Dec. 5, 1961 E. B. ANDER 3,011,754

BUTTERFLY VALVE

Filed Nov. 13, 1958 3 Sheets-Sheet 1

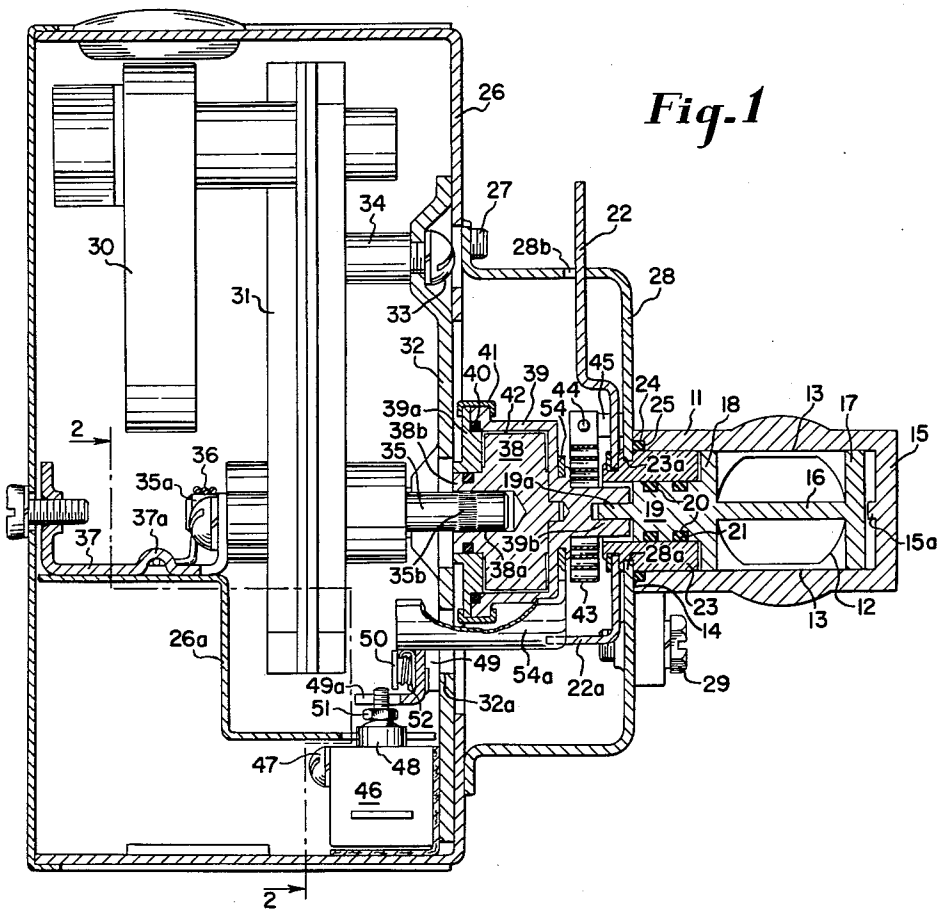


Fig. 1

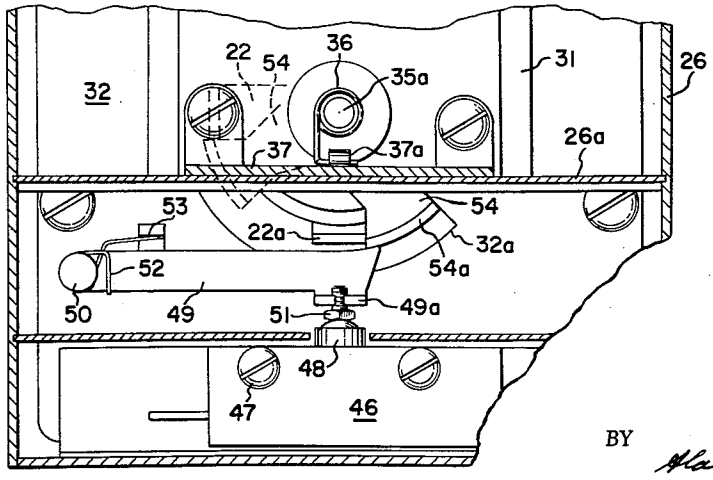


Fig. 2

INVENTOR.
ERIC B. ANDER

BY Alan M. Stanley

ATTORNEY

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BUTTERFLY VALVE

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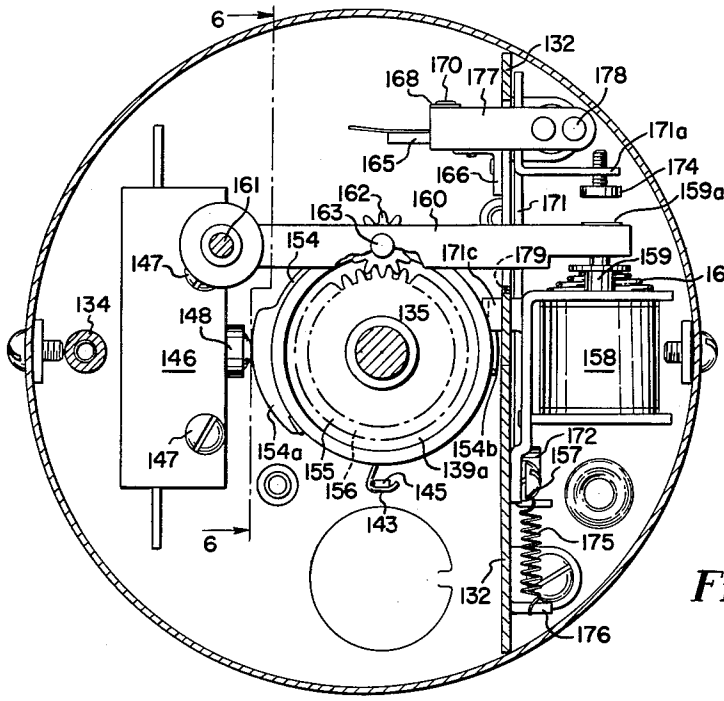


Fig. 4

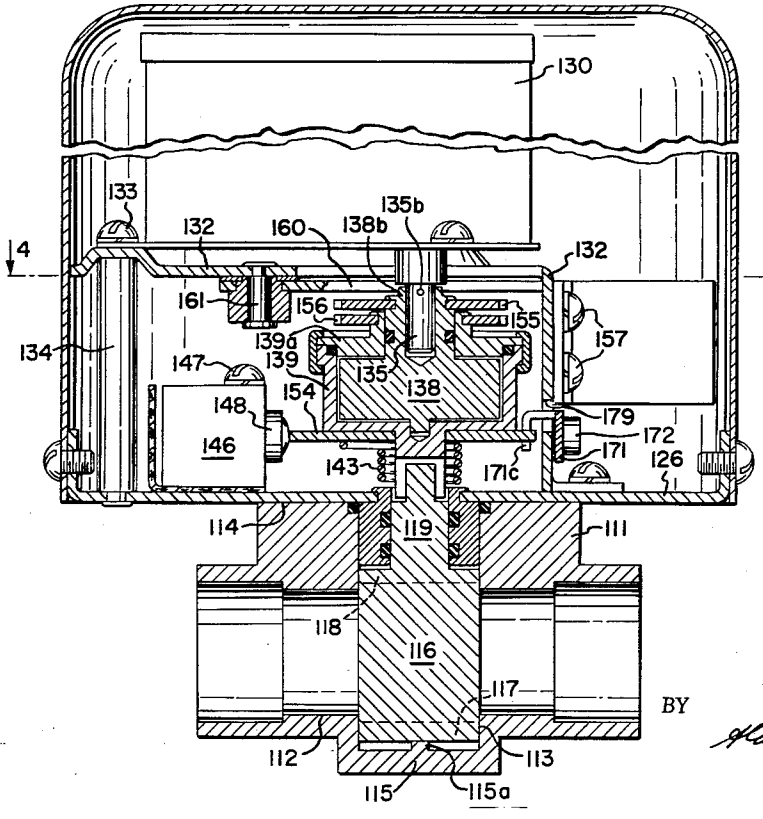


Fig. 3

INVENTOR.
ERIC B. ANDER

BY Alan M. Stanley

ATTORNEY

Dec. 5, 1961 E. B. ANDER 3,011,754

BUTTERFLY VALVE

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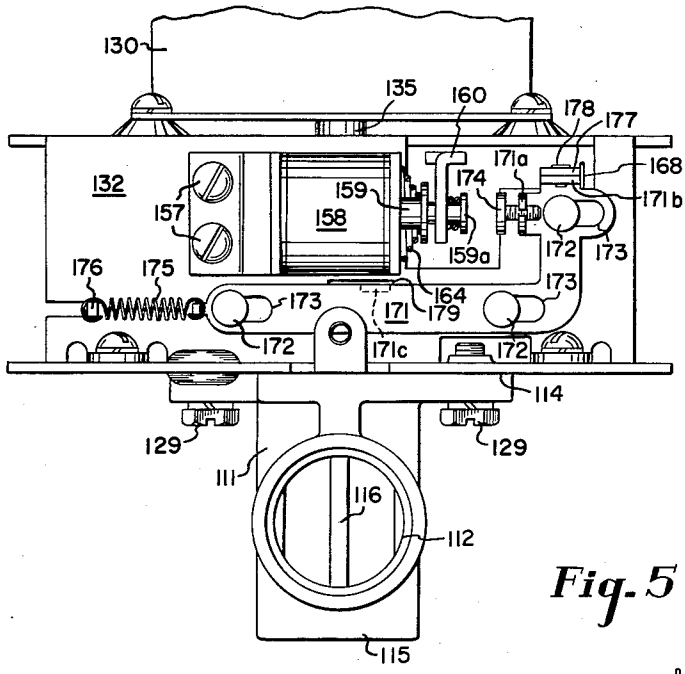


Fig. 5

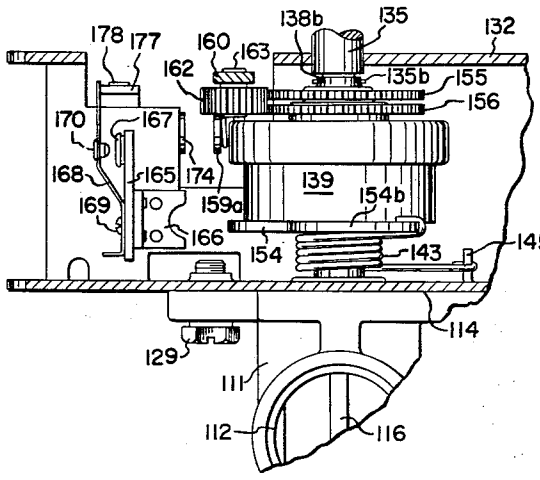


Fig. 6

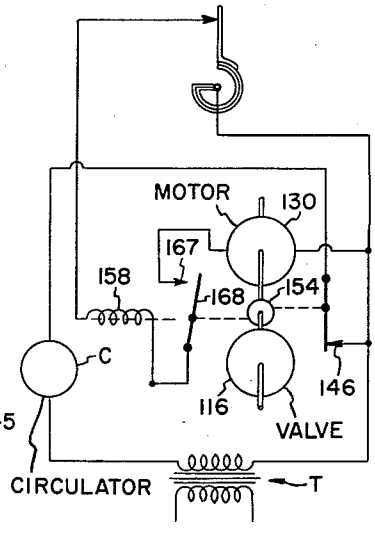


Fig. 7

INVENTOR.
ERIC B. ANDER

BY Glen M. Stanley

ATTORNEY

United States Patent Office

3,011,754

Patented Dec. 5, 1961

3,011,754

BUTTERFLY VALVE

Eric B. Ander, Minneapolis, Minn., assignor to Minneapolis-Honeywell Regulator Company, Minneapolis, Minn., a corporation of Delaware

Filed Nov. 13, 1958, Ser. No. 773,765

5 Claims. (Cl. 251—81)

This invention relates to motorized valves generally and, more particularly, it relates to a motorized water valve to be used in the zone control of hot water heating systems.

In heating systems of this type, a water circulating pump is usually employed to insure proper distribution of the hot water to all parts of the heating system according to the demand. Because of the use of such circulating means, if a zone control water valve is permitted to rapidly close, water hammer will result which is objectionable, both from the sound standpoint and from the standpoint of being injurious to the system

One of the objects of this invention is to provide a motorized valve for controlling the flow of water to the various zones of a heating system, which will close at a very slow rate so as to prevent water hammer.

Another object of the invention is to provide a motorized valve wherein a motor is driven only in one direction to open the valve, means being provided to permit closing of the valve at a slow rate while the motor remains stationary.

Another object of the invention is to provide a fluid drive between an electric rotary motor and a valve so that the valve will remain open only as long as the motor is energized.

Still another object of the invention is to provide a motorized valve having a fluid drive between the motor and the valve with power means for making a rigid connection between the motor and the valve while the motor is energized to open the valve and to hold the valve open when the motor is de-energized in the valve open position by a control operated by said motor.

Still further objects of the invention will become apparent upon reading the following detailed description of the invention in conjunction with the accompanying drawing wherein:

FIGURE 1 is a vertical sectional view taken transversely through the valve body and the motor housing mounted thereon;

FIGURE 2 is a sectional view taken along line 2—2 of FIGURE 1;

FIGURE 3 is a vertical sectional view taken along the longitudinal axis of the valve body and the motor housing of a modified form of the invention and with a portion thereof broken away;

FIGURE 4 is a sectional view taken along the line 4—4 of FIGURE 3;

FIGURE 5 is an end view of the modification of FIGURE 3 with the cover of the motor housing removed and a portion of the motor broken away;

FIGURE 6 is a fragmentary sectional view of the same modification taken along line 6—6 of FIGURE 4; and

FIGURE 7 is a wiring diagram of a system embodying the invention.

Referring now to FIGURE 1, of the drawing, the valve body is designated by the reference numeral 11. It has a straight through valve passage 12 which is intersected by a transversely extending bore 13 which extends inwardly from the surface 14 thereof into a boss 15 formed on the bottom of the valve body.

A butterfly valve 16, having a bearing and sealing disc 17 thereon in the boss 15 and a bearing and sealing disc 18 thereon in the bore 13 on the other side of the

passage 12 from the disc 17 abuts a short boss 15*a* formed on the inner surface of boss 15. A valve stem 19 extends outwardly from the disc 18 to the exterior of the valve body 11. The stem 19 has a pair of annular grooves 20 therein, in which is located a pair of sealing O-rings 21.

A manual actuator 22 is secured at an intermediate portion thereof to a bearing sleeve 23 that surrounds the valve stem 19. An O-ring 24, positioned in an annular groove 25 formed in the valve body around the open end of the bore 13, seals the valve 16 within the valve body.

A motor housing 26 is secured by bolts 27 to a bracket 28 which, in turn, is secured to the valve body 11 by means of bolts 29. The bracket 28 has a hole therethrough with a surrounding portion 28*a* thereof rotatably fitting in an annular groove 23*a* in the sleeve 23. The outer end of the lever 22 extends through a bayonet slot 28*b* extending through the side wall of the bracket 28 and slightly more than one-quarter of the distance around the bracket.

A motor 30 is mounted on a gear box 31 which, in turn, is mounted on the plate 32 by means of bolts 33 and spacing sleeves 34. The plate 32 is secured to the housing 26 by any suitable means, such as by welds, rivets or bolts (not shown).

A drive shaft 35 has a rearward projection 35*a* that is surrounded by a spring clutch 36 anchored at one of its ends in an upwardly struck loop 37*a* on a wall 37 of the motor housing. This spring clutch is a conventional one which normally frictionally engages and holds the motor shaft against rotation but which upon a torque being applied to the shaft in a direction which would tend to uncoil the spring, will permit said shaft to turn. This assures that the motor shaft will turn in only one direction. The other end of the drive shaft 35 extends beyond the housing 26 and is knurled at 35*b* so as to fit non-rotatably within a socket 38*a* of a disc or rotor 38 positioned in a rotary oil-filled housing or drum 39. The drum 38 has a hub portion 38*b* therein which has an external annular groove carrying an O-ring for sealing purposes. The drum 39 has a plate member 39*a* thereon which surrounds the hub portion 38*b* to form a fluid seal between the hub and drum. An O-ring seal 40 is also provided between the main portion 39 of the drum and the plate 39*a* by having the O-ring clamped therebetween by means of a channel shaped band 41 engaging the outer periphery of the plate 39*a* and an annular flange formed on the adjacent portion of the drum 39. A stem 39*b* projects from the drum 39 into the sleeve 23 so as to straddle a tongue 19*a* on the valve stem.

A clock-type of spring 43 is secured at its inner end to the drum stem 39*b* by having a portion thereof project into a slot (not shown) in the hub portion thereof, while the outer end of the spring is secured by means of a bolt 44 to an arm 45 extending from a side wall of the bracket 28. This spring is tensioned so as to normally be able to return the valve 16 to its closed position by turning the drum 39 against the friction between the drum 39 and the oil between the drum 39 and the rotor 38, when the rotor 38 has ceased being rotated by the motor and providing the manual opener 22 is not holding the valve in its open position, as illustrated in the drawing. The oil 42 between the drum 39 and rotor 38 is selected so that the spring can only very slowly move the valve to its closed position.

A snap switch 46 is mounted in the motor housing by means of bolts 47. It has leads (not shown) which are adapted to be connected to a water circulating pump of a heating system and possibly also to a fuel control valve so as to cause energization of either one or both upon the switch actuating plunger 48 thereof being moved in-

wardly. A lever 49 is pivoted at one of its ends on a pivot bolt 50 while the other end thereof carries an adjustable abutment screw 51 extending through an arm 49*a* that extends laterally from a lever 49. A torque spring 52 hooks under the lever 49 and is anchored at its other end in a slotted arm 53 formed on and extending outwardly from the plate 32. A spring thus normally biases the lever 49 away from the plunger 48 of the switch to cause the switch to assume its open position. An arm 54, for actuating the lever 49, is staked to a large diameter portion of the stem 39*b* at the base thereof and has a transversely extending arcuate arm 54*a* that extends through an arcuate slot 32*a*, formed in the plate 32, and over the lever 49. The slot 32*a* extends a little more than one-quarter of the distance around the shaft 35 so as to permit 90° rotation of the arm 54 therein and thus limit the reciprocating movement of the valve to its "full on" and "full off" positions as well as simultaneous closing and opening, respectively, of the switch 46 to cause operation of the pump only after the valve is opened and to assure stopping of the circulating pump when the valve starts to close. The arm 54 is illustrated as being against one end of the slot 32*a* with the lever 49 clamped down against the switch plunger 48 and holding said plunger in said contact closing position. It is being held in this position by the manually operable lever 22.

The valve also is being held in its open position by means of the lever 22, it being at one end of the slot 28*b*, the end that has a transverse notch for latching the handle in that end position. To move the valve to its closed positon, the lever 22 must be moved to the left, as viewed in FIGURE 1, and be permitted to be returned to its other end position in the slot 28*b* under the bias of the spring 43, or by manual power, to position the valve 16 at right angles to its illustrated position, thus cutting off the flow of water through the valve.

Operation

Assuming that the valve is installed in a hot water heating system, with the valve positioned between the water circulator and the radiators of the system, and with the valve in its closed position, energization of the motor 30 through leads (not shown), will cause the drive shaft 35 to be rotated at approximately 25 revolutions per minute by speed reduction gearing in the gear box 31. Rotation of the shaft 35 will rotate the disc or rotor 38 at a speed which, due to the viscosity of the fluid 42 between it and the drum 39, will cause the drum 39 to move the butterfly valve to its open position, at slightly less speed than the drive shaft 35, against the bias of spring 43. As the valve moves to its open position, the arm 54*a*, secured to the drum 39, will move from one end of the slot 32*a* around and into engagement with the top surface of the lever 49 to move it and operate the switch 46. Operation of the switch 46 will cause the circulator and burner to start operating. Obviously, if desired, the switch 46 would turn on the fuel burner only leaving the circulator to be turned on by some water temperature responsive switch (not shown). When the arm 54*a* reaches the "full on" position of the valve, it comes into engagement with the other end of the slot 32*a* to stop the valve in this position. With the stopping of the movement of the valve and the drum 39, the motor will be practically stalled except for the amount of movement that the rotor 38 can make with respect to the drum, the speed being determined by the amount of power developed by the motor. The motor will thus remain energized and hold the valve in its open position until the room thermostat that controls the energization of the motor becomes satisfied. Upon de-energization of the motor, the clutch spring 36 will prevent the spring 43 from rotating the rotor 38 in the opposite direction so the drum 38 can only move at a very slow rate in a valve closing direction due to the fluid drag between the drum 39 and the rotor 38. This assures very slow closing of the valve to prevent water hammer.

It is to be noted that when the valve is moved to its open position by the motor, the manual operable lever 22 does not move as the arm 54*a* moves away from the arm 22*a*. The lever 22 moves only when it is manually moved to the open position or released from the open position.

It will also be noted that as the valve moves toward its off position, the switch 46 will be opened, de-energizing the burner and/or the water circulator.

Modification

A modification of the invention is illustrated in FIGURES 3, 4, 5, 6 and 7 and is somewhat similar to the first described design; but differs from it in that means is provided to rigidly interlock the rotor and drum of the fluid drive, upon energization of the motor, for opening the valve, with means to break the circuit of the motor when the valve reaches the open position while leaving the means for holding the drum and rotor interlocked as long as there is a demand for water flow through the valve.

The elements of the modification that are the same or very similar to the first described design of the invention are designated by the reference numerals used in FIGURES 1 and 2 with 100 added thereto. Thus the valve body 11 of FIGURE 1 is designated by the reference numeral 111 in FIGURE 3 of the drawing. The drum rotating spring 43 of FIGURE 1 is designated by the reference numeral 43 while the corresponding spring is designated by the reference numeral 143 in FIGURE 3 of the drawing.

In the modification, one end of the spring 143 hooks around an arm 154*b* that extends outwardly from the arm 154 on the opposite side of the drive shaft 135 from the cam surface 154*a* that engages the switch button 148 of the switch 146. The other end of the spring hooks over an arm 145 struck up from the housing 126. This spring normally biases the valve to its closed position in the same manner as the spring 43 in the first described embodiment of the invention.

As can best be seen in FIGURES 3 and 6 of the drawing, 138*b* of the rotor 138 is somewhat longer than the hub 38*b* and has staked thereto a gear 155. The surrounding bearing portion 139*a* of the drum 139 is also a little longer than the corresponding member of the first modification and has a gear 156 of equal outside diameter to the gear 155 and positioned in side by side relationship with the gear 155.

A motor 130 is of much lower speed than the motor 30 of the first modification and has a drive shaft 135 that extends into the rotor 138 and is secured thereto by means of a pin 135*b* extending through aligned holes in the hub 138*b* and shaft 135.

A mounting plate 132 for the motor 130 is secured to the housing 136 by means of bolts 133 and spacing sleeves 134 therebetween. Mounted on this plate 132, by means of bolts 157, is a solenoid 158. The plunger 159 thereof is connected to the free end of a lever 160 which, in turn, is pivoted at its other end to the plate 132 by means of a pivot pin 161. Intermediate the ends of the lever 160 is an idler gear 162 rotatably secured to the lever by means of a pivot 163. The gear 162 is of sufficient axial length as to mesh with both of the gears 155 and 156 when the solenoid is energized to pull the lever 160 toward the gears 155 and 156 against the bias of a spring 164 to cause meshing of the idler gear with the gears 155 and 156.

Also mounted on the mounting plate or bracket 132 is a plate or block 165 of electrically insulating material riveted to an L-shaped bracket 166 which, in turn, is riveted to the plate 132. A fixed contact 167 is mounted on one end of the contact block while one end of a flexible contact arm 168 is secured to the other

end of the contact block by means of a screw 169. Intermediate the ends of the contact arm 168 is a contact button 170 that is normally biased into engagement with the fixed contact 167.

An actuator for the contact 170 consists of an L-shaped slider 171 that is reciprocably mounted on the plate 132 by means of headed rivets 172 extending through slots 173 in the slider and riveted to the plate 132. A transversely extending arm 171*a* is slotted and threaded at its outer end to receive an adjustable abutment screw 174. The abutment screw is coaxial with plunger 159 and is normally biased against the head 159*a* on the plunger by means of a coil tension spring 175 anchored at one of its ends at one end of the slider 171 and anchored at its other end on a transversely extending arm 176 on the plate 132. Another transversely extending arm 171*b* has a strip of electrically insulating material 177 secured thereto by means of rivets 178. This insulating strip extends through an opening in the wall 132 to the opposite side thereof and on the same side of the flexible contact arm 168 as the fixed contact 167.

While the contact 170 would normally be in engagement with the contact 167 with the plunger 159 pulled into the solenoid, as illustrated in FIGURE 5 of the drawing, the contact 170 is held out of engagement with the fixed contact by the insulating strip 177 being in engagement with the contact arm 168 and holding it out of engagement with the fixed contact against its inherent resiliency tending to close the contacts. The means for holding the insulating strip in this position is the arm 154*b* of the arm 154 secured to the drum of the fluid drive connection between the motor and the valve. This arm 154*b* engages a transversely extending L-shaped arm 171*c* (FIGURE 4) extending through a slot 179 in the plate 132 from the slider 171 so as to be engaged by the arm 154*b* slightly before the valve reaches its full open position so as to lift the abutment screw 174 away from the head 159*a* on the solenoid plunger and to lift the contact 170 out of engagement with the fixed contact 167. The contacts 167 and 170 are in the circuit to the motor 130 so that when the valve is moved to its open position, the motor is stopped to retain it in that position.

The solenoid 158 is in a circuit to a room thermostat so that when the thermostat calls for circulation of hot water in the heating system, the solenoid will remain energized as long as the room thermostat is calling for heat. Therefore, after the valve has been moved to its open position, it will remain in the open position due to the fact that the idler gear 162 remains in engagement with the gear 155 and 156 thus preventing the spring 143 from returning the valve to its closed position by slippage between the rotor 138 and the drum 139, even though the motor is no longer energized to rotate the valve in the valve opening direction.

Operation

The elements of the modification of the invention are illustrated in FIGURES 3 through 7 being in a valve open position due to the room thermostat having called for water circulation. This resulted in the solenoid 158 pulling the idler gear 162 into engagement with the gears 155 and 156 and the contacts 170 and 167 being closed due to the slider 171 following the plunger under the bias of spring 175. When the contacts closed, the motor was energized to rotate the drive shaft 135 to open the valve and close the switch 146 to start the circulator "C," by actuating the plunger 148 inwardly by the cam surface 154*a* engaging it as the valve reached its open position. Also, as the valve neared its open position, the arm 154*b* engaged the arm 171*c* to move the slider 171 away from the solenoid plunger and to move the insulation strip 177 against the contact arm 168 to break the circuit to the motor. This is the position that the elements are in as illustrated in the drawing. They will stay in this position until the room thermostat "R" connected to the solenoid 158 and transformer "T" becomes satisfied breaking the circuit to the solenoid. When this happens, the spring 164 will move the lever 160 upwardly to disengage the idle gear 162 from the gears 155 and 156 and to position plunger 159 against abutment 174 to hold the contact 170 out of engagement with contact 167.

When the idler gear disengages from the gears 155 and 156, the spring 143 will rotate the drum 139 and valve 116 with respect to the rotor 138 and motor to close the valve.

Should the gears 155 and 156 ever be out of alignment at the time the lever 160 moves toward the gears, the slippage between the rotor and the drum will soon cause the teeth on the gears 155 and 156 to align and enable the spring 175 to draw the lever further inwardly to cause meshing of the teeth of the idler with the teeth of gears 155 and 156. The main function of the idler 162 is to hold the valve in its open position when the motor stops. In the first embodiment of the invention, the motor remains energized through the thermostat to hold the valve in its open position, to accomplish the same result.

In each embodiment of the invention, the valve is rotated to its closed position very slowly under the bias of the torque spring connected to the drums.

While I have described the preferred embodiment of the invention with alternate means for stopping and holding the valve in its open position and permitting the valve to close slowly when it is so desired, it is deemed to be obvious that other modifications may be made therein without departing from the spirit of the invention. Therefore, the scope of the invention is to be determined from the appended claims.

I claim as my invention:

1. A motorized valve comprising a valve body, a butterfly valve in said body and having a valve stem extending into an opening through a wall of said body, a motor housing mounted on said valve body, a motor in said housing and having a drive shaft extending therefrom, means connected to said shaft for limiting its movement to one direction, a fluid drive coupling operably connecting said motor to said valve, said coupling having first and second parts rotatable with respect to each other and having liquid therebetween which transmits but slight torque from one part to the other at slow speeds but considerable torque therebetween at high speeds, spring means for biasing said valve to its closed position, means to stop said valve at its open position, and abutment means to stop said valve at its closed position.

2. The combination comprising a valve having a stem thereon that rotates through an angle between open and closed positions of said valve, motor means for rotating said valve stem in one direction only to open said valve, means for resiliently biasing said stem in the other direction to close said valve, fluid drive means connecting said motor to said stem, said drive means having two relatively movable parts with fluid therebetween, a pair of equal diameter gears mounted on said parts in side by side relationship, an idler gear movable into and out of engagement with said pair of gears, power means for actuating said idler gear, a pair of normally closed contacts controlling energization of said motor means, abutment means normally separating said contacts and mounted to move with said idler gear to permit said contacts to close, and means connected to said valve stem for separating said contacts when said valve reaches its open position.

3. The combination comprising a valve having a stem thereon that rotates through an angle between open and closed positions of said valve, motor means for rotating said valve stem in one direction only to open said valve, means for resiliently biasing said stem in the other direction to close said valve, fluid drive means connecting said motor to said stem, said drive means having two relatively movable parts with fluid therebetween, a pair of equal diameter gears mounted on said parts in side by side

relationship, an idler gear movable into and out of engagement with said pair of gears, power means for actuating said idler gear, a pair of normally closed contacts controlling energization of said motor means, abutment means normally separating said contacts and mounted to move with said idler gear to permit said contacts to close, a normally open switch for energizing a fluid circulator connected to said valve, and means connected to said valve stem for separating said pair of contacts and closing said switch when said valve reaches its open position.

4. The combination of claim 3 wherein said abutment means has a lost-motion connection with said power means and is normally biased in a direction to permit said contacts to close.

5. A motorized valve comprising a valve body having an inlet and an outlet and a valve therebetween, a valve stem extending into an opening through a wall of said valve body, a motor housing mounted on said valve body,

a motor in said housing and having a drive shaft extending therefrom, means connected to said shaft for limiting its movement to one direction, a fluid drive coupling operably connecting said motor to said valve stem, said coupling having first and second parts rotatable with respect to each other and having a fluid therebetween which transmits but slight torque from one part to the other at slow speeds but considerable torque therebetween at high speeds, spring means for biasing said valve to its closed position, means to stop said valve at its open position, and abutment means to stop said valve at its closed position.

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