Oct. 6, 1959 H. WILHELM 2,907,846

POLARIZED SWITCHING CONTACT DEVICE

Filed Sept. 17, 1957

Fig. 1.

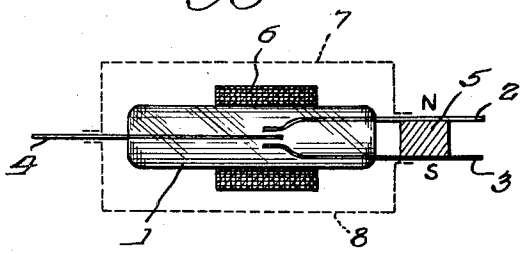


Fig. 2.

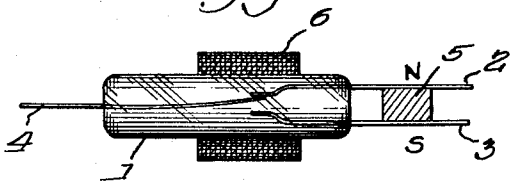


Fig. 3.

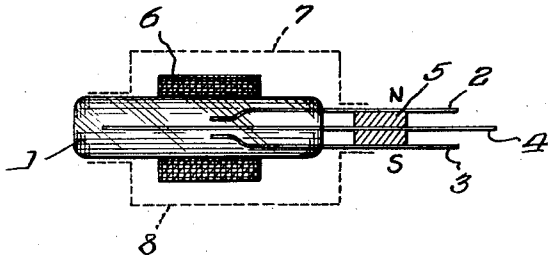
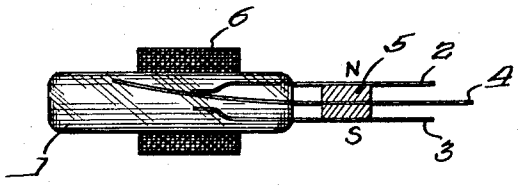


Fig. 4.



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United States Patent Office 2,907,846
Patented Oct. 6, 1959

2,907,846

POLARIZED SWITCHING CONTACT DEVICE

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Application September 17, 1957, Serial No. 684,612

8 Claims. (Cl. 200—93)

This invention is concerned with a polarized switching contact device for a polar contact relay and may be considered in the nature of an improvement on the polar contact employed in the balanced polar mercury contact relay described by J. T. L. Brown and C. E. Pollard in "The Bell System Technical Journal," November 1953, page 1393 FF.

The contact described in the above noted paper is enclosed in a sealed glass tube, and is polarized by means of two permanent magnets connected with the pole-pieces terminating outside of the glass tube. Permalloy plates connected with the outer poles of the magnets extend on the outside of the glass tube, forming magnetic return paths to the magnetically opposite end of the armature contact spring of the relay.

The present invention provides a structure which is greatly simplified as compared with the above indicated known arrangement. The contact according to the invention comprises a single permanent magnet disposed between the ends of the outer contact springs which project from the protective glass tube.

The various objects and features of the invention will appear from the following description which will be rendered with reference to the accompanying drawing.

Fig. 1 shows in schematic manner a symmetrically constructed contact comprising an inner switching spring which is in normal position disposed midway between two outer contact springs;

Fig. 2 illustrates a structure comprising an inner switching spring disposed in normal position in engagement with one of the outer contact springs; and

Figs. 3 and 4 show modifications, each utilizing an inner switching spring extending for most of its length between two outer springs; Fig. 3 showing a structure in which the inner switching spring is in normal position disposed midway of the outer springs, and Fig. 4 showing a structure in which the inner switching spring is normally in engagement with an outer spring.

Referring now to Fig. 1, numeral 1 indicates the protective glass tubing in which are enclosed the normal contact springs 2 and 3 and the switching contact spring 4. A permanent magnet 5 is disposed between the portions of the springs 2 and 3 which project from the glass tubing 1, the poles of such magnet being indicated by letters N and S. Numeral 6 indicates an energizing coil surrounding the glass tubing 1. Numerals 7 and 8 are magnetic return paths, which are not absolutely necessary and the function of which will presently be described.

In the normal position of the parts, as shown in Fig. 1, the outer contact springs 2 and 3 are permeated by the flux from the permanent magnet 5, the magnetic circuit extending over the two air gaps between the inner ends of the outer contact springs 2 and 3 and the inner end of the switching spring 4.

It is of particular significance that there are outside of these air gaps which constitute jointly the working air gap, no other air gaps in the magnetic circuit. The magnetic circuit is very short, embracing, as it does, only those parts of the structure which are directly involved in the contact making and breaking operation. This feature simplifies construction and provides a considerable advantage over and above the initially mentioned known structure, in which the permanent magnetic flux extends over a much longer path containing necessarily several air gaps in addition to the effective working air gap. As compared with this situation, the magnetic circuit according to the invention, provides the least possible magnetic impedance and little scattering.

Depending upon the adjustment and stiffness of the contact springs, particularly the switching spring 4, and upon the dimensioning of the permanent magnet 5, the switching contact spring 4 may be normally disposed either in the intermediate position, as shown in Fig. 1, or in engagement with one of the normal springs, as shown in Fig. 2.

Two cases must be considered in connection with Fig. 2, assuming symmetric arrangement of the paths. The contact spring 4 may be normally in engagement with either one or the other spring 2 or 3, and spring 4 may remain in the actual position into which it may have been operated. Depending upon adjustment, one or the other position may be the preferred one, and the spring 4 will return to such preferred position after each operative actuation.

In the case of a structure according to Fig. 1, when the actuating coil or winding 6 is energized, there will be superimposed an actuating flux upon the permanent flux supplied by the permanent magnet 5 and flowing across the working air gap, and such superimposed flux will strengthen the field in one part of the air gap while weakening it in the other part, or vice versa. The force of attraction between the switching spring 4 and one of the outer springs will increase while decreasing in the direction of the other outer spring, resulting in contact-making engagement of the inner switching spring with the outer spring as determined by the increase of the attractive force. Upon disconnection of current from the actuating coil 6 and consequent deenergization thereof, the switching spring 4 will return into its normal intermediate position midway of the outer relatively stationary normal springs 2 and 3.

However, in the case of a structure according to Fig. 2, assuming symmetric arrangement of the parts, and with the movable switching spring 4 normally in engagement with one of the stationary springs, the switching spring will remain in the position into which it had been actuated, and will be placed into alternate position by oppositely directed flux. In the case of a non-symmetric arrangement of parts, in which the switching spring 4 returns always into its initial position, there will be required an actuating flux of predetermined direction or polarization, in order to place the switching spring for the duration of such flux into the desired alternate contact-making position.

In order to utilize as fully as possible the effectiveness of the actuating flux generated by the coil 6, there is provided, as shown in Fig. 1, a magnetic return path extending over magnetically conductive strips 7 and 8 indicated in dash lines, these strips extending from the outer end of the switching spring 4 to the outer ends of the springs 2 and 3 and interconnecting the ends of the magnetic actuating circuit. The symmetric disposition of the strips 7 and 8 effects symmetric application of the actuating flux.

The magnetic return path may also be formed by a tube surrounding the entire contact device and forming at the same time a kind of protective cap. Adjusting

means may be suitably provided in the magnetic return path, for example, a variable air gap, so as to adjust the symmetry with the desired accuracy. The magnetic return path may also be active on one side, that is, non-symmetric, thus providing for the possibility to make the actuation of the switching spring **4** in one or the other direction dependent upon an actuating flux of respectively different strengths.

In the embodiments according to Figs. 3 and 4, the stationary portion of the switching spring **4** extends through the permanent magnet **5**, thus leaving the glass tubing at the same end as the two outer contact springs **2** and **3**. Since the switching spring **4** is in this manner disposed in the magnetic circuit controlled by the permanent magnet **5**, the magnetic forces governing the normal contact position will be much greater than in the structure according to Fig. 1. The corresponding embodiment is for this reason, and assuming a symmetrical construction, particularly adapted to operate as a switch-over relay with the switching contact spring **4** in a normal position in engagement with one of the relatively stationary contact springs, as shown in Fig. 4.

It is, of course, clear that non-symmetric setting may be provided by proper adjustment, to cause the switching spring **4** to assume a preferred position in engagement with a predetermined normal spring on one side thereof, or to assume a central position midway between the normal springs, as illustrated in Fig. 3.

The magnetic return path for amplifying the effectiveness of the activating flux may be provided in Figs. 3 and 4 analogous to Fig. 1. It is, of course, likewise possible, to provide for such return flux only on one side so as to produce non-symmetric actuating fluxes.

Changes may be made within the scope and spirit of the appended claims.

I claim:

1. A polarized contact device comprising a protective tubing, contact springs enclosed within said tubing and comprising an inner contact switching spring and two outer springs, each having a relatively movable inner portion and a relatively stationary portion, a permanent magnet disposed between the relatively stationary portions of said outer springs, the free ends of which project from said tubing to the outside, said permanent magnet being relatively stationary with respect to said tubing and spacing said outer springs apart by an amount corresponding to the spacing therebetween at the points of entry thereof into said protective tubing with the relatively movable portions of such springs disposed inwardly from said magnet, the inner ends of said outer contact springs being disposed in relatively close proximity to the inner end of the inner contact switching spring, said latter spacing between said contact springs providing the working air gap therebetween.

2. A polarized contact device comprising a protective tubing, contact springs enclosed within said tubing and comprising an inner contact switching spring and two outer springs, a permanent magnet disposed between said outer springs at the ends thereof which project from said tubing to the outside, said permanent magnet spacing said outer springs apart by an amount corresponding to the spacing therebetween at the points of entry thereof into said protective tubing, the inner ends of said outer contact springs being disposed in relatively close proximity to the inner end of the inner contact switching spring, said latter spacing between said contact springs providing the working air gap therebetween, said inner contact switching spring including a relatively stationary portion, said relatively stationary portion extending through said permanent magnet.

3. A device according to claim 1, comprising means for producing a magnetic flux for actuating said contact switching spring, and means forming a magnetic return path and interconnecting the ends of said magnetic actuating flux.

4. A device according to claim 2, comprising means for producing am agnetic flux for actuating said contact switching spring, and means forming a magnetic return path and interconnecting the ends of said magnetic actuating flux.

5. A device according to claim 3, wherein said magnetic return path extends symmetrically with respect to said contact springs.

6. A device according to claim 4, wherein said magnetic return path extends symmetrically with respect to said contact springs.

7. A device according to claim 3, wherein said magnetic return path extends solely along one side of said contact springs.

8. A device according to claim 4, wherein said magnetic return path extends solely along one side of said contact springs.

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