Feb. 2, 1960

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2,923,794

SUBMINIATURE RELAY

Filed April 9, 1957

2 Sheets-Sheet 1

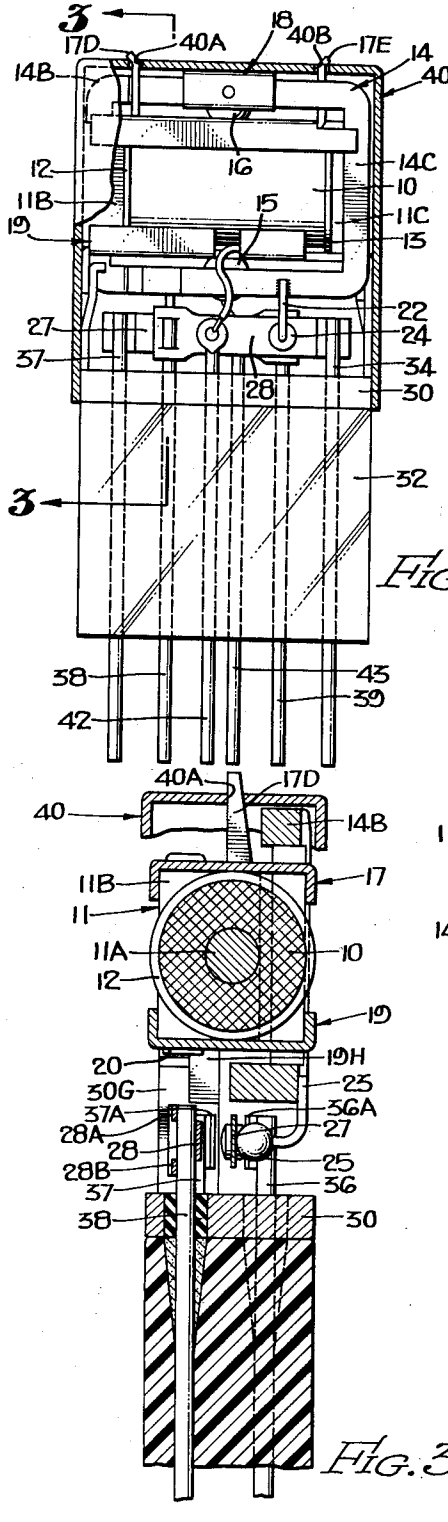


FIG. 1.

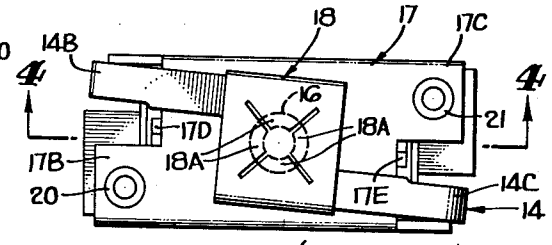


FIG. 2.

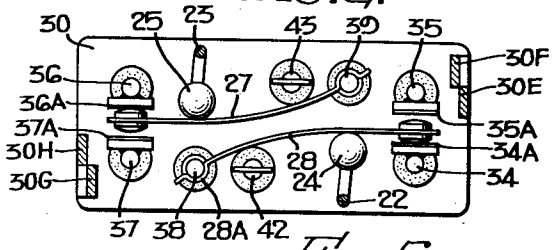


FIG. 5.

FIG. 3.

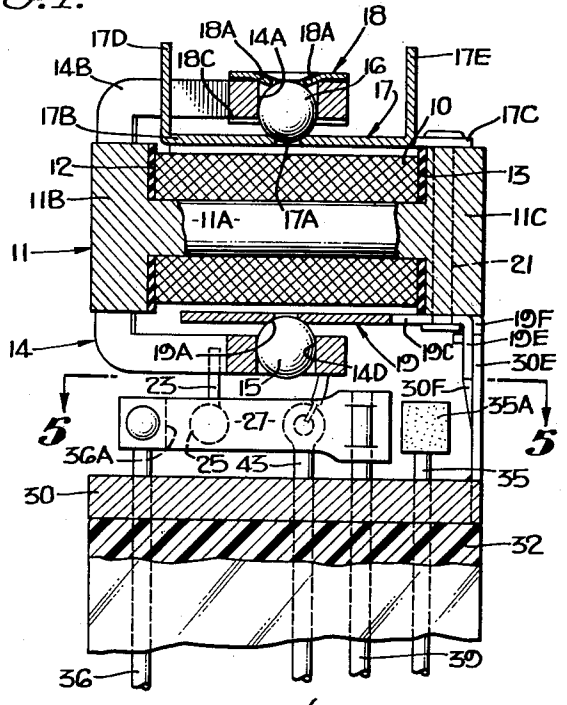


FIG. 4.

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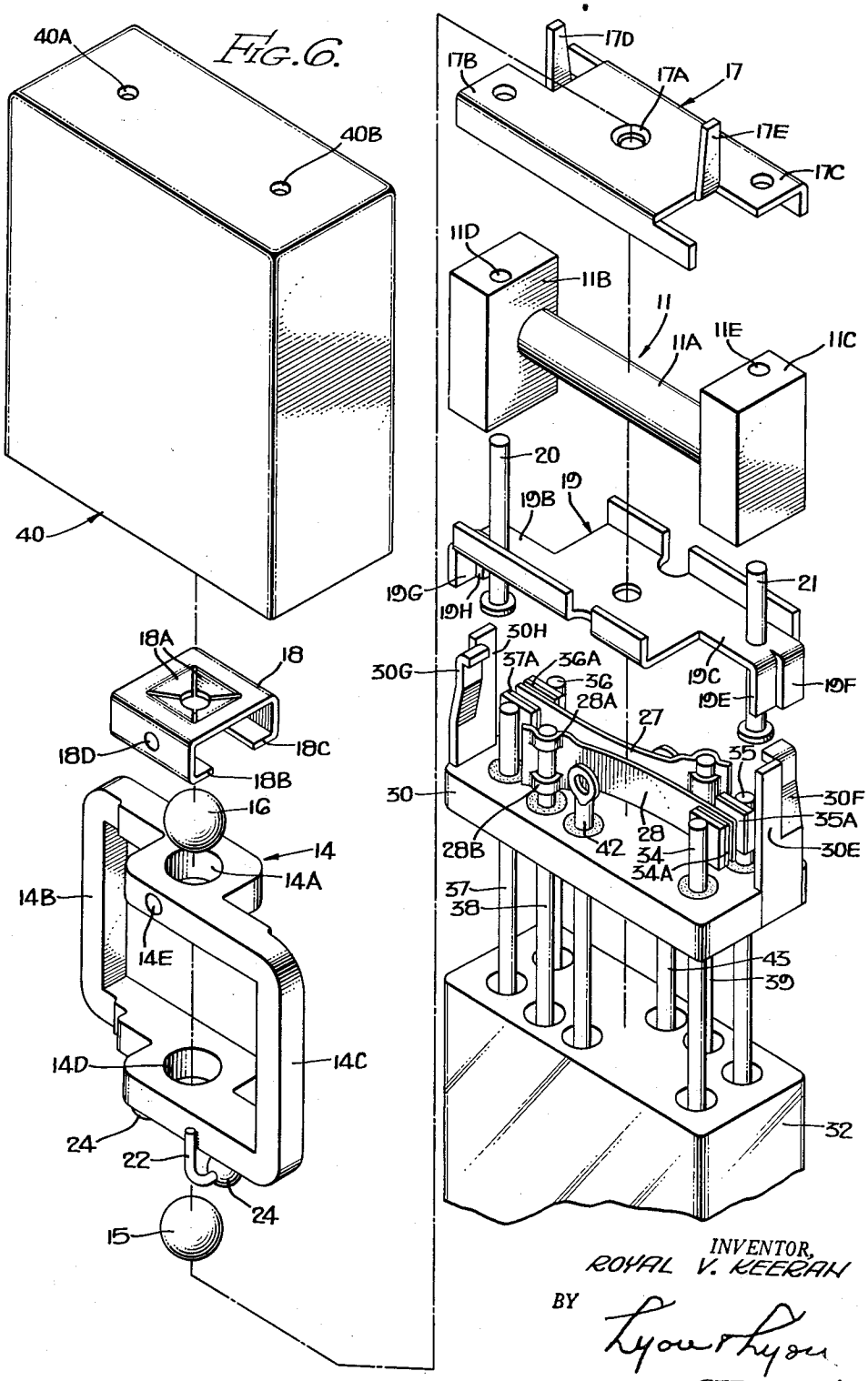
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2 Sheets-Sheet 2

FIG. 6.



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SUBMINIATURE RELAY

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11 Claims. (Cl. 200—104)

The present invention relates to improved relay structure which, as described herein, is of relatively small size and capable of operating satisfactorily under vibrational conditions and/or while subjected to large acceleration or deceleration forces.

It is an object of the present invention to provide a relay construction having the above indicated properties.

Another object of the present invention is to provide an improved relay of this character having a plug-type base and which is enclosed by a small generally rectangular housing.

Another object of the present invention is to provide an improved relay of this character having a novel pivoted armature structure cooperating magnetically with a pair of polepieces so that the same may operate satisfactorily even though subjected to high vibrational and/or acceleration or deceleration forces.

Another specific object of the present invention is to provide an improved relay having a movable armature structure which is balanced both statically and dynamically so as to achieve the above indicated results.

Another specific object of the present invention is to provide an improved relay construction with associated mounting means allowing convenient mounting in a rectangular housing.

Another object of the present invention is to provide a subminiature relay construction in which the small elements thereof may be conveniently and expeditiously assembled.

The features of the present invention which are believed to be novel are set forth with particularity in the appended claims. This invention itself, both as to its organization and manner of operation, together with further objects and advantages thereof, may be best understood by reference to the following description taken in connection with the accompanying drawings in which:

Figure 1 is a combined sectional and elevational view of a relay construction in the process of being assembled within a rectangular housing and shows also a convenient auxiliary holder which is used only in the assembly process.

Figure 2 is a top plan view of a relay before placement in the rectangular housing.

Figure 3 is a sectional view taken generally on the line 3—3 of Figure 1.

Figure 4 is a sectional view taken generally on the line 4—4 of Figure 2.

Figure 5 is a view taken generally in the direction indicated by the line 5—5 in Figure 4.

Figure 6 is a perspective view of elements of the relay and auxiliary mounting holder illustrated in detached relationship, but without the coil on the core member.

The relay includes a novel solenoid construction and the energizing winding therefore is a cylindrical toroidal winding 10 wound on and closely fitting the cylindrical portion 11A of the specially formed and ground core member 11 having offset spaced polepieces 11B and 11C.

The polepieces 11B and 11C, as shown in Figure 6, are in the form of rectangular blocks which, however, have their central axes offset with respect to the axis of the cylindrical portion 11A on which the winding is wound.

The insulated wire comprising the winding 10 is wound directly on the cylindrical portion 11A with insulated spacers 12 and 13 abutting the polepieces 11B and 11C to insulate the winding.

A special form of armature 14, ball bearing mounted, cooperates magnetically with the polepieces 11B and 11C, and includes generally a rectangular apertured member, as shown in Figure 6, with a pair of offset portions 14B and 14C for magnetic attraction by the offset polepieces 11B and 11C, respectively. The armature is pivotally mounted, using the following construction, on bearing balls 15 and 16.

The upper bearing ball 16 is smaller than the centrally apertured portion 14A in the armature and contacts the chamfered apertured portion 17A (Figure 4) in the upper bearing plate 17, and also contacts the four resilient fingers 18A of the generally U-shaped retaining member 18 which is retained by its inwardly extending portions 18B, 18C on the armature 14. The lower ball 15 has a diameter slightly larger than the diameter of the centrally apertured bore 14D in the armature (the bores 14A and 14D are centrally aligned), so that the ball 15 contacts the inner cylindrical wall of the bore 14D, as shown in Figure 4. The ball 15 is also in contact with the chamfered portion 19A of the lower bearing plate 19.

The upper and lower bearing plates 17 and 19 are secured on the spaced polepieces 11B and 11C by staking, riveting, or the like. For this purpose, the upper and lower bearing plates 17 and 19 each have corresponding offset portions 17B, 17C and 19B, 19C, with aligned apertured portions that are also aligned with the apertured portions 11D and 11E so as to receive the fastening pins or rivets 20, 21.

In this subassembly the ball 15 is placed in the apertured portion 14D, the upper ball 16 is placed in the apertured portion 14A and the resilient retaining member 18 is slipped into place on the armature 14 so that each one of the resilient fingers 18A exerts substantially equal forces on the ball 16; and to secure the assembly, a fastening pin is placed through the aligned apertured portions 18D and 14E. By this construction the armature 14 is pivotally mounted on the bearing plates 17 and 19 on the spring loaded balls 15 and 16.

The armature 14 has secured thereto, by, for example, welding, one end of two switch actuating pins 22 and 23, the lower ends of such pins 22 and 23 having formed thereon insulated glass beads 24 and 25, respectively, and it is these beads 24 and 25 which contact switch elements, as described later, for actuation of the associated switches.

The relay switch as shown herein is essentially a double pole, double throw switch with movable arms 27 and 28 (Figure 5).

The switch elements (with the exception of the actuating beads 24 and 25) are mounted on a metallic base 30 through which pins extend, the pins, however, being insulated from the base 30 using conventional construction. These pins or posts are relatively long and extend through an auxiliary rectangular block 32 which provides a convenient holder for assembly purposes; considering the fact that the relay elements are very small after complete assembly the block 32 is no longer used and the pins are cut so as to provide short mounting pins that may be inserted in an electrical connector (not shown).

The pins 34, 35, 36 and 37 have stationary contacts 34A, 35A, 36A and 37A secured thereto. The pins 38

and 39 have releasably secured thereto one end of the movable switch arms 28 and 27, respectively. For this purpose, each of the arms 27 and 28, as shown in Figure 6, has outwardly extending bowed portions 28A and 28B to resiliently engage their supporting posts.

The switch arms 27 and 28 are of resilient material and constantly engage the corresponding glass beads 25 and 24 so as to bias the armature portions 14B and 14C away from the corresponding polepieces 11B and 11C.

The switch assembly described above is retained on the lower bearing plate 19 by cooperation of downwardly extending portions 19E, 19F, 19G and 19H of the bearing plate 19 with upwardly extending portions 30E, 30F, 30G and 30H of the base 30. For this purpose the elements 30G and 30F are in the nature of hooked resilient fingers which resiliently engage the base portions 19F and 19G.

Rectangular metallic open end casing 40 encloses the assembly and is secured, using the following technique.

The lower inner edge of the casing 40 snugly contacts the rectangular base 30 and is provided with a pair of apertured portions 40A and 40B through which extensions 17D and 17E pass. The upper ends of these extensions 17E and 17D are secured to such apertured portions 40A, 40B by soldering, or the like, and the lower portion of the casing 40 may likewise be soldered along its contact surface with the base 30 to provide a hermetically sealed relay construction. If desired, the casing may be filled with an inert gas after prior evacuation, using well known techniques.

In order that the relay may operate satisfactorily under extreme conditions of vibration and/or acceleration or deceleration, special care is taken to provide a statically and dynamically balanced armature 14, and this entails a grinding process in the final stages of fabrication of the armature 14.

It will be observed that the magnetically cooperating surfaces of the polepieces 11B and 11C and magnetically cooperating faces of the armature portions 14B and 14C (in the energized condition) extend generally parallel with and in the same plane in which the axis of the core portion 11A lies. If desired, some "anti-freeze," such as a thin layer of non-magnetizable material, for example copper, may be plated or painted on the adjacent cooperating magnetic surfaces of the armature and polepieces.

The two leads of the actuating winding 10 are, in the assembly process, soldered to the soldering lugs which are provided on the pins 42 and 43.

The relay is illustrated in its non-energized condition, but may be energized by applying the coil voltage to pins 42 and 43 in which case the armature 14 is pivoted from its non-energized condition shown in Figure 2, due to the magnetic attraction, on the one hand, between elements 11B, 14B and, on the other hand, by the magnetic attraction between 11C and 14C, in which case the glass beads 24, 25 (Figure 5) carried by the armature 14 move the switch arms 27 and 28 to their other positions. Upon subsequent de-energization of the coil 10, the resilient switch arms 27 and 28 cause the armature 14 to be returned to its non-energized position shown in Figure 2.

While the particular embodiments of the present invention have been shown and described, it will be obvious to those skilled in the art that changes and modifications may be made without departing from this invention in its broader aspects and, therefore, the aim in the appended claims is to cover all such changes and modifications as fall within the true spirit and scope of this invention.

I claim:

1. A solenoid construction comprising a core member having a central portion with two integrally formed offset polepieces, a winding on the central portion of said core member, a generally open rectangular armature surrounding said coil and having offset portions attracted by said polepieces, said armature portions and polepieces having magnetically cooperating faces, and means pivotally mounting said armature about an axis passing through said central portion with the faces of the offset polepieces and the faces of said armature offset portions lying substantially in a common plane with the axis of said central portion.

2. In an arrangement of the character described, a core member having a cylindrical central portion integrally formed at the ends thereof with generally rectangular offset polepieces, a generally rectangular open armature having offset portions attracted by said polepieces, said armature portions and polepieces having cooperating planar faces which lie substantially in a common plane with the axis of said cylindrical portion, a coil wound around said cylindrical portion, a first bearing plate, a second bearing plate, means securing said first plate and said second plate in spaced relationship on said polepieces, said first and second plates having a centrally located chamfered ball engaging portion, said armature having first and second centrally disposed and aligned apertured portions, a first bearing ball engageable with said chamfered portion of said first plate and with the first apertured portion in said armature, a second ball engageable with the chamfered portion in the second plate and having a diameter less than the diameter in the second apertured portion of said armature and being disposed in said second armature apertured portion, said first and second plates being disposed between said armature and said core member, and a resilient clip mounted on said armature and pressing said second ball into engagement with said chamfered portion of said second bearing plate.

3. An arrangement as set forth in claim 2, including a switch base, means securing said switch base to said first bearing plate, a pair of resilient movable switch arms mounted on said base, a pair of switch actuating arms extending from said armature and engageable with corresponding switch arms, said switch arms being resilient and urging said armature offset portions away from said polepieces.

4. An arrangement as set forth in claim 3, including a casing snugly fitted around said base and enclosing said switch, said core member and said armature, said casing having two spaced apertured portions, a pair of integrally formed extensions on said second bearing plate extending through said casing apertured portions and secured thereto.

5. An arrangement as set forth in claim 4 in which said means for securing said switch base to said first bearing plate comprises a pair of resilient clips engageable with said first bearing plate.

6. An arrangement as set forth in claim 5, including contact pins extending through said switch base and mounting said switch actuating arms.

7. In an arrangement of the character described, a core member having a central portion with a pair of offset integrally formed polepieces at the ends thereof, a winding on said central portion of said core member, a generally open rectangular armature surrounding said winding and having offset ends magnetically cooperating with said polepieces, and means pivotally mounting said armature on said core member.

8. In an arrangement of the character described, a core member, a winding on said core member, said core member having polepieces at its opposite ends, an armature having ends thereof cooperating magnetically with said polepieces, a first bearing plate secured to said core member and extending between said armature and said core member, a second bearing plate secured to said core member and extending between said core member and said armature, said first and second plates each having a bearing ball seat, said armature having a first and second centrally disposed and aligned apertured portions, a first bearing ball having a diameter less than the first

apertured portion in the armature to receive said first ball, said first ball being in contact with said seat in said first bearing plate and in contact with said first apertured portion in the armature, a second bearing ball having a diameter less than said second apertured portion in said armature so that said second ball may freely pass through said second armature apertured portion and a resilient clip slidably mounted on said armature and having resilient portions engaging said second bearing ball and pressing said second bearing ball in the seat of said second bearing plate.

9. An arrangement as set forth in claim 8, including a switch base, a resilient clip securing said base to said first bearing plate, a resilient switch actuating arm mounted on said base, a switch actuating finger attached to said armature and engaging said resilient switch arm so that said switch arm biases said armature away from said polepieces.

10. In an arrangement of the character described, a core member, a winding on said core member, said core member having pole pieces at its opposite ends, an armature having ends thereof cooperating magnetically with said pole pieces, a first bearing plate secured to said core member and extending between said armature and said core member, a second bearing plate secured to said core member and extending between said core member and said armature, said first and second plates each having a bearing ball seat, said armature having a first and second centrally disposed and aligned apertured portions, a first bearing ball having a diameter less than the first apertured portion in the armature to receive said first

ball, said first ball being in contact with said seat in said first bearing ball and in contact with said first apertured portion in the armature, a second bearing ball having a diameter less than said second apertured portion in said armature so that said second ball may freely pass through said second armature apertured portion, and resilient means on said armature engaging said second bearing ball and pressing said second bearing ball in the seat of said second bearing plate.

11. A solenoid construction comprising a core member having a central portion with two pole pieces, a winding on the central portion of said core member, a generally open rectangular armature surrounding said coil and having portions attracted by said pole pieces, said armature portions and pole pieces having magnetically cooperating faces, and means pivotally mounting said armature about an axis passing through said central portion with the faces of the pole pieces and the faces of said armature portions lying substantially in a common plane with the axis of said central portion.

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