

[Designation of Document] Specification

[Title of the Invention] ELEVATOR

[Technical Field]

[0001]

The present invention relates to an elevator for detecting opening or closing of a door part of an elevator car or a door part disposed on each floor of a building structure.

[Background Art]

[0002]

An elevator has a doorway on each floor of a building structure so as to allow access to people and articles. Similarly, an opening for allowing access to the people and the articles is disposed in an elevator car in which the people get and the articles are placed. The doorway and the opening of the elevator car respectively have an openable and closeable door part.

[0003]

The door part has a detection switch for detecting a state where the door part is closed (hereinafter, referred to as "door closing"). For example, as a technique for detecting an open/closed state of the door part by using a detection switch, a technique disclosed in Patent Document 1 is known. Patent Document 1 discloses the technique as follows. An operation permission determination circuit outputs an operation permission command to an operation control circuit, only in

a case where a fully closed state confirmation signal (ON-signal) is input from both a hall door fully closed state confirmation circuit and a cage door fully closed state confirmation circuit. When a cage door is open or closed, in a case where an input signal output from the hall door fully closed state confirmation circuit and an input signal output from the cage door fully closed state confirmation circuit do not coincide with each other, any one of a hall door switch and a cage door switch is determined as abnormal, and an operation prohibiting command is output.

[0004]

For example, as another technique for detecting the open/closed state of the door, a technique disclosed in Patent Document 2 is known. Patent Document 2 discloses the technique including a motor for generating a driving force for opening or closing a plurality of cage doors, a transmission mechanism for transmitting the driving force of the motor to the cage doors so as to open or close the cage doors in conjunction with each other, and a pulse generator for generating a pulse signal corresponding to a rotation amount of the motor. Furthermore, Patent Document 2 discloses the technique including a first switch for detecting that one of the cage doors reaches a first reference point and a second switch for detecting that the other one of the cage doors reaches a second reference point.

[Related art Document]

[Patent Document]

[0005]

[Patent Document 1] JP-A-2007-223730

[Patent Document 2] JP-A-10-67480

[Summary of the Invention]

[Problem that the Invention is to Solve]

[0006]

If dust and dirt are accumulated in a door rail or a door sill due to the long-term use, an opening/closing operation is performed in a state where the door part is inclined. Accordingly, even though an upper end portion of the door part is closed, there is a possibility that a gap may appear in a lower end portion of the door part. However, according to the techniques disclosed in Patent Document 1 and Patent Document 2, the detection switch is disposed only in the upper end portion of the door part. Therefore, although the upper end portion of the door part is closed, even in a state where the gap appears in the lower end part of the door part, it is determined similar to a normal case as if the door part is closed. Consequently, there is a problem in that the elevator car departs unintentionally.

[0007]

In view of the above-described problem, an object of the invention is to provide an elevator which can prevent the elevator from erroneously detecting that a door part is normal

even in a state where a gap appears in an upper end portion or a lower end portion of the door part. [Means for solving the problem]

[0008]

In order to solve the above-described problem and to achieve the object, there is provided an elevator including an elevator car, a door part, an upper detection switch, a lower detection switch, and a control unit. The elevator car causes an elevator hoistway disposed in a building structure to perform elevating movement. The door part covers an opening of the elevator car or a doorway disposed on each floor of the building structure so as to be openable and closeable. The upper detection switch outputs an upper door closing detection signal when it is detected that the door part moves to a closing end position which is a position where the door part covers and closes the opening or the doorway in an upper end portion in a vertical direction of the door part. The lower detection switch outputs a lower door closing detection signal when it is detected that the door part moves to the closing end position in a lower end portion in the vertical direction of the door part. The control unit determines whether or not to cause the elevator car to perform the elevating movement, based on the upper door closing detection signal and the lower door closing detection signal. In addition, the control unit determines that the elevator car is capable of performing the elevating

movement, when the control unit receives both the upper door closing detection signal and the lower door closing detection signal. [Advantage of the Invention]

[0009]

According to the elevator having the above-described configuration, it is possible to prevent the elevator from erroneously detecting that the door part is normal even in a state where a gap appears in the upper end portion or the lower end portion of the door part.

[Brief Description of the Drawings]

[0010]

[Fig. 1] Fig. 1 is a schematic configuration diagram illustrating an elevator according to an embodiment.

[Fig. 2] Fig. 2 is a front view illustrating a door unit of an elevator car according to the embodiment.

[Fig. 3] Fig. 3 is a front view illustrating a door part on one side of a pair of door parts according to the embodiment.

[Fig. 4] Fig. 4 is a side view illustrating the door part of the embodiment.

[Fig. 5] Fig. 5 is a flowchart illustrating a departure command operation of the elevator car according to the embodiment.

[Fig. 6] Fig. 6 illustrates the door unit according to the embodiment, and is a front view illustrating a state where a gap appears on a lower end portion side of the door part.

[Fig. 7] Fig. 7 illustrates the door unit according to the embodiment, and is a front view illustrating a state where a gap appears on an upper end portion side of the door part.

[Fig. 8] Fig. 8 is a flowchart illustrating a failure prediction diagnostic operation of the door unit according to the embodiment.

[Fig. 9] Fig. 9 is a front view illustrating a building side door unit disposed on a building structure side according to the embodiment.

[Best Mode for Carrying Out the Invention]

[0011]

Hereinafter, an elevator according to an embodiment will be described with reference to Figs. 1 to 9. The same reference numerals will be given to common members in each drawing.

1. Embodiment

1-1. Configuration of Elevator

[0012]

First, a configuration of the elevator according to the embodiment (hereinafter, referred to as "this example") will be described with reference to Fig. 1.

Fig. 1 is a schematic configuration diagram illustrating the elevator according to this example.

[0013]

As illustrated in Fig. 1, an elevator 1 according to this example is a so-called elevator having no machine room, which

does not have a machine room installed above an elevator hoistway 100 formed inside a building structure. In the elevator 1 according to this example, an example will be described using the elevator having no machine room. However, the invention is not limited thereto. The invention may be applicable to the elevator having the machine room installed above the elevator hoistway 100.

[0014]

The elevator 1 has an elevator car 110 which performs elevating movement inside the elevator hoistway 100, a hoisting machine 120, a balance weight 130, a first driven pulley 140, a second driven pulley 150, a rope 170, and an elevator control device 60 (refer to Fig. 4).

[0015]

A lifting pulley 111 is disposed in a lower portion of the elevator car 110. The rope 170 is wound around the lifting pulley 111. Details of the elevator car 110 will be described later.

[0016]

A weight side pulley 131 is disposed in an upper portion of the balance weight 130. The rope 170 is wound around the weight side pulley 131. The hoisting machine 120 is located in a lowest portion of the elevator hoistway 100. The elevator car 110 and the balance weight 130 perform the elevating movement using a traction type via the rope 170. The hoisting machine

120 is controlled to be driven by a control unit.

[0017]

The first driven pulley 140 and the second driven pulley 150 are fixed to an uppermost portion of the elevator hoistway 100. One end 171 and the other end 172 of the rope 170 are fixed to the uppermost portion of the elevator hoistway 100. The rope 170 is hung on the first driven pulley 140 from the weight side pulley 131 disposed in the balance weight 130, and is wound around the hoisting machine 120, the second driven pulley 150, and the lifting pulley 111 of the elevator car 110 in this order.

[0018]

The hoisting machine 120 is driven, thereby causing the elevator car 110 and the balance weight 130 to perform the elevating movement inside the elevator hoistway 100. Hereinafter, a direction in which the elevator car 110 and the balance weight 130 perform the elevating movement will be referred to as the vertical direction.

[0019]

The elevator car 110 has a cage 10 for allowing access to people and articles and a door unit 12. The door unit 12 is configured to include a pair of door parts 11A and 11B. An opening is disposed on one surface of the cage 10, and the access to people and articles is allowed through the opening. The pair of door parts 11A and 11B is disposed so as to cover the

opening of the cage 10, and is openable and closeable in the cage 10.

[0020]

Fig. 2 is a front view illustrating the door unit 12 disposed in the elevator car 110.

As illustrated in Fig. 2, the pair of door parts 11A and 11B is supported by a door pocket 13 disposed in the cage 10 and a door sill 14 so as to be movable in an opening/closing direction. The door pocket 13 is disposed in an upper end portion of the vertical direction of the opening in the cage 10, and the door sill 14 is disposed in a lower end portion of the opening.

[0021]

An upper end portion 11a in the vertical direction of a first door part 11A has a first door hanger 17A, and the upper end portion 11a in the vertical direction of a second door part 11B has a second door hanger 17B.

[0022]

Movement rollers 25 are respectively rotatably disposed in the first door hanger 17A and the second door hanger 17B. The movement roller 25 slidably engages with a door rail 16 (to be described later).

[0023]

The first door hanger 17A has a first interlocking member 26 and an upper switch pressing member 31. The first interlocking member 26 protrudes upward from an upper end portion

of the first door hanger 17A. The second door hanger 17B has a second interlocking member 27. The second interlocking member 27 protrudes upward from an upper end portion of the second door hanger 17B. The first interlocking member 26 and the second interlocking member 27 interlock with a transfer belt 22 (to be described later).

[0024]

A lower end portion 11b in the vertical direction of the first door part 11A and the second door part 11B has a slider 18 which is slidably inserted into a guide groove disposed in the door sill 14. The lower end portion 11b of the first door part 11A has a lower switch pressing member 32 (to be described later). A lower detection switch 50 is disposed on the first door part 11A side in the door sill 14.

[0025]

The door pocket 13 has the door rail 16, a drive unit 21, the transfer belt 22, a driven roller 23, and an upper detection switch 40. The door rail 16 is located in the door pocket 13 so as to extend parallel to a horizontal direction. The movement roller 25 disposed in the door hangers 17A and 17B slidably engages with the door rail 16.

[0026]

The drive unit 21 is located on one end portion side in the horizontal direction in the door pocket 13, and the driven roller 23 is located on the other end portion side in the

horizontal direction in the door pocket 13. The transfer belt 22 is wound around a drive shaft of the drive unit 21 and the driven roller 23.

[0027]

The transfer belt 22 is formed in an endless state in which both end portions interlock with each other in a longitudinal direction. If the drive unit 21 is driven, the transfer belt 22 performs circulating movement between the driven roller 23 and the drive shaft of the drive unit 21. In this case, a lower portion and an upper portion in the vertical direction of the transfer belt 22 move in mutually opposite directions.

[0028]

The first interlocking member 26 of the first door part 11A interlocks with the lower portion of the transfer belt 22, and the second interlocking member 27 interlocks with the upper portion of the transfer belt 22. Therefore, if the drive unit 21 is driven so as to move the transfer belt 22, the pair of door parts 11A and 11B move in a door closing direction in which the door parts 11A and 11B move close to each other via the interlocking members 26 and 27, or in a door opening direction in which the door parts 11A and 11B move away from each other.

[0029]

Fig. 3 is a front view illustrating the first door part 11A, and Fig. 4 is a side view illustrating the first door part

11A.

As illustrated in Figs. 3 and 4, the upper switch pressing member 31 has an upper support bracket 33 and an upper cam switch piece 34. The upper support bracket 33 protrudes upward from the upper end portion of the first door hanger 17A. The upper end portion in the vertical direction in the upper support bracket 33 is located above the door rail 16 in the vertical direction. The upper end portion of the upper support bracket 33 has the upper cam switch piece 34.

[0030]

The upper cam switch piece 34 protrudes toward the door pocket 13 from the upper support bracket 33. The upper cam switch piece 34 is supported by the upper support bracket 33, and is located above the door rail 16 in the vertical direction so as to face the door rail 16. The upper cam switch piece 34 is formed in a substantially flat plate shape. The upper cam switch piece 34 is located in the upper end portion of the upper support bracket 33 so as to be substantially parallel to the horizontal direction.

[0031]

An inclined surface portion 34a is formed in one end portion on a side in the door closing direction of the first door part 11A in the upper cam switch piece 34. The inclined surface portion 34a is inclined downward in the vertical direction as the inclined surface portion 34a extends from one end portion

of the upper cam switch piece 34 toward a side in the door closing direction side of the first door part 11A. The upper cam switch piece 34 comes into contact with the upper detection switch 40 (to be described later), when the upper cam switch piece 34 moves to a position (hereafter, referred to as a "closing end position") T1 where the first door part 11A and the second door part 11B cover and close the opening.

[0032]

The upper detection switch 40 has an upper switch main body 41 and an upper switch bracket 42. The upper switch bracket 42 is fixed above the door rail 16 in the door pocket 13 in the vertical direction. The upper switch main body 41 is fixed to the upper switch bracket 42.

[0033]

The upper switch main body 41 has a contact roller 41a. The contact roller 41a is disposed in the lower end portion in the vertical direction of the upper switch main body 41. If the first door part 11A moves to the closing end position T1, the contact roller 41a faces the upper cam switch piece 34. The contact roller 41a is pressed upward in the vertical direction by coming into contact with the inclined surface portion 34a of the upper cam switch piece 34. The contact roller 41a comes into contact with a horizontal portion of the upper cam switch piece 34. In this manner, the upper switch main body 41 is turned on. The upper detection switch 40 outputs

an upper door closing detection signal to the elevator control device 60.

[0034]

The inclined surface portion 34a is disposed in the upper cam switch piece 34, and the contact roller 41a is disposed in the upper switch main body 41. In this manner, it is possible to relax an impact force generated when the upper cam switch piece 34 and the upper switch main body 41 come into contact with each other. As a result, the upper switch main body 41 comes into contact with the upper cam switch piece 34. Therefore, it is possible not only to prevent the upper switch main body 41 from being damaged, but also to suppress abnormal sound generated at the time of the contact therebetween.

[0035]

The lower switch pressing member 32 has a lower support bracket 35 and a lower cam switch piece 36. The lower support bracket 35 is fixed to the lower end portion 11b of the first door part 11A, and protrudes downward from the lower end portion 11b in the vertical direction. The lower end portion in the vertical direction of the lower support bracket 35 is located below the door sill 14 in the vertical direction. The lower cam switch piece 36 is disposed in the lower end portion of the lower support bracket 35.

[0036]

The lower cam switch piece 36 protrudes downward in the

vertical direction of the door sill 14 from the lower end portion of the lower support bracket 35. The lower cam switch piece 36 is supported by the lower support bracket 35, and is located below the door sill 14 in the vertical direction so as to face the door sill 14. The lower cam switch piece 36 is formed in a substantially flat plate shape. The lower cam switch piece 36 is located substantially parallel to the horizontal direction in the lower end portion of the lower support bracket 35.

[0037]

The inclined surface portion 36a is formed in one end portion on the side in the door closing direction of the first door part 11A in the lower cam switch piece 36. The inclined surface portion 36a is inclined downward in the vertical direction as the inclined surface portion 36a extends from one end portion of the lower cam switch piece 36 toward the side in the door closing direction of the first door part 11A. The lower cam switch piece 36 comes into contact with the lower detection switch 50 (to be described later), when the first door part 11A moves to the closing end position T1.

[0038]

The lower detection switch 50 has a lower switch main body 51 and a lower switch bracket 52. The lower switch bracket 52 is fixed to the lower end portion in the vertical direction of the door sill 14. The lower switch bracket 52 protrudes downward in the vertical direction from the lower end portion

of the door sill 14. The lower switch main body 51 is fixed to the lower switch bracket 52.

[0039]

The lower switch main body 51 has a contact roller 51a. The contact roller 51a is disposed in the lower end portion in the vertical direction of the lower switch main body 51. If the first door part 11A moves to the closing end position T1, the contact roller 51a faces the lower cam switch piece 36. If the contact roller 51a is pressed after coming into contact with the lower cam switch piece 36, the lower switch main body 51 is turned on. The lower detection switch 50 outputs a lower door closing detection signal to the elevator control device 60.

1-2. Control system of Elevator

[0040]

Next, a configuration of a control system of the elevator 1 having the above-described configuration will be described with reference to Fig. 4.

As illustrated in Fig. 4, the elevator 1 has the elevator control device 60 serving as an example of the control unit. The elevator control device 60 controls the driving of respective units such as the hoisting machine 120 (refer to Fig. 1) and the drive unit 21 which opens and closes the door parts 11A and 11B. The elevator control device 60 has a departure condition determination unit 61 and a failure prediction

diagnostic unit 62.

[0041]

The departure condition determination unit 61 and the failure prediction diagnostic unit 62 are respectively connected to the upper detection switch 40 and the lower detection switch 50 in a wireless or wired manner. Based on the upper door closing detection signal and the lower door closing detection signal which are respectively output from the upper detection switch 40 and the lower detection switch 50, the departure condition determination unit 61 determines whether or not to cause the elevator car 110 to perform the elevating movement, that is, whether or not to cause the elevator car 110 to depart. In a case where the departure condition determination unit 61 determines that the elevator car 110 can depart, the departure condition determination unit 61 outputs a departure command to the elevator control device 60. Based on the departure command output from the departure condition determination unit 61, the elevator control device 60 drives the hoisting machine 120 (refer to Fig. 1) so as to cause the elevator car 110 to perform the elevating movement.

[0042]

The failure prediction diagnostic unit 62 diagnoses a failure prediction of the door parts 11A and 11B, based on the upper door closing detection signal and the lower door closing detection signal. A storage unit 63 is disposed in the failure

prediction diagnostic unit 62. The storage unit 63 stores a first timer, a second timer, a first threshold, and a second threshold. The first timer measures and stores a time spent until the lower detection switch 50 outputs the lower door closing detection signal after the upper detection switch 40 outputs the upper door closing detection signal. The second timer measures and stores a time spent until the upper detection switch 40 outputs the upper door closing detection signal after the lower detection switch 50 outputs the lower door closing detection signal.

[0043]

The failure prediction diagnostic unit 62 diagnoses the failure prediction of the door unit 12, based on the time stored in the first timer, a value of the first threshold, the time stored in the second timer, and a value of the second threshold. The failure prediction diagnostic unit 62 has a communication unit (not illustrated) for outputting a diagnosis result to an external management center or the elevator control device 60.

2. Departure Command Operation of Elevator Car

[0044]

Next, an example of a departure command operation of the elevator car 110 in the elevator 1 having the above-described configuration will be described with reference to Figs. 5 to 7.

Fig. 5 is a flowchart illustrating the example of the departure command operation of the elevator car 110. Fig. 6 is a front view illustrating a state where a gap appears on the lower end portion side of the door part. Fig. 7 is a front view illustrating a state where a gap appears on the upper end portion side of the door part.

[0045]

As illustrated in Fig. 5, in a case where an operation button disposed in the elevator car 110 is operated by a person, or if a predetermined time elapses in a state where the pair of door parts 11A and 11B is open, the elevator control device 60 outputs a door closing command (Step S11). If the door closing command is output through the process in Step S11, the drive unit 21 is driven so as to move the pair of door parts 11A and 11B in the door closing direction in which both of these move close to each other.

[0046]

Next, if the predetermined time elapses, the departure condition determination unit 61 determines whether or not the upper detection switch 40 is turned on (Step S12). That is, the departure condition determination unit 61 determines whether or not the first door part 11A moves in the door closing direction, whether or not the upper cam switch piece 34 of the upper switch pressing member 31 presses the contact roller 41a of the upper detection switch 40, and whether or not the upper

door closing detection signal is output from the upper detection switch 40.

[0047]

In a case where it is not determined that the upper detection switch 40 is turned on even after the predetermined time elapses in the process in Step S12 (determined as NO in Step S12), the departure condition determination unit 61 outputs a door opening command to open the pair of door parts 11A and 11B (Step S14). That is, the departure condition determination unit 61 determines that the gap appears in the upper end portion 11a of the pair of door parts 11A and 11B. The departure condition determination unit 61 temporarily opens the pair of door parts 11A and 11B.

[0048]

If the door closing command is output again in the process in Step S11, the elevator control device 60 drives the drive unit 21 so as to move the pair of door parts 11A and 11B in the door closing direction in which both of these move close to each other.

[0049]

In the process in Step S12, in a case where the departure condition determination unit 61 receives the upper door closing detection signal from the upper detection switch 40 and determines that the upper detection switch 40 is turned on (determined as YES in Step S12), the departure condition

determination unit 61 determines whether or not the lower detection switch 50 is turned on (Step S13). That is, the departure condition determination unit 61 determines whether or not the lower cam switch piece 36 of the lower switch pressing member 32 presses the contact roller 51a of the lower detection switch 50, and whether or not the lower door closing detection signal is output from the lower detection switch 50.

[0050]

In a case where it is not determined that the lower detection switch 50 is turned on even after the predetermined time elapses in the process in Step S13 (determined as NO in Step S13), the departure condition determination unit 61 outputs the door opening command to open the pair of door parts 11A and 11B (Step S14). That is, the departure condition determination unit 61 determines that a gap appears in the lower end portion 11 b of the pair of door parts 11A and 11B. The departure condition determination unit 61 temporarily opens the pair of door parts 11A and 11B.

[0051]

In the process in Step S13, in a case where the departure condition determination unit 61 receives the lower door closing detection signal from the lower detection switch 50 and determines that the lower detection switch 50 is turned on (determined as YES in Step S13), the departure condition determination unit 61 outputs the elevator car departure

instruction (Step S15).

[0052]

Here, if dust and dirt are accumulated in the guide groove on the door sill 14 side due to the long-term use, as illustrated in Fig. 6, a door closing operation is performed in a state where the lower end portion 11b of the door part 11A is inclined. Therefore, the door parts 11A and 11B are closed while being inclined in a so-called inverted V-shape in which a gap S1 in the lower end portion 11b of the pair of door parts 11A and 11B is larger than that in the upper end portion 11a. In this state, the upper detection switch 40 is pressed by the upper cam switch piece 34, and is turned on. However, the contact roller 51a of the lower detection switch 50 is not in contact with the lower cam switch piece 36. Accordingly, the lower detection switch 50 is not pressed.

[0053]

In addition, if dust and dirt are accumulated on the door rail 16 side due to the long-term use, as illustrated in Fig. 7, the door closing operation is performed in a state where the upper end portion 11a of the door part 11A is inclined. Therefore, the door parts 11A and 11B are closed while being inclined in a so-called V-shape in which a gap S2 in the upper end portion 11a of the pair of door parts 11A and 11B is larger than that in the lower end portion 11b. In this state, the lower detection switch 50 is pressed by the lower cam switch

piece 36, and is turned on. However, the contact roller 41a of the upper detection switch 40 is not in contact with the upper cam switch piece 34. Accordingly, the upper detection switch 40 is not pressed.

[0054]

In contrast, according to the elevator 1 of this example, when both the upper detection switch 40 and the lower detection switch 50 are turned on and both the upper door closing detection signal and the lower door closing detection signal are output, the elevator car 110 can perform the elevating movement. In this manner, as illustrated in Figs. 6 and 7, even in a state where the pair of door parts 11 A and 11 B is closed while being inclined in the inverted V-shape or in the V-shape, it is possible to prevent the elevator control device 60 from erroneously detecting the door unit 12 as if the door unit 12 is normal. As a result, it is possible to prevent the elevator car 110 from performing the elevating movement in a state where the gaps S1 and S2 appear in the upper end portion 11a and the lower end portion 11b of the pair of door parts 11A and 11B.

[0055]

In a case where any one of the upper door closing detection signal and the lower door closing detection signal is not output even after the predetermined time elapses, the departure condition determination unit 61 determines that the door closing operation of the door unit 12 is abnormal, and opens the pair

of door parts 11A and 11B. In this manner, foreign substances caught in the upper end portion 11a or the lower end portion 11b of the pair of door parts 11A and 11B can be removed, or the dust and dirt accumulated in the door sill 14 or the door rail 16 can be removed.

3. Failure prediction Diagnostic Operation

[0056]

Next, an example of a failure prediction diagnostic operation of the door unit 12 in the elevator 1 having the above-described configuration will be described with reference to Fig. 8.

Fig. 8 is a flowchart illustrating the failure prediction diagnostic operation.

[0057]

As illustrated in Fig. 8, in a case where the operation button disposed in the elevator car 110 is operated by a person, or if the predetermined time elapses in a state where the pair of door parts 11A and 11B is open, the elevator control device 60 outputs the door closing command (Step S21). Next, the failure prediction diagnostic unit 62 determines whether or not the upper detection switch 40 is turned on (Step S22). That is, the failure prediction diagnostic unit 62 determines whether or not the upper door closing detection signal is output from the upper detection switch 40.

[0058]

In the process in Step S22, in a case where the failure prediction diagnostic unit 62 receives the upper door closing detection signal from the upper detection switch 40 and determines that the upper detection switch 40 is turned on (determined as YES in Step S22), the failure prediction diagnostic unit 62 causes the first timer to start time measurement (Step S23). Next, the failure prediction diagnostic unit 62 determines whether or not the lower detection switch 50 is turned on (Step S24). That is, the failure prediction diagnostic unit 62 determines whether or not the lower door closing detection signal is output from the lower detection switch 50.

[0059]

In the process in Step S24, in a case where the failure prediction diagnostic unit 62 receives the lower door closing detection signal from the lower detection switch 50 and determines that the lower detection switch 50 is turned on (determined as YES in Step S24), the failure prediction diagnostic unit 62 causes the first timer to stop the time measurement (Step S25). That is, the failure prediction diagnostic unit 62 causes the first timer to measure a time spent until the lower detection switch 50 outputs the lower door closing detection signal after the upper detection switch 40 outputs the upper door closing detection signal.

[0060]

Next, the failure prediction diagnostic unit 62 causes the storage unit 63 to store the time measured by the first timer (Step S26). Subsequently, the failure prediction diagnostic unit 62 determines whether or not the time measured by the first timer exceeds the first threshold (Step S27).

[0061]

In the process in Step S27, in a case where the failure prediction diagnostic unit 62 determines that the time measured by the first timer exceeds the first threshold (determined as YES in Step S27), the failure prediction diagnostic unit 62 outputs an inverted V-shape failure prediction to an external management center or the elevator control device 60 (Step S28). Subsequently, the elevator control device 60 performs a normal operation (Step S40). In this manner, the failure prediction diagnostic unit 62 can prevent the occurrence of a so-called inverted V-shape failure in which the gap S1 of the lower end portion 11b of the pair of door parts 11A and 11B is larger than that of the upper end portion 11a as illustrated in Fig. 6.

[0062]

In the process in Step S27, in a case where the failure prediction diagnostic unit 62 determines that the time measured by the first timer does not exceed the first threshold (determined as NO in Step S27), the failure prediction diagnostic unit 62 determines that the inverted V-shape failure as

illustrated in Fig. 6 does not occur. Subsequently, the elevator control device 60 performs the normal operation (Step S40).

[0063]

In the process in Step S22, in a case where the failure prediction diagnostic unit 62 determines that the upper detection switch 40 is not turned on (determined as NO in Step S22), the failure prediction diagnostic unit 62 determines whether or not the lower detection switch 50 is turned on (Step S31). In the process in Step S31, in a case where the failure prediction diagnostic unit 62 determines that the lower detection switch 50 is not turned on, the failure prediction diagnostic unit 62 returns to the process in Step S22.

[0064]

In the process in Step S31, in a case where the failure prediction diagnostic unit 62 receives the lower door closing detection signal from the lower detection switch 50 and determines that the lower detection switch 50 is turned on (determined as YES in Step S31), the failure prediction diagnostic unit 62 causes the second timer to start the time measurement (Step S32). Next, the failure prediction diagnostic unit 62 determines whether or not the upper detection switch 40 is turned on (Step S33).

[0065]

In the process of Step S33, in a case where the failure

prediction diagnostic unit 62 receives the upper door closing detection signal from the upper detection switch 40 and determines that the upper detection switch 40 is turned on (determined as YES in Step S33), the failure prediction diagnostic unit 62 causes the second timer to stop the time measurement (Step S34). That is, the failure prediction diagnostic unit 62 causes the second timer to measure a time spent until the upper detection switch 40 outputs the upper door closing detection signal after the lower detection switch 50 outputs the lower door closing detection signal.

[0066]

Next, the failure prediction diagnostic unit 62 causes the storage unit 63 to store the time measured by the second timer (Step S35). Subsequently, the failure prediction diagnostic unit 62 determines whether or not the time measured by the second timer exceeds the second threshold (Step S36).

[0067]

In the process in Step S36, in a case where the failure prediction diagnostic unit 62 determines that the time measured by the second timer exceeds the second threshold (determined as YES in Step S36), the failure prediction diagnostic unit 62 outputs the V-shape failure prediction to the external management center or the elevator control device 60 (Step S37). Subsequently, the elevator control device 60 performs the normal operation (Step S40). In this manner, the failure prediction

diagnostic unit 62 can prevent the occurrence of a so-called V-shape failure in which the gap S2 of the upper end portion 11a of the pair of door parts 11A and 11B is larger than that of the lower end portion 11b as illustrated in Fig. 7.

[0068]

In the process in Step S36, in a case where the failure prediction diagnostic unit 62 determines that the time measured by the second timer does not exceed the second threshold (determined as NO in Step S36), the failure prediction diagnostic unit 62 determines that the V-shape failure as illustrated in Fig. 7 does not occur. Subsequently, the elevator control device 60 performs the normal operation (Step S40). In this manner, the failure prediction diagnostic operation performed using the failure prediction diagnostic unit 62 is completed.

[0069]

In this way, according to the elevator 1 of this example, the failure prediction of the door unit 12 can be diagnosed, based on a difference between the timings at which the upper detection switch 40 and the lower detection switch 50 respectively output the upper door closing detection signal and the lower door closing detection signal. As a result, the door sill 14 or the door rail 16 can be cleaned, or maintenance work can be carried out for the door unit 12 before the failure occurs in the door unit 12. Furthermore, it is also possible to adjust a gap such as the gap S1 and S2 of the upper end portion

11a and the lower end portion 11b of the pair of door parts 11A and 11B.

[0070]

In the above-described example, an example has been described in which the failure prediction diagnostic unit 62 outputs the failure prediction when the time measured by the first timer or the second timer exceeds the first threshold or the second threshold. However, the invention is not limited thereto. For example, the storage unit 63 may store a difference ("time difference") in advance between the time at which the upper door closing detection signal is output when the door closing operation of the pair of door parts 11A and 11B is performed at an initial stage of installing the elevator 1 and the time at which the lower door closing detection signal is output. Subsequently, the failure prediction may be determined by comparing the time difference stored in advance in the storage unit 63 with the time difference after the elevator 1 is used for a predetermined period.

[0071]

Further, in the above-described example, an example has been described as follow. The first timer and the second timer are disposed in the failure prediction diagnostic unit 62 so as to predict the failure, based on the time difference between the times at which the upper detection switch 40 and the lower detection switch 50 respectively output the upper door closing

detection signal and the lower door closing detection signal. However, the invention is not limited thereto. For example, an encoder may be disposed in the drive unit 21 so as to determine the failure prediction, based on an actual position of the door part 11A when the upper detection switch 40 and the lower detection switch 50 respectively output the upper door closing detection signal and the lower door closing detection signal.

4. Configuration Example of Building Side Door Unit

[0072]

In the above-described embodiment, an example has been described in which the upper detection switch 40 and the lower detection switch 50 are disposed in the door parts 11A and 11B of the elevator car 110. However, the invention is not limited thereto. For example, the invention may be applied to a building side door unit which covers the doorway disposed in each floor of a building structure so as that the doorway is openable and closeable.

[0073]

Next, a configuration example of the building side door unit will be described with reference to Fig. 9.

Fig. 9 is a front view illustrating the building side door unit.

[0074]

As illustrated in Fig. 9, a building side door unit 212 has a pair of door parts 211A and 211B. The pair of the door

parts 211A and 211B are movably supported by a door pocket 213 disposed in the doorway of a building and a door sill 214. The door pocket 213 is disposed in the upper end portion in the vertical direction of the doorway, and the door sill 214 is disposed in the lower end portion of the doorway.

[0075]

A first door hanger 217A is disposed in an upper end portion 211a in the vertical direction of a first door part 211A, and a second door hanger 217B is disposed in the upper end portion 211a in the vertical direction of a second door part 211B. Movement rollers 225 are respectively rotatably disposed in the first door hanger 217A and the second door hanger 217B. The movement roller 25 slidably engages with a door rail 216 disposed in the door pocket 213.

[0076]

The first door hanger 217A has a first interlocking member 226 and an upper switch pressing member 231. The second door hanger 217B has a second interlocking member 227 and a locking hook member 271 configuring a locking mechanism 270. The locking hook member 271 is rotatably supported by the second door hanger 217B.

[0077]

A slider 218 slidably inserted into the guide groove disposed in the door sill 14 is disposed in a lower end portion 211b in the vertical direction of the first door part 211A and

the second door part 211B. A lower switch pressing member 232 is disposed in the lower end portion 211b of the first door part 211A. A lower detection switch 250 is disposed on the first door part 11A side of the door sill 14.

[0078]

The door pocket 213 has the door rail 216, a first pulley 221, a transfer belt 222, a second pulley 223, a fixing hook member 272, and an upper detection switch 240.

[0079]

The first pulley 221 is located on one end portion side in the horizontal direction in the door pocket 213, and the second pulley 223 is located on the other end portion side in the horizontal direction in the door pocket 213. The transfer belt 222 formed in an endless state is wound around the first pulley 221 and the second pulley 223. The first interlocking member 226 and the second interlocking member 227 interlock with the transfer belt 222.

[0080]

The fixing hook member 272 is fixed to the door pocket 213. The fixing hook member 272 engages with the locking hook member 271 so as to be releasable therefrom. The locking hook member 271 and the fixing hook member 272 configure the locking mechanism 270.

[0081]

The upper switch pressing member 231 has an upper support

bracket 233 and an upper cam switch piece 234. A configuration of the upper support bracket 233 and the upper cam switch piece 234 is the same as a configuration of the upper support bracket 33 and the upper cam switch piece 34 which are disposed in the elevator car 110. Thus, description thereof will be omitted.

[0082]

The upper detection switch 240 has an upper switch main body 241 and an upper switch bracket 242. The upper switch main body 241 has a contact roller 241a which comes into contact with the upper cam switch piece 234 when the first door part 211A moves to the closing end position. The other configuration is the same as the configuration of the upper detection switch 40 disposed in the elevator car 110. Thus, description thereof will be omitted.

[0083]

The lower switch pressing member 232 has a lower support bracket 235 and a lower cam switch piece 236. A configuration of the lower support bracket 235 and the lower cam switch piece 236 is the same as a configuration of the lower support bracket 35 and the lower cam switch piece 36 which are disposed in the elevator car 110. Thus, description thereof will be omitted.

[0084]

The lower detection switch 250 has a lower switch main body 251 and a lower switch bracket 252. The lower switch main body 251 has a contact roller 251a which comes into contact

with the lower cam switch piece 236 when the first door part 211A moves to the closing end position. The other configuration is the same as the configuration of the lower detection switch 50 disposed in the elevator car 110. Thus, description thereof will be omitted.

[0085]

In the upper detection switch 240, if the contact roller 241a is pressed after coming into contact with the upper cam switch piece 234, the upper switch main body 241 is turned on. The upper detection switch 240 outputs the upper door closing detection signal to the elevator control device 60 (refer to Fig. 4). If the contact roller 251a is pressed after coming into contact with the lower cam switch piece 236, the lower switch main body 251 is turned on. The lower detection switch 250 outputs the lower door closing detection signal to the elevator control device 60 (refer to Fig. 4).

[0086]

The departure condition determination unit 61 of the elevator control device 60 receives the upper door closing detection signal and the lower door closing detection signal from the upper detection switch 240 and the lower detection switch 250 which are disposed in the building side door unit 212 on each floor. The departure condition determination unit 61 outputs an elevator car departure instruction, when the departure condition determination unit 61 receives door closing

detection signals from all of the detection switches including the upper detection switch 40 and the lower detection switch 50 which are disposed in the elevator car 110, and the upper detection switch 240 and the lower detection switch 250 which are disposed in the building side door unit 212 on each floor.

[0087]

In this manner, in a state where gaps appear not only in the elevator car 110 but also the upper end portion 211a or the lower end portion 211b of the door parts 211A and 211B disposed in the building structure, it is possible to prevent the elevator car 110 from performing the elevating movement. As a result, it is possible to prevent the elevator car 110 from being interfered during the elevating movement, due to foreign substances entering the inside of the elevator hoistway 100 through the gap in the upper end portion 211a or the lower end portion 211b of the door parts 211A and 211B which are disposed in the building structure.

[0088]

The failure prediction diagnostic unit 62 receives the door closing detection signals individually from the upper detection switch 240 and the lower detection switch 250 which are disposed in the building side door unit 212 on each floor. In this manner, a state of the building side door unit 212 on each floor can be individually diagnosed.

[0089]

The present invention is not limited to the embodiment described above and illustrated in the drawings, and various modification examples can be made without departing from the gist of the invention described in the appended claims.

[0090]

In the embodiment described above, an example has been described in which the opening of the cage is opened or closed by causing the pair of door parts to move close to or to move away from each other. However, the invention is not limited thereto. The opening of the cage may be opened or closed by moving one door part.

[0091]

The detection switch is not limited to the detection switch having the contact roller described above. The switch pressing member for pressing the detection switch is not limited to the cam switch piece having the inclined surface portion described above. The invention can employ other various structures as long as the detection switch can be turned on when the door part moves to the closing end position T1.

[0092]

An example has been described in which the invention employs a mechanical detection switch for detecting that the door part moves to the closing end position T1 when the detection switch is pressed by the switch pressing member. However, the invention is not limited thereto. As the detection switch,

the invention may employ an optical detection switch including a light emitting unit for emitting light and a light receiving unit for receiving the light emitted from the light emitting unit. A light blocking plate may be disposed in the door part in order to block the light emitted from the light emitting unit when the door part moves to the closing end position T1. In this way, as the detection switch, the invention can employ infrared sensors or other various detection switches in addition to the mechanical and optical detection switches.

[0093]

In the description herein, terms such as "parallel" and "orthogonal" are used. However, the terms not only mean a strictly "parallel" and "orthogonal" state, but also mean a "substantially parallel" and "substantially orthogonal" state including a "parallel" and "orthogonal" state in a range where a function thereof can be further fulfilled.

[Description of Reference Numerals and Signs]

[0094]

1: elevator

10: cage

11A, 11B: door part

11a: upper end portion

11b: lower end portion

12: door unit

13: door pocket

14: door sill
16: door rail
17A, 17B: door hanger
21: drive unit
31: upper switch pressing member
32: lower switch pressing member
33: upper support bracket
34: upper cam switch piece
34a, 36a: inclined surface portion
35: lower support bracket
36: lower cam switch piece
40: upper detection switch
41: upper switch main body
41a, 51a: contact roller
42: upper switch bracket
50: lower detection switch
51: lower switch main body
52: lower switch bracket
60: elevator control device (control unit)
61: departure condition determination unit (control unit)
62: failure prediction diagnostic unit
63: storage unit
100: elevator hoistway
110: elevator car
120: hoisting machine

130: balance weight

170: rope

212: building side door unit

S1, S1: gap

T1: closing end position

Claims

1. An elevator comprising:
 - an elevator car that causes an elevator hoistway disposed in a building structure to perform elevating movement;
 - a door part that covers an opening of the elevator car or a doorway disposed on each floor of the building structure so as to be openable and closeable;
 - an upper detection switch that outputs an upper door closing detection signal when it is detected that the door part moves to a closing end position which is a position where the door part covers and closes the opening or the doorway in an upper end portion in a vertical direction of the door part;
 - a lower detection switch that outputs a lower door closing detection signal when it is detected that the door part moves to the closing end position in a lower end portion in the vertical direction of the door part; and
 - a control unit that determines whether or not to cause the elevator car to perform the elevating movement, based on the upper door closing detection signal and the lower door closing detection signal,
 - wherein the control unit determines that the elevator car is capable of performing the elevating movement, when the control unit receives both the upper door closing detection signal and the lower door closing detection signal,
 - wherein the control unit has a failure prediction diagnostic unit for diagnosing a failure prediction of the door part, based on the upper door closing detection signal and the lower door closing detection signal, and
 - wherein the failure prediction diagnostic unit diagnoses the failure prediction of the door part, based on a timing at which the upper door closing detection signal is output from the upper detection switch and a timing at which the lower door closing detection signal is output from the lower detection switch.
2. The elevator according to claim 1,
 - wherein the control unit opens the door part in a case where the control unit does not receive any one of the upper door closing detection signal and the lower door closing detection signal, even though a predetermined time elapses after a door closing command to close the door part is output.
3. The elevator according to claim 1,
 - wherein the failure prediction diagnostic unit has a storage unit which stores a time spent until the lower door closing detection signal is output from the lower detection switch after the upper

door closing detection signal is output from the upper detection switch and a time spent until the upper door closing detection signal is output from the upper detection switch after the lower door closing detection signal is output from the lower detection switch.

4. The elevator according to claim 1,
wherein the upper detection switch and the lower detection switch are disposed in all of the door parts in the door part disposed in the elevator car and the door part disposed in the doorway on each floor of the building structure, and

wherein the control unit causes the elevator car to perform the elevating movement, when the control unit receives all of the upper door closing detection signal output from the upper detection switch disposed in all of the door parts and the lower door closing detection signal output from the lower detection switch disposed in all of the door parts.

5. The elevator according to claim 1, further comprising:
a door pocket that is disposed in an upper end portion in the vertical direction of the opening or the doorway, and that has a guide rail which supports the door part so as to be movable in an opening/closing direction of the door part; and

a door sill that is disposed in a lower end portion of the opening or the doorway in the vertical direction, and that supports the door part so as to be movable in the opening/closing direction of the door part,

wherein the upper detection switch has

an upper switch bracket fixed to the door pocket, and

an upper switch main body fixed to the upper switch bracket,

wherein the lower detection switch has

a lower switch bracket fixed to the door sill, and

a lower switch main body fixed to the lower switch bracket,

wherein an upper pressing member for pressing the upper detection switch at the closing end position is disposed in the upper end portion of the door part in the vertical direction,

wherein a lower pressing member for pressing the lower detection switch at the closing end position is disposed in the lower end portion of the door part in the vertical direction,

wherein the upper pressing member has

an upper support bracket fixed to the upper end portion of the door part, and

an upper cam switch piece fixed to the upper support bracket so as to press a contact roller disposed in the upper switch main body,

wherein the lower pressing member has

a lower support bracket fixed to the lower end portion of the door part, and

a lower cam switch piece fixed to the lower support bracket so as to press a contact roller disposed in the lower switch main body, and

wherein one end portion on a side in a door closing direction which is a direction in which the door part is closed in the upper cam switch piece and the lower cam switch piece has an inclined surface portion inclined downward in the vertical direction as the inclined surface portion faces a side in the door closing direction of the door part.