June 27, 1933. F. ZUCKSCHWERDT 1,915,462

MERCURY SWITCH

Filed Sept. 21, 1931

Fig. 1

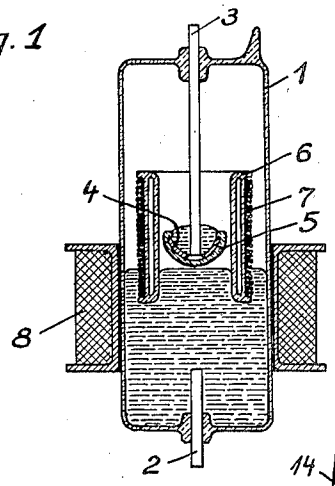


Fig. 2

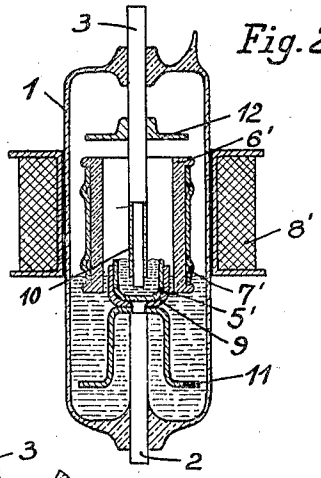
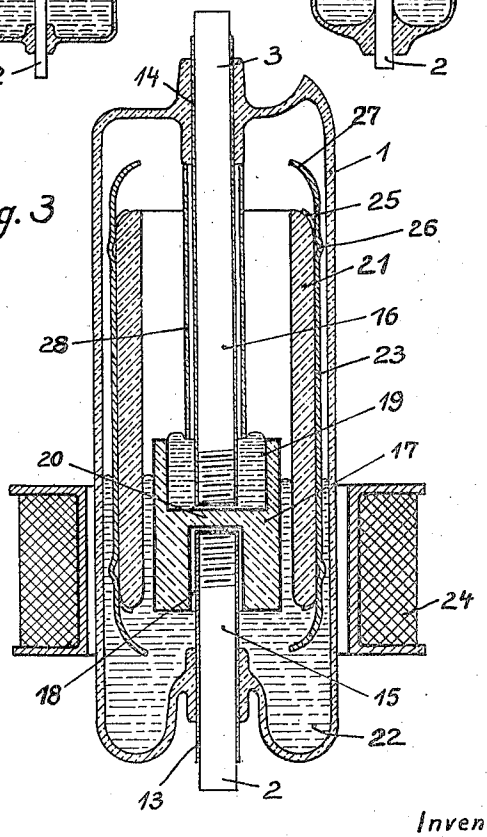


Fig. 3



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UNITED STATES PATENT OFFICE

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MERCURY SWITCH

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In electric switches using mercury as a contact making medium it is common to use a vertical glass or quartz tube fitted with electrodes and containing the mercury and a cylindrical diving or displacing body adapted to be raised or lowered by magnetic forces, applied from the outside, and thereby interrupt or close a current circuit between the mercury portions.

The invention consists therein that in a vertical glass tube the electrodes are arranged axially on both ends, the top electrode is fitted with a cup of quartz or the like insulating material adapted to be filled with mercury, and said cup is surrounded by a hollow cylindrical diver of insulating material and fitted with an envelope of magnetizable material. This arrangement gives all parts of the switch concentrical shapes, so that the heat produced by the current and by the opening sparks becomes uniformly distributed, this the more as the sparks are enclosed in the diver and its envelop, and thereby a very good durability and security against rupture by heat are ensured.

A specially simple and reliable construction consists further in centering the cup on the bottom electrode, so that the top electrode does not need to hold it but dives freely into it and at the utmost hinders it from slipping off from the bottom electrode.

Further details will appear below.

The invention is illustrated on hand of several examples in the drawing, in which

Fig. 1 is a vertical section of a switch having the cup fastened to the top electrode,

Fig. 2 is a vertical section of a switch having the cup fastened to the bottom electrode,

Fig. 3 is a vertical section of a switch having the cup resting on the bottom electrode and secured by the top electrode.

According to Fig. 1, a glass tube 1 a bottom electrode 2 and a top electrode 3, both air tightly secured by melting the glass on them. On the top electrode 3 a thin walled cup 4 of metal is fastened by riveting, and said cup is pressed into a quartz cap 5. A diver 6 consisting of a hollow quartz cylinder is inserted in the tube, and said diver is provided on its outer surface with windings 7 of soft iron wire. Outside the tube 1 a solenoid 8 is arranged for moving the diver. The bottom portion of the tube is filled with mercury up to the level shown in the drawing, so that the diver 6, 7 swims thereon at the illustrated height, and no contact exists between the said mercury and a further mercury mass enclosed in said cup 4, 5. A current closure on the solenoid 8 effects a drawing down of the diver 6, 7 and consequently a contact between both mercury masses.

According to Fig. 2, the tube 1 as well as the electrodes 2, 3 are of the same general shape and arrangement as in Fig. 1. The mercury cup consists only of a quartz cup 5′ held by a fitting 9 of cup or star like shape on the bottom electrode 2, whereas the top electrode 3 freely projects into said cup. A quartz tube 10 encloses the top electrode in the vicinity of the mercury level for obviating an occasional spark drawing on the electrode itself. The same arrangement may also be used in the switch shown in Fig. 1.

The diver here consists of a quartz tube 6′ with an iron envelop 7′ consisting of an iron sheet which is rolled up and slipped onto the tube 6′ under elastic deformation. The amount of mercury is here so defined that this relatively heavy diver displaces the mercury up to the contact giving level, and the solenoid 8′ is mounted on such a level that on a current closure it raises the diver 6′, 7′ and opens the mercury contact. It will be understood that also in this device this arrangement may be the same as in the first described switch, i. e. so that closing of the auxiliary current in the solenoid effects the closure of the main current going through the switch electrodes.

The bottom and top electrodes 2, 3 are provided with elastic abutments 11, 12 respectively for confining occasional violent movements of the diver. The lower abutment 11 and the cup fitting 9 as well as the wall of the tube 1 include sufficient free space for the flow of the mercury during the switching movements. For better guiding, the diver may have small projections sliding on the tube wall.

According to Fig. 3, the parts 1, 2, 3 are

again essentially the same as described in the foregoing description. Each of the electrodes 2, 3 consists of a tube 13, 14 respectively, of a usual nickel iron alloy, and of a copper rod 15, 16 respectively, loosely inserted therein and united by screw threads near the inner ends. Iron end plates welded to the tubes 13, 14 serve for protecting the copper from the mercury.

Between the electrodes a cup 17 is arranged which consists of a cylindrical body of quartz or other insulating material excavated on its top and bottom sides. The bottom excavation 18 contains the free inner end of the bottom electrode 15 with small play, so as to ensure good centering of the cup, and the top excavation 19 is larger and serves as a mercury cup. The wall 20 intermediate both excavations lies with small play between both electrodes so that the cup 17 is thereby held in place.

The cup 17 is surrounded with a larger clearance by a tube like diver 21 of quartz or other insulating material swimming on the mercury contained in the tube 1. The diver 21 is enveloped by a mantle 23 of magnetizable material, and the tube 1 is surrounded by a solenoid 24 serving for moving said diver downward. The mantle or envelop 23 is secured against axial dislocation on the diver 21 by projections 25 bent out of the sheet metal forming said envelop and gripping over the ends of the diver 21. Projections 26 pressed outward from the envelop 23 serve for guiding it on the tube wall. Long, narrow extensions 27 of the envelop 23 serve for elastically confining the movements of the entire diver by abutting against the end walls of the tube 1.

The inside portion of the top electrode 3, 14, 16 is enclosed in a tube 28 of quartz or other temperature resisting insulating material extending up to the cup 17 for protecting the electrode against sparks.

The operation corresponds to that described in connection with Fig. 1, i. e. a current closure on the solenoid causes the switch to close the main current, but also according to Fig. 2 the inverse effect may be attained, i. e. that a current closure on the solenoid may open the current circuit in the switch.

In all described modifications the solenoid may be replaced by an axially displaceable permanent magnet in case that the switching operation shall be effected not by an auxiliary current but by any mechanical device.

I claim:

1. A mercury switch comprising in combination a hermetically closed tube of insulating material partly filled with mercury, a top electrode and a bottom electrode projecting into said tube, a cup of mercury-filled insulating material permanently surrounding the lower portion of said top electrode, a hollow cylindrical diver of insulating material surrounding said cup and swimming on the mercury in said tube, and an envelop of magnetizable material on said diver.

2. A mercury switch as claimed in claim 1, in which the cup of mercury-filled insulating material is attached to the lower end of the top electrode.

3. A mercury switch as claimed in claim 1, in which the cup of mercury-filled insulating material is mounted on the upper end of the lower electrode.

4. A mercury switch as claimed in claim 1, including stop elements to limit the vertical movement of the diver.

In witness whereof I affix my signature.

FRITZ ZUCKSCHWERDT.