March 20, 1951 J. S. ZIMMER 2,546,053

ELECTROMAGNET CONTROL DEVICE

Filed Sept. 1, 1948

Fig. 1.

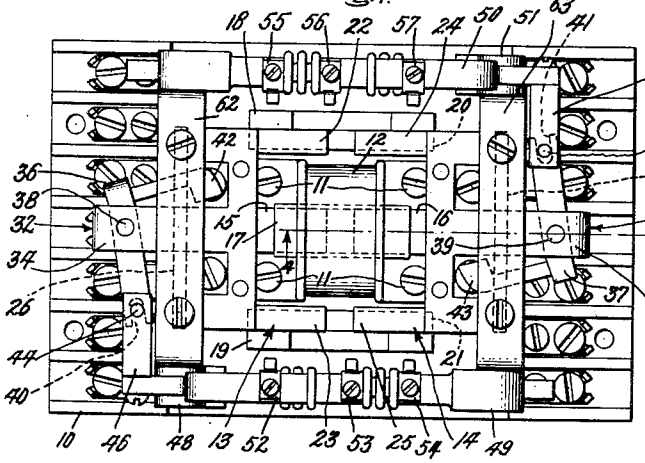


Fig. 3.

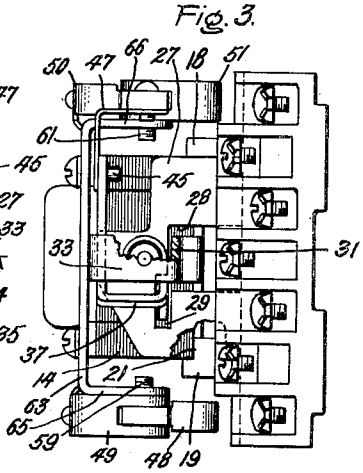


Fig. 2.

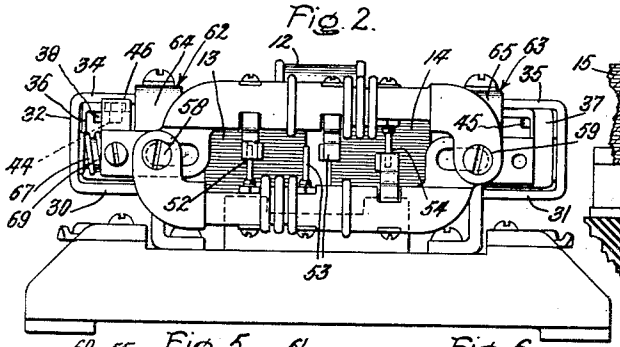


Fig. 4.

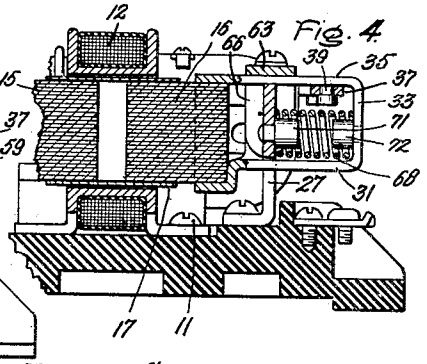


Fig. 5.

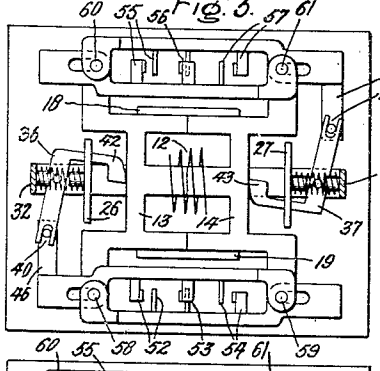


Fig. 6.

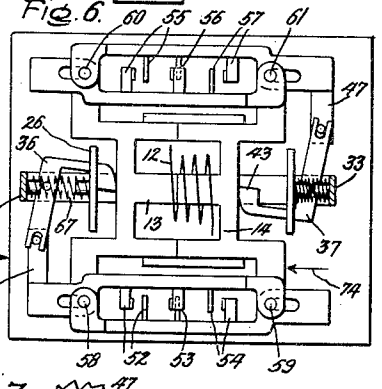
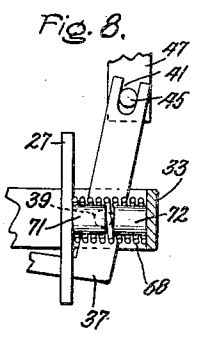


Fig. 8.



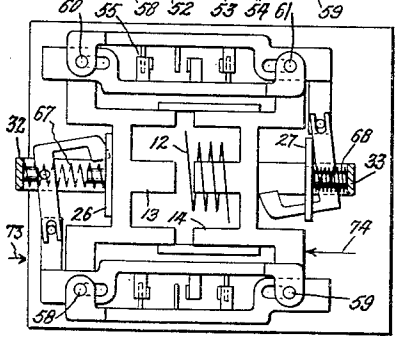


Fig. 7.

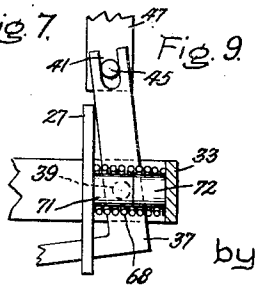


Fig. 9.

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ELECTROMAGNET CONTROL DEVICE

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Application September 1, 1948, Serial No. 47,203

5 Claims. (Cl. 175—336)

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My invention relates to improvements in electric control devices, and more particularly to shockproof electric circuit breakers, relays, and the like.

Devices, such as circuit breakers, relays, and the like, which are intended to function under abnormal conditions of an electric circuit are liable to operate falsely under shock conditions. On board warcraft, especially in time of battle, such shock-produced false operations may prove extremely crucial by effecting the de-energization of motors and other apparatus critically needed in operation. Of course, circuit breakers for a relay could be made insensitive to ordinary mechanical shock by restraining the motion of the moving parts with a sufficiently strong spring, or by introducing a sufficient amount of friction. These expedients, however, are undesirable because the relay or circuit breaker or like device is thereby made very insensitive to operation in the intended manner. In other words, in order to overcome the strong restraining effect, a large force must be applied to the armature of a relay, for example, in order to affect operation of the device on the occurrence of abnormal circuit conditions. This operating force is obtainable only at the sacrifice of sensitivity of response. Control devices such as mentioned above have also been made using moving parts balanced about the axis of rotation, so that a translational shock does not cause them to operate. Such arrangements, however, are not proof against operation on rotational shock.

An object of my invention is to provide an improved arrangement for rendering devices insensitive to either translational or rotational shock without materially interfering with their intended operational response.

In accordance with my invention, I provide a two-position shockproof control device wherein two relatively movable members are jointly and severally capable of maintaining the device in a given condition without altering said condition on the occurrence of shock and yet are capable of being moved in opposite directions so as jointly to effect a desired change in such condition of the device. Finally, in accordance with my invention, these members may be two armatures arranged on opposite sides of an energizing coil, the armatures being connected respectively to complementary contacts adapted to make or break a circuit in response to movement of said armatures, the armatures being supported on a base and so mounted as to move relatively with respect to the movement of the base.

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My invention will be better understood from the following description when considered in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing, Fig. 1 is a top elevational view of a relay embodying my invention; Fig. 2 is a side elevational view of the aforementioned relay; Fig. 3 is an end elevational view with a portion of a supporting bracket broken away to illustrate the spring biasing means and slidable mounting arrangement; Fig. 4 is a fragmentary cross-sectional view along line 4—4 of Fig. 1; Figs. 5, 6 and 7 illustrate diagrammatically several operating sequences of the relay in accordance with my invention; and Figs. 8 and 9 are fragmentary views illustrating in more detail the spring biasing and stop means.

The relay shown in the drawing comprises a base 10 adapted for mounting in any particular position desired. As shown in Fig. 1 of the drawing, it will be assumed that the base 10 is attached to a vertical support (not shown) such as a wall so that the observer is looking toward the top of the relay.

Centrally located on the base 10 and rigidly but demountably secured thereto by screws or bolts 11 is an operating winding 12. A pair of oppositely disposed E-shaped laminated magnetizable armatures 13 and 14 are slidably mounted on the base 10 with their center legs protruding into the coil 12 from opposite ends thereof. The magnets are arranged to actuate a pair of electric switch contacts in a manner which will be described hereinafter.

As described, the magnets are mounted on opposite sides of the winding 12 to permit slidable movement of the center legs 15 and 16 of the magnets into and out of the coil opening. Means for guiding the legs 15 and 16 are provided by a brass channel piece 17 having a slidable fit within the coil opening and arranged to partially surround the leg members 15 and 16. This particular arrangement permits the ready removal of the winding in the event of failure of this member or for any other reason found necessary.

Both magnets are slidably supported on a pair of track-like members 18 and 19 integral with the base 10. The members 18 and 19 are provided with shoulders 20 and 21 disposed respectively along the inner edges of these members. The outer legs 22—25 of the magnets are arranged to slide freely on these shoulders.

Means for guiding and retaining the magnets,

so as to insure their movement in a substantially linear direction on the shoulders 20—21 is provided by a pair of supporting members 26 and 27 extending laterally from, and fastened to, the base 10 intermediate the ends of said base and the backs of the respective magnets. These supporting members are provided with apertures 28 and 29, as shown in Fig. 3, the aperture 28 and its counterpart (not shown) in the member 26 serving as guides for a pair of lower arms 30—31 integral with a pair of U-shaped brackets 32 and 33. These arms and the upper arms 34 and 35 of these brackets are secured, respectively, to the back of the magnets 13 and 14. This arrangement is clearly illustrated in Fig. 4.

In order to maintain the magnets 13 and 14 in attracted position when the base 10 is subjected to shock movement, I provide motion-stopping means for arresting the relative motion of the magnets, with respect to the base 10, comprising a pair of bell crank members 36 and 37 supported by the U-shaped brackets 32—33, said members being pivotally movable about a pair of pins 38 and 39 riveted, brazed or welded to the brackets 32—33. The members 36—37 are provided, respectively, with bifurcated ends 40 and 41 and dog-leg portions 42 and 43. The bifurcated ends are arranged to engage, respectively, a pair of pins 44 and 45 secured, respectively, to a pair of L-shaped members 46 and 47. These L-shaped members are in turn secured to pairs of slidable interlocking contact supporting members, or control members, 48—51, carrying a plurality of complementary contact members 52—57.

The contact supporting members are secured, at their points of slidable interlock, by a plurality of pins 58—61 to a pair of U-shaped brackets 62 and 63 which are in turn secured to the first mentioned U-shaped brackets 32—33. This arrangement provides for the relative movement of the contacts 52—57 in response to relative movement of the magnets 13—14, since one end of each of the contact supporting members 48—51 is firmly secured, respectively, to a plurality of arms 64—66 integral with the brackets 62—63, while the opposite ends of the contact supporting members are arranged in slidable engagement with the pins 58—61 supporting said fixed ends. Thus, a pair of members 50 and 48 are rigidly joined together by bracket 62, so that arm 47 which is mounted on member 50 moves in accordance with the motion of this pair. Similarly, members 51 and 49 are joined by bracket 63 and arm 46 mounted on the member 49 moves in accordance with the motion of this pair.

The relative movements of the magnets 13—14 with respect to each other will cause the dog-like portions 42—43 to move in and out of the apertures 29 in the guide members 26—27 and are so arranged with respect to the backs of the magnets 13—14 that they serve to arrest the movement of the magnets under certain operating conditions as will be presently explained.

Means for biasing the magnets to unattracted position are provided by a pair of helical compression springs 67 and 68, the ends of which are supported on pairs of cylindrical stop members 69—72 which are secured, respectively, to the members 27 and 33 and 26 and 32. The purpose of the stops 69—72 will be explained in connection with the operation of the relay.

Figs. 5, 6 and 7 illustrate diagrammatically several operating sequences of the relay constructed in accordance with my invention. In Fig. 5, the winding 12 has been suitably energized to cause the magnets 13—14 to be attracted one to the other. The motion of the magnets through the medium of the contact support members 48—51 cause the complementary contacts 52—57 to open or close in accordance with any desired predetermined arrangement. When the magnets 13—14 are attracted one to the other, the members 42 and 43 assume the position shown in Fig. 5. Now let us assume that the base 10 has been subjected to a shock in a direction shown by an arrow 73, as illustrated in Fig. 6. This shock movement causes movement of both magnets with respect to the base 10 and in the direction shown by an arrow 74, but without movement of the magnets relative to each other. The brackets 32 and 33, the bell cranks 36 and 37 and the contact supporting members 48—51 all move with the magnets 13 and 14 and without movement relative to each other. This movement of the operating parts is opposed by the spring 68 (as shown in detail in Fig. 8), and the dog leg portion 42 of the bell crank member 36, positioned between the supporting member 26 and the back portion of the magnet 13 when the coil 12 is energized, serves as a stop to limit movement of the magnet 13 in the direction shown by the arrow 74. Since the inertia of the magnet 14 will force it into contact with the magnet 13, the retention of the magnets 13—14 in their attracted position is assured. Thus, it can be seen that any shock imparted to the base in the direction shown by the arrow 73 will cause the leading magnet 13 to be stopped and the following magnet 14 will be urged with greater pressure against the magnet 13. If shock is imparted to the base 10 in the opposite direction, the same action will take place in a converse manner.

Referring now to Fig. 7, there is illustrated the position of the magnets 13—14 when they are in an unattracted position and subjected to shock. In the unattracted position portions 42 and 43 are inoperable and play no part in the shockproof function of the device. As in the case of Fig. 6, the assumed shock imparted to the base is in the direction indicated by the arrows 73, and the movement of the magnets 13—14 with respect to the base 10 is in the direction indicated by the arrow 74. With the coil 12 deenergized, however, the leading magnet 13 will move in the direction indicated by the arrow 74 until stopped by member 26, while the magnet 14 has its movement limited by the cylindrical stop members 71—72 (as shown in detail in Fig. 9). Thus, the tendency of the magnet 13 is to move as far away from the magnet 14 as it can, until it engages member 26. It will be understood that members 27 and 26 and cylindrical stops 69—72 are so positioned and proportioned that the trailing magnetizable armature, in this case armature 14, cannot move far enough to contact the other armature, and preferably the trailing armature is permitted to move a lesser distance than the leading armature It can be readily observed that a relay constructed in accordance with my invention will provide a positive shock-proof mechanism capable of maintaining any predetermined operating position regardless of the direction of shock impact to the relay structure. It will be obvious that neither translational or rotational shock will in any way effect the position taken by the magnets. While I have illustrated, by way of example, the use of a shockproof structure adapted to actuate a switching arrangement, such a structure is readily adapted to operate, by suitable connecting means, levers, pistons, or other

control members, between predetermined operating positions.

The embodiment of my invention which has been illustrated and described has been selected for the purpose of setting forth the principles involved. It will be obvious that my invention may be modified to meet conditions for different specific uses and it is, therefore, intended to cover by the appended claims all such modifications as fall within the spirit and scope of this invention.

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

1. A shockproof control device comprising a base, a pair of magnetizable armatures slidably mounted on said base and arranged for movement toward and away from each other, resilient means connected to said base for biasing said armatures to unattracted spaced-apart positions, an energizing coil mounted on said base for simultaneously moving both said armatures to attracted positions in engagement with each other, said biasing means yieldably centering said armatures with respect to said base when said armatures are so engaged, separate fixed stop means positioned on said base to limit movement of each of said armatures toward the other and beyond said centered position, separate movable stop means for each of said armatures, and linkage means connecting each said movable stop means to the other armature whereby said movable stop means are in stopping position only when said armatures are engaged to limit movement of each of said armatures in a direction away from the other and beyond its unattracted position.

2. A shockproof control device comprising a base, a pair of magnetizable armatures slidably mounted on said base for movement toward and away from each other, resilient means joining said armatures to said base for biasing said armatures to unattracted spaced-apart positions, an energizing coil mounted on said base for simultaneously moving both said armatures to attracted positions in engagement with each other, said biasing means yieldably centering said armatures with respect to said base when said armatures are so engaged, separate fixed stop means positioned on said base to limit movement of each of said armatures toward engagement and beyond said centered position, separate movable stop means for each armature actuated by the other armature and operable only when said armatures are engaged to limit movement of each of said armatures in a direction away from the other and beyond its unattracted position, and a pair of relatively movable cooperating control members each fixedly connected to one of said armatures.

3. A shockproof control device comprising a base, a pair of oppositely disposed E-shaped magnetizable armatures each slidably mounted on said base for movement toward and away from each other, resilient means connected to said base for biasing said armatures to unattracted spaced-apart positions, an energizing coil positioned on said base to encircle the abutting center legs of said armatures for simultaneously moving both said armatures to attracted positions in engagement with each other, said biasing means yieldably centering said armatures with respect to said base when said armatures are so engaged, separate fixed stop means positioned on said base to limit movement of each of said armatures toward engagement and beyond said centered position, a mounting bracket fixedly connected to each said armature, movable stop means pivotally mounted on each said bracket movable to a position to limit movement of the associated armature away from the other and beyond its unattracted position, means connecting each said movable stop means to said other armature for actuation to stopping position only when said armatures are engaged, and a pair of cooperating control members slidably mounted upon said base and each fixedly connected to one of said armatures.

4. An electromagnet control device comprising a base, a pair of oppositely disposed magnetizable armatures slidably mounted on said base for movement toward and away from each other, resilient means connected to said base for biasing said armatures to unattracted spaced apart positions, an energizing coil positioned on said base for simultaneously moving both said armatures to attracted positions in engagement with each other, said biasing means yieldably locating said armatures in a predetermined position with respect to said base when said armatures are so engaged, separate fixed stop means to limit the movement of each of said armatures toward engagement and beyond said predetermined position, each such separate fixed stop means being constructed and arranged so that when said coil is deenergized its corresponding armature is prevented from moving far enough beyond said predetermined position to contact the other armature, movable stop means connected to each said armature to limit the movement thereof in a direction away from the other armature and beyond its unattracted position, and means for disabling said movable stop means when said coil is deenergized and said armatures are in their unattracted positions.

5. An electromagnet control device comprising a base, a pair of magnetizable armatures slidably mounted on said base for movement toward and away from each other, resilient means connected to said base for biasing said armatures to unattracted spaced-apart positions, an energizing coil mounted on said base for simultaneously moving both said armatures to attracted positions in engagement with each other, said biasing means yieldably locating said armatures in a predetermined position with respect to said base when said armatures are so engaged, separate stop means for each armature to limit the movement of each of said armatures in a direction away from the other and beyond its unattracted position, and a linkage connecting each said stop means to the other armature for actuation to stopping position only when said armatures are engaged.

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