United States Patent [19]

Pratt

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[45] **Jan. 2, 1973**

[54] **MINIATURE RELAY**

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[52] **U.S. Cl.**.....**335/128,** 335/203

[51] **Int. Cl.**.....**H01h 51/06**

[58] **Field of Search**.....335/128, 203, 187

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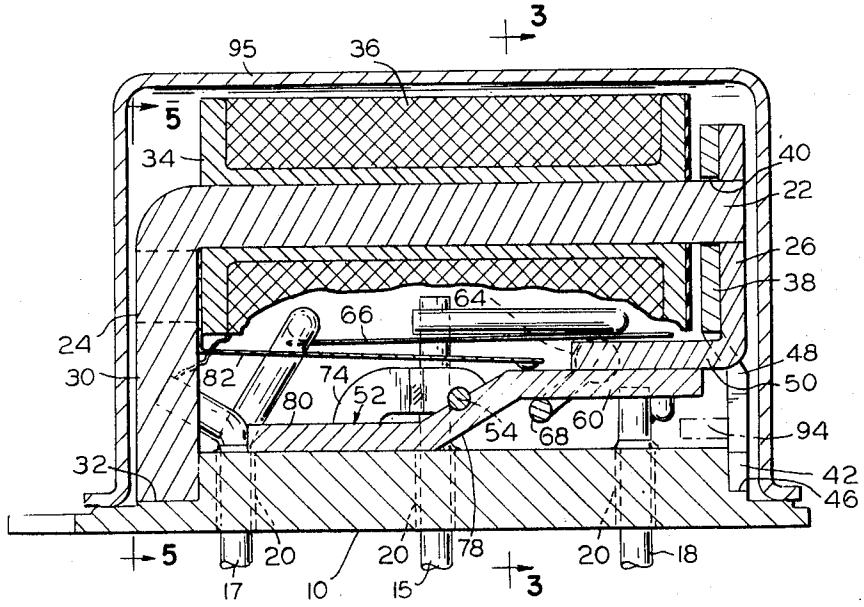
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[57] **ABSTRACT**

A compact electromagnetic relay includes an operating coil disposed upon a core which is positioned above a magnetic header by magnetic and non-magnetic end supports. A balanced armature is located between the core and header, and pivots about an axis perpendicular to the axis of the core and parallel to the surface of the header when magnetically attracted by the said header and a pole end portion.

9 Claims, 5 Drawing Figures



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SHEET 1 OF 2

FIG. 1

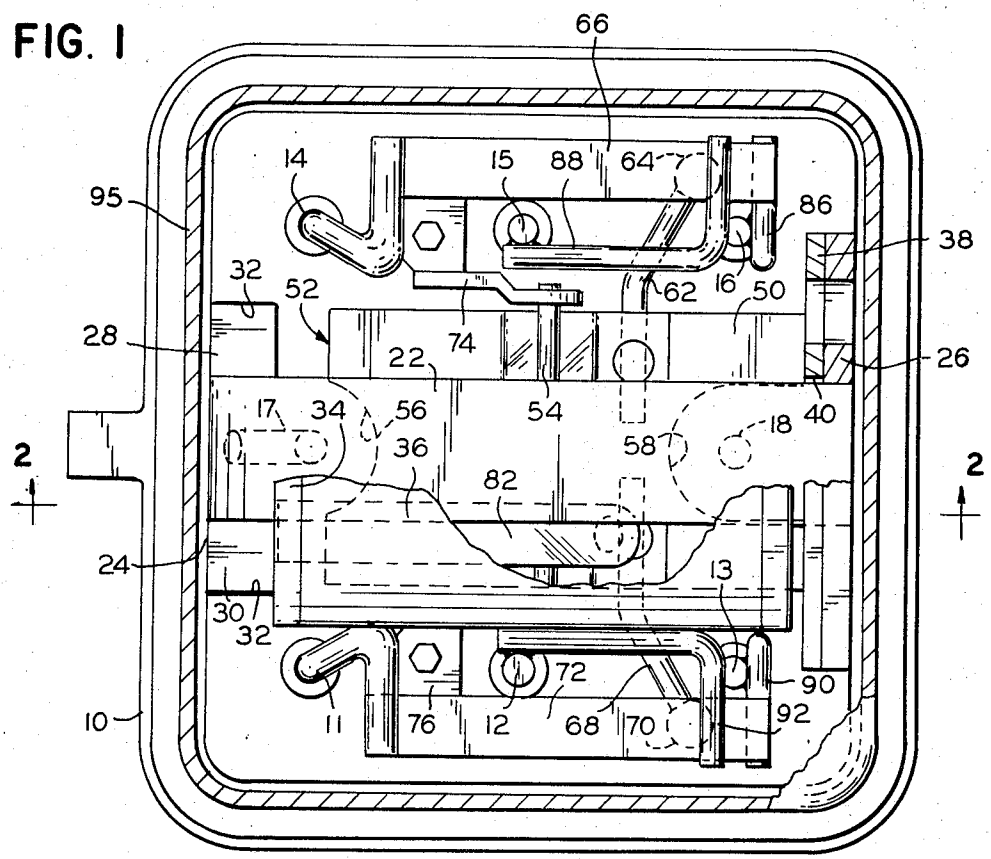
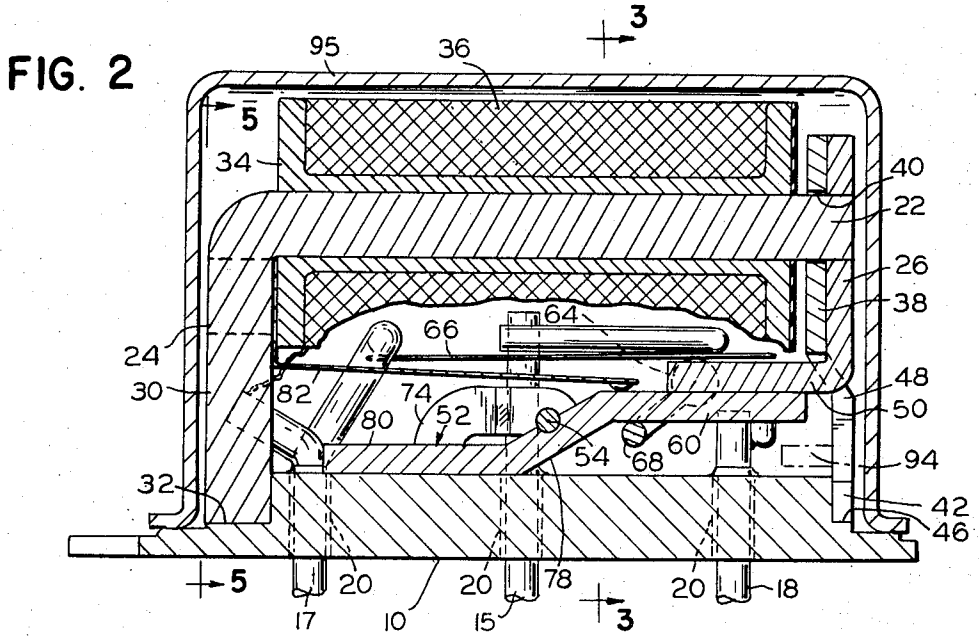


FIG. 2



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FIG. 3

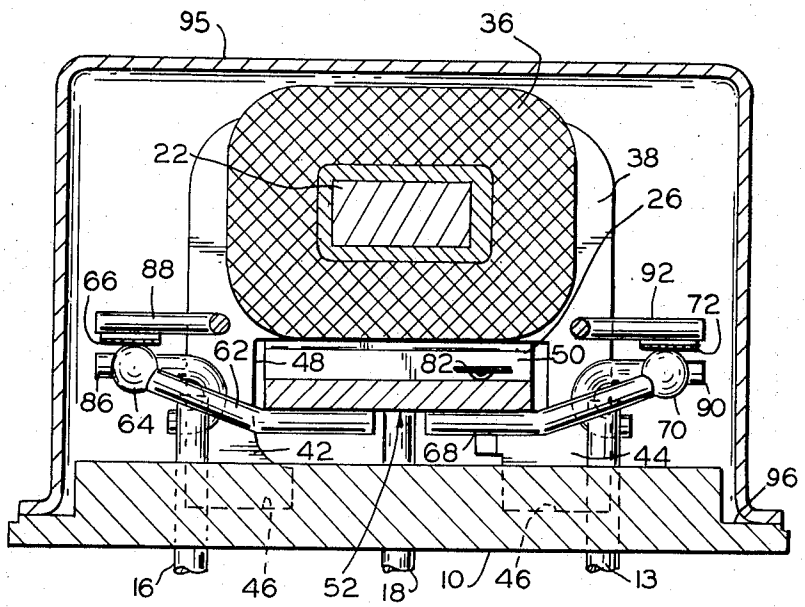
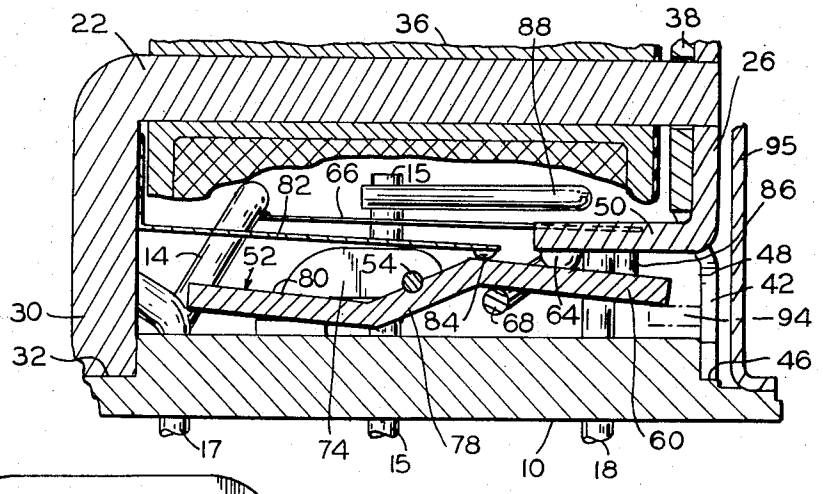


FIG. 4



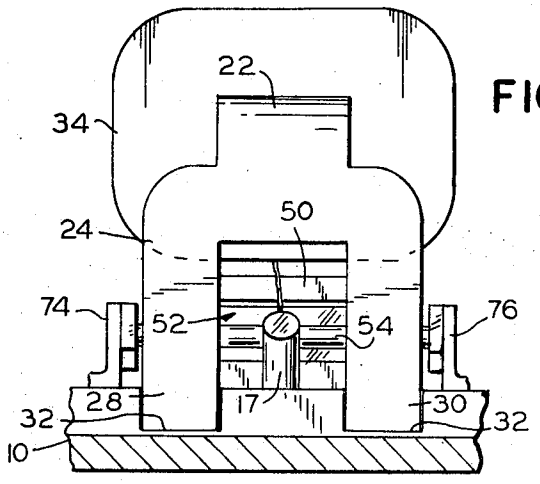


FIG. 5

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MINIATURE RELAY

BACKGROUND OF THE INVENTION

Miniaturization of electromagnetic relays is usually limited by the essential structure which the device must include, i.e. core, coil, contacts, and the like, suitable for attaining desired sensitivity and other operating properties. Conventional relays are often cumbersome and include multi-pole core structure at one end of an operating coil or coils for attracting a movable armature disposed at such location. Another type of relay employs a balanced armature which is attracted to the sides of core legs, the armature being pivoted upon a separate header about an axis parallel to the core legs. This type of structure tends to be elongated in the direction of the armature axis.

SUMMARY OF THE INVENTION

According to the present invention, a miniature, light weight relay has an extremely compact and efficient structure. The relay includes a magnetically permeable core having an operating coil positioned thereon, and first and second core legs extending laterally to a first side of the core concluding in pole end portions extending back along the core in a direction generally toward one another. A balanced armature is pivoted for rotation with respect to an axis which is substantially perpendicular to the axis of the core and displaced at the side thereof in non-intersecting relation to the core and coil. The armature ends extend adjacent the said core pole end portions such that one end of the armature is located between a first pole end portion and the core, while a second end of the armature is located on the remote side of the remaining pole end portion from the core. The armature is preferably formed of substantially flat material facing the core and coil, thereby consuming very little additional space.

According to a preferred embodiment of the invention, one of the pole end portions comprises the mounting header for the relay. Thus, no additional space is required for an insulating or non-magnetic header, but rather the balanced armature is attracted to engage the magnetic header and a second pole end portion disposed above the header. The relay core and coil are preferably supported adjacent the last pole end portion by a non-magnetic member extending from the header. The completed relay is typically about one-third of an inch square, and about one-fourth of an inch high.

It is therefore an object of the present invention to provide an improved, sensitive, light weight, and miniature relay.

It is a further object of the present invention to provide an improved miniature relay employing a minimum number of parts whereby the relay can be small in overall construction and economical to manufacture.

It is another object of the present invention to provide an improved miniature relay wherein moving parts are compactly positioned, and wherein structure is utilized for multiple purposes.

The subject matter which I regard as my invention is particularly pointed out and distinctly claimed in the concluding portion of this specification. The invention, however, both as to organization and method of operation, together with further advantages and objects thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings wherein like reference characters refer to like elements.

DRAWINGS

FIG. 1 is a partially broken away, plan view of the light weight, miniature relay according to the present invention;

FIG. 2 is a vertical cross section of the relay taken at 2—2 in FIG. 1, and illustrating the balanced armature in operated position;

FIG. 3 is a vertical cross section of the relay according to the present invention taken at 3—3 in FIG. 2;

FIG. 4 is a partial vertical cross section viewed from the same location as FIG. 2, but illustrating the relay armature in normal non-operated position; and

FIG. 5 is a partial end view of a portion of the relay, inside the outer shell, as taken at 5—5 in FIG. 2.

DETAILED DESCRIPTION

Referring to the drawings, a miniature, light weight relay according to the present invention includes a header **10**, typically 0.368 inch square, having a height of about 0.04 inch, and formed of magnetically permeable material, i.e. material having high permeability. A plurality of rod-like, conducting terminals **11–18** extend through the header and are insulated therefrom by means of fused bushings forming glass eyelets **20** which complete an hermetic seal between the header and the terminals.

The relay according to the present invention is provided with a core **22** of magnetically permeable material having laterally downwardly extending leg means **24** and **26** at respective ends thereof also formed of magnetically permeable material. Leg means **24**, which is unitary with the core, is bifurcated to provide a pair of legs **28, 30** received within notches **32** at the end of the header. The legs **28, 30** are welded to the header so as to form a continuous magnetic circuit therewith. Between leg means **24** and **26**, the core **22** is provided with a bobbin **34** upon which is wound an operating coil **36** having end connections secured to terminals **17** and **18** at points above the level of header **10**. As will be understood by those skilled in the art, the relay is selectively connected to a source of operating power via terminals **17** and **18** whereby a magnetic flux is established in core **22** by coil **36**.

The right-hand end of core **22** (as viewed, for example in FIG. **2**), is supplied with a non-magnetic metal support **38** apertured at **40** to receive the right-hand end of the core **22** therethrough. Support **38** is secured as by welding to the hereinbefore mentioned core leg means **26** also received upon the outer end of core **22** for extending the magnetic circuit thereof. As most clearly appears in FIG. **3**, the support **38** has lower legs **42, 44** received and welded within notches **46** in header **10**.

Support **38** is provided with aperture **48** between its lower legs **42, 44** through which a pole end portion **50** of core leg means **26** extends. The end portion **50** is substantially flat and is disposed in a horizontal plane spaced from the axis of core **22** just below bobbin **34** and coil **36** while being parallel to the flat top surface of header **10**. End portion **50** extends back under core **22** for about a quarter the length thereof in position for en-

gaging armature 52 as hereinafter more fully described. Pole end portion 50 is disposed between armature 52 and core 22. It is noted that support 38 completes structure for positioning core 22 and core leg means 26 without shunting magnetic flux away from the armature it is intended to operate.

Core leg means 24 is regarded as also having a pole end portion taking the form of header 10 extending rightwardly from legs 28, 30. The header 10 forms a magnetic circuit with core 22 and leg means 24, and its flat upper surface is adapted to be engaged by armature 52. The pole end portion 50 and the pole end portion as formed by header 10 extend in opposed relation generally toward one another having parallel surfaces adapted for engagement by armature 52 when the operating coil is energized. The pole end portion provided by header 10 is positioned farther from the axis of core 22 than is pole end portion 50, whereby the armature 52 may be disposed therebetween.

Armature 52 is secured to a pivot pin 54 in such a manner that the armature is balanced with respect thereto. It will be noted that the ends of the armature are recessed at 56 and 58 to provide clearance for terminals 17 and 18 connected to operating coil 36. The recess 58 is deeper, while the armature is somewhat larger to the right of the pivot pin. Also, the right-hand end, 60, of the armature carries a bent actuator 62 which is welded to the underside thereof and which extends to one side of the armature, carrying a glass bead 64 at its tip end adapted for operating movable reed contact 66 of the relay. Reed contact 66 is a flexible metal strip attached at its extremity, as by welding, to a horizontally bent portion of terminal 14. A second similar actuator 68 is also welded to the underside of the armature and extends from the opposite side of the armature where it is provided with a glass bead 70 adapted for operating movable reed contact 72 welded at one end to terminal 11. The balanced armature is shock resistant in movement and enhances the sensitivity and positioning adaptability of the relay.

Pivot pin 54 is journaled in a pair of pivot pin supports 74 and 76 attached to header 10, which dispose the axis of pivot pin 54 in substantially perpendicular relation to the axis of core 22 and also in spaced relation from the axis of core 22 in the same direction as core leg means 24 and 26 extend. The armature 52 is a substantially flat metal member of magnetically permeable material which is bent to have a central portion 78 angularly related to the header when left-hand end 80 of the armature is in abutting relation with the top surface of header 10. The armature ends 60 and 80 are planar and parallel, being spaced so that end 60 is disposed in flat, parallel, abutting relation to pole end portion 50 when armature end 80 is in flat, parallel, abutting relation to header 10. The planes of the pole end engaging surfaces of the armature, if extended, pass the axis of pivot pin 54 on opposite sides thereof.

The armature is normally held in the position illustrated in FIG. 4 through the action of biasing spring 82 secured at one end to core leg means 24. The biasing spring 82 is provided at its opposite extremity with a tab 84 which bears against the top of armature 52, normally causing the armature to take the position illustrated in FIG. 4 such that armature ends 60 and 80 are equispaced respectively from the pole end portion 50 and the top of header 10. Support 38 provides, near its lower extremity, a stop 94 for limiting clockwise motion of balanced armature 52 when the latter is under the impetus of bias spring 82. Under these circumstances, the bead 64 of actuator 62 normally does not touch the movable reed contact 66. Consequently, the movable reed contact 66 makes connection with U-shaped lower fixed contact 86 joined to terminal 16 near its upper extremity. When the actuating coil is provided with predetermined current, a magnetic flux is established, and the armature 52 is attracted to the position illustrated in FIG. 2 against the bias of spring 82. Bead 64 of actuator 62 then pushes movable reed contact 66 against an L-shaped fixed contact 88 welded to terminal 15 near its upper extremity. Both movable and fixed contacts are electrically conductive and are suitably gold-plated.

The relay in the illustrated embodiment comprises a double pole double throw relay, therefore including a similar set of contacts on its opposite side. Thus, movable reed contact 72, supported by terminal 11, is located between lower contact 90 secured to terminal 13 and upper contact 92 secured to terminal 12. Normally, the bias spring 82 keeps contact 72 in contact with terminal 90 until the armature is actuated and bead 70 of actuator 68 forces reed contact 72 upwardly into connection with contact 92.

To complete construction of the relay, a non-magnetic shell 95 is secured to the upper surface of a flange 96 around the edge of header 10 as by welding. In a typical instance, the shell was about 0.217 inch in height. The chamber thus formed is preferably filled with a suitable gaseous atmosphere. The relay may be conveniently mounted by means of the aforementioned header on an equipment panel or circuit board, the latter providing means through which terminals 11-18 may pass for making connection not only to the operating coil, but also to various relay contacts.

The relay has been described with reference to normal positive simultaneous operation for both sets of contacts. Alternatively, the reed movable contacts 66 and 72 may be provided with a transverse curvature for achieving a snap action. The relay, although then less sensitive, is able to carry somewhat heavier current. While sets of contacts are described, it will also be appreciated that one set may be eliminated if desired.

The relay according to the present invention is very compact and efficient. The entire compact structure is supported in close proximity to the lower side of the operating coil between said operating coil and the mounting header 10, with the armature pivoting axis being perpendicular to core and coil axis but spaced therebelow. Thus, the flat armature is closely adjacent the core and coil and consumes little space. The header 10 itself provides the dual functions of support, and as a part of the magnetic circuit. As the operating coil is energized, the armature 52 is strongly attracted at respective ends 80 and 60 thereof by header 10 and pole end portion 50 for completing a magnetic circuit through core 22, leg means 24, header 10, armature 52, and leg means 26 without utilizing conventional pole piece structure.

While I have shown and described a preferred embodiment of my invention, it will be apparent to those skilled in the art that many changes and modifications

may be made without departing from my invention in its broader aspects. I therefore intend the appended claims to cover all such changes and modifications as fall within the true spirit and scope of my invention.

I claim:

1. An electromagnetic relay comprising:

a magnetically permeable core and an operating coil positioned upon said core for establishing magnetic flux in said core,

first and second core legs joined respectively to said core beyond the ends of said coil and extending laterally to a first side of said core and coil, each of said legs being formed of magnetically permeable material and respectively including first and second opposed pole end portions extending back along said core, said pole end portions being offset with respect to one another so that the first pole end portion is father from said core, said first pole end portion comprising a header formed of magnetically permeable material, the first core leg being joined to said header so that said first core leg and said core are supported thereby,

a balanced armature formed of magnetically permeable material pivoted for rotation with respect to an axis which is substantially perpendicular to the axis of said core and coil and displaced at said first side of said core and coil in non-intersecting relation thereto, and means also joined to said header for pivotally engaging said armature at the axis thereof to position the axis of said armature in substantially parallel relation to said header, the ends of said balanced armature on either side of the axis thereof extending adjacent said pole end portions such that a first end of said armature is located between a first pole end portion and said core while the second end of said armature is located on the remote side of the remaining pole end portion from said core, said pole end portions being disposed in substantially parallel relation to said core and to the axis of said armature,

and means for normally biasing said balanced armature to position the ends thereof in spaced relation with said pole end portions adapting the balanced armature for movement into engagement with said pole end portions for completing a magnetic circuit therewith upon energization of said operating coil.

2. The relay according to claim 1 comprising contact means adjacent said armature and a contact means actuator carried by said armature for operating said contact means when said armature is drawn toward said pole end portions.

3. An electromagnetic relay comprising:

a magnetically permeable core and an operating coil positioned upon said core for establishing magnetic flux in said core,

first and second core legs joined respectively to said core beyond the ends of said coil and extending laterally to a first side of said core and coil, each of said legs being formed of magnetically permeable material and respectively including first and second opposed pole end portions extending back along said core, the first pole end portion comprising a header of magnetically permeable material joined to the first core leg so the core is supported thereby,

a balanced armature formed of magnetically permeable material and means for pivotally supporting said armature about an axis of rotation disposed in substantially parallel relation to said header of magnetically permeable material, said axis being substantially perpendicular to the axis of said core and coil and displaced at said first side of said core and coil in non-intersecting relation thereto, the ends of said balanced armature on either side of the axis thereof extending adjacent said pole end portions such that a first end of said armature is located between a first pole end portion and said core while the second end of said armature is located on the remote side of the remaining pole end portion from said core,

and means for normally biasing said balanced armature to position the ends thereof in spaced relation with said pole end portions adapting the balanced armature for movement into engagement with said pole end portions for completing a magnetic circuit therewith upon energization of said operating coil.

4. The relay according to claim 3 wherein said pole end portions are disposed in substantially parallel relation to said core and to the axis of said armature, and wherein said pole end portions are offset with respect to one another so that the first pole end portion is farther from said core.

5. The relay according to claim 3 wherein said balanced armature is in general facing relation to said core and coil, said armature comprising a central portion, provided with a pivot member defining the axis of said armature, a first end of the armature presenting a flat surface extending outwardly from said central portion on one side of said axis toward a said pole end portion, and the second end of said armature presenting a flat surface extending outwardly from said central portion on the remaining side of said axis toward the remaining pole end portion, said armature end surfaces being substantially parallel for engaging said pole end portions with rotation of said armature into a position parallel thereto.

6. The relay according to claim 3 wherein the second core leg end portion is positioned in spaced relation to said header to maintain the same spacing with respect to the second armature end as is maintained between the first armature end and said header in the non-operated condition of said relay, whereby energization of said operating coil moves said armature into substantial engagement with the second core end portion and said header.

7. The relay according to claim 6 wherein said balanced armature is positioned to present a first end thereof in parallel abutting relation to said header when said operating coil is energized.

8. The relay according to claim 6 wherein the second core leg is provided with a non-magnetic support extending from said second core leg and joined to said header.

9. The relay according to claim 3 comprising contact means adjacent said armature at a side thereof, and a contact means actuator carried by said armature and extending to the side thereof for operating said contact means when said armature is drawn toward said pole end portions.

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