March 5, 1935. C. J. WARNKE 1,993,045

MERCURY SWITCH

Filed Jan. 5, 1931

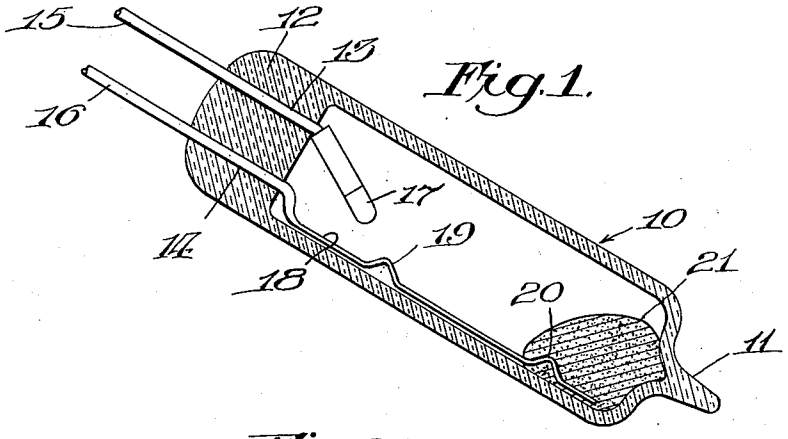


Fig. 1.

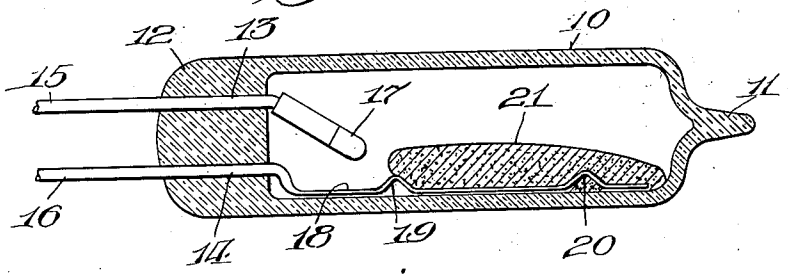


Fig. 2.

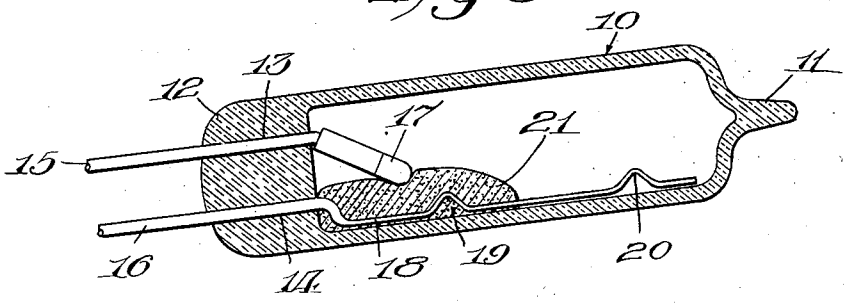


Fig. 3.

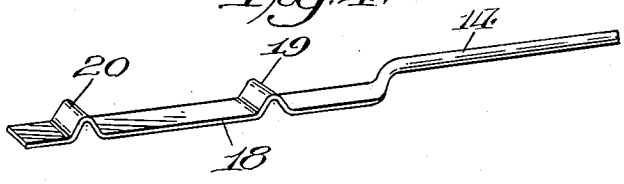


Fig. 4.

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MERCURY SWITCH

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Application January 5, 1931, Serial No. 506,558

4 Claims. (Cl. 200—152)

My invention relates to mercury switches and is concerned primarily with the production of a device of this nature which is characterized by an improved manner of operation.

One object of my invention is to provide a mercury switch which is arranged to interpose a temporary obstruction to the free movement of the mercury in order to prevent oscillation thereof and its slow bumping tendency under vibratory conditions, as well as to insure a positive snap action of the mercury by reason of its rapid displacement to make and break the circuit when the switch container has been tilted sufficiently to overcome the retardation presented by the obstruction.

A further object is to devise a mercury switch in which the completion or interruption of the electrical circuit within the switch is effected between the mercury and an electrode, the mercury being always in electrical connection with one electrode of the switch and movable, while still maintaining this contact, to make and break the circuit with the other electrode, the contact therefor being in the nature of mercury to metal.

A further object is to provide a switch of the character indicated in which that electrode with which the mercury is always in contact extends substantially the length of the switch container, preferably adjacent the floor thereof, for facilitating the movement of the mercury between its operative and inoperative positions.

A further object is to devise a switch of the character described and particularly one having a floor electrode whose length is such as to maintain contact with the mercury in all operative positions of the switch container, the electrode being provided with crimps, corrugations, or other projections for interposing obstructions to the free movement of the mercury and preferably disposed to achieve the desired snap action as the mercury approaches and leaves the other electrode to make and break the circuit, respectively.

A further object is to devise a mercury switch which is operable by a movement through a small angle and is, therefore, peculiarly adapted for use in a wide range of installations where space conditions are restricted and where the extent of available movement in the apparatus controlled is small.

Mercury switches, as now made, fall generally into the classes of mercury to mercury contact or mercury to metal contact. The former type is relatively expensive to manufacture, since it requires special shapes of containers and particular arrangements and dispositions of the electrodes in order to assure the character of contact indicated. In the mercury to metal type of switch, while it is generally intended to secure such a kind of contact under commercial operation, the arcing more frequently obtains between the two electrodes, rather than from the mercury to one electrode, with a definite formation as regards the deposits of impurities from the mercury on the container walls forming the switch tube. These impurities tend to cloud the tube and form deposits of slag or film which eventually results in a short circuiting of the switch and thus decreases its useful life. Moreover, switches of this character are inclined to have a sluggish action, particularly in small angle installations, and where used under conditions of vibration, the mercury tends to oscillate in the switch container or to slowly bump therealong, all of these operative conditions being objectionable and conducive to lessening the useful life of the switch.

With these disadvantages in view, the mercury switch disclosed in the present application has been devised. The character of the switch construction definitely provides for the mercury to metal contact, through arranging for a constant contact of the mercury with one of the electrodes, whether the switch is occupying an operative, an inoperative, or an intermediate position. Such arcing as may occur, therefore, can bridge the space only between the mercury and one electrode, so that the rate of deposits of the above noted impurities within the switch tube is substantially halved with a resulting extension in the operative life of the switch, relative to similar types now in use. As a further specific improvement, one of the electrodes is generally arranged adjacent the floor of the switch container and extends substantially throughout the length thereof, thus facilitating within the limits presently noted the riding of the mercury back and forth along the container floor. Switches of this type may be operated through a small angle and therefore require only a low power source.

One of the most important advantages embodied in the present invention is the disposition of suitably disposed obstructions in the path of the mercury movement which exercise substantially a damming effect on the flow of the mercury, preventing its movement in either direction until the switch container has been tilted sufficiently to overcome the obstruction. Oscillatory movements of the mercury are, therefore, inhibited and the mercury mass is generally maintained in a given location until the switch

container has been tilted sufficiently to overcome the obstruction, whereupon the mass moves with a rush into either circuit making or circuit breaking positions. My improved switch is, therefore, characterized by substantially a snap action which greatly improves its operative characteristics, reducing arcing with its tendency to vaporize the mercury and cause slag and film deposits within the container tube, all of which advantages result in lengthening the useful life of the switch.

These and further objects of my invention will be set forth in the following specification, reference being had to the accompanying drawing, and the novel means by which said objects are effectuated will be definitely pointed out in the claims.

In the drawing:

Figure 1 is a sectional elevation of one form of my improved switch, showing the same tilted in an exaggerated, circuit breaking position in order to illustrate with more clearness the internal construction of the switch.

Fig. 2 is a view similar to Fig. 1, with the mercury still occupying a circuit interrupting position, but with the switch container having reached such an angular position that further movement in a counter-clockwise direction will cause a displacement of the mercury mass toward the left, or toward a circuit making position.

Fig. 3 is a view similar to Fig. 2, showing the switch container in a succeeding position with the mercury mass bridging the gap between the electrodes to complete the electrical circuit within the switch.

Fig. 4 is a perspective view of one form of an improved type of electrode which may be employed in connection with my switch.

The switch shown in Fig. 1 is intended merely as illustrative of switches of this general character and it will be understood that the details of construction may be modified as appears desirable, dependent upon the external shape of the switch container and the disposition and number of the lead-in conductors employed. As illustrated, the switch comprises a container 10 which may be formed of glass or other suitable substance and in the type shown has a generally elongated shape, although the precise nature of the latter forms no part of the present invention. However shaped, the container 10 will have a portion 11 which is pinch-sealed during the manufacture of the switch in the usual manner in order to hermetically seal said container, and through some portion of the closure constituting the container, represented generically by the numeral 12 designating an end wall of the container 10, lead-in conductors 13 and 14 are sealed and connected internally of the container to any suitable source of electricity by means of conductors 15 and 16, respectively.

Within the container 10, the lead-in conductor 13 has provided on the extremity thereof an electrode 17, while the lead-in conductor 14 may have attached thereto or formed therewith by any of the well known means an electrode 18 which extends substantially the length of the container 10 and relatively close to the bottom thereof, Fig. 1 illustrating a vertical section of the switch, or the electrode 18 may extend less than the length of the switch container, since the generic aspect of my invention resides in features that will be presently described. In cross section, the electrode 18 is illustrated as having a quadrilateral configuration with which good results have been obtained, although it is considered to be within the generic scope of this invention to shape said electrode as desired. It will also be understood that the electrode 18 may be formed as a continuation of the lead-in conductor 14, thus eliminating the high resistance spot which would otherwise occur if the junction is formed in the manner first indicated above.

Adjacent the electrode 17, the electrode 18 is crimped, or otherwise treated, to provide a projection 19 and a similar projection 20 is formed on the electrode 18 at a predetermined distance remote from the electrode 17 for a purpose hereinafter explained. This disposition of the projections 19 and 20 is to be regarded only as one embodiment of the invention, since their primary purpose is to interpose a damming resistance to the free flow of the mercury as hereinafter described, so that it is obvious that, in a different style of mercury switch, equivalent projections may be formed on the wall of the container 10 itself.

Except for the relation between the electrode 18 and the remainder of the switch parts and the conception of interposing a resistance to the free flow of the mercury, the details of construction of the switch form no part of the present invention, the sealing of the lead-in conductors 13 and 14 within the end wall 12 being such as to prevent leakage at these points, and said conductors being formed of material that is characterized by substantially the same coefficient of thermal expansion as the material forming the container 10, in accordance with standard practice. This container also encloses a body of mercury 21 which is always in contact with the floor electrode 18 in the type of switch illustrated in the drawing, although so far as the conception embodied in the use of the projections 19 and 20 is concerned, the mercury 21 may not have any contact with either electrode in a circuit breaking position. However, in the type shown, the mercury 21 is shifted from end to end of the switch container 10 as said container is tilted by any approved means, the position of the mercury in Fig. 1 indicating a circuit breaking position, as does also Fig. 2, and it being understood that when the container 10 is tilted to the position shown in Fig. 3, the mercury mass will move along the bottom of said container until it bridges the space between the electrodes 17 and 18, thus completing the electrical circuit within the switch.

As will be obvious from the above description, such arcing as may occur within the switch during its operation is always from the mercury 21 to the electrode 17 for the type of switch illustrated, with the attainment of the advantages which have been noted particularly above. Referring to Fig. 2 and considering that the container 10 is being tilted by rotation in a counter-clockwise direction, it will be apparent that in moving toward the left as shown in said figure, the mercury 21 encounters the projection 19 which temporarily dams the flow of said mercury in the indicated direction until the container 10 has been moved sufficiently to permit the mass of mercury to flow over the crest of the projection 19. At this time, the flow occurs with a sudden rush so that the movement of the mercury into contact with the electrode 17 occurs with great rapidity with a corresponding reduction in the tendency of the switch to arc. Similarly, when the container 10 is rotated in a clockwise direction, the projection 20 will dam the flow of the

mercury 21 toward the right, retaining it in circuit closing position with the electrode 17, until the container 10 has achieved a position such that the mass of mercury is enabled to ride over the crest of the projection 20. Thereupon, the mercury mass 21 will move with great rapidity toward the right to achieve a circuit breaking position with a corresponding reduction in any arcing tendency between the mercury and the electrode 17. As noted above, so far as this aspect of the invention is concerned, it is deemed to be within the scope of the invention to embody the projections 19 and 20 or any required number thereof in the forms shown, or they may be formed on the container wall itself, or upon any auxiliary device which may be mounted within the container 10, provided the operative relation with respect to the mercury is retained.

While I have shown one set of elements and combinations thereof for effectuating my improved mercury switch, it will be understood that the same is intended for purpose of illustration only and in no wise to restrict my device to the exact forms and structures shown, for many changes may be made therein without departing from the spirit of my invention.

I claim:

1. A mercury switch comprising a tiltable, sealed container, electrodes positioned within said container and connectible to an external source of electrical energy, and a mass of mercury always in contact with one of said electrodes and movable, while maintaining said contact, to bridge the space between said electrodes, said constantly contacted electrode being provided with imperforate projections having a height sufficient to restrain the free movement of the mercury toward circuit-closing or opening positions until the container has been tilted a predetermined degree.

2. A mercury switch comprising a tiltable, sealed container, electrodes positioned within said container and connectible to an external source of electrical energy, one of said electrodes extending substantially the length of said container adjacent the floor thereof, and a mass of mercury movable in said container to bridge the space between said electrodes, said last named electrode being provided with imperforate projections having a height sufficient to restrain the free movement of the mercury toward a circuit-closing or opening position until the container has been tilted a predetermined degree.

3. In a mercury switch comprising a tiltable sealed container, electrodes positioned within said container and connectible to an external source of electric energy, one of said electrodes being positioned adjacent to the floor of the container and extending longitudinally thereof, a mass of mercury movable in said container to bridge the space between said electrodes, and a projection on the last named electrode adapted to prohibit the flow of mercury to and/or from circuit closing position until the container has tilted through a pre-determined angle, said projection being arranged so as to allow the mercury to pass over it when the said angle has been reached.

4. A mercury switch comprising a tiltable sealed container, electrodes positioned within said container and connectible to an external source of electric energy, one of said electrodes being relatively flat and being positioned adjacent to the floor of the container and extending longitudinally thereof, a mass of mercury movable in said container to bridge the space between said electrodes, and a projection on the last named electrode adapted to prohibit the flow of mercury to and/or from circuit closing position until the container has tilted through a pre-determined angle, said projection being arranged so as to allow the mercury to pass over it when the said angle has been reached.

CARL J. WARNKE.