March 7, 1944.

V. L. FINIZIO

2,343,653

MERCURY SWITCH

Filed Oct. 16, 1941

Fig.1.

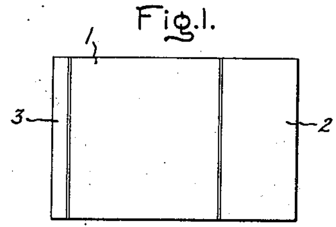


Fig.2.

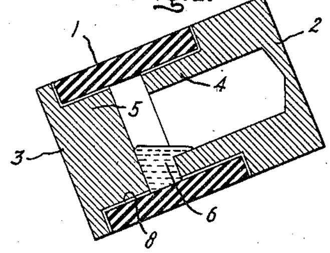


Fig.3.

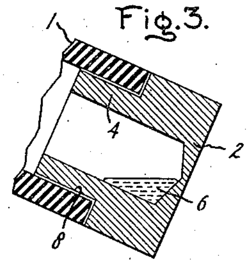


Fig.4.

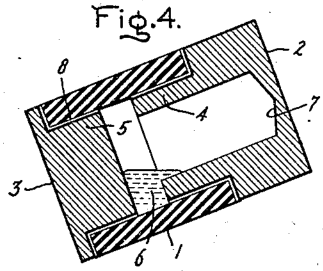
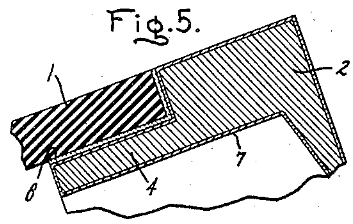


Fig.5.



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UNITED STATES PATENT OFFICE

2,343,653

MERCURY SWITCH

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Application October 16, 1941, Serial No. 415,203

4 Claims. (Cl. 200—152)

The present invention relates to electric switches of the fluid flow type and particularly to switches employing mercury to close the circuit therethrough.

A particular object of the invention is to provide a fluid flow switch made of inexpensive materials and by simple and inexpensive assembly methods. A further object of the invention is to provide a fluid flow switch having a positive action and low internal resistance. A still further object of the invention is to provide a fluid flow switch which will have a long useful life.

For a consideration of what I believe to be novel and my invention, attention is directed to the accompanying description and the claims appended thereto.

In the accompanying drawing,

Fig. 1 is a side elevation of a liquid contact circuit closer embodying one form of my invention;

Fig. 2 is a central longitudinal section through the circuit closer with the tube tilted to the closed position;

Fig. 3 is a similar longitudinal section with the tube tilted to the open position;

Fig. 4 is a similar longitudinal section through the circuit closer showing electrodes of modified form;

Fig. 5 is an enlarged detail view of a portion of the structure of Fig. 4.

Each of the circuit closers illustrated has a tubular member 1 of physically strong insulating material, such as commercial gray fiber, a phenol-aldehyde resin, an amino-triazine-aldehyde resin, methyl acrylate, methyl methacrylate, a vinyl resin such as the copolymers of vinyl acetate and vinyl chloride, or glass, the ends of the tubular member being closed off with metal terminals 2, 3 constituted, for example, of iron (preferably cold-rolled steel). The terminal 2 is cup-shaped and has a reduced portion 4 which extends into and is force-fitted to the tube 1. The solid terminal 3, at the other end of the tube 1, also has a reduced portion 5 which extends into and is force-fitted to the tube 1. A limited quantity of mercury 6 is contained in the cup 4 in amount sufficient to bridge the gap at the bottom of the switch between the surfaces 4 and 5 when the switch is in the closed position. The force fitting of the members provides an air and mercury tight frictional seal which serves to prevent the escape of gases and vapors and mercury from the interior of the switch. A thin coating of a suitable adhesive, e. g., an alkyd resin, shown at 8 Fig. 5, serves to insure a gas-tight seal at the junction of the members 1, 2 and 3.

In the operation of the switch toward the closed position, tilting the tube 1 20° below horizontal causes the mercury to extend out of cup 4 and to bridge the gap between the lip of the cup of terminal 2—4 and the inner face of the terminal 3—5, thus closing the circuit through the switch. To open the circuit, the tube 1 is tilted in the reverse direction to 20° above horizontal, causing the mercury to leave the terminal 3—5 and to recede into the cup 4, thus interrupting the circuit through the switch.

By virtue of the fact that the reduced portion 5 of the terminal 3—5 fills the bore of the tube at one end thereof and the reduced portion of the cup-shaped terminal 2—4 fills the bore at the other end of the tube, the mercury in the closed position of the switch will always be in contact with the two terminals at any axial angle of rotation of the tube. In view of the close proximity which exists between the opposed terminal surfaces, only a very small quantity of mercury is required to produce reliable and consistent action of the switch, this feature being of importance in reducing the switch cost. Moreover the fact that a definite well of annular form exists between the opposed surfaces of the parts 5 and 4 assures the retention of the mercury in contact with these parts and minimizes the likelihood of "flickering" due to vibration of the switch when it is in closed position.

As the switches above described are air-filled, it is found in the case of iron (steel) parts that in operation the heat of the arc sometimes tends to produce an interaction of the oxygen component of the air and the metal surfaces inside the switch resulting in an oxide film on the metal surfaces with a consequent progressive rise in the internal resistance of the switch above that which would be obtained with electrodes having clean metal surfaces. I have found that by providing a thin nickel plating shown at 7, Figs. 4 and 5, on the surface of the iron or cold-rolled steel electrodes contacting with the mercury air-filled switches can be made having a constant low internal resistance as well as favorable operating and current-carrying characteristics and long life.

It has been observed that solid nickel contact terminals, if used for a long time in contact with mercury, tend to produce a "stringy" condition of the mercury which renders it sluggish and tends to produce unsatisfactory switch operation. This difficulty is absent in the case of iron electroplated with nickel as in the construction described in the foregoing. A complete explanation of this fact is not known, but it is believed to be attributable to the favorable surface characteristics of nickel when applied as an extremely thin coating by electroplating or the like.

In a particular instance it has been found satisfactory to electroplate cold-rolled steel contact elements with nickel to a thickness of only about one-half millimeter. The slight added cost of the plating operation is more than offset by the fact that due to the constant low internal resistance of the nickel-plated form of switch, the size of a switch of the same current rating as an iron terminal switch can be materially reduced.

By the use of cold-rolled iron electrodes force-fitted into the ends of an insulating tube of commercial gray fiber, I am able to produce a very low cost switch, and where it is desired that the switch shall have low internal resistance characteristics, I am able to accomplish this result by a thin nickel-plating on one or both of the cold-rolled iron electrodes at an additional cost of a fraction of a cent per switch. Such switches, in a size not materially greater than ⅜ inch in diameter and ½ inch in length, will successfully make and break currents of 3 to 5 amperes at 6 volts and currents of 1 to 3 amperes at 12 volts throughout a long life.

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

1. In a mercury switch, the combination of an insulating sleeve, a metallic tube closed at one end and having the other end thereof fitted into one end of the said sleeve to provide a first electrode for the switch, a metallic cap having a portion thereof fitted into the opposite end of the sleeve and extending into proximity with the said tube to provide the other electrode of the switch, said tube and said cap each having an enlarged portion providing a shoulder which abuts against the corresponding extremity of the insulating sleeve, and a mass of mercury movable in said tube and sleeve to open and close the circuit through said switch, the opposed surfaces of said cap and the end of said tube forming between them an annular well in which said mercury is retained when the switch is in closed-circuit position.

2. A mercury switch including an insulating sleeve, a metallic tube closed at one end and having the other end thereof fitted into one end of said sleeve to provide a first electrode for the switch, a metallic cap having a portion thereof fitted into the opposite end of the sleeve and extending into proximity with the said tube to provide the other electrode of the switch, and a mass of mercury movable in said tube and sleeve to open and close the circuit through said switch, the opposed surfaces of said cap and the end of said tube forming between an annular well in which said mercury is retained when the switch is in closed-circuit position.

3. A switch comprising an air-filled insulating tube containing a charge of mercury, ferrous metal electrodes operatively related to and having surfaces accessible to the mercury, and a thin coating of nickel covering at least the said surfaces of the electrodes.

4. In a mercury switch, the combination of an air-filled tube of insulating material, nickel-plated iron electrodes spaced apart in said tube, and a mass of mercury in said tube movable into and out of bridging contact with said electrodes to make and break the circuit through said switch.

VICTOR L. FINIZIO.