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LIQUID CONTACT DEVICE

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Fig. 1.

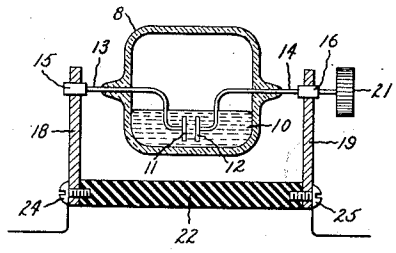
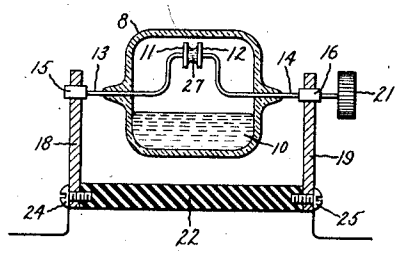


Fig. 2.



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LIQUID CONTACT DEVICE

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5 Claims. (Cl. 200—33)

The present invention relates to an improved form of liquid contact switch having a time-delay characteristic.

According to the invention, use is made of spaced terminal elements which are immersed in liquid contact medium in one position of the switch and which are above the level of the medium in another position of the switch. The spacing and configuration of the terminal elements are made such as to assure the retention of a quantity of the contact medium between the elements when they are moved from an immersed to a non-immersed position, and by this means the complete opening of the switch is delayed until the retained medium is removed by vaporization. The amount of the delay thus realized is a function of the resistance characteristics of the particular contact medium employed and of the magnitude of the current flowing between the terminal elements—since these factors jointly determine the rate of heating and consequently the rate of evaporation of the medium.

The invention is applicable in any situation where a time delay characteristic is considered desirable and has the advantage of providing a switch which is substantially free from arcing at the instant of current interruption.

The features which I desire to protect herein are pointed out with particularity in the appended claims. The invention itself, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawing, in which Fig. 1 is a sectional view of a switch which constitutes one embodiment of the invention and Fig. 2 is another view of the switch of Fig. 1, showing the same in a second operating position.

Referring particularly to Fig. 1, there is shown a switch enclosure 8 which is constituted of insulating material, for example, glass. Within the enclosure there are provided a pair of contact terminals 11 and 12 which are supported in spaced relation as shown. In the switch position illustrated these terminals are immersed in a liquid contact medium which is of such low resistivity as to provide a substantially direct conductive connection between the terminals. For this purpose one may employ a liquid metal, such as mercury or gallium, but for reasons which will be stated at a later point I prefer a substance of somewhat higher resistivity than mercury, such as an electrolyte which contains an excess of one of the dissociation products of the electrolyte. One example of the latter type of substance is an aqueous solution of potassium iodide containing an excess of iodine. The free space within the switch enclosure may be filled with an arc-suppressing gas which is inert with respect to the terminal elements and the contact material. When using potassium iodide as the contact material, helium at a pressure of about one atmosphere may be appropriately used as the filling gas.

The terminal elements 11 and 12 are supported by means of lead-in conductors 13 and 14 which are sealed through the opposite ends of the switch enclosure and which terminate in enlarged cylindrical portions 15 and 16 of sufficient size to provide bearing surfaces for rotatably supporting the switch. The parts 15 and 16 are fitted in conforming openings in metallic supports 18 and 19 so as to permit free rotation of the switch. A knob 21 which is fixed to one end of the part 16 serves to facilitate rotational movement of the switch.

The supports 18 and 19 are mounted on an insulating base member 22 and are respectively provided with contact terminals 24 and 25 for permitting connection of the supports to conductors leading to the circuit in which the switch is to be used. From these terminals a circuit through the switch is completed through the supporting members 18 and 19 and the lead-in conductors 13 and 14.

The terminal elements 11 and 12 should be of relatively extensive surface area and should be so closely spaced as to assure retention of a portion of the contact material between the elements when they are moved from an immersed to a non-immersed position. In a particular case it has been found advantageous to employ for this use a pair of flat iron disks about 0.5 inch in diameter and with a separation of about 0.03 inch, this being the construction shown in Figs. 1 and 2. However, other terminal shapes may be employed, such, for example, as a cup-shaped configuration.

The mode of use of the invention may best be understood by reference to Fig. 2 which shows the switch of Fig. 1 after the switch has been rotated by an amount sufficient to raise the terminal elements 11 and 12 above the surface of the contact material 10. As is indicated at 27, the space between the terminal elements retains a body or globule of the contact material which is held in place by capillary attraction. As a result of the presence of this globule it is apparent that with the switch in the condition shown

the switching circuit is not actually open, since current flow is maintained through the globule. However, due to the relatively restricted cross-sectional area of the current path, considerable heating of the globule will occur as a result of the resistance losses in it, and vaporization of the contact material will take place. Because of this action the globule may be expected to disappear within a relatively short interval, the time required for complete dissipation of the globule being a function of its resistivity and also of the strength of the current in the switching circuit. In a particular case, using as a contact material an aqueous solution of potassium iodide having an excess of iodine (about 50% potassium iodide and 20% iodine) the time required for complete evaporation of the contact material retained by the terminal elements was found to vary from about one second with a current flow of three amperes to more than thirty seconds with a current of one ampere. Since the time required to vaporize the globule represents a corresponding delay in opening the switching circuit, the arrangement described is considered to have utility in any situation where a time delay characteristic is desired. Inasmuch as the interruption of the current is preceded by a progressive increase in the resistance of the current path and an attendant decrease in the current flow, the actual current at the time of interruption may be very small, leading to a negligible amount of arcing during the interrupting action.

Other liquid contact materials than potassium iodide may obviously be used in practicing the invention and, indeed, most electrolytes which contain an excess of one of the dissociation products of the electrolyte exhibit high conductivity and may therefore be applied to this use, provided their other properties are suitable. A particular alternative to the electrolyte mentioned above comprises a solution of potassium bromide with an excess of bromine. Liquid metals such as mercury or gallium may also be employed although the low resistivity of these latter substances indicates their unsuitability except in circuits where the current which is to be passed through the switch is sufficiently high to assure vaporization of the globule retained between the terminal elements within a reasonable period.

While the invention has been described by reference to a particular embodiment thereof, it will be understood that numerous structural modifications may be made by those skilled in the art without actually departing from the invention, and I therefore aim in the appended claims to cover all such equivalent variations as come within the true spirit and scope of the foregoing disclosure.

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

1. A time delay switch comprising a body of liquid contact material and cooperating terminal elements which are immersed in the contact material during certain positions of the switch and which are above the level of the material in certain other positions of the switch, the said terminal elements being metal bodies of relatively extensive surface area which are positioned in face-to-face relation and in such close proximity as to assure the retention of a quantity of contact material between the bodies when they are moved from an immersed to a non-immersed position, thereby to delay complete opening of the switch for a period sufficient to permit vaporization of the retained contact material.

2. A time delay switch comprising a body of liquid contact material and cooperating terminal elements which are immersed in the contact material during certain positions of the switch and which are above the level of the material in certain other positions of the switch, the said terminal elements being disk-like metal bodies positioned in face-to-face relation and in such close proximity as to assure the retention of a quantity of contact material between the bodies when they are moved from an immersed to a non-immersed position, thereby to delay complete opening of the switch for a period sufficient to permit vaporization of the retained contact material.

3. A time delay switch comprising a body of a liquid contact material constituted of an electrolyte which contains an excess of one of the dissociation products of the electrolyte and cooperating terminal elements which are immersed in the contact material during certain positions of the switch and which are above the level of the material in other positions of the switch, the said terminal elements providing opposed surfaces which are so closely spaced as to assure the retention of a globule of the contact material between them as the elements are moved from an immersed to a non-immersed position, thereby to delay complete opening of the switching circuit until the said globule is vaporized by heating produced by resistance losses in the globule.

4. A time delay switch comprising a body of liquid contact material constituted of a solution of potassium iodide with an excess of iodine and cooperating terminal elements which are immersed in the contact material during certain positions of the switch and which are above the level of the material in other positions of the switch, the said terminal elements providing opposed surfaces which are so closely spaced as to assure the retention of a globule of the contact material between them as the elements are moved from an immersed to a non-immersed position, thereby to delay complete opening of the switching circuit until the said globule is vaporized by heating produced by resistance losses in the globule.

5. A switch comprising a body of liquid contact material and cooperating terminal elements which are immersed in the contact material when the switch is in closed-circuit position and which are above the level of the material when the switch is in open-circuit position, the said terminal elements being constructed and arranged so that a quantity of the contact material insufficient to carry the normal load current of the switch without substantial heating is retained between the elements as they are moved from their immersed to their non-immersed position, whereby complete opening of the switch circuit is delayed for a time sufficient to permit evaporation of the said quantity of contact material as a result of the heating action of the normal load current passing therethrough.

CHAUNCEY G. SUITS.