June 29, 1948. J. F. DRIES 2,444,157

ELECTROMAGNETIC SWITCH

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Fig. 1

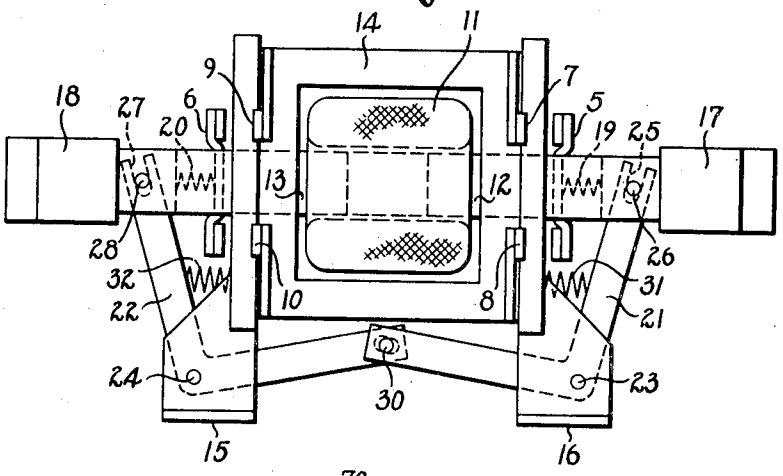
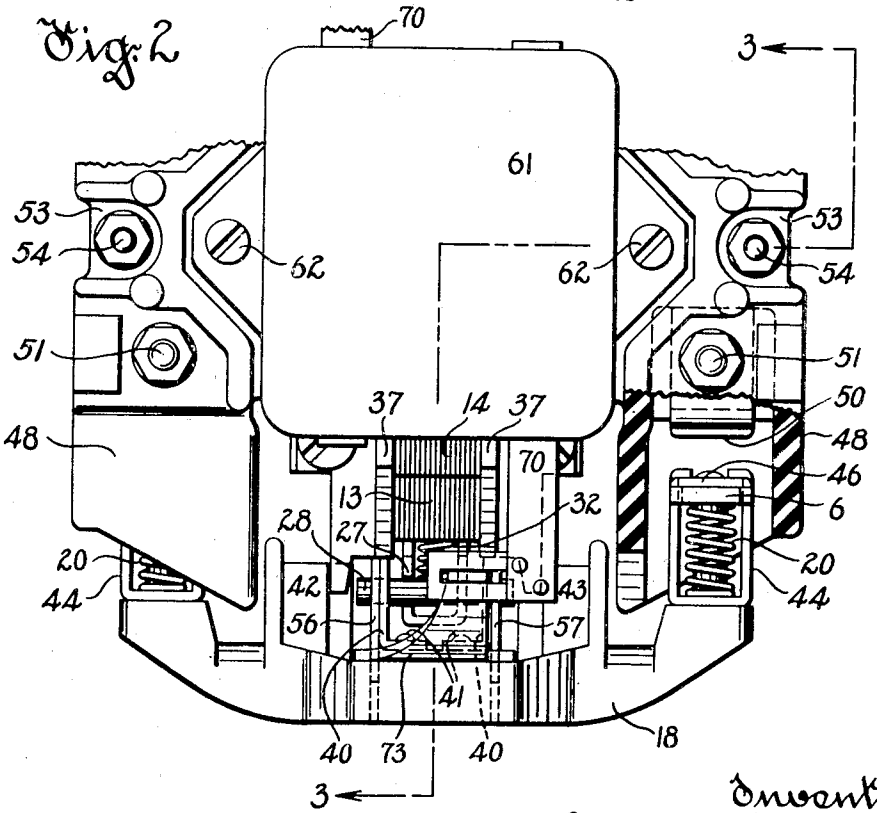


Fig. 2



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Fig. 3

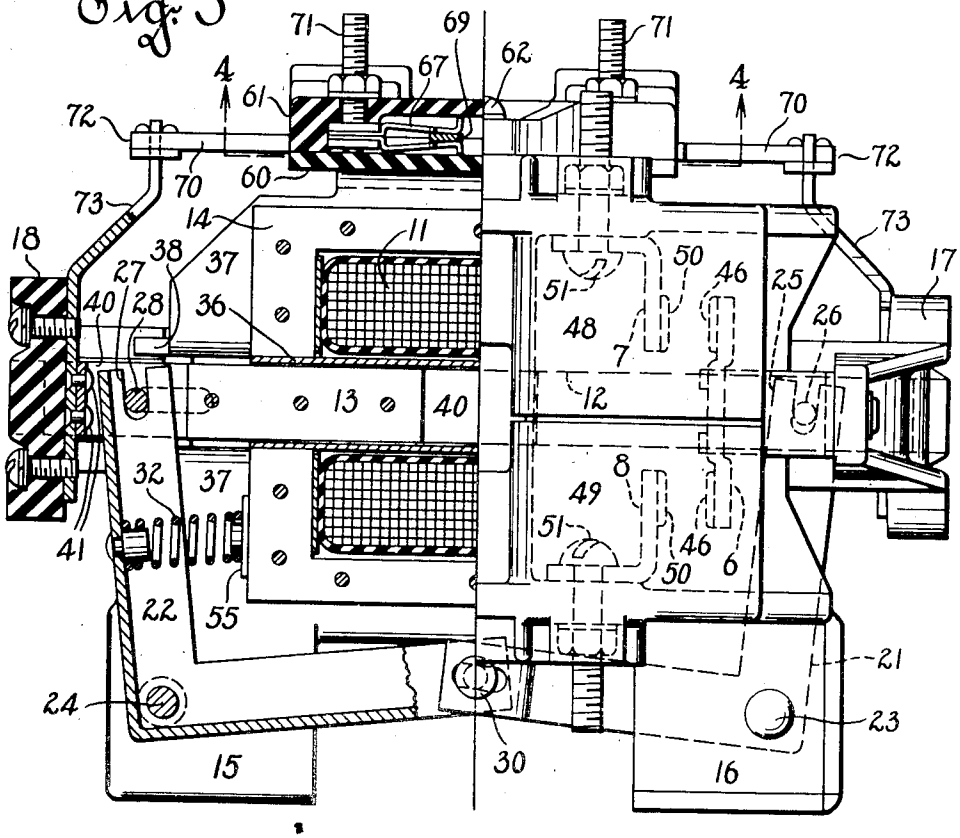


Fig. 4

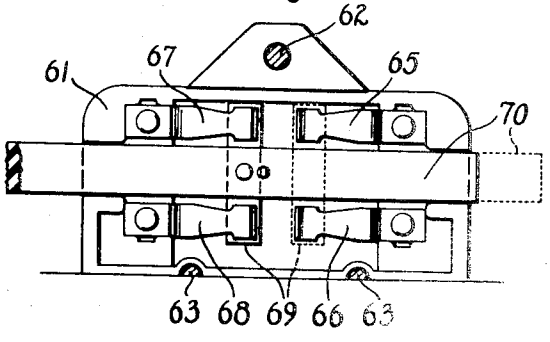
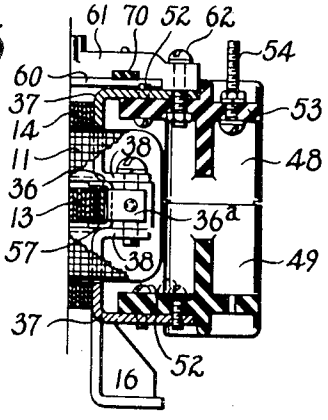


Fig. 5



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UNITED STATES PATENT OFFICE

2,444,157

ELECTROMAGNETIC SWITCH

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Application April 16, 1943, Serial No. 483,252

2 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.

For such service shock-proof switches have been in demand, and at the present time there is a demand for an electromagnetic switch to meet high shock test, the switch to remain open or closed when subjected to shock in any direction.

The present invention has among its objects to provide an electromagnetic switch to meet such shock tests.

Another object is to provide a shock-proof switch to be operated by a plunger type electromagnet and without need of any mechanical latch.

Another object is to provide such a shock-proof electromagnetic switch of comparatively simple construction and of reasonable cost.

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 drawings,

Figure 1 is a more or less schematic view affording a general understanding of the proposed switch;

Fig. 2 is a top plan view of a physical embodiment of the switch depicted in Fig. 1 but with part of the switch broken away;

Fig. 3 is a side elevation of the switch shown in Fig. 2, sectioned in part along the broken line 3—3, Fig. 2;

Fig. 4 is a sectional view along the broken line 4—4, Fig. 3, showing auxiliary control contacts associated with the electromagnetic switch, and

Fig. 5 is a view mainly in section and on a reduced scale looking into the switch unit at one side of the axis of the electromagnet from a point within the unit in front of the electromagnet.

Referring to Fig. 1, the same shows two movable contact elements 5 and 6, respectively, to bridge stationary contacts 7—8 and 9—10. The contact arrangement is such as to require the bridging elements 5 and 6 to be drawn towards one another to engage their respective stationary contacts, and to be moved away from one another to disengage their respective stationary contacts. To move the contact elements 5 and 6 toward one another there is provided an electromagnet 11 having axially aligned reciprocable magnetic plungers 12 and 13 to be drawn together by energization of the electromagnet. The electromagnet is provided with a suitable magnetic

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frame 14 having supports 15 and 16, such structure affording support for the stationary contacts 7 to 10. On the other hand, the plungers 12 and 13 of the electromagnet afford supports for the contact elements 5 and 6. In practice the contact arrangement is preferably duplicated to provide like stationary contacts and movable contact elements on opposite sides of each plunger, the movable contacts at each end of the electromagnet being supported by an insulating block fixed to the outer end of the respective plunger. Thus the contact elements 5 are carried by a block 17 attached to the plunger 12, while the contacts 6 are carried by a block 18 attached to the outer end of the plunger 13, said contact elements having limited play on said blocks, and being under the bias of suitable springs, springs 19 for the contacts 5, and springs 20 for the contacts 6. The plungers 12 and 13 of the electromagnet are reciprocable in end openings of the magnetic frame and are supported and interlocked by bell crank levers 21 and 22. The bell crank levers 21 and 22 are respectively pivotally supported at points 23 and 24 on the supports of the magnetic frame, and lever 21 has a slotted extremity 25 to receive a cross pin 26 of the plunger 12, while the arm 22 has a similarly slotted extremity 27 to receive a cross pin 28 on the plunger 13. The tail portions of the levers are interlocked by a pin 30 on one extending through a closed slot in the other lever, the slot being of sufficient length to permit each plunger to reciprocate between two suitable extreme positions. Springs 31 and 32 bias the bell crank levers into the relation illustrated in Fig. 1 to separate the plungers 12 and 13 for disengagement of the contact elements 5 and 6 from their respective stationary contacts.

As will be observed from Fig. 1, 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 and common to the axis of the pin 30 interlocking the bell crank levers, and in practice the corresponding elements on opposite sides of this plane are preferably balanced as regards mass. Thus it will be observed that when the contact elements 5 and 6 are out of engagement with their stationary contacts they and their reciprocating supports are in a floating state, and when subjected to any shock tending to move either contact element into engagement with its stationary contacts there will be counteraction by the oppositely disposed contact element and its reciprocating support through the interconnection afforded by the bell crank levers. Likewise when the electromagnet is energized to draw the plungers 12 and 13 together for engagement of the contact elements 5 and 6 with their stationary contacts any tendency of either

plunger to disengage its associated contacts under shock will be counteracted by the othe plunger and its respective support through the interconnection afforded by the bell crank levers. On the other hand, as will be apparent, the interconnection of the plungers in nowise obstructs separation of the contact elements from their respective stationary contacts when the electromagnet is deenergized. Switches of this construction have been fully tried out in practice and where the electromagnet is controlled through shock-proof contacts such as those hereinafter described said switches have demonstrated ability to withstand high shock in any direction. Of course it is possible for any movable contact element to disengage its respective stationary contacts momentarily through yield of its associated spring, but such disengagement being only momentary is permissible under the shock test mentioned.

Referring to Figs. 2 to 5, the switch structure shown is especially designed for alternating current, the magnet frame 14 and plungers 12 and 13 being laminated as best shown in Figs. 2 and 5. As shown in Figs. 3 and 5 the plungers are slidable in channel strips 36 of suitable material located within the electromagnet and projecting therefrom, being provided with outwardly turned supporting end flanges 36a, Fig. 5. The magnet frame is supported by and between a pair of like metal standards 37 formed with base portions constituting the elements 15 and 16 of Fig. 1 which have been referred to as supports for the magnet frame. The standards 37 which extend beyond the magnet frame in all directions preferably are riveted to the magnet frame, and each standard has at opposite ends of the electromagnet a pair of outwardly turned flanges 38 (Fig. 5) between which is supported and secured by a screw an element to which an end flange 36a of one of the channel strips 36 is secured as by riveting. The channel strips being thus fixed to the standards serve to support the electromagnet as well as the plungers.

Each plunger, as best shown in Fig. 2, has extended side plates 40 which carry its respective cross pin 26 or 28 and which have inturned extremities for support of the respective contact carrying block 17 or 18. Each contact carrying block which preferably comprises a molding of insulating material is centrally secured as by rivets 41 to the inturned extremities of the plunger side plates 40, and each block has parts 42 and 43 projecting towards the electromagnet and into slots (not shown) in the standards 37 whereby each block is slidingly supported and guided on either side of its respective plunger. Each contact carrying block adjacent each end thereof has fixed thereto a U-shaped metal carrier 44 (Fig. 2) for one of the contact elements 5 or 6, each such element comprising a metal plate notched on opposite sides to fit onto the carrier for support thereby and for sliding motion thereon. Each contact element is pressed against inturned extremities of its U-shaped carrier 44 by one of the springs 20 or 19 which is interposed between the contact element and the base of its carrier, being held in place by suitable studs on said plate and carrier. Preferably each contact element has at opposite ends contact tips 46 (Fig. 3) of suitable material.

Each set of contacts 7—8 and 9—10 is carried by a two-part hollow molded insulating chute 48—49, each set of chute parts being secured to one of the standards 37. Each of the contacts

7 to 10 comprises, as best shown in Fig. 3, a right angle plate with a contact tip 50 of suitable material, each right angle contact plate being secured by a bolt 51 to one part of its respective two-part insulating chute, the outer portion of the securing bolt affording a wiring terminal. The insulating chute for each set of stationary contacts extends outwardly from said contacts to provide an arcing chamber receiving the cooperating bridging contact element 5 or 6, preferably being sufficiently extended so that the movable contact element never leaves such chamber. For attachment of the chute parts 48—49 to the standards said parts and standards are provided with overlapping parts (Fig. 5), the attachment being made by screws 52. While the four insulating chutes may if desired be formed separately it is preferred to mold in one piece the upper portions of the chutes on the same side of the magnet frame and to similarly mold in one piece the lower portions of the same chutes, utilizing a connecting portion 53 (Figs. 2 and 5) of the upper chute portions for support of a terminal stud 54 for the electromagnet. Thus provision is made for terminal studs for the electromagnet on opposite sides thereof.

The bell crank levers 21 and 22 preferably are of channel strip form fitting between the portions 15 or the portions 16 of the standards 37, the pivot pin of each lever extending through such portions of the standards. One bell crank lever has extensions to receive therebetween the channel end of the other lever, the connecting pin 30 passing through such extensions of the one lever and the channel end of the other lever. The upstanding channel portions of the two bell crank levers project into the space between the extended side plates 40 of their respective plungers (Fig. 2) and are slotted to engage the cross pins of said plungers, as aforedescribed. The springs for biasing the bell crank levers are in each instance as best shown in Fig. 3 interposed between said levers and a fixed abutment 55, being suitably supported as by studs on said lever and said abutment.

For limiting the biased movement of the bell crank levers and the consequent biased movement of the plungers the latter preferably are provided with motion limiting links. As shown in Fig. 2 there are two links 56 and 57 arranged adjacent the extended side plates of the plunger 13. These links seated at one end in slots in the contact carrying block 18 extend through the electromagnet and beyond the plunger 12 into similar slots in the contact carrying block of plunger 12. The plate 57 is interlocked with the plunger 13 by its cross pin 28, whereas the plate 56 also penetrated by pin 28 is slotted to afford relative movement of plunger 13 and plate 56. While not shown in detail, the plate 56 is connected to the cross pin of the plunger 12 without lost motion similarly to the connection between plate 57 and the cross pin of plunger 13, whereas the plate 57 has a slotted connection with the cross pin of plunger 12 similar to the connection between plate 56 and the cross pin of plunger 13. The slots in the two plates are so positioned and are of such length as to permit the plungers to separate only to the desired extent and to permit the plungers according to preference, to be drawn into contact upon energization of the electromagnet or only into a relation insuring a predetermined air gap.

From the foregoing it will be apparent that the details of the switch are worked out to afford symmetry and balance of the duplicate switches

while at the same time minimizing cost by use of like and interchangeable parts for the two switches. Also it will be noted that facility of assembly and removal of parts has been provided for along with compactness. Also it is to be understood that the switch shown is designed to function when mounted for movement of its movable parts in either a horizontal plane or a vertical plane, the contacts to be utilized as desired, as for example to afford a double pole switch with multi point break for each pole.

As aforeindicated, it is important to afford shock-proof control contacts for the electromagnet and at times it is desirable to provide the switch with other auxiliary contacts which should be shock-proof, such contacts being provided in the construction shown. These contacts are all mounted in a two-part molded insulating block 60—61 overlying the electromagnet and secured to the standards 37, as best illustrated in Fig. 5. As shown in Fig. 5, the two-part block 60—61 rests upon the portions of the standards to which the upper chute parts are attached and the outer section of the block 60—61 is secured to the standards by bolts 62, the inner section of the block being secured to the outer section by bolts 63 (Fig. 4).

The contacts housed in block 60—61 are illustrated in Figs. 3 and 4, the latter figure showing only one-half of the block and hence only one-half of the number of contacts to be accommodated by said block. The contacts shown in Fig. 4 comprise four double contacts 65, 66, 67 and 68, each comprising two leaf springs (Fig. 3) normally engaging and yieldable to receive therebetween a contact blade 69. The contact blade 69 is carried by a thin but rigid strip 70 of insulating material, which strip is reciprocable in the insulating block 60—61 to cause said contact blade to bridge selectively contacts 65 and 66 or contacts 67 and 68. The leaf springs of each contact are carried by a stud 71 penetrating and clamped to section 61 of the insulating block, the stud serving as a wiring terminal external of the block, and the block is designed to afford each contact only enough clearance to spread for reception of the bridging blade. Thus when any contact is spread through engagement therewith of the bridging blade disengagement through shocking of the leaf springs is precluded, whereas when the contacts are disengaged by the blade movement of the leaf springs under shock is unimportant. On the other hand, when the contacts are either engaged or disengaged by the blade it is important to insure against appreciable movement of the blade, and this is provided for by virtue of the fact that for operation of said blade it is connected to one of the plungers of the electromagnet and hence is stabilized through the medium of that which stabilizes the plungers. With the contact layout of Fig. 4 duplicated there would be two bridging contacts to be actuated, each through the medium of a reciprocable strip 70 and said strip would be connected to the plungers 12 and 13, respectively, as shown in Fig. 3. Each actuating strip 70 as shown in Fig. 3 has a transversely slotted and reinforced end 72 to receive the tip of an arm 73 carried by plunger 12 or plunger 13, this arm being shown (Figs. 2 and 3) as an extension of a plate interposed between the end of the plunger and its respective contact carrying block 18.

Thus the switch of Figs. 2 to 5 is immune to high shocks both as regards its main and auxiliary contacts, the latter of course being variable in respect to number and relation to the bridging contacts as may be desired. In connection with the auxiliary contacts it will be noted that the same are of a design which will function regardless of the plane in which they may be disposed according to the mounting of the switch.

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

1. In an electric switch, the combination with main contacts, electromagnetic means, operative connections between said main contacts and said electromagnetic means, said connections being operable by said electromagnetic means to place said contacts in a certain relation and being biased to place said contacts in a different relation upon deenergization of said electromagnetic means and comprising a plurality of movable interconnected parts for counteraction by one another under shock thereby to resist change in relation of said contacts under shock when said contacts are placed in either of the aforementioned relations, and auxiliary contacts affording a medium through which a maintaining circuit for said electromagnetic means may be established, certain of said auxiliary contacts being operable by said electromagnetic means through the medium of said operative connections, and said auxiliary contacts for further protection against disengagement under shock being of the sliding engagement type and having means to guard against separation thereof by shock thereto at an angle to the plane of engagement thereof.

2. In an electric switch, the combination with main contacts, electromagnetic means, operative connections between said main contacts and said electromagnetic means, said connections being operable by said electromagnetic means to place said contacts in a certain relation and being biased to place said contacts in a different relation upon deenergization of said electromagnetic means and comprising a plurality of movable interconnected parts for counteraction by one another under shock thereby to resist change in relation of said contacts under shock when said contacts are placed in either of the aforementioned relations, and auxiliary contacts affording a medium through which a maintaining circuit for said electromagnetic means may be established, certain of said auxiliary contacts being operable by said electromagnetic means through the medium of said operative connections, and said auxiliary contacts for further protection against disengagement under shock comprising contacts of the sliding engagement type wherein certain of the contacts wedge between others which exert thereon opposing pressures and wherein said other contacts are confined to permit only the required spreading thereof.

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