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S. V. WORTH ET AL

2,990,460

ELECTRIC SWITCH

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Fig. 1

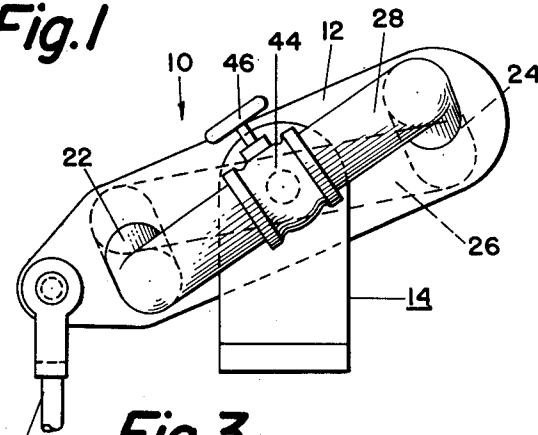


Fig. 2

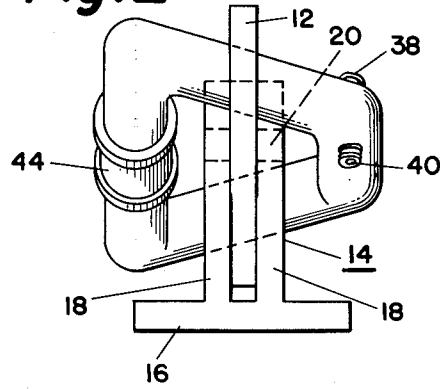


Fig. 3

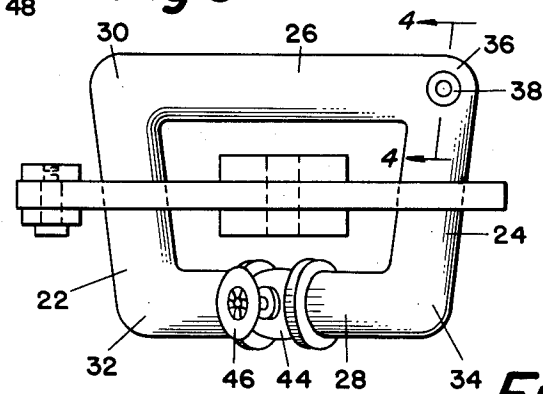


Fig. 4

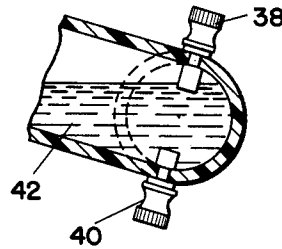


Fig. 5

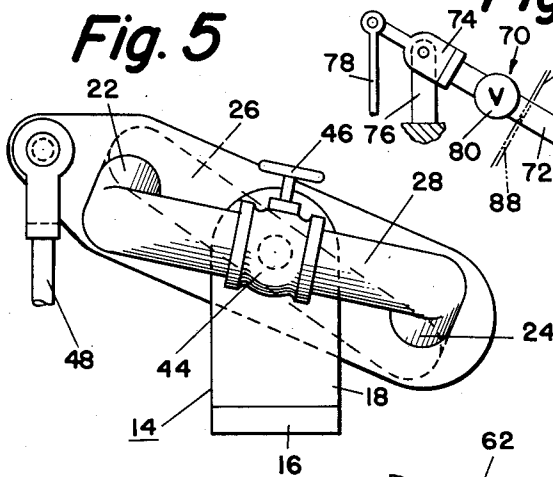


Fig. 8

Fig. 6

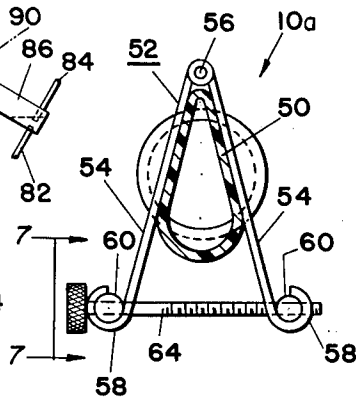
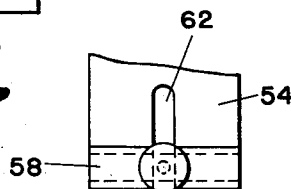


Fig. 7



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ELECTRIC SWITCH

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11 Claims. (Cl. 200—33)

The present invention relates to an electric switch, and more particularly to an electric switch having a time delay between the actuation of the switch to its on position and the actual closing of the switch.

For the operation of many types of electrically operated devices, it is often desirable to have a switch which will provide a delay time between the actuation of the switch to its on position, and the actual closing of the switch, but which will provide substantially no delay time between the actuation of the switch to its off position and the opening of the switch. Furthermore, it is also desirable to have such a switch in which the delay time between the actuation of the switch to its on position and the actual closing of the switch can be varied.

It is an object of the present invention to provide a novel electric switch.

It is another object of the present invention to provide a novel electric switch having a delay period between the actuation of the switch to its on position and the actual closing of the switch.

It is still another object of the present invention to provide an electric switch having a delay period between the actuation of the switch to its on position and the actual closing of the switch, but having substantially no delay time between the actuation of the switch to its off position and the opening of the switch.

It is a further object of the present invention to provide an electric switch having a time delay between the actuation of the switch to its on position and the actual closing of the switch, which delay time can be varied.

Other objects will appear hereinafter.

For the purpose of illustrating the invention there is shown in the drawings forms which are presently preferred; it being understood, however, that this invention is not limited to the precise arrangements and instrumentalities shown.

FIGURE 1 is a side elevational view of the electric switch of the present invention in its off position.

FIGURE 2 is an end elevational view of the switch of the present invention in its off position.

FIGURE 3 is a top elevational view of the switch of the present invention in its off position.

FIGURE 4 is a sectional view taken along line 4—4 with the switch being in its on position.

FIGURE 5 is a side elevational view of the switch of the present invention in its on position.

FIGURE 6 is a sectional view through a modification of the switch of the present invention.

FIGURE 7 is a view taken along line 7—7 of FIGURE 6.

FIGURE 8 is a schematic view of still another modification of the switch of the present invention.

Referring initially to FIGURES 1-3, the switch of the present invention is generally designated as 10.

Switch 10 comprises a vertical mounting plate 12 which is pivotally supported intermediate its ends on a supporting bracket 14. Supporting bracket 14 comprises a horizontal base 16, and a pair of spaced, parallel legs 18 extending upright from the base 16. The mounting plate 12 is pivotally supported between the legs 18 of the mounting bracket 14 by a horizontal pivot pin 20 which extends through the legs 18 and the mounting plate 12. Thus, the mounting plate 12 is supported for pivotation about a horizontal axis.

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A pair of parallel tubes 22 and 24 extend through and are secured to the mounting plate 12 adjacent opposite ends of the mounting plate 12. The tubes 22 and 24 are of equal length, and project the same distance beyond each side of the mounting plate 12. A tube 26 extends along one side of the mounting plate 12, and connects one end of the tube 22 to one end of the tube 24. A tube 28 extends along the other side of the mounting plate 12 and connects the other end of the tube 22 to the other end of the tube 24. The tubes 22, 24, 26, and 28 are connected to form a closed passageway extending through the tubes. The tubes 22 and 24 are angled downwardly in opposite directions with respect to each other. Thus, the corner 30 at the junction between the tube 22 and the tube 26 is vertically higher than the corner 32 at the junction between the tube 22 and the tube 28, whereas the corner 34 at the junction between the tube 24 and the tube 28 is higher than the corner 36 at the junction between the tube 24 and the tube 26. The tubes 22, 24, 26, and 28 are made of an electrical insulating material such as a plastic.

A pair of electrically conductive metal terminals 38 and 40 extend through the corner 36 at the junction between the tube 24 and the tube 26. The terminal 38 extends downwardly through the top of the corner 36, and the terminal extends upwardly through the bottom of the corner 36. An electrically conductive liquid 42, such as mercury, is provided within the closed passageway provided by the tubes 22, 24, 26, and 28.

A valve 44 is provided in the tube 28 between the corners 32 and 34. Valve 44 may be any well known type of valve having a variable size opening therethrough for controlling the flow through the valve 44. Valve 44 has a handle 46 by which the size of the opening through the valve 44 can be varied. An actuating rod 48 is pivotally connected to one end of the mounting plate 12 by which the switch 10 can be actuated between its off and on positions.

The switch 10 of the present invention operates as follows:

The switch 10 is in its off position when the actuating rod 48 is pulled downwardly so that the tube 22 is lower than the tube 24. In this position of the switch 10, the corner 32 is lower than the corners 30, 34, and 36, so that all of the liquid 42 will be in the corner 32.

To actuate the switch 10 to its on position, and thereby close the switch 10, the rod 48 is pushed upwardly to pivot the mounting plate 12 until the tube 24 is lower than the tube 22 as shown in FIGURE 5. In this position of the switch 10, the corner 36 is lower than the corners 30, 32, and 34 so that all of the liquid 42 will flow from the corner 32 to the corner 36. Since the corner 30 is always higher than the corner 32, the liquid 42 cannot flow from the corner 32 to the corner 36 through the tube 22 and tube 26. Thus, all of the liquid 42 flows down the tube 28 and down the tube 24 to the corner 36.

When the corner 36 becomes completely filled with the liquid 42 which is electrically conductive, the terminals 38 and 40 will be electrically connected through the liquid 42 to close the switch 10. There is just a sufficient amount of the liquid 42 in the tubes so that all of the liquid 42 must be in the corner 36 before the corner 36 is completely filled to electrically connect the terminals 38 and 40. During the passage of the liquid 42 from the corner 32 to the corner 36, the liquid 42 must pass through the valve 44. The valve 44 restricts the flow of the liquid 42 so as to provide a time delay between the time that the mounting plate 12 was pivoted to its on position and the time that all of the liquid 42 reaches the corner 36 to electrically connect the terminals 38 and 40 and thereby electrically close the switch 10. The particular delay time of the switch 10 is determined by the size of the

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opening through the valve 44 which can be varied by turning the handle 46.

To open the switch 10, the actuating rod 48 is pulled downwardly again to pivot the mounting plate 12 to its off position in which the tube 22 is lower than the tube 24 as shown in FIGURE 1. In the off position of the switch 10, the corner 32 is lower than the corners 30, 34, and 36 so that all of the liquid 42 will flow from the corner 36 to the corner 32. Since the corner 34 is always higher than the corner 36, the liquid 42 cannot flow from the corner 36 back through the tube 24, but the liquid 42 must flow through the tube 26 and the tube 22 to the corner 32. As soon as some of the liquid 42 leaves the corner 36, the corner 36 will be emptied sufficiently to electrically disconnect the terminals 38 and 40, and thereby open the switch 10. Thus, although the switch 10 provides a time delay between the actuation of the switch to its on position and the electrically closing of the switch 10, there is substantially no time delay between the actuation of the switch 10 to its off position and the electrically opening of the switch 10.

Referring to FIGURES 6 and 7, a modification of the switch of the present invention is generally designated as 10a. Switch 10a is identical to the switch 10 shown in FIGURE 1, except with regard to the means for restricting the flow of the liquid 42 to provide the time delay.

In the switch 10a, the means for restricting the flow of the liquid 42 comprises a tube 50 of a flexible plastic, which tube 50 is either inserted into or entirely replaces the tube 28 of the switch 10 of FIGURE 1. A clamp 52 is provided around the flexible tube 50. Clamp 52 comprises a pair of flat arms 54 which are pivotally connected together at one end by a pivot pin 56. The free ends 58 of the clamp arms 54 are bent through substantially 300° to encircle a separate pin 60. Each of the arms 54 has a slot 62 extending longitudinally therethrough from the free end 58 of the arm 54. A screw 64 extends transversely through one of the pins 60, across the space between the arms 54, and is threaded into the other pin 60. The screw 64 extends through the slots 62 in the arms 54.

The switch 10a operates in the same manner as the switch 10 as previously described. To vary the time delay of the switch 10a, the screw 64 is rotated to either pull the arms 54 of the clamp 52 together, or spread the arms 54 of the clamp 52 apart. When the arms 54 of the clamp 52 are pulled together, the arms 54 squeeze the flexible tube 50 therebetween, and close the passageway through the tube 50 to decrease the delay time. When the arms 54 of the clamp 52 are spread apart, the passage through the flexible tube 50 is opened to decrease the delay time.

Although the switch 10 of the present invention is shown having only one pair of terminals 38 and 49, the switch 10 can also be provided with an additional pair of the terminals in the lower corner 32 between the tubes 22 and 28 and with a second valve in the tube 26. Thus there would be provided a double throw switch having a delay time for closing both sets of terminals. Since the liquid 42 would have to pass through different valves to reach each of the sets of terminals, the delay time for each set of terminals can be different. Also, although the terminals 38 and 40 are shown extending respectively through the top and bottom of the corner 36, both of the terminals 38 and 40 can extend through either the top, or the bottom or the sides of the corner 36.

Referring to FIGURE 8, the modification of the switch of the present invention is generally designated as 70.

Switch 70 comprises a single tube 72 of an electrical insulating material which is closed at both ends. One end of the tube 72 is secured to the end of a mounting plate 74. Mounting plate 74 is pivotally supported on a supporting bracket 76. An actuating rod 78 is pivotally connected to the other end of the mounting plate 74.

A valve 80 is provided in the tube 72 between the ends

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of the tube 72. Valve 80 may be any type of restriction means for reducing the area of the tube 72 and which permits the restricted area to be varied. A pair of terminals 82 and 84 extend through the tube 72 adjacent the free end of the tube 72. The tube 72 contains an electrically conductive liquid 86, such as mercury.

In the use of the switch 70, the switch 70 is in its off position when the actuating rod 78 is pulled downwardly to lift the free end of the tube 72 up. The liquid 86 flows to the supported end of the tube 72 and thereby disconnects the terminals 82 and 84. When the actuating rod 78 is pushed upwardly to lower the free end of the tube 72, the liquid 86 flows through the valve 80 to the terminals 82 and 84. The valve 80 restricts the flow of the liquid 86 so that there is a delay time before a sufficient amount of the liquid 86 reaches the free end of the tube 72 to electrically connect the terminals 82 and 84. The tube 72 may also be provided with a pair of terminals adjacent its supported end to provide a double throw switch.

As shown in FIGURE 8, the tube 72 of the switch 70 has a pair of terminals 88 and 90 therethrough adjacent the valve 80. When the switch 70 is actuated to the on position of the tube 72, the liquid 86 flows through the valve 80 and across the terminals 88 and 90 to electrically connect the terminals 88 and 90. As long as the liquid 86 flows across the terminals 88 and 90 the electrical circuit containing the terminals 88 and 90 is closed. The length of time that the terminals 88 and 90 will remain connected is determined by the restriction of the valve 80. Thus, if the valve 80 is wide open, the liquid 86 will flow quickly across the terminals 88 and 90 to connect the terminals 88 and 90 only for a short period. However, if the valve 80 is closed to provide only a small opening, the liquid will flow across the terminals 88 and 90 for a longer period.

Thus, by using the terminals 88 and 90 which are spaced from the ends of the tube 72, the switch 70 can be used to maintain a circuit closed for a desired period of time. The switch 70 of the present invention permits the time of maintaining the circuit closed to be varied as desired. The switch 10 of the present invention may also be provided with a pair of terminals spaced from the lower corners 36 or 32 to permit the closing of a circuit for a desired length of time.

The present invention may be embodied in other specific forms without departing from the spirit or essential attributes thereof and, accordingly, reference should be made to the appended claims, rather than to the foregoing specification as indicating the scope of the invention. We claim:

1. A time delay switch comprising a mounting plate supported for pivotation about a horizontal axis, a pair of tubes extending through and supported by said mounting plate, said tubes extending downwardly in opposite directions so that one pair of diagonally opposite ends of said tubes are lower than the other pair of diagonally opposite ends, a second pair of tubes, each of said second pair of tubes connecting a higher end of one of said first pair of tubes to the lower end of the other of said first pair of tubes, said tubes being connected together to provide a closed passageway therethrough, a pair of electrical terminals extending through the low end of one of said first pair of tubes, an electrically conductive liquid within said tubes, and means for restricting the flow of the liquid from the low end of the other of said first pair of tubes to the low end of said one of the first pair of tubes.

2. A switch in accordance with claim 1 in which the amount of the electrically conductive liquid within said tubes is just sufficient to bridge the space between the terminals when all of the liquid is in the low end of the one tube of the first pair.

3. A switch in accordance with claim 1 in which the means for restricting the flow of the fluid comprises a

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valve having an opening therethrough which is smaller in area than the area of said tubes.

4. A switch in accordance with claim 3 in which the valve has a variable size opening therethrough.

5. A switch in accordance with claim 1 in which the means for restricting the flow of the fluid comprises a flexible tube through which the fluid must flow, and a clamp around said flexible tube and adapted to vary the size of the opening through said flexible tube.

6. A time delay switch comprising a mounting plate supported for pivotation about a horizontal axis, a hollow tube of electrical insulating material, said tube being in the form of a quadrangle and being supported on said mounting plate with two of the sides thereof extending through the mounting plate and the other two sides thereof extending along opposite sides of said mounting plate, said quadrangular tube being twisted so that two of the diagonally opposite corners of said tube are lower than the other two diagonally opposite corners, a pair of electrical terminals extending through one of said lower corners of said tube, an electrically conductive liquid within said tube, and means for restricting the flow of said liquid between the other lower corner of said tube and said one lower corner which contains said terminals.

7. A switch in accordance with claim 6 in which the amount of the electrically conductive liquid within said

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tube is just sufficient to bridge the space between said terminals when all of the liquid is in the one lower corner of said tube.

8. A switch in accordance with claim 6 in which the means for restricting the flow of the fluid comprises a valve having an opening therethrough which is smaller in area than the area of said tube.

9. A switch in accordance with claim 8 in which the valve has a variable size opening therethrough.

10. A switch in accordance with claim 9 in which said valve is mounted in the side of said tube which extends from said other lower corner along the mounting plate.

11. A switch in accordance with claim 6 in which the means for restricting the flow of the fluid comprises a flexible tube connected in the tube between said other lower corner and the high corner on the same side of the mounting plate, and a clamp extending around said flexible tube and adapted to vary the size of the opening of said flexible tube.

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