June 26, 1928. 1,675,131

L. A. M. PHELAN ET AL

ELECTRICAL SWITCH

Filed March 1, 1924

Fig 1.

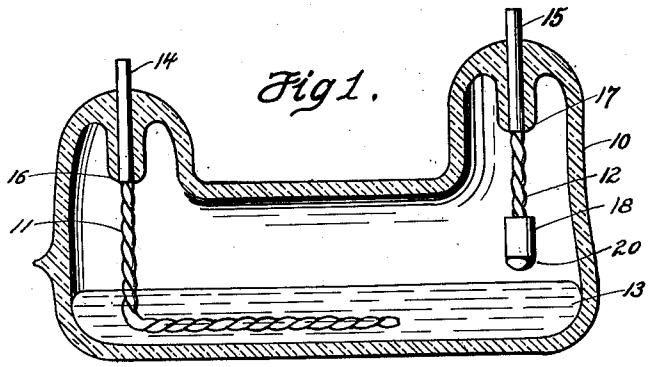


Fig 4.

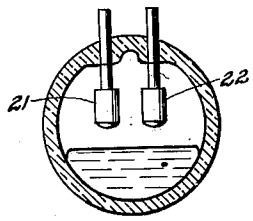


Fig 2.

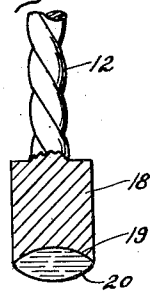


Fig 5.

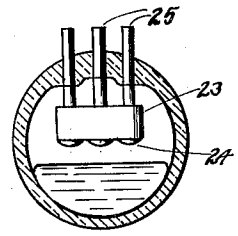
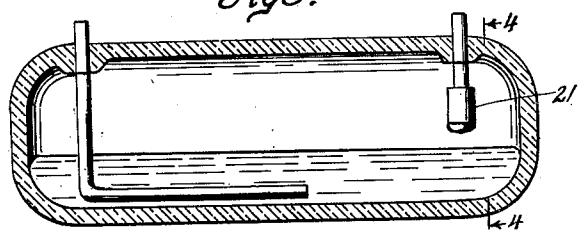


Fig 3.



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Patented June 26, 1928. 1,675,131

UNITED STATES PATENT OFFICE.

LOUIS A. M. PHELAN AND CLIFFORD HOTCHKISS, OF BELOIT, WISCONSIN, ASSIGNORS, BY DIRECT AND MESNE ASSIGNMENTS, TO ABSOLUTE CON-TAC-TOR CORPORATION, A CORPORATION OF INDIANA.

ELECTRICAL SWITCH.

Application filed March 1, 1924. Serial No. 696,279.

Our invention relates to electrical switches and has special reference to electrical contact making devices comprising spaced electrodes that are sealed into a closed container and are adapted to be brought into electrical conducting relation with one another through the agency of a movable conducting body, preferably a liquid, such as mercury, likewise disposed in said container, which upon being tilted is instrumental in performing the circuit closing or circuit opening functions of the switch.

More particularly, our invention relates to an electrical contactor device of the character indicated above, wherein electrical contact making or breaking will always be effected between two or more bodies of the conducting liquid. In contact making devices of this type as heretofore used, the circuit is usually made or broken between the body of conducting fluid on the one side and an electrode of solid conducting material on the other. With such contactor devices as heretofore used, it has been our experience that the occurrence of arcing directly upon an electrode of solid conductive material will sooner or later cause deterioration and extensive pitting of such electrodes. Particles of the solid material will be driven off or volatilized and will thus not only greatly reduce or deform the electrode, but will furthermore contaminate the conducting fluid and the various insulating portions of the switch.

However, with the switch embodying our present invention all arcing directly upon unprotected surfaces of solid conductive electrodes is avoided. In the device comprising this invention, the arcing takes place only between surfaces of the conducting liquid and hence, if a portion of this liquid is driven off or volatilized, no permanent injury to the device will result, since upon cooling, the volatilized material will again become liquid and revert to its former condition.

The applicants are well aware that attempts have previously been made to make and break an electrical circuit, between two bodies of conducting liquid within a container, but in all such instances it has been the usual practice to permit the make or break of the circuit, together with the resulting arc, to occur directly on or closely adjacent to the container walls. This form of structure is very unreliable for making or breaking an appreciable quantity of current since the heat of the arcing will very soon destroy the adjacent container wall and also effect the formation of a conductive scum over the wall portion, which scum will short-circuit the switch. Furthermore, if such switches are hermetically sealed to exclude all oxygen or to retain a suitable insulating and inert atmosphere, the heat of arcing will soon sufficiently deteriorate the container wall to permit the entrance of air or the exhaustion of the inert atmosphere from the container.

In order to avoid the aforementioned defects of the prior devices when used on heavy currents, with the structure embodying our present invention, the make and break and the consequent arcing are made to take place at a point widely spaced from the container walls, as well as from all other portions of the switch which may be subject to injury from the excessive heat.

In order to achieve the foregoing advantages, we have developed an electrode structure having an enlarged head portion which is spaced from the container walls and which is adapted to gather and hold suspended a drop of the conducting liquid so that when the main body of the conducting liquid is tilted, contact will be made or broken between this suspended drop and the main body of liquid. The suspended drop of conducting liquid will therefore comprise the actual contact point of the electrode and serve to protect the solid conductive portion thereof from actual exposure to the arc and the excessive heat.

The objects and advantages above indicated, as well as further aims of our invention, will become more fully apparent from the following specification and claims taken in connection with the accompanying drawing, in which—

Figure 1 is a cross-sectional view taken longitudinally through the center of an electrical contactor embodying our invention;

Fig. 2 is a detail sectional view of an electrode as used in the structure of Fig. 1;

Fig. 3 is a cross-sectional view taken longitudinally through the center of a modified form of electrical contactor embodying our invention;

Fig. 4 is a sectional view taken upon the line 4—4 of Fig. 3; and,

Fig. 5 is a sectional view similar to Figure 4 but showing a still further modification of the structure embodying our invention.

The contactor device shown in Fig. 1 comprises in a general way a container 10 of blown glass or other suitable insulating material having contained therein a pair of electrodes 11 and 12 and also a body of conducting liquid such as mercury 13.

The electrodes 11 and 12 may be respectively provided with leading-in wires 14 and 15 sealed into the container in any suitable manner, such for example, as shown and described in Patent No. 1,598,875 of Louis A. M. Phelan and Clifford Hotchkiss, entitled "Electrical apparatus".

As stated in the above prior application, the electrodes 11 and 12 should preferably be formed of a material which is inert in the presence of an electric arc under the conditions present in the device. In furtherance of this end, the body of mercury is preferably refined to an unusual state of purity and the remaining space within the container may be filled with an inert gas.

As shown in Fig. 1, the electrode 11 merely comprises stranded wires extending for a considerable distance along the container in a position where they will be submerged in the body of mercury 13. This electrode may be joined to the leading-in wire 14 at a point 16 where the leading-in wire emerges from the glass. With the joint at this point all of the leading-in wire is protected by the glass from exposure within the container—only the electrode wire which is inert under the conditions present, being exposed within the container.

The electrode 12 likewise may comprise a stranded wire connected at a point 17 to the leading-in wire 15 and terminated by an enlarged electrode head in the form of a solid cylinder 18 having a cavity at 19 in its lower end. The cavity at 19 may take any desired form which will serve to retain therein a drop of the conducting liquid such as indicated at 20. As here shown the cavity is symmetrical about the axis of the cylindrical electrode head and is formed with a cross-section of the shape of a segment.

In the operation of the contactor shown, the body of mercury 13 upon being tilted in the proper direction may submerge the electrode head 18 and then if the container is tilted in the opposite direction, the mercury will recede from the electrode thus opening the circuit. After the circuit has been made and broken in this manner for several times, it has been found that a drop of the mercury will adhere to the concave lower end of the electrode and thereafter each contact will be effected only between the resulting bodies of the liquid, and the solid electrode head 18 will be protected from any direct effects of the arc. If a portion of the suspended drop 20 becomes volatized no permanent injury results since the vapor will soon condense upon striking the cold walls of the container and then return to the main body of the conducting liquid.

Figures 3 and 4 illustrate a modified construction embodying our invention wherein a plurality of the enlarged electrode heads 21 and 22 having concave ends are employed. The use of the plurality of electrodes in this manner is especially desirable where the contact is designed to make and break heavy currents.

Figure 5 comprises a sectional view similar to Figure 4, but showing instead of a plurality of separate electrode heads a single large electrode 23 provided with a plurality of cavities, each of which is designed to retain a suspended drop of the conducting fluid as at 24.

In this modification, in order to provide leading-in wires of suitable current-carrying capacity and at the same time to permit gas tight seals through the container wall to be made, a number of spaced conductor wires or bars as at 25, are used. This construction permits the use of comparatively small conductor bars or wires, and, therefore, reduces the liability of breakage of the container wall due to expansion or contraction in respect to the conductors when the device is heated.

While we have shown and described several embodiments of our invention, it is to be understood that many further modifications may be made therein without departing from the spirit and scope of the appended claims and we desire that only such limitations shall be imposed upon our invention as are specifically pointed out in the claims and such as are required by the prior art.

Having thus described our invention, what we claim as new and desire to secure by Letters Patent in the United States, is:

1. In an electrical switch, a contact making and breaking electrode comprising a suspended drop of conducting liquid.

2. In an electrical switch, a contact making and breaking electrode comprising a drop of conducting liquid of substantial volume suspended from and covering the lower end of a solid conductive member.

3. An electrical switch comprising a tiltable container, two normally vertically spaced bodies of conducting liquid of substantial volume therein that unite to close a circuit upon tilting the container, one of said bodies being suspended from a conductive member to which it is attached by adhesion.

4. An electrical switch comprising a tiltable container, a movable body of mercury therein, and an electrode to which a suspended body of mercury adheres at a point spaced from the container walls while the remainder of said body of mercury is separated from the said adhering suspended volume of mercury and displaced upon tilting of the container.

5. Means for making and breaking an electrical circuit comprising a container, a pair of electrodes, and two volumes of conductive liquid therein that are each of substantial size and which upon tilting the container unite or separate at a point spaced from the container walls, one of said volumes constituting a suspended body of conductive liquid that attaches itself by adhesion to one of said electrodes, the other of said electrodes being adapted to engage with said other volume of mercury.

6. In a mercury switch, an electrode of solid conductive material formed in a shape to retain in suspended relation a substantial mass of mercury thereon as a contacting point.

7. An electrical switch comprising an hermetically sealed tiltable container, a main movable body of conducting liquid therein, and an electrode for contacting with said body on tilting said switch, said electrode having a concave lower end upon which a portion of said body of conducting liquid adheres in suspended relation.

8. In a mercury switch, an electrode of solid conductive material that is wetted by mercury under predetermined conditions, said electrode being formed with a cavity to retain in suspended relation a substantial mass of mercury thereon as a contacting point.

9. In an electrical switch, a contact making and breaking electrode for heavy currents comprising a plurality of suspended drops of conducting liquid.

10. An electrical switch comprising an electrode having a plurality of cavities at its lower surface, and a body of conductive liquid for contacting with said surface at predetermined times, said cavities serving to severally hold a portion of said body of conductive liquid in suspended position.

11. A tiltable electric switch comprising a container, a main body of mercury therein which is connected to one electric terminal of said switch, an electrode in said container for holding in a suspended position a second body of mercury which attaches itself to said electrode by adhesion whereby said second body of mercury is spaced from the walls of said container, said bodies of mercury being brought into circuit making and breaking relation on tilting said container whereby the electric circuit is made and broken at points spaced from the container walls, and means for connecting said suspended body of mercury and said electrode to another electric terminal of said switch.

12. A tiltable electric switch comprising a container, a main body of mercury therein which is connected to one electric terminal of said switch, an electrode to which a second body of mercury is held through the action of adhesion in suspended relation and spaced from the walls of said container, said bodies of mercury being brought into circuit making and breaking relation on tilting said container whereby the electric circuit is made and broken at points spaced from the container walls, and means for connecting said suspended body of mercury and said electrode to another electric terminal in said switch.

13. An electric switch comprising a tiltable container, a main body of mercury therein, which is movable on the tilting of said container, means for connecting said main body of mercury to one electric terminal of said switch, an electrode to which a second body of mercury is held through the action of adhesion in suspended relation and spaced from the walls of said container, said bodies of mercury being brought into circuit making and breaking relation on tilting said container whereby the electric circuit is made and broken at said second body of mercury which is spaced from the container walls, and means for connecting said suspended body of mercury and said electrode to another electric terminal of said switch.

In witness whereof, we have hereunto subscribed our names.

LOUIS A. M. PHELAN.
CLIFFORD HOTCHKISS.