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ELECTROMAGNETIC MINIATURE RELAYS

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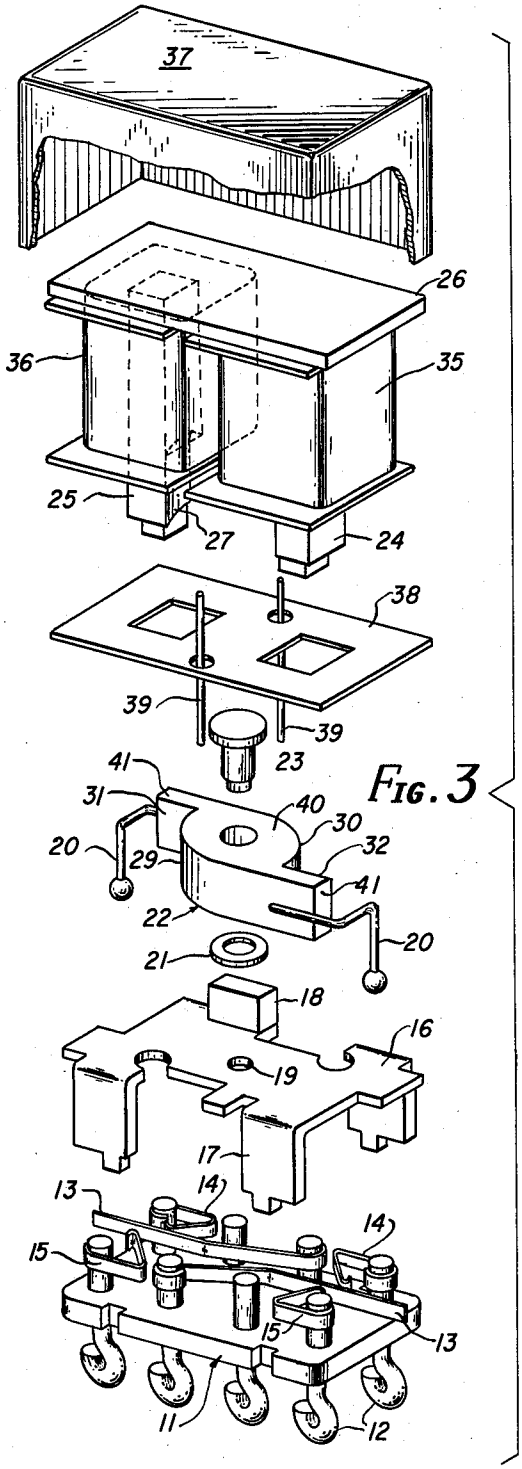

FIG. 3

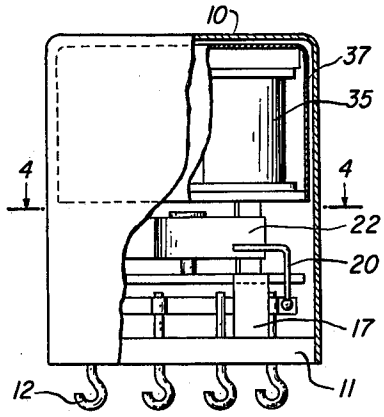

FIG. 1

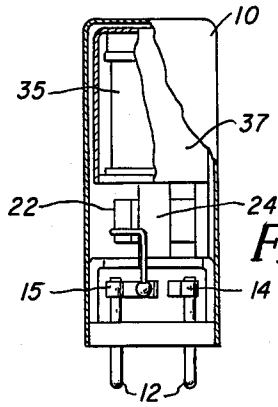

FIG. 2

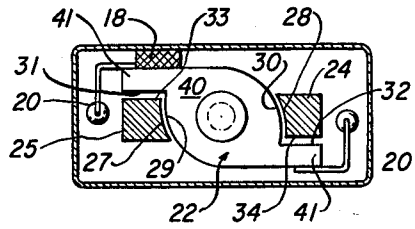

FIG. 4

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ELECTROMAGNETIC MINIATURE RELAYS

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My invention relates to electrical relays, and more particularly to miniature relays of the type enclosed within a rectangular case. The primary object of my invention is to increase the sensitivity and reliability of relays of this type. These are characteristics of considerable importance in military applications.

It is another object of my invention to provide a relay with a magnetic path of minimum reluctance.

Another object of my invention is to provide a relay wherein the coils are hermetically sealed from the contact spring assembly.

Another object of my invention is to provide a means to reliably restore the armature, thus making the relay more shock resistant.

These and other objects and features of my invention will become apparent from the following general description and the more detailed description taken in connection with the accompanying drawings.

My invention features, in a general way, a relay comprising: a rectangular outer casing, a contact spring arrangement, and an electromagnet assembly. The electromagnet assembly comprises two coils mounted on a two pole core structure. About the two coils and the corresponding portion of the core structure is an inner case which hermetically seals the coils. At one end of each of the two poles there are pole faces which cooperate with corresponding faces of a bearing-pin-mounted armature which rotates in a predetermined arc. The armature which comprises a hub of unique design and two parallel extending arms carries two radially extending pins. These pins actuate contact springs which are made of resilient material and are mounted to terminal posts.

In the accompanying drawings,

FIGURE 1 is an elevational view of a relay according to my invention with the two cases thereof partially cut away.

FIGURE 2 is a side view of a relay according to my invention with the two cases thereof partially cut away.

FIGURE 3 is an exploded perspective view of the relay which shows the electromagnetic assembly and how the particular elements thereof relate to each other.

FIGURE 4 is a sectional elevation view, taken substantially on the line 4—4 of FIGURES 1 and 2, which shows the relationship of the faces of the armature with the faces of the pole pieces.

Referring now to FIGURE 1, FIGURE 2, and FIGURE 3 of the drawings, a rectangular shaped outer casing 10, consisting of a shell with a closed end, fits over header plate 11 thereby forming an air tight enclosure for the remaining relay components. Header plate 11 has eight apertures through which terminal posts 12 extend. Mounted to the inwardly extending portion of these terminal posts is a spring assembly consisting of: two armature springs 13, two make springs 14, and two break springs 15. One end of each of the two inherently biased armature springs 13 is mounted to a terminal post 12 while the other end thereof is unsupported and moves between break spring 15 and make springs 14 when actuated by pins 20 carried by armature 22.

Surrounding the spring assembly is a frame structure which consists of: a plate 16, and four extending legs 17 which are mounted to header plate 11. Plate 16 serves as the mounting for a permanent magnet 18, a bearing pin 23, and pole pieces 24 and 25. Bearing pin 23, secured within the central aperture of plate 16, carries armature 22. Armature 22 comprises a hub 40 and two arms 41. The arms 41 each have two flat sides, one of which is coplanar with a flat side of the hub 40. The other is adjoined to a curved side 29 and 30 of the hub 40. The point of adjoinment is a maximum distance from the axis with the distance diminishing at points on the curved sides successively more remote from the adjoinment point. Furthermore, the curved sides blend into the flat sides of the hub forming but two continuous sides which are connected together by two arms 41. The armature furthermore is separated from plate 16 by washer 21 and rotates in a predetermined arc. One end of this arc is established by permanent magnet 18 and the other end by pole pieces 24 and 25. These rectangularly shaped pole pieces, mounted at one end to the frame structure, are connected at the opposite end by a yoke 26. Moreover, at the ends of pole pieces 24 and 25 mounted to the frame structure are two cut away curved pole faces 27 and 28 which conform to the curved sides 29 and 30 of armature 22. Thus, these curved pole faces 27 and 28 in combination with the flat pole faces 33 and 34, concurrently serve as the stops at one end of the arc of travel of the armature.

Coils 35 and 36 which are carried by pole pieces 24 and 25 between yoke 26 and pole faces 27 and 28 provide when energized the magnetic field necessary for the operation of the relay. These coils are enclosed by means of a case 37 and a closure plate 38. The case 37 fits over the end pieces of the coil as well as the yoke 26 leaving only the outer surface of one of the end portions of the coils exposed. Closure plate 38, having two square apertures through which the pole face portions of the pole pieces 25 and 24 extend, and two apertures through which the lead out wires of coils 35 and 36 extend, forms the closure to this opening. In addition to forming an enclosure, case 37 and closure plate 38 hermetically seal off any organic gases that could emanate from the coils and damage the spring assembly of the relay.

Describing now the operation, the relay is operatively responsive when electrical current, furnished at terminal posts 12, energizes the coils 35 and 36 through the lead out wires 39 extending from the terminal posts to the coils. Referring now to FIGURE 4, the energized coils create a magnetic field throughout the magnetic structure of the relay inducing an attracting force upon armature 22 which carries pins 20. This results in the armature, or particularly the faces thereof, cooperating with the corresponding faces of pole pieces 24 and 25. As shown in FIGURE 2, this operation also results in moving armature spring 13 against its bias or away from the break spring 15 and against the make spring 14. Efficient cooperation of the respective faces is accomplished by virtue of the particular armature configuration shown in FIGS. 3 and 4. The armature is shaped so that a component tangential force is developed which acts over the air gaps between curved faces 27—29 and 28—30 in addition to and coincident with the principal tangential force acting over the air gaps between flat faces 31—33 and 32—34. The hub thus features two eccentric curved sides 29 and 30 which are so arranged that at the point where the curved sides adjoin the arms 41 the distance from the axis is a maximum and decreases at points successively more remote from the point of adjoinment. In this way the total attracting force is substantially increased and the magnetic structure thereby operates under less reluctance and hence improved efficiency. Compared with known designs in which the armature is formed out of a flat piece of metal advantage is taken of the relatively large hub which provides a relatively friction-free and dynamically well balanced rotational support for the armature by reason of a bearing pin 23 extending through the center of the hub.

Upon restoring or deenergizing of the coils 35 and 36, permanent magnet 18 mounted to the frame structure acts upon the back side of one of the armature arms, moving the armature to its restored position. The armature springs actuated by pins 20 mounted to and carried by armature 22 thus also returns to normal. This means of restoring is most reliable as it is not subjected to fatigue or tension failures as are other means, for instance, restoring springs. The permanent magnet, moreover, permits the relay to be more shock resistant, a feature necessary in applications in which relays of this type are frequently used.

My invention has been described in detail, however, it is understood that the present disclosure has been made only by way of example and that numerous changes in the detail and structure may be made without departing from the scope of my invention as hereinafter claimed.

What is claimed is:

1. An electro-magnetic actuator for an electrical relay comprising: two energizing coils each having an aperture through the center thereof; a core structure having two pole pieces extending through said apertures and providing a magnetic field in response to the energization of said coils, an armature mounted between said pole pieces and rotatable in response to said magnetic field, said pole pieces each having at one end thereof a flat face and an adjoining face curved eccentrically with respect to the axis of rotation of said armature; said armature having a hub with two parallel arms extending oppositely therefrom, said arms each having a flat face extending adjacent one of said flat faces of said pole pieces, said hub having two side faces abutting said flat faces of said arms and curved eccentrically with respect to said axis such that points on said side faces near said abutment are spaced further from said axis than points on said side faces remote from said abutment, so that said flat face

and said curved face of each of said pole pieces are simultaneously contacted by said flat face of one of said arms and one of said side faces of said hub; pins connected to and extending from said arms of said armature, and contact springs spaced from said armature and engaged by said pins in response to the rotatable movement of said armature.

2. An electro-magnetic actuator as claimed in claim 1, wherein said armature thereof furthermore includes a bearing pin which extends through the center of said hub and carries said armature.

3. An electro-magnetic actuator as claimed in claim 2, wherein said arms each further include a second flat face parallel to said first mentioned flat face and continuous and coplanar with a portion of said side faces of said hub.

4. In an electrical relay an electro-magnetic actuator as claimed in claim 3 and comprising further a permanent magnet spaced from one of said arms having a flat face which is contacted by one of said second flat faces of said arms in response to the de-energization of said coil.

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