

# **Elevator Pit Ladder Structure with Safety Switch and Elevator**

## **Technical Field**

The present invention relates to an elevator pit ladder structure with a safety switch and an elevator having the same.

## **Background**

In the elevator pit, facilities such as a damper seat, guide seat, and drainage device are usually provided, and in order to perform maintenance and repair on these facilities, a ladder for the maintenance personnel to enter and exit the pit is provided.

A ladder that is upright fixed directly below the port of the pit is known in the art. However, according to the industry standards, the distance between the ladder and the wall of the hoistway wall is required to be more than a predetermined level. Hence, such a ladder may protrude from the hoistway wall, as a result of which there is a risk that the ladder interferes with the car and the car attachments. In order to avoid the interference, it is necessary to increase the size of the hoistway, which will result in an increase in cost and a decrease in product competitiveness.

In addition, the existing elevator does not have a safety switch at the use position of the pit ladder, so there is a possibility that the elevator does not lose power when the maintenance personnel are in the pit, and there is a safety hazard.

In addition, since the above-mentioned ladder is arranged upright, the ladder is steep, which is disadvantageous for the maintenance personnel to climb. Further, since it is fixedly arranged, the whole ladder is located below the port of the pit, and there is no such a part exposed to the outside for enabling the maintenance personnel to hold. Thus, the maintenance personnel will have a fear when they step on the ladder, and there may be a safety accident of falling off.

## **Contents of the Invention**

In view of the above problems, the present invention provides an elevator pit ladder structure with a safety switch that is convenient to use and has high safety, and an elevator having the elevator pit ladder structure.

One aspect of the invention relates to an elevator pit ladder structure with a safety switch, characterized in that, the elevator pit ladder structure has a ladder, the ladder comprising: two long sides extending in parallel with each other in a predetermined direction; and a plurality of tread portions that are connected between the two long sides vertically to the two long sides and are disposed at a predetermined interval along an extension direction of the two long sides, the ladder being set to have a usage state and a storage state, wherein in the usage state one end of the ladder in the extension direction is

placed at the bottom of the pit, while the other end opposite to the one end in the extension direction is laid on the lower edge of a pit port, so the ladder is in a state enabling the user to climb; in the storage state the ladder is removed from the pit port and is supported at a position of a second hoistway wall close to the pit port, the second hoistway wall being adjacent to a first hoistway wall provided with the pit port; wherein the elevator pit ladder structure further comprises: a support mechanism fixed to the second hoistway wall for supporting the ladder in the storage state, and a safety switch that is turned on in accordance with the ladder being supported on the support mechanism so as to operate the elevator and is turned off in accordance with the ladder being removed from the support mechanism so as to stop operation of the elevator.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that the safety switch comprises: a switch casing mounted to the support mechanism; and a switch connector mounted to the ladder, the switch connector being connected with the switch casing to turn on the safety switch when the ladder is supported by the support mechanism, the switch connector being separated from the switch casing to turn off the safety switch when the ladder is removed from the support mechanism.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that in the usage state, a portion of the other end of the ladder is exposed to the pit port.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that in the usage state, the ladder is inclined in such a way of going away from the first hoistway wall towards one end side, i.e., bottom side of the pit, from the other end side, i.e., port side of the pit.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that in the storage state, the ladder is supported vertically and close to the second hoistway wall.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that the ladder is provided, on the other end side, with a hook that is connected to a lading door dill in the usage state.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that the support mechanism is a fixing holder, and the ladder is supported by hanging on the fixing holder in the storage state.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that the fixing holder is formed with two guide rails extending in the up and down direction, and the inner sides of the two long sides slide on the two guide rails when the ladder is hung on the fixing holder, so that the ladder is guided.

The elevator pit ladder structure with a safety switch according to the above aspect also may be configured such that a catch slot as a notch portion is formed at upper ends of the two guide rails, and the ladder is provided, at a position closer to the other end side than the plurality of tread portions, with a locking portion as the short side for connecting the two long sides, the locking portion being engaged in the catch slot in the storage state.

According to another aspect, the invention relates to an elevator having an elevator pit ladder structure as claimed in any of the above aspects.

The elevator pit ladder structure with a safety switch as configured above and the elevator having the same elevator pit ladder structure with a safety switch have the advantages of being convenient to use and enhancing the safety.

### **Description of the Drawings**

FIG. 1 is a view showing the ladder in usage state having the elevator pit ladder structure according to the present invention.

FIG. 2 is a view showing the ladder in storage state having the elevator pit ladder structure according to the present invention.

FIG. 3 is an enlarged view of a portion surrounded by a circle in FIG. 2, illustrating the ladder, the support mechanism, and the safety switch when the ladder having the elevator pit ladder structure according to the present invention is about to be in a storage state.

FIG. 4 is an enlarged view of a portion surrounded by a circle in FIG. 2, illustrating the ladder, the support mechanism, and the safety switch when the ladder having the elevator pit ladder structure according to the present invention has been in the storage state.

FIG. 5 is a view showing a hook on the ladder side.

### **Embodiments**

Hereinafter, the elevator pit ladder structure according to the present invention will be described in detail with reference to the accompanying drawings.

FIG. 1 is a view showing the ladder in usage state having the elevator pit ladder structure according to the present invention. FIG. 2 is a view showing the ladder in storage state having the elevator pit ladder structure according to the present invention.

As shown in FIG. 1, the elevator is provided with a pit 11 at the bottom of the hoistway, and a hoistway wall 12 at one side has a pit port 10 for enabling the maintenance personnel to enter and exit the pit. The elevator pit ladder structure with a safety switch according to the present invention is arranged in the pit 11.

Roughly speaking, the elevator pit ladder structure with a safety switch according to the present invention comprises a ladder 2, a support mechanism 3, and a safety switch 4.

Next, the structures of the ladder 2, the support mechanism 3, and the safety switch 4 will be described in detail with reference to the drawings.

As shown in FIG. 1, the ladder 2 comprises two long sides 21 extending in parallel with each other in a predetermined direction; and a plurality of tread portions 22 that are connected between the two long sides vertically to the two long sides 21 and are disposed along an extension direction of the two long sides 21 at a predetermined interval that can be spanned by legs of a person.

As shown in FIGS. 1 and 2, the ladder 2 can be set to have a usage state and a storage state. FIG. 1 illustrates the usage state, in which one end (lower end) of the ladder 2 in the extension direction is placed at the bottom of the pit 11, and the other end (upper end) opposite the one end in the extension direction is laid on the lower edge of the pit port 10. In this case, the maintenance personnel can climb down the ladder 2 and enter the pit 11.

In addition, in the usage state shown in FIG. 1, a part of the upper end of the ladder 2 as the other end projects out from the pit port, that is, the ladder 2 has a projecting part that protrudes into the pit port 10. The projecting part acts as a handrail when the maintenance personnel start to step on the ladder 2.

In addition, in the usage state shown in FIG. 1, the ladder 2 in the usage state is inclined in such a way of going away from the hoistway wall 12 provided with the pit port 10 towards a lower end side as one end side (bottom side of the pit) from an upper end side as the other end side (port side of the pit).

Further, as shown in FIG. 5, the ladder 2 is provided with hooks 24 on the upper end side as the other end side, and in the usage state, the hooks are coupled to the lading door dill, thereby firmly maintaining the inclined state of the ladder 2. However, the specific installation position of the hooks is not limited to the illustrated case, and it is only necessary to dispose the hooks on the ladder 2 side to maintain the ladder 2 in such a state in which the other end (upper end) is laid on the lower edge of the pit port.

Further, the ladder 2 is provided, at a position closer to the other end side (upper end side) than the plurality of tread portions 22, with a short side that connects the two long sides, the short side acting as a locking portion 23 that stably supports the ladder in the storage state. The locking portion 23 as the short side may have substantially the same configuration as the plurality of tread portions 22.

As shown in FIG. 2, the support mechanism 3 of the elevator pit ladder structure according to the invention is secured to the hoistway wall 13 adjacent to the pit port, and supports the ladder 2 in the storage state.

In the storage state shown by FIG. 2, the ladder 2 is removed from the pit port 10 and is supported on the hoistway wall 13 adjacent to the hoistway wall 12 provided with the pit port 10, in particular supported at a position of the hoistway wall 13 in close proximity to the pit port 10, wherein the proximity degree to the pit port 10 is such an extent that the

serviceman can, at the pit port 10, make the operations of making the ladder 2 supported on the hoistway wall 13 and removing the ladder 2 from the hoistway wall 13.

In addition, in the storage state shown by FIG. 2, the ladder 2 is vertically disposed in very close proximity to the hoistway wall 13.

Further, the support mechanism 3 is specifically configured as a fixing holder, and as shown in FIG. 4, the ladder 2 in the storage state is attached to the fixing holder 3 and hence is supported. Specifically, as shown in FIGS. 3 and 4, the fixing holder 3 is formed with two guide rails 31 extending in the up and down direction, and a catch slot 32 as a notch portion is formed at upper ends of the two guide rails 31. When the ladder 2 is to be mounted on the fixing holder 3, the opposite inner sides of the two long sides 21 of the ladder 2 slide on the two guide rails 31 so that the ladder 2 is guided, as shown in FIG. 3. When the ladder 2 is guided to a position where the locking portion 23 is inserted into the catch slot 32, the ladder 2 is firmly supported on the fixing holder 3.

Although the configuration of the support mechanism has been described above by taking the fixing holder 3 as an example, the support mechanism is not limited thereto, and the configuration of the support mechanism can be adjusted correspondingly according to the configuration of the ladder.

The safety switch 4 provided by the elevator pit ladder structure according to the present invention is configured to be turned on in accordance with the ladder 2 being supported on the fixing holder 3 as the support mechanism to achieve the normal communication of the elevator safety circuit and enable the elevator to normally work, and to be turned off in accordance with the ladder 2 being removed from the fixing holder 3 as the support mechanism so as to achieve the automatic disconnection of the elevator safety circuit and stop operation of the elevator.

Specifically, as shown in FIGS. 3 and 4, the safety switch 4 comprises a switch casing 41 mounted to the fixing holder 3 as the support mechanism, and a switch connector 42 mounted to the ladder 2, in particular mounted on the locking portion 23 of the ladder 2 in a downward projecting manner. When the ladder 2 is supported on the fixing holder 3 as shown in FIG. 4, the switch connector 42 is connected to the switch casing 41 to turn on the safety switch 4, and when the ladder 2 is separated from the fixing holder 3 as shown in FIG. 3, the switch connector 42 is disconnected from the switch casing 41 to turn off the safety switch 4. Here, the case where the safety switch comprises a switch casing disposed on the fixing holder side and a switch connector disposed on the ladder side is described. However, the present invention is not limited to this case, and the specific configuration, installation position of the safety switch and the like can be appropriately modified as required, so long as it is configured to be turned on in accordance with the ladder being supported on the support mechanism and turned off in accordance with the ladder being removed from the support mechanism.

Next, the effects of the elevator pit ladder structure according to the present invention will be described.

The elevator pit ladder structure with a safety switch according to the present invention is configured such that the ladder can be switched between the usage state and the storage state, so that the ladder can be vertically stored close to the hoistway wall when the ladder is not used, and hence the distance between the ladder in the storage state and the hoistway wall is smaller than the said distance in the usage state, even abutting on the hoistway wall. Thus, it is possible to avoid interference between the ladder and the car without the need of increasing the hoistway, thereby reducing the cost and enhancing the product competitiveness.

Further, the elevator pit ladder structure with a safety switch according to the present invention is configured such that the safety switch is turned on in accordance with the ladder being supported on the fixing holder so as to operate the elevator and is turned off in accordance with the ladder being removed from the fixing holder so as to stop operation of the elevator, that is, the safety switch is operated along with the fixation and removal of the ladder relative to the fixing holder. Thus, it is possible to ensure that the elevator is powered off when the maintenance personnel are in the pit without having to intentionally operate the safety switch, thereby reliably eliminating the security risks.

Further, the ladder in the usage state has a projecting part that protrudes into the pit port. This projecting part acts as a handrail, and thus it is possible to reduce the fear of the maintenance personnel when starting to step on the ladder, and to avoid the falling accident of the stepping on the air, thereby improving the safety.

In addition, in the usage state, the ladder is arranged obliquely, so that it is easier for the maintenance personnel to climb than the conventional vertically-arranged ladder.

As described above, the elevator pit ladder structure with a safety switch and the elevator having the same elevator pit ladder structure according to the present invention have the advantages of being convenient to use and enhancing the safety.

Although the embodiments of the invention have been described above, the embodiments are provided by way of example only and are not intended to limit the scope of the invention. New embodiments can be carried out in other various ways, and various omissions, substitutions and changes can be made without departing from the scope of the invention. These embodiments and their modifications are intended to be included within the scope and spirit of the invention, and also within the scope of the appended claims and their equivalents.

## CLAIMS

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1. An elevator pit ladder structure with a safety switch, characterized in that,  
the elevator pit ladder structure has a ladder, the ladder comprising: two long sides extending in parallel with each other in a predetermined direction; and a plurality of tread portions that are connected between the two long sides vertically to the two long sides and are disposed at a predetermined interval along an extension direction of the two long sides,  
the ladder is set to have a usage state and a storage state, wherein in the usage state, one end of the ladder in the extension direction is placed at the bottom of the pit, while the other end opposite to the one end in the extension direction is laid on the lower edge of a pit port, so the ladder is in a state enabling the user to climb; in the storage state the ladder is removed from the pit port and is supported at a position of a second hoistway wall close to the pit port, the second hoistway wall being adjacent to a first hoistway wall provided with the pit port,  
the elevator pit ladder structure further comprises:  
a support mechanism fixed to the second hoistway wall for supporting the ladder in the storage state, and  
a safety switch that is turned on in accordance with the ladder being supported on the support mechanism to operate the elevator, and is turned off in accordance with the ladder being removed from the support mechanism to stop operation of the elevator.
2. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,  
the safety switch comprises:  
a switch casing mounted to the support mechanism; and  
a switch connector mounted to the ladder,  
the switch connector being connected with the switch casing to turn on the safety switch when the ladder is supported by the support mechanism, the switch connector being separated from the switch casing to turn off the safety switch when the ladder is removed from the support mechanism.
3. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,  
in the usage state, a portion of the other end of the ladder is exposed to the pit port.
4. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,  
in the usage state, the ladder is inclined in such a way of going away from the first

hoistway wall towards one end side, i.e., bottom side of the pit, from the other end side, i.e., port side of the pit.

5. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,

in the storage state, the ladder is supported vertically and close to the second hoistway wall.

6. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,

the ladder is provided, on the other end side, with a hook that is connected to a lading door dill in the usage state.

7. The elevator pit ladder structure with a safety switch as claimed in claim 1, characterized in that,

the support mechanism is a fixing holder, and the ladder is supported by hanging on the fixing holder in the storage state.

8. The elevator pit ladder structure with a safety switch as claimed in claim 7, characterized in that,

the fixing holder is formed with two guide rails extending in the up and down direction, and the inner sides of the two long sides slide on the two guide rails when the ladder is hung on the fixing holder, so that the ladder is guided.

9. The elevator pit ladder structure with a safety switch as claimed in claim 8, characterized in that,

a catch slot as a notch portion is formed at upper ends of the two guide rails,

the ladder is provided, at a position closer to the other end side than the plurality of tread portions, with a locking portion as the short side that connects the two long sides,

the locking portion is engaged in the catch slot in the storage state.

10. An elevator, characterized by comprising an elevator pit ladder structure as claimed in any one of claims 1-9.