Sept. 3, 1963 R. H. WILLIAMS, JR 3,102,974

SUBMINIATURE RELAYS

Filed March 16, 1960

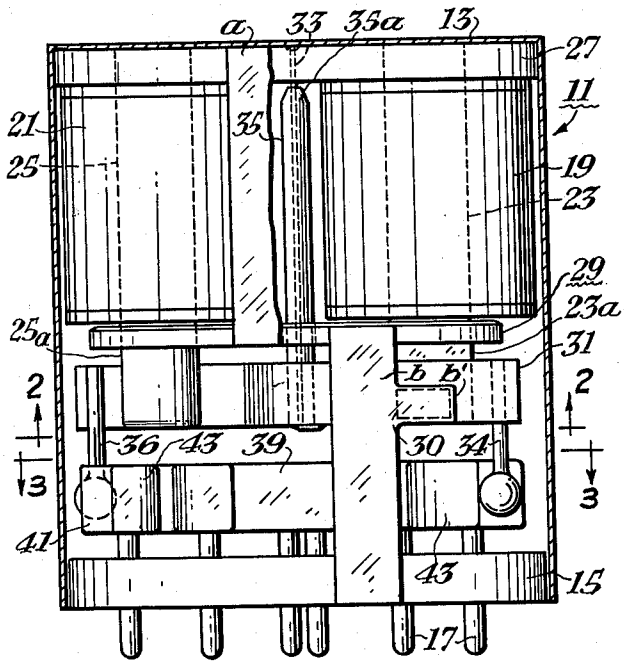


Fig. 1.

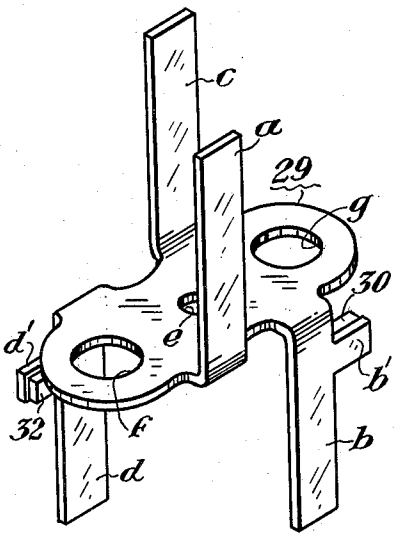


Fig. 4.

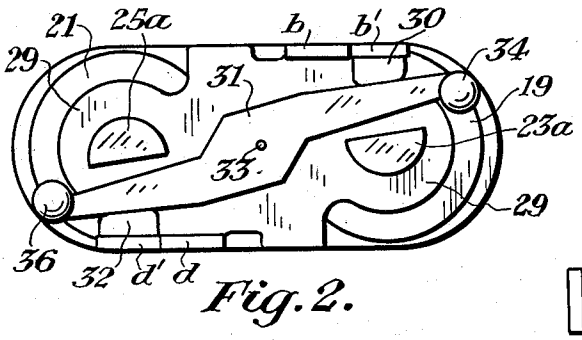


Fig. 2.

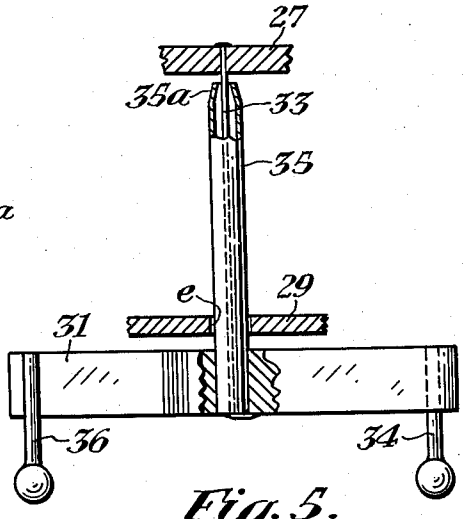


Fig. 5.

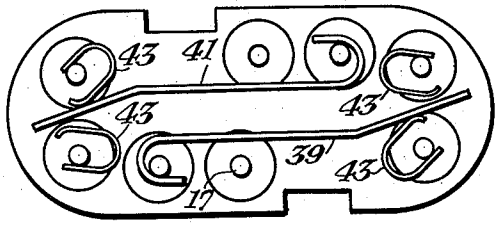


Fig. 3.

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SUBMINIATURE RELAYS

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My invention relates to relays and more particularly to relays of small size and light weight commonly referred to in the art as subminiature or crystal case relays.

Subminiature relays are especially useful in airborne electronic applications and especially in missiles where relays are subjected to intense vibrations and severe shock conditions over a wide range of ambient temperature.

Accordingly, it is a principal object of my invention to provide an improved subminiature relay which will withstand intense vibrations and severe shock while maintaining fast and sensitive operation over wide ranges of temperature.

It is another object of my invention to provide an improved wire suspension for an armature which provides the low torsional torque of a fine wire while providing the high resistance to bending stresses and the stronger bearing surface of a relatively thick wire.

It is another object of my invention to provide a subminiature relay in which improved control of quality and manufacture is provided to thus give extra assurance of reliability.

In the attainment of the foregoing objects I provide a relay including two coils mounted on two cores with one end of each of the cores affixed to a backstrap. The other end of each of the cores passes through an aperture in a mounting bracket and forms a pole piece. The armature is supported, i.e., suspended on a wire which is affixed at one end to the backstrap and is free to rotate at its other end. A tube or sleeve is circumposed on the wire. One end of the tube is affixed to the armature and the other end is contracted around the wire. The tube provides a relatively large bearing surface for the wire and strengthens the wire with respect to bending torque. The armature is positioned between the pole pieces and is rotatable toward and away from pole pieces upon energization and deenergization respectively of the associated coils. Insulative pins affixed to the armature actuate spring contacts mounted on a header plate.

Other objects and advantages of my invention will become apparent from the following description taken in connection with the accompanying drawing in which like reference characters refer to like elements throughout and in which:

FIG. 1 is a front elevational view of a preferred form of the relay with the relay casing in cross section;

FIG. 2 is a sectional view taken along lines 2—2 of FIG. 1 looking in the direction of the arrows to show armature operation;

FIG. 3 is a sectional view taken along lines 3—3 of FIG. 1 looking in the direction of the arrows to show the spring contact structure;

FIG. 4 is an isometric view of the relay supporting bracket of FIG. 1; and

FIG. 5 is an elevational view of the armature suspension assembly of FIG. 1.

I shall first describe one embodiment of a relay according to my invention, and shall then point out the novel features thereof in the appended claims.

Referring to the figures and particularly to FIGURE 1, the relay assembly 11 is contained within an inverted cup-shaped casing 13 of any suitable material, such as brass or nickel silver. As seen from FIGS. 2 and 3,

the end of casing 13 is elliptical in shape for providing a compact structure. The other or open end of casing 13 is closed by a header plate 15 of any suitable material such as steel. The periphery of header 15 is bonded to the inner surface of casing 13. A plurality of terminal pins 17 extend through the header 15 and are bonded and hermetically sealed thereto. Terminal pins 17 provide electrical connections from relay 11 to the associated external circuitry, not shown.

In one embodiment, the height of relay 11 is approximately 1 inch, the width is ¾ of an inch and the depth is 5/16 of an inch. The relay weighs approximately ½ ounce.

A pair of coils 19 and 21 are mounted on respective cores 23 and 25 which cores each have one end affixed to a backstrap 27. Backstrap 27 fits against the top of casing 13. The other end of each of cores 23 and 25 pass through respective apertures *f* and *g*, see FIG. 4, formed on a bracket member 29 to provide pole pieces 23*a* and 25*a* for actuating an armature 31 as will become apparent. Cores 23 and 25 are circular in cross section; however, pole pieces 23*a* and 25*a* have been contoured to have a flat surface to provide a better mating surface with armature 31.

Bracket 29 is the overall support for the relay assembly. As best seen from FIG. 4, bracket 29 is formed to have a center portion, not numbered, and four legs *a*, *b*, *c* and *d*; legs *a* and *c* are bent upward and are affixed as by welding to backstrap 27, and legs *b* and *d* are bent downward and are affixed as by welding to header 15. Each of legs *b* and *d*, in addition, includes lateral extensions *b'* and *d'* on which are mounted respective permanent magnets 30 and 32 which magnets bias the armature 31 to an initial position.

Referring now particularly to FIGS. 4 and 5, armature 31 is suspended beneath the center portion of bracket 29 by a fine, flexible wire 33. In one embodiment wire 33 is of beryllium copper approximately 1/64 inch in diameter. Wire 33 has one end, the upper end as oriented in FIG. 1, affixed or anchored as by welding to backstrap 27 and passes between coils 19 and 21 and through an aperture *e* formed in the center portion of bracket 29; armature 31 is affixed to the other end of wire 33 as by welding. An elongated tube or sleeve 35 is circumposed about wire 33. One end of tube 35 is affixed to armature 31 as by welding. Tube 35 passes through aperture *e* in bracket 29 and its outer surface provides a bearing surface against the sides of the aperture when the armature 31 rotates. The other or upper end of tube 35 is reduced in size to form a contracted portion 35*a* which closely surrounds wire 33 to serve as a relatively low-friction, side-thrust bearing; alternatively, the diameter of the opening, i.e., the inner surface of tube 35 may be made smaller along part or all of the length of the tube for the same purpose.

Referring now also to FIG. 2, armature 31 is positioned to have one end extending between the pole piece 23*a* and the permanent magnet 30 which is affixed to leg *b* of bracket 29. The other end of armature 31 extends between the pole piece 25*a* and the permanent magnet 32 which is affixed to leg *d* of bracket 29. Armature 31 has a conventional type of rotary action, that is, when the coils 19 and 21 are energized, the armature swings toward the pole pieces 23*a* and 25*a* and torsionally stresses or twists wire 33. When the coils are deenergized the armature is returned to its initial position due to the torsional torque of wire 33, the pressure of the movable contact springs 39 and 41, and due to the magnetic attraction of permanent magnets 30 and 32. When armature 31 rotates, tube 35 rotates in aperture *e* of bracket 29 and wire 33 is torsionally stressed or twists within tube 35. By circumposing tube 35 on wire 33 a

relatively larger and stronger bearing surface is essentially provided between the faces of aperture *e* in bracket 29 and wire 33. Otherwise, due to the small diameter of wire 33, a jewel bearing would have to be employed to prevent excessive wear. Tube 35 also functions to strengthen wire 33 with respect to bending torques. In effect, then, fine wire 33 and tube 35 provide the advantage of utilizing a thin wire to provide low torsional torque while also providing the advantages which would be obtained if a relatively thicker wire were used, namely higher resistance to bending stresses and a larger stronger bearing surface.

The wire suspension for armature 31 possesses various advantages. The wire suspension holds the armature in place without end play such as would be present with conventional bearing construction. As noted above, wire 33 acts as a torsion spring to provide some restoring torque to tend to return the armature to its normal position when the coils are deenergized. The single end anchoring permits the use of a larger and stronger suspension wire for a given torsional force and also allows for expansion or contraction of various parts due to temperature changes without adversely affecting the operation of the relay.

A pair of contact actuating members 34 and 36 each consisting of metal rods terminating in a sphere of insulating material, such as glass, are attached to opposite ends of armature 31. Members 34 and 36 transfer the motion of armature 31 to movable contact springs 39 and 41 mounted on the header plate 15, see FIG. 3. Movable contacts 39 and 41 each have one end affixed to a respective terminal pin 17 and the other end extends between two other terminal pins 17. Springs 43 have one end rigidly affixed to pins 17 and the other or free ends are arranged to be contacted by the free ends of movable contacts 39 and 41. Movable contacts 39 and 41 thus make contact with a resilient surface for reducing contact bounce and making the relay contacts less subject to being undesirably opened or closed due to severe shock and vibration stresses.

Although I have herein shown and described only one form of apparatus embodying my invention, it will be understood that various changes and modifications may be made therein within the scope of the appended claims without departing from the spirit and scope of my invention.

Having thus described my invention, what I claim is:

1. In a relay including an armature, a backstrap and pole pieces, means for mounting said armature adjacent said pole pieces for rotation through a predetermined arc and comprising, a tube secured at one end to said armature and free at the other end, a torsionally flexible member internally extending completely through said tube along its longitudinal axis, one end of said member being suspended from said backstrap and the other end being secured to said armature, and a bracket member positioned between said backstrap and said armature including an aperture with said tube extending through said aperture with clearance so that the surfaces of said bracket member which define said aperture provide a bearing surface for said tube during rotation of said armature.

2. In a relay including an armature, a backstrap and pole pieces, means for mounting said armature adjacent said pole pieces for rotation through a predetermined arc and comprising, a torsionally flexible member suspended at one end from said backstrap and being secured to said armature at a point removed from its suspended end, a bracket member disposed between the suspended end of said flexible member and said armature and having an aperture in coaxial alignment with said member, and a tube fixed to said armature at one end extending through said aperture with clearance and being constricted and unattached at its other end adjacent the suspended end of said torsionally flexible member to serve as a relatively low-friction side-thrust bearing for said torsionally flexible member during rotation of said armature.

3. A relay comprising a magnetizable member including a backstrap and pole pieces, an armature adapted to magnetically coact with said pole pieces, a torsionally flexible wire suspending said armature from said backstrap, a tube free at one end and secured at the other end to and rotatable with said armature with said wire extending internally through said tube along its longitudinal axis for strengthening the bending torque of said flexible wire, and a bracket between said armature and said backstrap encircling said tube in such manner that said bracket provides a bearing surface for said tube.

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