Oct. 25, 1966 C. E. BLAKE ET AL 3,281,732

ADJUSTABLE CONTACT ASSEMBLY FOR RESONANT REED RELAYS

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Fig-1

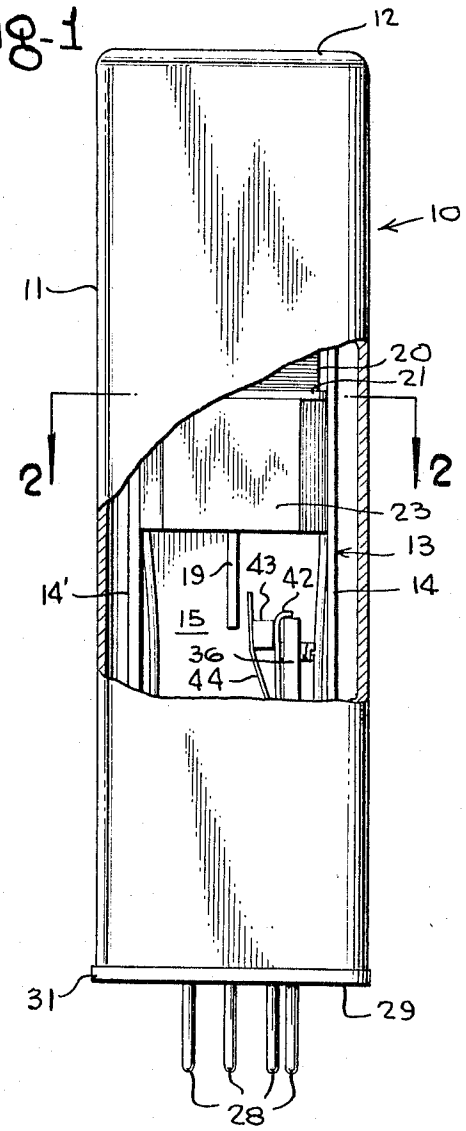
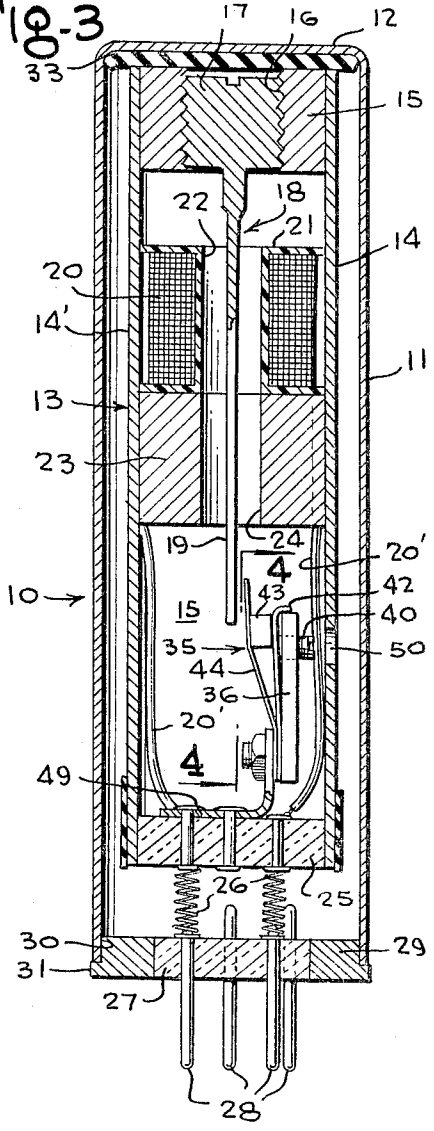



Fig-3



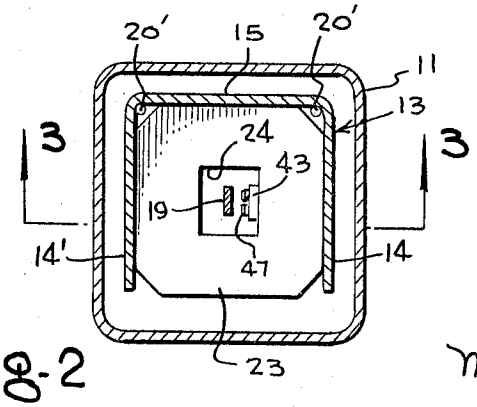




Fig-2

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Fig. 4

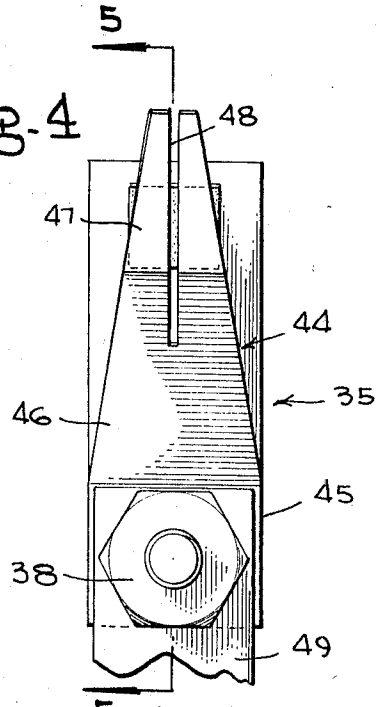
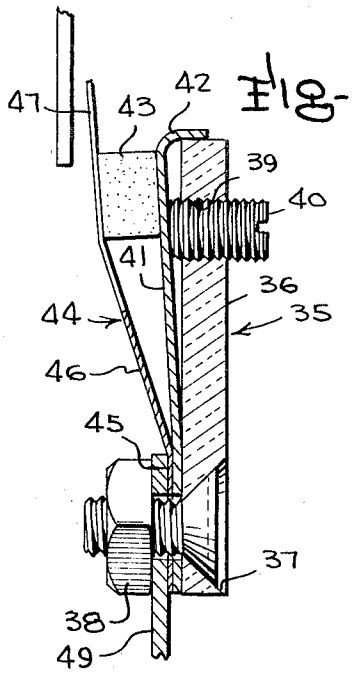



Fig. 5



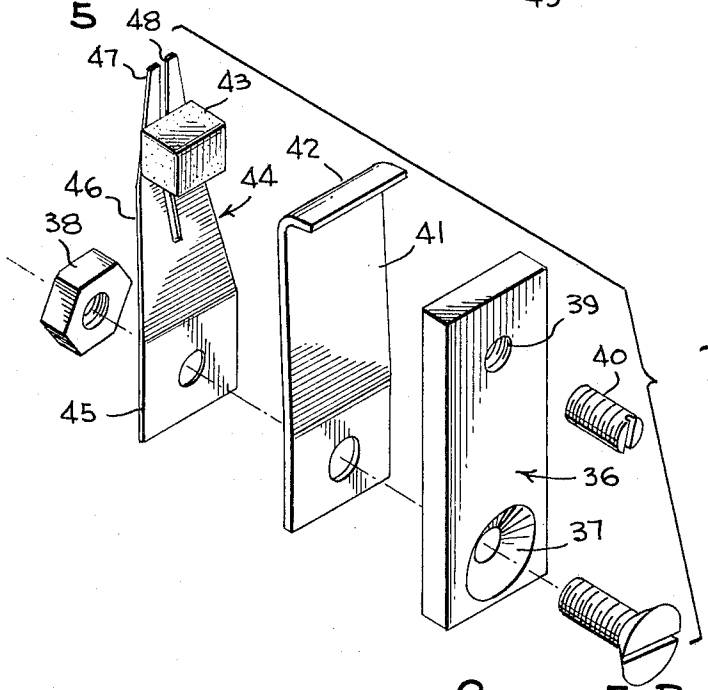




Fig. 6

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3,281,732

# ADJUSTABLE CONTACT ASSEMBLY FOR RESONANT REED RELAYS

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2 Claims. (Cl. 335—94)

The present invention relates in general to frequency selective resonant reed relays, and more particularly to stationary contact assemblies for resonant reed relays.

Resonant reed relays customarily comprise a tuned vibratile reed of paramagnetic material clamped at one end and having a selected natural resonant frequency of vibration determined by the thickness and length of cut of the reed. The reed extends through an opening in a permanent magnet which sets up a constant magnetic field about the reed, and through an electromagnetic air core driving coil to which alternating current signals are applied to vary the total flux field so as to produce vibration of the reed when the frequency of the applied signal approximates the natural resonant frequency of the reed. A stationary contact is disposed to be periodically engaged by the reed or by a contact on the reed when the reed vibrates with maximum amplitude responsive to an applied signal frequency corresponding to the selected resonant frequency characteristic of the reed. Such resonant reed relays have come into wide use in electronic communication equipment such as telemetering, radiotelephony, mobile radio receiver systems, paging systems, remote control systems, encoder and decoder networks, data processing and many other applications where it is desirable to selectively close circuits to activate one selected responder device out of a plurality of devices in signal responder systems.

As the drive level to the reed coil is increased past threshold (that point in voltage at which contact closure occurs) the impedance to the reeds excursion is also increased. With sufficient drive level, the reed will tend to reverse its direction prior to a reverse in direction of the current through the coil. As a result, the apparent frequency of the reed increases since the reed tends to travel faster than the driving signal. A further result is that, as the frequency of the driving signal is increased past resonance, the tendency of the reed to travel faster than the driving signal continues; thus contact closure occurs for several cycles above the point in frequency at which the relay would normally pull in. It is, therefore, also possible to pulse the reed with a signal the frequency of which is above the normal pull-in point with a resultant firing of the reed (contact closure) and the reed will remain so fired until the driving signal is removed or greatly reduced.

The sudden application of a driving signal (pulsing) whose frequency and amplitude are such that contact closure shall occur usually results in a momentary misfire of the reed. That is, the reed hitting the contact causes the contact to deviate greatly from its normal position. If, on the next cycle at which contact closure should occur, the contact is not in its normal position, no contact closure may occur.

Once the reed is vibrating, however, although it does not misfire, the contact still tends to deviate greatly from its normal position. That is, as the reed approaches the point of maximum deviation from its rest position, it tends to push the contact slightly past that point; thus, at that time, contact closure ceases and does not occur again until the following cycle. As a result, the percentage of a cycle that contact closure actually occurs (dwell time) is very low. All of these undesirable characteristics are related directly to the type of contact used.



An object of the present invention is the provision of a novel resonant reed relay construction which greatly reduces or eliminates apparent changes in reed frequency with high level driving signals.

Another object of the present invention is the provision of a novel resonant reed relay construction which eliminates or greatly reduces continuous firing or triggering the reed as the frequency of the driving signal is increased past the normal pull-in limits.

Another object of the present invention is the provision of a novel resonant reed relay construction which minimizes momentary misfiring when the reed is pulsed with a signal whose frequency and amplitude cause contact closure.

Another object of the present invention is the provision of a novel resonant reed relay construction wherein the percentage of a cycle during which contact closure occurs is increased.

Other objects, advantages, and capabilities of the present invention will become apparent from the following detail description, taken in conjunction with the accompanying drawings illustrating a preferred embodiment of the invention.

In the drawings:

FIGURE 1 is a side elevation of a resonant reed relay constructed in accordance with the present invention with the near wall of the enclosure or casing broken away to reveal the interior;

FIGURE 2 is a horizontal transverse section view of the resonant reed relay taken along the line 2—2 of FIGURE 1;

FIGURE 3 is a vertical section view of the resonant reed relay, taken along the line 3—3 of FIGURE 2;

FIGURE 4 is an elevation view to enlarged scale taken along the line 4—4 of FIGURE 3;

FIGURE 5 is a vertical section view taken along the line 5—5 of FIGURE 4; and

FIGURE 6 is an exploded perspective view of the contact assembly.

Referring to the drawings illustrating a preferred embodiment of the present invention, the resonant reed relay structure, generally designated by the reference character 10 comprises an elongated rectangular shielding enclosure 11 of substantially square cross-section having an integrally formed closure end wall 12 at one end, which shielding enclosure is preferably formed of drawn copper and serves to minimize the effects of external fields. Supported within the shielding enclosure is a rigid frame 13, which may be formed of a channel-shaped elongated thin steel member to house the operative components of the reed relay, the frame 13 having channel sides 14, 14' as illustrated in FIGURE 2. The frame 13 supports a base 15, which is a solid rectangular block of material such as brass whose periphery conforms to the inner dimensions of the frame and is secured to the frame adjacent the upper end thereof as viewed in FIGURES 1 and 3. The base 15 is provided with a central cylindrical opening 16 concentric with the medial axis of the frame to receive a conforming cylindrical end portion 17 of the metalic vibratory reed member 18 in secured relation within the opening 16. The reed portion 19 of the reed member 18 is an elongated thin member of rectangular cross-section having considerably greater width than thickness, and may for example be formed of nickel-chrome-steel alloy for temperature stability. The thickness and length of cut of the reed determines the resonant frequency and the reed responds to variations in the magnetic field surrounding the reed 19 by vibrating to and fro relative to the stationary end adjoining the portion 17. Spaced from the base 15 and surrounding the reed 19 is an electromagnetic driving coil 20 wound on a dialectric spool or coil form 21 hav-

ing a rectangular central opening 22 through which the reed 19 extends. Adjacent the driving coil 20 is a permanent magnet 23 in the form of a solid rectangular block of simple one piece construction, made for example, of a well known alnico material, which is peripherally secured to the walls of the frame 13 and has a rectangular central opening 24 aligned with the opening 22 of the coil 20 to accommodate the reed 19. The lower end of the frame 13 is closed by a mounting block 25, which may be made of an insulating material such as phenolic resin, secured as by cementing to the frame 13. The mounting block 25 is apertured to pass desired electrical conductors including the leads 20' for the driving coil 20 to flexible conductors, such for example, as conductive coil springs 26 to a disc of insulating material 27 through which suitable terminal prongs 28 extend forming male plug terminals which may be inserted into corresponding sockets of an electrical plug to make electrical connection with the circuitry with which the reed relay unit is to be associated. The disc 27 is peripherally secure in a cylindrical aperture in a metalic cap member 29 having a constricted portion 30 of rectangular cross-section corresponding to the inner configuration of the shield enclosure 11 and having a lip portion 31 to butt against the lower edges of the enclosure 11.

The upper end of the frame 13 is supported in the shielding enclosure 11 by a block or panel of resilient material 33, such as foam rubber, which is secured to the frame 13 or base 15, as by cement and peripherally engages the lateral walls of the enclosure 11, coacting with the springs 26 to resiliently support the frame in a manner minimizing the effect of external loading.

The reed 19 is designed to make contact with a stationary contact when the resonant reed relay is energized. The stationary contact assembly of the present invention is indicated by the reference character 35, and comprises a contact base member 36, which may be a rectangular strip of electrically insulative material such as phenolic block, having a countersunk hole 37 near its lower end to receive a conductive mounting screw and nut 38 and a threaded hole 39 near its upper end to receive a contact adjustment screw 40. A contact support arm 41 formed of a thin rectangular strip of electrically conductive material such as beryllium copper having a curved upper extremity 42 lapping the upper end of the contact base member 36 is mounted against the surface of contact base member 36 facing the reed 19 by mounting screw and nut 38, and is inclined outwardly from the base member 36 at a suitable angle by adjustment screw 41 bearing against the upper portion of the arm 41. A contact cushion 43 bears against the supporting arm 41 near the upper end thereof, the cushion being formed by a square or rectangular pad of soft, flexible electrically insulative material such as neoprene foam. The contact member 44 is a thin strip of electrically conductive material such as beryllium copper having a lower portion 45 substantially coextensive with the contact base member 36 in the zone of the mounting screw and nut 38 which is secured with the lower end portion of the contact support arm 41 flat against the adjacent surface of base member 36. The portion of the contact member 44 rising above the portion 45 may be tapered in profile and includes an intermediate portion 46 inclining away from the support arm 41 to a distance corresponding substantially to the thickness of the pad 43 and an upper portion 47 bent into substantial parallelism with the plane of the free portion of support arm 41. The contact cushion 43 may be secured in any suitable manner to the supporting arm 41, or to the upper portion of the contact member 44, or to both. The contact member 44 may be bifurcated if desired by providing slot 48 extending from the upper end thereof as illustrated, to increase the flexibility of the upper portion of the contact member 44, or the slot may be omitted, as desired. The upper end portion of the contact member 44 serves as the stationary contact to be intermittently engaged by the reed 19, and the reed 19 may directly engage the upper end portion of the contact member 44 or a contact button (not shown), formed for example of silver to minimize the effects of arcing, may be mounted on the reed to make contact with the contact member 44.

The contact assembly 35 is mounted in any suitable manner on the mounting block 25, as by an L-shaped electrically conductive bracket 49 apertured in its upright arm to receive and be secured by the mounting screw and nut 38 to the contact base member 36 in electrical communication with contact member 44 and secured by rivets to the mounting block 25 and to one of the springs 26 connected to an appropriate one of the terminal prongs 28. An access opening 50 is preferably provided in the wall 14 of the frame 13 in axial alinement with the adjustment screw 40 to permit insertion of a screw driver bit for adjusting screw 40 and the angular position of support arm 41 to establish the desired spacing of contact member 44 from the reed 19.

It will be appreciated that when an A.C. signal is applied to the driving coil 20, a varying magnetic field is established about the reed 19. When this field is varied at a rate corresponding to the mechanical resonant frequency of the reed, commonly at some frequency in the range 70 to 800 c.p.s. although sometimes as low as 20 c.p.s. or as high as 1600 c.p.s., the reed 19 vibrates, gradually increasing its distance of excursion until it strikes the upper end portion 47 of the contact member 44, once each electrical cycle. Due to the particular construction of the above-described contact assembly, particularly the resilient cushioning of the contact member 44 by the pad 43, the flexibility of the contact member 44 above the portion clamped against the support arm 41 and base 36, and the fine adjustment of position of the upper end 47 thereof, the contact member does not deviate from its normal position to any significant degree comparable to the contact wire formerly used as the stationary contact, thereby minimizing the continuous firing or triggering of the reed by driving signals whose frequencies are above the normal pull-in limits, and reducing the possibility of momentary misfire when pulsed with a signal of proper amplitude and frequency or reduction of contact closure time in cycle arising from the significant deviation of the contact from rest position occurring in prior wire contacts.

While only one form of the present invention has been particularly shown and described, it will be apparent that various modifications may be made within the spirit and scope of the invention, and it is desired, therefore, that only such limitations be placed on the invention as are imposed by the prior art and set forth in the appended claims.

What is claimed is:

1. In a resonant reed relay having an elongated vibratory reed of electrically conductive magnetic material normally arranged along a vertical axis having one end supported in fixed relation in said relay and a free end portion adapted to vibrate in a transverse plane through said axis over a selected range of excursions responsive to variations in a surrounding magnetic flux field of selected frequency, an electromagnetic driving coil for establishing the varying flux field, and a permanent magnet establishing a biasing magnetic field about said reed; the improvement comprising an adjustable stationary contact assembly coactive with the free end portion of said reed to be periodically engaged thereby and complete an electrical circuit through said reed and contact assembly comprising a vertically elongated insulative base member having a planar mounting surface facing said axis substantially paralleling said axis disposed substantially perpendicular to said transverse plane, a deformable contact support arm substantially coextensive vertically with said base member in overlying relation to said base member between said surface and said axis and having upper and

lower ends substantially aligned horizontally with upper and lower ends of said base member, said support arm being secured at a fixed point to said mounting surface in abutment therewith adjacent the lower ends of said support arm and base member and having an elongated portion extending to the upper end portion thereof along a plane inclined to said mounting surface, an elongated flexible electrically conductive contact member having a lower end portion fixed to said support arm and mounting surface at said fixed point and including an intermediate portion inclined from the region of said fixed point in angular relation to the plane of said support arm toward said reed and an upper free end portion spaced toward the reed from and substantially paralleling the plane of said support arm to be engaged by the vibrating reed when the latter is undergoing maximum excursions and establish electrical contact therewith, a resilient pad interposed between and engaging said end portion of said contact member and said support arm to position said free end portion relative to said support arm and resist and damp deflection of said contact member end portion toward said support arm by said reed, and adjustment screw means threaded in said base member and engaging said support arm at said spaced position to vary the angular relation to said mounting surface of said support arm and the end portion of said contact member positioned relative to said support arm by said pad.



2. In a resonant reed relay, the contact assembly defined in claim 1, wherein said contact member is formed of thin sheet metal, said contact member having upwardly convergent lateral edges along the intermediate and upper end portions thereof defining a truncated triangular configuration, and said contact member having a slot extending along the longitudinal center axis thereof from said upper end into said intermediate portion dividing said upper end portion into a pair of laterally spaced narrow segments disposed to be engaged by the vibrating reed.

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