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ELECTROMAGNETIC SEALED REED PRINTED CIRCUIT SWITCHING ASSEMBLY

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Fig. 1

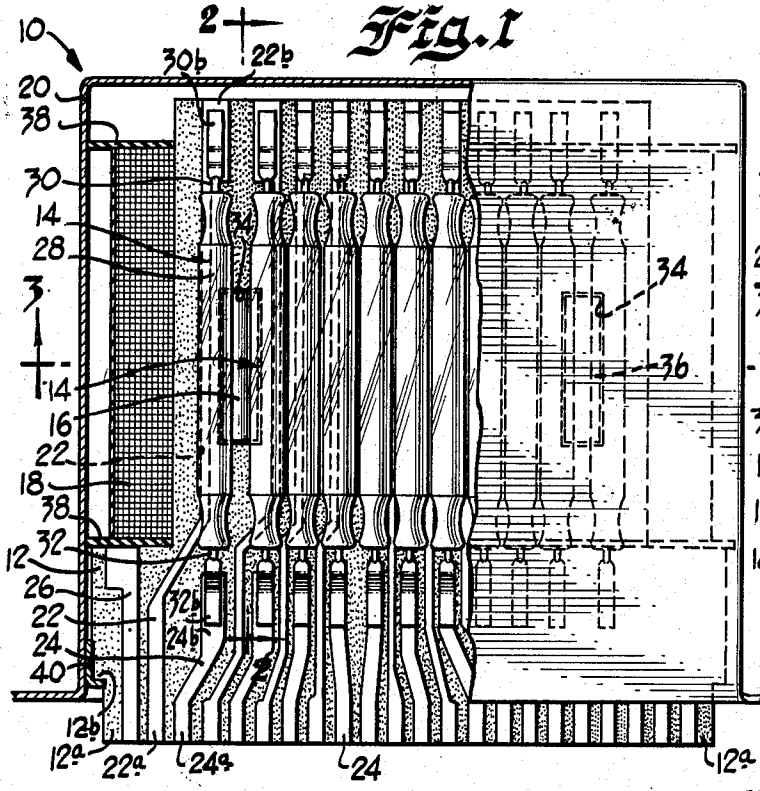
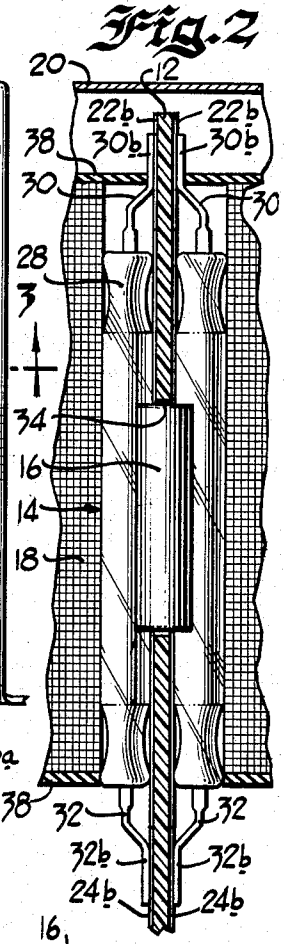


Fig. 2



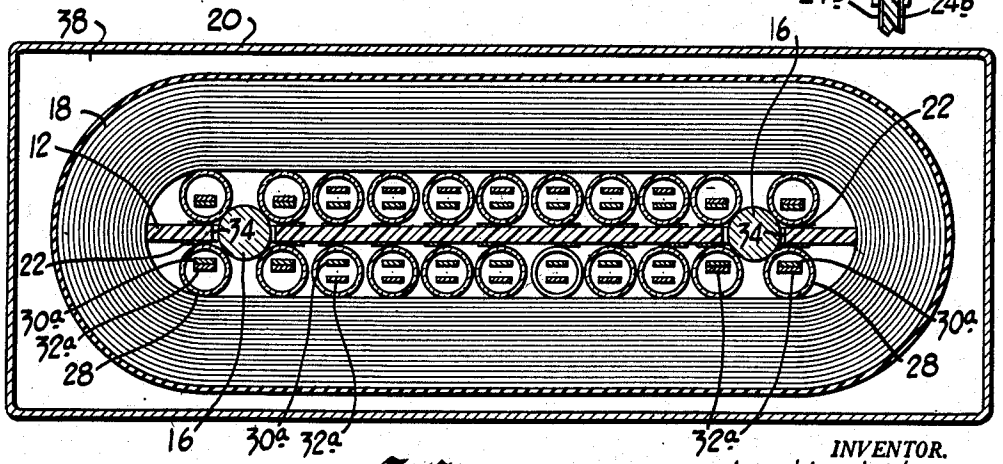


Fig. 3

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3,114,019 ELECTROMAGNETIC SEALED REED PRINTED CIRCUIT SWITCHING ASSEMBLY

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This invention relates to a switching assembly and, more particularly, to a switching assembly including a plurality of sealed switch units.

Because of the desirable operating characteristics of individual sealed switch units, such as mercury contact switches or "dry" type switches, various devices have been proposed for using a plurality of these sealed units to provide a switch having a switching capacity approximating that of conventional multiple contact electromagnetic relays. These electromagnetic relays can comprise a plurality of contacts that are closed by the operation of a solenoid, a plurality of contacts that are opened by the operation of a solenoid, or a plurality of contacts, different ones of which are opened and closed by the operation of a solenoid. In prior devices, groups of sealed switching units provided with a common operating winding or a plurality of individual operating windings form switching assemblies in which all of the sealed units are either operated to an open circuit condition or to a closed circuit condition by the energization of the winding or windings.

A switching assembly in which different ones of the sealed switch units are operated to open and closed circuit conditions can be formed by providing different magnetic biasing means, such as a permanent magnet, for each of the sealed units. When a common operating winding is energized, the different magnetic biases cause some of the sealed switch units to be operated to closed circuit conditions, while others of the sealed units are operated to open circuit conditions. In assemblies including a large number of sealed switch units, it is desirable to reduce the number of permanent magnets in order to reduce the size, cost and weight of the assembly. One manner of reducing the number of permanent magnets is to use a single permanent magnet for biasing several switch units, and United States Patent Nos. 2,519,463 and 2,877,315 disclose assemblies in which all of a group of sealed switch units are biased by a common magnetic means. However, in devices of the type shown in these patents, the size and weight of the magnet is excessive, and the manner of mounting the permanent magnet adjacent the sealed switch units is not such as to permit the close juxtaposition of the switch units, some of which are to be magnetically biased and others of which are not.

Accordingly, one object of the present invention is to provide a new and improved switching assembly.

Another object is to provide a switching assembly including a plurality of sealed switch units.

Another object is to provide a switching assembly in which a single permanent magnet magnetically biases a plurality of sealed switch units.

A further object is to provide a switching assembly in which different ones of a plurality of sealed switch units are operated to open circuit conditions and closed circuit conditions by the energization of a single operating winding.

A further object is to provide a switching assembly including new and improved means for mounting a plurality of sealed switch units and permanent magnetic means for biasing at least a portion of these switch units.

Another object is to provide a uniplanar dielectric panel supporting a plurality of sealed switch units which is provided with spaced apertures for receiving permanent

magnets for magnetically biasing different groups of the sealed switch units.

In accordance with these and many other objects, an embodiment of the invention comprises a uniplanar dielectric panel having a printed circuit pattern formed on one or both of its outer surfaces. A plurality of sealed switch units are mounted on either or both of the sides of the panel in a generally parallel relationship by securing terminals of magnetic material extending from opposite ends of an elongated dielectric housing included in the sealed switch unit to the printed circuit pattern. Each of the dielectric envelopes includes at least two magnetic elements that are movable into or out of contact in response to the application of a suitable flux field.

To provide an assembly of the sealed switch units in which an applied field operates certain of the units to an open circuit condition and others of the units to a closed circuit condition, selected ones of the sealed switch units are magnetically biased to an open or closed circuit condition opposite that of the remaining units. This is accomplished without substantially increasing the cost, size and weight of the switching assembly by providing the dielectric panel with one or more spaced openings positioned between or adjacent groups of the sealed switch units for receiving permanent magnets. The axis of polarization of each of the magnets extends generally parallel to the dielectric envelopes of the adjacent sealed switch units. The magnetic bias provided by the permanent magnet operates the adjacent sealed switch units to open or closed circuit conditions opposite to that of the remaining sealed switch units mounted on the dielectric panel. The panel together with the sealed switch units and permanent magnets mounted thereon is disposed within a common operating winding, and the switching assembly is enclosed in a suitable housing.

When an energizing signal of suitable polarity is applied to the winding, the sealed switch units are operated to their alternate open or closed circuit conditions. In the sealed switch units disposed adjacent the permanent magnets, the polarity of the field provided by the energization of the winding is such as to oppose the magnetic bias applied to these units so that these units are operated to their alternate open or closed circuit condition. The applied field actuates the remaining sealed switch units which are not magnetically biased to their alternate open or closed circuit condition.

Many other objects and advantages of the present invention will become apparent from considering the following detailed description in conjunction with the drawings in which:

FIG. 1 is an elevational view in partial section of a switching assembly embodying the present invention;

FIG. 2 is an enlarged fragmentary sectional view taken along line 2—2 in FIG. 1 assuming that a complete switching assembly is shown therein; and

FIG. 3 is an enlarged sectional view taken along line 3—3 in FIG. 1, again assuming that a complete switching assembly is shown therein.

Referring now more specifically to the drawings, therein is disclosed a switching assembly, indicated generally as 10, which includes a uniplanar dielectric panel 12 having a printed circuit pattern formed on one or both sides thereof. A plurality of sealed switch units, indicated generally as 14, are mounted on the panel 12 on one or both sides thereof in a generally parallel relationship. If the sealed switch units 14 provide normally open contacts and it is desirable to provide at least a group of normally closed contacts in the switching assembly 10, one or more permanent magnets 16 are mounted on the panel 12 adjacent groups of the sealed switch units 14 to magnetically bias the contacts in these

adjacent units 14 to a normally closed condition. Thus, the sealed switch units 14 in the switching assembly 10 provide both opened and closed pairs of contacts.

The dielectric panel 12 with the sealed switch units 14 and the permanent magnets 16 mounted thereon is disposed within a common operating winding 18, and this assembly is inserted in a suitable housing or enclosure 20. When the winding 18 is energized by a signal which develops a flux field of opposite polarity to that provided by the permanent magnets 16, the magnetic bias of the magnets 16 is overcome and the sealed switch units 14 disposed adjacent the permanent magnets are operated to an open circuit condition. The flux field generated by the energization of the winding 18 operates the remaining sealed switch units 14 to a closed circuit condition.

The printed circuit panel 12 includes a printed circuit pattern on one or both sides thereof which comprises a plurality of electrically conductive segments, such as segments of copper foil. These conductive segments provide means for securing the sealed switch units 14 to the panel 12 and means for extending electrical connections between these units and external circuitry. In the switching assembly 10 shown in the drawings, the printed circuit pattern includes a plurality of conductive segments 22 having a first enlarged end portion 22*a* disposed adjacent a portion 12*a* of the panel 12 which extends out of the housing 20 to provide a male connector element. Each of the segments 22 also includes a second enlarged portion 22*b* that is adapted to be connected to one terminal of the sealed switch unit 14. The printed circuit pattern also includes a second group of conductive segments 24 having a first portion 24*a* on the projecting portion 12*a* and a second enlarged portion 24*b* to which the other terminal of each sealed switch unit 14 is secured. In addition, the printed circuit pattern on the dielectric panel 12 can include a group of segments 26 for extending electrical connections to the operating winding 18. The panel 12 can be formed and provided with the printed circuit pattern thereon in the manner described in detail in the copending application of Arthur J. Koda, Serial No. 731,390, filed April 28, 1958, now Patent No. 3,038,976 which copending application is assigned to the same assignee as the present application.

The sealed switch units 14 can comprise any of the constructions well known in the art, such as the mercury contact switch shown in Burton Patent No. 2,577,602 or the "dry reed" relay shown in Ellwood Patent No. 2,289,830. The switch units 14 also can be pivoted armature switch of the type shown in the copending application of Wilhelm Juptner, Serial No. 678,236, filed August 14, 1957, now Patent No. 3,033,956, or a "dry" switch having offset magnetic terminals of the type shown in the copending application of Arthur J. Koda, Serial No. 848,263, filed October 23, 1959, both of which copending applications are assigned to the same assignee as the present application. The sealed switch units 14 illustrated in the drawings are of the type described in detail in the latter copending application of Arthur J. Koda and include an elongated and generally cylindrical dielectric housing 28 from the opposite ends of which extend a pair of offset magnetic terminals 30 and 32. The terminals 30 and 32 include flexible, overlapping portions 30*a* and 32*a* (FIG. 3) which are disposed within the dielectric envelope 28 and which are movable into and out of engagement. In the particular type of sealed switch units 14 shown in the drawings, the portions 30*a* and 32*a* of the terminals 30 and 32 are normally held out of engagement or spaced from each other. The sealed switch units 14 are mounted on the panel 12 in generally parallel relationships by securing or soldering offset portions 30*b* and 32*b* of the terminals 30 and 32 to the enlarged portions 22*b* and 24*b*, respectively, of the conductive segments 22 and 24.

To provide means for magnetically biasing one or more of the sealed switch units 14 to a closed circuit condition in which the overlapping portions 30*a* and 32*a* of the magnetic terminals 30 and 32 are in engagement or electrical contact with each other, the printed circuit panel 12 is provided with a pair of spaced opening 34. These openings are disposed substantially midway along the lengths of the dielectric envelopes 28 between adjacent pairs of the sealed switch units 14. Each of the permanent magnets 16 is mounted in one of the openings 34 and is provided with an axis of polarization extending generally parallel to the dielectric envelopes 28. The magnetic field provided by each of the permanent magnets 16 biases the magnetic terminals 30 and 32 in the four adjacent switch units 14 to a closed circuit condition in which the portions 30*a* and 32*a* are in engagement (FIG. 3). The field of the parmanent magnet 16 is not sufficient to actuate the sealed switch units 14 that are not immediately adjacent the opening 34.

To provide a means for operating the switching assembly 10, the common operating winding 18 is provided. This winding, which is disposed between a pair of bobbin elements 38, can be wound directly on the printed circuit panel 12 following the mounting of the bobbin elements 38 thereon. Alternatively, the bobbin and coil assembly can be formed independently, and the panel 12 carrying the sealed switch units 14 and magnets 16 can be inserted into the axial opening in the winding 18. The terminals of the winding 18 are connected to conductive segments on the dielectric panel 12, such as the segments 26. When the winding 18 and the panel 12 have been assembled, this assembly is inserted into the housing 20, and the ends of the bobbin plates or cards 38 engage the inner walls of the housing 20 to properly position the winding 18 and the panel 12 within this housing. A pair of L-shaped detent or locking elements 40, which are detachably secured to the end walls of the housing 20 and which engage a shouldered portion 12*b* on the dielectric panel 12, secure the assembled winding 18 and panel 12 in a predetermined position within the housing 20.

When the switching assembly 10 is to be operated, the winding 18 is energized from a potential source of a polarity such that the flux field induced by the energization of the winding 18 is opposite to the polarization of the magnetic biasing field provided by the permanent magnets 16. Thus, the field induced by the energization of the winding 18 overcomes the magnetic bias provided by the permanent magnets 16 so that the portions 30*a* and 32*a* of the terminals 30 and 32 on the sealed switch units 14 disposed immediately adjacent the permanent magnets 16 are moved to separated positions by the inherent resilience of these portions of the terminals. The field induced by the energization of the winding 18 also moves the portions 30*a* and 32*a* of the terminals 30 and 32 in the remaining switch units into engagement so that these sealed switch units are operated to a closed circuit condition. When the energization of the winding 18 is removed, the portions 30*a* and 32*a* in the sealed switch units 14 spaced from the biasing magnets 16 are restored to an open circuit condition or moved out of engagement by the inherent resilience of these elements. Further, the permanent magnets 16 magnetically bias the portions 30*a* and 32*a* in the adjacent sealed switch units 14 into engagement to provide closed circuit conditions in these switch units. Accordingly, the sealed switch assembly 10 provides means by which different groups of sealed switch units carried on a single printed circuit panel 12 and enclosed by the common operating winding 18 are operated to different combinations of opened and closed circuit conditions without requiring the use of an excessive number of permanent magnetic biasing means.

Although the present invention has been described with reference to a single embodiment thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this invention.

What is claimed and desired to be secured by Letters Patent of the United States is:

1. A switching assembly comprising a uniplanar panel of dielectric material having at least one opening formed therein, a plurality of sealed switch units each comprising an elongated dielectric envelope containing at least a pair of magnetic switching elements movable into and out of engagement, means securing said sealed switching units on said panel in a spaced parallel relationship, at least two of said sealed switch units being mounted on opposite sides of said opening, and a permanent magnet mounted in said opening adjacent said two sealed switch units, said permanent magnet having an axis of polarization that extends generally parallel to said two sealed switch units to bias the magnetic switching elements in said two sealed switch units.

2. A switching assembly comprising a dielectric panel forming an opening, a plurality of sealed switch units each having an elongated dielectric housing containing at least one magnetic switch element operable between open and closed circuit conditions, means mounting a first two of said sealed switch units on said panel at opposite sides of said opening and extending generally parallel to each other, means mounting an additional switch unit on said panel adjacent each of said first two units, each of said additional units extending parallel to the adjacent one of the first two units and being spaced from said opening a distance greater than the adjacent first unit, a permanent magnet mounted in said opening, said permanent magnet having an axis of polarization extending generally parallel to all of said sealed switch units and providing a field of sufficient strength to magnetically bias the first two switch units mounted adjacent said opening and of insufficient strength to effectively bias said additional switch units, and a winding surrounding said panel and the sealed switch units mounted on said panel.

3. A switching assembly comprising a uniplanar panel of dielectric material having at least one opening formed therein, a printed circuit pattern on the panel, a plurality of sealed switch units each comprising an elongated dielectric envelope containing at least two magnetic switching elements movable into and out of electrical contact, means mounting said sealed switch units on both sides of said panel in a generally parallel relationship by securing the switch units to the printed circuit pattern, at least one sealed switch unit on each side of said panel being mounted adjacent said opening, and a permanent magnet mounted in said opening for biasing the magnetic switching elements in the adjacent sealed switch units, said permanent magnet having an axis of polarization extending generally parallel to said sealed switch units.

4. A switching assembly comprising a dielectric panel having an opening, a plurality of sealed switch units each having an elongated dielectric housing containing at least one magnetic switch element operable between open and closed circuit conditions, means mounting two of said sealed switch units on said panel at opposite sides of said opening and extending generally parallel to each other, means mounting two additional sealed switch units on the other side of said panel at opposite sides of said opening and extending generally parallel to each other, a permanent magnet mounted in said opening, said permanent magnet having an axis of polarization extending generally parallel to said sealed switch units and providing a field of sufficient strength to magnetically bias the switch units mounted adjacent said opening, and a winding surrounding said panel and the sealed switch units mounted on said panel.

5. A switching assembly comprising a unipplanar panel of dielectric material having at least one opening formed therein, a plurality of sealed switch units each having an elongated dielectric housing containing at least a pair of magnetic switching elements operable between open and closed circuit conditions, mounting means mounting said sealed switch units on said panel in a generally parallel relationship, at least two of said sealed switch units being mounted immediately adjacent said opening, a permanent magnet mounted in said opening, said permanent magnet having an axis of polarization extending generally parallel to said sealed switch units for magnetically biasing the switching elements in the switch units immediately adjacent said opening to a first one of said open and closed circuit conditions, the remaining sealed switch units being in the other one of said open and closed circuit conditions, and a winding surrounding said panel and said sealed switch units for overcoming the bias of said permanent magnet to operate the switch units immediately adjacent said opening to said other one of the open and closed circuit conditions and for operating said remaining sealed switch units to said first one of said open and closed circuit conditions.

6. The switching assembly set forth in claim 5 in which said mounting means includes means for mounting four of said sealed switch units immediately adjacent said opening, two of said sealed switch units being mounted on opposite sides of said opening on one side of said panel and two of said sealed switch units being mounted on opposite sides of said opening on the other side of said panel.

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