May 31, 1932. G. D. BOWER 1,861,046

SWITCH FOR MAGNETICALLY OPERABLE DEVICES

Filed May 24, 1928

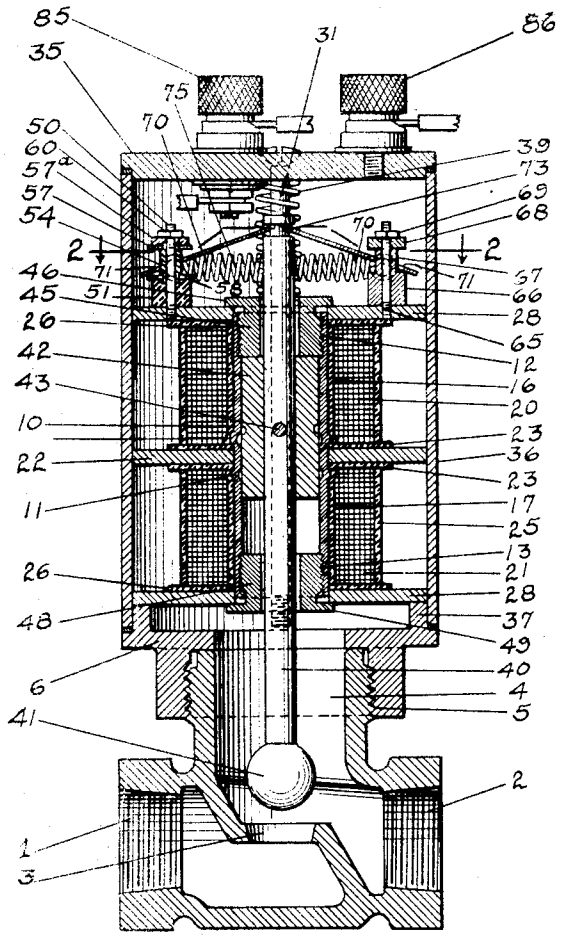


Fig. 1

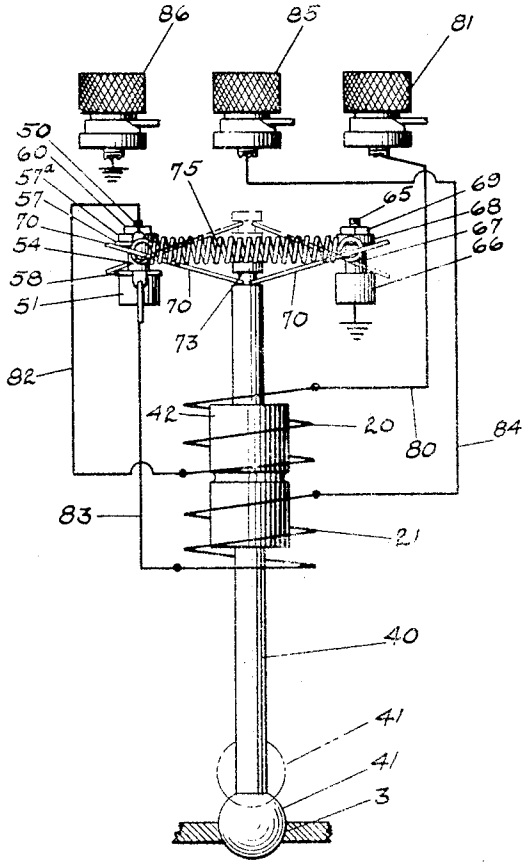


Fig. 6

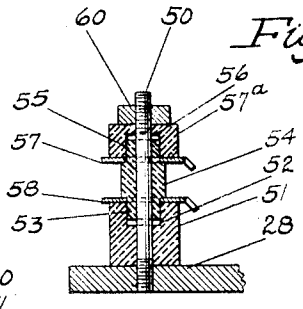


Fig. 3

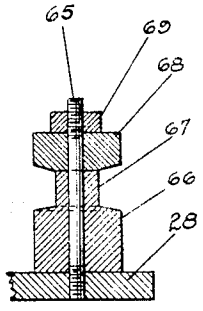


Fig. 4

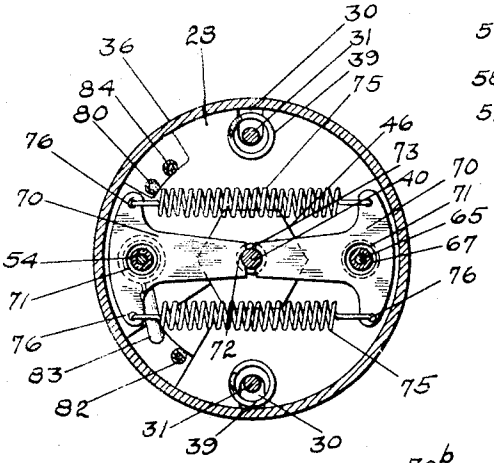


Fig. 2

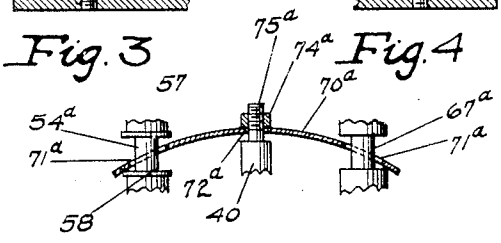


Fig. 5

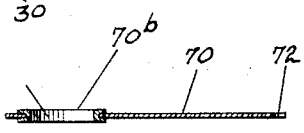


Fig. 7

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UNITED STATES PATENT OFFICE

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SWITCH FOR MAGNETICALLY OPERABLE DEVICES

Application filed May 24, 1928. Serial No. 280,220.

This invention relates to improvements in magnetically operable valves, and is particularly concerned with a mechanism including a movable valve control element and a pair of coils for moving the elements alternately in opposite directions, along with a circuit control device and circuit connections arranged so that the coils can be alternately energized, and so that the circuits are controlled by movements of the plunger or valve element to obtain alternate energization of the coils. Another object is to provide a switch mechanism for a device of the class described which is easily assembled, which has few parts, and which is accessibly positioned with reference to other parts of the device.

Features of the invention include all the details of construction; the arrangement of the parts; the manner of assembly; the use of few parts which can be cheaply produced; and to the method by which the plunger controls the coils which operate it.

Features and advantages of the invention will be set forth in the description of the drawings forming a part of this application, and in said drawings

Figure 1 is a vertical section through the whole device;

Figure 2 is a plan section substantially on line 2—2 of Figure 1;

Figure 3 is a detail vertical section of one of the contact posts;

Figure 4 is a similar view of another contact post;

Figure 5 is a modification of the contact-controlling construction;

Figure 6 is a diagrammatic view showing the wiring arrangement; and

Figure 7 is a detail section of one of the contact elements.

The present embodiment of the invention includes a T-coupling providing passages 1—2 connected by a port 3 as a valve seat. A third passage or extension 4 is threaded exteriorly as at 5, said threads having engaged therewith corresponding threads of a plate or base member 6 upon which the mechanism is mounted. The coil construction and the manner of mounting it are considered features of the invention. A metallic tube 10 is punched out as at 11 to form lugs and the tube is threaded at opposite ends interiorly respectively at 12—13. Embracing the tube are tubular elements indicated at 16—17. Against or around this insulating material the coils 20—21 are disposed, the coils being separated by a metallic plate 22 positionally secured by the lugs 11. The coils are insulated from the plate 22 by suitable washers 23. A suitable tubular wrapping or casing 25 is provided for each coil. Against ends of the coils are engaged insulating washers 26 corresponding to the washers 23. Metallic supporting and centering washers 28 are provided one at the outer end of each coil. The washers 22 and 28 are each diametrically slotted as shown at 30, see Figure 2, and the slots are aligned for the passage of tie bolts 31. Each tie bolt passes through a cap piece 35, closing the top of the tubular casing 36, the lower end of which casing rests upon the base element 6. The base element is formed with an annular flange 37 to center the lower end of the casing. Interposed between the cap 35 and the upper washer 28 are springs 39, one spring for and encircling each bolt. These springs are under compression when the parts are properly positioned, as shown in the drawing. By this means, the coil structure is yieldably held against the base, while the elements 35 and 36 are secured.

The construction of the coil, its assembly, and this means for yieldably holding it in its operative position are each a feature of the invention, as well as the arrangement of the base piece 4 removably attached to the coupling or analogous element.

Another important feature of the invention relates to the arrangement of the plunger and the switch by which it is controlled and which it controls. This plunger in this instance comprises a stem 40 having a terminal ball valve 41 engageable with seat 3 when the plunger is in lowermost position and adapted to assume the position shown in the drawings, to allow flow through the coupling when in its opposite limit position. The plunger is a movable core for the electro-

magnetic device, which includes the coils 20—21. In this instance the stem or plunger has a core piece detachably arranged as a sleeve 42, secured to the element 40 by pin 43. The plunger projects upwardly through and beyond the element 28, passing through a guide and stop plug 45 engaged with the threads 12. Thus the stem 42 is slidable through this plug, and the plug acts as a closure for the tube and as a stop engageable by the element 42 to limit outward, upward-movement of the stem. Another feature of the invention is that the plug 45 has the flange 46 which engages and clamps the element 28 to the coil structure. A substantially similar plug is engaged at the bottom of the tube and numbered 48. This plug has a flange 49 engaging the lower plate 28, and securing it with respect to the coil and tube.

Another and very important feature of the invention is the construction and arrangement of the contacts by which the coils can alternately receive current, which current is controlled by the movement of the plunger, and which provides a very simple construction cheap to manufacture and easily assembled, and in the nature of a switching mechanism. To this end there are arranged upon the upper plate 28, in this instance in diametric relation to the axis of the stem 40, a pair of stud-like elements one of conducting material and the other of insulating material, each having a different construction. The stud 50 or the stud which is adapted to insulate a pair of contacts to be described, comprises a post 50 in threaded engagement at its lower end with the plate 28, and having threads at its upper end. Slidably arranged over the post is an insulating collar 51 recessed as at 52 to receive the reduced extension 53 of another insulating collar 54, having an opposite reduced extension 55 entering a recess 56 of a third insulating collar 57*a*. The reduced extensions 55 and 53 provide shoulders against each of which is arranged a conducting element or contact. These contacts are respectively indicated 57—58. These contacts may be the terminal connecting elements of a conductor and, in the device as made, each is soldered to the terminals of a conductor. A nut 60 engaged with the threads of the stem 50, secures all of the insulating sleeves just described. The element 54 provides a slide and guide for a contact or switch element which is adapted to be translated to alternately engage the metallic members 57 and 58. The shoulders formed by the reduced portions of the elements 54 act to hold the elements 57 and 58 in a predetermined spaced relation. It will be seen that the space may be varied, if desired, by substituting an element similar to 54, in which the distance between the shoulders is greater or less. The other stud which is of conducting material is illustrated in detail in Figure 4 and its parts are arranged on a stem 65. A sleeve 66 is first slipped over the stem and this sleeve has a terminal reduced portion 67. Against the terminal reduced portion is arranged an element 68 which is greater in diameter than the reduced portion and therefore a groove is formed between the shoulder of element 66 and the opposing element 68. A clamping nut 69 secures the elements in a manner similar to the nut 60.

In order to electrically connect the contacts 57—58 with the element 67, for example, or in order to establish a circuit connection between said contacts and some other electrical member, an element 70, (see Figs. 1 and 2) or its equivalent (see Fig. 5) is used. Element 70 has an opening 71 which is loosely traversed by the insulating collar 54. The opposite end of the element is notched as at 72 to abuttingly engage the stem 40 within a circumferential groove 73. Thus the element 70, due to the loose engagement with the stud, is capable of following the movements of the plunger to be positioned alternately above and below a horizontal line drawn through the middle portions of the elements 54 and 67. The element 70 which operates between the contacts 57 and 58 has its opening provided with a liner 70^b (see Fig. 7). As shown in Figure 5, the circuit making element is a single piece 70^a of flexible material connected loosely with the elements 54—67.

The element 70^a has each terminal provided with an opening 71^a which respectively engages the studs 54^a and 67^a in exactly the same manner as for the first described form. An opening 72^a is traversed by a stud 75^a and a nut 74^a is traversed by a stud 75^a, and a nut 74^a in threaded engagement with the stud secures the element 70^a in proper operative position.

Note, (see Fig. 2) that the two elements 70 are diametrically related to the axis of the plunger. Means is provided cross-connecting the elements in a manner to cause them to yieldably hold the plunger at opposite limit positions, and/or assist in bringing the plunger to those positions, and at the same time to be manipulated by the plunger to control the circuit connections according to the positions of the plunger. In this instance, this means comprises springs 75 arranged in parallel relation one at each opposite side of and parallel with a diameter passing through the axes of the stems 50—65 and the plunger 40. The springs are connected by their terminals with openings 76 of the elements 70. The arrangement is such that a yieldably over-the-center lock is obtained. With the plunger in the position shown in Figure 1, the spring is causing the notched terminal portions to pull upwardly on the plunger, with the elements 70 fulcruming upon the lower shoulders. It will be noted that the ends of the springs are connected at points

between the engaging portions of the element 70, respectively with contacts 57—58 and plunger 40, in other words, between the fulcrum points. When the plunger is in its lowermost position an opposite action will take place. Thus the yieldable force is applied in a manner to assist in bringing the plunger to the limit positions after the terminals or the middle portions or portion of the element or elements 70 or 70ª have passed across a line which lies in the plane of the axes of the springs.

Figure 6 diagrammatically illustrates the circuits. One end of the coil 20 is connected by conductor 80 with a suitable binding post 81 carried by and insulated from the cover 35. The opposite end of this coil 20 is connected by conductor 82 with, in this instance, contact 57. The opposite contact 58 is connected by conductor 83 with one side of the coil 21 and the opposite side of the coil 21 is connected by conductor 84 with binding post 85 also insulated from the cover 35. A third binding post 86 is suitably grounded on cover 35. Stem 65 is also grounded.

A feature of this invention includes the method of interrupting the circuit through the coil and of completing the circuit through the other coil just before completion of each operation of the valve. It will be noticed that the elements 70 are held in proper position by the studs and by their engagement with the stem. Another feature is that there is no adjustment of any spring contacts necessary. This assures a proper operation at all times because the contact is necessarily maintained to the proper coil until after the toggle mechanism is passed over the center. It will be seen that when it has passed over the center the toggle mechanism cuts off the current through the actuating coil and snaps to a position where it exerts a very considerable force on the plunger, this force acting in a direction in which the plunger is moving or has moved, to assist this movement after passing over the center and to yieldably hold the plunger at its limit position. This action is partially due to the clearance obtained as the result of the relation of the openings 71 to the studs 54, the studs thus acting as toggle retaining and guiding elements.

All details of construction of the device are claimed as well as the general relations of the parts.

In assembly the springs are connected to the elements 70, and then the terminal notch of one element is properly engaged with the plunger and then the opening 70 engaged over the element 67. The nut 68 is then applied. The same operation is repeated for the opposite element 70. This assembly is extremely simple and the elements can be cheaply made.

An important feature of the invention is that the contact mechanism and the toggle associated therewith provides means whereby, immediately upon movement of element 70 away from a respective contact, the resilient means causes the toggle element or elements 70 (or equivalent device) to snap into position in which it exerts a very considerable mechanical force urging and continuing the element 40 in the same direction. At the same time the conducting element 70 snaps to its opposite contact making position. In other words, the tripping and contact making mechanism, when it reaches what may be termed the critical point, that is the point where the contact is broken preparatory to making the opposite contact, instantly exerts a mechanical force on the element 40 urging it in the same direction and towards its limit of movement. It will be noted that this force is immediately applied as the current is cut off from that coil which has started movement of the plunger (thus removing the magnetic pull) so that mechanical force is instantly substituted for the magnetic pull, to positively and unfailingly complete the movement. The springs, or equivalent devices, not only instantly assist in moving the element 40, but cause instantaneous make and break of the contacts.

I claim as my invention:

1. A switch mechanism including a member arranged for translation, posts as stationary contacts each having a circumferential groove, conducting means rockably connected with the grooves, and member to electrically connect the posts, and springs connected to and adapted to act upon said conducting means in a manner to assist translative motion of the member.

2. A switch mechanism including a member arranged for translation, posts as stationary contacts each having a circumferential groove, conducting means rockably connected with the grooves and member to electrically connect the posts, and coil springs connected to and adapted to act upon said conducting means in a manner to assist translative motion of the member.

3. A switch mechanism including a member arranged for translation, posts as stationary contacts each having a circumferential groove, conducting means rockably and detachably connected with the grooves and member to electrically connect the posts, and coil springs connected to and adapted to act upon said conducting means in a manner to assist translative motion of the members, said posts having elements which are removable to allow detachment of the conducting means.

4. A switch mechanism including a member arranged for translation, posts as stationary contacts each having a circumferential groove, conducting means rockably connected with the grooves and member, coil springs connected to and adapted to act upon said conducting means in a manner to assist

translative motion of the member, each post being formed of sections including a cap section removable to permit disengagement of the conducting means from the grooves.

5. A switch mechanism including a member arranged for translation, posts as stationary contacts one at each opposite side of said member arranged on a diameter passing through the axis of the member, each post having a circumferential groove, conducting means rockably and detachably connected with the grooves and member, coil springs connected to said conducting means and adapted to act upon said conducting means in a manner to assist translative motion of the member and yieldably secure it at opposite motion limits.

6. A switch mechanism including a member arranged for translation, a pair of posts axially parallel with said member arranged on a diameter passing through the axis thereof, each post having a circumferential groove crossing a plane perpendicular to the axis of the member and located between the motion limits thereof, each opposite end of the groove of one of the posts being provided with an electrical contact, conducting means rockably removably connected with the grooves, and member, and aligned on the aforementioned diameter, and coil springs symmetrically arranged one at each opposite side of and substantially axially parallel with said conducting means, said springs being adapted to act upon said conducting means to assist translative motions of the member and yieldably secure it at motion limits respectively at opposite sides of the aforementioned plane, said conducting means being adapted to alternately make electrical contact with one of said contacts, conformably to motion limits of said member, said posts being formed of sections including a cap section removable to permit disengagement of the conducting means from the grooves.

7. A switch mechanism including a member arranged for translation, a pair of posts axially parallel with said member arranged on a diameter passing through the axis thereof, each post having a circumferential groove crossing a plane perpendicular to the axis of the member and located between the motion limits thereof, each opposite end of the groove of one of the posts being provided with an electrical contact, conducting toggle elements one for each post, each rockably connected with a groove of the corresponding post and having a pivotal abutting engagement with the member, said toggles being axially aligned on the aforementioned diameter, and coil springs symmetrically arranged one at each opposite side of and substantially axially parallel with said toggles, each spring connecting one of the toggles with the other at points outwardly beyond the axes of the posts in direction of the aforementioned diameter, said springs being adapted to assist translative motions of the member, and one of said toggles being adapted to alternately engage the contacts of said post, conformably to motion limits of said member.

8. A switch mechanism including a member arranged for translation, said element having a circumferential groove therein, a pair of posts arranged symmetrically on a diameter through the axis of the movable element, each having a circumferential groove in a plane parallel to the groove of the movable element, and lying in a plane located substantially midway between the motion limits of the movable element, opposite sides of the grooves of one of the posts being formed of electric conducting material and being insulated from one another, toggle elements one for each post rockably connected with a corresponding groove, each element having a notch engaging the groove of the movable element, and said elements being symmetrically arranged with respect to a line passing through the axes of the posts and movable element, and coil springs symmetrically related one at each opposite side of the line through the axes before mentioned, and parallel therewith, and each connecting one of the toggles with the other and adapted to assist translative motion of the elements and to assist in securing the element at limits of motion respectively at opposite sides of the plane of the grooves of the posts, one of the toggles being adapted to alternately engage the conducting elements, conformably to motion limits of said member.

9. A switch mechanism including a member arranged for translation, a pair of posts as stationary contacts, each post having a circumferential groove crossing a plane which is substantially perpendicular to the axis of the member and located between the motion limits thereof, each opposite end of the groove of one of the posts being provided with an electrical contact, conducting means rockably connected with the grooves and with the member, and coil springs adapted to act upon the conducting means to assist translative motion of the member and yieldably secure it at motion limits respectively at opposite sides of the aforesaid plane.

10. A switch mechanism including a member arranged for translation, a pair of posts as stationary contacts, arranged on a diameter passing through the axis of the member, one post at each side of said member, each post having a circumferential groove crossing a plane which is substantially perpendicular to the axis of the member and located between the motion limits thereof, conducting means rockably connected with the grooves and with the member and aligned on the aforesaid diameter, and coil springs con-

nected with said conducting means and adapted to act thereon to assist translative motion of the member and yieldably secure it at motion limits respectively at opposite sides of the aforesaid plane.

In witness whereof, I have hereunto set my hand this 12th day of May, 1928.

GEORGE D. BOWER.