United States Patent

Müller

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[45] **Sept. 26, 1972**

[54] **COMPACT ELECTROMAGNETIC RELAY**

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[73] Assignee: **Babcock Electronics Corporation**, Costa Mesa, Calif.

[22] Filed: **May 14, 1971**

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[52] **U.S. Cl.**.....**335/128**, 335/202

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

[58] **Field of Search**.....335/202, 203, 179, 125, 128

[56] **References Cited**

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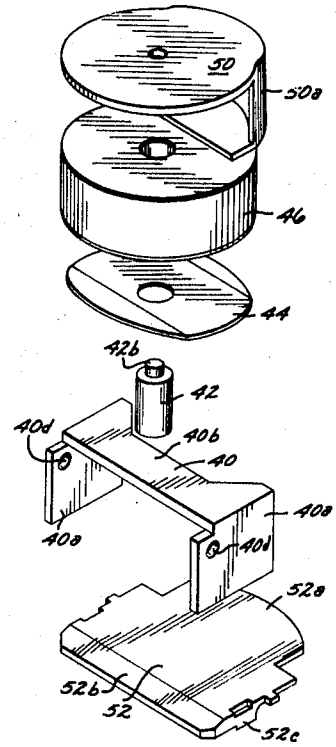
[57] **ABSTRACT**

A small compact relay comprises a contact assembly having a header which carries electrical connectors as well as relatively movable electrical contacts, and an electromagnetic operator having a frame member to which is secured one end of a core and whereon is mounted an electromagnetic winding, there being another frame member fixed to the other end of the core and having a pole portion extending adjacent the winding. An armature is pivotally mounted on the first mentioned frame member to provide an electromagnetic air gap with said pole member, and a return spring is mounted relative to said first mentioned frame to urge said armature in a given position relative to said pole member.

10 Claims, 10 Drawing Figures



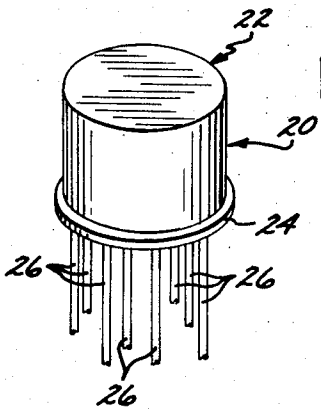


FIG.1

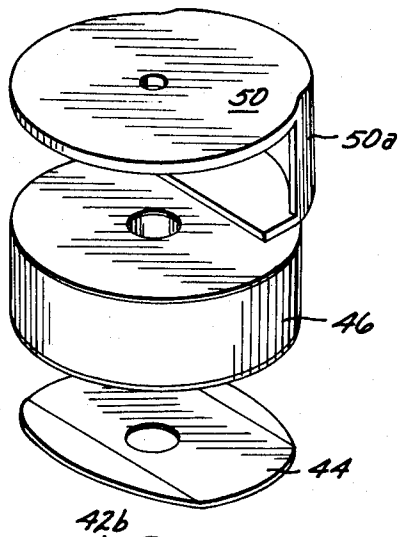


FIG.2

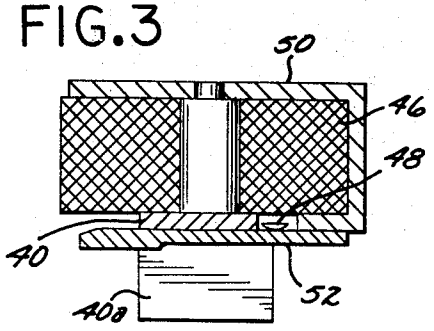


FIG.3

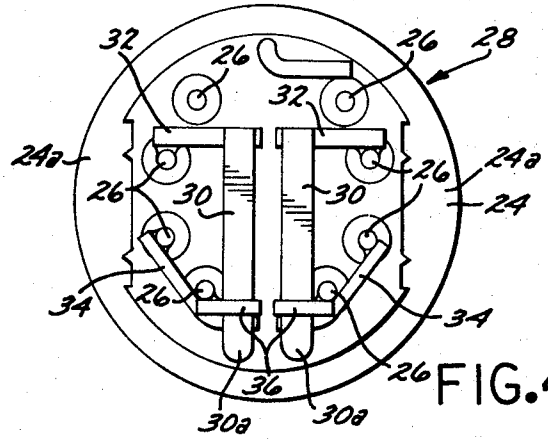
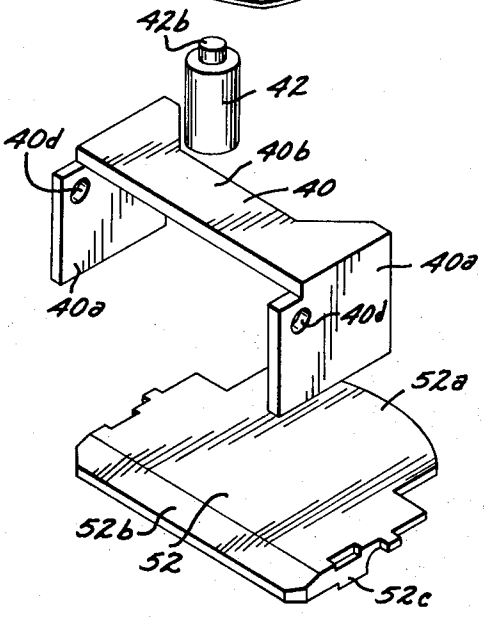


FIG.4



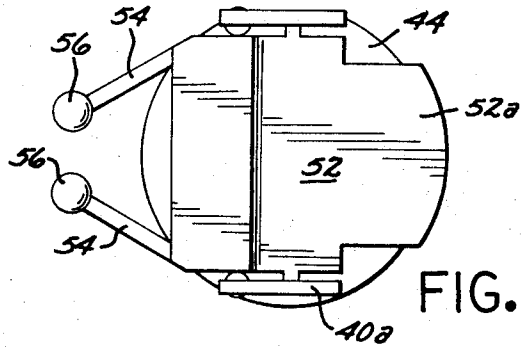


FIG.5

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FIG.6

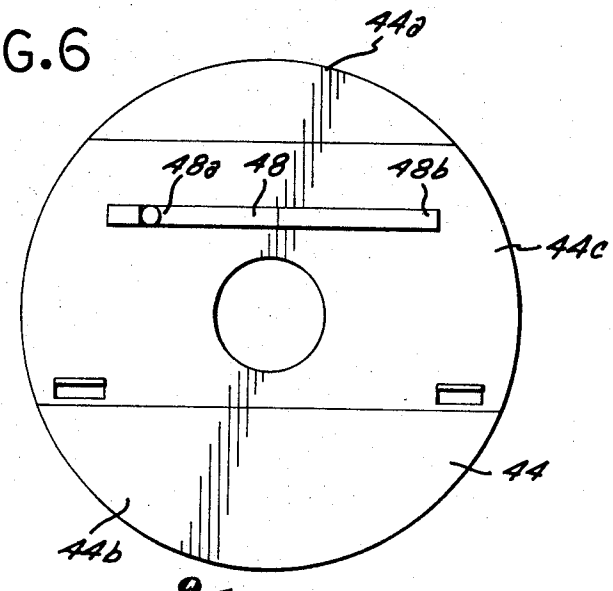


FIG.7

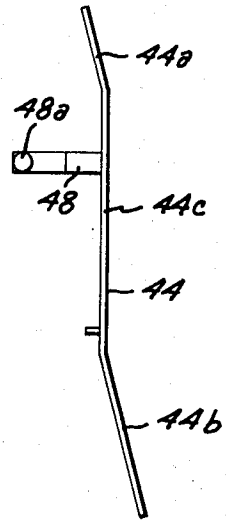


FIG.8

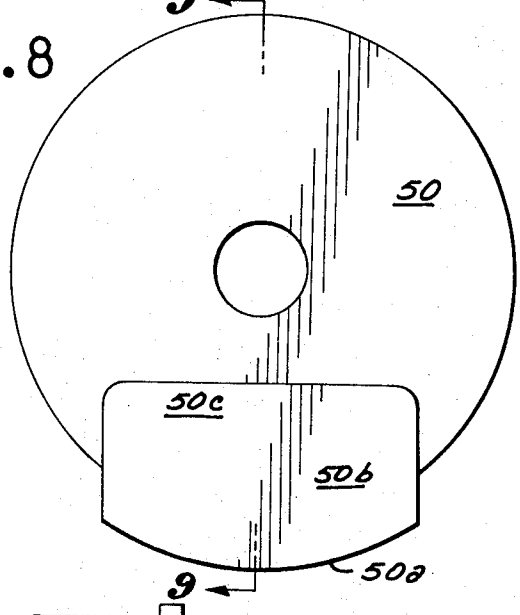
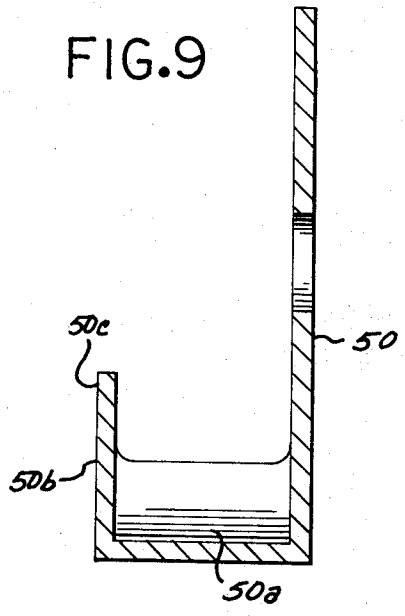


FIG.9



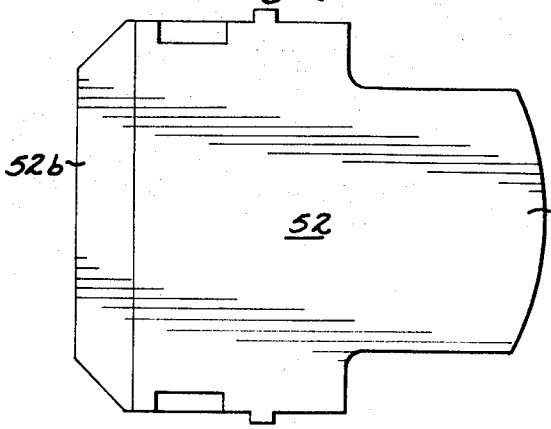


FIG.10

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COMPACT ELECTROMAGNETIC RELAY

This present invention relates generally to compact, electromagnetic relays, and more particularly, to such relays as are used on electronic printed circuit boards and the like.

As is well-realized, the electronics industry has undergone many revolutionary changes within the past several decades, perhaps the most notable of which is the advanced degree of miniaturization which has permeated substantially all segments of the electronics arts. Such advances have been instigated by the tremendous growth in the electronic industry and the heavy emphasis placed on electronics for use in aerospace applications. The industries associated with missiles, rocketry, and space travel, have incurred the most noted advances in the art of miniaturizing circuit components of virtually all kinds.

For some period of time, it has been realized by the electronic industries that it would be extremely beneficial to have a small compact efficient relay wherein the parts are so arranged that the desired efficiencies and functions result without causing the relay to be larger than the usual miniature and subminiature circuit component. Such devices, it was realized, would be particularly desirable for use on electronic circuit boards where many circuit components are formed on an extremely small surface.

To this end, the present invention has been devised to afford a small compact relay wherein the electromagnetic operator can be tested and evaluated separate and apart from many of the other relay components.

It is an object of the present invention to provide a highly compact electromagnetic relay wherein the electromagnetic operator or assembly is complete so that it can be meaningfully tested and evaluated.

Another object of the present invention is to provide a compact electromagnetic relay as characterized above, wherein a return spring is provided integrally with the electromagnetic unit and armature so that the operator can be tested separately.

A further object of the present invention is to provide a compact electromagnetic relay as characterized above which is less sensitive to physical forces which heretofore have caused prior relay structures to vibrate excessively.

A still further object of the present invention is to provide an electromagnetic relay as characterized above, which is simple and inexpensive to manufacture and which is rugged and dependable in operation.

The novel features which I consider characteristic of my invention are set forth with particularity in the appended claims. The device itself, however, both as to its organization and mode of operation, together with additional objects and advantages thereof, will best be understood from the following description of specific embodiments when read in connection with the accompanying drawings, in which:

FIG. 1 is an external perspective view of a relay made in accordance with the present invention;

FIG. 2 is an exploded perspective view of some of the components of the subject relay;

FIG. 3 is a longitudinal sectional view through the relay of FIG. 1;

FIG. 4 is a top plan view of the contact assembly;

FIG. 5 is a bottom plan view of the electromagnetic operator;

FIG. 6 is an elevational view of the return spring;

FIG. 7 is an end view of such spring;

FIG. 8 is an elevational view of one of the frame members;

FIG. 9 is a sectional view taken substantially along line 9—9 of FIG. 8; and

FIG. 10 is a plan view of the armature used in the subject relay.

Like reference characters indicate corresponding parts throughout the several views of the drawings.

Referring to FIG. 1 of the drawings, there is shown therein a relay **20** constructed in accordance with the present invention. An enclosure, **22**, is provided for the components of relay **20**, and such enclosure is made to correspond in all dimensions to the enclosure typically used for housing transistors and the like. The transistor enclosure referred to in the art as a TO–5 can is of optimum size and shape to conform to substantially all circuit geometry on today's market.

Relay **20** further comprises a header **24** wherein is mounted a plurality of circuit connectors **26** as shown in FIG. **1**.

Referring to FIG. **4** of the drawings, a contact assembly **28** is shown therein as comprising the header **24** and the various electrical connectors **26**.

A pair of movable contacts **30** which may take substantially any desired form, but are shown in the drawing as being formed of flexible sheet material welded to a mounting post **32**, respectively. Each such mounting post is secured to a separate one of the connectors **26** on one side of header **24**, as by welding, brazing, soldering, or the like. As such, the extended or free ends **30***a* of the contacts **30** can be moved up and down to make and break electrical contact with suitable stationary contacts.

Affording a pair of stationary contacts are generally L-shaped contacts **33** individually welded to a separate one of said connectors **26** at a point removed from the vicinity of flexible movable contacts **30**. Such generally L-shaped stationary contacts **34**, as shown in FIG. **4** of the drawings, are positioned beneath the contacts **30** as shown.

Additional stationary contacts **36** are caused to overlay the contacts **30**, as shown in FIG. **4**, and these short contacts are, in like fashion, secured to appropriate connectors **26** as by welding, brazing, soldering, or the like.

The inherent resiliency of movable contacts **30** is utilized to cause them to engage the stationary contacts **36**. Thus, the movable contacts **30** are normally in space relation to the stationary contacts **34**, thus causing the contacts **36** to be the normally closed contacts and the contacts **34** to be the normally open contacts.

Separate and apart from the aforedescribed contact assembly, is the electromagnetic operator for the subject relay **20**. Referring to FIG. **2** of the drawings, such operator comprises a frame member **40** which is generally U-shaped, having a pair of spaced support legs **40***a* and an intermediate portion **40***b*. Support legs **40***a* are adapted to engage the header **24**, as at locations **24***a*, to enable said frame member **40** to be firmly secured thereto as by welding, brazing, soldering, or the like.

Firmly secured to the intermediate portion 40*b* of frame member 40, as by welding, brazing, soldering, or the like, is a core 42. A spring retainer 44 and an electromagnetic winding 46 are placed over said core.

As shown most clearly in FIG. 6 of the drawings, the spring retainer 44 is provided with offset edge portions 44*a* and 44*b* joined by an intermediate portion 4*c*. A spring element 48 is formed out of the intermediate portion 44*c*, as by stamping and forming, such that the end 48*a* is free from the intermediate portion 44*c* and the spring element is secured to such intermediate portion at the end portion 48*b*. The purpose and function of such spring element will be hereinafter described in detail.

Mounted on top of electromagnetic winding 46 is a frame member 50 having and arcuate depending portion 50*a* which constitutes a pole member adjacent the winding 46. The spring retainer 44, winding 46 and frame member 50 are assembled on the core 42, the end portion 42*b* of the latter extending through the centrally located opening in frame member 50. While all of such parts are thus assembled, the end 42*b* of core 42 is firmly and rigidly secured to the frame member 50 to form a unitary structure capable of withstanding excessive vibrations and physical shocks.

As shown most clearly in FIGS. 8 and 9 of the drawings, frame member 50 is provided with the arcuate pole member 50*a* of such length as to extend the length of the electromagnetic winding 46. The pole member is provided with a return portion 50*b* which affords a pole face 50*c* for cooperation with an armature as will hereinafter be described.

Mounted between the support legs 40*a* of the frame member 40 is an armature 52. As shown in FIG. 10 of the drawings, the armature is formed with a magnetic end portion 52*a* which cooperates with the pole face 50*c*, as will hereinafter be explained, and an operating end portion 52*b* which carries suitable contact actuators for engaging the movable contacts 30. As shown in FIG. 5 of the drawings, one such form of actuators may comprise arms 54 which carry glass or ceramic balls 56 which engage the contactors 30.

As shown most clearly in FIGS. 2 and 3, the armature 52 is further provided with a pair of depending tabs 52*c* to which are fastened, as by welding, brazing, soldering, or the like, pivot means in the form of spheres which fit within openings 40*d* formed in the support legs 40*a* of member 40. To accomplish this, armature 52 is properly positioned within the U-shaped configuration of frame member 40, the spheres are positioned within the openings 40d, and the latter are then firmly welded to the depending tabs 52*c* are the armature. Thus, the armature is firmly but pivotally secured to the frame member 40.

To insure optimum operation, armature 52 should be weight-balanced about its pivotal mounting in support legs 40*a* of frame member 40. Since said armature is not formed symmetrically about such pivotal mounting, the operating end portion 52*b* thereof should be of greater thickness than the magnetic end portion 2*a* to the extent necessary for proper weight balancing.

As shown most clearly in FIG. 3 of the drawings, with all of the parts assembled as hereinabove described, the spring element 48 of spring retainer 44 is caused to exert a downward pressure on magnetic portion 52*a* of armature 52 to cause the latter to be pivoted in a clockwise direction as viewed in said FIG. 3. This causes the actuators on armature 52 to permit the inherent resiliency of the movable contacts 30 to cause the latter to engage the normally closed stationary contacts 36.

When is is desired to actuate the relay to its opposite position, it is merely necessary to energize the electromagnetic winding 46. This causes magnetic flux to flow in a circular path comprising core 42, frame member 50, pole members 50*a* and 50*b*, the air gap between pole face 50*c* and armature 52, armature 52, and frame member 40 back to core 42. When this occurs, the armature is pivoted about the spherical bearing members to cause the magnetic portion 52*a* to engage the pole face 50*c*. The glass spheres 56 on the ends of arms 54 thus engage the movable contacts 30 so as to move them from engagement with normally closed stationary contacts 36 into engagement with normally open stationary contacts 34. This movement of armature 52 is against the biasing force of spring element 48. When the winding 46 is de-energized, the aforedescribed magnetic flux diminishes thus enabling spring element 48 to return armature 52 to its original position. This permits the inherent resiliency of contacts 30 to return them into engagement with stationary contacts 36.

To better control the movement of armature 52 between its several positions, limit stop means may be provided. For instance, such stop means may be secured to header 24 to limit the movement of said armature in one direction.

In assembling a relay, it is desirable, if not mandatory, to be able to test the entire electromagnetic operator as a subassembly, to thereby ascertain its operational characteristics and to permit of final adjustments before it is assembled with the other relay components. Due to the fact that the electromagnetic operator of the instant invention is complete in and of itself before it is anchored to the header 24, it is seen that the entire operator can be tested and evaluated. This result obtains by virtue of the fact that all of the magnetic components and the major biasing forces are built within the electromagnetic operator.

It is thus seen that the present invention provides a small compact, highly sensitive relay which is particularly well-adapted for use in standard transistor containers presently available today. The subject relay is of such shape and configuration as to make maximum use of the space within such container while nonetheless providing optimum operating characteristics.

Although I have shown and described several specific embodiments of the present invention, it is realized that many modifications thereof are possible.

I claim:

1. In a compact electromagnetic relay, the combination of a contact assembly comprising a header having a plurality of electrical connectors and at least one pair of relatively movable contacts thereon, a mounting frame adapted to be secured to said header having a pair of relatively short support legs and an intermediate portion, a magnetic core having a first end portion fixed to the intermediate portion of said frame and a second end portion directed away from said header, an electromagnetic winding on said core, a frame member

affixed to said second end of said core and having a pole portion adjacent said winding and terminating in a magnetic pole face, an armature pivotally mounted on said mounting frame legs for movement thereon relative to said pole face to thereby actuate said contacts, said legs being of minimum length to accommodate only said armature and said contact assembly between said header and the intermediate portion of said mounting frame, and spring means mounted relative to said mounting frame to urge said armature to a given position spaced from said pole face.

2. In a highly compact electromagnetic relay, the combination according to claim 1, wherein said mounting frame is generally U-shaped having its support legs in spaced relation, said armature being pivotally mounted on said legs within said U-shaped configuration.

3. In a compact, electromagnetic relay, the combination according to claim 2, wherein said support legs are of minimum length to bridge said armature and contact assembly to thereby minimize vibration due to external forces.

4. In a compact electromagnetic relay, the combination of a contact assembly comprising a header having a plurality of electrical connectors and at least one pair of relatively movable contacts thereon, a mounting frame adapted to be secured to said header, a magnetic core having a first end portion fixed to said frame and a second end portion away from said header, an electromagnetic winding on said core, a frame member affixed to said second end of said core and having a pole portion adjacent said winding and terminating in a magnetic pole face, an armature pivotally mounted on said mounting frame for movement thereon relative to said pole face to thereby actuate said contacts, and a spring retainer on said core having a spring element formed therefrom to engage said armature to urge the same to a given position spaced from said pole face.

5. In a compact electromagnetic relay, the combination according to claim 4, wherein said support legs of said mounting frame are formed with aligned openings, and mounting spheres are secured to said armature while movably positioned within said openings to thereby afford pivotal mounting for said armature on said mounting frame.

6. In a compact electromagnetic relay, the combination according to claim 5, wherein said electromagnetic winding and said spring retainer are firmly gripped between said mounting frame and frame member before said core is secured thereto to provide a compact, unitary structure.

7. In a compact electromagnetic relay, the combination according to claim 6, wherein said core is generally cylindrical to provide minimum reluctance for the magnetic flux generated by said winding.

8. In a compact electromagnetic relay, the combination according to claim 7, wherein said contacts and said electromagnetic winding are connected to separate ones of said electrical connectors of said contact assembly.

9. In a compact electromagnetic relay, the combination according to claim 8, wherein said U-shaped mounting frame has a portion intermediate said support legs, said intermediate portion and said pole face of said frame member being substantially coplanar with the spring element urging said armature to said given position.

10. In a compact electromagnetic relay, the combination according to claim 9, wherein said spring element is interposed between said intermediate portion of said mounting frame and said pole face of said frame member, the pivotal mounting for said armature being spaced from said spring element such that the latter creates frictional forces on said armature while moving the latter towards said given position.

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