

Aug. 26, 1947.

D. ELLIS ET AL
LATCH FOR CONTACTORS

2,426,301

Filed Sept. 15, 1942

2 Sheets-Sheet 1

Fig. 1.

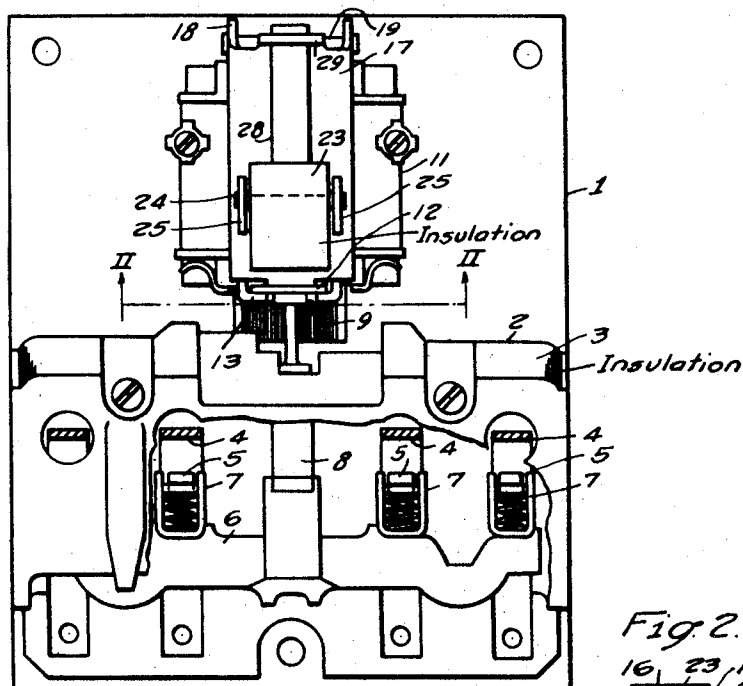


Fig. 2.

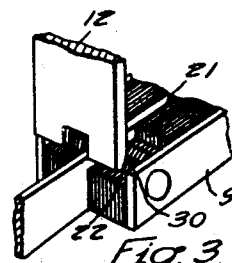
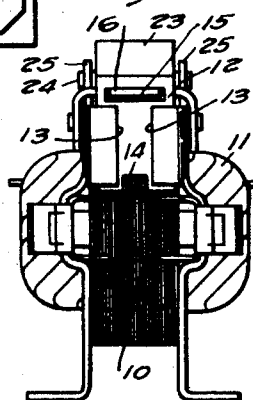


Fig. 3.

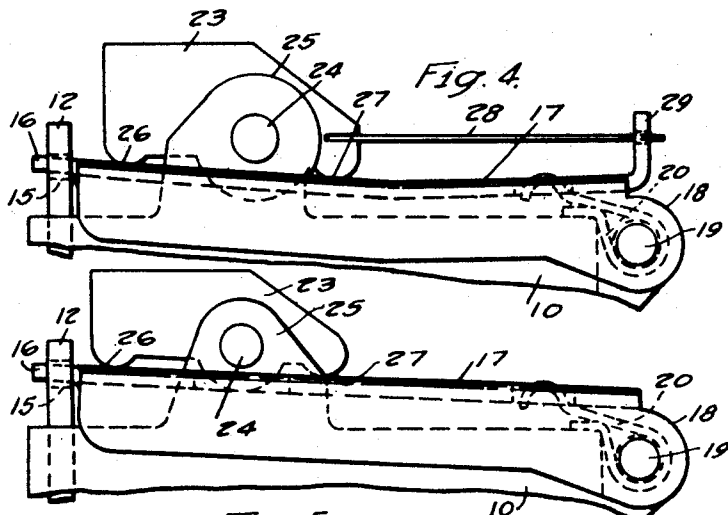


Fig. 5.

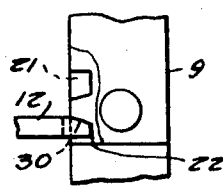


Fig. 6.

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2 Sheets-Sheet 2

Fig. 7.

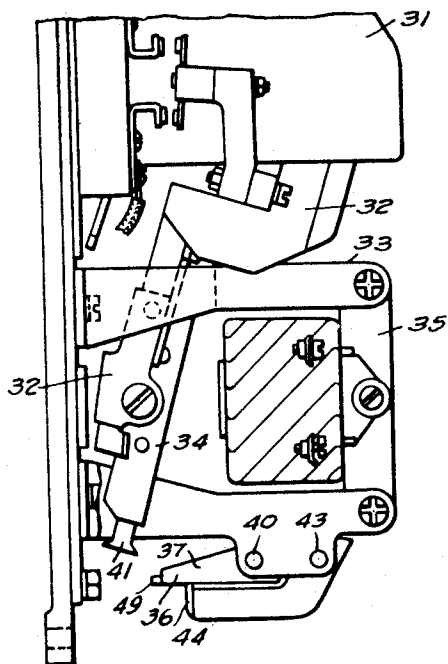


Fig. 8.

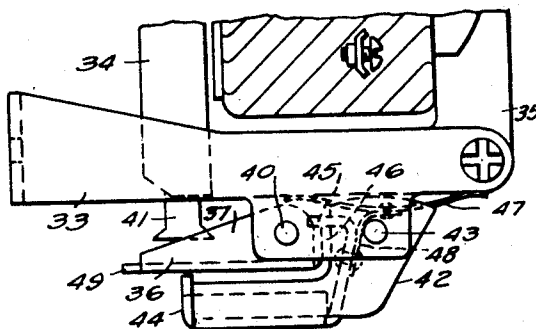


Fig. 9.

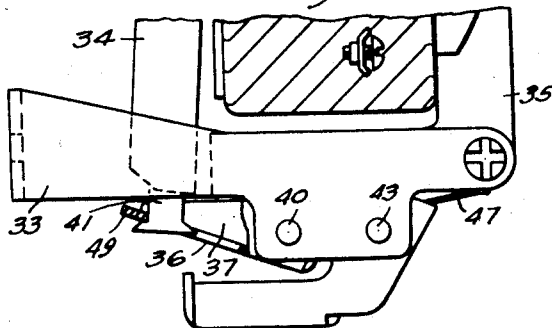


Fig. 10.

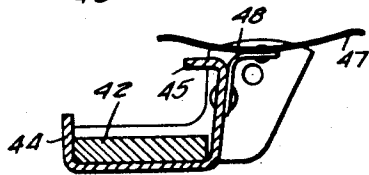
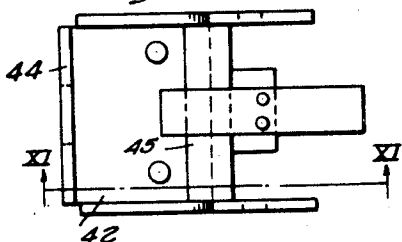


Fig. 11.

Fig. 12.

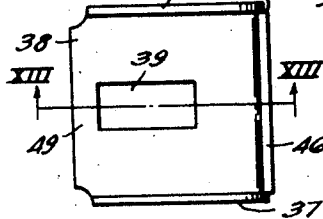
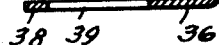


Fig. 13.



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2,426,301

LATCH FOR CONTACTORS

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Application September 15, 1942, Serial No. 458,388

14 Claims. (Cl. 200—87)

1

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This invention relates to a latching means for contactors and, more particularly, to latching mechanisms which are automatically operable to prevent failure of a contactor or switch under shock.

The failure or uncontrolled movement of a switch or contactor from a selected one of either its open or closed positions under shock is well known. To prevent such failures or uncontrolled movements, latches have been provided for locking switches in their open or closed positions. Such latches, whether manually or magnetically operated, have had the common disadvantage of requiring attention from an operator in operating the latch to either lock the switch in a selected position or release the switch for movement from a selected position. Moreover, during the time that such latching mechanism is in its inoperative position permitting movement of the switch between its open and closed positions, the latching mechanism heretofore employed provided no protection against an uncontrolled movement of the switch. This defect has been particularly pronounced in electromagnetically operated switches wherein space does not permit the use of electromagnetic interlocks for operating the latching mechanisms.

One of the principal objects of this invention is to provide latching mechanisms which require no attention to operate the same and which are automatically operable to prevent an uncontrolled movement of a switch by shock.

A further object of the invention is to provide latching mechanisms which are automatically operable in response to a shock force for latching a switch against an uncontrolled movement from the position occupied at the time the shock force is applied.

A further object is to provide an improved form of latch operating mechanism for moving a latch to a position locking a switch against movement and which mechanism is automatically actuated by the application of a shock force to the switch of such proportions likely to cause an uncontrolled movement of the switch.

A further object is to provide an improved form of latch operating mechanism comprising a member mounted for vibrating movement and connected to the latch in such manner that vibrating movement of the member is effective to operate the latch, and in which the vibrating movement of the member is had automatically by the application of a shock force to the switch.

Other objects and advantages of the invention will become apparent from the following description taken in connection with the accompanying drawings in which:

Figure 1 is a front elevational view of a switch, parts thereof being broken away, provided with

latching mechanism constructed in accordance with the principles of this invention;

Fig. 2 is a bottom plan view taken substantially on the line II—II of Fig. 1 showing the switch operating and latching mechanism with the armature of the electromagnetic operating mechanism removed;

Fig. 3 is a broken away perspective view of a part of the apparatus shown in Fig. 1 illustrating the manner in which the latch cooperates with a switch operating part to prevent uncontrolled movements of the switch;

Fig. 4 is a broken away side elevational view of the latching mechanism shown in Fig. 1;

Fig. 5 is a view similar to Fig. 4 of a modified form of latching mechanism.

Fig. 6 is a broken away side elevational view of a part of the apparatus shown in Fig. 1, illustrating the manner in which the latch moves into the armature slots to lock the switch against movement.

Fig. 7 is a side elevational view of a modified form of electric switch, parts thereof being broken away, provided with a modified form of latching mechanism embodying the principles of the latching mechanism shown in Fig. 1.

Fig. 8 is an enlarged partial view of the apparatus shown in Fig. 7, illustrating the position of the parts when the switch operating armature is in closed position.

Fig. 9 is a view similar to Fig. 8 showing the position of the parts after operation to latch the armature and hold the switch operated thereby in closed position.

Fig. 10 is a top plan view of the latch operating part shown in Fig. 7.

Fig. 11 is a sectional view taken substantially on the line XI—XI of Fig. 10.

Fig. 12 is a top plan view of the latch shown in Fig. 7, and

Fig. 13 is a sectional view taken substantially on the line XIII—XIII of Fig. 12.

Referring to Fig. 1 of the drawings, the numeral 1 designates a support having a contactor or switch of the plunger type, indicated as a whole by the numeral 2, mounted thereon. The switch 2 comprises a molded housing 3 formed of insulating material secured to the base 1 and carries a plurality of stationary contacts 4. A plurality of movable contacts 5 are mounted on a cross bar 6 by saddles 7, the cross bar 6 being mounted for vertical movement in the housing 3 for moving the contacts 5 into and out of engagement with the stationary contacts 4. The cross bar 6 is connected to a member 8 which in turn is connected to an armature 9. The armature 9, as shown in Fig. 1, is preferably mounted for vertical movement in a magnet frame 10 mounted on the support 1 which is provided with a coil 11 for energizing the same to move the armature

9 vertically upward from the position shown in Fig. 1 to a position engaging movable contacts 5 with the stationary contacts 4. The parts thus far described form no part per se of this invention, this invention being limited to the latching mechanism to be described.

Referring to Figs. 1 and 2, a latch 12 is mounted for sliding rectilinear movement in a space between guiding members 13, connected to frame 10, and the surface 14 of the laminations forming a part of the frame 10. The upper end of the latch 12, as viewed in Figs. 4 and 5, is provided with a slot 16 for the reception of a tongue 16 formed at the end of an operating lever 17. As best shown in Figs. 1, 4 and 5, the lever 17 is a channel shaped member straddling the frame 10 and has its end 18 connected thereto by a pivot bar 19 extending transversely of the frame 10. A coil spring 20 is provided for biasing the lever 17 to the position shown in Figs. 4 and 5. In this position the tongue 16 is effective to maintain the latch 12 in its inoperative position permitting free movement of the armature 9 of the switch between its open and closed positions. Upon counterclockwise movement of the lever 17 from its position shown in Figs. 4 and 5 the latch 12 will move inwardly to engage with the armature 9 and thereby prevent uncontrolled movements of the switch 2. If the switch 2 is in its open position as shown in Fig. 1 the latch 12 will move into a slot 21 formed in the laminations of the armature 9 as shown in Fig. 3. If the armature 9 is moved vertically upward to close the switch 2, the latch 12 will move into a slot 22 formed in the laminations at the end of the armature 9 to prevent downward movement of the armature and thereby movement of the switch 2 to its open position.

To operate the lever 17 and move the latch 12 inwardly to prevent uncontrolled movements of the switch 2, a member 23 is mounted on a pivot 24 carried by ears 25 secured to the frame 10. As will be readily apparent from Figs. 4 and 5, the axes of the pivots 19 and 24 are parallel and the pivot 24 is located intermediate the ends 16 and 18 of the lever 17. The member 23 is provided with parts 26 and 27, respectively, on opposite sides of the pivot 24 which engage with the outer surface of the lever 17 when the member 23 is in its balanced position as shown in Figs. 4 and 5. It will be noted that the mass of the member 23 is so distributed with respect to the pivot 24 that its center of gravity C. G. is spaced from the axis of pivot 24 and is positioned between vertical and horizontal planes containing such axis for a purpose to be described.

Upon the application of a shock force to the base 1 carrying the switch 2 of such proportions as would otherwise cause an uncontrolled movement of the switch 2, the member 23 will be vibrated in an arcuate path about the pivot 24. Such movement is effective through the parts 26 and 27 to impart counterclockwise movement to the lever 17 for moving the latch 12 to its locking position before an uncontrolled movement of the switch 2 takes place. The parts 26 and 27 are so arranged with respect to the pivot 27 and the lever 17 that a given angular movement of the member 23 from its position shown in Figs. 4 and 5 will be effective to impart the same amount of movement to the lever 17 regardless of the direction in which the member 23 is initially angularly displaced. In other words, the part 26 is located further than the part 27 from the pivot 24 since the part 26 must travel over a

larger arcuate path in order to impart the same movement to the lever 17 that would be imparted thereto by the part 27 for an equal angular displacement of the member 23 in an opposite direction.

Due to the center of gravity C. G. being displaced from the pivot axis 24 a shock force applied to the switch 2 is effective to displace the member 23 angularly from its position shown in Figs. 4 and 5. In order that the member 23 will be equally responsive to shocks from horizontal and vertical directions the center of gravity C. G. is preferably located in a radial plane bisecting the angle formed by horizontal and vertical planes passing through the axis of a pivot 24.

The preferred construction of latch operating mechanism is illustrated in Figs. 1 and 4 and in this showing a leaf spring 28 having one end connected to the member 23 and its other end loosely engaged in a slot formed in a part 29 projecting outwardly from the lever 17 is provided. The spring 28 functions to balance the member 23 when in the position shown in Fig. 4 and upon movement of the member 23 about its pivot 24 the spring 28 will be flexed. Flexing of the spring 28 by movement of the member 23 is effective to cause the member 23 to oscillate about its pivot 24 for a longer period of time than is the case where such spring is omitted as in Fig. 5. Where the spring 28 is omitted, it is necessary to employ a stronger biasing spring 20, for the lever 17 since in such case, the spring 20 must not only return the lever 17 and latch 12 to their positions as shown in Fig. 5 but must also balance the member 23 about its pivot axis 24. By the use of the spring 28 a lighter spring 20 for biasing the latch operating parts to their unlatched position may be employed. The use of a lighter spring 20 together with a spring 28 results in a slower movement of the lever 17 in a clockwise direction and of the latch 12 to its unlatched position than is the case with the modification omitting the spring 28 as shown in Fig. 5. The desirability of using the spring 28 is in part determined by the natural frequency of vibration of the support 1 under shock and the speed with which the switch 2 tends to move from a selected position by the application of such shock.

In operation, the application of a shock force to the base 1 of the switch will unbalance the mass 23 and cause the same to vibrate or oscillate about the axis of its pivot 24. As such oscillation takes place, the parts 26 and 27 will strike the surface of the lever 17 and drive the same inwardly about its pivot 19 to move the latch 12 to its inner position in engagement with the armature 9. As pointed out above, the parts are so designed that the latch 12 will be moved into locking engagement before movement of the switch from the position occupied at the time of application of the shock can take place. The amplitude of oscillation or vibration allowed the mass 23 is limited by movement of the latch 12 into engagement with the armature. Upon movement of the latch 12 into engagement with the armature, further movement of the lever 17 will be prevented and oscillation of the mass 23 will be limited by engagement of the parts 26 and 27 with its surface.

As the amplitude of oscillation of the mass 23 diminishes, the bias on lever 17 provided by the spring 20 will function to move the lever 17 in a clockwise direction to withdraw the latch 12 and to maintain lever 17 in a position to be en-

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gaged by the parts 26 and 27 as such parts move to the ends of their diminishing oscillatory path. As the amplitude of oscillation of the mass 23 diminishes, the parts 26 and 27 function to control the speed at which the latch 12 is withdrawn, and the latch 12 will be withdrawn at a rate determined by the rate at which the amplitude of vibration of the mass diminishes. This gives a delayed return action for preventing movement of the latch 12 to its inoperative position before the shock force is effective to cause an uncontrolled movement of the contactor. As pointed out above, the use of the spring 28 functions to delay the return movement of the latch 12 by diminishing the rate at which the amplitude of operation of the mass 23 decreases.

Switches movable back and forth between open and closed positions are commonly provided with a bias for movement toward one of such positions and magnetic means for moving the switch against such bias to the other of such positions. In accordance with this practice, the switch illustrated in Fig. 1 is provided with a gravity bias for moving the same to its open position. After operation of the magnet to move the switch to its closed position, a holding circuit (not shown) is provided for maintaining the magnet energized to prevent movement of the switch by its bias to open position in a manner well known in the art. In some cases, the impact or shock force may be of such proportions as to cause an interruption of the holding circuit, as by opening the control contacts thereof, and, in such cases, it is desirable that the switch be locked in its closed position, even though the mass 23 has ceased to vibrate, until such time as the holding circuit may be restored to prevent movement of the switch by its bias to open position. The latching mechanism of this invention functions to prevent movement of the switch from its closed position when the holding circuit is interrupted by a shock.

Should the impact or shock open the holding circuit, the armature 9 will move downwardly under its bias a small amount to engage the side 30 of the notch 22 with the end of the latch 12. This downward movement of the armature 9 is of course, less than the overtravel movement of the contacts 5 and may take place without disengagement of the contacts. The engagement of the surface 30 with the latch 12 functions to prevent withdrawal of the latch 12 by the lever 17 as the mass 23 ceases to oscillate, and the latch 12 will be held in its locked position until such time as the magnet is energized to disengage the surface 30 from the end of the latch 12 and remove the load of the armature 9 thereon.

The parts of the modification shown in Figs. 7 through 13 correspond and function similarly to the parts of the modification shown in Figs. 1 through 6. In this showing, the numeral 31 designates as a whole a switch or a contactor which is preferably of the type shown in the copending application of D. Ellis and J. H. Alspach, Serial No. 458,386, filed September 15, 1942, and assigned to the assignee of this invention. In this showing, a movable contact carrying member 32 is provided and is mounted for pivotal movement about the support 33 to and from positions opening and closing the switch. The member 32 is provided with resilient means (not shown) for biasing the switch to its open position as shown in Fig. 7. In addition, electromagnetic operating means comprising an armature 34 carried by the member 32, and a magnet 35 are provided for

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moving the member 32 against its bias to close the switch. Upon energization of the magnet 35, the armature 34 will be moved to the position shown in Fig. 8, in which position the contact of the switch 31 will be closed.

To lock the switch 31 against movement, a latch 36 is provided. As best shown in Figs. 12 and 13, the latch 36 comprises a channel-shaped member having parallel sides 37 connected together by a web 38 in which an opening 39 is formed. As best shown in Fig. 8, the latch 36 is pivotally connected to the support 33 by a pivot 40. The armature 34 is provided with an extension 41 having an enlarged end adapted to pass through the opening 39 in a manner and for a purpose to be described.

To operate the latch 36, a mass 42 is connected to the support 33 by a pivot 43 for vibrating or oscillatory movement with respect thereto. The mass 42 is provided with an upwardly extending part 44 at the left-hand side thereof, as viewed in Fig. 8, for engagement with the lower surface of the latch 36. The mass 42 is also provided with an inwardly extending part 45 at the right-hand side thereof, as viewed in Fig. 8, for engagement with a flange 46 formed on the latch 36. To balance the mass 42, a curved leaf spring 47 having its ends engaged with the support 33, as shown in Fig. 8, and its midpoint connected by a bracket 48 to the mass 42 is provided. The spring 47 functions for the same purposes as does the spring 28 in the modification shown in Figs. 1 and 4.

In the balanced position of the mass 42, the part 45 will engage with the flange 46 and the part 44 will engage with the under surface of the latch 36. Upon the application of a shock force to the switch 31, the mass 42 will be caused to vibrate or oscillate about its pivot 43 to move the latch 36 into locking position. As the mass 42 moves counterclockwise the part 45 will engage the flange 46 to move the latch 36 clockwise into locking position as shown in Fig. 9. As the mass 42 moves in an opposite direction or counterclockwise, the part 44 will function to move the latch 36 clockwise into latching position.

If the switch is in its open position, as shown in Fig. 7, the end 49 of the latch 36 will engage with the part 41 to prevent movement of the switch to its closed position. If the switch is in its closed position as shown in Fig. 8, the latch 36 upon movement to its latching position will cause the part 41 to move through the opening 39 to latch the switch in its closed position.

Assuming that a shock force applied to the switch 31 when in closed position has opened the holding circuit for the magnet 35, the bias of the member 32 will tend to move the armature 34 from the position shown in Fig. 8 to the position shown in Fig. 7. With the latch 35 in its closed position, the enlarged end of the member 41 will interlockably engage with the latch 36 to arrest movement of the armature 34 after a small initial movement thereof, as shown in Fig. 9. The latch 36 will thus function to hold the armature 34 against further movement and thereby maintain the switch in its closed position until such time as the holding circuit (not shown) is restored to reenergize the magnet 35 and move the armature 34 from the position shown in Fig. 9 to the position shown in Fig. 8. As this latter action takes place, the latch 36 will disengage the enlarged end of the member 41 and will return

from the position shown in Fig. 9 to the position shown in Fig. 8.

From the foregoing, it will be apparent that there is provided latching mechanism which is automatically operable to lock a switch in a selected position against movement under shock. It will also be apparent that this mechanism requires no attention on the part of an operator since the latching mechanism is automatically operable in response to the application of a shock force. Moreover, it will be additionally noted that the latching mechanism does not interfere in any manner with the normal operation of an electromagnetically operated switch and functions only to prevent undesired or uncontrolled movements of such switches by shock forces. By the provision of an actuating member which is made to vibrate and move a latch to a position locking the switch against movement, an effective and simple mechanism is provided which is automatically operated by those forces which would otherwise be effective to cause an uncontrolled or undesired switch movement.

Since numerous changes may be made in the above described construction and different embodiments of the invention may be made without departing from the spirit and scope thereof, it is intended that all the matter contained in the foregoing description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

We claim as our invention:

1. In combination, a support, an electric switch mounted on said support and having a part movable back and forth between two positions to open and close the same, a latch mounted on said support for locking said part in one of its positions, and means for operating said latch comprising a lever pivotally mounted on said support and connected to said latch whereby pivotal motion of said lever is effective to actuate said latch, resilient means for biasing said lever and latch to a position in which said latch is inoperative to lock said part, and a member pivotally mounted on said support for oscillatory movement with respect thereto and adapted to be set into oscillation by the application of a shock force to said support, said member being engaged with said lever and effective upon movement thereof to pivot said lever and thereby move said latch to lock said part against movement with respect to said support.

2. The combination claimed in claim 1 wherein said member is provided with a spring for balancing the same in a position centrally of its path of oscillatory movement.

3. In combination, a support, an electric switch mounted on said support and having a part movable back and forth between two positions to open and close the same, a latch mounted on said support for rectilinear movement from an unlatched position to a position locking said part against movement from one of its positions, and means for operating said latch comprising a lever pivoted at one end to said support and connected at its other end to said latch, resilient means biasing said lever to a position maintaining said latch in its unlatched position, and a member pivoted for oscillatory movement with respect to said support at a point intermediate the ends of said lever and having parts engageable with said lever, said member being adapted to be set into oscillation by the application of a shock force to said support, oscillation of said member being effective through said lever engag-

ing parts to actuate said lever against its bias and thereby move said latch to its locking position.

4. In combination, an electric switch having a part movable back and forth between two positions to open and close the same, a latch movable to a position latching said part against movement out of either of said positions, said latch having a bias for movement to a position inoperative to latch said part, and means for moving said latch to latching position comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that its maximum amplitude of movement is limited by movement of said latch into locking position, the movement of said latch by its bias out of locking position being at a rate determined by the rate at which the amplitude of vibrating movement of said member decreases.

5. In combination, an electric switch having a part movable back and forth between two positions to open and close the same, a latch movable to a position latching said part against movement out of either of said positions, said latch having a bias for movement to a position inoperative to latch said part, and means for moving said latch to latching position comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that its maximum amplitude of movement is limited by movement of said latch into locking position, the movement of said latch by its bias out of locking position being at a rate determined by the rate at which the amplitude of vibrating movement of said member decreases, and resilient means for retarding the rate at which the amplitude of movement of said vibrating member decreases.

6. In combination, an electric switch having a part movable back and forth between two positions to open and close the same and having a bias for movement to one of such positions, a latch movable to an operative position latching said part against movement out of either of said positions and having a bias for movement to its unlatched position, and operating means for said latch comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that vibrating movement thereof is effective to move said latch against its bias to its operative position.

7. In combination, an electric switch having a part movable back and forth between two positions to open and close the same and having a bias for movement to one of such positions, a latch movable to an operative position latching said part against movement out of either of said positions and having a bias for movement to its unlatched position, and operating means for said latch comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that vibrating movement thereof is effective to move said latch against its bias to its operative position, movement of said latch by its bias out of said operative position being normally controlled by said vibrating member and at a rate determined by the rate at which

the amplitude of vibrating movement of said member decreases.

8. In combination, an electric switch having a part movable back and forth between two positions to open and close the same and having a bias for movement to one of such positions, a latch movable to an operative position latching said part against movement out of either of said positions and having a bias for movement to its unlatched position, and operating means for said latch comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that vibrating movement thereof is effective to move said latch against its bias to its operative position, movement of said latch by its bias out of said operative position being normally controlled by said vibrating member and at a rate determined by the rate at which the amplitude of vibrating movement of said member decreases, said latch and part having interengageable parts for preventing movement of said latch by its bias to unlatched position when said latch is operatively engaged with said part to prevent movement thereof under the bias of said part.

9. In combination, an electric switch having a part movable back and forth between two positions to open and close the same and having a bias for movement to one of said positions, an electromagnet having an armature for moving said part against its bias to the other of said positions, a latch, said armature having slots into which said latch may move to prevent movement of said part, and operating means for moving said latch into one of said slots comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that vibrating movement thereof is effective to move said latch into one of said slots, to prevent movement of said part from the position occupied at the time of application of said shock force.

10. In combination, an electric switch having a part movable back and forth between two positions to open and close the same and having a bias for movement to one of said positions, an electromagnet having an armature for moving said part against its bias to the other of said positions, a latch, having an opening therein, said armature having a part receivable in said opening when said part is in the other of said positions to prevent movement of said switch by its bias, and operating means for moving said latch to an operative position in which said part extends through said opening comprising a member mounted for vibrating movement and adapted to be set into vibration by the application of a shock force to said switch, said member being engageable with said latch in such manner that vibrating movement thereof is effective to move said latch to said operative position.

11. A shock-proof contactor, comprising a support; an electromagnet secured to said support; an armature assembly movable relative to said support under control by said magnet; latch means movably arranged on said support and engageable with said assembly to prevent, when operative, said assembly from moving, said latch means being biased to be normally disengaged from said assembly; an inertia member vibratably mounted on said support for performing vi-

bratory motion relative thereto when shock is applied to said support, said inertia member being arranged relative to said latch means for moving said means into latching engagement with said assembly due to said motion.

12. A shock-proof contactor, comprising a support; an electromagnet secured to said support; an armature assembly movable relative to said support under control by said magnet; latch means having a lever pivotally mounted on said support for angular motion relative thereto and being engageable with said assembly to prevent, when said lever is in latching position, said assembly from moving, and biasing means for holding said lever normally out of said latching position; and a vibratory system having an inertia member pivotally mounted on said structure about an axis substantially in parallel to the pivot axis of said lever for performing vibratory motion substantially in the plane of angular motion of said lever when shock is applied to said support, said inertia member being arranged for moving said lever to said latching position due to said vibratory motion.

13. A shock-responsive latching device, comprising a support; a structure movable relative to said support; latch means engageable with said structure to prevent, when engaged, said structure from moving and having a member movably arranged on said support and biased to a position in which said means are disengaged from said structure; and an inertia mass journaled to said support for oscillatory motion about a pivot axis and having two parts engageable with said member and located at spaced points on opposite sides of the pivot axis in order to force said member alternately out of said position in order to effect latching of said structure when said mass performs vibratory motion due to the application of shock to said support.

14. A shock-responsive latching device, comprising a support; a structure movable relative to said support; latch means engageable with said structure to prevent, when engaged, said structure from moving and having a lever pivoted to said support for angular motion relative thereto and being biased toward a position in which said means are disengaged from said structure; and a vibratory system having an inertia mass pivoted to said support about an axis in parallel to the pivot axis of said lever and having two parts engageable with said lever and located at opposite sides respectively of the pivot axis of said means in order to move said lever alternately out of said position to effect latching of said structure when said mass vibrates due to the occurrence of shock, said two parts being differently spaced from said pivot axis of said mass so as to impart substantially equal movements to said lever.

DELBERT ELLIS,
OWEN L. TAYLOR.

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