Oct. 4, 1932. P. K. CRAMBLET 1,880,829

MERCURY SWITCH

Filed Jan. 24, 1927

Fig. 1.

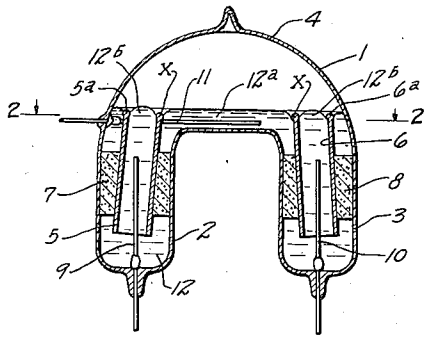


Fig. 2.

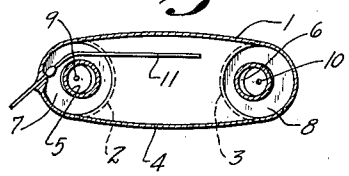


Fig. 4.

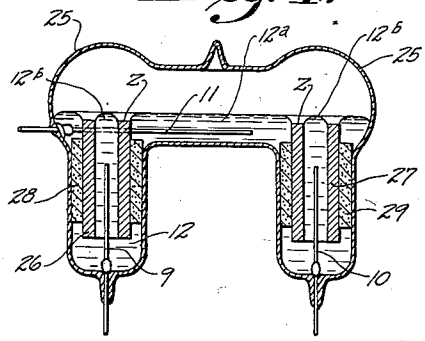


Fig. 3.

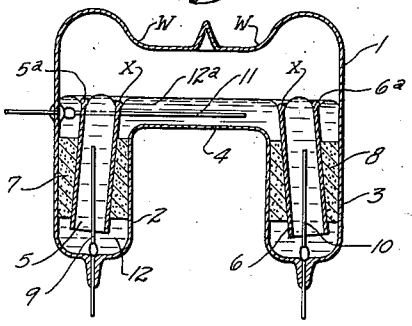
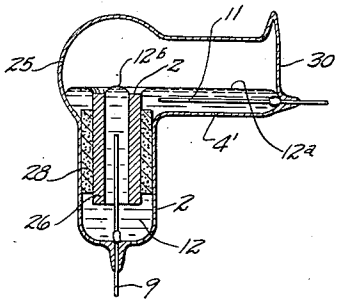


Fig. 5.



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UNITED STATES PATENT OFFICE

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MERCURY SWITCH

Application filed January 24, 1927. Serial No. 163,027.

This invention relates in general to mercury switches and more particularly to a mercury switch especially adapted to be operated shuttle fashion, that is to be reciprocated back and forth bodily to effect rapid operation of the switch, although also adapted to be operated by a rocking or tilting movement or otherwise.

One object of the present invention is to provide a switch of this character embodying a soft glass outer envelope and hard glass or quartz inner tubes or sleeves which are so organized with the outer envelope as to obtain a mercury to mercury make and break and to confine the arc to a relatively broad area or surface of the hard glass or quartz tubes located at points removed from the soft glass envelope whereby to avoid slotting or other deterioration of the inner tubes or sleeves as well as to prevent breakdown of the outer envelope.

Another object of the invention is to provide a mercury switch of this character wherein only a small portion of the mercury moves to effect the operation of a switch, the bulk of the mercury remaining stationary and serving to immerse electrodes of the switch. Splashing or undesirable movement of the mercury is precluded.

Other objects and advantages reside in certain novel features of the construction, arrangement and combination of parts which will be hereinafter more fully described and particularly pointed out in the appended claims, reference being had to the accompanying drawing forming a part of this specification, and in which:

Figure 1 is a view in transverse central vertical section showing a switch embodying the present invention;

Fig. 2 is a view in horizontal section on line 2—2 of Fig. 1;

Fig. 3 is a view similar to Fig. 1 of a modified form of the invention;

Fig. 4 is a view similar to Figures 1 and 3 of still another modified form of the invention; and

Fig. 5 is a similar sectional view showing a variation of the construction illustrated in Figure 4.

Referring to the drawing, and more particularly to Figures 1 and 2, it will be seen that the mercury switch embodying the present invention includes a soft glass outer envelope designated generally at 1. Preferably this soft glass envelope 1 is of U shape having legs 2 and 3 providing mercury wells and a connecting portion or body portion 4. With a soft glass envelope this shape may be readily obtained by heating a glass tube and bending it on a mould or form. In the legs 2 and 3 tubes or sleeves 5 and 6, respectively, are mounted, the tube 5 being supported in spaced relation to the walls of the leg 2 on an annular supporting member and partition 7 and the tube 6 being similarly supported in spaced relation to its leg 3 on an annular supporting member and partition 8. The tubes 5 and 6 are of any suitable hard glass composition. The supporting members and partitions 7 and 8 preferably consist of asbestos and may be built up by winding a strip of asbestos tape, the wound strip or tape being cemented to the tubes or sleeves 5 and 6 and to the legs 2 and 3 of the soft glass envelope. The upper ends of the partitions 7 and 8 terminate within the legs 2 and 3 and below the body portion 4.

An electrode 9 extends in through and is sealed in the lower end of the leg 2 and terminates within the hard glass tube 5; an electrode 10 extends in through and is sealed in the lower end of the leg 3 and terminates within the hard glass tube 6; and an electrode 11 extends in through the upper portion of the leg 2 at the juncture of the leg 2 and the body portion 4 and this electrode 11 is bent or curved around the tube or sleeve 5 and lies just above the bottom wall of the connecting portion 4.

Within the envelope 1 a body of mercury 12 is provided and this body of mercury fills up the wells provided by the legs 2 and 3 and the tubes or sleeves 5 and 6 and a portion 12*a* of the mercury is disposed in the connecting portion 4 of the envelope 1. Upon reciprocation of the switch the shiftable portion 12*a* of the mercury located within the body portion of the envelope 1 shifts back and forth and alternately makes and breaks elec-

trical connection between electrodes 10 and 11 on the one hand and the electrodes 9 and 11 on the other. It is to be noted that a mercury to mercury make and break always occurs and that the make and break is between the mercury 12*a* and globule of mercury designated at 12*b* and formed at the upper end of each of the hard glass tubes 5 and 6. The portions of the mercury contained in the legs 2 and 3 and the tubes 5 and 6 are held substantially stationary by these parts. The electrodes 9, 10 and 11 are always immersed in mercury and the make and break or arcing zone occurs on the hard glass sleeves or tubes and at points removed from the wall of the soft glass envelope.

The hard glass tubes 5 and 6 have enlarged lips 5*a* and 6*a* respectively at their upper ends, these lips enlarging the surface presented by the upper ends of the tubes to afford a hard glass surface of relatively great area on which the arc occurs. In this way the action of the arc is distributed over a relatively great area and slotting or deterioration of the tubes as a result of the arcing is avoided. It is to be understood in this connection that the arc occurs on the surface X provided by the lip 6*a*. This surface X is located at a point removed from and relatively remote with respect to the walls of the soft glass outer envelope because of the relation of the tubes to this outer envelope. As shown in Figure 1, the tubes 5 and 6 extend into the connecting portion but are angled slightly to keep the arcing area away from the curving upper wall of the connecting portion. The angular positioning of the tubes is obtained by building up the ring-like partitions 7 and 8 to accomplish this result. These partitions 7 and 8 completely block the space between the outer periphery of the tubes and the inner walls of the wells so that the tubes afford the only means of communication between the interior of the wells and the connecting portion of the outer envelope. It is as a result of this feature that the make and break always occurs between the shiftable portion 12*a* of the mercury and the globules 12*b* presented at the upper ends of the hard glass tubes. As only a small portion 12*a* of the mercury moves it is possible to obtain a very rapid operation of the switch without splashing the mercury or obtaining any undesirable movements thereof.

In the form of the invention shown in Fig. 3, instead of constructing the soft glass envelope of a single tube, the U-shaped form is achieved by making the legs 2 and 3 and the body portion 4 of separate pieces of soft glass tubing welded together as indicated at W. Otherwise the construction is identical with that shown in Figures 1 and 2.

In the form of the invention shown in Fig. 4, a U-shaped form somewhat similar to that shown in Fig. 3 is had but with the modification shown in Figure 4 the legs 2 and 3 have bulbous enlargements 25 giving greater clearance between the arcing zone and the soft glass envelope. In this instance the different sections of the soft glass tube may be made separate and welded together or may be produced and united in any other suitable manner. In this form of the invention relatively heavy quartz tubes 26 and 27 are provided and are mounted in asbestos partitions and supports designated at 28 and 29. The asbestos partitions and supports are similar to the asbestos partitions and supports 7 and 8 but are designed to dispose their quartz tubes not inclined but coaxial with the legs 2 and 3. Moreover, with this construction the asbestos partitions and supports 28 extend up entirely through the legs 2 and 3 and into the connecting portion 4. With the heavy quartz tubes 26 and 27 it is not necessary to provide lips on the upper ends of the tubes as the cross section is such that the upper ends of the tubes present surfaces of relatively great area. On this relatively wide surface the arcs occur at the regions indicated at Z. As in the other embodiments of the invention, electrodes 9, 10 and 11 are provided and are immersed in a body of mercury 12, portions of which fill the wells and a portion 12*a* of which is located in the body portion and is shiftable therein as hereinbefore described. As in the other embodiments of the invention, globules 12*b* are formed at the upper ends of the tubes 26 and 27.

In Figure 5 the invention is embodied in a switch having but two electrodes, and in connection with this embodiment it is to be understood that any of the switches hereinbefore described are susceptible of this modification and that Figure 5 illustrates the variation of type of switch shown in Figure 4 only as an example. Fundamentally, all that the variation shown in Fig. 5 involves is the use of but half of the switch shown in Figure 4 with a reversal of the electrode 11 for the sake of convenience. Thus in Figure 5 there is a shortened body portion 4′ with only one bulbous enlargement 25, the end of the body portion 4′ remote from the bulbous enlargement 25 being closed as at 30. The soft glass outer envelope in the switch shown in Figure 5 employs only one leg, that is the leg 2, and has the quartz glass tube 26 supported on the leg 2 by the asbestos partition 28. The body 12 of the mercury is of somewhat less volume and includes a shiftable portion 12*a*, as before, and as in the other instance the shiftable portion 12*a* makes and breaks with the globule 12*b* across the relatively wide surface Z presented at the upper end of the heavy quartz glass tube. The electrode 9 extends up through the tube 26 as in the other embodiments of the invention.

While the tubes which are mounted on the legs in the manner described are preferably

of hard glass or quartz, it is to be understood that these tubes may be constituted of any substance capable of withstanding high temperatures and rapid temperature fluctuations.

The invention claimed is:

1. A mercury switch comprising an outer envelope of soft glass provided with spaced wells and a connecting portion between said wells, tubes disposed in the wells in spaced relation to the walls thereof and constituted of a substance capable of withstanding high temperatures and rapid temperature fluctuations, cement impregnated ring-like partitions of asbestos interposed between the tubes and the wells for supporting the tubes on the wells and blocking the space between the outer periphery of the tubes and the inner walls of the wells to make the openings of the tubes the only means of communication between the wells and the connecting portion of the outer envelope, a body of mercury having portions filling the wells and the tubes, and a shiftable portion located in the connecting portion of the envelope and alternately making and breaking contact with the portions of the mercury in the tubes, and electrodes sealed in the outer soft glass envelope and immersed in the mercury.

2. A mercury switch of the character described comprising a soft glass outer envelope of U-shape form and including spaced legs and a connecting body portion, a hard glass tube in each leg, means for supporting each hard glass tube in spaced relation to the wall of its leg, an electrode extending through and sealed in the lower end of each leg of the outer soft glass envelope and terminating in the adjacent hard glass tube, a third electrode extending through and sealed in one of the legs of the soft glass envelope at the juncture of such leg and the body portion, said third electrode extending around the adjacent hard glass tube and terminating at a point midway of body portion of the soft glass envelope and just above the bottom wall thereof, and a body of mercury located in the soft glass envelope and filling the legs thereof and the hard glass tubes in all positions of the switch, the body of mercury having globules at the upper ends of the hard glass tubes, the body of mercury having a portion disposed in the body portion of the soft glass envelope and shiftable back and forth as the switch is operated whereby to alternately bridge the third electrode and the electrodes within the hard glass tubes.

In witness whereof, I hereto affix my signature.

PAUL K. CRAMBLET.