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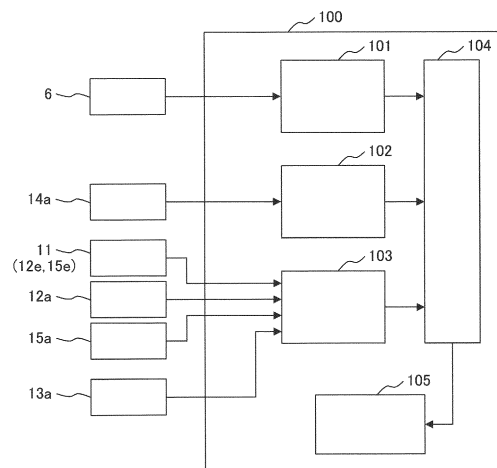
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(54) **ELEVATOR CONTROL DEVICE, ELEVATOR, AND ELEVATOR CONTROL METHOD**

(57) An elevator control device having an operation control unit to control operation of an elevator in accordance with an operation mode selected by a selector switch installed at an upper part of an elevator car includes: a maintenance worker boarding/leaving judgment unit to judge whether a maintenance worker boards or leaves the elevator car on the basis of a signal from a governor encoder for detecting a travel distance of the elevator car in a hoistway; and a switch operation permission unit to permit the operation control unit to operate in an operation mode selected by the selector switch on the basis of a state where the maintenance worker boards or leaves the elevator car judged at the maintenance worker boarding/leaving judgment unit.

FIG. 3



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Description

Technical Field

[0001] The present invention relates to an elevator control device, an elevator, and an elevator control method.

Background Art

[0002] There is a technology disclosed in Japanese Unexamined Patent Application Publication No. 2016-117558 (PTL 1) as a technology relating to maintenance work of an elevator. The patent literature describes that "A braking release mode of releasing the braking state of an elevator car if a predetermined operation is inputted to a predetermined device while the elevator car is in the braking state during a predetermined operation mode is provided.... A braking state can be released just by a maintenance worker performing braking release operation even when an elevator car 1 is braked undesirably and raising and lowering the elevator car 1 becomes impossible while the maintenance worker performs inspection work on the elevator car 1".

Citation List

Patent Literature

[0003] PTL 1: Japanese Unexamined Patent Application Publication No. 2016-117558

Summary of Invention

Technical Problem

[0004] By the technology described in PTL 1, however, a maintenance worker on an elevator car is at risk if an elevator operation mode is wrongly restored to a normal mode even in a state where the maintenance worker is on the elevator car.

[0005] In view of the above situation, an object of the present invention is to provide an elevator control device, an elevator, and an elevator control method, which are capable of improving safety in maintenance work of an elevator.

Solution to Problem

[0006] The configuration described in CLAIMS is adopted for example in order to solve the above problem. The present application includes a plurality of means for solving the above problem and an example of the means is as follows: an elevator control device having an operation control unit to control operation of an elevator in accordance with an operation mode selected by a selector switch installed at an upper part of an elevator car includes a maintenance worker boarding/leaving judgment

unit to judge whether a maintenance worker boards or leaves the elevator car on the basis of a signal from a governor encoder for detecting a travel distance of the elevator car in a hoistway, and a switch operation permission unit to permit the operation control unit to operate in an operation mode selected by the selector switch on the basis of a state where the maintenance worker boards or leaves the elevator car judged at the maintenance worker boarding/leaving judgment unit.

Advantageous Effects of Invention

[0007] The present invention of the above configuration makes it possible to provide an elevator control device, an elevator, and an elevator control method, which are capable of improving safety of a maintenance worker in maintenance work of an elevator.

[0008] Problems, configurations, and effects other than the above descriptions will be obvious from the explanations of the following embodiments.

Brief Description of Drawings

[0009]

Figure 1 is a general configuration diagram of an elevator according to an embodiment.

Figure 2 is a circuit diagram of switches and detectors involved in maintenance work of an elevator according to an embodiment.

Figure 3 is a block diagram of an elevator control device according to an embodiment.

Figure 4 is a flowchart showing procedures of maintenance work of an elevator by a maintenance worker.

Figure 5 is a flowchart showing a first elevator control method according to an embodiment.

Figure 6 is a flowchart showing a second elevator control method according to an embodiment.

Figure 7 is a flowchart showing a modified example of the second elevator control method according to an embodiment.

Description of Embodiments

[0010] Embodiments relating to an elevator control device, an elevator, and an elevator control method according to the present invention are hereunder explained in detail in reference to the drawings. Here, in the embodiments explained below, firstly a general configuration of an elevator is explained and successively an elevator control device installed in the elevator and an elevator control method implemented by the elevator control device are explained.

«Configuration of elevator control device»

[0011] Figure 1 is a general configuration diagram

showing an example of an elevator 1 to which an elevator control device and an elevator control method according to an embodiment are applied. As shown in Figure 1, the elevator 1 has a hoistway 1a installed in the manner of vertically penetrating the interior of a building or the like. The lower part of the hoistway 1a constitutes a pit 1b formed by being dug from the bottom floor of a building.

[0012] The elevator 1 has a hoisting machine 2, a rope 3, an elevator car 4, a counterweight 5, a governor encoder 6, and a PosiTector 7 in the hoistway 1a. A car top stop switch 11, a car top maintenance operation device 12, and a handrail 13 are installed at the upper part of the elevator car 4. Further, the elevator 1 has platform doors 14 at positions corresponding to respective platform floors 1f over a sidewall of the hoistway 1a, and a pit maintenance operation device 15 in the pit 1b at the lower part of the hoistway 1a. Furthermore, the elevator 1 has an elevator control device 100 for controlling operation of the elevator car 4 and operation of switching an operation mode between a normal mode and a maintenance mode is implemented. Those components constituting the elevator 1 are explained hereunder.

<Hoisting machine 2>

[0013] The hoisting machine 2 is fixed to the interior of the pit 1b of the hoistway 1a in the state of wrapping the rope 3. The hoisting machine 2 has a motor not shown in the figure and is configured so as to move the rope 3 by the rotation of the hoisting machine 2.

<Rope 3>

[0014] The rope 3 is for hanging the elevator car 4 and the counterweight 5. For example, both the ends of the rope 3 are fixed to a ceiling 1c of the hoistway 1a and the rope 3 is wrapped at intermediate parts around two pulleys 3a fixed to the ceiling 1c and is wrapped around the hoisting machine 2 and the counterweight 5 respectively between the two pulleys 3a and the fixed part. The rope 3 lifts and lowers the elevator car 4 and the counterweight 5 freely in the hoistway 1a by the drive of the hoisting machine 2.

<Elevator car 4>

[0015] The elevator car 4 is for carrying people and luggage and is installed in the state of being hanged in the hoistway 1a by the rope 3. For example, the rope 3 is wrapped around car pulleys 4a fixed to an upper part or a lower part of the elevator car 4, and the elevator car 4 rises or lowers vertically in the hoistway 1a in accordance with rotation of the hoisting machine 2. The elevator car 4 has a car door (not shown in the figure) that slides horizontally to open and close at a position facing the platform doors 14 installed at the hoistway 1a. Further, an operation button (not shown in the figure) for controlling a designation of the elevator car 4 and opening and

closing of the car door and contacting outside in the event of an emergency is installed at a position close to the car door.

5 <Counterweight 5>

[0016] The counterweight 5 is for balancing the elevator car 4 and is installed in the state of being hung in the hoistway 1a by the rope 3. A counterweight pulley 5a is fixed to the counterweight 5 and the rope 3 is wrapped around the counterweight pulley 5a. As a result, the counterweight 5 rises and lowers in a vertical direction opposite to the elevator car 4 in the hoistway 1a in accordance with rotation of the hoisting machine 2.

15 <Governor encoder 6>

[0017] The governor encoder 6 detects the number of revolutions of the hoisting machine 2 and is installed in the hoisting machine 2 as a travel distance detection means for detecting a travel distance of the elevator car 4. The governor encoder 6 is connected to the elevator control device 100 so that information on the detected number of revolutions of the hoisting machine 2 may be transmitted to the elevator control device 100. In particular, the governor encoder 6 acts as one of detectors to judge whether or not the operation mode of the elevator 1 may be switched.

25 <PosiTector 7>

[0018] The PosiTector 7 outputs a signal to judge whether or not the elevator car 4 is located at a position of allowing the car door installed in the elevator car 4 to be opened. For example, the PosiTector 7 includes light shielding plates 7a formed in the manner of protruding from the inner wall of the hoistway 1a and an optical sensor 7b formed in the manner of protruding from the outer wall of the elevator car 4 toward the inner wall of the hoistway 1a. Then whether or not the elevator car 4 is located at a platform floor is detected by the output of an on/off signal from the optical sensor.

45 <Car top stop switch 11>

[0019] The car top stop switch 11 is a switch for stopping the travel of the elevator car 4 in the hoistway 1a. The car top stop switch 11 is installed at a position close to a platform door 14 at an upper part of the elevator car 4 and is arranged at a position where a maintenance worker M who has opened a platform door 14 can press the switch immediately from a platform floor 1f. The car top stop switch 11 is connected to the elevator control device 100 and acts as one of judgment switches to judge whether or not the operation mode of the elevator 1 may be switched.

<Car top maintenance operation device 12>

[0020] The car top maintenance operation device 12 is a device for a maintenance worker M to operate the travel of the elevator car 4 for maintenance and inspection of the elevator 1. For example, the car top maintenance operation device 12 has an operation mode selector switch 12a, a lift switch 12b, a down switch 12c, a travel switch 12d, and a car stop switch 12e.

[0021] In the switches, the operation mode selector switch 12a is a switch for selecting the operation mode of the elevator 1 between a normal mode and a maintenance mode. The lift switch 12b, the down switch 12c, and the travel switch 12d are operation switches for the maintenance worker M to operate and move the elevator car 4 when the operation mode is switched to the maintenance mode. Further, the car stop switch 12e is one of switches for stopping the travel of the elevator car 4 and functions similarly to the car top stop switch 11.

[0022] The car top maintenance operation device 12 having such respective switches is connected to the elevator control device 100. Then in particular, the operation mode selector switch 12a and the car stop switch 12e are also judgment switches to judge whether or not the operation mode of the elevator 1 may be switched.

<Handrail 13>

[0023] The handrail 13 is a freely assembled frame member installed at an upper part of the elevator car 4. A handrail switch 13a that switches on or off by assembling the handrail 13 is installed in the handrail 13. The handrail switch 13a is connected to the elevator control device 100 and acts as one of switches to judge whether or not the operation mode of the elevator 1 may be switched.

<Platform door 14>

[0024] The platform doors 14 are installed at positions of the heights of respective platform floors 1f where the elevator car 4 stops over a wall surface of the hoistway 1a. Each of the platform doors 14 slides to open and close in the horizontal direction, does not have a unique power, and opens and closes following a car door by engaging with the car door of the elevator car 4. Further, a platform door open/close detector 14a that is turned off by the opening of the door is installed in each of the platform doors 14. Each of the platform door open/close detectors 14a is connected to the elevator control device 100 that will be explained later and acts as one of detectors to judge whether or not the operation mode of the elevator 1 may be switched.

<Pit maintenance operation device 15>

[0025] The pit maintenance operation device 15 has functions similar to the car top maintenance operation

device 12 explained earlier and is installed in the pit. For example, the pit maintenance operation device 15 has a pit side operation mode selector switch 15a, a pit side lift switch 15b, a pit side down switch 15c, a pit side travel switch 15d, and a pit side car stop switch 15e. The respective switches function similarly to the respective switches installed in the car top maintenance operation device 12.

[0026] The pit maintenance operation device 15 is connected to the elevator control device 100. Then the pit side operation mode selector switch 15a and the pit side car stop switch 15e act as judgment switches to judge whether or not the operation mode of the elevator 1 may be switched.

<Elevator control device 100>

[0027] The elevator control device 100 is for controlling operation of the elevator 1 in a normal mode and a maintenance mode including drive of the hoisting machine 2 for lifting and lowering the elevator car 4 and open and close of the car door that is a door installed in the elevator car 4. Further, the elevator control device 100 judges whether or not the operation mode may be switched on the basis of signals from switches, detectors, and moreover the governor encoder 6. The site where the elevator control device 100 is installed is not limited and, as an example, the elevator control device 100 may be installed in any of the interior of the pit 1b, a machine room (not shown in the figure) at an upper part of the hoistway 1a, and the platform floors 1f.

[0028] The elevator control device 100 includes a calculator such as a microcomputer. The calculator has a CPU (Central Processing Unit), a ROM (Read Only Memory), and a RAM (Random Access Memory). Further, the calculator has an input section including a buffer circuit.

[0029] Figure 2 is a circuit diagram of switches and detectors involved in maintenance work of an elevator according to an embodiment. As shown in the figure, in an elevator control device 100, a contact point of a platform door open/close detector 14a is captured by an input buffer 14bu. Here, for example, the platform door open/close detector 14a is a detector that is turned on in the state of closing a platform door 14 and turned off in the state of opening a platform door 14, the platform door open/close detectors 14a at respective floors are connected in series, and the input buffer 14bu is in an off state when one of the multiple platform door open/close detectors 14a is turned off.

[0030] Further, in the elevator control device 100, a contact point of a car top stop switch 11 is captured by an input buffer 11bu. Here, the car top stop switch 11 is regarded as a switch to stop an elevator car in the state of off as an example. On this occasion, the car top stop switch 11 is connected in series to a car stop switch 12e and a pit side car stop switch 15e, those having similar functions. Then by one of the switches being off, the input buffer 11bu is in the state of off.

[0031] Further, in the elevator control device 100, the contact point on the normal mode side is captured by an input buffer 12bu and the contact point on the maintenance mode side is captured by an input buffer 12bu' in the contact points of an operation mode selector switch 12a of a car top maintenance operation device 12. Likewise, the contact point on the normal mode side is captured by an input buffer 15bu and the contact point on the maintenance mode side is captured by an input buffer 15bu' in the contact points of a pit side operation mode selector switch 15a of a pit maintenance operation device 15. Moreover, in the elevator control device 100, a contact point of a handrail switch 13a is captured by an input buffer 13bu.

«Detailed configuration of elevator control device»

[0032] Figure 3 is a block diagram of an elevator control device 100 according to an embodiment. As shown in the figure, the elevator control device 100 has, as respective parts for judging whether or not the operation mode of an elevator 1 should be switched, a maintenance worker boarding/leaving judgment unit 101, a platform door open/close judgment unit 102, a switch confirmation unit 103, a switch operation permission unit 104, and an operation control unit 105. Those respective units have the functions explained below. A CPU in the elevator control device 100 reads and runs programs stored in a ROM, and thus implements the functions.

<Maintenance worker boarding/leaving judgment unit 101>

[0033] The maintenance worker boarding/leaving judgment unit 101 monitors a signal from a governor encoder 6. Further, the maintenance worker boarding/leaving judgment unit 101 acquires a position of an elevator car 4 on the basis of the signal from the governor encoder 6. Furthermore, the maintenance worker boarding/leaving judgment unit 101 judges whether a maintenance worker boards or leaves the elevator car 4 on the basis of change of the monitored signal of the governor encoder 6 and the acquired position of the elevator car.

<Platform door open/close judgment unit 102>

[0034] The platform door open/close judgment unit 102 judges whether a platform door 14 closes or opens on the basis of a signal from a platform door open/close detector 14a. Further, the platform door open/close judgment unit 102 judges whether a platform door 14 has changed from an open state to a close state or from a close state to an open state on the basis of a signal from the platform door open/close detector 14a.

<Switch confirmation unit 103>

[0035] The switch confirmation unit 103 is a unit to con-

firm the state of a judgment switch to judge whether or not the operation mode of an elevator 1 may be switched. The judgment switch is any of a car top stop switch 11, an operation mode selector switch 12a, a pit side operation mode selector switch 15a, and a handrail switch 13a. Further, although the figure is not shown here, a car stop switch 12e and a pit side car stop switch 15e are also captured by an input buffer identical to the contact point of the car top stop switch 11 and hence act as judgment switches.

[0036] The switch confirmation unit 103 judges whether all of those judgment switches are on a normal mode side or on a maintenance mode side.

15 <Switch operation permission unit 104>

[0037] The switch operation permission unit 104 permits the operation control unit 105 to operate in a switched operation mode when an operation mode is switched by the operation mode selector switch 12a of a car top maintenance operation device 12. In particular, the switch operation permission unit 104 is connected to the maintenance worker boarding/leaving judgment unit 101, the platform door open/close judgment unit 102, and the switch confirmation unit 103 and permits operation in an operation mode selected by switching the operation mode selector switch 12a on the basis of judgments at those units.

30 <Operation control unit 105>

[0038] The operation control unit 105 controls operation of the elevator 1 in an operation mode selected by switching the operation mode selector switch 12a of the car top maintenance operation device 12 when the switch operation permission unit 104 permits.

[0039] Meanwhile, functions included in the respective units constituting the aforementioned elevator control device 100 are explained in more detail in the following elevator control method.

«Elevator control method»

[0040] An elevator control method by an elevator control device 100 explained in reference to Figures 2 and 3 is explained hereunder. A first elevator control method explained here is a method of mode switching process from a normal mode to a maintenance mode implemented by an elevator control device 100 when operation work of an elevator 1 starts. Further, a second elevator control method is a method of return process from a maintenance mode to a normal mode implemented by an elevator control device 100 when operation work of an elevator 1 finishes.

[0041] Figure 4 is a flowchart showing procedures of maintenance work of an elevator by a maintenance worker. A series of operations implemented by a maintenance worker are explained hereunder in reference to Figure 4

before the elevator control methods implemented by an elevator control device 100 are explained. Here, the states of switches operated in respective operations are explained together.

[0042] A maintenance worker implements the following operations when maintenance work of an elevator 1 starts. Firstly, the maintenance worker opens a platform door 14 (S1). This allows a platform door open/close detector 14a to detect an off state. Successively, the maintenance worker boards an upper part of an elevator car 4 (S2). This makes the elevator car 4 heavier and lower and a governor encoder 6 detects a minute change in the lowering of the elevator car 4. Further, the maintenance worker immediately presses a car top stop switch 11 (S3). This turns the car top stop switch 11 off. Successively, the maintenance worker assembles a handrail 13 and switches an operation mode selector switch 12a of a car top maintenance operation device 12 to a maintenance mode (S4). This makes a handrail switch 13a off and a maintenance mode side on and a normal mode side off in the operation mode selector switch 12a.

[0043] After the operation mode selector switch 12a is switched to the maintenance mode by implementing the above procedures, the maintenance worker implements maintenance work of the elevator 1 by operation of an operation switch of the car top maintenance operation device 12 (S5). Here, the operation switch includes a lift switch 12b, a down switch 12c, and a travel switch 12d.

[0044] After the maintenance work finishes, the maintenance worker implements the following operations for finishing the maintenance work of the elevator 1. Firstly, the maintenance worker switches the operation mode selector switch 12a of the car top maintenance operation device 12 to the normal mode and folds the handrail 13 (S6). This makes the maintenance mode side off and the normal mode side on in the operation mode selector switch 12a. Further, the handrail switch 13a is turned on. Successively, the maintenance worker presses the car top stop switch 11 (S7). This makes the car top stop switch 11 on. Successively, the maintenance worker leaves the upper part of the elevator car 4 (S8). This makes the elevator car 4 lighter and rise and the governor encoder 6 detects a minute change in the rising of the elevator car 4. Finally, the maintenance worker closes the platform door 14 (S9). This makes the platform door open/close detector 14a detect an on state.

[0045] Elevator control methods implemented by an elevator control device 100 when maintenance work of an elevator is implemented by a maintenance worker as explained above are explained hereunder on the basis of the flowcharts in Figures 5 to 7 in reference to Figure 3. The processes shown in those flowcharts represent methods implemented by programs constituting respective units of the elevator control device 100.

<First elevator control method>

[0046] Figure 5 is a flowchart showing a first elevator

control method according to an embodiment. The procedures shown in the figure are procedures of mode switching process from a normal mode to a maintenance mode implemented by an elevator control device 100 when maintenance work of an elevator 1 starts, and include the following steps.

[Step S101]

[0047] At Step S101, a platform door open/close judgment unit 102 judges whether or not a platform door 14 opens. On this occasion, the platform door open/close judgment unit 102 judges that the platform door 14 has opened (YES) from a close state because a platform door open/close detector 14a reverses from on to off and the process advances to the next Step S102. On other occasions, the platform door open/close judgment unit 102 judges that the platform door 14 does not open (NO) and Step S101 is repeated.

[0048] By this judgment, it is detected that a maintenance worker M has opened a closed platform door 14 for maintenance work (operation S1 in Figure 4).

[Step S102]

[0049] At Step S102, a maintenance worker boarding/leaving judgment unit 101 acquires and retains a position of an elevator car 4 on the basis of a signal from a governor encoder 6. The position of the elevator car 4 acquired here is defined as the position of the elevator car 4 at the time when the platform door 14 is judged to have opened (YES) at Step S101 before the maintenance worker boards the elevator car 4.

[Step S103]

[0050] At Step S103, a switch confirmation unit 103 judges whether or not all the judgment switches have switched to a maintenance mode side. On this occasion, the switch confirmation unit 103 confirms, as judgment switches, whether or not a car top stop switch 11 is off, a handrail switch 13a is off, and a maintenance mode side is on and a normal mode side is off in an operation mode selector switch 12a. Further at the same time, the switch confirmation unit 103 confirms that a normal mode side is on in contact points of a pit side operation mode selector switch 15a.

[0051] This makes the platform door open/close judgment unit 102 judge that a maintenance worker has pressed the car top stop switch 11 (operation S3 in Figure 4), has assembled the handrail 13, and has switched the operation mode selector switch 12a of the car top maintenance operation device 12 to a maintenance mode (operation S4 in Figure 4).

[0052] The process advances to the next Step S104 when the switch confirmation unit 103 judges that all the judgment switches have switched to a maintenance mode side (YES) or repeats the confirmation of Step

S103 until all the judgment switches are judged to have switched to a maintenance mode side (YES).

[Step S104]

[0053] At Step S104, the maintenance worker boarding/leaving judgment unit 101 acquires a position of the elevator car 4 on the basis of a signal from the governor encoder 6. The position of the elevator car 4 acquired here is the position of the elevator car 4 in the state where all the judgment switches are judged to have switched to a maintenance mode side (YES) at Step S103.

[Step S105]

[0054] At Step S105, the maintenance worker boarding/leaving judgment unit 101 judges whether or not a maintenance worker boards the elevator car 4. On this occasion, the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker boards an upper part of the elevator car 4 (YES) when the position of the elevator car 4 has shifted downward in comparing the position of the elevator car 4 retained at Step S102 with the position of the elevator car 4 detected at Step S104.

[0055] By judging at Step S105 that a maintenance worker boards an upper part of the elevator car 4 (YES), it can be judged that a maintenance worker M has opened a platform door 14 (operation S1 in Figure 4) and successively has boarded an upper part of the elevator car 4 (operation S2 in Figure 4). Further, by the judgment, it is confirmed that a maintenance worker M boards an upper part of the elevator car 4 in the state of judging that all the judgment switches have switched to a maintenance mode side (YES) at Step S103.

[0056] Here, the process repeats Step S105 until it is judged that a maintenance worker boards an upper part of the elevator car 4 (YES) and the process advances to the next Step S106 when it is judged that a maintenance worker boards an upper part of the elevator car 4 (YES).

[Step S106]

[0057] At Step S106, a switch operation permission unit 104 permits an operation control unit 105 to operate for switching to a maintenance mode.

[0058] This makes the operation control unit 105 control travel of the elevator car 4 on the basis of operation of an operation switch of the car top maintenance operation device 12 (operation S5 in Figure 4) by a maintenance worker M who has boarded the elevator car 4.

<Effect of first elevator control method>

[0059] According to the above first elevator control method and an elevator control device 100 to implement the method, operation of switching the operation mode from a normal mode to a maintenance mode is permitted

on the basis of a state where a maintenance worker M boards or leaves an elevator car 4 judged at a maintenance worker boarding/leaving judgment unit 101. It is therefore possible to prevent operation in a maintenance mode from being implemented and an elevator car 4 from traveling in a state where a maintenance worker M does not board the elevator car 4. Accordingly, it is possible to improve safety in maintenance work of an elevator 1.

10 <Second elevator control method>

[0060] Figure 6 is a flowchart showing a second elevator control method according to an embodiment. The procedures shown in the figure are procedures of return process from a maintenance mode to a normal mode implemented by an elevator control device 100 when maintenance work of an elevator 1 finishes and include the following steps.

20 [Step S201]

[0061] At Step S201, a maintenance worker boarding/leaving judgment unit 101 judges whether or not a maintenance worker M has left an elevator car 4. On this occasion, the maintenance worker boarding/leaving judgment unit 101 monitors a signal from a governor encoder 6 and judges that the maintenance worker M has left the elevator car 4 (YES) when it is detected that the position of the elevator car 4 has shifted upward at Step S202 on the basis of the monitored signal. On this occasion, as an example, it is also possible to judge that the maintenance worker M has left the elevator car 4 (YES) when the elevator car 4 rises to the position retained at Step S102 of the mode switching process to a maintenance mode.

[0062] The process advances to the next Step S202 when the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left the elevator car 4 (YES), or repeats judgment of Step S201 until it is judged that a maintenance worker M has left the elevator car 4 (YES).

[Step S202]

[0063] At Step S202, the maintenance worker boarding/leaving judgment unit 101 retains the position of the elevator car 4 when the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left the elevator car 4 (YES) at Step S201.

[Step S203]

[0064] At Step S203, a switch confirmation unit 103 judges whether or not all the judgment switches have switched to a normal mode side. On this occasion, the switch confirmation unit 103 confirms, as judgment switches, whether or not a maintenance mode side is off and a normal mode side is on in an operation mode se-

lector switch 12a, a handrail switch 13a is on, and a car top stop switch 11 is on. Further, at the same time, the switch confirmation unit 103 confirms that a normal mode side is on in contact points of a pit side operation mode selector switch 15a.

[0065] This makes a platform door open/close judgment unit 102 judge that a maintenance worker has switched the operation mode selector switch 12a of a car top maintenance operation device 12 to a normal mode, has folded a handrail 13 (operation S6 in Figure 4), and has pressed the car top stop switch 11 (operation S7 in Figure 4).

[0066] The process advances to the next Step S204 when the switch confirmation unit 103 judges that all the judgment switches have switched to an operation mode side (YES).

[0067] Otherwise, the process returns to Step S201 until the switch confirmation unit 103 judges that all the judgment switches have switched to an operation mode side (YES) and repeats Steps S201 to S203.

[0068] This prevents the return process from advancing to the next Step S204 in the state where a maintenance worker M still boards the elevator car 4 when the maintenance worker M boards and leaves the elevator car 4 repeatedly in the middle of switch operation of the judgment switches. In other words, the return process advances to Step S204 only when all the judgment switches have switched to an operation mode side in the state where a maintenance worker M has left the elevator car 4 (operation S8 in Figure 4).

[Step S204]

[0069] At Step S204, a platform door open/close judgment unit 102 judges whether or not a platform door 14 has closed. On this occasion, the platform door open/close judgment unit 102 judges that the platform door 14 has closed from an open state (YES) because a platform door open/close detector 14a detects reversion from off to on, and the process advances to the next Step S205. On other occasions, the platform door open/close judgment unit 102 judges that the platform door 14 does not close (NO) and Step S204 is repeated.

[0070] By this judgment, it is detected that a maintenance worker M has implemented the operation of closing the platform door 14 (operation S9 in Figure 4) in order to finish the maintenance work.

[Step S205]

[0071] At Step S205, the maintenance worker boarding/leaving judgment unit 101 acquires the position of the elevator car 4 on the basis of a signal from the governor encoder 6. The position of the elevator car 4 acquired here is defined as the position of the elevator car 4 at the time when the platform door 14 closes.

[Step S206]

[0072] At Step S206, the maintenance worker boarding/leaving judgment unit 101 judges whether or not a maintenance worker has left the elevator car 4. On this occasion, the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left the elevator car 4 (YES) when the maintenance worker boarding/leaving judgment unit 101 confirms that the position of the elevator car 4 does not change by comparing the position of the elevator car 4 retained at Step S202 with the position of the elevator car 4 detected at S205. Then when the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker has left the elevator car 4 (YES), the process advances to Step S207. In contrast, on other occasions, the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker does not leave the elevator car 4 (NO), and the process advances to Step S206'.

[Step S206']

[0073] Meanwhile, at Step S206', the maintenance worker boarding/leaving judgment unit 101 instructs an operation control unit 105 to raise an alarm. As a result, the operation control unit 105 judges that the platform door 14 may possibly close while a maintenance worker M still remains at an upper part of the elevator car 4 for example, and makes displays installed in an elevator 1 and an external system for operating the elevator 1 display the alarm. Alternatively, an alarm may be sounded from a speaker.

[0074] Successively, the process returns to Step S204, and repeats the judgment whether or not the platform door 14 has closed from an open state by the platform door open/close judgment unit 102 and subsequent steps. As a result, the return process can advance to the next Step S207 only when the platform door 14 closes from an open state in a state where a maintenance worker M leaves the elevator car 4.

[Step S207]

[0075] At Step S207, a switch operation permission unit 104 permits the operation control unit 105 to operate in the state of being switched to a normal mode. On this occasion, the switch operation permission unit 104 judges that an operation mode is never implemented while a maintenance worker M remains at an upper part of the elevator car 4 because it is confirmed that a maintenance worker has left the elevator car 4 at Step S206, and permits operation in a normal mode. Then the operation control unit 105 implements operation control of an elevator 1 in a normal mode.

<Effect of second elevator control method>

[0076] According to the above second elevator control method and an elevator control device 100 to implement the method, operation of switching the operation mode from a maintenance mode to a normal mode is permitted on the basis of a state where a maintenance worker M boards or leaves an elevator car 4 judged at a maintenance worker boarding/leaving judgment unit 101. Then the configuration of permitting return to a normal mode only when it is confirmed that a maintenance worker M has surely left the elevator car 4 can be obtained. The operation mode therefore returns from a maintenance mode to a normal mode only after a maintenance worker M has left the elevator car 4 and has been evacuated from the interior of a hoistway 1a toward a platform floor 1f, and it is possible to provide an elevator control device 100, an elevator 1, and an elevator control method, which allow safety of a maintenance worker M to be secured.

[0077] As a result, safety can be improved in maintenance work of an elevator 1. Moreover, safety can be improved at a low cost without the need of installing specific equipment at each of platform floors 1f.

[0078] Further, the aforementioned switching to a normal mode is permitted only when a platform door open/close judgment unit 102 judges that a platform door 14 has changed to a close state in a state where a maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left an elevator car 4. This makes safety further improve in maintenance work of an elevator 1.

<Modified example of second elevator method>

[0079] Figure 7 is a flowchart showing a modified example of the second elevator control method according to an embodiment. A control method of the modified example shown in the figure is a method of implementing Step S205' in place of Steps S205 to S206' in the second elevator control method shown in Figure 6. Step S205' is as follows.

[Step S205']

[0080] At Step S205', a maintenance worker boarding/leaving judgment unit 101 judges whether or not a predetermined time has elapsed after the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left an elevator car 4 (YES) at Step S201. On this occasion, the maintenance worker boarding/leaving judgment unit 101 judges whether or not a predetermined time has elapsed in a state where the position of the elevator car 4 retained at Step S202 is maintained on the basis of a signal from a governor encoder 6.

[0081] Otherwise, the maintenance worker boarding/leaving judgment unit 101 may also judge whether or not a predetermined time has elapsed after a platform

door open/close judgment unit 102 judges that a platform door 14 has closed (YES) at Step S204 if it is after the maintenance worker boarding/leaving judgment unit 101 judges that a maintenance worker M has left an elevator car 4 (YES) at Step S201.

[0082] The predetermined time in the above judgment may be any time as long as it is enough time for a maintenance worker having left an elevator car 4 to close a platform door 14, and is set at a time in about one to three minutes as an example.

[0083] The process advances to Step S207 when it is judged that a predetermined time has elapsed (YES), or repeats Step S205' until it is judged that a predetermined time has elapsed (YES). By implementing this judgment too, it is judged that a maintenance worker M has surely left an elevator car 4. Effects similar to the second elevator control method and an elevator control device 100 in which the second elevator control method is implemented therefore can be obtained.

[0084] Meanwhile, the present invention is not limited to the embodiments and modified examples stated above, and further includes various modified examples. For example, the above embodiments are explained in detail for the present invention to be comprehensible and the present invention is not necessarily limited to the case having all the explained configurations. Further, a part of a configuration in an embodiment can be replaced with a configuration of another embodiment or a configuration of an embodiment can be added to a configuration of another embodiment. Furthermore, a part of a configuration in an embodiment can be added to, deleted from, or replaced with another configuration.

Reference Signs List

[0085]

1... elevator
 1a... hoistway
 4... elevator car
 6... governor encoder
 12a... operation mode selector switch
 14... platform door
 14a... platform door open/close detector
 11... car top stop switch
 13a... handrail switch
 15a... pit side operation mode selector switch
 100... elevator control device
 101... maintenance worker boarding/leaving judgment unit
 102... platform door open/close judgment unit
 103... switch confirmation unit
 104... switch operation permission unit
 105... operation control unit
 M... maintenance worker

Claims

1. An elevator control device having an operation control unit to control operation of an elevator in accordance with an operation mode selected by a selector switch installed at an upper part of an elevator car, the elevator control device further comprising:
 - a maintenance worker boarding/leaving judgment unit to judge whether a maintenance worker boards or leaves the elevator car on the basis of a signal from a governor encoder for detecting a travel distance of the elevator car in a hoistway; and
 - a switch operation permission unit to permit the operation control unit to operate in an operation mode selected by the selector switch on the basis of a state where the maintenance worker boards or leaves the elevator car judged at the maintenance worker boarding/leaving judgment unit.
2. The elevator control device according to Claim 1, wherein the switch operation permission unit permits the operation control unit to operate in a maintenance mode when the maintenance worker boarding/leaving judgment unit judges that a maintenance worker boards the elevator car in a state where the operation mode is switched from a normal mode to the maintenance mode by the selector switch.
3. The elevator control device according to Claim 1, wherein the switch operation permission unit permits the operation control unit to operate in a normal mode when the operation mode is switched from a maintenance mode to the normal mode by the selector switch in a state where the maintenance worker boarding/leaving judgment unit judges that a maintenance worker has left the elevator car.
4. The elevator control device according to Claim 3, comprising a platform door open/close judgment unit to judge an open or close state of a platform door on the basis of a signal from a platform door open/close detector installed at a platform door of the hoistway, wherein the switch operation permission unit permits the operation control unit to operate in a normal mode when the platform door open/close judgment unit judges that the platform door has changed from an open state to a close state in a state where the maintenance worker boarding/leaving judgment unit judges that a maintenance worker has left the elevator car.
5. The elevator control device according to Claim 4, wherein the switch operation permission unit permits the operation control unit to operate in a normal mode when a predetermined time has elapsed after the maintenance worker boarding/leaving judgment unit judges that a maintenance worker has left the elevator car.
6. The elevator control device according to any one of Claims 1 to 5, comprising a switch confirmation unit to confirm states of all judgment switches for judging whether or not the operation mode should be switched between a normal mode and a maintenance mode, wherein the switch operation permission unit permits the operation control unit to operate in an operation mode switched by the selector switch when the switch confirmation unit confirms that the all judgment switches are on a maintenance mode side or a normal mode side.
7. An elevator comprising an elevator car, a governor encoder for detecting a travel distance of the elevator car in a hoistway, a selector switch of an operation mode installed at an upper part of the elevator car, and an elevator control device having an operation control unit to control operation of the elevator in accordance with an operation mode selected by the selector switch, wherein the elevator control device has:
 - a maintenance worker boarding/leaving judgment unit to judge whether a maintenance worker boards or leaves the elevator car on the basis of a signal from the governor encoder; and
 - a switch operation permission unit to permit the operation control unit to operate in an operation mode selected by the selector switch on the basis of a state where the maintenance worker boards or leaves the elevator car judged at the maintenance worker boarding/leaving judgment unit.
8. An elevator control method by which an operation control unit controls operation of an elevator in accordance with an operation mode selected by a selector switch installed at an upper part of an elevator car, wherein a maintenance worker boarding/leaving judgment unit judges whether a maintenance worker boards or leaves the elevator car on the basis of a signal from a governor encoder for detecting a travel distance of the elevator car in a hoistway; and a switch operation permission unit permits the operation control unit to operate in an operation mode selected by the selector switch on the basis of a state where the maintenance worker boards or leaves the elevator car judged at the maintenance worker boarding/leaving judgment unit.
9. The elevator control method according to Claim 8, wherein the switch operation permission unit permits

the operation control unit to operate in a maintenance mode when the maintenance worker boarding/leaving judgment unit judges that a maintenance worker boards the elevator car in a state where the operation mode is switched from a normal mode to the maintenance mode by the selector switch. 5

10. The elevator control method according to Claim 8, wherein the switch operation permission unit permits the operation control unit to operate in a normal mode when the operation mode is switched from a maintenance mode to the normal mode by the selector switch in a state where the maintenance worker boarding/leaving judgment unit judges that a maintenance worker leaves the elevator car. 10 15

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FIG. 1

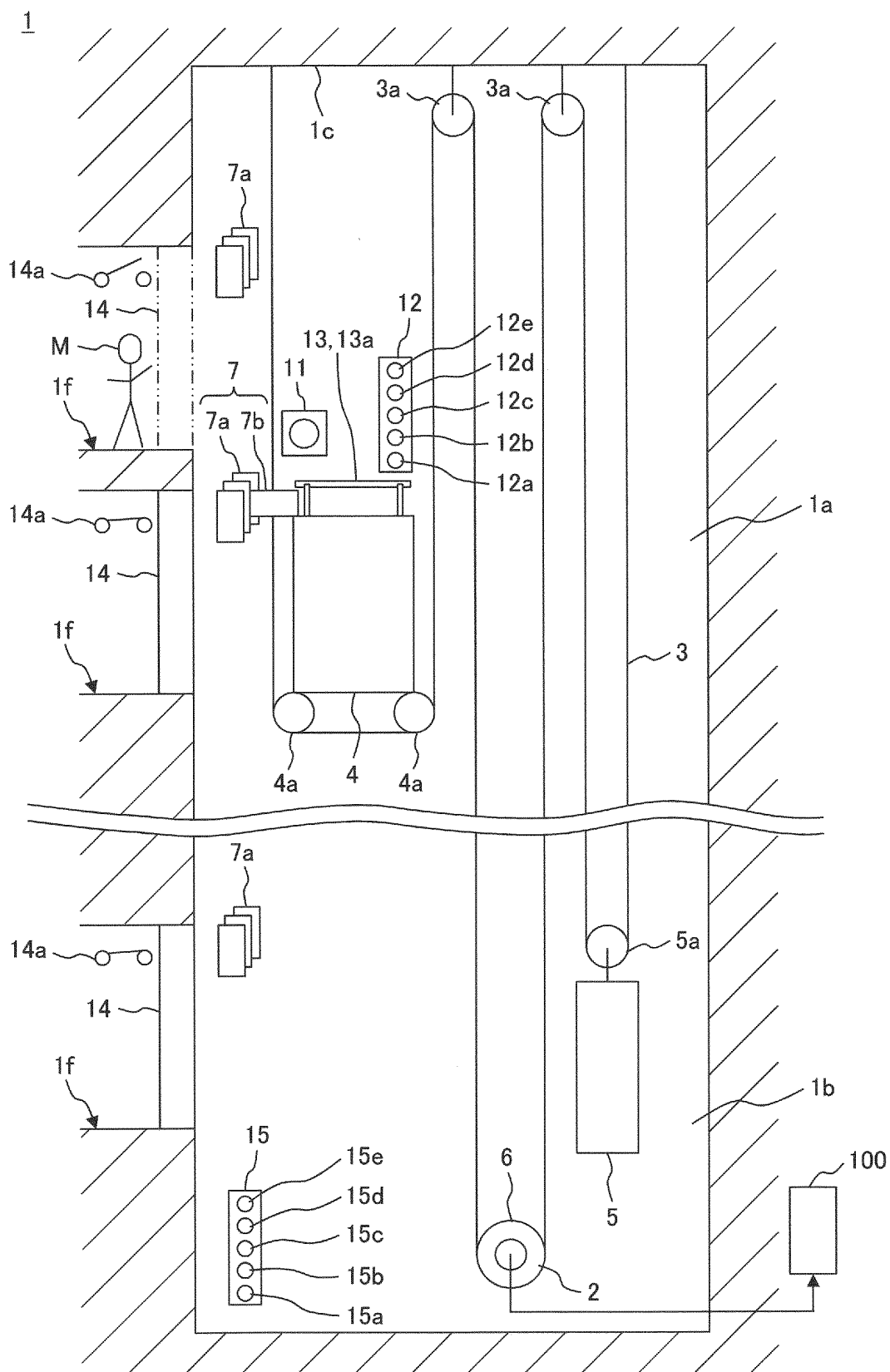


FIG. 2

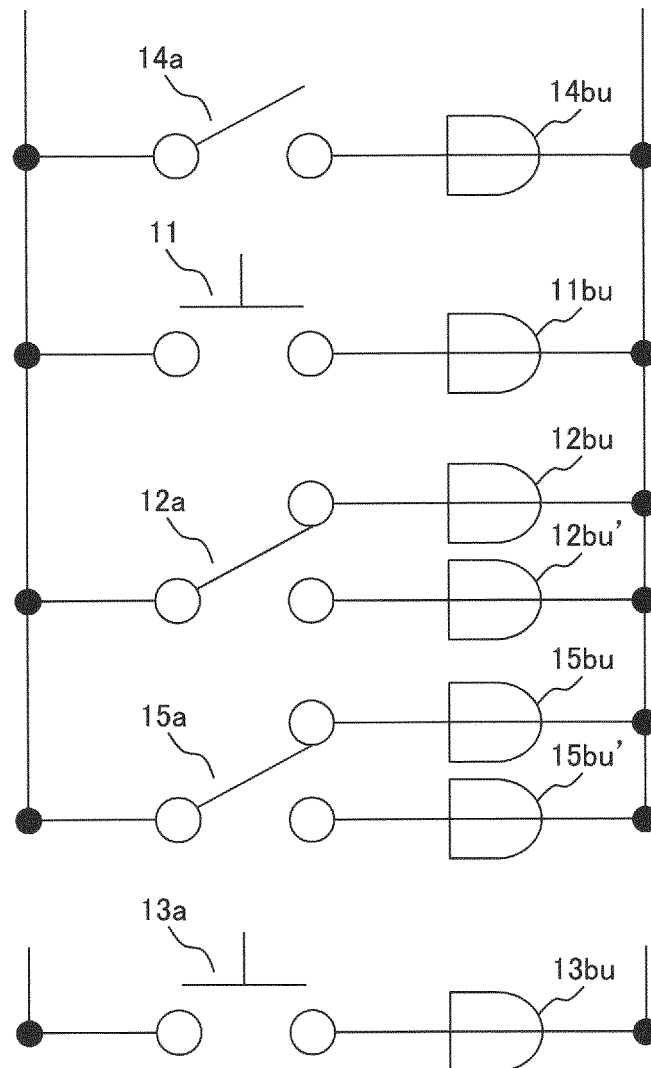


FIG. 3

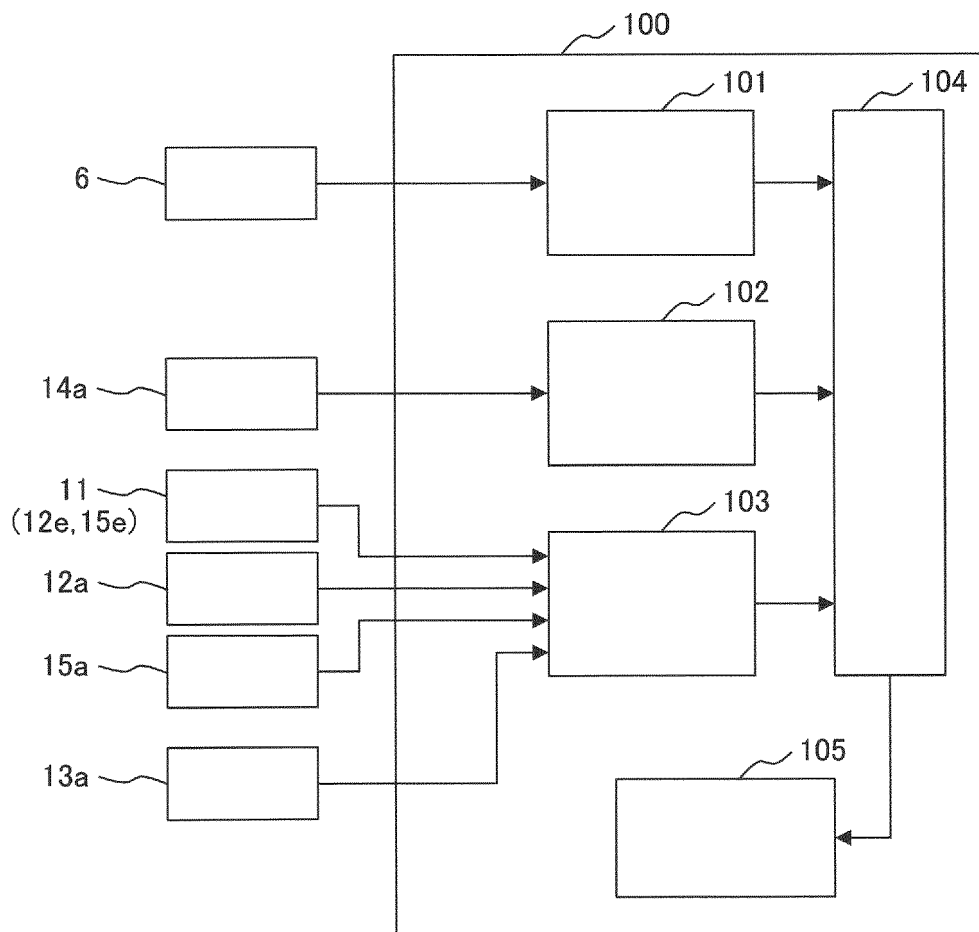


FIG. 4

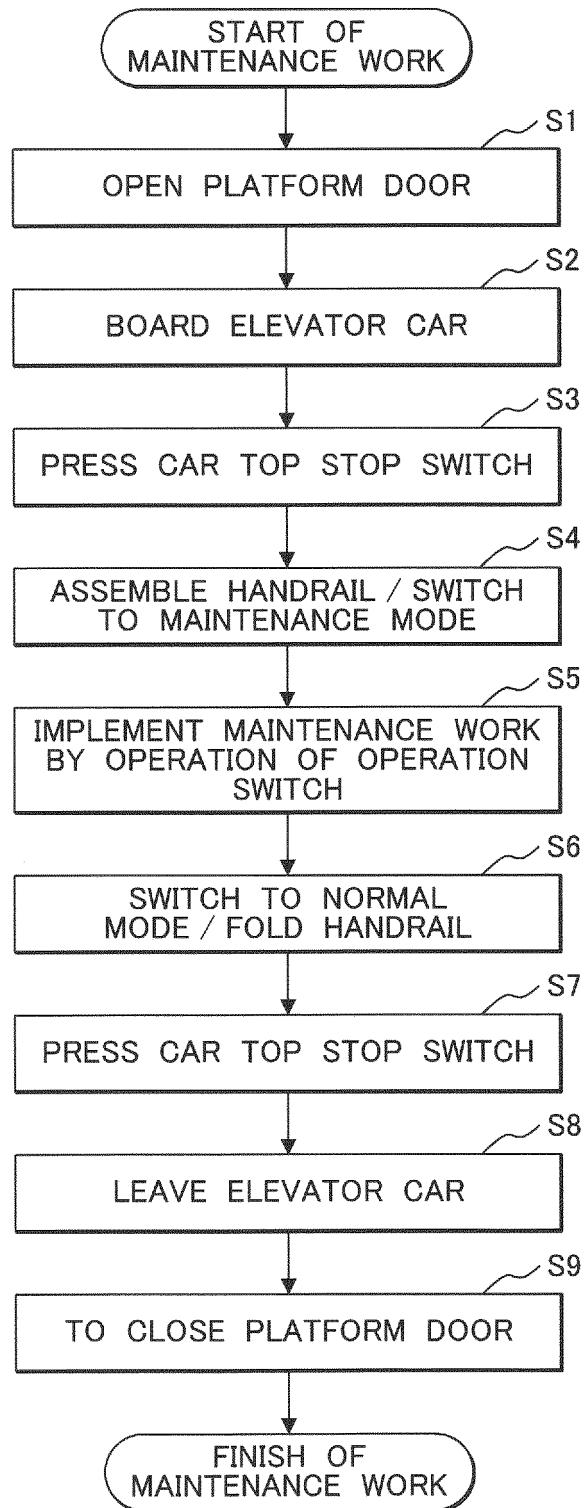


FIG. 5

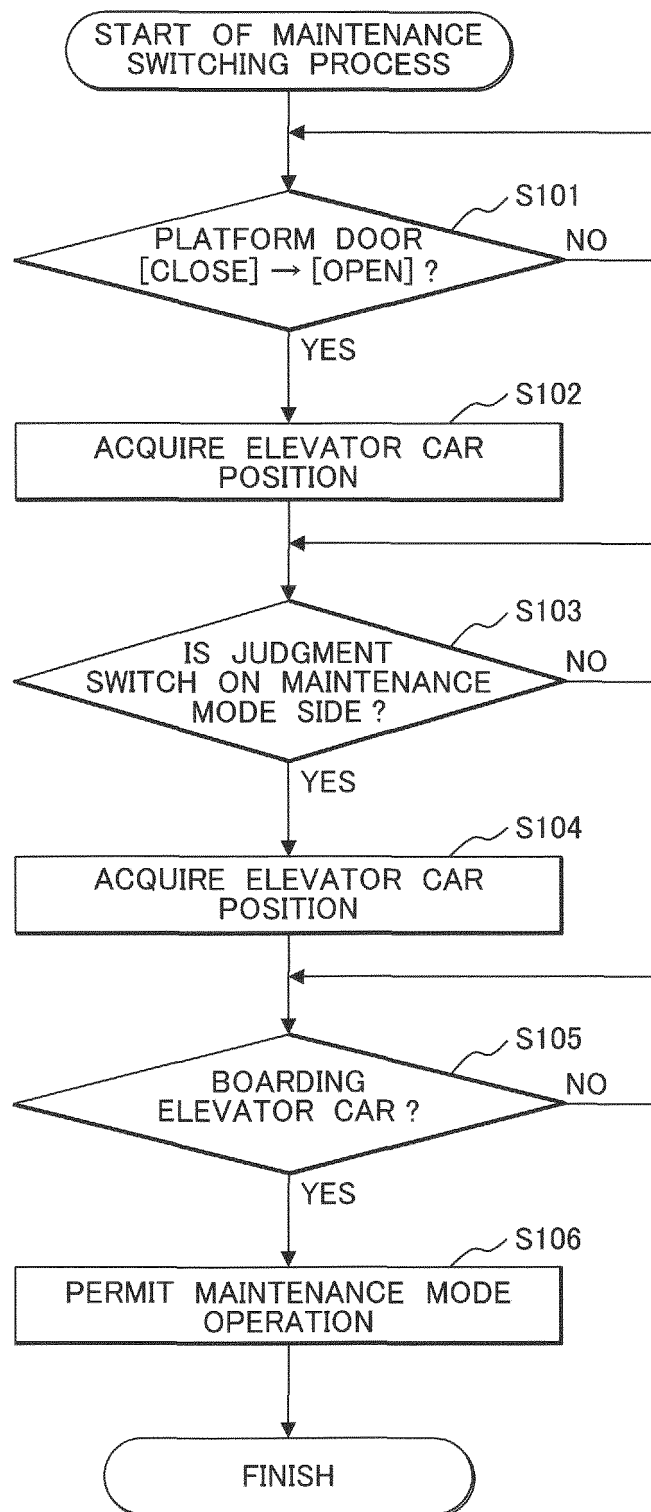


FIG. 6

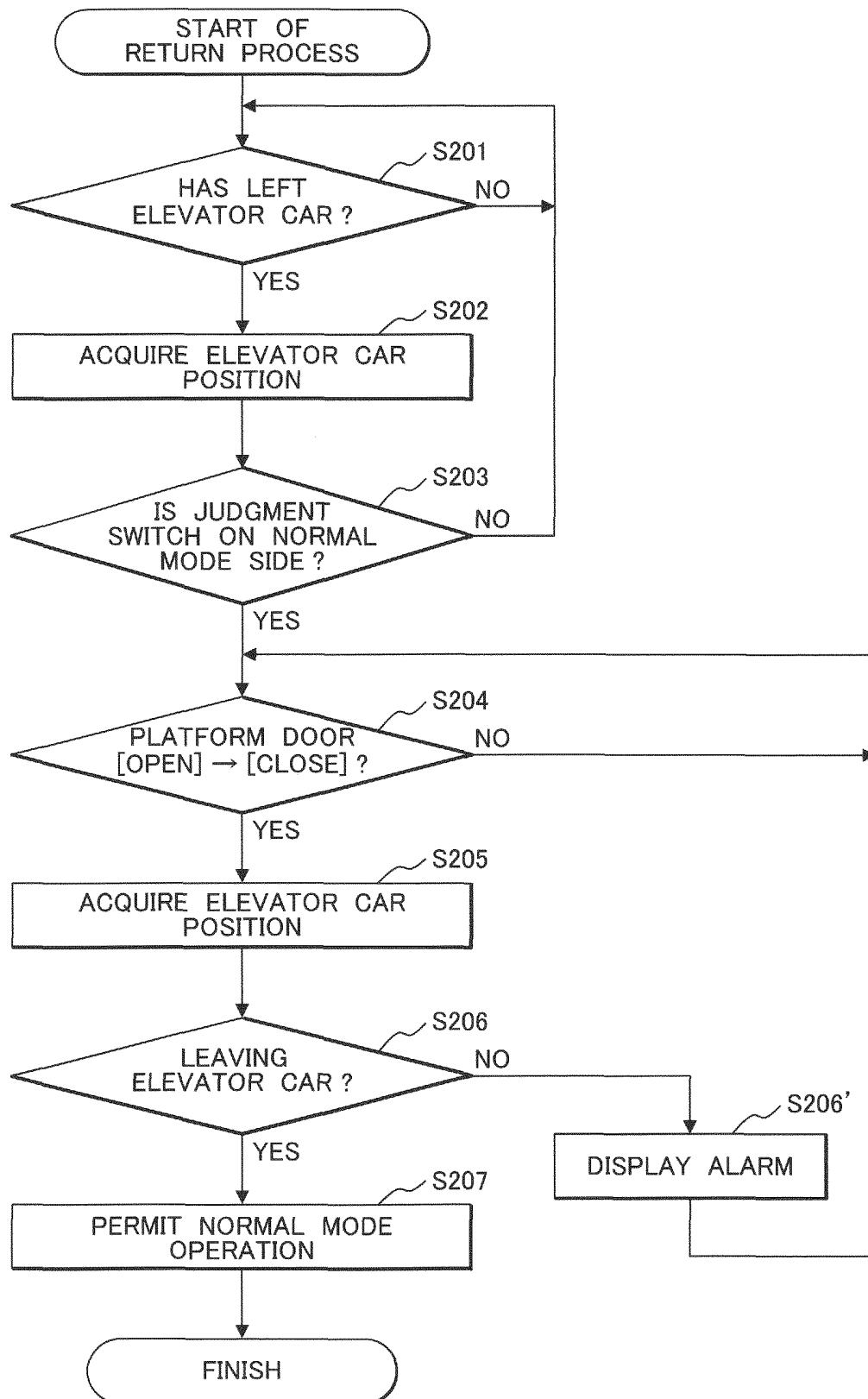
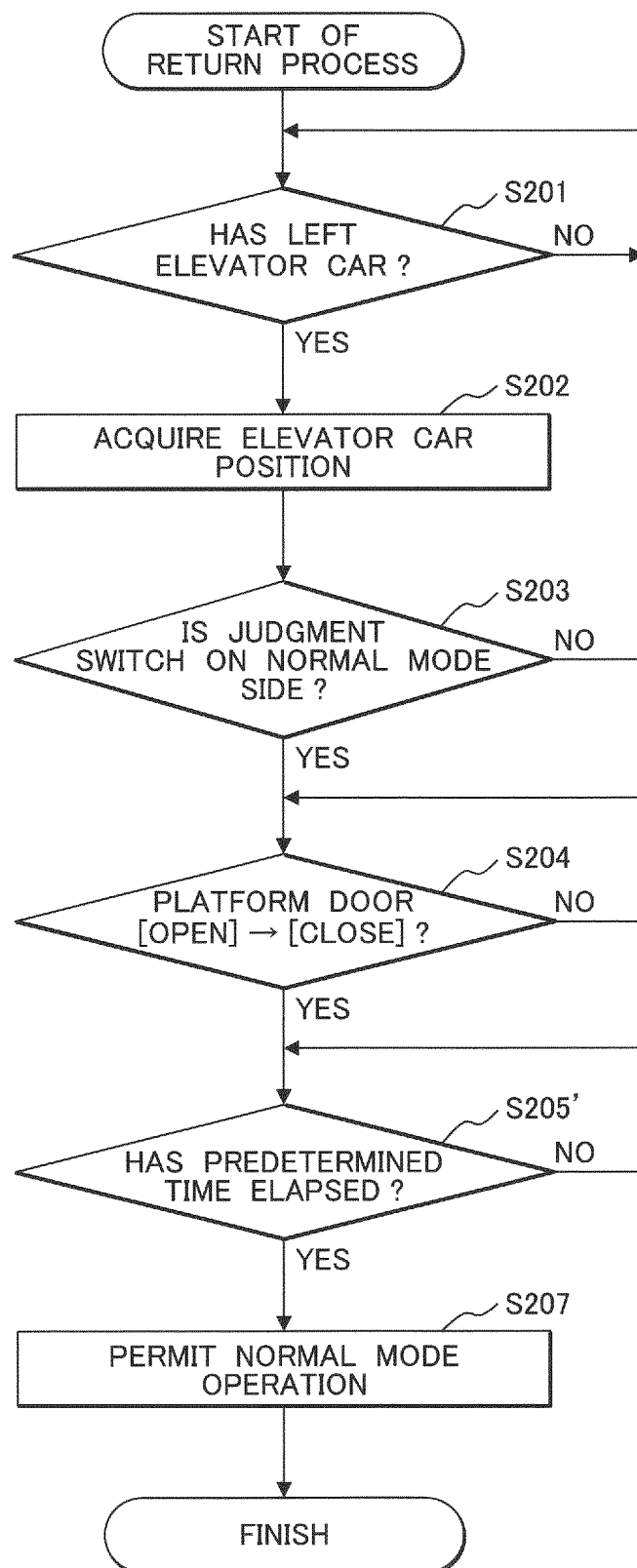


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/042973

A. CLASSIFICATION OF SUBJECT MATTER Int. Cl. B66B5/00 (2006.01) i According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED Minimum documentation searched (classification system followed by classification symbols) Int. Cl. B66B5/00-B66B5/28		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2018 Registered utility model specifications of Japan 1996-2018 Published registered utility model applications of Japan 1994-2018 Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2017-19610 A (HITACHI, LTD.) 26 January 2017, paragraphs [0011]-[0024], fig. 1-4 (Family: none)	1-10
A	JP 2004-224542 A (MITSUBISHI ELECTRIC BUILDING TECHNO-SERVICE CO., LTD.) 12 August 2004, paragraphs [0012]-[0025], fig. 1-4 (Family: none)	1-10
A	JP 2002-3113 A (HITACHI BUILDING SYSTEMS CO., LTD.) 09 January 2002, paragraph [0016], fig. 1 (Family: none)	1-10
A	US 2008/0245619 A1 (MONZON-SIMON, Andres) 09 October 2008, paragraphs [0024]-[0035], fig. 1 & JP 4668263 B2 & EP 1753688 B1 & CN 1942385 B	1-10
☐ Further documents are listed in the continuation of Box C.	☐ See patent family annex.	
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Date of the actual completion of the international search 09.02.2018	Date of mailing of the international search report 27.02.2018	
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.	

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