Sept. 26, 1950 M. L. JEFFREY 2,523,369

SHOCKPROOF RELAY

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Fig. 4

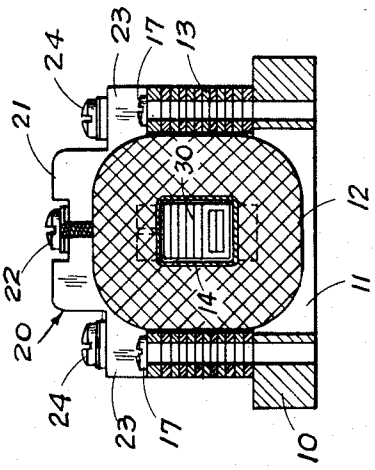


Fig. 3

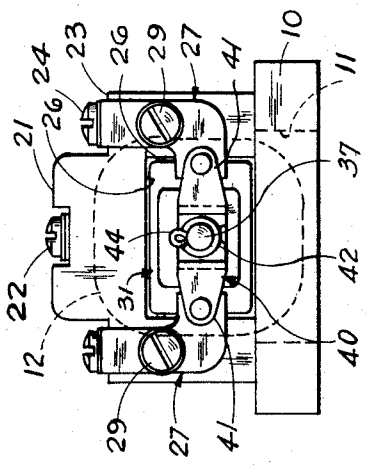


Fig. 2

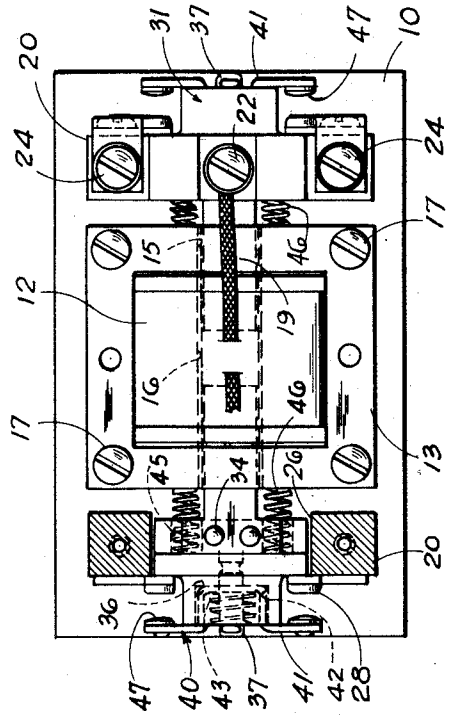
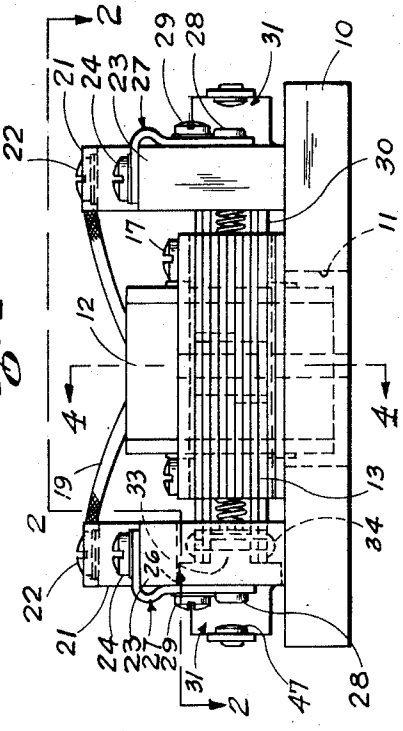


Fig. 1



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Fig. 5

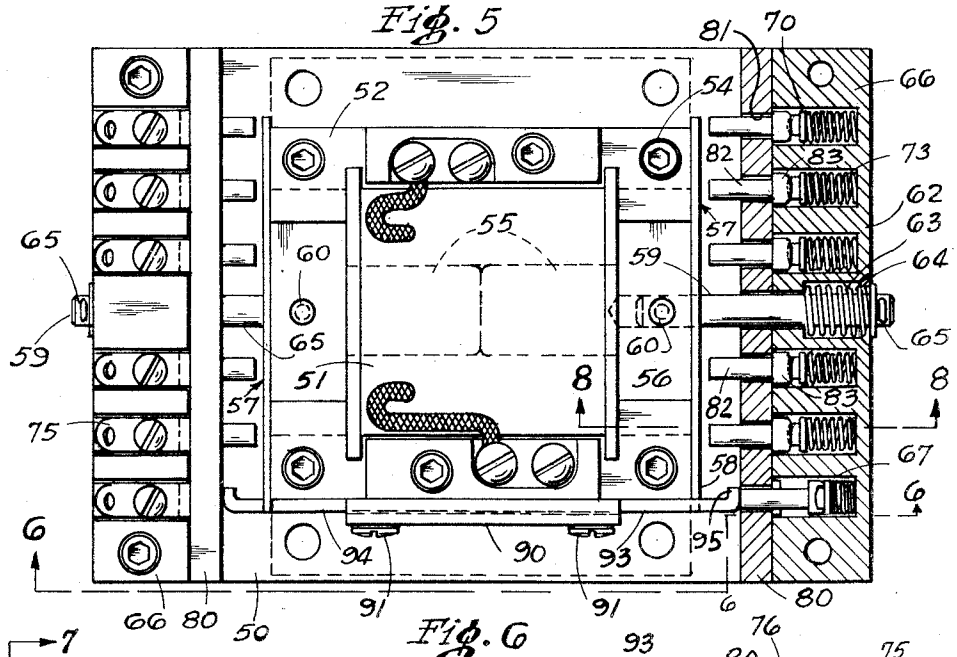


Fig. 6

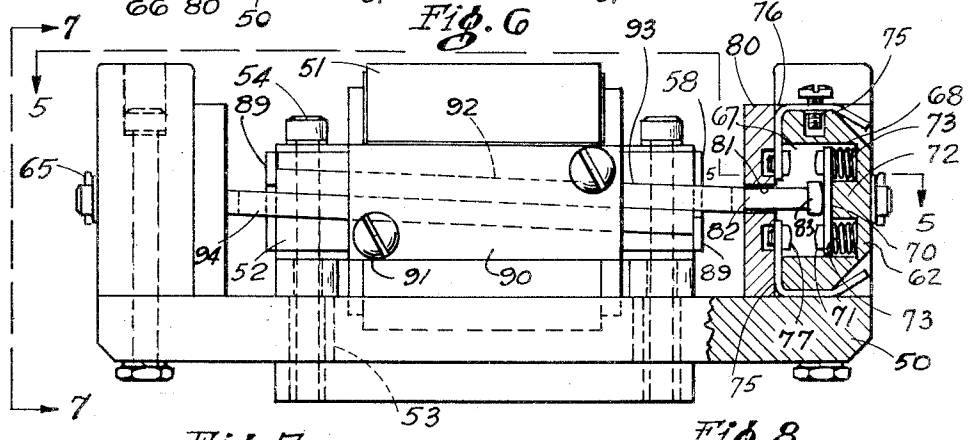


Fig. 7

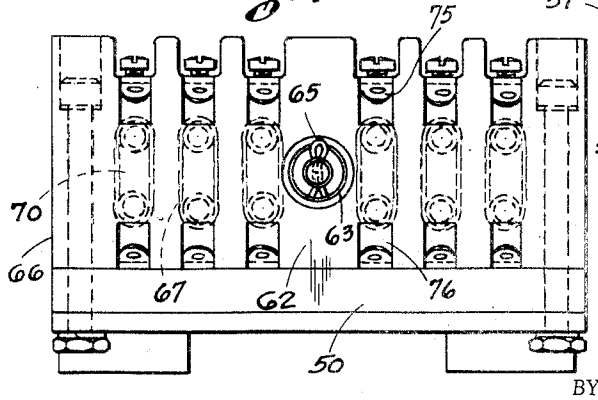
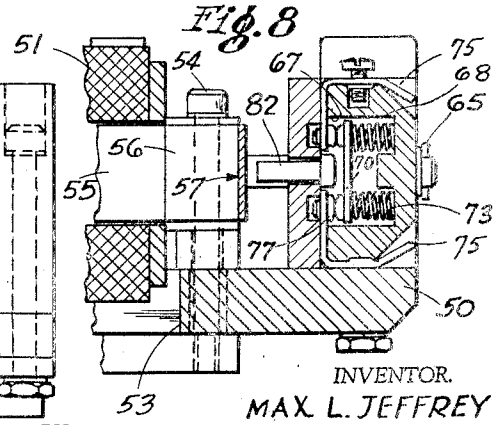


Fig. 8



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SHOCKPROOF RELAY

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6 Claims. (Cl. 200—103)

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This invention relates to improvements in electrical apparatus and more particularly to improvements in shock proof relays or switches.

It is often desirable in connection with so called relays or switches to provide switches which will maintain the circuit closed or open in spite of extraneous forces which are operating against the action of the switch. For instance, it often is desirable to provide a switch which will maintain the circuit in which it is connected closed although severe shocks are applied to it which have a tendency to open it. These switches may be subject to shocks where they are mounted on a reciprocating mechanism or where they are mounted on a mechanism such as a gun mount. In the case of a gun mount, the recoil is sometimes very great, and the switch controlling the operation may be in such a position that the recoil tends to open the contacts.

By the present invention, I have provided a switch or relay which is substantially shock proof and the means for attaining the results desired is relatively simple as compared with previous devices which contemplated various complicated levers to effect the desired end.

Still other advantages of the invention results in the versatility of the apparatus, it being such that it adapts itself to control more than one circuit wherein all the circuits may be made or broken simultaneously, or some of the circuits may be made and others broken simultaneously by the same prime mover.

Still other advantages of the invention and the invention itself will become more apparent from the following description of an embodiment thereof, which description is illustrated by the accompanying drawings and forms a part of this specification.

In the drawings:

Fig. 1 is an elevational view of a switch of my invention;

Fig. 2 is a view taken from a plane indicated by the line 2—2 of Fig. 1;

Fig. 3 is an end elevational view;

Fig. 4 is a section taken on the line 4—4 of Fig. 1;

Fig. 5 is a view similar to Fig. 2, of a modified form of the invention;

Fig. 6 is an elevational view of the device of Fig. 5 with certain parts broken away and shown in section;

Fig. 7 is an end elevational view of the device of Fig. 5; and

Fig. 8 is a fragmentary section taken on the line 8—8 of Fig. 5.

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Referring now to the drawings throughout which like parts are designated by like reference characters, and more particularly to Fig. 1, which illustrates simplified form of my invention, I preferably provide a means for establishing a concentrated magnetic flux which operates to attract a pair of movable elements to move them in opposite directions from each other. Means is also provided to move the elements in a direction opposite to that in which they are moved by the flux, preferably in the form of a spring.

A plurality of movable contacts are provided, being carried by said movable elements, which elements move in one direction by the flux and in the other direction by the separate means such as a spring or springs. A linkage is also provided whereby certain selected contacts may be opened simultaneously with the closing of the others.

More particularly, the invention includes a base 10 illustrated as being of generally rectangular formation and which is formed with a central opening 11 into which the solenoid winding 12 may extend. The solenoid winding is provided with a plurality of cooperating stator plates 13 which surround the periphery of the winding. The winding itself is supported on a form 14 that provides a hollow core. The stator is provided with openings 15 at opposite ends, which align with the hollow core of the coil 16. The laminated stator and its associated coil are secured to the base by studs 17 which extend through the lamination of the stator and are threaded into the base, the opening 11 allowing the coil to extend therein with the core opening adjacent to the base and parallel therewith.

At each end of the base, spaced from the ends and also spaced from the stator there are provided contact supports and armature guide members 20; each of the members 20 is formed of insulating material such as Bakelite and, as best shown in Figs. 3 and 4, is provided with an upper portion 21 in which there is threaded a screw 22 to which the wire 19 from the solenoid winding connects and which forms a convenient means for connecting a source of power to the solenoid winding. The member 20 is also provided with a pair of bosses or shoulders 23 adjacent to and lower than the part 21 upon which are supported the contact strips 27 that carry connecting screws 24 and the fixed contacts 28. The intermediate portion of the member 20 is formed with a rectangular opening 26 which extends to the base 10, the purpose of which will hereinafter more clearly appear. The contact strips 27 are secured to the sides of the members 20 by screws 29 and the

lower ends are of L-shaped formation, extending over the edge of the opening 26 and support contacts 28 opposite to the opening.

A pair of T-shaped armatures are provided the heads adapted to be guided by the members 20 and the stems of which are attracted into the hollow core of the solenoid winding from opposite directions. The armatures are of laminated construction, which is common in this type of device, being provided with a stem 30 which is adapted to slide into the hollow core 16. Each armature head 31 is adapted to carry movable contacts which cooperate with the fixed contacts to make or break the circuit. The armatures are retracted from the core 16 by spring mechanism which engages with the head of the armature. Each armature is provided with an insulated contact member which may be Bakelite and includes a rectangular portion 33. The outer laminations of the armature extend on opposite sides of this portion and are held thereto by rivets 34. The member is provided with a body or base portion of substantially the same conformation on the opening 26 and is adapted to reciprocate in the opening 26 and be guided thereby. Extending from the body opposite to the stem 30 is a rectangular cup 36 which is integral with the body, and molded into the body inside the cup is a pin 37 which extends from the bottom of the cup outward beyond the edge of the cup. The movable contact member comprises a bar 40 including laterally extending arms 41 and a U-shaped mid portion 42 which is provided with a central opening adapted to be disposed about the pin 37. A helical spring 43 is disposed around the pin 37 in engagement with the bottom of the U-shaped portion 42, the bar being secured in place by a cotter pin or key 44 which engages the other end of the spring. This spring thus holds the contact bar resiliently on the end of the armature. The U-shaped portion of the bar 40 provides a sliding fit with the sides of the cup 36 which thus provides a convenient guide therefor maintaining the same with its contacts in proper alignment with the fixed contacts.

The side of the Bakelite member juxtaposed to the stator 13 is provided with a pair of recesses 45 opening toward the stator which recesses receive springs 46 that are seated therein and which engage with the ends of the stator plates 13 adjacent to the core 15. The springs are of a length sufficient to urge the movable contacts to an open position. The rectangular opening 26 in the fixed contact supporting member guides the armature heads and the L-shaped portions of the contact strips 27 also serve as stops which limit the outward movement of the armatures.

The operation of the device is as follows:

The winding of the solenoid is energized by connecting a source of current to the screws 22 of the solenoid. When the solenoid winding is energized, the stems of the armatures are attracted toward the center of the winding until their ends engage with each other. Just prior to the time of contact of the armature ends, the contact bars 40 with the contacts 47 are forced into engagement with the fixed contacts 28. The travel of the armature is such that the movable contacts are forced against the fixed contacts and the springs 43 which are compressed before the armature ends engage thus providing an effective electrical connection between the contacts.

Under these conditions, both sets of contacts being made from opposite directions, it will be seen that if a shock is applied to the base from either end, that although the sudden shock may cause one set of contacts to break, the shock will have no effect on the other contacts other than to seat them more tightly against their fixed contacts. Obviously, shocks from the side of the base have no effect on the apparatus. The fixed contacts are commonly connected into a circuit in parallel with each other so that both contacts serve to close the same circuit, thus assuring that, although one set of contacts may be broken, the other set will maintain the circuit closed.

Referring now to the other figures of the drawing, and particularly to Fig. 5, where there is illustrated by a plan view, a modified form of the invention, wherein a base 50 of generally rectangular formation is provided to the mid portion of which is secured the solenoid winding and the stator plates 51 and 52 respectively. The center of the base may be formed with a recess or opening 53 to allow clearance space for the winding. The stator plates may be secured to the base by screws 54 in a manner similar to that previously described.

The device is shown in an operated position wherein the armatures have been attracted into hollow core of the solenoid winding. The armatures each include the stem 55 and the T-shaped head 56 of the usual laminated construction.

The head 56 is provided with a plate 57 which is secured to the head of the armature by welding or in any other suitable manner and extends laterally beyond the ends of the head as indicated at 58. The armature is retracted from the winding by a spring means which is connected to a stem 59 secured to the head. The stem 59 is secured in the mid portion of the head and is held therein by a rivet 60. It extends outwardly through a contact chamber housing 62 and through a recess 63 in said housing, which housing is disposed on the end of the base. A spring 64 surrounds the stem 59 and is seated in the bottom of the recess 63, the other end of the spring being engaged with the stem by a cotter key 65. It will thus be seen that the spring 64 tends to urge the stem 59 outwardly together with the armature. The assembly is the same for each end.

The base is provided with contact housings 62 on each end which are formed with portions 66 that have laterally spaced vertically extending channels 67 best shown in Figs. 5 and 6. The bottoms of the channels are provided with recesses or bores 68 in which are seated springs 73. In each of these channels, there is disposed a movable contact member comprising a strip 70 carrying contacts 71, the mid portion of which abuts the bottom 72 between the recesses 68. The springs 73 which are seated in the bottom of the recesses on either side of the bottom 72 engage the contact strips to the rear of the contacts. The contacts are guided by the chamber and are normally forced to the left as viewed in the figures toward the armature head. The fixed contacts are disposed at the top and bottom of the channels 67 and are supported by strips 75 which extends through the channels 76 in the members and carry the contacts 77 on their ends disposed opposite to the movable contacts in the path of travel thereof. The chamber is closed by a member 80 of generally rectangular formation which may be secured therein in any desired manner and which is provided with a plurality of openings 81 opposite to the channels 67 and in which are disposed the shanks of operating pins. The operating pins comprise shanks or stems 82 and heads 83, which heads are dis-

posed in the chamber and engage the movable contact strips intermediate the contacts. The shanks are adapted to extend beyond the confines of the chamber and in the path of travel of the armature head.

The extensions **58**, as well as the body of the strip **57**, are adapted to engage with the ends of the shanks **82** of the pins for operating the movable contacts when the solenoid is deenergized and the armatures are pulled outward by the spring **64** operating against the stem **59**. In this manner, when the solenoid is energized, the armatures are attracted into the solenoid and the head **57—58** drawn away from the ends of the pins, the springs **73** then move the movable contact strips and their contacts into contact with the fixed contacts **77**.

Preferably, the construction is such that the armatures, when attracted into the solenoid, are in spaced relation to the contact operating pins. In this construction, it will be seen that shocks applied to either end of the device have substantially no effect upon at least one set of contacts, since one set of contacts will merely be seated more securely than the other. The fixed contacts on opposite ends may be connected in parallel as described for the preceding embodiment.

Means is also included to provide contacts which are also operated by the armatures but which operate opposite to the contacts previously described. In this connection, each of the members **58** is provided with an extension **89** at its end as can best be seen in Fig. 6. A plate **90** is connected to the side of the stator **52** by screws **91** and is provided with a channel **92** on the side toward the stator, which channel extends at an inclination from the horizontal as can best be seen in Fig. 6. Two bars, **93** and **94**, are disposed in the channel in juxtaposed relation to each other, one end of each bar being in engagement with the extensions **89** of the head **57** on the respective armatures. The other end of each bar extends beyond the ends of the stator in opposite directions and each is provided with a bent angular end **95**, adapted for engagement with the stems **82** of the end contact operating pins.

As previously stated, when the armatures were attracted into the solenoid, the contacts were made by the springs forcing the movable contacts against the fixed contacts. In the case of the last mentioned member, however, it will be seen that the armatures on the opposite ends engage the bars and force them against the pins of the contact operating member and open the contacts. Therefore, when the solenoids operate, there are a plurality of contacts which are closed, and at least one set of contacts which are opened.

It will therefore be seen that I have provided a relay or switch as shown in Figs. 1 to 4 inclusive where the contacts are made by pulling the movable contacts into engagement with the fixed contacts upon energization of the solenoid; that the structure is such that heavy blows on the ends of the switch will not open the circuit since blows tending to unseat one set of contacts merely seats the other set more firmly. Another advantage of the construction is that the solenoid armatures operate against the springs **46** which absorb some of the shock before the armatures strike against each other. This shock is still further absorbed by the springs **43** which hold the movable contact bars in the armature sockets.

The economies of construction will be very apparent because of the simplicity of the device.

Although I have shown only two sets of contacts in Figs. 1–4, it will be apparent that more than one set of contacts may be provided if desired by comparatively simple changes that will be apparent to those versed in the art. For instance, the U-shaped member **42** instead of having the contacts secured directly thereto could carry insulated contacts, which thus could be increased in number and break one or more circuits.

In connection with the apparatus shown in Figs. 5 to 8 inclusive, it will be seen that the majority of the contacts are closed upon the operation of the solenoid, but that they are closed by the springs rather than directly by the pull of the solenoid. It should also be noted that the construction is such that the contacts are in individual chambers and that therefore arcing at the contacts is confined within the space, the only access to the space being around the operating stems **82** which have a sliding fit in the openings in the member **80**. Furthermore, the end contacts which are operated by the bars **93—94**, to open their cooperating contacts when the other contacts are closed, may also be duplicated on the other side of the switch to provide two sets of such contacts if desired. It will also be apparent that the extensions **58** of the plate **57** could be shorter if desired and the lugs **89** would thus have to be longer, but the angular portion **95** could extend over and engage with two sets of the contacts and thus several circuits be opened and/or closed as desired.

Having thus described my invention, I am aware that numerous and extensive departures may be made therefor without departing from the spirit or scope of the appended claims.

I claim:

1. A base, a solenoid winding carried by said base, stator plates for said winding, a hollow core for said winding, a pair of armatures for cooperation with said winding each including a head portion and a stem portion with the stem portions adapted to enter said core from opposite directions, said head portions being movable between said stator ends, plates carried by said head portions on the ends opposite the stems and extending laterally from the head portions, contact supporting means carried by said base at opposite ends thereof and comprising a housing, contact strips and contacts thereon slidably disposed in the housing and spring means for urging said strips to one side of the housing and an operative member for each strip having a head in engagement therewith and a stem extending out of said housing into the path of travel of said plates.

2. A base, a solenoid winding carried by said base, stator plates for said winding, a hollow core for said winding, a pair of armatures for cooperation with said winding each including a head portion and a stem portion with the stem portions adapted to enter said core from opposite directions, said head portions being movable between said stator ends, plates carried by said head portions on the ends opposite the stems and extending laterally from the head portions, contact supporting means carried by said base at opposite ends thereof and comprising a housing, contact strips and contacts thereon slidably disposed in the housing and spring means for urging said strips to one side of the housing and an operative member for each strip having a head in engagement therewith and a stem extending out of said housings into the path of travel of said plates, a guide connected to each armature

extending in the opposite direction from the stem and through each contact housing and spring means for said guides for moving said armatures outward upon de-energization of said winding.

3. A multiple contact shock proof relay including a base, a solenoid winding rigidly mounted in said base and a stator member therefor, armatures for said winding each including a head reciprocable between the ends of said stator and having a stem adapted to be attracted into the winding upon energization thereof, contact housing members on opposite ends of said base and each being formed with a plurality of vertically extending chambers, contact strips extending into said chambers and supporting fixed contacts in one end of each chamber in spaced relation to each other, movable contact members for said chambers having contacts therein spaced for engagement with said fixed contacts and movable longitudinally in said chamber toward and away from the fixed contacts, spring means for said movable contacts biasing them to a closed position with the fixed contacts, plungers extending into said chambers into engagement with said movable members for moving them against said spring pressure and having ends extending beyond said support toward said armatures, said armature heads adapted for simultaneous engagement with said plungers, and means to move said armatures into engagement with said plungers upon de-energization of said solenoid winding.

4. A multiple contact shock proof relay comprising a base frame, housings carried on opposite ends of said base and each enclosing a plurality of contacts, fixed and movable contacts disposed in said housings, said contacts each having spring means biasing the contacts to closed position and operating pins for each of said contacts extending out of said housings adapted to be moved to open said contacts, solenoid means disposed in said base intermediate said housings and having armatures adapted upon energization of the solenoid, to be moved in opposite directions to each other, heads for each armature adapted for engagement with some of said pins and links carried by said frame and operable by the armature to move some of the contacts at the end of the base opposite the head of the armature which operates said last named contacts.

5. A shock proof relay including a base, a solenoid winding, stator plates for said winding supported on said base, said base being provided with an opening and said winding extending into said opening, a hollow core for said winding, armatures extending into said winding from opposite ends adapted to be attracted into the core upon energization of the winding, fixed contacts supported by said base and movable contacts operably connected to said armatures, armature spring means for urging said armatures outward of said cores, and contact spring means for urging the contacts in a direction opposite to the urging of said armature springs, said contacts being disposed on opposite ends of said base and adapted to be connected in parallel, at least one set of said contacts being so disposed that forces tending in the presence of shock to open one of said parallel connected contacts, tend to close the other.

6. A shock proof relay including a base, a solenoid winding, stator plates for said winding supported on said base, said base being provided with an opening and said winding extending into said opening, a hollow core for said winding, armatures extending into said winding from opposite ends adapted to be attracted into the core upon energization of the winding, fixed contacts supported by said base and movable contacts operably connected to said armatures, armature spring means for urging said armatures outward of said core, and contact spring means for urging the contacts in a direction opposite to the urging of said armature springs, said contacts being disposed on opposite ends of said base and adapted to be connected in parallel, at least one set of said contacts being so disposed that forces tending in the presence of shock to open one of said parallel connected contacts, tend to close the other, guide means for said movable contacts for guiding the opening and closing movements thereof.

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