

Oct. 30, 1962

R. L. PEEK, JR
SWITCHING DEVICE

3,061,696

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2 Sheets-Sheet 1

FIG. 1

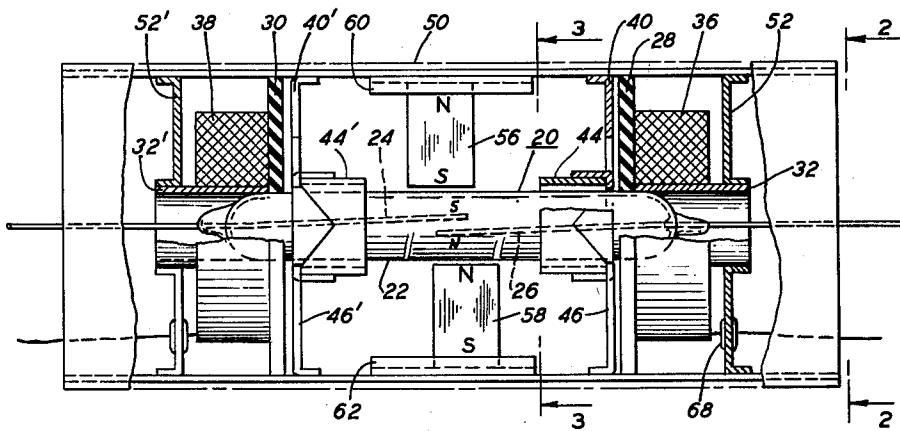


FIG. 2

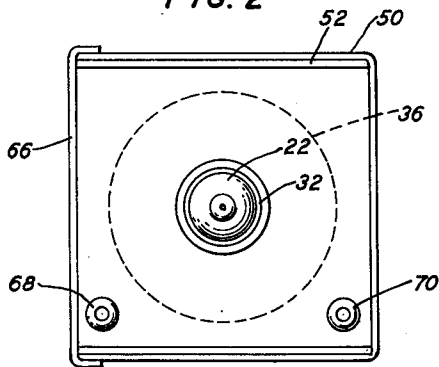
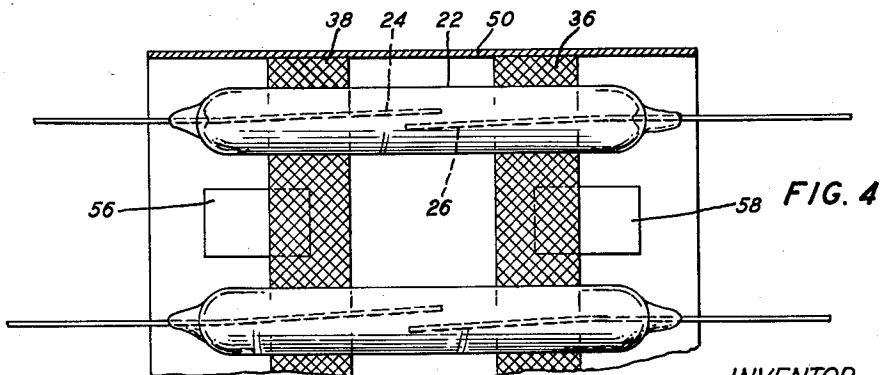
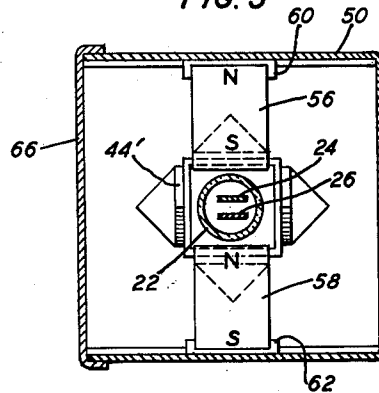


FIG. 3



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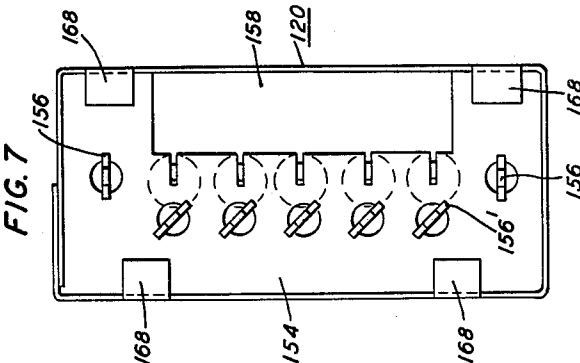
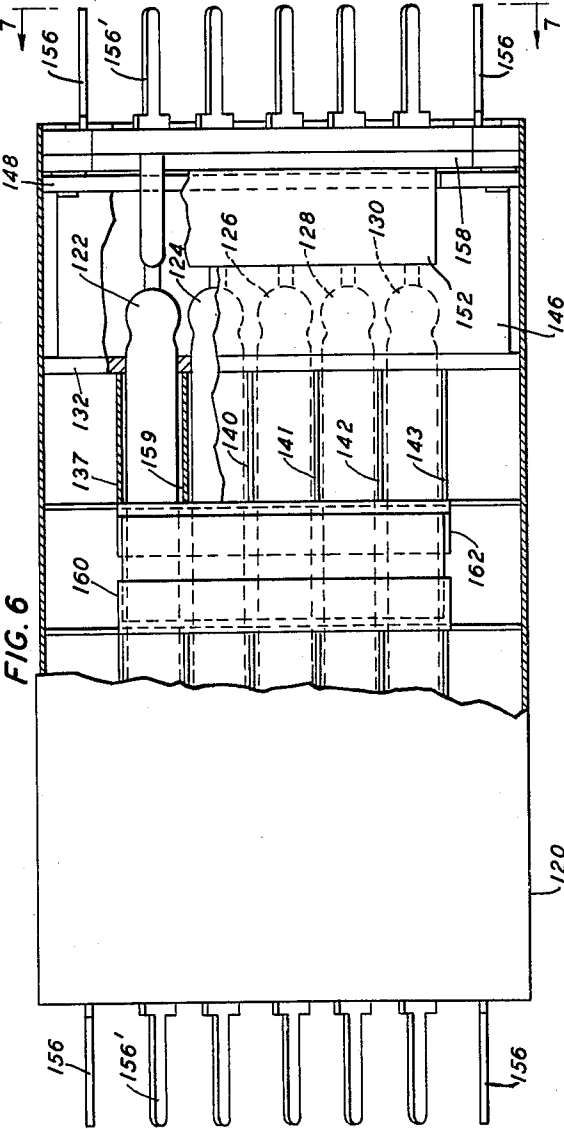
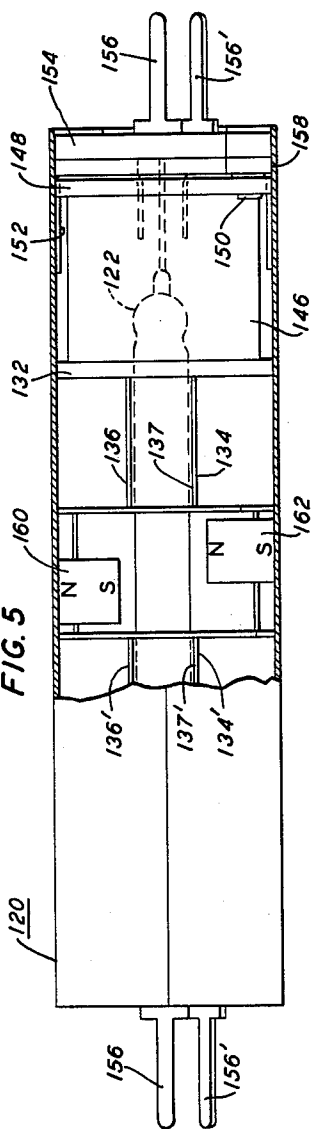
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2 Sheets-Sheet 2



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3,061,696

SWITCHING DEVICE

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11 Claims. (Cl. 200—87)

This invention relates to circuit controlling devices and more particularly to cross-coil switches employed, for example, in coordinate or cross-coil switching systems illustrated by United States Patent 2,187,115 to W. B. Ellwood and W. H. T. Holden issued January 16, 1940.

Switches of the cross-coil type comprise in general a row and column array of crosspoints, each crosspoint comprising a reed switch having a pair of magnetic reed contacts in spaced overlapping relation, a first signal winding at one end of the switch coupled to the contacts thereof and common to all crosspoints in that row and a second winding at the other end of the switch coupled to the contacts thereof and common to all crosspoints in that column, whereby the contacts are operated by a current of suitable magnitude and polarity appearing in both signal windings, the contacts being held closed by the current in one of the windings and released by the removal of the current in that winding.

Important among the criteria for evaluation of such devices in coordinate switching systems are energy requirements, freedom from false operation, pulse duration of releasing current, and stability in both the operated and unoperated states.

One general object of this invention is to improve the performance characteristics of cross-coil switches.

Another object of this invention is a lock-up cross-coil switch which cannot operate on energization of a single winding.

A more specific object of this invention is the reduction of energy requirements for cross-coil switches.

Another specific object of this invention is to render cross-coil switches relatively insensitive to shock and vibration in the operated and unoperated states.

Still another specific object of this invention is the release of contacts of cross-coil switches with current pulses of relatively short duration.

According to one feature of the invention, magnetic means provide a magnetic field transverse to the axis of the magnetic reeds of the sealed switch in the region where the reeds overlap, the field tending to separate the reeds until operation thereof and thereafter serving to hold the reeds firmly together thereby eliminating the operation of the signal windings and their accompanying energy requirement.

According to still another feature of this invention, the magnetic means are offset in opposite directions with respect to the overlapped portion of the reeds to provide the magnetic field which holds the reeds operated.

According to another feature of the invention, a magnetic shunt is provided that prevents false operation of the switch on a single coil alone, no upper limit being placed on the coil current to prevent false operation when only one coil is energized.

These and other objects and features of the invention will be apprehended more fully from the following detailed specification when taken in conjunction with the appended drawings in which:

FIG. 1 is a side view of an individual crosspoint or switching device included in the cross-coil switch of the present invention, the crosspoint shown partially broken away to show underlying structure thereof;

FIG. 2 is an end view of the crosspoint of FIG. 1 along the line 2—2;

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FIG. 3 is a cross-sectional view of the crosspoint of FIG. 1 along the line 3—3;

FIG. 4 is another embodiment of a crosspoint of a switch of the present invention;

FIG. 5 is a top view of another crosspoint using the principles of the switch of FIG. 1 with parts being broken away to show the make-up of the switch;

FIG. 6 is a side view of the crosspoint of FIG. 5 with parts being broken away to show the underlying structure; and

FIG. 7 is an end view of the crosspoint of FIG. 5.

Referring to FIG. 1, the crosspoint or switching device of the present invention comprises a conventional sealed reed switch 20 consisting of a sealed glass envelope 22 and magnetic reed contacts 24 and 26 secured in the envelope in spaced overlapped relation. The switch is supported at each end by spoolheads 28 and 30 of suitable material, e.g., fibreboard fixed within a metallic housing 50. Enclosing the ends of the switch 20 are metallic sleeves 32 and 32' which are attached to return members 52 and 52', respectively, the sleeves and members being part of the operating magnetic circuit to be described hereinafter. The sleeves also support signal windings 36 and 38, respectively, which are made up in coil fashion in a manner well known in the art.

For one direction of operating current, the magnetic circuit of the present invention is from the cover 50 through the return member 52, the sleeve 32, the reed 26, via the air gap to the reed 24, the sleeve 32', the return member 52' and thence back to the cover 50. Other magnetic circuits included in the switch are provided by magnetic shunts 40 and 40' which are of identical construction, the parts of the latter shunt being designated with prime marks to distinguish them from the parts of the former shunt. The details of the shunt are best seen in FIGS. 1 and 3. Each shunt includes a collar member 44 that encloses a portion of the switch length and a support member 46 to which the collar is attached. All of the shunt parts are of magnetic material, e.g., steel. Each shunt provides an alternate magnetic path from the adjacent reed back to the cover thereby reducing the field in the gap to the other reed.

Interposed between the shunts of the switch of FIG. 1 is a pair of permanent magnets 56 and 58 each being attached to slide members 60 and 62, respectively. The slides in turn are secured to the housing 50. The magnets are mounted on opposite sides of the reeds to supply a transverse magnetic field in the gap between the contact members 24 and 26. Additionally, the magnets are offset in opposite directions with respect to the gap to prevent balancing of magnetic forces in the air gap for reasons which will be described in more detail hereinafter.

Finally, referring to FIGS. 1 and 2, it will be seen that the switch is energized through leads which extend through grommets 68 and 70. A cover 66 fits over the housing and completes the assembly of the switch.

In the normal or unoperated position of the switch, as shown in FIG. 1, the signal windings are not energized and the reed contacts are separated. Due to closeness of positions, the reed 24 is attracted toward the magnet 56 as a result of the magnetic field thereof. Similarly, the reed 26 is attracted toward the magnet 58. The holding action of the magnets due to the flux in a path from the magnet 56 across the air gap and along the reed 24, through the shunt 40', and back through the case 50 to the opposite pole of the magnet 56 and a similar flux path through the magnet 58, the reed 26, the shunt 40, and the case 50 tends to keep the reeds separate which makes the switch relatively insensitive to shock and vibration in the unoperated state.

On energization of either the signal winding 36 or

38 a part of the magnetic field associated therewith passes between the reeds by way of the air gap therebetween. The action of the magnetic shunts 40 and 40', as the case may be, limits the magnetic field between the reeds to prevent their closing. The structure of the present shunt is such that no upper limit is placed on the current supplied to one signal winding to prevent false operation of the switch. Thus, the reeds will never close when only one signal winding is energized.

The switch is operated by energizing the signal windings 36 and 38 in the same direction and of a polarity that will cause the poles formed at the outer ends of each reed (as shown in FIG. 1) to oppose the pole of the adjacent magnet. As the reeds close, the transverse magnetic field of the magnets will aid the flux in the air gap between the reeds and thereby contribute to their closure. Once the reeds are in a closed position the transverse field of the magnets acting through a flux path from the magnet 56 through the reed 26, across the air gap to the shunt 40, back through the case 50 to the opposite pole of the magnet 56; and an aiding flux from the magnet 58 through the case 50, the shunt 40', across the air gap to the reed 24, along reed 24, across the reed 26 and back through the air gap to the opposite pole of the magnet 58 will converge in the closed portion of the reeds and provide sufficient magnetic force to retain the reeds in a closed position without the need for further current appearing in the signal windings. Thus, the energy requirement of the switch of the present invention is reduced by the action of the magnets. The holding action of the magnets varies in accordance with the strength and offset thereof and the spacing between the reeds, and is selected such that the switch will be insensitive to shock and vibration in the operated state, as well as in the unoperated state.

To release the contacts of the switch, a pulse of current having a polarity opposite to that of the closing current is supplied to either or both of the signal windings. By symmetry of design both signal windings have an equal effect on the closed portion of the reeds and may be energized to open or unlock the switch. This feature eliminates the requirement of unlocking the switch by energizing the signal windings in a prescribed sequence, as in other prior art devices.

The reverse current pulse in the windings produces a flux that reduces or nullifies the holding action of the transverse field in the reeds, the reeds separating as a consequence. The poles formed at the outer ends of the reeds, as a result of the reverse current, are opposite to those of the adjacent magnets resulting in the reeds being attracted to the particular adjacent magnet, thus opening the switch.

At the end of the release pulse, the magnetic field is again wholly that produced by the magnets, giving a pull drawing each reed toward the adjacent permanent magnet, and an opposing pull in the gap between the reeds, tending to produce closure of the reeds. With the configuration of this invention, having the permanent magnets only slightly offset, the net force resultant of these opposing pulls is in the direction to open the switch, except where the reeds are in contact or very nearly so. Hence the release pulse need only last till the reeds have started to open, as their subsequent vibration cannot restore them fully to the closed position where they would be held by the permanent magnet field, and they will therefore remain open.

Release by a pulse of short duration further decreases the energy requirements of the switch. The short release pulse also contributes to high speed operation of the switch as compared to other lock-up relays using reed switches and magnets which require a pulse duration of a considerably longer period to insure that as the reeds oscillate the gap will not be close enough for the permanent magnet field to cause closure of the reeds.

In connection with the use of the present device in

a cross-coil switch, the absence of holding current is of great advantage to such system. A cross-coil switch is described fully in my previously filed application Serial No. 712,230, filed January 30, 1958, now Patent No. 2,969,434. Briefly, a cross-coil switch comprises a plurality of crosspoint switching devices arranged in rows and columns. In each row a series connection is made among corresponding windings of each crosspoint in the row, or a common coil may replace these windings. Similarly, in each column a series connection is made among the remaining windings of each switch, or a common coil may replace these windings. A crosspoint is closed by energizing both windings which link that crosspoint and held closed by energizing a single winding. The holding current of a crosspoint sometimes combines with the energizing current of another crosspoint to produce false operation of other crosspoints. The present switch, however, overcomes this objection since the holding current is eliminated. Thus, the energizing current of another crosspoint cannot produce false operation of another crosspoint since no holding current can combine with the energizing current. Although the lock-up crosspoint of the present invention has been described with the magnets centered above the air gap, the magnets may be placed in other positions with equal effectiveness as a lock-up crosspoint in a cross-coil switch at the ends of the switch as shown in FIG. 4. The magnetic shunting (not shown) for the switch of FIG. 4, however, would be from the center of the switch to the housing and not from the ends of the switch to the housing as in the switch described in conjunction with FIGS. 1 through 3.

The application of the present invention in a crosspoint switching device 120 is shown in FIGS. 5, 6, and 7. The structure of the crosspoint 120 in FIGS. 5 and 6 will be described at one end only, the structure of the other end being identical to that described.

The crosspoint switch 120 includes five reed switches 122, 124, 126, 128, and 130 supported by a spoolhead 132 of suitable material, e.g., fibreboard. Enclosing each switch is a magnetic shunt assembly 134 consisting of vertical strips 136 and 137 and horizontal strips 138 through 143. The shunt is made up of a plurality of pigeon holes, each containing a switch, the vertical strips and the horizontal strips of the shunt covering the sides, tops, and bottoms, respectively, of the switches. The ends of the switches beyond the spoolhead 132 are surrounded by a signal winding 146 held between the spoolhead 132 and another spoolhead 148 which includes a grommet assembly 150 for connecting the leads of the winding to the outside. A pair of bracket members 152 of J-shape configuration form return path members of the magnetic circuit of the switch, the shorter legs of the brackets extending into the center of the winding whereas the longer legs overhang the winding. Terminating the end of the switch is a plate assembly for connecting the switch to outside circuitry. The assembly includes a terminal plate 154 having terminals 156 thereon and a separator member 158 having apertures to receive the flattened reed members of a switch (see FIG. 6). The separator and terminal plate apertures hold the reed switch parallel to the central plane of the supporting structure and they also locate the reed switch so that the air gap thereof is at the center line of the magnets. The terminals are connected to the reeds and the leads of the windings by soldered wires. Completing the switch are permanent magnets 160 and 162 which are spot welded directly to a housing 168 that is held in position by tab members 170 which fold against the terminal plate.

The present switch represents one crosspoint in a cross-coil switch, the operation of the crosspoint being the same as that previously described for FIGS. 1, 2, and 3 except that five reed switches are operated instead of a single reed switch.

It is to be understood that numerous other modifica-

tions of the present invention may be made by those skilled in the art without departing from the spirit and the scope of the present invention.

What is claimed is:

1. A coordinate switch comprising a plurality of magnetic reed switches arranged in row and columnar fashion, each switch having a first signal winding at one end thereof, a second signal winding at the other end thereof, the first signal windings in each row being connected in series, the second signal windings in each column being connected in series, cover means enclosing the reed switches, means for providing a magnetic field transverse to each switch to magnetically latch a switch upon operation thereof, and means for magnetically shunting each switch to prevent operation on energization of one signal winding.

2. A coordinate switch as defined in claim 1 wherein the magnetic means comprises at least one permanent magnet disposed outside the switch to provide a magnetic field which retains the contacts of the switch in a closed condition after removal of energizing currents to both signal windings.

3. A coordinate switch as defined in claim 1 wherein permanent magnets are disposed outside the switch at opposite ends of the switch, the axis of the magnets lying in a plane parallel to the reed members of the switch.

4. A coordinate switch as defined in claim 1 wherein the magnetic means provide a magnetic field transverse to the overlapping portion of the reed contacts.

5. A coordinate switch as defined in claim 1 wherein the magnetically shunting means is between the windings and comprises a plurality of vertical strips and horizontal strips forming a plurality of pigeon holes, each reed switch being assigned to a pigeon hole, the horizontal and vertical strips being connected to the cover means of said switch.

6. A switching device comprising a pair of fixed magnetic reeds, corresponding ends of said reeds being in spaced overlapping relation, magnetic means supplying a magnetic field in the region where the reeds overlap, a first signal winding encompassing one reed member, a second signal winding encompassing the other reed member, and means for bypassing the magnetic field to the reeds so that closure thereof occurs only when both windings are energized.

7. A switching device comprising a pair of magnetic reeds, corresponding ends of said reeds being in spaced overlapping relation, at least one permanent magnet supplying a magnetic field through a magnetic shunting means to the region where the reeds overlap, a first signal wind-

ing encompassing one reed member, and a second signal winding encompassing the other reed member.

8. A switching device comprising a sealed envelope, a pair of magnetic reeds within said envelope, one end of each reed being supported in the envelope, the other end of the reeds being in spaced overlapping relation, a pair of permanent magnets on opposite sides of the envelope supplying a magnetic field through magnetic shunting means to the region where the reeds overlap, a first signal winding encompassing one reed member, and a second signal winding encompassing the other reed member.

9. A switching device comprising a sealed envelope, a pair of magnetic reeds within said envelope, one end of each reed being supported in the envelope, the other end of the reeds being in spaced overlapping relation, magnetic means offset in opposite directions with respect to the overlapping portions of the reeds, a first signal winding encompassing one reed member, and a second signal winding encompassing the other reed member.

10. The switching device defined in claim 9 wherein the magnetic means supplies a magnetic field transverse to the overlapping portion of the reed contacts.

11. A switch device comprising a sealed envelope, a pair of magnetic reeds within said envelope, one end of each reed being supported in the envelope, the other end of the reeds being in spaced overlapping relation, a pair of permanent magnets on opposite sides of the envelope offset in opposite directions with respect to the overlap portion of the reeds, a first signal winding encompassing one end of said envelope, a second signal winding encompassing the other end of said envelope, first and second magnetic shunt means associated with the first and second signal windings, respectively, each shunt including a sleeve and a support member connected to a housing enclosing the switch.

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