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TIME DELAY MERCURY SWITCH
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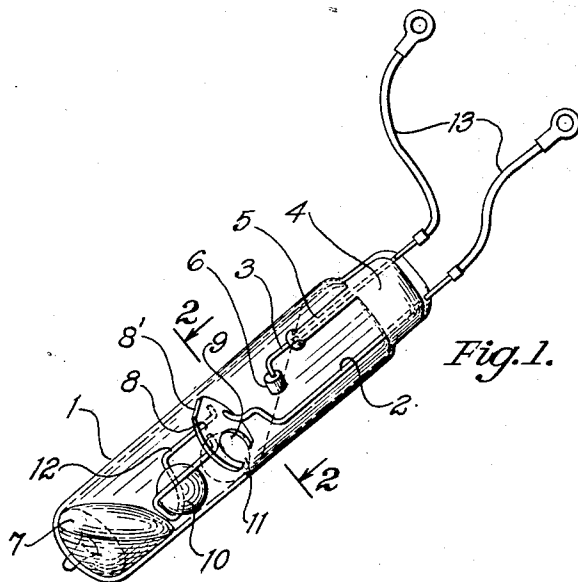


Fig. 1.

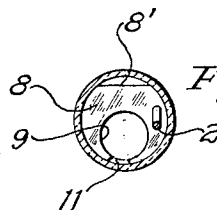


Fig. 2.

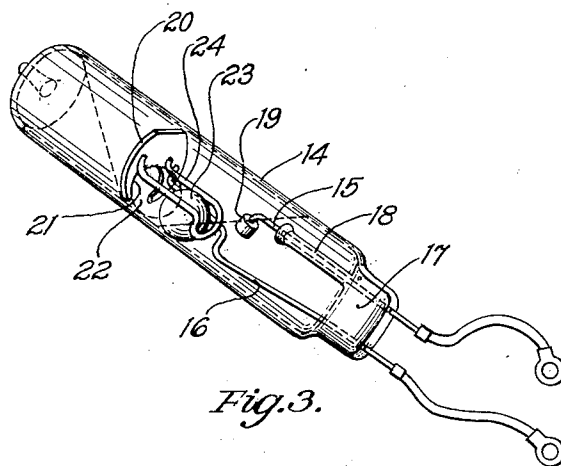


Fig. 3.

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TIME DELAY MERCURY SWITCH

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9 Claims. (Cl. 200—33)

This invention relates to a mercury switch, and more particularly to a switch of this kind in which a time delay is introduced into the making or breaking of contact therein.

5 An object of my invention is to produce a mercury switch in which a body of mercury flows between two sections of a tube in order to make and break a circuit and in which the passage of said body of mercury is delayed in one direction and unimpeded in the other, so as to produce delayed action in one position of the switch and an immediate action in the other position of said switch.

10 This operation contemplates the production of two types of switches, namely a delay circuit-making, quick circuit-breaking switch and a delay circuit-breaking, quick circuit-making switch.

15 Another object of this invention is to produce switches of the foregoing type with a minimum of structural complexity and a maximum of reliability.

20 The foregoing and other objects of my invention will be best understood from the following description of exemplifications thereof, reference being had to the accompanying drawing, wherein—

25 Fig. 1 is a perspective view of a delay circuit-making, quick circuit-breaking switch embodying my invention;

30 Fig. 2 is a cross-section taken along line 2—2 of Fig. 1; and

35 Fig. 3 is a perspective view of a delay circuit-breaking, quick circuit-making switch also embodying my invention.

The switch shown in Fig. 1 comprises a glass envelope 1 with two conductors 2 and 3 sealed through a press 4 at one end thereof. The conductor 3 is insulated by being coated with a glass covering 5 along the substantial portion of its length within the envelope 1. The conductor 3 carries a contact-making and breaking terminal 6 at its outer end. The envelope 1 contains a body of mercury 7 and is filled with an inert gas, preferably hydrogen, at a pressure somewhat below atmospheric pressure. When the body of mercury 7 contacts both the conductor 2 and the terminal 6, a circuit is established between the conductors 2 and 3, and thus the switch is in its closed position. When, however, the body of mercury leaves the terminal 6, the switch is in its opened position.

40 In order to produce a time delay in one direction of operation of a mercury switch of the kind described above, there is introduced a baffle plate 8 supported transversely within the glass envelope 1. The baffle plate 8 is made of some suitable metal, for example, a steel disk welded to the outer end of the conductor 2, whereby said baffle plate is supported in position within

the glass envelope. The baffle plate 8 is provided at one side thereof with a circular opening 9 intercepting one edge of the baffle plate, leaving one side of the baffle plate cut away. A metal ball 10, preferably of steel, is provided so as to close the circular opening 9 in one position of the switch. The ball 10 is made somewhat larger in diameter than the opening 9. The baffle plate 8 is also cut away to a limited extent at one side of the opening in its edge, as indicated at 11. When the metal ball 10 closes the circular opening 9, a closure is effected only to the extent as indicated by the dotted line in the lower portion of Fig. 2. Thus the cut-away portion 11 leaves a small aperture through which the mercury within the switch can pass slowly, as will be described below. In order to keep the metal ball 10 within the proper limits of motion, a retaining frame 12 is welded to that side of the baffle plate 8 at which the metal ball 10 is located. The retaining frame 12 is of sufficient extent to permit the metal ball 10 to roll away from the opening 9 and leave it substantially unobstructed for the passage of mercury there-through when the switch is tilted substantially to a position as shown in Fig. 1. The conductors 2 and 3 extend through the press 4 to the exterior of the switch envelope 1. The conductors 2 and 3 may likewise be provided with external flexible leads 13 in order that the switch may be connected in whatever circuit it is desired to control.

The operation of the switch which I have described is substantially as follows. With the switch initially in the position as shown in Fig. 1, the body of mercury 7 is at the lower end thereof and the circuit between the conductor 2 and the terminal 6 is opened. As the switch envelope 1 is rotated in a clockwise direction, the metal ball 10 will roll into the position as indicated by the dotted lines in Fig. 1 so as to close the circular opening 9 to the extent as indicated by the dotted lines in the lower portion of Fig. 2. Not only will this motion of the ball 10 be affected by the force of gravity acting on the wall itself but the weight of the body of mercury 7 behind the ball 10 will push said ball firmly into position in said opening 9. I have found that the mercury will not flow through openings which are less than a predetermined size. This permits considerable latitude in the clearance between the edges of the baffle plate 8 and the inner walls of the envelope 1 as well as the clearance between the edges of the opening 9 and the outer surface of the metal ball 10. It is merely necessary that these clearances be reasonably close. The small opening at 11, however, is of sufficient size so that the mercury flows in a relatively small stream through said opening. The mercury flowing from one side of

the baffle disk to the other displaces the gas within the envelope. Therefore it is desirable to cut away the upper edge of the baffle disk 8 at 8' so as to provide a gas vent, whereby the gas displaced may flow freely from one side to the other of said baffle plate. The small stream of mercury gradually fills the upper end of the envelope 1 to the level indicated by the dotted line adjacent the terminal 6. However, when the envelope in Fig 1 is rotated in the clockwise direction, this level is not reached until substantially all of the mercury 7 has flowed through the opening at 11. Therefore, the circuit is not closed until a predetermined time interval has elapsed after the actuation of the switch. The length of this time delay depends upon the specific dimensions of the envelope, the baffle disk 8, and the mercury 7.

If it is desired to open the switch, the envelope 1 is rotated in a counter-clockwise direction back to the position indicated in Fig. 1. Thereupon the ball 10 rolls to the end of the frame 12, leaving the opening 9 unobstructed. It will be noted, furthermore, that the lower glass wall of the envelope 1 through the bottom of the opening 9 is also unobstructed. This permits the body of mercury 7 to flow freely along said glass surface through the opening 9 to its position in the lower end of the envelope. Under these conditions the mercury 7 leaves the terminal C substantially instantaneously upon the actuation of the switch to its open position.

From the foregoing it will be seen that the specific form of the switch illustrated in Fig. 1 introduces a time delay in the closing of the circuit while the breaking of the circuit takes place substantially instantaneously.

If a switch is desired in which a time delay is introduced in the breaking of the circuit, it is merely necessary to support the metal ball on the opposite side of the baffle disk. Such an arrangement is shown in Fig. 3. The switch in Fig. 3 comprises a glass envelope 14 having two conductors 15 and 16 sealed through a glass press 17 at one end thereof. The conductor 15 is insulated by a glass covering 18 and provided with a contact-making terminal 19, as described in connection with conductor 3 of Fig. 1. The conductor 16 supports a baffle plate 20 provided with a circular opening 21, one edge of which is cut away at 22, as described in connection with the baffle plate 8 of Fig. 1. A metal ball 23 is located on the same side of the baffle plate 20 as the contact-making terminal 19, and is adapted to substantially close the opening 21 in one position of actuation of the switch. A retaining frame 24 is likewise welded to the same side of the baffle disk 20, and permits a limited motion of the ball 23 so that it may close and open the circular opening 21. The envelope 14 is provided with a body of mercury and a gas filling, as described in connection with Fig. 1.

When the envelope 14 is substantially in the position as indicated in Fig. 3, the body of mercury reaches substantially the level shown by the horizontal dotted lines. In this position the circuit between the terminal 19 and the conductor 16 is completed. As the envelope 14 is rotated in a counter-clockwise direction, the metal ball 23 closes the opening 21 and causes the mercury to flow in a smaller stream through the cut-away portion at 22. Thus the mercury flows slowly from the right-hand end of the envelope 14 to the left-hand end thereof. Due to this delayed flow of mercury, the level of the mercury does not fall

below the contact-making terminal 19 until a predetermined time interval has elapsed. This time interval likewise depends upon the dimensions of the various parts of the switch. When the flow of mercury stops, it attains a level substantially as indicated by the dotted line at the left-hand end of Fig. 3.

If it is now desired to re-close the switch, the envelope 14 is rotated in a clockwise direction back to the position shown in Fig. 3. The ball 23 rolls away from the opening 21, and therefore the flow of mercury through said opening is substantially unimpeded, whereupon the original level is reached without appreciable lapse of time. Therefore, upon this actuation of the switch, the circuit is re-closed substantially instantaneously.

Of course it is to be understood that this invention is not limited to the particular details of construction as described above as many equivalents will suggest themselves to those skilled in the art. For example, instead of forming the restricted aperture adjacent one edge of the large circular opening, a separate restricted aperture could be provided in the face of the baffle plate. It is accordingly desired that the appended claims be given a broad interpretation commensurate with the scope of the invention.

What is claimed is:

1. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

2. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, guiding means for guiding said closure member into closing engagement with said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

3. A time delay switch comprising an envelope, a partition member comprising a metal plate extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through a wall of said envelope and extending into one of said chambers, said metal plate being electrically con-

nected to and supported by one of said conductors, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a metal closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

layed flow of said liquid may occur when said opening is closed by said closure member.

4. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in the same chamber as said conductors and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

7. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, one edge of said opening being cut away to provide an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member, the flow of said liquid through said opening being substantially unimpeded when said opening is uncovered by said closure member.

5. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in the other of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

8. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member, an inert gas filling in said envelope, and a gas vent in the upper part of said partition member connecting both chambers through which gas, displaced by the flow of said liquid, may pass.

6. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member intercepting the edge of said partition member to provide an uninterrupted path along one side wall of said envelope for the flow of said liquid in one direction, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, and an aperture of restricted size in said partition member through which a de-

9. A time delay switch comprising an envelope, a seal at one end of said envelope, a separate partition member supported from said seal, extending transversely across said envelope and dividing the interior of said envelope into two chambers, two conductors sealed through said seal and extending into one of said chambers, a body of conducting liquid in said envelope adapted to move into electrical contact with both of said conductors in the closed position of said switch, an opening in said partition member, a closure member located in one of said chambers and adapted to move toward said partition member to close said opening and away from said partition to uncover said opening, guiding means supported by said partition member for guiding said closure member into closing engagement with said opening, and an aperture of restricted size in said partition member through which a delayed flow of said liquid may occur when said opening is closed by said closure member.

PERCY L. SPENCER.