Sept. 18, 1928. 1,684,603

H. L. STEPHENSON

VALVE

Filed June 3, 1927

Fig. 1.

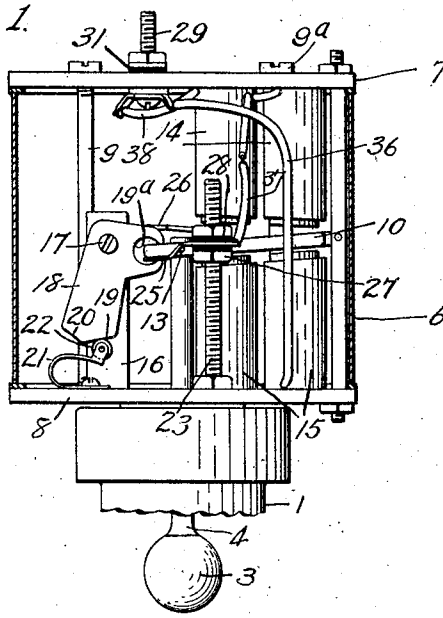


Fig. 3

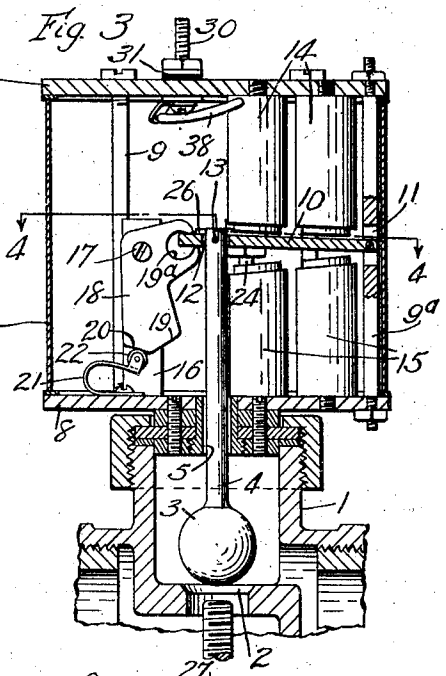


Fig. 2.

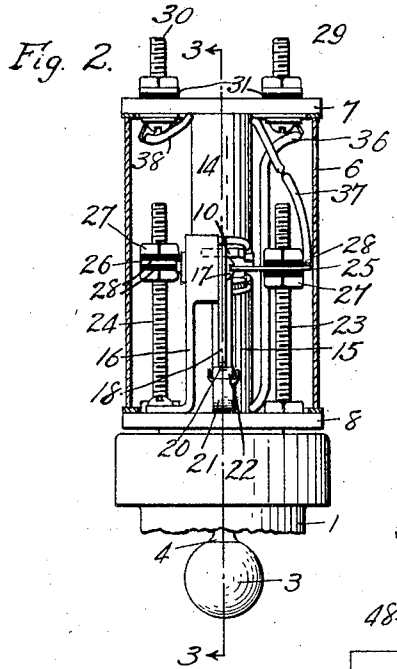


Fig. 4.

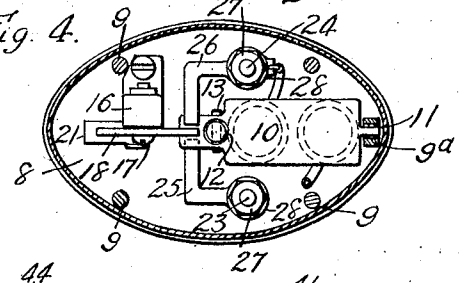
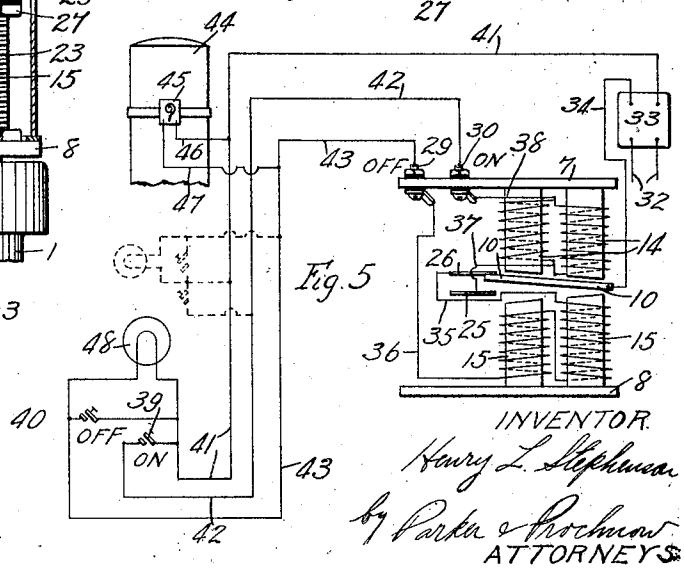


Fig. 5



INVENTOR.
Henry L. Stephenson
by Parker & Prochnow
ATTORNEYS

Patented Sept. 18, 1928. 1,684,603

UNITED STATES PATENT OFFICE.

HENRY L. STEPHENSON, OF BUFFALO, NEW YORK.

VALVE.

Application filed June 3, 1927. Serial No. 196,204.

This invention relates to electrically operated valves, and particularly to the type useful for the control of gas flow to a gas burner. One object of this invention is to provide an improved and simplified electrically operated valve, which will be dependable and certain in action; with which the valve element will be yieldingly held in both open and closed positions; and with which a maximum magnetic pull causing operations in both directions may be obtained.

A further object of the invention is to provide an improved electrically operated valve which will be relatively compact, simple and inexpensive.

Various other objects and advantages will be apparent from the following description of an embodiment of the invention, and the novel features will be particularly pointed out hereinafter in connection with the appended claims.

In the accompanying drawings:—

Fig. 1 is an elevation, with the auxiliary casing in section, of an electrically operated valve constructed in accordance with this invention;

Fig. 2 is an end elevation of the same;

Fig. 3 is a sectional elevation of the same, with the section taken approximately along the line 3—3 of Fig. 2;

Fig. 4 is a sectional plan of the same with the section taken approximately along the line 4—4 of Fig. 3; and

Fig 5 is a diagram illustrating electric circuits which may be employed for operating the valve.

In the illustrated embodiment of the invention, the valve proper may have a casing 1, formed with a valve seat 2, and having a valve element 3 movable toward and from the seat to open or close the valve. The valve element 3 may have an operating stem 4 which reciprocates in and through a passage 5 in a wall of the valve casing. An auxiliary casing 6 for housing the operating mechanism may be attached to the valve casing 1 in any suitable manner, and the stem 4 of the valve element 3 extends into the casing 6. The casing 6 is preferably a closed casing, and therefore packing between the stem 4 and the passage 5 will be unnecessary. The end plates 7 and 8 of the auxiliary casing 6 are preferably of magnetic material, and the side shell of the casing is preferably of non-magnetic material, such as brass.

The side shell of the auxiliary casing may be clamped between the end plates 7 and 8 in any suitable manner, such as by bolts or studs 9, which pass between the end plates 7 and 8 in order to draw them toward one another, and to clamp the side shell between them. One of the plates, such as 8, may be utilized as the part of the auxiliary casing which is attached to the valve casing. A relatively flat armature or bar 10 of magnetic material is disposed in the auxiliary casing 6 and pivoted at one end to another stud 9^a, preferably in a slot or opening 11 of that stud. This armature or bar 10 adjacent its free end is provided with an aperture 12 into or through which the valve stem 4 extends, the stem being pivoted, by a pin 13, to the armature bar as it passes through the same. The passage or aperture 12 in the armature bar may be somewhat larger than the stem, so as to permit of the free pivotal movement of the armature bar and an endwise reciprocating movement of the valve stem.

Electromagnetic coils 14 are secured by their core ends to one of the end plates, such as 7, of the auxiliary casing, so as to project towards the armature bar. Similarly another pair of electromagnetic coils 15 are secured by their core ends to the other end plate 8 of the auxiliary casing, so as to extend towards the armature or bar 10 from the opposite direction, that is on the opposite side of the armature or bar. The armature 10 is thus disposed between the free core ends of the two sets of electromagnetic coils 14 and 15 and oscillates between these sets. The free core ends of these sets of electromagnetic coils have their end faces in planes which converge toward the pivotal axis of the armature or bar, so that as the armature approaches the free core ends of either set of electromagnetic coils, it will be substantially parallel to and equidistant from both core ends of that set of coils. In view of the fact that the end plates 7 and 8 are of magnetic material, each end plate and the coils and their cores connected thereto constitute in effect a horse shoe electromagnet extending at its open side towards the armature and with the armature or magnetic bar 10 forming the keeper for both of these horse shoe electromagnets.

A stud or post 16 extends into the interior of the auxiliary casing from one of the end plates or walls, such as 8, and at a point approximately in line with or in the plane

of the armature or bar 10, when the latter is in an intermediate position, preferably approximately midway between said horse shoe electromagnets, is provided with a pivot pin 17 which pivotally mounts a lever 18. The lever 18 is provided in its edge nearest the free end of the armature with an undercut notch 19[a] into which the free end of the armature or bar 10 extends, so that the lever rockably embraces the free end of the armature or bar 10. Because of this engagement, the lever 18 will be oscillated concomitantly with the movements of the armature 10. The lever 18 preferably extends along the stud or post 16 toward one of the end plates, such as 8, and at its free end is provided with two cam edges 19 and 20 which intersect one another at an oblique angle, both of these cam edges being also oblique to a theoretical line joining their junction or intersection with one another with the pivot pin 17.

A leaf spring 21 is secured in any suitable manner to the interior of the auxiliary casing 6, such as to the end plate 8, and at its free end this leaf spring rotatably supports a cam follower or roller 22 which is yieldingly pressed by the leaf spring against the intersecting cam edges or surfaces 19 and 20, the cam roller engaging with said edges 19 and 20 alternately as the lever is oscillated by the oscillations of the armature between open and closed positions. The point of intersection of the edges or surfaces 19 and 20 is so disposed relatively to the cam roller that the cam roller passes this point of intersection when the armature is at an intermediate point of its travel in either direction between open and closed positions of the valve element. The pressure of the cam roller upon the surfaces 19 and 20 tends to rotate the lever 18 in one direction or the other depending upon which cam surface the edge 19 or 20 the roller happens to be engaging at any time, and hence the lever, and through it the armature and valve element, will be yieldingly biased toward either open or closed position from an intermediate position.

Threaded rods or studs 23 and 24 may be provided within the casing 6 and extend from one of the end plates, such as 8. Leaf spring contacts 25 and 26 are mounted on said studs 23 and 24 respectively, for adjustment along the same in any desired manner, such as by clamping the contacts 25 and 26 between nuts 27 which are threaded upon the studs and disposed upon both sides of the contact spring. The contacts are insulated from the studs and nuts in any suitable manner, such as by insulating washers or elements 28. The contact 25 extends at its free end below the free end of the armature for engagement thereby when the armature moves in a direction to carry the valve element into closed position, the contact being resilient and flexing to permit a slight continued movement of the armature as it approaches its closed position. Similarly, the contact 26, also of resilient material, extends above the free end of the armature for engagement thereby, as the armature approaches its upper limit of movement or open position, this contact also flexing to some extent to permit continued movement of the armature into its full open position as it engages the contact 26. Suitable circuit terminals or posts 29 and 30 are mounted on and extend through one of the plates of the auxiliary casing, such as the plate 7, these posts or terminals being insulated from the plate 7 in any suitable manner, such as by washers or bushings 31.

Referring now particularly to Fig. 5 which illustrates diagrammatically the circuit connections which may be employed for causing operation of the valve, and which also illustrates the circuits of the electromagnetic coils 14 and 15, the source of current for the operation of the valve may be supplied through suitable electrical mains 32. The current passing through the mains 32 may be reduced in voltage by a transformer 33 of any suitable construction. A wire 34 connects one terminal of the output side of the transformer to the armature 10, the armature being preferably and for convenience grounded in the frame, that is to the casing 6 to which for convenience the wire 34 leads. A wire 35 connects the upper contact 26 to one end of one of the coils 15, the coils 15 being connected in series with one another, and the other end of the other coil 15 is connected by wire 36 to one of the terminals or posts in the plate 7, such as the post 29, connection being made at the end of the post which is within the casing 6. The upper electromagnetic coils 14 are preferably connected in parallel to one another in order to obtain greater pull, and the wire 37 connects the lower contact 25 with one end of these parallel connected coils 14. A wire 38 connects the other ends of the coils 14 to the inner end of the terminal post 30.

One or more "on" switches 39 and "off" switches 40 may be provided for controlling the electromagnets 14 and 15. A wire 41 connects the other output terminal of the transformer 33 with one side of both switches 39 and 40. A wire 42 connects the other side of the switch 39 to the terminal post 30, and a wire 43 connects the other side of the switch 40 with the terminal post 29. By closing the switch 39, a circuit will be established as follows: from the transformer through wire 41, switch 39, wire 42, terminal post 30, wire 38, electromagnetic coils 14, wire 37, contact 25, the armature 10 and wire 34, back to the transformer. If the armature happens to be in an upper position, that is in its attractive position with

respect to that electromagnet, the circuit will be open at the contact 25 and the armature. If, however, the armature happens to be in its retracted position with respect to those electromagnetic coils 14, the circuit will be completed as traced, and current will pass through both of the coils 14 in parallel, and cause an attraction of the armature upwardly, thus moving the valve stem upwardly into its open position. The gas then passes to the burner, not shown, and the water in the domestic heating boiler 44 is then heated in a well known manner.

If at any time thereafter the switch 40 is operated, a circuit will be established as follows: from the transformer 33 through wire 41, switch 40, wire 43, terminal post 29, wire 36, the series coils 15 wire 35, contact 26, armature 10 and wire 34, back to the transformer. The circuit thus established will energize the electromagnet 15 and create a downward pull upon the armature, the downward movement of the armature causing a movement of the valve element 3 into closed position in the seat 2. This circuit is broken as soon as the armature becomes disengaged from the contact 26. In order that the circuit last described may be effective to cause a movement of the valve element into closed position when sufficient water has been heated, and without requiring manual attention, I may also mount a thermostatic switch 45 of any suitable construction adjacent to the boiler 44, so that when the water in the boiler 44 down to the switch 45 is heated to the desired temperature, the switch automatically will close a circuit between the wires 46 and 47, which are connected respectively to the wires 41 and 43. This thermostatic switch thus automatically closes a circuit in parallel to the switch 40 without manual attention. The switch 45 may be mounted for adjustment lengthwise, that is vertically, along the tank 44, so that the amount of water which will be heated to a desired temperature before the burner is cut off may be varied.

To indicate visually at the switches 39 and 40, the condition of the valve, a high resistance electric lamp 48 may be connected in shunt across the "off" switch 40. With a lamp connected in that manner, a circuit through the lamp will be established whenever the armature is in its "open" position where it engages the contact 26. The resistance of the lamp, however, is so high that the current flowing in the cut off circuit will be insufficient to cause actuation or movement of the armature 10. The illumination of the lamp, however, by this current will clearly show that the burner for the heater is running, that is, that the valve is open. Whenever the switch 40 is operated or the thermostatic switch is effective, the lamp 48 will be shunted by the operation of the switches 40 and 45, thus cutting out the relatively high resistance caused by the lamp. Immediately considerable current will flow in the circuit through the coils 15, and this current will be sufficient to cause movement of the armature and valve element into closed position.

The operation of the valve will be understood from the preceding description, it being noted that the valve element is moved alternately between open and closed positions through the action of the armature 10, depending upon which horse shoe electromagnet is effective upon the armature. It will be further observed that the valve element will be yieldingly biased into either open or closed positions from an intermediate position, so that the valve element will remain in the position into which it is moved. The construction is relatively simple and inexpensive, and has been found to function very satisfactorily, and to be dependable as well as compact.

It will be obvious that various changes in the details, which have been herein described and illustrated in order to explain the nature of the invention, may be made by those skilled in the art within the principle and scope of the invention as expressed in the appended claims.

I claim as my invention:—

1. An electrically operated valve, comprising a valve element movable between open and closed positions, a pivoted armature connected to said valve element to cause movement of the latter between said positions, electromagnetic means disposed to attract said armature alternately between open and closed positions, a lever pivoted adjacent the armature for oscillation upon an axis parallel to the axis of oscillation of the armature, said lever having in its edge nearest the armature a notch embracing a portion of the armature, whereby the armature will rock in said notch and cause oscillation of said lever in either direction, and a spring device acting upon said lever to bias it and said armature in either direction from an intermediate position, whereby the armature and valve element will be yieldingly biased into either open or closed position.

2. An electrically operated valve comprising a valve element mounted for movement between open and closed positions, an armature connected to said element for movement therewith in both directions, a pivoted lever having in its edge adjacent its pivot a notch rockably engaging a portion of the armature, said lever having intersecting cam surfaces oblique to one another, and a spring pressed follower running on said cam surfaces alternately as the lever is shifted by the movements of said armature between

open and closed positions, the pressure of said follower on said surfaces causing a yielding bias on the lever in either direction from an intermediate position, whereby said armature and valve element will be yieldingly held in either open or closed position.

3. An electrically operated valve comprising a valve element mounted for movement between open and closed positions, an armature connected to said element for movement therewith in both directions, a pivoted lever having in its edge adjacent its pivot a notch rockably engaging a portion of the armature, said lever having a pair of intersecting cam surfaces oblique to one another aud oblique to a theoretical line from the pivot of said lever to the intersection of said surfaces, and a spring pressed cam roller running on said surfaces alternately as the lever is oscillated by the movements of the armature between open and closed positions, the roller passing said intersection while the armature is in an intermediate position between open and closed position, whereby the armature and valve element will be yieldingly held in either open or closed position.

4. An electrically operated valve comprising a valve element mounted for movement between open and closed positions, an armature connected to said element for movement therewith in both directions, a pivoted lever having in its edge adjacent its pivot, a notch rockably engaging a portion of the armature, said lever having intersecting cam surfaces on its edges which are oblique to one another and oblique to a theoretical line joining the pivot of said lever and the intersection of said surfaces, a leaf spring mounted adjacent the lever, and a cam roller carried by the free end of said spring and running on said cam surfaces alternately as the lever is oscillated by the movements of the armature between open and closed positions, said cam roller passing the intersection of such surfaces when the armature is at an intermediate point in its movement between open and closed positions whereby the armature and valve element will be yieldingly held in open or closed position by said lever and the action of said cam roller on said cam surfaces.

5. In an electrically operated valve, a valve element mounted for movement between open and closed positions, an armature connected to said element for movement therewith, electromagnetic means for operating the armature and through it the valve element alternately between open and closed positions, a lever pivoted adjacent the armature and having in its edge adjacent the pivot a notch rockably embracing a portion of the armature, whereby said lever will be oscillated by the movements of said armature between open and closed positions, one end of said lever having two intersecting oblique edge portions forming cam surfaces, said cam surfaces being oblique to a theoretical line joining the intersection of said surfaces and the pivot of said lever, and a spring pressed cam roller riding on the oblique cam surfaces alternately as the lever is oscillated by the movement of the armature between open and closed positions, the roller passing the intersection of said surfaces, when the armature is at an intermediate point in its movement between open and closed positions, whereby said armature and said valve element will be held in open or closed position yieldingly by the action of the spring pressed cam roller on said lever.

6. In an electrically operated valve, an armature pivoted at one end, electromagnets disposed on opposite sides of said armature with the planes of the free ends of their cores converging towards the pivot of the armature, whereby as the armature approaches the ends of the cores of the electromagnets, it will be approximately parallel to said ends of the cores, a valve element connected to said armature at a distance from its pivot, whereby the movements of said armature between said electromagnets will move said valve element between open and closed positions, a lever pivotally mounted adjacent the free end of the armature and having, in its edge and in approximately a line between the pivot of the lever and the pivot of the armature, a notch rockably embracing the free end of said armature, whereby said lever will be oscillated by movements of said armature and valve element, and spring actuated means acting upon said lever to yieldingly bias it in either direction from a dead center position, said dead center position being at an intermediate point in its movements when said armature and valve element are at an intermediate point in their movements between open and closed positions.

7. In an electrically operated valve, a valve element movable between open and closed positions, an armature connected to said valve element for moving the same between open and closed positions, a plurality of electromagnetic devices associated with said armature for moving it between said positions, spring contacts disposed on opposite sides of said armature for engagement thereby as it approaches its limits of movement between said positions, a circuit for each electromagnetic device including the spring contact engaged by the armature when in retracted position with respect to that device, and means for yieldingly holding the armature and valve element in either of said positions.

8. In an electrically operated valve, a valve casing, an auxiliary casing mounted

on said valve casing, a valve element in said valve casing and having a stem extending into said auxiliary casing, said valve element and stem being movable between open and closed positions, an armature connected to said stem and disposed in said auxiliary casing for movement concomitantly with said valve stem, electromagnetic means associated with said armature for moving the latter between said positions, studs mounted in said auxiliary casing, a spring contact insulated from and carried by each of said studs and extending into proximity to said armature, one of said contacts being disposed for contact by said armature when the armature approaches one of said positions, the other contact being disposed for engagement with the armature when the armature approaches the other of its said positions, circuits for said electromagnetic means for controlling the movements of said armature, the circuit for causing movement in each direction including the contact in engagement with the armature at the beginning of that movement, and means for yieldingly biasing the armature and valve element into either of said positions from a neutral intermediate position.

9. In an electrically operated valve, a valve casing, an auxiliary casing connected to said valve casing, a valve element in said valve casing having an operating stem extending into said auxiliary casing and movable between open and closed positions, an armature in said auxiliary casing, an electromagnet disposed adjacent said armature and operable thereon to move the same and said valve element into open position, a second electromagnet disposed adjacent said armature and operable thereon to move the armature and valve element into closed position, a stud extending into said auxiliary casing, a lever pivoted on said stud with the pivotal axis in approximately the plane of the armature when the armature is at an intermediate point in its movement between said electromagnets, said lever having in the edge adjacent said armature a notch rockably embracing a portion of the armature to cause concomitant movement of said armature and lever and also having oblique cam surfaces, and a spring actuated cam roller acting upon said cam surfaces and yieldingly biasing said lever in either direction from an intermediate position through which said lever passes as the armature moves between open and closed positions, whereby the armature and valve element will be yieldingly held in either open or closed position.

10. In an electrically operated valve, a valve casing, an auxiliary casing connected to said valve casing, a valve element in said valve casing having an operating stem extending into said auxiliary casing and movable between open and closed positions, an armature in said auxiliary casing, a horse shoe electromagnet disposed adjacent said armature and operable thereon to move the same and said valve element into open position, a second horse shoe electromagnet disposed adjacent said armature and operable thereon to move the armature and valve element into closed position, a stud extending into said auxiliary casing, a lever pivoted on said stud with the pivotal axis in approximately the plane of the armature when the armature is at an intermediate point in its movement between said electromagnets, said lever having in the edge adjacent said armature a notch rockably embracing a portion of the armature to cause concomitant movement of said armature and lever, and means having a cam action on said lever for biasing it towards either limit of its movement from an intermediate position, whereby the valve element will be yieldingly held in either open or closed position.

11. In an electrically operated valve, a valve element having a stem and mounted for movement between open and closed positions, a bar armature pivotally mounted at one end and pivoted intermediate of its ends to said stem, horse shoe electromagnets disposed on opposite sides of said armature and toward and from the free core ends of which said armature moves as the valve element moves between open and closed positions, the free core ends of said electromagnets converging towards the pivotal mounting of said armature, so as to permit the close approach of said armature bar to the free core ends of both electromagnets, a lever pivotally mounted adjacent the free end of said armature and having a slot rockably engaging the free end of said armature, and means acting upon said lever to bias it yieldingly in either direction from an intermediate position, whereby said armature and valve element will be yieldingly held in either both open or closed position and operating circuits for both of said electromagnets.

HENRY L. STEPHENSON.