Dec. 22, 1936. R. J. McFALL ET AL 2,064,935

ELECTRICALLY CONTROLLED VALVE

Filed Dec. 6, 1932

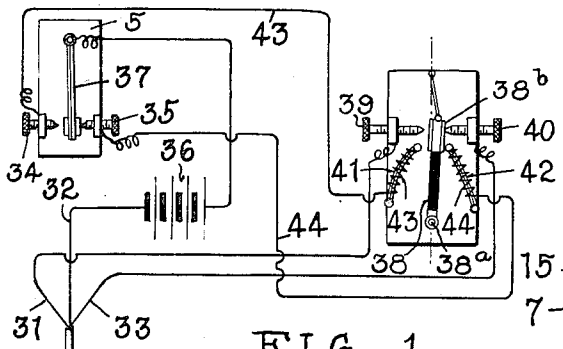


FIG. 1.

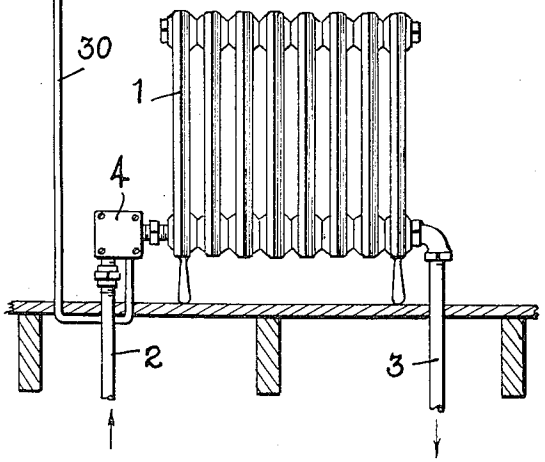


FIG. 2.

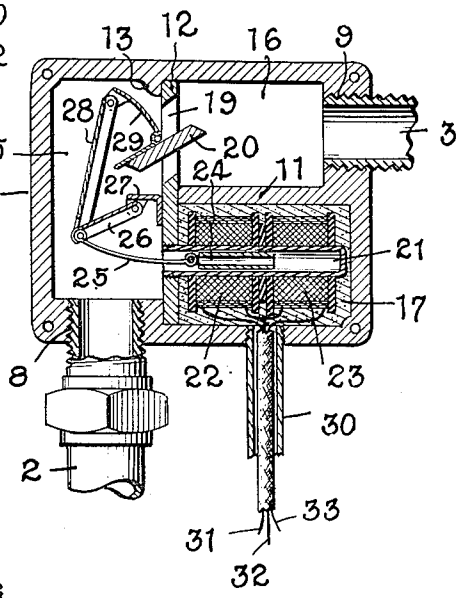


FIG. 3.

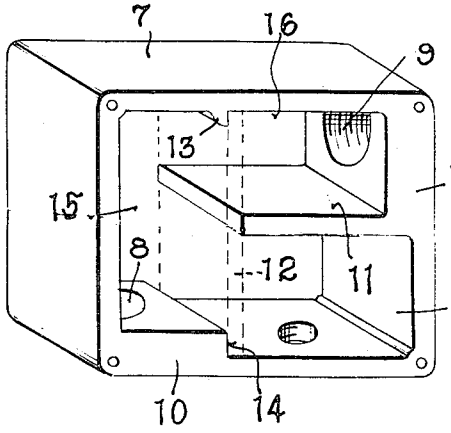
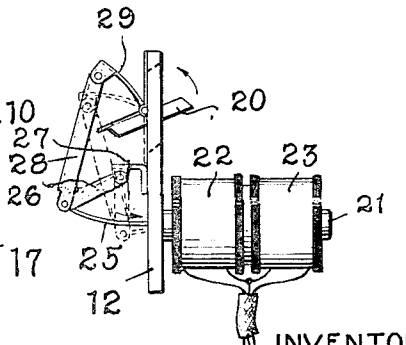


FIG. 4



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Patented Dec. 22, 1936 2,064,935

UNITED STATES PATENT OFFICE

2,064,935

ELECTRICALLY CONTROLLED VALVE

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Application December 6, 1932, Serial No. 645,984

13 Claims. (Cl. 137—139)

This invention relates to electrically controlled valves similar to that disclosed in our copending application, Serial No. 524,932, filed March 24, 1931, now Patent No. 2,016,507, granted Oct. 8, 1935, and has particular reference to such valves when used in connection with a thermostat for regulating the temperature of a room or other space heated or cooled by a circulating fluid medium flowing through the valves.

The primary object of the present invention is to provide a novel and improved form of electrically operated control valve wherein the valve and mechanism for operating the same may be easily and quickly removed as a unit from the valve casing for repairs or replacements.

Another object is to provide a valve of this character wherein the entire valve structure and operating means therefor shall be disposed within a fluid tight casing, thereby eliminating packed joints and similar troublesome constructions encountered in devices of this character wherein the operating means for the valve is disposed on the exterior of the valve housing.

The invention provides an advantageous arrangement of valve mounting and operating mechanism in conjunction with an operating circuit including a source of power, a thermostat and means in the circuit and operated thereby for making and breaking the connection to either of two operating solenoids whereby a desirable time lag is provided, as will be described.

With the foregoing and other objects in view, the invention may be stated to consist in the various novel features of construction and arrangement or combination, all of which will be fully described hereinafter and pointed out in the appended claims.

In the drawing accompanying and forming a part of this application,

Fig. 1 is an assembly view showing a radiator, a thermostat, and a current operated circuit breaker, illustrating the circuits by which the thermostat controls the electro magnetically operated valve;

Fig. 2 is a longitudinal sectional view through the valve casing and mechanism therein;

Fig. 3 is a perspective view of the valve casing with the valve and operating mechanism unit removed therefrom; and

Fig. 4 is a side elevation of the valve and operating mechanism unit removed from the casing.

In the drawing accompanying and forming a part of this application, 1 denotes a heat exchange device, which in the present instance for purposes of illustrating one embodiment of our invention is shown as an ordinary house radiator having a fluid inlet pipe 2 and an outlet pipe 3. Our improved control valve is indicated generally at 4 and is connected between the radiator 1 and inlet pipe 2. Also shown in Fig. 1 are electrical control devices of suitable character, to accomplish the desired results. In this instance are shown a room thermostat 5, which is electrically connected to the valve operating mechanism to be described hereinafter, and is responsive to room temperature. In conjunction with the room thermostat 5 is an electrically operated circuit interrupter for making and breaking the circuits controlled by thermostat 5, and which is peculiar in that it provides a desired lag in the operation, as will be described.

The control valve is shown in detail in Figs. 2, 3 and 4 and comprises a suitable housing or casing 7 substantially rectangular in shape and having an inlet port 8 and an outlet port 9 formed in the bottom and side walls respectively as viewed in Figs. 2 and 3. The portions of the walls adjacent said openings are preferably thickened as indicated at 10 to provide ample threads for receiving the inlet and outlet pipes 2 and 3. Extending longitudinally of the casing from the side wall containing the outlet port is a horizontal partition 11, and detachably mounted within the casing at the end of said partition is a vertical partition 12. The partition 12 extends between the top and bottom walls of the casing and at its upper end abuts a projection 13 depending from the inner surface of the top wall and at its lower end said partition abuts a shoulder 14 formed by the thickened portion 10 of the lower wall of the casing. The projection 13 and shoulder 14 engage the partition on one surface and the end of the horizontal partition 11 engages the opposite surface of said partition to hold the same in position but permitting the partition 12 to be readily removed from the casing.

The partitions 11 and 12 divide the interior of the casing into three compartments consisting of an inlet compartment 15, an outlet compartment 16 and a valve operating mechanism compartment 17.

As shown in Figs. 2 and 4, the partition 12 is provided adjacent its upper portion with a valve port 19 and pivotally mounted on said partition and cooperating with said port is a valve 20. The lower portion of said partition is provided with an aperture into which is secured a tube 21, so as to have a fluid tight fit obtainable by

threaded connection or otherwise. Mounted on said tube are a pair of electro magnetic windings 22 and 23. A solenoid core 24 is slidably mounted in tube 21 and this core is pivotally connected to one end of a link 25, the opposite end of which is pivotally connected to an arm 26. The arm 26 is pivotally supported at its opposite end from a bracket 27 that is mounted on partition 12. Also pivotally connected to the outer end of the arm 26 is a link 28 which in turn is pivotally connected to an arm 29 that is fastened to valve 20.

In the valve operating elements 25, 26, 27, 28 and 29, there is provided a particular advantage which insures a maximum of application of power at the moment the valve approaches its final closing movement. As shown in Fig. 2, the valve is opened to its maximum extent, and the solenoid core 24 is at its extreme left position with the links 26, 28 and 29 raised upwardly. In the closed position, the solenoid core 24 is at the extreme right of the tube 21 the valve is closed, the arm 26 extends downwardly from its pivot point at the bracket 27 and the lower end of the link 28 is moved correspondingly inwardly and downwardly to such a position that it is substantially parallel to the link 26. As illustrated, these parts are substantially of channel shape or U-shaped in cross section to provide for strength and rigidity and the side portions receive the pivot pins connecting them. Preferably, and as shown in Figs. 2 and 4, the arm 26 is of somewhat less width than the link 28, so that the former may fit or be nested within the latter. In the extreme lowermost position, when the arm 26 tends to be parallel with the link 28, this nesting position would become increasingly apparent. The important factor in the parallel positioning of the arm 26 and the link 28 in the lowermost position is that the power applied by the solenoid in bringing the valve to its final closing position is a pull of the lower end of the link 28 almost centrally endwise of the solenoid, and thus the power is more efficiently used than if part of the power was consumed in pulling the link 28 downwardly. The closing action is also made effective by the fact that the downward and inward movement of the lower end of the link 28 toward the solenoid tends to become more effective as the link 28 approaches the pivot point of the arm 26 where it is connected to the bracket 27. These construction details also serve to provide a maximum of power to not only close the valve, but to lock it in closed position, thereby utilizing the power of the solenoid to the greatest advantage, and tending to lessen leakage past the valve.

The compartment 17 containing windings 22 and 23 is preferably filled with a waterproof insulating compound. The coils are shown as controlled by three wires which are brought out of the housing through a conduit 30. One wire 31 is connected to the end of winding 22, a second wire 32 is connected to the common connection between the windings, and a third wire 33 is connected to the end of winding 23.

Referring to Fig. 1, it will be noted that the wires 31 and 33 leading from the solenoid coils are connected respectively to contacts 39 and 40 of an interrupter having an arm 38 pivoted at 38^a for a slight movement to either side of a central position between and to engage the contacts 39 and 40. The wire 32 is connected through a battery 36 or other source of electricity to the thermal bar 37 of the thermostat 5. At the upper end of the arm 38 are contact strips 38^b which conduct the current between the contacts 39 and 40, respectively, and actuating elements 41 and 42, as will now be described. These elements 41 and 42 may be any devices capable of being actuated by the current of the circuit. As illustrated, these elements comprise bi-metallic strips which are fixed at their lower ends and are wound with wires 43 and 44 respectively, which lead from the elements 41 and 42 to the contacts 34 and 35, respectively, at the room thermostat 5. The elements 41 and 42 and the respective windings are so constructed that the influence of the current tends to heat them with the result that each element, as it becomes heated, bends and thrusts against the contact piece 38^b at the upper end of the arm 38, and thrusts the arm past the center line and over against the opposite contact. In the position shown in Fig. 1, the element 41 has just completed the work of thrusting the arm 38 over against the contact 40 and the element 41 is shown somewhat curved in shape. In this position, as illustrated, the current will pass from the wire 44 through the winding around the element 42, through the contact piece 38^b, to the contact 40, and thence by wire 33 to its respective solenoid winding 23, and will tend to move the solenoid core to the right, as shown in Fig. 2, closing the valve 20. As soon as a sufficient time lag has elapsed for the element 42 to become heated, it will thrust the arm 38 to the left and past a center position and over against the contact 39 and the element 41, which latter in the meantime has had time to cool off and straighten somewhat from the curved position shown in Fig. 1. When the arm 38 has thus been moved to the left, the current will pass through the wire 43 through the contact plate 38^b to the contact 39, and thence through the wire 31 to the solenoid winding 22, reversing the position of the solenoid core 24 and opening the valve 20.

The foregoing operation is subject to the variable factor provided by the thermal bar 37 of the thermostat 5 and it will be obvious that the energizing of the respective solenoids depends on the position of the bar 37 and whether it is in engagement with either contact 34 or contact 35. There is a distinct advantage, according to this invention, in having the main circuits prepared in accordance with the current actuated interrupter including the arm 38 and the actuating elements 41 and 42, because this latter device provides a momentary time lag within which the current passing through the bar 37 to either the contact 34 or 35 may take effect on the respective solenoids. Assuming that the bar 37, which may be subject to room temperature, remains on either one of the contacts 34 or 35, the action of the interrupter with its movement of the arm 38 serves to energize the solenoid coils only momentarily.

A suitable cover plate (not shown) is fitted to the casing 7 to enclose the structure. It will be obvious from the above description that the valve and valve operating mechanism is readily accessible for repairs or replacement by removing the cover plate from the casing, then sliding partition 12 from the casing. The entire valve structure and operating mechanism is carried by the partition.

The construction and mounting of the arm 38 is preferably such that when actuated by either of the elements 41 or 42, and being thrust by either slightly past the center or vertical posi-

tion, as shown in Fig. 1, it will snap over to the opposite contact. Any such satisfactory snap action construction may be used, the details of which do not form a part of this invention, and are not illustrated.

By further reference to the structure shown in Figs. 2 and 4, it will be noted that the valve **20** controlling the conduit passage and valve port **19** is pivoted at its middle point so that one-half of the valve rocks in one direction of the conduit and the other half of the valve rocks in the opposite direction during the opening or closing movement of the valve **20**. The structure thus comprises a balanced valve mechanism in that one-half of the effective surface of the valve plate **20** moves in one direction longitudinally of the passageway to be closed and the other half of the effective surface of the valve plate moves in the opposite direction. The valve is actuated by the motor means through the interconnecting links which, as hereinbefore described, so function that when the valve is closed the links and valve may not be actuated except under influence of the operating motor means, which in this case is a solenoid core. It is therefore immaterial for the purpose of this invention whether the valve **20** be illustrated as one pivoted plate or whether the valve port and closure therefore be divided up into a plurality of operating plates, so long as the above mentioned relation is maintained.

While we have shown our improved valve as controlling a radiator, it will be obvious that it may be used for controlling the flow of fluid through any other device and all such uses are contemplated to be within the spirit of our invention and the appended claims.

What we claim is:

1. An electrically controlled valve comprising a casing having an inlet and an outlet opening therein, partitions dividing said casing into an inlet chamber, an outlet chamber and a valve operating mechanism chamber, one of said partitions being removable from said casing, said removable partition having a port establishing communication between said inlet and outlet chambers, a valve carried by said removable partition and controlling said port, and electromagnetic means also carried by said removable partition and operatively connected with said valve.

2. An electrically controlled valve comprising a casing having an inlet and an outlet opening therein, a partition extending from one wall of said casing, a second partition arranged at an angle to the first mentioned partition, said partitions dividing said casing into an inlet chamber, an outlet chamber, and a valve operating mechanism chamber, said second partition having a valve controlled opening establishing communication between said inlet and outlet chambers, electromagnetic means carried by said second partition and disposed within said valve operating mechanism chamber, and means operatively connecting said electromagnetic means with said valve, said second partition and associated mechanism being removable from said casing as a unit.

3. An electrically controlled valve comprising a casing having an inlet and an outlet opening therein, partitions dividing said casing into an inlet chamber, an outlet chamber, and a valve operating mechanism chamber, one of said partitions being removable, said removable partition having a valve controlled opening establishing communication between said inlet and outlet chambers, a solenoid carried by said removable partition and disposed within said valve operating mechanism chamber, a pair of pivotally connected links interconnecting said valve and the solenoid core, and an arm pivotally connected to said removable partition and to the pivotal connection between said links.

4. An electrically controlled valve comprising a casing having an inlet and an outlet opening therein, a partition in said casing having a port therein, a valve mounted to open or close said port, electric motor means within said casing, a pair of pivotally connected links interconnecting said valve and said motor means, and an arm having one end pivotally connected to said pair of links at a point between the extreme ends thereof and having the opposite end of said arm pivotally connected at a fixed point with respect to said casing.

5. An electrically controlled valve comprising a casing having an inlet and an outlet opening therein, a partition in said casing having a port therein, a valve mounted to open or close said port, electric motor means within said casing, a pair of pivotally connected links interconnecting said valve and said motor means, and an arm having one end pivotally connected to said pair of links at a point between the extreme ends thereof and having the opposite end of said arm pivotally connected at a fixed point with respect to said casing, that link of said pair of pivotally connected links nearest adjacent said valve being adapted to have its lower end move around the fixed point of said arm as a center under the influence of the motor means when the valve approaches the closing position and in which movement said link approaches the fixed point of said arm and said link and said arm approach a parallel relation.

6. An electrically controlled valve comprising a conduit having a passageway therethrough, a valve mounted to open or close said passageway, electric motor means associated with said conduit, a pair of pivotally connected links interconnecting said valve and said motor means, and an arm having one end pivotally connected to said pair of links at a point between the extreme ends thereof and having the opposite end of said arm pivotally connected at a fixed point with respect to said conduit, that link of said pair of pivotally connected links nearest adjacent said valve being adapted to have its lower end move around the fixed point of said arm as a center under the influence of the motor means when the valve approaches the closing position and in which movement said link approaches the fixed point of said arm and said link and said arm approach a parallel relation.

7. An electrically controlled valve comprising a plate having a passageway therethrough, a balanced valve mechanism constructed to open and close said passageway and comprising a valve member pivotally mounted on said plate on an axis extending diametrically across the passageway, motor means for actuating said valve, and a plurality of links interconnecting said valve and said motor means, said links constituting locking means whereby when said valve is in the closed position, pressure on the valve can not move said links and movement of said motor means may serve to open said valve.

8. An electrically controlled valve comprising a plate having an opening therethrough, balanced valve mechanism including a valve member pivotally mounted on said plate on an axis extending

across said opening, and adapted to open or close the same, said valve member having half of its effective surface area adapted to move in one direction and the other half of its effective surface area adapted to move in the opposite direction during the opening or closing about said axis, motor means for operating said valve, and a plurality of links interconnecting said motor member and said valve means whereby pressure on the valve surface is equalized and when the valve is closed said links may be moved only through actuation by said motor means.

9. An electrically controlled valve comprising a casing, partitions dividing said casing into an inlet chamber, an outlet chamber, and a magnet chamber, said inlet and outlet chambers having inlet and outlet passages, respectively, and one of said partitions having a port affording communication between said inlet and outlet chambers, a valve member controlling said port and pivotally mounted on said partition, electro-magnetic means in said magnet chamber, and an operative mechanical connection between said electro-magnetic means and said pivoted valve member for both positively opening and closing the latter, that partition having the port being removable along with the elements mounted thereon by endwise movement thereof and laterally from said casing.

10. An electrically controlled valve comprising a casing, partitions dividing said casing into an inlet chamber, an outlet chamber, and a magnet chamber, said inlet and outlet chambers having inlet and outlet passages, respectively, and one of said partitions having a port affording communication between said inlet and outlet chambers, a valve member controlling said port and pivotally mounted on said partition, electro-magnetic means in said magnet chamber, and link and lever mechanism located in one of said other chambers and operatively connecting said electro-magnetic means with said valve member, that partition having the port being removable along with the elements mounted thereon by endwise movement thereof and laterally from said casing.

11. An electrically controlled valve comprising a casing, a partition extending across said casing and dividing the same into inlet and outlet chambers, said partition having a port therethrough affording communication between said chambers, a valve controlling said port, and electro-magnetic means mechanically connected with said valve for operating the same, said partition being removable by endwise movement thereof and laterally from said casing, and both said valve and said electro-magnetic means being mounted upon and movable with said partition as a unit.

12. The combination with a plate having a port, a valve mounted on said plate and controlling said port, an electro-magnetic motor device for operating said valve, link and lever mechanism connecting said motor device and valve, said mechanism lying on one side of said plate, and said motor device being carried by said plate and disposed on the other side thereof.

13. Valve apparatus comprising a plate having a port therethrough constituting a valve seat, a valve member of the "butterfly" type pivotally mounted on said plate on a central axis extending transversely of said port, the edges of said valve member on opposite sides of said axis being adapted to move in opposite directions into engagement with oppositely facing edges of said seat to close said port, electro-magnetic motor means for moving said valve member, and a mechanical connection between said motor means and valve member comprising a plurality of links so disposed that when said valve is closed, said links serve to hold the valve against opening by pressure.

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