Dec. 13, 1949 R. P. SWEGER 2,491,140

ARMATURE ASSEMBLY

Filed April 11, 1945

Fig. 1.

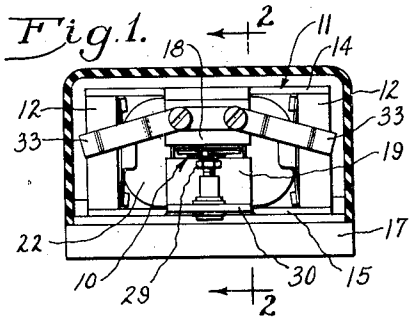


Fig. 2.

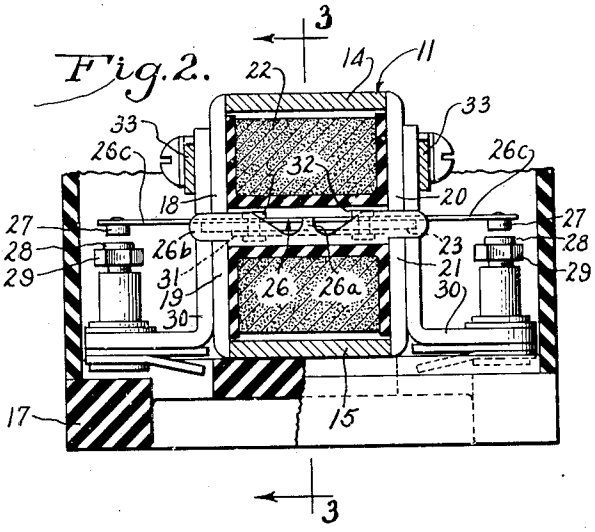


Fig. 3.

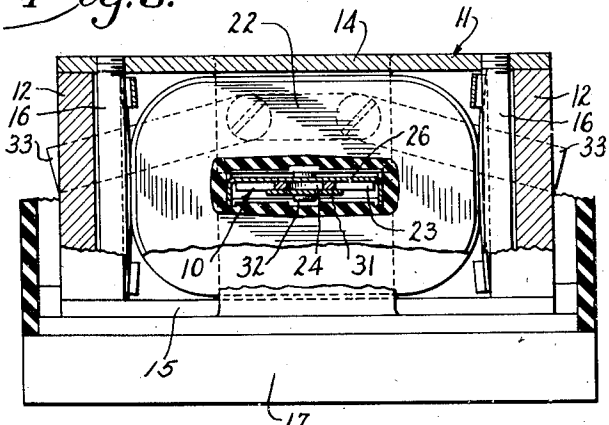


Fig. 4.

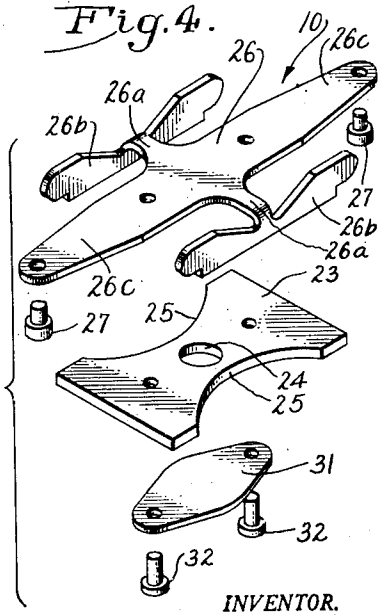
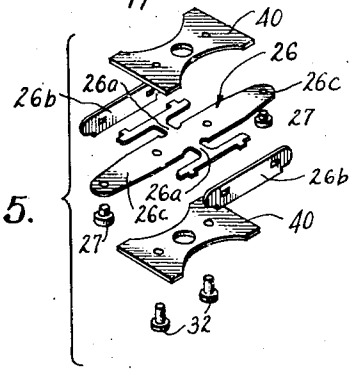


Fig. 5.



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ARMATURE ASSEMBLY

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3 Claims. (Cl. 200—87)

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The present invention pertains to armature assemblies for relays or like devices.

Generally stated, the object of the present invention is to provide an armature assembly for relays or like devices which is of such character that temperature changes within a wide range will not adversely affect its operating characteristics.

Further objects and advantages will become apparent as the following description proceeds, taken in connection with the accompanying drawings in which:

Figure 1 is a side elevation of a relay equipped with an armature assembly embodying the present invention, the casing being shown in section.

Fig. 2 is an enlarged sectional view taken substantially along the line 2—2 in Fig. 1.

Fig. 3 is a sectional view taken substantially along the line 3—3 in Fig. 2.

Fig. 4 is an exploded perspective view of the armature assembly.

Fig. 5 is an exploded perspective view of a modified armature assembly also embodying the present invention and, like the assembly of Fig. 4, adapted for use in the relay shown in Figs. 1 to 3.

Referring more particularly to the exemplification of the invention illustrated in the drawings, the invention has been shown as embodied in an armature assembly designated generally as 10. This particular assembly happens to have been designed for use in the polarized relay shown in Figs. 1 to 3. The relay shown is simply an example of one of the many forms of devices in which armature assemblies embodying the present invention may be used; and this particular relay as a whole is, with the exception of the novel armature assembly here under consideration, disclosed and claimed in the copending application of Clark V. Bullen and Carl J. Anderson, Serial No. 487,244, filed May 17, 1943, which issued as Patent 2,443,784 on June 22, 1948. It will be understood therefore that there is no intention to limit the present invention to such an installation nor to details inessential to practice of the invention, even though a preferred embodiment is described and shown in some detail. On the contrary, the intention is to cover all uses, modifications, alterations and alternative constructions falling within the spirit and scope of the invention as expressed in the appended claims.

In the particular relay shown, the stator, designated generally as 11, comprises a pair of block-shaped permanent magnets 12 made of Alnico or other material having a high degree of magnetic retentivity. The magnets are spanned by upper

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and lower bridges 14, 15, being fixed in place by through-fasteners 16. Inturned from the opposite side edges of each of the bridges 14, 15 are integral ears constituting pairs of opposed pole pieces 18, 19 and 20, 21. The air gaps between the ends of the respective pairs of pole pieces are aligned with each other on the transverse center line of the stator structure. The pole pieces are permanently magnetized by the magnets 12. The upper pole pieces 18, 20 may, for example, be north poles and the lower pole pieces south poles.

Encircling the transverse center line of the stator 11 passing through the air gaps between the two pairs of pole pieces is an actuating winding 22. If an armature, a specific example of which is described below, is positioned to extend axially through such winding, energization of the latter will tend to rock the armature about its center. Flow of current through the winding in one direction will cause the armature to rock in one direction, while flow of current in the opposite direction will correspondingly cause the armature to rock in an opposite direction. Contacts may thus be controllably opened or closed in accordance with the direction of current flow through the actuating winding.

Polarized relays of the general type described above are extremely sensitive instruments. They are intended to respond when a very feeble current is applied to the actuating winding. For precision results it is, moreover, necessary that any drift or change in the so-called "control point" should be eliminated. In other words, the value of the current to which the relay responds should not be subject to inadvertent change during use of the instrument.

Factors which contribute to change in the control point are numerous. They have been difficult to segregate both because they arise from a variety of causes and because of the minute character of the aberrations in operation which are involved. The present invention is based in large measure on my discovery that the more or less necessary use of two metals in an armature assembly for such a device is likely to result in what seems to be a thermally induced bowing of the bimetal structure and which, in any event, manifests itself in the operation of the relay as a shift in control point. Normally the armature assembly must include an armature made of ferromagnetic material in order that it may perform its magnetic circuit functions. Likewise, a second member is normally secured to the armature and made of a different metal either to afford a desired high degree of electrical conductivity to ac-

commodate the same for use as a contact support or a desired springiness for movably supporting the armature, or both. Actual measurement of any thermally induced bowing of such a bimetallic structure, resulting from the dissimilar thermal expansion characteristics of the two metals which comprise it, must usually be done by microscope because of the minute character of the movement which takes place. My own conclusion or deduction is that such warpage does take place and is responsible for the shift in control point upon change in temperature, the latter shift being a definitely detectable physical phenomenon. That deduction is rather conclusively affirmed by my discovery that when the armature assembly is constructed in accordance with the present invention to compensate mechanically for any such tendency to warp, control point shift as an incident to temperature change is obviated.

In the armature assembly 10 illustrated herein is included an armature 23 consisting of a thin platelike wafer of soft iron or other suitable ferromagnetic material. It is generally rectangular in form, being dimensioned to extend into the air gaps between both of the opposed pairs of pole pieces 18, 19 and 20, 21. The central portion of the armature is of reduced cross-section so that it will readily become saturated in the event of application of excessive current to the actuating winding 22. For that purpose a central aperture 24 and side notches 25 are fashioned in the armature.

To the top face of the armature 23, and in face-to-face contact with it, is secured a carrier 26 in the form of a one-piece resilient sheet metal stamping. Such stamping is made of electrically conductive but non-magnetic material, preferably beryllium copper. Thin and torsionally flexible lateral projections 26*a* are preferably provided in the stamping 26 to extend from the central portion of the latter as shown (Fig. 4) and serve to permit rocking of the armature about its transverse central axis during operation of the relay.

The projections 26*a* are bent downward and their outer ends terminate in elongated supporting elements or bridges 26*b* which are clamped between the opposed end faces of the pole pieces (Fig. 2). Also constituting a part of the stamping 26 are elongated and oppositely extending cantilever contact fingers 26*c*. To the outer ends of these fingers are fixed contact points 27 positioned for coaction with stationary contact points 28 carried on adjusting screws 29, supported by brackets 30 fixed to outer sides of the lower pole pieces 19, 21.

The dissimilarity in metals used in the armature assembly elements 23 and 26 described above, and occasioned by their respective different functions, results in a structure consisting of two metal parts secured together in face-to-face contact and which have widely divergent thermal expansion characteristics. With such an arrangement as that so far described it has been found that the relay displays a shift in control point incident to temperature change. What apparently happens is that the bimetal structure 23, 26 warps more or less in the manner of a bimetal thermostat blade when subjected to temperature change, resulting in a variation in spacing between the ends of the armature and the stator pole pieces, or variation in contact spacing, or both.

Pursuant to the present invention, the difficulty outlined above is overcome by fixing to the face of the armature 23 opposite that to which is attached the sheet metal stamping 26 a second sheet metal stamping which is adapted to inhibit or prevent the bowing which would otherwise occur. In the present instance a stamping 31 which is approximately of a diamond shape is fixed to the underside of the armature 23.

The stamping 31 is fixed to the armature 23 by the same pair of rivets 32 which secure the carrier stamping 26 in place, so that the points of attachment of the two sheet metal members to the armature match. Moreover, such points of attachment are preferably located symmetrically with respect to both the longitudinal and transverse axes of the armature.

In order that the two sheet metal stampings 26, 31 shall prevent the application or development of bending forces on the armature, the two should have substantially the same coefficient of thermal expansion. That is most simply achieved by fashioning them both from the same material. Moreover, the two sheet metal faces should develop approximately the same strength, that is to say, have approximately the same resistance to compression or tension, between the points of riveting. For that purpose they may be made of metal of the same gauge and shaped as shown to afford cross-sections of substantially the same mean area.

With the added stamping 31 secured to the underside of the armature as described above, shift in control point for the relay, incident to change in temperature, is substantially eliminated so far as the armature is concerned.

The assembly and operation of the relay shown will in general be clear from the foregoing. By way of brief recapitulation, it may be noted that the parts are arranged as illustrated and the contacts adjusted for a desired clearance. Forces applied to the armature 23 by the permanent magnet flux may be readily balanced by adjusting shunts 33. In the illustrated arrangement such magnetic shunts are shown as being four in number, two being pivoted on each of the upper pole pieces 18, 20. These strips are of ferromagnetic material and are resiliently urged into contact with the outer faces of adjacent ones of the permanent magnets 12. By shifting the shunts the magnetic potential across the corresponding air gaps may be correspondingly varied to bring the armature into magnetic balance.

Having assembled and adjusted the relay as noted above, the same is operated by applying energizing current to the actuating winding 22. A current flowing in one direction will cause the armature 23 to rock counterclockwise (as viewed in Fig. 2) thereby closing the lefthand pair of contact points 27, 28. Similarly, current flowing in the opposite direction through the winding 22 will rock the armature clockwise to close the other or righthand pair of contacts 27, 28. Upon deenergization of the actuating winding the torsionally stressed carrier projections 26*a* restore the armature to its mid position and in which both sets of contacts are open.

By reason of the temperature compensating arrangement, including specifically the added stamping 31 described above, the instrument's control point remains substantially unchanged even though the armature be subjected to widely varying temperatures. The precision of the instrument is thus effectually protected against impairment by change in armature temperature.

In Fig. 5 is shown a modified armature assembly also embodying the present invention. In this instance two layers of iron with one of beryllium

copper sandwiched between has been used, rather than the reverse arrangement previously described in which a layer of iron is sandwiched between two of conductive sheet metal.

In the particular construction shown in Fig. 5 a pair of duplicate ferromagnetic armature sections **40** are used. Each is of the same shape as the armature **23** heretofore described although each section may be of only approximately half the thickness of the single piece armature **23**. Between the sections **40** is sandwiched a sheet metal carrier **26** similar in construction to that previously described, but with the supporting elements **26b** formed as separate stampings. The carrier and the armature parts are secured together by a pair of rivets **32** as before. With such an arrangement thermally induced bowing of the armature is effectually prevented for the reasons mentioned previously.

I claim as my invention:

1. In an armature assembly for a relay or the like, the combination comprising a plate-like ferromagnetic armature member and a sheet metal contact supporting member disposed in face-to-face relation and having dissimilar thermal expansion characteristics, pivot means for said armature having a pivoting axis lying parallel to the plane thereof, a third member made of the same material as one of said first-mentioned members, together with means for rigidly securing all three of said members together in stacked relation with the two members of like material having the remaining member sandwiched therebetween, and the resistance to bending of the two members of like material being substantially equal so that there is no tendency for a point on said armature remote from said pivoting axis to rotate about said axis upon subjecting said assembly to a change in temperature.

2. In an armature assembly for a relay or the like, the combination of a plate-like ferromagnetic armature, a contact support including a non-magnetic electrically conductive portion of sheet metal overlying one face of said armature and having a contact supporting finger integral therewith and projecting outward from the armature, a second portion of sheet metal of the same material as the first-mentioned one overlying the opposite face of said armature, means for rigidly securing said portions of sheet metal to the respective opposite faces of said armature at a plurality of points matched in position for each of said portions of sheet metal, the resistance to lateral bending of each of said portions of sheet metal between their respective points of attachment to said armature being substantially equal.

3. In an armature assembly for a relay or the like, the combination of a plate-like ferromagnetic armature, a contact support including a non-magnetic electrically conductive portion of sheet metal overlying one face of said armature and having a pair of contact supporting fingers integral therewith and projecting outward from the armature at opposite ends of the latter in alignment with each other, means adapting said armature for pivotal mounting about a central axis parallel to the plane of said armature and perpendicular to the longitudinal axis of said contact supporting fingers, a second portion of sheet metal of the same material and thickness as the first one overlying the opposite face of said armature, and a plurality of rivets passed through said armature rigidly securing said portions of sheet metal to the latter's opposite faces at matched points spaced on the armature in a direction longitudinal of said fingers equi-distant from the pivotal axis thereof.

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