



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
18.01.2012 Bulletin 2012/03

(51) Int Cl.:
B66B 5/00 (2006.01) B66B 5/02 (2006.01)

(21) Application number: **09841483.2**

(86) International application number:
PCT/JP2009/054883

(22) Date of filing: **13.03.2009**

(87) International publication number:
WO 2010/103655 (16.09.2010 Gazette 2010/37)

(84) Designated Contracting States:
AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO SE SI SK TR

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(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, after performing failure diagnosis for a brake device (7) and a brake control section (103), a first diagnosis section (105) and a second diagnosis section (106) compare the contents of the failure diagnosis with each other. When confirming that the

results of the comparison are not identical with each other, the first diagnosis section (105) and the second diagnosis section (106) determine that a failure occurs in at least any one of the first diagnosis section (105) and the second diagnosis section (106).

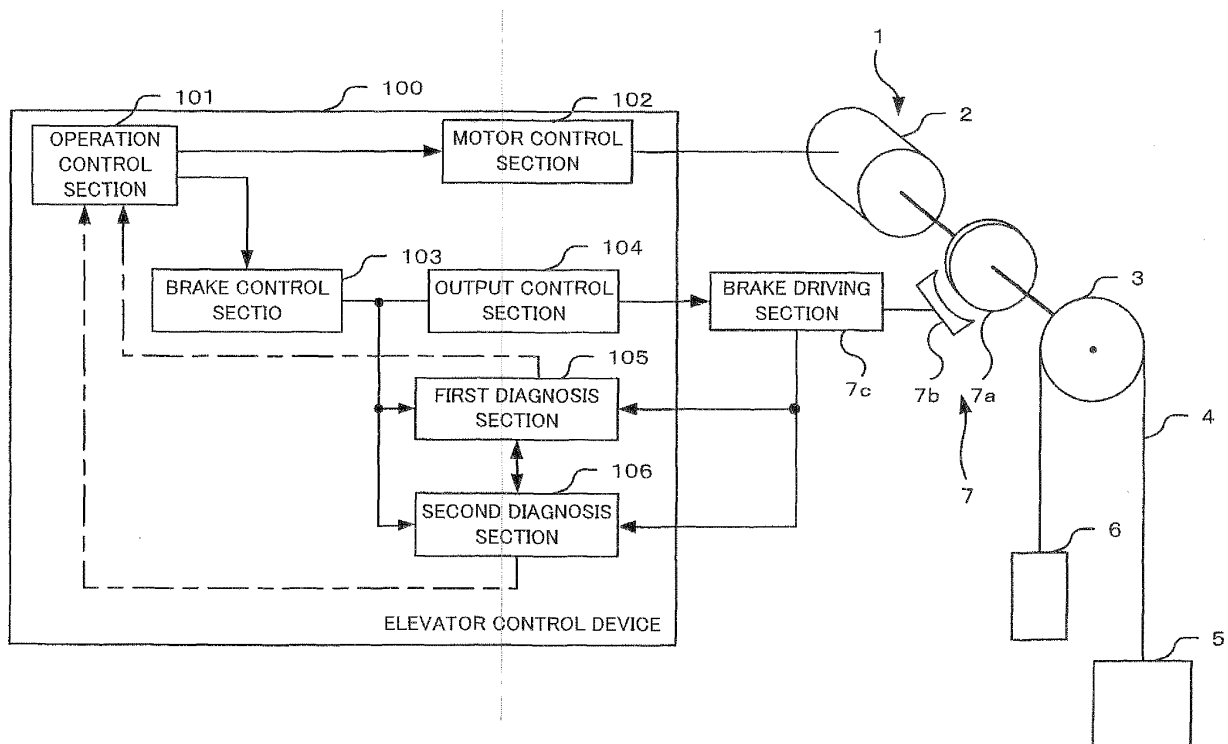


Fig. 1

Description

Technical Field

[0001] The present invention relates to an elevator apparatus having a failure diagnosis function for a brake device.

Background Art

[0002] In a conventional brake control device for an elevator, a controller for controlling the actuation of a brake device has a function of detecting a failure of the brake device. When detecting the failure of the brake device, the controller stops the supply of power to the brake device to place the brake device in a braking state (for example, see Patent Literature 1).

[0003] Patent Literature 1: JP 2005-126183 A

Disclosure of the Invention

Problem to be solved by the Invention

[0004] In the conventional brake control device for the elevator as described above, the failure of the brake device can be detected by the controller. However, a failure occurring in the controller itself cannot be detected. Therefore, when a failure occurs in the controller, the failure cannot be detected for the brake device. As a result, there is a fear in that a car is continuously operated even though the failure occurs in the brake device.

[0005] The present invention has been made to solve the problem described above, and therefore has an object to provide an elevator apparatus capable of detecting a failure when the failure occurs in at least any one of a plurality of diagnosis sections.

Means for solving the Problem

[0006] An elevator apparatus according to the present invention includes: a car provided in a hoistway; a motor for driving raising and lowering of the car; a brake device for braking rotation of the motor; signal generation means for generating a brake diagnosis signal relating to an operation of the brake device; an operation control section for collectively controlling an operation of the car; a motor control section for controlling the driving of the motor in response to a command from the operation control section; a brake control section for controlling an operation of the brake device in response to a command from the operation control section, the brake control section being capable of generating a brake-control-section diagnosis signal; and a plurality of diagnosis sections capable of performing at least failure diagnosis for the brake device based on the brake diagnosis signal from the signal generating means among the failure diagnosis for the brake device and failure diagnosis for the brake control section based on the brake-control-section diagnosis signal from

the brake control section, in which, when each of the plurality of diagnosis sections compares a content of diagnosis performed by the self diagnosis section with a content of diagnosis performed by another one of the plurality of diagnosis sections and confirms that the contents of diagnosis are not identical with each other, it is determined that a failure occurs in at least any one of the plurality of diagnosis sections including the self diagnosis section.

Brief Description of the Drawings

[0007] [FIG. 1] FIG. 1 is a configuration diagram illustrating an elevator apparatus according to Embodiment 1 of the present invention.

[FIG. 2] FIG. 2 is a flowchart illustrating a failure diagnosis operation performed by a first diagnosis section illustrated in FIG. 1 for a brake device.

[FIG. 3] FIG. 3 is a flowchart illustrating the failure diagnosis operation performed by the first diagnosis section illustrated in FIG. 1 for the brake control section.

[FIG. 4] FIG. 4 is a configuration diagram illustrating an elevator apparatus according to Embodiment 2 of the present invention.

[FIG. 5] FIG. 5 is a configuration diagram illustrating an elevator apparatus according to Embodiment 3 of the present invention.

[FIG. 6] FIG. 6 is a configuration diagram illustrating an elevator apparatus according to Embodiment 4 of the present invention.

[FIG. 7] FIG. 7 is a configuration diagram illustrating an elevator apparatus according to Embodiment 5 of the present invention.

[FIG. 8] FIG. 8 is a flowchart illustrating a failure diagnosis operation performed by a first diagnosis section for a brake device according to Embodiment 6 of the present invention.

Best Modes for carrying out the Invention

[0008] Hereinafter, preferred embodiments of the present invention are described referring to the drawings.

Embodiment 1

[0009] FIG. 1 is a configuration diagram illustrating an elevator apparatus according to Embodiment 1 of the present invention.

In FIG. 1, a hoisting machine 1 is provided in a hoistway. The hoisting machine 1 includes a motor 2 and a sheave 3. The sheave 3 is rotated by the motor 2. A rope 4 is looped around the sheave 3. A car 5 and a counterweight 6 are suspended from the rope 4. The car 5 and the counterweight 6 are raised and lowered in the hoistway by a driving force of the motor 2.

[0010] A brake device 7 is mounted to the hoisting ma-

chine 1. The brake device 7 includes a brake wheel 7a, a brake shoe 7b serving as a braking piece, and a brake driving section 7c. The brake shoe 7b and the brake driving section 7c constitute a brake unit. The brake wheel 7a is mounted to a rotary shaft of the motor 2. The brake wheel 7a is rotated together with the sheave 3 by the motor 2.

[0011] The brake shoe 7b is displaceable between a braking position and a release position. The braking position is a position at which a brake lining of the brake shoe 7b comes into contact with a braking surface (for example, an outer circumferential surface) of the brake wheel 7a. The release position is a position at which the brake lining of the brake shoe 7b is separated at a distance from the braking surface of the brake wheel 7a. That is, the release position is a position at which the brake lining and the braking surface of the brake wheel 7a are held in a non-contact state.

[0012] The displacement of the brake shoe 7b is driven by the brake driving section 7c. The brake lining of the brake shoe 7b is pressed against the braking surface of the brake wheel 7a by the brake driving section 7c. As a result, the rotation of the motor 2 is braked. The brake driving section 7c includes a spring for biasing the brake shoe 7b toward the brake wheel 7a and an exciting coil for separating the brake shoe 7b away from the brake wheel 7a against the biasing force of the spring (both are not shown). When the exciting coil is excited, the brake shoe 7b is located at the release position.

[0013] Feedback-signal generation means (not shown) for generating a feedback signal relating to an actuation state of the brake device 7 is (mechanically or electrically) connected to the brake driving section 7c. The feedback-signal generation means is, for example, a current detector for generating a signal according to a current flowing through the exciting coil of the brake driving section 7c, a switch for generating a signal according to the position (braking position or release position) of the brake shoe 7b, or the like. A switch or a sensor capable of generating the signal relating to the actuation state of the brake device 7 may be used as the feedback-signal generation means. Moreover, a plurality of types of switches or sensors may be used in combination as the feedback-signal generation means.

[0014] The operation of the car 5 is controlled by an elevator control device 100. The elevator control device 100 includes an operation control section 101, a motor control section 102, a brake control section 103, an output control section 104, a first diagnosis section 105, and a second diagnosis section 106. The operation control section 101 collectively controls the operation of the car 5. Moreover, the operation control section 101 transmits a motor driving command to the motor control section 102 according to operating conditions of the car 5. Further, the operation control section 101 transmits a brake driving command to the brake control section 103 according to the operating conditions of the car 5.

[0015] The motor control section 102 controls the driv-

ing of the motor 2 in response to the motor driving command from the operation control section 101. The brake control section 103 sets the braking force of the brake device 7 in response to a brake driving command from the operation control section 101 and according to the operating conditions of the car 5. Then, the brake control section 103 transmits an output command for exerting the set braking force, to the output control section 104.

[0016] The output control section 104 is provided between the brake control section 103 and the brake device 7. The output control section 104 determines the magnitude of a voltage to be applied to the exciting coil of the brake device 7 in response to the output command received from the brake control section 103 and applies the determined magnitude of the voltage to the exciting coil.

[0017] The first diagnosis section 105 performs failure diagnosis for the brake device 7 and the brake control section 103. Similarly, the second diagnosis section 106 performs failure diagnosis for the brake device 7 and the brake control section 103. The first diagnosis section 105 and the second diagnosis section 106 perform the failure diagnosis independently of each other. The first diagnosis section 105 and the second diagnosis section 106 perform the failure diagnosis as needed.

[0018] An example of diagnosis processing is described. The first diagnosis section 105 and the second diagnosis section 106 can detect a power abnormality, a braking-force abnormality, a mechanical abnormality of the brake device 7 or the like based on the feedback signal (brake diagnosis signal) from the brake driving section 7c. The first diagnosis section 105 and the second diagnosis section 106 can also detect an output-waveform abnormality or an operation abnormality of the brake control section 103 or the like based on the feedback signal (brake-control-section diagnosis signal) from the brake control section 103. Therefore, when detecting the above-mentioned abnormalities, the first diagnosis section 105 and the second diagnosis section 106 determine that a failure occurs in the brake device 7 or the brake control section 103.

[0019] After performing the failure diagnosis for the brake device 7 and the brake control section 103, the first diagnosis section 105 and the second diagnosis section 106 compare the contents of the failure diagnosis with each other. Specifically, each of the first diagnosis section 105 and the second diagnosis section 106 compares the results of diagnosis performed by the self diagnosis section and the results of diagnosis performed by the second diagnosis section 106 and the first diagnosis section 105 (another diagnosis section).

[0020] When confirming that the results of comparison are not identical with each other, the first diagnosis section 105 and the second diagnosis section 106 determine that a failure occurs in at least any one of the first diagnosis section 105 and the second diagnosis section 106. Specifically, the first diagnosis section 105 and the second diagnosis section 106 determine that the failure oc-

curs in at least any one of a plurality of diagnosis sections including the self diagnosis section. In this case, each of the first diagnosis section 105 and the second diagnosis section 106 transmits a diagnosis-section failure signal to the operation control section 101 (indicated by alternate long and short dash lines shown in FIG. 1).

[0021] Further, when confirming that the results of comparison of the contents of the diagnosis are identical with each other and therefore confirming the occurrence of the failure in the brake device 7 or the brake control section 103, each of the first diagnosis section 105 and the second diagnosis section 106 transmits a brake failure signal or a brake-control-section failure signal to the operation control section 101.

[0022] In response to the diagnosis-section failure signal, the brake failure signal, or the brake-control-section failure signal described above, the operation control section 101 stops the driving of the motor 2 through an intermediation of the motor control section 102 so as to stop the operation of the car 5. In the case of the reception of the diagnosis-section failure signal, the brake failure signal, or the brake-control-section failure signal when the car 5 is present between landing floors, the operation control section 101 may first open a door of the car 5 at the nearest floor and then stop the operation of the car 5.

[0023] The elevator control device 100 can include hardware (not shown) including a computation processing section (CPU), a storage section (ROM, RAM, or hard disk), and a signal input/output section. A program for realizing operations illustrated in FIGS. 2 and 3 is prestored in the storage section of the elevator control device 100. The functions 101 to 106 of the elevator control device 100 can also be realized respectively by pieces of hardware independent of each other.

[0024] Next, an operation is described. FIG. 2 is a flowchart illustrating an operation performed by the first diagnosis section 105 illustrated in FIG. 1 during the failure diagnosis. In FIG. 2, the first diagnosis section 105 performs the failure diagnosis for the brake device 7 based on the signal from the feedback-signal generation means (Step S101). Then, the first diagnosis section 105 compares the content of diagnosis with that of the second diagnosis section (another diagnosis section) 106 (Step S102) to confirm whether or not the content of the diagnosis is identical with that of the second diagnosis section 106 (Step S103).

[0025] When confirming that the contents of the diagnosis are identical with each other in this step, the first diagnosis section 105 confirms whether or not the brake device 7 is normal based on the content of diagnosis performed by the self diagnosis section (Step S104). Then, when the brake device 7 is normal, the first diagnosis section 105 repeats the same operation.

[0026] When confirming the contents of the diagnosis are not identical with each other as a result of the confirmation of whether or not the content of the diagnosis of the first diagnosis section 105 is identical with that of the second diagnosis section 106 (NO in Step S103), the

first diagnosis section 105 determines that the failure has occurred in any one of the first diagnosis section 105 and the second diagnosis section 106 and transmits the diagnosis-section failure signal to the operation control section 101 (Step S105). Then, the first diagnosis section 105 waits until being reset (Step S107). After being reset, the first diagnosis section 105 repeats the same operation.

[0027] Further, when confirming that the failure has occurred in the brake device 7 as a result of the confirmation of whether or not the brake device 7 is normal (NO in Step S104), the first diagnosis section 105 transmits the brake failure signal to the operation control section 101 (Step S106). Then, the first diagnosis section 105 waits until being reset (Step S107). After being reset, the first diagnosis section 105 repeats the same operation.

[0028] FIG. 3 is a flowchart illustrating a failure diagnosis operation performed by the first diagnosis section 105 illustrated in FIG. 1 for the brake control section 103. The failure diagnosis operation performed by the first diagnosis section 105 for the brake control section 103 differs from the operation illustrated in FIG. 2 in that the brake control section 103 is a target of the failure diagnosis and the brake-control-section failure signal is transmitted to the operation control section 101 after the detection of the failure of the brake control section 103. The remaining operation is the same as that illustrated in FIG. 2. An operation of the second diagnosis section 106 is the same as that of the first diagnosis section 105.

[0029] According to the elevator apparatus of Embodiment 1 as described above, the first diagnosis section 105 and the second diagnosis section 106 compare the contents of the diagnosis for the brake device 7 or the brake control section 103 with each other. When confirming that the results of comparison are not identical with each other, the first diagnosis section 105 and the second diagnosis section 106 determine the occurrence of the failure in at least any one of the first diagnosis section 105 and the second diagnosis section 106. By the configuration described above, in case of failure in at least any one of the diagnosis sections 105 and 106, the failure can be detected.

[0030] When the first diagnosis section 105 and the second diagnosis section 106 detect the failure of any of the first diagnosis section 105 and the second diagnosis section 106, the first diagnosis section 105 and the second diagnosis section 106 transmit the diagnosis-section failure signal to the operation control section 101. Then, the operation control section 101 stops the operation of the car 5. Specifically, the operation control section 101 does not allow the car 5 to operate under a state in which the failure occurs in any one of the first diagnosis section 105 and the second diagnosis section 106, that is, under a state in which the failure diagnosis can not be performed for the brake device 7 and the brake control section 103. Therefore, the operation of the car 5 in the state in which the brake device 7 and the brake control section

103 is still faulty can be avoided in advance.

[0031] In Embodiment 1, the two diagnosis sections, that is, the first diagnosis section 105 and the second diagnosis section 106, are used. However, the number of diagnosis sections is not limited to two and may also be three or more. Specifically, three or more diagnosis sections may be provided for multiplexing the diagnosis sections. In this case, even if the failures simultaneously occur in the plurality of diagnosis sections, the failures can be detected.

[0032] In Embodiment 1, when receiving the failure detection signal from the second diagnosis section 106, the operation control section 101 stops the operation of the car 5. However, the operation is not limited to the example described above. When receiving the failure detection signal from the second diagnosis section 106, the operation control section 101 stops the operation of the car 5 and may, for example, transmit information of the occurring failure to a remote monitoring center.

[0033] Further, in Embodiment 1, it is the second diagnosis section 106 that transmits the failure detection signal to the operation control section 101. However, the transmission of the failure detection signal is not limited to the example described above. One or both of the first diagnosis section 105 and the second diagnosis section 106 may transmit the failure detection signal to the operation control section 101.

[0034] Moreover, the output control section 104 described in Embodiment 1 can be omitted. In this case, in place of the output control section 104, the brake control section 103 may determine the magnitude of voltage to be applied to the exciting coil of the brake device 7 and apply the determined magnitude of voltage to the exciting coil.

Embodiment 2

[0035] In Embodiment 1, the number of the brake shoe 7b and the brake driving section 7c included in the brake device 7, the brake control section 103, and the output control section 104 is one for each. On the other hand, in Embodiment 2, the number of the used components described above is two for each, that is, brake shoes 7b and 7d, brake driving sections 7c and 7e, brake control sections 103A and 103B, and output control sections 104A and 104B. Specifically, in Embodiment 2, two brake units are used.

[0036] FIG. 4 is a configuration diagram illustrating an elevator apparatus according to Embodiment 2 of the present invention. In FIG. 4, the brake shoe 7b, the brake driving device 7c, the brake control device 103A, the output control section 104A, and the first diagnosis section 105 constitute a first brake system. The brake shoe 7d, the brake driving device 7e, the brake control device 103B, the output control section 104B, and the second diagnosis section 106 constitute a second brake system.

[0037] The first diagnosis section 105 of Embodiment 2 performs failure diagnosis for the brake shoe 7b, the

brake driving section 7c, and the brake control device 103A included in the first brake system. The second diagnosis section 106 of Embodiment 2 performs failure diagnosis for the brake shoe 7d, the brake driving section 7e, and the brake control device 103B included in the second brake system. That is, each of the first diagnosis section 105 and the second diagnosis section 106 of Embodiment 2 performs the failure diagnosis for one of the brake shoes 7b and 7d and one of the brake driving sections 7c and 7e of the brake system which includes the self diagnosis section. The remaining configuration and operation are the same as those of Embodiment 1.

[0038] According to the elevator apparatus of Embodiment 2 as described above, even when the first diagnosis section 105 and the second diagnosis section 106 perform the failure diagnosis respectively for the brake systems different from each other, the same effects as those of Embodiment 1 can be obtained.

Embodiment 3

[0039] The output control section 104 of Embodiment 1 controls the application and the interruption of the voltage to the brake driving section (exciting coil) 7c in response to the output command from the brake control section 103. On the other hand, the output control section 104 of Embodiment 3 controls the application and the interruption of the voltage to the brake driving section 7c in response to the output command from the brake control section 103 or braking commands from the first diagnosis section 105 and the second diagnosis section 106.

[0040] FIG. 5 is a configuration diagram illustrating an elevator apparatus according to Embodiment 3 of the present invention. In FIG. 5, when detecting a failure of at least any one of the brake device 7, the brake control section 103, the first diagnosis section 105, and the second diagnosis section 106, the first diagnosis section 105 and the second diagnosis section 106 of Embodiment 3 transmit the failure detection signal to the operation control section 101 and transmits the braking command to the output control section 104 (indicated by broken lines shown in FIG. 5).

[0041] The output control section 104 interrupts the voltage to the brake driving section 7c in response to the braking command from the first diagnosis section 105 or the second diagnosis section 106. Specifically, the output control section 104 forcibly places the brake device 7 in an actuating state in response to the braking command from the first diagnosis section 105 or the second diagnosis section 106. The remaining configuration and operation are the same as those of Embodiment 1.

[0042] According to the elevator apparatus of Embodiment 3 as described above, when detecting the failure of at least any one of the brake device 7, the brake control section 103, the first diagnosis section 105, and the second diagnosis section 106, the first diagnosis section 105 and the second diagnosis section 106 transmit the braking command to the output control section 104. By the

configuration described above, even when the failure occurs in the brake control section 103, the brake device 7 can be forcibly placed in the braking state by the braking commands from the first diagnosis section 105 and the second diagnosis section 106.

[0043] In Embodiment 3, both the first diagnosis section 105 and the second diagnosis section 106 transmit the braking command to the output control section 104. However, the transmission of the braking command is not limited to the example described above. Only any one of the first diagnosis section 105 and the second diagnosis section 106 may transmit the braking command to the output control section 104.

Embodiment 4

[0044] The output control section 104A of Embodiment 2 controls the application and the interruption of the voltage to the brake driving section 7c in response to the output command from the brake control section 103A. In addition, the output control section 104B of Embodiment 2 controls the application and the interruption of the voltage to the brake driving 7e in response to the output command from the brake control section 103B. Similarly to Embodiment 3, the output control section 104A and 104B of Embodiment 4 control the application and the interruption of the voltage to the brake driving sections 7c and 7e in response to the braking commands from the first diagnosis section 105 and the second diagnosis section 106.

[0045] FIG. 6 is a configuration diagram illustrating an elevator apparatus according to Embodiment 4 of the present invention. In FIG. 6, when detecting a failure of at least any one of the brake device 7, the brake control section 103, the first diagnosis section 105, and the second diagnosis section 106, the first diagnosis section 105 and the second diagnosis section 106 of Embodiment 3 transmit the failure detection signal to the operation control section 101 and transmit the braking command to both the output control section 104A and 104B (indicated by broken lines shown in FIG. 6). Specifically, each of the first diagnosis section 105 and the second diagnosis section 106 transmits the braking commands to the output control sections 104A and 104B of both the systems respectively including the self diagnosis section and the other diagnosis section. The remaining configuration and operations are the same as those of Embodiment 2 and Embodiment 3.

[0046] According to the elevator apparatus of Embodiment 4 as described above, even when each of the first diagnosis section 105 and the second diagnosis section 106 performs the failure diagnosis for the brake system different each other, the same effects as those of Embodiment 3 can be obtained.

Embodiment 5

[0047] The first diagnosis section 105 and the second

diagnosis section 106 of Embodiment 4 transmit the braking commands to the output control sections 104A and 104B of both the systems respectively including the self diagnosis section and the other diagnosis section. For example, in the case where the failure occurs in the first diagnosis section 105 between the first diagnosis section 105 and the second diagnosis section 106, there arises a possibility that the braking commands from the second diagnosis section 106 to the output control sections 104A and 104B are not normally transmitted as a result of the occurrence of the failure of the first diagnosis section 105 at some timing of generation of the command and for some circuit configurations.

[0048] On the other hand, each of the first diagnosis section 105 and the second diagnosis section 106 of Embodiment 5 transmits the braking command only to the output control section 104A and 104B, which is included in the different brake system, as illustrated in FIG. 7 (indicated by broken lines shown in FIG. 7). Specifically, each of the first diagnosis section 105 and the second diagnosis section 106 does not transmit the braking command to one of the output control sections 104A and 104B, which is included in the brake system including the self diagnosis section. The remaining configuration and operation are the same as those of Embodiment 4.

[0049] According to the elevator apparatus of Embodiment 5 as described above, each of the first diagnosis section 105 and the second diagnosis section 106 transmits the braking command to one of the output control sections 104A and 104B, which is included in the brake system different each other. By the configuration described above, at least any one of the brake shoes 7b and 7d of the brake device 7 is displaced in the braking position without being affected by the failure of the first diagnosis section 105 or the second diagnosis section 106 so that the brake device 7 can be more reliably brought into the braking state.

[0050] In Embodiments 2, 4, and 5, the examples where the number of brake systems is two have been described. However, the number of brake systems may be three or more.

Embodiment 6

[0051] In Embodiment 1, the first diagnosis section 105 and the second diagnosis section 106 wait until the first diagnosis section 105 and the second diagnosis section 106 are reset after detecting the failure of any one of the brake device 7, the brake control section 103, and the first diagnosis section 105, and the second diagnosis section 106. On the other hand, the first diagnosis section 105 and the second diagnosis section 106 of Embodiment 6 detect a failure of any one of the devices 7, 103, 105, and 106. After the detection of the failure of each of the devices, the failure diagnosis is performed again.

[0052] FIG. 8 is a flowchart illustrating a failure diagnosis operation performed by the first diagnosis section 105 for the brake device 7 according to Embodiment 6

of the present invention. The operation of the first diagnosis section 105 of Embodiment 6 differs in an operation after the transmission of the failure signal output by the first diagnosis section 105 of Embodiment 1 to the operation control section 101 (operation after Steps S105 and S106 illustrated in FIG. 2). Here, only differences from Embodiment 1 are described.

[0053] In FIG. 8, the first diagnosis section 105 of Embodiment 6 transmits the failure signal for any one of the devices 7, 103, 105, and 106 to the operation control section 101 (Steps S105 and S106) and transmits a diagnosis operation request to the operation control section 101 (Step S301). In response to the diagnosis operation request from the first diagnosis section 105, the operation control section 101 performs a diagnosis operation. The diagnosis operation is an operation for, for example, experimentally raising and lowering the car 5 from a bottom floor to a top floor through the hoistway.

[0054] During the diagnosis operation performed by the operation control section 101, the first diagnosis section 105 performs the failure diagnosis again for each of the devices 7, 105, and 106 (Step S302). Then, the first diagnosis section 105 confirms whether or not the results of previous diagnosis are erroneous based on the results of the second failure diagnosis (Step S303). When confirming that the results of the previous diagnosis are erroneous without detecting the failure of each of the devices 7, 105, and 106 in this step, the first diagnosis section 105 transmits a return-to-normal operation enabling signal to the operation control section 101 (Step S304) and repeats the same operation.

[0055] On the other hand, when detecting the failure of each of the devices 7, 105, and 106 again in the second failure diagnosis, the first diagnosis section 105 interrupts the diagnosis operation performed by the operation control section 101 and waits until being reset (Step S305). After being reset, the first diagnosis section 105 repeats the same operation. A failure diagnosis operation performed by the first diagnosis section 105 for the brake control section 103 is the same as the operation illustrated in FIG. 8. The operation of the second diagnosis section 106 is the same as that of the first diagnosis section 105. Further, the remaining configuration and operation are the same as those of Embodiment 1.

[0056] According to the elevator apparatus of Embodiment 6 as described above, each of the first diagnosis section 105 and the second diagnosis section 106 performs the second failure diagnosis during the diagnosis operation performed by the operation control section 101. When the failure is not confirmed in the second failure diagnosis, the failure detected in the first failure diagnosis is determined as being due to temporary erroneous diagnosis. As a result, an operation interruption time period of the car 5, which is caused with the erroneous diagnosis, can be minimized.

[0057] In Embodiment 6, the example where the second failure diagnosis is performed by the first diagnosis section 105 and the second diagnosis section 106 of Em-

bodiment 1 has been described in Embodiment 6. However, the first diagnosis section 105 and the second diagnosis section 106 of each of Embodiments 2 to 5 may perform the second failure diagnosis described in Embodiment 6.

[0058] In Embodiment 6, after the first diagnosis section 105 and the second diagnosis section 106 detect the failure in the first failure diagnosis and then perform a rescue operation (operation for closing the door of the car 5 at the nearest floor), the operation control section 101 of the elevator may perform the diagnosis operation.

[0059] Further, the example where the first diagnosis section 105 and the second diagnosis section 106 perform the failure diagnosis for both the brake device 7 and the brake control section 103 (103A and 103B) has been described in Embodiments 1 to 6. However, the first diagnosis section 105 and the second diagnosis section 106 may perform the failure diagnosis only for the brake device 7, and the failure diagnosis for the brake control section 103 maybe omitted.

Claims

1. An elevator apparatus, comprising:

- a car provided in a hoistway;
- a motor for driving raising and lowering of the car;
- a brake device for braking rotation of the motor;
- signal generation means for generating a brake diagnosis signal relating to an operation of the brake device;
- an operation control section for collectively controlling an operation of the car;
- a motor control section for controlling the driving of the motor in response to a command from the operation control section;
- a brake control section for controlling an operation of the brake device in response to a command from the operation control section, the brake control section being capable of generating a brake-control-section diagnosis signal; and
- a plurality of diagnosis sections capable of performing at least failure diagnosis for the brake device based on the brake diagnosis signal from the signal generating means among the failure diagnosis for the brake device and failure diagnosis for the brake control section based on the brake-control-section diagnosis signal from the brake control section,
- wherein when each of the plurality of diagnosis sections compares a content of diagnosis performed by the self diagnosis section with a content of diagnosis performed by another one of the plurality of diagnosis sections and confirms that the contents of diagnosis are not identical

with each other, it is determined that a failure occurs in at least any one of the plurality of diagnosis sections including the self diagnosis section.

2. An elevator apparatus according to claim 1, further comprising a plurality of output control sections provided between the brake control section and the brake device, each being for controlling an output signal to the brake device in response to commands from the brake control section, wherein, when detecting a failure of at least any one of the brake device, the brake control section, and the plurality of diagnosis sections, the plurality of diagnosis sections transmit a braking command for actuating the brake device to the plurality of output control sections.

3. An elevator apparatus, comprising:

a car provided in a hoistway;
 a motor for driving raising and lowering of the car;
 a brake device for braking rotation of the motor, including a brake wheel rotated along with the rotation of the motor and a plurality of brake units for braking the rotation of the brake wheel;
 signal generation means for generating a brake diagnosis signal relating to operations of the plurality of brake units;
 an operation control section for collectively controlling an operation of the car;
 a motor control section for controlling the driving of the motor in response to a command from the operation control section;
 a plurality of brake control sections included in different brake systems for the plurality of brake units, respectively, each being for controlling an operation of the plurality of brake units in response to the command from the operation control section and being capable of generating a brake-control-section diagnosis signal; and
 a plurality of diagnosis sections respectively included in the different brake systems, capable of performing at least failure diagnosis for the plurality of brake units based on the brake diagnosis signal from the signal generating means among the failure diagnosis for the plurality of brake units and failure diagnosis for the plurality of brake control sections based on the brake-control-section diagnosis signals from the plurality of brake control sections in the brake system including the self diagnosis section, wherein, when each of the plurality of diagnosis sections compares the content of diagnosis performed by the self diagnosis section with the content of diagnosis performed by another one of the plurality of diagnosis sections and con-

firms that the contents of diagnosis are not identical with each other, it is determined that a failure occurs in at least any one of the plurality of diagnosis sections including the self diagnosis section.

4. An elevator apparatus according to claim 3, further comprising: a plurality of output control sections, each being provided between one of the plurality of brake control sections and one of the plurality of brake units included in the same brake system and being provided for each of the brake systems, for controlling output signals to the plurality of brake units in response to commands from the plurality of brake control sections, wherein:

the plurality of diagnosis sections transmit braking commands for actuating the brake device to all the plurality of output control sections when detecting a failure of at least any one of the brake device, the plurality of brake control sections, and the plurality of diagnosis sections; and the plurality of output control sections cause the brake units to brake the rotation of the brake wheel in response to the braking command from at least one of the plurality of diagnosis sections.

5. An elevator apparatus according to claim 3, further comprising: a plurality of output control sections, each being provided between one of the plurality of brake control sections and one of the plurality of brake units included in the same brake system and being provided for each of the brake systems, for controlling output signals to the plurality of brake units in response to commands from the plurality of brake control sections, wherein:

the plurality of diagnosis sections transmit braking commands for actuating the brake device to the plurality of output control sections included in another one of the brake systems when detecting a failure of at least any one of the brake device, the plurality of brake control sections, and the plurality of diagnosis sections; and the plurality of output control sections cause the plurality of brake units to brake the rotation of the brake wheel in response to the braking command from at least one of the plurality of diagnosis sections.

6. An elevator apparatus according to claim 1, wherein the plurality of diagnosis sections transmit a diagnosis operation request for second failure diagnosis to the operation control section when detecting the failure of at least any one of the brake device, the plurality of brake control sections, and the plurality of diagnosis sections, and determining that first detected failure is erroneous diagnosis when the first de-

tected failure is not detected in the second failure diagnosis as a result of the second failure diagnosis during a diagnosis operation performed by the operation control section.

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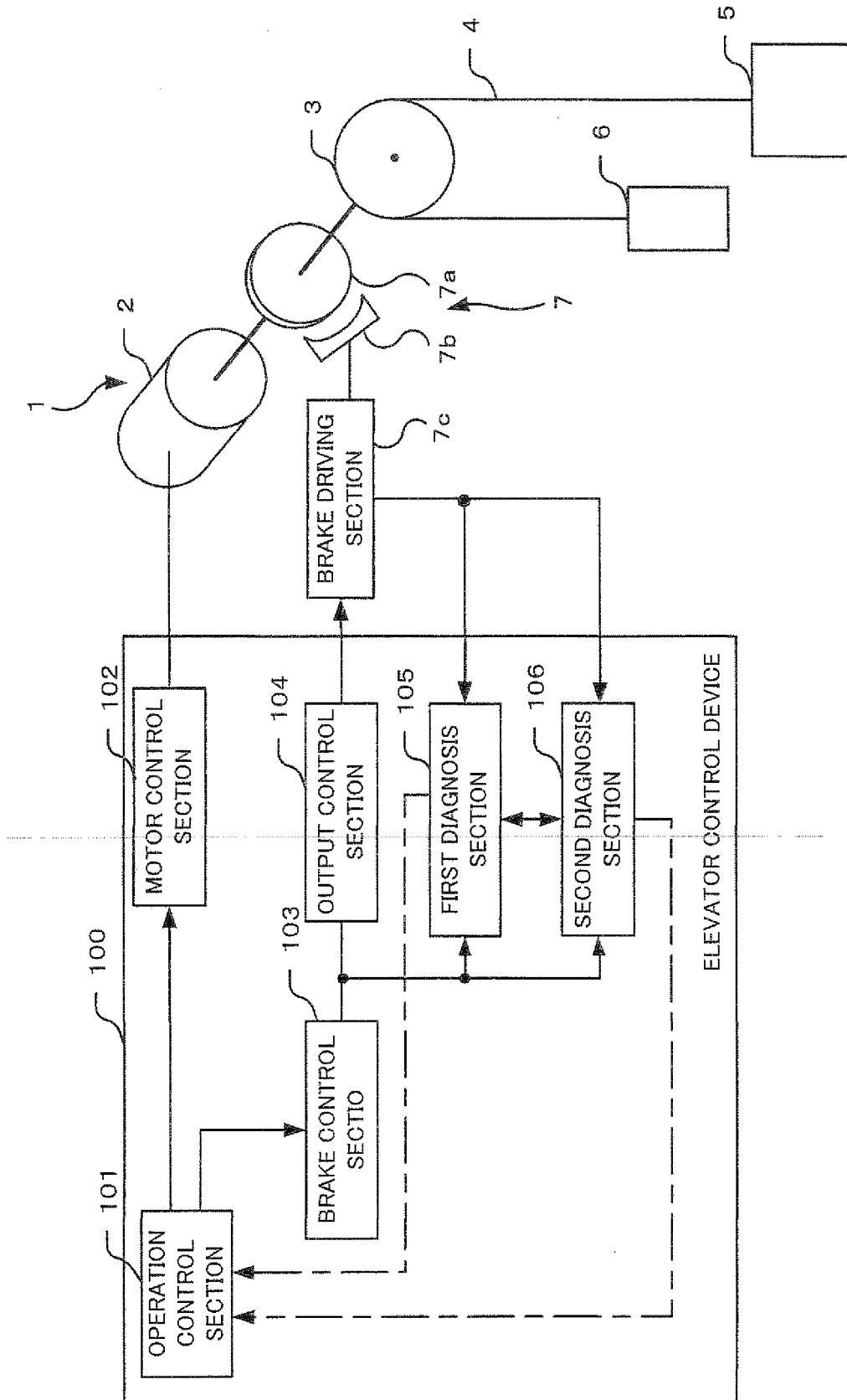


Fig. 1

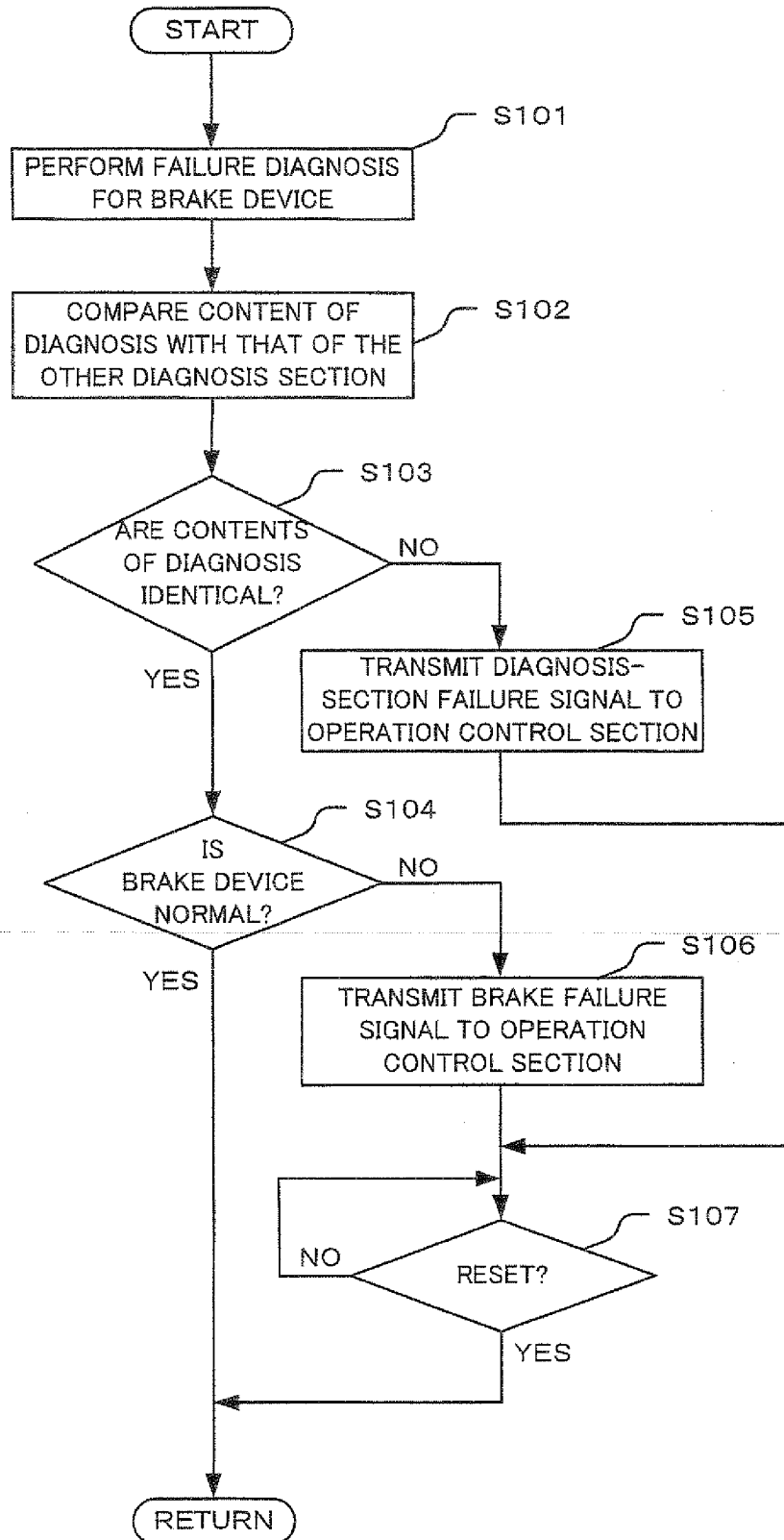


Fig. 2

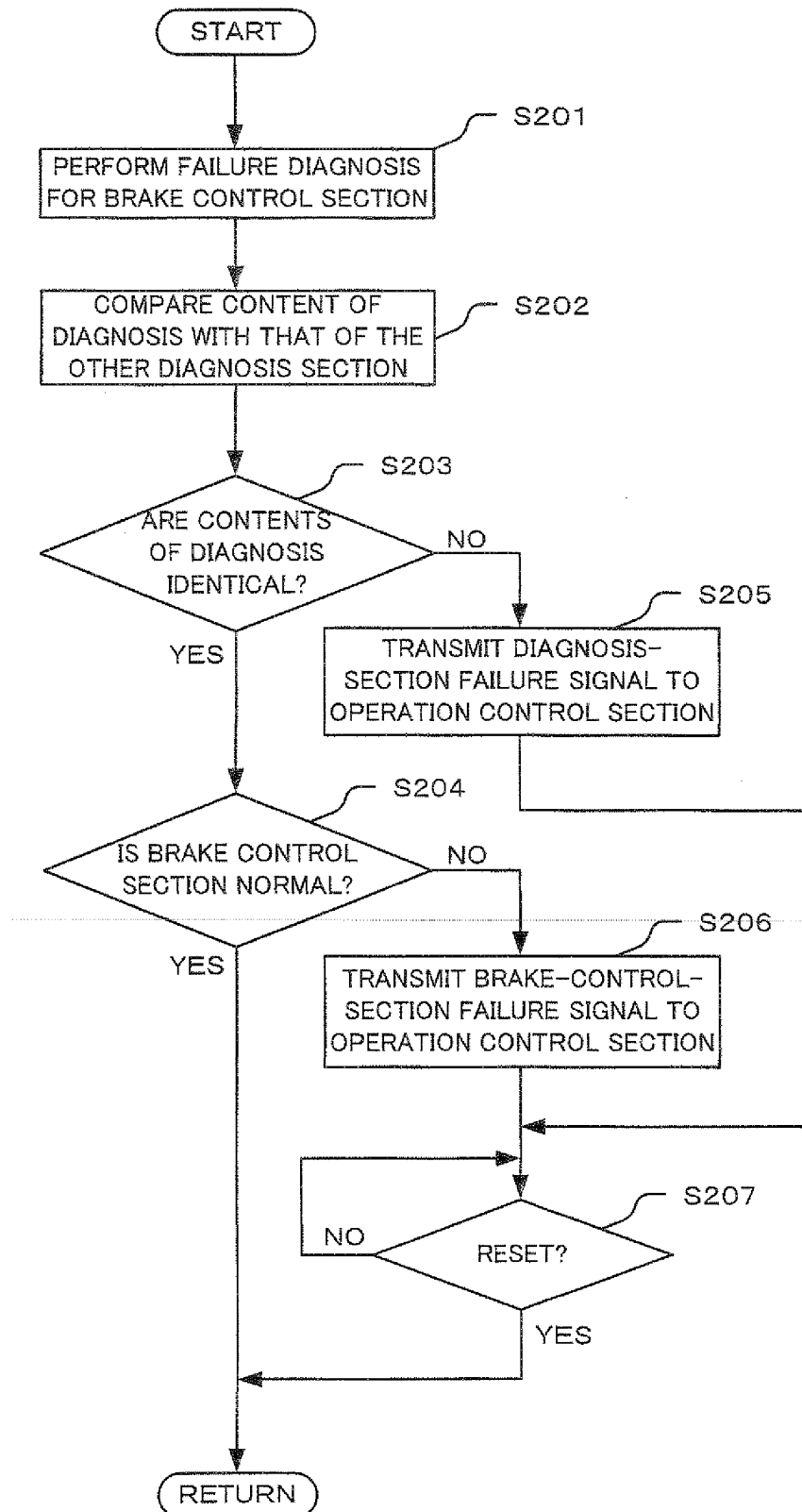


Fig. 3

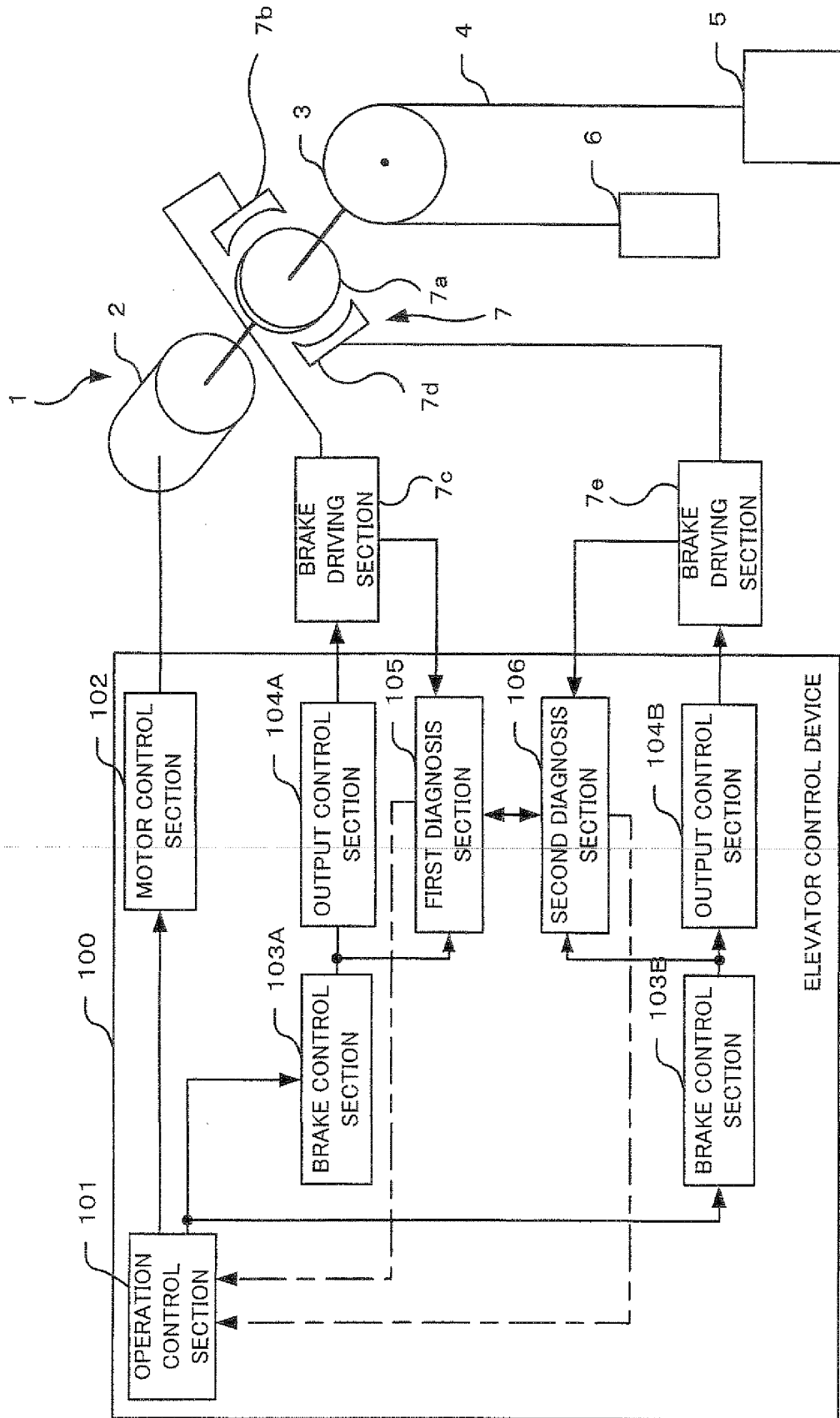


Fig. 4

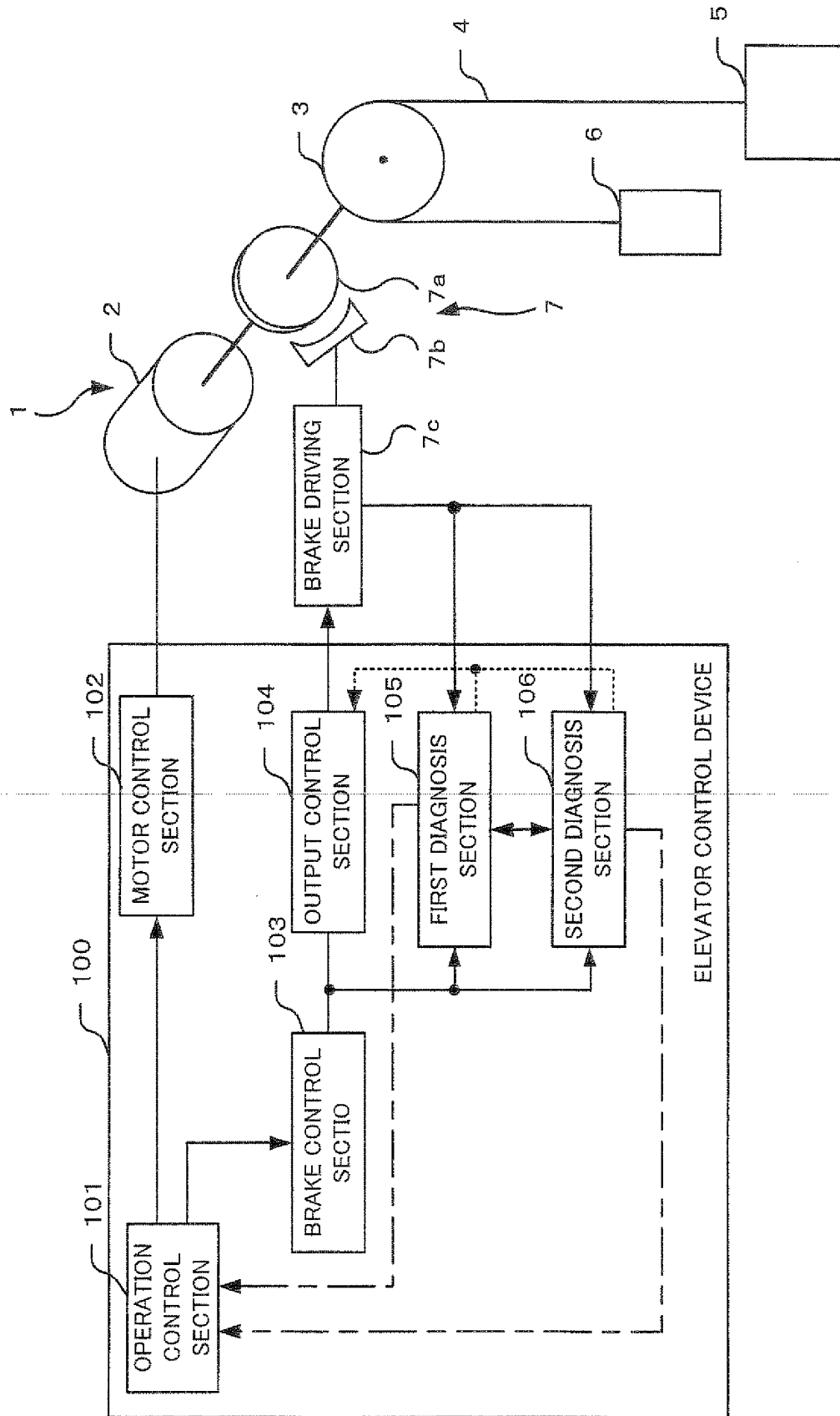


Fig. 5

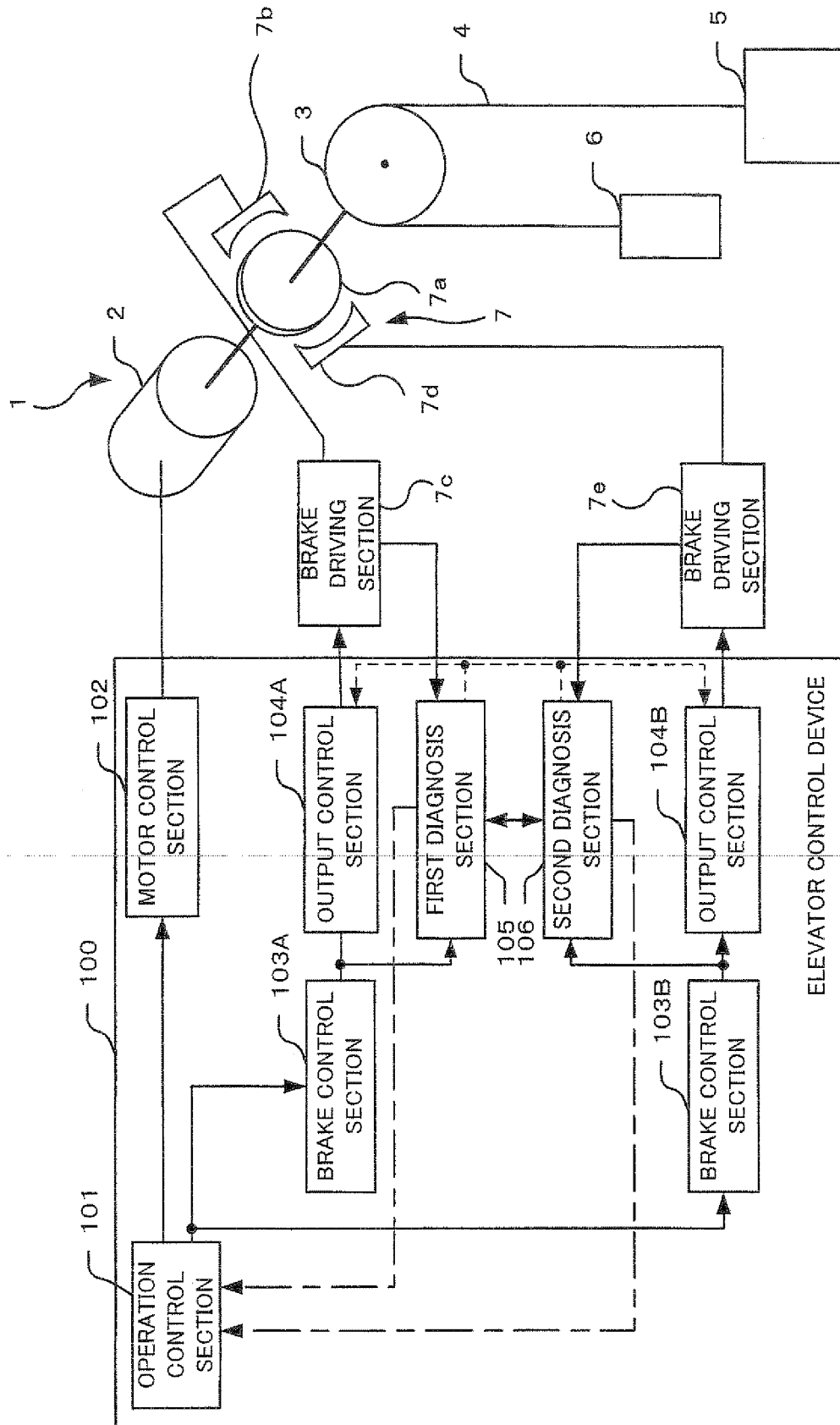


Fig. 6

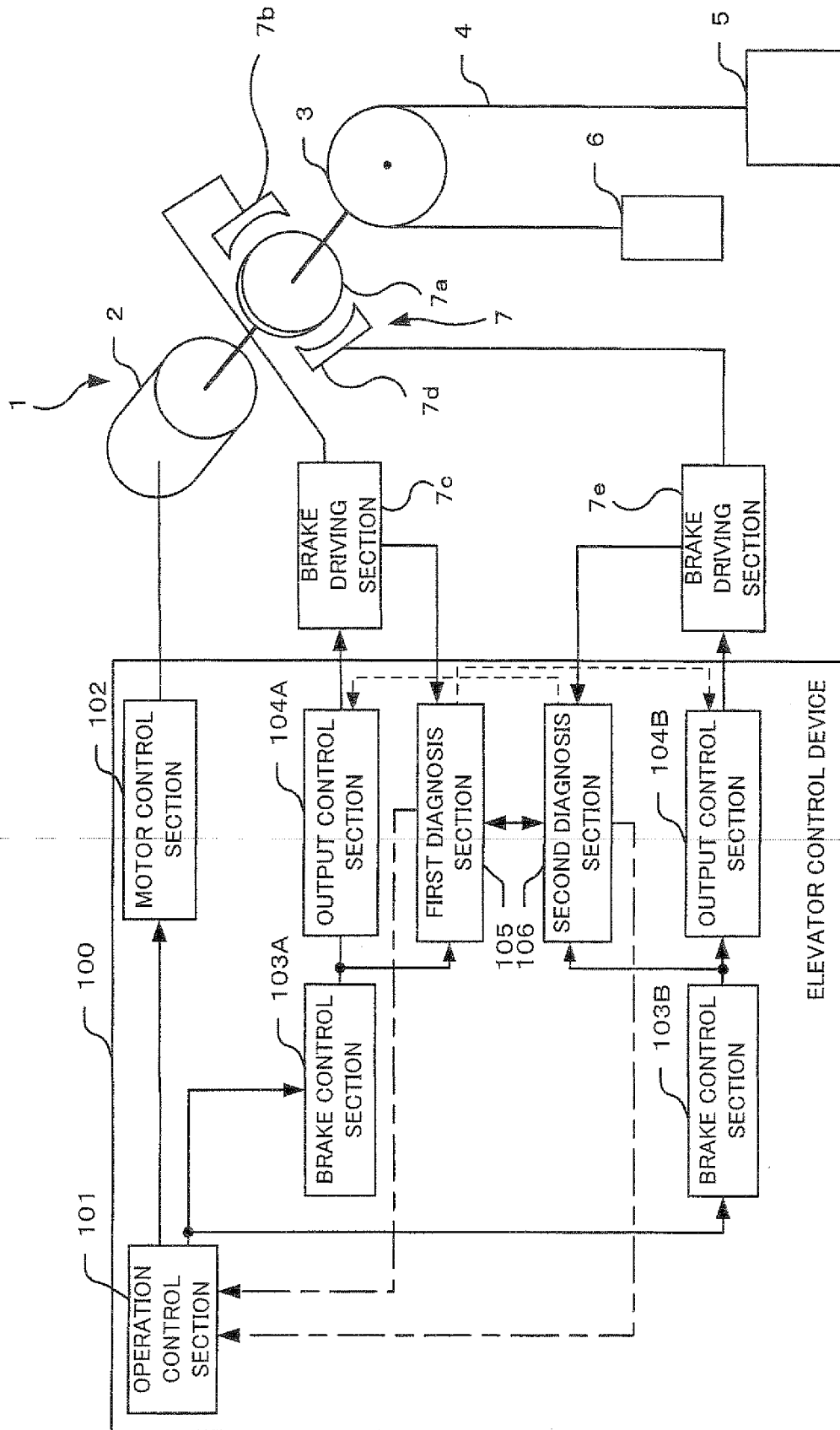


Fig. 7

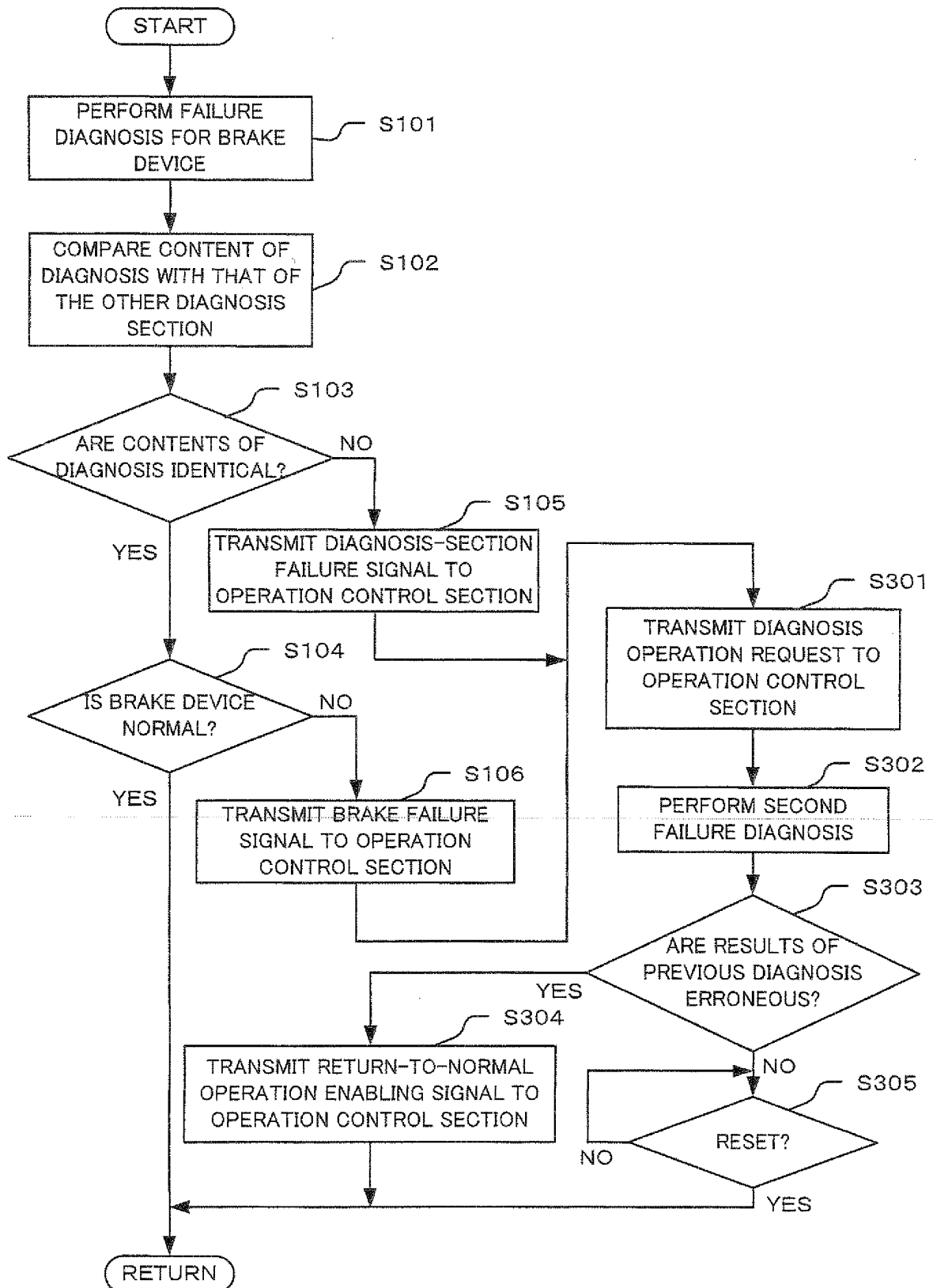


Fig. 8

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/054883

A. CLASSIFICATION OF SUBJECT MATTER

B66B5/00(2006.01) i, B66B5/02(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)

B66B5/00-B66B5/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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 2002-316777 A (Hitachi, Ltd.), 31 October 2002 (31.10.2002), paragraphs [0013] to [0035]; fig. 1 to 8 (Family: none)	1-6
A	JP 3888474 B2 (Inventio AG.), 08 December 2006 (08.12.2006), paragraphs [0009] to [0010]; fig. 3 & AU 4205996 A & FI 960249 A0	1-6
A	JP 2007-84177 A (Toshiba Elevator and Building Systems Corp.), 05 April 2007 (05.04.2007), paragraphs [0013] to [0031]; fig. 1 to 2 (Family: none)	1-6

☐ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

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Date of the actual completion of the international search
03 December, 2009 (03.12.09)Date of mailing of the international search report
15 December, 2009 (15.12.09)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005126183 A [0003]