April 10, 1962 A. N. FISCHER 3,029,326

RESONANT REED RELAY

Filed Oct. 22, 1959

FIG. 2

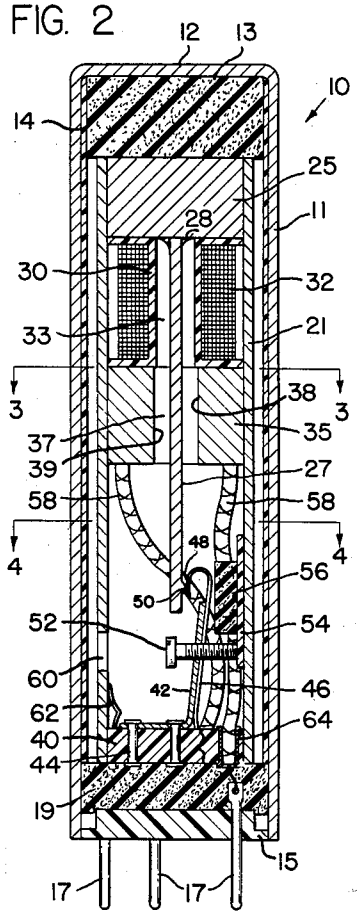
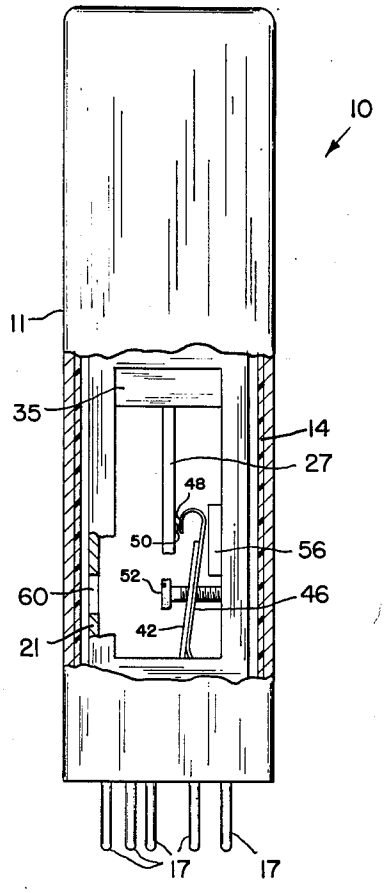


FIG. 1



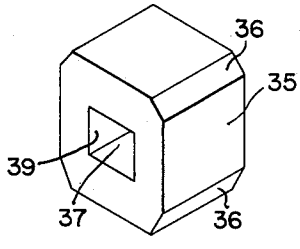


FIG. 5

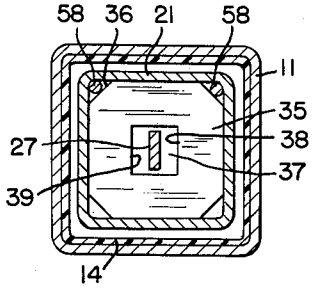


FIG. 3

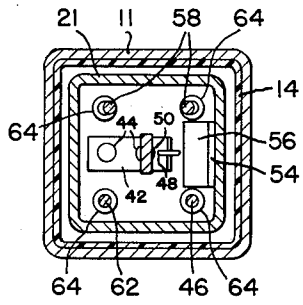


FIG. 4

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RESONANT REED RELAY

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The present invention relates to resonant reed relays.

In mobile radio telephone communication apparatus, for example, a resonant reed relay structure of the type herein may be used to condition an individual receiver for operation in response to a signal of a distinct frequency. It is well known that these relay structures contain a reed of paramagnetic material which has a resonant frequency of vibration in accordance with its physical dimensions. The reed, which serves as one contact in a circuit, is caused to vibrate at its resonant frequency in response to a signal having a frequency corresponding to the resonant frequency of the reed.

The operating characteristics of a resonant reed relay containing a reed of a certain resonant frequency are determined to a large extent by the influence which the permanent magnet, which controls the relay, has on the reed. Anything which effects this magnetic influence will necessarily alter the selectivity characteristics of the structure. For example, an increase in ambient temperature reduces the flux-density of the permanent magnet field thus adversely affecting the operation of the relay. Also, the gradual decay in the strength of the permanent magnet, and subjecting the relay to shock causes it to get out of adjustment which alters its operational characteristics.

Resonant relay structures heretofore known were unable to accurately overcome or compensate for the above external factors. This limited their use, and rendered them unreliable under certain environmental conditions.

In some resonant reed relays heretofore known an adjustable shunt is provided for varying the field of the permanent magnet to adjust the selectivity of the reed structure.

Any resonant relays heretofore known were so constructed, and the individual components of the assemblies were so formed that structures which were designed to operate at lower frequencies, from sixty to five hundred cycles, for example, were unable to be assembled and adjusted for use with resonant reeds having a higher natural frequency, from five hundred cycles to fifteen hundred cycles for example.

One of the objects of the present invention is to provide an improved resonant reed relay structure which overcomes the disadvantages of the previous structures.

Another object of this invention is to provide an improved resonant reed relay structure which permits the accurate calibration of the operational characteristics of the relay with a minimum of final adjustment.

Another object of this invention is to provide an improved resonant reed relay structure which has a permanent magnet field of constant high flux-density.

A further object of this invention is to provide an improved resonant reed relay structure which permits the rearrangement of parts in the assembly so as to be operable over a wide range of frequencies.

Another object of this invention is to provide an improved resonant reed relay that employs a single piece ceramic magnet for creating magnetic fields of a constant high flux-density.

A further object of this invention is to provide an improved resonant reed relay structure where the casing serves as a return path for the flux of the permanent magnet, thereby serving to further increase the flux-density of the magnet.

A further object of this invention is to provide an improved resonant reed relay whose operational characteristics may be varied while retaining the same high flux-density of the permanent magnet.

A still further object of this invention is to provide a resonant reed relay structure which has a low internal resonance and which has an improved resilient mounting means for isolating the reed structure from its supporting chassis.

A still further object of this invention is to provide an improved resonant reed relay structure which is reliable under all operational conditions, has a long life, is of simple construction, and inexpensive to manufacture.

Other objects of this invention will become apparent from the specification, the drawing, and the appended claims.

In the drawing:

FIG. 1 is a view in elevation with parts broken away showing a resonant reed relay constructed in accordance with one embodiment of this invention;

FIG. 2 is a sectional view showing one arrangement of the components of the assembled resonant reed relay;

FIG. 3 is a sectional view taken on line 3—3 of FIG. 2;

FIG. 4 is a sectional view taken on line 4—4 of FIG. 2; and

FIG. 5 is a view in perspective showing the configuration of the permanent magnet which is used to control the operating characteristics of the relay.

A resonant reed relay constructed according to this invention comprises an outer casing which is insulated from and resiliently supports an inner casing. The internal resonance of the structure itself is maintained at a very low natural frequency and the transfer of vibrations from the inner housing to the outer housing is damped or absorbed by placing resilient vibration-absorbing material at each end of the relay. A base having an elongated vibratory reed attached thereto is rigidly supported in the inner casing. A single piece permanent ceramic magnet is adjustably positioned in the inner housing. This magnet has a central opening through which the reed extends or with which the reed is aligned, depending upon the desired operational characteristics of the relay. An electromagnetic coil is positioned in the inner casing surrounding the reed and adjacent the permanent magnet. Both the coil and the permanent magnet may be positioned in the inner housing at any predetermined distance between the free end of the reed and the base in accordance with the frequency and the operational characteristics desired. Mounted on the reed is a contact which is positioned to engage a stationary contact that is resiliently mounted on a wall of the inner casing.

Referring to the drawing, the resonant reed relay structure, generally referred to as **10**, comprises an elongated rectangular housing **11** which has an integrally formed closure **12** at one end. A sheet of Mylar insulation **14** lines the walls of the housing **11**. Mounted in the housing **11** and positioned adjacent the closed end **12** is a block of resilient material **13** which may be foam rubber. Closing the other end of the housing **11** is a rectangular cap **15** which is attached to and hermetically seals the housing **11**. Mounted adjacent the cap **15** in the housing **11** is a block **19** which is made of a resilient material similar to the block **13**. A plurality of plug-in terminals **17** extend through the cap **15** and into the block **19**. Mounted in the housing **11** and supported between the resilient blocks **13** and **19** is a rectangular inner casing **21** which is slightly smaller than the outer casing **11** so as to be spaced and insulated therefrom.

A base **25** which is made of a material such as brass is attached in the inner casing **21** and disposed substan-

tially flush with one end of the casing 21 to engage the surface of the block 13. A reed 27 is rigidly attached at one end to the base at 28, such as by silver soldering. This reed which in cross-section is of greater width than thickness, may be made of any suitable material, which has a sufficiently small temperature coefficient of expansion. As has been previously stated the thickness and length of the reed 27 determines the natural frequency of vibration. Therefore, by selecting reeds of different dimensions different frequencies can be attained.

Mounted in the inner casing 21 adjacent the base 25 is a spool 30 made of an insulating material and upon which is wound a coil 32. The spood 30 is substantially rectangular in section and has a substantially rectangular opening 33 located centrally therein and through which the reed 27 may extend. The spool 30 is cemented to the walls of the inner casing 21.

A permanent magnet 35, which is of generally rectangular shape in cross-section but which has chamfered corners 36, is positioned in the casing 21 surrounding the reed 27. The magnet 35, which is made of well known ceramic materials, is of single piece construction, and has a central rectangular opening 37.

The surface of the magnet 35 is in contact with the walls of the casing 21, and is magnetized so that opposite walls 38 and 39 of the opening 37 of the magnet which are parallel to the wide surfaces of the reed 27 are of opposite polarity.

A mounting block 40, which may be made of an insulating material, such as phenolic resin, is attached, as by cementing, to the inner casing 21 adjacent the foam rubber block 19. A bracket 42 which is bent to extend in the casing 21 toward the reed 27, is attached by rivets 44 to the mounting block 40. A wire 46 is attached by soldering to the bracket 42 and is bent at one end to form a contact 48 and is connected at its other end to one of the terminals 17. The contact portion 48 is disposed adjacent but normally spaced from a contact protuberance 50 on the reed 27. The contact 48 is adjustable away from or towards the protuberance 50 of the reed 27 in accordance with any desired degree of amplitude of reed vibration by a screw 52 which is threaded in the bracket 42. One end of the screw 52 bears against a piece of Mylar insulation 54, which is cemented to the wall of the inner casing 21. Attached to the Mylar insulation 54 between the wire 46 and the Mylar 54 is a block of foam rubber 56 which serves to cushion the contact 48 when vibrating. An opening 60 in the inner casing 21 is provided so that the screw 52 may be adjusted.

The coil 32 is connected in an electrical circuit by wires 58 which extend between chambered corners of the magnet 15 and the casing 21 and are each attached to one terminal 17 to energize the coil 32 in accordance with the frequency of the calling signals. The reed 27 is set in vibration when the coil 32 is energized at the resonant frequency of the reed 27. Soldered to the wall of the inner casing 21 is a wire 62 which is connected to one of the terminals 17. This wire 62 is adapted to be so connected in a circuit with the terminal 17, to which the wire 46 is connected, that a circuit is closed each time the protuberance 50 makes contact with the contact 48, thus producing a frequency in the outgoing circuit which corresponds to the operating frequency of vibration of the reed. The outgoing closed circuit in the device includes the reed 27, its base 25 and the inner casing 21.

The magnet 35, as already stated, is adjustable longitudinally of the casing 21 to compensate for variations in manufacture and for different desired operating characteristics.

Assuming, for example, that a resonant reed relay constructed according to this invention is to operate at six hundred cycles, a reed, which has a natural frequency of vibration corresponding to this frequency, is attached to the base 25, and the permanent magnet 35 is adjusted in the casing 21 to tune the reed 27 sharply to this frequency.

As the flux of a ceramic magnet, such as 35, has a linear temperature coefficient, and the structure of the relay is such that the permanent magnet 35 may be longitudinally positioned relative to the reed, the operational characteristics of the relay can be accurately calibrated for ambient temperature conditions which differ from normal and the permanent magnet can be accurately positioned closer or further away from the tip of the reed to compensate therefor.

The position of the permanent magnet is adjusted also to produce various operational characteristics of the relay. For example, if the band width is to be increased or decreased, the permanent magnet is positioned closer to or further from the base 25.

Assuming that the structure is to be assembled for response to a low frequency, such as 250 cycles for example, the permanent magnet 35 is positioned more closely to the base. In the event that the frequency requires the permanent magnet to be positioned so close to the base that the spool 30 is unable to fit between the base 25 and the magnet 35, the electromagnetic coil may be positioned on the opposite side of the permanent magnet between the permanent magnet and the free end of the reed.

Thus, it is apparent that the high flux-density of the one piece ceramic magnet 35 is not decreased for lower frequencies, but that by changing the position of magnet 35 relative to the base 25, the effectiveness of the flux on the reed can be altered.

Since the ceramic magnet is an insulator, an uninsulated wire may come in contact with the magnet without impairing the operation of the relay.

Thus, I have provided an improved resonant reed relay which has a reed structure that is resiliently mounted so as to be effective against shock, which has an inner casing that serves as the return path for the flux of a permanent magnet, in which the magnet may be adjustably positioned for reeds of either low or high frequencies, and which can be reliably adjusted to provide for different desired operational characteristics under different environmental conditions.

While the invention has been described in connection with a specific embodiment thereof, it will be understood that it is capable of further modification, and this application is intended to cover any variations, uses, or adaptations of the invention following, in general, the principles of the invention and including such departures from the present disclosure as come within known or customary practice in the art to which the invention pertains and as may be applied to the essential features hereinbefore set forth, and as fall within the scope of the invention or the limits of the appended claims.

Having thus described my invention, what I claim is:

1. A resonant reed relay, comprising an outer housing, one end of which has a plurality of electrically conductive prongs extending therefrom, a resilient mount positioned in each end of said outer housing, at least one of said resilient mounts comprising a block of vibration absorbing material, an inner housing contained within said outer housing and engaging one of said resilient mounts at each end to secure said inner housing within but spaced from the walls of said outer housing, a permanent magnet having a central bore therethrough, a base secured in said inner housing at one end thereof, a reed rigidly attached at one end to said base and extending longitudinally in said inner housing and in alignment with the bore of said magnet, said magnet being adjustable longitudinally in said inner housing to vary the operational characteristics of said relay, an electromagnetic coil positioned in said inner housing surrounding said reed, said coil being connected to a pair of said prongs for energizing said coil at the natural frequency of vibration of said reed to cause said reed to vibrate, a contact protuberance on said reed, and

adjustable fixed contact positioned in said inner housing and adapted to be engaged by said protuberance during vibration of said reed, a wire connecting said inner housing to another of said prongs, and means connecting said adjustable contact to still another of said prongs for closing a circuit periodically at the frequency of vibration of said reed.

2. A resonant reed relay according to claim 1 wherein said permanent magnet is made of ceramic material.

3. A resonant reed relay according to claim 1 wherein said bore is rectangular in shape and said reed is made from a flat strip of metal.

4. A resonant reed relay according to claim 1 wherein said permanent magnet is a single piece ceramic magnet and said bore of the magnet is rectangular in shape.

5. A resonant reed relay, comprising an elongated rectangular outer housing, one end of said housing having a plurality of electrically conductive prongs attached thereto, an elongated rectangular inner housing contained within said outer housing, a resilient rectangular block positioned in each end of said outer housing and engaging respective adjacent ends of said inner housing to secure said inner housing within but spaced from the walls of said outer housing, a rectangular base attached in said inner housing at one end thereof, a single piece ceramic magnet, said magnet having a rectangular bore, an elongated reed rigidly attached at one end to said base and extending longitudinally in said inner housing and aligned with said central rectangular bore, said permanent magnet being in engagement with said inner housing and adjustable longitudinally in said inner housing to vary the operational characteristics of said relay, a rectangular spool having a central rectangular opening therethrough, said spool being positioned in said inner housing adjacent the permanent magnet and surrounding said reed, a coil wound on said spool being connected to a pair of said prongs for energizing said coil to cause said reed to vibrate, a protuberance on said reed, a fixed contact positioned in said inner housing and normally spaced from said reed protuberance, a wire connecting said inner housing to another of said prongs, and means connecting said fixed contact to still another of said prongs to close a circuit during vibration of said reed.

6. A resonant reed relay comprising an outer housing closed at both ends, an electrically-conductive inner tubular housing, resilient mounts interposed between each end of said inner housing and the corresponding end of the outer housing, said inner housing being supported from said outer housing on said mounts, at least one of said mounts comprising a block of vibration absorbing material, means insulating said inner housing from said outer housing, a metallic base secured in said inner housing in engagement with said resilient block and closing one end of inner housing, an insulating block closing the other end of said inner housing and mounted adjacent the other resilient mount, a vibratory reed, which is of greater width than thickness, secured at one end to said base, an insulating spool positioned in said inner housing to surround said reed and having an electromagnetic coil wound thereon, a bored permanent block magnet also positioned in said inner housing with its bore aligned with the bore of said spool so that said reed may pass through its bore, said magnet having a bore which is rectangular in cross-section and being magnetized so that the two side opposite walls of its bore which are parallel to the wide surfaces of the reed are of opposite polarity, a fixed contact secured to said insulating block in position to be engaged by said reed as it vibrates, means for connecting said reed and fixed contact in an electric circuit when said reed makes contact with said fixed contact, and means for connecting said coil in an electric circuit.

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