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ADJUSTABLE VIBRATING REED RELAY

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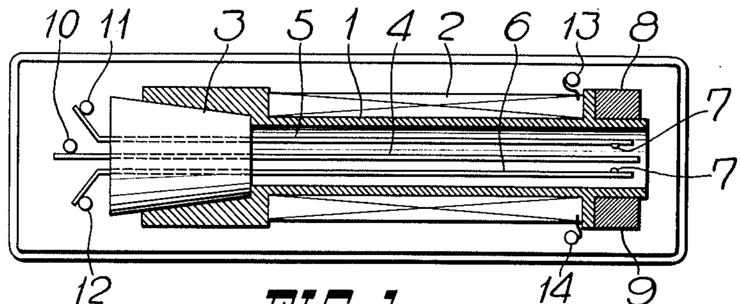


FIG. 1.

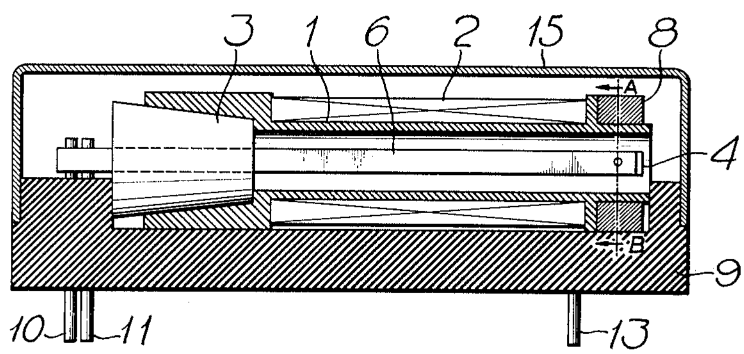
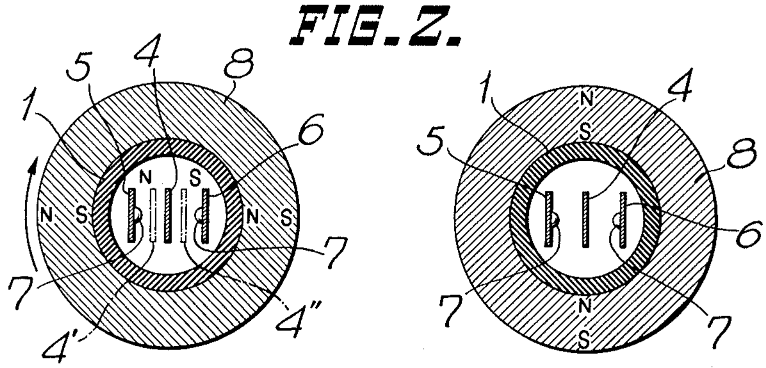


FIG. 2.



(a) FIG. 3. (b)

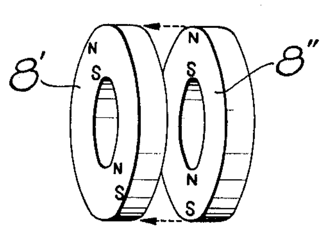


FIG. 4.

Hitoshi Masaki
Seiji Otobe
Ariyoshi Kaneda
Yasuo Arakawa
INVENTORS

BY
Stevens, Davis, Miller & Mosher
Attorneys

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3,213,233

ADJUSTABLE VIBRATING REED RELAY

Hitoshi Masaki, Yokohama-shi, Kanagawa-ken, Seiji Otobe, Saitama-ken, Ariyoshi Kaneda, Setagaya-ku, Tokyo, and Yasuo Arakawa, Yokohama-shi, Kanagawa-ken, Japan, assignors to Asahi Denki Kogyo Kabushiki Kaisha, Kanagawa-ken, Japan, a corporation of Japan

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The present invention relates to a relay having a vibrating magnetic reed.

A vibrating magnetic reed having natural frequency is supposed to be subjected to alternating magnetic field. The amplitude of the reed increases rapidly when the frequency of the alternating field is brought into agreement with the natural frequency of the reed. If a fixed contact is located opposite the reed and a winding means is provided, which is supplied with alternating current of an arbitrary frequency to establish the alternating field, upon the agreement between the frequency of the current and the natural frequency of the reed, intermittent contact action is made between the fixed contact and the reed. This arrangement, therefore, functions as a frequency discriminating relay. In this type of vibrating reed relay the reed is generally subjected to the D.C. field by means of a permanent magnet, and consequently the vibration condition varies with the intensity of the permanent magnet. Mass production of permanent magnet of constant intensity, however, is extremely difficult. And therefore, a disadvantage lies in the fact that the relay of uniform characteristics cannot be produced with ease.

It is an object of the present invention to eliminate the above-mentioned disadvantage and provide a vibrating reed relay in which the vibration characteristics can be adjusted easily even if permanent magnets are not uniform in their strength and vibrating reeds or fixed contact parts are structurally not uniform.

This and other objects of the present invention shall be apparent from the following detailed description with reference to the accompanying drawings which illustrate preferred embodiments in which:

FIG. 1 is a plan section taken across the essential parts of the present invention with a cover member removed;

FIG. 2 is a longitudinal section;

FIG. 3 is an enlarged section taken along line A–B in FIG. 2; and

FIG. 4 is a perspective view of one part of another embodiment.

Referring to the drawings, it has a cylindrical bobbin **1** on which a coil **2** is wound and a conical reed holder **3** fitted in the corresponding conical hollow, the hollow being formed at one end of the bobbin. A reed strip **4** is made of magnetic material having good resiliency and less residual magnetism but great permeability and two contact strips **5** and **6** are of the same material for the purpose of the elimination of contact potential difference. Two contact strips are arranged respectively on either side of the reed strip and they are inserted and fixed to the holder. The contact strips **5** and **6** have different natural frequency from that of the reed strip **4**. A contact projection **7** is formed at the tip of the contact strip. An annular permanent magnet **8** of ferrite and the like is fitted rotatably on the top of the bobbin **1**. This permanent magnet, as shown in FIG. 3 is so magnetized that the opposite parts of any diameter have N and S poles respectively. The relay body as mentioned above is fitted in the semicylindrical groove of an insulation base **9**. The reed strip **4** and the contact strips **5**, **6** are connected at their

ends to terminal pins **10** and **11**, **12**, while both ends of the winding **2** are connected to terminal pins **13**, **14** and then a cover member **15** is fitted onto the base.

Consequently, the permanent magnet **8** is rotated so that N and S poles are arranged with respect to the reed strip **4** and the contact strips **5**, **6** as shown in FIG. 3(*a*). When the winding **2** is supplied with A.C. current the reed strip **4** is magnetized at the top N or S alternatively with the frequency of said A.C. current, so that the reed is displaced at the top as indicated by chain line **4′** or **4″** when magnetized N or S.

In other words the reed strip **4** is vibrated with the frequency equal to that of A.C. current with which the coil **2** is supplied. And upon the agreement between the frequency of the current and the mechanical natural frequency of the reed strip the amplitude increases rapidly to make intermittent contact between the contact strips **5** and **6**.

As the contact strips **5** and **6** are provided with the contact projections **7**, the reed strip **4** does not come in close contact with the contact strips **5** and **6**, but an air layer of suitable thickness is left between the reed strip and the contact strip. This eliminates incomplete contact due to the resulting air-pressure from the movement of the reed strip and prevents the excessive transmission of the reed vibration to the contact strip as well as the transmission of the vibration to the base **9** due to the resiliency of the contact strips **5** and **6**. If use is made of one of the contacts **5** and **6** between which the reed strip **4** is arranged, the intermittent current of the frequency equal to that of the current flowing in the coil **2** can be obtained, but if the contact strips **5** and **6** are connected in parallel with each other, the output of the double frequency can be obtained. Generally the reed strip **4** of the natural frequency less than the order of 500 cycles vibrates with relatively large amplitude, but the amplitude decreases rapidly for the frequency more than the order of 500 cycles. Therefore, it is difficult to obtain the output of high frequency. However, as mentioned above, the double frequency can be obtained by arranging the contact strips on either side. In this respect it is extremely advantageous.

The amplitude of the reed strip **4** depends on the intensity of the permanent magnet **8** and, therefore, it is necessary to adjust the intensity of the permanent magnet in order to permit the reed strip to vibrate with such a proper amplitude that the reed strip comes in appropriate contact with the contact strip **5** or **6**, if the coil **2** is supplied with a predetermined value of current.

In accordance with the present invention, if the permanent magnet **8** is rotated in the direction shown by the arrow in FIG. 3(*a*) into the position as seen in FIG. 3(*b*), the component of the magnetic field intensity in the direction of vibration vanishes and consequently, the amplitude becomes substantially null as if the permanent magnet were removed. Any intensity component of the magnetic field can be obtained in the vicinity of the middle position. Therefore, even if the intensity of magnetization or the spacing of the reed strip with respect to the contact strip **5** or **6** is not uniform, the proper contact state can be obtained in the present invention by simply rotating the permanent magnet **8**. In the embodiment mentioned above the permanent magnet **8** is a single member, but the permanent magnet may have a dual construction consisting of two annular permanent magnets **8′** and **8″**, each of which can be rotated independently as seen in FIG. 4. In other words the finer adjustment can be obtained by rotating either of two permanent magnets or each of them in the opposite directions, while the broad adjustment can be obtained by rotating both of them simultaneously in the same direction.

Thus, in the present invention the contact state and the vibration of the reed strip can be freely adjusted by such extremely simple operation.

Therefore, it is unnecessary to make the intensity of the permanent magnet strictly uniform and the structure of every associated part extremely accurate, in consequence of which the mass production of vibrating reed relays can be performed very easily.

While there have been described what is at present considered to be the preferred embodiments of the present invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What we claim is:

1. A vibrating reed relay comprising a hollow bobbin of circular cross-section and of non-magnetic material with a coil wound thereon, a vibrating reed strip of resilient, magnet material, at least one contact strip having a contact point near one end, said vibrating strip and said contact strip being fixed at one end and arranged within said bobbin in parallel with each other and to the longitudinal axis of said coil, an annular permanent magnet rotatably fitted over one end of said bobbin in coaxial relation with said coil, said magnet surrounding the free ends of said contact strip and said vibrating strip, said magnet being magnetized in such a manner that N and S poles appear on a diameter of the annulus respectively at two intersections of said diameter with the outer periphery of the annulus and another S and N poles appear at two intersections of said diameter with the inner periphery of the annulus, said N pole of the outer periphery being opposite said S pole of the inner periphery and said S pole of the outer periphery being opposite said N pole of the inner periphery.

2. A vibrating reed relay according to claim **1** wherein said annular permanent magnet comprises at least two annular permanent magnets being superposed on each other and adapted to rotate independently.

3. A vibrating reed relay comprising a hollow cylindrical bobbin having a coil wound thereon, a vibrating reed strip of a resilient, magnetic material, a contact strip, said strips being fixed at one end with their free ends extending into said bobbin parallel to each other and to the longitudinal axis of said coil, and means to adjust the vibration characteristics of said vibrating reed, wherein said means to adjust the vibration characteristics of said vibrating reed comprise an annular permanent magnet coaxial with said coil, said magnet being positioned surrounding the free ends of said vibrating reed strip and said contact strip, and said magnet being free to rotate about the longitudinal axis of said coil whereby said rotation of said magnet will vary the component of magnetic field intensity through the range of complementing to opposing the motion of said vibrating reed strip.

4. A vibrating reed relay according to claim **3** wherein said annular permanent magnet has N and S poles appearing in attracting sequence across a diameter of the annulus.

5. A vibrating reed relay according to claim **3** wherein said annular permanent magnet comprises at least two annular permanent magnets superposed on each other and adapted to rotate independently.

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BERNARD A. GILHEANY, *Primary Examiner.*