Dec. 20, 1966 J. D. BEIERLE 3,293,502

MINIATURE DRY REED RELAY CROSSPOINT MATRIX PACKAGE

Filed Feb. 24, 1965

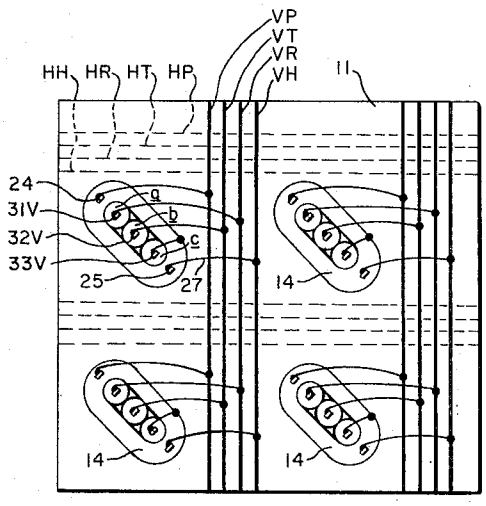


FIG. 2

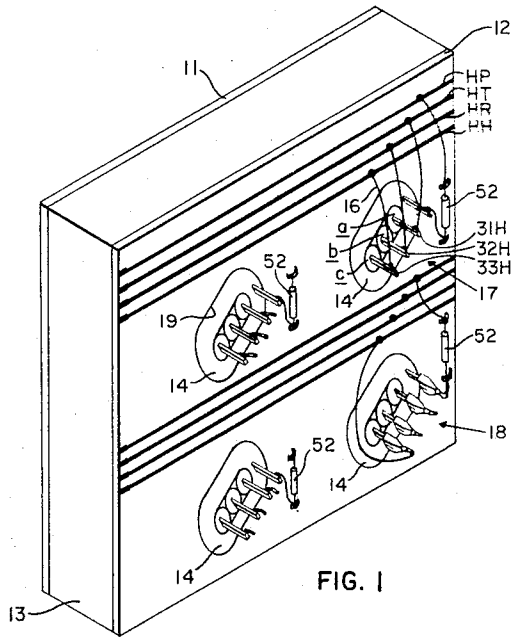


FIG. 1

FIG. 3

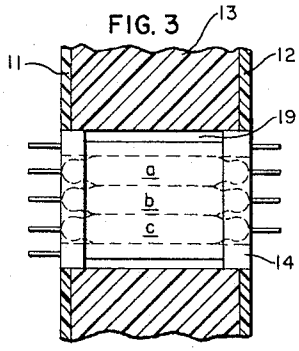


FIG. 4

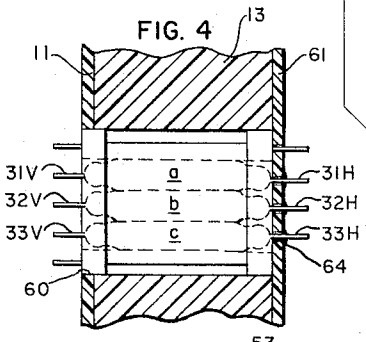
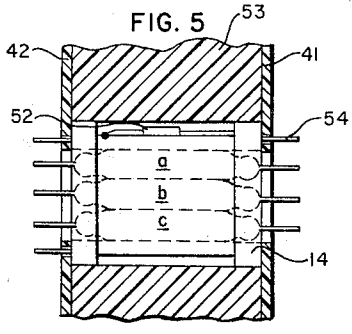


FIG. 5



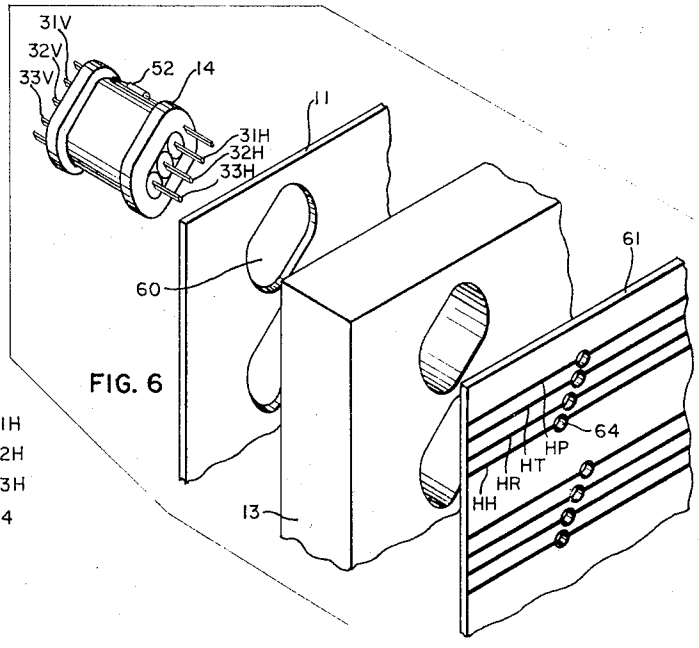


FIG. 6

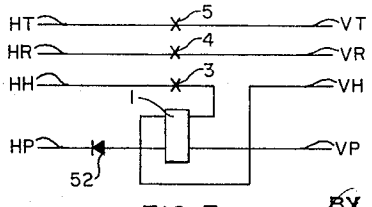


FIG. 7

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MINIATURE DRY REED RELAY CROSS-POINT MATRIX PACKAGE

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This invention relates to a matrix package of cross-point switching elements of the reed relay type, in which the electrical connections are effected by printed circuit techniques.

In United States Patent 3,030,451, there is disclosed a reed relay matrix arrangement employing two U-shaped frames, each having sets of conductors printed thereon. On one frame there are vertical sets of conductors, and on the other frame there are horizontal sets of conductors. The reed relays used in the arrangement are mounted between and perpendicular to the two frames at the cross-points of the vertical and horizontal conductor sets. The relay terminals are placed through apertures in the frames which also pass through the printed conductor strips, and the terminals and conductors are interconnected at these points.

Because of the aforementioned way of sandwiching the relays between the frames, the reed relays of the above mentioned patent are not individually replaceable. If one of the relays has to be replaced, all connections to one of the cards have to be severed. Also, because of the above technique used in connecting the relay terminals to the conductors, there will be a problem of aligning the relays with the frames to make the connections.

To solve the foregoing problems of the prior art, an arrangement has been proposed in U.S. Patent 3,193,731. This arrangement is generally satisfactory, and in particular it facilitates alignment. However, this arrangement requires the use of a stacked or composite printed circuit board. This construction is mechanically more complex. Furthermore, because the cards forming the composite board are placed close to each other in a front to back manner, in order to reach the inside card, to unsolder or solder the terminals of an individual relay, the outside card must have holes somewhat larger than the inside card so as to provide the necessary accessibility. Also, neither in the above prior art, Patent 3,030,451, nor in Patent 3,193,731, has any provision been made for individually replacing the reed capsules.

Accordingly, it is an object of this invention to provide a reed relay matrix package wherein the reed relays are placed between printed circuit cards in such a manner that at least the individual capsules, or the individual relays, may be replaced without disturbing the other relays.

Another object of this invention is to provide a mounting package requiring a minimum area which allows for ease of alignment of the relays with respect to two spaced printed circuit cards as the relays are connected at the various crosspoints of the matrix.

Other objects and features of the invention will become more apparent by reference to the following description taken in conjunction with the accompanying drawings of which:

FIG. 1 is a perspective view of one embodiment of the matrix card package according to the invention;

FIG. 2 is a rear view of the embodiment of FIG. 1;

FIG. 3 is a side view of the embodiment of FIG. 1;

FIG. 4 is a side view of an alternative embodiment of the matrix card package according to the invention;

FIG. 5 is a side view of another alternative embodiment of the invention;

FIG. 6 is an exploded perspective view of the arrangement of FIG. 4; and

FIG. 7 is a schematic diagram of a typical circuit for use in conjunction with the matrix card package.

The matrix card package as shown in FIGS. 1–3 comprises a molded plastic supporting block **13** which is interposed between two printed circuit cards **11** and **12**. One card **11** has vertical conductor sets such as VP, VT, VR, VH printed thereon, and the other card **12** has horizontal conductor sets such as HP, HT, HR, HH printed thereon. The block **13** and the cards **11** and **12** have mutually aligned apertures such as **19**, each large enough to receive a relay bobbin of the type shown in FIG. 6. Each bobbin **14** houses a plurality of reed capsules, such as *a*, *b*, *c* and together the bobbin **14** and its capsules *a*, *b*, *c* form a reed relay. The reed capsules *a*, *b*, *c* are electrically connected to the printed conductors VP, VT, VR, VH and HP, HT, HR, HH by means of wire straps such as **16** as shown in FIG. 1. A number of techniques may be used to connect the straps **16** to the capsules at their terminals, such as **31H**, **32H**, **33H**. Two techniques are shrown in FIG. 1, one **17**, using a solder connection, and the other **18**, using a clip-on type connection.

As shown in FIG. 2, the bobbins such as **14** are horizontally displaced with respect to the associated vertical sets of conductors such as VP, VT, VR, VH and are vertically displaced with respect to the associated horizontal sets of conductors such as HP, HT, HR, HH. This positioning of the bobbins locates them adjacent the crosspoints of the matrix formed by the aforementioned conductors, and in such a manner that they in no way physically interfere with these conductors and vice versa. To facilitate this arrangement the terminals such as **31V**, **32V**, **33V** of the reed capsules such as *a*, *b*, *c*, housed in the bobbins such as **14** and the terminals, such as **24** and **25** of the windings, wound on the bobbins, are individually connected by wire straps such as **27** to the appropriate corresponding conductors such as VH.

In the embodiment in FIG. 3, the supporting block **13** and printed circuit cards **11** and **12** are designed with apertures such as **19** of a sufficient size to receive the bobbins such as **14** which house the reed capsules such as *a*, *b*, *c*.

The above mentioned location of the bobbins and the above mentioned design of the apertures for receiving the bobbins, enables the bobbins or the reed capsules, as the case may be, to be individually replaced if a failure should occur, without disturbing the remaining bobbins or capsules in the package.

Preferably, as shown in FIG. 2, the bobbins such as **14** are positioned generally diagonally with respect to the horizontal and vertical conductors such as VP, VT, VR, VH and HP, HT, HR, HH so as to minimize the amount of space required by the matrix as a whole. More particularly, the aforementioned arrangement permits minimum spacing between adjacent vertical conductor sets and also between adjacent horizontal conductor sets.

Furthermore, a minimum spacing is made possible between individual parallel conductors, such as VP and VT or HP and HT because, although conductors are displaced relatively to the mounting areas of the individual relay there is no need for larger holes and "lanes" or "pads"

in one card as would be required for the outside cards of a multi-layer matrix card arrangement. Therefore, a relatively high packaging density is obtainable according to the techniques of the present invention.

It should be understood, of course, that crosspoint relays comprising a different number of reed capsules may require a different array of the capsules within the bobbin and a different orientation of the bobbin.

An alternative arrangement according to the invention is disclosed in FIGS. 6 and 4 of the drawings. As will be seen from FIG. 6, the matrix card package, according to this embodiment, also comprises a molded plastic block **13** which is interposed between two printed circuit cards **11** and **61**. One of the cards **11** has vertical conductor sets printed theron, and the other card **61** has horizontal conductor sets printed thereon such as HP, HT, HR, HH. However, in this version of the matrix card package, only one of the cards **11** which has the physical design and the conductor layout shown in FIG. 2, has apertures such as **60** large enough to receive and pass the bobbins such as bobbin **14**. The other card **61** has apertures such as **64** large enough only to receive the individual terminals such as **31H**, **32H**, **33H** of the reed capsules such as *a, b, c*. As shown in FIGS. 6 and 4 these apertures **64** pass through the printed conductors on card **61**, and the corresponding capsule terminals **31H**, **32H**, **33H** are individually connected directly to the respective conductors on this card. At the other end the capsule terminals **31V**, **32V**, **33V** are electrically connected to the conductors by strapping wires like those shown in FIGS. 1 and 2.

As shown in FIG. 6 this arrangement allows the bobbins to be spaced vertically closer, thus less area is needed for the overall matrix package. It will also be noted that in this embodiment the bobbins can be individually removed from one end only of the matrix package, namely the far end as viewed in FIG. 6. However, in many instances removal from one side is all that is required.

FIG. 5 shows an arrangement according to the invention whereby the reed capsules alone are individually replaceable. Here the supporting block **53** is as large in width as the bobboin **14**, including its flanges, is long. The printed circuit cards **41** and **42** once again have vertical and horizontal condutor sets thereon, respectively, and the supporting block **53** is positioned between the cards **41** and **42**. However, as in the instant case the flanges of bobbin **14** are interposed between the cards, and the bobbin itself cannot be removed without removal of one of the printed circuit cards.

The assumption underlying this version of the matrix card package is that the bobbin, or the winding thereon, or diode **52** will become damaged or break down much more infrequently than the reed capsules and that therefore it will suffice to make provision for the individual replacement of the reed capsules *a, b, c*.

This embodiment may also be constructed so that the reed capsules *a, b, c* can only be removed from one end of the matrix card package. If this is desired, card **41** will be designed the same as, or similar to, card **61** of FIG. 4. With this construction, only the reed capsules *a, b, c* will be individually removable, namely to the left only as viewed in FIG. 5.

FIG. 7 shows a schematic diagram of a typical circuit that may be used in conjunction with the matrix card package as previously presented.

As shown in FIG. 7, the pull leads VP and HP are connected through winding **1** of the relay by a back feed preventing diode **52**. Physically, this diode **52** may be placed in a number of positions. One such position is shown in FIG. 1. Here the diode **52** is placed outside the matrix card package where it can be permanently mounted by means of pins. An alternative mounting arrangement is shown in FIGS. 5 and 6, where the diode **52** is placed on the outside of the winding of the relay bobbin **14**, within the area defined by the flanges of the bobbin **14**. These are only two of many techniques which may be

used for mounting diodes such as **52**. The hold leads VH, HH are connected through winding **2** of the relay and the relay contacts **3** in series. The VT, HT and VR, HR leads are connected through relay contacts **5** and **4** respectively, as shown.

It will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broadest aspects and therefore the aim in the appended claims is to cover all such changes and modifications as in the true spirit and scope of this invention.

What is claimed is:

1. A reed relay crosspoint matrix package comprising in combination: a plurality of relay bobbins, one at each of the crosspoints of said matrix, each said bobbin having a plurality of reed capsules with terminals extending therefrom; two printed circuit cards of insulating material having apertures therethrough and disposed perpendicularly to and at the two ends, respectively, of said bobbins; a support structure positioned between said cards for supporting both said bobbins and said cards; the apertures of said cards being aligned with the corresponding bobbins, with the apertures of at least one of said cards being of a size sufficient to pass at least said capsules, and one of said cards having sets of generally rectilinear and mutually parallel vertical conductors and the other of said cards having sets of generally rectilinear and mutually parallel horizontal conductors printed thereon; the conductor set on at least said one card being laterally spaced from and clearing said apertures; and means for electrically interconnecting said terminals to said conductors.

2. A reed relay crosspoint matrix package comprising in combination: a plurality of bobbins having windings wound thereon, one bobbin at each of said crosspoints, each said bobbin having a plurality of reed capsules with terminals extending therefrom; two printed circuit cards of insulating material having apertures therethrough; said cards being disposed perpendicularly to and at the two ends, respectively, of said bobbins, the apertures of said cards being aligned with the corresponding bobbins, and the apertures of at least one of said cards being of a size sufficient to pass said bobbins; a support structure positioned between said cards and having apertures aligned with said apertures in said cards, for receiving said bobbins, said support structure supporting both said bobbins and said cards; one of said cards having sets of generally rectilinear and mutually parallel vertical conductors and the other of said cards having sets of generally rectilinear and mutually parallel horizontal conductors printed thereon; the conductor sets on at least said one card being laterally spaced from and clearing said apertures in said card; and strapping means for electrically interconnecting said terminals to said conductors on said card, whereby, upon disconnection of the corresponding strapping means, said bobbins may be individually removed from said package.

3. A reed relay crosspoint matrix package comprising in combination: a plurality of bobbins having windings wound thereon, one bobbin at each of said crosspoints, each said bobbin having a plurality of reed capsules with terminals extending therefrom; two printed circuit cards of insulating material having apertures therethrough; said cards being disposed perpendicularly to and at the two ends, respectively, of said bobbins, and the apertures of said cards being aligned with the corresponding bobbins and being of a size sufficient to pass at least said capsules; a supporting block of insulating material positioned between said cards and having apertures aligned with said apertures in said cards for receiving said bobbins, said block supporting both said bobbins and said cards; one of said cards having sets of generally rectilinear and mutually parallel vertical conductors and the other of said cards having sets of generally rectilinear and mutually parallel horizontal conductors printed thereon; the conductor sets on said cards being laterally spaced from and

clearing said apertures in said cards; and strapping means for electrically interconnecting said terminals to said conductors, whereby, upon disconnection of the corresponding strapping means, said capsules may be individually removed from said package.

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