May 23, 1967 H. CHANOWITZ 3,321,723

SEALED SWITCH ASSEMBLY WITH IMPROVED CONNECTING MEANS

Filed Oct. 21, 1965

Fig. 1

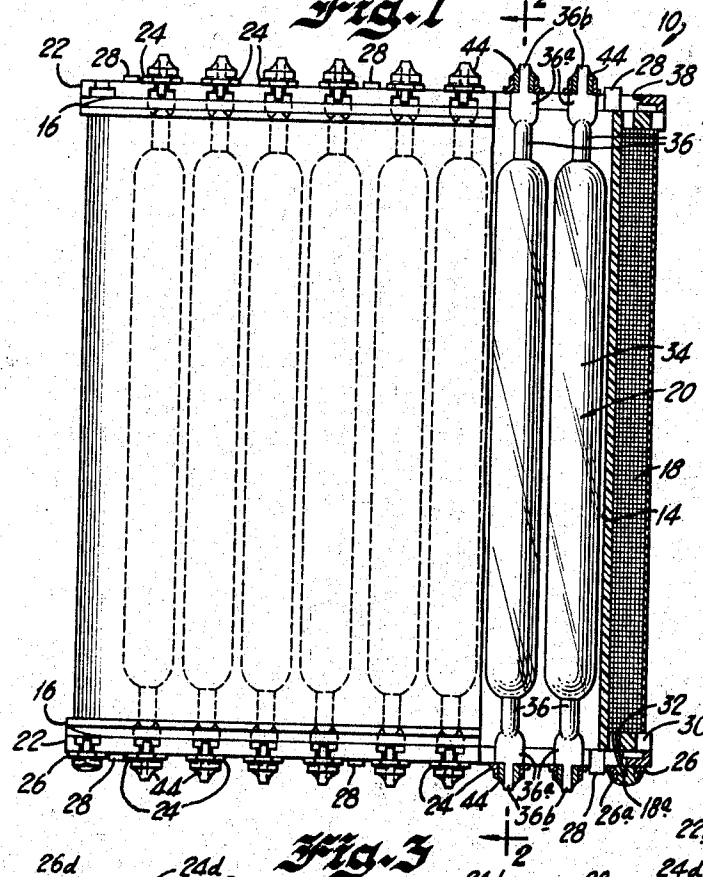


Fig. 2

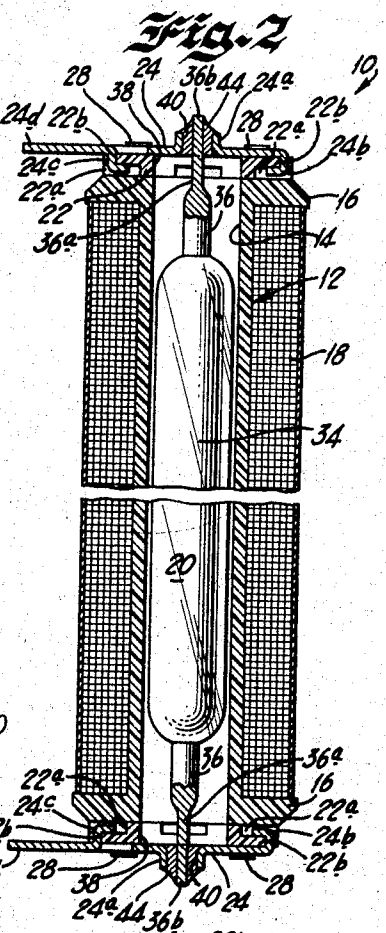


Fig. 3

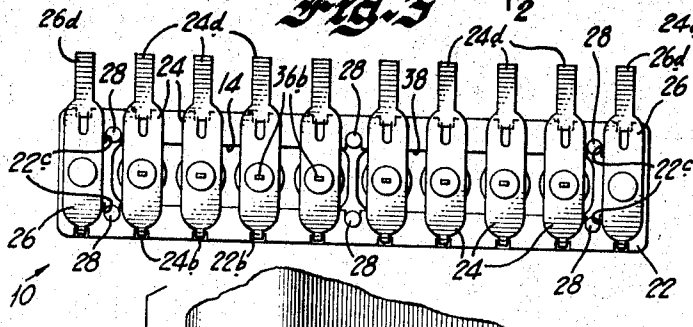


Fig. 4

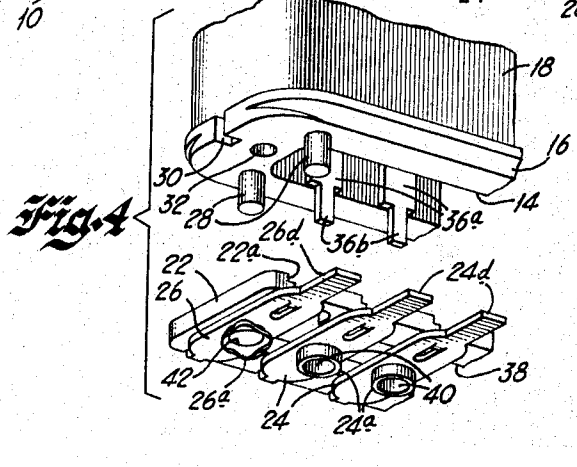
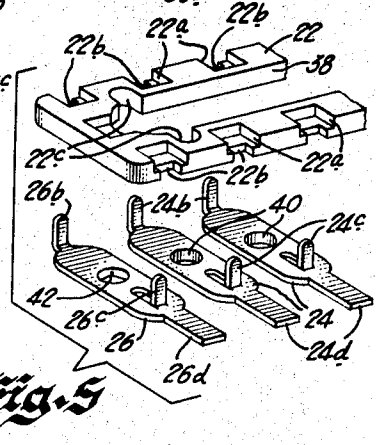


Fig. 5



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United States Patent Office 3,321,723
Patented May 23, 1967

3,321,723

SEALED SWITCH ASSEMBLY WITH IMPROVED CONNECTING MEANS

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Filed Oct. 21, 1965, Ser. No. 499,583
6 Claims. (Cl. 335—152)

This invention relates to a switching assembly and, more particularly, to a switching assembly of the type using sealed magnetic reed switches.

One of the many applications for sealed magnetic or reed switches is in switching assemblies that can be mounted on or connected to other supporting structures, such as a printed circuit board. In prior switching assemblies of this type, the magnetic terminals of the reeds were bent to provide connectors for mechanically and electrically connecting the switches to the conductive pattern on the printed circuit boards. However, the bending of the terminals necessary in this arrangement and the distortion of the terminals when the board on which the switches are mounted is flexed results in the transmission of stresses to the switch that frequently resulted in damage to the glass-metal seals.

Another arrangement previously used, such as that shown in United States Patent No. 3,215,794, is to solder or weld the switch terminals to separate connectors that are free or carried on the coil bobbin, and the connectors then serve to insulate the seals from the stresses resulting from flexure of the printed circuit board. However, particularly, in those assemblies in which the terminals are welded to the connectors, the forces applied to the terminals during welding, either with the switches held in fixtures or disposed in the coil bobbin, tend to set up stresses in the reed switch that adversely affect the seal. This is particularly true because of the lack of symmetry between the elongated glass housings and the terminals. In addition, the magnetic circuits in these prior types of switching assemblies are not as efficient as desirable.

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

Another object is to provide a switching assembly using sealed switches in which a floating or stress-free connection is made between the terminals of the magnetic switches and the package or housing for the relay or switching assembly.

A further object is to provide a switching assembly in which the terminals of the sealed switches are allowed freedom to find a stress-free position when they are secured to connectors during assembly of the relay.

A further object is to provide a new and improved switch terminal-connector structure for use with sealed glass switches.

A further object is to provide a sealed magnetic switch assembly including connector structures providing an improved magnetic circuit for the switching assembly.

Another object is to provide a new and improved terminal for use with leads to coils or windings.

In accordance with these and many other objects, an embodiment of the present invention comprises a switching assembly including a coil bobbin carrying a winding and having a pair of end walls connected by an axially extending opening within which one or a plurality of sealed switch units are disposed with their magnetic terminals projecting from opposite ends of the opening. To provide means for mounting the switches on the coil bobbin and to provide connectors for connecting the assembly to an external structure, such as a printed circuit board, a pair of end plates are provided on which are detachably mounted a plurality of generally uniplanar connectors formed of magnetic material. These terminals extend

across or bridge the axial opening at the ends of the coil and, on one side, include a projecting portion adapted to be inserted in openings in a printed circuit board. Each of the terminals also includes a bossed opennig substantially larger than the reduced cross section portions formed on the ends of the magnetic switch terminals. Each of the end plates can also include lead connectors comprising a bossed opening through which a lead to the winding is inserted and around which the lead is wrapped so that the convolutions of the lead are disposed below the outer edge of the bossed portions.

When the relay is to be assembled, the sealed switches are disposed within the axial opening, and the end plates are then moved into predetermined positions adjacent the end walls of the bobbin by the use of cooperating guide and positioning structures on the end walls and end plates. As the end plates move into position adjacent the end walls, the ends of the magnetic terminals of the sealed switches enter the openings in the connectors. Since the switches are completely free of external holding forces and are free to move to any desired position relative to the bobbin or the adjacent switches because of the enlarged openings in which the ends of the terminals are received, the switches inherently find a stress-free position. A suitable bonding or securing material, such as solder, is applied to the connectors at the opposite ends of the switching assembly, as by the use of a solder wave machine, and the solder fills the openings in the connectors to mechanically and electrically connect the sealed switches to the connector terminals and thus to the coil bobbin and the remainder of the relay or switch package. Because of the fact that the connectors are made of magnetic material and bridge the ends of the operating winding or coil, the reluctance of the magnetic circuit for the sealed switches is reduced as well as any stray fields, and the sensitivity of the switches is substantially enhanced. Further, during this soldering operation, the coil leads are soldered in their position wrapped around the bossed portions of the lead connectors, and the leads are protected from damage.

Many other objects and embodiments 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 illustrating a switching assembly embodying the present invention;

FIG. 2 is a fragmentary enlarged sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is an end elevational view of the switching assembly shown in FIG. 1;

FIG. 4 is an exploded perspective view of a portion of the coil bobbin and an end plate carrying a plurality of connectors; and

FIG. 5 is an exploded perspective view showing a group of the connectors and a portion of the end plate on which the connectors are detachably mounted.

Referring now more specifically to the drawings, therein is illustrated a switching assembly **10** which embodies the present invention and which includes a coil bobbin or former indicated generally as **12** having an axially extending opening **14** which terminates in a pair of transversely extending end walls **16**. A winding **18** is disposed on the bobbin **12**, and a plurality of sealed switches **20** are disposed within the axial opening **14** to be surrounded by the winding **18**. To provide means for connecting the sealed switches **20** to the switching assembly **10** and to provide means for mechanically and electrically connecting this assembly to an external means, such as a printed circuit panel, the switching assembly **10** includes a pair of end plates **22** on which are detachably mounted a

plurality of switch terminal connectors **24** and a group of lead connectors **26**. The end plates **22** are carried on or secured to the end walls **16** of the bobbin **12** and are of a construction to permit the sealed switches **20** to be connected to the terminals **24** in a stress-free position during assembly of the relay **10**. In addition, the connectors **24** and **26** are formed of magnetic material to improve the magnetic circuit of the switching assembly **10** and increase the sensitivities of the individual switches **20** therein.

Referring now more specifically to the coil bobbin **12**, this bobbin is formed of an insulating or dieelectric material and includes the transversely extending end walls which are each provided with a generally uniplanar outer surface from which a plurality of locating pins **28** (FIGS. 3 and 4) extend. One or both of the end walls **16** is provided with a notch **30** and an opening **32** adjacent its opposite end through which extend start or finish leads **18***a* for the winding **18**.

The sealed switches **20** can be of a conventional construction and include an elongated glass or insulating housing **34** in the opposite ends of which a pair of magnetic reeds **36** are sealed with their inner ends normally disposed in an overlapped and spaced position. The outer ends of the magnetic elements **36** include somewhat flattened or uniplanar terminal portions **36***a*, and the outer ends of the terminal portions **36***a* are shouldered to provide a substantially narrow outer end **36***b*. The lengths of the coil form **12** and the sealed switches **20** are related so that the ends of the terminal portions **36***a* extend from opposite ends of the axial opening **14** beyond the end walls **16**.

To provide the end connector structures, the end plates **22** are provided with a central opening **38** through which the switch terminals **36** extend and are provided on their inner faces with a plurality of pairs of transversely aligned recesses **22***a* communicating with the outer surfaces of the plate **22** through notches **22***b* (FIG. 5). The end plates **22** also include a plurality of notches or recesses **22***c* communicating with the opening **38** which are spaced from each other the same as the locating pins **28** on the end walls **16**.

The switch terminal connectors **24** are formed of a magnetic material, such as nickel-iron, and are generally uniplanar in configuration. Each of the connectors **24** includes an opening **40** surrounded on the outer wall of the connector **24** by a bossed portion **24***a*. Each of the connectors **24** also includes a pair of lugs **24***b* and **24***c* and a generally rectangular lower end portion **24***d* which is adapted to be inserted into a mounting or locating aperture on a printed circuit board. The connectors **24** are assembled on the end plates **22** by placing these connectors against the outer walls of the end plates **22** with the lugs **24***a* and **24***b* disposed in the notches **22***b* and with the opening **40** aligned with the opening **38** and the bossed portions **24***a* facing outwardly from the end plate **22**. The lugs **24***b* and **24***c* are then bent over into the recesses **22***a* as illustrated in FIG. 2 of the drawings.

The lead connectors **26** are substantially identical to the terminal connectors **24** in including a centrally disposed opening **42** which is surrounded on its outer wall by a bossed portion **26***a* (FIGS. 1 and 3) which is fluted in configuration. The lead connector **26** also includes a pair of lugs or tabs **26***b* and **26***c* which are received within the notches **22***b* on the end plates **22** and turned into the recesses **22***a* when the connectors **26** are mounted on the end plates **22**. The connectors **26** further include a generally rectangular end portion **26***d* for establishing connection with the printed circuit board.

When the switching assembly **10** is to be assembled, the plurality of sealed switches **20** are placed within the axial opening **10**, and the end plates **22** with the terminals **24**, **26** carried thereon are moved into an assembled relationship with the end walls **16** of the bobbin **12** by inserting the guiding or locating pins **28** on the wall **16** into the recesses or notches **22***c* on the end plates **22**. The end plates **22** can be secured in position by swaging, heat fusing, or applying cement to the pins **28** and the adjacent area of the end plates **22**. As the plates **22** are moved into position adjacent the end walls **16**, the ends **36***b* of the switch terminals **36** move into the openings **40** and the surrounding bossed portions **24***a*. The shoulders on the terminal portions **36***a* loosely engage the inner walls of the terminals **24** to axially locate the sealed switches **20**. Since the end portions **36***b* of the terminals **36***a* are substantially smaller than the diameter of the openings **40**, the switches **20** are free to assume any stress-free position within the axial opening **14** so that no stress is applied to these switches from the connector structures **24**. This is true even though the reeds **36** and the envelopes **34** are not symmetrically disposed in many switches **20**.

The start and finish leads **18***a* of the winding **18** are threaded through the notch **30** or the opening **32** and through the openings **42** in the lead connectors **26**. These leads are then wrapped around the fluted, bossed portions **26***a*. Because of the undulating edge of the bossed portion **26***a*, the lead is always below the outer extremity of the bossed portion **26***a*, and there is no possibility that the lead will be damaged or broken. This arrangement also permits the winding leads to be firmly anchored to the connectors **26** prior to the complete assembly of the switching unit **10**.

The assembled unit can then be placed in a carriage or fixture for a solder wave machine to pass through a solder bath which wipes against the outer walls of the connectors **24** and **26** at one end of the assembly **10**. During this operation, a mass of solder **44** goes into the openings **40** and both fills and covers the bossed portions **24***a* and **26***a* to provide good mechanical and electrical connections between the connectors **24**, **26**, the terminals **36***a* of the sealed switches **20**, and the leads **18***a* for the winding **18**. The switching assembly **10** is then inverted to pass through the solder wave machine again so that the connections are made at the other end of the assembly. Since the switches **20** are not subjected to any forces during the assembling of the switch terminals **36***a* and the switch terminal connectors **24** or during the connection of these components, the sealed switches **20** are mounted on the switch assembly **10** in a stress-free position. Further, by the provision of the magnetic connectors **24** and **26** which extend completely across or bridge the ends of the axial opening **14**, the reluctance of the flux path of the field developed by the winding **18** is reduced, and the sensitivity of the switches **20** is increased.

It is also possible to replace individual switches in the assembly **20**. This can be done by bending the lug **24***b* (FIG. 2) out of the recess **22***a* and by then applying heat in proximity to the bossed portion **24***a* on this connector **24** to remove the mass of solder **44**. The connector **24** can then be turned and the lug **24***c* taken out of the corresponding recess **22***a* to remove this connector **24** from the assembly **10**. By applying heat to the bossed portion **24***a* at the opposite end, the solder **44** connecting the terminal **36***a* at the opposite end is placed in a molten condition, and the sealed switch **20** can be withdrawn from the axial opening **14** through the opening **38** in the end plate **22** from which the terminal connector **24** has been removed. The switch **20** can be replaced by following the above-identified steps in an opposite sequence.

Although the present invention has been described with reference to a single illustrative 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 the present invention.

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

1. A switching assembly comprising a coil bobbin having an axial opening and spaced end walls, a winding on the bobbin, a pair of end plates each having recessed portions on an inner surface, a plurality of connectors

carried on each of the end plates, each of said connectors being generally uniplanar and disposed in a generally parallel relation to the end plate, each of said connectors including an opening and lug portions received in the recessed portions on the end plates, a sealed switch unit disposed in the axial opening and having a pair of switch terminals projecting from its opposite ends, and means mounting the end plates on the bobbin with the inner surfaces of the end plates adjacent the end walls, the switch terminals being received within the openings in the connectors when the end plates are adjacent the end walls.

2. The switching assembly set forth in claim 1 in which the opening is surrounded by a bossed portion on the connector and in which the switch terminals extend into the bossed portions.

3. A switching assembly comprising a coil bobbin having an end wall, a winding on the bobbin and having a lead, at least one generally uniplanar connector carried on the end wall, said connector having a generally circular opening therein surrounded by an annular portion projecting outwardly away from the end wall, the lead to the winding passing through the opening and being wound around the projecting portion, and a mass of material securing the lead to the connector.

4. The switching assembly set forth in claim 3 in which the outer edge of the annular portion that is spaced from the end wall includes a recessed portion through which the lead passes from the opening.

5. A switching assembly comprising an operating winding means having an axial opening, a sealed switch unit including an elongated insulating housing in the opposite ends of which a pair of terminals are sealed, said sealed switch unit being disposed in the axial opening of the operating winding means with the terminals projecting outwardly beyond the ends of the operating winding means, the transverse dimensions of the axial opening being greater than the transverse dimensions of the insulating housing so that the sealed switch unit is free to be disposed in various positions within the axial opening, a connector means secured to the operating winding means at the opposite ends of the axial opening, each of the connector means having an opening therein which is disposed one of the terminals of the sealed switch unit, the portions of the terminals disposed within the openings in the connector means being substantially smaller than the openings to space the terminals from contact with the connector means and to permit the sealed switch unit to occupy any position relative to the operating winding means and the connector means that avoids the application of stress to the terminals regardless of the relation of the terminals to the elongated housing, and a mass of electrically conductive connecting material disposed in the openings interposed between the terminals and the connector means to secure the sealed switch unit to the connector means in a stress-free relation.

6. The switching assembly set forth in claim 5 in which the connector means include generally tubular or bossed or projecting portions defining the openings in which the terminals are received.

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