

April 21, 1942.

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2,280,062

MOTORIZED MECHANISM

Filed Dec. 11, 1939

2 Sheets-Sheet 1

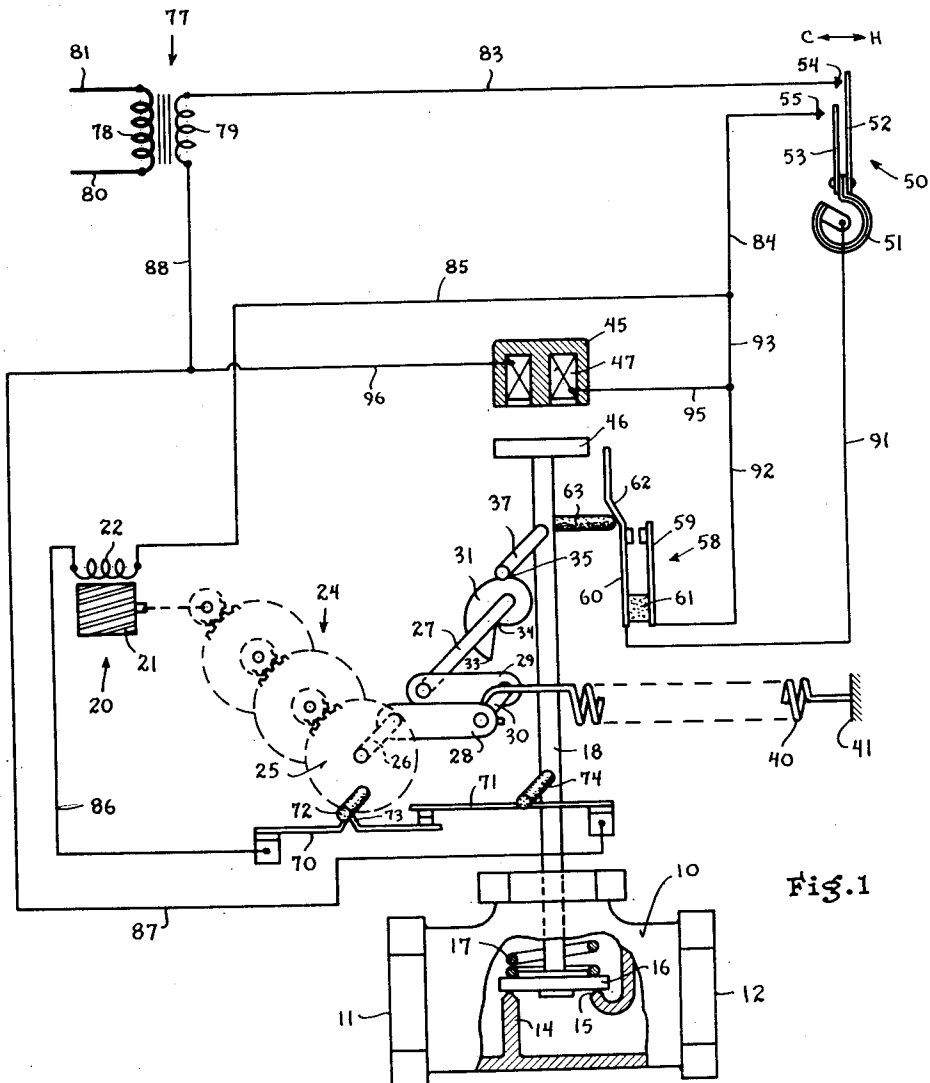


Fig. 1

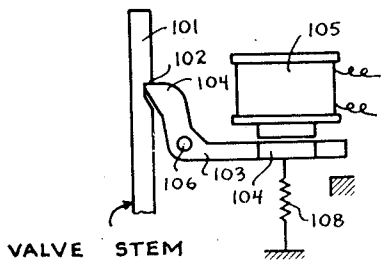


Fig. 2

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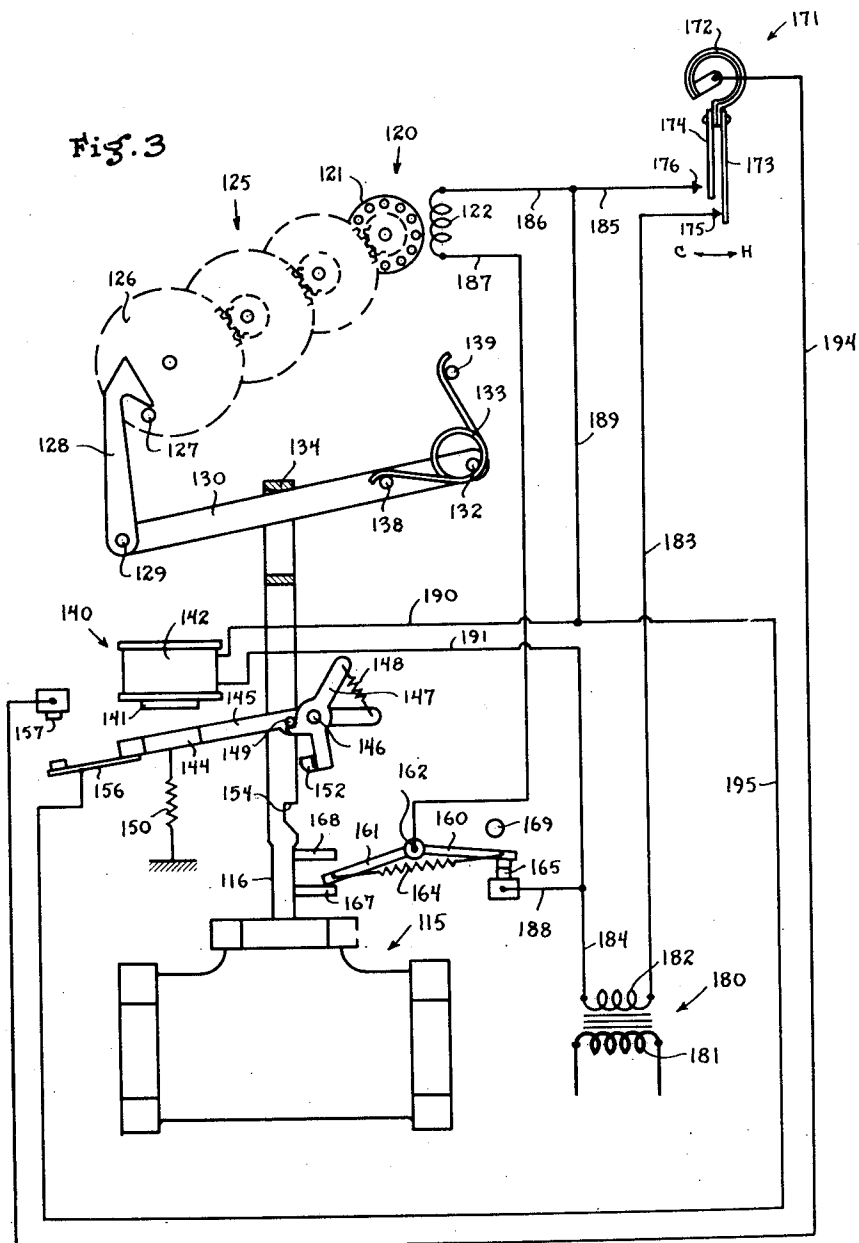
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2 Sheets-Sheet 2



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UNITED STATES PATENT OFFICE

2,280,062

MOTORIZED MECHANISM

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Application December 11, 1939, Serial No. 308,674

15 Claims. (Cl. 172-239)

The present invention is concerned with a motorized mechanism and more particularly one adapted to position a member movable between a safe first position and an active second position.

In many instances it is desirable to utilize a motor to position a device which is movable between a safe normal position and an active position. Thus one typical instance is that of a motorized valve controlling the flow of gas to a gas burner or the flow of other heating fluid to a heating apparatus. In such a case, the valve is biased to closed position to insure the return of the valve to this position in the event of power failure. Another type of device of this character is a switch which is active only when it is closed. It is desirable in case of failure of the switch actuating mechanism for the switch to be moved to its circuit open or its safe position. The present invention is concerned with an arrangement wherein a motor positions such an element, the arrangement being particularly adaptable to the positioning of a valve.

An object of the present invention is to provide an arrangement wherein a motor moves a member to an active position wherein it is retained by a holding means separate from the motor, the transmission means between the motor and the positioned member being thereafter returned to the starting position so that upon release of the holding means, the member is free to return by suitable biasing means to its safe normal position.

Another object of the present invention is to provide, in an arrangement wherein a motor moves a member from a safe position to an active position and a holding means separate from the motor retains the member in its active position, transmission means between the motor and the member including a pair of separable links and means for separating the links after the member has been moved to active position, so that upon release of the holding means, the member is free to return by suitable biasing means to its safe normal position.

A further object of the present invention is to provide such an arrangement wherein the positioned member is a valve biased to closed position.

A still further object of the invention is to provide an arrangement of the type mentioned in the previous objects wherein the motor is continuously operated until the transmission mechanism has been returned to its starting position.

A still further object of the invention is to provide an arrangement such as set forth above

in which the motor moves the positioning element to its active position where it is retained by the holding means and is thereupon deenergized and a biasing means is employed to return the transmission mechanism to its starting position.

A still further object of the present invention is to provide arrangements such as set forth above in which the holding means is electrically operated and is energized by the same source of power as the motor.

Other 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 preferred form of the invention,

Figure 2 is a schematic showing of a modification of one of the details of the arrangement of Figure 1, and

Figure 3 is a schematic view of a modified form of the invention.

Referring to the drawings for a more detailed understanding of the invention, the system is shown in Figure 1 in connection with the positioning of a valve. The valve is provided with a valve housing 10 having an inlet connection 11 and an outlet connection 12. Extending through the valve body is the usual transverse partition wall 14 which is apertured at 15 to provide a valve seat upon which the valve disc 16 seats. A spring 17 biases the valve disc 16 into engagement with its valve seat. Secured to the valve disc 16 is a valve stem 18.

A motor 20 is provided for moving the valve disc to its open position against the action of biasing spring 17. The motor 20 is shown as being of the induction type, having a rotor 21 and a field winding 22. The motor is connected to a reduction gear train generally indicated by the reference numeral 24. The gear at the low speed end of this gear train is designated by the numeral 25. Secured to gear 25 is a shaft 26 and axially aligned with shaft 26 is a second shaft 27. Secured to shafts 26 and 27 are crank arms 28 and 29, the crank arms being connected by a rod 30. At the outer end of shaft 27 is a cam 31. The motor 20 is so designed that upon energization of the field winding 22, the gear train is rotated in a direction such that gear 25 and shafts 26 and 27 are rotated in a clockwise direction. The cam 31 is shown in the position which it normally assumes when the valve is closed. The radius of the cam gradually increases in a counter-clockwise direction up to its high point 33. The cam surface immediately drops down

to an arcuate portion extending from point 34 to point 35. This portion of the cam is of uniform radius for reasons to be pointed out hereinafter. Projecting from the valve stem 18 is an arm 37 which engages the cam 31 and acts as a cam follower. It will be obvious that as the cam 31 is rotated in a clockwise direction from the position shown, the valve stem 18 will be raised until the cam follower 37 leaves the high point 33 whereupon the valve stem, unless otherwise restrained, is free to drop to the position shown in which position it remains throughout the rest of the revolution of the cam.

A spring 40 has one end secured to the rod 30. This spring 40 serves to oppose the action of the motor during the valve opening portion of the cycle and is effective to aid the motor after the high point 33 of the cam has left the cam follower 37.

It will be recalled that in the previous paragraph it was stated that the valve stem, after the cam follower 37 has passed over the high point of the cam, would be free to return to the position shown unless otherwise restrained. Suitable means are provided for normally holding the valve stem in valve open position when moved to this position. This means comprises an electromagnet 45 which cooperates with an armature 46 secured to the upper end of valve stem 18. The electromagnet 45 is provided with a winding 47 in the conventional manner. When the valve stem is moved to its uppermost position by the action of cam 31, armature 46 is firmly moved into engagement with the electromagnet 45. Means are provided for energizing the electromagnet at this stage of the cycle so that the electromagnet is normally able to maintain the valve in open position as will be described latter.

A thermostat 50 is provided for controlling the operation of the valve. It is to be understood that any other control switch can be utilized. The thermostat as illustrated, comprises a bimetallic element 51 to which are secured contact arms 52 and 53 which engage with contacts 54 and 55, respectively. Contact arm 52 is less widely separated from contact 54 than contact arm 53 is from contact 55. The bimetallic element 51 is so arranged that it moves the contact arms 52 and 53 to the left upon a temperature fall as indicated by the legends on the drawing wherein the letter C represents "cold" and the letter H represents "hot." Upon a fall in temperature, due to the unequal spacing of the contact arms from the contacts, contact arm 52 will engage contact 54 and upon further fall in temperature contact arm 53 will engage contact 55. Energization of the motor is further controlled by a maintaining switch generally designated by the numeral 53. This switch comprises a pair of switch blades 59 and 60. The blades 59 and 60 are secured to an insulated block 61. The blade 60 has a curved upper portion 62 forming a cam surface cooperating with an arm 63 of insulating material secured to the valve stem 18. Upon upward movement of valve stem 18, the arm 63 engages the curved portion 62 of switch blade 60 and moves switch blade 60 into circuit making engagement with switch blade 59.

Energization of the motor is further controlled by a cycling switch mechanism including a pair of cooperating switch blades 70 and 71. The switch blade 70 has an upwardly projecting portion 73 which cooperates with a pin 72 concentrically carried by the gear 25. When the gear 25 is in the position shown, a pin 72 engages the

portion 71 of switch blade 70 to hold switch blade 70 in its lowermost position. A pin 74 of insulating material carried by the valve stem 18 cooperates with the switch blade 71. When the valve stem is in valve closed position, as shown, the switch blade 71 is engaged by pin 74 and held in its lowermost position wherein it contacts switch blade 70 even when this switch blade is depressed by engagement of pin 72 with portion 71 thereof, as previously described. Both switch blades 70 and 71 are biased upwardly.

A step down transformer 77 is provided for the purpose of supplying low voltage power for the operation of the motor and its control system. This transformer comprises a line voltage primary winding 78 and a low voltage secondary winding 79. The line voltage primary 78 is connected to line wires 80 and 81 leading to a suitable source of power (not shown).

Operation of species of Figure 1

As previously indicated, the various elements are shown in the position occupied when the valve is closed. This is the position which they assume when the temperature to which thermostat 50 is subjected is at or above the desired value. Upon a drop in temperature, switch blade 52 is first moved into engagement with contact 54. This, by itself, results in the establishment of no energizing circuits. Upon a further drop in temperature, switch blade 53 is moved into engagement with contact 55 and the following energizing circuit is established to the field winding 22: from the upper terminal of secondary 79 through conductor 83, contact 54, contact arm 52, contact arm 53, contact 55, conductors 84 and 85, field winding 22, conductor 86, switch blades 70 and 71, and conductors 87 and 88 to the other terminal of secondary 79. The energization of field winding 22, as previously explained, results in clockwise rotation of gear 25 and shafts 26 and 27. The rotation of shaft 27 together with cam 31 results in the valve stem being moved upwardly towards valve open position. While the upward movement of valve stem 18 permits switch arms 71 to move upwardly, this does not result in the circuit being interrupted since the initial movement of gear 25 also moves pin 72 away from the upwardly projecting portion 73 of switch blade 70 so as to allow this switch blade to follow switch blade 71.

After an initial upward movement of valve stem 18 has taken place, the arm 63 engages the inclined portion 62 of switch blade 60 to move switch blades 59 and 60 into contact making engagement. The result is that the following maintaining circuit is established to field winding 22: from the upper terminal of secondary 79 through conductor 83, contact 54, contact arm 52, bimetallic element 51, conductor 91, switch blades 60 and 59, conductors 92, 93, and 85, field winding 22, conductor 86, switch blades 70 and 71 and conductors 87 and 88 to the other terminal of secondary 79. It will be noted that this new circuit to field winding 22 is independent of contact arm 53 and contact 55. It is this contact arm and contact which are the last to be engaged and are consequently the first to be disengaged. Thus it is assured that upon initial engagement of both pairs of contacts the motor will continue to remain energized even though one set of contacts is immediately thereafter separated. In this way, an appreciable temperature differential is required between the succes-

sive operation of the device so that chattering or excessively frequent operation is avoided.

Upon engagement of both contact arms 52 and 53 with their respective contacts 54 and 55, an energizing circuit is established to the winding 47 of electromagnet 45. As soon as switch blades 60 and 59 are moved into engagement, a maintaining circuit is established to the winding 47. Since this maintaining circuit is established before it is necessary for the electromagnet to become active, it is only necessary to consider this maintaining circuit which is as follows: from the upper terminal of secondary 79 through conductor 83, contact 54, contact arm 52, bimetallic element 51, conductor 91, switch blades 60 and 59, conductors 92 and 95, winding 47, and conductors 96 and 88 to the other terminal of secondary 79. Since winding 47 is energized independently of contact 55 during the initial movement of the valve, it is assured that when armature 46 is moved into engagement with electromagnet 45, the electromagnet will be effective to retain the armature in engagement therewith. There is no positive connection between the cam 31 and the pin 37 so that as soon as the high point 33 of cam 31 passes the pin 37 the valve stem is under the sole control of magnet 45. The motor continues to rotate until the gear train returns to the position shown at which time pin 72 engages the upwardly projecting portion 73 of switch blade 70 to move this blade to its lowermost position. Since switch blade 71 has moved upwardly by reason of the upward movement of pin 74 and since this pin is still in this uppermost position by reason of the valve stem being held upwardly by the electromagnet 45, switch blades 70 and 71 will no longer be in engagement when switch blade 70 is moved to its lowermost position. The result is that the switch blades 70 and 71 are separated at this point to terminate energization of the field winding 22. It will be seen that the cam 31 and the pin 37 constitute a pair of separable links, and that after the high point 33 of cam 31 passes pin 37, the links are separated in such a manner that the valve is free to return to its closed position upon release by the magnet 45.

The valve disc 16 is held in open position as long as electromagnet 45 remains energized. This will continue as long as contact arm 52 of the thermostat is in engagement with contact 54. Switch 58, connected in parallel with contacts 53—55, is closed. Therefore separation of contacts 53 and 55 does not affect the energization of electromagnet 45. As soon as the contact arm 52 separates from contact 54, the winding 47 of electromagnet 45 will be deenergized so as to permit the biasing spring 17 to move the valve abruptly to closed position.

The maintaining circuit previously described, including contacts 52—54 and switch 58, prevents the opening of contacts 53—55 from causing immediate deenergization of solenoid 45 and consequent closure of valve 16. An appreciable differential is thereby provided between the temperature at which contacts 53—55 close, causing the valve to open, and the temperature at which contacts 52—54 open, causing the valve to close. This temperature differential prevents erratic operation of the valve because of chattering thermostat contacts either due to vibration, or from other causes.

A common application of thermostatically controlled motorized valve is in the gas heating art wherein the valve controls the flow of gas to a

gas burner in accordance with the need for burner operation as indicated by the temperature to which the thermostat is responsive. In this field, it is essential that if there is a power failure, the valve will be moved to closed position. It will readily be seen that where the normal cycle is completed, the valve is under the sole control of the electromagnet and obviously any power failure results in immediate closure of valve disc 16. It is always possible, though unlikely, that such a power failure might occur during the opening cycle and in such a case, if some other means than motor 20 were not provided for actuating the gear train 24, the cam 31 might be left in intermediate position wherein the valve would be held in a partially open position. The spring 40 is provided for guarding against such a contingency. The spring 40, acting through the crank arm formed of crank arms 28 and 29 and rod 30 tends to bias the gear 25 and cam 31 in a counter-clockwise direction during the initial portion of the operating cycle. As the valve approaches open position the moment arm exerted by spring 40 is increased due to the fact that the crank arms 28 and 29 tend to approach a position more nearly transverse to the direction of pull of spring 40. Before the crank arms 28 and 29 have revolved 180° to the dead center position, the high point 33 of cam 31 has moved from underneath the pin 37 so that even if a power failure resulted in the cam 31 remaining in this position, the valve could completely close. As pointed out previously, the radius of the cam surface is constant from point 34 to point 35 so that when the cam is in any position wherein the cam follower 37 would engage this portion of the cam surface, the valve can move to completely closed position.

It will be seen that I have provided an arrangement wherein a motor is employed to drive a valve to open position, leave it under the control of a holding means and then to return the gear train and the various other elements of the connecting mechanism to the starting position. In this way it is assured that the valve will always be free to close upon termination of the holding effect of the holding means. It will further be noted that I have provided means whereby the valve may be safely closed in the event of a power failure at any time during its operating cycle.

Modification of Figure 2

In Figure 2, there is illustrated a slightly modified form of holding means which may be employed with the valve of Figure 1. In the arrangement of this figure, an electromagnetic latch is employed in lieu of a plain electromagnet. Such a latch has the advantage that it is capable of holding a considerably greater load for the same number of ampere-turns in the electromagnet. The valve stem in this figure is designated by the numeral 101. It will be understood that this valve stem is identical in function and arrangement to the valve stem 18 of Figure 1 with the sole exception that instead of an armature being secured at the upper end thereof, the valve stem is provided with a notch 102. A pivoted latch 103 has a nose portion 104 which is adapted to extend into the notch 102 and retain the valve stem against downward movement. Secured to the horizontal arm of the pivoted latch 103 is an armature 104 which cooperates with an electromagnet 105. The latch 103 is pivoted about a pivot 106 and is biased

clockwise by a spring 108. The electromagnet 105 when energized overcomes the effect of spring 108 to maintain the latch in its latching position. As soon as the electromagnet is de-energized however the spring 108 is effective to rotate the latch 103 in a clockwise direction to move the nose 104 out of the notch 102 and permit downward movement of the valve stem 101. It will be understood that the electromagnet 105 is connected into the circuit in the same manner as magnet 45 of Figure 1 and that the operation of this system is in all other respects identical to that of Figure 1.

Species of Figure 3

In Figure 3 I have shown a modified form of my invention. In the arrangement of this figure, a motor is effective to move the valve in cooperative relation with a holding means as in the species of Figure 1. Unlike the previous species, however, a biasing spring is effective to return the motor and its connecting mechanism to the starting position.

Referring to the specific structure of Figure 3 the valve is generally designated by the reference numeral 115, this valve is provided with a valve stem 116. The valve is similar in construction to the valve of Figure 1 so that upward movement of valve stem 116 causes the valve to be moved to open position and downward movement of stem 116 causes the valve to be closed.

A motor 120 is employed for positioning the valve. This motor comprises a rotor 121 and a field winding 122. The rotor 121 is connected through a reduction gear train comprising a gear 126 at the low speed of the gear train. A pin 127 projects outwardly from the gear 126 and is adapted to cooperate with a hook 128. The hook 128 is pivotally secured at 129 to a lever 130 pivotally supported by a pivot pin 132. The lever 130 extends through an elongated eye portion 134 at the upper end of valve stem 116. The motor 120 is so designed as to cause clockwise movement of gear 126 upon energization of the motor. Upon such clockwise movement, the pin 127 engages the hook 128 and rotates the lever 130 in a clockwise direction. This results in the lever 130 moving valve stem 116 upwardly.

A coil spring 133 is associated with the lever 130 for returning the transmission mechanism to its starting position. The spring 133 is positioned about the pivot pin 132. One arm of spring 133 engages a pin 138 secured to lever 130 and the other arm engages a fixed pin 139. The result is that spring 133 exerts a force tending to rotate lever 130 in a counter-clockwise direction.

An electromagnet 140 is provided for retaining the valve stem in valve open position. This electromagnet comprises a core 141 and a winding 142. Cooperating with the core 141 is an armature 144 carried by a lever 145 pivoted about a fixed pivot pin 146. A spring 150 biases the lever 145 away from the electromagnet. Also secured to the pivot pin 146 is a member 147. A spring 148 is connected between the outer ends of member 147 and lever 145 so as to tend to rotate member 147 clockwise with respect to lever 145. Such clockwise movement is limited by a stop pin 149 carried by lever 145. Member 147 is thus connected to lever 145 through a strain release connection whereby the member 147 unless otherwise restrained tends to rotate with lever 145. Carried at the lower end of member 147

is a projection 152 which is adapted to enter a notch 154 in the valve stem 116 when the stem is raised to substantially valve open position.

Secured to the left hand end of lever 145 is a switch blade 156 which is adapted to cooperate with a fixed contact 157. The switch blade 156 and contact 157 are employed for establishing a maintaining circuit to the apparatus as will be presently described.

An over center snap action switch is employed for controlling the energization of the motor. This switch comprises a switch arm 160 and an arm 161 both pivoted about a pivot point 162. Connecting the two members 160 and 161 is a spring 164. The switch arm 160 is adapted to engage a contact 165. The arm 161 is positioned by two arms 167 and 168 projecting from valve stem 116. As the valve stem is moved upwardly, the arm 167 is effective to rotate arm 161 in a clockwise direction until the arm 161 is aligned with arm 160. This portion of the movement is resisted by spring 164. As soon as arm 161 is moved farther however, it is past the "dead center" position so that spring 164 is immediately effective to continue the clockwise movement of arm 161 until it engages the upper arm 168 whereupon arm 160 is abruptly moved upwardly until it engages a stop pin 169. The switch arm 160 is thus separated from contact 165 with a snap action. The projecting arms 167 and 168 are so positioned that this snap separation of switch blade 160 of contact 165 takes place just as the valve reaches open position and at the time when notch 154 is adjacent the projection 152 of member 147.

A thermostat 171 controls the operation of the valve. This thermostat is equivalent in function and in structure to thermostat 50 of the species of Figure 1. The thermostat comprises a bimetallic element 172 to which are secured contact arms 173 and 174. The bimetallic element is effective upon a temperature drop to move contact arms 173 and 174 to the left and upon a temperature rise to the right. Contact arms 173 and 174 are adapted to engage fixed contacts 175 and 176. The spacings of the contact arms 173 and 174 from contacts 175 and 176 are such that contact arm 173 is first engaged with contact 175 and contact arm 174 is then engaged with contact 176.

A step down transformer 180 is employed for supplying low voltage power to the motor and its control system. This transformer comprises a line voltage primary 181 and a low voltage secondary 182. The line voltage primary 181 is connected to a suitable source of power (not shown).

Operation of Figure 3 species

The various elements are shown in the position they assume when the temperature is at or above the desired value. Under these conditions the valve is in its closed position. Upon a temperature drop, contact arm 173 is moved into engagement with contact 175 and upon a further drop, contact arm 174 is moved into engagement with contact 176. No energizing circuit is established until contact arm 174 engages contact 176. As soon as this happens, the following energizing circuit is established to the field winding 122: from the right hand terminal of secondary 182 through conductor 183, contact 175, contact arm 173, contact arm 174, contact 176, conductors 185 and 186, field winding 122, conductor 187, contact arm 160, contact 165 and conductors

188 and 184 to the other terminal of secondary 182. The establishment of this circuit causes energization of field winding 122 and rotation of the gear train in such a direction that gear 125 is moved in a clockwise direction. As previously explained, this causes the pin 127 to engage with hook 128 and rotate lever 130 in a clockwise direction. This movement of lever 130 results in valve stem 116 being raised towards valve open position.

At the same time that the field winding 122 is first energized, a circuit is established to the winding 142 of the electromagnet 140 as follows: from the right hand terminal of secondary 180 through conductor 183, contact 175, contact arms 173 and 174, contact 176, conductors 185, 189, and 190, magnet winding 142 and conductors 191 and 184 to the other terminal of secondary 182. The energization of electromagnet 140 results in the lever 145 being rotated in a clockwise direction. While movement of member 147 is impeded by reason of the fact that the projection engages the right hand edge of valve 116 and is unable to enter the notch 154, movement of lever 145 is still possible due to the strain release connection between members 145 and 147. In other words, the lever 145 is moved upwardly until the armature 144 engages the core 141 against the action of spring 150 and spring 148 which urges the projection 152 against the edge of valve stem 116. Movement of lever 145 in the manner described results in the movement of switch blade 156 into engagement with contact 157. As soon as such engagement takes place, a maintaining circuit is established to the field winding as follows: from the right hand terminal of secondary 182 through conductor 183, contact 175, contact arm 173, bimetallic element 172, conductor 194, contact 157, switch blade 156, conductors 195, 189, and 186, field winding 122, conductor 187, switch arm 160, contact 165, and conductors 188 and 184 to the other terminal of the secondary 182. At the same time a maintaining circuit is established to the magnet 142 as follows: from the right hand terminal of secondary 182 through conductor 183, contact 175, contact arm 173, bimetallic element 172, conductor 194, contact 157, contact arm 156, conductors 195 and 190, magnet winding 142 and conductors 191 and 184 to the other terminal of secondary 182.

The establishment of the two maintaining circuits just traced results in the energization of the motor and of the electromagnet being independent of the engagement of contact arm 174 with contact arm 176. The advantage of this feature is the same as described in connection with Figure 1. In other words, a differential is introduced into the operation to prevent chattering or excessively frequent operations of the valve.

As the valve approaches open position, the notch 154 in the valve stem 116 comes adjacent the projection 152 of member 147. This member is forced into the notch by reason of the action of spring 148 which, as previously explained, has been placed under tension by movement of the lever 145 into the position in which the armature is engaged with the electromagnet. Immediately after the projection 152 has entered the notch 154, the arm 161 is moved beyond center with respect to arm 160 so as to cause these two arms to snap over center thereby abruptly separating switch arm 160 from contact 165. The separation of these two contacts

results in the interruption of both of the circuits to field winding 122 previously traced. The motor is thus completely deenergized so that biasing spring 133 is now free to rotate lever 130 in a counter-clockwise direction. The biasing spring 133 is of such size that it is able to rotate the gear train 125 and the motor rotor 121 in the reverse direction back to their original positions. Such return movement of lever 130 does not cause the valve to close due to the fact that the valve stem is now latched in open position by the projection 152 of member 147 which extends into the notch 154. The movement of lever 130 downwardly in a counter-clockwise direction, in spite of the valve stem 116 remaining in valve open position, is possible because of the elongated eye portion 134 which provides the connection between the lever 130 and the valve stem 116.

It will be seen that the lever 130 and the elongated eye portion 134 of stem 116 constitute a pair of separable links, and that after lever 130 is returned to the bottom of the eye portion 134 by the action of spring 133, the links are separated in such a manner that the valve is free to return to its closed position upon release of projection 152 by electromagnet 142.

The valve remains in its open position until contact arm 173 has separated from contact 175. When this happens, the electromagnet 140 is deenergized so that the lever 145 moves to the position shown in the drawings in which the projection 152 is no longer in the notch 154. This movement of lever 145 is caused by not only the effect of gravity on the lever but also by the biasing spring 150.

As with the species of Figures 1 and 2, it is assured that the valve will always return to closed position in the event of power failure regardless of when such power failure occurs. Obviously such a power failure will result in the release of armature 144 so that the lever 145 is ineffective to retain the valve in open position. If the power failure occurs before the projection 152 has entered the notch 154, then the valve is being held in open position only by the action of motor 120. Upon such power failure at this time, the spring 133 is effective to return the transmission mechanism to its initial position and the valve returns to its closed position by its own biasing means.

Whenever the valve stem returns to closed position, switch arm 160 is snapped back into engagement with contact 165 through the action of the projecting arm 168. Switch blade 160 is thus again positioned in engagement with contact 165 so as to make possible the reenergization of the motor for the next operating cycle.

While the invention has been described in connection with valve operators since this is the application for which it is most adapted, it is to be understood that the invention is applicable to the positioning of other devices movable between a safe position to which the device is biased and a further active position. In general, while I have shown certain specific embodiments of my invention, it is to be understood that this is for purposes of illustration only and that the invention is to be limited only by the scope of the appended claims.

I claim as my invention:

1. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for re-

taining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including a uni-directional electric motor and a biasing means, means for transmitting motion from said motor means to said member, a main control switch, switching means operable by said motor means and said member, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and means controlled by said switching means operative to control the energization of said electric motor in such a manner that said motor is effective to move said element into cooperative relation with said holding means and subsequently to drive said motion transmitting means back to its original position, said biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

2. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including an electric motor and a biasing means, means for transmitting motion from said motor means to said member, a main control switch, a normally closed cycling switch, means for opening said switch when said member is in said second position and said transmission means is returned to said original position, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and a circuit for said motor including said cycling switch operative to cause the energization of said rotary electric motor by said source of power until said element is moved into cooperative relation with said holding means and said motion transmitting means is returned to its original position, said biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

3. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electromagnetic holding means for retaining said member in said second position when an armature associated with said member is moved into cooperative relation therewith, a rotary electric motor, means for transmitting motion from said motor to said member, a connection between said motion transmitting means and said member permitting movement of said motion transmitting means back to its original position without affecting the position of said member when said member is in said second position, a main control switch, switching means operable in accordance with the position of said member, a source of power, means controlled by said main control switch for connecting said source of power to said electromagnetic holding means, and a single energizing circuit for said motor controlled by both said main control switch and said switching means operative upon closure of said main control switch to control the energization of the mo-

tor by said source of power in such a manner that said armature is moved into cooperative relation with said holding means and said motion transmitting means is then returned to its original position.

4. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including a rotary electric motor and a biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said motion transmitting means back to its original position without affecting the position of said member when said member is in said second position, a main control switch, switching means operable in accordance with the position of said member, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and means controlled by both said main control switch and said switching means operative upon closure of said main control switch to control the energization of said rotary electric motor by said source of power in such a manner that said element is moved into cooperative relation with said holding means and said motion transmitting means is then returned to its original position, said biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

5. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including a rotary electric motor and a biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said motion transmitting means back to its original position without affecting the position of said member when said member is in said second position, a main control switch, switching means operable by said motor means and said member, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and means controlled by both said main control switch and said switching means operative upon closure of said main control switch to cause said motor to be energized until it has moved said element into cooperative relationship with said holding means and has then driven said motion transmitting mechanism back to its original position, said biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

6. In combination, a member movable between

a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including a rotary electric motor and a biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said motion transmitting means back to its original position without affecting the position of said member when said member is in said second position, a main control switch, switching means operated by said member, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and means controlled by both said main control switch and said switching means operative upon closure of said main control switch to cause said motor to be energized until it has moved said element into cooperative relationship with said holding means and to deenergize said motor immediately thereafter, said biasing means being effective upon deenergization of said motor at any time to return said motion transmitting means to its starting position.

7. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, electrically operated holding means for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, motor means including an electric motor and a biasing means, transmission means between said motor means and said member comprising a rotary cam driven by said motor and a cam follower associated with said member, said cam having a substantial portion of its periphery of uniform radius and the remainder of gradually increasing radius, said uniform radius being of such magnitude that when the cam follower is in engagement with that portion of the cam, said member is maintained in said safe position by its bias, a main control switch, switching means operable by said movable member and said motor means, a source of power, means controlled by said main control switch for connecting said source of power to said electrically operated holding means, and means controlled by said switching means operative to control the energization of said electric motor by said source of power in such a manner that said element is moved into cooperative relation with said holding means and said transmission means is then returned to its original position, said biasing means being so connected to said transmission means that in the event of power failure during the movement of said motor it is effective at all times to insure that said cam is moved to a position wherein said cam follower engages the portion of said cam surface of uniform radius so that said member is moved by its bias to said first position.

8. In combination, a member movable between a safe first position and an active second position, said member being biased to said safe first position, a latch for retaining said member in said second position when an element associated with said member is moved into cooperative relation therewith, an electromagnet for moving said latch to its operative position, a switch positioned by said electromagnet, a

strain release connection between said latch and said electromagnet so that upon energization thereof said electromagnet can assume its energized position and position said switch even though said element is not in cooperative relation with said latch, an electric motor for moving said member to said second position, a main control switch, switching means operable by said movable member, a source of power, means controlled by said main control switch for connecting said source of power to said electromagnet to cause said electromagnet to bias said latch to its operative position and to position its associated switch, and means controlled by said electromagnet switch and said switching means for causing the energization of the motor to move said element into cooperative relation with said latch and thereafter deenergizing said motor.

9. In combination, a member biased to a first position, a latch for retaining said member in a second position when a shoulder portion of said member is moved adjacent said latch, an electromagnet for moving said latch to its operative position, a switch positioned by said electromagnet, a strain release connection between said latch and said electromagnet so that upon energization thereof said electromagnet can assume its energized position and position said switch even though said shoulder is not adjacent said latch, an electric motor for moving said member to said second position, a main control means under the control of said main control switch for energizing said electromagnet to cause said electromagnet to bias said latch to its operative position and to position its associated switch, switching means operated by said member, and means controlled by both said electromagnet switch and said switching means operative as a result of closure of said main control switch to cause energization of the motor until said shoulder portion is engaged by said latch and thereafter to deenergize said motor.

10. In combination, a member movable between a first position and a second position, means biasing said member to said first position, electrically operated means for holding said member in said second position against the action of said biasing means, motor means including an electric motor and a second biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said transmitting means back to a position corresponding with the first position of said member while said member remains in its second position, a first switch, a second switch operable in accordance with the position of said member, an energizing circuit for said holding means, an energizing circuit for said motor, and means including said circuits controlled by said switches and operative upon closure of said first switch to cause said motor means to move said transmitting means and hence said member from first to second position and then to return only said transmitting means to its position corresponding to the first position of said member said second biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

11. In combination, a member movable between a first position and a second position,

means biasing said member to said first position, electrically operated means for holding said member in said second position against the action of said biasing means, motor means including an electric motor and a second biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said transmitting means back to a position corresponding with the first position of said member while said member remains in its second position, a first switch, a second switch operable in accordance with the relative positions of said transmitting means and said member, an energizing circuit for said holding means, an energizing circuit for said motor, and means including said circuits, controlled by said switches and operative upon closure of said first switch to cause said motor means to move said transmitting means and hence said member from first position to second position and then to return only said transmitting means to its position corresponding to the first position of said member said second biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

12. In combination, a member movable between a first position and a second position, means biasing said member to said first position, electrically operated means for holding said member in said second position against the action of said biasing means, motor means including an electric motor and a second biasing means, means for transmitting motion from said motor means to said member, a connection between said motion transmitting means and said member permitting movement of said transmitting means back to a position corresponding with the first position of said member while said member remains in its second position, a first switch, a second switch operated by said member, an energizing circuit for said holding means, an energizing circuit for said motor, and means including said circuits controlled by said switches and operative upon closure of said first switch to cause said motor means to move said transmitting means and hence said member from first position to second position and then to return only said transmitting means to its position corresponding to the first position of said member said second biasing means being so connected to said motion transmitting means that in the event of power failure during the movement of said motor it is effective to move said motion transmitting means to a position wherein said member is free to move by its bias to said first position.

13. In combination, a member biased to a first inactive position, holding means for retaining

said member in a second active position when an element associated with said member is moved into cooperative relationship therewith, a rotary electric motor, means for transmitting motion between said motor and said member, a main control switch, a second switch operable in accordance with the position of said member, and a single energizing circuit including said motor controlled by said switches and operative upon closure of said main control switch to cause movement of said member from first to second position, thereby moving said element into cooperative relationship with said holding means, and then to cause movement of said motion-transmitting means to a position corresponding to the first position of said member.

14. In combination, a member biased to a first position, an electromagnet for retaining said member in a second position when an armature connected to and movable with said member is moved into engagement with said electromagnet, an electric motor, means for transmitting motion from said motor to said member, a connection between said transmitting means and said member permitting movement of said transmitting means back to its original position while said member remains in its second position, a main control switch, a second switch operable in accordance with the position of said member, and a single energizing circuit including said motor controlled by said switches and operative upon closure of said main control switch to cause movement of said member from first to second position, thereby moving said armature into engagement with said electromagnet, and then to cause movement of said motion-transmitting means to a position corresponding to the first position of said member.

15. In combination, a member biased to a first position, electrically operated holding means for retaining said member in a second position when an element associated with said member is moved into cooperative relationship with said holding means, an electric motor, means for transmitting motion from said motor to said member, a connection between said transmitting means and said member permitting movement of said transmitting means back to its original position while said member remains in its second position, a main control switch, a second switch operable in accordance with the position of said member, and a single energizing circuit including said motor controlled by said switches and operative upon closure of said main control switch to cause movement of said member from first to second position, thereby moving said element into cooperative relationship with said holding means, and then to cause movement of said motion-transmitting means to a position corresponding to the first position of said member.

ROBERT S. CRAIG.