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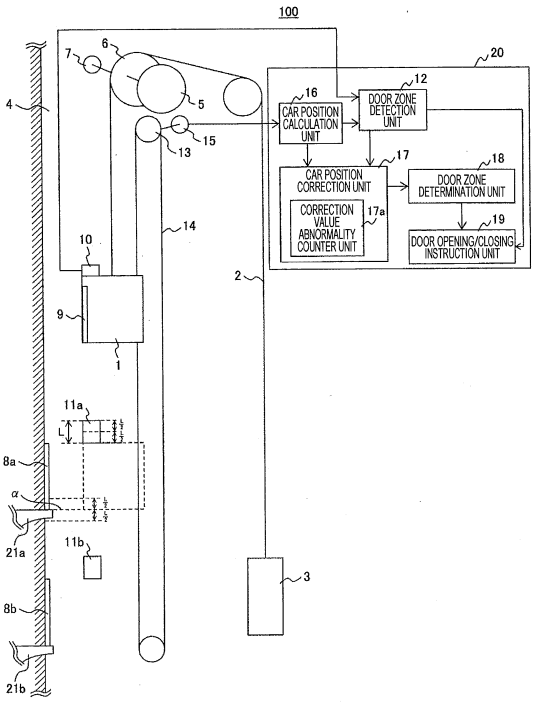
(54) ELEVATOR SYSTEM

(57) Provided is an elevator system capable of determining availability of opening/closing of a car door after determining whether a car is located in a door zone even if a position detection device provided on the car breaks down. An elevator system (100) includes a plate to be detected (11) provided in a hoistway (4), a car position detection device (10) provided on the car (1) and which detects the plate to be detected (11), a car moving amount measurement device (7 or 15) that measures a moving amount of the car, and a control device (20) that controls the aforementioned plate and devices, the control device includes a door zone detection unit (12) that detects a door zone that is an openable/closable region of a door of the car by the car position detection device and a car position calculation unit (16) that calculates a position of the car by the car moving amount measurement device, and determines whether the car is in the door zone on the basis of the position of the car calculated in the car position calculation unit when the car position detection device is determined to have broken down.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to an elevator system.

Background Art

[0002] In a conventional elevator, a photoelectric position detection device (position detection sensor) is installed on a car, for example, and the position detection device detects a plate to be detected installed in a hoistway corresponding to each floor, thereby to detect an opening/closing permitted (openable/closable) region (door zone) of a door of the car with respect to a door of a landing.

[0003] PTL 1 is an example of an elevator that detects a door zone using a position detection device. PTL 1 discloses an elevator with a safety position sensor for detecting a door zone indicating a region where a passenger can get on and off when a position of a car reaches a lift position where doors of the car and a landing are openable/closable, the elevator including first and second position detection sensors provided on the side of the car, separated by a predetermined distance in a lifting direction, and installed to face the side of the landing, a plate to be detected provided on the side of the landing and disposed such that the door zone is detected by the position detection sensors, and a logic computer to which signals of the first and second position detection sensors are input and which outputs a result of logic operation of the input signals, wherein a logic OR output signal by the logic computer is a signal that has detected the door zone.

Citation List

Patent Literature

[0004] PTL 1: WO 2011/111096

Summary of Invention

Technical Problem

[0005] In the conventional configuration for detecting the door zone by the position detection device provided on the car, when the position detection device performs erroneous detection or breaks down, unsecured safety is determined even if the car is located in the door zone and the doors cannot be opened/closed, and a situation where a passenger is trapped in the car may be caused.

[0006] PTL 1 increases the number of the position detection sensors to two and installs these two sensors separated by a predetermined distance, and uses the logic OR output signals of the signals as door zone detection signals. However, even when two position detection sensors are provided, these sensors are the same photoelectric-type sensors, and thus erroneous detection due to external light or the like may occur at the same time.

[0007] In view of the foregoing, the present invention provides an elevator system capable of determining availability of opening/closing of a car door after determining whether a car is located in a door zone even if a position detection device provided on the car breaks down.

Solution to Problem

[0008] To solve the above problem, the present invention provides an elevator system including a car that moves up and down in a hoistway, a counterweight that moves up and down with the car, a rope having one end connected to the car and the other end connected to the counterweight, and a motor that drives the rope, the elevator system including a plate to be detected provided in the hoistway, a car position detection device provided on the car and which detects the plate to be detected, a car moving amount measurement device that measures a moving amount of the car, and a control device that controls the car position detection device and the car moving amount measurement device, wherein the control device includes a door zone detection unit that detects a door zone that is an openable/closable region of a door of the car with the car position detection device, a car position calculation unit that calculates a position of the car with the car moving amount measurement device, and a door zone determination unit that determines whether the car is located in the door zone on the basis of the position of the car calculated in the car position calculation unit when the car position detection device is determined to have broken down.

Advantageous Effects of Invention

[0009] According to the present invention, provided is an elevator system capable of determining availability of opening/closing of a car door after determining whether a car is located in a door zone even if a position detection device provided on the car breaks down.

[0010] Problems, configurations, and effects other than those described above will be clarified by the description of the embodiment below.

Brief Description of Drawings

[0011]

[FIG. 1] FIG. 1 is a diagram schematically illustrating an example of an elevator system according to the present invention.

[FIG. 2] FIG. 2 is a flowchart illustrating an example of an operation of the elevator system according to the present invention.

Description of Embodiments

Embodiment

[0012] Hereinafter, an embodiment of the present invention will be described in detail with reference to the drawings.

[0013] FIG. 1 is a diagram schematically illustrating an example of an elevator system according to the present invention. As illustrated in FIG. 1, in an elevator system 100 according to the present invention, a car 1 is connected to a counterweight 3 via a rope 2, and moves up and down in a hoistway 4. The movement (up and down) of the car 1 is performed by driving of a sheave 6 by a motor 5. A pulse generator (motor encoder) 7 such as an encoder is attached to the motor 5, and a speed of the motor 5, a position and a moving distance of the car 1, and the like are calculated from pulses generated by rotation of the motor 5. The car 1 is provided with a car door 9 that opens and closes facing a door 8 (8a or 8b) on the side of landing 21 (21a or 21b).

[0014] A governor governor rope 14 is connected to the car 1 and is driven with the car 1. The governor governor rope 14 is wound around a governor 13, and the governor 13 is rotated with the driving of the governor rope 14. A pulse generator (governor encoder) 15 is attached to the governor 13, similarly to the motor 5.

[0015] A car position detection device (position detection sensor) 10 is provided on the car 1, and detects an openable/closable region (door zone) of the car door 9 in the hoistway 4 by detecting a plate to be detected 11 (11a or 11b) installed on a wall of the hoistway 4.

[0016] Here, the "door zone" will be described. The plate to be detected 11 has a predetermined length (a length L in FIG. 1) in a lifting direction of the car 1, and this length L corresponds to a region (door zone) where the car door 9 can be opened. That is, when the car position detection device 10 of the car 1 is located at a position where the plate to be detected 11 is detectable (the range of the length L), a difference between a position of a floor of the car 1 and a position of a floor of the landing 21 is determined to secure sufficient safety for allowing a passenger to get on and off the car 1, and the landing door 8 and the car door 9 are opened and closed.

[0017] For example, in FIG. 1, assuming that the position of the floor of the landing 21a is α when the car 1 is located at the landing 21a, the car door 9 is opened and closed when the floor of the car 1 is located within a range of L/2 above or below α. The plate to be detected 11 is provided in the hoistway 4 to correspond to the door zone on each story.

[0018] In the present invention, the car position detection device 10 provided on the car 1 is not particularly limited. For example, a photoelectric-type, a magnetic-type, or a capacitance-type contactless detection sensor can be used. A detection signal output by the car position detection device 10 is input to a door zone detection unit 12 in a control device 20 and the door zone is detected, a door zone detection signal output from the door zone detection unit 12 is received by a door opening/closing instruction unit 19, and the door opening/closing instruction unit 19 transmits an opening/closing instruction of the door to the car door 9 and the landing door 8.

[0019] Here, in the case where the car position detection device 10 for detecting the door zone erroneously detects the door zone for any reason or breaks down, in a conventional elevator, the car is determined to be located outside the door zone, and the car door is determined not to be openable/closable despite the position of the car located within the door zone, depending on a failure mode. As a result, there is a possibility that the passenger is trapped in the car 1 even in an unnecessary case. In view of the above, the present invention determines whether the car 1 is located in the door zone even when the car position detection device 10 breaks down, and the door opening/closing instruction unit can output an opening/closing permission instruction of the car door. To realize the configuration, in the present invention, a device (hereinafter, referred to as "car moving amount measurement device") capable of detecting the position (absolute position) of the car 1 by measuring a moving amount of the car 1 is used, and when the car position detection device 10 breaks down, whether the car 1 is located within the door zone is determined using the car moving amount measurement device.

[0020] Any device may be used as the car moving amount measurement device as long as the device can detect the position of the car 1. For example, the above-described motor encoder 7 or governor encoder 15 is suitable. Since these pulse generators generate pulses according to a rotation amount of the motor 5 or the governor 13, the position of the car 1 can be calculated from the count of the pulses. The governor encoder 15 is more favorable because a slip amount is smaller than that of the motor encoder 7. The governor encoder 15 is typically used to detect the speed of the car 1, but in the present invention, the governor encoder 15 is used to detect the door zone. The rotation amount (the number of pulses) detected and output by the governor encoder 15 is input to a car position calculation unit 16 of the control device 20, and the position of the car 1 is calculated.

[0021] Next, a procedure for detecting the door zone using the car position detection device 10 and the governor encoder 15 will be described. FIG. 2 is a flowchart illustrating an example of an operation of the elevator system according to the present invention. In the case of using the governor encoder 15 as the car moving amount measurement device, there is a possibility of occurrence of a gap between the actual position of the car 1 and the position of the car 1 calculated by the car position calculation unit 16 due to wear of the governor 13, slipping of the governor rope 14, and the like. Therefore, the position of the plate to be detected 11 is recorded in advance, and it is favorable to adjust the position of the car 1 calculated by the car position calculation unit to the position of the plate to be detected 11 recorded in ad-

vance when there is a difference between the position of the plate to be detected 11 recorded in advance and the position of the car 1 calculated by the car position calculation unit 16, every time the car position detection device 10 detects the plate to be detected 11.

[0022] For example, after the start of an operation of the elevator, positions of all the plates to be detected 11 provided in the hoistway 4 are recorded in advance from values of the pulses of the motor encoder 7 at the time when the car 1 passes through the plates to be detected 11. A car position correction unit 17 corrects the position of the car calculated by the car position calculation unit 16 every time the car position detection device 10 passes through the plate to be detected 11. At this time, it is favorable to make a correction only when a difference between the position of the plate to be detected 11 and the position of the car 1 falls within a predetermined threshold value (hereinafter, a "first threshold value: X (mm)". The car position correction unit 17 includes a correction abnormality counter unit 17a. When the difference exceeds X, the car position correction unit 17 does not correct the position of the car 1 calculated by the car position calculation unit 16, and counts up threshold value excess record in the correction value abnormality counter unit 17a (S1 and S2). S1 and S2 are performed every time the car position detection device 10 detects the plate to be detected 11 during traveling of the elevator.

[0023] At a normal operation of the elevator, the car is stopped at a story registered by car call provided at the landing and a story registered by car call provided in the car. Meanwhile, at an abnormal operation, after an emergency situation is detected, the car 1 is forcibly moved to a closest story and is stopped. In any case, after stop of the car at a certain story is detected ("Yes" in S3), breakdown of the car position detection device is determined (S4). Determination as to whether the car position detection device 10 has broken down can be made in such a manner that travel record of the car 1 (the detection signal of the plate to be detected 11 by the car position detection device 10) and the position of the plate to be detected 11 recorded in advance are compared in the control device 20 after stop of the car, and the determination is performed according to whether the car position detection device 10 generates a signal at a position where no plate to be detected 11 is detected.

[0024] When it is determined that the car position detection device 10 has not broken down in S4 ("No" in S4), the door zone detection unit 12 detects the door zone, and the door opening/closing instruction unit 19 determines that the car door 9 and the landing door 8 are openable/closable and permits opening/closing of the doors (S7).

[0025] On the other hand, when it is determined that the car position detection device 10 has broken down in S4 ("Yes" in S4), the control device 20 determines presence or absence of the count of the correction value abnormality counter unit 17a (S5). When the correction value abnormality counter unit 17a counts correction value abnormality ("No" in S5), the position of the car 1 calculated in the car position calculation unit 16 is considered to be greatly erroneous, and a door zone determination unit 18 determines that the car 1 is located outside the door zone and the door opening/closing instruction unit 9 determines that the doors are not openable/closable (not permitted) (S8).

[0026] When the correction value abnormality counter unit 17a does not count correction value abnormality in S5 ("Yes" in S5), the control device 20 determines whether the current position (at the time of landing) of the car 1 calculated by the car position calculation unit 16 falls within a predetermined threshold value (hereinafter, a "second threshold value: Y (mm)") from a position of a floor of a story where the car 1 is stopped, the position being recorded in advance (S6). When the current position exceeds the threshold value Y, the position of the car 1 calculated by the car position calculation unit 16 is considered to be greatly erroneous, and the door zone determination unit 18 determines that the car 1 is located outside the door zone and the door opening/closing instruction unit 9 determines that the doors are not openable/closable (S8). On the other hand, when the current position of the car 1 falls within the second threshold value Y from the position of the floor of the story where the car 1 is stopped, the door zone determination unit 18 determines that the car 1 is located within the door zone, and the door opening/closing instruction unit 9 determines that the doors are openable/closable and permits opening/closing (S7).

[0027] It is necessary to set the above-described threshold value Y to fall within a range in which a passenger 1 can safely get on and off. For example, the threshold value Y is favorably set equal to or less than a value obtained by subtracting X (mm) from a value of a "prescribed door zone range $\times$ 0.5" (mm). More specifically, Y = $\pm$ 100 mm is favorable, when the door zone range (distance (L)) is 250 mm and X = 20 mm. With the setting, even when the position of the car 1 calculated in the car position calculation unit 16 causes an error of X mm during a period from last correction to when the car 1 is stopped at a stop floor, the car 1 is determined to fall within the range of the door zone, and thus the opening/closing of the doors can be permitted.

[0028] According to the present invention, as described above, even when the car position detection device 10 is determined to break down, whether the car 1 is located in the door zone is determined in S5 and S6 by the control device 20, and permission of the opening/closing of the doors can be instructed. Therefore, as compared with the conventional case where the position is uniformly determined to be outside the door zone when the position detection sensor is determined to break down, the opportunity that the passenger is trapped in the car 1 can be decreased.

[0029] As described above, according to the present invention, providing of an elevator system capable of de-

termining whether a car is located in a door zone even if a position detection device provided on the car breaks down can be exhibited.

[0030] Note that the present invention is not limited to the above-described embodiments, and includes various modifications. For example, description of the embodiments has been given in detail for easy understanding of the present invention, and the present invention is not necessarily limited to those having all the described configurations. Further, a part of the configuration of a certain embodiment can be replaced with the configuration of another embodiment. Further, the configuration of another embodiment can be added to the configuration of a certain embodiment. Further, another configuration can be added to/deleted from/replaced with a part of the configurations of the embodiments.

Reference Signs List

[0031]

1	car
2	rope
3	counterweight
4	hoistway
5	motor
6	sheave
7	pulse generation device (motor encoder)
8, 8a, 8b	landing door
9	car door
10	car position detection device
11, 11a, 11b	plate to be detected
12	door zone detection unit
13	governor
14	governor rope
15	pulse generation device (governor encoder)
16	car position calculation unit
17	car position correction unit
17a	correction value abnormality counter unit
18	door zone determination unit
19	door opening/closing instruction unit
20	control device
21a, 21b	landing
100	elevator system

Claims

1. An elevator system including a car that moves up and down in a hoistway, a counterweight that moves up and down with the car, a rope having one end connected to the car and the other end connected to the counterweight, and a motor that drives the rope, the elevator system comprising:

a plate to be detected provided in the hoistway,
a car position detection device provided on the car and which detects the plate to be detected,
a car moving amount measurement device that measures a moving amount of the car, and a control device that controls the car position detection device and the car moving amount measurement device, wherein
the control device includes a door zone detection unit that detects a door zone that is an openable/closable region of a door of the car with the car position detection device, a car position calculation unit that calculates a position of the car with the car moving amount measurement device, and
a door zone determination unit that determines whether the car is located in the door zone on the basis of the position of the car calculated in the car position calculation unit when the car position detection device is determined to have broken down.

2. The elevator system according to claim 1, wherein the car moving amount measurement device is a pulse generation device that outputs a pulse according to the moving amount of the car.

3. The elevator system according to claim 2, wherein the pulse generation device is connected to the motor, and generates a pulse according to rotation of the motor.

4. The elevator system according to claim 2, further comprising: a governor rope connected to the car and driven with the car, and a governor around which the governor rope is wound and rotated with the governor rope, wherein the pulse generation device is connected to the governor and generates a pulse according to rotation of the governor.

5. The elevator system according to claim 1, wherein the control device further includes a car position correction unit, wherein
the car position correction unit calculates a difference between a position of the plate to be detected recorded in advance and the position of the car calculated in the car position calculation unit when the plate to be detected has been detected by the car position detection device during traveling of the car, and performs correction to adjust the position of the car calculated in the car position calculation unit to the position of the plate to be detected recorded in advance.

6. The elevator system according to claim 5, wherein the correction by the car position correction unit is performed when the difference between the position of the plate to be detected recorded in advance and

the position of the car calculated in the car position calculation unit falls within a first predetermined threshold value.

7. The elevator system according to claim 6, wherein the car position correction unit leaves a threshold value excess record when the difference between the position of the plate to be detected recorded in advance and the position of the car calculated in the car position detection unit exceeds the first predetermined threshold value,

the control device determines that the car is not in the door zone in the door zone determination unit when there is the threshold value excess record,
calculates a difference between a position of a floor of a story where the car is stopped, the position being recorded in advance, and the position of the car calculated by the car position calculation unit when there is not the threshold value excess record, and determines that the car is in the door zone in the door zone determination unit when the difference falls within a second predetermined threshold value, and
determines that the car is not in the door zone in the door zone determination unit when there is not the threshold value excess record, and the difference between the position of a floor of a story where the car is stopped, the position being recorded in advance, and the position of the car calculated by the car position calculation unit exceeds the second threshold value.

FIG. 1

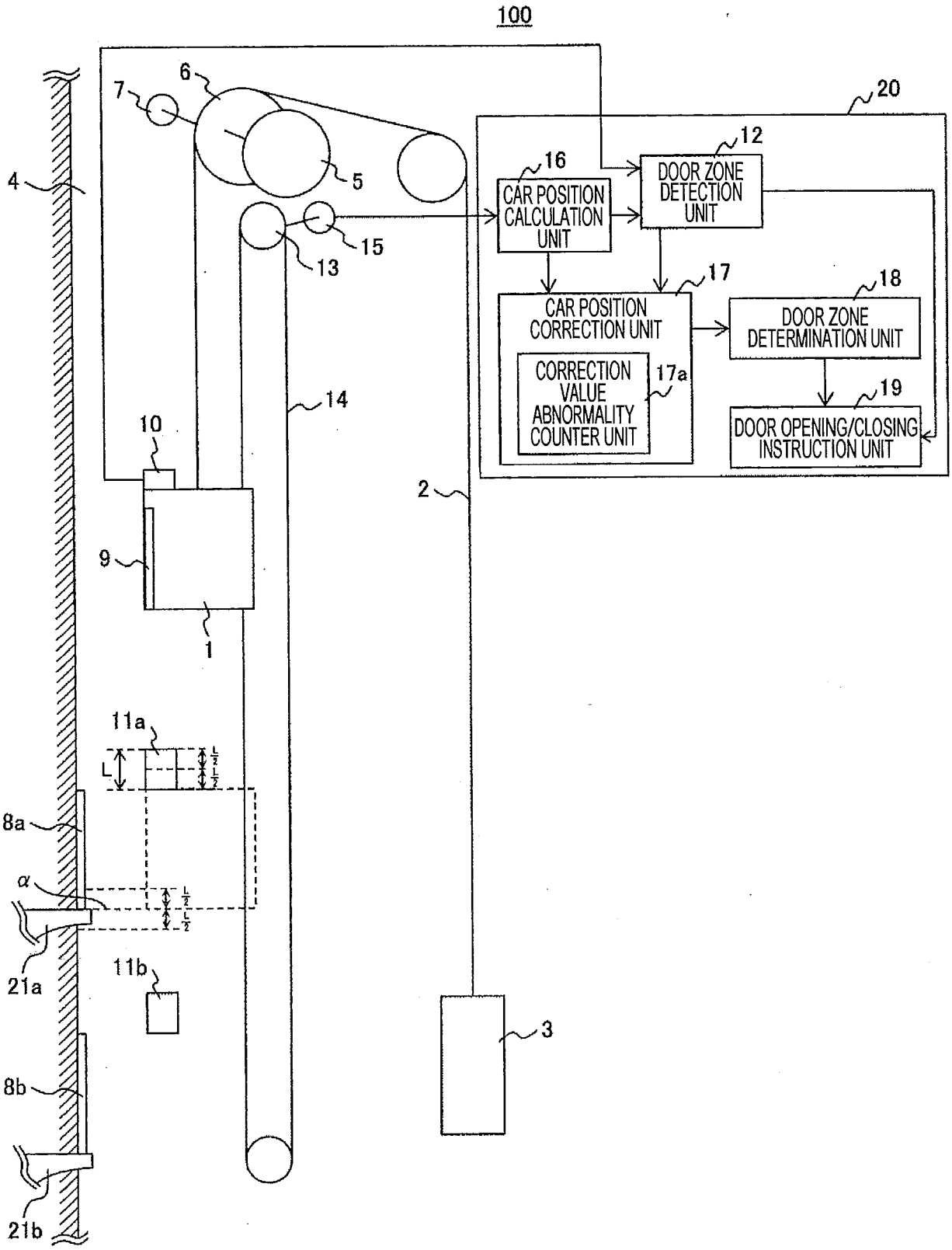
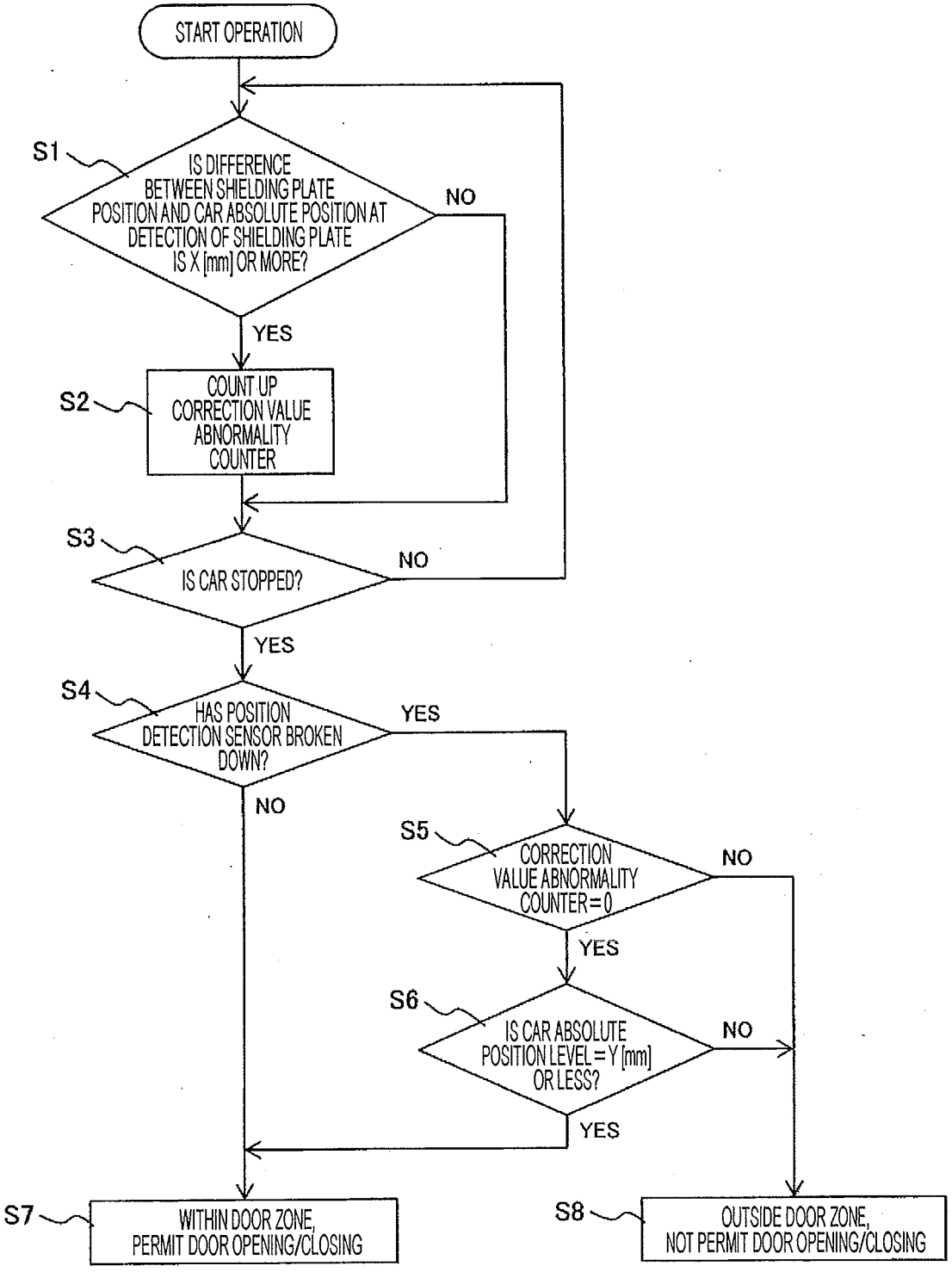

100
6
7
5
4
15
13
14
10
9
1
2
3
11a
L
L/2
L/2
8a
α
L/2
L/2
21a
11b
8b
21b
20
12
DOOR ZONE DETECTION UNIT
16
CAR POSITION CALCULATION UNIT
17
CAR POSITION CORRECTION UNIT
17a
CORRECTION VALUE ABNORMALITY COUNTER UNIT
18
DOOR ZONE DETERMINATION UNIT
19
DOOR OPENING/CLOSING INSTRUCTION UNIT

FIG. 2


START OPERATION
S1
IS DIFFERENCE BETWEEN SHIELDING PLATE POSITION AND CAR ABSOLUTE POSITION AT DETECTION OF SHIELDING PLATE IS X [mm] OR MORE?
NO
YES
S2
COUNT UP CORRECTION VALUE ABNORMALITY COUNTER
S3
IS CAR STOPPED?
NO
YES
S4
HAS POSITION DETECTION SENSOR BROKEN DOWN?
YES
NO
S5
CORRECTION VALUE ABNORMALITY COUNTER=0
NO
YES
S6
IS CAR ABSOLUTE POSITION LEVEL=Y [mm] OR LESS?
NO
YES
S7
WITHIN DOOR ZONE, PERMIT DOOR OPENING/CLOSING
S8
OUTSIDE DOOR ZONE, NOT PERMIT DOOR OPENING/CLOSING

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/060334

A. CLASSIFICATION OF SUBJECT MATTER
B66B1/36(2006.01)i, *B66B3/02*(2006.01)i, *B66B5/02*(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B1/00-1/52, B66B3/00-3/02, B66B5/00-5/28

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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 2012-66881 A (Hitachi, Ltd.), 05 April 2012 (05.04.2012), paragraphs [0014] to [0033]; fig. 1 to 8 & SG 179342 A1 page 3, line 27 to page 8, line 6; fig. 1 to 8 & CN 102408047 A	1-7
Y	JP 5-319726 A (Mitsubishi Electric Corp.), 03 December 1993 (03.12.1993), paragraphs [0022] to [0025]; fig. 1 to 4 & KR 10-1996-0012683 B1 & CN 1078443 A	1-7
Y	JP 2014-139106 A (Hitachi, Ltd.), 31 July 2014 (31.07.2014), paragraph [0020]; fig. 1 (Family: none)	4

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

* Special categories of cited documents:
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"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
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Date of the actual completion of the international search	Date of mailing of the international search report
19 May 2016 (19.05.16)	31 May 2016 (31.05.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/060334

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 2003-118946 A (Hitachi, Ltd.), 23 April 2003 (23.04.2003), paragraphs [0012] to [0017]; fig. 1 to 3 (Family: none)	5-7
Y	JP 59-78084 A (Mitsubishi Electric Corp.), 04 May 1984 (04.05.1984), page 2, upper left column, line 19 to lower left column, line 11; fig. 1 (Family: none)	7
Y	JP 2014-40320 A (Hitachi, Ltd.), 06 March 2014 (06.03.2014), paragraphs [0035] to [0043]; fig. 4 (Family: none)	7

Form PCT/ISA/210 (continuation of second sheet) (January 2015)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- WO 2011111096 A **[0004]**