

March 29, 1966

W. B. ELLWOOD
METHOD OF ASSEMBLING AND MAGNETICALLY
ADJUSTING A REED SWITCH

3,242,557

Filed June 29, 1962

2 Sheets-Sheet 1

FIG. 1

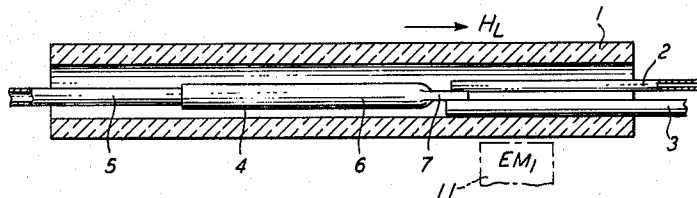


FIG. 2

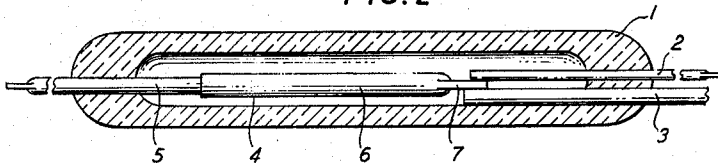
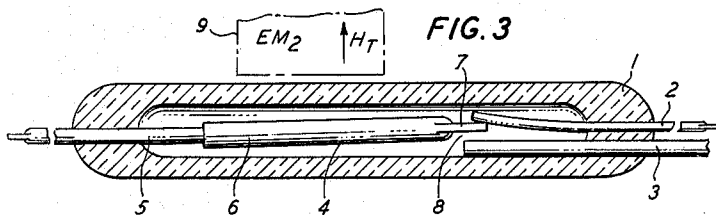


FIG. 3



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FIG. 4

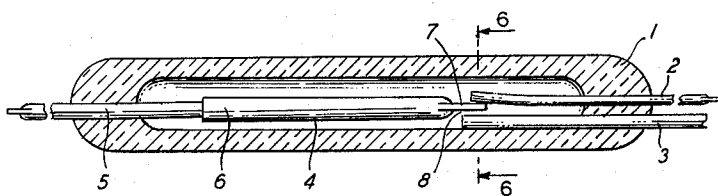


FIG. 5

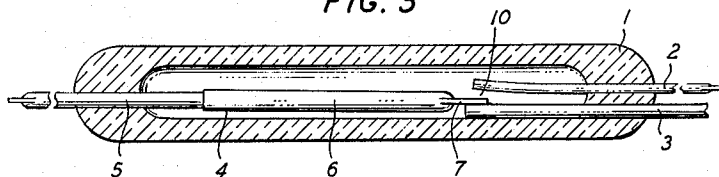
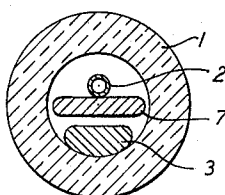


FIG. 6



INVENTOR
W. B. ELLWOOD
BY
John C. Morris
ATTORNEY

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METHOD OF ASSEMBLING AND MAGNETICALLY ADJUSTING A REED SWITCH

Walter B. Ellwood, New York, N.Y., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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This invention relates to circuit controlling devices and, more particularly, to sealed reed type switches or relays of the so-called "transfer" type.

The switches of interest usually conform to one or the other of two basic configurations. The first comprises a pair of parallel contacts wherein one serves as a "front contact" and the other as a "back contact" with both members sealed in one end of an encapsulating glass tube. Another flexible contact, commonly called the "swinger," is fastened in the other end of the encapsulating glass tube and positioned in such a manner that it overlaps and operates between the front and back contacts.

The second basic configuration comprises a pair of parallel contacts sealed in the same end of an encapsulated glass tube wherein one serves as a swinger and the other as a front or back contact. A third contact is sealed in the other end of the encapsulating glass tube parallel to and between the swinger and the wall of the tube. This contact serves as a back or front contact as required.

In general, the swinger and the front contact are made of a magnetic material, but the back contact may be magnetic or nonmagnetic as desired. In order to establish a transfer switching function, the swinger is biased in some fashion to a position against the back contact. As a result, application of an operative flux axially through the switch assembly will cause the swinger to move from its position against the back contact into a new position against the front contact, thereby producing the desired switching function.

Proper operation of the transfer device depends upon maintaining a firm contact between the swinger and the back contact. However, preset contact arrangements are usually adversely and almost always uncontrollably affected by the heat applied in sealing the encapsulating tube. The foregoing has proved to be a recurring problem. Various attempts to provide such a firm contact have been attempted, but none have proved to be satisfactory. The solution to the problem, however, lies in adjusting the forces between the contacts after the sealing operation.

One general object of this invention is to improve the performance characteristics of reed type transfer switches or relays.

Another general object of the invention is to simplify the structure and facilitate the manufacture of such switches or relays.

It is a specific object of the invention to provide a compact reed type switch or relay of economical construction that has positive switching action and which is insensitive to shock and vibration.

It is another specific object of the invention to provide a process whereby a reed type switch or relay can be assembled, positioned, sealed and adjusted in that order in a fast, convenient and inexpensive manner.

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It is still another specific object of this invention to provide a sealed contact transfer switch that is small, reliable, sensitive and fast operating.

In one illustrative embodiment of this invention, a transfer switch comprises a plurality of contact members. A first member serves as a front contact that is magnetic, fixed, substantially rigid, and is fastened at one end of an encapsulating tube, while another or second member, fastened parallel to and at the same end of the tube as the aforesaid member, serves as a back contact that is magnetic, fixed and moderately compliant. Still another or third member serves as a swinger that is magnetic, fixed, less compliant than the back contact, and is fastened in the opposite end of the encapsulating tube from the other contact members. The comparison involving "compliant" in the foregoing relates to deformation of the respective members. For a given common deflection the swinger member will permanently deform although the back contact member need not. The swinger is arranged to extend between the fixed front and back contact members in such a manner that it makes electrical connection with the back contact while establishing an air gap between itself and the front contact. Further, the swinger may comprise a bendable and a rigid part joined together. The elements recited are assembled in cooperative relationship within the hermetically sealed tube for insertion in an operating field. The tube is usually glass, but is not restricted thereto.

These and other features of the invention will be more fully apprehended from the following detailed description taken in conjunction with the appended drawing, in which:

FIGS. 1, 2 and 3 disclose the steps in assembling the embodiment of FIGS. 4 and 5;

FIG. 4 discloses an illustrative embodiment of the assembled invention in the unoperated state;

FIG. 5 discloses an illustrative embodiment of the assembled invention in the operated state; and

FIG. 6 is a section view from FIG. 4 along the line 6—6 showing preferred configurations of the operative contacts.

Referring to FIG. 1, the first step in the process leading to the final assembly of this invention comprises positioning the front contact 3 and back contact 2 with the swinger assembly 4 inserted therebetween in an unsealed encapsulating glass tube 1 with the contact 3 in a position against one wall of the tube. The elements are then held firmly against the glass tube by the application of a holding force induced by a flux emanating orthogonally from a magnet 11 and in alignment with each other by the application of another force induced by an axial flux H_L from a suitable source, until the tube ends are sealed about the positioned contact members.

In this embodiment, the elements are held in position by the holding forces manifested by virtue of their magnetic characteristics. However, the back contact 2 need not be magnetic. It is hollow, so a magnetic wire inserted through a hollow nonmagnetic material will accomplish the same result. Further, although the holding forces in this embodiment may conveniently be induced magnetically, the generation of such forces need not be limited thereto.

FIG. 1 further discloses an advantageous configuration for the contacting components. The back contact 2 is made from a hollow tube of suitable magnetic material,

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although it need not be tubular, magnetic or hollow. The hollow tube permits, if desired, filling of the enclosing tube with a suitable gas or evacuation of air after assembly. The back contact 2, in the illustrated embodiment, has approximately one third the cross section of the swinger 6. The front contact 3 is a rod of suitable magnetic material and may be plated with contact metal if necessary. The swinger contact 7, is a part of the swinger assembly 4. The swinger assembly 4 can be made up of three parts as shown: a support member 5 which is magnetic, cylindrical and hollow in the illustrative embodiment, although it need not be magnetic, cylindrical nor hollow, the swinger 6 made from a suitable magnetic material, cylindrically shaped in the illustrative embodiment, and of a cross section substantially greater than support member 5, and a swinger contact 7 formed by flattening the end of swinger 6. The support member is hollow to facilitate air evacuation or flushing, if desired, and allow, or not, the filling of the enclosing tube with a gas. The back contact 2 is chosen and positioned so that the portion inside the glass tube will have a greater compliance than the portion of the support member 5 inside the glass tube.

Reference to FIG. 2 shows the assembled contacting components permanently sealed in the encapsulating tube. The assembling process from FIG. 1 serves to fix the swinger contact 7 against the front contact 3 in the position these contacts will assume when the switch is operated. At this point there is no air gap between the swinger contact 7 and the front contact 3, or between the swinger contact 7 and the back contact 2. However, if so desired, an initial air gap may exist between the swinger contact 7 and the front contact 3 or the back contact 2.

FIG. 3 shows the process whereby an operating air gap is established between the swinger and the front contact while at the same time establishing a firm contact between the swinger and the back contact. This is accomplished by applying a force induced by an external magnetic flux from a magnet 9 in such a manner that the swinger assembly 4 and back contact 2 are moved in a direction away from the front contact, a direction opposite to that in which the swinger assembly 4 will normally operate. As the force induced by the flux from the magnet 9 acts primarily on the swinger 6, the back contact 2 is caused to move in the same direction as a result of swinger movement. Where, during assembly, an initial air gap exists between the swinger contact 7 and the back contact 2 or the front contact 3, the materials and cross section of the support member 5 and the back contact 2 may be chosen in such a manner that the application of the force induced by the external flux from the magnet 9 will cause the support member 5, but not the back contact 2, to be deflected beyond its elastic limit. However, in the embodiment disclosed in FIGS. 4 and 5, the back contact 2 is deflected beyond its elastic limit as well; although not as severely as the support member 5. As a result, the support member 5 assumes a positive "set" and a nonstatic energy system is created between the swinger assembly 4 and the back contact 2 at the instant of release of the force induced by flux from the magnet 9. However, when the energy system becomes static, the back contact 2 will exhibit a moment acting against the "set" in the support member 5 manifested as a firm connection between the contacts 2 and 7.

Reference to FIG. 4 shows the swinger assembly 4 and the back contact 2 in the position of static equilibrium. The moment induced in the support member 5 by the "set" is just offset by the opposite moment in the back contact 2. As a result, the swinger contact 7 and the back contact 2 make a firm electrical connection, and the required operating air gap 8 is established.

The operating of the switch will now be described with reference to FIG. 5. FIG. 5 shows the switch in the operated state. The application of an operating flux axially along the swinger assembly 4 and through the ma-

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nor magnetic path of the front contact 3 develops an unbalanced force between the swinger contact 7 and the front contact 3. When the operative flux creates a force large enough, and, since the front contact 3 is substantially rigid, the developed force acts in concert with the moment from the back contact 2 to overcome the static moment engendered in the support member 5 from the "set," plus the force developed between the swinger contact 7 and the minor magnetic path of the back contact 2. The resultant unbalanced force induces movement of the swinger assembly 4 to a position of electrical connection against the front contact 3. Thus, it is seen that the swinger assembly 4 goes from its position of static equilibrium in electrical connection against back contact 2 first to a point where the back contact 2 assumes static equilibrium, and then continues on to a position of static equilibrium against the front contact 3, thereby creating an air gap 10 to complete the transfer switching function. Removal of the operating flux allows the permanently induced moment in the support member 5 to reassert itself and return the swinger assembly 4 and back contact 2 to a position of electrical contact in static equilibrium as shown in FIG. 4.

In summary, there has been disclosed herein a reed transfer switch employing a novel means to establish a firm, positive connection between the swinger and the back contact in the unoperated condition. The switch is of small size and readily fabricated in manufacture. The operation of the switch is improved in that it is positive and is moderately insensitive to shock. Also the sensitivity of the switch is amenable to control during and after manufacture.

It is to be understood that the above-described structure is illustrative of the application of the principles of this invention. Numerous other modifications of the structure may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. The method of making a sealed reed switch that comprises assembling in a tube of insulation two substantially parallel, fixed reeds so that they extend beyond one end of the tube and a bendable reed swinger of magnetic material so that it extends beyond the other end of the tube, the tip of the swinger located between the tips of the fixed reeds, holding the reeds in place with one fixed reed snugly against the tube wall, sealing both ends of the tube to maintain the position of said reeds, applying a magnetic force to deflect the swinger and the other fixed reed away from the one fixed reed, and then relaxing the force, the relative elastic properties of the deflected reeds being such that the swinger reed takes a permanent set and the other fixed reed does not, thus leaving the swinger spaced from the one fixed reed and firmly pressed against the other.

2. The method of assembling a sealed contact reed transfer switch comprising the steps of:

inserting one end of a first, a second, and a flexible third reed member in the unsealed ends of an encapsulating tube in such a manner that all the members are parallel and the inserted end of the third reed member is positioned between the inserted ends of the first and second reed members, the inserted ends of said first and second reed members being electrically conducting front and back contacts, respectively, of which at least one is made of magnetic material, and the inserted end of said third reed member being an electrically conducting swinger made of magnetic material having a portion of its length less compliant than the back contact;

sealing the ends of said encapsulating tube about the protruding ends of the first, second and third reed members;

and thereafter magnetically deflecting the swinger against the back contact until the portion of said swinger that is less compliant than said back contact

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is strained beyond its elastic limit whereby the
swinger is thereafter urged against the back contact
and away from the front contact.

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WHITMORE A. WILTZ, *Primary Examiner*.
B. A. GILHEANY, B. DOBECK, R. W. CHURCH,
Examiners.