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

(11) **EP 1 958 911 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

(43) Date of publication:
20.08.2008 Bulletin 2008/34

(21) Application number: **05806280.3**

(22) Date of filing: **14.11.2005**

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

(86) International application number:
PCT/JP2005/020824

(87) International publication number:
WO 2007/055020 (18.05.2007 Gazette 2007/20)

(84) Designated Contracting States:
DE FR NL

(71) Applicant: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

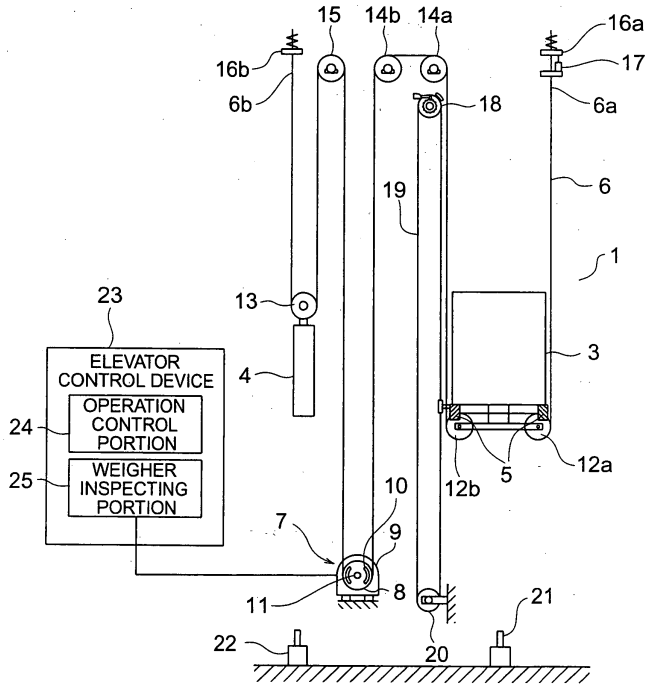
(72) Inventors:
- **OKAMOTO, Ken-Ichi**
  Tokyo 100-8310 (JP)
- **KIGAWA, Hiroshi**
  Tokyo 100-8310 (JP)
- **UEDA, Takaharu**
  Tokyo 100-8310 (JP)

(74) Representative: **Siegert, Georg**
Hoffmann - Eitle
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(54) ELEVATOR DEVICE

(57) In an elevator apparatus, a signal corresponding to a live load within a car is generated by a weighing device. The weighing device is automatically inspected by a weigher inspecting portion. The weigher inspecting portion issues a command to perform a test operation of the car, and detects an abnormality in the weighing device based on a signal output from the weighing device through the test operation.

FIG. 1



EP 1 958 911 A1

Description

Technical Field

[0001] The present invention relates to an elevator apparatus having a weighing device for generating a signal corresponding to a live load within a car.

Background Art

[0002] In a conventional method of inspecting an elevator weighing device, an inspector fits an acceleration sensor on a car, and then gets into the car to cause oscillation thereof. When an overload signal is output from the weighing device, the inspector checks an output of the acceleration sensor to determine whether or not there is an abnormality in the weighing device (see, e.g., Patent Document 1).

[0003] Patent Document 1: JP 09-272669 A

Disclosure of the Invention

Problem to be solved by the Invention

[0004] In the conventional method of inspecting the weighing device as described above, the inspector is required to fit the acceleration sensor on the car and get into the car at the time of inspection. Therefore, the operating efficiency in conducting inspection is low.

[0005] The present invention has been made to solve the above-mentioned problem, and it is therefore an obj ect of the present invention to obtain an elevator apparatus that makes it possible to enhance the efficiency in inspecting a weighing device.

Means for Solving the Problem

[0006] An elevator apparatus according to the present invention includes: a car; a weighing device for generating a signal corresponding to a live load within the car; and a weigher inspecting portion for issuing a command to perform a test operation of the car and detecting an abnormality in the weighing device based on a signal output from the weighing device through the test operation.

Brief Description of the Drawings

[0007]

Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 of the present invention.

Fig. 2 is a block diagram showing the configuration of an elevator control device of Fig. 1.

Fig. 3 is a graph showing an example of changes in a position of a car and a speed of the car with time during a test operation performed by a weigher inspecting portion of Fig. 1.

Fig. 4 is a graph showing an example of changes in an acceleration of the car with the time during the test operation performed by the weigher inspecting portion of Fig. 1.

Best Mode for Carrying Out the Invention

[0008] A preferred embodiment of the present invention will be described hereinafter with reference to the drawings.

Embodiment 1

[0009] Fig. 1 is a schematic diagram showing an elevator apparatus according to Embodiment 1 of the present invention. Referring to the figure, a pair of car guide rails (not shown) and a pair of counterweight guide rails (not shown) are installed within a hoistway 1. A car 3 is raised/lowered within the hoistway 1 while being guided by the car guide rails. A counterweight 4 is raised/lowered within the hoistway 1 while being guided by the counterweight guide rails.

[0010] An emergency stop device 5 for engaging the car guide rails to stop the car 3 as an emergency measure is mounted on a lower portion of the car 3. The emergency stop device 5 has a pair of braking strips, which are actuated through a mechanical operation to be pressed against the car guide rails, respectively.

[0011] A drive device (hoisting machine) 7 for raising/lowering the car 3 and the counterweight 4 via a main rope 6 is installed in a lower portion within the hoistway 1. The drive device 7 has a drive sheave 8, a motor portion 9 for rotating the drive sheave 8, a brake portion 10 for braking rotation of the drive sheave 8, and a motor encoder 11 for generating a detection signal corresponding to rotation of the drive sheave 8.

[0012] Employed as the brake portion 10 is, for example, an electromagnetic brake device. In the electromagnetic brake device, a brake shoe is pressed against a braking surface due to a spring force of a brake spring, so rotation of the drive sheave 8 is braked. Also, the brake shoe is opened away from the braking surface through excitation of an electromagnet, so braking is released.

[0013] A pair of car suspending pulleys 12a and 12b are provided on the lower portion of the car 3. A counterweight suspending pulley 13 is provided on an upper portion of the counterweight 4. Car-side return pulleys 14a and 14b and a counterweight-side return pulley 15 are disposed in an upper portion of the hoistway 1. A first cleat portion 16a and a second cleat portion 16b are fixed to the upper portion of the hoistway 1. The main rope 6 has a first end 6a and a second end 6b, which are connected to the cleat portions 16a and 16b, respectively.

[0014] The main rope 6 is sequentially looped around the car suspending pulleys 12a and 12b, the car-side return pulleys 14a and 14b, the drive sheave 8, the counterweight-side return pulley 15, and the counterweight

suspending pulley 13 from the first end 6a side. That is, in this example, the car 3 and the counterweight 4 are suspended within the hoistway 1 according to a 2:1 roping method.

[0015] The first cleat portion 16a is provided with a weighing device 17 for generating a signal corresponding to a live load within the car 3. A shackle spring, which is expanded/contracted as a result of a change in the live load within the car 3, is provided between the first end 6a and the cleat portion 16a. The weighing device 17 outputs a signal in accordance with expansion/contraction of the shackle spring or displacement of the first end 6a.

[0016] A speed governor 18 is installed in the upper portion of the hoistway 1. The speed governor 18 is provided with a speed governor sheave, an overspeed detecting switch, a rope catch, and the like. A speed governor rope 19 is looped around the speed governor sheave. The speed governor rope 19 is connected at both ends thereof to an operating mechanism of the emergency stop device 5. The lower end of the speed governor rope 19 is looped around a tension pulley 20, which is disposed in the lower portion of the hoistway 1.

[0017] When the car 3 is raised/lowered, the speed governor rope 19 is circulated, so the speed governor sheave is rotated at a rotational speed corresponding to a running speed of the car 3. In the speed governor 18, it is mechanically detected that the running speed of the car 3 has reached overspeeds. A first overspeed higher than a rated speed and a second overspeed higher than the first overspeed are set as the overspeeds to be detected.

[0018] When the running speed of the car 3 reaches the first overspeed, the overspeed detecting switch of the speed governor 18 is operated. When the overspeed detecting switch is operated, the power supplied to the motor portion 9 is shut off, and rotation of the drive sheave 8 is braked by the brake portion 10. As a result, the car 3 is stopped as an emergency measure. When the running speed of the car 3 reaches the second overspeed, the speed governor rope. 19 is gripped by the rope catch of the speed governor 18. As a result, the speed governor rope 19 is stopped from being circulated. When the speed governor rope 19 is stopped from being circulated, the emergency stop device 5 is operated to perform braking operation.

[0019] A car shock absorber 21 and a counterweight shock absorber 22 are installed in the lower portion within the hoistway 1. The car shock absorber 21, which is disposed directly below the car 3, absorbs a shock caused upon a collision of the car 3 with a bottom portion of the hoistway 1. The counterweight shock absorber 22, which is disposed directly below the counterweight 4, absorbs a shock caused upon a collision of the counterweight 4 with the bottom portion of the hoistway 1.

[0020] The travel of the elevator apparatus is controlled by an elevator control device 23. The elevator control device 23 has an operation control portion 24 for controlling the operation of the drive device 7, and a weigher inspecting portion 25 for detecting an abnormality in the weighing device 17. The weigher inspecting portion 25 issues a command to perform a test operation of the car 3, and detects an abnormality in the weighing device 17 based on a signal output from the weighing device 17 through the test operation.

[0021] Fig. 2 is a block diagram showing the configuration of the elevator control device 23 of Fig. 1. The elevator control device 23 is constituted by a computer having a CPU (calculation processing portion) 26, a memory (ROM, RAM, and the like) 27, an input portion 28 to which external signals including a weighing device signal are input, and an output portion 29 from which a signal is output to the outside. That is, the functions of the operation control portion 24 and the weigher inspecting portion 25 are realized by the computer. Programs for realizing the functions of the operation control portion 24 and the weigher inspecting portion 25 are stored in the memory 27. The CPU 26 performs calculation processings regarding the functions of the operation control portion 24 and the weigher inspecting portion 25 based on the programs.

[0022] Next, a method of inspecting the weighing device 17 will be described. In initializing the elevator apparatus, a signal from the weighing device 17 at the time of a sudden stop of the car 3 is confirmed to inspect whether or not the weighing device 17 is normal. More specifically, after the brake portion 10 has been released with the weights of the car 3 and the counterweight 4 unbalanced with each other so as to accelerate the car 3, the brake portion 10 is caused to perform braking operation to make a sudden stop of the car 3. It is then checked whether or not a value of the weighing device signal during acceleration resulting from the unbalanced state and an oscillation frequency of the weighing device signal after the sudden stop are appropriate. In carrying out this check, an acceleration determined by the weight of an entire system and the amount of unbalance of the car 3, an oscillation frequency determined by a composition of a rope system and the weights of the car 3 and the counterweight 4, and the like are used.

[0023] When it is determined that the weighing device 17 is normal during inspection at the time of initialization as described above, data such as an output waveform of the weighing device signal at that time or a characteristic quantity thereof (bias value corresponding to an unbalance acceleration or an oscillation frequency after the stop) and the like are saved in the memory 27.

[0024] In inspecting the weighing device 17 after the elevator apparatus has been operated, a command to perform the test operation of the car 3 is issued from the weigher inspecting portion 25 when there is no passenger within the car 3, for example, at night. The test operation performed in this case is similar to the operation performed during inspection at the time of initialization. In the weigher inspecting portion 25, after the test operation has been performed, the output waveform saved

in the memory 27 or the characteristic quantity thereof is compared with an output waveform of a signal output from the weighing device 17 through the test operation or a characteristic quantity thereof. When a difference between both the values is within a predetermined range, it is determined that the weighing device 17 is normal. When the difference between both the values is outside the predetermined range, it is determined that the weighing device 17 is abnormal. When an abnormality in the weighing device 17 is detected, an error signal is output from the weigher inspecting portion 25. Then, measures are taken to inform an elevator supervising room, stop the operation of the elevator apparatus, etc.

[0025] Fig. 3 is a graph showing an example of changes in the position of the car and the speed of the car with time during the test operation performed by the weigher inspecting portion 25 of Fig. 1. Fig. 4 is a graph showing an example of changes in the acceleration of the car with time during the test operation performed by the weigher inspecting portion 25 of Fig. 1. When the test operation is performed with the aid of the unbalance acceleration as described above, the car 3 behaves as shown in Fig. 3. Thus, when the weighing device 17 is normal, a signal as shown in Fig. 4 is output from the weighing device 17. From this signal, the value of the weighing device signal during acceleration resulting from the unbalanced state and the weight of the car, which is estimated from the oscillation frequency of the weighing device signal after the sudden stop, are compared with the data at the time of initialization.

[0026] The inspection of the weighing device 17 as described above is automatically conducted at preset timings or on a preset cycle. That is, the elevator control device 23 has control modes including an automatic inspection mode for automatically inspecting the weighing device 17.

Alternatively, the inspection of the weighing device 17 may be started in response to reception of an inspection command signal from an external device, for example, a remote supervision board, or the like.

[0027] In the elevator apparatus constructed as described above, the weigher inspecting portion 25 issues a command to perform a test operation of the car 3, and automatically detects an abnormality in the weighing device 17 based on a signal output from the weighing device 17 through the test operation. Therefore, the efficiency in inspecting the weighing device 17 can be enhanced.

[0028] Further, the weigher inspecting portion 25 performs the test operation with the aid of the unbalance acceleration of the car 3. Therefore, the test operation of the car 3 can be performed easily without the aid of manpower.

Furthermore, the weigher inspecting portion 25 causes oscillations in the car 3 as the test operation of the car 3, and detects an abnormality in the weighing device 17 based on a weight of the car 3, which is estimated from a time-series waveform of a signal from the weighing device 17. Therefore, the presence or absence of an abnormality in the weighing device 17 can be confirmed by the simple test operation, so the weighing device 17 can be inspected in a short period of time.

Still further, the weigher inspecting portion 25 compares the data acquired from the weighing device 17 through the test operation of the car 3 with the data saved at the time of initialization to detect an abnormality in the weighing device 17. Therefore, an operation of inputting data or the like with the aid of manpower is not required in inspecting the weighing device 17, so the inspection can be conducted with ease.

[0029] The test operation of the car 3 is not limited to the foregoing examples. For example, it is also appropriate to make a shift to the automatic inspection mode with no passenger within the car 3, cause the car 3 to run normally throughout a preset section, and compare a weight of the car, which is estimated from signals from the weighing device 17 during acceleration and deceleration, with the data saved at the time of initialization.

[0030] Further, the weighing device or an arithmetic circuit for processing a signal from the weighing device may be configured as a dual system. The present invention is applicable in this case as well.

Furthermore, the data saved at the time of initialization, which serve as a comparison criterion, may be updated through an inspection similar to the inspection during initialization when an operation such as periodic inspection using manpower is performed. Thus, erroneous detection of an abnormality in the weighing device can be prevented from being caused due to a secular change such as elongation of the main rope 6.

Still further, the method of detecting the weighing device is not limited in particular as long as the output therefrom continuously changes in response to changes in the load within the car 3.

Further, the place where the weighing device is installed is not limited in particular either. For example, the weighing device may be provided on the lower portion of the car, the drive device, the return pulley, or the like. If the elevator apparatus is designed such that the end of the main rope is connected to the car, the weighing device may be provided at that portion of the main rope which is connected to the car.

Claims

1. An elevator apparatus, comprising:

a car;
a weighing device for generating a signal corresponding to a live load within the car; and
a weigher inspecting portion for issuing a command to perform a test operation of the car and detecting an abnormality in the weighing device based on a signal output from the weighing device through the test operation.

2. The elevator apparatus according to Claim 1, further comprising an elevator control device for controlling operation of the car,
wherein the elevator control device has control modes including an automatic inspection mode for automatically inspecting the weighing device by means of the weigher inspecting portion.

3. The elevator apparatus according to Claim 1, wherein the weigher inspecting portion starts inspecting the weighing device in response to reception of an inspection command signal from an external device.

4. The elevator apparatus according to Claim 1, further comprising:

a drive device having a drive sheave, a motor portion for rotating the drive sheave, and a brake portion for braking rotation of the drive sheave, for raising/lowering the car;
a main rope looped around the drive sheave, for suspending the car; and
a counterweight suspended by the main rope,

wherein the weigher inspecting portion releases the brake portion with weights of the car and the counterweight unbalanced with each other to accelerate the car, and then causes the brake portion to perform braking operation to make a sudden stop of the car, as the test operation of the car.

5. The elevator apparatus according to Claim 1, wherein the weigher inspecting portion causes oscillations in the car as the test operation of the car, and detects an abnormality in the weighing device based on a weight of the car, which is estimated from a time-series waveform of a signal from the weighing device.

6. The elevator apparatus according to Claim 1, wherein:

the weigher inspecting portion can save therein data on the weighing device obtained when an operation similar to the test operation of the car is performed during initialization; and
the weigher inspecting portion compares data acquired from the weighing device through the test operation of the car with the data saved during initialization to detect an abnormality in the weighing device.

FIG. 1

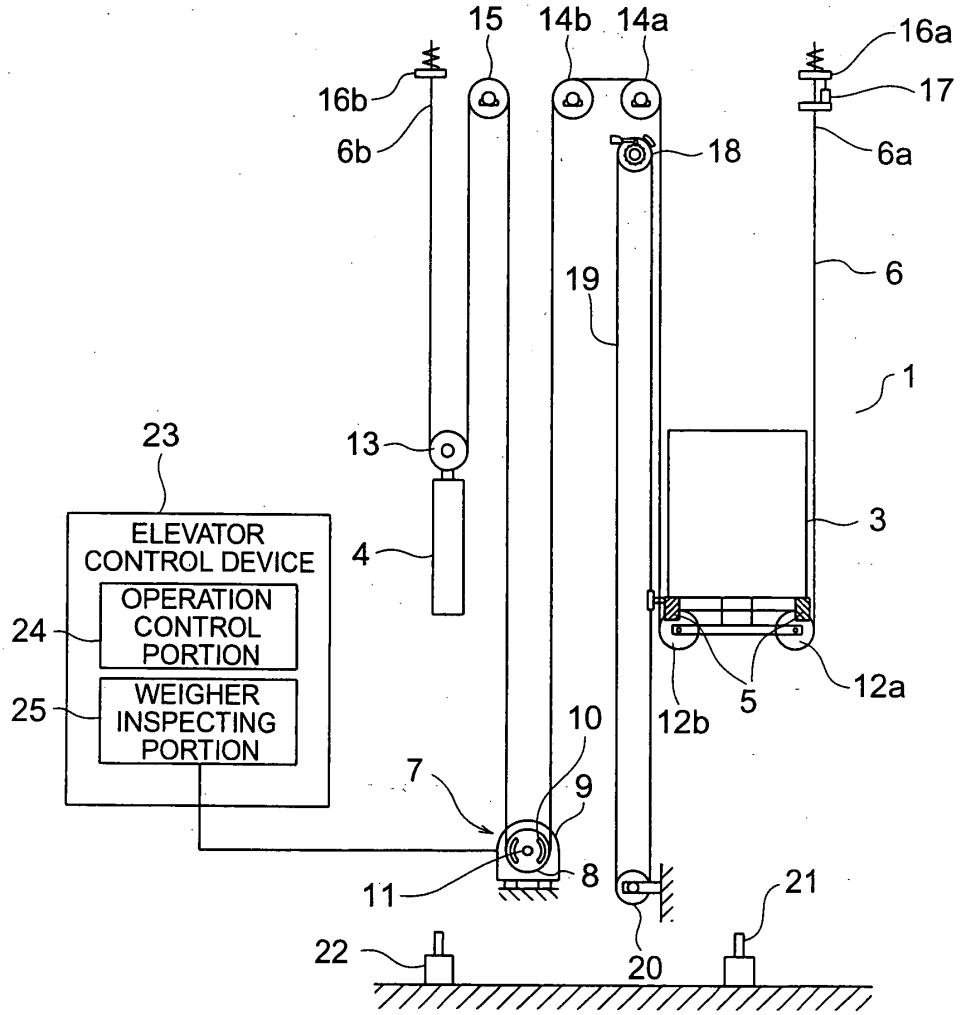

15
14b
14a
16a
16b
17
6b
18
6a
19
6
1
23
13
3
4
ELEVATOR CONTROL DEVICE
OPERATION CONTROL PORTION
24
WEIGHER INSPECTING PORTION
25
12a
5
12b
10
7
9
8
11
21
22
20

FIG. 2

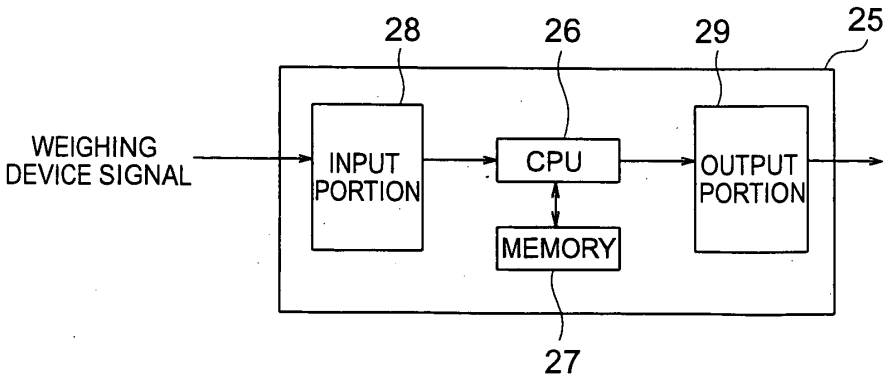

28
26
29
25
WEIGHING DEVICE SIGNAL
INPUT PORTION
CPU
OUTPUT PORTION
MEMORY
27

FIG. 3

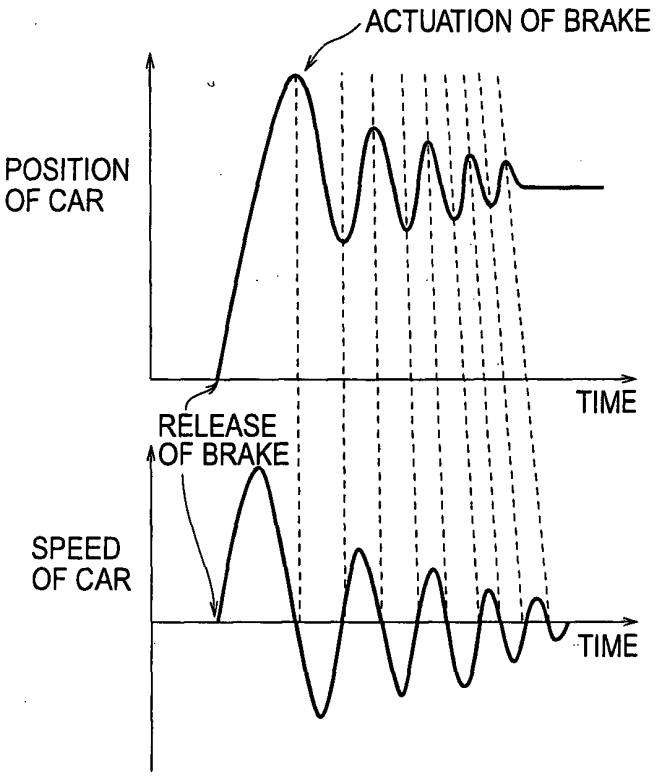
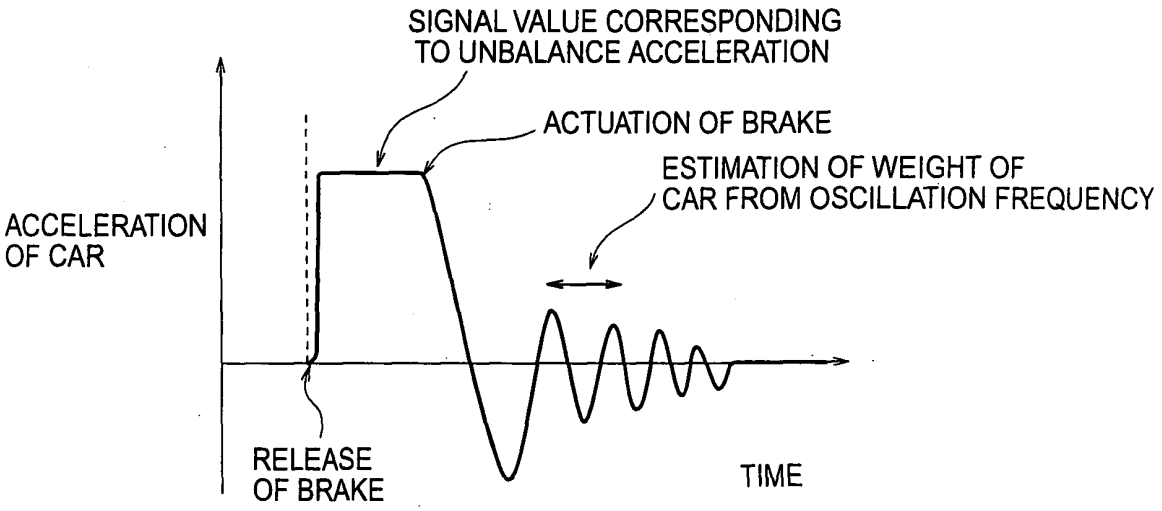

ACTUATION OF BRAKE
POSITION OF CAR
TIME
RELEASE OF BRAKE
SPEED OF CAR
TIME

FIG. 4


SIGNAL VALUE CORRESPONDING TO UNBALANCE ACCELERATION
ACTUATION OF BRAKE
ESTIMATION OF WEIGHT OF CAR FROM OSCILLATION FREQUENCY
ACCELERATION OF CAR
RELEASE OF BRAKE
TIME

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2005/020824

A. CLASSIFICATION OF SUBJECT MATTER
B66B5/00(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B1/00-B66B20/00

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.
X A	JP 06-115846 A (Mitsubishi Electric Corp.), 26 April, 1994 (26.04.94), Claims 1 to 2 (Family: none)	1-3,6 4-5
A	JP 09-002752 A (Kabushiki Kaisha Hitachi Building System Service), 07 January, 1997 (07.01.97), Claims 1 to 9 (Family: none)	1-2,5-6
A	JP 08-012206 A (Mitsubishi Electric Corp.), 16 January, 1996 (16.01.96), Claims 1 to 4 (Family: none)	3-5

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier application or patent but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
09 August, 2006 (09.08.06)	15 August, 2006 (15.08.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 9272669 A **[0003]**