

ELEVATOR WITH INTER-FLOOR ADJUSTMENT FUNCTION

FIELD

Embodiments described herein relate generally to an elevator with an inter-floor adjustment function.

5

BACKGROUND

Recently, in skyscrapers, etc., in order to improve space efficiency, an elevator which comprises two cars vertically and enables mass transport is used as a vertical transportation means inside such
10 buildings. In general, this type of elevator is called a double-deck elevator.

In the double-deck elevator, there is a type equipped with an inter-floor adjustment function, which adjusts the distance between upper and lower cars
15 within a car frame by moving the cars relative to each other so that the cars can simultaneously stop at the destination floors even when the height of each floor of the building is not constant. The inter-floor adjustment function is operated by, for example, an
20 inter-floor adjustment control device mounted on the car frame. Hereinafter, the elevator (double-deck elevator) equipped with the inter-floor adjustment function is called an elevator with an inter-floor adjustment function.

25 In the elevator with the inter-floor adjustment function, the operation of the inter-floor adjustment function while the doors are open at the stopped floors of the cars (in short, while the passengers get in and out of the elevator) is dangerous for the passengers.

30 In order to avoid this risk, many elevators are configured not to activate the inter-floor adjustment function while the doors are open at the stopped floors of the cars by the instruction from the control panel (elevator control device) which controls the elevator
35 as a whole or the control of the inter-floor adjustment control device.

However, when the above instruction of the control

panel is incorrectly output, or the signal input circuit of the inter-floor adjustment device malfunctions, etc., the inter-floor adjustment function might be operated even while the doors are open at the
5 stopped floors of the cars.

In order to solve this problem, when the cars have moved to the outside of the predetermined range (door open travel allowable zone) while the door is open, the power source circuit for inter-floor adjustment is shut
10 off by a door open travel protection device.

However, within the door open travel allowable zone, the power source circuit for inter-floor adjustment is not shut off. Further, if the cars have moved to the outside of the door open travel allowable
15 zone and the power source circuit for inter-floor adjustment has been shut off by the door open travel protection device, a difference in height is produced between the floors of the cars and the thresholds of the landing halls. This difference causes passengers
20 to trip, etc.

In consideration of the above situation, the embodiments described herein aim to provide an elevator which is equipped with an inter-floor adjustment function and can certainly prevent the inter-floor
25 adjustment function from being operated while the doors of the cars are open.

SUMMARY

According to an embodiment, an elevator with an inter-floor adjustment function is provided. The
30 elevator has a car frame in which at least two cars are connected in an upper and lower direction, and the inter-floor adjustment function configured to adjust a distance between the at least two cars of the car frame. The elevator with the inter-floor adjustment
35 function comprises a detection unit configured to detect a door-open state of each of the at least two cars when the cars stop at a set of floors, and a

disabling unit configured to disable the inter-floor adjustment function when the door-open state of any one of the at least two cars is detected.

BRIEF DESCRIPTION OF THE DRAWINGS

5 FIG. 1 is a figure showing a structure of an elevator with an inter-floor adjustment function according to a first embodiment.

10 FIG. 2 is a diagram showing a circuit structure of the elevator with the inter-floor adjustment function shown in FIG. 1.

 FIG. 3 is diagram showing a circuit structure of an elevator with an inter-floor adjustment function according to a second embodiment.

15 FIG. 4 is diagram for explaining a structure of a servo pack 22 shown in FIG. 3.

 FIG. 5 is diagram showing a circuit structure of an elevator with an inter-floor adjustment function according to a third embodiment.

20 FIG. 6 is diagram showing a circuit structure of an elevator with an inter-floor adjustment function according to a fourth embodiment.

DETAILED DESCRIPTION

Embodiments will be described hereinafter with reference to the accompanying drawings.

25 (First Embodiment)

 First, a first embodiment is explained. FIG. 1 shows a structure of an elevator with an inter-floor adjustment function according to this embodiment. Here, the elevator is explained as a double-deck
30 elevator comprising two cars 2 and 3 in one car frame 1. Hereinafter, among the two cars 2 and 3 shown in FIG. 1, the car located on the upper side is referred to as the upper car 2, and the car located on the lower side is referred to as the lower car 3.

35 A main rope 12 winds around a traction machine 11 via a deflector sheave 13, etc. By the drive of the traction machine 11, the car frame 1 ascends and

descends in the hoistway through the main rope 12.

As shown in FIG. 1, the upper car 2 is movably connected to the car frame 1 in the upper and lower direction through ball screws 4a and 4b. Similarly,
5 the lower car 3 is movably connected to the car frame 1 in the upper and lower direction through ball screws 5a and 5b. These ball screws 4a, 4b, 5a and 5b are supported by an upper beam 6 and an intermediate beam 7, and move the upper car 2 and the lower car 3 in the
10 upper and lower direction by driving motors 8a and 8b.

An inter-floor adjustment control device 20 and a door control device which is not shown in the figure, etc., are mounted in the car frame 1.

The inter-floor adjustment control device 20 has a
15 function (hereinafter, referred to as an inter-floor adjustment function) of adjusting the distance between the upper car 2 and the lower car 3 of the car frame 1 by driving the motors 8a and 8b in accordance with the instruction from an elevator control device 30. The
20 inter-floor adjustment control device 20 comprises a changeable memory device (not shown in the figure) such as an EEPROM, a memory card or a USB memory.

In this memory device, information which is necessary for operating the inter-floor adjustment
25 function and performing adjustment of the distance between the upper car 2 and the lower car 3 (in short, inter-floor adjustment) is stored. This information includes, for example, an inter-floor length table in which the inter-floor length relative to each
30 destination floor is set in terms of control, an operation speed table in which the speed for conducting the inter-floor adjustment operation is set, and a preliminary operation speed table in which the speed at the time of the preliminary operation for inter-floor
35 adjustment is set for each operation direction (ascent/descent).

The door control device is a device for

controlling the opening and closing operations of the hall doors provided in the doorways of the elevator halls (landing halls) and the car doors provided in the upper car 2 and the lower car 3.

5 These kinds of devices are connected to the elevator control device 30 provided in a machine room, etc., of the building in which the double-deck elevator is installed through a tail cord 15 connected to a duct-under-car 14.

10 The elevator control device 30 is a so-called "control panel", and controls the elevator as a whole, including the drive control of the traction machine 11.

 In FIG. 1, the inter-floor adjustment control device 20 is separated from the elevator control device 30. However, physically, only the drive control portion such as the motors 8a and 8b may be mounted in the car frame 1, and the others may be provided in the elevator control device.

 FIG. 2 shows a circuit structure of the elevator with the inter-floor adjustment function shown in FIG. 1. As shown in FIG. 2, the inter-floor adjustment control device 20 is configured to input a door closing signal (DC) for monitoring hall doors 101 provided in the doorway of the hall at each floor of the building and car doors 102 provided in the upper car 2 and the lower car 3 in series when the cars 2 and 3 stops at a set of floors.

 In a case where all of the hall doors 101 and the car doors 102 are closed, a door closing signal is input into the inter-floor adjustment control device 20. On the other hand, in a case where at least one of all of the hall doors 101 and the car doors 102 is open, a door closing signal is not input into the inter-floor adjustment control device 20.

35 In this manner, in the inter-floor adjustment control device 20, it is possible to detect the door-open state (or door-closed state) of the cars (the

upper car 2 and the lower car 3) of the elevator with the inter-floor adjustment function when the cars 2 and 3 stop at a set of floors.

5 The inter-floor adjustment control device 20 comprises an inter-floor adjustment control unit (hereinafter, referred to as a KCU) 21, a servo pack 22 and a brake power source 23.

10 The KCU 21 operates as a control unit which controls the inter-floor adjustment control device 20 as a whole. For example, the KCU 21 outputs a control signal in order to cause the servo pack 22 to drive the servo motors 8a and 8b.

15 The servo pack 22 realizes a servo mechanism together with the motors (hereinafter, referred to as servo motors) 8a and 8b shown in FIG. 1.

20 The servo pack 22 operates as a drive unit which drives the servo motors 8a and 8b for activating the inter-floor adjustment function. Specifically, the servo pack 22 comprises an inverter comprising a switching element, and supplies alternating-current power to the servo motors 8a and 8b by means of the switching element. The servo motors 8a and 8b are motors for controlling the positions and speeds, etc., of the upper car 2 and the lower car 3 in inter-floor adjustment.

25 The servo pack 22 is connected to, for example, an inter-floor adjustment driving power source provided inside the elevator control device 30.

30 The brake power source 23 supplies power to a brake device (mechanism) 9 which brakes the servo motors 8a and 8b. The brake device 9 is provided in each of the servo motors 8a and 8b although the illustration of the structure is omitted in FIG. 2.

35 The inter-floor adjustment control device 20 comprises an electromagnetic contactor (MC), an electromagnetic relay (R) and an electromagnetic relay (BK). The electromagnetic contactor (MC), the

electromagnetic relay (R) and the electromagnetic relay (BK) have a function of opening and closing an electrical circuit by the operation of an electromagnet.

5 The electromagnetic contactor (MC) comprises a magnet coil 24a and a contact point 24b. The magnet coil 24a is provided at a position to be connected to the KCU 21. The contact point 24b is provided at a position to open and close the electrical circuit
10 between the inter-floor adjustment driving power source provided inside the elevator control device 30 and the servo pack 22.

 In the above electromagnetic contactor (MC), when current flows into the magnet coil 24a, moving pieces
15 of iron are attracted by magnetic force, and the contact point 24b closes in conjunction with the attraction. In sum, according to the electromagnetic contactor (MC), when current flows into the magnet coil 24a, the electrical circuit between the inter-floor
20 adjustment driving power source and the servo pack 22 becomes conductive.

 The electromagnetic relay (R) is an electromagnetic relay for shutting off the driving power source of the inter-floor adjustment device (that
25 is, the inter-floor adjustment driving power source), and comprises a magnet coil 25a, a contact point 25b and a contact point 25c. The magnet coil 25a is provided in the electrical circuit in which a door closing signal is input into the inter-floor adjustment
30 control device 20. The contact point 25b is provided at a position to open and close the electrical circuit between the KCU 21 and the magnet coil 24a of the electromagnetic contactor (MC). The contact point 25c is provided at a position to open and close the
35 electrical circuit between the brake power source 23 and the brake device 9.

 In the electromagnetic relay (R), similarly to the

above electromagnetic contactor (MC), when current flows into the magnet coil 25a, moving pieces of iron are attracted by magnetic force, and the contact point 25b and the contact point 25c close in conjunction with the attraction. In sum, according to this electromagnetic relay (R), when current flows into the magnet coil 25a, the electrical circuit between the KCU 21 and the electromagnetic contactor (MC) becomes conductive, and further, the electrical circuit between the brake power source 23 and the brake device 9 becomes conductive.

The electromagnetic relay (BK) is an electromagnetic relay for shutting off the driving power source of the brake device 9 (that is, the brake power source 23), and comprises a magnet coil 26a and a contact point 26b. The magnetic coil 26a is provided at a position to be connected to the KCU 21. The contact point 26b is provided at a position to open and close the electrical circuit between the brake power source 23 and the brake device 9. As described above, the contact point 25c of the electromagnetic relay (R) and the contact point 26b of the electromagnetic relay (BK) are both provided between the brake power source 23 and the brake device 9. In the example shown in FIG. 2, the contact point 25c of the electromagnetic relay (R) is provided on the brake power source 23 side, and the contact point 26b of the electromagnetic relay (BK) is provided on the brake device 9 side.

In this type of electromagnetic relay (BK), similarly to the aforementioned electromagnetic contactor (MC) and electromagnetic relay (R), when current flows into the magnet coil 26a, moving pieces of iron are attracted by magnetic force, and the contact point 26b closes in conjunction with the attraction. In sum, according to the electromagnetic relay (BK), when current flows into the magnet coil 26a, the electrical circuit between the brake power

source 23 and the brake device 9 becomes conductive.

Hereinafter, this specification explains the operation of the elevator (double-deck elevator) with the inter-floor adjustment function according to this embodiment.

First, this specification explains a case where all of the hall doors 101 and the car doors 102 are closed. In this case, a door closing signal (DC) is input into the inter-floor adjustment control device 20. When a door closing signal is input into the inter-floor adjustment control device 20 in this manner, the inter-floor adjustment control device 20 can detect the door-closed state of the cars (the upper car 2 and the lower car 3).

When a door closing signal is input into the inter-floor adjustment control device 20, current flows into the magnet coil 25a of the electromagnetic relay (R). Therefore, the contact point 25b and the contact point 25c of the electromagnetic relay (R) close.

When the inter-floor adjustment function is operated by the control of the KCU 21, the contact point 25b is closed (in other words, the electrical circuit between the KCU 21 and the magnet coil 24a of the electromagnetic contactor (MC) is conductive). In this case, the electromagnetic contactor (MC) can be controlled by the KCU 21. When the electromagnetic contactor (MC) is controlled by the KCU, current flows into the magnet coil 24a, and the contact point 24b of the electromagnetic contactor (MC) closes. By this structure, the electrical circuit between the inter-floor adjustment driving power source provided inside the elevator control device 30 and the servo pack 22 becomes conductive. In this manner, the necessary power is supplied to the servo pack 22, and the servo motors 8a and 8b are driven.

Similarly, when the inter-floor adjustment function is operated by the control of the KCU 21,

current flows into the magnet coil 26a of the electromagnetic relay (BK), and the contact point 26b of the electromagnetic relay (BK) closes. At this time, as described above, the contact point 25c of the electromagnetic relay (R) and the contact point 26b of the electromagnetic relay (BK) are both closed (in other words, the electrical circuit between the brake power source 23 and the brake device 9 is conductive). In this manner, power is supplied to the brake device 9, and accordingly, the brake device 9 is driven.

When a door closing signal is input into the inter-floor adjustment control device 20, power is supplied to the servo pack 22 and the brake device 9. Therefore, it is possible to activate the inter-floor adjustment function in the inter-floor adjustment control device 20.

Next, this specification explains a case where at least one of all of the hall doors 101 and the car doors 102 is opened. The above door closing signal monitors the hall doors 101 and the car doors 102 in series. Therefore, when at least one of all of the hall doors 101 and the car doors 102 is open, a door closing signal is not input into the inter-floor adjustment control device 20. When a door closing signal is not input into the inter-floor adjustment control device 20, the inter-floor adjustment control device 20 can detect the door-open state of the cars (the upper car 2 and the lower car 3).

When a door closing signal is not input into the inter-floor adjustment control device 20, current does not flow into the magnet coil 25a of the electromagnetic relay (R). Therefore, the control by the KCU 21 is impossible, and the contact point 25b and the contact point 25c of the electromagnetic relay (R) are open.

When the contact point 25b of the electromagnetic relay (R) is open (in other words, the electrical

circuit between the KCU 21 and the magnet coil 24a of the electromagnetic contactor (MC) is not conductive), current does not flow into the electromagnetic coil 24a. Therefore, the contact point 24b of the
5 electromagnetic contactor (MC) is opened. According to this structure, the electrical circuit between the inter-floor adjustment driving power source provided inside the elevator control device 30 and the servo pack 22 does not become conductive (in short, is shut
10 off). In this manner, the necessary power is not supplied to the servo pack 22, and the servo motor 8a or 8b is not driven.

Similarly, when the contact point 25c of the electromagnetic relay (R) is opened (in other words,
15 the electrical circuit between the brake power source 23 and the brake device 9 is not conductive), power is not supplied to the brake device 9, and therefore, the brake device 9 is not driven.

When a door closing signal is not input into the inter-floor adjustment control device 20, power is not
20 supplied to the servo pack 22 or the brake device 9. Therefore, the inter-floor adjustment function cannot be operated in the inter-floor adjustment control device 20.

25 As described above, in this embodiment, when the door-open state of the cars (the upper car 2 and the lower car 3) is detected by the presence or absence of input of a door closing signal into the inter-floor adjustment control device 20, the inter-floor
30 adjustment function is disabled by shutting off the power supply to the servo pack 22 which drives the servo motors 8a and 8b in order to activate the inter-floor adjustment function. According to this structure, even when the instruction of the elevator
35 control device 30 is incorrectly output, etc., it is possible to certainly prevent the operation of the inter-floor adjustment function while the doors of the

upper car 2 and the lower car 3 are open, thereby preventing the movement of the upper car 2 and the lower car 3. In sum, in this embodiment, it is possible to prevent the generation of a difference in height between the upper car 2 or the lower car 3 and the threshold of the landing hall (hall) by the wrong operation of the inter-floor adjustment function while the doors of the upper car 2 and the lower car 3 are open.

In addition, in this embodiment, the power supply to the brake device 9 which brakes the servo motors 8a and 8b is shut off while the doors of the upper car 2 and the lower car 3 are open. Thus, it is possible to prevent the operation of the inter-floor adjustment function while the doors of the upper car 2 and the lower car 3 are open by means of a double system together with the above-described shutoff of the power supply to the servo pack 22.

(Second Embodiment)

Next, a second embodiment is explained. FIG. 3 shows a circuit structure of an elevator (double-deck elevator) with an inter-floor adjustment function according to this embodiment. The components which are identical to the aforementioned FIG. 2 are designated by the same reference numbers and symbols. Thus, the detailed explanations of the components are omitted. Here, the components which are different from FIG. 2 are mainly explained.

In this embodiment, when (the operation of) the inter-floor adjustment function is disabled while the doors of an upper car 2 and a lower car 3 are open, a base block function which is the protection function of a servo pack 22 is used. In this respect, this embodiment is different from the first embodiment.

As shown in FIG. 3, an inter-floor adjustment control device 200 of this embodiment comprises an electromagnetic relay (R). The electromagnetic relay

(R) comprises a contact point 25d. The contact point 25d is provided at a position to be connected to the servo pack 22. When current flows into a magnet coil 25a, the contact point 25d opens accordingly.

5 In this embodiment, a signal (hereinafter, referred to as a base block signal) for activating the base block function is configured to be input into the servo pack 22 when the contact point 25d is closed.

10 In this embodiment, in order to disable the inter-floor adjustment function by using the base block function which is the protection function of the servo pack 22, as shown in FIG. 3, the contact point 25b of the electromagnetic relay (R) in the aforementioned first embodiment is not provided.

15 Here, by reference to FIG. 4, the structure of the servo pack 22 shown in FIG. 3 is explained. As shown in FIG. 4, the servo pack 22 comprises an inverter 221 and a base block portion 222.

20 A switching element (transistor) 221a is mounted in the inverter 221. The inverter 221 supplies alternating-current power to servo motors 8a and 8b by the switching element 221a.

25 The base block portion 222 is a functional portion for activating the base block function which is the protection function of the servo pack 22. The base block portion 222 blocks the instruction (a control signal for activating the inter-floor adjustment function) output from a KCU 21 to the inverter 221 based on the above base block signal.

30 Hereinafter, this specification explains the operation of the elevator (double-deck elevator) with the inter-floor adjustment function according to this embodiment.

35 First, this specification explains a case where all of hall doors 101 and car doors 102 are closed. In this case, a door closing signal (DC) is input into the inter-floor adjustment control device 200. When a door

closing signal is input into an inter-floor adjustment control device 200, the inter-floor adjustment control device 20 can detect the door-closed state of the cars (the upper car 2 and the lower car 3).

5 After a door closing signal is input into the inter-floor adjustment control device 200, current flows into the magnet coil 25a of the electromagnetic relay (R). Thus, the contact point 25d of the electromagnetic relay (R) opens.

10 When the contact point 25d of the electromagnetic relay (R) is open, a base block signal is not input to (the base block portion 222 provided in) the servo pack 22. Thus, the control signal output from the KCU 21 to the inverter 221 is not blocked.

15 In this case, (the inverter 221 provided in) the servo pack 22 supplies alternating-current power to the servo motors 8a and 8b based on the control signal from the KCU 21. In this manner, the servo motors 8a and 8b are driven.

20 When a door closing signal is input into the inter-floor adjustment control device 200, the control signal from the KCU 21 is input into the inverter 221 provided in the servo pack 22. Therefore, it is possible to activate the inter-floor adjustment
25 function in the inter-floor adjustment control device 200.

 Next, this specification explains a case where at least one of all of the hall doors 101 and the car doors 102 is open. The above-described door closing
30 signal monitors the hall doors 101 and the car doors 102 in series. Therefore, when at least one of all of the hall doors 101 and the car doors 102 is open, a door closing signal is not input into the inter-floor adjustment control device 200. When a door closing
35 signal is not input into the inter-floor adjustment control device 200, the inter-floor adjustment control device 200 can detect the door-open state of the cars

(the upper car 2 and the lower car 3).

When a door closing signal is not input into the inter-floor adjustment control device 200, current does not flow into the magnet coil 25a of the electromagnetic relay (R). Thus, the contact point 25d of the electromagnetic relay (R) closes.

When the contact point 25d of the electromagnetic relay (R) is close, a base block signal is input to the base block portion 222 provided in the servo pack 22. In this case, the control signal output from the KCU 21 to (the inverter 221 provided in) the servo pack 22 is blocked by the base block portion 222. Specifically, the base block portion 222 blocks the base signal of the switching element (transistor) 221a mounted in the inverter 221. According to this structure, the switching in the servo pack 22 is disabled, and the alternating-current power from the inverter 221 to the servo motors 8a and 8b is not supplied. Therefore, the servo motor 8a or 8b is not driven.

When a door closing signal is not input into the inter-floor adjustment control device 200, the control signal from the KCU 21 is blocked, and therefore, the inter-floor adjustment function cannot be operated in the inter-floor adjustment control device 200.

The operations of an electromagnetic contactor (MC), a contact point 25c of the electromagnetic relay (R) and an electromagnetic relay (BK), etc., in this embodiment are the same as the first embodiment. Thus, the detailed explanations of the operations are omitted.

As described above, in this embodiment, the inter-floor adjustment function is disabled by blocking the control signal output from the KCU 21 to the servo pack 22 while the doors of the upper car 2 and the lower car 3 are open. By this arrangement, even when the instruction of an elevator control device 30 is incorrectly output, etc., it is possible to prevent the

operation of the inter-floor adjustment function while the doors of the upper car 2 and the lower car 3 are open, thereby preventing the movement of the upper car 2 and the lower car 3.

5 (Third Embodiment)

Next, a third embodiment is explained. FIG. 5 shows a circuit structure of an elevator (double-deck elevator) with an inter-floor adjustment function according to this embodiment. The components which are
10 identical to the aforementioned FIG. 2 are designated by the same reference numbers and symbols. Thus, the detailed explanations of the components are omitted. Here, the components which are different from FIG. 2 are mainly explained.

15 In this embodiment, when (the operation of) the inter-floor adjustment function is disabled while the doors of an upper car 2 and a lower car 3 are open, the electrical circuit between a servo pack 22 and servo motor 8a or 8b is shut off. In this respect, this
20 embodiment is different from the first embodiment.

As shown in FIG. 5, an inter-floor adjustment control device 210 according to this embodiment comprises an electromagnetic contactor (MC2).

The electromagnetic contactor (MC2) comprises a
25 magnet coil 210a and a contact point 210b. The magnet coil 210a is provided at a position to be connected to a KCU 21. The contact point 210b is provided at a position to open and close the electrical circuit between the servo pack 22 and the servo motor 8a or 8b.

30 In this type of electromagnetic contactor (MC2), when current flows into the magnet coil 210a, moving pieces of iron are attracted by magnetic force, and accordingly, the contact point 210b closes. In sum, according to this electromagnetic contactor (MC2), when
35 current flows into the magnet coil 210a, the electrical circuit between the servo pack 22 and the servo motor 8a or 8b becomes conductive.

The inter-floor adjustment control device 210 comprises an electromagnetic relay (R). The electromagnetic relay (R) comprises a contact point 25e. The contact point 25e is provided at a position to open and close the electrical circuit between the KCU 21 and the magnet coil 210a of the electromagnetic contactor (MC2).

In this type of electromagnetic relay (R), when current flows into a magnet coil 25a, accordingly, the contact point 25e closes. In sum, according to the electromagnetic relay (R), when current flows into the magnet coil 25a, the electrical circuit between the KCU 21 and the electromagnetic contactor (MC2) becomes conductive.

FIG. 5 illustrates the electromagnetic contactor (MC) composed of the magnet coil 24a and the contact point 24b shown in FIG. 2 as an electromagnetic contactor (MC1) for convenience.

In this embodiment, the electrical circuit between the servo pack 22 and the servo motor 8a or 8b is shut off in order to disable the inter-floor adjustment function. Therefore, as shown in FIG. 5, the contact point 25b of the electromagnetic relay (R) of the first embodiment is not provided.

Hereinafter, the operation of the elevator (double-deck elevator) with the inter-floor adjustment function according to this embodiment is explained.

First, this specification explains a case where all of hall doors 101 and car doors 102 are closed. In this case, a door closing signal (DC) is input into the inter-floor adjustment control device 210. When a door closing signal is input into an inter-floor adjustment control device 210, the inter-floor adjustment control device 210 can detect the door-closed state of the cars (the upper car 2 and the lower car 3).

When a door closing signal is input into the inter-floor adjustment control device 210, current

flows into the magnet coil 25a of the electromagnetic relay (R). Thus, the contact point 25e of the electromagnetic relay (R) closes.

5 When the inter-floor adjustment function is operated by the control of the KCU 21, the contact point 25e is closed (in other words, the electrical circuit between the KCU 21 and the magnet coil 210a of the electromagnetic contactor (MC2) is conductive). In this case, current flows into the magnet coil 210a, and
10 the contact point 210b of the electromagnetic contactor (MC2) closes. According to this structure, the electrical circuit between the servo pack 22 and the servo motor 8a or 8b becomes conductive, and alternating-current power is supplied from the servo
15 pack 22 to the servo motors 8a and 8b. Thus, the servo motors 8a and 8b are driven.

When a door closing signal is input into the inter-floor adjustment control device 210, alternating-current power is supplied to the servo motors 8a and
20 8b. Therefore, the inter-floor adjustment function can be operated in the inter-floor adjustment control device 210.

Next, this specification explains a case where at least one of all of the hall doors 101 and the car
25 doors 102 is open. The above door closing signal monitors the hall doors 101 and the car doors 102 in series. Therefore, when at least one of all of the hall doors 101 and the car doors 102 is open, a door closing signal is not input into the inter-floor
30 adjustment control device 210. When a door closing signal is not input into the inter-floor adjustment control device 210, the inter-floor adjustment control device 210 can detect the door-open state of the cars (the upper car 2 and the lower car 3).

35 When a door closing signal is not input into the inter-floor adjustment control device 210, current does not flow into the magnet coil 25a of the

electromagnetic relay (R). Therefore, the contact point 25e of the electromagnetic relay (R) opens.

When the contact point 25e of the electromagnetic relay (R) is open (in other words, the electrical circuit between the KCU 21 and the magnet coil 210a of the electromagnetic contactor (MC2) is not conductive),
5 current does not flow into the magnet coil 210a. Therefore, the contact point 210b of the electromagnetic contactor (MC2) opens. According to
10 this structure, since the electrical circuit between the servo pack 22 and the servo motor 8a or 8b is not conductive (is shut off), alternating-current power is not supplied to the servo motor 8a or 8b. Thus, the servo motor 8a or 8b is not driven.

15 When a door closing signal is not input into the inter-floor adjustment control device 210, alternating-current power is not supplied to the servo motor 8a or 8b. Therefore, the inter-floor adjustment function cannot be operated in the inter-floor adjustment
20 control device 210.

The operations of the electromagnetic contactor (MC1), a contact point 25c of the electromagnetic relay (R) and an electromagnetic relay (BK), etc., in this embodiment are the same as the first embodiment.
25 Therefore, the detailed explanations of the operations are omitted.

As described above, in this embodiment, the inter-floor adjustment function is disabled by shutting off the electrical circuit between the servo pack 22 and the servo motor 8a or 8b while the doors of the upper
30 car 2 and the lower car 3 are open. According to this arrangement, even when the instruction of an elevator control device 30 is incorrectly output, etc., it is possible to prevent the operation of the inter-floor adjustment function while the doors of the upper car 2
35 and the lower car 3 are open, thereby preventing the movement of the upper car 2 and the lower car 3.

(Fourth Embodiment)

Next, this specification explains a fourth embodiment. FIG. 6 shows a circuit structure of an elevator (double-deck elevator) with an inter-floor adjustment function according to this embodiment. The components which are identical to the aforementioned FIG. 2 are designated by the same reference numbers and symbols. Thus, the detailed explanations of the components are omitted. Here, the components which are different from FIG. 2 are mainly explained.

In this embodiment, the electrical circuit between a KCU 21 and a servo pack 22 is shut off when (the operation of) the inter-floor adjustment function is disabled while the doors of an upper car 2 and a lower car 3 are open. In this respect, this embodiment is different from the first embodiment.

As shown in FIG. 5, an inter-floor adjustment control device 220 according to this embodiment comprises an electromagnetic relay (R). The electromagnetic relay (R) comprises a contact point 25f. The contact point 25f is provided at a position to open and close the electrical circuit between the KCU 21 and the servo pack 22. When current flows into a magnet coil 25a, accordingly, the contact point 25f closes.

In this embodiment, the inter-floor adjustment function is disabled by shutting off the electrical circuit between the KCU 21 and the servo pack 22. Therefore, as shown in FIG. 6, the contact point 25b of the electromagnetic relay (R) of the first embodiment is not provided.

Hereinafter, this specification explains the operation of the elevator (double-deck elevator) with the inter-floor adjustment function according to this embodiment.

First, this specification explains a case where all of hall doors 101 and car doors 102 are closed. In

this case, a door closing signal (DC) is input into the inter-floor adjustment control device 220. When a door closing signal is input into the inter-floor adjustment control device 220, the inter-floor adjustment control device 220 can detect the door-closed state of the cars (the upper car 2 and the lower car 3).

When a door closing signal is input into the inter-floor adjustment control device 220, current flows into the magnet coil 25a of the electromagnetic relay (R). Thus, the contact point 25f of the electromagnetic relay (R) closes.

When the inter-floor adjustment function is operated by the control of the KCU 21, the contact point 25f is closed (in other words, the electrical circuit between the KCU 21 and the servo pack 22 is conductive). Thus, the control signal output by the KCU 21 is input in the servo pack 22. By this structure, alternating-current power is supplied from the servo pack 22 to servo motors 8a and 8b, and the servo motors 8a and 8b are driven.

When a door closing signal is input into the inter-floor adjustment control device 220, a control signal is input in the servo pack 22, and the servo motors 8a and 8b are driven. Thus, the inter-floor adjustment function can be operated in the inter-floor adjustment control device 220.

Next, this specification explains a case where at least one of all of the hall doors 101 and the car doors 102 is open. The above door closing signal monitors the hall doors 101 and the car doors 102 in series. Therefore, when at least one of all of the hall doors 101 and the car doors 102 is open, a door closing signal is not input into the inter-floor adjustment control device 220. When a door closing signal is not input into the inter-floor adjustment control device 220, the inter-floor adjustment control device 220 can detect the door-open state of the cars

(the upper car 2 and the lower car 3).

When a door closing signal is not input into the inter-floor adjustment control device 220, current does not flow into the magnet coil 25a of the
5 electromagnetic relay (R). Therefore, the contact point 25f of the electromagnetic relay (R) opens.

When the contact point 25f of the electromagnetic relay (R) is open (in other words, the electrical circuit between the KCU 21 and the servo pack 22 is not
10 conductive), the control signal output by the KCU 21 is not input in the servo pack 22. In this case, alternating-current power is not supplied from the servo pack 22 to the servo motor 8a or 8b. Thus, the servo motor 8a or 8b is not driven.

15 When a door closing signal is not input into the inter-floor adjustment control device 220, a control signal is not input in the servo pack 22. Thus, the servo motor 8a or 8b is not driven. In this manner, the inter-floor adjustment function cannot be operated
20 in the inter-floor adjustment control device 220.

The operations of an electromagnetic contactor (MC), a contact point 25c of the electromagnetic relay (R) and an electromagnetic relay (BK), etc., in this embodiment are the same as the first embodiment.
25 Therefore, the detailed explanations of the operations are omitted.

As described above, in this embodiment, the inter-floor adjustment function is disabled by shutting off the electrical circuit between the KCU 21 and the servo
30 pack 22 while the doors of the upper car 2 and the lower car 3 are open. According to this structure, even when the instruction of an elevator control device 30 is incorrectly output, etc., it is possible to prevent the operation of the inter-floor adjustment
35 function while the doors of the upper car 2 and the lower car 3 are open, thereby preventing the movement of the upper car 2 and the lower car 3.

According to each embodiment described above, it is possible to provide an elevator with an inter-floor adjustment function which can prevent the inter-floor adjustment function from being operated while the doors
5 of the cars are open.

While certain embodiments have been described, these embodiments have been presented by way of example only, and are not intended to limit the scope of the inventions. Indeed, the novel embodiments described
10 herein may be embodied in a variety of other forms; furthermore, various omissions, substitutions and changes in the form of the embodiments described herein may be made without departing from the spirit of the inventions. The accompanying claims and their
15 equivalents are intended to cover such forms or modifications as would fall within the scope and spirit of the inventions.

WHAT IS CLAIMED IS:

1. An elevator with an inter-floor adjustment function, the elevator having a car frame in which at least two cars are connected in an upper and lower direction and the inter-floor adjustment function configured to adjust a distance between the at least two cars of the car frame, characterized by comprising:
 - a detection unit configured to detect a door-open state of each of the at least two cars when the cars stop at a set of floors; and
 - a disabling unit configured to disable the inter-floor adjustment function when the door-open state of any one of the at least two cars is detected.
2. The elevator with the inter-floor adjustment function of claim 1, characterized by further comprising:
 - motors configured to activate the inter-floor adjustment function; and
 - a driving unit configured to drive the motors, characterized in that
 - the disabling unit shuts off power supply to the driving unit.
3. The elevator with the inter-floor adjustment function of claim 2, characterized by further comprising:
 - a brake device configured to brake the motors driven by the driving unit, characterized in that
 - the disabling unit further shuts off power supply to the brake device.
4. The elevator with the inter-floor adjustment function of claim 1, characterized by further comprising:
 - motors configured to activate the inter-floor adjustment function;
 - a driving unit configured to drive the motors; and
 - a control unit configured to control the driving unit in order to drive the motors by outputting a

control signal to the driving unit, characterized in that

the disabling unit blocks the control signal output from the control unit to the driving unit.

5 5. The elevator with the inter-floor adjustment function of claim 1, characterized by further comprising:

motors configured to activate the inter-floor adjustment function; and

10 a driving unit configured to drive the motors, characterized in that

the disabling unit shuts off an electrical circuit between the driving unit and the motors.

15 6. The elevator with the inter-floor adjustment function of claim 1, characterized by further comprising:

motors configured to activate the inter-floor adjustment function;

a driving unit configured to drive the motors; and

20 a control unit configured to control the driving unit in order to drive the motors by outputting a control signal to the driving unit, characterized in that

25 the disabling unit shuts off an electrical circuit between the driving unit and the control unit.