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ELECTROMAGNETIC RELAYS

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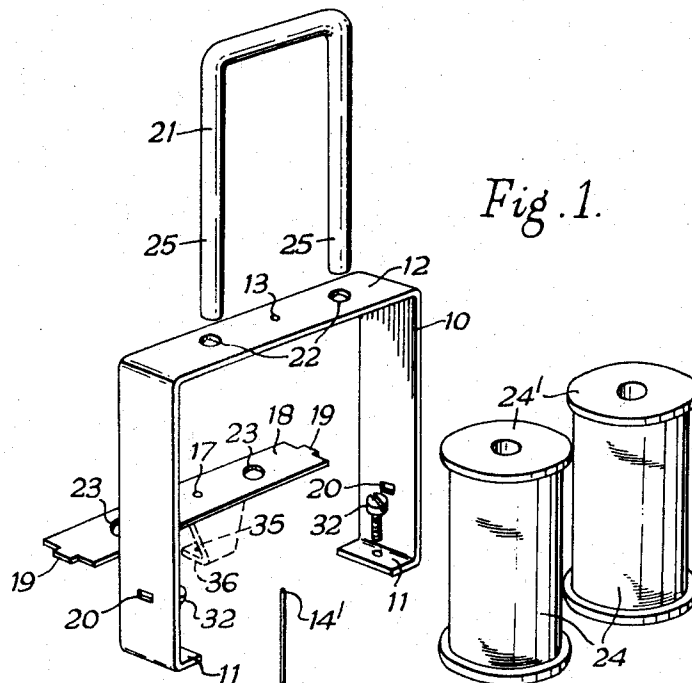


Fig. 1.

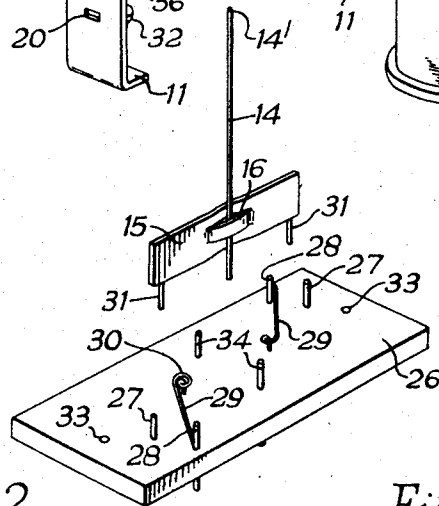


Fig. 2.

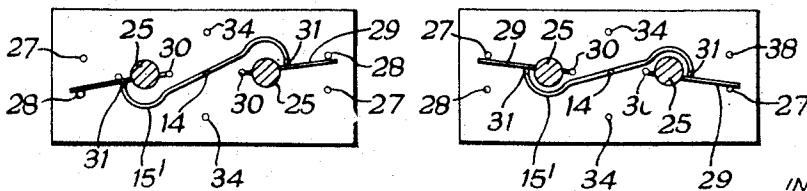


Fig. 3.

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The present invention relates to electromagnetic relays and particularly, although not exclusively, to miniature relays.

In relays for electrical control systems, such as guided missiles for example, it is important that the weight and physical dimensions should be small. Moreover since such relays may be subjected to vibration or forces of acceleration of considerable magnitude, it is necessary that the armature should be balanced. In most known relays with balanced armatures, the armature is arranged to pivot in suitable bearings, and this necessitates the manufacture of a number of cylindrical component parts which are usually formed by a machining process. When such relays are of small physical dimensions the machining of the component parts becomes a difficult and costly process. Furthermore, the assembly of the parts to form the completed relay, and the adjustment of the device when so assembled, requires a high degree of technical skill, and this adds considerably to the cost of manufacture.

It is one object of the present invention to provide an improved miniature relay with a balanced armature system, in which at least the majority of the component parts are such that they may be manufactured from flat plates or strips by suitable bending processes, thus avoiding the need for machining of cylindrical component parts.

It is another object of the invention to provide an improved miniature relay with a balanced armature system which is easy to assemble and adjust.

According to the present invention an electromagnetic relay comprises an armature fixed at its centre to an elongated torsion bar intermediate the ends of the bar, one end of the bar being fixed to the frame of the relay and the bar in the vicinity of the armature passing freely through a guide member fixed to the frame, an electromagnet having a winding and poles arranged to co-operate with the armature near the ends thereof, and two resilient contact-making members normally resting against back contacts and engaged by, although not fixed to, the armature on either side of its centre, the arrangement being such that energisation of the electromagnet causes the armature to rock about the axis of the torsion bar and displace the contact-making members from the back contacts into engagement with a pair of front contacts.

Other features of the invention will be apparent from the following description with reference to the accompanying drawing in which,

Fig. 1 is a perspective view of parts of one embodiment of the invention, disassembled, and

Figs. 2 and 3 are plan views in the unoperated and operated condition respectively of a modified armature and contact assembly, that may be used instead of that shown in Fig. 1.

Referring to Fig. 1, the relay frame is in the form of a member 10 bent into U-shape and having its two ends bent inwards to form lugs 11. The horizontal part 12 of the frame is provided with a hole 13 in which one

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end 14' of a beryllium-copper torsion bar 14 is fixed, for example by ring punching or spot welding.

An armature 15 in the form of an approximately rectangular flat plate of soft iron or other suitable magnetic material is slotted at 16 and bent as shown in order to provide an aperture through which the bar 14 passes. The armature is fixed to the bar near to the lower end of the bar by spot welding or otherwise. The lower extremity of the bar 14 passes through a hole 17 in a transverse frame member 18 of non-magnetic material in the form of a flat rectangular plate having its ends cut away to form lugs 19 engaging in slots 20 in the frame 10. This member 18 acts as a guide member for the torsion bar 14.

A soft iron rod 21 of circular cross-section is bent to the shape shown and forms a U-shaped magnet core. The core is a sliding fit in holes 22 in the part 12 of the frame and holes 23 in the transverse member 18. Coils 24 wound on formers 24' are provided around the limbs of the core 21 and within the frame 10.

The components so far described may be assembled by fixing the end 14' of the bar 14 in the hole 13 with the armature 15 lying, as shown, in the plane of the core 21. The member 18 is then put into place with the lower end of the bar 14 in the hole 17 and the lugs 19 in the slots 20. The lugs are then fixed in the slots by spot welding or by swaging the ends of the lugs. The wound coil formers 24' are then arranged in position within the frame 10 and the core 21 is passed through the holes 22, the coil formers 24' and the holes 23, the armature 15 being slightly twisted to allow the ends 25 of the core to pass and come to lie alongside the armature.

A spring-set assembly comprises a flat rectangular base 26 of insulating material having two pairs of contact members 27, 28 in the form of rigid pillars passing through holes in the base and fixed thereto. Two moving contact members each comprise a resilient member 29, for example of silver-bronze alloy or beryllium-copper, fastened by spot welding to a rigid pillar 30 passing through a hole in the base 26 and fixed therein. These members 29 are arranged normally to bear against the back contact members 28.

The armature 15 has two actuating pins 31 of insulating material fixed thereto and projecting downwardly therefrom. When the frame 10 is assembled on the base 26 with the lugs 11 resting on the upper surface of the base 26, each of the pins 31 is adapted to lie against one of the resiliently mounted contact-making members 29, the armature being turned, twisting the bar 14, through a small angle to bring the pins 31 behind the members 29, that is to say on the same side thereof as the pillars 28. The lugs 11 are fixed to the base 26 in this example by screws 32 engaging in holes 33, although other means such as rivets may be used to avoid the use of any threaded parts.

In the unoperated condition the resilience of the members 29 is such as to maintain these members against the back contacts 28 against the small torsional force exerted by the bar 14. The ends of the armature 15 are then spaced from the ends 25 of the core. When the coils 24 are energised, the armature is attracted to the core and the pins 31 engaging the contact members 29 move the latter into contact with the contact members 27.

Two further pillars 34 pass through and are fixed in holes in the base 26. The ends of the windings 24, which may be connected in series, are connected to the upper ends of the pillars 34.

The base 26 may be formed of a suitable synthetic resin and the pillars 27, 28 and 34 may be embedded therein by a suitable moulding process.

The lower ends of these pillars 27, 28 and 34 may be used as soldering tags or they may be arranged to plug into suitable co-operating sockets.

In a modification, in order to give further support to the lower end of the torsion bar 14, this bar may extend downward and pass through a hole 35 in an L-shaped bracket 36 fixed to the member 18 as indicated in broken lines.

In a further modification shown in Figs. 2 and 3, the armature 15' is bent into approximately S shape. Thus the ends of the armature are curved similarly to the co-operating poles 25. The relative positions of the co-operating parts in the unoperated and operated conditions is shown in these figures respectively.

The embodiments described have the advantage that the magnetic actuator, including the parts 10, 21, 24, 18, 14, 15 on the one hand, and the springset assembly including the base 26 and the parts mounted thereon on the other hand, can be assembled as separate units and adjusted before being brought together in the final process of assembly. This yields a considerable saving in overall manufacturing time, as both units may be assembled and adjusted concurrently.

The completed relay may be sealed within a suitable hermetically sealed or dustproof container of known type.

In order to reduce any tendency for the armature to stick to the ends 25 of the core when the excitation is removed, these ends 25 may be coated in known manner with non-magnetic material. For instance they may be plated with non-magnetic metal or metals.

In one example, a relay as shown in Fig. 1 has a frame 10 measuring about $\frac{3}{4}$ inch x $\frac{3}{4}$ inch.

I claim:

1. An electromagnetic relay comprising a frame, an armature, an elongated torsion bar fixed to said armature intermediate the ends of said torsion bar and having one end fixed to said frame, the other end of said bar being free to move together with said armature in rocking movement about the axis of said bar, the armature being supported against movement axially of said bar solely by said bar, an apertured guide member fixed to said frame, said torsion bar passing freely through the aperture in said guide member but being guided for rotation about its longitudinal axis by edge portions of said guide member defining said aperture, an electromagnet having poles adjacent to and co-operating with said armature and contact means positioned to be actuated by said armature upon rocking movement thereof about the longitudinal axis of said torsion bar.

2. A relay according to claim 1, comprising a back contact and a front contact fixedly supported with respect to said frame and insulated from one another, and a movable contact yieldingly mounted relatively to said frame, normally resting against said back contact, and positioned to be engaged by said armature and thereby to be moved from engagement with said back contact into engagement with said front contact.

3. A relay according to claim 1, wherein the armature is slotted and deformed to provide an aperture through which the torsion bar passes and in which the bar is fixed.

4. An electromagnetic relay comprising an actuator assembly and a spring-set assembly each forming a unitary structure, and means connecting said assemblies together in operative relation, said actuator assembly comprising a frame, an armature, an elongated torsion member fixed at one end to said frame and fixed intermediate its ends to said armature, the other end of said bar being free to move together with said armature in rocking movement about the axis of said bar, the armature being supported against movement axially of said bar solely by said bar, an electromagnet mounted on said frame and having pole portions close to said armature, and an apertured guide member fixed to said frame and having said torsion member passing freely through the aperture therein, the

portions of said guide member at said aperture rotatably guiding said torsion member about its longitudinal axis and said spring-set assembly comprising a base fastened by said connecting means to said frame, front and back contact members fixed in mutually insulated relation on said base, and a movable contact member yieldingly mounted upon said base and positioned to be engaged by said armature, rocking of said armature about the longitudinal axis of said torsion member effecting displacement of said moving contact member from engagement with said back contact member to engagement with said front contact member.

5. A relay according to claim 4 comprising a pin fixed to said armature and projecting therefrom approximately parallel to said torsion member, said pin engaging said movable contact member but not being fixed thereto.

6. A relay according to claim 4, wherein said electromagnet comprises an approximately U-shaped core member including two limbs united at one end by a yoke, and a winding on each said limb of said core member, said frame including two apertured transverse portions, each of said limbs passing through an aperture in each of said transverse portions, and said windings being disposed between said transverse portions.

7. A relay according to claim 4, wherein said pole portions are of cylindrical shape, and wherein said armature adjacent said pole portions is curved similarly to said pole portions.

8. An electromagnetic relay comprising a frame, an armature, an elongated torsion bar, fixed to said armature, supporting the armature for pivotal movement about the axis of the torsion bar, said torsion bar being fixed only at one end to said frame and constituting the sole support of said armature against movement of the latter axially of said torsion bar, said armature being secured to said torsion bar at a point spaced from its fixed end to provide an elongated torsionally resilient portion of the bar therebetween, a guide member fixed to said frame and having an apertured portion located near said armature with the torsion bar extending through and being rotatably guided in the aperture of said portion, an electromagnet having poles adjacent to and cooperating with said armature, contact means positioned to be actuated by said armature upon rocking movement thereof about the longitudinal axis of said torsion bar in response to energization of said electromagnet, said armature being a generally flat magnetic plate and including means utilizing only the materials of said plate and said bar for securing them together.

9. An electromagnetic relay comprising a frame, an armature, an elongated torsion bar, fixed to said armature, supporting the armature for pivotal movement about the axis of the torsion bar, said torsion bar being fixed only at one end to said frame and constituting the sole support of said armature against movement of the latter axially of said torsion bar, said armature being secured to said torsion bar at a point spaced from its fixed end to provide an elongated torsionally resilient portion of the bar therebetween, a guide member fixed to said frame and having an apertured portion located near said armature with the torsion bar extending through and being rotatably guided in the aperture of said portion, an electromagnet having poles adjacent to and cooperating with said armature, contact means positioned to be actuated by said armature upon rocking movement thereof about the longitudinal axis of said torsion bar in response to energization of said electromagnet, said guide member being located between said armature and the fixed end of said torsion bar with the apertured portion thereof being of small extent axially of the bar to minimize the length of said relay, said electromagnet having energizing windings located substantially entirely between said guide member and the portion of said frame to which said one end of the bar is fixed.

10. An electromagnetic relay comprising a frame, an

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armature, an elongated torsion bar, fixed to said armature, supporting the armature for pivotal movement about the axis of the torsion bar, said torsion bar being fixed only at one end to said frame and constituting the sole support of said armature against movement of the latter axially of said torsion bar, said armature being secured to said torsion bar at a point spaced from its fixed end to provide an elongated torsionally resilient portion of the bar therebetween, a guide member fixed to said frame and having an apertured portion located near said armature with the torsion bar extending through and being rotatably guided in the aperture of said portion, an electromagnet having poles adjacent to and cooperating with said armature, contact means positioned to be actuated by said armature upon rocking movement thereof about the longitudinal axis of said torsion bar in response to energization of said electromagnet, said electromagnet having a generally U-shaped core with two generally parallel

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limbs interconnected by a cross yoke, a coil wound on each of said limbs, said one end of said torsion bar being secured to said frame near the center of said yoke with the bar extending between said coils substantially coplanar with the axes of said coils, the free ends of said limbs constituting the poles of the electromagnet and extending into the path of rocking movement of said armature whereby the primary attraction of each pole upon the armature is in the direction substantially perpendicular to the plane of the coil axes.

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