July 16, 1963 R. B. FARMER 3,098,135

RELAY CONSTRUCTION

Original Filed Jan. 16, 1958

Fig. 1

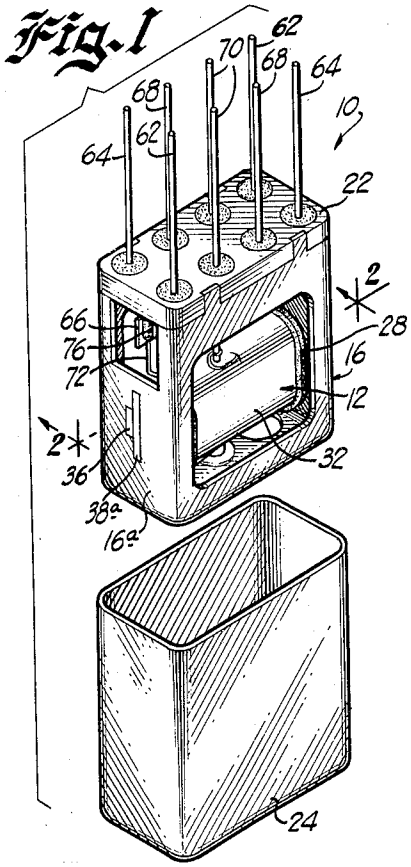


Fig. 2

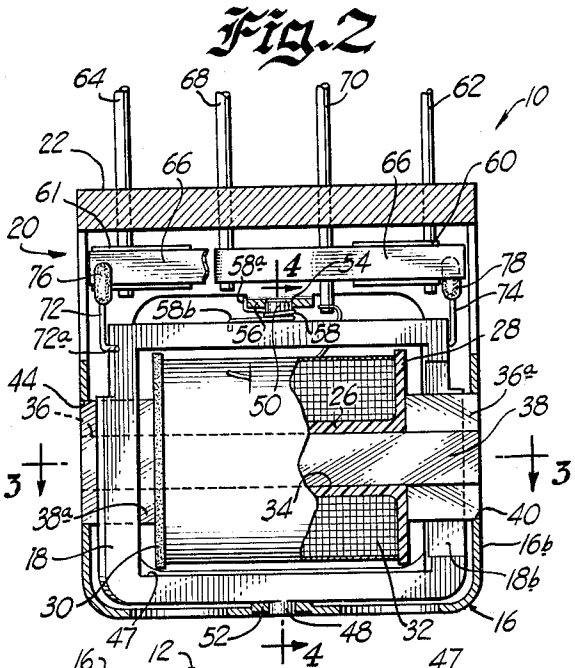


Fig. 3

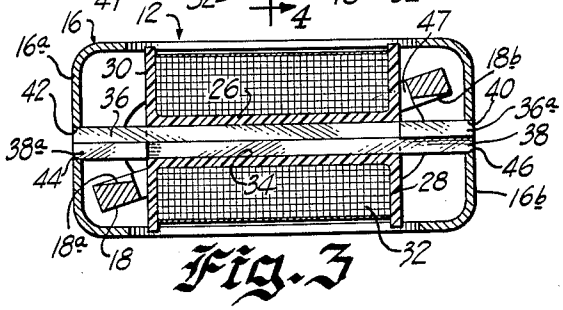


Fig. 5

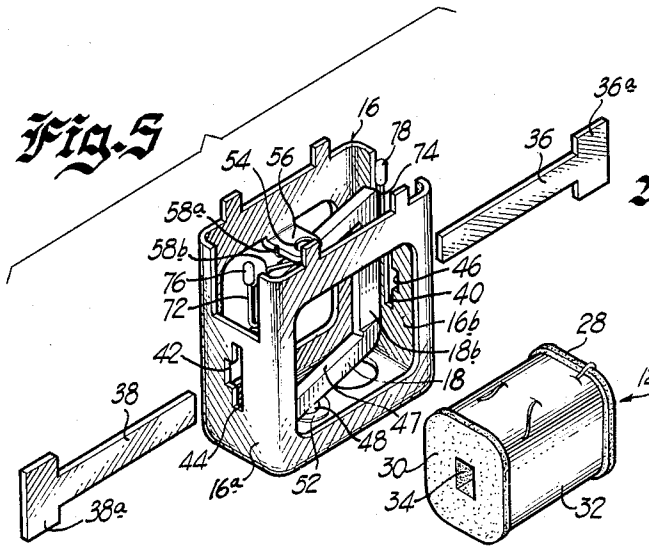
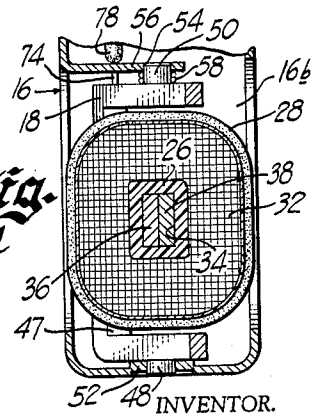


Fig. 4



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RELAY CONSTRUCTION

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13 Claims. (Cl. 200—87)

This invention relates to a relay and, more particularly, to a new and improved miniature relay having dynamically balanced operating characteristics. This application is a continuation of the copending application of Robert B. Farmer, Serial No. 709,375, filed January 16, 1958, now abandoned.

With the reduction in the physical size of electronic equipment provided by the use of smaller electronic devices, such as miniature vacuum tubes and transistors, and by the use of printed circuit techniques, for instance, it has become necessary to reduce the physical size of electromagnetic switching devices which often form a part of this equipment The miniaturization of electronic equipment is particularly important in mobile applications, such as equipment adapted to be used in aircraft. In these applications, the components are subjected to severe conditions of vibration and shock and thus, the miniaturized components must have stable operating characteristics which are not adversely affected by these factors.

Accordingly, one object of the present invention is to provide a new and improved miniature relay.

Another object is to provide a relay including new and improved electromagnetically operated means for actuating a contact assembly.

A further object is to provide new and improved means for mounting the operating coil of an electromagnetic switch on a supporting frame therefor.

A still further object is to provide new and improved means for mounting a relay operating coil, which means also provides a portion of the magnetic circuit for the relay.

In accordance with these and many other objects, an embodiment of the present invention comprises a coil structure having an axially extending opening in which are slidably mounted, in parallel relationship, a pair of magnetic core elements. The two core elements are formed with enlarged end portions which are disposed at opposite ends of the coil structure to be received within enlarged slots formed in a pair of spaced end walls of a supporting frame, the other ends of the two core elements being received within smaller slots formed contiguous to the enlarged slots. The enlarged head portions on the oppositely extending core elements thus provide means for locating the operating coil assembly in a predetermined position on the supporting frame and also provide enlarged pole pieces forming a portion of the magnetic circuit for the relay.

To provide a means for actuating a plurality of spring assemblies carried on a header plate to which the supporting frame is secured, the relay includes a substantially rectangular armature which is pivotally mounted on the supporting frame for movement about an axis perpendicular to the core elements. The armature is provided with a centrally disposed opening through which the core elements and the coil assembly extend so that spaced intermediate portions of the armature are disposed immediately adjacent the enlarged portions of the core elements which provide the pole pieces. A pair of actuator arms secured to the armature at points spaced equally from the axis of rotation thereof actuates the spring assemblies when the coil assembly is energized to pivot the armature

into engagement with the enlarged end portions of the core elements.

Many other objects and advantages of the present invention will become apparent from the following detailed description when taken in conjunction with the following drawings wherein:

FIG. 1 is an exploded view showing a minature relay embodying the present invention removed from a protective dust cover or housing therefor;

FIG. 2 is an enlarged sectional view taken along line 2—2 in FIG. 1;

FIG. 3 is a sectional view taken along line 3—3 in FIG. 2 assuming that the entire relay construction is shown therein;

FIG. 4 is a sectional view taken along line 4—4 in FIG. 2 again assuming that the entire relay construction is shown therein; and,

FIG. 5 is an exploded perspective view of a field structure and operating coil mounting assembly included in the relay of the present invention.

Referring now more specifically to the drawings, therein is shown a relay, indicated generally as **10**, embodying the present invention and which includes a coil assembly **12** including an axially extending opening. A core assembly **14**, which is slidably mounted in the opening in the coil assembly **12**, is carried on a supporting frame **16** to provide the sole support for the coil assembly **12**. The core assembly **14** includes enlarged end portions which space the coil assembly **12** relative to the frame **16** and which also provide pole pieces. An armature **18**, which is substantially rectangular in configuration and which is provided with a centrally disposed opening, is pivotally mounted on the frame **16** for movement about an axis normal to the core assembly **14**. The core assembly **14** and the coil assembly **12** extend through the opening in the armature **18** so that opposite ends of the armature **18** are disposed adjacent opposite ends of the core assembly **14** on opposite sides thereof. When the coil assembly **12** is energized, the armature **18** is pivoted in a clockwise direction (FIG. 3) so that the opposite ends thereof move toward the core assembly **14**. In so moving, the armature **18** actuates a contact spring assembly **20** which is carried on a header plate **22** to which the supporting frame **16** is connected. A dust cover **24** is provided for enclosing the relay assembly **10**.

Referring now more specifically to the coil assembly **12**, this comprises a dielectric coil bobbin **26** having a pair of end walls **28** and **30** and on which an operating coil **32** is wound. The coil bobbin **26** defines an axially extending opening **34** which is substantially rectangular in cross-section.

The core assembly **14**, in addition to providing a portion of the magnetic circuit for the relay **10** in affording pole pieces spaced axially of the core assembly **12**, also provides the sole means for supporting the coil assembly **12** in a proper position on the frame **16**. The core assembly **14** includes a pair of magnetic and somewhat T-shaped elements **36** and **38**, each having an enlarged head portion **36***a* or **38***a* of somewhat rectangular configuration. In order to detachably mount the coil assembly **12** on the frame **16**, the assembly **12** is placed within the housing **16** between a pair of spaced end walls **16***a* and **16***b*. The core element **36** is then inserted into the opening **34** so that the enlarged end **36***a* is received within an enlarged slot **40** (FIG. 5) formed in the sidewall **16***b* and so that the other end of the element **36** is received within a smaller slot **42** which is formed within the end wall **16***a* in alignment with the slot **40**. The second core element **38** is then inserted into the opening **34** in the coil bobbin **26** so that the enlarged end **38***a* thereof is positioned within an enlarged slot **44** in the end wall **16***a* and so that the oppposite end of the element **38** is disposed

in a smaller slot 46 which is formed in the end wall 16*b* in alignment with the slot 44. The width and height of the core elements 36 and 38 are such that these elements tightly engage the inner surfaces of the bobbin 26 which define the opening 34. Further, the enlarged portions 36*a* and 38*a* engage the end plates 28 and 30 of the bobbin 26 so that the coil assembly 12 is positively held in a centrally disposed position within the supporting frame 16. When the coil assembly 12 is to be removed from the relay 10, it can easily be disassembled merely by pressing the small ends of the elements 36 and 38 at opposite ends of the frame 16 and removing them from the opening 34 in the coil bobbin 26.

The enlarged portions 36*a* and 38*a*, which are disposed on laterally opposite sides of the core assembly 14, provide pole pieces toward which recessed portions 18*a* and 18*b* on the armature 18 move when the coil assembly 12 is energized. To provide a compact assembly including the armature 18 and the coil assembly 12, an opening 47 is formed in the armature 18 through which the coil assembly 12 and the core assembly 14 extend. The armature 18 is pivotally mounted on the frame 16 for rotation about an axis normal to the coil assembly 12 and the core assembly 14 by a pair of pins 48 and 50 which are formed integral with the armature 18. The axis defined by the pins 48 and 50 coincides with the center of mass of the armature 18 so that this armature is dynamically balanced to prevent undesired movement due to shock and acceleration, for instance. The pin 48 is received within an opening formed in a bossed portion 52 of the frame 16 which provides a bearing surface engaging the outer surface of the armature 18. The pin 50 is received within an opening 54 (FIGS. 2, 4 and 5) formed in a lug 56 which is formed integral with a side wall of the frame 16. In the released condition of the relay 10, the armature 18 is resiliently biased to the position shown in FIG. 3 by a spring 58 having a convolute bight portion encircling the pin 50, a first offset end portion 58*a* which engages the lug 56, and a second offset end portion 58*b* which bears against one side of the armature 18.

The contact assembly 20, which is actuated by the armature 18 when the relay 10 is operated, includes two similar form C contact assemblies carried on the header plate 22 adjacent opposite ends of the armature 18. Each of these assemblies comprises a pair of generally V-shaped contact springs 60 and 61 (FIG. 2) carried on a pair of terminal pins 62 and 64 and an elongated transfer spring 66, one end of which is carried on a terminal pin 68. The terminal pins 62, 64 and 68 are sealed within spaced openings in the header plate 22. The transfer springs 66 are so positioned as to normally engage the break springs 60 so that, upon operation of the relay 10, the springs 66 are moved out of engagement with the break springs 60 and into engagement with the make springs 61. The header plate 22 also supports a pair of terminal pins 70 to which the leads to the coil 32 are connected.

To provide means for actuating the contact assembly 20, the opposite ends of the armature 18 are provided with a pair of depending arms 72 and 74, the free ends of which are embedded in dielectric beads 76 and 78, respectively. The dielectric beads 76 and 78 on the actuator pins 72 and 74 are disposed in opposite sides of the two transfer springs 66 so that, when the armature 18 is pivoted in a clockwise direction (FIG. 3), these beads move into engagement with the free ends of the transfer springs 66 and move these springs relative to the springs 60 and 61. The actuator arms 72 and 74 are preferably secured to the opposite ends of the armature 18 by welding and are each provided with an offset end portion, such as a portion 72*a* (FIG. 2), which is adapted to engage the frame 16 when the armature 18 is biased to its normal position by the spring 58, thereby to limit counterclockwise movement of the armature 18.

In operation, when the winding 32 is energized by an operating signal of any polarity, the flux field induced by

the coil 32 passes along the core elements 36 and 38 to one of the pole pieces or enlarged portions 36*a* and 38*a*, passes across the air gap to one of the recessed portions 18*a* and 18*b* on the armature 18, and then returns to the core assembly 14 through the armature 18 and the air gap formed between the other of the pole pieces 36*a* and 38*a* and the other of the recessed portions 18*a* and 18*b*. The force produced by this flux field pivots the armature 18 in a clockwise direction (FIG. 3) against the action of the spring 58 so that the recessed portions 18*a* and 18*b* of the armature 18 move into engagement with the pole pieces afforded by the enlarged portions 36*a* and 38*a* of the core elements 36 and 38. In moving to this position, the dielectric beads 76 and 78 carried on the ends of the actuator arms 72 and 74 move into engagement with the free end portions of the transfer springs 66 so that these springs are moved out of engagement with the break springs 60 and into engagement with the make springs 61.

When the energizing signal is removed from the winding 32, the spring 58 rotates the armature 18 in a counterclockwise direction (FIG. 3) so that the recessed portions 18*a* and 18*b* of the armature 18 move away from the pole pieces provided by the enlarged portions 36*a* and 38*a*. During this movement, the dielectric beads 76 and 78 carried on the ends of the actuator arms 72 and 74 move out of engagement with the transfer springs 66 so that these springs, by their own resiliency, move out of engagement with the make springs 60 and into engagement with the break springs 61. This counterclockwise deflection of the armature 18 is arrested by engagement of the offset ends of the arms 72 and 74 with the inner surface of the frame 16.

Accordingly, the relay 10 of the present invention includes new and improved means for removably mounting the coil assembly 12 on the supporting frame 16 by the use of the core assembly 14. The core elements 36 and 38 not only serve to properly locate the coil assembly 12 in a proper position on the supporting frame 16 but also provide pole pieces toward which the armature 18 is moved by the energization of the operating winding 32.

Although the present invention has been described in conjunction with a single embodiment thereof, it will be apparent that numerous other modifications and changes may be made by those skilled in the art which will fall within the spirit and scope of the principles of this invention.

What is claimed as new and desired to be secured by Letter Patent of the United States is:

1. A relay construction comprising a coil structure defining an axially extending passageway; a frame having a pair of spaced end walls each defining an opening; a first core element mounted in said openings and passing through said passageway, said first core element having an enlarged portion disposed between one of said end walls and one end of said coil structure to provide a first pole piece; and a second core element mounted in said openings and passing through said passageway parallel to said first core element, said second core element having an enlarged portion disposed between the other of said end walls and the other end of said coil structure to provide a second pole piece.

2. A relay construction comprising a coil bobbin having a pair of spaced end plates joined by a hollow element defining a substantially rectangular opening; a winding on said bobbin; a frame structure including a pair of spaced end walls, each of said end walls defining a pair of adjacent slots of a first length and of a second length less than said first length; a first core element slidably mounted in said opening and having one end disposed in the slot of said second length in one of said end walls, said first core element also including an enlarged portion disposed in the slot of said first length in the other of said end walls and abutting one of the end plates on said bobbin; and a second core element slidably mounted in said opening parallel

to said first core element and having one end disposed in the slot of said second length in said other end wall, said second core element also including an enlarged portion disposed in the slot of said first length in said one end wall and abutting the other end plate of said bobbin.

3. The relay construction set forth in claim 2 including an armature pivotally mounted on said frame with spaced portions of said armature disposed adjacent the enlarged portions on said first and second core elements.

4. A relay construction comprising a coil structure defining an axially extending passageway; a frame structure including a pair of spaced walls, each of said walls having a pair of contiguous slots formed therein; and a pair of core elements slidably mounted in a parallel relation in said passageway and in the pairs of slots in said spaced walls to provide the sole means for supporting said coil structure on said frame structure, said core elements including enlarged portions positioned at opposite ends of said coil structure to locate the position of said coil structure on said frame structure.

5. A relay construction comprising a coil structure having an axially extending opening, a frame structure including a pair of spaced walls, a pair of core elements for mounting said coil structure on said frame structure, each of said core elements having an enlarged pole piece portion, said core elements being mounted on said walls and being inserted into said axially extending opening from opposite ends of said coil structure so that said enlarged pole piece portions are disposed at the opposite ends of said coil structure to both mount said coil structure on said frame structure and provide spaced pole pieces at opposite ends of said coil structure.

6. A relay construction comprising a frame including a pair of spaced supporting elements each having an opening therein, a coil structure positioned between said supporting elements and having first and second end walls and an axial opening extending between said walls, a pair of core elements each having an enlarged portion extending generally transverse to the length of the core element, a first one of said core elements being inserted through the opening in one of said supporting elements into said axial opening so that the enlarged portion on said first core element engages said first wall, a second one of said core elements being inserted through the opening in the other of said supporting elements into said axial opening so that the enlarged portion on said second core element engages said second wall, said first and second core elements supporting said coil structure on said frame, and a movably mounted armature including two spaced portions each positioned adjacent one of said enlarged portions.

7. A relay construction comprising a coil structure having an axially extending opening, a frame structure including a pair of spaced and generally parallel walls, each of said pair of walls including a slot aligned with the slot in the other wall, a pair of core elements for mounting said coil structure on said frame structure, each of said core elements having an enlarged pole piece portion, said core elements being mounted in the slots on said walls and being inserted through said slots into said axially extending opening from the opposite ends of said coil structure with said enlarged pole piece portions disposed at the opposite ends of said coil structure so that said core elements both mount said coil structure on said frame structure and provide spaced pole pieces at the opposite ends of said coil structure.

8. The relay construction set forth in claim 7 in which said core elements include flat and generally uniplanar portions disposed in a contiguous parallel relation within said axially extending opening.

9. A relay construction comprising a coil structure having an axially extending opening, a frame structure including a pair of spaced and generally parallel walls, each of said pair of walls including a slot aligned with the slot in the other wall, a pair of core elements for mounting

said coil structure on said frame structure, each of said core elements having an enlarged pole piece portion extending generally transverse to the length of the core element, one of said core elements being inserted through the slot in a first one of said walls and through said axially extending opening to be received in the slot in a second one of said pair of walls so that the pole piece portion on said first core element is disposed adjacent said first wall, a second one of said core elements being inserted through the slot in said second wall and through the axially extending opening to be received in the slot in said first wall so that the pole piece portion on said second core element is disposed adjacent said second wall, said core elements serving both to mount said coil structure on said frame structure and to provide spaced pole pieces at the opposite ends of said coil structure, and movably mounted armature means including spaced portions disposed adjacent the transversely extending pole piece portions on said core elements.

10. The relay construction set forth in claim 9 in which said core elements include flat and generally uniplanar portions disposed in a contiguous parallel relation within said axially extending opening.

11. A relay construction comprising a coil structure including a coil bobbin with first and second bobbin end walls connected by a portion defining an opening; a unitary supporting frame structure of generally rectangular configuration having apertured front and back walls, an open bottom, and spaced and generally parallel side walls, said side walls each having a slot therein generally aligned with the slot in the other side wall, said coil structure being disposed within the generally rectangular frame structure with the opening generally aligned with the slots in the side walls; a pair of core members for mounting said coil structure on said frame structure, each of said core members having an enlarged pole piece portion extending generally transverse to the length of the core member, a first one of said core members being inserted through the slot in a first one of said side walls and through said opening so that the pole piece portion on the first core member engages the first bobbin end wall and is disposed between the first bobbin end wall and the first side wall, the second one of said core members being inserted through the slot in the second side wall and through the opening so that the pole piece portion on the second core member engages the second bobbin end wall and is disposed between the second bobbin end wall and the second side wall, said core members serving both to mount said coil structure on said frame structure and to provide spaced pole pieces at the opposite ends of the coil structure; armature means including spaced portions extending upwardly adjacent the transversely extending pole piece portions on the core members; and means including a lug projecting inwardly from one of the front and back walls of the frame structure adjacent the lower end of the aperture therein for pivotally mounting said armature means on said frame structure.

12. The relay construction set forth in claim 11 including a header plate secured to the lower end of the frame structure to close the open bottom and disposed below the armature means; contact means carried on the header plate and disposed below the armature means, said contact means including a pair of contact springs each having a free end portion generally aligned with and disposed below one of the pole piece portions; and two spaced means depending from and secured to the armature means at points aligned with the pole piece portions for engaging and operating the free end portions of the contact springs.

13. The relay construction set forth in claim 5 including pivotally mounted armature means having a central portion disposed below said coil structure and end portions extending upwardly from said central portion adjacent the pole piece portions on the core elements, con-

tact means disposed below said armature means and including two contact springs each having a free end portion positioned generally below one of the pole piece portions, and two means each secured to and depending from the armature means at spaced points generally aligned with the pole piece portions and the end portions of the armature means for engaging and actuating the free end portions of the contact springs.

References Cited in the file of this patent

UNITED STATES PATENTS

1,104,077	Smith	July 21, 1914
1,273,820	Cahusac	July 30, 1918
1,991,210	Henderson et al.	Feb. 12, 1935
2,436,354	Burke et al.	Feb. 17, 1948
2,718,568	Somers	Sept. 20, 1955
2,923,794	Keeran	Feb. 2, 1960