June 28, 1949. C. W. KUHN 2,474,742

ELECTROMAGNETIC SWITCH

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Fig. 1

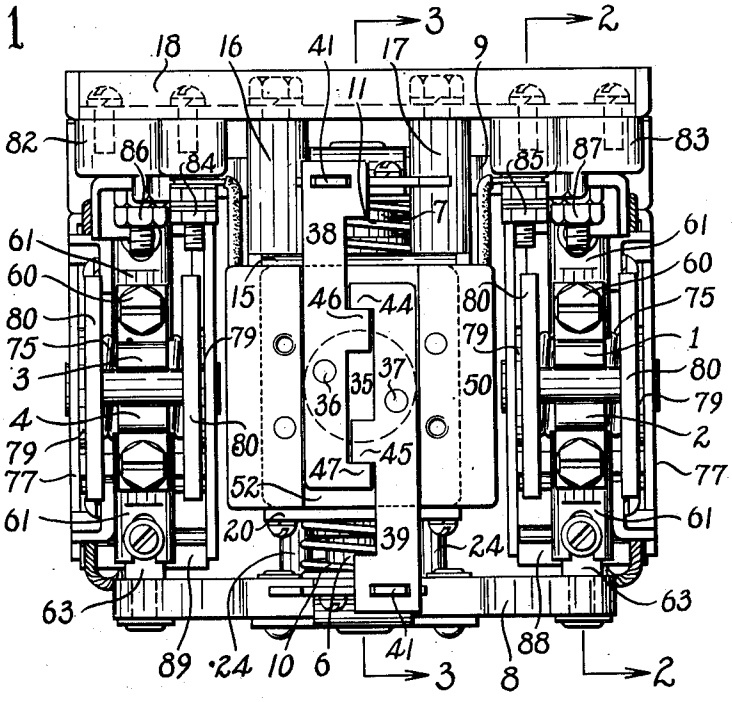
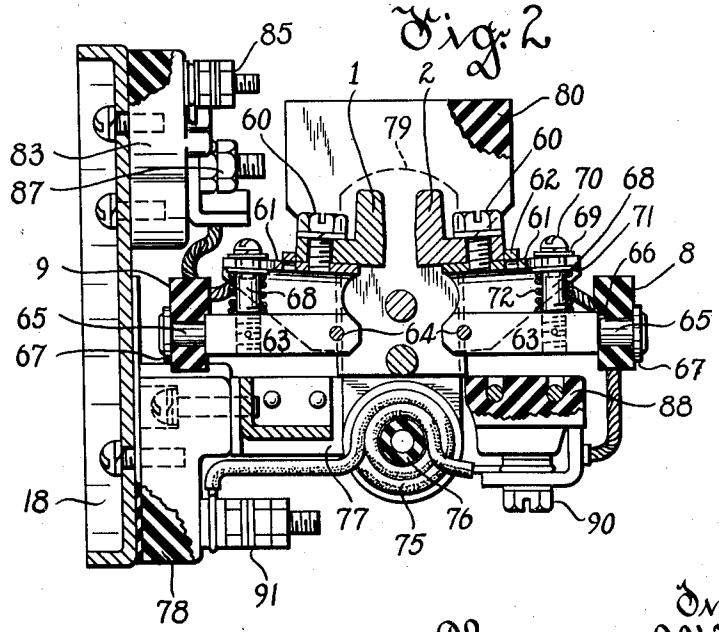


Fig. 2



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Fig. 3

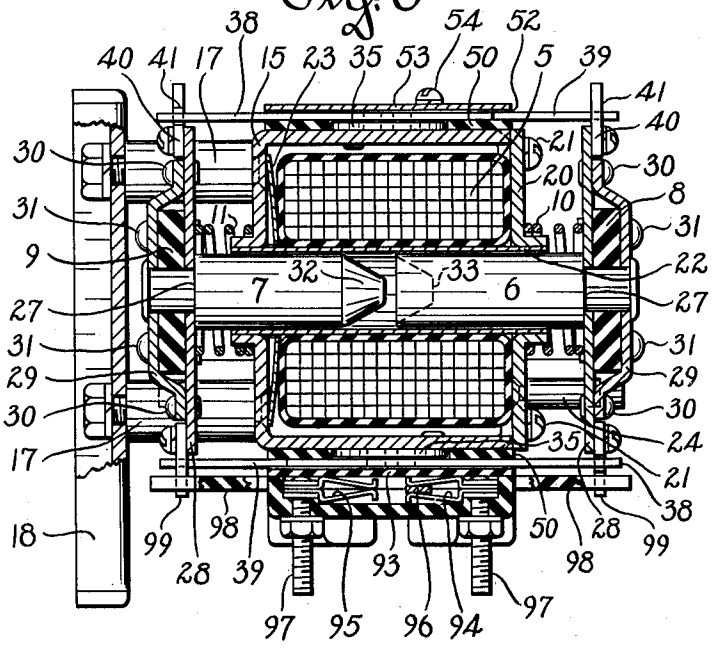
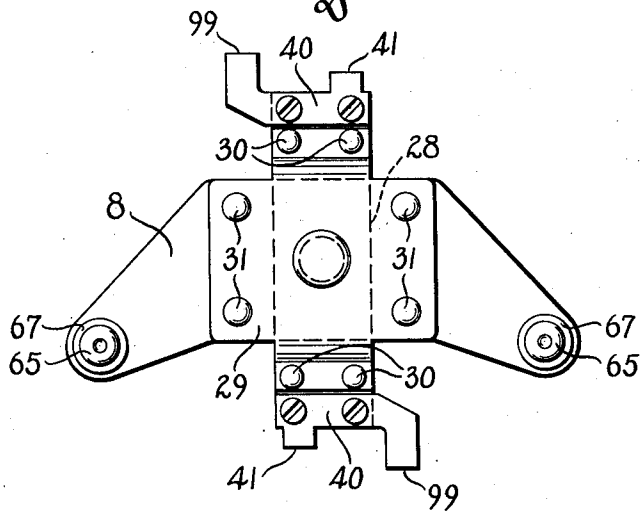


Fig. 4



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UNITED STATES PATENT OFFICE

2,474,742

ELECTROMAGNETIC SWITCH

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Application July 8, 1943, Serial No. 493,811

17 Claims. (Cl. 200—103)

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This invention relates to electromagnetic switches and is particularly applicable to and advantageous for electromagnetic switches used aboard ships.

An earlier proposed electromagnetic switch especially designed for alternating current which has been found to meet very satisfactorily high shock test comprises oppositely moving contact carrying elements interconnected to prevent movement of either independently of the other, such elements being biased into a given relation subject to movement into another relation and retention in the latter relation by electromagnetic means, the assembly being of a symmetrical and balanced form.

The present invention is particularly applicable to such general form of switch, and has among its objects modification thereof to render the same better suited to control of comparable direct current.

Another object is to provide a switch of the aforementioned general type capable of handling relatively heavy direct current which may be made safe, durable and reliable, and yet compact and of satisfactory dimensions.

Another object is to provide a switch of the aforementioned character which will be quiet in operation.

Various other objects and advantages of the invention will hereinafter appear.

One embodiment of the invention is illustrated in the accompanying drawings which will now be described, it being understood that the embodiment illustrated is susceptible of various modifications without departing from the scope of the appended claims.

In the drawing,

Figure 1 is a top plan view;

Fig. 2 is a sectional view taken on line 2—2 of Fig. 1;

Fig. 3 is a sectional view taken on line 3—3 of Fig. 1; and

Fig. 4 is a detail view.

Referring to the drawing, the switch shown therein comprises in general two pairs of contacts 1—2 and 3—4 (Fig. 1), these pairs of contacts being spaced to receive therebetween an electromagnet (Fig. 3) having a winding 5 and opposed and aligned plungers 6 and 7. The plungers 6 and 7 respectively carry insulating blocks 8 and 9 of like form, shown in Fig. 4, which extend transversely of the axis of the electromagnet, each carrying at opposite extremities contacts of the aforementioned two pairs of contacts. More specifically block 8 carries at

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opposite extremities thereof contacts 2 and 4, while block 9 carries contacts 1 and 3. The plungers 6 and 7 have associated springs 10 and 11, respectively, which bias said plungers apart normally to separate contacts 1 and 2 and contacts 3 and 4 as shown in Fig. 1. On the other hand, the electromagnet is energizable to draw the plungers together to engage contacts 1 and 2 and also contacts 3 and 4, holding them in engagement so long as it remains energized. It will be noted that the structure described is generally symmetrical with respect to the axis of the electromagnet and with respect to an axis passing transversely through the magnet and through the spaces between the contacts of the two pairs of contacts when disengaged.

Referring to Fig. 3, the electromagnetic winding 5 is carried within a substantially rectilinear magnet frame 15, said frame having rearwardly extending sets of posts 16 and 17 for attachment to a supporting panel 18, the arrangement shown being such as to provide for vertical break by the contacts with the switch fixed to a vertical supporting panel. The magnet frame as shown is sectional, comprising a U-shaped part to which the suporting posts 16 and 17 are fixed, and a front plate 20 secured as by screws 21 to the free ends of the U-shaped part. Such front plate and the opposed wall of the U-shaped part have flanged openings to receive and support a tube 22 on which the winding 5 is mounted and in which the plungers 6 and 7 are reciprocably supported. As shown the tube 22 carries a spring washer 23 interposed between the winding 5 and the adjacent wall of the magnet frame and for a purpose later set forth the front plate 20 is provided with a pair of spaced projecting pins 24.

Further referring to Fig. 3, the insulating blocks 8 and 9 which carry the contacts each comprise part of an assembly further illustrated in Fig. 4, fitting onto a reduced outer end portion of its respective plunger, being suitably secured thereon in engagement with an annular shoulder 27 on the plunger. Each of said assemblies is shown as comprising a flat oblong plate 28 and a formed plate 29 holding therebetween the insulating contact carrying block which preferably is recessed to receive the flat plate for interlock against rotary movement relative thereto. The plates 28 and 29 are preferably secured together as by rivets 30 and preferably the insulating block is secured to the formed plate 29 as by rivets 31. The springs 10 and 11 which bias the plungers apart surround the

plungers and are interposed between the magnet frame and the plates 28 of the contact carrying assemblies. The plunger 7 is shown as provided with a tapered end portion 32 adjacent the plunger 6 and the latter plunger is shown as provided with a tapered recess 33 to receive said tapered end portion of plunger 7. This construction of the adjacent end portions of the plungers has been found advantageous in various respects, but generally satisfactory results have been obtained without the tapered formation.

The two contact carrying assemblies have portions disposed between the supporting posts 16 and 17 in the case of the rear assembly and between the pins 24 in the case of the front assembly for restraint against turning about the axis of the plungers. Also the contact carrying assemblies are interlocked for prevention of movement independently of one another and for limitation of their relative movement, preferably by the means illustrated in Fig. 1. This means comprises a disk 35 oscillatable about a fixed axis and having engaged therewith by crank pins 36 and 37 at diametrically opposed points two reciprocable bars 38 and 39, the bar 39 being connected to the front contact carrying assembly, and the bar 38 being connected to the rear contact carrying assembly. More specifically referring to Figs. 3 and 4, the front contact carrying assembly has fixed to the upper end of its plate 28 as by screws a plate 40 with an upstanding lug 41 which projects through an opening in the bar 39 while the rear contact carrying assembly has a similar plate with a lug 41 projecting through an opening in the bar 38. Thus since the bars 38 and 39 have crank pin connections with the disk 35 it will be apparent that any motion of either assembly will be transmitted to the other through the bars and the connecting rotary oscillatable disk. Also the bar 39 is provided with laterally extending lugs 44 and 45 coacting with laterally extending lugs 46 and 47 on the bar 38 to limit relative rectilinear motion of the bars and thereby correspondingly limiting relative movement of the contact carrying assemblies. Preferably the disk 35 is set in a circular opening in an insulating plate 50 suitably fixed to the top of the magnetic frame, said disk being confined to a rotary motion about a fixed axis through engagement with the insulating plate into which it is set and preferably also the insulating plate 50 is recessed to provide a channel 52 to receive the bars 38 and 39. A cover plate 53 secured to the magnet frame as by screws 54 serves to clamp the interlocking assembly to the top of the magnet frame. A like interlocking mechanism is preferably provided on the bottom of the frame to similarly interlock the contact carrying assemblies at their lower ends also, and such interlocking mechanism is illustrated in Fig. 3. This second interlocking mechanism being structurally the same as that described further description thereof is unnecessary beyond pointing out that it preferably has its bars 38 and 39 arranged so the bars 38 as well as the bars 39 of the two interlocking mechanisms lie on opposite sides of the axis of the plungers.

Referring to Fig. 2 which shows the contacts 1—2, each contact is shown as comprising an angular element fixed by a bolt 60 to a formed inverted U-shaped rocking element 61, said element having a struck-up portion 62 forming an abutment for the contact to prevent turning of the latter on the bolt. The rocking element 61 has its downwardly extending portions spaced to straddle a supporting post 63 of rectangular cross section to which said rocking element is pivotally connected by a pin 64. The supporting post 63 is fixed to the insulating block of one of the aforedescribed contact carrying assemblies. As shown in Fig. 2, the post 63 has a reduced portion 65 passing through its respective insulating block and having a flat surface thereof engaged by a shoulder 66 on the block to prevent turning of the post. The post 63 has on its reduced end a washer 67 to bear against the insulating supporting block and the reduced end of the post is turned over onto the washer to rivet the post to the block. Threaded into post 63 is an upstanding pin 68 extending into a slot in the rocking member 61 and having at its upper extremity a washer 69 to engage the upper side of the member 61 to form a stop therefor, said washer being secured to the pin by a screw 70. Also the pin carries a second washer 71 engaging the under side of member 61, said washer being under the bias of a coil spring 72 surrounding the pin and interposed between said washer and post 63. Thus considering contact 2 of Fig. 2, the spring 72 biases the rocking member 61 to rotate counterclockwise on its pivot 64 to a limit established by the washer 69 on the pin 68 and initially adjustable by turning the pin, whereas said spring permits member 61 to rotate clockwise on its pivot when contact 2 meets with resistance within the range of movement of its respective plunger. On the other hand, the contact 1 which is mounted in a like manner on its respective contact carrying assembly is biased by its respective spring in a clockwise direction, and as will be understood contacts 3 and 4 are mounted on the contact carrying assemblies in the same manner as contacts 1 and 2.

Further referring to Fig. 2, the same shows contacts 1 and 2 and is likewise exemplary of contacts 3 and 4, with the plungers of the electromagnet spread apart under the influence of the springs 10 and 11, the contacts of each pair under such conditions having a predetermined suitable air gap therebetween. On the other hand, when the plungers are drawn together by the electromagnet the contacts of each pair are engaged, each of the contacts yielding with a slight rocking motion against the action of its respective spring 72 until the plungers seal, bringing the contacts to rest. Such resiliency in the support of the contacts affords cushioning thereof when brought into engagement, whereas the energy stored in the springs 72 resists rebound of the contacts and insures intimate engagement thereof while the electromagnet remains energized. In view of the slight rocking motion of the contacts incident to engagement thereof their adjacent faces are preferably formed as illustrated with their upper portions receding slightly. Thus provision is made for contact over a substantial area adjacent the upper ends of the contacts when they first engage through rectilinear movement, whereas upon subsequent rocking of the contacts the area of engagement shifts downwardly to the surfaces which in spread relation of the contacts diverge slightly in a downward direction.

Thus it will be observed that since the switch unit as a whole is symmetrical, comprising two structurally identical parts oppositely disposed with respect to a vertical plane midway of the ends of the electromagnet, balancing of such

parts in respect of mass will adapt the unit to meet high shock test. As will be observed when the sets of contacts are out of engagement any shock tending to move either contact carrying assembly will be counteracted by the other contact carrying assembly, whereas the same will also be true when the contacts are engaged as the result of energization of the electromagnet. Moreover as the switch is free of fixed contacts, all contacts and their supports being substantially floating transmission of shocks thereto will be reduced to a minimum, and as will also be the noise incident to engagement of the contacts. As hereinbefore indicated, quietness of the switch in closing has been found to be enhanced by using plungers of the tapered form shown.

For extinguishing arcs formed upon separation of the two pairs of contacts each pair is preferably provided with an electromagnetic blowout device as shown in Figs. 1 and 2. The blowout devices may in practice assume various different forms and as the devices illustrated are distinctive only in specific construction for ruggedness, durability, etc., they will not be described in detail. Briefly described each blowout device as shown in Fig. 2 comprises a blowout winding 75 arranged below its respective contacts with its axis at right angles to the plane of movement of said contacts. The winding 75 is supported on a core 76 in turn supported by a bracket 77 carried by an insulating block 78 fixed to the supporting panel 18. The frame 77 which is preferably formed of non-magnetic material carries at opposite ends of the winding 75 upstanding magnetic plates 79, which plates have fixed thereto suitable insulating arc shields 80. As will be understood, the plates 79 are spaced to receive therebetween the contacts of their respective pairs of contacts, while the insulating shields 80 are interposed between the plates 79 and the enclosed contacts, the shields adjacent their respective contacts being enlarged upwardly and laterally.

As shown in Fig. 1, the supporting panel 18 has fixed thereto adjacent the top thereof insulating blocks 82 and 83 respectively carrying terminal studs 84 and 85, to which are carried the terminal leads of the electromagnetic winding 5, and also terminal studs 86 and 87 to which are carried pigtails from the contacts 1 and 3, respectively. The frames 77 of the two blowout devices carry insulating blocks 88 and 89, respectively, which carry terminal studs 90 to which are led pigtails from the contacts 2 and 4, respectively, one such terminal stud 90 being shown in Fig. 2. As shown in Fig. 2, the blowout winding has one terminal connected to the terminal stud 90 and its other terminal connected to a terminal stud 91 carried by the insulating block 78, and as will be understood the other blowout winding has similar connections.

Switches of this character commonly require for maintaining circuits and other purposes auxiliary switches and a preferable form of switch is illustrated in parts in Fig. 3. As here shown the auxiliary contacts are carried by an insulating block 93 secured to the underside of the switch unit directly below and against the aforedescribed lower interlocking mechanism for the two contact carrying assemblies. These auxiliary switches are of the sliding engagement type, and of a design to meet high shock test. While the drawing shows only two stationary contacts 94—95 and one movable contact 96, the auxiliary switch mechanism would in practice ordinarily have more of the same kind of stationary contacts and preferably two of the same kind of movable contacts. Each stationary contact comprises a pair of spring clips carried by and secured to the insulating block 93 by a terminal stud 97, whereas each movable contact comprises a sliding blade to enter between and to spread the clips of the stationary contacts. As will be noted, the clips of each stationary contact have outwardly bent extremities which facilitate entry of the cooperating sliding contact therebetween and which by abutment with the adjacent insulating parts limit possible spreading of the clips. Preferably spreading of the clips is thus limited to the smallest amount sufficient to enable entry of the sliding contact. The sliding contacts are preferably of a form to bridge two or more stationary contacts arranged in a side by side relation, and as shown the contact 93 is slidable to engage the opposed contacts 94 and 95 selectively according to the position of one of the contact carrying assemblies to which it is operatively connected. Assuming employment of two movable contacts 96, each would be operable through the medium of one of two sliding bars 98 shown as respectively connected to the front and rear contact carrying assemblies, these bars in respect of mounting and connection to the contact carrying assemblies being similar to the bars of the aforedescribed interlocking devices. As shown in Fig. 4, each plate 48 has a second lug 99 to be received in an opening in one of the bars 98, but as will be understood only the lugs 99 of the lower plates of the two contact carrying assemblies would be required for operatively connecting the two bars 98 illustrated in Fig. 3.

As will be understood, when the contacts 1—2 and 3—4 are engaged the magnetic pull thereon must be maintained to insure continued engagement thereof under shock which of course requires maintaining the circuit of winding 5 through the medium of shock-proof auxiliary contacts and the aforedescribed type of auxiliary contact has been found very effective to so supplement the required shock-proof characteristics of the switch itself. Thus the combination of the herein disclosed switch and auxiliary contacts will meet high shock test in either open or closed position of the switch and without need of any latching mechanisms, whereas as aforeindicated the switch has capacity for controlling direct current circuits subjected to current of relatively high value.

What I claim as new and desire to secure by Letters Patent is:

1. In an electric switch to meet shock test, the combination with a pair of coacting contacts, both movable, of individual actuating means for said contacts having like movements oppositely of one another to move said contacts into and out of abutting relation, and means by which said actuating means are interconnected to prevent at any time such movements thereof independently of one another whereby they are subjected to counteraction one by another under shock.

2. In an electric switch to meet shock test, the combination with a pair of cooperating contacts, both movable, of individual actuating means for said contacts by which said contacts are wholly supported and which have like movements oppositely of one another to move said contacts into and out of abutting relation, and means interconnecting said contact supporting and actu-

ating means to prevent at any time such movements thereof independently of one another thereby to effect counteraction one by another under shock.

3. In an electric switch to meet shock test, the combination with a pair of coacting contacts, both movable, of individual supporting and actuating means for said contacts confined to rectilinear movements at right angles to the plane of engagement of said contacts for engaging and disengaging said contacts, and means interconnecting said contact supporting and actuating means to prevent at any time such rectilinear movements thereof independently of one another, thereby to subject them to counteraction one by another under shock.

4. In an electric switch to meet shock test, the combination with a pair of coacting contacts, both movable, of individual supporting and actuating means for said contacts confined to rectilinear movements at right angles to the plane of engagement of said contacts, for engaging and disengaging said contacts, and means interconnecting said contact supporting and actuating means to prevent at any time such rectilinear movements thereof independently of one another, thereby to subject them to counteraction one by another under shock, said contacts having limited rocking play on their respective supporting and actuating means to yield when brought into engagement and having spring biasing means opposing such yielding thereof.

5. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, coacting contacts wholly supported by said plungers, and means interconnecting said plungers to prevent at any time independent movements thereof, and to limit their biased movements, subjecting them to counteraction one by another under shock.

6. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, contacts movable by said plungers, and means interconnecting said plungers to prevent at any time independent movements thereof and to subject them to counteraction one by another under shock, said interconnecting means comprising an element oscillatable about a fixed axis and bars linking said plungers to said oscillatable element.

7. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, contacts movable by said plungers, and means interconnecting said plungers to prevent at any time independent movements thereof and to subject them to counteraction one by another under shock, said interconnecting means comprising an element oscillatable about a fixed axis and bars linking said plungers to said oscillatable element, said bars having interengaging parts to limit relative movement thereof and thus limit the extent of separation of said plungers under the bias thereof.

8. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, means interconnecting said plungers to prevent at any time independent movements thereof and to subject them to counteraction one by another under shock, said means including means to limit biased movement of said plungers away from one another, and contacts wholly supported by said plungers to be engaged one with another upon movement of said plungers electromagnetically.

9. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, means interconnecting said plungers to prevent at any time independent movements thereof and to subject them to counteraction one by another under shock, said means including means to limit biased movement of said plungers away from one another, and contacts wholly supported by said plungers to be engaged one with another upon movement of said plungers electromagnetically, each of said plungers having for support of each contact thereof a spring biased rocker limited in range of movement, rendering said contacts upon engagement thereof yielding against their bias.

10. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, said plungers respectively having a tapered end and a correspondingly tapered recess, means interconnecting said plungers to prevent at any time independent movements thereof and to subject them to counteraction one by another under shock, and contacts wholly supported by said plungers to be engaged one by another upon movement of said plungers electromagnetically, each of said plungers having for support of each contact thereof a spring biased rocker limited in range of movement, rendering said contacts upon engagement thereof yielding against their bias.

11. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, coacting contacts wholly supported by said plungers, a fixed blowout device and means interconnecting said plungers to prevent at any time independent movements thereof subjecting them to counteraction one by another under shock and to bring about final engagement of said contacts always in substantially the same relation to said fixed blowout device.

12. In an electric switch to meet shock test, in combination, electromagnetic means comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, coacting contacts wholly supported by said plungers, a fixed blowout device and means interconnecting said plungers to prevent at any time independent movements thereof subjecting them to counteraction one by another under shock and to bring about final engagement of said contacts always in substantially the same relation to said fixed blowout device, said contacts affording a vertical break and said blowout device comprising a blowout winding below said contacts and vertically extending magnetic elements spaced to receive therebetween said contacts.

13. In an electric switch to meet shock test, in combination, spaced pairs of coacting contacts, electromagnetic actuating means disposed between said pairs of contacts and comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, said plungers wholly supporting all of said con-

tacts and each supporting one contact of each pair, and means interconnecting said plungers to prevent at any time independent movements thereof and to limit spread of said plungers under the bias thereof, the two sets of movable parts comprising the plungers and contacts carried thereby being balanced and counteracting one another under shock.

14. In an electric switch to meet shock test, in combination, spaced pairs of coacting contacts, electromagnetic actuating means disposed between said pairs of contacts and comprising axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, said plungers wholly supporting all of said contacts and each supporting one contact of each pair, and means interconnecting said plungers to prevent at any time independent movements thereof and to limit spread of said plungers under the bias thereof, the two sets of movable parts comprising the plungers and contacts carried thereby being balanced and counteracting one another under shock and said interconnecting means comprising duplicate complete devices one on either side of the axis of said electromagnetic means for symmetry and balance of the switch as a whole.

15. In an electric switch to meet shock test, in combination, electromagnetic means having axially aligned magnetic plungers biased apart and adapted to be drawn together electromagnetically, said electromagnetic means also having means for attachment thereof to a vertical panel with the axis of said plungers perpendicular to said panel, coacting contacts wholly supported by said plungers to afford vertical break, and means interconnecting said plungers to prevent at any time independent movements thereof, subjecting them to counteraction one by another under shock and to limit separation of said plungers under the bias thereof.

16. In an electric switch to meet shock test, the combination with a pair of oppositely moving coacting contacts, of individual actuating means for said contacts having like movements oppositely of one another in a plane at right angles to the plane of engagement of said contacts to move said contacts into and out of abutting relation, and means by which said actuating means are interconnected to prevent at any time such movements thereof independently of one another, thereby to render them subject to counteraction one by the other under shock, said individual actuating means together with their respective contacts and their respective interconnecting parts being substantially identical in respect of structure and weight.

17. In an electric switch to meet shock test, the combination with a pair of oppositely moving coacting contacts, of individual actuating means for said contacts having like movements oppositely of one another in a plane at right angles to the plane of engagement of said contacts to move said contacts into and out of abutting relation, and means by which said actuating means are interconnected to prevent at any time such movements thereof independently of one another, thereby to render them subject to counteraction one by the other under shock, said individual actuating means together with their respective contacts constituting substantially floating units substantially identical in respect of structure and weight.

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