(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 921 038 A1

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

(43) Date of publication:
14.05.2008 Bulletin 2008/20

(21) Application number: **05776101.7**

(22) Date of filing: **31.08.2005**

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

(86) International application number:
PCT/JP2005/015872

(87) International publication number:
WO 2007/026416 (08.03.2007 Gazette 2007/10)

(84) Designated Contracting States:
DE ES FR NL PT

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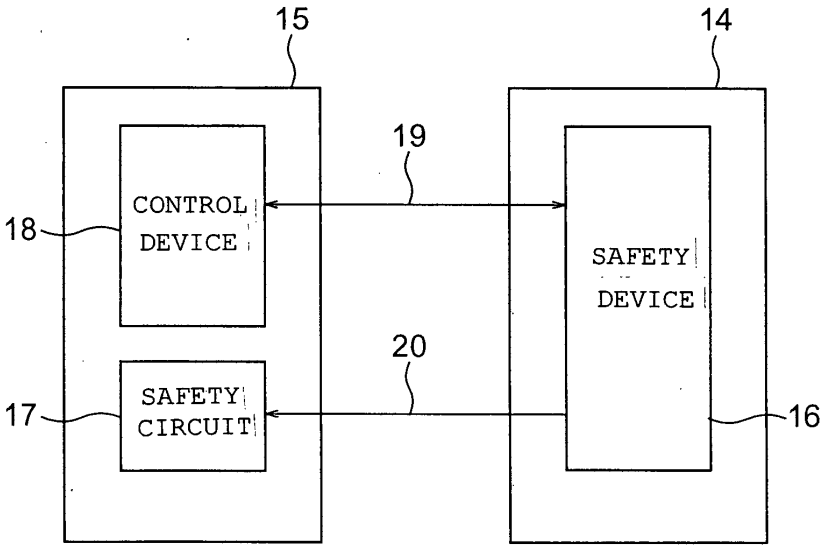
(54) CONTROL SYSTEM FOR ELEVATOR

(57) In a hoistway, an electronic safety device and a control device are installed. The electronic safety device determines presence or absence of an abnormality in an elevator and, when receiving a predetermined confirmation request signal, outputs a confirmation response signal. The control device outputs the confirmation request signal to the electronic safety device during an operation of the elevator and detects presence or absence of reception of the confirmation response signal from the electronic safety device, thereby determining presence or absence of an abnormality in an electric connection with the electronic safety device. Based on the determination on the presence or absence of the abnormality in the elevator and the determination on the presence or absence of the abnormality in the electric connection, the control device controls the operation of the elevator.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to an elevator control system, including an electronic safety device for determining presence or absence of an abnormality in an elevator and a control device for controlling an operation of the elevator based on information from the electronic safety device.

Background Art

[0002] Conventionally, in order to monitor a state of an elevator, there has been proposed a safety chain for an elevator device, for performing wireless communication between each equipment of the elevator and the control device. A base transceiver is electrically connected to the control device, and a transceiver is electrically connected to each equipment. A token is outputted from the base transceiver. The token outputted from the base transceiver is passed onto the transceiver of each equipment in succession and then returns to the base transceiver. In a case of a breakdown of any of the equipment, the token is blocked by the broken device, so the token does not return to the base transceiver. In this case, the operation of the elevator is stopped by the control device (see Patent Document 1).

[0003] Patent Document 1: JP 2003-40543 A

Disclosure of the Invention

Problem to be solved by the Invention

[0004] As described above, for the conventional elevator, as a system for enhancing performance thereof, there has been proposed a system for monitoring a state of the elevator by wireless communication. Accordingly, in a case where a safety device for monitoring the state of the elevator is individually installed, in order to enhance the performance, the device can be provided as an electronic safety device for electrically determining presence or absence of an abnormality in the elevator and transmitting information to the control device.

[0005] In this case, for example, when the electronic safety device suffers a breakdown, for repair, it is required to remove the electronic safety device from the control device. Usually, in a state where the electronic safety device is removed from the control device, the operation of the elevator is not performed. However, in the conventional elevator, even when the electronic safety device is kept removed from the control device, by performing a short-circuiting treatment, it is possible to easily perform a normal operation of the elevator. Thus, in this case, the electronic safety device does not function at the time of normal operation, so soundness of the operation of the elevator decreases.

[0006] The present invention has been made to solve the above-mentioned problem, and it is therefore an object of the present invention to obtain an elevator control system, capable of more reliably preventing a normal operation of the elevator from being continued while an electronic safety device is kept electrically disconnected from a control device.

Means for solving the Problem

[0007] An elevator control system according to the present invention includes: an electronic safety device for determining presence or absence of an abnormality in an elevator and outputting a confirmation response signal when the electronic safety device receives a predetermined confirmation request signal; and a control device, which outputs the confirmation request signal to the electronic safety device during an operation of the elevator and detects presence or absence of reception of the confirmation response signal from the electronic safety device to determine presence or absence of an abnormality in an electrical connection with the electronic safety device, for controlling the operation of the elevator based on the determination on the presence or absence of the abnormality in the elevator and the determination on the presence or absence of the abnormality in the electrical connection.

Brief Description of the Drawings

[0008]

Fig. 1 is a structural view showing an elevator according to Embodiment 1 of the present invention.
Fig. 2 is a structural view of the electronic safety device and the control device of Fig. 1.
Fig. 3 is a flow chart showing the connection confirmation operation of the control device CPU of Fig. 2.

Best Modes for carrying out the Invention

[0009] Hereinafter, preferred embodiments of the present invention will be described with reference to the drawings.

Embodiment 1

[0010] Fig. 1 is a structural view showing an elevator according to Embodiment 1 of the present invention. In the figure, in a hoistway 1, there are provided a car 2 and a counterweight 3. In an upper portion of the hoistway 1, there are provided a hoisting machine (drive device) 4 for raising and lowering the car 2 and the counterweight 3 and a deflector sheave 5 arranged in the vicinity of the hoisting machine 4. The hoisting machine 4 has a hoisting machine main body 6 including a motor and a drive sheave 7 rotated by the hoisting machine main body 6.

[0011] A plurality of main ropes 8 are looped around the drive sheave 7. The car 2 and the counterweight 3

are suspended in the hoistway 1 by the main ropes 8. The car 2 and the counterweight 3 are raised and lowered in the hoistway 1 by rotation of the drive sheave 7.

[0012] In the upper portion of the hoistway 1, there is provided a governor sheave 9 and in a lower portion of the hoistway 1, there is provided a tension pulley 10. A governor rope 11 moved together with the car 2 is looped around the governor sheave 9 and the tension pulley 10. Therefore, the governor sheave 9 and the tension pulley 10 are rotated when the car 2 moves.

[0013] The governor sheave 9 is provided with an encoder (detection sensor) 12 for generating a signal corresponding to the rotation of the governor sheave 9. In the hoistway 1, there are separately provided an electronic safety device 14 and a control device 15.

[0014] Fig. 2 is a structural view of the electronic safety device 14 and the control device 15 of Fig. 1. In the figure, each of the electronic safety device 14 and the control device 15 is individually mounted on a support base in the hoistway 1. The electronic safety device 14 and the control device 15 are mounted in the hoistway 1, respectively, thereby being electrically connected to each other through a communication line 19.

[0015] The electronic safety device 14 includes a safety device CPU (safety device processing portion) 16 for determining presence or absence of the abnormality in the elevator. Further, the control device 15 includes a safety circuit 17 for stopping the operation of the elevator when the abnormality in the elevator occurs and a control device CPU (control device processing portion) 18 for controlling the operation of the eleavtor.

[0016] The safety device CPU 16 performs the determination of presence or absence of the abnormality in the elevator (determination of presence or absence of an abnormality of the electronic safety device 14 itself, presence or absence of an abnormality of a speed of the car 2, and the like) based on information from various detection sensors such as the encoder 12. Further, when the safety device CPU 16 performs the determination that the abnormality in the elevator does not occur and the state of the elevator is normal (state normality determination), the safety device CPU 16 turns on an internal circuit to output a normal signal 20 to the safety circuit 17. Further, when the safety device CPU 16 performs the determination that the abnormality in the elevator occurs (state abnormality determination), the safety device CPU 16 turns off the internal circuit to stop the output of the normal signal 20.

[0017] When the normal signal 20 from the safety device CPU 16 is inputted to the safety circuit 17, the safety circuit 17 is not actuated. When the safety circuit 17 is not actuated, the operation of the elevator is controlled by the control device CPU 18 to be a normal operation. Further, the safety circuit 17 is actuated by stoppage of the input of the normal signal 20 from the safety device CPU 16. As a result, the operation of the elevator is forcedly stopped.

[0018] In order to determine presence or absence of an abnormality of the electrical connection between the electronic safety device 14 and the control device 15, the control device CPU 18 outputs predetermined confirmation request signals (electrical signals) to the safety device CPU 16 through the communication line 19 during the operation of the elevator. The confirmation request signals are outputted at predetermined time intervals.

[0019] When the safety device CPU 16 receives the confirmation request signal from the control device CPU 18, the safety device CPU 16 outputs a confirmation response signal (electrical signal) to the control device CPU 18 through the communication line 19. Each confirmation response signal is outputted from the safety device CPU 16 every time the safety device CPU 16 receives the confirmation request signal.

[0020] When the control device CPU 18 receives the confirmation response signal from the safety device CPU 16 within a predetermined time after the output of the confirmation request signal, the control device CPU 18 performs a determination that there is no abnormality in the electrical connection between the electronic safety device 14 and the control device 15 (connection normality determination). Further, when the control device CPU 18 does not receive the confirmation response signal from the safety device CPU 16 even after the predetermined time from the output of the confirmation request signal, the control device CPU 18 performs a determination that there occurs an abnormality in the electrical connection between the electronic safety device 14 and the control device 15 (connection abnormality determination). That is, based on presence or absence of the reception of the confirmation response signal from the safety device CPU 16, the control device CPU 18 determines whether or not the electrical connection between the electronic safety device 14 and the control device 15 is abnormal.

[0021] When the control device CPU 18 performs the connection normality determination, the control device CPU 18 allows the normal operation of the elevator to be continued. Further, while the control device CPU 18 is performing the connection abnormality determination, the control device CPU 18 stops the operation of the elevator even if the normal signal 20 is inputted to the safety circuit 17. Note that, the elevator control system includes the electronic safety device 14 and the control device 15.

[0022] Next, a connection confirmation operation of the control device CPU 18 for determining presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15 will be explained. Fig. 3 is a flow chart showing the connection confirmation operation of the control device CPU 18 of Fig. 2. As shown in the figure, when the control device CPU 18 determines presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15, the control device CPU 18 outputs the confirmation request signal to the safety device CPU 16 (S1). After that, the control device CPU 18 detects whether or not the control device CPU 18 has received the confirmation re-

sponse signal from the safety device CPU 16 (S2).

[0023] In a case where the control device CPU 18 has received the confirmation response signal from the safety device CPU 16, the control device CPU 18 performs the connection normality determination (S3), and the connection confirmation operation of the control device CPU 18 ends. Further, in a case where the control device CPU 18 has not received the confirmation response signal from the safety device CPU 16, the control device CPU 18 determines whether or not the predetermined time has passed (S4).

[0024] In a case where the predetermined time has not passed, the control device CPU 18 repeats the determination on whether or not the control device CPU 18 has received the confirmation response signal from the safety device CPU 16 until the predetermined time passes. After that, in a case where there is no reception of the confirmation response signal from the safety device CPU 16 even after the predetermined time has passed, the control device CPU 18 performs the connection abnormality determination (S5), and the connection confirmation operation of the control device CPU 18 ends.

[0025] Next, an operation of the elevator control system will be explained. When the operation of the elevator is performed normally, the state normality determination is performed by the safety device CPU 16, and the connection normality determination is performed by the control device CPU 18. At this time, the normal signal 20 from the safety device CPU 16 is inputted to the safety circuit 17, and the operation of the elevator is not stopped.

[0026] When, for example, the speed of the car 2 becomes abnormal and the safety device CPU 16 performs the state abnormality determination, the input of the normal signal 20 to the safety circuit 17 is stopped. As a result, the safety circuit 17 is actuated and the operation of the elevator is forcedly stopped.

[0027] Further, when, for example, the electronic safety device 14 is removed from the support base and the electronic safety device 14 is electrically disconnected from the control device 15, the confirmation response signal outputted from the safety device CPU 16 does not reach the control device CPU 18, so reception of the confirmation response signal by the control device CPU 18 is stopped. As a result, the control device CPU 18 performs the connection abnormality determination, and even when the input of the normal signal 20 to the safety circuit 17 is continued, the operation of the elevator is stopped.

[0028] In the elevator control system as described above, the control device 15 outputs the confirmation request signal to the electronic safety device 14 during the operation of the elevator and determines whether or not the electrical connection with the electronic safety device 14 is abnormal based on presence or absence of the reception of the confirmation response signal from the electronic safety device 14. Therefore, it is possible to determine whether or not the electronic safety device 14 is electrically disconnected from the control device 15 with more reliability. Accordingly, even in a case where the reception of the normal signal 20 by the electronic circuit 17 is forcedly continued by the short-circuiting treatment with respect to the control device 15, it is possible to prevent the normal operation of the elevator from being continued when the electronic safety device 14 is actually disconnected electrically from the control device 14. As a result, it is possible to prevent the normal operation of the elevator during repair of the electronic safety device 14, thereby making it possible to increase the soundness of the operation of the elevator.

[0029] Further, the control device 15 stops the operation of the elevator when the control device 15 determines that the electrical connection with the electronic safety device 14 is abnormal. Therefore, it is possible to further increase the soundness of the operation of the elevator.

Embodiment 2

[0030] Further, in the above-mentioned example, the control device CPU 18 detects presence or absence of the reception of the confirmation response signal from the electronic safety device 14, thereby determining presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15. However, a microswitch (detection device) for detecting attachment/detachment of the electronic safety device 14 may be provided to the support base, to thereby allow the control device CPU 18 to determine the presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15 based on information from the microswitch. That is, the microswitch for detecting the presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15 may be provided to the support base.

[0031] In this case, the microswitch is turned on by coming into contact with the electronic safety device 14 when the electronic safety device 14 is mounted on the support base, and the microswitch is turned off when the electronic safety device 14 is removed from the support base. Further, in the control device CPU 18, when the microswitch is on, it is determined that there is no abnormality in the electrical connection between the electronic safety device 14 and the control device 15, and when the microswitch is off, it is determined that there occurs the abnormality in the electrical connection between the electronic safety device 14 and the control device 15.

[0032] Even in the elevator control system as described above, the control device CPU 18 can determine the presence or absence of the abnormality in the electrical connection between the electronic safety device 14 and the control device 15 based on information from the microswitch, so it is possible to prevent a situation in which the normal operation of the elevator is performed when the electronic safety device 14 is being removed from the support base. Therefore; it is possible to in-

crease the soundness of the operation of the elevator.

Embodiment 3

[0033] Further, in the above-mentioned example, the control device CPU 18 stops the operation of the elevator when performing the connection abnormality determination, but may cause the operation of the elevator during the connection abnormality determination to be a low-speed operation. In this case, regardless of presence or absence of the reception of the normal signal 20 by the electronic circuit 17, the control device CPU 18 causes the operation of the elevator to be the low-speed operation when performing the connection abnormality determination. Further, in the low-speed operation by the control device CPU 18, the speed of the car 2 is made lower than that in the normal operation, that is, a level of speed not interfering the operation of the elevator even when the electronic safety device 14 does not function.

[0034] As described above, when performing the connection abnormality determination, the control device CPU 18 causes the speed of the car 2 to be lower than that in the normal operation, thereby making it possible to prevent the normal operation of the elevator from being continued while the electronic safety device 14 is kept electrically disconnected from the control device 15. Further, it is possible to enhance an operational efficiency of the elevator.

Claims

1. An elevator control system, **characterized by** comprising:

an electronic safety device for determining presence or absence of an abnormality in an elevator and outputting a confirmation response signal when the electronic safety device receives a predetermined confirmation request signal; and
a control device, which outputs the confirmation request signal to the electronic safety device during an operation of the elevator and detects presence or absence of reception of the confirmation response signal from the electronic safety device to determine presence or absence of an abnormality in an electrical connection with the electronic safety device, for controlling the operation of the elevator based on the determination on the presence or absence of the abnormality in the elevator and the determination on the presence or absence of the abnormality in the electrical connection.

2. An elevator control system, **characterized by** comprising:

an electronic safety device for determining presence or absence of an abnormality in an elevator;
a control device electrically connected to the electronic safety device; and
a detection device for detecting presence or absence of an abnormality of an electrical connection between the electronic safety device and the control device,

characterized in that the control device controls an operation of the elevator based on information from each of the electronic safety device and the detection device.

3. An elevator control system according to claim 1 or 2, **characterized in that** the control device stops the operation of the elevator when the control device determines that the electrical connection with the electronic safety device is abnormal.

4. An elevator control system according to claim 1 or 2, **characterized in that** the control device causes the operation of the elevator to be a low-speed operation when the control device determines that the electrical connection with the electronic safety device is abnormal.

FIG. 1

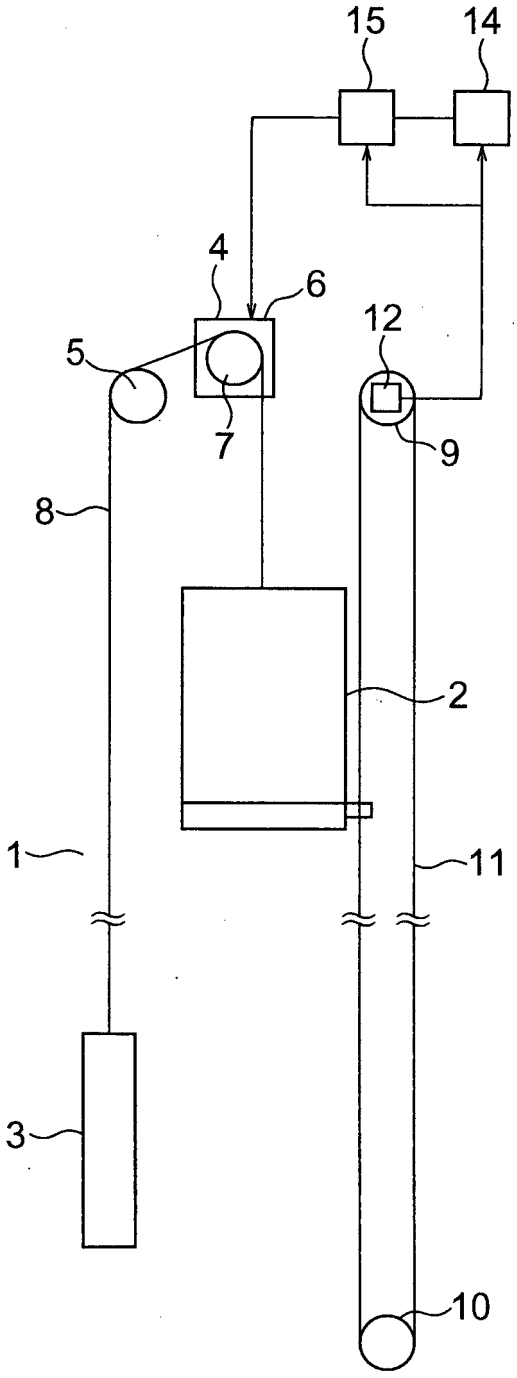


FIG. 2

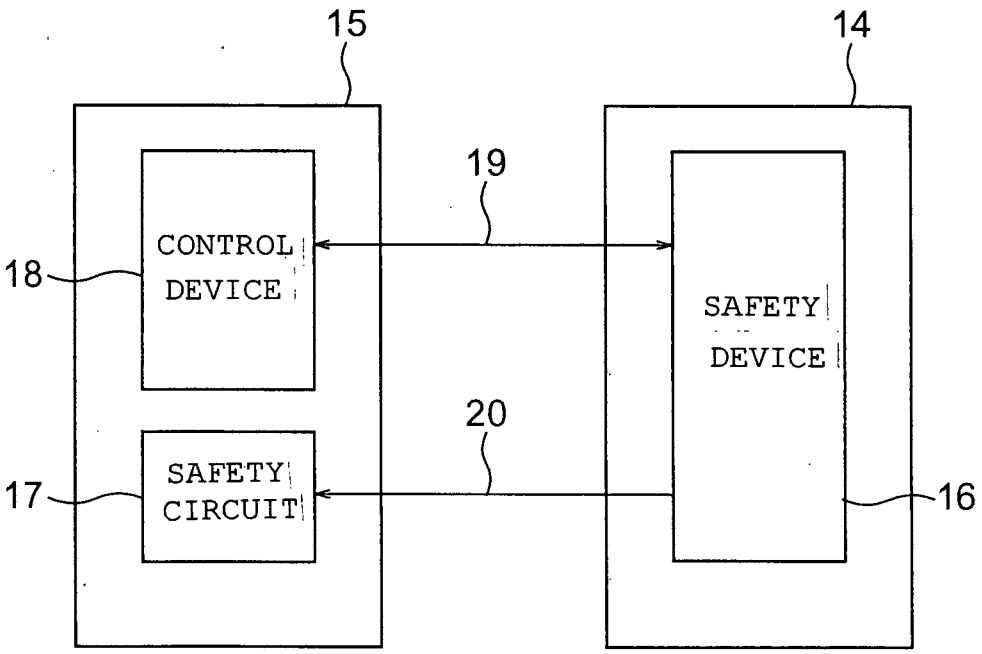
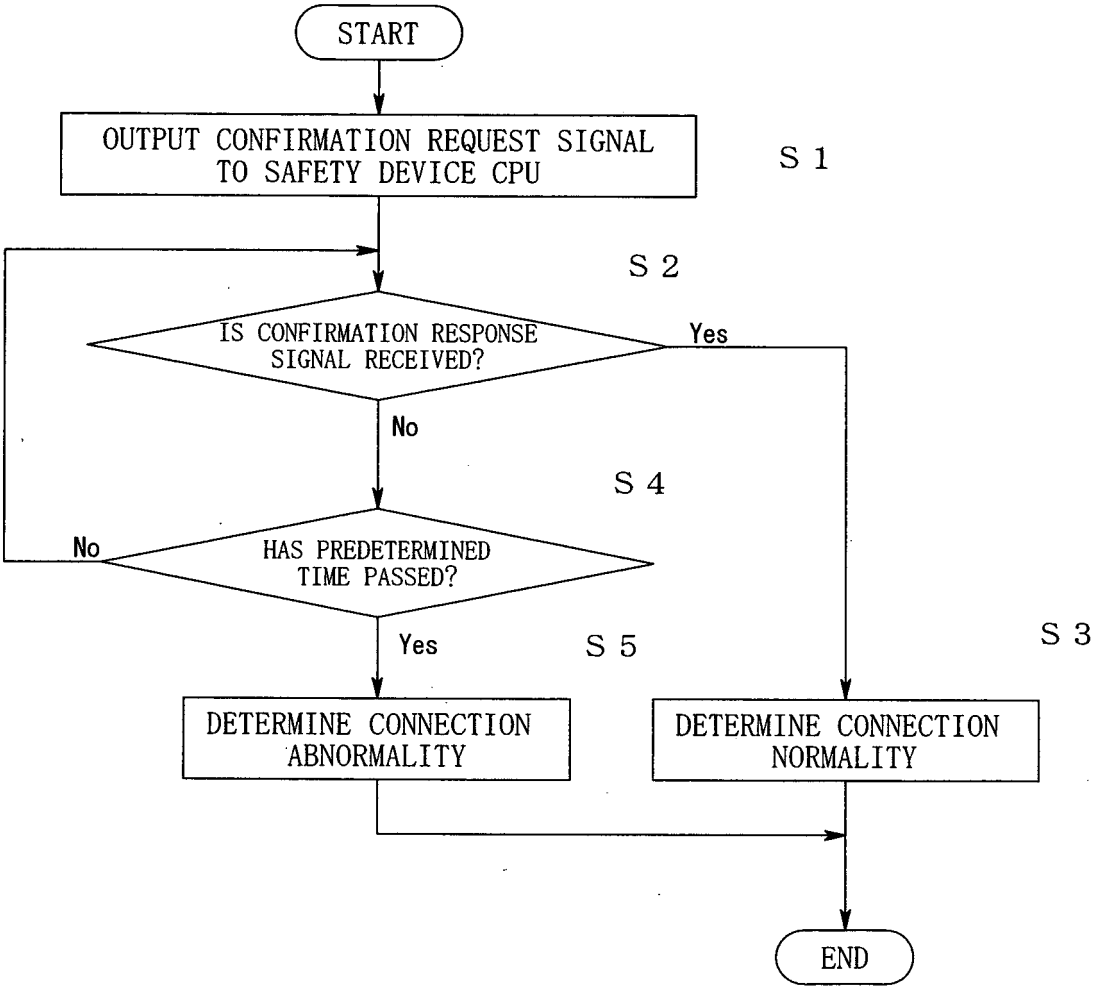

15
14
19
CONTROL DEVICE
18
SAFETY DEVICE
20
SAFETY CIRCUIT
17
16

FIG. 3


START
OUTPUT CONFIRMATION REQUEST SIGNAL TO SAFETY DEVICE CPU
S 1
S 2
IS CONFIRMATION RESPONSE SIGNAL RECEIVED?
Yes
No
S 4
No
HAS PREDETERMINED TIME PASSED?
Yes
S 5
S 3
DETERMINE CONNECTION ABNORMALITY
DETERMINE CONNECTION NORMALITY
END

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/015872

A. CLASSIFICATION OF SUBJECT MATTER
B66B5/02(2006.01)

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)
B66B1/00(2006.01)-***B66B5/28***(2006.01)

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 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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	JP 2002-538061 A (Otis Elevator Co.), 12 November, 2002 (12.11.02), Abstract; Par. Nos.[0031], [0033]; Figs. 1, 3 & WO 00/51929 A1 & US 6173814 B1 & EP 1159218 A & BR 0008623 A & CN 1342129 A	1-4
Y	JP 4-261243 A (Mitsubishi Electric Corp.), 17 September, 1992 (17.09.92), Abstract; Fig. 1 (Family: none)	1-4
Y	JP 2000-177943 A (Toshiba Corp.), 27 June, 2000 (27.06.00), Abstract; Fig. 1 (Family: none)	1-4

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

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"A" document defining the general state of the art which is not considered to be of particular relevance
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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
30 May, 2006 (30.05.06)	06 June, 2006 (06.06.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (April 2005)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/015872

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 57-42470 A (Mitsubishi Electric Corp.), 10 March, 1982 (10.03.82), Claim 1 (Family: none)	3-4
A	JP 2003-104648 A (Mitsubishi Electric Corp.), 09 April, 2003 (09.04.03), Par. Nos. [0027] to [0029]; Figs. 7 to 10 & WO 03/029123 A1 & EP 1431229 A1 & US 2004/0200671 A1 & CN 1558864 A	1-2

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2003040543 A **[0003]**