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ELECTRO-MAGNETIC SWITCHING DEVICE

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Fig. 1.

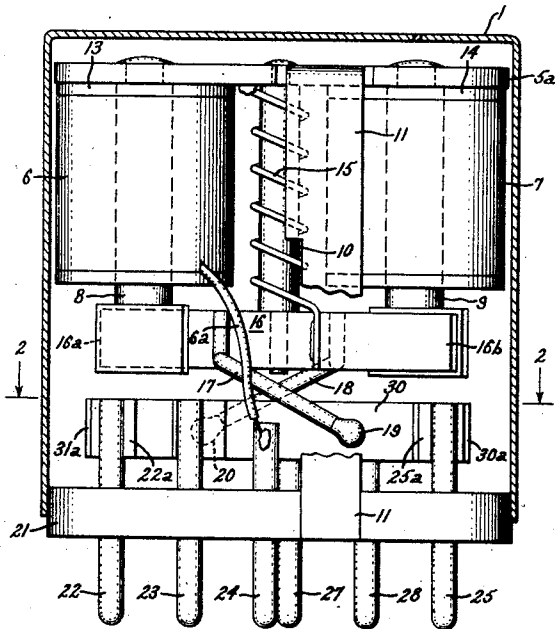


Fig. 2.

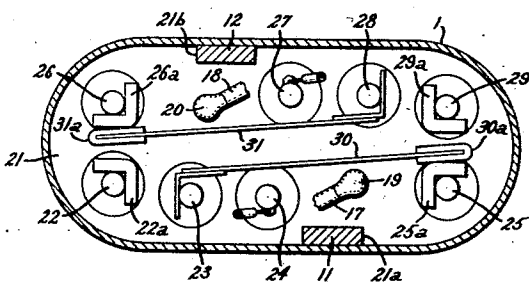
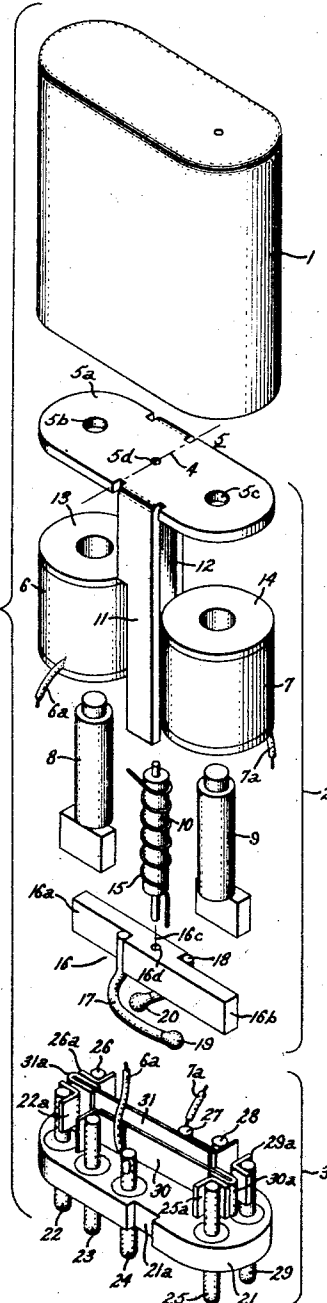


Fig. 3.



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ELECTRO-MAGNETIC SWITCHING DEVICE

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1 Claim. (Cl. 200—104)

This invention relates to electromagnetic switching devices, more particularly to electromagnetic relays and it has for an object the provision of a compact switching device of this character which is simple, reliable and inexpensive.

Still more particularly, the invention relates to relays which are suitable for use in environments or applications such for example as on aircraft in which they may be subjected to heavy shock and vibration, and a still further object of the invention is the provision of a relay of this character which will not close or open its contacts in response to shock and vibration.

A further object of the invention is the provision of a relay which is easy to manufacture, simple to adjust, and which facilitates improved control of quality in manufacture and gives extra assurance of reliability.

A still further object of the invention is the provision of a relay which, by virtue of the disposition and confirmation of its components, is capable of being constructed in extremely small sizes and weights.

In carrying the invention into effect in one form thereof, a U-shaped magnetic structure is provided with a stationary shaft centrally disposed between its upright legs and secured to the baseplate portion of the structure which joins the legs. A pair of coils is provided for energizing the magnetic structure and each is mounted on a different leg thereof. A balanced armature member, mounted on the shaft for rotation about its main axis, serves to open and close contacts disposed on opposite sides of the axis of the shaft. A helical spring surrounds the shaft and has one end attached to the stationary supporting frame and the other to the armature. It serves to bias the armature away from the pole faces with which the legs of the magnetic structure are provided to a position that is determined solely by the spring without the aid of stops and in which position its only connection to the frame is the centrally disposed shaft and spring.

For a better and more complete understanding of the invention, reference should now be had to the following specification and to the accompanying drawing of which Fig. 1 is a view in front elevation, with the cover in section, of a preferred form of the relay, Fig. 2 is a sectional view taken on the line 2—2 of Fig. 1 looking in the direction of the arrows and Fig. 3 is an exploded view in perspective.

Referring now to the drawing and particularly to the exploded view of Fig. 3, the relay is shown as comprising, in addition to its cover or casing 1, two main parts i. e. the magnetic structure and armature subassembly 2 and the contact making subassembly 3. The magnetic structure subassembly 2 comprises a coil supporting or frame member 5, a pair of operating coils 6 and 7, a pair of core members 8 and 9, a stationary shaft 10 which provides a pivot or bearing for the armature 16. As shown, the frame member 5 has a base 5a of generally oblong shape with rounded ends. On its long sides the base member is provided with integral upright members 11 and 12. These uprights are offset from each other on opposite sides of the transverse centerline 4 as clearly

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shown in Figs. 2 and 3. Preferably, the frame 5 is made of stamping steel and is formed by a stamping operation.

On opposite sides of the centerline 4 are located the operating coils 6 and 7 which are wound upon spools 13 and 14. These spools may be made of any suitable material such for example as the resin known as nylon. The coils are wrapped with a suitable insulating wrapping material such as the tetrafluorethylene polymer manufactured by the E. I. du Pont de Nemours Company and marketed under the trademark Teflon. The coil leads may be insulated with the same material. As shown, the spools 13 and 14 have central bores to receive the core members 8 and 9 respectively.

The core members 8 and 9 are preferably made of a good magnetic material such as cold rolled steel. They are in the form of round bars having portions of reduced diameter at their upper ends and are flattened at their lower ends to provide pole faces opposite the armature.

Located between the core members 8 and 9 is the stationary shaft 10 which is provided with end portions of reduced diameter. It is surrounded by the helical coil spring 15 which is preferably made of a material having a high degree of resiliency, high tensile strength and resistance to fatigue such for example as Phosphor bronze. It will be noted that the baseplate 5a of the frame is provided with openings 5b and 5c to receive the reduced diameter portions of the core members 8 and 9 and is also provided with a centrally disposing opening 5d to receive the reduced diameter portion of the shaft 10.

As shown in Fig. 3, the armature structure comprises an armature member 16 and contact actuators 17 and 18. The armature is generally a rectangular bar-shaped member having balanced arms 16a and 16b on opposite sides of its axis of rotation 16c. These arms are not direct linear extensions of each other but are symmetrically jogged or offset from each other so as to occupy generally parallel planes. Preferably, the armature 16 is made of a good magnetic material such as cold rolled steel. The two contact actuators 17 and 18 are mounted on the armature symmetrically with respect to its axis of rotation. Preferably, these actuators are made of steel wire. One end of each is secured to the armature by any suitable method such for example as spotwelding. On the opposite ends are provided suitable insulators such as glass beads 19 and 20.

The contact subassembly 3 comprises a header member 21 which has the same rounded end oblong configuration as the baseplate 5a of the frame. It is provided with slots or notches 21a and 21b cut in the long edges in appropriate positions to receive the upright legs of the frame member 5. Passing through the header and insulated therefrom by means of glass insulating seals are a plurality of pin connections 22, 23, 24, 25, 26, 27, 28 and 29. Pins 24 and 27 constitute the lead-in terminals for the coils 6 and 7. Pins 22, 25, 26 and 29 constitute the lead-in terminals for the stationary contacts and pins 23 and 28 constitute the lead-in terminals for the movable contacts.

Secured to the stationary contact terminals 22, 25, 26 and 29 by means of a suitable method such as resistance spotwelding, are contact tips 22a, 25a, 26a and 29a respectively. The movable contact springs 30 and 31 are fastened to the lead-in terminals 23 and 28 respectively by a suitable method such as spotwelding. At their free ends these contact springs are provided with contacts 30a and 31a respectively. By means of their movable spring contact arms 30 and 31, the moving contact tips 30a and 31a are biased out of engagement with stationary contacts 29a and 22a respectively to provide two normally open contacts, and are biased into engagement with stationary contacts 25a and 26a respectively to provide two normally closed contacts thus the relay is a double-pole double-throw relay having a normally closed con-

tact and a normally open contact on either side of the axis of rotation of the armature.

Preferably each of the contact tips 22a, 25a, 26a, 29a, 30a and 31a is made of steel and silver laminations with the steel laminations spotwelded to the lead-in terminals. The movable contact springs are preferably made of a material having high tensile strength, high resilience and good electric and thermal conductivity such for example as beryllium copper.

In assembling the relay, the core members 8 and 9 are passed through the bores of the spools 13 and 14, and the reduced diameter portions of the cores are passed through the circular openings 5b and 5c in the baseplate portion of the frame. The shoulders formed by the full diameter portions are brought into good metal to metal contact with the baseplate and then, by means of a riveting tool, the ends of the reduced diameter portions are upset and peened over to provide a solid rivet connection. Thus the baseplate of the frame and the core members together constitute a U-shaped magnetic structure.

In a similar manner, the reduced diameter portion of the stationary shaft 10 is inserted in the centrally disposed opening 5d in the baseplate and the projecting end peened over and tightly riveted thereto. The end of the helical coil spring 15 remote from the baseplate is secured to the armature by any suitable method such as spotwelding, while using the shaft as a fixture.

The header is then mounted to the frame by sliding the free ends of the upright arms 11 and 12 into the respectively cooperating slots 21a and 21b and the ends of the arms are then secured to the header by any suitable method such as spotwelding. Finally, the end of the helical coil spring 15 nearest the baseplate 5a of the frame is fastened to the frame in such a position that equal gaps exist between the faces of the armature and the opposing flattened pole faces of the core members. These gaps must be equal to the sum of the closing travel of the movable contact springs, the wear allowance or "wipe" of the contacts and the clearance between the glass insulator bead of the actuator arms and the movable contact springs in the deenergized condition of the relay.

The coil leads 6a and 7a are welded to the header lead-in pins 24 and 27 and the coils 6 and 7 are electrically connected together in such polarity that their magnetomotive forces add to produce a flux through the magnetic circuit, i. e. through the leg 9 of the U-shaped magnetic structure, the baseplate 5a, the leg 8 of the magnetic structure, across the air gap to arm 16a of the armature member, through the armature to the opposite arm 16b, and across the remaining air gap to the core leg 9.

In response to energization of the operating coils, the armature rotates against the bias of the helical spring in a counterclockwise direction as viewed from the section 2-2 to cause the actuators 18 and 19 to engage and move the movable contact arms 30 and 31 first to open the normally closed contacts 26a, 31a and 25a, 30a and subsequently to close the normally open contacts 22a, 31a and 29a, 30a. After closing the normally open contacts, the armature travels an additional distance to its fully seated position. This additional travel is taken up in deflection of the movable contact arms 30 and 31 and provides the "wear allowance" or "wipe" of the contacts.

In the deenergized condition of the operating coils, helical spring 15 rotates the armature 16 in a clockwise direction to permit the movable contact springs to open the normally open contacts 29a, 30a and 22a, 31a and to close the normally closed contacts 25a, 30a and 26a, 31a. The helical coil spring 15 rotates the armature to a posi-

tion in which there is clearance between the actuator glass insulating means 19 and 20 and the movable contact springs 30 and 31.

Thus in the deenergized condition of the relay, the armature "floats," i. e. is out of engagement with the movable contact springs and does not rest against mechanical stops. Its free or deenergized position is determined solely by the helical spring surrounding the stationary shaft 10. This spring and shaft furnish the only contact or attachment between the armature and the frame in the deenergized condition of the relay. Since the spring and shaft engage the armature only at its center and the armature is evenly balanced on either side of its central axis of rotation, sudden violent shocks applied to the frame produce no turning moment tending to rotate the armature to open its normally closed contacts.

Although in accordance with the provisions of the patent statutes, this invention is described as embodied in a specific structure and the principle thereof has been described together with the best manner in which it is now contemplated applying that principle, it will be understood that the structure shown and described is merely illustrative and that the invention is not limited thereto since alterations and modifications will readily suggest themselves to persons skilled in the art without departing from the true spirit of this invention or from the scope of the annexed claim.

What I claim as new and desire to secure by Letters Patent of the United States is:

A relay comprising a contact supporting member, a pair of legs extending normally to said supporting member, a crosspiece of magnetic material secured to said legs and extending in a plane parallel to said contact supporting member, a pair of cores, each mounted on said crosspiece and extending toward said contact supporting structure, a coil on each core, a shaft fixedly secured to said crosspiece between said cores and extending toward said contact supporting member, an armature member freely rotatably mounted on said shaft for rotation in a plane perpendicular to the axis thereof, said armature having balanced arms extending in opposite directions toward said cores, a coil spring having one end secured to said crosspiece and encompassing said shaft and its other end secured to the armature adjacent the center thereof whereby said armature is supported on said shaft and biased away from said cores solely by said spring, a plurality of contacts mounted on said contact supporting member, said contacts having movable and stationary members, and contact actuating members symmetrically mounted on said armature member engaging said movable contact members.

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