May 18, 1965 E. R. MYATT 3,184,563

MAGNETICALLY CONTROLLED REED SWITCHING DEVICE

Filed Sept. 7, 1962

Fig. 1.

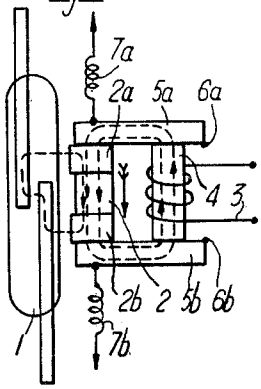


Fig. 2.

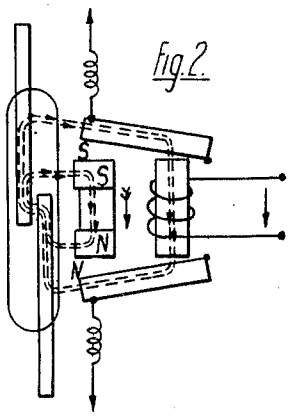


Fig. 3.

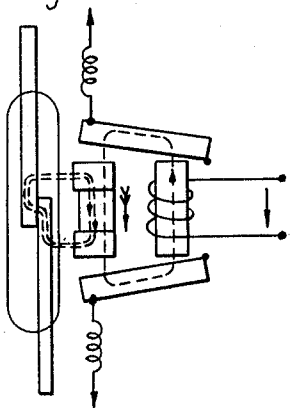


Fig. 4.

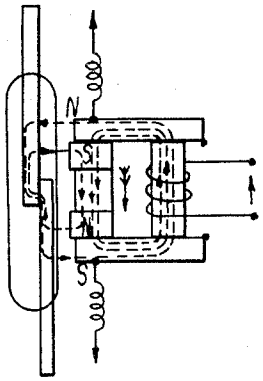
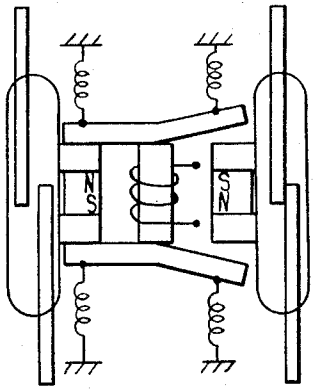


Fig. 5.



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MAGNETICALLY CONTROLLED REED SWITCHING DEVICE

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7 Claims. (Cl. 200—87)

The present invention relates to reed relays and more particularly to holding arrangements for such relays.

A reed relay is an electromagnetic relay having one or more reed switches (sometimes called a reed contact) for its contacting elements. A reed switch is a known device and in one form consists of a pair of leaf springs made from magnetic material having prepared contacting surfaces at their free ends which are adjacent but separated by a small gap, and sealed in a protective case; usually glass.

To operate the reed switch a magnetic flux is induced into the springs so as to set up a magnetic field across the gap between the adjacent ends. This causes the springs to bend towards each other and so close the contacts. When the flux is removed the springs draw apart under their own tension and the contacts open.

The operating flux is usually generated by passing a D.C. through an electric coil surrounding the relay, but in order to maintain the contacts closed it is necessary to keep the energising current flowing thereby consuming a large amount of power.

It has been proposed to overcome this difficulty by placing permanent magnets close to the reed so that the permanent magnet supplies the necessary flux to hold the contacts together after they have been operative by a pulse of current applied through the operating coil.

Hitherto such holding arrangements have been difficult to apply in practice, especially where one permanent magnet has to hold three or four reed switches, because variations in operating characteristics between reed switches, variations in permanent magnet steels, and variations in operating and releasing pulses, all combine to make the difference between a correct and incorrect operation very marginal.

In the present invention we provide a holding circuit for a reed relay which is more reliable in operation and better adapted to mass production techniques. It should be noted, however, that the invention is applicable to relays other than reed relays.

According to the present invention therefore there is provided an electro-magnetic relay in which a magnetic circuit associated with one or more contact units each of whose contacts is both electrically and magnetically conductive includes a source of a steady magnetic flux large enough to retain said one or more contacts operated in which said said magnetic circuit also includes means for switching at least a major portion of the source's flux between a first flux path including said one or more contact units and a second flux path not including said one or more contact units, said flux being effective to maintain said one or more contact units operated when in said first flux path but not when in said second flux path, and in which said magnetic circuit has an operating coil which, when energized, changes the condition of said switching means so that said flux from said source is switched from said first flux path to said second flux path or vice-versa.

The invention will now be described with reference to the accompanying drawings in which:

FIG. 1 is a schematic diagram of a relay according to the invention in the released condition,

FIG. 2 shows the flux distribution of the relay when an operating pulse is applied,

FIG. 3 shows the relay in the held condition,

FIG. 4 shows the flux distribution when a pulse is applied to release the relay, and

FIG. 5 shows a method of operating a pair of reed switches.

The relays to be described are of the type known as remanent relays, a remanent relay being a relay which can be operated by the application of an operating current and which will remain in the operated condition when the operating current ends. In the relays to be described the magnetic circuit includes a source of magnetic flux other than the operating coil which can hold the contacts in an operated condition. In the unoperated condition of the relay the magnetic fluix is diverted away from the contacts, but when the relay is operated the operating current so modifies the magnetic circuit that the flux from the above-mentioned source flows in a circuit which includes the contacts which are to be retained in the operated condition when the operating current ends. To release the relay it is necessary to apply a further current to the operating coil so as to restore the magnetic circuit to its condition in which the contacts are not held operated: when this occurs the contacts revert to their non-operated states.

Referring to FIG. 1, a reed switch **1** has a permanent magnet **2** with magnetic end slings **2***a* and **2***b* mounted adjacent the envelope and opposite the gap between the reed switch springs. An electromagnet having a winding **3**, a soft iron core **4**, and a pair of armatures **5***a* and **5***b* pivoted at **6***a* and **6***b* is mounted so that the free ends of the armatures are adjacent the slings **2***a* and **2***b*. A pair of springs **7***a* and **7***b* bias the armatures away from the slings.

In the released condition shown in FIG. 1, the armatures **5***a* and **5***b* are in contact with the end slings **2***a* and **2***b* and the ends of the electromagnet core **4**. The flux from the permanent magnet **2** travels through a magnetic armature holding circuit consisting of the sling **2***b*, armature **5***b*, core **4**, armature **5***a*, and sling **2***a*. This flux is sufficient to hold the armatures **5***a* and **5***b* in the position shown against the action of the bias springs. The dimensions of the armature holding circuit are such that practically all the flux produced by the permanent magnet is absorbed by the circuit so there is only an insignificantly small flux from the permanent magnet flowing through the springs of the reed relay. The dotted lines show the flux paths.

To operate the relay a pulse of current is applied to the coil **3** so as to produce a counter flux in the core **4** as shown in FIG. 2. This causes the armatures **5***a* and **5***b* to drop-off under the action of the bias springs **7***a* and **7***b*. The armature holding circuit now has a high reluctance so that the flux of the permanent magnet **2** is directed to the springs of the reed switch. This flux, together with the flux produced by the pulse in coil **3** which also flows in the reed switch springs via the armatures **5***a* and **5***b*, is sufficient to close the reed contacts.

After the decay of the switching pulse the flux of the permanent magnet continues to flow through the reed springs so as to hold them closed—see FIG. 3.

To release the reed contacts a pulse is applied to the coil **3** so as to generate a flux in the core **4** having a direction shown in FIG. 4. This flux flows through the armature **5***a* and **5***b* and sets up a counter flux to the permanent magnet flux in the reed springs, which now open. At the same time the flux produced by this pulse is in the same direction as that produced by the permanent magnet in the armature magnetic circuit referred to above. The combined action of these fluxes is sufficient to cause

the armatures *5a* and *5b* to operate so that they once again assume the positions shown in FIG. 1.

In order to simplify the explanation of the operation only one reed switch has been shown in the figures. In a practical case two or more reed switches may be mounted on to the slings *2a* and *2b* so that all the reeds are opened and closed together.

In FIG. 5 there is shown a method of operating a pair of reed switches so that when the contacts of one reed switch are closed the contacts of the other are open and vice-versa. It will be noted that the two permanent magnets are oppositely polarised, so that a pulse in the coil acts simultaneously as an (operating or releasing) pulse for one half of the relay and a releasing (or operating) pulse for the other half. The armatures may of course be separate and pivoted as before, but FIG. 5 shows as an alternative a double-ended bent armature for each end of the core with a "knife-edge" pivot.

Sealed contact relays such as described above are especially convenient for use as cross-point elements in an automatic telephone exchange. Each cross-point in a switching array, at which a connection can be made between one of the inlets to the array and one of the outlets from the array, can have a single reed contact for each wire. Each of these reed contacts can be a reed contact controlled in the manner described above with reference to FIGS. 1 to 4 inclusive.

What I claim is:

1. An electrical switching device comprising a reed switch and associated magnetic flux system for selectively controlling the operation and restoration of said switch, the said magnetic flux system comprising a first flux source in flux linking relationship with said reed switch for generating magnetic flux of a magnitude insufficient to operate said reed switch, but sufficient to hold said reed switch operated, a selectively operable second flux source in flux linking relationship with said reed switch for generating magnetic flux and including correspondingly selectively operable armature means for magnetically shunting the said first flux source to operate the said switch, to hold the said switch operated, and to restore said operated switch in controlled sequence.

2. The electrical switching device as set forth in claim 1, wherein said first flux source comprises a permanent magnet having a pair of salient poles and the said second flux source comprises an electromagnet, and wherein said armature means includes a pair of armatures operable in response to energization of said electromagnet to engage respective ones of said poles and establish a magnetic short circuit therebetween.

3. The electrical switching device as set forth in claim 2 wherein said electromagnet comprises an electrical winding selectively energizable to generate magnetic flux through said reed switch in opposing relationship and in aiding relationship with the said magnetic flux generated by said first flux source.

4. The electrical switching device as set forth in claim 2 wherein said armatures are magnetically held in engagement with said poles when said electromagnet is deenergized.

5. An electrical switching device comprising a reed switch and associated magnetic flux system for selectively controlling the operation and restoration of said reed switch, the said magnetic flux system comprising a permanent magnet having a pair of salient poles in flux linking relationship with said switch and having a magnetic field of magnitude insufficient to hold said switch operated, a selectively operable electromagnet having a pair of armatures comprising salient poles of said electromagnet and movable into and out of engagement with said permanent magnet poles in response to different polarizations of said electromagnet, momentary energization of said electromagnet in a first direction moving said armatures out of engagement with said permanent magnet poles and operating said switch by combining said permanent magnet and electromagnet flux in aiding relationship through said switch.

6. The electrical switching device as set forth in claim 5 wherein momentary energization of said electromagnet in a second direction releases said operated switch by combining said permanent magnet and electromagnet flux in opposing relation through said switch.

7. The electrical switching device as set forth in claim 6 wherein flux generated by the energization of said electromagnet in a first direction opposes the flux from the said permanent magnet at the point of engagement of said armatures and said poles to move said armatures out of engagement therewith.

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