

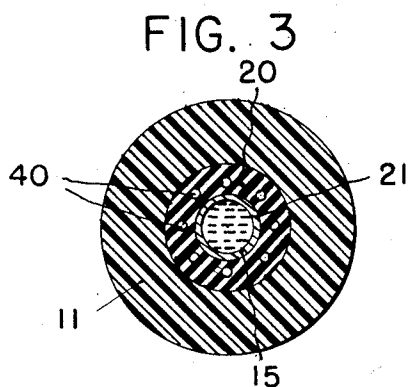
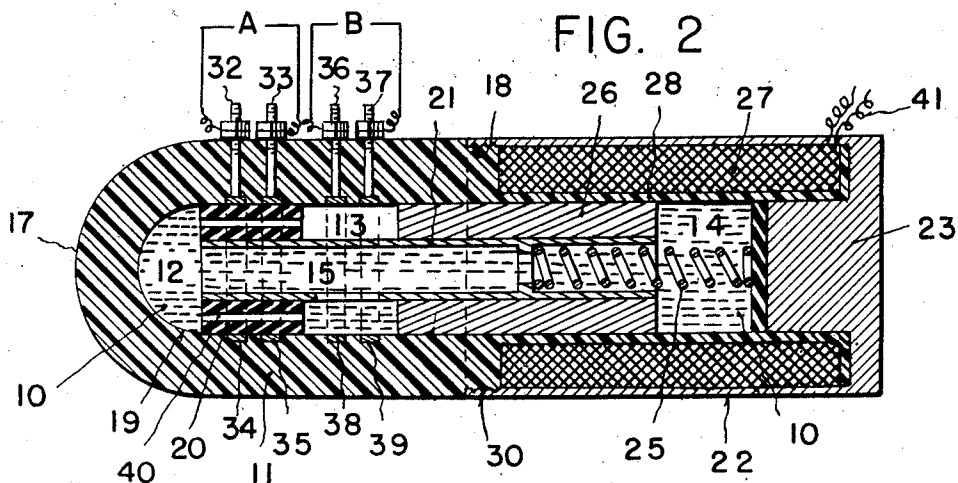
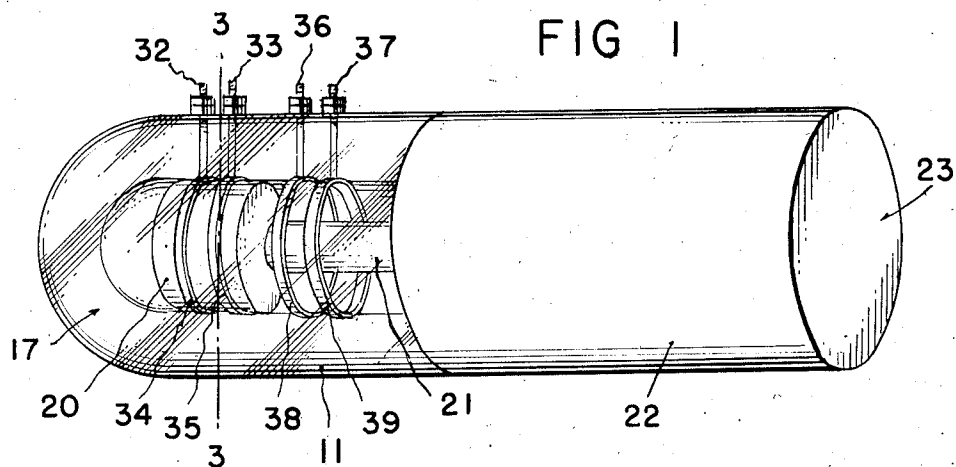
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MULTIPOSITIONED LIQUID SWITCH

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MULTIPOSITIONED LIQUID SWITCH

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This invention relates to electrical switches for the opening and closing of circuits and more particularly to those employing mercury or other fluid conducting mediums as an integral part of the means for making and breaking their contacts.

There have been a number of mercury switches designed and developed employing free flowing mercury as the medium for making contacts between the electrodes of their structures. While such may be advantageous for particular operative conditions, they have the limitation of requiring their normal positioning be retained in certain predetermined planes. The position may vary from the horizontal to the vertical depending on the natural or gravitational tendency of the mercury as arranged in the device to move freely from one portion of the structure to another when it is wholly tilted, by the operative movement of the individual switch. In a particular case, a sponge for holding the mercury in natural suspension or by capillary or surface tension, is used so the switch may offer possibilities of being used and operated in any plane. This may meet some situations but not to a maximum degree, because there is a chance for leakage, as the capillary attraction is diminished or the friction resulting from use frees the mercury from the sponge. The free mercury in such instances tends to bring about short circuits and current leaks, that affect the efficiency and effectiveness of the switch. In this invention, a structure for a switch or relay is employed that holds a conducting fluid as the medium for making the necessary closing or bridging of contacts at the electrodes. The medium is enclosed in and fills an envelope where it is under positive mechanical control at all times. It is operably actuated by a solenoid and piston whenever the requirements make it necessary to move it from one location to another. By reason of this the device may be positioned in any plane without affecting its proper operation. The arrangement also avoids the use of loose parts and any tendency to operate by extraneous vibration induced in the structures holding the device. The term switch throughout this description is intended to be comprehensive enough to include relays and other circuit controls for opening and closing circuits.

It is an object of the hereindescribed invention to provide a new and improved switching device employing a fluid conducting medium for making and breaking its contacts, that will avoid one or more of the disadvantages and limitations of the prior art.

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Another object of this invention is to provide a new and improved switching device that will operate with a fluid conducting medium forming its switching means, and which is positively controlled in its movement by the mechanism embodied in its structure.

A further object of the invention is to provide a new and improved switching device that will employ a fluid conduction medium for its contact control actuating through the use of an internal electrical propulsion means.

An additional object of the invention is to provide a new and improved switch that will be operable in any plane it may be positioned in and while employing a fluid conducting medium filling it as the means for making electrical contacting control at its electrodes.

Other objects will become evident as the invention is more fully disclosed.

For a clearer understanding of the invention, its objects, principles and operation, reference is made to the accompanying drawings. These drawings in conjunction with the following description outline a particular form of the invention, by way of example, not as a limitation, while the claims emphasize the scope of the invention.

Referring to the drawings:

Figure 1 is a view in perspective of a fluid medium switch embodying this invention;

Figure 2 is a longitudinal section through the switch shown in Figure 1;

Figure 3 is a transverse section sectional view on line 3-3 of Figure 1.

Similar reference characters refer to the same parts throughout the drawings.

The drawings indicate a particular form of enveloped switch of the mercury type. The mercury 10 is enclosed within the envelope 11, and fills the sub-chambers and the passage 15 within a longitudinal cylindrical tube 21. Mercury is selected in this instance as a matter of convenience, but it is appreciated that other conducting fluids may be employed where such is adaptable to the needs of the particular switch. The reference to the fluid conducting medium or mercury is therefore understood to be broad enough to include all such conducting mediums whether specifically designated or not, in this description.

The envelope 11 consists of a transparent shell formed with a rounded and closed-in nose 17 at one end portion termed the front section. This section is screw-threadably formed at its opposite end portion at 18 on the outer periphery thereof. An elongated cylindrical chamber 19

is provided in the central portion of the envelope 11 and for the greater part of its length. The chamber 19 is divided into three sub-chambers, 12, 13, and 14, which are subject to variation during use. The subchamber 12 is in the nose of the shell and forms one end of the chamber 19. The subchamber 13 is in a portion of the chamber 19 separated from the subchamber 12 by an insulated cylindrical piston 20 reciprocable in the chamber 19. The envelope 11 is preferably made of Lucite, glass, or plastic that has insulating characteristics. Likewise the piston 20 is of plastic or other suitable insulating material. The piston 20 is connected to a cylindrical core 26 of magnetic material reciprocable in chamber 19 by means of a tube 21. The remaining element of the envelope 11 is casing 22 of stainless steel or other suitable material. It has an open end portion internally screw-threaded as at 30 to fit on to the screw threads 18 on the front section of the envelope. The casing 22 is termed the rear section of the envelope and is closed in at its rear end, as indicated in the drawings, and has an inwardly projecting head 23. The head 23 is preferably cylindrical and serves as a base for a coil spring 25 to rest on. This spring is of the compressible type. The casing 22 contains a solenoid 27, insulated therefrom by an extending cylindrical wall 28. The tube 21 also serves internally as a surface and guideway for the core 26 to travel into when pulled by the magnetic influence of the solenoid 27. The piston 20 is firmly mounted on the tube 21 and spaced from the core 26 to provide the subchamber 13 in between. The piston 20 has a series of passages 40 through it longitudinally, connecting the subchamber 12 with subchamber 13, so the mercury 10 can flow from one to the other as the piston-tube-core moves. A pair of electrodes 32 and 33 respectively arranged for coupling to an exterior circuit A are disposed through the wall of the envelope 11 so they will connect to conductor rings 34 and 35 recessed in it. Another pair of electrodes 36 and 37 spaced therefrom for external circuit B likewise extend through the shell and make contact with the internal rings 38 and 39 respectively.

The normal positions of the elements of the device are as indicated in Figure 2. The chamber 12 is at the nose of the shell, restricted in volume, and is filled with mercury. The piston 20 covers the rings 34 and 35 and insulates them. The subchamber 13 leaves the electrode rings 38 and 39 open to contact with the mercury therein and forming a closed circuit at that location. The subchamber 14 contains the spring 25 which is shown expanded to keep the core and piston in the positions mentioned. However, as the coil of the solenoid 27 is energized through its leads 41 it will attract and pull on the core 26 and cause it to move tube 21 and compress the spring 25. At the same time, the piston 20 fast to the tube 21 will be moved in the same direction and uncover the electrode rings 34 and 35 and allow access of the mercury 10 thereto to close these contacts and the circuit A. Simultaneously the rings 38 and 39 will be covered up and insulated by the piston 20 as it moves down the passage 21 so that circuit B is now open. During these movements of the core and piston, the mercury 10 will be forced to flow from the chamber 14 through the tube passage 15 into the subchamber 12 and also through passages 40. An opening is provided in the wall of the tube 21 to communicate with sub-chamber 13.

When the current through leads 41 is turned off from the solenoid and deenergizes it, the spring 25 returns the core 26 to its normal position. At the same time the piston moves to cover up the contact rings 34 and 35 while simultaneously exposing the rings 38 and 39 to the mercury that flows in around them as the subchamber 13 is displaced to a position aligned with them. The mercury in this device not only works as a conductor but also may dampen the action of the moving parts, and it acts as a cooling agent to the portions heated by the current flowing through the solenoid and the electrodes.

The structure of the switch is so arranged that it affords convenient access to all parts for inspection, replacement or repair. The front section is transparent as well as insulating and enables the user to visually observe what is going on inside where the operative parts function. The form of the device enables it to be placed in any position. It will operate just as effectively whether in the vertical, horizontal or angular planes because it does not depend on the influence of gravity or capillary attraction to flow its fluid conducting medium. The arrangement is compact and avoids the use of extraneous fastenings such as bolts, rivets and catches. This feature enables the cost of production in manufacturing and assembling the device, to be kept at an economical figure.

While but one form of the form of the invention is shown in the drawings, it is not desired to limit this application for patent to this particular construction, as it is appreciated that other forms can be designed and made that would involve the same principles and come within the scope of the appended claims.

What I claim is:

1. A fluid switch assembly comprising a casing including front and rear sections abutting and joined together in a detachable manner, electrodes passing from the exterior into the interior of the front section and enclosed in insulation, said casing being provided with a longitudinal chamber extending substantially throughout its length, said rear section being formed with an annular recess therein, a solenoid encompassed by said rear section and extending from said recess, a hollow plunger including a tube, a core and a piston extended therefrom disposed in said chamber and reciprocable therein, said tube, piston and core member so arranged and spaced as to divide said chamber into three spaced sub-chambers in axial alignment, a fluid conducting medium in said chambers and tube for operatively contacting said electrodes, said solenoid on being energized being adapted to pull said core towards it and move the plunger so that the medium will be propelled from one subchamber to another and selectively bridge and unbridge said electrodes while the piston is covering and uncovering them as it takes up certain predetermined positions in its travel.

2. The switch of claim 1 with a resilient member disposed in said chamber and operatively contacting said core member for returning the same to a former predetermined position had by it and its piston when the solenoid is not actuating it.

3. The switch of claim 1 in which the piston is insulated from said medium but traveling therein and including passages longitudinally there-through for facilitating the movement of the medium as the plunger is pulled by said solenoid.

4. A mercury relay for use in any position with

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respect to vertical and horizontal including a casing having a closed bore therein, a spring-pressed plunger sliding in said bore and including a hollow tube shorter than the bore and having at one end a piston of insulation with axial openings therethru and having at the other end an armature, spaced to provide a sub-chamber between the piston and the armature, a solenoid partly surrounding the armature in a position to move the plunger against the urge of its spring, a terminal for a first circuit, a terminal for a second circuit, both terminals being located in the closed bore in the path of the piston and in the path of the sub-chamber as it moves with the hollow tube, and a body of mercury within the bore at both ends, in the tube and in the sub-chamber, hence in contact with one of said terminals, the movement of the plunger under pull of the solenoid moving the mercury from one end to the other end of the bore and moving the mercury out of contact with said one terminal and into contact with the other terminal.

5. The relay of claim 4 in which the terminals are each two spaced rings.

6. The relay of claim 4 in which the tube has a transverse opening adjacent one of the terminals and leading from the inside of the tube to said sub-chamber to permit flow of mercury to and from the terminal as the piston moves and the mercury consequently flows thru the longitudinal bores in the piston as well as thru said opening.

7. In a mercury switch, a container having a

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bore, a solenoid surrounding the bore, a hollow piston snugly fitting the bore and having a hole therethru parallel to the axis, an armature core coaxial with the piston and a hollow tube connecting the piston and core in spaced relation to provide between them a sub-chamber, a pool of mercury within the tube, at both ends of the bore and in the sub-chamber, whereby the member in reciprocating will force the mercury from one end of the chamber to the other and will force the mercury thru said hole into or out of the sub-chamber between the piston and core.

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