Oct. 11, 1932. K. HUNCIKER 1,882,614

INCLOSED MERCURY SWITCH

Filed July 31, 1931

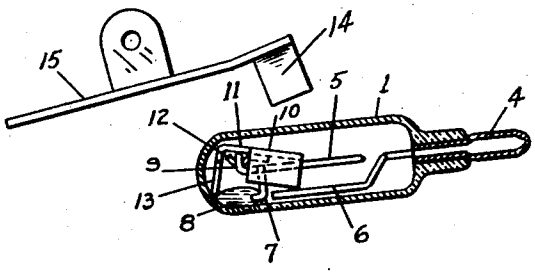


Fig.1

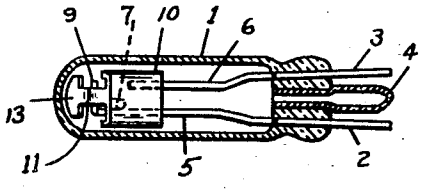


Fig.2

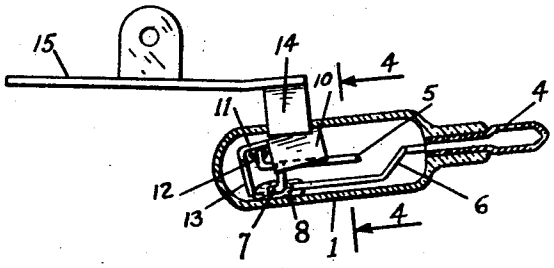


Fig.3

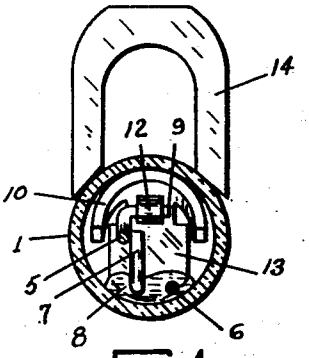


Fig.4

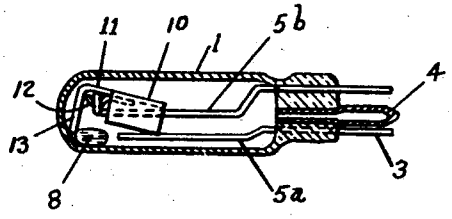


Fig.5

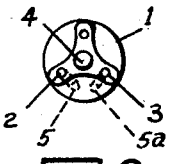


Fig.6

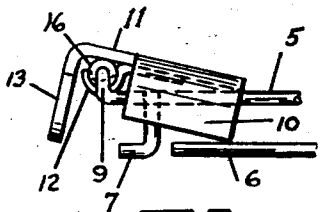


Fig.7

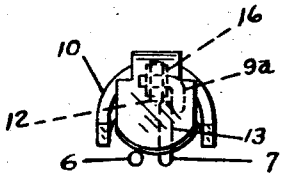


Fig.8

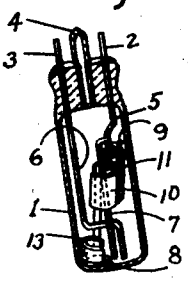


Fig.9

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UNITED STATES PATENT OFFICE

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INCLOSED MERCURY SWITCH

Application filed July 31, 1931. Serial No. 554,182.

This invention relates to improvements in electric switches and more particularly to inclosed mercury switches.

The tilting mercury tube switch, including a small quantity of mercury inclosed in a sealed glass tube having spaced apart electrodes sealed in the walls is of such construction that when tilted about its axis in one direction the mercury flows to one end and closes the circuit between the electrodes and when tilted in the opposite direction the mercury flows away from and breaks the circuit between the electrodes, has a recognized place in the electric switch art. The operation of such switches depends upon the tilting movement of the tube and there are many occurrences where an inclosed contact switch is desirable but the tilting of such a switch is either undesirable or impossible to be installed.

It is an object of this invention to provide a mercury tube switch in which the mercury tube may remain in fixed position and the mercury caused to make and break the circuit therethrough without tilting the switch tube.

With this and other objects in view, reference is made to the accompanying sheet of drawing which illustrates preferred forms of this invention, with the understanding that minor detail changes may be made therein without departing from the scope of this invention.

In the drawing,—

Figure 1 is a view illustrating a part of the operating means in side elevation and a mercury tube switch embodying this invention partly in central longitudinal vertical section and partly in side elevation, showing the position of the parts when the circuit is broken.

Figure 2 is a view of the mercury tube switch illustrated in Figure 1 partly in central longitudinal horizontal section and partly in top plan view.

Figure 3 is a view similar to Figure 1 showing the position assumed by the parts when the circuit is closed.

Figure 4 is an enlarged detail view partly in section and partly in elevation taken on the line 4—4, Figure 3 looking in the direction of the arrows.

Figure 5 is a view in central longitudinal vertical section through a mercury tube switch, with parts in side elevation, of a modified form of this invention.

Figure 6 is a view in end elevation of Figure 5.

Figure 7 is an enlarged detail view in side elevation of the actuating parts in modified form.

Figure 8 is a view in end elevation of Figure 7.

Figure 9 is a view in central vertical sections with parts in elevation of another modified form.

The embodiment of this invention illustrated in Figures 1 to 4 include a sealed glass tubular container 1 rounded at one end and having two leading in wires 2 and 3 sealed in a central horizontal plane on each side of a tipped filling stem 4 at the other end. Electrodes 5 and 6 are welded to the leading in wires 2 and 3, respectively, which extend in prolongation thereof with electrode 5 continuing in the same plane toward the opposite closed end while electrode 6 is bent downward and extended parallel and adjacent the lower wall of the tube 1 and terminated at a distance from the rounded end, as shown. Electrode 5 is provided with a right angular extension 7 welded thereto terminating in or near the body of mercury adjacent the lower wall of the tube 1 spaced apart from and opposite the end of the other electrode 6.

A relatively small body of mercury 8 is inclosed in the tube 1, so that when the rounded end of the tube 1 is depressed slightly, as shown in Figures 1 and 3, and fixed in that position, the mercury will collect and normally remain at the lower end of the tube 1

out of contact with the electrode 6. In this position when the leading in wires 2 and 3 are connected in an electric circuit, the said circuit will be opened within the tube and to close the circuit therein the mercury 8 must bridge the gap between the electrode 6 and the extension 7 of the electrode 5.

In accordance with this invention the mercury 8 is bodily moved to contact the said electrodes to close the circuit and when released will return by gravity to the rounded end of the tube, expose the ends of one or both electrodes, and open the circuit therebetween. One means for bodily moving the mercury to close the circuit is shown in Figures 1 to 4, inclusive. In this form the electrode 5 is extended beyond the attached projection 7 and then bent upward and to the right, as shown in Figures 1, 2 and 4, to form a fulcrum 9 for the mercury moving element. This element includes a portion of magnetic metal 10 preferably semi-circular in cross section and clearly shown in Figure 4 with a central longitudinal member 11 projecting therefrom towards the rounded end of the tube 1 which is provided upon its underside with an engaging member 12 embracing the fulcrum 9, whereby the element may be rotated thereabout, and the projecting portion 11 is then bent at right angles to provide a slightly wider mercury engaging member 13 curved at its lower end, as shown in Figure 4, so that when the element is rotated about the fulcrum 9 the portion 13 will engage the body of mercury and bodily move it to close the electrical connection between the electrode 6 and the projection 7 of the electrode 5. The portion 10 is of greater size and weight so that the mercury moving element normally assumes the position shown in Figure 1.

It is desired with this invention to make possible the passage of small amounts of current through the switch and in order not to pass this current through the mercury moving means, which would be impractical because of its resistance, the electrode extension 7 is welded to the electrode 5 and so positioned that upon movement of the parts to close the circuit the mercury first makes contact with extension 7 and then with electrode 6. To insure this operation the extension 7 may be positioned, as shown in the drawing, to always be immersed in the mercury.

It is readily seen that with this arrangement small amounts of current can be passed and that electrode 5 beyond the point of weld with extension 7, is used, as a matter of convenience and simplicity in construction, as the fulcrum for the mercury moving means 13 and not as a conductor. Furthermore, the construction of this switch without the extension 7 would still be impractical, regardless of the current passed therethrough because the electrode connection made through the fulcrum would result in arcing, causing the element to stick.

The arrangement of the parts, comprising the conducting means as shown, is an essential part of this invention in producing a switch of this design.

The mercury engaging member 13 is shaped at its lower extremity, as shown in Figure 4, to conform to the contour of the curved end of the tube so when in open position, as shown in Figure 1, it rests to prevent the mercury from flowing under and becoming lodged behind it.

To actuate the mercury moving element a permanent magnet 14 is employed. It is preferable to mount the magnet upon a pivoted support 15 adapted to move the magnet away from the fixed tube 1 when it is desired to open the circuit therethrough and adapted to cause the magnet to approach the tube above the magnetic portion 10 of the contained mercury moving element with the poles of the magnet on opposite sides of the tube 1, as shown in Figure 4, whereby the magnetic portion 10 is attracted by the magnet and causes the element to rotate about the fulcrum 9 to bodily move the mercury 8 to contact and close the circuit between the electrode 6 and the projection 7 of the other electrode and maintain the circuit closed as long as the magnet 14 holds the portion 10 in its uppermost position, as shown in Figure 3, and upon the removal of the magnet 14, the weight of the portion 10 causes the element to rotate about its fulcrum removing the support of the portion 13 for the body of mercury whereupon the mercury flows by gravity to the bottom of the curved end of the tube 1 and opens the contact between the electrodes.

Mercury tube switches of the general type illustrated in Figures 1, 2 and 3 are a machine product, the leading in wires 2 and 3 with the electrodes 5 and 6 welded thereto and the filling stem 4 are positioned in a work holder, the tube 1, closed at one end, is positioned over the work holder, the open end heated and sealed to embrace the leading in wires and filling stem. The filling stem is open and the contained air is removed from the tube and replaced with the mercury and the desired gas and then tipped off, as shown. The particular construction and arrangement of the element for bodily moving the mercury as heretofore described is such that the said element may be assembled upon the electrode before it is placed in the work holder to be received and sealed within the tube 1.

Figures 5 and 6 illustrate another manner for supporting the element for bodily moving the mercury. In this instance, the leading in wires 2 and 3 each are welded to simi-

lar electrodes 5 and 5ª, respectively, which extend parallel to each other adjacent the bottom of the tube 1, terminating in the same plane at a distance from the rounded end of the tube. The element for bodily moving the mercury is constructed, as above described, and is fulcrumed upon a third wire 5ᵇ which may be of the same material as the electrode welded to a leading in wire to facilitate in the sealing of the open end and extends the same distance from the exterior of the sealed tube 1 as the leading in wires 2 and 3 and may be positioned in the work holder with them and sealed in the tube by a three part pressing jaw so that the wire 5ᵇ enters adjacent the top of the seal, as shown in Figure 6. The wire is then bent downward and extended parallel to the axis of the tube, as shown in Figure 5, and at a point between the extension of the electrodes 5 and 5ª and the rounded end of the tube is bent upward and at right angles to the axis of the tube 1 to form a fulcrum 9ª upon which the element for bodily moving the mercury is mounted for rotation. Inasmuch as the exterior projection of the wire 5ᵇ is only used in positioning the moving parts carried thereon during the fabrication of the switch and forms no part of the circuit to be controlled thereby, it may be cut off flush with the exterior of the seal, if desired.

In supporting the element 13 for bodily moving the mercury as shown in Figures 5 and 6 and just described, the same results are obtainable as those achieved in the type shown in Figure 1 where the extension 7 is used to eliminate the possibility of the mercury moving means being used as a conductor.

If desired, the element 13 in the type shown in Figure 1 may also be made independent of connection with the electrode by mounting the fulcrum 9 upon a sleeve 16 of insulating material, as shown in Figures 7 and 8.

A switch constructed in accordance with this invention permits the mercury tube to be held stationary and provides a means for bodily moving a body of mercury to and from the electrodes to close and open the electric circuit which means is employed only to cause the movement of the mercury and forms no part of the connection made when the circuit is closed through the switch.

Figure 9 illustrates the application of this invention to construct with slight modifications in the arrangement of the parts, a switch which will operate in a near vertical position. The magnet used to attract the magnetic portion 10 to actuate the closing of the circuit through the switch would in this case be positioned to operate to right of the tube when same is mounted as shown in the drawing.

What I claim is:

1. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted within the container adapted to be actuated by external magnetic means to bodily move said fluid to contact said electrodes to close the circuit through the switch.

2. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted independently of the electrical connections within the container adapted to be actuated by external magnetic means to engage and bodily move said fluid to contact said electrodes to close the circuit through the switch.

3. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and an angular fluid moving member pivoted within the container having a portion on one side of the pivot adapted to engage the fluid and a heavier portion of magnetic material on the other side of the pivot normally maintaining the first portion to allow the fluid to remain out of contact with the electrodes and adapted to respond to external magnetic attraction to be rotated and cause the first portion to bodily move the fluid to close the circuit through the electrodes.

4. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted within the container adapted to be actuated by external magnetic means to bodily move said fluid to contact said electrodes to close the circuit through the switch, said pivoted means being rotatably mounted upon an extension of one of the electrodes.

5. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted within the container adapted to be actuated by external magnetic means to bodily move said fluid to contact said electrodes to close the circuit through the switch, said pivoted means being rotatably mounted upon an extension of one of the electrodes and insulated therefrom.

6. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted within the container adapted to be actuated by external magnetic means to bodily move said fluid to contact said electrodes to close the

circuit through the switch, and a support for said pivoted means sealed in the wall of the container.

7. A fluid switch including a sealed container having two spaced apart electrodes supported in the walls thereof and containing a body of conductive fluid normally out of contact therewith, and means pivoted within the container adapted to be actuated by external magnetic means to bodily move said fluid to contact said electrodes to close the circuit through the switch, and a support for said pivoted means sealed in the wall of the container and independent of said electrodes.

KARL HUNCIKER.