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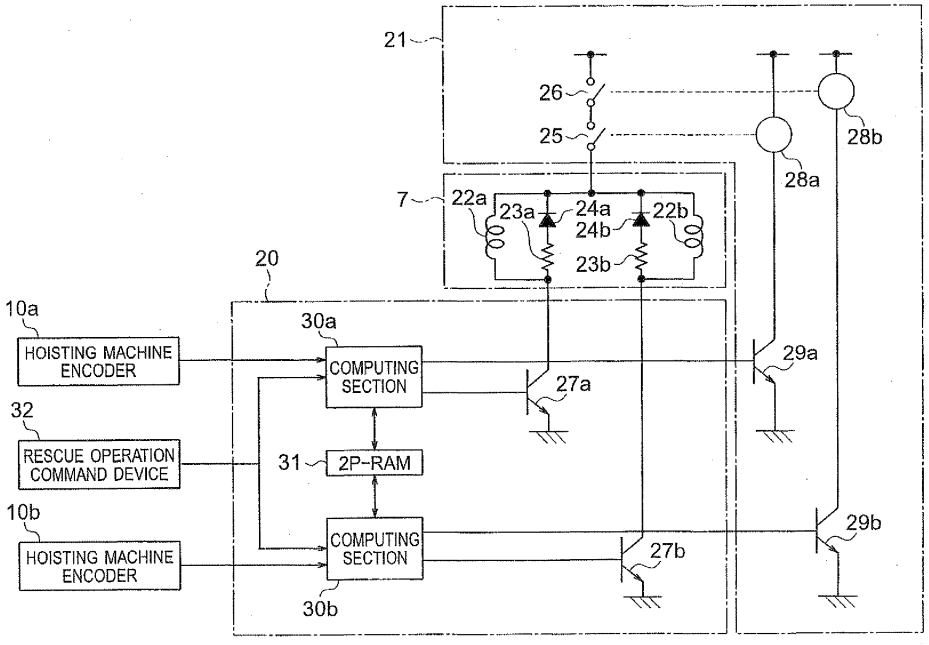
(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, a brake control device controls a brake device for braking a travel of a car and performs a rescue operation when the car is stopped between floors. During the rescue operation, the car is moved to a landing floor by using imbalance between a load of the car side and a load of a counterweight. The brake control device includes a first computing section and a second computing section for executing the same computation processing independently of each other for performing the rescue operation. The first computing section and the second computing section compare their own computation results with each other to detect a failure of at least one of the first computing section and the second computing section.

FIG. 2



EP 2 287 102 A1

Description

Technical Field

[0001] The present invention relates to an elevator apparatus capable of performing a rescue operation of moving a car to a landing floor by controlling a brake device in a case where the car is stopped between floors due to a failure of a travel control device, a power failure, or the like.

Background Art

[0002] With a conventional rescue operation device at failure of an elevator, a brake is released in case of a failure of the elevator to allow a car to run using imbalance between a load of the car side and a load of a counterweight. At this time, a travel distance or a speed of the car is detected. Based on the result of detection, a braking operation of the brake is performed (for example, see Patent Document 1).

[0003] Patent Document 1: JP 2005-247512 A

Disclosure of the Invention

Problem to Be Solved by the Invention

[0004] With the conventional rescue operation device at failure as described above, if a failure occurs in a sensor for detecting the travel distance or the speed or in a computing device for controlling the brake, there is a fear in that the car may not be appropriately moved to a landing floor and may be accidentally moved to a terminal end of a hoistway.

[0005] The present invention has been made to solve the problem described above, and has an object to provide an elevator apparatus capable of preventing runaway of a car due to an erroneous operation of a brake control device during a rescue operation for the car so as to improve reliability.

Means for Solving the Problem

[0006] An elevator apparatus according to the present invention includes: a hoisting machine including a driving sheave; suspension means wound around the driving sheave; a car and a counterweight, each being suspended by the suspension means and being raised and lowered by the hoisting machine; a brake device for braking running of the car; and a brake control device for controlling the brake device and performing a rescue operation of moving the car to a landing floor in a case where the car is stopped between floors, the rescue operation being performed by using imbalance between a load of the car side and a load of the counterweight in which: the brake control device includes a first computing section and a second computing section for executing the same computing processing independently of each other for performing the rescue operation; and the first computing section and the second computing section compare own computation results with each other, to thereby detect a failure of at least one of the first computing section and the second computing section.

Brief Description of the Drawings

[0007]

FIG. 1 is a configuration diagram illustrating an elevator apparatus according to a first embodiment of the present invention.

FIG. 2 is a circuit diagram illustrating a brake device, a brake control device, and a brake power feed device illustrated in FIG. 1.

FIG. 3 is a circuit diagram illustrating the brake device, the brake control device, and the brake power feed device of an elevator apparatus according to a second embodiment 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.

First Embodiment

[0009] FIG. 1 is a configuration diagram illustrating an elevator apparatus according to a first embodiment of the present invention. In the drawing, a car 1 and a counterweight 2 are suspended by suspension means 3 in a hoistway, and are raised and lowered in the hoistway by a driving force of a hoisting machine 4. As the suspension means 3, a plurality of ropes or a plurality of belts are used.

[0010] The hoisting machine 4 includes: a driving sheave 5 around which the suspension means 3 is wound; a hoisting machine motor 6 for rotating the driving sheave 5; and a brake device 7 for braking the rotation of the driving sheave 5. The brake device 7 includes: a brake drum 8 coaxially connected to the driving sheave 5; a brake shoe 9 which is brought into contact with and separated away from the brake drum 8; a brake spring for pressing the brake shoe 9 against the brake drum 8, to thereby apply a braking force thereto; and an electromagnetic magnet for separating the brake shoe 9 away from the brake drum 8 against the brake spring, to thereby cancel the braking force.

[0011] A hoisting machine encoder section 10 for generating a signal according to a rotation speed of the driving sheave 5 (a signal associated with a speed of the car 1) is provided to the hoisting machine motor 6. The hoisting machine encoder section 10 includes a first hoisting machine encoder 10a and a second hoisting machine encoder 10b (FIG. 2) corresponding to a first speed detector and a second speed detector for generating detection signals which are independent of each other.

[0012] In the vicinity of a top terminal landing of the hoistway, an upper hoistway switch 11 is provided. In the vicinity of a bottom terminal landing of the hoistway, a lower hoistway switch 12 is provided. The hoistway switches 11 and 12 are used as position correction switches, each being used for detecting an absolute position of the car 1 to correct car positional information. An operation cam 13 for operating the hoistway switches 11 and 12 is provided to the car 1.

[0013] On a bottom (in a pit) of the hoistway, a car buffer 14 and a counterweight buffer 15 are provided. The car buffer 14 is located immediately below the car 1. The counterweight buffer 15 is located immediately below the counterweight 2.

[0014] In an upper part of the hoistway, a governor sheave 16 is provided. In a lower part of the hoistway, a tension sheave 17 is provided. A governor rope 18 is wound around the governor sheave 16 and the tension sheave 17. Both ends of the governor rope 18 are connected to the car 1. The governor rope 18 is circulated along with the raising and lowering of the car 1. In this manner, the governor sheave 16 is rotated at a speed according to a running speed of the car 1.

[0015] A governor encoder section 19 for generating a signal according to a rotation speed of the governor sheave 16, that is, a speed of the car 1, is provided to the governor sheave 16. The governor encoder section 19 includes a first governor encoder and a second governor encoder for generating detection signals which are independent of each other.

[0016] The brake device 7 is controlled by a brake control device 20. The signals from the hoisting machine encoder section 10, the hoistway switches 11 and 12, and the governor encoder section 19 are input to the brake control device 20. Further, a signal according to a current of the electromagnetic magnet of the brake device 7 is input to the brake control device 20.

[0017] The brake control device 20 controls the braking force of the brake device 7 so that a deceleration rate of the car 1 is not increased excessively when the car 1 is caused to make an emergency stop.

[0018] Further, the brake control device 20 performs a rescue operation of controlling the brake device 7 to automatically move the car 1 to a landing floor according to an external command when the car 1 is stopped between floors due to a failure of a travel control device (not shown) for controlling a travel of the car 1, a power failure, or the like. In the rescue operation for the car 1, the car 1 is allowed to run at a low speed to a predetermined landing floor (for example, the nearest floor) by using imbalance between a load of the car 1 side and a load of the counterweight 2.

[0019] Electric power is supplied to the electromagnetic magnet of the brake device 7 by a brake power feed device 21. The electric power supply to the brake device 7 by the brake power feed device 21 is controlled by the brake control device 20.

[0020] FIG. 2 is a circuit diagram illustrating the brake device 7, the brake control device 20, and the brake power feed device 21 illustrated in FIG . 1. The electromagnetic magnet of the brake device 7 is provided with a first brake coil (electromagnetic coil) 22a and a second brake coil (electromagnetic coil) 22b.

[0021] A current is caused to flow through the brake coils 22a and 22b to excite the electromagnetic magnet. As a result, an electromagnetic force for canceling the braking force of the brake device 7 is generated, so that the brake shoe 9 is separated away from the brake drum 8. Further, by de-energizing the brake coils 22a and 22b, the excitation of the electromagnetic magnet is canceled. As a result, the brake shoe 9 is pressed against the brake drum 8 by a spring force of the brake spring. Further, the braking force of the brake device 7 is controlled by controlling voltage commands to the brake coils 22a and 22b.

[0022] The first brake coil 22a is connected in parallel to a circuit obtained by connecting a first discharge resistor 23a and a first discharge diode 24a in series. The second brake coil 22b is connected in parallel to a circuit obtained by connecting a second discharge resistor 23b and a second discharge diode 24b in series.

[0023] One end of the first brake coil 22a and one end of the second brake coil 22b are connected to a power source through an intermediation of a first electromagnetic switch 25 and a second electromagnetic switch 26. The first electromagnetic switch 25 and the second electromagnetic switch 26 are connected in series. Another end of the first brake coil 22a is connected to the ground through an intermediation of a first brake coil controlling switch 27a. Another end of the second brake coil 22b is connected to the ground through an intermediation of a second brake coil controlling switch 27b.

[0024] The first electromagnetic switch 25 is opened and closed by a first driving coil 28a. One end of the first driving coil 28a is connected to a power source. Another end of the first driving coil 28a is connected to the ground through an intermediation of a first electromagnetic switch controlling switch 29a.

[0025] The second electromagnetic switch 26 is opened and closed by a second driving coil 28b. One end of the second driving coil 28b is connected to a power source. Another end of the second driving coil 28b is connected to the ground through an intermediation of a second electromagnetic switch controlling switch 29b. As each of the controlling switches 27a, 27b, 29a, and 29b, a semiconductor switch is used.

[0026] The brake control device 20 includes a first computing section 30a and a second computing section 20b for executing the same computation processing independently of each other for performing a rescue operation. The first computing section 30a controls opening and closing of the first brake coil controlling switch 27a and the first electromagnetic switch controlling switch 29a. The second computing section 30b controls opening and closing of the second brake coil controlling switch 27b and the second electromagnetic switch controlling switch 29b.

[0027] Each of the first computing section 30a and the second computing section 30b includes microcomputer. Adual-port RAM 31 is connected between the first computing section 30a and the second computing section 30b. The first computing section 30a and the second computing section 30b compare their own computation results with each other through an intermediation of the dual-port RAM 31, to thereby monitor whether or not a failure has occurred in at least any one of the first computing section 30a and the second computing section 30b.

[0028] A signal from the first hoisting machine encoder 10a is input to the first computing section 30a. A signal from the second hoisting machine encoder 10b is input to the second computing section 30b. The first computing section 30a and the second computing section 30b compare their own input signals with each other through an intermediation of the dual-port RAM 31, to thereby monitor whether or not a failure has occurred in at least any one of the first hoisting machine encoder 10a and the second hoisting machine encoder 10b.

[0029] A rescue operation command device (brake release device) 32 for issuing a rescue operation command is connected to the first computing section 30a and the second computing section 30b. A portion, to which the rescue operation command device 32 is to be connected, is provided, for example, to a landing button device at a specific floor. For performing the rescue operation, a cover is removed from the landing button device by a maintenance worker. The rescue operation command device 32 is connected to the exposed connection portion.

[0030] The same program for performing the rescue operation is stored in each of the first computing section 30a and the second computing section 30b. When a command of starting the rescue operation is input by the rescue operation command device 32, the first computing section 30a opens the first brake coil controlling switch 27a, while the second computing section 30b opens the second brake coil controlling switch 27b. In this manner, the car 1 is raised or lowered by the imbalance between the load of the car 1 side and the load of the counterweight 2. However, when there is a balance between the load of the car 1 side and the load of the counterweight 2, a rescue is independently performed by a manual operation.

[0031] When the rescue operation is started, the first computing section 30a and the second computing section 30b calculate and monitor the speed of the car 1 based on the signal from the hoisting machine encoder 10a and the signal from the hoisting machine encoder 10b, respectively. Then, the first computing section 30a controls the first brake coil controlling switch 27a and the second computing section 30b controls the second brake coil controlling switch 27b so that the speed of the car 1 does not exceed a preset speed (lower than a rated speed).

[0032] Specifically, if the detected speed has not reached a target speed, application voltage signals, which are to be transmitted to the brake coil controlling switches 27a and 27b, are increased, to thereby reduce the braking force. When the detected speed reaches the target speed, the application voltage signals, which are to be transmitted to the brake coil controlling switches 27a and 27b, are reduced, to thereby increase the braking force.

[0033] After that, when the arrival of the car 1 at a landing position is detected by a landing detection device (not shown), the first computing section 30a opens the first brake coil controlling switch 27a and the first electromagnetic switch controlling switch 29a, while the second computing section 30b opens the second brake coil controlling switch 27b and the second electromagnetic switch controlling switch 29b. In this manner, the car 1 is stopped.

[0034] If a difference between the signal from the first hoisting machine encoder 10a and that from the second hoisting machine encoder 10b or a difference between the computation result obtained by the first computing section 30a and that obtained by the second computing section 30b exceeds a preset threshold value during the rescue operation, the first computing section 30a and the second computing section 30b determine that some failure has occurred and open the first electromagnetic switch controlling switch 29a and the second electromagnetic switch controlling switch 29b.

[0035] When at least any one of the first electromagnetic switch controlling switch 29a and the second electromagnetic switch controlling switch 29b is opened, the first brake coil 22a and the second brake coil 22b are deenergized, to thereby stop the car 1. At the same time, the rescue operation is forcibly interrupted.

[0036] A battery (not shown) is provided to each of the brake control device 20 and the brake power feed device 21. As a result, the rescue operation may be performed even in case of power failure.

[0037] In the elevator apparatus described above, the first computing section 30a and the second computing section 30b for executing the same computation processing independently of each other for performing the rescue operation are provided to the brake control device 20. The first computing section 30a and the second computing section 30b compare their own computation results with each other, to thereby detect the failure of at least any one of the first computing section 30a and the second computing section 30b. Therefore, the runaway of the car 1 due to an erroneous operation of the brake control device 20 may be prevented during the rescue operation for the car 1. As a result, reliability may be improved.

[0038] Further, the first computing section 30a and the second computing section 30b performing the rescue operation respectively based on the signals from the hoisting machine encoders 10a and 10b that are different from each other. Therefore, even a failure of at least any one of the hoisting machine encoders 10a and 10b may also be detected. Thus, the reliability may be further improved.

[0039] Further, the first computing section 30a and

the second computing section 30b compare the signal from the first hoisting machine encoder 10a and that from the second hoisting machine encoder 10b with each other, to thereby detect a failure of at least any one of the first hoisting machine encoder 10a and the second hoisting machine encoder 10b. Therefore, a failure of at least any one of the computing sections 30a and 30b and that of at least any one of the hoisting machine encoder 10a and 10b may be detected in distinction from each other. Thus, recovery from the failure may be smoothly performed.

[0040] Further, the first electromagnetic switch 25 and the second electromagnetic switch 26 are connected in series between the first brake coil 22a and the second brake coil 22b, and the power source. The first computing section 30a and the second computing section 30b open the first electromagnetic switch 25 and the second electromagnetic switch 26 when a failure is detected. Thus, upon detection of a failure, the rescue operation may be more reliably and quickly interrupted.

Second Embodiment

[0041] Next, FIG. 3 is a circuit diagram illustrating the brake device 7, the brake control device 20, and the brake power feed device 21 of an elevator apparatus according to a second embodiment of the present invention. In this embodiment, the first electromagnetic switch 25 and the second electromagnetic switch 26 are connected in parallel to the power source. Therefore, the first brake coil 22a is de-energized by opening the first electromagnetic switch 25, while the second brake coil 22b is de-energized by opening the second electromagnetic switch 26. The remaining configuration is the same as that of the first embodiment.

[0042] With the circuit configuration described above, the runaway of the car 1 due to the erroneous operation of the brake control device 20 may also be prevented during the rescue operation for the car 1. As a result, the reliability may be improved.

[0043] Although the first hoisting machine encoder low and the second hoisting machine encoder 10b are used as the first speed detector and the second speed detector, respectively, in the first embodiment and the second embodiment described above, the speed detectors are not limited thereto. Alternatively, for example, the first governor encoder and the second governor encoder may be used.

Further, although the configuration with a dual system using the first computing section 30a and the second computing section 30b is employed in the first embodiment and the second embodiment described above, a triple system or higher multiple system may be used.

Further, although the brake device 7 for braking the rotation of the driving sheave 5 to brake the car 1 is described in the first embodiment and the second embodiment described above, the brake device is not limited thereto. For example, a brake (rope brake) for gripping the suspension means 3 to brake the car 1, a brake (car brake) mounted on the car 1, which is engaged with a guide rail to brake the car 1, or the like may be used.

Further, the number of the brakes is not limited to one. A plurality of the brakes may be used.

Further, although the car 1 is raised and lowered by the single hoisting machine 4 in the first embodiment and the second embodiment described above, the elevator apparatus may use a plurality of the hoisting machines.

Claims

1. An elevator apparatus comprising:

a hoisting machine including a driving sheave:

suspension means wound around the driving sheave;
a car and a counterweight, each being suspended by the suspension means and being raised and lowered by the hoisting machine;
a brake device for braking running of the car; and
a brake control device for controlling the brake device and performing a rescue operation of moving the car to a landing floor in a case where the car is stopped between floors, the rescue operation being performed by using imbalance between a load of the car side and a load of the counterweight, wherein:

the brake control device comprises a first computing section and a second computing section for executing the same computing processing independently of each other for performing the rescue operation; and
the first, computing section and the second computing section compare own computation results with each other, to thereby detect a failure of at least one of the first computing section and the second computing section.

2. The elevator apparatus according to claim 1, wherein the first computing section and the second computing section automatically interrupt the rescue operation when the failure is detected.

3. The elevator apparatus according to claim 1, further comprising a first speed detector and a second speed detector for generating signals associated with a speed of the car independently of each other, wherein:

the first computing section controls the brake device based on the signal from the first speed

detector for the rescue operation; and
the second computing section controls the brake device based on the signal from the second speed detector for the rescue operation.

4. The elevator apparatus according to claim 3, wherein the first computing section and the second computing section compare the signal from the first speed detector and the signal from the second speed detector with each other, to thereby detect a failure of at least one of the first speed detector and the second speed detector.

5. The elevator apparatus according to claim 1, wherein:

the brake device comprises brake coil for generating an electromagnetic force for canceling a braking force;
between the brake coil and a power source, a first switch to be opened and closed by the first computing section and a second switch to be opened and closed by the second computing section are connected in series; and
the first computing section and the second computing section respectively open the first switch and the second switch when the failure is detected.

FIG. 1

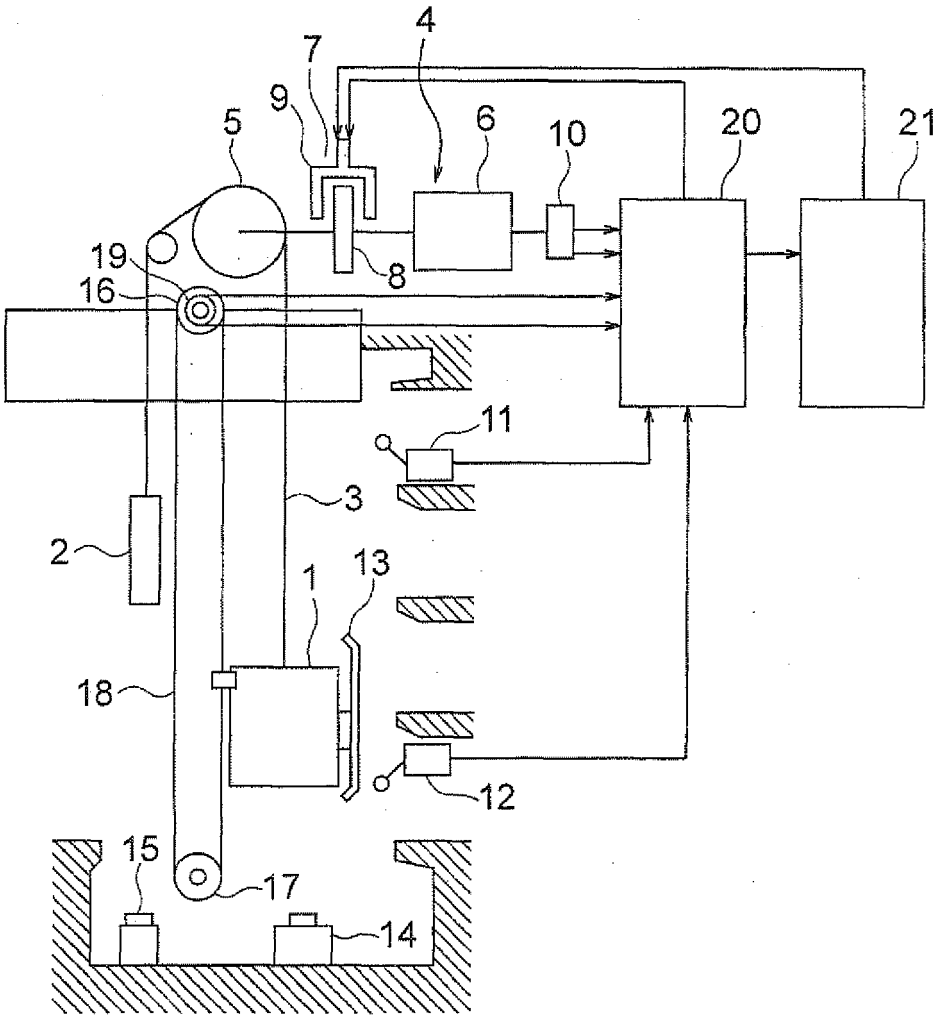
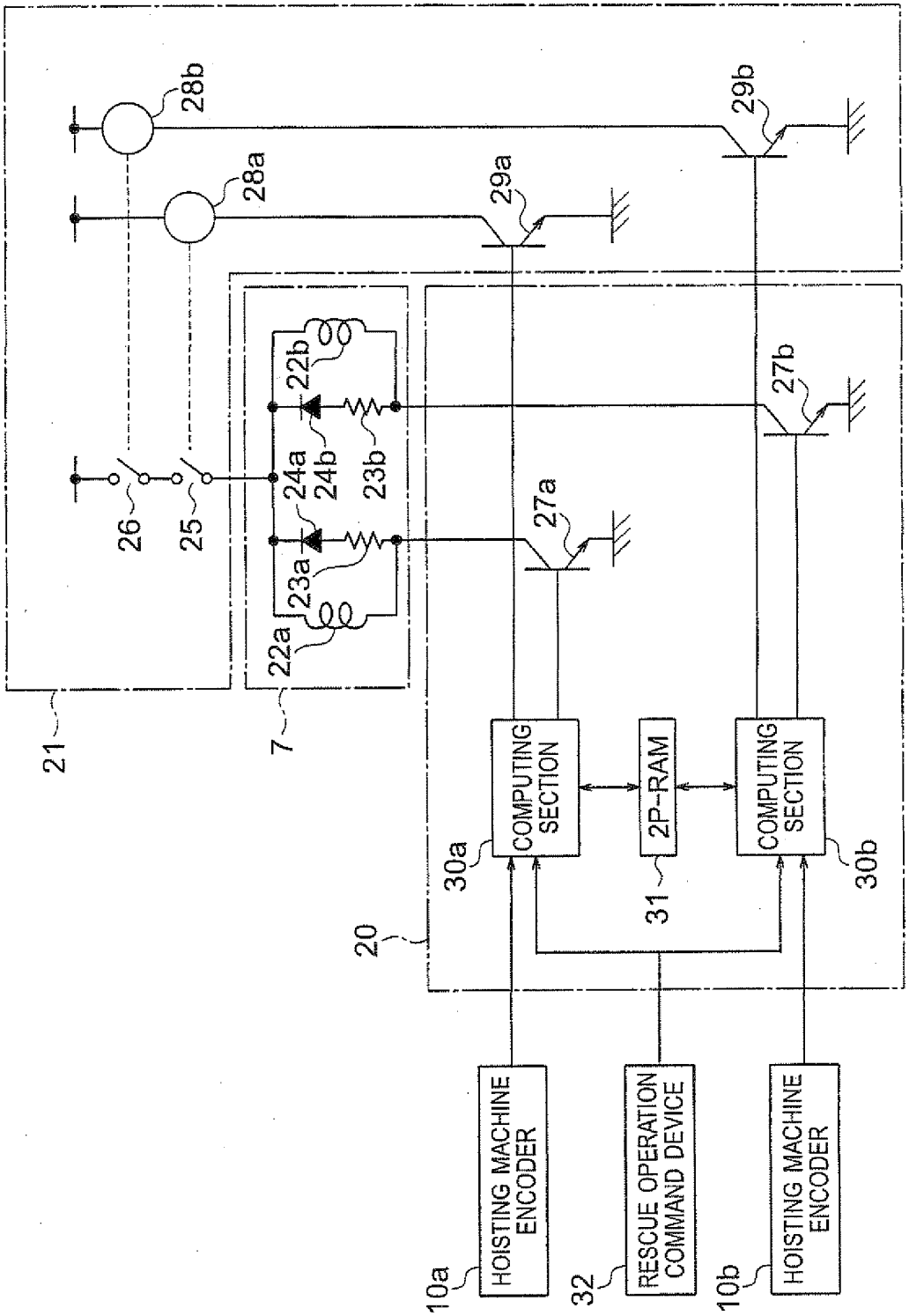


FIG. 2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COMPUTING SECTION
2P-RAM
31
COMPUTING SECTION
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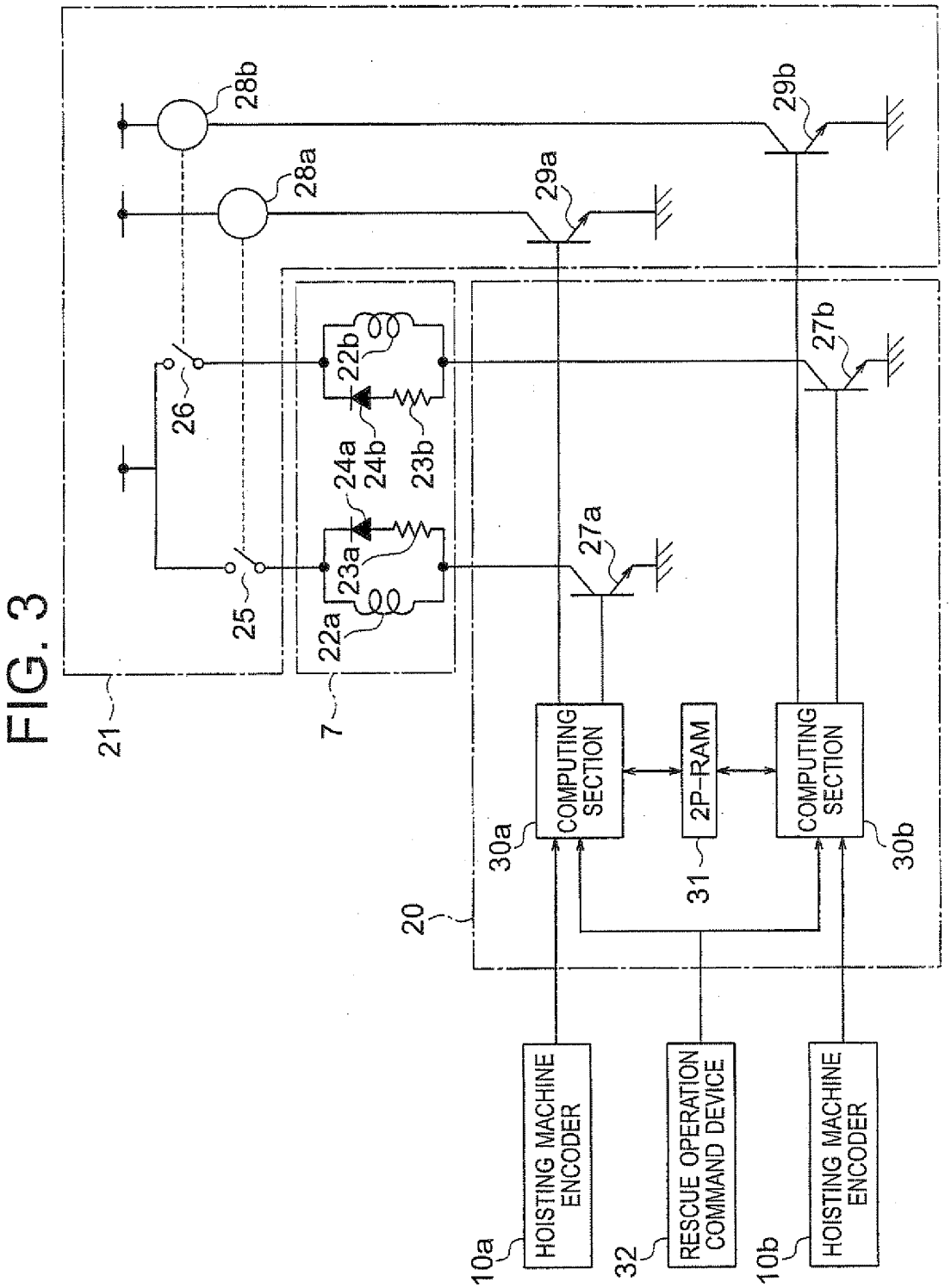
HOISTING MACHINE ENCODER
32
RESCUE OPERATION COMMAND DEVICE
10b
HOISTING MACHINE ENCODER

FIG. 3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2P-RAM
COMPUTING SECTION
10a
HOISTING MACHINE ENCODER
32
RESCUE OPERATION COMMAND DEVICE
10b
HOISTING MACHINE ENCODER

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2008/061323

A. CLASSIFICATION OF SUBJECT MATTER
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)
B66B5/02

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.
Y A	JP 2002-326776 A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 12 November, 2002 (12.11.02), Abstract; Claims 1 to 2 (Family: none)	1-4 5
Y A	WO 2007/060733 A1 (Mitsubishi Electric Corp.), 31 May, 2007 (31.05.07), Par. Nos. [0004] to [0005], [0012] to [0013], [0018], [0020] to [0023], [0028] to [0029] & EP 1958909 A1	1-4 5
Y A	WO 2008/012896 A1 (Mitsubishi Electric Corp.), 31 January, 2008 (31.01.08), Abstract; Par. Nos. [0006], [0019], [0033] to [0037] (Family: none)	3-4 5

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
04 March, 2009 (04.03.09)	17 March, 2009 (17.03.09)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2005247512 A **[0003]**