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LIQUID CONTACT OPERATING THROUGH A MECHANICAL
DISPLACEMENT OF MERCURY
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3,358,109

Fig. 1

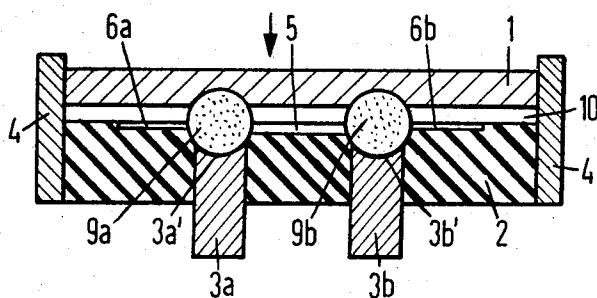


Fig. 2

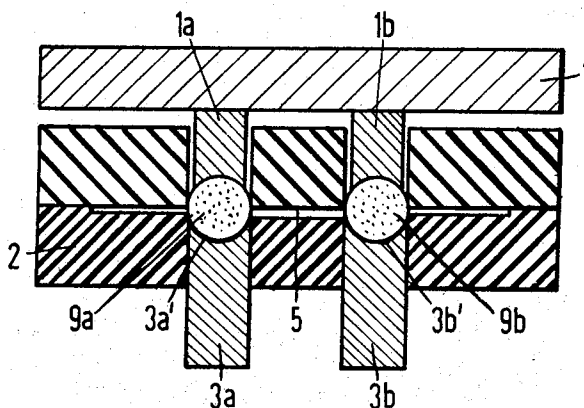
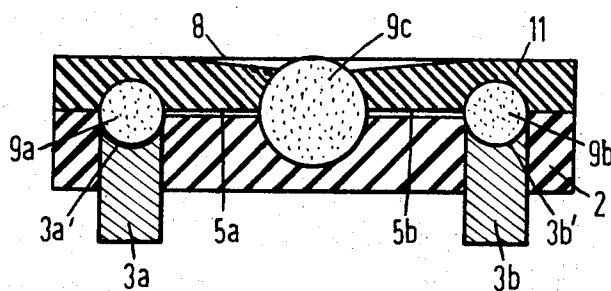


Fig. 3



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LIQUID CONTACT OPERATING THROUGH A MECHANICAL DISPLACEMENT OF MERCURY

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2 Claims. (Cl. 200—152)

ABSTRACT OF THE DISCLOSURE

An electrical contact structure utilizing mechanical displacement of mercury in a capillary passageway to connect a pair of electrical terminals, each having a drop of mercury associated therewith, which drops are connected over the capillary passageway upon such mercury displacement.

The disclosure

It has long been a known practice, particularly for switching electrically highly loaded circuits to use switch tubes filled with mercury, in which an immersion armature is frequently provided inside the switch tube and operatively effects changes in the surface level of the mercury and thereby controls a contact connection operating in an opening and closing manner.

Such liquid contacts operating with mercury are, in their operation, considerably dependent on position, so that as a rule they can be used only in stationary applications. A further serious disadvantage resides in the fact that only relatively low switching speeds are attainable with such contact systems, which is related to the mass of mercury which must be moved. All mercury switches or mercury relays of this type have in common, however, freedom from chattering since uncertain electrical connections cannot occur as they do in the usual metal contact systems.

In order to be able to also utilize the advantage of a chatter-free operation through use of mercury for applications in which high switching speeds and independence of position are essential, it has already been proposed that mercury contacts be employed in which the amount of mercury used is reduced to a minimum, as the relations with respect to positional independence and switching speeds are improved as the supply of mercury disposed in the switching space is reduced. The switch actuation is effected in the previously proposed arrangement by means producing a deformation of a drop of mercury during operation and relies upon the effective surface tension of the mercury to effect a subsequent restoration of the open condition existing in the initial or starting position.

Underlying the invention is the problem of creating such a liquid contact, operating with mechanical displacement of mercury, which makes use of these basic principles and, in so doing, permits a very simple arrangement for manufacture. According to the invention this is achieved by an arrangement in which there is disposed, preferably in a hermetically sealed switching passage or space, at least two drops of mercury, located in respective depressions defined by connecting terminals. The cross section of such passage, in relation to the volume of the mercury drops, should be of such dimension that a capillary is formed whereby in resetting of the actuating member the mercury thread formed in such capillary will break and the mercury thereupon flow back into the respective depressions in the connecting terminals. In a preferred form of construction embodying the invention provision may be made for the compensation of an

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overstroke of the actuating member, in the form of overflow channels associated with the respective depressions, and whose cross sections are smaller in comparison with the capillary passage.

Such a liquid contact not only is chatter-free in its operation, but is also independent of position, since the surface tension of the deformed mercury drops generates such a strong resetting force that the effective gravity can be neglected. Moreover, the slight mass to be moved of the mercury drops results in the achievement, in such a liquid contact, of switching speeds which can normally be attained only in relays employing metal contacts.

Expediently the entire structure defining the switching space comprises parts made of electrically insulating material, in particular glass or ceramic material. In order to exclude environmental influences which can lower the switching properties of the mercury, it is further advantageous to hermetically seal the switching space and to fill it with a suitable protective gas. It also is expedient that the capillary passage or the overflow channels have a smoother surface in comparison to the other surfaces defining the switching space.

Normally there is utilized as an actuating member an adjustable plate or block, preferably shiftable by electromagnetic means, which acts directly upon the mercury drops. It is, however, also possible to provide such an actuating plate with plungers slidably disposed in guides, and operative to produce a mechanical coupling with the mercury drops. It is thereby possible to more efficiently close off the space in which the mercury is located, and in this system, in the same manner as in the case of direct operation, the plungers are withdrawn upon a resetting of the mercury drops. Variations in these forms of construction can be achieved, with retention of the same fundamental principle, by inserting in the capillary passage or space an additional drop of mercury, which, for example, may be deformed by a membrane and thereby establishes an electrical connection between the connecting terminals over the thereby divided capillary passage.

Further details of the invention will be apparent from the following description of several examples of construction. All forms of construction have in common the presence of at least one drop of mercury, in which, after deformation, a part of the mercury is pressed into a capillary space and thereby a switch release is possible over the terminal electrodes standing in connection with the mercury.

Referring to the drawing, in which like reference characters indicate like or corresponding parts:

FIG. 1 is a transverse section of a contact arrangement embodying the invention;

FIG. 2 is a similar view of a modification of the construction of FIG. 1; and

FIG. 3 is a similar view of a further modification.

Referring to FIG. 1, the liquid contact according to the invention utilizes a plate 2 of insulating material, in which there are arranged two connecting electrodes 3a and 3b. If the actuating plate 1, illustrated as being vertically movable, which is disposed between lateral guides 4, is shifted in the direction of the arrow, the mercury drops 9a and 9b located in recesses or depressions 3a' and 3b' of the connecting electrodes, are forced into the capillary space 5, whereby an electrical connection is established between the drops 9a and 9b, and thus between the terminals 3a and 3b. In addition there may be provided overflow channels 6a and 6b, whose cross section is smaller in comparison to the capillary space 5. The cross section of the capillary space is so dimensioned, in relation to the volume of the mercury drops 9a and 9b, that in a resetting of the operating plate 1 to its original position the mercury thread formed in the capillary space 5 breaks and the

mercury flows back into the depressions 3a' and 3b', which condition constitutes the rest state of the liquid contact and is illustrated in FIG. 1.

A similar construction is illustrated in FIG. 2, in which in contrast to the construction according to FIG. 1, instead of the provision of an actuating plate 1 directly engageable with the mercury drops 9a and 9b, there are provided plungers 1a and 1b mounted thereon, which engage the merging drops 9a and 9b and are correspondingly shaped. Functionally, however, the same actuation operation occurs as described with respect to the form of construction illustrated in FIG. 1.

FIG. 3 illustrates the utilization of an additional mercury drop 9c operatively disposed in the thereby divided capillary space 5a/5b, whereby it is possible to eliminate the deformation of the mercury drops 9a and 9b, with the displacement of the mercury, in this case, taking place only from the volume of the drop 9c, with the operating member comprising a membrane 8. It is possible in this arrangement to dispense with the overflow channels illustrated in FIGS. 1 and 2, since in the event of an overstroke the mercury may flow between the membrane 8 and a plate 11 which carries such membrane.

All the forms of construction have in common the feature that the structure defining the switching passage or space is made of insulating material, preferably of glass or ceramic material. However, a metal must be employed for the connecting terminals disposed in the plate of insulating material, which does not form an alloy with the mercury. The actuating member of any of the embodiments can be shifted by any suitable mechanical transmitting device, there preferably being used the usual systems embodiment in electromagnet relays.

Changes may be made within the scope and spirit of the appended claims which define what is believed to be new and desired to have protected by Letters Patent.

I claim:

1. A liquid contact operable by mechanical displacement of mercury, comprising a body of insulating material having a plurality of recesses therein, a drop of mercury in each of said recesses, said body being constructed to form capillary connecting means between such mercury drops, a connecting terminal engageable with one mercury drop, and a second connecting terminal engageable with another mercury drop, and actuating means engageable with at least one mercury drop, operative to effect a deformation thereof whereby mercury is displaced into said capillary connecting means to establish an electrical connection between said connecting terminals, said body being provided with overflow channels operatively communicating with mercury forming said drops, which channels have a cross section which is less than that of the capillary connecting means, for the compensation of an over actuation of the actuating member.
2. Liquid contact according to claim 1, wherein the capillary connecting means, and the overflow channels, have a smoother surface in comparison to the other surfaces of the other portions of the mercury contactable portions of said body.

References Cited

UNITED STATES PATENTS

3,184,693 5/1965 Lancot ----- 200—152 X

FOREIGN PATENTS

22,717 10/1897 Great Britain.

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