Jan. 13, 1959 C. E. POLLARD, JR 2,868,926

SWITCH

Filed June 25, 1957

FIG. 1

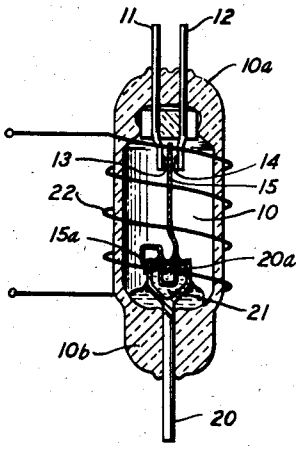


FIG. 2

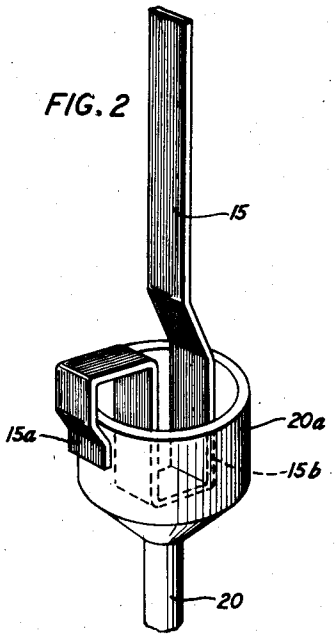


FIG. 3

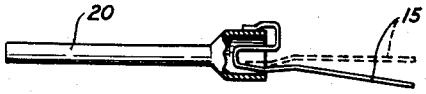
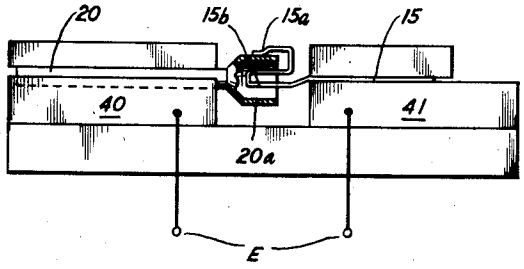


FIG. 4



INVENTOR
C. E. POLLARD JR.
BY John C. Morris
ATTORNEY

United States Patent Office

2,868,926

Patented Jan. 13, 1959

2,868,926

SWITCH

Charles E. Pollard, Jr., Hohokus, N. J., assignor to Bell Telephone Laboratories, Incorporated, New York, N. Y., a corporation of New York

Application June 25, 1957, Serial No. 667,914

7 Claims. (Cl. 200—112)

This invention relates to switches, and more particularly to switches of the mercury contact type.

Switches of the mercury contact type, exemplified by the structure disclosed in Patent 2,609,464, issued to J. T. L. Brown and C. E. Pollard, Jr., on September 2, 1952, exhibit a long service life with a high degree of reliability. Such switches include magnetically operated, mercury wetted armature reeds which are hermetically sealed under pressure in gas-filled envelopes.

The mercury reservoir in switches of this type serves three important functions. That part of the mercury in which a portion of the armature reed is immersed serves to dampen armature vibration, while the part of the mercury that, due to capillary action, extends along the armature reed to the contact zone provides continuously replenished contact surfaces and avoids deterioration of the underlying contact metal; the mercury that extends to the contact zone also serves to minimize contact chatter.

Portions of the readily movable, relatively large mercury mass may, however, under the influence of shock or vibration, impinge upon elements of the switch and as a result deleteriously affect the operation thereof. Accordingly, a need has existed for a mercury switch structure which would include a relatively small amount of mercury so arranged that the tendency of the mercury to move in response to shock or vibration would be minimized. While attempting to minimize the tendency of the mercury to move or "fly" and to limit the total amount of mercury available to be moved, it was realized that it would be necessary not to inhibit the desired contact wetting and liquid damping action of the mercury.

An additional need confronted those working in the field of mercury contact switches when the size requirements for these switch units were reduced. In switch units having envelopes or housings measuring about one inch in length, it was found that the relatively short magnetic armature reeds required in such structures did not possess sufficient resiliency for efficient switch operation. Accordingly, spring members were connected between the armatures and their supporting elements in an attempt to increase the resiliency of the movable assemblies. Such attempts were not completely satisfactory, however, because the problem of providing suitable spring members with mercury wettable surfaces was found to be a troublesome one.

Thus, an object of this invention is a switch structure of a type which successfully meets the abovementioned needs.

More specifically, an object of the present invention is an improved mercury contact switch which requires a relatively small quantity of mercury for successful operation thereof.

Another object of this invention is a switch structure which provides an appreciable amount of liquid damping.

A further object of the present invention is a mercury switch structure in which damage to the elements thereof due to shock or vibration is minimized.

These and other objects of the present invention are

realized in an illustrative embodiment thereof wherein a switch unit comprises a flared exhaust tube. The tube extends through and is sealed in one end of a housing, the flared portion of the tube being contained within the housing and serving as a reservoir for a quantity of mercury.

The illustrative embodiment includes an armature reed, one end of which is formed as a folded loop. The end of the loop is designed to be secured to the outer surface of the flared portion of the exhaust tube. In so securing the reed, a substantial part of the loop thereof extends within the flared portion of the exhaust tube.

Accordingly, a feature of this invention is a switch structure, the exhaust tube of which is formed as a flared mercury reservoir.

Another feature of the present invention is a switch structure having an armature reed, one end of which is folded into and secured to the flared portion of the exhaust tube.

Thus, in accordance with aspects of this invention, there is provided a switch of the mercury contact type in which the mercury is contained almost entirely within the flared portion of an exhaust tube. As the mercury reservoir is thus localized to the immediate vicinity of the end of the armature reed, less mercury is required than in similar structures wherein the mercury is contained by the switch housing itself.

Furthermore, since the mercury contained within the flared portion of the exhaust tube entirely surrounds a substantial length of the looped end of the armature reed, an appreciable amount of liquid damping is provided.

Also, illustrative embodiments of this invention minimize the possibility of mercury being impelled by shock or vibration to damage elements of the switch, for, as indicated above, only a relatively small amount of mercury is required in these novel structures, and most of that which is required is restrained against movement within the flared portion of the exhaust tube.

A complete understanding of the invention, and of these and other features and advantages thereof, may be gained from consideration of the following detailed description in conjunction with the accompanying drawing in which:

Fig. 1 is an elevation view in section of an illustrative embodiment of the principles of the present invention;

Fig. 2 is an enlarged perspective view of the armature reed and exhaust tube of the structure of Fig. 1;

Fig. 3 is a view, partially in section, of the armature reed and exhaust tube of the embodiment of Fig. 1, the armature reed being shown in its before- and after-alignment positions; and

Fig. 4 is a view of an apparatus adapted to be employed in aligning the armature reed of the illustrative embodiment shown in Fig. 1.

The structure shown in Fig. 1 comprises an envelope or housing **10**, which may be advantageously of glass, into one end of **10***a* of which are sealed pole-pieces **11** and **12**, the pieces **11** and **12** having contact elements **13** and **14**, respectively, secured thereto in any suitable manner.

Centrally positioned in the illustrated symmetrical structure is an armature reed **15**. The reed **15**, which may be advantageously made of a strip of high permeability materials, is shown (Fig. 2) as having a plurality of capillary grooves formed on its front and back surfaces. Furthermore, as clearly shown in Fig. 2, the lower part of the reed **15** is looped.

It is noted that the reed may, for example, be formed to be lenticular in cross section rather than as shown in Fig. 2.

Extending through and sealed in the other or lower end **10***b* of the switch housing **10** is an exhaust tube **20**, a portion **20***a* of which is flared. The flared portion **20***a*

serves as a repository for a quantity of mercury **21**. The end **15***a* of the looped part of the reed **15** is secured, as by welding, to the outer surface of the flared portion **20***a*, a substantial length of the looped part thereby extending into the mercury **21**.

The looped configuration is a highly desirable one, for, among other advantages, it imparts enough resiliency to the relatively short armature reed to insure efficient switching operation thereof without the necessity for an auxiliary spring member.

Disposed about the housing **10** is an energizing coil **22**.

In the manufacture of switches of the type hereindescribed, difficulty has been encountered in accurately positioning the armature reeds thereof. Fig. 3 shows, in solid lines, an unaligned armature reed folded down into and secured to the flared portion of the exhaust tube **20**, the dotted lines thereof indicating the desired position of the member **15**.

The noted positioning problem led to the development of an efficient method for the alignment of armature reed assemblies. The method contemplates clamping the armature reed **15** and the exhaust tube **20** in their desired positions (Fig. 4) by means of conductive clamp members **40** and **41**. A voltage E is then applied between the clamps to heat the folded and unclamped reed portion **15***b* to a high temperature for a relatively short interval of time (1,000° C. for approximately two-tenths of a second was found suitable for aligning one illustrative switch structure).

After cooling and unclamping, the armature reed **15** remains in alignment with the exhaust tube **20**, with little or no springback to its before-clamping position.

A feature of this method resides in the fact that there is little heating, and thus no warping, of the clamps **40** and **41**. Also, a nickel coating, included on some illustrative armature reeds, is not deleteriously affected by the short heating cycle of this method.

Other aligning methods, e. g., heating the armature reed-exhaust tube assembly in a hydrogen atmosphere, have been found to necessitate a relatively extended heating cycle. Such a cycle commonly warps the clamp members and over-diffuses the nickel plating on the reeds.

The theory of operation of switches of the mercury contact type is well known to those skilled in this art and, accordingly, is not described here. Also, the description of the illustrated embodiment of this invention has been made rather brief, for, aside from the fully described folded armature reed and flared exhaust tube, the specific details of the illustrated unit are well known to workers in the mercury switch field. The specific details, which are clearly suggested in such disclosures as the above-identified Brown-Pollard patent, are not inextricably related to the novelty of the present invention.

In summary, an embodiment illustrative of the principles of this invention is a mercury switch unit wherein a limited quantity of mercury is maintained against free movement by a flared reservoir member to which a looped end of an armature reed is secured, the looped end extending into the mercury reservoir and thereby providing an appreciable amount of liquid damping for the resiliently mounted armature reed.

It is to be understood that the above-described arrangements are illustrative and not restrictive of the principles of this invention. Other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. A mercury switch unit having a housing, a tubular member extending through one end of said housing, the housed end of said member being flared, an armature reed comprising a looped end, a portion of said looped end being secured to the outer surface of said flared end so that a substantial length of said looped end extends into said flared end, a pool of mercury within said flared end, contact means disposed about the other end of said armature reed, and energizing means for moving said armature reed with respect to said contact means, whereby a highly reliable, resiliently mounted, effectively damped armature reed assembly is provided.

2. A switch unit comprising a housing, an exhaust tube extending through and sealed in one end of said housing, said exhaust tube having its housed end flared, a pool of mercury within said flared portion, an armature reed within said housing, said reed having one end thereof formed as a loop, said loop being secured to and extending into said flared end of said exhaust tube, contact means extending through and sealed in the other end of said housing for engagement with the other end of said armature reed, and energizing means surrounding said housing.

3. In combination, a housing having a flared container extending through and sealed in one end thereof, said flared container having a quantity of mercury therein, armature means within said housing, said armature means having a folded end portion secured to and extending into said flared mercury container, contact means extending through and sealed in the other end of said housing, and energizing means associated with said housing for moving the other end of said armature means into and out of contacting relation with said contact means.

4. A switch unit comprising a housing, a flared member within said housing, said flared member having therein a quantity of mercury, an armature reed within said housing, one end of said reed being formed as a folded loop, said folded loop being secured to said flared member so that a substantial length of said loop is immersed in said contained mercury, contact means for engagement with the other end of said armature reed, and energizing means disposed about said housing.

5. In combination, housing means, a member extending through and sealed in said housing means, the housed end of said member being flared, a pool of mercury contained within said flared section, armature reed means, one end of said armature reed means being looped, said looped end being secured to said flared section so that a substantial portion of said loop extends into said pool of mercury, contact means extending through and sealed in said housing means, and energizing means disposed about said housing means for moving the other end of said armature reed into and out of contact with said contact means.

6. A switch unit comprising a housing, a flared member within said housing, said flared member having therein a quantity of mercury, an armature reed within said housing, said armature reed having a fixed and a movable end, the fixed end including a loop portion, a substantial length of said loop portion being immersed in said contained mercury, contact means for engagement with the movable end of said armature reed, and energizing means disposed about said housing.

7. A switch unit comprising a housing, a reservoir member within said housing, said reservoir member having therein a quantity of mercury, an armature reed within said housing, said armature reed having a fixed and a movable end, the fixed end including a loop portion, a substantial length of said loop portion being immersed in said mercury, contact means for engagement with the movable end of said armature reed, and energizing means disposed about said housing.

References Cited in the file of this patent

UNITED STATES PATENTS

2,445,406	Pollard	July 20, 1948
2,508,508	Garvin	May 23, 1950
2,609,464	Brown et al.	Sept. 2, 1952
2,769,875	Brown et al.	Nov. 6, 1956

FOREIGN PATENTS

254,851	Great Britain	July 15, 1925