MERCURY BUTTON SWITCH WITH INSULATED TERMINAL

Filed June 2, 1958

Fig. 1.

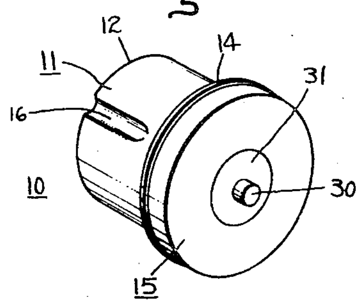


Fig. 2.

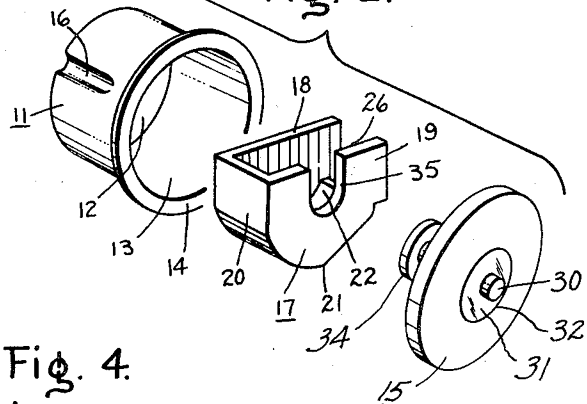


Fig. 3.

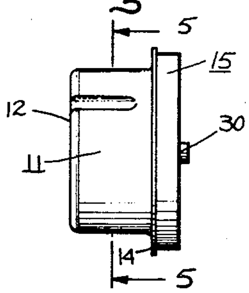


Fig. 4.

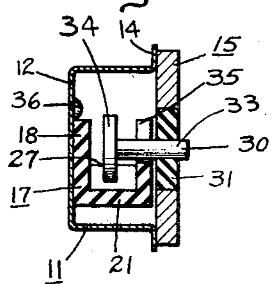


Fig. 9.

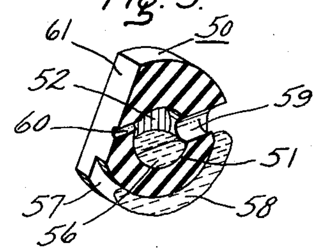


Fig. 5.

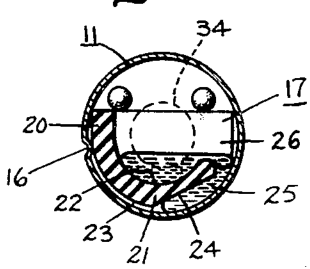


Fig. 6.

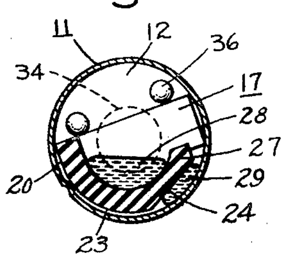


Fig. 10.

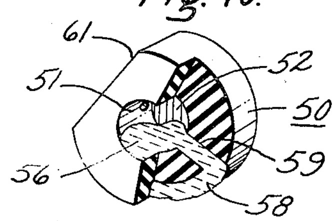


Fig. 11.

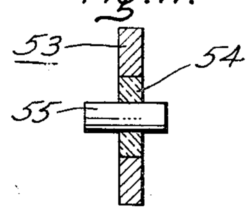


Fig. 7.

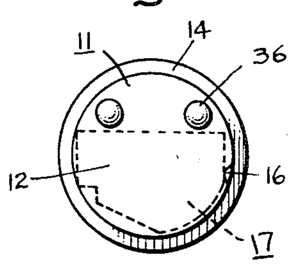
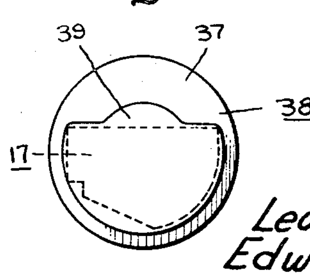


Fig. 8.



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MERCURY BUTTON SWITCH WITH INSULATED TERMINAL

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Application June 2, 1958, Serial No. 739,083

14 Claims. (Cl. 200—152)

The present invention relates to liquid contact switches and particularly to a novel mercury button switch of the type which has been widely used for controlling residential lighting circuits, as well as in other miscellaneous applications such as a tipover switch for a portable electric heater.

One patent showing a typical method of assembling such a mercury button switch in a switch housing for mounting in an electrical switch box is the Payne Patent No. 2,101,093. Up until this time, mercury button switches have been manufactured as disclosed in the Walker Patent No. 2,101,115 and a second Payne Patent No. 2,177,498, all of which patents are assigned to the same assignee as is the present invention. Such a mercury button switch comprises a ceramic barrier sandwiched between a pair of hat-shaped metal shells and the assembly is hermetically sealed together by a glass seal around the rims of the shells and to the periphery of the ceramic barrier. A small opening is made through the barrier offset from the pivotal axis of the button, and a pool of mercury is located between each metal shell and the adjacent side of the barrier when the switch is in its open position. As the button is turned to dip the opening of the barrier into the mercury, the mercury will flow through the opening and join into a common pool and thus close the circuit between the two metal shells.

Great care is taken to clean the switch parts before assembly so that the mercury will not become contaminated and sluggish during the expected life of the switch. Welded on the inner surface of each metal shell is a small composite platinum strip which is not appreciably affected by oxidation during the subsequent heating of the glass seal. The purpose of the platinum is to insure a low-resistance electrical path between the mercury and the metal shells. Unfortunately, the glass will not seal to the metal shells unless the metal is coated with an oxide. Once the mercury button is completely assembled, a low current high voltage operation cleans up the internal surfaces.

While this construction seems to be very simple, it presents many difficult manufacturing problems. Probably, the biggest problem has been in forming the glass seal between the metal shells and the ceramic barrier. The ingredients which constitute the ceramic barrier are mainly clay and magnesia included in a suitable binder. It has always been difficult to make the ceramic barrier so that its coefficient of thermal expansion will be substantially equal to that of the metal shells and the glass seal. This is a critical factor which affects the dimensions of the mating parts since the button is heated until it is red hot so that the glass ring will melt and shrink around the shells and the barrier and form a hermetic seal. It should be recognized that the former mercury button designs were excellent from an operational standpoint once they passed the initial test in the factory, but, unfortunately, there has always been a high rejection

rate which has held the cost of these switches above that of standard mechanical switches.

The new and improved design of the present invention was made primarily to eliminate the three-component seal between the glass, the metal shells, and the ceramic barrier. The mercury button of this invention comprises a series of parts that may be effectively cleaned prior to assembly and which will not be contaminated by oxidation during the various steps of assembly. This invention further allows the use of a vitreous ceramic cup or tube made from materials best suited for withstanding high arc temperatures, and inert when so used, without regard to its temperature coefficient of expansion. Finally, this invention has made it possible to realize a saving in the cost of materials for the switch as well as to decrease the scrap losses.

The present invention utilizes a recessed metal shell that is open at only one end, and provided with a circular flange around the opening which is welded to a metal cover plate to form a hermetically sealed container for holding an arc-quenching hydrogen gas. The pivotal axis of the switch extends through the center axis of the cover plate, and the over-all size of this new switch is comparable to that of the before-mentioned mercury button switches which have been so widely used to date. One modification of this invention includes an insulating cup of refractory material such as steatite, cordierite, alumina, vycor, or the like, that is seated on the interior curved surface of the shell, and it has two parallel side walls which are arranged closely adjacent the closed end of the shell and the cover plate, respectively. This cup is slightly larger in over-all size than one-half the size of the interior space of the switch housing, and it is held from movement by a pair of interior embossments made in the closed end wall of the shell which engage the top edge of the related parallel side wall of the cup. The bottom wall of the cup has one end portion raised off of the surface of the shell to form an underlying pocket. This provides a space for two pools of mercury when the button is in its open circuit position, one pool being within the cup and the other being under the raised bottom wall of the cup. The end wall of the cup adjacent the raised bottom wall has been removed to allow the mercury to pour in and out of the cup so that by turning the switch housing about its pivotal axis, the free edge of the raised bottom wall of the cup acts as a barrier to separate the mercury into two distinct pools thereby opening the circuit.

When the button is rotated to close the circuit the two pools of mercury will be moving in substantially parallel directions, one above the other, until they meet in an unrestricted space at the open end wall to close the circuit. One important feature of this invention is the geometry of the ceramic cup so that the two pools of mercury are substantially of equal volume. If one pool were a great deal larger than the other, the affinity of the mercury for itself would tend to cause the mercury in the large pool to consume the small pool of mercury when the circuit is being opened. Also, the two pools of mercury are less likely to bounce away from each other as the circuit is being closed. This bouncing effect is a type of explosion found in most all mercury contact switches, and is caused by high temperature arcs which are struck between the two pools of mercury mainly as they come together. The high temperature tends to vaporize the mercury and reduce the cross-section of the mercury that carries the current from one pool to the other. In so doing, the temperatures increase further until the pools flow together or the pools are blown apart.

This invention minimizes this explosive tendency because the kinetic energy of the two pools of mercury are acting in a common direction as the two pools of mercury are poured over the edge of the barrier to obtain a maximum closure force with the least amount of movement of each pool. Stated in another manner, the two pools of mercury attempt to occupy the same space at the leading edge of the barrier when the switch is actuated to a closed circuit position so that the two pools of mercury are flowing toward each other. The result of this is that the greatest closing force is obtained with the least amount of momentum and velocity of each pool. High velocity contributes to this explosive or bouncing effect since the mercury pools do tend to splatter when brought to a sudden stop. The surgically clean mercury used in the switch has such an affinity for itself because of its high surface tension that it does not flow into the small clearances between the outer surfaces of the cup and the metal shell. Thus, it should be understood that the mercury will either be found in two pools in the open circuit position or in a common pool in the closed circuit position.

The central portion of the metal cover plate has a glass seal in which is mounted an insulated terminal that extends through the metal cover and terminates near the bottom wall of the ceramic cup. Hence, the circuit through the switch is through this insulated terminal and then through the common pool of mercury to the metal shell of the button. This terminal is always immersed in the mercury so that there is mercury-to-mercury contact when the switch is being closed to prevent the erosion of the terminal if the closing of the switch were between the mercury and the metal terminal. Also, the two pools of mercury are drawn towards each other upon closing while, if the mercury had to make contact with the metal terminal, the mercury would tend to draw away from the metal and would have to be forced into wetting the metal.

A second embodiment of this invention replaces the open ceramic cup with a closed cup or tube of ceramic that fits closely within the metal shell. The tube is closed at one end and open at the other end nearest the insulated terminal in the cover plate. A narrow circumferential groove is formed around the lower half of the tube and it constitutes an outer pocket for the mercury. The bore of the tube represents the inner pocket, and there is a radial hole through the wall of the tube communicating between the two pockets for the mercury.

When this switch is rotated to close the circuit the two pools of mercury will be moving in substantially parallel directions, as in the first embodiment, and they will merge within the communicating hole in the tube. This hole through the ceramic tends to confine the arc that is struck during the making and breaking of the circuit. The walls of the hole will also provide a cooling effect and reduce the severity of the arcing. Apparently, in the first modification, the open area above the ceramic cup allows the mercury to first vaporize and then condense on the interior of the metal shell. This possibility is lessened in the second modification by confining the arc within the radial hole through the ceramic and closing the top of the cup by reshaping it into a tube to insulate the inner surface of the top half of the metal shell from the mercury in the inner pool.

Accordingly, the principal object of this invention is to provide a mercury button switch with a hermetically sealed enclosure formed by two members that are sealed directly together.

A further object of this invention is to provide a design for a mercury button switch so that the parts may be effectively cleaned prior to assembly, and may be assembled without contaminating such cleaned parts.

A further object of this invention is to provide a mercury button switch with a hermetically sealed enclosure formed by two precleaned metallic members which are welded or otherwise fastened to each other.

A further object of this invention is to provide a novel mercury button switch design that permits the use of a vitreous ceramic cup piece using materials best suited for withstanding the high arc temperatures without serious regard to the temperature coefficient of expansion of the finished product.

A further object of this invention is to provide a mercury button switch with an insulating cup or tube of superior refractory characteristics and with a geometry designed to predetermine the volumes of the two mercury pools reliably so that, on closing the switch, the kinetic energy of the two pools will be approximately equal and most favorable in effecting a positive closure of the electric circuit without adverse openings due to surface explosions from the mercury pools.

A further object of this invention is to provide a mercury button switch with a simplified design which takes advantage of the high surface tension characteristic of very pure mercury which, when used in an assembly of clean parts, allows a reduction in the amount of mercury needed while retaining the same over-all size and high current rating of former mercury button switches.

A further object of this invention is to provide a mercury button switch of a simplified design which permits all components to be cleaned to a high purity and machine assembled without detrimental human handling so that the assembled device is immediately operable to handle high electrical currents.

Our invention will be better understood from the following description taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

Figure 1 is an isometric view showing a mercury button switch embodying our invention.

Figure 2 is an exploded view of the several parts which make up the switch of the first modification; minus, of course, the pool of mercury.

Figure 3 is a front elevational view of the switch of Figure 1.

Figure 4 is a cross-sectional elevational view through a vertical central plane of Figure 3.

Figure 5 is a transverse cross-sectional view taken on the lines 5—5 of Figure 3 showing the switch in closed circuit position.

Figure 6 is a cross-sectional view similar to that of Figure 5 except that the switch has been rotated in a counterclockwise direction to break the circuit through the pool of mercury.

Figure 7 shows a back-elevational view of the closed end of the metal shell which forms the main portion of the switch enclosure, while the outline of the ceramic cup is shown in dotted lines.

Figure 8 is a back-elevational view of a second modification of the metal shell of Figure 7 where the shell more closely conforms to the outline of the ceramic cup which is again shown in dotted lines.

Figure 9 is an isometric view partly in cross-section of the insulating tube of a second modification of this invention, minus the metal shell to show the mercury separated into two pools.

Figure 10 is another isometric view of the tube of Figure 9, but turned to look from the right side; the tube having been rotated clockwise to pour the mercury through the radial hole in the tube to close the circuit.

Figure 11 is a cross-sectional view through the center of the cover plate for use with the ceramic tube of the second modification of Figures 9 and 10.

Referring in detail to the drawing, and in particular to the first modification of Figures 1 and 2, **10** represents a completely assembled mercury button switch embodying our invention. There is a hollow enclosure formed by two elements, namely, a main portion or shell **11** and a cover plate **15**. The shell is of thin metal stock in the shape of a circular cylinder that is closed at one end **12** and open at its opposite end **13**. Around the outside rim of the open end **13** is a circular flange **14** adapted to be welded to the metal cover plate 15 to make a hermetically sealed container for holding the switch parts. An indentation 16 is made in the outer surface of the shell 11 so that a switch trigger (not shown) may have a portion seated in the indentation for effecting driving engagement between the trigger and the mercury button. It should be understood that the pivotal axis of the switch is along the central axis of the cylindrical metal shell and that the button is designed to oscillate through an arc of approximately 20° between its open an closed positions.

A third element in the switch is an insulating cup 17 of refractory material seen in Figure 2 with parallel side walls 18 and 19 connected by a vertical end wall 20 and a bottom wall 21 which may be considered as having two portions. Now turning to the transverse cross-section of Figure 5 of the drawing, the insulating cup 17 is assembled in the metal shell 11 leaving only small clearances between the outer surfaces of the cup and the adjacent inner surfaces of the switch enclosure. The upper surface 22 of the bottom wall 21 of the cup is concave upwardly, while the under surface of the bottom wall 21 is convex downwardly in the half-section 23 that is nearest the vertical end wall 20 of the cup. The under surface of the remaining half-section 24 of the bottom wall 21 is inclined upwardly at an angle of about 35° from a horizontal line to establish a pocket 25 between this inclined surface 24 and the adjacent inner surface of the metal shell 11. In the closed position of the switch illustrated in Figure 5, the mercury is formed into a common pool filling both the interior of the cup and the pocket 25. This is possible since the cup has an open end wall 26 opposite the vertical end wall 20 permitting the mercury in the cup to communicate with the mercury in the pocket 25 depending upon the angle of rotation of the shell. Figure 6 shows the shell rotated to an angle of approximately 20° in a counterclockwise direction so that the free edge 27 of the bottom wall 21 of the cup separates the mercury pool into an inner and an outer pool, 28 and 29 respectively, and acts as a barrier to prevent arcing between the pools of mercury.

One terminal or electrode of this switch is the metal shell 11. The other terminal of the switch is terminal 30 which is supported in the metal cover plate 15 but insulated therefrom by means of a refractory material such as glass 31 that is compression-molded into a circular opening 32 at the center of the cover. The insulated terminal consists of a small pin 33 having at its inner end a round head 34 as best seen in Figure 4. The head 34 is designed to be immersed in the inner pool 28 of mercury within the cup 17. This is accomplished by forming a vertical slot 35 in the adjacent side wall 19 of the cup so that the pin 33 of the terminal may extend through the slot and complete the circuit from the shell 11 through the common pool of mercury to the head 34 of the terminal and then out through the pin 33 which, as mentioned before, is insulated from the cover 15. The head 34 of the insulated terminal 30 is shown in Figure 4 near the center of the cup between the side walls 18 and 19. An alternate arrangement would be to have the head 34 closely adjacent the wall 19 so that it would tend to prevent the mercury from running out of the slot 35 if this developed into a problem. The side walls 18 and 19 of the insulated cup 17 as well as the one vertical end wall 20 are relatively high to prevent the mercury within the insulating cup from bounding over these walls and contacting the shell 11 to inadvertently close the circuit.

It is not necessary to positively fasten the cup 17 in the shell 11 since this would be a time-consuming and expensive operation. One solution is to merely form a pair of embossments 36 on the interior of the end wall 12 of the shell 11 to engage the top of the side wall 18 thereby preventing the cup from rotating within the shell. This has enabled us to feed the cup 17 into the

shell by means of automatic machinery and eliminate a great deal of hand assembly work. These embossments 36 appear as dimples on the outside of the shell, as best seen in Figure 7.

Figure 8 shows a modification of the shell 11 of Figure 7 whereby the shell is no longer a circular cylinder, although it does have a circular flange 37 similar to the flange 14 of Figure 2. However, the main portion of the shell identified as 38 has been shaped to conform generally to the configuration of the insulating cup 17, while also providing a raised portion as at 39 to permit the assembly of the head 34 of the insulating terminal 30 into the cup 17.

One method for assembling the mercury button switch 10 is first to rest the metal shell 11 on its closed end 12 and then place the ceramic cup 17 within the shell. Approximately 3.9 grams of pure mercury is then poured into the shell, and the shell closed by the cover plate 15 having the terminal 30 already mounted therein. This assembly is then moved to a welding machine where a cylindrical rubber boot is made to surround the button. As the welding head of the machine is lowered, it compresses the rubber boot and establishes a gas-tight chamber around the button. The air in this chamber is then evacuated by means of a vacuum pump which tends to lift the cover 15 slightly off the shell until the button is also evacuated. Once the air has been evacuated, a hydrogen gas is fed into the chamber and fills the interior of the button. Finally, the welding heads are brought together and the peripheral edge of metal cover plate 15 is welded to the circular flange 14 of the metal shell. The purpose of evacuating the air from the button is to preserve the clean, active qualities of the mercury which otherwise could be destroyed by oxidation products of air in the presence of the heat of an arc.

The second modification of this invention is shown in Figures 9–11. The metal shell 11 remains unchanged, while the open cup 17 of Figure 2 has been replaced by a closed cup or tube 50 of similar ceramic material. This tube has substantially the same diameter as the inner diameter of the shell 11 and is closely fitted therein to eliminate any relative movement between them. The tube 50 has a central bore 51 that is closed at one end 52 and open at the other end that is nearest to the cover plate 53 for the shell 11. As shown in Figure 11, the cover 53 has a central glass window 54 with a terminal pin 55. The inner end of the terminal pin is immersed in the mercury pool 56 located within the bore or inner pocket 51 of the ceramic tube. An outer pocket is formed below the inner pocket by a narrow circumferential groove 57 in the lower half of the tube. A second pool of mercury 58 is present within the groove and in electrical contact with the inner surface of the metal shell 11. Hence, the switch of the second embodiment has one insulated terminal 55 immersed in the inner mercury pool 56 and the metal shell 11 as the second terminal which supports the outer mercury pool 58.

A radial hole 59 extends through the wall of the tube 50 so that the two pools of mercury may be joined within the hole for closing the circuit. On the opposite side of the tube from the hole 59 is a small vent opening 60 to allow the mercury that vaporizes within the inner pocket 51, when the circuit is closed, to return through the opening and replenish the mercury that had been lost from the outer pool. A portion of the side of the tube 50 is removed in the vicinity of the vent opening 60 as at the flat surface 61 to increase the size of the expansion chamber as well as to assist in accurately locating the tube in the shell 11 with respect to the indentation 16.

Having described above the details of our improved mercury button switch, it will be appreciated by those skilled in this art that this design has simplified the manufacturing techniques for assembling the switch since the switch enclosure is formed by welding two metal parts together. This eliminates the three-component seal between a glass ring, a ceramic barrier, and a pair of metal shells as in the former design. Also, the new design permits the use of surgically clean switch parts and mercury which will not be contaminated by the methods of assembly as explained with relation to the oxidation problem in the former swtich design for bonding the glass to the metal shells. Since the coefficient of thermal expansion of the ceramic cup of this invention need not be matched with two other components, it has been possible to select the best refractory material for the barrier to withstand the high arcing temperatures.

An important feature of this design is the relative disposition of the two mercury pools with relation to the pivotal axis of the button so that when the button is rotated to close the circuit, the two pools will be moving in substantially parallel directions. In this way, it is possible to take advantage of the kinetic energy of these two pools of mercury to overcome the normal tendency of the two pools of mercury to rebound away frm each other. Furthermore, the pen end 26 of the insulating cup 17 is advantageous, for if the two pools of mercury were joined within a restricted opening, the gases which form when an arc is struck would have little room for expansion. This would tend to increase the pressure of the gases as well as the possibility of repeated explosions as the arc is restruck.

While we have chosen a sealed enclosure for the button by fastening a metal cover plate over a metal shell, it is appreciated that there are other variations of this invention which would not require such an arrangement. One example would be to form the seal enclosure out of an insulating material which would have mounted in its outer wall a terminal member immersed in the outer pool of mercury. Likewise, the insulating terminal could be mounted in the wall of the enclosure above the inner pool of mercury rather than being brought in from the side of the enclosure as illustrated.

Modifications of this invention will occur to those skilled in this art, and it is to be understood, therefore, that this invention is not limited to the particular embodiments disclosed but that it is intended to cover all modifications which are within the true spirit and scope of this invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A mercury button switch comprising a cylindrical metal shell having one open end and a metal cover permanently sealed over the opening to make a hermetically tight container, an insulating cup of refractory material confined on the arcuate interior surface of the shell with parallel side walls closely adjacent the closed end of the shell and the cover, the side wall adjacent the cover having a vertical slot, the central portion of the cover being of insulating material which supports a terminal that extends through the cover, the inner end of the terminal passing through the said slot of the insulating cup and terminating near the bottom of the cup, the bottom floor of the cup being generally concave upwardly with one end of the floor being raised off the shell, the end of the cup adjacent the said raised end of the floor being open so that the free edge of the raised floor of the cup in the open circuit position of the switch serves as a barrier between two pools of mercury, one pool being in the cup and the other being below the raised end of the floor; whereby when the enclosure is rotated to cause both mercury pools to flow in parallel directions toward the free edge of the barrier, the kinetic energy of the mercury will contribute to the reliable closing of the electrical circuit from the terminal in the cover through the common mercury pool to the outer metal shell of the switch.

2. A mercury button switch comprising a recessed metal shell having one open end that is permanently sealed by a metal cover plate to make a hermetically tight

container, the container having a pivotal axis about which it is adapted to rotate, an insulating cup of refractory material seated on the interior surface of the shell with the bottom of the cup being distant from the said pivotal axis, and the side walls of the cup being parallel and disposed closely adjacent the closed end of the shell and the cover plate respectively, one end wall of the cup being open while the bottom of the cup adjacent the said open end is raised out of engagement with the shell, and a terminal member extending through the metal cover and being insulated therefrom with its inner end located adjacent the bottom wall of the insulating cup, and a quantity of mercury in the switch container so that in the closed position of the switch the mercury will complete the circuit between the insulated terminal of the cover plate and the metal shell, the said circuit being opened by rotating the switch container about its pivotal axis until the free edge of the bottom wall of the insulating cup adjacent the open end thereof separates the mercury into two pools one being within the insulating cup and the other being under the raised portion of the bottom wall of the cup.

3. A liquid contact switch comprising a hermetically sealed housing having a pivotal axis about which the housing may be oscillated between an open and a closed circuit position, an insulating cup of refractory material confined to the bottom of the switch housing and generally below the said pivotal axis, a pocket formed beneath a major portion of the cup and between the bottom of the cup and the adjacent inner surface of the housing for containing a pool of mercury, a second pool of mercury of substantially equal volume being contained within the cup, the switch being in its opened circuited position when the cup separates the mercury into two pools, and separate switch terminal means in contact with the two pools of mercury so that when the housing is rotated slightly about its pivotal axis the two pools of mercury will flow over the edge of the cup and complete the circuit.

4. A liquid contact switch comprising a hermetically sealed enclosure for containing an arc-quenching gas, the enclosure having a pivotal axis about which the switch may be tilted between an open and a closed circuit position, an insulating barrier fixed in the lower portion of the enclosure below the pivotal axis for dividing this portion into two pockets, an inner pocket within the barrier and an outer pocket beneath the barrier, and a separate pool of mercury within each pocket when the circuit is open, at least two switch terminals forming part of the switch enclosure but insulated from each other, each pool of mercury being in electrical contact with a different terminal, whereby for the closed circuit position of the switch the enclosure is tilted to move the two pools of mercury in parallel directions one above the other until they flow together around the leading edge of the barrier.

5. A liquid contact switch, as recited in claim 4, wherein the switch enclosure is of electrical conducting material which forms the terminal for the outer pool of mercury, a second terminal extending through an insulated portion of the switch enclosure with its inner end immersed in the inner pool of mercury.

6. A liquid contact switch, as recited in claim 5, wherein the switch enclosure is formed with a cylindrical metal shell that is open at only one end and a metal cover which is hermetically sealed directly to the shell for containing an arc-quenching gas such as hydrogen, the pivotal axis of the switch enclosure coinciding with the central longitudinal axis of the cylinder shell.

7. A liquid contact switch comprising a hermetically sealed metal enclosure having a pivotal axis, an insulating cup located in the lower portion of the enclosure below the said pivotal axis, a pocket formed between a major portion of the bottom wall of the cup and an adjacent inner surface of the enclosure, a pool of mercury within the cup, and a second pool of mercury in the said pocket of substantially the same volume as the first pool

of mercury, one side of the cup being open so that the bottom wall has a free edge that is substantially parallel to the pivotal axis of the switch with the bottom wall of the cup serving as a barrier for separating the mercury into two pools depending on the angle of tilt of the switch enclosure, and a pair of switch terminal means insulated from each other and each joined with a different mercury pool when the switch is in the open circuit position.

8. A liquid contact switch as recited in claim 7 wherein the hermetically sealed enclosure is formed by a cylindrical metal shell that is open at only one end for receiving the insulating cup, the opening being closed by a metal cover plate that is sealed to the shell, the metal enclosure being in contact with the outermost pool of mercury and serving as one terminal of the switch, while a second terminal protrudes through the cover plate and is held by means of an insulating medium therein with its inner end immersed in the pool of mercury within the insulating cup.

9. A liquid contact switch as recited in claim 8 wherein the said insulating cup is held from rotating within the switch enclosure by means of at least one embossment on the inner surface of the enclosure for engagement with the walls of the cup.

10. A mercury button switch comprising a hermetically sealed enclosure formed by a cylindrical metal shell having an open end that is closed by a separate metal cover that is sealed directly thereto, a ceramic cup within the enclosure and having its outer surfaces closely adjacent the complementary interior surfaces of the enclosure, a pocket formed between a section of the bottom wall of the cup and an adjacent inner surface of the enclosure, a first pool of mercury within the cup, and a second pool of mercury in the said pocket of substantially the same volume as the first pool of mercury, one side of the cup being open so that the two separate pools of mercury may flow together as the switch is tilted about the central longitudinal axis of the cylindrical shell, the metal enclosure being in contact with the outermost pool of mercury and serving as one terminal, while there is a second terminal extending through a portion of the said cover and connected to the cover by means of an insulating material, the inner end of this second terminal being immersed in the pool of mercury within the cup so that the circuit between the terminals is made and broken as the two pools of mercury combine and separate respectively.

11. A liquid contact switch comprising a hermetically-sealed metal housing having a pivotal axis about which the housing may be oscillated between an open and a closed circuit position, an insulating tube of refractory material fixed within the housing with the central axis of the tube coinciding with the said pivotal axis, the tube having a bore that is open at one end and closed at the other, an insulating window formed in one wall of the housing with a terminal member extending therethrough and into the bore of the said tube along the pivotal axis of the housing, a circumferential groove in the lower half of the tube to form an outer pocket beneath the tube, the bore of the tube representing an inner pocket, and a radial hole through the tube communicating with both pockets, a measured amount of mercury contained in the housing, the switch being in its open circuited position when the radial hole separates the mercury into two pools, the inner end of the insulated terminal member being immersed in the inner pool of mercury, while the metal housing is the second terminal of the switch and is in electrical contact with the outer pool of mercury, so that when the housing is rotated slightly about its pivotal axis, the two pools of mercury will flow together within the radial hole and complete an electrical circuit.

12. A liquid contact switch as recited in claim 11 with a small vent opening extending through a wall of the tube above the two pools of mercury and generally disposed the said radial hole to allow the return of the mercury vapor to the outer pocket formed beneath the tube.

13. A liquid contact switch comprising a hermetically-sealed enclosure for containing an arc-quenching gas, the enclosure having a pivotal axis about which the switch may be tilted between an open and a closed circuit position, an insulating cup fixed in the enclosure and dividing the interior of the enclosure into two pockets, an inner pocket within the barrier and an outer pocket beneath the cup, and an access opening communicating with both pockets, a separate pool of mercury within each pocket when the circuit is open, at least two switch terminals forming part of the switch enclosure but insulated from each other, each pool of mercury being in electrical contact with a different terminal, whereby for the closed circuit position of the switch the enclosure is tilted to move the two pools of mercury in parallel directions one above the other until they flow together within the access opening.

14. A liquid contact switch as recited in claim 13 wherein the switch enclosure is of electrical conducting material which forms the terminal for the outer pool of mercury, a second terminal extending through an insulated portion of the switch enclosure with its inner end immersed in the inner pool of mercury.

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