Aug. 27, 1929. A. M. DISTELI 1,726,426

LIQUID CONTACT SWITCH

Filed Dec. 22, 1926

Fig. 1.

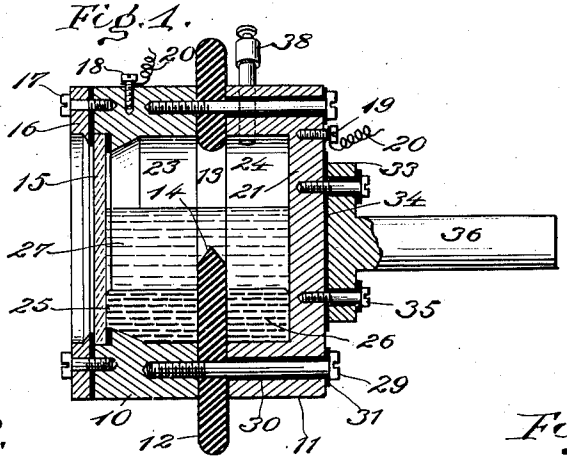


Fig. 2.

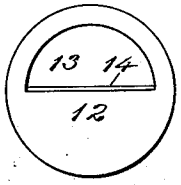


Fig. 3.

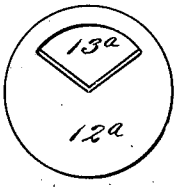


Fig. 4.

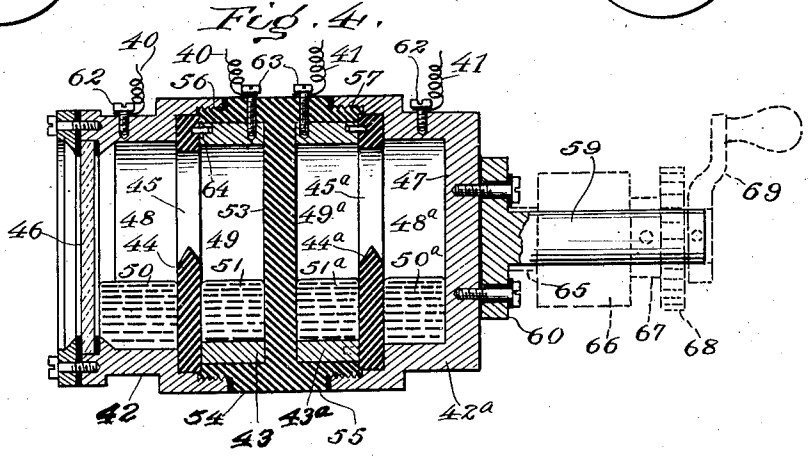


Fig. 6.

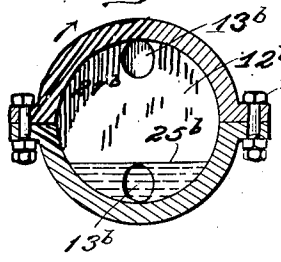
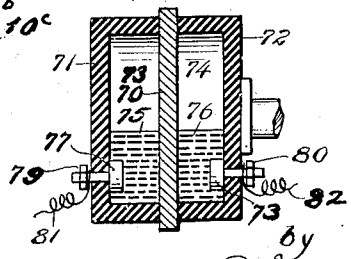


Fig. 5.



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UNITED STATES PATENT OFFICE.

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LIQUID-CONTACT SWITCH.

Application filed December 22, 1926, Serial No. 156,445, and in Switzerland March 10, 1926.

This invention is a novel liquid contact switch, or mercury switch so-called, for making and breaking an electric circuit or circuits.

The general objects of the invention consist in affording a mercury switch which will be convenient and efficient in use, and which will be simple and rugged in structure and not easily breakable. A further object is to provide a contact making and breaking device of this kind in which the surface of liquid contact will be of relatively large area so as to give highly effective conduction. Other and further objects and advantages of the present invention will be explained in the hereinafter following description of an illustrative embodiment thereof or will be apparent to those conversant with the subject.

To the attainment of the aforesaid objects and advantages the present invention consists in the novel liquid contact switch, and the novel features of combination, arrangement, structure and design herein described or illustrated.

In the accompanying drawings Fig. 1 is a central longitudinal section of a liquid contact switch embodying the present invention.

Figs. 2 and 3 are detached views showing forms of apertured separating wall which may be employed in either of the embodiments of Figs. 1 or 4.

Fig. 4 is a view similar to Fig. 1 showing modifications of structure embodied in a multiple switch embodying the present invention.

Fig. 5 is a similar central section showing a modified embodiment of certain features.

Fig. 6 is a transverse section showing a modification in the means of connecting the components of the device.

The illustrated embodiment is a mercury switch which comprises opposite containers or cups enclosing liquid chambers, and a wall separating the chambers, with a portion of the conducting liquid or mercury in each chamber, circuit terminals for the respective chambers, and means whereby in one position the circuit is closed between the terminals through the mercury but is open in another or the opposite position of the switch; the shift being made preferably by a bodily rotation of the assembled device. In the preferred embodiment the separating wall between the containers is apertured in such a manner that in one position the liquid portions unite to close the circuit but are separated by the wall when the switch is in open position.

Thus Fig. 1 shows a cup or container 10 which may be termed the outer cup, and opposite to it a second or inner cup or container 11, the two facing each other and being separated by a disk or wall 12. In this embodiment the two containers are preferably constructed of conducting metal which is not subject to attack by mercury, such as iron, while the separating disk is of insulating material such as bakelite. The separating disk or wall is formed with an aperture 13 which is eccentric in position so that by revolving the switch the aperture can be brought to its higher level as shown in Figs. 1 and 2, thus separating the conducting liquid, the lower edge of the aperture being sharpened or beveled at 14 to assist the separation. An advantageous shape for the communicating opening 13 is semi-circular as shown in Fig. 2, although the arrangement could be altered considerably, for example as with the disk 12^a in Fig. 3 having a quadrant aperture 13^a.

The first cup or container 10 is shown as provided with a transparent or glass end wall 15. This serves the double purpose of showing the position of the switch and of inspecting the condition of the interior elements. In some cases the glass wall can be dispensed with and indicating marks or words applied to the switch to show which position it occupies. The glass end plate 15 is shown clamped to the cup by a ring 16 secured tightly in place by screws 17, with washers interposed to prevent passage of liquid.

There may be a terminal post or screw 18 mounted directly in the metal of the first or outer cup 10 and a similar post or screw 19 on the cup 11, these adapted to receive the wires 20 constituting part of the circuit which is to be opened and closed by the switch. The container 11, opposite to the glass plate 15, is closed by an integral end wall 21.

This described structure provides two interior liquid chambers 23 and 24 in the containers 10 and 11 respectively. A body of mercury 25 is shown contained in the chamber 23 and a similar portion of mercury 26 in the chamber 24. The total quantity of mercury is such that when the switch is reversed or inverted the mercury will pass through the aperture 13 and unite the two

portions, thus closing the circuit, but is not so great that the two portions can not be separated by the intermediate disk 12. The arrangement is very effective because the mercury has an extended area of contact with the respective containers at the two sides of the disk, and of course perfect conductivity from one to the other when the circuit is closed. In some cases it is advantageous to apply a substantial layer of oil 27 which floats on top of the mercury and is of non-conducting character, but such as to protect and minimize oxidization of the mercury. In lieu of oil a chemically inert gas could be substituted, such as helium, or a vapor.

The three main elements 10, 11 and 12, with the mercury contained therein, constitute an assemblage which may be firmly and permanently secured into an entity in various ways, for example by longitudinal screws 29 or the like adapted to cause the two containers to be drawn firmly together in a liquid tight manner against the separating disk. Each of the screws 29 is shown as surrounded by an insulating bushing 30 and provided with an insulating washer 31 so as to avoid metallic contact with one of the containers, while passing through the disk 12 into a threaded recess in the opposite container.

The described switch may be mounted in various ways, but preferably in a manner to permit rotation through an angle sufficient to reverse the switch. Thus a mounting plate or flange 33 is shown separated from end wall 21 of the inner cup 11 by an insulating sheet 34 and attached in place of insulated screws 35. The flange or mounting 33 may be integral with an axle or other form of holder 36 which may be mounted in a suitable bearing to permit the described adjusting operations.

In cases where there is danger of internal pressure, due for example to heating from excessive switching operations, it may be desirable to provide a safety valve 38, which may be of any well known type, comprising for example a steel ball spring pressed inwardly upon a conical seat, and capable of yielding under high pressure. This gives automatic pressure relief from expansion or formation of gas pressure.

The described unitary device is not only rigid but liquid tight, and rugged and strong against breakage; and the circumferentially extened portion or flange of the disk 12 gives protection against liability to accidental short circuit across from cup to cup, and danger to the user.

The Fig. 4 embodiment is a double switch, and its principles can be extended into a multiple switch. At one part of the switch a first pair of line wires 40 are to be connected or disconnected, while at another part a second pair of wires 41 are connected or disconnected, by the switch.

One unit or section, namely at the left side of the figure comprises a first or outer container or cup 42 and a second or inner container 43 which may be in the form of a metal ring rather than a cup, with a separating disk 44 between the two, having an eccentric aperture 45 as before. The right hand portion of the figure shows substantially corresponding elements, the outer and inner containers 42^a and 43^a with the separating disk 44^a containing aperture 45^a. The outer end of the containing cup 42 is shown as consisting of transparent material 46, while the outer end of container 42^a may be an integral metal wall 47. The containers 42 and 43 enclose chambers 48 and 49 while the corresponding containers at the other end enclose chambers 48^a and 49^a. These four chambers respectively carry portions or bodies of mercury 50, 51, 50^a and 51^a.

These two complete units may be mutually joined to a middle or partition piece or wall 53, composed of insulating material such as bakelite or hard rubber, having left and right flanges 54 and 55, cylindrical in form. The left flange 54 is shown as having a threaded engagement 56 with the container cup 42 while the right flange has similar threaded engagement 57 with the container 42^a This arrangement gives a very compact and secure assemblage of parts. Owing to the offset or shouldered contour of the container 42 it is able to press inwardly against the face of the disk 44. The cylindrical container 43 can be pressed between the disk 44 and the partition wall 53. The threaded engagement 56 secures all these parts firmly in position. The entire apparatus may be carried by an axle or stem 59 as before, the same formed with a flange 60 secured to the end wall 47.

The circuit may be arranged through a terminal screw 62 extended into the container 42 and connecting with one of the circuit wires 40, while the other wire 40 is connected to a terminal screw 63 shown extended through the partition flange 54 and into the cylindrical container 43, thus establishing communication and serving to position the container. The corresponding parts at the right hand unit bear similar reference numbers. Each of the separating disks may have a positioning pin 64 entering recesses in the disk and in the container cylinder 43, thus positioning the disk.

As shown in Fig. 4 the two apertured disks 44 and 44^a are shown in the same position so that the reversal of the switch will close both circuits, namely through wires 40 and through wires 41. The mode of reversal might be varied. The central partition piece 53 is in the nature of a support and this might be mounted for rotation to operate the switch. Upon inspecting the condition of the switch through the glass end 46 at the left, this shows

the adjustment at both sections of the switch. This may be used and operated as a double pole switch.

The arrangement is readily susceptible to variation as to the timing of the operation of the switch at each section. Thus instead of opening and closing the two circuits simultaneously they may be operated alternately or in sequence. This may readily be effected simply by inverting one of the separating disks for example the disk 44[a] so as to bring the positioning pin 64 into engagement with an opposite recess in the container ring 43[a], such recess being indicated in dotted lines in the lower part of the figure; or the readjustment could be effected by the cooperation of the terminal screw 63 with a series of threaded recesses in the container ring. There may be more than two switch sections and they may readily be timed so that a rotation of the switch will operate to close the circuit successively through the respective sections.

Fig. 5 shows a modification wherein the arrangement is reversed in that the separating disk 70 is composed of conducting metal, while the opposite cups 71, 72 are composed of insulating material and enclose chambers 73, 74 in which are contained bodies of mercury 75 and 76 both constantly in electrical contact with the disk 70. As before each chamber has a circuit terminal, namely the contact blocks 77 and 78, having their stems extending through the container walls, with exterior terminal devices or nuts 79, 80 to which the line wires 81, 82 are attached. In the position shown the circuit is closed through the contact blocks, the mercury and the separating disk, whereas upon inverting the device the mercury will break contact with the blocks and thus break the circuit. This simple arrangement could be employed for closing and opening two circuits simultaneously by connecting the wire 81 and the disk 70 as part of one circuit and the wire 82 and the disk 70 as part of another circuit. By then shifting one of the two cups or its contact piece through 180°, the switch will close one circuit while opening the other, and vice versa, upon rotation.

Fig. 6 may be considered as a modification of either Fig. 1 or Fig. 4, for example Fig. 1, and indicates one of the cups or containers 10 as constructed in two symmetrical halves 10[b], 10[b] secured together by the tightening screws 10[c]. In this case the separating disk or wall 12[b] may be of substantially the internal diameter of the container so as to be clamped firmly in the position shown. This mode of structure and assemblage is in lieu of the longitudinal bolts of Fig. 1 or the screw connection of Fig. 4. Fig. 6 illustrates also that the apertures need not be sectors as in Figs. 1–4, but may be of other shapes such as the elliptical openings 13[b], and this figure illustrates also that there may be a plurality of the communicating apertures 13[b], for example two of them spaced oppositely. With this arrangement the switch may be rotated always in one direction and will make or close the circuit and break the circuit twice on each rotation. The mercury may be supplied to a depth as shown at 25[b] and above the mercury the space may be filled with an inert gas such as helium 27[b].

In the case of any of the embodiments the rotation of the switch may be effected either by hand or mechanical connections. Thus at the right side of Fig. 4, surrounding the axle 59 are shown the following elements. A spacing washer 65 contacts the flange 60 and spaces it from a fixed bearing or journal 66 of any usual type. Outside of this is shown a collar 67 pinned to the axle and this collar may constitute the hub of a gear 68 which may be in mesh with other gears for effecting the desired rotation. Pinned to the axle outside of these elements is shown a handle in the nature of a crank, which may be employed for effecting the desired rotation.

It will thus be seen that there have been described several illustrative embodiments of the principles of the present invention and attaining the objects thereof. Since various matters of combination, arrangement, structure and design may be modified without departing from the inventive features, it is not intended to limit the invention to such matters except so far as set forth in the appended claim.

What is claimed is:

A multiple rotary mercury switch comprising an insulating disk separating two pairs of mercury chambers, a metallic ring at each side of such disk, an apertured insulating disk against each ring, a metallic cylindrical container against each apertured disk, means holding all assembled, and circuit connections.

In testimony whereof, I have affixed my signature hereto.

ALFRED M. DISTELI.