

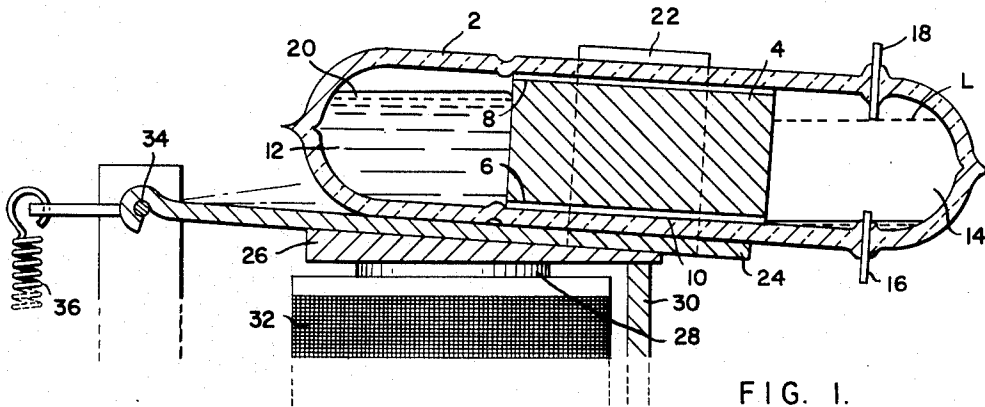
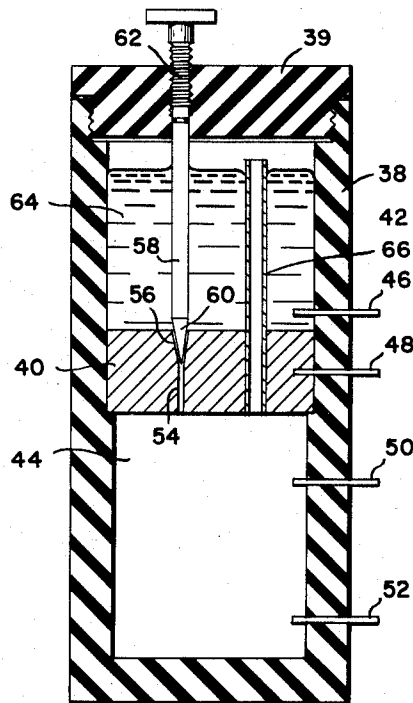
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MERCURY TIME DELAY SWITCH

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MERCURY TIME DELAY SWITCH

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This invention relates to time delay switches and has particular reference to switches of the mercury type.

Switches of the mercury type have many known advantages, but attempts heretofore made to utilize the flow of mercury for time delay purposes have not been successful. Attempts to provide time delay involve the flow of mercury from a pool thereof through a capillary or other fine passage provided merely by a hole or by a needle valve, or both, a needle valve being usable where adjustable time delay is desired. The fact, however, that mercury will not wet most materials or does so erratically, and generally with some solution, makes such switches erratic in operation in that the flow is discontinuous and non-uniform and may cease altogether when the head producing the flow is insufficient to overcome surface tension.

It is the object of the present invention to provide switches in which uniform wetting and surface tension effects occur so that flow is reliable and uniform. In brief, this is achieved by utilizing as the conductive liquid mercury containing small amounts of gold or silver which will then uniformly wet various materials, of which nickel is the most desirable for optimum operation.

The objects of the invention relate to the provision of reliable time delay switches and will become apparent from the following description read in conjunction with the accompanying drawing, in which:

FIGURE 1 is a vertical section taken through a relay including a mercury time delay switch provided in accordance with the invention; and

FIGURE 2 is a vertical section through another form of switch of adjustable time delay and arranged for resetting by inversion.

Referring first to FIGURE 1, there is indicated at 2 a glass capsule which may be hermetically sealed, and containing above the mercury therein an inert gas or vacuum. Within this capsule there is a plug 4 desirably of nickel, comprising a pair of passages 6 and 8 which may be formed by longitudinal grooves in the plug. The groove 8 is provided merely for equalization of the atmosphere within the capsule. The groove 6 which may be capillary in size is for the control of flow of the mercury and desirably adjacent to this groove, at 10, the glass envelope is coated with a thin film of nickel which may be deposited by any of the various processes used for formation of such films. The plug 4 may be fixed in position by dimples in the envelope, by cementing, or the like. If cementing is used it should, of course, be kept away from the passage 6. The plug divides the capsule into a pair of chambers 12 and 14, the latter being provided with a bottom electrode 16 and an upper electrode 18. The mercury in the capsule is indicated at 20.

The switch just described is adapted to be operated by imparting a tilting movement thereto. This may be produced by cam action or in many other ways, but for purposes of illustration the capsule is shown as retained in a clamp 22 formed as part of a lever 24 having an armature portion 26 attractable by an electromagnet comprising the core 28 and core extension 30, the core carrying the winding 32. The arm 24 is pivoted at 34 to a frame and normally urged away from the magnet, against a stop (not shown) by a spring 36.

When the electromagnet is deenergized the capsule is tilted to slope upwardly toward the right whereupon the

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mercury will flow into the chamber 12. When the magnet is energized the mercury will slowly flow through the capillary passage 6 to rise, after an interval, in the chamber 14 to the level L at which it will bridge the electrodes 16 and 18. Other electrode arrangements may, of course, be used, including break electrodes in the chamber 12, or both make and break electrodes as may be desired.

In accordance with the present invention the mercury contains in solution small amounts of gold or silver to provide wetting of the nickel so that the flow through the passage 6 takes place uniformly and uninterruptedly. Other materials than nickel which may be wetted by such a mercury solution may be used, but nickel is preferred because of its insolubility in mercury. The amount of gold or silver dissolved in the mercury is subject to wide variation. Even small percentages will cause mercury to wet nickel. Less than 1% of either of the dissolved metals is desirably used to avoid any possibility of separation by crystallization. With materials other than nickel more silver or gold may be required to be dissolved to secure the wetting action, but the amounts used will still be well below 1% of dissolved metal for most materials, for example glass. The plug 4 may be of non-wettable material, but the walls of the capillary 6 should be wettable, for example, by being casted with a thin film of nickel, or by the provision of a nickel tube.

FIGURE 2 illustrates an alternative embodiment of the invention, there being particularly illustrated a switch providing a time delay when in upright position but rapid restoration when inverted. Adjustable time delay is also provided.

In this arrangement a housing 38 of insulating material is covered by a cap 39. A plug 40 separates the housing into an upper chamber 42 and a lower chamber 44. Electrodes may be arranged quite arbitrarily as desired, and there are indicated by way of example the electrodes 46, 48, 50 and 52. The electrode 48 is shown as electrically connected to the nickel plug 40 which may function as one of the electrodes as well as the separator.

The nickel plug 40 is provided with a capillary (or larger) opening 54 provided at its upper end with a conical seat 56 cooperating with the conical end 60 of a needle valve 58 threaded at 62 through the cap 39. At least the conical portion 60 of this needle valve should be of nickel. The body of mercury within the housing is shown at 64. For the purpose of venting and providing rapid flow of the mercury for restoring operation there is the tube 66 secured in the plug 40. This tube may be of large bore and consequently no special precautions need be taken to insure free flow therethrough.

The operation of the switch will be obvious from its structure. With the needle valve adjusted to provide a suitable small clearance at the seat 56, this being primarily determinative of the delay, the mercury 64 will flow past the valve and through the opening 54 into the lower chamber 44, rising to bridge the electrodes such as 50 and 52 to close a circuit or uncovering the electrode 46 to open a circuit between terminals 46 and 48. It will be evident that the arrangement may be readily designed, with placement of the electrodes, to effect even such a fairly elaborate operation as to make a circuit after a predetermined interval and then, after another interval, break the circuit.

Restoration of the mercury to the upper chamber may be effected merely by inverting the switch to provide rapid flow through the tube 66. This type of operation is particularly useful in connection with bore hole instruments which may be kept inoperative while inverted and which become operative only when placed in upright position within a bore hole.

As in the previous modification, the mercury used con-

tains in solution gold or silver for wetting purposes to insure continuous and reliable flow.

It will be evident that numerous variations in details of construction may be made without departing from the invention as defined in the following claims.

What is claimed is:

1. A mercury switch comprising means providing a pair of chambers, electrode means exposed to the interior of at least one of said chambers, means providing a restricted elongated passage for flow of mercury between said chambers, and mercury within the switch for conductive contact with said electrode means and adapted to flow from one chamber to the other through said restricted elongated passage, said mercury containing in solution a metal in an amount not substantially in excess of 1% and said passage having its walls formed of a metal wettable by said mercury containing the metal in solution, said metal in solution providing uniform wetting of said walls so that said mercury is capable of flowing as a uniformly and slowly moving stream through said passage under the action of gravity to accumulate as a pool in said other chamber, the restriction of said passage being such as to control the rate of flow of the mercury therethrough to provide a time delay, after initiation of flow, for change of the conductive relationship of the mercury to said electrode means.

2. A mercury switch comprising means providing a pair of chambers, electrode means exposed to the interior of at least one of said chambers, means providing a restricted, elongated passage for mercury between said chambers, and mercury within the switch and adapted to flow from one chamber to the other through said restricted, elongated passage, said mercury containing in solution a metal in an amount not substantially in excess of 1%, and said passage having its walls formed of a material wettable by said mercury containing the metal in solution, said metal being of the group consisting of silver and gold, and said mercury being capable of flowing uniformly through said passage.

3. A mercury switch comprising means providing a pair of chambers, electrode means exposed to the interior of at least one of said chambers, means providing a restricted

elongated passage for flow of mercury between said chambers, and mercury within the switch for conductive contact with said electrode means and adapted to flow from one chamber to the other through said restricted elongated passage, said mercury containing in solution a metal in an amount not substantially in excess of 1% and said passage having its walls formed of nickel wettable by said mercury containing the metal in solution, said metal in solution providing uniform wetting of said walls so that said mercury is capable of flowing as a uniformly and slowly moving stream through said passage under the action of gravity to accumulate as a pool in said other chamber, the restriction of said passage being such as to control the rate of flow of the mercury therethrough to provide a time delay, after initiation of flow, for change of the conductive relationship of the mercury to said electrode means.

4. A mercury switch comprising means providing a pair of chambers, electrode means exposed to the interior of at least one of said chambers, means providing a restricted, elongated passage for mercury between said chambers, and mercury within the switch and adapted to flow from one chamber to the other through said restricted, elongated passage, said mercury containing in solution a metal of the group consisting of silver and gold in an amount not substantially in excess of 1%, said passage having its walls formed of nickel, and said mercury being capable of flowing uniformly through said passage.

References Cited by the Examiner

UNITED STATES PATENTS

2,303,161	11/1942	Gerisch	200—33
2,732,459	1/1956	Pollard	200—112
2,849,550	8/1958	Olmer et al.	200—33
2,851,547	9/1958	Hartz	200—33
2,901,580	8/1959	Kelly	200—152

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