Sept. 2, 1952 J. W. WINTER 2,608,467

MERCURY SWITCH

Filed Dec. 13, 1948

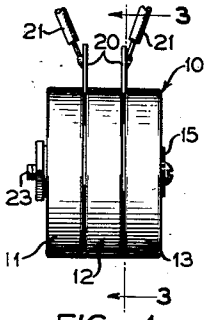


FIG. 1

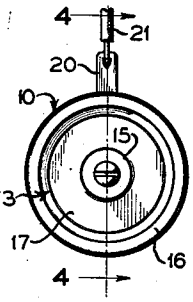


FIG. 2

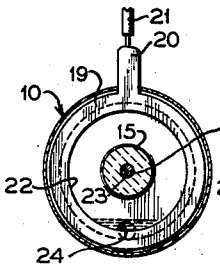


FIG. 3

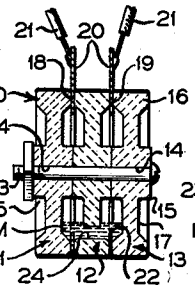


FIG. 4

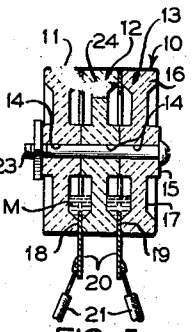


FIG. 5

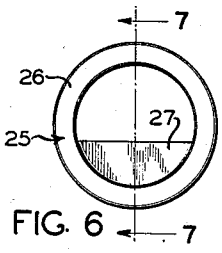


FIG. 6

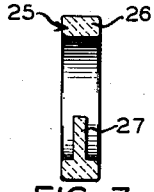


FIG. 7

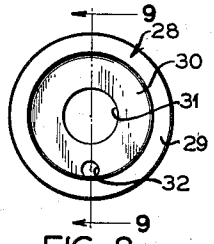


FIG. 8

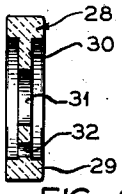


FIG. 9

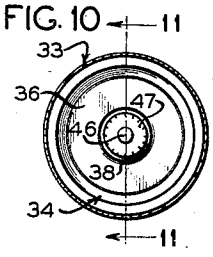


FIG. 10

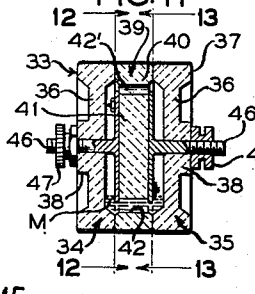


FIG. 11

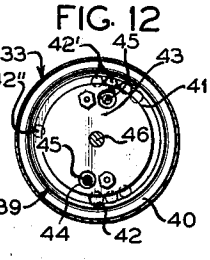


FIG. 12

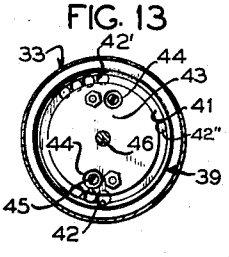


FIG. 13

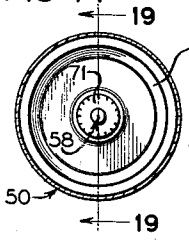


FIG. 14

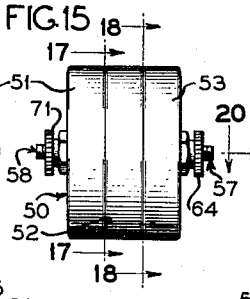


FIG. 15

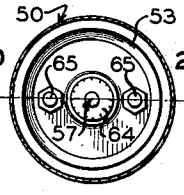


FIG. 16

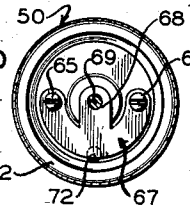


FIG. 17

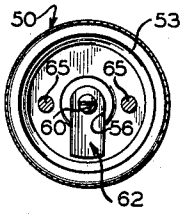


FIG. 18

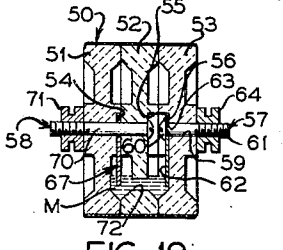


FIG. 19

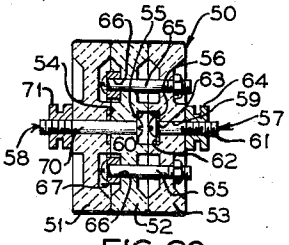


FIG. 20

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Patented Sept. 2, 1952

2,609,467

UNITED STATES PATENT OFFICE

2,609,467

MERCURY SWITCH

George W. Winter, Crooksville, Ohio

Application December 13, 1948, Serial No. 64,950

15 Claims. (Cl. 200—152)

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This invention relates to circuit makers and breakers, and more particularly to a fluid-operated electrical switch employing a liquid metal such as mercury or the like as a contact medium.

Heretofore switches of various types, including those operated by mercury, have been in wide use. However, most of these, and particularly those of the mercury type have suffered from numerous deficiencies, such as those of complexity, relatively high expense of manufacture, and the necessity for the use of certain materials which are particularly susceptible to breakage such as glass, or the requirement for critical materials in short supply which are relatively difficult to obtain, such as various kinds of metals.

Accordingly, it is an object of the present invention to provide a novel switch of the class set forth in which the deficiencies enumerated above are overcome.

A further object of the invention is to provide a mercury-operated switch which is simple and inexpensive, of relatively high strength, and which is easy to assemble and repair.

A still further object of the invention is to provide a mercury-operated switch in which most of the parts are of a ceramic material, susceptible of mass production on a low unit cost basis.

A further object of the invention is to provide a compact, light-weight, mercury switch in which the body of the switch is insulated, in order that the hazard of electrical shock is reduced or substantially eliminated.

Another object of the invention is to provide a mercury-operated switch in which the parts are easily assembled, and may be readily replaced.

Further objects and advantages of the invention will be apparent from the following description, taken in conjunction with the accompanying drawings, wherein:

Fig. 1 is a side elevation of a preferred form of the invention;

Fig. 2, an end elevation of the device shown in Fig. 1;

Fig. 3, a transverse section on the line 3—3 of Fig. 1;

Fig. 4, a longitudinal section on the line 4—4 of Fig. 2, illustrating the switch in closed position;

Fig. 5, a sectional view similar to Fig. 4, but illustrating the switch in open position;

Fig. 6, an elevation of a modified form of central disc;

Fig. 7, a section on the line 7—7 of Fig. 6;

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Fig. 8, an elevation of another modification of the central disc;

Fig. 9, a section on the line 9—9 of Fig. 8;

Fig. 10, an end elevation of a modified form of switch;

Fig. 11, a section on the line 11—11 of Fig. 10;

Fig. 12, a section on the line 12—12 of Fig. 11;

Fig. 13, a section on the line 13—13 of Fig. 11;

Fig. 14, an end elevation of still another modification of the switch;

Fig. 15, a side elevation of the switch illustrated in Fig. 14;

Fig. 16, an elevation of the opposite end to that disclosed in Fig. 14;

Fig. 17, a section on the line 17—17 of Fig. 15;

Fig. 18, a section on the line 18—18 of Fig. 15;

Fig. 19, a section on the line 19—19 of Fig. 14; and

Fig. 20, a section on the line 20—20 of Fig. 16.

Referring to the drawings, the mercury switch 10, illustrated in Figs. 1 to 5, inclusive, includes a plurality of non-conducting substantially flat separators which may be in the form of disc-shaped ceramic members 11, 12, and 13, which are positioned adjacent one another on a common axis. Each of the discs has a central aperture 14, surrounded by a hub 15, and a rim about its periphery 16, which is connected to the hub by a spider 17. Positioned between the inner disc 12 which constitutes a barrier, and the outer discs 11 and 13 are ring-shaped contacts or conductors 18 and 19. These contacts have a projection or ear 20 for attachment to a conductor 21; their outer dimension or diameter is substantially equal to that of the discs 11 and 13, but is preferably slightly less in order to avoid contact with an outside member. The contacts are provided with a relatively large central bore leaving a rim 22 whose inner border or edge has a slightly lesser diameter than the inner diameter of the rim 16 of the disc.

The entire assembly of discs and conductors is clamped together with the rims 22 of the conductors being retained between the rims 16 of the discs, and a fastener 23 extends through the bores of the three discs to maintain the unitary assembly.

It is apparent, particularly from Figs. 4 and 5, that the hubs of the discs are drawn into intimate contact by the fastener, and therefore the latter is protected from contact with the mercury which may be contained between the spiders of adjacent discs.

In order to provide for the communication of a conducting fluid, such as mercury, between

the conducting rings 18, an aperture 24 is provided in the spider of the central disc, and in a position just within the rim thereof. In order to conduct current from one conducting ring to another, mercury or other suitable conducting fluid is placed in the space between the spiders of two or more discs in an amount sufficient to contact a substantial portion of the rings 18 and 19, when the switch is in the position shown in Fig. 4. The aperture 24, although preferably located as shown, can perform its proper function provided it is off-center of the disc.

The elements shown in Figs. 1 to 5, inclusive, may be easily assembled, it being preferable or relatively easy to pour in the necessary amount of mercury by placing the switch on its side prior to assembly of the third disc, and pouring through the aperture 24 in the central disc until just before the mercury overflows. The remaining conductor ring and disc may then be positioned, and the fastener 23 placed in the bores of the elements and tightened. A suitable sealing coating, such as varnish or the like is applied between the surfaces of the conductor rings and discs where there is contact between adjacent elements in order to prevent leakage of the mercury from the space provided for it. A non-conducting coating may be applied to the exterior of the switch body if desired in order to afford additional protection for it and improve its appearance.

In the operation of the switch it is contemplated that the same will be mounted for rotation on an axis which corresponds to that of the elements of the switch, and that suitable conductors will be attached to the ears of the conductor rings of the switch, providing enough slack in the conductors so that the switch may be rotated through an arc of at least 180°. It is apparent that in order to operate the switch it is only necessary to rotate the same from the position shown in Fig. 4 to that in Fig. 5, or the switch may be rotated through a lesser arc so that the aperture 24 is raised above the level of the mercury. In Fig. 4, the aperture 24 in the central element is at the lower part of the switch, and the mercury will therefore provide electrical communication between the conductors. When the switch is rotated to a position corresponding to that shown in Fig. 5, the mercury will then separate, a portion flowing into the spaces between the central and the outer spiders, the aperture in this position being at the upper or top of the switch and above the level of the mercury, thus preventing any electrical circuit between the conducting elements.

A modification of the central member or disc 12 is shown in Fig. 6, and comprises a disc 25 having a rim 26, and a sector 27 which covers less than one-half of the central portion of the disc. This disc is adapted to be substituted for the disc 12 shown in Figs. 1 to 5, inclusive, and it is apparent that the sector 27 divides the body of mercury in the switch when the switch is in a position corresponding to that of Fig. 5. When the switch is rotated to its other position, however, the sector 27 will no longer act as a barrier and the mercury will flow through the upper part of the disc which is not filled in by the sector 27 and complete the contact through the conductor elements.

Another form of central disc is shown in Fig. 8, and comprises a member 28 having a peripheral hub 29, and a web 30 provided with a central bore 31 and a relatively small aperture 32 which is positioned on a radius of the disc and substantially adjacent to the rim 29. The function of this disc and aperture is substantially like that of the disc 12 previously described.

In Figs. 10 to 13, inclusive, a modified form of switch is shown, which is adapted to be positioned between a pair of contacts, and therefore does not require attachment of lead wires to projecting ears, as with the earlier forms of the device. This modification comprises a switch 33 which has outer disc members 34 and 35 which are substantially like the disc members 11 and 13 previously described, except that a web 36 of each of the discs extends between the rims 37 and is provided with a hub 38 on the outer side only, of each of the discs. The central disc 39 includes a rim 40 and web 41. Spaced apertures or groups of apertures 42, 42', 42'', etc., are provided in the web of the disc substantially adjacent its rim. The apertures are spaced in such a manner that the circuit will be completed through the switch for desired time intervals as the switch rotates. For example, the switch may be rotated by clockwork mechanism or the like so that it makes a complete revolution in 24 hours. During this time it may be desired to complete the circuit therethrough from 5 p. m. to 1 a. m. and off and then from 6 a. m. to 8 a. m. and off and then again for an hour in the afternoon.

The conductor members are preferably substantially circular plates 43. In order to attach the members 43 to the central disc 39 fastening members 45 are connected to each of the members and pass through the disc and are received or have their extremities within apertures or cut-out portions 44 of the opposite member on the other side of the central disc. It is apparent, therefore, that means is provided for attaching the members 43 to the central disc 39 without thereby providing direct connection or electrical conduction between the contacts.

Attached to or integral with each of the conductors 43 is a stud or post 46 which projects laterally therefrom and is adapted to be received by the bores of the adjacent discs 34 and 35, respectively. For maintaining the switch in assembled relationship fasteners 47 are secured upon the studs 46.

From the above description it will be apparent that the switch may be inserted between contact points, in the manner of a fuse and that a circuit may be completed therethrough at selected intervals and for desired periods by positioning the apertures in the central disc accordingly. This type construction is of course applicable for use where only a single aperture is provided.

In Figs. 14 to 20, inclusive, a still further modification of the switch is shown. The form shown includes the switch 50, comprising discs 51, 52 and 53 occupying the same relative relationship as those in the previous forms of the device. These discs are formed like the discs of Figs. 1 to 5, inclusive, except that one side of each disc has a recess in the disc hub.

The recesses in the discs 51, 52 and 53 will be referred to by the numerals 54, 55 and 56, respectively, for convenience.

The switch is of the same general type as that shown in Figs. 10 to 13, inclusive, in that it is adapted to be rotatably positioned between a pair of contacts. The contacts are adapted to receive the extremities of posts 57 and 58 which extend from the ends of the switch. The post 57 is posi-

tioned in the central bore 59 of the disc 53 and comprises a fastener having a head 60 and a threaded portion 61. A conductor member 62 which is substantially rectangular in shape is provided with a bore 63 for receiving the post or stud 57, and is maintained in intimate relationship with the stud through contact with the head 60 thereof. A nut, or the like, 64 is engaged with the threaded portion 61 of the stud for fastening the same to the disc 53. For fastening the disc 53 to the disc 52 bolts or other suitable fastening means 65 are adapted to pass through apertures provided in the webs of the discs. The fasteners are received in apertures 66 of a yoke-shape conductor 67, which has a central projection 68. The central projection 68 is provided with a bore 69 for the reception of a fastening member 70 which passes through the central bores of the discs 52 and 51, and is secured therein by a nut 71.

It is apparent from the description and an examination of the drawings, particularly Figs. 19 and 20, that the recesses in the hubs of the discs receive the heads of the fastening members 57 and 70, the projection 68 of the conductor 67, and also an extremity of the conductor 62.

In order to provide for the communication of mercury between the conductors 67 and 62, an aperture 72 is provided in the web of the disc 52 substantially adjacent its rim.

The operation of this switch is substantially the same as of those previously described. The switch is adapted to be positioned between conductors with the projecting stud members 57 and 58 supported by the conductors in such a manner that the switch will rotate. When the switch is in the position shown in Fig. 19, the mercury M in the recesses between the discs will bridge the conductors 62 and 67 and provide electrical connection between the posts or studs 57 and 58. When it is desired to break the contact the switch is rotated approximately 180° or until the aperture 72 is above the level of the mercury which will then be diverted into separate portions of the switch.

It is apparent that the invention contemplates the provision of a mercury switch which is comprised chiefly of ceramic disc members. These are capable of mass production at low cost, and the elements are sufficiently alike that relatively few modifications of the disc are necessary to provide the various forms of the switches shown.

Although mercury switches operating on somewhat similar principles have been used before, none is believed to be as simple of assembly and operation and inexpensive of manufacture as those contemplated in the present invention.

It will be appreciated that the requirements of certain installations will necessitate the use of one or more of the switches herein described.

It will be obvious to those skilled in the art that various changes may be made in the invention without departing from the spirit and scope thereof, and therefore the invention is not limited by that which is shown in the drawings and described in the specification, but only as indicated in the appended claims.

What is claimed is:

1. A switch comprising a plurality of non-conducting substantially flat separators positioned adjacent to each other in face-to-face relationship, the rim portions of said separators being in substantially contiguous relationship, a recess defined by facing walls of adjoining separators within the rim portions thereof, conductor means within two or more recesses on either side of an intermediate separator and extending externally of the separators, said intermediate separator having aperture means therein establishing communication between said recesses, whereby a fluid conductor may be placed in said recesses to complete a circuit between said conductor means through said aperture means.

2. The invention according to claim 1 in which the conductor means are ring-shaped and the inner periphery thereof extends into the recessed portions.

3. The invention according to claim 1 wherein the conductors are of ring shape and the outer periphery thereof is within the outline of the separators and at least a portion of the inner periphery extends into the recessed portions.

4. The invention according to claim 1 wherein the conductors are clamped between the rim portions of adjoining separators and are provided with central apertures, and wherein the separators have contiguous hub portions within said apertures, and fastening means extending through said hub portions.

5. The invention according to claim 1 in which the aperture means is in the form of a segment of a circle.

6. The invention according to claim 1 in which the intermediate separator includes a web portion of less width than said rim portion, and said aperture means provides communication through the web portion.

7. The invention according to claim 1 in which the conductor means are discs provided with central extensions projecting outwardly of the outer separators centrally thereof, and means for securing said conductors and separators in assembled relation.

8. The invention according to claim 1 in which the conductor means are plates extending from the center of the separators toward the aperture means and the conductor means have portions projecting outwardly of the separators centrally thereof, and means for securing said separators and conductor means in assembled relation.

9. The invention according to claim 1 in which the separators are provided with aligned bores and wherein one conductor means includes a portion extending into a recess and a portion projecting outwardly through a portion of said aligned bores and a portion of the other conductor is positioned in another recess with the other portion of the conductor projecting through another portion of the aligned bore and said conductors are out of electrical connection except when a conducting fluid provides electrical connection between the conductors through the aperture means.

10. The invention according to claim 1 in which one conductor means is positioned between the intermediate and a first outer separator and a fastening member extends through a bore in said intermediate and first outer separators and said conductor for securing said first outer and intermediate separators in assembled relation and providing a portion of the said conductor extending externally, and other fastening means extending between said intermediate separator and a second outer separator for securing said intermediate and said second outer separator in assembled relation.

11. The invention according to claim 10 in which the electrical conductor is generally yoke-shaped and the second fastening means extend through said yoke-shaped conductor for securing said yoke-shaped conductor in assembled relation.

12. A switch comprising a plurality of non-conducting members positioned adjacent each other and having their axes substantially aligned, the outer of said members being provided with substantially aligned central bores and having rims and web portions of substantially less thickness than the rims in order to provide spaces between the webs of adjacent members, conductors attached to opposite sides of the inner member, a lateral projection on each conductor extending through the central bore of the adjacent outer member, the inner member being provided with one or more off-center apertures, a pool of liquid mercury in the spaces between the webs of the members adapted to provide electrical contact between the conductors when the switch is in a position in which the mercury extends through an aperture and bridges the conductors, and means whereby the switch may be rotatably mounted between a pair of contacts with the projections of the conductors in intimate relationship with said contacts.

13. The structure defined in claim 12, the conductors comprising plates, and fasteners securing the plates to the web of the central member, each of the fasteners being in contact with one plate only.

14. The structure defined in claim 12, the one

or more off-center apertures being spaced in groups around the member in order that uniform rotation of the member will permit the circuit to be completed through the switch at predetermined intervals of time.

15. The structure defined in claim 12, the one or more off-center apertures being provided around the inner member in order that the circuit may be alternately completed and broken for predetermined time intervals by rotation of the switch at a predetermined speed.

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