July 23, 1940. L. W. GILLESPIE 2,208,841

TIME DELAY MERCURY SWITCH

Filed Jan. 26, 1939

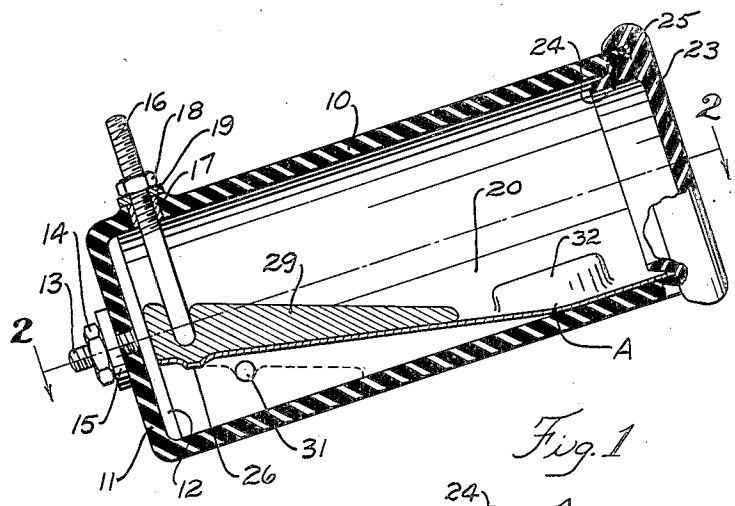


Fig. 1

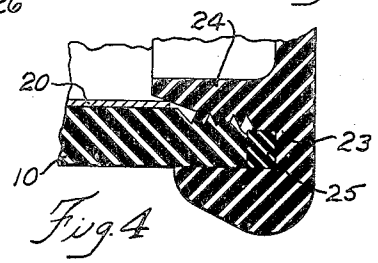


Fig. 4

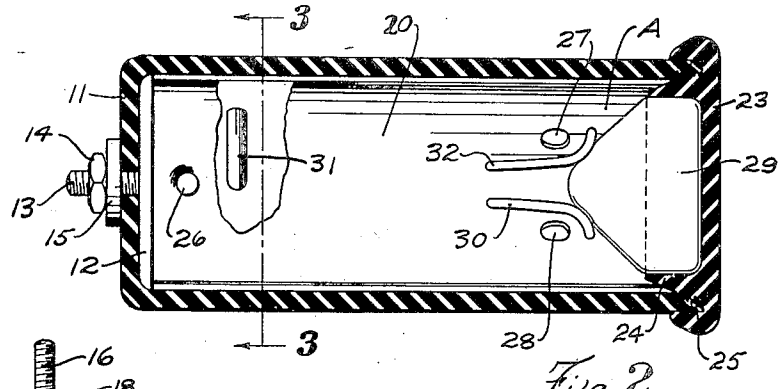


Fig. 2

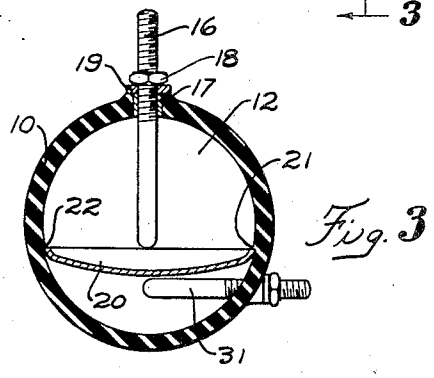


Fig. 3

Inventor
Leonard W. Gillespie,
By Minturn & Minturn,
Attorneys

Patented July 23, 1940

2,208,841

UNITED STATES PATENT OFFICE

2,208,841

TIME DELAY MERCURY SWITCH

Leonard W. Gillespie, Greensburg, Ind.

Application January 26, 1939, Serial No. 252,857

5 Claims. (Cl. 200—33)

This invention relates to means for controlling the time interval between opening and closing of an electrical circuit by means of controlling the flow of mercury within an envelope. A primary object of the invention is to provide a switch structure which will permit an operation of the switch to have an open circuit condition in one position of the switch, an initially closed circuit condition in another position of the switch, and to have an opening of the circuit while still in that second position after a definite time interval by flow of the mercury through an orifice which determines in part the time interval, the adjustment of an electrode further contributing to the determination of that interval.

There is furthermore the optional object of the invention to include in the structure the closing of a second circuit at or following the end of the above indicated time interval of the opening of the initially closed circuit.

Other important objects include structural means for carrying out the above indicated objects and also the complete sealing of the envelope containing the mercury against admittance of atmospheric gases and the like and also the control of flow of mercury itself to give the desired action, and such additional advantages as will become apparent to those versed in the art from the following description of one particular form of the invention as illustrated in the accompanying drawing, in which

Fig. 1 is a diametrical, longitudinal, vertical section through a switch structure embodying my invention, rocked to an initially closed circuit position;

Fig. 2, a transverse section on the line 2—2 in Fig. 1, but showing the switch tilted to an opposite position;

Fig. 3, a transverse section on the line 3—3 in Fig. 2; and

Fig. 4, a detail in section of the envelope seal.

Like characters of reference indicate like parts throughout the several views in the drawing.

A suitable envelope 10 is formed to be tubular in shape with one end 11 preferably integrally formed with the tube. The envelope 10 may be made out of any suitable material such as the usual and well-known synthetic resinous insulating compounds although pure iron may be employed if desired provided the electrodes, hereafter to be described, are insulated therefrom.

Against the closed end 11 of the envelope is positioned an iron disk 12 having a stud 13 sealably extending through the end 11 and secured in position by any suitable means such as a nut 14 bearing against a sealing washer 15. The projecting stud 13 serves as one electrode of the switch.

A second electrode 16 enters through the side of the envelope 10 to form a gas sealed fit therethrough and is preferably adjustable as to length of protrusion into the envelope. In the form herein shown, the electrode 16 screw-threadedly enters through a ferrule 17 with a tight fit to permit longitudinal adjustment of the electrode and a nut 18 carried by the electrode compresses a sealing washer 19 against the external end of the ferrule and the annular lip of a boss around the ferrule formed on the external side of the envelope.

Within the envelope 10 is positioned a trough 20 which is U-shaped at its end adjacent the open end of the envelope 10 and continues this shape throughout a short length of the trough. From the inner end of this short length which is designated by the letter A, Fig. 1, the floor of the trough slopes upwardly until at the rear end of the trough the floor is carried to the level of the side edges of the trough. In other words there is a gradual diminishing depth of the trough from the point A to the rear end. The lateral edges of the trough are preferably abutted against shoulders 21 and 22 formed throughout the length of the envelope 10 in its internal face parallel to the axis of the envelope.

A cap 23 is formed to engage the envelope 10 about its open end in any suitable manner to form a gas tight seal therewith. In the form herein shown, this cap 23 has a central annular flange 24 entered within the open end of the envelope 10 to screw-threadedly engage with the envelope. A gasket 25 is compressed between the end of the envelope 10 and a laterally extending part of the cap 23 to complete the seal. Of course, any suitable sealing cement or plastic may be employed between the junction of the cap and the envelope 10.

The annular flange 24 which extends into the open end of the envelope 10 is preferably tapered toward the axis of the cap so that this flange 24 will engage over the outer end of the trough 20 and tend to wedge that end of the trough down snugly against the wall of the envelope 10 as the cap 23 advances inwardly to its seating position against the end of the envelope. By this means, the outer end of the trough 20 is not only seated against the envelope 10 but is tended to be urged rearwardly against the disk 12.

The inner end of the trough 20 where it abuts

the disk 12 may be united with the disk 12 in an initial assembly such as by welding or the two parts may be merely abutted one against the other with a sufficient closeness of fit as will prevent any substantial leakage of mercury between the two parts during the operation of the switch.

The lateral edges of the trough 20 are preferably carried at positions below a diametrical plane through the envelope in order to permit a wide range of adjustment as to length of the electrode 16 within the envelope. Toward the rear end of the trough 20 near the disk 12, the trough 20 is provided with a centrally located orifice 26, herein shown as being in axial alignment with the electrode 16.

Immediately adjacent but behind the line of contact A between the trough 20 and the wall of the envelope 10 are provided orifices 27 and 28 in the trough 20, each orifice being spaced a like distance upwardly from the center line of the trough. However, this upward spacing from the center line is kept as small as possible as will permit mercury appearing under the trough to flow through these orifices 27 and 28 completely onto the upper side of the trough over its outer end when the switch is tilted to have that part of the trough in a lowermost position. A limited quantity of mercury 29 is carried within the envelope 10.

When the switch is tilted to that position as indicated in Fig. 1, the mercury 29 will be carried to the inner end of the trough 20 and complete a circuit between the disk 12 and the electrode 16 as indicated, the trough 20, when made of metal, serving as a continuation of the electrode 12. Assuming that the switch is left in this tilted position, Fig. 1, that circuit will remain closed for a period of time depending upon the size of the orifice 26 and the position of the end of the electrode 16 in reference to the floor of the trough 20. Thus by controlling these two features, the length of the electrode 16 and the size of the orifice 26, an appreciable range of time may be introduced in respect to the period of closing of the circuit. It is to be understood that it is not intended that this switch structure operate to control high currents or voltages. The structure does work satisfactorily on low currents such as from one to five amperes.

After the mercury 29 has flowed through the orifice 26, it will assume some such position as indicated by the dash lines in Fig. 1 under the trough 20. Then upon reverse tilting of the switch, the mercury will be discharged through the orifices 27 and 28 onto the upper side of the trough 20 to assume some such position as indicated in Fig. 2. It is to be noted that the mercury does not flow back through these orifices 27 and 28 when the switch is tilted back to the position as indicated in Fig. 1 by reason of the presence of the baffles 32 and 30 extending upwardly from the floor of the trough 20 around from the forward sides of the orifices and in between as indicated in Fig. 2.

The flow of mercury from under the trough 20 onto the upper side through these orifices is around the forward ends of the respective baffles. The flow of mercury from the pool indicated in Fig. 2, back to the other end of the trough 20 on its upper side is between the baffles.

Where it is desired to control a second circuit through the same switch structure and to have that second circuit closed at the end of a definite time interval, a second electrode 31 is introduced through a side wall of the envelope 10, as indicated particularly in Fig. 3, to extend under the trough 20 in spaced relation therefrom in such manner that when the mercury has passed through the orifice 26 and reached the level as indicated by the dash lines in Fig. 1, this mercury will complete a circuit between the disk 12 and the electrode 31. Rocking the switch to a reversed position from that indicated in Fig. 1 will, of course, open this second circuit. The electrode 31 is simply carried through the wall of the envelope 10 so as to prevent any leakage of vapors or gases about its junction with the envelope.

It is to be understood that all of the metal parts exposed to the mercury 29 are to be formed of pure iron or commercially pure iron to prevent contamination of the mercury by amalgamation or the like. The envelope 10 may be formed of glass as well as the other type of insulating materials above indicated, and some inert gas may be employed within the envelope as is the usual practice in mercury switches.

While I have herein shown and described my invention in the one particular form, it is obvious that structural changes may be employed without departing from the spirit of the invention and I, therefore, do not desire to be limited to that precise form except by the limitations as may be imposed by the following claims.

I claim:

1. In a mercury switch, an envelope, a floor sloping upwardly from near one end to the other end of the envelope and closed off at its upper end in respect to the envelope, an electrode at the upper end of the floor, a second electrode adjacent the upper end of the floor spaced from the first electrode, and a quantity of mercury flowable over said floor, said floor having an orifice through it near its upper end and a second orifice adjacent its lower end, whereby mercury flowing through the upper orifice may be returned to the upper side of the floor through said second orifice.

2. In a mercury switch, an envelope, a floor sloping upwardly from near one end to the other end of the envelope and closed off at its upper end in respect to the envelope, an electrode at the upper end of the floor, a second electrode adjacent the upper end of the floor spaced from the first electrode, and a quantity of mercury flowable over said floor, said floor having an orifice through it near its upper end and a second orifice adjacent its lower end, whereby mercury flowing through the upper orifice may be returned to the upper side of the floor through said second orifice, and a baffle extending upwardly from said floor in front of said lower orifice preventing return flow of mercury through that orifice.

3. In a mercury switch, a tubular envelope, a U-shaped trough extending from the inside wall of the envelope near one end upwardly toward the other end of the envelope, a quantity of mercury in the envelope, means for sealing off each end of said trough to prevent passage of mercury therearound, an electrode sealably carried through the envelope into communication with said trough at its upper end portion, a second electrode sealably carried through the envelope above the trough in juxtaposition with its upper end portion and spaced from the first electrode, said trough having an opening through it in its upper end portion of a size to control the rate of flow of the mercury therethrough to the under side of the trough, and a pair of openings in the

trough in its lower portion adjacent the contact of its under side with the envelope, said holes being spaced circumferentially one from the other and equidistant from the center of the trough, and a separate baffle extending respectively upwardly from the trough from in front of each lower hole and thence around the orifice between it and the trough center to define an alley between the two baffles for return flow of mercury up the trough without flow back into those lower holes.

4. In a mercury switch, an envelope, a floor sloping upwardly from near one end to the other end of the envelope, an electrode at the upper end of the floor, a second electrode adjacent the upper end of the floor spaced from the first electrode, and a quantity of mercury flowable over said floor, said floor having an orifice through it near its upper end and a second orifice adjacent its lower end, whereby mercury flowing through the upper orifice may be returned to the upper side of the floor through said second orifice, and a third electrode under said floor located to form a circuit with one of the other of said electrodes upon said mercury flowing through said orifice to reach a depth under the floor sufficient to reach the third electrode.

5. In a mercury switch, a tubular envelope, a U-shaped trough extending from the inside wall of the envelope near one end upwardly toward the other end of the envelope, a quantity of mercury in the envelope, means for sealing off each end of said trough to prevent passage of mercury therearound, an electrode sealably carried through the envelope into communication with said trough at its upper end portion, a second electrode sealably carried through the envelope above the trough in juxtaposition with its upper end portion and spaced from the first electrode, said trough having an opening through it in its upper end portion of a size to control the rate of flow of the mercury therethrough to the under side of the trough, and a pair of openings in the trough in its lower portion adjacent the contact of its under side with the envelope, said holes being spaced circumferentially one from the other and equidistant from the center of the trough, and a separate baffle extending respectively upwardly from the trough from in front of each lower hole and thence around the orifice between it and the trough center to define an alley between the two baffles for return flow of mercury up the trough without flow back into those lower holes, and a third electrode sealably carried through the envelope under the upper portion of said trough.

LEONARD W. GILLESPIE.