June 24, 1947. A. SKROBISCH 2,422,861

DYNAMICALLY BALANCED RELAY

Filed Sept. 28, 1943

Fig.1.

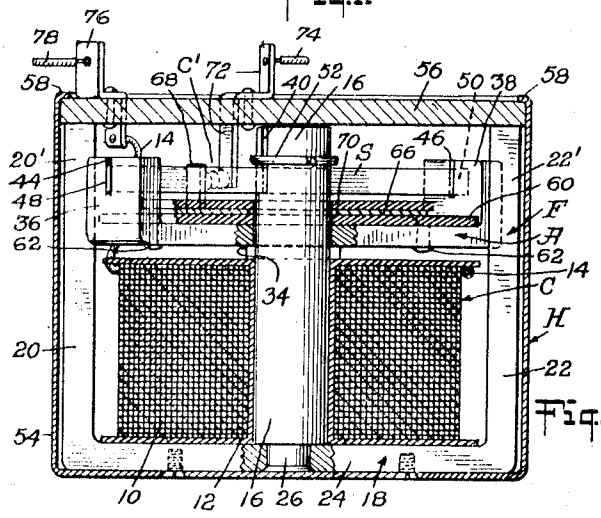


Fig.3.

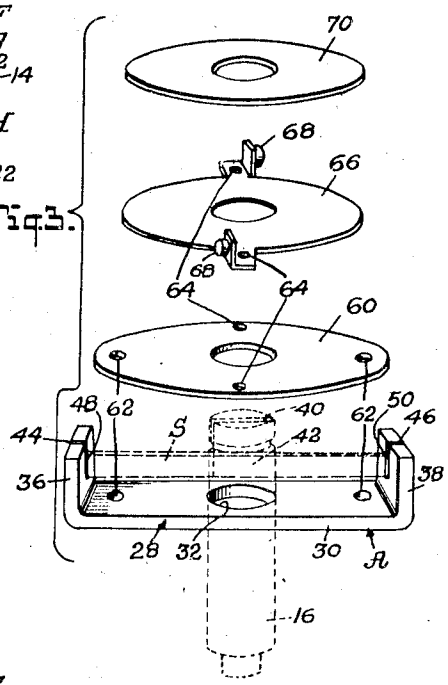


Fig.2.

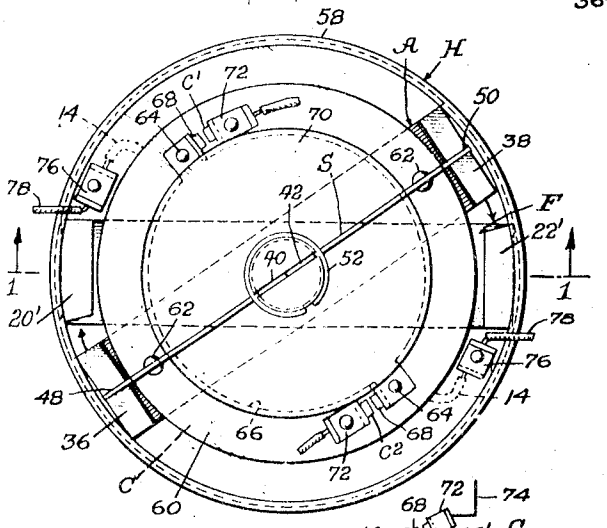


Fig.4.

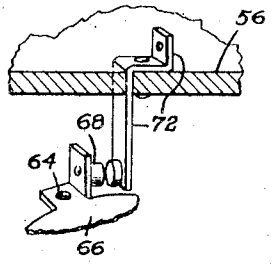
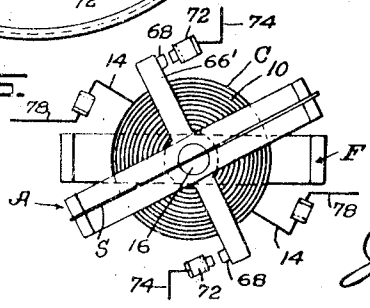


Fig.5.



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Patented June 24, 1947

2,422,861

UNITED STATES PATENT OFFICE

2,422,861

DYNAMICALLY BALANCED RELAY

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Application September 28, 1943, Serial No. 504,168

6 Claims. (Cl. 175—336)

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This invention relates to a dynamically balanced relay.

The prime object of the present invention centers about the provision of a relay which is inherently insensitive to any linear acceleration or deceleration, sudden or gradual, in any direction, such as may be encountered in aircraft use.

Relays having dynamically balanced armatures have been suggested heretofore. So far as I am aware, none of these has been constructed on principles which adequately meet the requirements encountered in a moving medium such as an airplane, where high speeds, changes of speed and of direction of movement and accelerations and decelerations of all kinds constitute the normal conditions of travel. To effectively meet the requirements, all of the moving parts of the relay, namely, the armature, the controlling spring or springs, and the actuated contact or contacts should be so constructed and mounted that a substantially absolute dynamic balance is obtained, and in such a way that such parts are movably sensitive only to an acceleration or deceleration which is not encountered in use. The design and construction of a dynamically balanced relay of this nature is the prime desideratum of the present invention.

Ancillary objects of the invention include the provision of a dynamically balanced relay which is compact, structurally simple and is capable of ease and certainty of action and operation.

To the accomplishment of these objects and such other objects as may hereinafter appear, my invention relates to the relay combination as sought to be defined in the appended claims and as described in the accompanying specification taken together with the appended drawings, in which:

Fig. 1 is a vertical elevational view of the relay embodying the principles of the present invention, this view being shown partly in section taken in the plane of the line 1—1 of Fig. 2;

Fig. 2 is a plan view thereof;

Fig. 3 is an exploded view of parts thereof;

Fig. 4 is a perspective view of a detail; and

Fig. 5 is a top plan view illustrating the electrical connections of the parts of the relay.

Referring now more in detail to the drawings, the dynamically balanced relay of the present invention comprises a single electromagnet coil C, the metallic field member therefor generally designated as F, the movable armature A, all housed or contained in a housing or container H, and one or more contact elements generally designated as c^1 and c^2 actuated by the operation of the relay.

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The electromagnet coil C comprises a single coil of wire 10 wound and mounted on a bobbin or spool 12, the coil terminating in the leads 14, 14. The metallic field member F forming the magnetic paths for the relay comprises a core in the form of a post 16 mounted centrally (in the bore) of the coil C and a U-shaped piece generally designated as 18, the branches 20 and 22 of which lie on opposite sides of the coil C and the base 24 of which lies along the bottom end of the coil C. The core 16 is attached centrally to the base 24 as by being riveted as at 26 thereto. The upper ends 20' and 22' of the branches 20 and 22 form the field pole pieces for the relay and these preferably extend upwardly somewhat beyond the vertical dimensions of the armature A. The coil C is mounted so as to snugly fit on the post 16 and be supported on and within the metallic field member F. The post 16 and the U-shaped piece 18 are made of a magnet steel.

The movable armature A is located at the other or top end of the coil C and, following the constructional principles of the present invention, is rotatably mounted about the axis of the core 16. Preferably the post defining this core extends upwardly sufficiently to mountingly receive the armature A and the elements carried by the armature, as is most clearly shown in Fig. 1 of the drawings. The armature A also preferably comprises a U-shaped piece generally designated as 28, the base 30 of which is centrally orificed as at 32 so that the armature is received by the upper end of the post 16, the said armature being thereby mounted to rotate on and about said post 16, the same being spaced from the coil C by a non-magnetic spacer ring or washer 34.

The branches 36 and 38 of the U-shaped armature A form pole pieces which extend radially in opposite directions from the axis of the core or post 16 to lie adjacent the field pole pieces 20' and 22' as best shown in Fig. 2 of the drawings. Preferably the field pole pieces 20' and 22' and the armature pole pieces 36 and 38 are all equidistant radially from the coil or core axis, all of these pole pieces therefore lying in the same circumference of the relay coil structure as is most clearly evident from Figs. 2 and 5 of the drawings. When the coil C is energized, the armature A, assuming its normal position to be that shown in the drawings, is rotatably moved about the core axis in the clockwise direction as indicated by the arrows in Fig. 2.

For returning the armature A and holding

the same in its normal relay deenergized position as shown in the drawings, the controlling spring generally designated as S is provided. The spring S is preferably a leaf spring fixedly anchored at its center at the axis of the coil C or core 16, the said spring also exending radially in opposite directions from said axis and having its free ends connected to the ends of the armature. Preferably the top of the post 16 is longitudinally and medially slitted as at 40 to receive the middle portion 42 of the spring S, such reception being adequate to effect the anchoring of the spring at the center or axis of the post. The armature pole pieces 36 and 38 are also vertically slitted as at 44 and 46, respectively, to receive the ends 48 and 50, respectively, of the spring S; thereby the free ends of the spring are connected to the armature ends or pole pieces. The armature A and the parts carried thereby including the spring S are held in position on the post by means of a split snap spring 52. These parts are readily assembled on the post by placing the armature over the post, by then inserting the leaf spring into the post and armature slots, and by then snapping the ring in position.

By means of this recited construction all of the essential movable parts of the relay (as well as the added parts to be described below) embody a construction and a mounting which entails absolute symmetry around the axis of the coil and core. The armature A structurally and positionally is symmetrical about the coil axis and the controlling spring S is also structurally and positionally symmetrical about the same axis. The magnetic paths are similarly symmetrical about this axis, the paths of the lines of magnetic force extending up the center post 16 out radially in opposite directions through both arms of the armature A to the armature pole pieces 36 and 38, and then down from the field pole pieces 20' and 22', through both the branches 20 and 22 of the field member, to and through the two arms of the base 24 of the field member, returning to and meeting at the bottom of the center post 16. The armature together with its controlling spring (as well as all of the parts which it carries) is fully balanced with respect to its own center about which it rotates, thus nullifying the inertia effect of any change of speed and any acceleration or deceleration in any linear direction, and in fact in any other direction as well except in a rotary or angular direction about the relay axis (a condition impossible to meet with in aircraft use). Motion in the vertical direction of the relay is prevented by the collar 34 and the snap ring 52.

The relay parts may be conveniently housed or contained in the housing H which comprises a cylindrical casing coaxial with the coil. This housing may comprise an aluminum container body provided with a top closure 56 made preferably of a transparent plastic so that the interior parts may be visible therethrough as indicated in Fig. 2 of the drawings. The closure or cover 56 is held in position between the inturned flange 58 of the casing body and the top ends of the field pole pieces 20' and 22' as best shown in Fig. 1 of the drawings. This closure 56 may be provided with the fixed contact parts and the connectors of the relay as will be described further hereinbelow.

The armature A may be supplied or provided with the movable relay contacts. To maintain the dynamic balance desired, I preferably employ a symmetrically shaped element for carrying the contacts and also preferably employ contacts

symmetrically disposed thereon, the symmetry being about the core axis. This may be accomplished in many ways, the way exemplified comprising the use of an insulating base washer 60 riveted as at 62, 62 to the armature A to which is riveted as at 64, 64 the contact ring 66 (made, for example, of Phosphor bronze, etc.) containing the upstandingly mounted contact elements 68, 68. An insulating cover washer 70, made, for example, of Bakelite or similar material, may then be placed over the contact ring. Thus all of the elements supported by the armature including the two movable contacts are also dynamically balanced, the construction provided for the relay enabling this to be accomplished.

Cooperating with the armature contacts 68, 68 and defining the contacts c^1 and c^2 above referred to, stationary contacts 72, 72 are provided, which latter are both fixed to and mounted on the housing closure 56 in a manner clearly shown in Figs. 1, 2, 4 and 5 of the drawings, the upper ends of these contacts extending outwardly for attaching reception of conductor leads 74, 74. In Fig. 5 of the drawings the contact ring 66 is symmetrically represented as a bar 66' which form (illustrating any symmetrical form) it may take. The closure 56 may also carry in a similar way the connectors 76, 76 to which the leads 14, 14 are connected interiorly of the casing and to which exterior leads 78, 78 may be attached.

The dynamically balanced relay of the present invention, its construction, manner of assembling and the functioning thereof to achieve the main purpose of the invention will, it is believed, be fully apparent from the above detailed description thereof. A dynamically balanced relay is produced in which an almost absolute dynamic balance is obtained, and in such a way that all of the moving parts of the relay are movably sensitive only to an acceleration or deceleration of a kind not encounterable in use. The relay may, therefore, be mounted with complete safety in a fast moving medium such as an airplane, where high speeds, changes of speed and direction of movement and accelerations and decelerations of all kinds are the normal conditions met with. In addition to accomplishing this main purpose, I have provided a unit which is exceedingly compact and which is very simple in construction. This structure, including also the efficiency in the magnetic paths provided, produces a unit which possesses ease and certainty of action and operation.

It will be apparent that structural changes may be made within the principles of the invention described and which come within the purview of the invention as defined in the following claims.

I claim:

1. A dynamically balanced relay comprising an electromagnet coil, a metallic field forming the magnetic paths therefor consisting of a core mounted centrally of the coil and a U-shaped piece the branches of which lie on opposite sides of the coil and the base of which lies along an end of the coil, the core being attached centrally to the base, the ends of said branches forming field pole pieces for the coil, a movable armature at the other end of the coil rotatably mounted about the axis of said core and having its pole pieces extending radially in opposite directions from said axis to lie adjacent the field pole pieces, and a spring for said armature anchored fixedly at the axis of said core and also extending radially in opposite directions from said axis and con-

nected at its free ends to the ends of said armature.

2. The relay of claim 1 in which the spring is a leaf spring and in which the free ends of the leaf spring are connected to the pole pieces of the armature.

3. A dynamically balanced relay comprising an electromagnet coil, a metallic field forming the magnetic paths therefor consisting of a core mounted centrally of the coil and a U-shaped piece the branches of which lie on opposite sides of the coil and the base of which lies along an end of the coil, the core being attached centrally to the base, the ends of said branches forming field pole pieces for the coil, and a movable armature at the other end of the coil rotatably mounted about the axis of said core and also comprising a U-shaped piece, the base of which is mounted to rotate on and about said core and the branches of which form pole pieces extending radially in opposite directions from said core to lie adjacent the field pole pieces, the field pole pieces and the armature pole pieces being located equi-distant radially from the core axis and lying in the same circumference about the core axis.

4. A dynamically balanced relay comprising an electromagnet coil, a metallic field forming the magnetic paths therefor consisting of a core mounted centrally of the coil and a U-shaped piece the branches of which lie on opposite sides of the coil and the base of which lies along an end of the coil, the core being attached centrally to the base, the ends of said branches forming field pole pieces for the coil, a movable armature at the other end of the coil rotatably mounted about the axis of said core and also comprising a U-shaped piece, the base of which is mounted to rotate on and about said core and the branches of which form pole pieces extending radially in opposite directions from said axis to lie adjacent the field pole pieces, and a spring for the armature anchored fixedly to said core and also extending radially in opposite directions from its axis and connected at its free ends to the ends of the armature.

5. A dynamically balanced relay comprising an electromagnet, a metallic field forming the magnetic paths therefor consisting of a post and a U-shaped piece the branches of which lie on opposite sides of said post and to the base of which

the said post is centrally attached, the ends of said branches forming field pole pieces, an armature rotatably mounted about the axis of said post and having its pole pieces extending radially in opposite directions from said axis to lie adjacent the field pole pieces, and a spring for said armature anchored fixedly at the axis of the post and also extending radially in opposite directions from said axis and connected at its free ends to the ends of the armature.

6. A dynamically balanced relay comprising an electromagnet coil, a metallic field forming the magnetic paths therefor consisting of a core mounted centrally of the coil and a U-shaped piece the branches of which lie on opposite sides of the coil and the base of which lies along an end of the coil, the core being attached centrally to the base, the ends of said branches forming field pole pieces for the coil, a movable armature at the other end of the coil rotatably mounted about the axis of said core and having its pole pieces extending radially in opposite directions from said axis to lie adjacent the field pole pieces, the field pole pieces and the armature pole pieces being located equi-distant radially from the core axis, and a cylindrical casing coaxial with said core enclosing the relay, the said casing being provided with a cover held between the casing top and the field pole pieces.

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