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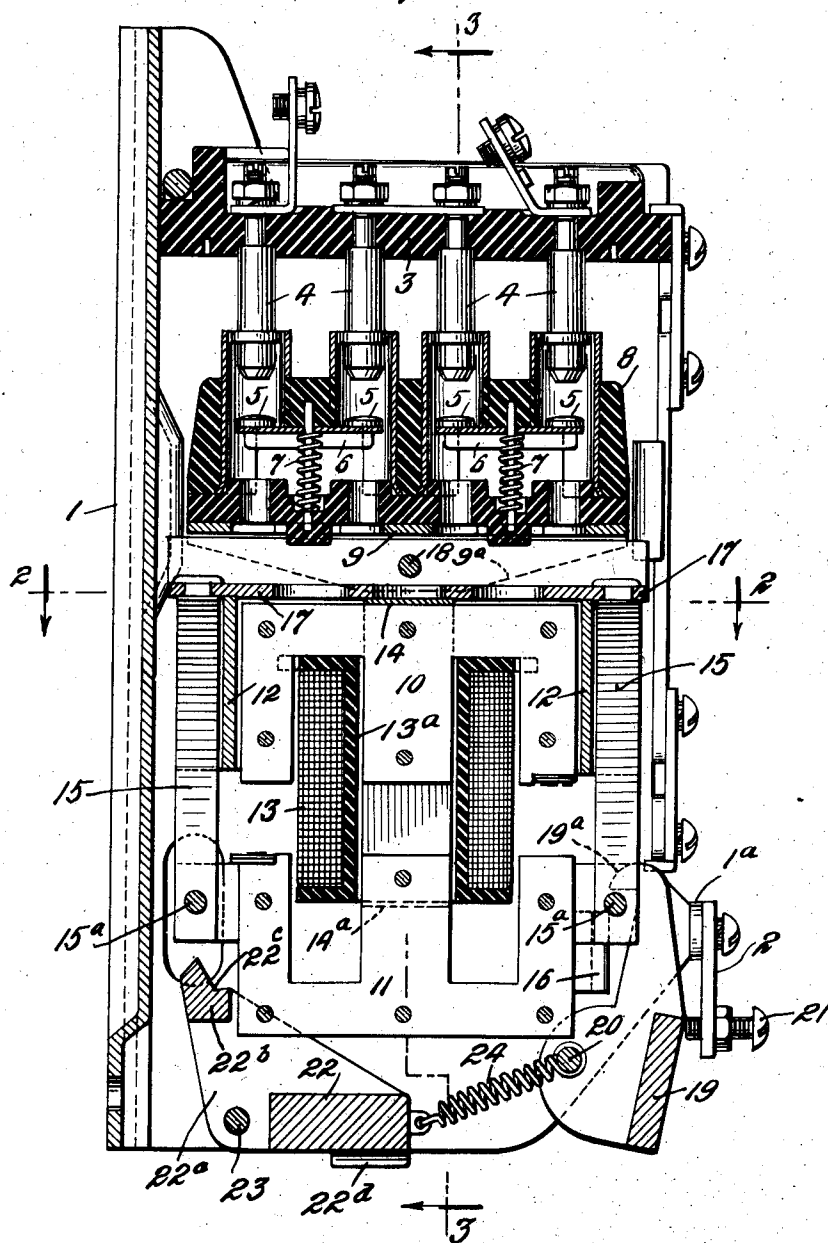
2,424,776

SHOCKPROOF ELECTROMAGNETIC DEVICE

Original Filed Nov. 25, 1941

2 Sheets-Sheet 1

Fig. 1.



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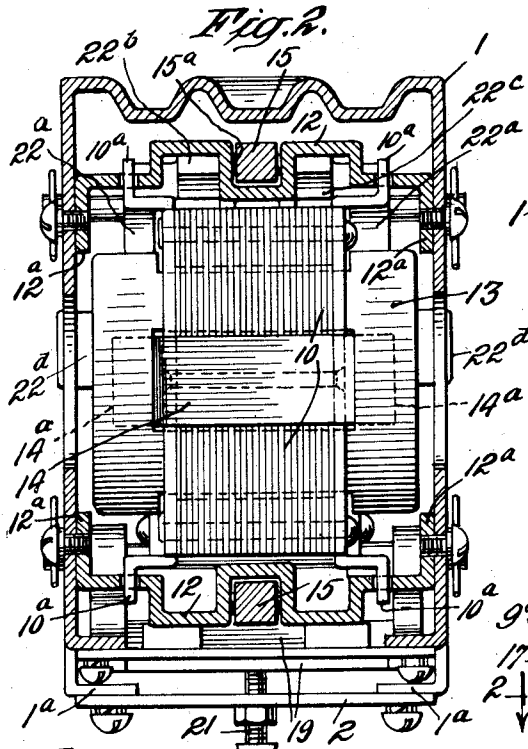
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UNITED STATES PATENT OFFICE

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SHOCKPROOF ELECTROMAGNETIC DEVICE

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No. 420,327. Divided and this application June
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6 Claims. (Cl. 175—341)

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This invention relates to electromagnets and is particularly adapted for the operation of switches although the invention is also applicable to the control of various other devices.

This application is a division of my pending original United States application Serial No. 420,327, filed November 25, 1941, which has resulted in Patent No. 2,378,162, granted June 12, 1945. The accompanying drawings disclose certain improvements described and claimed in the pending United States application of Frank G. Logan, Serial No. 417,990, filed November 6, 1941, which has resulted in Patent No. 2,378,002, granted June 12, 1945, and also discloses certain improvements described and claimed in the aforesaid original application and are not particularly described herein except insofar as is desirable for the disclosure of the improvement covered by this divisional application.

The main object of this improvement is to provide means for preventing the switch or other controlled device from being actuated under the impact of severe shocks when the magnet is energized and for preventing the actuation of the switch or other controlled device under severe shocks when the magnet is deenergized. Another object is to provide such means which will be readily applicable to various forms and types of electromagnetically operated devices. Other objects and advantages will be understood from the following description and accompanying drawings.

Fig. 1 is a vertical central section of one embodiment of the invention in a plane at right-angles to the back of the switch; Fig. 2 is a horizontal section on the line 2—2 of Figs. 1 and 3; Fig. 3 is a vertical section on the line 3—3 of Fig. 1; and Fig. 4 is a horizontal section on the line 4—4 of Fig. 3.

The apparatus is supported by a frame or base 1 of sheet metal having a general U-shaped form. The base of the U extends vertically and the two side portions extend forwardly from the base portion. A pair of projecting portions 1a extends from the side portions of the base and are bent inwardly at right-angles at the front of the frame and at the lower portion thereof, as particularly shown in Fig. 2. These projections serve to support a plate 2.

At the top of the frame is supported a contact head or block 3 of insulating material which supports the downwardly extending fixed contacts 4. The movable contacts 5 are carried by cross pieces 6 which are yieldably supported by springs 7. These parts are carried by a movable

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contact block 8 of insulating material which is supported by a channel-shaped sheet metal strip 9 having downwardly extending side portions 9a. The parts are shown in the open position of the switch and when the channel piece 9 is moved upwardly upon the energization of the magnet, the movable contacts are moved upwardly to close the switch. When the magnet is deenergized for opening the switch, the pressure of the contacts and the springs 7, together with the weight of the parts, force the movable contact head downwardly with a quick opening movement.

The magnet core actuating the switch to closed position is composed of two similar laminated parts, an upper non-actuated part 10 and a lower actuated part 11. Each part is built up of laminations of general E form. The non-actuated part 10 is supported to provide a certain amount of movement for self-adjustment and is shown as having the legs extending vertically downward. The actuated part 11 is shown with its legs extending upwardly. Between the side portions of the frame are sheet metal cross brackets 12 which are bent to the shape shown in Fig. 2 and provided with side portions 12a by which they are securely fastened to the side portions of the main frame. These cross brackets loosely support the non-actuated portion 10 of the magnet by providing slots for receiving projections 10a from the end plates of the laminated portion 10. The magnet coil 13 is carried by a spool 13a of insulating material and is held in place, as shown in Fig. 3, by a U-shaped strip 14 of metal, the base of the U passing over the top of the laminae 10 and the legs extending downwardly inside the magnet coil. The supporting strip 14 is provided with outwardly extending projections 14a at the lower ends of the legs which pass under and support the magnet coil.

The actuated portion of the magnet comprising the laminae 11 is provided with end plates 11a, as shown in Fig. 4 which extend along opposite sides of the laminae and are bent at right-angles to pass inwardly over the ends of the laminae and again bent outwardly at right-angles to form extensions 11b. These end extensions are spaced from each other for receiving the driving rod 15 which latter are connected for actuation of the movable contact head. At the front portions of the end plates 11a is secured a pair of angular pieces 16 which are bent at right-angles so as to extend toward the side portions of the main frame.

There are two drive rods 15, one in the back and one in the front of the apparatus, for con-

necting the actuated portion of the magnet with the movable contact head. These rods are of square cross section, as shown in Fig. 2, and are pivotally connected by pins 15a between the extensions 11b of the end plates, as shown in Fig. 4. The drive rods extend upwardly from these pivotal connections and are loosely guided in their movement by the two brackets 12, as shown in Fig. 2, these brackets being bent at their middle portions to form vertical guiding channels for the rods. The upper ends of the rods are riveted, or otherwise firmly secured to the ends of a metal strip or yoke 17 of channel form, the bent side portions extending upwardly, as shown in Fig. 3. These side portions fit freely within the downwardly extending side portions of the strip or yoke 9 which has been previously described as being fixed to the movable contact head. The two yoke pieces are pivotally connected together at their middle portions by a pin 18, as shown in Figs. 1 and 3.

The provision for preventing undesired opening or closing of the switch when subjected to severe vertical shocks or to vertical components of shocks is accomplished by inertia controlled latches, the operation of which is dependent upon change of motion of the entire structure. One of the latches is for preventing the switch from closing under severe shocks and the other is for preventing the switch from opening under severe shocks. One of these inertia latches is shown in the lower right-hand portion of Fig. 1. It comprises a weighted body portion 19 which extends across the lower front portion of the main frame, as shown in Fig. 4, and is provided with a latch 19a at each end which extends upwardly and is provided with an inwardly projecting hooked end, as shown in Fig. 1. These two ends of the latches are normally positioned, as shown in Fig. 1, somewhat above and in front of the angular pieces 16 secured to the actuated portion of the magnet core. The two latches are pivoted on a pin 20 which is supported at its ends in the side portions of the main frame. The weighted portion 19 of the latch being positioned outwardly from the pin 20, tends to maintain the latches in the position shown in Fig. 1 out of engagement with the angular pieces 16. An adjustable screw 21 mounted on the tie-plate 2 limits the outward movement of the latches. The radius from the axis of the pin to the center of gravity of the mass 19 is shorter than the distance from the axis of the pin 20 to the hooked ends of the latches. It follows that any movement of the mass 19 about its pivot is amplified in the movement of the hooked end of the latch in proportion to their relative distances from the pivot pin. Under normal conditions the latches are out of engagement with the angular pieces 16 and thus energizing of the magnet coil will permit the switch to be closed by the upward movement of the laminae 11 and of the rods 15 and of the movable contact head. But if the switch is in the open position and the apparatus is subjected to a severe vertical shock, or to the vertical component of a shock, the actuated portions of the switch might move with relation to the fixed contacts and result in an undesired closing of the switch. However, before this can occur, the mass 19 will move upwardly with reference to its pivot and by the amplification of movement referred to, the hooked ends of the latches will be rapidly moved inwardly and engage the angular pieces 16 before the switch can close and thereby restrain and prevent the closing of the switch.

After the passing of the shock the inertia latch will fall to its normal position so that the switch will be free to close upon energization of its magnet.

A similar inertia latch or stop prevents the undesired opening of the switch under severe vertical shocks by a reverse manner of operation. A mass 22 is positioned at the lower central portion of the switch, as shown in Fig. 1, and extends crosswise between the side portions of the main frame. The mass is provided near its ends with supporting plates 22a which are pivotally mounted upon a pin 23 which extends between and is supported by the side portions of the frame. Between the extensions 22a is a cross bar 22b, the upper portion of which is notched at 22c. A spring 24 is connected at one end to the weight 22 and at its other end to the pin 20 for normally holding this locking means in the position shown in Fig. 1. The mass 22 is provided with extensions 22d, as shown in Fig. 3, which normally engage the lower edges of the side portions of the main frame for limiting the upward movement of the restraining means to the position shown in Fig. 1.

When the switch is closed, the lower inside corner of the actuated portion of the core is positioned opposite and above the notch 22c of the inertia latch. When the apparatus is subjected to a severe vertical shock, or to a vertical component thereof, when the switch is closed, the opening of the switch is prevented because any tendency to open the switch will cause the mass 22 to move downwardly overcoming the tension of the spring 24 and due to the amplified relative movement of the notch 22c by reason of its distance from its axis from the pin 23 being greater than the distance from its axis to the center of gravity of the mass 22, the notched portion 22c will move under the lower inside corner of the actuated core portion of the switch before the switch has had time to open. This action will prevent the opening of the switch until the full effects of the shock or shocks have passed, after which the spring 24 will move the restraining means to the normal position shown in Fig. 1 where it will permit the normal opening of the switch when desired.

Although a particular embodiment of this improvement has been shown and described with reference to the control of a switch, various modifications may be made therein for adaptation to particular requirements and to the control of other devices without departing from the scope of the invention.

I claim:

1. An electromagnetic device having a magnetic element movable between different positions, a fixed support, and a restraining element pivoted on said support normally disengaged from said movable element, said restraining element being rotatable on its pivot independently of said movable element under shocks for then engaging and restraining the movement of said movable element when said movable element is in at least one of said positions.

2. An electromagnetic device having a magnetic element movable between different positions, a fixed support, and a restraining element pivoted on said support and normally disengaged from said movable element, said restraining element being rotatable on its pivot independently of said movable element under shocks and having a projecting portion for then engaging said movable element for restraining its

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movement when in at least one of said positions.

3. An electromagnetic device having a magnetic element movable between different positions, a fixed support, and a restraining element pivoted on said support and normally disengaged from said movable element, said restraining element being rotatable on its pivot independently of said movable element under shocks and having a projecting portion for then engaging said movable element for restraining its movement when in at least one of said positions, the distance from the center of gravity of said pivoted element to its axis being less than the distance from said projecting portion to said axis.

4. An electromagnetic device comprising an electromagnet, an element movable between different positions controlled by said electromagnet, a fixed support, and a restraining element pivoted on said support and normally disengaged from said controlled element, said restraining element being rotatable on its pivot independently of said controlled element under shocks for then engaging and restraining the movement of said controlled element when said controlled element is in at least one of said positions.

5. An electromagnetic device comprising an electromagnet, an element movable between different positions controlled by said electromagnet, a fixed support, and a restraining element pivoted on said support and normally disengaged from said controlled element, said restraining element being rotatable on its pivot independently of said controlled element under shocks and having a projecting portion for then engaging

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and restraining the movement of said controlled element when said controlled element is in at least one of said positions.

6. An electromagnetic device comprising an electromagnet, an element movable between different positions controlled by said electromagnet, a fixed support, and a restraining element pivoted on said support and normally disengaged from said controlled element, said restraining element being rotatable on its pivot independently of said controlled element under shocks and having a projecting portion for then engaging and restraining the movement of said controlled element when said controlled element is in at least one of said positions, the distance from the center of gravity of said pivoted element to its axis being less than the distance from said projecting portion to said axis.

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