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MAGNETICALLY CONTROLLED SWITCHING DEVICE

Filed Aug. 21, 1963

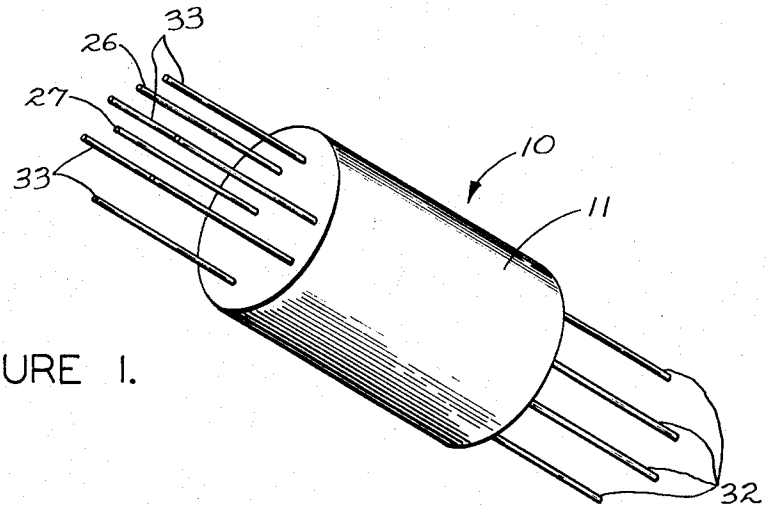


FIGURE 1.

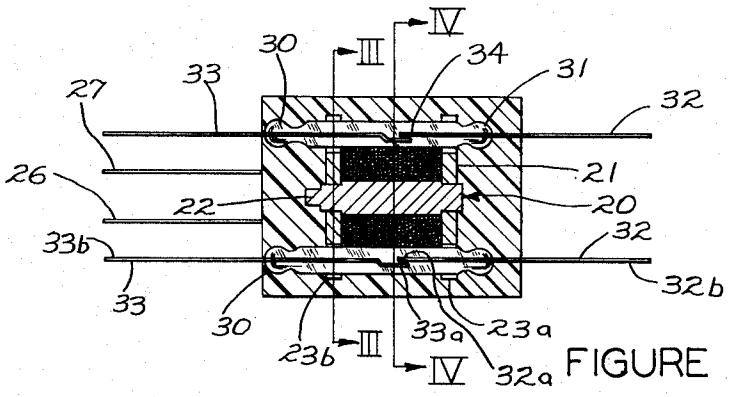


FIGURE 2.

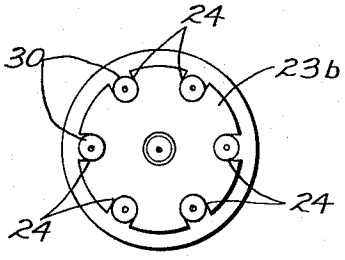


FIGURE 3.

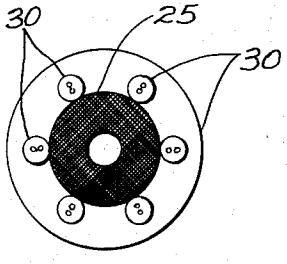


FIGURE 4.

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3,254,171 MAGNETICALLY CONTROLLED SWITCHING DEVICE

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The present invention relates to switching devices and, more particularly, to a switching device employing a plurality of magnetic reed switches.

In recent years, there has been a tremendous increase in the demand for miniature switches. This has accounted for the development of the magnetic reed switch. However, with a further trend toward microminiaturization, the demand for a smaller magnetic reed switching device has been increasing. Moreover, as a result of microminiaturization it is necessary that the energy requirement for operating a magnetic reed switching device also be reduced substantially.

In general, many of the magnetic reed switching devices have left much to be desired, since most of the magnetic reed switching devices are bulky, require high power consumption for operation as well as adequate space for heat dissipation, and are rather expensive to manufacture. It would be desirable, therefore, to provide a magnetic reed switching device having substantially lower energy requirements and capable of operating at a much lower magnetic flux.

Accordingly, it is an object of the present invention to provide an improved magnetic reed switching device.

Another object of the present invention is to provide an improved magnetic reed switching device having a substantially lower energy requirement than heretofore available.

An additional object of the present invention is to provide an improved magnetic reed switching device having a bobbin of magnetically permeable material supporting a signal winding and a plurality of reed switches in a simple and facile manner and operable at a higher efficiency than devices currently available on the market since less ampere turns are required for operating the reed switches thus requiring fewer turns of copper in the signal winding.

A further object of the present invention is to provide an improved magnetic reed switching device having less leakage flux than the switching devices currently available.

Still another object of the present invention is to provide a magnetic reed switching device which is more economical to manufacture.

Further objects and advantages of the present invention will become apparent as the following description proceeds, and the features of novelty which characterize the invention will be pointed out with particularity in the claims annexed to and forming a part of this specification.

Briefly, the improved magnetic reed switching device comprises a bobbin of magnetically conductive material having a signal winding encompassing the core of the bobbin and a plurality of magnetic reed switches disposed around the periphery of the bobbin, each of the magnetic reed switches being in spaced parallel relationship to the core of the bobbin. The assembly is preferably moulded into a cast matrix of suitable insulating material.

For a better understanding of the present invention reference may be had to the accompanying drawings in which:

FIGURE 1 is an isometric view of a magnetic switching device built in accord with the present invention;

FIGURE 2 is a longitudinal section of the magnetic reed switching device shown in FIGURE 1;

FIGURE 3 is a sectional view taken on line III—III of FIGURE 2, assuming that FIGURE 2 shows that complete structure; and

FIGURE 4 is a sectional view taken on line IV—IV of FIGURE 2, assuming that FIGURE 2 shows the complete structure.

Referring now to the drawings there is illustrated a magnetic reed switching device, generally indicated at **10**, which comprises an electromagnet **20**, and a plurality of magnetic reed switches **30**.

Considering first the electromagnet **20**, it comprises a bobbin **21** of magnetically conductive material, such as iron, provided with a core **22** and a pair of end members **23***a* and **23***b* in spaced parallel relationship fixedly secured to the opposite ends of the core **22**. Magnet wire is wound around the core **22** to form a signal winding **25** for generating magnetic flux when the electromagnet is energized, i.e., by applying a source of voltage to a pair of terminals **26** and **27** connected to the signal winding **25**. Each of the end members of the bobbin **22** is provided with a plurality of arcuate slots **24**, as best seen in FIGURE 3 of the drawings, and each pair of slots receives one of the magnetic reed switches **30** (see FIGURE 2).

The magnetic reed switches are readily available on the market and generally consist of an elongated gas-filled envelope **31** of vitreous material having flexible magnetizable reeds **32** and **33** sealed into either end thereof. The reeds **32** and **33** are of a low electrical and magnetic impedance and may be of any suitable material, such as pure iron or an iron-nickel alloy. The envelope **31** protects the reeds **32** and **33** from corrosion and the like. Generally the atmosphere within the envelope **31** may be of any noncorrosive gas, e.g., hydrogen, helium, or nitrogen. As best shown in FIGURE 2 of the drawings, the reeds **32** and **33** are cantilevered from the opposite ends of the envelope **31**, the inner ends of the reeds overlapping each other in spaced relationship as indicated at **34**. Preferably, the overlapping portions **32***a* and **33***a* of the reeds **32** and **33** respectively are normally coated with a precious metal, such as gold, to improve the contact characteristics.

One method for operating the magnetic reed switching device is to create a magnetic potential difference between reeds **32** and **33** at the area of overlap. When the potential difference is sufficiently great or, on the other hand, when sufficient magnetic flux flows across the gap, the inner ends or overlapping portions **32***a* and **33***a* of the reeds **32** and **33** come together to make an electrical contact thus electrically uniting the external circuit connected to the terminal portions **32***b* and **33***b* of the reeds **32** and **33**, respectively.

It will be appreciated that the amount of magnetic flux necessary to bring together the overlapping portions **32***a* and **33***a* of the magnetic reed switches is extremely small since the air gap of the electromagnet is very short. Thus, the power consumption or energy requirement of the magnetic reed switching device is reduced substantially not only because a fewer number of ampere turns is necessary, but also because of the increase in efficiency of the electromagnet **20**. According to test results, .25 watt or less are necessary to operate the magnetic reed switching device built in accord with the present invention, while 1.5 to 2 watts are necessary for operating magnetic reed switching devices currently available on the market. Moreover, inasmuch as fewer ampere turns are necessary to operate the magnetic reed switches, the heat dissipated by the magnetic reed switching device is also reduced. Thus, the lower energy requirement, the fewer ampere turns necessary to operate the magnetic reed switches, and the lower heat dissipation account for a substantial increase in efficiency of the magnetic switching device **10**.

In operation, the source of voltage is applied across the terminals **26** and **27** of the signal winding **25** to generate a magnetic flux in the electromagnet **20**. For one direction of operating current, the magnetic circuit of the magnetic reed switching device of the present invention is from the core **22** through the end member **23***b* to the flexible magnetizable reed **33**, through a portion of the reed **33** to the internal end of the reed **33**, across the contact gap at **34** designated by the overlapping portions **32***a* and **33***a* of the reeds **32** and **33** respectively, through a portion of the flexible magnetizable reed **32** to the end member **23***a* and through the end member **23***a* back to the core **20**. If the operating current is reversed, the magnetic circuit is also reversed.

The embodiment shown in the drawings of the present invention employs a pair of end members provided with 6 slots for receiving 6 magnetic reed switches **30**, the end members not being limited to 6 slots. It will be appreciated that less than 6 magnetic reed switches may be employed with the bobbin having six slots in the end members. It is also to be understood that it is not necessary to support the magnetic reed switches **30** in the slots **24**, i.e., the magnetic reed switches may be disposed around the periphery of the end members, however, in the preferred form of the invention, the slots are employed to maintain the energy requirement and ampere turns necessary to operate the magnetic reed switches at a minimum. Such an arrangement also reduces the leakage flux when the electromagnet **20** is energized since fewer ampere turns are necessary to close the overlapping portions **32***a* and **33***a* of the reeds **32** and **33**, respectively. From the above description, it is apparent that a very simple magnetic reed switching device has been produced.

As will become apparent to a person skilled in the art, if it is desired not to close the contacts of all of the magnetic reed switches simultaneously, then magnetic reed switches having lower and higher pull-in characteristics are employed with the magnetic reed switching device. In other words, when the electromagnet **20** is energized, only those magnetic reed switches requiring the lower number of ampere turns to operate the switch will be pulled in and, when the voltage across the terminals of the signal winding is increased sufficiently to obtain the proper magnetic flux in the magnetic circuit, the magnetic reed switches having higher pull-in characteristics will be pulled in.

While there has been illustrated and described what is at present considered to be a preferred embodiment of the present invention, it will be appreciated that numerous changes and modifications are likely to occur to those skilled in the art, and it is intended in the appended claims to cover all those changes and modifications which fall within the true spirit and scope of the present invention.

The invention claimed is:

1. In a magnetic reed switching device comprising a magnetizable core, a pair of magnetizable planar end members fixedly secured in spaced parallel relationship to the ends of the core, a plurality of arcuate notches arranged around the periphery of each of the end members, and a plurality of magnetic reed switches disposed in spaced parallel relationship to the core, said reed switches including a nonmagnetic enclosure wherein the reeds of said switches are sealed, each of the spaced ends of said enclosures extending beyond said end member and being disposed and supported in said arcuate notches.

2. In a magnetic reed switching device comprising a magnetizable core, a pair of magnetizable planar end members fixedly secured in spaced parallel relationship to the ends of the core, a plurality of arcuate notches arranged around the periphery of each of the end members, a plurality of magnetic reed switches disposed in spaced parallel relationship to the core, said reed switches including a nonmagnetic enclosure wherein the reeds of said switches are sealed, each of the spaced ends of said enclosures extending beyond said end members and being disposed and supported in said arcuate notches, and a body of cast insulating material fixedly securing the reed switches to the end members.

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