Jan. 7, 1930. W. R. WALKER 1,743,067

MERCURY SWITCH

Filed Sept. 18, 1928

Fig. 1

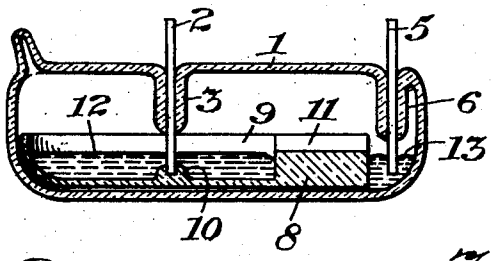


Fig. 2

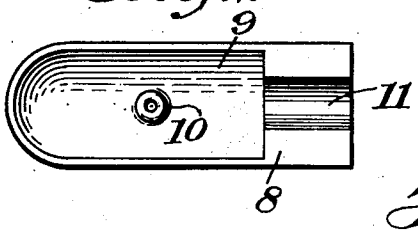


Fig. 3

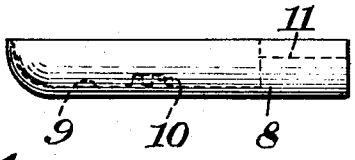


Fig. 4



Fig. 5

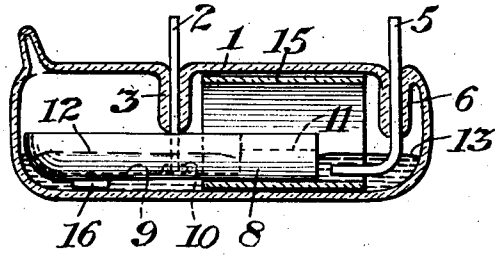


Fig. 7

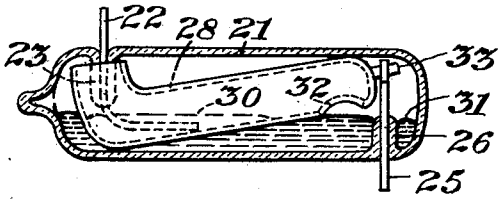
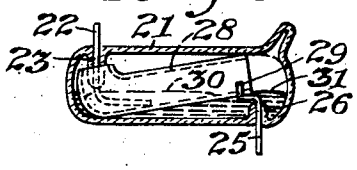


Fig. 6



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UNITED STATES PATENT OFFICE

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MERCURY SWITCH

Application filed September 18, 1928. Serial No. 306,626.

The present invention relates to switches, and particularly to that type of switch in which mercury is used to make and break the circuit between two terminals within a closed envelope.

The particular object of the invention is to provide means whereby relatively large currents may be safely ruptured within an enclosing envelope of soft glass, thereby decreasing the cost of such switches in that cheaper glass, lead-in and electrode material can be used in the production of my new switches, such material also being more easily worked. Other objects will be obvious from an inspection of the accompanying specification and drawings.

The invention consists in the novel arrangement and combination of parts, as hereinafter set forth and claimed.

Heretofore it has been usual to provide envelopes of hard glass, which were necessary to withstand the heat produced by the arc which occurs when a circuit is opened while carrying a relatively large current such as 20 or 25 amperes, at 110 volts. By the introduction of suitable shields and baffles of hard glass, quartz, porcelain, or the like according to the present invention it is possible to use a soft glass envelope with safety, although such an envelope without the baffle cannot safely rupture much over 5 amperes.

I have discovered that switches of the type disclosed herein and in my Patent 1,676,754 issued July 10, 1928 on an application filed June 17, 1925, the present application being for improvements thereon, possess the property of safely making and breaking when tilted or rotated circuits carrying 50 to 75 amperes, and when the improvements of my above referred to patent and of this application are embodied in a switch of the type disclosed in the Mailey Patent 1,537,921 issued May 12, 1925 and of the type disclosed in British Patent 183,683 circuits of greater amperage can be safely made and broken, and the added cost of production of the switch will be offset by the greater current breaking property of the switch in continuous commercial use as compared with the amperages which hard or soft glass devices described in the patents above referred to will successfully make and break in commercial practice.

For the purpose of illustration several switches embodying the invention are shown in the accompanying drawings, in which

Fig. 1 is a longitudinal cross section of a switch embodying the invention,

Fig. 2 is a plan view of the baffle shown in Fig. 1,

Fig. 3 is a front view of the same baffle,

Fig. 4 is an end view thereof,

Fig. 5 is a central vertical section, with the baffle shown in elevation, of a modification of Fig. 1 for larger current capacity,

Fig. 6 is a similar view to Fig. 5 of a switch of different design but embodying the invention, and

Fig. 7 is a longitudinal cross section with the interior shield in elevation of a modification of Fig. 6 for larger current capacity.

In all the figures the envelope is preferably formed of a soft glass, and may be either evacuated or filled with hydrogen, ammonia, nitrogen or other inert gas, in a manner well known to those skilled in the art. A filling of hydrogen or ammonia is, however, preferred. The inleads are preferably formed of dumet, which is a nickel steel wire coated with copper, and specially designed for sealing into soft glass but may be of any other material having a suitable coefficient of expansion. Since the copper would impair the action of the mercury, the portion of said inleads which project within the envelope are preferably formed either of nickel previously welded to the dumet, or of nickel steel, exposed by removing the copper coating from the dumet inside the container wall, although other metals may be used without departing from this invention. The shields or barriers used in the various figures are either blown or molded from hard glass, quartz, porcelain or any suitable refractory material, and are inserted within the envelopes before the ends of said envelopes are closed.

With particular reference to Figs. 1, 2, 3, 4 and 5 envelope 1 is of tubular shape with closed ends. An inlead 2 of dumet enters said envelope 1 through a reentrant seal 3 in

the top of said envelope and a little toward one end thereof. A similar inlead 5 enters said envelope 1 through a reentrant seal 6 in the top of said envelope and adjacent to the end more distant from inlead 2. A refractory shield or baffle 8, which is boatlike in shape, is located within said envelope 1 at the bottom thereof, with one end adjacent to the end of said envelope 1 which is nearer inlead 2, and with the other end of said shield 8 terminating near said inlead 5. A central depression 9 in shield 8 into which inlead 2 projects has an annular projection 10 extending upward from the bottom thereof which engages with said inlead 2 whereby said shield 8 is fixed in its position within said envelope 1. A longitudinal channel 11 which is somewhat more shallow than depression 9 and which is centrally disposed in the upper surface of shield 8 extends from the depression 9 to the end of said shield 8 adjacent to inlead 5. Mercury is provided in said envelope to a level slightly below the bottom of said channel 11 when the switch is in the open position, as shown, and is thus divided into a pool 12 within the shield 8 in contact with inlead 2 and a pool 13 surrounding said shield and in contact with inlead 5. When the envelope is tipped slightly so as to tend to elevate pool 12 above pool 13 the mercury in pool 12 will run through channel 11 and unite the two pools, thus closing the circuit from inlead 2 to inlead 5. When the envelope is restored to the level position illustrated, the mercury will run in the reverse direction through channel 11 until the bottom of channel 11 at the point where it opens into depression 9 is at the same lever as the mercury, when the mrecury will thereby again be separated into the two pools 12 and 13, and the arc will form betwen the two pools at that point. It will thus be seen that the arc is substantially confined to the depression 9 and the channel 11 where the arc resisting shield 3 is effective in protecting the soft glass envelope from the heat thereof.

The switch illustrated in Fig. 5 is designed for larger currents than that of Figs. 1, 2, 3 and 4, and in addition to being somewhat larger has an additional protection for the soft glass envelope. A tubular liner 15 of quartz, hard glass or other refractory material is provided for the envelope 1 and extends from a point near the seal 3 to a point near the seal 6. One end of shield 8 rests within said refractory liner 15, and the other end has a support 16 of the same thickness as the liner 15, whereby shield 8 is evenly supported within said envelope 1. Inlead 5 is bent to project within one end of liner 15. With this structure the arc is even more effectively confined within refractory parts than in the structure shown in Fig. 1, since the arc takes place at the junction of channel 11 and depression 9, which is well within the tubular liner 15.

In Fig. 6 the sealed soft glass envelope 21 has an inlead 22, preferably of dumet, which enters said envelope through reentrant seal 23 at the top and adjacent to one end thereof. The end of inlead 22 is curved so as to extend toward the opposite end of said envelope 21. A similar inlead 25 enters said envelope 21 at the bottom of the end opposite to seal 23 through the reentrant seal 26 and is curved so as to extend toward inlead 22. An arc shield 28 of hard glass, quartz or other refractory material is substantially tubular in shape, with a bend toward one end thereof, said bent end opening upward to receive the inlead 22 and a portion of seal 23. At said bent end shield 28 is supported on the bottom of envelope 21, while at the opposite end a curved bracket 29 of nickel or nickel steel welded to said inlead 25 holds that end of said shield 28 firmly against the top of said envelope 21, the tubular shield 28 being of such diameter that it will rest within said envelope 21 at a considerable angle therewith. Mercury is provided within said envelope to a level slightly below the opening in the straight end of said shield 28 when the envelope is in a level position, and is divided into a pool 30 inside of shield 28 in contact with inlead 22, and a pool 31 outside said shield in contact with the inlead 25. The walls of said shield 28 rise around seal 23 to a height somewhat above the lowermost part of the opening in the opposite end of said shield, so that the mercury pools 30 and 31 cannot mingle through that opening. When the envelope is tilted so as to tend to raise pool 30 above pool 31 the mercury passes through the open end of shield 28 and merges the two pools, thereby connecting inleads 22 and 25. When the envelope is restored to the level position illustrated the mercury flows in the reverse direction through said open end of shield 28 until the bottom thereof is at the same level as the mercury, when the mercury is again separated by the end of said shield 28 into the two pools 30 and 31, and an arc takes place between the two pools as the circuit is opened. As the pool 30 is receding rapidly at this time due to the sloping bottom of the shield 28 the arc is drawn within said shield 28 whereby said envelope 21 is shielded from the heat thereof.

Fig. 7 shows a modification of the switch of Fig. 6 which is designed to interrupt larger currents, and in addition to being somewhat larger has a slightly different supporting means for the shield, as made necessary by a change in structure which even more effectively shields said envelope from the arc. The envelope 21 has inleads 22 and 25 as before, entering through seals 23 and 26 respectively. The shield 28 is of the same shape as in Fig. 6 except that the straight end

thereof is closed, and an opening 32 is made in the bottom thereof near the end through which the mercury flows when the envelope is tipped. Inlead 25 engages with a projection 33 on the end of said shield 28 to rigidly hold that end of said shield against the top of envelope 21. Mercury is provided to a height just below the lowermost point of opening 32 when the envelope is level, forming the pools 30 and 31 as before. The operation is the same as that of the switch of Fig. 6, the break occurring between pools 30 and 31 over the lowermost point of opening 32, so that the arc is almost entirely enclosed within said shield 28.

Greater sensitivity may be obtained in any of these switches by etching the portion of the barrier over which the mercury flows with hydrofluoric acid previous to introduction within the envelope. The simplicity of this compared to etching the inside of the envelope as has been done heretofore is obvious.

It will be observed that by the structure illustrated in the various figures the inner parts are fixed in position within the envelope without resort to packing.

When used on direct current the shielded inlead is connected to the negative side of the line so that the hottest part of the arc is well within the shield.

I claim:

1. In a mercury switch a tubular envelope, a tubular lining within said envelope, leads sealed into said envelope, one of said leads forming an exterior support for said tubular lining, another of said leads terminating within said lining and mercury in said envelope in sufficient quantity to form a conducting path between said leads when the switch is in a closed circuit position.

2. In a mercury switch a tubular envelope, a tubular lining within said envelope, leads sealed into said envelope, one of said leads forming an exterior support for said tubular lining, another of said leads terminating within said lining, and mercury in said envelope in sufficient quantity to form a conducting path between said leads when the switch is in a closed circuit position, said tubular lining being at such an angle with said envelope that the arc occurring upon opening of the circuit is drawn within said tubular lining.

3. In a mercury switch a tubular envelope, a tubular lining within said envelope with one end closed and the other end upturned, leads sealed into said envelope, one of said leads extending into said upturned end of said tubular lining, and another of said leads forming an exterior support for said closed end of said tubular lining, an opening in the lower side of said tubular lining and mercury within said envelope in a quantity sufficient to form a conducting path between said leads through said opening when the switch is in a closed circuit position, said tubular lining being at such an angle with said envelope as to cause the arc occurring when the circuit is ruptured to take place within said tubular lining.

Signed at Hoboken in the county of Hudson and State of New Jersey this 17th day of September A. D. 1928.

WARREN R. WALKER.