

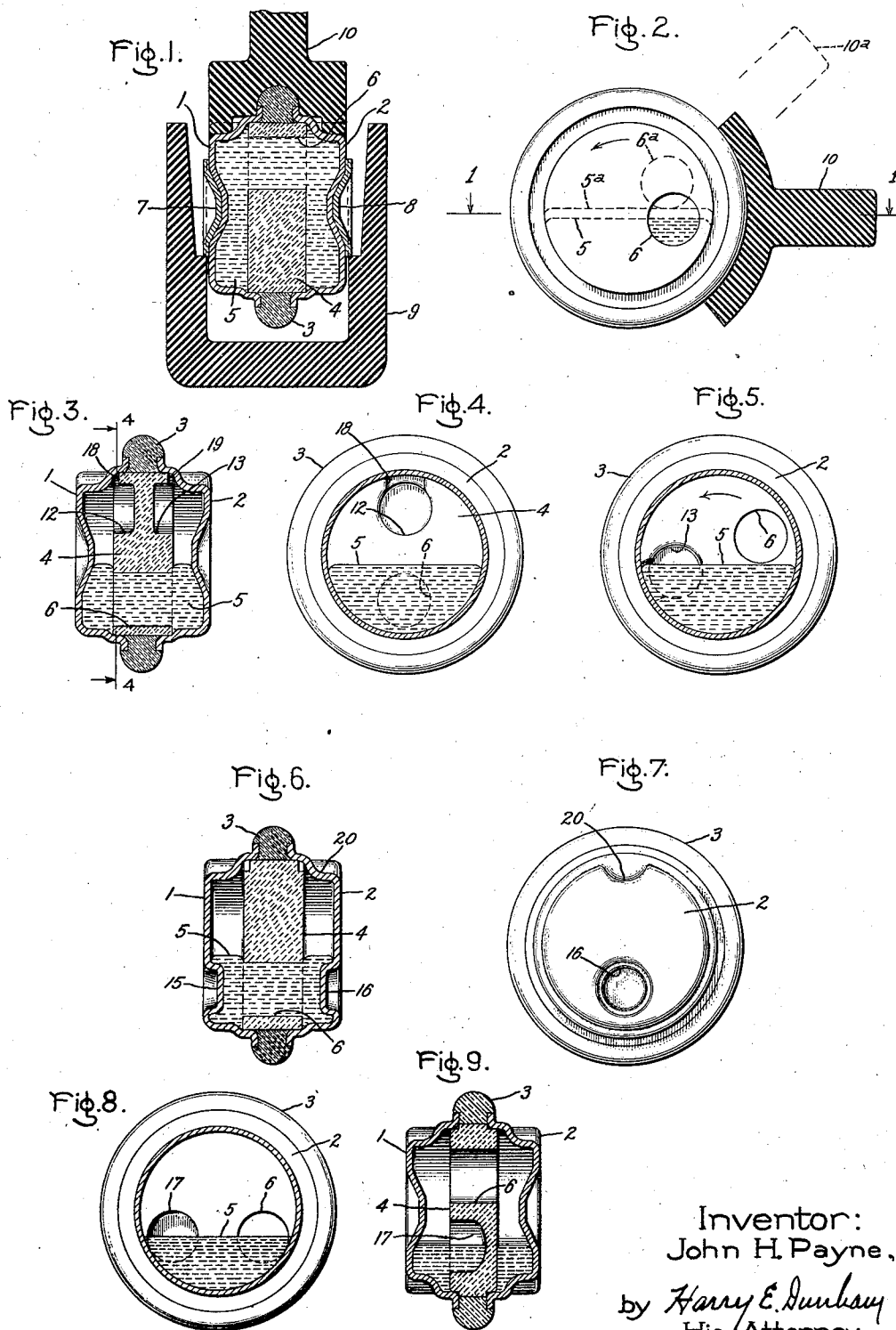
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BARRIER FOR MERCURY SWITCHES

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BARRIER FOR MERCURY SWITCHES

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5 Claims. (Cl. 200—152)

My invention relates to an improved construction for electrical switches of the type in which the electrical continuity of a liquid contact medium is interrupted by the interposition of a mechanical barrier.

It is an object of my present invention to provide a switch of the above class in which the physical motion required to accomplish a positive switching operation is reduced to a minimum.

To this end I employ in connection with the interrupting barrier complementary liquid displacement means calculated to offset the effect of the barrier in increasing or decreasing the level of the contacting medium as the extent of immersion of the barrier increases or decreases.

The novel features which I believe to be characteristic of my invention are set forth with particularity in the appended claims. My invention, itself, however, will best be understood by reference to the following specification taken in connection with the accompanying drawing, in which Fig. 1 is a sectionalized view of a liquid contact switch of the type with which my invention is particularly concerned and a supporting housing for the same; Fig. 2 is a side view of the same taken in a plane 90° displaced from that of Fig. 1 and having the housing and one side of the switch removed; Fig. 3 is a sectionalized view of a switch button embodying the improved construction of my invention; Figs. 4 and 5 are additional views in section of the button shown in Fig. 3, and Figs. 6 to 9 are illustrations of alternative modifications of which my invention is capable.

The nature of the problem with which my invention deals may be most readily appreciated by reference to Figs. 1 and 2. Referring particularly to Fig. 1, I have illustrated a switch button comprising a pair of dished metallic receptacles or cups 1 and 2 which when placed in opposed relationship as shown form an enclosing chamber for a quantity of a conducting fluid such as mercury. The dished receptacles 1 and 2 are spaced and hermetically sealed together by a circular fillet of thermoplastic insulating material 3, such as glass fusion-welded or otherwise secured in vacuum-tight relation with the adjacent peripheries of the receptacle members.

In order to divide the switch enclosure into separate symmetrically positioned chambers, there is provided a refractory insulating barrier 4 of magnesia, alumina, or similar arc-resisting material forming a diaphragm or partition extending centrally across the switch body. With the assembly so far described the metallic receptacles 1 and 2 are adapted to be maintained in

electrically non-conducting relation. However, in order to permit current to flow between them, there is additionally provided in the switch enclosure a body of mercury, or other suitable liquid contacting medium 5, of such depth as to be capable of flowing through a circular aperture 6 formed in the barrier 4, when the switch-button is in the position shown.

The switch button as a whole is frictionally supported as in a ball and socket joint by conducting metallic abutments 7 and 8 whose projecting faces fit into corresponding depressions in the switch walls. The abutment members themselves are securely mounted on the supporting walls of a housing 9 which is composed of suitable insulating material, for example a phenolic condensation product. For varying the angular position of the switch-button, and, consequently the position of the aperture 6 with reference to the surface of the mercury pool 5, I provide an insulating handle 10 which may be affixed to an external surface of the switch by suitably clamping the same thereto.

The mode of operation of a switch of the type described will be apparent upon an inspection of Fig. 2, which shows a side elevation of the switch button with its interior exposed by the removal of the cup member. In this figure the position of the aperture 6 shown in solid outline represents the approximate degree of immersion required to insure a contacting relationship between the mercury bodies on each side of the barrier 4. It has been observed that with a smaller portion of the aperture below the mercury surface, the surface tension of the mercury tends to prevent it from flowing freely through the aperture.

It is obvious that a counter-clockwise motion of the switch handle 10 will be effective to raise the lower edge of the aperture 6 above the level of the mercury 5, thus causing the solid portions of the barrier to interrupt the electrical continuity thereof. It should be noted, however, that the angular rotation of the handle which is required to accomplish this result is considerably increased by the fact that a decrease in the extent of immersion of the aperture 6 raises the actual elevation of the mercury surface. This is due to the fact that a greater proportion of the solid barrier 4 is immersed in the mercury than was previously the case, thus correspondingly increasing the displacement of the same. For this reason the aperture 6 will not completely clear the mercury surface until it reaches the position indicated in dotted outline as 6a, corre-

sponding to the position of the switch handle noted as 10a. At this time the level of the liquid contact material will have been raised by increased displacement due to movement of the solid barrier to the position designated as 5a.

While this effect is present to a certain extent in all liquid contact devices of the general type under consideration its importance is greatly magnified in a switch structure of small dimensions such as that which I have described above. In such a structure the fact that the total volume of the fluid medium is relatively small with reference to the volume of the barrier aperture tends to exaggerate the magnitude of the mercury level variations. It will be readily understood that this result is particularly objectionable.

This result is particularly objectionable in applications where the switch-button is desired to be moved with a minimum of energy, as by the delicate mechanism used in control operations. It will be clear in this connection that the change in mercury level described above actually represents the expenditure of enough energy to lift the volume of mercury comprised between the surface levels 5 and 5a.

In Figs. 3, 4, and 5, I have illustrated a switch-button, constructed in accordance with the principles of my invention, which overcomes the objectionable effects described above. In this figure the parts corresponding to those described in connection with Figs. 1 and 2 are similarly numbered. In addition to the structural elements already described my improved construction embodies compensating liquid displacement means in the form of a pair of recesses or depressions 12 and 13 formed in the opposite surfaces of the barrier 4. These are shown as being spaced diametrically with respect to the aperture 6, but may assume any angular position such that their immersion in the liquid contacting medium increases as the aperture is withdrawn therefrom. Furthermore, while the depressions are exemplified as being of circular outline, it will be understood that other shapes may be used without departing from the scope of my invention. The depressed channels 12 and 13, of which the former is shown most clearly in Fig. 4, while intended chiefly as an aid in aligning the switch-button parts, also serve to augment the corrective effect of the main recesses 12 and 13. The significance of the arrangement just described will be most readily appreciated from an inspection of Fig. 5, which illustrates the manner in which the increased displacement of mercury occasioned by raising the aperture 6 above the mercury surface is compensated by a correspondingly increased immersion of the depressions 12 and 13. It will be apparent that by a suitable choice of dimensions any increase in the mercury level may be wholly or partially offset by a corresponding decrease caused by the recessed areas. A condition of zero level variation will be attained when the aggregate volume of the depressions 12 and 13 is about the same as that of the aperture 6, and when the rate of decrease of immersion of the former equals the rate of increase of the latter. When this last-described condition is fulfilled rotation of the switch-button may be accomplished with the expenditure of no energy beyond that required to overcome the frictional resistance and the surface tension of the mercury. Furthermore, the angular distance through which the switch is required to be rotated to open or

close a conducting path will be reduced to a minimum.

In Figs. 6 and 7, in which parts corresponding to those already described are identically numbered, I have illustrated an alternative variation of which my invention is capable. In this modification instead of providing recessed areas angularly positioned from the aperture 6 and operating to decrease the immersed volume of the barrier 13, I provide positive liquid displacement means arranged adjacent the aperture 6 and adapted to be immersed simultaneously therewith. As illustrated, these take the form of protuberances 15 and 16 projecting inwardly from the walls of the dished receptacles 1 and 2 and in alignment with the aperture 6. If the displacement of the projecting portions is comparable to the volume of the aperture itself, the level disturbing effect produced by raising the aperture above the mercury surface will be substantially offset by the simultaneous and converse effect of the projections 15 and 16. As before the completeness of the compensation will depend upon the relative volumes of the displacing parts. It will be understood that the external depression 20 appearing in Fig. 7 is provided solely as an aid in aligning the switch parts and does not affect the operation of the mercury displacing elements.

Figs. 8 and 9 illustrate a further modification of my invention in which a single recess 17 is placed on one side of the barrier 4. For the sake of clarity Fig. 9 represents the switch-button as being rotated 90° from the position shown in Fig. 8 and comprises a section taken on the line of centers of the aperture 6 and the recess 17. It will be noted that in order to permit the use of a smaller quantity of mercury the angular displacement between the recess and the aperture is made substantially less than 180°.

In rotating the switch-button counter-clockwise to the off-position, the progressive immersion of the recess 17 prevents any rise in the mercury level. Furthermore, the fact that the chambers on opposite sides of the barrier 4 are in physical communication through the aperture 6 assures an equalizing flow of mercury toward the recessed side while the aperture is being moved in an upward direction.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since many modifications in the structure may be made, and I contemplate by the appended claims to cover all such modifications as fall within the true spirit and scope of my invention.

The structure of the button switch itself, apart from the level governing means described, does not form part of the present invention, but is fully described and claimed in my copending application, Serial No. 759,527, filed December 28, 1934, and assigned to the same assignee as this application.

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

1. In an electrical switch containing a liquid contacting medium, a contact-governing barrier having an aperture therein adapted to be successively immersed in and withdrawn from said medium by rotation of said switch, said barrier being provided with a depression extending only partially therethrough and positioned to be immersed in said medium as said aperture is withdrawn therefrom.

2. In an electrical switch, an enclosing vessel,

an insulating barrier dividing said vessel into a plurality of electrically separate compartments and being provided with an aperture therein, a quantity of mercury in said vessel adapted to

5 establish an electrical circuit between said compartments through said aperture, said barrier being also provided with a depression extending partially therethrough, which depression is of such size and so positioned as substantially to reduce variations in mercury level caused by changes in the degree of immersion of said aperture.

3. In an electrical switch, a liquid contacting medium, a contact-governing barrier having an aperture therein adapted to be immersed in said medium by rotation of said switch, said barrier having a depression extending partially therethrough, which depression is of a size comparable to that of said aperture and is approximately diametrically displaced with respect to said aperture.

4. For use in a liquid contact switch a circuit-interrupting barrier comprising an insulating septum having an aperture therethrough and de-

pressions in the surfaces thereof angularly displaced from said aperture, said depressions being of a size comparable to that of said aperture and extending only partially through said septum.

5. An electrical switch comprising a pair of juxtaposed shallow dished metal members forming an enclosure, a quantity of mercury within said enclosure, an insulating barrier interposed between said dished members and dividing said enclosure into a pair of electrically separate mercury storage spaces of small volume in comparison with their depth, said barrier being provided with an aperture adapted to be immersed in said mercury in certain positions of said switch and being further provided with one or more depressions extending partially therethrough, which depressions are of an aggregate volume comparable with that of said aperture and are displaced therefrom by an angle effective to minimize variations in the depth of said mercury occasioned by changes in the degree of immersion of said aperture.

JOHN H. PAYNE.