Aug. 31, 1965 T. N. SAATY 3,204,059

MAGNETICALLY LATCHED RELAY

Filed Nov. 15, 1962

FIG. 1

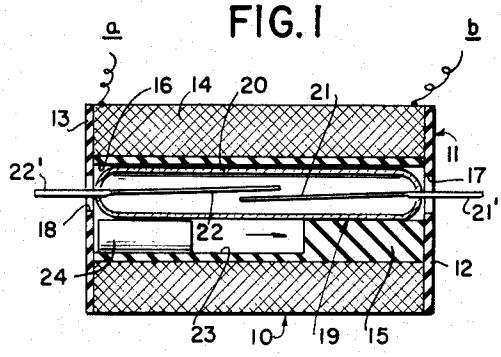
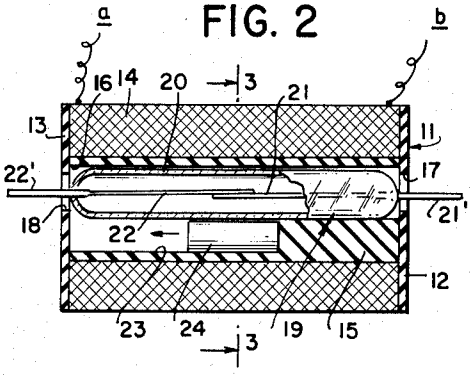


FIG. 2



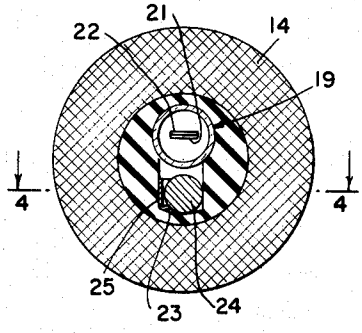


FIG. 3

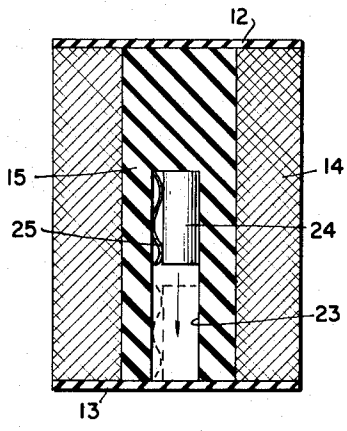


FIG. 4

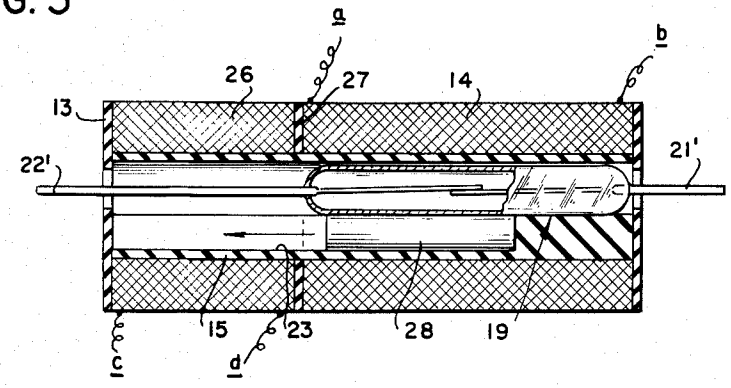


FIG. 5

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MAGNETICALLY LATCHED RELAY

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This invention relates to a novel electrical relay in which provision is made for producing a bagnetic field which serves to actuate the relay and for bringing into operation another magnetic field which serves to lock the relay in its actuated condition.

More specifically, the relay of the present invention includes magnetically actuated contacts, an electrical coil or solenoid for actuating said contacts, and means for producing another magnetic field which is capable of being brought into operative relationship with the contacts, either by the magnetic field of the solenoid with actuates the contacts or by a separate solenoid, in order to hold the contacts of the relay in their actuated condition.

Although the relay of the present invention can be designed to bring the latching magnetic field into or out of operation each time the solenoid is energized, an ancillary feature of the relay is that it can also be designed so that only the contacts of the relay will be actuated when the solenoid is energized by a weaker current and the latching magnetic field of the relay is brought into or out of operative relationship with the contacts only when the solenoid is energized by a stronger current.

In a preferred embodiment, the latching magnetic field is produced by a permanent magnet accommodated for movement within the relay from an inoperative position to a position at which its field exerts a latching effect on the contacts of the relay. In this arrangement, both the contacts of the relay and the permanent magnet are within and influenced by the magnetic field produced by the solenoid. Thus, the contacts of the relay are actuated upon each energization of the solenoid, and when the magnetic field of the solenoid is strong enough and of proper polarity, the permanent magnet is displaced thereby from one position to another.

For a more complete understanding of the invention, reference may be had to the following detailed description taken in conjunction with the accompanying figures of the drawings, in which:

FIGURE 1 is a side view in longitudinal cross-section of the magnetically latched relay showing the solenoid thereof energized by an electrical potential of one polarity;

FIGURE 2 is a side view in longitudinal cross-section of the relay shown in FIGURE 1 with the electrical potential which energizes the solenoid reversed;

FIGURE 3 is a cross-sectional view of the relay taken along the line 3—3 of FIGURE 2, looking in the direction of the arrows;

FIGURE 4 is a cross-sectional view of the relay taken along the line 4—4 of FIGURE 3, looking in the direct tion of the arrows; and

FIGURE 5 is a side view in longitudinal cross-section of another embodiment of the invention.

The magnetically latched relay **10**, shown in FIGURE 1, includes a hollow spool-like frame **11** of magnetically impermeably, rigid material, such as Bakelite. The frame **11** has a shank **15** on which a core **14** of magnet wire is wound between two discs **12** and **13** which form the ends of the frame **11**. The shank **15** is provided with a longitudinal channel **16** extending therethrough and in communication with centrally disposed apertures **17** and **18** formed in the discs **12** and **13**, respectively.

A switch **19**, comprising a sealed capsule **20** of glass or some similar material and containing two partially overlapping contacts **21** and **22**, formed of ferrous or other magnetic material, is accommodated within the channel **16**. The sealed capsule **20** can, if necessary, be resiliently mounted within the channel by one or more rings or sleeves interposed between the capsule and the frame **11**. The contacts **21** and **22** are embedded in and supported at opposite ends of the glass capsule, and the inner overlapping ends thereof are normally spaced apart from each other when the coil **14** is not energized. The external leads **21'** and **22'** of the contacts **21** and **22**, respectively, project through and extend beyond the apertures **17** and **18**, respectively.

The shank **15** of the frame **11** also contains a channel or groove **23** which extends from the inner surface of the disc **13** to some distance beyond the midsection of the frame **11**. In the embodiment shown, the channel **23** is in open communication with the channel **16**, and the outer surface of the glass capsule **20** defines part of the channel **23**.

A permanent magnet **24** is accommodated within the channel **23** for sliding movement from one end to the other. A leaf spring **25** of wavy form is affixed to a side of the magnet **24** and bears against the wall of the channel **23** with light friction so that the magnet **24** will be displaced by the magnetic field established by the coil **14** but will not move or slide accidentally under the influence of gravity if it is oriented in different positions.

In operation, the energization of the coil **14** produces a magnetic field through the channel **16** of the frame, closing the ferrous contacts **21** and **22**. In addition, if the strength of the magnetic field is sufficiently high and of proper polarity, the permanent magnet **24** will be displaced from one end of the channel **23** to the other.

When the permanent magnet **24** is in the position illustrated in FIGURE 1, that is to say, the position remote from the overlapping ends of the contacts **21** and **22**, its magnetic field will not have any significant effect on the contacts. When an electrical potential of proper polarity is supplied to the input terminals *a*, *b* of the coil **14**, the permanent magnet **24** will be displaced within the channel **23** from the inoperative position shown in FIGURE 1 to the operative position shown in FIGURE 2, at which operative position the magnetic field produced by the permanent magnet will hold the contacts **21**, **22** closed even though the coil **14** is then deenergized. When the polarity of the electrical potential supplied to the input terminals *a*, *b* of the coil **14** is reversed, as illustrated in FIGURE 2, the permanent magnet **24** will be displaced from the operative position shown in FIGURE 2 to the inoperative position shown in FIGURE 1.

In the operation of the relay, the energization of the coil **14**, irrespective of the polarity of the electrical potenial supplied to the input terminals *a*, *b* of the coil **14**, produces a magnetic field through the channel **16** of the frame with maximum concentration through the ferrous contacts **21** and **22**, thereby closing the contacts. In addition, if the strength of the magnetic field is sufficiently high and of proper polarity, the permanent magnet **24** will be shifted between its inoperative position and its latching position.

In one proposed type of relay of the present invention, the coil **14** of the relay is responsive both to stronger and weaker pulses of varying polarity. The weaker pulses, irrespective of polarity, will close the contacts **21** and **22** of the relay for the duration of the energization of the coil **14**. On the other hand, a stronger pulse of

proper polarity will displace the permanent magnet 24 from the inoperative position shown in FIGURE 1 to the latching position shown in FIGURE 2 to maintain the contacts closed even beyond the duration of the pulse supplied to the coil 14. The magnetically latched contacts 21 and 22 will remain closed until a relatively strong pulse of opposite polarity is supplied to the coil 14 to displace the permanent magnet from the latching position to the inoperative position, whereupon after the duration of the pulse, the inherent resiliency of the contacts will restore them to open condition.

In the alternative embodiment of the invention shown in FIGURE 5, a second coil 26 is wound on an extended end portion of the shank 15 separated from the coil 14 by a separator disc 27 of insulating material. The groove 23 continues into the extended portion of the shank 15, terminating at the inner surface of the disc 13. A permanent magnet 28 is slidingly positioned within the groove 23.

In operation, the coil 14 is energized to close the contacts 21 and 22. Moreover, the coil 26 is independently energized by impressing an electrical potential of proper polarity across the coil terminals *c*, *d*, where its magnetic field latches the contacts 21 and 22 in closed condition. By reversing the polarity of the potential impressed on the coil terminals, the magnet can be restored to its initial inoperative position.

Thus in the embodiment of the invention shown in FIGURE 5, the permanent magnet is kept substantially out of the magnetic field of the coil 14 in its inoperative position, thereby reducing the demagnetizing influence of the magnetic field established by the coil 14. Moreover, the motion of the permanent magnet 28 can be controlled independently of the magnetic field of coil 14, so that only the power necessary to actuate the contacts 21, 22 need be supplied to the coil 14.

It will be obvious to those skilled in the art that the above described exemplary embodiments are susceptible of modification and variation without departing from the spirit of the invention. The invention, therefore, should not be limited to any specified form or embodiment, except insofar as such limitations are expressly set forth in the claims.

I claim:

1. A relay comprising at least one magnetic reed contact, means for producing a magnetic field which, when rendered operative, latches said contact in one condition of operation, and means for producing a reed-actuating magnetic field which is magnetically coupled with said contact and said first-mentioned means for producing a latching magnetic field said reed-actuating magnetic field actuating the magnetic reed contact and rendering operative the means for producing said latching magnetic field.

2. A relay comprising a pair of magnetically activated contacts normally in one position relative to each other in the presence of a magnetic field, means for producing a first magnetic field magnetically coupled to the pair of contacts for shifting the contacts from one position to another, means for producing a second magnetic field which means is within the influence of said first magnetic field so that if the first magnetic field is of sufficient strength and proper polarity the means for producing said second magnetic field is displaced to a position where the second magnetic field holds the contacts in their actuated position.

3. A relay comprising at least one magnetic reed contact, means for producing a first magnetic field which actuates the contact, and movable means for producing a second magnetic field which holds the contact in actuated condition, the movement of said movable means being determined by the polarity of said first magnetic field.

4. A relay comprising a frame, magnetic reed contacts supported by said frame, a winding on said frame which, when energized, actuates the contacts, and magnetic field producing means supported for movement in said frame from a position at which the magnetic field has no influence on said contacts to a position at which the magnetic field holds said contacts in actuated condition, said movable means being displaced by the magnetic field of said winding.

5. A relay comprising a spool-like insulated frame, a winding on said frame, a sealed capsule mounted within said frame, a pair of magnetic contacts within the capsule and actuated by the energization of the winding, and a permanent magnet within said insulated frame and accommodated for movement from a position in which the magnetic field thereof has no significant influence on the contacts to a position in which it holds the contacts in actuated condition, the displacement of said permanent magnet being controlled by the magnetic field produced by said winding.

6. A relay as set forth in claim 5 including resilient means to hold said permanent magnet against displacement by gravity.

7. A relay comprising a frame, magnetic reed contacts, a solenoid for actuating said contacts, a magnet accommodated for movement within said frame from a position in which it does not hold the contacts in actuated condition to a position in which it holds the contacts in actuated condition and means for displacing the magnet from one position to the other.

8. A relay as set forth in claim 7 in which said means for displacing the magnet is a separate solenoid.

9. A relay comprising a spool-like insulated frame, first and second windings on said frame, a sealed capsule within said first winding, magnetically actuated contacts within the capsule and actuated by said first winding, and a magnet within said insulated frame and displaced by said second winding to a position in which it holds the contacts in actuated condition.

10. A relay comprising at least one magnetic reed contact, magnetic means movable in response to a magnetic field of sufficient strength and given polarity from a position at which it does not influence the contact to a position at which it does influence the contact, and electromagnetic means energizable to actuate the contact and, when the magnetic field produced by the electromagnetic means is of sufficient strength and of proper polarity, to impart motion to the magnetic means to move it from one position to another.

11. A relay comprising a frame, at least one magnetic reed contact, a guide passage for a permanent magnet, the permanent magnet at one end of the guide passage holding the contact closed, and at the other end permitting it to open, and electromagnetic means on each energization actuating the contact and, when of predetermined polarity, imparting latching movement to the permanent magnet.

12. A relay as set forth in claim 11 in which separate electromagnetic means actuate the contact and impart movement to the permanent magnet.

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