provided with the reduced portion 9 mentioned above and against the shoulder thus formed by the junction of the valve stem 10 and the reduced portion 9, a washer 15 is placed. This washer abuts the upper side of the diaphragm 14 and a similar washer 16 is placed upon the reduced portion 9 and abuts the underside of the diaphragm 14, a nut 17 serving to clamp these parts tightly together, whereby the valve stem 10 extends through the diaphragm 14 in gas-tight relation thereto.

The mechanism for operating the valve stem 10 is mounted between a pair of side plates 20 and 21 which extend upwardly from the base 11. The base 11 is provided with a plurality of small circular openings 22 into which lugs 23, formed on the side plates 20 and 21, project so as to properly position the bottom edges of these side plates. The upper edge of each of these side plates 20 and 21 is provided with a notch and these notches receive a bridging member 24 which extends across the space between the plates 20 and 21. Screws 25 pass through the bridging member 24 and are screw-threadedly received by the base 11 to firmly clamp side plates 20 and 21 to the base 11.

A main operating shaft 26 is journaled in the side plates 20 and 21. Secured to this main operating shaft 26 is a pinion 27 and a gear 28. The pinion 27 cooperates with teeth 29 formed in the valve stem 10 whereby rotary movement of the main operating shaft 26 serves to raise and lower the valve stem 10 to move the valve disc 8 away from and towards the opening 7 in the partition 2 of the valve casing 1. The upper end of valve stem 10 is guided by a guiding member or bushing 30 which is secured to the bridging member 24. A coiled spring 31 has one of its ends secured to the side plate 20 and its other end secured to the pinion 27 and tends to rotate main operating shaft 26 in valve closing direction (see Fig. 6).

The gear 28 cooperates with a pinion 32 which is mounted upon a stud shaft 33 that is secured to the side plate 21. A gear 34 is secured to the pinion 32 and meshes with a motor pinion 35 that is secured to the rotor shaft 36 of a motor having a field structure indicated at 37. One end of this rotor shaft 36 is journaled in a bearing 38 that is secured to the side plate 20 and the other end of this rotor shaft 36 is journaled in a bearing 39 which is secured to the side plate 21. This latter end of the rotor shaft 36 is provided with a reduced portion 40 to which the arms 41 and 42 of a fly-ball governor are secured. These arms support weights 43 and 44 as well as braking members 45 and 46 which cooperate with the inner surface of a circular member 47 that is secured to the side plate 21.

The field structure 37 is mounted between the

side plates 20 and 21 by means of suitable bolts 49, nuts 50, and spacing sleeves 51.

The valve stem 10 is maintained in raised position against the bias of spring 31 by a latching mechanism that includes a somewhat resilient latching arm 52 having a bent-over end 53 that is adapted to move between the teeth of the gear 34. This arm 52 is secured to a stud 54 and a rigid arm 55 which is also secured to the stud 54 serves to re-inforce and guide the latching arm 52, the latching arm 52 passing through an opening formed in the bent-over end 56 of this re-inforcing arm 55. The stud 54 is secured to an armature 57 which is pivoted on a shaft 58 that is journaled in side members 59 and 60 that in turn support a field structure 61. This field structure 61 includes a relay coil 62 for producing a magnetic flux in the field structure 61 to attract the armature 57. The armature 57 is biased to the position shown in Fig. 2 by means of a spring 63 which is wound about the shaft 58 and has one of its ends abutting the supporting member 59 and its other end abutting the stud 54. A piece of insulating material 64 is secured to the lower end of armature 57 and acts as a switch controlling arm. Switch arms 65 and 66 are secured to the piece of insulating material 64 and respectively cooperate with switch arms 67 and 68 which are in turn mounted upon supporting blocks of insulating material 69 and 70. The arrangement is such that when the relay coil 62 is deenergized, the parts assume the position shown in Fig. 2 wherein the latching arm 52 is disengaged from the teeth of gear 34, the switch arm 65 is engaging the switch arm 67, and the switch arm 66 is disengaged from switch arm 68. Upon energization of the relay coil 62, the armature 57 moves to the position shown in Fig. 5 wherein the latching arm 52 is engaged with the teeth of gear 34. Under these conditions, the switch arm 65 disengages switch arm 67 but switch arm 66 moves into engagement with switch arm 68. This relay is mounted upon the side plate 20 by means of suitable bolts 71, nuts 72 and spacing sleeves 73.

Part of the switching mechanism for controlling the motor and relay is carried by a panel 75 of insulating material which is secured to the side plate 20 by means of screw and nut assemblies indicated at 76. Mounted upon this panel 75 is a bracket 77 to which four switch arms 78, 79, 80 and 81 are secured. These switch arms are all insulated from each other and from the bracket 77 by insulating members 82, 83, 84 and 85, with the exception that the switch arm 81 is electrically connected to the bracket 77 either through the medium of screw and nut assemblies 86, which fasten these parts together, or by an electrical connection that will be explained hereinafter in connection with the wiring diagram of Fig. 9. The bracket 77 is connected to a binding post 87 by a connecting link 88.

The switch arms 78 to 81 inclusive are controlled by the main operating shaft 26. Secured to this main operating shaft 26 is a collar 90 which is adapted to extend through a cover side plate 91. Integral with this collar 90 is a disc 92. Mounted adjacent to the disc 92 and embracing the collar 90 is a similar disc 93 which is provided with a pair of slots 94 through which screws 95 extend by means of which the disc 93 may be secured to the disc 92 so that disc 93 moves in conformity with the movements of main operating shaft 26. However, the slot 94 and screws 95 provide for a relative adjustment between the disc 93 and the disc 92 for reasons which will become

apparent hereinafter. The disc 93 is provided with an extension 96 which supports a stud shaft 97 upon which a roller 98 of insulating material is journaled. Upon movement of main operating shaft 26 in a counter-clockwise direction, as viewed in Fig. 3 of the drawings, the roller 98 approaches and finally engages switch arm 81. The switch arm 81 is thereupon lifted into engagement with the switch arm 80 and the switch arm 80 is moved upwardly. Such movement of switch arm 80 causes upward movement of switch arm 79 into engagement with switch arm 78, there being a small piece of insulating material 99 secured to the underside of switch arm 79 and against which the switch arm 80 is adapted to bear. Continued movement of main operating shaft 26 in this counter-clockwise direction causes the roller 98 to pass beyond the switch arm 81 so that the switch arms 78 to 81 inclusive return to the position shown in Fig. 3. This movement of main operating shaft 26 in counter-clockwise direction as viewed in Fig. 3 causes a lifting movement of the valve stem 10 and a consequent opening of the valve.

The panel 75 additionally supports a time switch that comprises a bimetallic element 100 and an associated electrical heating element 101. One end of bimetallic element 100 is secured to a bracket 102 that is mounted upon the panel 75 and the other end of bimetallic element 100 cooperates with a contact 103 which is adjustably mounted in a bracket 104 that is also secured to the panel 75. Upon energization of the electrical heater 101, the bimetallic element 100 is heated, and after a time period, this bimetallic element 100 separates from contact 103. The length of time required for the separation of bimetallic element 100 from contact 103 depends upon the adjustment of contact 103 in its supporting bracket 104. The ends of electrical heating element 101 are respectively secured to terminal posts 105 and 106.

The side plate 21 also supports a panel of insulating material indicated at 110 and this panel in turn has mounted upon it certain switching mechanism for also controlling the operation of the motor and relay of the valve mechanism. A bracket 111 which is secured to the panel 110 supports a flexible switch arm 112 that is provided with a backing member of insulating material 113. This switch arm 112 cooperates with a similar switch arm 114 which is carried by a bracket 116 that is likewise secured to the panel 110. The switch arm 114 controls a switch arm 115, the switch arms 114 and 115 being connected together through a piece of insulating material 115'. This switch arm 115 cooperates with a switch arm 117 that is secured to a bracket 118 which is mounted upon the panel 110. The brackets 111, 115 and 118 are respectively provided with binding posts 119, 120 and 121. The arrangement is such that switch arm 113 is normally disengaged from switch arm 114 and switch arm 115 is normally disengaged from switch arm 117. These switch arms are adapted to be operated by a stud 122 which is screw-threaded into a collar 123 that is in turn secured to main operating shaft 26 (see Fig. 6). Upon movement of main operating shaft 26 in valve opening direction, the shaft 26 rotates in clockwise direction as viewed in Fig. 4 and the stud 122 moves towards the piece of insulating material 113 which is carried by the switch arm 112. When the valve has been moved to full open position, the stud 122 engages the piece of insulat-

ing material 113 thereby moving switch arm 112 into engagement with switch arm 114 and this movement in turn moves switch arm 115 into engagement with switch arm 117.

The valve of the present invention is adapted to be manually operated under certain conditions. For the purpose of this manual operation, the collar 123 is provided with a sleeve 125 which extends along main operating shaft 26 to the end thereof. A screw 127, which is threaded into the end of main operating shaft 26, engages the sleeve 125 to hold the sleeve 125 and the collar 123 securely upon the main operating shaft 26. A hollow operating knob 128 fits over the collar 123 and is provided with an angular slot 129 through which the stud 122 extends. The operating knob 128 is normally biased to the position shown in Fig. 6 by means of a coiled spring 130 which surrounds the sleeve 125 and has one of its ends abutting the collar 123 whereas its other end abuts the operating knob 128. When it is desired to operate the valve manually, the operating knob 128 is rotated in clockwise direction as viewed in Fig. 4 and the angularity of the slot 129 causes rotation of the main operating shaft 26 in valve opening direction and at the same time causes inward movement of the operating knob 128. This operating knob 128 is provided with a notch 131 that forms a shoulder which is adapted to engage a stud 132 that is secured to side plate 21. When the valve has thus been partially opened by manual manipulation of the knob 128, the shoulder formed by the notch 131 engages the stud 132 so that the valve is held in such partially open position against the bias of the closing spring 31.

Mounted upon panel 110 and associated with the operating knob 128 is a pair of switch arms 133 and 134. A piece of insulating material 135 is secured to the switch arm 134 and the arrangement is such that the inward movement of operating knob 128, set out above, causes the same to engage this piece of insulating material 135 and moves switch arm 134 into engagement with switch arm 133. As a result, whenever the valve is manually moved to a partial open position and latched therein, the switch arms 133 and 134 are moved into engagement with each other. The switch arm 133 is secured to a bracket 136 that is mounted upon panel 110 and is provided with a binding post 137. Similarly, the switch arm 134 is secured to a bracket 138 that is mounted upon panel 110 and is provided with a binding post 139.

In many instances, it is desired to operate a damper in control of the flow of secondary air to a burner in conformity with the movements of the valve which controls the supplying of fuel to the burner. For this purpose, a stud 140 is secured to and carried by the side cover plate 91 mentioned above. A damper operating arm 141 is provided with an elongated slot 142 near one of its ends through which the stud 140 is adapted to pass. The collar 90 which is secured to the main operating shaft 26 is provided with a pair of threaded holes 143 and 144 either of which is adapted to receive a screw 145 which passes through the damper arm 141. With the parts in the position shown in Fig. 8, the screw 145 is threaded into the hole 143 and whenever the main operating shaft 26 moves in valve opening direction (counterclockwise as viewed in Fig. 8), the extreme right-hand end of damper lever 141 will move downwardly. If the opposite movement of damper arm 141 is desired, the

screw 145 is placed in the threaded hole 144 of the collar 90 and under these conditions, the right-hand end of damper arm 141 will move upwardly when the valve is moved towards open position.

Referring to Fig. 9 of the drawings, the motor of the valve is therein diagrammatically illustrated as comprising a squirrel cage rotor 150 and an associated field winding 151. The operation of the valve is shown as controlled by a temperature responsive switch such as a room thermostat which includes a bimetallic actuating element 152 that has one of its ends secured as indicated at 153. The other end of bimetallic element 152 controls a contact arm 154 which is adapted to engage an associated contact 155 when the temperature to which bimetallic element 152 responds drops to a predetermined value. It will be understood that any other type of controller, either automatic or manual, could be utilized to control the operation of the gas valve.

The system is also shown as including the usual safety pilot which is indicated herein as comprising a bimetallic element 156 which has one of its ends secured to a bracket 157. This bimetallic element 156 cooperates with a contact 158. A pilot light indicated at 159 impinges upon, or is closely associated with, bimetallic element 156 so that the same moves into engagement with contact 158 whenever the pilot light is burning properly.

The system is also shown as including a fan motor 160 which may be utilized to circulate air heated by the flow of fuel through the gas valve, as is well-known in the art. High voltage power is supplied by line wires 161 and 162 and low voltage power is furnished by a step-down transformer 163 having a high voltage primary 164 connected to the line wires 161 and 162 and a low voltage secondary 165.

With the parts in the position shown, the pilot is operating properly but the temperature of the room or space in which the bimetallic element 152 is located is sufficiently high. The field winding 151 and the relay coil 62 are both deenergized under these conditions and the valve is closed. Likewise, the fan motor 160 is deenergized.

If the temperature to which bimetallic element 152 responds should now lower sufficiently so that contact arm 154 is moved into engagement with contact 155, an energizing circuit for field winding 151 is established as follows: secondary 165, wire 166, binding post 137, wire 167, bracket 157, bimetallic element 156, contact 158, wire 168, a binding post 169 which is mounted upon panel 110, wire 170, contact 155, contact arm 154, bimetallic element 152, wire 171, binding post 139, wire 172, wire 173, wire 174, field winding 151, wire 175, switch arm 67, switch arm 65, wire 176, wire 177, wire 178, bracket 118, binding post 121, and wire 179 to the other side of secondary 165. Energization of field winding 151 causes rotation of rotor 150 and rotor shaft 36. This rotation is transmitted to the main operating shaft which simultaneously raises the valve stem 10, rotates the roller 98 towards the switch arm 81, and rotates the stud 122 towards the switch arm 112.

When the valve has thus been opened to a predetermined extent, which is determined by the adjustment of disc 93 in relation to the associated disc 92, roller 98 engages switch arm 81 and causes movement of switch arm 81 into

engagement with switch arm 80 as well as switch arm 79 into engagement with switch arm 78, all as explained above. Engagement of switch arm 79 with switch arm 78 energizes relay coil 62 as follows: secondary 165, wire 166, binding post 137, wire 167, bracket 157, bimetallic element 156, contact 158, wire 168, binding post 169, wire 170, contact 155, contact arm 154, bimetallic element 152, wire 171, binding post 139, wire 172, wire 173, wire 180, relay coil 62, wire 181, wire 182, switch arm 78, switch arm 79, wire 183, bracket 104, contact 103, bimetallic element 100, bracket 102, wire 184, wire 178, bracket 118, binding post 121, and wire 179 to the other side of secondary 165. Energization of relay coil 62 moves the latching arm 52 into engagement with the teeth of gear 34, as explained above, to prevent further rotation of main operating shaft 26 wherefor no further opening movement of the valve takes place. During the movement of armature 57 of the relay mechanism to this latching position, switch arm 65 moves from engagement with switch arm 67 wherefor the above-described energizing circuit for field winding 151 is interrupted. This interrupting action of the circuit for field winding 151 takes place prior to the engagement of latching arm 52 with the teeth of gear 34 wherefor the parts are already slowing down and perhaps even stopped by the time this latching action takes place. Such movement of armature 57 also moves switch arm 66 into engagement with switch arm 68 which completes a circuit to heating element 101 as follows: secondary 165, wire 166, binding post 137, wire 167, bracket 157, bimetallic element 156, contact 158, wire 168, binding post 169, wire 170, contact 155, contact arm 154, bimetallic element 152, wire 171, binding post 139, wire 172, wire 185, terminal 106, heating element 101, terminal 105, wire 186, switch arm 80, switch arm 81, wire 187, link 88, binding post 87, wire 188, switch arm 68, switch arm 66, wire 176, wire 177, wire 178, bracket 118, binding post 121 and wire 179 to the other side of secondary 165.

The valve is now in an intermediate open position and an intermediate flow of gas is supplied to the burner. This amount of gas is not sufficient to cause an appreciable "popping" in the type of burners that are apt to "pop" upon the supplying thereto of a full supply of fuel, nor is it large enough to require more air than is drawn into a large burner when the stack flue thereof is cold. After a time, depending upon the adjustment of contact 103 in relation to bimetallic element 100, bimetallic element 100 will have been heated sufficiently by the heating element 101 to separate from contact 103. When this occurs, the circuit traced above for relay coil 62 is interrupted whereupon the relay returns to the position shown in Fig. 9, wherein switch arms 65 and 67 are in engagement and switch arms 66 and 68 are disengaged. Such movement of the armature also releases the latching arm 52 from the teeth of gear 34, whereupon the parts are again enabled to rotate. Separation of contact 66 from contact 68 interrupts the energizing circuit for heating element 101 traced above, whereas engagement of contact 65 with contact 67 re-establishes the aforementioned circuit for field winding 151. Rotor 150, therefore, rotates the main operating shaft 26 further in valve opening direction.

By the time the valve has been moved to a substantially full open position, the roller 98 has passed completely under switch arm 81 so that

switch arm 81 disengages switch arm 80 and switch arm 79 disengages switch arm 78. When the valve is thus full open, the stud 122 engages the piece of insulation 113 which is secured to the switch arm 112 and moves switch 112 into engagement with switch arm 114, which in turn moves switch arm 115 into engagement with switch arm 117. Engagement of switch arms 112 and 114 energizes fan motor 160 as follows: line wire 162, wire 190, binding post 120, bracket 116, switch arm 114, switch arm 112, bracket 111, binding post 119, wire 191, fan motor 160 and wire 192 to the other line wire 161. Engagement of switch arm 115 with contact 117 establishes a new energizing circuit for relay coil 62 which is as follows: secondary 165, wire 166, binding post 137, wire 167, bracket 157, bimetallic element 156, contact 158, wire 168, binding post 169, wire 170, contact 155, contact arm 154, bimetallic element 152, wire 171, binding post 139, wire 172, wire 173, wire 180, relay coil 62, wire 181, wire 193, switch arm 115, switch arm 117, bracket 118, binding post 121, and wire 179 to the other side of the secondary 165. Armature 57 is thereupon again attracted and first separates switch arm 65 from switch arm 67 whereupon the energizing circuit for field winding 151 is again interrupted. Armature 57 continues its movement and places latching arm 52 into engagement with the teeth of gear 34 to stop further rotation of the parts and maintain the parts in their position against the biasing action of return spring 31. Also, this movement of armature 57 moves switch arm 66 into engagement with switch arm 68. This movement of switch arm 66 into engagement with switch arm 68, however, does not energize heating element 101 at this time because switch arms 80 and 81 are no longer in engagement. The supply of gas to the burner is thus increased to a maximum wherefor there will be no "popping" action in that type of burner which requires a small initial supply of gas; and in burners of the larger type the stack flue will have been heated by this time so that sufficient draft is present to supply as much combustion supporting air as is necessary. If a secondary air damper is being controlled, it will be connected to the damper arm 141 so that such secondary air damper will be moved in accordance with the movements of the gas valve itself.

Whenever the temperature to which bimetallic element 152 responds rises sufficiently to separate contact arm 154 from contact 155, the last mentioned circuit for relay coil 62, as well as all other circuits, will be interrupted. Armature 57, therefore, returns to the position shown wherein the latching arm 52 is removed from engagement with the teeth of gear 34. The return spring 31 is thus permitted to rotate the main operating shaft 26 and associated parts in reverse direction so that the valve moves to closed position. The fly-ball governor described above prevents too fast a movement of the parts in valve-closing direction wherefor the valve disc 8 does not strike its seat sufficiently hard to result in rebounding of the valve disc 8 from its seat.

If the pilot flame should be out so that the bimetallic element 156 is not engaging the associated contact 158, it will be impossible to open the valve if it is closed, or all circuits will be broken if the valve is in any open position whatsoever so that the valve will close. It is, therefore, impossible to operate the valve or maintain the same automatically in a partial or full open position if the safety pilot is extinguished.

From the foregoing it will readily be seen that if a failure of electrical power should occur, the valve will be moved to closed position under the influence of return spring 31. If a power failure should occur and persist for any length of time, it might be desirable to manually open the valve so that gas could be supplied to the burner. This can be accomplished by manually rotating operating knob 128. Rotation of this knob until the shoulder formed by notch 131 engages the stud 132 moves the valve to a partially open position and the inward movement of the knob 128, explained above, causes engagement of switch arms 133 and 134. This rotation of knob 128 is not sufficient to cause stud 122 to close switch arms 115 and 117. Whenever the electrical power returns, field winding 151 will be energized irrespective of the condition of the safety pilot or the controlling room thermostat by a circuit as follows: secondary 165, wire 166, binding post 137, bracket 136, switch arm 133, switch arm 134, bracket 138, binding post 139, wire 172, wire 173, wire 174, field winding 151, wire 175, switch arm 67, switch arm 65, wire 176, wire 177, wire 178, bracket 118, binding post 121 and wire 179 to the other side of secondary 165. The valve is, therefore, moved further open and in so doing releases the pressure of stud 132 on the knob 128, whereupon the spring 130 will be effective to move the knob 128 to its normal position. This opens or separates switch arms 133 and 134. If the controlling thermostat is calling for heat at this time and if the safety pilot is operating properly, the valve will move to complete open position and will move switch arm 115 into engagement with switch arm 117 to energize relay coil 62 and maintain the valve in full open position as heretofore explained. However, if the controlling thermostat is satisfied, or if the safety pilot be out, then separation of switch arms 133 and 134 interrupts all circuits to the various parts and the valve returns to closed position.

From the foregoing description, it will be apparent that I have provided a compact and novel valve structure as well as a control system by which a valve is initially moved to a partial open position and then after a time period, automatically opens to a further extent. It will be evident that many changes may be made by those skilled in the art, both in the detailed construction of the valve and the manner in which it is controlled, without departing from the spirit of my invention. I intend therefore, to be limited only by the scope of the appended claims.

I claim:

1. In an electrically operable valve, in combination, a valve, electrical means to move the valve from closed to open position when energized, timing means, means responsive to valve movement operative to interrupt valve movement when the valve reaches a partially open position and to place said timing means in operation, and means controlled by said timing means to resume valve movement after a time period.

2. In an electrically operable valve, in combination, a valve, electrical means to move the valve from closed to open position when energized, timing means, means responsive to valve movement operative to place said timing means in operation and deenergize said electrical means when said valve reaches a partially open position, and means controlled by said timing means to re-energize said electrical means after a time period.

3. An electrical valve control system of the class described, comprising, in combination, a

valve, electrical means to move said valve from a first position to a second position, electrical means operative to interrupt valve movement, switching means operated by valve movement when said valve reaches a predetermined position to control said valve movement, interrupting means to interrupt valve movement, electrical timing means energized when said valve reaches such predetermined position, and switching means controlled by said timing means to control said valve movement interrupting means to permit further movement of the valve after a time period.

4. An electrical valve control system of the class described, comprising, in combination, a valve, electrical means to move said valve from a first position to a second position, electrical means operative to interrupt valve movement, switching means operated by valve movement when said valve reaches a predetermined position to control said valve movement interrupting means to interrupt valve movement, switching means operated by said valve movement interrupting means, electrical timing means controlled by said switching means, controlled by said timing means operative to control said valve movement interrupting means to permit further valve movement after a time period.

5. In a valve control system, in combination, a valve, first electrical means to move said valve from a first position to a second position, means to energize said first electrical means, second electrical means operative to prevent valve movement when energized, timing means placed in operation upon energization of said second electrical means, switching means operated by valve movement operable to energize said second electrical means when the valve reaches a predetermined position, switching means operated by said second electrical means to deenergize said first electrical means, and switching means controlled by said timing means to deenergize said second electrical means after a time period whereby to cause reenergization of said first electrical means and further movement of said valve.

6. In a valve control system, in combination, a valve, first electrical means to move said valve from a first position to a second position, means to energize said first electrical means, second electrical means operative to prevent valve movement when energized, switching means operated by valve movement operative to energize said second electrical means when the valve reaches a predetermined position, electrical timing means, switching means operated by said second electrical means when energized to deenergize said first electrical means and energize said timing means, and switching means operated by said timing means to deenergize said second electrical means after a time period.

7. In a motorized valve, in combination, a valve, a rotary electrical motor to move the same from a first position to a second position when energized, electromagnetic means to interrupt valve movement when energized, means to energize said motor means, switching means operated when said valve reaches a predetermined position to energize said electromagnetic means, and timing means to deenergize said electromagnetic means after a time period.

8. In a motorized valve, in combination, a valve, a rotary electrical motor to move the same from a first position to a second position when energized, electromagnetic means to interrupt valve movement when energized, means to ener-

gize said motor means, switching means operated when said valve reaches a predetermined position to energize said electromagnetic means, first switching means operated by said electromagnetic means, electrical timing means energized by said switching means, and second switching means controlled by said timing means to deenergize said electromagnetic means after a time period.

9. In a motorized valve, in combination, a valve, a rotary electrical motor to move the same from a first position to a second position when energized, electromagnetic means to interrupt valve movement when energized, means to energize said motor means, switching means operated when said valve reaches a predetermined position to energize said electromagnetic means, switching means operated by said electromagnetic means, electrical timing means energized by said switching means, and second switching means controlled by said timing means to deenergize said electromagnetic means after a time period, said first switching means also deenergizing said motor means upon energization of said electromagnetic means.

10. In a valve control system, in combination, a valve, motor means to move the valve from a first position to a second position, means to hold the valve in any position to which it is moved, means controlled by valve movement to operate said valve holding means when said valve reaches a predetermined position between its first and second positions, timing means to render said valve holding means inoperative after a time period, and means controlled by valve movement to again render said valve holding means operative when the valve reaches said second position.

11. In a valve control system, in combination, a valve, motor means to move the valve from a first position to a second position, means to hold the valve in any position to which it is moved, means controlled by valve movement to operate said valve holding means when said valve reaches a predetermined position between its first and second positions, timing means to render said valve holding means inoperative after a time period placed in operation when said holding means is operated and the valve is in said predetermined position, and means to render said valve holding means operative when the valve reaches said second position.

12. In combination, a valve, motor means to move said valve from a first position to a second position, valve holding means to hold said valve in any position to which it is moved, means responsive to valve movement to operate said valve holding means when the valve reaches a position between said first and second positions, means operated by said valve holding means to interrupt the supply of power to said motor means, timing means placed in operation when said valve reaches such intermediate position to render said valve holding means inoperative after a time period, and means operated when said valve reaches its second position to again operate said valve holding means.

13. In an electrical valve control system, in combination, a valve biased to a first position, electric motor means to move the same from said first position to a second position when energized, means to hold the valve in any position to which it is moved by said electric motor means, electric means in control of said valve holding means, electric timing means, switching means controlled by movement of said valve to an intermediate position and by said electric means

to energize said timing means and electric means and to deenergize said motor means, switching means operated by said timing means to deenergize said electric means after a time period, and switching means operated when said valve reaches its second position to again energize said electric means.

14. An actuating mechanism for a device which it is desired to move from a first position to a second position, comprising, in combination, electric means to move said device from the first position to the second position, electric means operative to interrupt movement of the device, switching means operative when the device reaches a predetermined position to control said device movement interrupting means to interrupt movement of the device, switching means operated by said device movement interrupting means, electric timing means controlled by said switching means, and switching means controlled by said timing means operative to control said device movement interrupting means to permit further movement of the device after a time period.

15. The combination with an element movable from a first position to a second position, of a rotary electric motor to move such element from the first position to the second position when energized, electromagnetic means to interrupt movement of the element when energized, means to energize said motor means, switching means operated when said element reaches a predetermined position to energize said electromagnetic means, and timing means to deenergize said electromagnetic means a timed period after the same has been energized.

16. An actuating mechanism for positioning an element, comprising, in combination, power means to move the element from a first position to a second position, means to hold the element in any position to which it is moved by the power means, means controlled by movement of the element to operate said holding means when said element has been moved to a predetermined position between its first and second positions, timing means to render said element holding means inoperative after a time period and placed in operation when said holding means is operated and the element is in said predetermined position, and means to render said element holding means again operative when the element reaches said second position.

17. In combination, a valve, means for moving said valve between first and second valve positions, and interrupting means including a timing device operative to stop valve movement for a time period while said valve is moving from said first to said second position at a position intermediate said first and second positions, said time period being independent of the time at which said valve is operated, said interrupting means being ineffective to stop movement of the valve when said valve is moving from said second to said first position in the course of its normal operation.

18. In combination, a valve, electrical motor means for moving said valve from a first position to a second position, means including a timing

switch movable between a circuit open and circuit closed position, said last named means being operative to stop valve movement for a time period when said valve reaches a position intermediate said first and second positions, said time period being determined by the time required for said timing switch to move between its circuit controlling positions and being independent of the time at which said valve is operated, and means for adjusting the length of said time period to thereby adjust the time required for said valve to move from said first to said second position.

19. In combination, a valve, electrical motor means for moving said valve from a first position to a second position, means including a thermal time switch movable between a circuit open and circuit closed position, said last named means being operative to stop valve movement for a time period when said valve reaches a position intermediate said first and second positions, said time period being determined by the time required for the temperature of said thermal time switch to change sufficiently to cause said switch to move between its two circuit controlling positions and being independent of the time at which said valve is operated, and means associated with said time switch for adjusting the length of said time period to thereby adjust the time required for said valve to move from said first to said second position.

20. In combination, a valve biased towards closed position, motor means for opening said valve against its bias, means to hold said valve in any position to which it is moved, means controlled by valve movement to operate said valve holding means when said valve reaches a partially open position, and timing means operative to render said valve holding means inoperative a timed period after it has been placed in operation to permit continued movement of the valve towards open position.

21. In combination, a valve, means biasing said valve towards closed position, electrical motor means for moving said valve against its bias, a gear train connecting said motor means and said valve, electromagnetically actuated holding means cooperating with an element of said gear train, and means for so energizing said holding means that it is effective to hold the valve at a partially open position upon said valve being moved in valve opening direction, said holding means having no effect upon the return movement of said valve to closed position.

22. In combination, a valve, means biasing said valve towards closed position, electrical motor means for moving said valve against its bias, a gear train connecting said motor means and said valve, holding means comprising a stop movable into engagement with an element of the gear train to stop movement of the valve at a partially open position, and means including a timing device operable a predetermined period of time after said valve has stopped at said partially open position to cause said stop to be withdrawn from engagement with said gear train.

JAMES R. WILLIAMS.

CERTIFICATE OF CORRECTION.

Patent No. 2,145,146.

January 24, 1939.

JAMES R. WILLIAMS.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 6, first column, line 25, claim 4, before "controlled" insert and switching means; and that the said Letters Patent should be read with this correction therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 4th day of April, A. D. 1939.

Henry Van Arsdale

(Seal)

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