

May 13, 1958

W. B. ELLWOOD

2,834,848

ELECTRIC SWITCH

Filed Sept. 2, 1955

2 Sheets-Sheet 1

FIG. 1

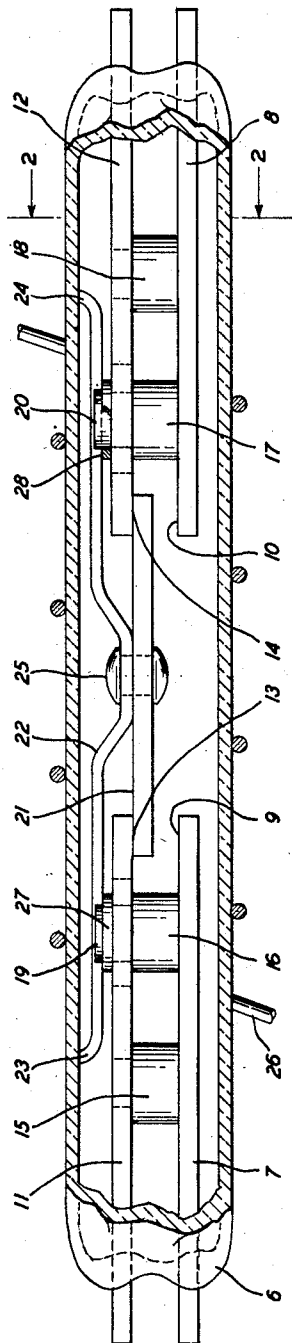


FIG. 2

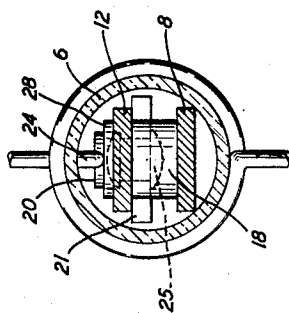
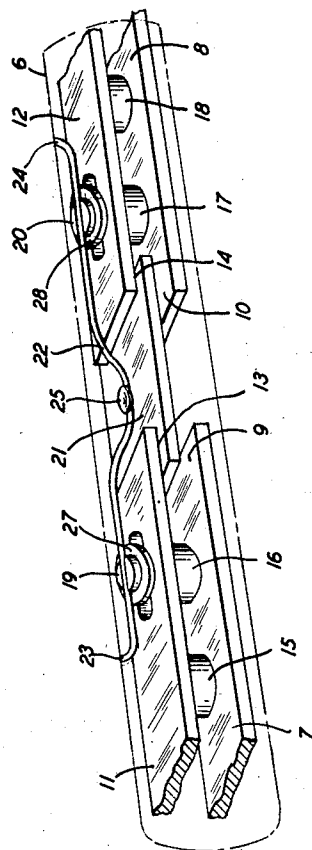


FIG. 3



INVENTOR
W. B. ELLWOOD
BY *W. B. Ellwood*

ATTORNEY

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W. B. ELLWOOD

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FIG. 4

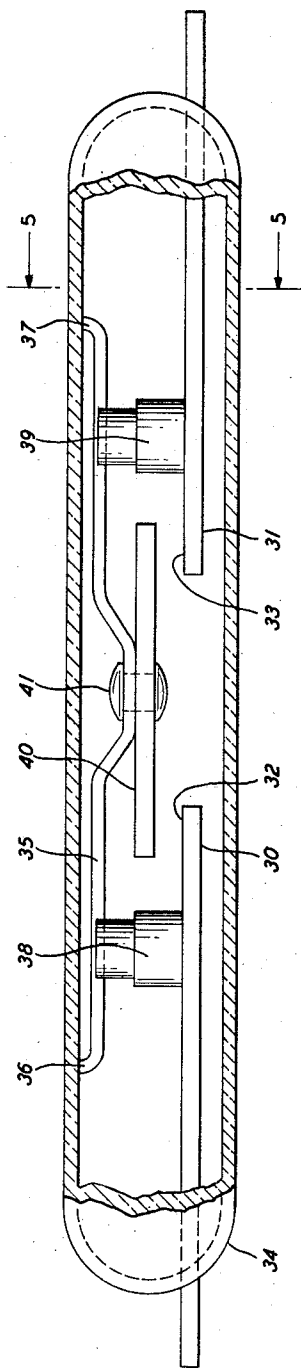
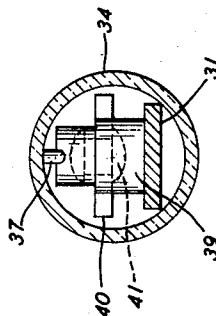


FIG. 5



INVENTOR
W. B. ELLWOOD
BY *Interner*
ATTORNEY

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2,834,848

ELECTRIC 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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12 Claims. (Cl. 200—87)

This invention relates to circuit controlling devices and, more particularly, to such devices of the type commonly referred to as reed switches.

There has been developed a glass-sealed reed device acting as the contact means for a relay which may be placed axially within an energizing coil where it becomes extremely rapid in action and very sensitive. Such a device is disclosed in Patent 2,289,830, granted July 14, 1942, to W. B. Ellwood. Heretofore, primarily because of the effect of the sealing operation on the positioning of the reed contact members, it has been often necessary to realign these elements after assembly, and this has been difficult to accomplish due to their inaccessibility after the closing of the seal. Also, special assembly jigs have been necessary to hold the various component parts of the switch in position during the sealing operation. Furthermore, and this has been of special moment in cases where the switches have been employed to control circuits for inductive loads, the arc developed across the contact tips has been unduly prolonged because of the small contact gap. The prolonged arc has frequently caused the contact members to stick together.

One general object of this invention is to improve circuit controlling devices of the type wherein enclosed contact members are energized by means external to the enclosure to open or close a conductive path.

More specifically, objects of this invention include to enable inner parts of an enclosed switch to be completely assembled and aligned prior to any required envelope or enclosure sealing operation without the necessity for external jigs, etc., to reduce arcing upon operation of the contact member of such a switch and to minimize contact sticking.

Additional objects of this invention are to facilitate the fabrication of the enclosed type of switch, to simplify the structure thereof and to reduce the size of circuit controlling devices capable of performing multiple functions, for example, make and break of plural circuits or transfer.

In one illustrative embodiment of this invention a circuit controlling device comprises an enclosure housing, a pair of contact members, a movable bridging armature controlled by a spring to bridge these members and support bushings to position the various component parts of the assembly in fixed spaced relation to each other.

In accordance with one feature of this invention, contact members are held against one side of an enclosure or envelope and a spring support is held against the other side of the envelope by means of ceramic bushings, which are so positioned as to accurately determine the contact gap. The contact members may be moved lengthwise along the envelope prior to sealing in order to adjust the amount of overlap between these members and the armature.

In accordance with another feature of this invention, the aforementioned armature is positioned so that it will bridge the gap between the contact members when an encircling winding is energized or when some other means

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is made effective to control the members. The design of the switch is such that by the use of a bridging armature of this nature the arc across the contact tips can be greatly reduced without materially increasing the size of the assembly. Furthermore, the full floating characteristic of such an armature provides leverage to break sticking contacts.

In accordance with a further feature of this invention the armature is supported by a preformed and pretensioned wire or reed spring, which does not constitute a part of the electrical circuit. The spring rests against the inner wall of the switch enclosure and therefore does not exert any force on any required seal. Consequently, the maintenance of the contact pressure is independent of the strength of such a seal, and the spring design further reduces contact sticking upon release of the armature.

The invention may be embodied in switches for performing a variety of different functions, such as to make or break circuits, to control a plurality of circuits concomitantly or to effect transfer between circuits. Further, one or more magnets may be associated with the armature actuating system to provide polarized operation, or the armature may be operated by electrostatic means.

The invention and the features thereof will be understood more clearly and fully from the following detailed description with reference to the accompanying drawings, in which:

Fig. 1 is a longitudinal view of a transfer switch illustrative of one embodiment of the invention with part of the glass envelope broken away;

Fig. 2 is a sectional view taken along the line 2—2 in Fig. 1;

Fig. 3 is a perspective view of salient portions of the transfer switch shown in Fig. 1;

Fig. 4 is a longitudinal view of a reed switch illustrative of another embodiment of the invention with part of the glass envelope broken away; and

Fig. 5 is a sectional view taken along the line 5—5 in Fig. 4.

Referring to Fig. 1 of the drawings, there is shown broadly the preferred structure and assembly of the invention. The elements of the switch are enclosed in an envelope 6 made of a vitreous material such as glass. An inert gas such as helium or nitrogen may be inserted in this enclosure for the purpose of further reducing arcing across the contact tips, but this is by no means essential for successful operation of the invention. Inserted in the envelope 6 are two front contact members 7 and 8 having contact areas 9 and 10, respectively. These contact members may be formed of any suitable material of high electrical conductivity, but inasmuch as the switch is operated by an external magnetic force it is important that they be made magnetic. Of course, in the event that the device is operated by some means other than magnetic, the only requirement is that these parts be constructed of a suitable material for that application. The contact members 7 and 8 are positioned such that they rest against the inner wall of the envelope 6 (see Fig. 2), and they are supported thereby during assembly without the necessity for external jigs, fixtures, etc.

Supported in spaced relation to front contact members 7 and 8 are back contact members 11 and 12 having contact areas 13 and 14, respectively. These back contact members are similar in construction to front contact members 7 and 8 except that they are made from material having non-magnetic properties in the region of contact areas 13 and 14 in order to insure successful operation of the switch. They are supported by four non-conductive bushings 15, 16, 17 and 18, which are made preferably of a ceramic or other inorganic material in order to elim-

inate the presence of any undesirable vapors in the envelope 6, such as are frequently found when certain organic materials are used. These bushings rest against front contact members 7 and 8 and serve both as supports for back contact members 11 and 12 and as spacing means to accurately predetermine the distance between the front and back contacts of the switch. In this manner the contact gap is unaffected by any expansion or contraction of the glass envelope 6 when the seal is made but is solely a function of the dimensions of the bushings. Although cylindrical bushings and planar contact areas have been illustrated, it is apparent that these structural details may be varied considerably in size, shape or configuration and still come within the scope and spirit of the invention.

As shown in Fig. 3, bushings 16 and 17 have projecting portions 19 and 20, respectively, which extend through openings in back contact members 11 and 12. These openings may extend in a longitudinal direction so that after assembly the back contact members may be adjusted in order to accurately determine the dimensions of contact areas 13 and 14 prior to the sealing operation. Similarly, the dimensions of contact areas 9 and 10 may be predetermined by sliding front contact members 7 and 8 in a longitudinal direction along the inner wall of the envelope 6. In this manner the amount of overlap between the various contact members and a movable bridging armature or member or element 21, which in effect will constitute the contact areas previously referred to, may be accurately adjusted in accordance with various circuit requirements. This bridging armature or member or element 21 will be subsequently described.

Affixed to projecting portions 19 and 20 are two ceramic washers 27 and 28, which operate to hold back contact members 11 and 12 in position prior to the sealing operation. Although circular washers have been illustrated, it is apparent that they may be of any desired configuration as long as they fulfill the purpose described above. For example, additional spacing bushings may be substituted therefore and still come within the spirit and scope of the invention.

Supported by the projecting portions 19 and 20 of bushings 16 and 17 is a pretensioned symmetrical spring 22. In the preferred embodiment the spring rests against the washers 27 and 28 in longitudinal grooves or slots in projecting portions 19 and 20; but, in order to reduce manufacturing costs, these grooves may be omitted without departing from the scope and spirit of the invention. Furthermore, in switches requiring only a moderate pretensioning of the spring 22, the washers 27 and 28 may be eliminated entirely since the weight of back contact members 11 and 12 will be sufficient to hold them in position prior to sealing. The spring 22 has curved end portions 23 and 24 which are positioned against the inner wall of the envelope 6. These end portions exert a pressure on the envelope due to the tension in the spring; and, consequently, all the component parts of the invention are held in position, thereby greatly facilitating the sealing operation. Since the spring 22 does not form part of the electrical circuit of the switch, it may be fabricated from a highly resilient and durable spring material without regard for its electrical properties. Beryllium copper or similar precipitation hardening alloy is recommended for this purpose since it can be preformed and hardened in a suitable mold prior to insertion in the switch envelope.

Attached to the center portion of spring 22 by means of a rivet or spot-weld 25 is a magnetic bridging armature 21. In its normal position (as shown) the tension in the spring holds the armature against contact areas 13 and 14 of back contact members 11 and 12, while in its actuated position the armature comes in contact with contact areas 9 and 10 of front contact members 7 and 8. Both the front and back contact pressures are solely a function of the amount of tension in the spring 22 and the forces effective across the air gaps, and,

consequently, these pressures are entirely independent of the strength of the glass seal. Since the spring may be accurately pretensioned prior to sealing, it is no longer necessary to make adjustments after the seal has been closed. By using a bridging armature design of this nature, the double series break and make characteristics operate to greatly reduce contact arcing, while the full-floating characteristic provides leverage to break sticking contacts when the switch is actuated. Although the armature 21 has been illustrated as a flat bar having a rectangular cross section, various other designs are readily adaptable for use in the invention. For example, it might be advantageous for the purpose of reducing sensitivity to dirt, etc., to make the armature of two or more parallel round rods, thereby increasing the reliability and life of the over-all device.

Other details will be understood from the following description of the mode of operation of the device.

When a magnetic field is applied to the switch of Fig. 1, such as by an energizing winding 26 encircling all or part of the envelope 6, there is a force of attraction between the bridging armature 21 and the front contact members 7 and 8. This force causes the armature 21 to overcome the tension in the spring 22 and to break contact with the back contact members 11 and 12. Because of the double series contact break design, any force exerted on the bridging armature will produce a moment about one of the back contact members that will tend to overcome sticking contacts.

As the armature 21 moves away from back contact members 11 and 12, it comes into contact with front contact members 7 and 8, thereby completing the transfer. When the magnetizing current is removed, the natural resiliency of the spring 22 will cause the armature 21 to break contact with front contact members 7 and 8 and to come into contact with back contact members 11 and 12, thereby returning the switch to its normal position. In a manner similar to that described previously, any sticking between the bridging armature 21 and the front contact members 7 and 8 will be greatly reduced by the moment created by the force of the spring 22 when the magnetic field is released.

In Figs. 4 and 5 there is shown a switch embodying the features of the invention designed to open and close a single circuit. Two magnetic contact members 30 and 31 having contact areas 32 and 33, respectively, are positioned against the inner wall of a glass enclosure 34; and a symmetrical wire spring 35, of a construction similar to that hereinbefore described, is positioned with its curved ends 36 and 37 resting against the opposite inner wall of enclosure 34. Two ceramic bushings 38 and 39 separate the contact members 30 and 31 from the spring 35, so that the various switch components are held rigidly in position prior to sealing. Although the only essential requirement for these bushings is that they be of non-conductive material, they have been illustrated as being substantially the same as bushings 17 and 18 in Fig. 1 in order to maintain a certain amount of uniformity and hence interchangeability of parts between the two embodiments of the invention. A magnetic bridging armature 40 is supported by the spring 35 by means of rivet 41, and in its normal position it remains out of contact with the contact areas 32 and 33 of contact members 30 and 31.

When a magnetizing current is applied to a coil encompassing the envelope 34 (see Fig. 1), there is an attractive force between the ends of the armature 40 and the contact members 30 and 31. This force causes the armature 40 to overcome the tension in the spring 35 and to come into contact with contact areas 32 and 33. When the energizing current is released, the tension in the spring 35 will cause the armature 40 to return to its normal position. It will be noted that if the spring 35 is properly pretensioned the magnitude of the force necessary to actuate the switch is very small, and, consequently,

the device is highly sensitive in operation. Furthermore, due to the reduction in contact arcing and the rapidity with which sticking contacts may be broken (as pointed out previously), the switch is extremely reliable.

Although specific embodiments of the invention have been shown and described, it will be understood that they are but illustrative and that various modifications may be made thereon without departing from the scope and spirit of the invention.

What is claimed is:

1. A switch comprising a switch envelope, a plurality of contact members enclosed in said envelope and having contact areas, a bridging element movably supported within said envelope and arranged when moved to bridge contact areas of certain of said members, support means for said bridging element comprising a spring, and spacing means within said envelope for positioning said contact members in spaced juxtaposed relation to each other and to said spring and for positioning a portion of said spring against the inner wall of said envelope.

2. A switch comprising a switch envelope, a plurality of adjustable contact members enclosed in said envelope and having contact areas, a bridging element movably supported within said envelope and arranged when moved to bridge contact areas of certain of said members, support means for said bridging element comprising a spring, and spacing means within said envelope for positioning said contact members in spaced juxtaposed relation to each other and to said spring and for positioning a portion of said spring against the inner wall of said envelope.

3. A switch comprising a switch envelope, a plurality of adjustable contact members enclosed in said envelope and having contact areas, a bridging element movably supported within said envelope and arranged when moved to bridge contact areas of certain of said members, support means for said bridging element comprising a symmetrical spring attached to said bridging element and having the symmetrical extremities thereof positioned against the inner wall of said envelope, and spacing means within said envelope for positioning said contact members in spaced juxtaposed relation to each other and to said spring and for positioning said extremities of said spring against the inner wall of said envelope.

4. A switch comprising a switch envelope, a plurality of adjustable contact members enclosed in said envelope and having contact areas, a bridging element movably supported within said envelope and arranged when moved to bridge contact areas of certain of said members, support means for said bridging element comprising a spring attached to said bridging element and having a portion thereof positioned against the inner wall of said envelope, means comprising a nonconductive spacer for positioning one of said adjustable members in spaced relation to said spring, and means comprising a nonconductive spacer for positioning another of said adjustable members in spaced relation to said spring.

5. A switch comprising a switch envelope, a plurality of adjustable contact members enclosed in said envelope and having contact areas, a bridging element movably supported within said envelope and arranged when moved to bridge contact areas of certain of said members, support means for said bridging element comprising a symmetrical spring attached to said bridging element and having the symmetrical extremities thereof positioned against the inner wall of said envelope, means comprising a nonconductive spacer for positioning one of said adjustable members at one end of said envelope and along the inner wall thereof in spaced relation to said spring, and means comprising a nonconductive spacer for positioning another of said adjustable members at the other end of said envelope and along the inner wall thereof in spaced relation to said spring.

6. A switch comprising a switch envelope, a pair of magnetic members extending from either end of said envelope, a pair of nonmagnetic members positioned ad-

jacent said magnetic members in spaced juxtaposed relation thereto, a magnetic bridging element extending between said magnetic and said nonmagnetic members and in operative relation thereto, a support for said bridging element comprising a spring having a portion thereof positioned against the inner wall of said envelope, means comprising a nonconductive spacer for positioning said members at one end of said envelope in spaced substantially parallel relation to each other and to said spring, and means comprising a nonconductive spacer for positioning said members at the other end of said envelope in spaced substantially parallel relation to each other and to said spring.

7. A switch comprising a switch envelope, a pair of magnetic members extending from either end of said envelope, a pair of nonmagnetic members positioned adjacent said magnetic members in spaced juxtaposed relation thereto, one pair of said members being positioned along the inner wall of said envelope, a magnetic bridging element extending between said magnetic and said nonmagnetic members, said magnetic members being spaced apart by a distance slightly less than the length of said bridging element and said nonmagnetic members being spaced apart by a distance slightly less than the length of said bridging element, whereby each end of said bridging element is in position to engage one of said magnetic or nonmagnetic members, a support for said bridging element comprising a spring having a portion thereof positioned against the inner wall of said envelope, means comprising a nonconductive spacer for positioning said members at one end of said envelope in spaced substantially parallel relation to each other and to said spring, means comprising a nonconductive spacer for positioning said members at the other end of said envelope in spaced substantially parallel relation to each other and to said spring, and means for causing said element to move.

8. A switch comprising a switch envelope, a pair of adjustable magnetic members extending from either end of said envelope and positioned along the inner wall thereof, a pair of adjustable nonmagnetic members positioned above said magnetic members in spaced juxtaposed relation thereto, a magnetic bridging element extending between said magnetic members and said nonmagnetic members, said magnetic members being spaced apart by a distance slightly less than the length of said bridging element and said nonmagnetic members being spaced apart by a distance slightly less than the length of said bridging element, whereby each end of said bridging element is in position to engage one of said magnetic or nonmagnetic members, a support for said bridging element comprising a spring attached to said bridging element and having a portion thereof positioned against said inner wall of said envelope, means comprising nonconductive spacers for positioning said adjustable members at one end of said envelope in spaced substantially parallel relation to each other and to said spring, means comprising nonconductive spacers for positioning said adjustable members at the other end of said envelope in spaced substantially parallel relation to each other and to said spring, and means for causing said element to move.

9. A switch comprising a switch envelope, a pair of adjustable magnetic members extending from either end of said envelope, a pair of adjustable nonmagnetic members positioned adjacent said magnetic members in spaced juxtaposed relation thereto, one pair of said members being positioned along the inner wall of said envelope, a magnetic bridging element extending between said magnetic members and said nonmagnetic members, said magnetic members being spaced apart by a distance slightly less than the length of said bridging element and said nonmagnetic members being spaced apart by a distance slightly less than the length of said bridging element, whereby each end of said bridging element is in position to engage one of said magnetic or nonmagnetic

members, a support for said bridging element comprising a symmetrical spring attached to said bridging element and having the symmetrical extremities thereof positioned against the inner wall of said envelope, means comprising nonconductive spacers for positioning said adjustable members at one end of said envelope in spaced substantially parallel relation to each other and to said spring, means comprising nonconductive spacers for positioning said adjustable members at the other end of said envelope in spaced substantially parallel relation to each other and to said spring, and means for causing said element to move.

10. A switch comprising an elongated tubular sealed envelope, a pair of adjustable magnetic members extending from either end of said envelope and positioned along the inner wall thereof, a pair of adjustable nonmagnetic members positioned above said magnetic members in spaced juxtaposed relation thereto, a magnetic bridging element extending between said magnetic members and said nonmagnetic members, said magnetic members being spaced apart by a distance slightly less than the length of said bridging element and said nonmagnetic members being spaced apart by a distance slightly less than the length of said bridging element, whereby each end of said bridging element is in position to engage one of said magnetic or nonmagnetic members, a support for said bridging element comprising a symmetrical spring attached to said bridging element and having each end thereof positioned against the inner wall of said envelope, means comprising nonconductive spacers for positioning said adjustable members at one end of said envelope in spaced substantially parallel relation to each other and to said spring, means comprising nonconductive spacers for positioning said adjustable members at the other end of said envelope in spaced substantially parallel relation to each other and to said spring, and means for causing said element to move.

11. A switch assembly and an elongated cylindrical envelope for containing said assembly, said envelope having

a seal at one end, elongated, longitudinally spaced contact members within and in engagement with the side wall of the envelope, a bridging element spanning the space between said contact members and overlapping contact areas thereof, a bowed spring having an intermediate portion attached to the bridging element and end portions in contact with the side wall of the envelope, and insulators intermediate the ends of each contact member, each insulator embraced between a portion of the spring and one of the contact members, said spring being tensioned to bias the bridging element into one position and to secure the assembly within the envelope.

12. A switch assembly and an envelope for containing said assembly, spaced contact members within and in engagement with the side wall of the envelope, a bridging element spanning the space between said contact members and overlapping contact areas thereof, a spring having an intermediate portion attached to the bridging element and end portions in contact with the side wall of the envelope, and insulators embraced between a portion of the spring and one of the contact members, said spring being tensioned to bias the bridging element into one position and to secure the assembly within the envelope.

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