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(54) ELEVATOR SYSTEM

AUFZUGSSYSTEM

SYSTÈME D'ASCENSEUR

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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus that uses a plurality of speed detectors that generate signals that correspond to rotation of a driving sheave, and that controls a braking device by means of a braking control portion based on the plurality of circuit signals from these speed detectors.

BACKGROUND ART

[0002] Conventionally, elevator safety systems are constituted by safety chains that are series circuits that include a plurality of switches and a plurality of contacts. Among these contacts and switches, an overspeed governor, a limit switch, etc., are operated in response to operation of a car, for example. Landing door switches, locking devices, etc., are operated in response to door movements.

[0003] In answer to this, in elevators that use conventional electronic safety systems, various kinds of sensors, contacts, and switches are monitored by a central controller by means of electronic safety buses. A bus node is connected to each sensor, contact, and switch at its respective position. Status information is transmitted to the central controller from the bus nodes. A microprocessor board that has input/output ports that are connected to the safety buses and the bus nodes is disposed in the central controller (see Patent Literature 1, for example).

[0004] In conventional elevator braking control apparatuses, on the other hand, a hoisting machine brake is activated to make the car perform an emergency stop by a first braking control portion when an abnormality is detected. If deceleration of the car becomes greater than or equal to a predetermined value during emergency braking operation of the hoisting machine brake, braking force of the hoisting machine brake is reduced by a second braking control portion (see Patent Literatures 2 and 3, for example).

[0005]

[Patent Literature 1]
Japanese Patent Publication No. 2002-538061 (Gazette)
[Patent Literature 2]
WO 2007/088599 A1
[Patent literature 3]
EP 2 048 104 A1

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006] However, in a conventional electronic safety system such as that described above, a communicating means, and power source wiring, etc., to drive it, is required for each bus node, increasing costs. In conventional braking control apparatuses, it has not been possible to detect sensor abnormalities or abnormalities in the braking control portions themselves.

[0007] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus that can achieve wire saving while suppressing cost increases, and also improve braking control reliability.

MEANS FOR SOLVING THE PROBLEM

[0008] In order to achieve the above object, there is provided an elevator apparatus according to claim 1. Preferred embodiments of the invention are characterized by what is disclosed in the dependent claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

Figure 1 is a structural diagram that shows an elevator apparatus according to Embodiment 1 of the present invention;
Figure 2 is a structural diagram that shows a detailed configuration of the elevator apparatus from Figure 1;
Figure 3 is a flowchart that shows operation of a braking control portion from Figure 2;
Figure 4 is an explanatory diagram that shows temporal changes in driving sheave speed, driving sheave deceleration, a state of first and second brake electromagnetic relays, and a state of first and second deceleration controlling switches when a car decelerates immediately after emergency stop command generation;
Figure 5 is a flowchart that shows an abnormality diagnostic operation of first and second braking control computing portions from Figure 2;
Figure 6 is a structural diagram that shows an elevator apparatus according to Embodiment 2 of the present invention;
Figure 7 is a structural diagram that shows an elevator apparatus according to Embodiment 3 of the present invention; and
Figure 8 is a structural diagram that shows an elevator apparatus according to Embodiment 4 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0010] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0011] Figure 1 is a structural diagram that shows an elevator apparatus according to Embodiment 1 of the present invention. In the figure, a car 1 and a counterweight 2 are suspended inside a hoistway by a main rope 3 that functions as a suspending means, and are raised and lowered inside the hoistway by a driving force from a hoisting machine 4.

[0012] The hoisting machine 4 has: a driving sheave 5 around which the main rope 3 is wound; a hoisting machine motor 6 that rotates the driving sheave 5; and a braking device 7 that brakes rotation of the driving sheave 5. The braking device 7 has first and second braking portions 7a and 7b.

[0013] A speed detecting portion 8 that generates a signal that corresponds to rotational speed of a rotating shaft thereof, i.e., rotational speed of the driving sheave 5, is disposed on the hoisting machine motor 6. The hoisting machine motor 6 and the braking device 7 are controlled by an operation controlling apparatus 9. The signal from the speed detecting portion 8 is input into the operation controlling apparatus 9.

[0014] The braking portions 7a and 7b each have: a brake drum (a brake wheel) that is coupled so as to be coaxial with the driving sheave 5; a brake shoe that can be placed in contact with and separated from the brake drum; a brake spring that applies a braking force by pressing the brake shoe against the brake drum; and an electromagnet that releases the braking force by separating the brake shoe from the brake drum in opposition to the brake spring.

[0015] Figure 2 is a structural diagram that shows a detailed configuration of the elevator apparatus from Figure 1. A first brake coil (a first electromagnetic coil) 11 is disposed on the electromagnet of the first braking portion 7a. A second brake coil (a second electromagnetic coil) 12 is disposed on the electromagnet of the second braking portion 7b.

[0016] The first and second brake coils 11 and 12 are connected in parallel relative to a power source. First and second brake electromagnetic relays 13 and 14 are connected in series between the first and second brake coils 11 and 12 and the power source.

[0017] A first deceleration controlling switch 15 is connected between the first brake coil 11 and ground. A second deceleration controlling switch 16 is connected between the second brake coil 12 and ground. Semiconductor switches, for example, can be used as the first and second deceleration controlling switches 15 and 16. Electric current that flows to the first and second brake coils 11 and 12 is controlled by ON/OFF switching these first and second deceleration controlling switches 15 and 16 to control application of the braking force by the first and second braking portions 7a and 7b.

[0018] The speed detecting portion 8 includes first and second encoders 8a and 8b that function as first and second speed detectors that each generate a detection signal independently.

[0019] The operation controlling apparatus 9 has: a hoisting machine control portion 21 that controls the hoisting machine motor 6; a braking control portion 22 that controls the braking device 7; and a front end portion 23. The hoisting machine control portion 21, the braking control portion 22, and the front end portion 23 are accommodated inside a shared control board.

[0020] First and second hoisting machine electromagnetic relays 17 and 18 are connected in series between the hoisting machine motor 6 and the hoisting machine control portion 21. The front end portion 23 functions as an interface between encoder signals, switch command signals, and interrupting signals, etc., for driving the hoisting machine motor 6 and the braking device 7, and the hoisting machine control portion 21 and braking control portion 22.

[0021] The front end portion 23 has: a first front end computing portion 23a; a second front end computing portion 23b; a front end shared memory portion (a 2-port RAM) 23c; a front end failure alarm portion 23d; and the front end communicating portion 23e.

[0022] The signal from the first encoder 8a is input into the first front end computing portion 23a. The signal from the second encoder 8b is input into the second front end computing portion 23b.

[0023] The first front end computing portion 23a controls respective ON/OFF switching of the first brake electromagnetic relay 13, the first deceleration controlling switch 15, and the first hoisting machine electromagnetic relay 17. The second front end computing portion 23b controls respective ON/OFF switching of the second brake electromagnetic relay 14, the second deceleration controlling switch 16, and the second hoisting machine electromagnetic relay 18.

[0024] The first and second front end computing portions 23a and 23b are each constituted by a computer, and perform computational processing based on the signals from the first and second encoders 8a and 8b to find the rotational speed of the driving sheave 5.

[0025] The first and second front end computing portions 23a and 23b are able to read and write shared data from and to the front end shared memory portion 23c. In addition, the first and second front end computing portion 23a and 23b compare the detection signals from the first and second encoders 8a and 8b and computational results with each other by means of the front end shared memory portion 23c. If a difference between the detection signals or a difference between the computational results exceeds a tolerance value, a failure detection signal is input into the front end failure alarm portion 23d.

[0026] The front end communicating portion 23e performs communication (serial communication) with the hoisting machine control portion 21 and the braking control portion 22.

[0027] The hoisting machine control portion 21 has: a hoisting machine driving portion 21a; a hoisting machine control computing portion 21b; and a hoisting machine control communicating portion 21c. The hoisting machine driving portion 21a is connected to the hoisting machine motor 6 by means of the first and second hoisting machine electromagnetic relays 17 and 18, and includes an inverter, etc., for driving the hoisting machine motor 6. The hoisting machine control communicating portion 21c performs communication (serial communication) with the braking control portion 22 and the front end portion 23.

[0028] A signal from the front end portion 23 that corresponds to the first and second encoders 8a and 8b is input into the hoisting machine control computing portion 21b by means of the hoisting machine control communicating portion 21c. The hoisting machine control computing portion 21b is constituted by a computer, and performs computational processing based on the signal from the front end portion 23 to generate a command signal for controlling the hoisting machine driving portion 21a.

[0029] The braking control portion 22 has: a first braking control computing portion 22a; a second braking control computing portion 22b; a braking control shared memory portion (2-port RAM) 22c; a braking control failure alarm portion 22d; and a braking control communicating portion 22e. The braking control communicating portion 22e performs communication (serial communication) with the hoisting machine control portion 21 and the front end portion 23.

[0030] A signal from the front end portion 23 is input into the first and second braking control computing portions 22a and 22b by means of the braking control communicating portion 22e. The first braking control computing portion 22a is constituted by a computer, and performs computational processing based on the signal that corresponds to the first encoder 8a to generate a signal for controlling ON/OFF switching of the first deceleration controlling switch 15. The second braking control computing portion 22b is constituted by a computer, and performs computational processing that is identical to that of the first braking control computing portion 22a based on the signal from the second encoder 8a to generate a signal for controlling ON/OFF switching of the second deceleration controlling switch 16.

[0031] The first and second braking control computing portions 22a and 22b are able to read and write shared data to the braking control shared memory portion 22c. In addition, the first and second braking control computing portion 22a and 22b compare input signals and computational results with each other by means of the braking control shared memory portion 22c. If a difference between the input signals or a difference between the computational results exceeds a tolerance value, a failure detection signal is input into the braking control failure alarm portion 22d.

[0032] When the car 1 is made to perform an emergency stop, the braking control portion 22 adjusts the braking force of the braking device 7 by controlling the ON/OFF switching of the first and second deceleration controlling switches 15 and 16 such that deceleration of the car 1 does not become excessive (deceleration control),

[0033] Next, operation will be explained. Each time the car 1 runs, the first and second front end computing portions 23a and 23b perform predetermined computations based on the signals from the first and second encoders 8a and 8b to detect the rotational speed of the driving sheave 5.

[0034] Here, the first front end computing portion 23a compares the signal from the first encoder 8a and the signal from the second encoder 8b via the front end shared memory portion 23c. If the difference therebetween is within a predetermined input signal allowable error range, the required computational processing is executed and the computational result is written to the front end shared memory portion 23c.

[0035] Similarly, the second front end computing portion 23b compares the signal from the second encoder 8b and the signal from the first encoder 8a via the front end shared memory portion 23c. If the difference therebetween is within a predetermined input signal allowable error range, the required computational processing is executed and the computational result is written to the front end shared memory portion 23c.

[0036] The first and second front end computing portions 23a and 23b each read in the computational result of the other circuit from the front end shared memory portion 23c and compare it with the computational result of their own circuit. If the differences therebetween are within a predetermined computational result allowable error range, the computational results are output to the front end communicating portion 23e.

[0037] If, however, the difference between the input signals from the first and second encoders 8a and 8b or the difference between the computational results is not within the allowable error range, the first and second front end computing portions 23a and 23b deem that some abnormality has arisen, and a failure detection signal is input to the front end failure alarm portion 23d.

[0038] The computational results from the first and second front end computing portions 23a and 23b and the failure detection signal that has been input into the front end failure alarm portion 23d are transmitted from the front end communicating portion 23e to the hoisting machine control portion 21 and the braking control portion 22. At this point, data concerning time of processing by the first and second front end computing portions 23a and 23b are added to the computational result messages. Thus, the time of processing by the first and second front end computing portions 23a and 23b is reflected in the computation by the hoisting machine control portion 21 and the braking control portion 22. Time is made a determining criteria in failure diagnosis, enabling reliability and precision of hoisting machine control and braking control to be increased.

[0039] Information concerning the failure occurrence location (location of abnormality) is added to the failure detection signal and transmitted. Thus, information concerning the failure occurrence location is reflected in the computation by the hoisting machine control portion 21 and the braking control portion 22.

[0040] If the signal from the first encoder 8a is constantly 0, for example, information to the effect that the failure occurrence location is the first encoder 8a is added to the failure detection signal, and transmitted to the hoisting machine control portion 21 and the braking control portion 22.

[0041] Computation to generate a command to activate the braking device 7 to brake is thereby executed in the braking control portion 22 by the first and second braking control computing portions 22a and 22b, and the computational results are transmitted to the front end portion 23 by means of the braking control communicating portion 22e. Thus, the braking device 7 is activated to brake by the front end portion 23.

[0042] In the hoisting machine control portion 21, computation to generate a command for stopping the raising and lowering of the car 1 is executed by the hoisting machine control computing portion 21b, and the hoisting machine motor 6 is stopped by the hoisting machine driving portion 21a.

[0043] Next, operation of the braking control portion 22 when the front end portion 23 communicates normal computational results will be explained. Figure 3 is a flowchart that shows operation of a braking control portion from Figure 2, and the first and second braking control computing portions 22a and 22b execute processing such as that shown in Figure 3 simultaneously in parallel.

[0044] In Figure 3, the first and second braking control computing portions 22a and 22b first initialize a plurality of parameters required for processing (Step S1). In this example, a driving sheave speed V0 (m/s) that is used in a car stopping determination, a driving sheave speed V1 (m/s) that stops deceleration control, and first and second threshold values $\gamma 1$ (m/s^2), $\gamma 2$ (m/s^2) ($\gamma 1 < \gamma 2$) for determining deceleration of the driving sheave 5 are set as parameters.

[0045] Processing after initialization is executed repeatedly and periodically at a preset sampling period. In other words, the first and second braking control computing portions 22a and 22b import signals from the front end portion 23 at predetermined intervals (Step S2). Next, driving sheave deceleration γ (m/s^2) is computed based on the signals from the front end portion 23 (Step S3).

[0046] Next, the first and second braking control computing portions 22a and 22b determine whether or not the driving sheave speed (motor rotational speed) V is greater than a stopping determining speed V0 and the driving sheave deceleration γ is greater than the first threshold value $\gamma 1$. If these conditions are not satisfied, commands for opening the first and second brake electromagnetic relays 13 and 14 are generated (Step S9), and these commands are transmitted from the braking control communicating portion 22e to the front end portion 23. The first and second brake coils 11 and 12 are thereby shut off from the power source, disabling deceleration control.

[0047] If conditions V > V0 and $\gamma > \gamma 1$ are satisfied, the first and second braking control computing portions 22a and 22b generate commands for closing the first and second brake electromagnetic relays 13 and 14 (Step S5), and these commands are transmitted from the braking control communicating portion 22e to the front end portion 23.

[0048] Now, during emergency stopping of the car 1, since passage of electric current to the hoisting machine motor 6 is also shut off, the car 1 may accelerate, or the car 1 may decelerate, in an interval from generation of the emergency stop command until the braking force actually acts, due to imbalances between the load on the car 1 and the load on the counterweight 2.

[0049] In the first and second braking control computing portions 22a and 22b, if $\gamma \leq \gamma 1$, it is deemed that the car 1 is being accelerated immediately after emergency stop command generation, and the first and second brake electromagnetic relays 13 and 14 are opened so as to apply braking force promptly. If $\gamma > \gamma 1$, it is deemed that the car 1 is being decelerated, and deceleration control is implemented by closing the first and second brake electromagnetic relays 13 and 14 such that deceleration does not become excessive.

[0050] In deceleration control, the first and second braking control computing portions 22a and 22b determine whether or not driving sheave deceleration γ is greater than a second threshold value $\gamma 2$ (Step S6). If $\gamma > \gamma 2$, commands are generated for ON/OFF switching the first and second deceleration controlling switches 15 and 16 at preset switching duties (50 percent, for example) in order to suppress the driving sheave deceleration γ (Step S7), and these commands are transmitted from the braking control communicating portion 22e to the front end portion 23. Thus, braking force from the braking device 7 is controlled by applying a predetermined voltage to the first and second brake coils 11 and 12. Here, the first and second deceleration controlling switches 15 and 16 are ON/OFF switched so as to synchronize with each other.

[0051] If $\gamma \leq \gamma 2$, the first and second deceleration controlling switches 15 and 16 are kept open. Next, the first and second braking control computing portions 22a and 22b perform a control stopping determination (Step S8). In the control stopping determination, a determination is made as to whether the driving sheave speed V is less than the threshold value V1. If V ≥ V1, return directly to input processing (Step S2). If V < V1, generate commands for opening the first and second brake electromagnetic relays 13 and 14 (Step S9), and then return to input processing (Step S2).

[0052] Now, Figure 4 is an explanatory diagram that shows temporal changes in driving sheave speed, driving sheave deceleration, a state of the first and second brake electromagnetic relays 13 and 14, and a state of the first and second deceleration controlling switches 15 and 16 when the car 1 decelerates immediately after emergency stop command generation.

[0053] If an emergency stop has arisen, the car 1 immediately commences deceleration. When deceleration reaches $\gamma 1$ at time T1, the first and second brake electromagnetic relays 13 and 14 are closed, and when deceleration reaches $\gamma 2$ at time T2, the first and second deceleration controlling switches 15 and 16 are ON/OFF switched. Thereafter, when the driving sheave speed becomes less than V1, the first and second brake electromagnetic relays 13 and 14 are opened, and deceleration control by the first and second deceleration controlling switches 15 and 16 is stopped.

[0054] Figure 5 is a flowchart that shows an abnormality diagnostic operation of the first and second braking control computing portions 22a and 22b from Figure 2. The first and second braking control computing portions 22a and 22b call up diagnostic processing such as that shown in Figure 5 at each point when processing is completed after input processing (Step S2) in Figure 3.

[0055] In the abnormality diagnostic operation, compatibility between the input values from the front end portion 23 and the computational results by the first and second braking control computing portions 22a and 22b is determined (Step S11). Specifically, if differences between the input values and the computational results are within a predetermined range, it is deemed that there is no abnormality, and a return is made to the next process in Figure 3.

[0056] If differences between the input values and the computational results exceed the predetermined range, it is deemed that there is an abnormality, and commands for opening the first and second brake electromagnetic relays 13 and 14 are generated (Step S12), and a failure detection signal is output to the braking control failure alarm portion 22d (Step S13).

[0057] When the failure detection signal is received, the braking control failure alarm portion 22d outputs commands that inform the hoisting machine control portion 21 of the failure of the braking control portion 22, and that also stop running of the elevator, by means of the braking control communicating portion 22e.

[0058] In an elevator apparatus of this kind, because a hoisting machine control communicating portion 21c is disposed in a hoisting machine control portion 21, and a braking control communicating portion 22e is also disposed in a braking control portion 22, and transmitting and receiving of data between the hoisting machine control communicating portion 21c and the braking control communicating portion 22e are enabled, wire saving inside a control board can be achieved while suppressing cost increases by using a chain method in which switch groups and contact groups are connected in series as an overall safety circuit.

[0059] Because first and second braking control computing portions 22a and 22b that perform identical computations for controlling a braking device 7 are disposed in the braking control portion 22, and a braking control shared memory portion 22c is also disposed, and the first and second braking control computing portions 22a and 22b compare input signals and computational results with each other by means of the braking control shared memory portion 22c, and also output a failure detection signal from the braking control communicating portion 22e if a compared result exceeds a predetermined range, failure of the first and second braking control computing portions 22a and 22b themselves can be detected, enabling braking control reliability to be improved.

[0060] By achieving wire saving and improving reliability in this manner, labor saving on equipment maintenance, installation, etc., can also be achieved.

[0061] In addition, because the first and second braking control computing portions 22a and 22b control braking force from the braking device 7 such that deceleration of the car 1 is less than or equal to a predetermined value when the car 1 is made to perform an emergency stop, and also disable deceleration control by outputting a failure detection signal, riding comfort during an emergency stop can be improved, and reliability can also be further improved.

[0062] Because a front end portion 23 that functions as an interface between various kinds of signals that include signals from the first and second encoders 8a and 8b, and the hoisting machine control portion 21 and the braking control portion 22 is used, additional wire saving in the control board can be achieved.

[0063] Because first and second front end computing portions 23a and 23b that perform identical computations for finding rotational speed of the driving sheave 5 are disposed in the front end portion 23 and a front end shared memory portion 23c is also disposed, and the first and second front end computing portions 23a and 23b compare input signals and computational results with each other by means of the front end shared memory portion 23c and also output a failure detection signal from the front end communicating portion 23e if a compared result exceeds a predetermined range, failure of the first and second front end computing portions 23a and 23b themselves, and failure of the first and second encoders 8a and 8b, etc., can be detected, enabling overall system reliability to be improved.

Embodiment 2

[0064] Next, Figure 6 is a structural diagram that shows an elevator apparatus according to Embodiment 2 of the present invention. In the figure, an operation controlling apparatus 9 has: a hoisting machine control portion 21; and a front end and braking control portion 24. The front end and braking control portion 24 includes both a function as the front end portion 23 and a function as the braking control portion 22 of Embodiment 1. The hoisting machine control portion 21 and the front end and braking control portion 24 are accommodated inside a shared control board.

[0065] The front end and braking control portion 24 has: first and second front end and braking control computing portions 24a and 24b; a front end and braking control shared memory portion 24c; a front end and braking control failure alarm portion 24d; and the front end and braking control communicating portion 24e.

[0066] The first front end and braking control computing portion 24a has functions of the first braking control computing portion 22a and the first front end computing portion 23a of Embodiment 1. The second front end and braking control computing portion 24b has functions of the second braking control computing portion 22b and the second front end computing portion 23b of Embodiment 1. The rest of the configuration is similar to that of Embodiment 1.

[0067] In an elevator apparatus of this kind, the number of parts can be reduced and the configuration simplified, enabling reductions in the size of the control board to be achieved, and also enabling costs to be reduced.

Embodiment 3

[0068] Next, Figure 7 is a structural diagram that shows an elevator apparatus according to Embodiment 3 of the present invention. In the figure, a front end portion 23 does not have a computing portion or a shared memory portion, and has only first and second front end communicating portions 23f and 23g. A braking control portion 22 has first and second braking control communicating portions 22f and 22g instead of a braking control communicating portion 22e. Input signals, deceleration controlling command signals, etc., can thereby be transmitted and received using two direct communication systems. Communication with a hoisting machine control portion 21 can be performed by one of the two systems. The rest of the configuration is similar to that of Embodiment 1.

[0069] In an elevator apparatus of this kind, the number of parts can be reduced and the configuration simplified, enabling reductions in the size of the control board to be achieved, and also enabling costs to be reduced.

Embodiment 4

[0070] Next, Figure 8 is a structural diagram that shows an elevator apparatus according to Embodiment 4 of the present invention, in the figure, two sets of door opening sensors 31 that detect if doors are in an open state are disposed on each of a car door and a plurality of landing doors. Two sets of floor aligning sensors 32 for adjusting differences in level between a floor of the car 1 and floors of the landings when the doors are in an open state are also disposed on the car 1. Signals from the door opening sensors 31 and the floor aligning sensors 32 are respectively input into corresponding first and second front end computing portions 23a and 23b.

[0071] The first and second front end computing portions 23a and 23b detect if the car 1 is driven when the doors are in an open state based on the signals from the door opening sensors 31 and the floor aligning sensors 32. The first and second brake electromagnetic relays 13 and 14 and the first and second hoisting machine electromagnetic relays 17 and 18 are also opened if the first and second front end computing portions 23a and 23b determine that the car 1 has moved beyond a predetermined floor alignment zone during a floor aligning operation.

[0072] If first and second braking control computing portions 22a and 22b detect that the doors are in an open state while the car 1 is in motion, the car 1 is made to perform an emergency stop and deceleration reducing control of the car 1 or the driving sheave 5 is also implemented during the emergency stopping operation.

[0073] In an elevator apparatus of this kind, because a power source relative to first and second brake coils 11 and 12 and a hoisting machine motor 6 is shut off immediately if it is detected that the car 1 has left the floor alignment zone when the doors are in an open state, reliability can be improved. Space between the floor of the car 1 and ceiling portions of the landings, or space between a ceiling portion of the car 1 and the floors of the landings, can also be ensured to be large.

[0074] Moreover, in Embodiment 4, if it is detected that the doors are in an open state, and rotational speed of the hoisting machine 4 is greater than or equal to a set value, electric current to first and second brake coils 11 and 12 may also be controlled by first and second deceleration controlling switches 15 and 16 such that the speed of the hoisting machine 4 follows a target deceleration pattern. Thus, because the hoisting machine 4 can be braked in a reduced target deceleration pattern even if the speed is high, deceleration during emergency braking can be reduced.

[0075] An operation controlling apparatus 9 according to Embodiment 4 may also have a configuration similar to those of Embodiments 2 and 3.

[0076] In addition, in Embodiment 4, a function that prevents motion with the doors open during the floor aligning operation has been given to the first and second front end computing portions 23a and 23b, but this function may also be given to the first and second braking control computing portions 22a and 22b.

[0077] Other safety monitoring functions may also be given to the front end computing portions 23a and 23b or the braking control computing portions 22a and 22b. For example, a function that monitors car speeds that can compress a terminal floor, or a function that prevents approach between cars in multi-car elevators, etc., may also be added.

[0078] A rope that has a circular cross section or a belt that has a flat cross section, etc., can be used as the main rope 3.

[0079] In addition, in the above examples, duplex systems have been described, but a multiplex system that is triplex or more may also be used.

Claims

1. An elevator apparatus comprising:

a hoisting machine (4) comprising: a driving sheave (5); a hoisting machine motor (6) that rotates the driving sheave (5); and a braking device (7) that brakes rotation of the driving sheave (5);
a suspending means (3) that is wound around the driving sheave (5);
a car (1) that is suspended by the suspending means (3), and that is raised and lowered by the hoisting machine (4);
first and second speed detectors (8a and 8b) that each generate a detection signal that corresponds to rotation of the driving sheave (5);
a hoisting machine control portion (21) that controls the hoisting machine motor (6) based on the detection signals from the first and second speed detectors (8a and 8b); and
a braking control portion (22, 24) that controls the braking device (7) based on the detection signals from the first and second speed detectors (8a and 8b),
wherein:

the hoisting machine control portion (21) comprises:

a hoisting machine control computing portion (21b) that performs computation for controlling the hoisting machine motor (6) based on signals that correspond to the first and second speed detectors (8a and 8b); and
a hoisting machine control communicating portion (21c) that performs transmitting and receiving of signals;

the braking control portion (22, 24) comprises:

a first braking control computing portion (22a, 24a) that performs computation for controlling the braking device (7) based on a signal that corresponds to the first speed detector (8a);
a second braking control computing portion (22b, 24b) that performs computation for controlling the braking device (7) based on a signal that corresponds to the second speed detector (8b);
a braking control shared memory portion (22c, 24c) that stores shared data for the first and second braking control computing portions (22a and 22b, 24a and 24b);
a braking control failure alarm portion (22d); and
a braking control communicating portion (22e, 24e) that performs transmitting and receiving of signals to and from the hoisting machine control communicating portion (21c); and

the first and second braking control computing portions (22a and 22b, 24a and 24b) compare input signals and computational results with each other by means of the braking control shared memory portion (22c, 24c), and also output a failure detection signal from the braking control communicating portion (22e, 24e) if a compared result exceeds a predetermined range, said failure detection signal being input into the braking control failure alarm portion (22d),

wherein the braking control failure alarm portion (22d), when the failure detection signal is received, outputs commands that inform the hoisting machine control portion (21) of the failure of the braking control portion (22) by means of the braking control communication portion (22e),
further comprising a front end portion (23) that has a front end communicating portion (23e) that performs transmitting and receiving of signals between the hoisting machine control communicating portion (21c) and the braking control communicating portion (22e), and that functions as an interface between various kinds of signal including signals from the first and second speed detectors (8a and 8b) and the hoisting machine control portion (21) and the braking control portion (22),
wherein:

the front end portion (23) further comprises:

a first front end computing portion (23a) that computes rotational speed of the driving sheave (5) based on a signal from the first speed detector (8a);
a second front end computing portion (23b) that computes rotational speed of the driving sheave (5) based on a signal from the second speed detector (8b); and
a front end shared memory portion (23c) that stores shared data for the first and second front end computing portions (23a and 23b); and

the first and second front end computing portions (23a and 23b) compare input signals and computational results with each other by means of the front end shared memory portion (23c), and also output a failure detection signal from the front end communicating portion (23e) if a compared result exceeds a predetermined range.

2. An elevator apparatus according to Claim 1, wherein the first and second braking control computing portions (22a and 22b, 24a and 24b) control braking force from the braking device (7) such that deceleration of the car (1) is less than or equal to a predetermined value when the car (1) is made to perform an emergency stop, and also disable deceleration control of the car (1) by outputting the failure detection signal.

3. An elevator apparatus according to Claim 1, wherein the front end portion (23) adds data concerning time of processing to computational results by the first and second front end computing portions (23a and 23b) before transmission to the braking control portion (22).

4. An elevator apparatus according to Claim 1, wherein the front end portion (23) adds information concerning failure occurrence location to the failure detection signal before transmission to the braking control portion (22).

5. An elevator apparatus according to Claim 1, further comprising:

   a door opening sensor (31) that detects if a door is in an open state; and
   a floor aligning sensor (32) for adjusting a difference in level between a floor of a landing and a floor of the car (1) when the door is in an open state,
   wherein the first and second front end computing portions (23a and 23b) interrupt a power source to the hoisting machine motor (6) and the braking device (7) if it is determined that the car (1) moves beyond a predetermined floor alignment zone during a floor aligning operation based on signals from the door opening sensor (31) and the floor aligning sensor (32).

6. An elevator apparatus according to Claim 1, further comprising:

   a door opening sensor (31) that detects if a door is in an open state,
   wherein the first and second braking control computing portions (22a and 22b) make the car (1) perform an emergency stop and also implement deceleration control during an emergency stopping operation if it is detected that the door is in an open state while the car (1) is in motion.

Patentansprüche

1. Aufzugsvorrichtung, mit:

einer Hebemaschine (4), umfassend: eine Antriebsrolle (5); einen Hebemaschinenmotor (6), der die Antriebsrolle (5) dreht; und eine Bremsvorrichtung (7), die die Drehung der Antriebsrolle (5) abbremst;
einem Aufhängmittel (3), das um die Antriebsrolle (5) gewickelt ist;
eine Kabine (1), die durch das Aufhängmittel (3) aufgehängt ist und die von der Hebemaschine (4) angehoben und abgesenkt wird;
erste und zweite Geschwindigkeitsdetektoren (8a und 8b), die jeweils ein Erfassungssignal erzeugen, das der Drehung der Antriebsrolle (5) entspricht;
einen Hebemaschinen-Steuerabschnitt (21), der den Hebemaschinenmotor (6) basierend auf den Erfassungssignalen von den ersten und zweiten Geschwindigkeitsdetektoren (8a und 8b) steuert; und
einen Bremssteuerabschnitt (22, 24), der die Bremsvorrichtung (7) basierend auf den Erfassungssignalen von den ersten und zweiten Geschwindigkeitsdetektoren (8a und 8b) steuert, wobei:

   der Hebemaschinen-Steuerabschnitt (21) umfasst:

      einen Hebemaschinen-Steuerungsberechnungsabschnitt (21b), der eine Berechnung zum Steuern des Hebemaschinenmotors (6) basierend auf Signalen durchführt, die den ersten und zweiten Geschwindigkeitsdetektoren (8a und 8b) entsprechen; und
      einen Hebemaschinen-Steuerungskommunikationsabschnitt (21c), der ein Senden und Empfangen von Signalen durchführt;

   der Bremssteuerabschnitt (22, 24) umfasst:

      einen ersten Bremssteuerungs-Berechnungsabschnitt (22a, 24a), der eine Berechnung zum Steuern der Bremsvorrichtung (7) basierend auf einem Signal durchführt, das dem ersten Geschwindigkeitsdetektor (8a) entspricht;
      einen zweiten Bremssteuerungs-Berechnungsabschnitt (22b, 24b), der eine Berechnung zum Steuern der Bremsvorrichtung (7) basierend auf einem Signal durchführt, das dem zweiten Geschwindigkeitsdetektor (8b) entspricht;
      einen gemeinsamen Bremssteuerungs-Speicherabschnitt (22c, 24c),

der gemeinsame Daten für die ersten und zweiten Bremssteuer-Berechnungsabschnitte (22a und 22b, 24a und 24b) speichert;
ein Bremssteuerungs-Fehleralarmabschnitt (22d); und
einen Bremssteuerungs-Kommunikationsabschnitt (22e, 24e), der ein Senden und Empfangen von Signalen zu und von dem Hebemaschinen-Steuerungskommunikationsabschnitt (21c) durchführt; und

der erste und der zweite Bremssteuerungs-Berechnungsabschnitt (22a und 22b, 24a und 24b) Eingabesignale und Berechnungsergebnisse mittels des gemeinsamen Bremssteuerungs-Speicherabschnitts (22c, 24c) miteinander vergleichen, und auch ein Fehlererfassungssignal aus dem Bremssteuerungs-Kommunikationsabschnitt (22e, 24e) ausgeben, wenn ein Vergleichsergebnis einen vorbestimmten Bereich überschreitet, wobei das Fehlererfassungssignal in den Bremssteuerungs-Fehleralarmabschnitt (22d) eingegeben wird,
wobei der Bremssteuerungs-Fehleralarmabschnitt (22d) dann, wenn das Fehlererfassungssignal empfangen wird, Anweisungen ausgibt, die den Hebemaschinen-Steuerabschnitt (21) über den Fehler des Bremssteuerabschnitts (22) mittels des Bremssteuerungs-Kommunikationsabschnitts informieren (22e),
ferner umfassend einen Front-End-Abschnitt (23), der einen Front-End-Kommunikationsabschnitt (23e) aufweist, der ein Senden und Empfangen von Signalen zwischen dem Hebemaschinen-Steuerungsverbindungsabschnitt (21c) und dem Bremssteuerungs-Kommunikationsabschnitt (22e) durchführt und der als eine Schnittstelle zwischen verschiedenen Arten von Signalen arbeitet, einschließlich Signalen von den ersten und zweiten Geschwindigkeitsdetektoren (8a und 8b) und dem Hebemaschinen-Steuerabschnitt (21) und dem Bremssteuerabschnitt (22),
wobei:

der Front-End-Abschnitt (23) ferner umfasst:

einen ersten Front-End-Berechnungsabschnitt (23a), der die Rotationsgeschwindigkeit der Antriebsrolle (5) basierend auf einem Signal von dem ersten Geschwindigkeitsdetektor (8a) berechnet;
einen zweiten Front-End-Berechnungsabschnitt (23b), der die Rotationsgeschwindigkeit der Antriebsrolle (5) basierend auf einem Signal von dem zweiten Geschwindigkeitsdetektor (8b) berechnet; und
einen gemeinsamen Front-End-Speicherabschnitt (23c), der gemeinsame Daten für den ersten und den zweiten Front-End-Berechnungsabschnitt (23a und 23b) speichert; und

wobei der erste und der zweite Front-End-Berechnungsabschnitt (23a und 23b) Eingangssignale und Berechnungsergebnisse mittels des gemeinsamen Front-End-Speicherabschnitts (23c) miteinander vergleichen und auch ein Fehlererfassungssignal von dem Front-End-Kommunikationsabschnitt (23e) ausgeben, wenn ein Vergleichsergebnis einen vorgegebenen Bereich überschreitet.

2. Aufzugsvorrichtung nach Anspruch 1, wobei der erste und der zweite Bremssteuerungs-Berechnungsabschnitt (22a und 22b, 24a und 24b) eine Bremskraft von der Bremsvorrichtung (7) derart steuern, dass eine Abbremsung der Kabine (1) kleiner oder gleich zu einem vorbestimmten Wert ist, wenn die Kabine (1) veranlasst wird, einen Notstopp durchzuführen, und auch eine Abbremsungssteuerung der Kabine (1) durch Ausgeben des Fehlererfassungssignals zu deaktivieren.

3. Aufzugsvorrichtung nach Anspruch 1, wobei der Front-End-Abschnitt (23) Daten bezüglich einer Verarbeitungszeit zu Berechnungsergebnissen durch die ersten und zweiten Front-End-Berechnungsabschnitte (23a und 23b) hinzufügt, vor einem Senden an den Bremssteuerabschnitt (22).

4. Aufzugsvorrichtung nach Anspruch 1, wobei der Front-End-Abschnitt (23) eine Information zum Fehlerauftrittsort zu dem Fehlererfassungssignal hinzufügt, vor einem Senden an den Bremssteuerabschnitt (22).

5. Aufzugsvorrichtung nach Anspruch 1, ferner umfassend:

einen Türöffnungssensor (31), der erfasst, ob sich eine Tür in einem offenen Zustand befindet; und
einen Bodenausrichtungssensor (32) zum Ein-

stellen eines Höhenunterschieds zwischen einem Boden eines Stockwerks und einem Boden der Kabine (1), wenn sich die Tür in einem offenen Zustand befindet,
wobei der erste und der zweite Front-End-Berechnungsabschnitt (23a und 23b) eine Stromquelle für den Hebemaschinenmotor (6) und die Bremsvorrichtung (7) unterbrechen, wenn bestimmt wird, dass sich die Kabine (1) während eines Bodenausrichtungsvorgangs über eine vorbestimmte Bodenausrichtungszone hinaus bewegt, basierend auf Signalen von dem Türöffnungssensor (31) und dem Bodenausrichtungssensor (32).

6. Aufzugsvorrichtung nach Anspruch 1, ferner umfassend:

einen Türöffnungssensor (31), der erfasst, ob sich eine Tür in einem offenen Zustand befindet, wobei der erste und der zweite Bremssteuerungs-Berechnungsabschnitt (22a und 22b) die Kabine (1) veranlassen, einen Notstopp durchzuführen und auch eine Abbremsungssteuerung während eines Notstoppbetriebs zu implementieren, wenn erfasst wird, dass sich die Tür in einem offenen Zustand befindet während die Kabine (1) in Bewegung ist.

Revendications

1. Appareil d'ascenseur comprenant :

une machine de levage (4) comprenant : une poulie motrice (5); un moteur de machine de levage (6) qui fait tourner la poulie motrice (5); et un dispositif de freinage (7) qui freine la rotation de la poulie motrice (5) ;
un moyen de suspension (3) qui est enroulé autour de la poulie motrice (5) ;
une cabine (1) qui est suspendue par le moyen de suspension (3), et qui est élevée et abaissée par la machine de levage (4) ;
des premier et second détecteurs de vitesse (8a et 8b) qui génèrent chacun un signal de détection qui correspond à la rotation de la poulie motrice (5) ;
une partie commande de la machine de levage (21) qui commande le moteur de la machine de levage (6) sur la base des signaux de détection émanant des premier et second détecteurs de vitesse (8a et 8b) ; et
une partie commande de freinage (22, 24) qui commande le dispositif de freinage (7) sur la base des signaux de détection émanant des premier et second détecteurs de vitesse (8a et 8b), dans lequel :

la partie commande de la machine de levage (21) comprend :

une partie calcul de commande de la machine de levage (21b) qui effectue un calcul pour commander le moteur de la machine de levage (6) sur la base de signaux qui correspondent aux premier et second détecteurs de vitesse (8a et 8b) ; et
une partie communication de commande de la machine de levage (21c) qui effectue l'émission et la réception de signaux ;

la partie commande de freinage (22, 24) comprend :

une première partie calcul de commande de freinage (22a, 24a) qui effectue un calcul pour commander le dispositif de freinage (7) sur la base d'un signal qui correspond au premier détecteur de vitesse (8a) ;
une seconde partie calcul de commande de freinage (22b, 24b) qui effectue un calcul pour commander le dispositif de freinage (7) sur la base d'un signal qui correspond au second détecteur de vitesse (8b) ;
une partie mémoire partagée de commande de freinage (22c, 24c) qui stocke des données partagées pour les première et seconde parties calcul de commande de freinage (22a et 22b, 24a et 24b) ;
une partie alarme de panne de commande de freinage (22d) ; et

une partie communication de commande de freinage (22e, 24e) qui effectue l'émission et la réception de signaux à destination et en provenance de la partie communication de commande de la machine de levage (21c) ; et
les première et seconde parties calcul de commande de freinage (22a et 22b, 24a et 24b) comparent les signaux d'entrée et les résultats de calcul entre l'une et l'autre au moyen de la partie mémoire partagée de commande de freinage (22c, 24c), et émettent également un signal de détection de panne à partir de la partie communication de commande de freinage (22e, 24e) si un résultat comparé excède une plage prédéterminée, ledit signal de détection de panne étant entré dans la partie alarme de panne de commande de freinage (22d),

dans lequel la partie alarme de panne de commande de freinage (22d), lorsque le signal de détection de panne est reçu, émet des commandes qui informent la partie commande de la machine de levage (21) de la panne de la partie commande de freinage (22) au moyen de la partie communication de commande de freinage (22e),
comprenant en outre une partie extrémité avant (23) qui possède une partie communication d'extrémité avant (23e) qui effectue l'émission et la réception de signaux entre la partie communication de commande de la machine de levage (21c) et la partie communication de commande de freinage (22e), et qui fonctionne en tant qu'interface entre divers types de signal incluant des signaux émanant des premier et second détecteurs de vitesse (8a et 8b) et de la partie commande de la machine de levage (21) et de la partie commande de freinage (22),
dans lequel :

la partie extrémité avant (23) comprend en outre :

une première partie calcul d'extrémité avant (23a) qui calcule une vitesse de rotation de la poulie motrice (5) sur la base d'un signal émanant du premier détecteur de vitesse (8a) ;
une seconde partie calcul d'extrémité avant (23b) qui calcule une vitesse de rotation de la poulie motrice (5) sur la base d'un signal émanant du second détecteur de vitesse (8b) ; et
une partie mémoire partagée d'extrémité avant (23c) qui stocke des données partagées pour les première et seconde parties calcul d'extrémité avant (23a et 23b) ; et

les première et seconde parties calcul d'extrémité avant (23a et 23b) comparent les signaux d'entrée et les résultats de calcul entre l'une et l'autre au moyen de la partie mémoire partagée d'extrémité avant (23c), et émettent également un signal de détection de panne à partir de la partie communication d'extrémité avant (23e) si un résultat comparé excède une plage prédéterminée.

2. Appareil d'ascenseur selon la revendication 1, dans lequel les première et seconde parties calcul de commande de freinage (22a et 22b, 24a et 24b) commandent une force de freinage émanant du dispositif de freinage (7) de sorte que la décélération de la cabine (1) soit inférieure ou égale à une valeur prédéterminée lorsque la cabine (1) est amenée à effectuer un arrêt d'urgence, et désactivent également une commande de décélération de la cabine (1) en émettant le signal de détection de panne.

3. Appareil d'ascenseur selon la revendication 1, dans lequel la partie extrémité avant (23) ajoute des données concernant le temps de traitement aux résultats de calcul par les première et seconde parties calcul d'extrémité avant (23a et 23b) avant transmission à la partie commande de freinage (22).

4. Appareil d'ascenseur selon la revendication 1, dans lequel la partie extrémité avant (23) ajoute des informations concernant l'emplacement de survenue de la panne au signal de détection de panne avant transmission à la partie commande de freinage (22).

5. Appareil d'ascenseur selon la revendication 1, comprenant en outre :

un capteur d'ouverture de porte (31) qui détecte si une porte est dans un état ouvert ; et
un capteur d'alignement de plancher (32) pour régler une différence de niveau entre un plancher d'un palier et un plancher de la cabine (1) lorsque la porte est dans un état ouvert,
dans lequel les première et seconde parties calcul d'extrémité avant (23a et 23b) interrompent une source d'alimentation du moteur de la machine de levage (6) et du dispositif de freinage (7) s'il est déterminé que la cabine (1) se déplace au-delà d'une zone d'alignement de plancher prédéterminée lors d'une opération d'alignement de plancher sur la base de signaux émanant du capteur d'ouverture de porte (31) et du capteur d'alignement de plancher (32).

6. Appareil d'ascenseur selon la revendication 1, comprenant en outre :

un capteur d'ouverture de porte (31) qui détecte si une porte est dans un état ouvert,
dans lequel les première et seconde parties calcul de commande de freinage (22a et 22b) amènent la cabine (1) à effectuer un arrêt d'urgence et mettent également en oeuvre une commande de décélération lors d'une opération d'arrêt d'urgence s'il est détecté que la porte est dans un état ouvert pendant que la cabine (1) est en mouvement.

FIG. 1

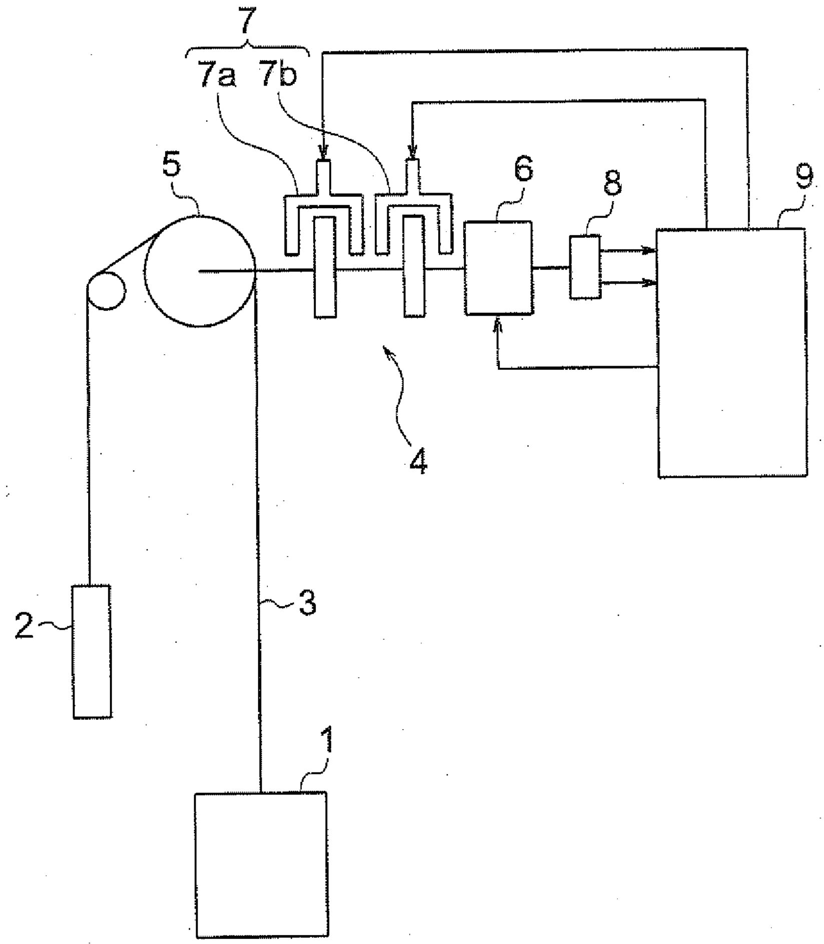


FIG. 2

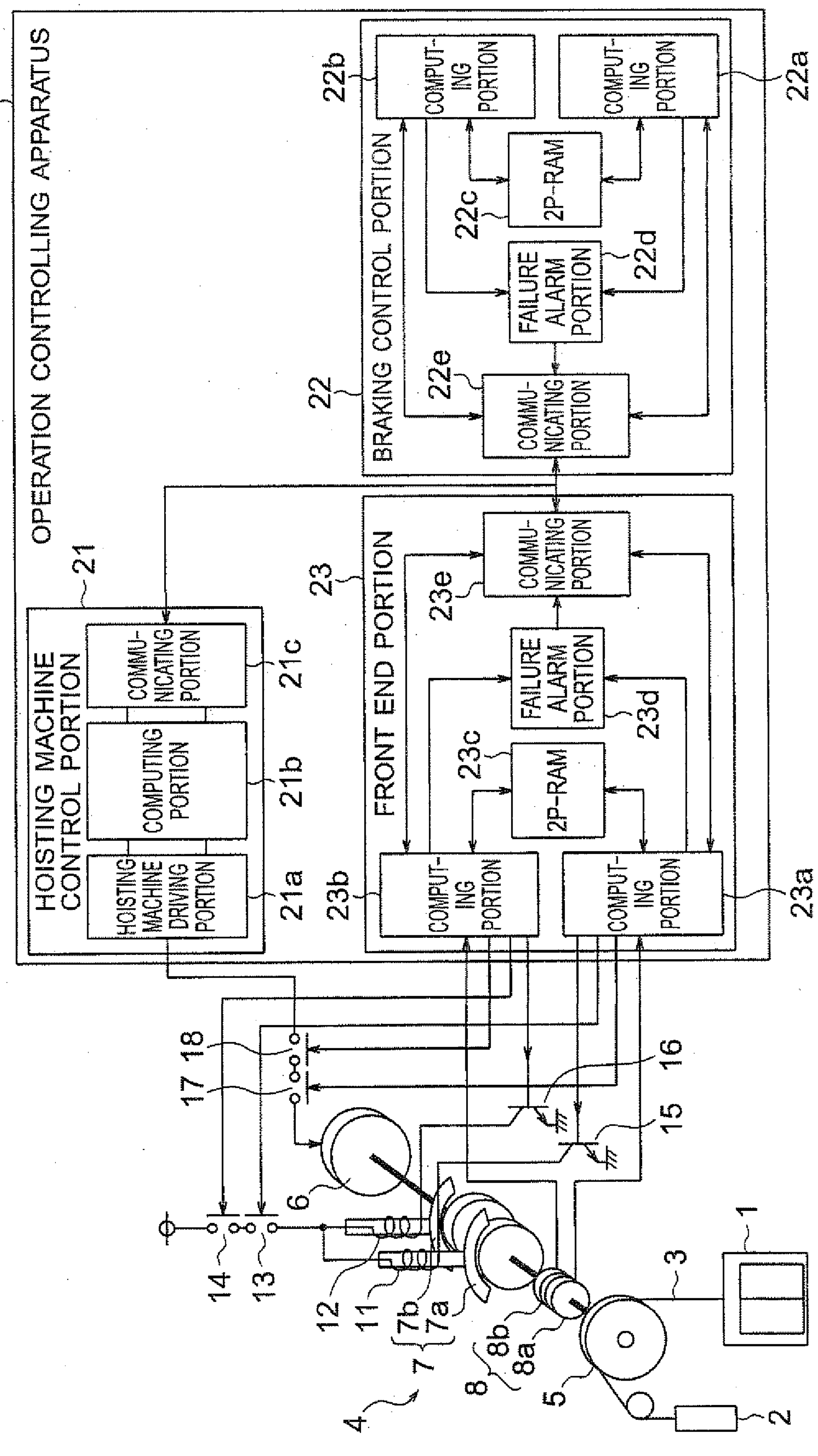

OPERATION CONTROLLING APPARATUS
9
BRAKING CONTROL PORTION
22
COMPUT-ING PORTION
22b
COMPUT-ING PORTION
22a
2P-RAM
22c
FAILURE ALARM PORTION
22d
COMMU-NICATING PORTION
22e
FRONT END PORTION
23
COMMU-NICATING PORTION
23e
FAILURE ALARM PORTION
23d
2P-RAM
23c
COMPUT-ING PORTION
23b
COMPUT-ING PORTION
23a
HOISTING MACHINE CONTROL PORTION
21
COMMU-NICATING PORTION
21c
COMPUTING PORTION
21b
HOISTING MACHINE DRIVING PORTION
21a
17
18
16
15
14
13
12
11
7b
7a
7
8b
8a
8
6
5
4
3
2
1

FIG. 3

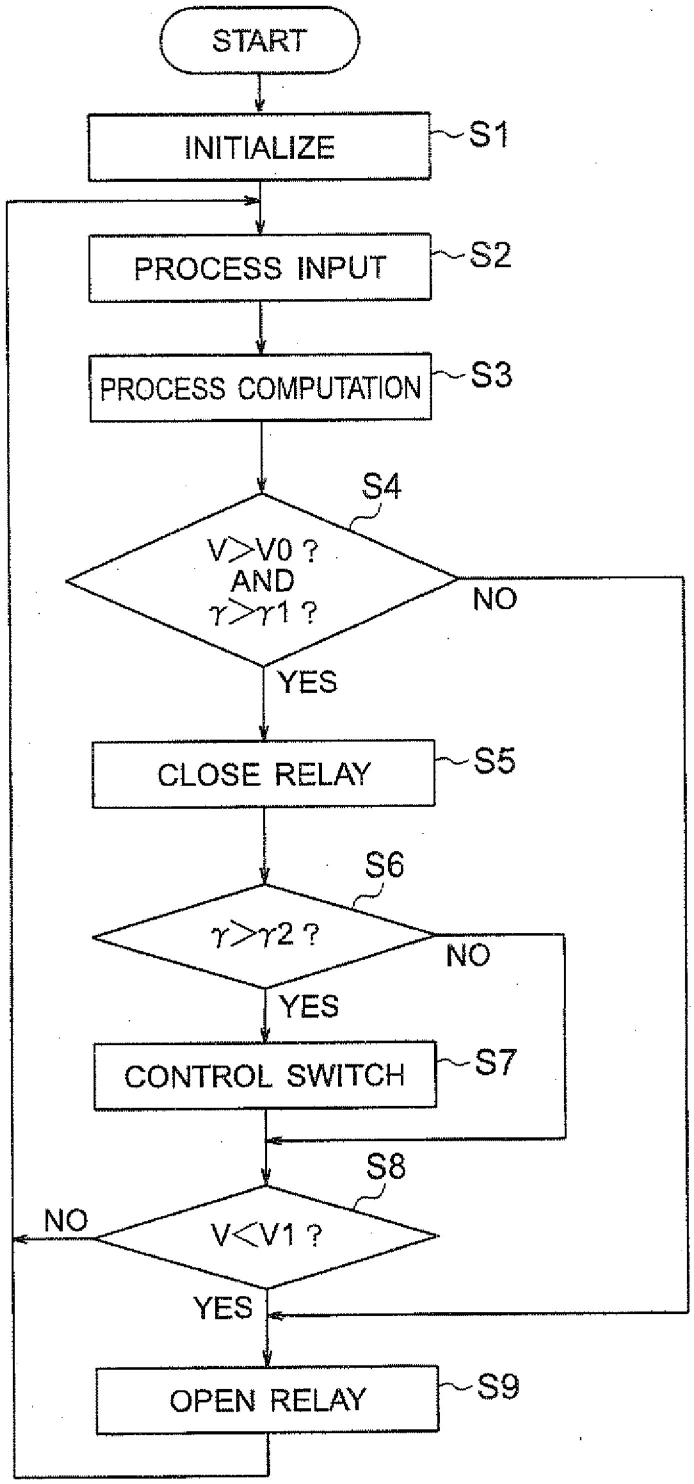
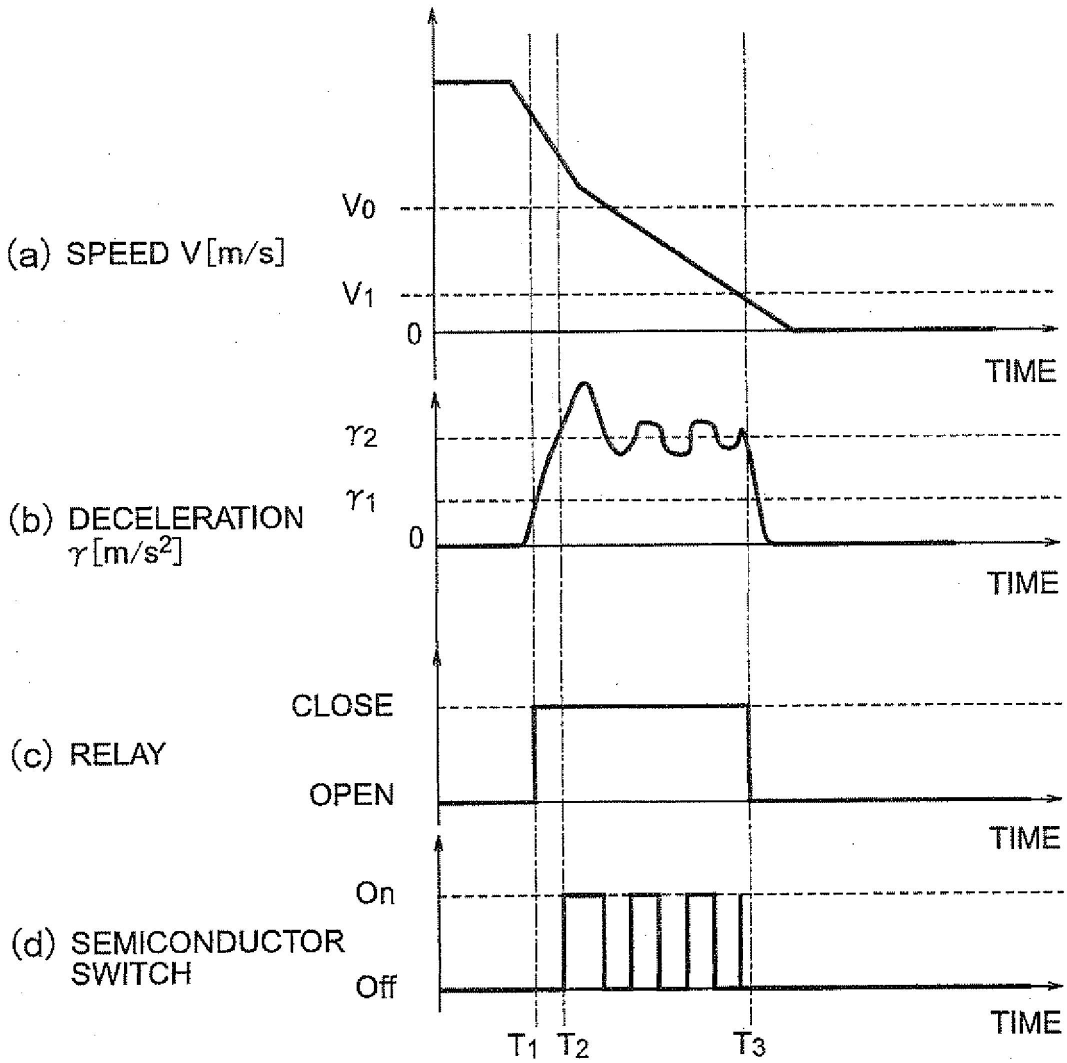

START
INITIALIZE
S1
PROCESS INPUT
S2
PROCESS COMPUTATION
S3
S4
V>V0 ?
AND
γ>γ1 ?
NO
YES
CLOSE RELAY
S5
S6
γ>γ2 ?
NO
YES
CONTROL SWITCH
S7
S8
NO
V<V1 ?
YES
OPEN RELAY
S9

FIG. 4



(a) SPEED V[m/s]
V0
V1
0
TIME
(b) DECELERATION γ[m/s2]
γ2
γ1
0
TIME
(c) RELAY
CLOSE
OPEN
TIME
(d) SEMICONDUCTOR SWITCH
On
Off
TIME
T1 T2 T3

FIG. 5

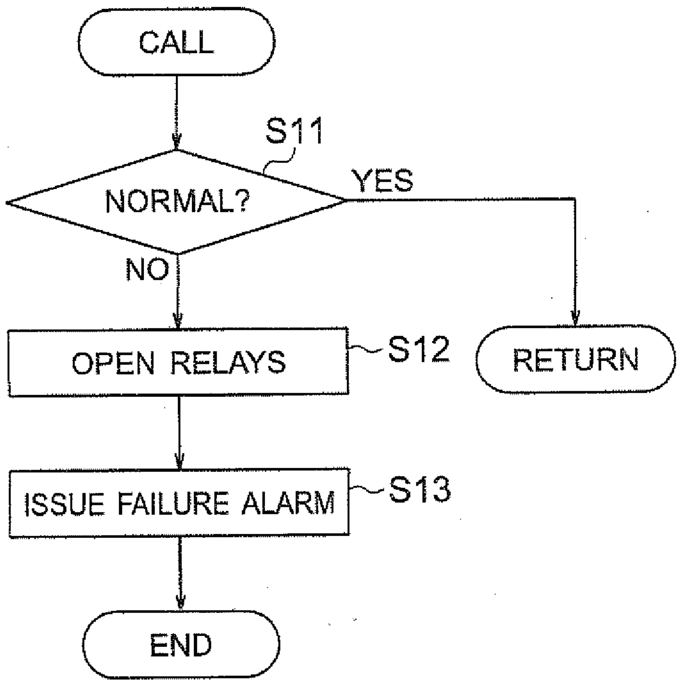

CALL
S11
NORMAL?
YES
NO
OPEN RELAYS
S12
RETURN
ISSUE FAILURE ALARM
S13
END

FIG. 6

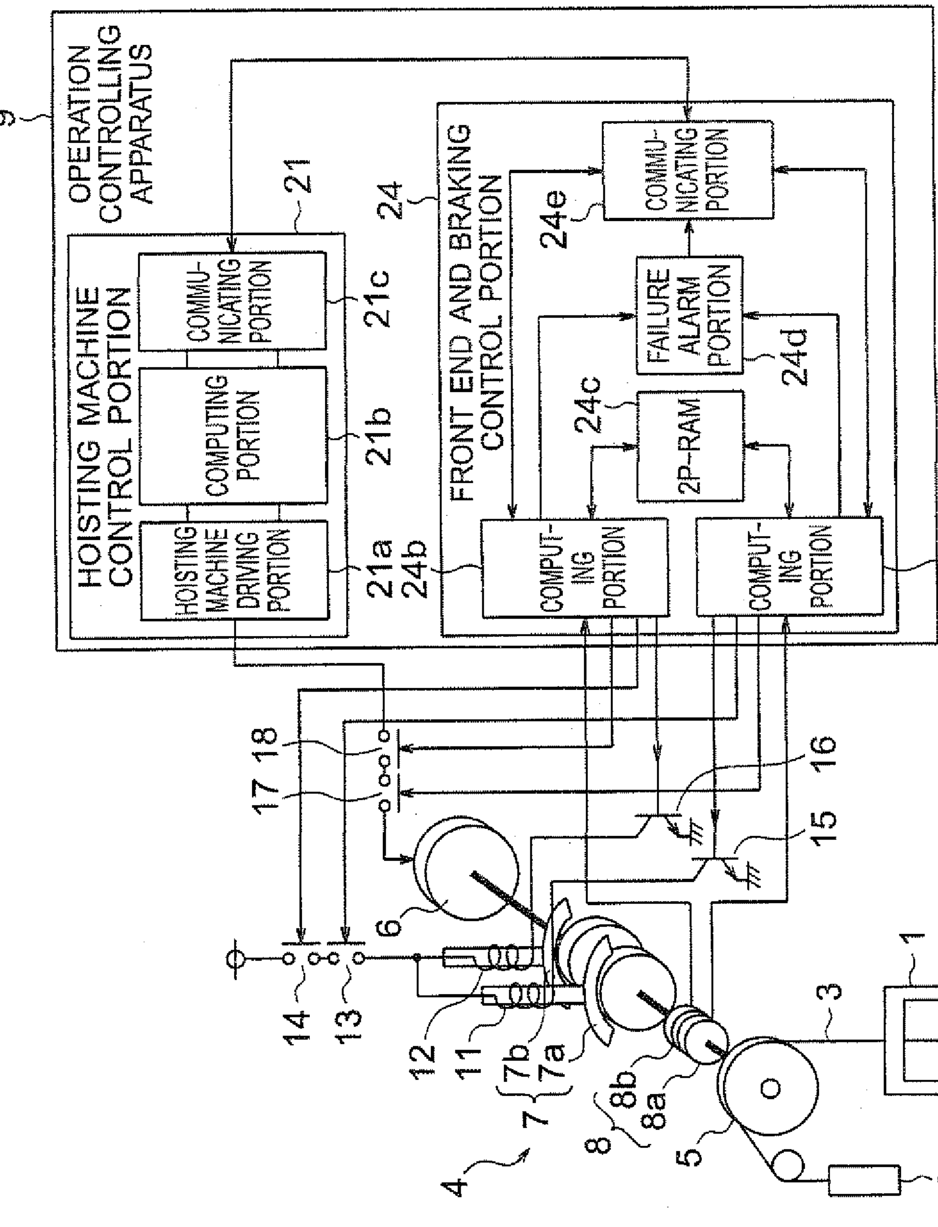

9
OPERATION CONTROLLING APPARATUS
21
HOISTING MACHINE CONTROL PORTION
HOISTING MACHINE DRIVING PORTION
COMPUTING PORTION
COMMU-NICATING PORTION
21a
21b
21c
24
FRONT END AND BRAKING CONTROL PORTION
COMPUT-ING PORTION
COMPUT-ING PORTION
2P-RAM
FAILURE ALARM PORTION
COMMU-NICATING PORTION
24a
24b
24c
24d
24e
1
2
3
4
5
6
7
7a
7b
8
8a
8b
11
12
13
14
15
16
17
18

FIG. 7

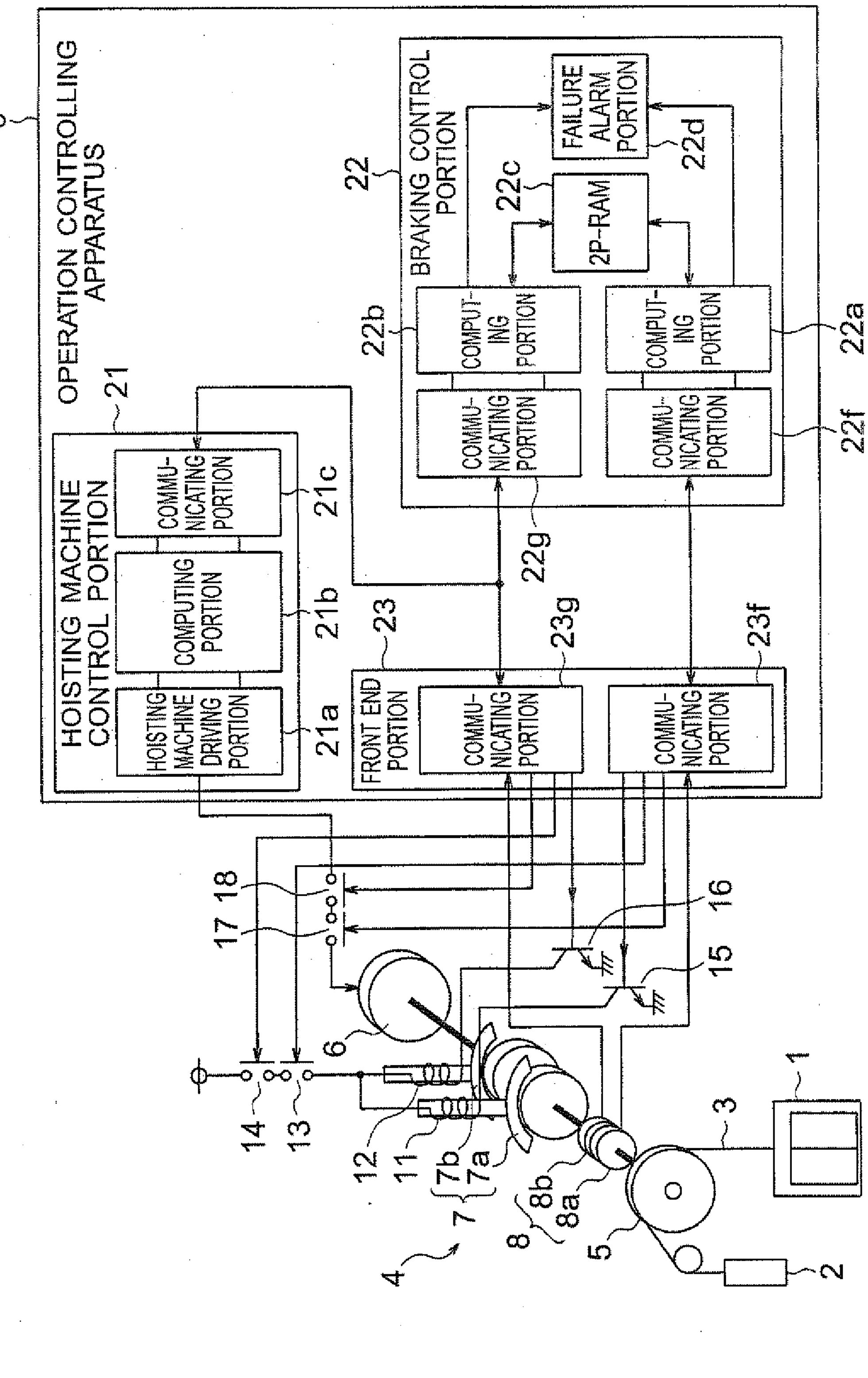
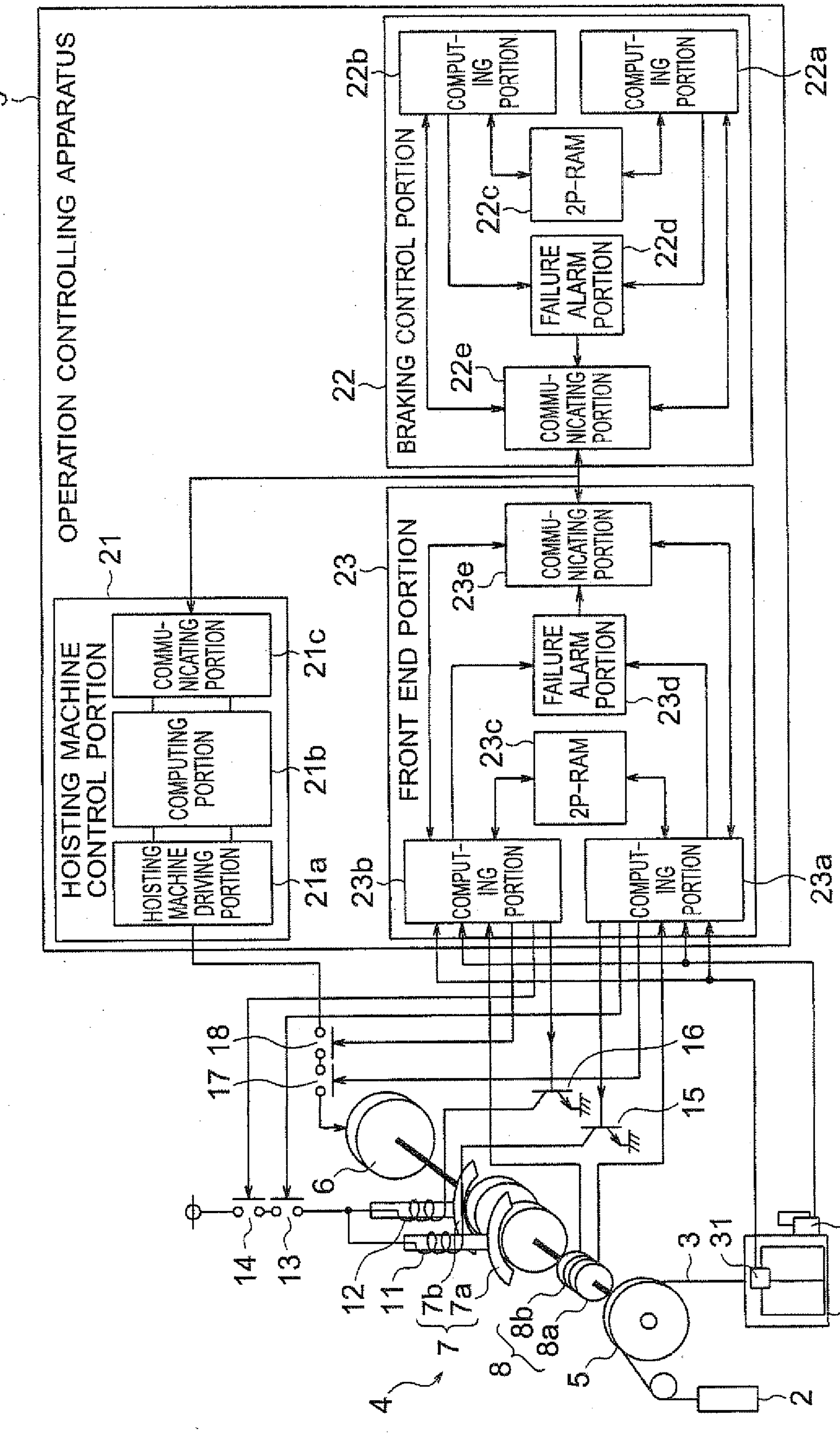

9
OPERATION CONTROLLING APPARATUS
21
HOISTING MACHINE CONTROL PORTION
HOISTING MACHINE DRIVING PORTION
21a
COMPUTING PORTION
21b
COMMU-NICATING PORTION
21c
22
BRAKING CONTROL PORTION
COMMU-NICATING PORTION
COMPUT-ING PORTION
22b
2P-RAM
22c
FAILURE ALARM PORTION
22d
COMMU-NICATING PORTION
22f
COMPUT-ING PORTION
22a
22g
23
FRONT END PORTION
COMMU-NICATING PORTION
23g
COMMU-NICATING PORTION
23f
17 18
16
15
14
13
12
11
6
7b
7a
7
8b
8a
8
5
4
3
1
2

FIG. 8


OPERATION CONTROLLING APPARATUS
HOISTING MACHINE CONTROL PORTION
HOISTING MACHINE DRIVING PORTION
COMPUTING PORTION
COMMU-NICATING PORTION
FRONT END PORTION
COMPUT-ING PORTION
2P-RAM
FAILURE ALARM PORTION
COMMU-NICATING PORTION
BRAKING CONTROL PORTION
COMPUT-ING PORTION
2P-RAM
FAILURE ALARM PORTION
COMMU-NICATING PORTION
9
21
21a
21b
21c
22
22a
22b
22c
22d
22e
23
23a
23b
23c
23d
23e
1
2
3
4
5
6
7
7a
7b
8
8a
8b
11
12
13
14
15
16
17
18
31
32

REFERENCES CITED IN THE DESCRIPTION

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- EP 2048104 A1 **[0005]**