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J. E. MAGEE

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FOOT LADDER ACTUATED SAFETY MEANS

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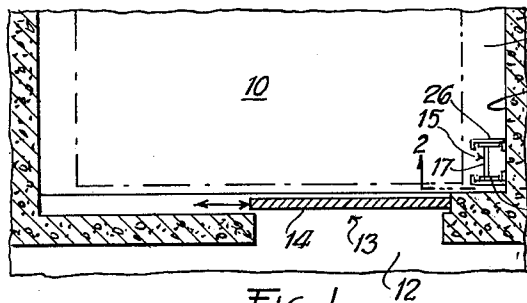


FIG. 1

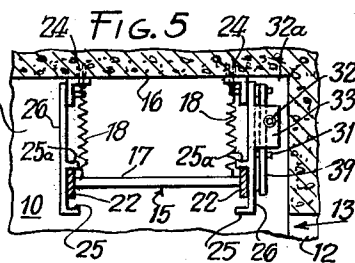


FIG. 5

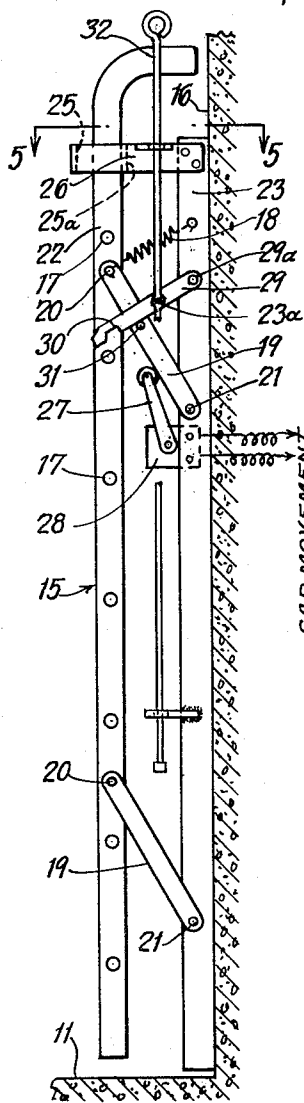


FIG. 2

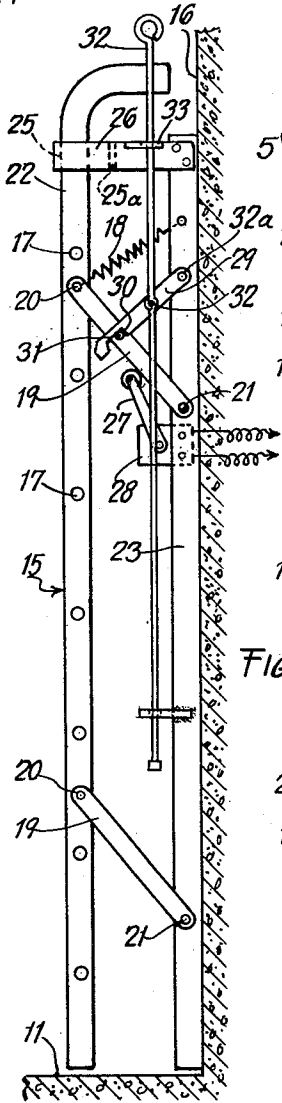


FIG. 3

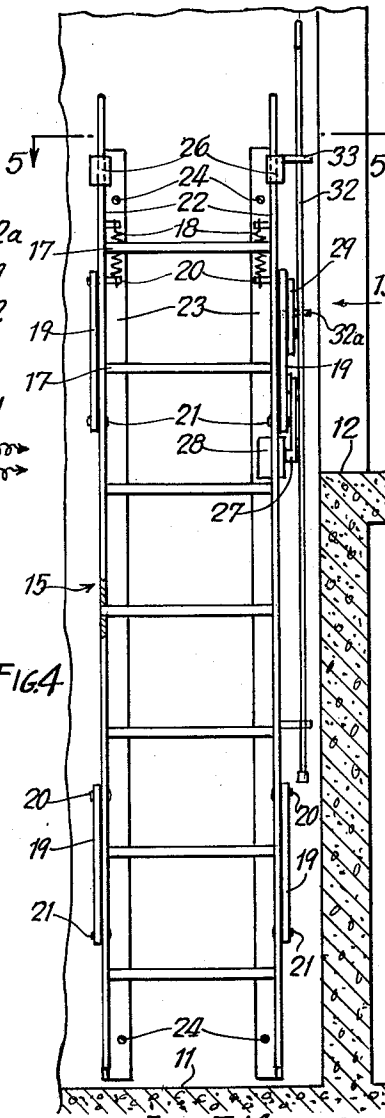


FIG. 4

INVENTOR: JOHNE. MAGEE
Ward, Keck, Haseltine, Omer & McElhannon
ATTORNEYS.

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FOOT LADDER ACTUATED SAFETY MEANS

John E. Magee, Greenburgh, N.Y.

(191 Forest Blvd., Ardsley, N.Y.)

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This invention relates to switch actuating safety devices, and more particularly to foot ladder installation arrangements incorporating safety switch actuation means to insure deactivation of operating machinery, such as an elevator, which is adjacent the ladder. The invention is particularly useful where a ladder is to be installed in an elevator pit, at the bottom of an elevator shaft, so that a workman may descend safely into the pit for elevator maintenance purposes. For this reason the invention will be described in connection with such use, although it will be understood that it may have other applications.

Currently certain relevant safety requirements in elevator installations are set forth by Rules 106.1(d) and 106.1(f) of the American Standard Safety Code for Elevators, Dumbwaiters and Escalators. Part 2 of the former rule relates to provision of a permanent ladder structure in the elevator pit where the pit depth is more than four feet below the lowest access door sill. The latter rule relates to provision of an elevator car movement stop switch accessible from the pit access door. Compliance with these rules may be said to afford negative protection in that reliance is placed upon the memory of maintenance personnel to actuate the stop switch before making use of the pit ladder.

Furthermore, in cases where electric circuit troubleshooting operations require testing of elevator wiring within the travelling-cable junction box underneath the elevator car, or where inspection of the guide rail safeties is desired, it becomes necessary to lower the car to a location where these elements are within reach from the pit floor. Frequently, such lowered location of the elevator car is below the lowermost floor level of its normal operating travel. In most cases, the elevator safety stop switch required by Rule 106.1(f) would have to be left in its position which permits continued downward movement of the car since the switch would be rendered inaccessible to a person in the elevator pit, it being blocked by the car in its abnormally lowered location.

It is an object of this invention to provide a safety device incorporated in a ladder installation to automatically and positively cause deactivation of operating machinery, such as an elevator, during the time when a person may be using the ladder which is permanently installed adjacent such machinery.

Another object of the invention is to incorporate means within the safety device provided to retain the protection afforded by its actuation until the safety device is manually released from its actuated condition.

A further object of the invention is to permit manual release and reactivation of the safety device by a person stationed either at the top or the bottom of the ladder.

A still further object of the invention is to provide permanently installed ladder means in an elevator pit which incorporates manually releasable safety means for automatically preventing movement of the elevator car at least while the ladder is being used by personnel, the safety means controlling car activation means of the elevator.

It is also an object of the invention to provide a safety switch actuating device in a ladder which is installed in an elevator pit and which conforms to certain elevator installation safety requirements promulgated by the American Standard Safety Code for Elevators, Dumbwaiters and Escalators.

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The invention will be described by reference to one preferred embodiment wherein a ladder commensurate in length with the depth of an elevator pit is mounted in fixed position within the pit to a supporting structure, such as the wall of the pit or an elevator pit framing member, and located so as to be conveniently accessible for use in climbing into the pit from the lowermost landing served by the associated elevator. The mounting means of the ladder incorporates a pantograph linkage between the ladder and its supporting structure which permits movement of the ladder while retaining its vertical relationship with respect to the pit floor. The pantograph linkage is spring biased to retain the ladder in its normal position slightly elevated with respect to the pit floor. The referred to limited movement is just sufficient to cause actuation of a switch which is operably associated with the ladder and which is biased against the pantograph construction and normally closed when the ladder is in its normal position. The switch is connected electrically in series with the emergency stop switch of the elevator so that when the switch is opened the power supply for moving the car is broken as effectively as it would be were the emergency stop switch opened. Downward ladder movement, in response to the weight of a person on a rung of the ladder, causes movement of the switch to its open position, and permits a latch to fall by gravity to latch the pantograph, and consequently the ladder in a position slightly lower than its normal position. A pantograph latch release rod extends vertically approximately the height of the ladder and is arranged to permit manual release of the latching mechanism from either the pit level or from the access door level by permitting the ladder and switch to move to their normal positions in response to their respective biases, provided that extraneous weight is not present on the ladder rungs at the time. Once manually released, the safety mechanism may be re-actuated by a downward pull, or by weight on any rung of the ladder. The switch contacts which are opened in conjunction with movement of the ladder to its lowered position are wired electrically to conform with code requirements.

These and other objects and features of the invention will be apparent from the foregoing and from the following description of one preferred embodiment thereof, when considered in conjunction with the accompanying drawings in which:

FIGURE 1 is a plan view showing the pit section of an elevator shaft in which a ladder is mounted in accordance with the invention;

FIGURE 2 is an enlarged side view of the ladder installation of FIGURE 1, as viewed from line 2-2 therein, showing the details of the safety device actuation means in its normal position;

FIGURE 3 is a view similar to FIGURE 2, but showing the safety device in its actuated position;

FIGURE 4 is a front elevation of the ladder installation to show more of the details thereof; and

FIGURE 5 is a top view of the ladder installation, shown partially in section as taken at lines 5-5 of FIGURES 2 and 4.

Referring to the several figures of the drawings, an elevator hoistway, generally indicated by the numeral 10, has floor 11 at the bottom of a pit in the hoistway situated below the lowermost elevator landing level 12. At landing level 12 is a doorway 13, normally closed by a door 14, through which access to the hoistway pit may be gained. Of course, doorway 13 is normally used for entrance into the elevator car (not shown) which operates within hoistway 10. For descending to the floor 11 of the elevator pit from the considerably higher landing level 12, there is a ladder 15 within the pit which extends between these levels and which is installed in accordance

with the invention. As shown by the drawings, the ladder may be situated vertically adjacent hoistway wall 16.

The operation of the means provided by the invention will be first described as it may be effected automatically upon use of the ladder by maintenance personnel to descend into the elevator pit such as for cleaning purposes. Assume entrance to the hoistway has been gained through the door to the shaft at the lowermost landing of the elevator. The hoistway door is opened by use of hoistway door lock unlatching means (not shown) customarily provided for the purpose. Conventional hoistway door interlock contacts (not shown) void car motion except when the door is fully closed. The door normally closes after entering personnel have passed through the doorway on to the pit access ladder.

Transfer of a person's weight from the door sill at landing level 12 to any rung 17 of ladder 15 results in a limited downward movement of the ladder against the upward biasing effect of ladder springs 18. This is permitted by freedom of pantograph links 19 to rotate about their pivots 20 and 21. Pivots 20 are located in ladder uprights 22, and pivots 21 are located in vertically extending supports 23 which parallel the ladder uprights and are attached, as by anchor bolts 24, to the hoistway wall 16. Thus, the ladder uprights 22, vertical supports 23, and pivotable connecting links 19 together form a pantograph arrangement of construction which achieves results afforded by the invention. Downward movement of the ladder is limited by contact of its uprights 22 against extending lugs 25 on ladder guide bars 26, the latter being attached to supports 23 as shown in FIGURE 3. Such contact is caused by the accompanying slight outward movement of the pantograph. Alternatively, ladder downward movement may be limited by its contact with the floor 11 of the elevator pit. Normal upward position of ladder 15 may be determined by its contact with extending lugs 25a of guide bars 26 as shown in FIGURES 2 and 5.

The downward movement of the ladder and pantograph links causes downward movement of an arm 27 to actuate a switch 28 which is spring biased against such movement. Such actuation of switch 28 opens a pair of electrical contacts therein (not shown) to break the electric circuit which supplies power to the motor which causes movement of the elevator car, thereby preventing restarting. These electrical contacts are wired electrically in series with the elevator car emergency stop switch (not shown) which is located in the car operating panel and therefore, opening of the contacts of switch 28 isolates the main elevator motor control circuits from their associated power source as effectively as would actuation of the elevator emergency switch.

When the ladder is thus weight-actuated to its lower position locking link 29, which is pivotally connected as at 29a to support 23, falls by gravity so that its shoulder portion 30 engages abutment means such as pin 31 on associated link 19 to lock the ladder in this lowered position and thereby hold open the electrical contacts within switch 28. This condition obtains even after weight has been removed from the ladder.

Thus, it will be seen that the invention provides means for actuating an elevator safety power shut-off switch, switch actuation being caused by the effect of the weight of the person standing on a rung of a ladder in the elevator pit. Other features provided by the invention will now be described in connection with their operation.

When service in the pit, such as cleaning has been completed, the workman will ascend the ladder to landing level 12 to emerge from the pit. Of course, his weight insures continued actuation of switch 28 to positively avoid the possibility of elevator movement in the manner above described. After he has ascended the ladder, the departing workman must lift the latch-release rod 32, which is attached to locking link 29 as by pivot connection 32a and guided in its movement by lugs 33, in order to reset switch 28 to permit elevator operation.

Lifting of rod 32 disengages shoulders 30 from pins 31 which permits springs 18 to exert their bias effect to lift the ladder 15 to its upward normal position. Upward movement of ladder 15 moves links 19 upwardly to allow the switch arm 27 to also move in response to the biasing means (not shown) of switch 28, thereby causing deactuating movement of switch 28. Such deactuating movement causes its internal electrical contacts to close so as to permit resumption of elevator service.

Assume now that after descending into the pit a workman desires access to equipment mounted underneath the elevator car. By lifting release rod 32, he can allow the car to be lowered to within his reach and can control its stopping by a downward pull on any ladder rung or by merely stepping on a lower rung thereof. Once stopped, locking link 29 remains in its locking position to insure retention of this status of the elevator until work is completed at which time the workman would again lift release rod 32 to permit ascent of the elevator. As previously described, use of the ladder by the workman to emerge from the pit continues to prevent car movement until the release rod 32 has been again lifted by him from his position on landing level 12. Thereafter, hoistway door interlock contacts (not shown) between the door 14 and doorway 13 would govern elevator car movement.

It can be seen from the foregoing description that a positive type of safety device is provided by the invention, whose actuation is automatic upon initiation of descent of personnel on a ladder into an elevator pit, but whose deactuation can be effected only manually, such as upon departure from the pit. Control of car starting and stopping while personnel are in the pit for necessary work underneath the car itself is an added advantage. In effect, the device provides an extended "lifeline" for those personnel required to work in an elevator pit.

Although the invention has been described in accordance with a preferred embodiment such as will be found useful in connection with elevator repair and maintenance, it will be understood that the means which are provided may be useful in other safety applications where workmen must climb upon ladders which are adjacent moving machinery or otherwise located in dangerous work areas. For example, the described actuation of switch 28 may cause deactivation of any type of machinery, such as pumps, blowers, etc., or may cause activation of such machinery, if such alternative is desirable for any purpose. As an example of the latter, a blower might be automatically activated to remove a possible accumulation of poisonous gases in a work pit location.

Furthermore, it will be understood that equivalent means or arrangements might be substituted for those which have been described, but that such substitutions would be within the scope of the invention which is limited only by the appended claims.

What is claimed is:

1. Safety switch actuation means comprising a foot ladder member connected by link means to a support for limited vertical pantographic movement with respect thereto, bias means biasing said ladder member upward to its normal position, means to limit the extent of said pantographic movement of the ladder member downward to a switch-actuated position thereof, said bias means having bias resistance such as to permit said downward movement of the ladder member only in response to a force exerted on the ladder member which is substantially equal to that normally applied thereto by a man engaging the ladder member to use the same, switch-contacts activation means of said safety switch connected for movement in response to said downward movement of the ladder member, locking means for locking the ladder member in its said switch-actuated position, and a manual release rod of said locking means arranged and constructed to be conveniently accessible from above said ladder.

2. In a work pit, a safety device for determining the activation of machinery operably associated with said pit comprising a foot ladder extending into said pit from the level of access thereto, said ladder mounted in said pit for limited vertical movement, bias means biasing said ladder upwardly to its normal position, means to limit the extent of vertical movement downward in response to a weight applied to said ladder, and a power supply switch of said machinery operatively engaging said ladder and actuated by its said downward movement to determine said machinery activation.

3. In a work pit, a safety device for determining the activation of machinery operably associated with said pit comprising a foot ladder extending into said pit from the level of access thereto, said ladder mounted in said pit for limited vertical movement, bias means biasing said ladder upwardly to its normal position, means to limit the extent of vertical movement downward in response to a weight applied to said ladder, a power supply switch of said machinery operatively engaging said ladder and actuated by its said downward movement to determine said machinery activation, and locking means for locking said ladder in a downward position wherein said switch is so actuated, said locking means including manual release means thereof accessible from said level of access to the pit and from the bottom of the ladder.

4. In a pit below an elevator hoistway, a pit access ladder installation including automatic circuit breaking means for preventing powered movement of an elevator car operable within said hoistway, said installation comprising a foot ladder extending into said pit from a level of access thereto, fixed support means of said ladder, a plurality of links pivotally connected to said ladder and support means, said ladder and said links arranged and constructed to provide limited vertical pantographic movement of said ladder with respect to said support means, spring bias means between said ladder and support means biasing said ladder and said links upward to a normal position thereof, means to limit the extent of said pantographic movement downward in response to a weight applied to said ladder, an elevator car power supply switch mounted in said pit, said switch having a switch actuation lever operable responsive to said downward movement of the ladder and spring biased against said downward movement thereof, gravity actuated locking means to lock said ladder in a downward position wherein said switch is actuated to electrically break the car movement power supply circuit to said elevator car, and a vertically extending release rod of said locking means arranged and constructed to be accessible from said level of access to the pit and from the bottom of the ladder.

5. In a pit below an elevator hoistway, a pit access ladder installation according to claim 4, said switch attached to said support means, and said switch actuation lever operably associated with one of said links.

6. In a pit below an elevator hoistway, a pit access ladder installation according to claim 4, said locking means comprising a locking link member pivotally connected at one of its ends to said support means and having a locking shoulder formed on its other end for engaging associated abutment means of one of said links when said locking means are gravity actuated.

7. In a pit below an elevator hoistway, a pit access ladder installation comprising a foot ladder extending into

said pit, fixed support means for said ladder, means movably connecting said ladder to said support means to provide limited vertical movement of said ladder to an upper position and to a lower position thereof with respect to said support means, and an elevator car control switch for controlling movement of said car mounted in said pit and operably associated with said ladder for actuation in response to movement of said ladder to either of its said positions, whereby movement of said car is prevented when the ladder is in its said lower position and is permitted when the ladder is in its said upper position.

8. Safety switch actuation means comprising a foot ladder member connected by link means to a support for limited vertical pantographic movement with respect thereto, bias means biasing said ladder member upward to its normal position, means to limit the extent of said pantographic movement of the ladder member downward to a switch-actuated position thereof, said bias means having bias resistance such as to permit said downward movement of the ladder member only in response to a force exerted on the ladder member which is substantially equal to that normally applied thereto by a man engaging the ladder member to use the same, and switch-contacts activation means of said safety switch connected for movement in response to said downward movement of the ladder member.

9. A foot ladder installation construction comprising a generally conventional foot ladder member, foot ladder support means, link means interconnecting said foot ladder member and said support means to effect substantially parallel pantographic movement of the former between upper and lower positions of the same with respect to the latter, spring bias means attached to said support means and operatively engaging said ladder member for biasing said ladder member normally to its said upper position, said bias means having bias resistance such as to permit said downward movement of the ladder member only in response to a force exerted on the ladder member which is substantially equal to that normally applied thereto by a man engaging the ladder member to use the same, and switch-contacts activation means connected to said support means, said switch-contacts activation means arranged and constructed for actuation responsive to said downward movement of the ladder member.

10. A foot ladder installation construction according to claim 9, wherein said link means comprises a plurality of links, and said switch-contacts activation means is operatively associated with one of said links.

11. A foot ladder installation construction according to claim 10, wherein said switch-contacts activation means comprises an arm pivotally connected to said support means and spring bias means biasing said arm into engagement with said one link, said arm and said one link having means for providing slidable movement therebetween during said vertical movement of the ladder member.

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