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3,284,741

LOCK-UP REED SWITCH

Filed April 21, 1964

Fig. 1

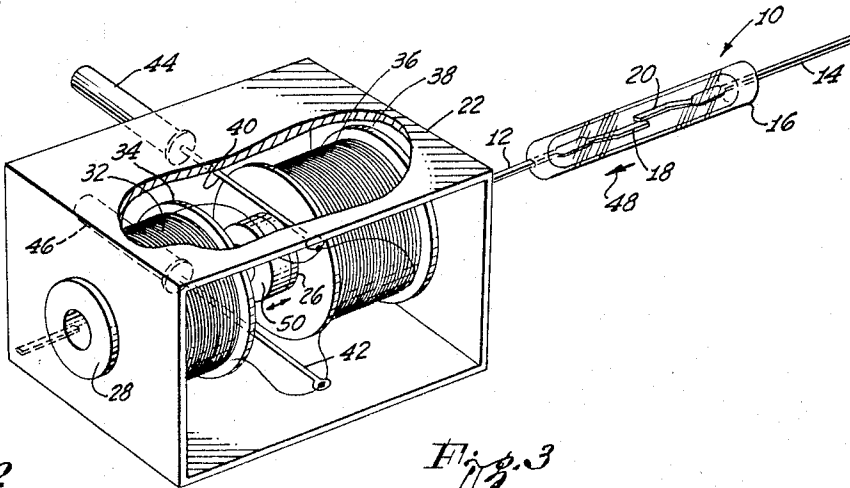


Fig. 2

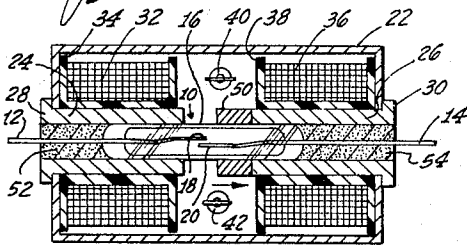


Fig. 3

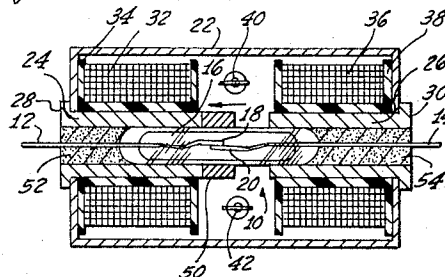


Fig. 4

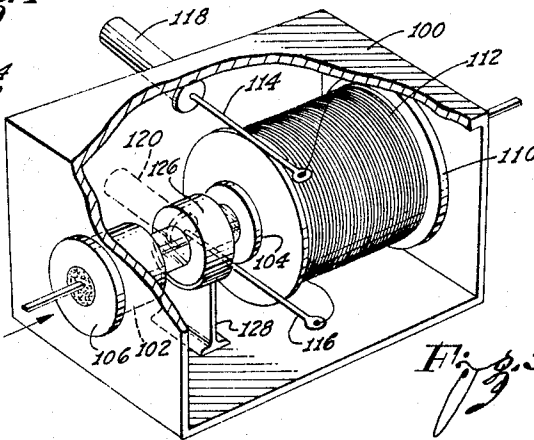
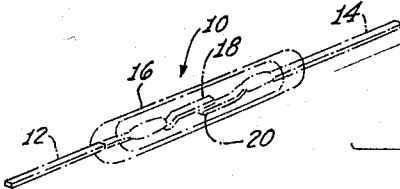
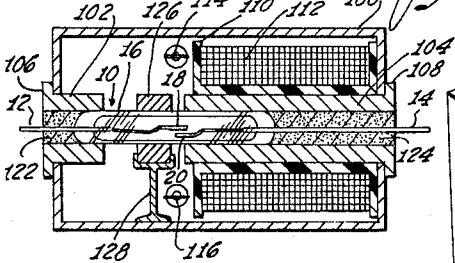


Fig. 5

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LOCK-UP REED SWITCH

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This application relates to a relay incorporating a reed switch which will be referred to as a reed relay. More particularly, the application relates to a lock-up type of reed relay.

An ordinary reed switch is constructed of a pair of reed elements extending through opposite ends of an elongated envelope. The reed elements overlap each other within the envelope and the overlapped portions of the reed elements provide contact areas. The reed elements are constructed of magnetic material and the position of the reed elements is influenced by magnetic fields. Usually a winding is disposed around the envelope to provide a particular type of magnetic field. When current is applied to the winding in a particular direction a magnetic path is established through the reed switch which magnetizes the reeds and moves the reeds toward each other to provide physical contact of the reeds at the contact areas.

In order to maintain the reed switch in a closed position, it is necessary to maintain current flowing through the winding. When it is desirable to keep the reed switch in a closed position for a long period of time, the maintenance of the current, of course, poses a constant drain on the power supply. Attempts have been made in the prior art devices to maintain the reed switch in a closed position without the use of constant current through the winding. The invention of the present application relates to a lock-up reed switch which uses a standard type of reed switch. The reed switch unit which is incorporated in the reed relay requires no special construction or special materials. The reed relay of the present invention may be used as part of stepping switches in telephone circuits or as part of a matrix converter in data processing systems or in any other types of applications where a lock-up type of reed switch is needed.

In a first embodiment of the invention, a permanent magnet is disposed at a particular distance from the overlapped portions of the reed elements. The particular distance is sufficiently far from the overlapped portions so that the magnetic field produced by the permanent magnet will not allow the reed elements to close. The reed relay is switched to a closed position by moving the permanent magnet to a position adjacent to the overlapped portions of the reed elements. In this position, the field produced by the permanent magnet exerts sufficient force on the overlapped portions of the reeds so that the reeds move toward each other to close. The reed relay is opened by moving the permanent magnet away from the overlapped portions of the reed elements.

In a particular structural design of the first embodiment of the invention, the permanent magnet is formed in a toroidal shape and slides along the envelope of the reed switch. A pair of windings are disposed at opposite ends of the envelope and energization of the windings controls the position of the permanent magnet.

In a second embodiment of the invention, a permanent magnet is disposed adjacent to the overlapping portions of the reed elements. The field produced by the permanent magnet is not sufficient to produce a closure of the reed elements. A winding is disposed around one end of the envelope, and energization of the winding produces a magnetic field in combination with the magnetic field produced by the permanent magnet, which is sufficient to

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close the reed switch. After de-energization of the winding, the field produced by the permanent magnet is sufficient to hold the reed switch in the closed position. A clearer understanding of the invention will be had with reference to the drawings, wherein:

FIGURE 1 illustrates a cutaway view of a first embodiment of the invention showing the reed switch in a position outside of the reed relay case;

FIGURES 2 and 3 show cross-sectional views of the embodiment of FIGURE 1 and illustrate the operation of the reed relay from an open to a closed position;

FIGURE 4 is a cross-sectional view of a second embodiment of the invention; and

FIGURE 5 is a cutaway view of the embodiment of FIGURE 4.

In FIGURES 1, 2 and 3 the first embodiment of the invention is shown. A reed switch 10 includes reed elements 12 and 14 which extend through opposite ends of an elongated envelope 16. Overlapping portions 18 and 20 of the reeds 12 and 14 form the contact area of the reed switch.

A casing 22 has openings at either end to receive tubular members 24 and 26. Integral flanges 28 and 30 are located at the extremities of the tubular members 24 and 26. The tubular members 24 and 26 are constructed of magnetic material. A first winding 32 is wound around a spool 34, and the spool 34 surrounds the tubular member 24. A second winding 36 is wound around a spool 38. The spool 38 surrounds the tubular member 26. The windings 32 and 36 are wound in opposite directions and may be either connected in series or in parallel. The windings illustrated in FIGURE 1 are connected in parallel.

The windings 32 and 36 are connected to wires 40 and 42 which are in turn soldered within terminals 44 and 46. The reed switch 10 is slid into the casing 22 as shown by the arrow 48 and the ends of the reed switch are surrounded by the tubular members 24 and 26. A toroidal permanent magnet 50 is disposed around the envelope of the reed switch 10 in sliding relationship to the reed switch in a position intermediate the ends of the tubular members 24 and 26. In order to maintain the reed switch 10 in a fixed position, the tubular members 24 and 26 may be partially filled with potting compound 52 and 54.

A clearer understanding of the operation of the lock-up reed switch of FIGURES 1, 2 and 3 may be seen with reference to FIGURES 2 and 3 wherein FIGURE 2 illustrates the reed relay in an open position, and FIGURE 3 illustrates the lock-up reed relay in a closed position. In FIGURE 2 it can be seen that the contact areas 18 and 20 of the reeds 12 and 14 are separated from each other. The permanent magnet 50 is to be righthand side of the gap between the ends of the tubular members 24 and 26. The permanent magnet 50 is to the righthand side of the tubular member 26 and is maintained in this position by magnetic attraction.

In order to close the reed relay, current is applied to the terminals 44 and 46. Since the windings 32 and 36 are wound in opposite directions, the magnetic fields produced by the windings are in opposite directions. The directions of the magnetic fields produced by the winding are arranged in relationship to the magnetic field produced by the permanent magnet 50 so that the permanent magnet 50 is moved toward the tubular member 24. This can be seen in FIGURE 3 where the permanent magnet 50 has moved to a position adjacent to the tubular member 24. In order to insure a positive action in the movement of the permanent magnet 50, the magnetic field produced by the winding 32 attracts the permanent magnet and the magnetic field produced by the winding 36 repels the permanent magnet 50.

The permanent magnet 50 when in the position shown in FIGURE 3 produces a magnetic field which is sufficient to magnetize the reeds 12 and 14 so that the contact areas 18 and 20 are attracted to each other. After the permanent magnet 50 has moved from its righthand to its lefthand position, the current applied to the terminals 44 and 46 may be removed and the permanent magnet 50 remains in its lefthand position magnetically attached to the member 24. The reed elements are maintained in a closed position as long as the magnetic member 50 remains in the lefthand position.

In order to reopen the reed elements of the reed relay, current is applied to the terminals 44 and 46 in an opposite direction to the current applied to close the reed switch. The application of current in an opposite direction produces magnetic fields in the windings 32 and 36 which repel the permanent magnet 50 from the winding 32 and attract the permanent magnet 50 to the winding 36. The permanent magnet then moves to the position as shown in FIGURE 2 and the reeds separate since they are no longer under the influence of the magnetic field produced by the permanent magnet 50.

It will be appreciated that the entire unit may be potted, with the exception of the space in which the permanent magnet slides. The potting of the entire unit would allow for extreme shock and vibration tolerances in the relay and would help to prevent moisture from entering into the reed relay.

FIGURES 4 and 5 illustrate the second embodiment of the invention wherein a fixed permanent magnet is used to maintain a reed switch in a closed position. In FIGURES 4 and 5 a reed switch 10 includes reed elements 12 and 14, an envelope 16 and contact areas 18 and 20 identical to the reed switch 10 of FIGURES 1, 2 and 3. A relay casing 100 has openings at opposite ends and tubular members 102 and 104 are disposed within the openings. An integral flange 106 is located at one end of tubular member 102, and an integral flange 108 is located at the other end of the tubular member 104.

A spool member 110 surrounds the tubular member 104 and a winding 112 is wound on the spool 110. The winding 112 is connected to wires 114 and 116 which in turn are soldered to terminals 118 and 120. The reed switch 10 is slid into the casing 100 and is supported at its extremities by tubular members 102 and 104. The reed switch 10 may be held in fixed position by the use of potting material 122 and 124. A permanent magnet 126 is formed in a toroidal shape and surrounds the envelope 16 of the reed switch 10 at a position to the left of the overlapping portion of the reed elements 12 and 14. The permanent magnet 126 is held in a fixed position by a support member 128. It will be appreciated that the permanent magnet 126 may be held in its fixed position by many different means other than the support member 128. Additionally, the entire relay may be potted and since the permanent magnet remains in a fixed position, there is no necessity for providing room within the surrounding area of the permanent magnet for sliding movement.

As shown in FIGURE 4, the reed relay is in an open position. When current is applied to the winding in a first particular direction, the reed elements 12 and 14 attract each other to close the reed switch. The current is applied to the winding 112 in a direction to aid the magnetic field produced by the permanent magnet 126. The permanent magnet 126, however, does not provide a sufficient field to close the reed elements 12 and 14. The additional magnetic field is supplied by the energization of the winding 112. After the reed switch is in a closed position, the current is removed from the winding 112. The magnetic field produced by the permanent magnet 126 is designed to provide sufficient force to hold the reed elements 12 and 14 in the closed position. This is possible since a smaller magnetic field is required to

hold the reed elements in a closed position than is required to initially close the reed elements from an open position.

The reed elements will remain in a closed position by operation of the permanent magnet 126 until it is desired to reopen the switch. The reopening is accomplished by providing a current through the winding 112 to oppose the magnetic field produced by the permanent magnet 126. This neutralizes the effect of the permanent magnet 126 and the reed elements reopen. Upon the removal of the opposing current from the winding 112 the magnetic field produced by the permanent magnet 126 is not sufficient to reclose the reed switch.

The two embodiments of the reed relays shown in FIGURES 1 through 5 both incorporate reed switches of standard construction. There is no necessity to use special materials or provide special construction of the reed switches. It will be appreciated that the invention has been described with reference to particular embodiments, but that other adaptations and modifications may be made. The invention, therefore, is only to be limited by the appended claims.

What is claimed is:

1. In combination with a switch device including an envelope and having a pair of magnetic reeds within the envelope with one end of each reed supported in the envelope and the other ends of the reeds in spaced overlapping relation,

a permanent magnet for providing a magnetic field, magnetic means operatively coupled to the permanent magnet for locating the permanent magnet at a particular distance from the spaced overlapping ends of the reeds,

means operatively coupled to the permanent magnet for moving the permanent magnet to a position adjacent the overlapping ends of the reeds, and magnetic means operatively coupled to the permanent magnet for maintaining the permanent magnet at the position adjacent the overlapping ends of the reeds.

2. In combination with a switch device including an envelope and having a pair of magnetic reeds within the envelope with one end of each reed supported in the envelope and the other ends of the reeds in spaced overlapping relation,

a permanent magnet for providing a magnetic field, magnetic means operatively coupled to the permanent magnet for locating the permanent magnet at a particular distance from the spaced overlapping ends of the reeds,

a source of energy, a winding operatively coupled to the source of energy for providing a magnetic field in response to the energy to move the permanent magnet to a position adjacent the overlapping ends of the reeds, and magnetic means operatively coupled to the permanent magnet for maintaining the permanent magnet at the position adjacent the overlapping ends of the reeds.

3. A switching device, including an envelope, two magnetic contact members enclosed in and extending through respective ends of the envelope and having the inner ends of the magnetic contact members forming spaced overlapping contact areas, first and second windings electrically interconnected and disposed at the respective ends of the envelope, a permanent magnet disposed adjacent to the envelope and movable between a first position adjacent to the first winding and a second position adjacent to the second winding, and first and second magnetic means adjacent the first and second windings and operatively coupled to the permanent magnet for maintaining the permanent magnet at the first and second positions.

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4. A switching device, including an envelope,
 two magnetic contact members enclosed in and extending through respective ends of the envelope and having the inner ends of the magnetic contact members forming spaced overlapping contact areas. 5
 a source of energy for producing first and second oppositely polarized signals,
 first and second windings electrically interconnected and disposed at the respective ends of the envelope and responsive to the first and second oppositely polarized signals for producing first and second magnetic fields, 10
 a permanent magnet operatively coupled to the first and second windings and disposed adjacent to the envelope and with the permanent magnet movable back and forth between a first position adjacent to the first winding and a second position adjacent to the second winding when the first and second windings produce first and second magnetic fields, and 20
 first and second magnetic means adjacent the first and second windings and operatively coupled to the permanent magnet for maintaining the permanent magnet at the first and second positions. 25
5. In combination with a switch including an elongated envelope, a pair of magnetic reeds extending through respective ends of the envelope and having a portion of the inner ends of the reeds in spaced overlapping relationship, 30
 first and second magnetic tubular members surrounding the respective ends of the elongated envelope and having the spaced overlapping portion of the reeds intermediate the first and second tubular members at a position adjacent to the first tubular member, 35
 a first electrical winding surrounding the first tubular member,

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- a second electrical winding wound in an opposite direction to the first electrical winding and electrically interconnected with the first electrical winding and surrounding the second tubular member,
 a permanent magnet surrounding the elongated envelope at a position intermediate the first and second tubular members, and
 means operatively coupled to the first and second windings for energizing the first and second windings with a first polarized signal for attracting the permanent magnet to the first winding to become magnetically attached to the first tubular member and for energizing the first and second windings with a second oppositely polarized signal for attracting the permanent magnet to the second winding to become magnetically attached to the second tubular member.

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