

ELEVATOR APPARATUS

Background of the Invention

The present invention relates to an elevator apparatus, and more particularly, to an elevator apparatus including a fixing device for maintenance that fixes a counterweight during a maintenance of an equipment disposed at a lower area of a hoistway.

5 An elevator apparatus having a structure as described below is known (see JP-A-2004-161432, for example). That is, a support member is provided to be fixed to a guide rail for a counterweight at a position where the support member does not hinder ascending/descending of the counterweight so as to prevent a car from descending in the case of performing maintenance of equipment, such as a hoisting machine, which is disposed below a
10 hoistway. During the maintenance of the equipment disposed below the hoistway, a control device is controlled to drive the hoisting machine so that the car and the counterweight are allowed to ascend and descend through a main rope to locate the car at the highest floor and locate the counterweight in the vicinity of the lowest floor. After that, an operator enters a pit, and a fixing device for maintenance is provided such that a fixing rod is inserted and fixed to a
15 counterweight frame from the support member and the counterweight is fixed to the guide rail for the counterweight.

Brief Summary of the Invention

In the conventional elevator apparatus, however, the counterweight is fixed to the hoistway. Accordingly, if the hoisting machine or the like is driven, the operation can be
20 carried out safely without moving the car as well as the counterweight. Yet, there is a possibility that a drive unit for driving the hoisting machine is operated also in a state where the counterweight is fixed during the pit operation. On the other hand, from the viewpoint of ensuring the safety during maintenance and inspection, it is desirable to reliably shut off power supply to the hoisting machine in conjunction with the operation of fixing the counterweight.

25 An object of the present invention is to provide an elevator apparatus in which a hoisting machine which may be in the vicinity of a maintenance work is prevented from being energized when a cage is prevented during the maintenance work from moving.

According to the invention, an elevator apparatus comprises a pair of a cage and a counterweight connected to each other by a main rope in a hoistway so that one of the cage and
30 counterweight rises when the other one of the cage and counterweight falls, a cage guide rail

along which the cage is movable vertically, a counterweight guide rail along which the counterweight is movable vertically, a fixing device for maintenance having a connecting member capable of fixing the counterweight with respect to the counterweight guide rail during a time period of maintenance work, and a hoisting machine driving the cage and the counterweight
5 through the main rope, wherein the fixing device for maintenance has a storage portion capable of holding the connecting member during another time period other than the time period of maintenance work, and a detecting portion for detecting non-existence of the connecting member in the storage portion and shutting off an electric power supply to the hoisting machine when the connecting member does not exist in the storage portion.

10 In the elevator apparatus described above, the electric power supply to the hoisting machine cannot be shut off when the connecting member exists in the storage portion, but the electric power supply to the hoisting machine can be shut off when the connecting member does not exist in the storage portion, so that during the time period of the maintenance work, the counterweight is prevented from ascending or descending and the hoisting machine is
15 prevented from energized, to keep a worker's safety.

Further, according to the invention, the storage portion is capable of holding therein a plurality of fixing rods as the connecting member, and the detecting portion is capable of detecting the non-existence of the connecting member in the storage portion when at least one of the fixing rods does not exist in the storage portion.

20 Therefore, irrespective of a total number of the fixing rods, the detecting portion can detect securely the non-existence of the connecting member with a simplicity in structure of the detecting portion.

Further, according to the invention, the storage portion is capable of holding therein a plurality of fixing rods as the connecting member, and has an insert holding member
25 including insert holes through which respective ones of the fixing rods are inserted into the insert holding member to be held by the insert holding member, a cam movable between a position at which the cam closes at least one of the insert holes to prevent at least one of the fixing rods from extending through the at least one of the insert holes and the detecting portion detects from the position of the cam the non-existence of the connecting member in the storage portion and
30 another position at which the cam opens at least one of the insert holes to allow at least one of the fixing rods to extend through respective one of the insert holes and the detecting portion detects from the another position of the cam the existence of the connecting member in the storage portion, and a stopper for limiting a movable range of the cam so that the cam is capable of being positioned at the position.

Therefore, when the cam is rotated to allow the all of the fixing rods to extend through respective ones of the insert holes, the detecting portion detects the existence of the connecting member in the storage portion to allow the electric power supply to the hoisting machine, whereby the electric power supply to the hoisting machine can be securely restarted in response to a completion of the maintenance work.

Further, according to the invention, the storage portion is capable of holding therein a plurality of fixing rods as the connecting member, and has an insert holding member including insert holes through which respective ones of the fixing rods are inserted into the insert holding member to be held by the insert holding member, and a cam movable between a position at which the cam closes at least one of the insert holes to prevent at least one of the fixing rods from extending through the at least one of the insert holes and the detecting portion detects from the position of the cam the non-existence of the connecting member in the storage portion and another position at which the cam opens at least one of the insert holes to allow at least one of the fixing rods to extend through respective one of the insert holes and the detecting portion detects from the another position of the cam the existence of the connecting member in the storage portion, and a stopper for limiting a movable range of the cam so that the cam is capable of being positioned at the position, and the cam is capable of being held at the another position by at least one of the fixing rods held in the insert holding member.

Therefore, the electric power supply to the hoisting machine is securely restarted and kept by the at least one of the fixing rods held in the insert holding member, and is shut off by a removal of the at least one of the fixing rods from the insert holding member to be kept easily.

In the elevator apparatus of the invention, the electric power supply to the hoisting machine cannot be shut off when the connecting member exists in the storage portion, but is shut off when the connecting member does not exist in the storage portion, whereby during the time period of the maintenance work, the counterweight is prevented from falling accidentally and the hoisting machine is prevented securely from being energized, so that the worker's safety is kept.

Brief Description of the Several Views of the Drawings

Fig. 1 is a front view showing essential parts of an elevator apparatus according to an embodiment of the present invention;

Fig. 2 is a sectional view showing the overall structure of the elevator apparatus to which the present invention is applied;

Fig. 3 is a plan view of the elevator apparatus shown in Fig. 1; and

Fig. 4 is an enlarged perspective view showing the essential parts of the elevator apparatus shown in Fig. 1.

Detailed Description of the Invention

5 Hereinafter, embodiments of the present invention will be described with reference to the drawings.

Fig. 2 is a side view showing a schematic structure of an elevator apparatus to which the present invention is applied. The elevator apparatus is structured as described below. That is, an end support portion 3 fixes one end of a main rope 2 to an upper portion within a
10 hoistway 1. An intermediate portion of the main rope 2 passes over a pulley 7, whose position is fixed, through a pair of car lower pulleys 5 and 6 which are disposed below a car 4. The intermediate portion further passes over a drive sheave 9 of a hoisting machine 8 which is fixed to a lower pit of the hoistway 1. The other end support portion 13, which is provided at an upper portion within the hoistway 1, fixes the other end of the main rope 2, through a pulley 10,
15 whose position is fixed, and a pulley 11 of a counterweight 12. A control device 14 is attached to a wall within the hoistway 1. The control device 14 drives the hoisting machine 8 to guide the car 4 along a guide rail 15 for the car and to guide the counterweight 12 to ascend and descend along guide rails 16 for the counterweight which are engaged with guide portions 29 shown in Fig. 1.

20 In the elevator apparatus structured as described above, in the case of performing maintenance of constituent equipment, such as the hoisting machine 8 or the control device 14, a fixing device 17 for maintenance is provided. The fixing device 17 for maintenance temporarily fixes a counterweight frame 18 of the counterweight 12 mechanically to the guide rails 16 for the counterweight, and inhibits the car 4 and the counterweight 12 from ascending
25 and descending.

Fig. 1 is an enlarged view showing the vicinity of the fixing device 17 for maintenance as an essential part of the elevator apparatus shown in Fig. 2. The counterweight 12 includes the counterweight frame 18, a plurality of weights 19, and the pulley 11. The counterweight frame 18 is allowed to be movable along the guide rails 16 for the counterweight
30 by the plurality of guide portions 29. The plurality of weights 19 is detachably loaded in the counterweight frame 18. The pulley 11 is rotatably attached to an upper portion of the counterweight frame 18. The guide rails 16 for the counterweight provided in the vicinity of the counterweight 12 are provided with the fixing device 17 for maintenance to inhibit the

counterweight 12 from ascending and descending. The fixing device 17 for maintenance includes fixing rods 20 and 21, such as a fixing bolt or a fixing pin, a storage portion 22, a pair of support members 23 and 24, and a detecting portion 25. The storage portion 22 stores the fixing rods 20 and 21. The pair of support members 23 and 24 are fixed to the guide rails 16 for the counterweight at positions where the support members do not hinder the vertical motion of the counterweight 12. Further, the support members 23 and 24 hold the counterweight frame 18, which stops at a predetermined position, so as to surround the counterweight frame 18, and mechanically couple the counterweight frame 18 and the guide rails 16 for the counterweight with the fixing rods 20 and 21 inserted. The detecting portion 25 detects that the fixing rods 20 and 21 are detached from the storage portion 22, turns off the hoisting machine 8, and electrically locks the car 4 and the like so as to be prevented from ascending and descending. The detecting portion 25 is, for example, a limit switch.

As shown in the plan view of Fig. 3, the storage portion 22 of the fixing device 17 for maintenance includes a holding bracket 26 having a substantially U-shape, bolts 27, nut-like holding screw fittings 37 and 38, a first cam 30, a second cam 31, and the detecting portion 25. The holding bracket 26 is disposed on the back surface side of the guide rails 16 for the counterweight, for example. The bolts 27 fix the holding bracket 26 to the guide rail 16 for the counterweight. The screw fittings 37 and 38 for maintenance are fixed to the inside of an opposing portion 28a of the holding bracket 26. The first cam 30 is provided outside an opposing portion 28b of the holding bracket 26 and is elastically urged by an urging spring or the like so as to be rotatable clockwise. Similarly, the second cam 31 is provided outside the opposing portion 28b and is elastically urged so as to be rotatable clockwise. The detecting portion 25 detects that the both cams 30 and 31 are rotated clockwise by a predetermined angle when the fixing rods 20 and 21 that inhibit rotation of the cams 30 and 31 are removed. The detecting portion 25 is, for example, a limit switch.

The detecting portion 25 detects that the fixing rods 20 and 21 are stored from the position where the both cams 30 and 31 are rotated when the fixing rods 20 and 21 are stored in the storage portion 22. When the storage is detected, the control device 14 allows a power supply circuit of the hoisting machine 8 to turn on to thereby activate a drive unit for driving the hoisting machine 8. However, as described later, when the fixing rods 20 and 21 are removed from the storage portion 22, the both cams 30 and 31 are rotated clockwise by an elastic urging force. The detecting portion 25 having detected the rotation electrically locks the power supply circuit of the hoisting machine 8 so as to be turned off.

A further detailed structure of the fixing device 17 for maintenance will be

described with reference to the perspective view of Fig. 4. As shown in Fig. 4, an insertion holding member 32 having insertion holes 32a and 32b, through which the fixing rods 20 and 21 are inserted and guided to be screwed into the holding screw fittings 37 and 38, respectively, is fixed to the outside of the opposing portion 28b of the holding bracket 26. A stopper 33 that
5 inhibits the clockwise rotation of the first cam 30 and the second cam 31 after the first cam 30 and the second cam 31 are rotated clockwise by the predetermined angle around a central shaft 34 by an elastic urging force is fixed to the insertion holding member 32. Free ends of the first cam 30 and the second cam 31, which are disposed between the insertion holding member 32 and the stopper 33, are respectively provided with insertion holes 30a and 31a that respectively
10 coincide with the insertion holes 32a and 32b of the insertion holding member 32. At the other end side of the first cam 30 and the second cam 31, an operation detecting portion 35 of the detecting portion 25 is disposed. The operation detecting portion 35 detects the clockwise rotation.

The holding screw fitting 37 and the insertion hole 32a of the insertion holding
15 member 32 are positioned on a straight line. When the first cam 30 is rotated counterclockwise at the storage position against the elastic urging force, the insertion hole 30a of the first cam 30 is also positioned on the straight line, and the fixing rod 20 is also positioned on the straight line. The holding screw fitting 38 and the insertion hole 32b of the insertion holding member 32 are positioned on another straight line. When the second cam 31 is rotated counterclockwise at the
20 storage position against the elastic urging force, insertion hole 31a of the second cam 31 is also positioned on the other straight line, and the fixing rod 20 is also positioned on the other straight line.

Herein, the first cam 30 and the second cam 31 constitute an interlock mechanism. The interlock mechanism allows the first cam 30 and the second cam 31 to be
25 rotated counterclockwise around the central shaft 34 by urging springs. When the insertion hole 30a of the first cam 30 and the insertion hole 31a of the second cam 31 do not coincide with the insertion holes 32a and 32b of the insertion holding member 32, the insertion of the fixing rods 20 and 21 is prevented. Specifically, at a position where the stopper 33 is brought into contact with the first cam 30 and the second cam 31, the fixing rods 20 and 21 are prevented
30 from being inserted to be stored in the storage portion 22. When the interlock mechanism allows the fixing rods 20 and 21 to be inserted to be stored in the storage portion 22, the first cam 30 and the second cam 31 can reliably reset the detecting portion 25.

Thus, the power supply of the hoisting machine 8 can be prevented from being driven. If the detecting portion 25, which is newly provided, is not reset at a proper time, the

hoisting machine 8 cannot be controlled to be driven thereafter by the control device 14. However, the interlock mechanism can reliably prevent the operation of resetting the detecting portion 25 from being omitted, by utilizing the timing and the feature of storing the fixing rods 20 and 21 into the storage portion 22.

5 Note that the structure of the interlock mechanism is not limited to that shown in the figure, but various structures may be used. For example, notches may be used in place of the insertion holes 30a and 31a, and any form that satisfies the insertion conditions of the fixing rods 20 and 21 as described above may also be used instead of using the insertion holes 30a and 31a. The first cam 30 and the second cam 31 are held at positions where the cams are brought
10 into contact with the stopper 33 by an elastic urging force in the stationary state. Alternatively, the cams may be held at the same position by other means such as mechanical engagement instead of using the elastic urging force.

 When the fixing rods 20 and 21 are stored in the storage portion 22 in the stationary state, the first cam 30 and the second cam 31 are first rotated counterclockwise against
15 the elastic urging force around the central shaft 34 from the state shown in Fig. 4 so that the insertion holes 30a and 31a and the insertion holes 32a and 32b of the insertion holding member 32 are positioned on the same straight line described above. In this state, the fixing rods 20 and 21 are inserted into the insertion holes 30a and 31a, respectively, and are then inserted into the insertion holes 32a and 32b of the insertion holding member 32, respectively. Further,
20 insertion-side leading ends of the fixing rods 20 and 21 are screwed into the holding screw fittings 37 and 38, respectively. In the state of holding the fixing rods 20 and 21, the both cams 30 and 31 are rotated counterclockwise against the elastic urging force. Also thereafter, the fixing rods 20 and 21 in the storage state inhibit the cams from being rotated clockwise by the elastic urging force.

25 In the case of storing the fixing rods 20 and 21 into the storage portion 22 by the interlock mechanism described above, the first cam 30 and the second cam 31, which inhibit insertion of the fixing rods, should be rotated without fail. The detecting portion 25 can be reset by utilizing the rotation of the first cam 30 and the second cam 31. Accordingly, at the time of storage, the detecting portion 25 is reset without fail, and the power supply of the
30 hoisting machine 8 can be controlled as usual by the control device 14. Thus, the operation of resetting the detecting portion 25 is prevented from being omitted.

 Next, the fixing device 17 for maintenance of the constituent equipment such as the hoisting machine 8 or the control device 14 will be described. First, the control device 14 drives the hoisting machine 8 to guide the car 4 to the vicinity of the highest floor of the

hoistway 1 along the guide rail 15 for the car through the main rope 2. Further, the counterweight 12 is positioned in the vicinity of the lowermost portion of the hoistway 1 along the guide rails 16 for the counterweight and brought into the state shown in Fig. 1. At this time, as shown in Fig. 1, the support members 23 and 24 hold predetermined portions of the counterweight frame 18 so as to surround the predetermined portions. In this state, as described above, the fixing rods 20 and 21 are stored in the storage portion 22, and the detecting portion 25 is reset according to the positions of the first cam 30 and the second cam 31.

After that, an operator entering the pit carries out an operation of fixing the counterweight 12 to the guide rails 16 for the counterweight by using the fixing device 17 for maintenance. This operation is carried out after the fixing rods 20 and 21 stored in the storage portion 22 are detached. As shown in Fig. 4, when the fixing rod 20 is extracted while being rotated, the insertion-side leading end of the fixing rod 20 is unscrewed from the holding screw fitting 37 and passes through the insertion hole 32a of the insertion holding member 32. After that, the fixing rod 20 is extracted from the insertion hole 30a of the first cam 30 and detached from the storage portion 22.

The fixing rod 20 thus detached is inserted between the support member 23 and the counterweight frame 18, which are shown in Figs. 1 and 3, thereby mechanically fixing the support member 23 and the counterweight frame 18. When a fixing pin is used as the support member 23, the fixing pin prevents disengagement. When a bolt is used as the support member 23, at least a portion of the bolt is screwed to prevent disengagement.

Next, when the fixing rod 21 shown in Fig. 4 is extracted while being rotated in a similar manner, the insertion-side leading end of the fixing rod 21 is unscrewed from the holding screw fitting 38 and passes through the insertion hole 32b of the insertion holding member 32. After that, the fixing rod 21 is extracted from the insertion hole 31a of the second cam 31 and detached from the storage portion 22. The second fixing rod 21 is inserted between the other support member 24 and the counterweight frame 18, which are shown in Figs. 1 and 3, thereby mechanically fixing the support member 24 and the counterweight frame 18.

At this time, the first cam 30 is rotated clockwise around the central shaft 34 by an elastic urging force (not shown). The second cam 31 is also rotated clockwise around the central shaft 34 by an elastic urging force (not shown). The other ends of the cams drive the operation detecting portion 35 of the detecting portion 25. Accordingly, the detecting portion 25 detects that the two fixing rods 20 and 21 are detached from the storage portion 22, and the power supply circuit of the hoisting machine 8 is turned off and electrically locked. This prevents the hoisting machine 8, which is often disposed in the vicinity of the maintenance

operation, from being accidentally activated.

In the case where the first cam 30 and the second cam 31 are separately rotated around the central shaft 34, the first cam 30 and the second cam 31 are rotated by the fixing rod first detached from the storage portion 22, and the detecting portion 25 can turn off and
5 electrically lock the power supply circuit of the hoisting machine 8. In such a mode, a safer elevator apparatus can be achieved. If such a mode is employed, in the case of returning the fixing rods 20 and 21, for example, the first cam 30 is rotated counterclockwise to return the fixing rod 20. At this time, the first cam 30 is returned to the position where the detecting portion 25 is reset. Meanwhile, the second cam 31 allows the detecting portion 25 to
10 continuously turn off and electrically lock the power supply circuit of the hoisting machine 8, and the second cam 31 is rotated counterclockwise to return the fixing rod 21, thereby resetting the detecting portion 25. Accordingly, the safety during the returning operation is improved. However, when the first cam 30 and the second cam 31 are mechanically coupled and integrally rotated around the central shaft 34, the cams are rotated by the fixing rod that is finally detached
15 from the storage portion 22, and the detecting portion 25 turns off and electrically locks the power supply circuit of the hoisting machine 8. Also in this case, the interlock mechanism described above is effectively operated.

In this manner, maintenance of the constituent equipment, such as the hoisting machine 8 or the control device 13, can be carried out safely, and the number of operators
20 located to secure the safety can be reduced. After completion of the operation, the procedure is performed reversely. That is, the fixing rods 20 and 21, which are used for the support members 23 and 24, are removed to be stored into the storage portion 22 again, so that the detecting portion 25 is reset according to the positions of the first cam 30 and the second cam 31.

In the case of using a limit switch as the detecting portion 25, when the electric
25 circuit of the hoisting machine 8 is turned off if a spring within the limit switch is broken, the power supply circuit can be reliably turned off based on the principle of fail-safe, which leads to safe operation of a system.

In this embodiment, to fix the balance weight frame 16 to the guide rail 15 for the car so as to inhibit the ascending/descending operation of the counterweight 12, the pair of guide
30 rails 16 for the counterweight are respectively attached with the support members 23 and 24, and the two fixing rods 20 and 21 are used to mechanically couple the counterweight frame 18 and the guide rails 16 for the counterweight. However, the number of the support members 23 and 24 and the fixing rods 20 and 21, and the attaching positions of the support members 23 and 24 can be arbitrarily selected depending on the support strength and the like.

Further, in this embodiment, the fixing rods 20 and 21, such as a fixing bolt, are used, but the fixing members are not limited thereto. Coupling members having other shapes may also be used. Furthermore, the detecting portion 25 detects the attachment/detachment of the coupling members, such as the two fixing rods 20 and 21, through the cams 30 and 31, respectively. Alternatively, even when the detecting portion 25 detects the attachment/detachment of the coupling member, such as at least one fixing rod 20, through the cam 30, substantially the same effect can be expected.

As a further another embodiment, in the case of performing maintenance of the constituent equipment, such as the hoisting machine 8 or the control device 14, the stopping position of the counterweight 12 may be determined such that the counterweight 12 is loaded on a buffer 36 which is disposed below the counterweight 12 as shown in Fig. 1.

The elevator apparatus structured as described above is provided with the storage portion 22 which stores the coupling members, such as the fixing rods 20 and 21, in the stationary state, and the detecting portion 25 which detects that the coupling members are extracted from the storage portion 22 and electrically locks the power supply circuit of the hoisting machine 8 so as to be held in the turned off state. Accordingly, in the state where the coupling members are stored, there is no need to turn off the power supply of the hoisting machine 8. Meanwhile, in the state where the coupling members are extracted to perform maintenance of the constituent equipment, such as the hoisting machine 8 or the control device 13, the power supply of the hoisting machine 8 is electrically locked so as to be turned off. Consequently, the counterweight 12 and the like are mechanically inhibited from ascending and descending during the maintenance operation, and the drive unit for driving the hoisting machine 8 is electrically inhibited reliably from being operated during the maintenance operation. This makes it possible to secure the safety of operators.

The fixing rods 20 and 21 are used as the coupling members. The cams 30 and 31 are provided such that the rotation of the cams 30 and 31 is inhibited by the fixing rods 20 and 21, which are stored in the storage portion 22 of the fixing device 17 for maintenance, and the cams 30 and 31 are rotated when the fixing rods 20 and 21 are extracted from the storage portion 22. Further, the detecting portion 25 detects that the fixing rods 20 and 21 are extracted by the rotation of the cams 30 and 31, thereby further facilitating the detection of the attachment/detachment of the fixing rods 20 and 21. Even when a plurality of fixing rods 20 and 21 is provided as needed, the common detecting portion 25 can be easily controlled by the cams. Moreover, the fixing rods 20 and 21 can be inserted from the insertion holes 32a and 32b of the insertion holding members 32 when the detecting portion 25 is reset by the cams 30 and

31. Consequently, the detecting portion 25, which is newly provided, prevents the operation of returning to the stationary state from being omitted when the fixing rods 20 and 21 are stored in the storage portion 22.

Claims:

1. An elevator apparatus comprising a pair of a cage and a counterweight connected to each other by a main rope in a hoistway so that one of the cage and counterweight rises when the other one of the cage and counterweight falls, a cage guide rail along which the cage is movable vertically, a counterweight guide rail along which the counterweight is movable vertically, a fixing device for maintenance having a connecting member capable of fixing the counterweight with respect to the counterweight guide rail during a time period of maintenance work, and a hoisting machine driving the cage and the counterweight through the main rope,

characterized in that the fixing device for maintenance has a storage portion for holding the connecting member during a normal condition, and a detecting portion for shutting off an electric power supply to the hoisting machine when the detecting portion detects that the connecting member is removed from the storage portion, a plurality of fixing rods are used as the connecting member, the storage portion has an insert holding member including insert holes through which respective ones of the fixing rods are inserted into the insert holding member to be held by the insert holding member, a cam for closing releasably inserting sides of the insert holes of the insert holding member and resetting the detecting portion when the cam reaches a position at which the fixing rods are capable of being inserted from the insert holes, and a stopper for positioning the cam at another position at which the cam closes the inserting sides of the insert holes, the cam is held at the position for resetting the detecting portion by the fixing rods inserted from the insert holes to be held in the storage portion and is moved by an elastic force to be positioned at the another position by the stopper to close the inserting sides of the insert holes when the fixing rods are removed from the storage portion, and the detecting portion detects that at least one of the fixing rods is removed from the storage portion.