

July 10, 1928.

1,676,752

W. R. WALKER

ELECTRIC SWITCH

Filed Nov. 25, 1924

2 Sheets-Sheet 1

Fig. 1

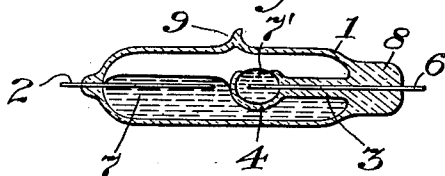


Fig. 2

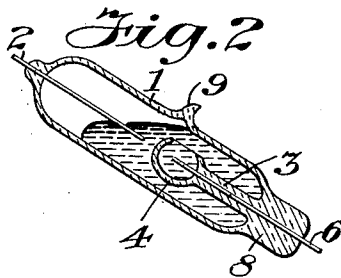


Fig. 3

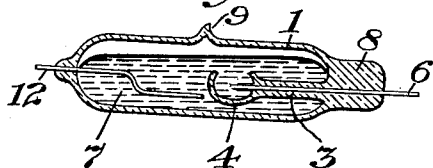


Fig. 4

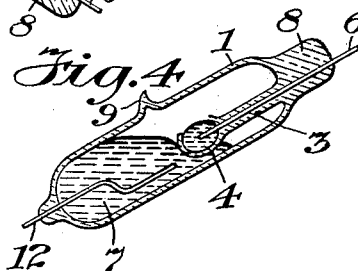


Fig. 5

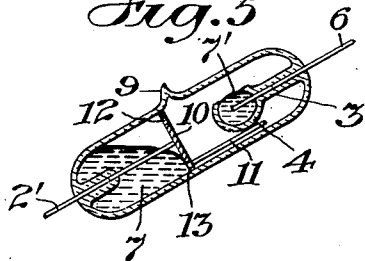


Fig. 6

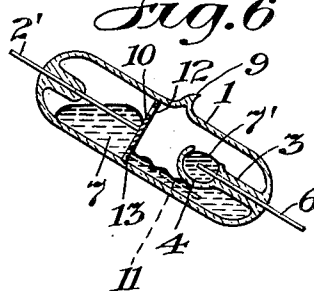


Fig. 7

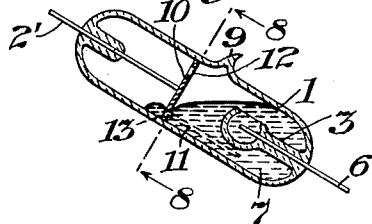


Fig. 8



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ELECTRIC SWITCH

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2 Sheets-Sheet 2

Fig. 9

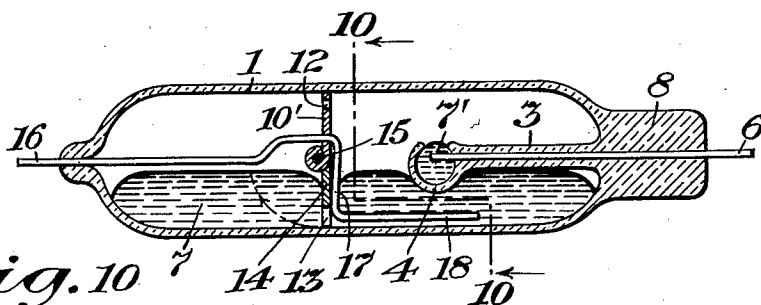


Fig. 10

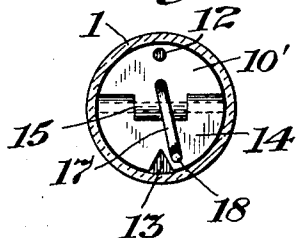


Fig. 11

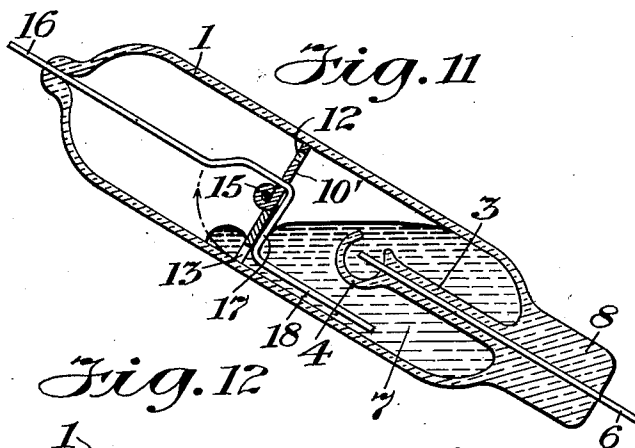
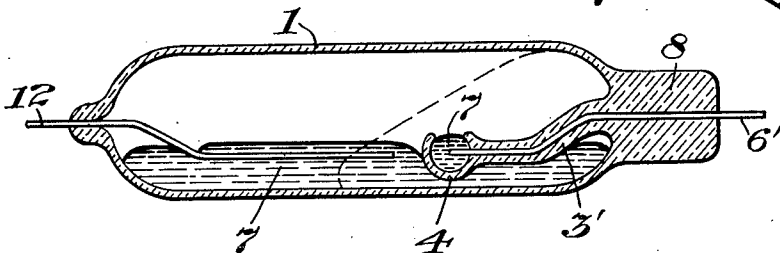


Fig. 12



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UNITED STATES PATENT OFFICE.

WARREN R. WALKER, OF GREAT KILLS, NEW YORK, ASSIGNOR TO COOPER HEWITT ELECTRIC COMPANY, OF HOBOKEN, NEW JERSEY, A CORPORATION OF NEW JERSEY.

ELECTRIC SWITCH.

Application filed November 25, 1924. Serial No. 752,099.

My present invention relates to switches of the liquid flow type. It relates particularly to the construction of an auxiliary cup for the end of one or more of the terminals of such a switch which cup serves to hold a quantity of the conducting liquid at such terminal end at all positions of the switch whereby circuit is made and broken in the switch between two bodies of the conducting liquid and whereby the terminals of the switch are protected from any arcing which might occur in the operation of the switch. My invention further relates to the method of making the switch of the present invention.

I have discovered that such a protecting cup is for some purposes advantageously mounted in the switch by mounting it on the end of a supporting arm which in turn is mounted to the interior wall of the switch envelope such as are commonly known in the art. This arm may be of varying length from a very short stub of almost negligible length to one reaching substantially the entire length of the interior of the switch envelope, according to the particular needs and conditions for which the switch is made. In the embodiment of my invention as shown in the accompanying drawings said supporting arm is made of the same material as the switch envelope and said protecting cup, which are of glass, and has extending therethrough from the outside of the switch envelope wall to the interior of the switch envelope the electrode whose end is to be protected by the liquid to be held in said cup. By this arrangement said arm serves both as a support for the cup and as means for insulating said electrode from the conducting liquid in the switch envelope other than that contained within the said cup. In the drawings,

Fig. 1, is a vertical elevation view in longitudinal section of a mercury switch showing a switch envelope of an insulating material such as glass having mounted therein a glass cup in the walls of the envelope and mounted thereto by an arm of glass through which extends an electrode from the exterior envelope into said cup, another electrode is shown sealed through the envelope wall and terminating within

the envelope, a quantity of conducting liquid is shown in the envelope and another quantity in said cup, the switch being shown in the open circuit position.

Fig. 2, is a sectional view of the switch of Fig. 1 shown as being tilted into the closed circuit position,

Fig. 3, is a longitudinal sectional view in elevation of a modified form of the switch of Fig. 1 and in the closed circuit position,

Fig. 4, is a view similar to that of Fig. 3 showing the same switch in the open circuit position,

Fig. 5, is a longitudinal sectional view in elevation of a time-delay closing switch embodying the cup structure of the switch of Fig. 1 and shown in the open circuit position,

Fig. 6, is a view similar to that of Fig. 5 showing the same switch as being tilted into the closed circuit position and with the conducting liquid thereof as flowing from the open circuit position into the closed circuit position,

Fig. 7, is a view similar to Fig. 6 showing the conducting liquid as having completely flowed and the switch being in the closed circuit position,

Fig. 8, is a sectional view along the line 8-8 of Fig. 7, showing details of the time lag producing element of the switch,

Fig. 9, is a longitudinal sectional view in elevation of a switch similar to that of Figs. 5, 6 and 7 in which the baffle is formed in two parts, one hinged to the other for movement from the normal position across the envelope in the direction away from the electrode cup but not movable from the normal position in the opposite direction. In this form of my invention the swinging in one direction of the lower part of the baffle permits a rapid and practically instantaneous flow of the mercury from the circuit making side of the baffle to the other side thereof; in the circuit making movement the flow of mercury will quickly close or move the baffle into its normal position across the switch envelope to inject the time lag element in the performance of the switch,

Fig. 10, is a sectional view taken along

the line 10—10 of Fig. 9 and looking in the direction of the arrows,

Fig. 11, is a view similar to that of Fig. 9 with the switch in the closed circuit position, and

Fig. 12 is an embodiment of the cup and arm of my invention in the switch having some of the features of the switches of Figs. 1 and 3.

In Figs. 1 and 2 of the drawing the sealed vitreous envelope 1 carries at one end the electrode 2 sealed through the wall thereof and terminating within the main body of the switch. At the opposite end of the envelope 1 from electrode 2 the arm 3 preferably of the same material as that of said envelope 1 is sealed to said envelope 1 and extends inwardly toward said terminal 2 and supports at its end the cup 4 also preferably of the same material as envelope 1 and arm 3. Said cup 4 has its rim formed to overhang the interior of the cup. The electrode 6 extends from the exterior of said envelope 1, longitudinally through said support member 3, and terminates in the interior of said cup 4, said arm 3 serving to completely insulate that portion of electrode 6 within envelope 1 from the conducting liquid 7 of said envelope except at that portion thereof which is within said cup 4. This portion or end of the electrode 6 which is within said cup 4 connects to the main body of conducting liquid 7 in the closed circuit position of the switch through the conducting liquid held within said cup 4 as shown in Fig. 2. In the open circuit position of the switch as shown in Fig. 1 a part 7' of the conducting liquid 7 is held within said cup 4, the level of said body of liquid 7 having fallen, in this position, to a level below said rim 5 of cup 4.

In the use and operation of the embodiment of my invention as shown in Figs. 1 and 2 for closing the circuit therethrough the switch is tilted from the position shown in Fig. 1 to that shown in Fig. 2 whereby an electrical conducting path is established between said electrodes 2 and 6 in the manner well known in the liquid switch art. For opening the circuit through the switch it is tilted from the position shown in Fig. 2 to the position in which the two bodies 7 and 7' separate as is shown in Fig. 1.

In the manufacture of the switch of my invention the glass supporting and insulating arm 3 is first formed about the electrode 6 and extending substantially throughout that portion about the length of said electrode 6 that is covered with glass in the finished switch. The cup 4 also is formed about the "inner" end of electrode 6 and fused to said support arm 3. The envelope 1 is formed in tubular shape with a tubulation at one end thereof large enough to admit said cup 4 which is passed therethrough

and the said tubulation and the outer end of arm 3 fused together, the tubulation being, in one method, flattened out to form a seal in which is incorporated the fused portion of arm 3 or a part thereof. This seal is indicated in Figs. 1 and 2 at the flattened portion 8. This method is adapted for economical and rapid performance by machine. Electrode 2 is then (or before this operation) sealed into the opposite end of envelope 1 in a position axially aligned therewith. The fact that the cup 4 and electrode 2 are centrally positioned axially in envelope 1 permits these to be assembled without having to regard whether they are other than axially aligned permit a rapidity of operation that results in a great saving of time and in the use of simple and comparatively cheap assembling machinery. The envelope 1 is then supplied with a proper quantity of conducting liquid 7 such as mercury and when desired an atmosphere of a spark quenching gas such as hydrogen and the envelope sealed-off as at the seal-off 9. The seal-off 9 is formed directly over the outer edge of the cup 4 as shown in Figs. 1 and 2 in those cases when minimum size is desired, this for the purpose of providing an increased distance from the point of liquid make and break to the envelope wall in order to prevent as much as possible the impinging of any such arc on said envelope wall.

In the modified form of my invention as shown in Figs. 3 and 4 is shown a switch similar in all respects to that of Figs. 1 and 2 except that arm 3, cup 4, and electrode 8 are mounted lower on the switch envelope than these parts in Figs. 1 and 2 and that the straight electrode 12 is replaced by a bent electrode 12 which extends downwardly into the mercury 7 and permits of the use of a smaller quantity of mercury than may be necessary in that of Figs. 1 and 2. By extending electrode 12 in close proximity and preferably to a point under cup 4 the amount of mercury 7 in the switch is, when desired, cut down. The operation of this form is substantially the same as that of the form shown in Figs. 1 and 2.

In other forms of my invention I drop the cup 4, or the cup 4 electrode 6 and arm 3 down nearer the bottom of the switch envelope to allow more space above the cup 4. In still other forms I make electrode 6 substantially of the shape of electrode 12 and the arm 3 shaped accordingly. This permits of the advantages of rapid machine manufacture as above described for the first form and at the same time permits of a greater space above cup 4, and also of the use of a minimum quantity of mercury in the switch.

In Figs. 5, 6, 7 and 8 is shown my invention as embodied in a time lag make

switch, that is a switch in which a time element may be induced between the tilting or moving of the switch into the closed circuit position and the actual establishment of a current path in the switch. This form is similar to that of Figs. 1 and 2 with the exception that there is substituted for electrode 2 an electrode 2' which is shorter than electrode 2 and which supports and connects with the baffle 10 which is of conducting material and the electrode extension 11 which also is of conducting material and which extends from baffle 10 along and close to the bottom of envelope 1 to a point near and preferably under cup 4. Baffle 10 carries near its upper edge the air port 12 and in its lower edge the mercury port 13, the latter to allow the mercury to flow at a restricted rate of flow from the open circuit position to the closed circuit position thereof and the former to permit the passage of gas in the switch from one side of the baffle to the other to equalize the pressure thereat as said mercury flows. The space between baffle 10 and the point of seal-in of electrode 2' is provided of such size as to hold all or substantially all of the mercury 7 when the switch is in the open circuit position.

In the use and operation of this embodiment of my invention to close a circuit there-through with a time lag between the moving of the switch from the open circuit position to closed circuit position the switch is tilted from the position shown in Fig. 5 to that shown in Fig. 6 in which position mercury 7 flows at an impeded rate through opening 13 until it attains equilibrium in the now lower end of the envelope. Upon reaching above the level of the rim of cup 4 mercury 7 joins and unites with mercury 7' thereby completing a current path between electrode 11-12-2' and electrode 6 and thereby through the switch. The time required for the establishment of current path through the switch in this manner may be controlled by varying the amount of mercury 7 in the switch, the size of opening 13, or opening 12, or both openings 12 and 13, or the position of baffle 10 with respect to the ends of the switch, the size of one or both of the two chambers into which baffle 10 divides envelope 1, or the position of cup 4, or any combination of these variations and disclosed in my copending application Serial Number 734,184 to which reference is hereby made. When the switch is tilted from the position of Fig. 7 to that of Fig. 5 the mercury 7 immediately flows from connection with mercury 7' thereby breaking the current path through the switch.

By placing baffle 10 in such a position with respect to the cup 4 that the mercury 7 is held above the level of the edge thereof for an appreciable length of time during its

flow through port 13 from the closed to the open circuit position a time lag break and time lag make switch is obtained.

In Fig. 12 is shown a form of my invention embodying features of switches of Figs. 1 and 3. In this switch the electrode 6' and the electrode supporting arm 3' are bent so that they enter the interior of the switch envelope 1 at substantially the middle thereof and extend downwardly toward the bottom of the wall of said envelope. This central position of the arm 3' and electrode 6' permits of rapid manufacture of the switch and assembly of the switch parts in a machine. Further the position of the cup 4 near the bottom of the envelope allows sufficient arcing space between the top of the cup and the envelope wall with the result of the permitting of the construction of a switch which will occupy a minimum amount of space at a very low cost and having all the operational advantages of the switches of Figs. 1 and 3. The electrode 12 of this switch like that of Fig. 3 is centrally sealed into the switch and extends downwardly into the body of mercury 7. The dashed line in this figure indicates the position of the mercury in the closed circuit position of the switch. The operation of the switch of these figures is substantially the same as that of Figs. 1 and 3.

In Figs. 9, 10 and 11 is shown a switch whose envelope 1 supports at one end the insulating arm 3 which supports at its inner end the cup 4 and through the length of which extends, from the exterior of the envelope, the electrode 6. Through the opposite end of the switch is sealed the electrode 16 which carries thereon the baffle 10'-14 which extends substantially across the interior of said envelope 1, the two parts thereof being joined at the horizontal hinge 15. The said electrode 16 extends through said part 10' of said baffle substantially horizontally and then on the cup side of said baffle part 10' turns directly downward in the part 17 thereof which serves to prevent movement of the baffle part 14 from the normal position across the switch envelope in the direction of said cup 4, the said electrode 16 being extended from said part 17 horizontally in the part 18 into proximity with said cup 4. The hinge construction 15 permits the movement of the lower baffle part 14 away from the normal position across the interior of the envelope 1 in the direction away from said cup 4.

In the use and operation of this embodiment of my invention and starting from the closed circuit position as shown in Fig. 11 the switch is tilted in a counter clockwise direction to permit the mercury body 7 to flow from the circuit making position. On said tilting the weight of the said mercury body 7 opens or swings the baffle part 14 on

said hinge 15 to permit of rapid flow of the mercury into that portion of the envelope 1 which is on the side of the baffle away from said cup 4 and therefore ready almost
 5 instantaneously after movement from the circuit making position into the circuit breaking position for movement back into the circuit making position and with the normal time lag element is said circuit making
 10 operation due to the restricted flow of the mercury body 7 by the small opening 13 in the baffle part 14. On the tilting from the open circuit position of the switch into the closed circuit position of the switch the
 15 flow of mercury will move said baffle part 14 into its normal position across the switch envelope 1 and the narrow passage 13 will restrict the mercury flow into the circuit closing position and inject a time lag into
 20 that part of its operation.

I claim:

1. In an electric switch of the liquid flow type, a sealed envelope of glass, a support arm in said envelope and unitary therewith,
 25 a cup formed on said arm, the opening of said cup being parallel to the longitudinal axis of the tube, and electrode sealed into said envelope and terminating therein and another electrode sealed into the envelope
 30 and terminating in said cup, and a body of mercury in said envelope in quantity sufficient to extend into said cup and to connect said electrodes in a closed circuit position of the switch and to form separate pools
 35 about said electrodes in an open circuit position thereof.

2. In an electric switch of the liquid flow type, an envelope, a support arm carried by the wall of said envelope and formed unitary therewith, a cup on the end of said support arm, the opening of said cup being
 40 parallel to the longitudinal axis of the tube, conducting liquid in said envelope, and in said cup, electrodes terminating in said envelope and in said cup and one of said electrodes extending from the outside of the switch longitudinally through said arm and
 45 terminating within said cup.

3. In an electric switch of the liquid flow type, a sealed envelope of vitreous material, an arm in said envelope formed unitary with and carried by the wall thereof, a cup on the end of said arm, the opening of said cup being parallel to the longitudinal axis
 50 of the tube, conducting liquid in said envelope and in said cup and electrodes sealed through the wall of said envelope and terminating within said envelope and said cup, respectively.

4. In an electric switch of the liquid flow type, a sealed envelope of vitreous material, an arm in said envelope formed unitary with and carried by the wall thereof, a cup on the end of said arm, the opening of said cup
 65 being parallel to the longitudinal axis of the

tube, conducting liquid in said envelope and in said cup, electrodes sealed through the wall of said envelope and terminating within said envelope and said cup respectively, and an atmosphere of hydrogen in said envelope. 70

5. In an electric switch of the liquid flow type, a sealed envelope of vitreous material, a support arm mounted within said envelope and formed unitary therewith, a cup carried by said arm, the opening of said cup being
 75 parallel to the longitudinal axis of the tube, a conducting liquid in said envelope and in said cup, an electrode sealed through the wall of said envelope and terminating in said conducting liquid at normal operating
 80 positions of the switch and an electrode extending from outside the switch longitudinally through said arm and terminating within said cup.

6. In an electric switch of the liquid flow type, a sealed envelope of vitreous material, a support arm mounted within said envelope formed unitary with and mounted to the wall thereof, a cup carried by said arm, the opening of said cup being parallel to the
 90 longitudinal axis of the tube, a conducting liquid in said envelope and in said cup, an electrode sealed through the wall of said envelope and terminating in said conducting liquid at normal operating positions of the switch and an electrode extending from
 95 outside the switch longitudinally through said arm and terminating within said cup, and a filling of spark quenching gas in said envelope. 100

7. In an electric switch of the liquid flow type, a sealed vitreous envelope, a baffle mounted substantially across the interior of said envelope dividing it into two chambers, said baffle being separate from the said envelope and being formed to admit the passage of fluent conducting material thereby, an electrode sealed through the wall of said container, a second electrode sealed there-through, a wall of vitreous material sealed
 110 to said envelope about and terminating above said second electrode, mercury in said envelope connecting with first said electrode and extending between the limits of said wall about second said electrode and connecting
 115 with said second electrode in the closed circuit position of the switch, and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said second electrode, said baffle
 120 being hinged to permit its movement in one direction only from its normal position across said envelope.

8. In an electric switch of the liquid flow type, a sealed vitreous envelope, a baffle
 125 mounted substantially across the interior of said envelope and dividing it into two chambers, a restricted opening near the bottom of said baffle and connecting the two chambers, an electrode sealed through the wall of 130

said envelope, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope about and terminating above said second electrode, mercury in said envelope connecting with first said electrode and extending between the limits of said wall about second said electrode and connecting with said second electrode in a closed circuit position of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about second said electrode, said baffle being hinged for movement in the line of liquid flow in the switch and means comprising an extension of said electrode to prevent movement of said baffle on its hinge from its normal position across the envelope in the direction of said wall about said second electrode.

9. In an electric switch of the liquid flow type, a sealed vitreous envelope having mercury therein, a baffle mounted substantially across the interior of said envelope and dividing it into two chambers, said baffle being cut away near its bottom to provide a restricted opening for the flow of said mercury therethrough and being cut away near its top to provide a restricted opening for the flow of gas therethrough to attain equilibrium in said switch, an electrode sealed through the wall of said envelope, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope and about and terminating above said second electrode, said mercury connecting with first said electrode and extending between the limits of said wall about said second electrode and connecting with said second electrode in a closed circuit position of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said electrode, said baffle being hinged to permit movement in the line of flow of mercury in the switch in one direction only.

10. In an electric switch of the liquid flow type, a sealed vitreous envelope having mercury therein, a baffle mounted substantially across the interior of said envelope and dividing it into two chambers, said baffle being cut away near its bottom to provide a restricted opening for the flow of said mercury therethrough and being cut away near its top to provide a restricted opening for the flow of gas therethrough to attain equilibrium in said switch, an electrode sealed through the wall of said envelope, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope and about and terminating above said second electrode, said mercury connecting with first said electrode and extending between the limits of said wall about said second electrode and connecting with said second electrode in a closed circuit position

tion of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said electrode said second electrode serving as a support for said baffle and being formed to prevent movement of said baffle on its hinges in one direction away from its normal position across said envelope.

11. In an electric switch of the liquid flow type, a sealed envelope of glass, a support arm in said envelope and a cup formed on said arm, the opening of said cup being parallel to the longitudinal axis of the tube, an electrode sealed into said envelope and terminating therein and another electrode sealed into the envelope and terminating in said cup, and a body of mercury in said envelope in quantity sufficient to extend into said cup and to connect said electrodes in a closed circuit position of the switch and to form separate pools about said electrode in an open circuit position thereof.

12. In an electric switch of the liquid flow type, a sealed vitreous envelope, a baffle formed separate from the envelope and spaced therefrom mounted substantially across the interior of said envelope dividing it into two chambers, said baffle having formed therein a restricted opening near the bottom to connect the two chambers, an electrode sealed through the wall of said container, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope about and terminating above said second electrode, mercury in said envelope connecting with first said electrode and extending between the limits of said wall about second said electrode and connecting with said second electrode in a closed circuit position of the switch, and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said second electrode said baffle being hinged to permit its movement in one direction only from its normal position across said envelope.

13. In an electric switch of the liquid flow type, a sealed vitreous envelope, a baffle formed separate from the envelope and spaced therefrom mounted substantially across the interior of said envelope and dividing it into two chambers, said baffle having formed therein a restricted opening near the bottom to connect the two chambers, an electrode sealed through the wall of said container, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope about and terminating above said second electrode, mercury in said envelope connecting with first said electrode and extending between the limits of said wall about second said electrode and connecting with said second electrode in a closed circuit position of the

switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about second said electrode said baffle being hinged to
 5 permit movement from its normal position across said envelope away from said wall about said second electrode.

14. In an electric switch of the liquid flow type, a sealed vitreous envelope, a baffle
 10 formed separate from the envelope and spaced therefrom mounted substantially across the interior of said envelope and dividing it into two chambers, said baffle having formed therein a restricted opening
 15 near the bottom to connect the two chambers, an electrode sealed through the wall of said container, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope about and
 20 terminating above said second electrode, mercury in said envelope connecting with first said electrode and extending between the limits of said wall about second said electrode and connecting with said second
 25 electrode in a closed circuit position of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about second said electrode and means comprising an ex-
 30 tension across said electrode to prevent movement of said baffle and said hinge from its normal position across the envelope in the direction of said wall about said second electrode.

35 15. In an electric switch of the liquid flow type, a sealed vitreous envelope having mercury therein, a baffle formed separate from the envelope and spaced therefrom mounted substantially across the interior of
 40 said envelope and dividing it into two chambers, said baffle being cut away near its bottom to provide a restricted opening for the flow of said mercury therethrough and being cut away near its top to provide a restricted
 45 opening for the flow of gas therethrough to attain equilibrium in said switch, an electrode sealed through the wall of said con-

tainer, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope and about and ter-
 50 minating above said second electrode, said mercury connecting with first said electrode and extending between the limits of said wall about said second electrode and connecting with said second electrode in a closed
 55 circuit position of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said electrode, said baffle being hinged to permit movement in the
 60 line of flow of mercury in the switch in one direction only.

16. In an electric switch of the liquid flow type, a sealed vitreous envelope having
 65 mercury therein, a baffle formed separate from the envelope and spaced therefrom mounted substantially across the interior of said envelope and dividing it into two chambers, said baffle being cut away near its bot-
 70 tom to provide a restricted opening for the flow of said mercury therethrough and being cut away near its top to provide a restricted opening for the flow of gas therethrough to attain equilibrium in said switch, an elec-
 75 trode sealed through the wall of said container, a second electrode sealed through said envelope, a wall of vitreous material sealed to said envelope and about and ter-
 80 minating above said second electrode, said mercury connecting with first said electrode and extending between the limits of said wall about said second electrode and connecting with said second electrode in a closed
 85 circuit position of the switch and in an open circuit position of the switch positioned at a level below that of the upper limit of said wall about said electrode, said baffle being hinged to permit movement in the
 90 line of flow of mercury in the switch in the circuit making direction only.

Signed at Hoboken, in the county of Hud-
 son and State of New Jersey, this 24th day
 of November, A. D. 1924.

WARREN R. WALKER.