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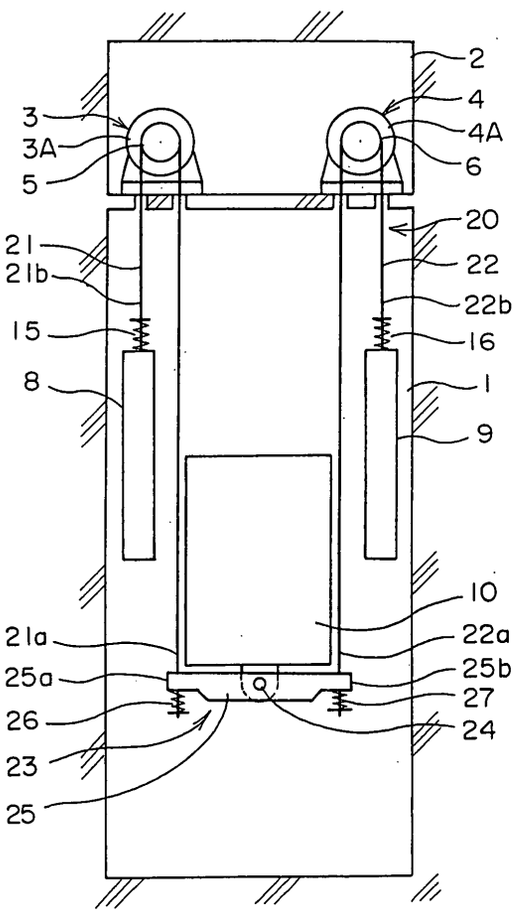
(54) **ELEVATOR EQUIPMENT**

(57) In an elevator apparatus, a balance mechanism having a pivoting shaft extending horizontally and a balance main body that is pivotable around the pivoting shaft is mounted to a car. The balance main body has a first rope connection portion, and a second rope connection portion positioned on an opposite side of the pivoting shaft from the first rope connection portion. A main rope body has a first main rope wound around a first drive sheave, and a second main rope wound around a second drive sheave. The first main rope has a first car end portion connected to the first rope connection portion, and a first counterweight end portion connected to a counterweight, and the second main rope has a second car end portion connected to the second rope connection portion, and a second counterweight end portion connected to the counterweight.

FIG. 1



EP 1 591 399 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which a single car is raised and lowered by a driving force from first and second driving machines.

BACKGROUND ART

[0002] Figure 11 is a structural diagram showing a conventional elevator apparatus such as that shown in EP 1 006 071 A1, for example. In the figure, a machine room 2 is disposed in an upper portion of a hoistway 1. First and second driving machines 3 and 4 are installed in the machine room 2. The first driving machine 3 has: a first driving machine main body 3A including a motor and a brake; and a first drive sheave 5 rotated by the first driving machine main body 3A. The second driving machine 4 has: a second driving machine main body 4A including a motor and a brake; and a second drive sheave 6 rotated by the second driving machine main body 4A.

[0003] A plurality of main ropes 7 (only one is shown in the figure) are wound around the first drive sheave 5 and the second drive sheave 6. The main ropes 7 have first end portions 7a and second end portions 7b. A first counterweight 8 is suspended by the first end portions 7a. A second counterweight 9 is suspended by the second end portions 7b. The first and second end portions 7a and 7b are connected to the first and second counterweights 8 and 9 by means of rope terminal springs 15 and 16.

[0004] A car 10 is suspended by intermediate portions of the main ropes 7. A suspension sheave beam 11 is secured horizontally to a lower portion of the car 10. Suspension sheaves 12 and 13 around which the main ropes 7 are wound are mounted to the suspension sheave beam 11. The main ropes 7 are secured to a central portion of the suspension sheave beam 11 by means of a rope securing portion 14.

[0005] In an elevator apparatus of this kind, the car 10 and the counterweights 8 and 9 are raised and lowered inside the hoistway 1 by the first and second drive sheaves 5 and 6 being rotated in opposite directions to each other. At this time, since the main ropes 7 are secured to the suspension sheave beam 11 by means of the rope securing portion 14, there is no movement of the main ropes 7 relative to the car 10.

[0006] Consequently, in a conventional elevator apparatus, since the main ropes 7 are secured to the suspension sheave beam 11, if differences arise in the rotational speed or the sheave diameter of the first and second drive sheaves 5 and 6 due to manufacturing errors or differences in age-related deformation (such as abrasion) between the first and second driving machines 3 and 4, there is a risk that tilting may occur in the car 10, reducing operating performance.

[0007] The main ropes 7 may also be connected to the suspension sheave beam 11 so as to allow for some displacement, but in that case, the movement of the main ropes 7 relative to the car 10 is slight, and there is still a risk that tilting may occur in the car 10.

DISCLOSURE OF THE INVENTION

[0008] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus enabling reductions in operating performance to be prevented by preventing tilting from arising in a car due to differences between first and second driving machines.

[0009] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator apparatus including: a first driving machine having a first drive sheave; a second driving machine having a second drive sheave; a main rope body wound around the first and second drive sheaves; and a car and a counterweight suspended inside a hoistway by the main rope body so as to be raised and lowered inside the hoistway by a driving force from the first and second driving machines, wherein: a balance mechanism having a pivoting shaft extending horizontally and a balance main body that is pivotable around the pivoting shaft is mounted to the car; the balance main body has a first rope connection portion, and a second rope connection portion positioned on an opposite side of the pivoting shaft from the first rope connection portion; the main rope body has a first main rope wound around the first drive sheave, and a second main rope wound around the second drive sheave; the first main rope has a first car end portion connected to the first rope connection portion, and a first counterweight end portion connected to the counterweight; and the second main rope has a second car end portion connected to the second rope connection portion, and a second counterweight end portion connected to the counterweight.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 is a developed structural diagram showing an elevator apparatus according to Embodiment 1 of the present invention;

Figure 2 is a plan showing the elevator apparatus in Figure 1;

Figure 3 is a developed structural diagram showing an elevator apparatus according to Embodiment 2 of the present invention;

Figure 4 is a plan showing an elevator apparatus according to Embodiment 3 of the present invention;

Figure 5 is a cross section taken along line V - V in Figure 4;

Figure 6 is a front elevation showing part of an ele-

vator apparatus according to Embodiment 4 of the present invention;

Figure 7 is a cross section taken along line VII - VII in Figure 6;

Figure 8 is a block diagram showing a control system of the elevator apparatus in Figure 6;

Figure 9 is a flowchart showing operation of a control apparatus in Figure 8;

Figure 10 is a front elevation showing part of an elevator apparatus according to Embodiment 5 of the present invention; and

Figure 11 is a structural diagram showing an example of a conventional elevator apparatus.

BEST MODE FOR CARRYING OUT THE INVENTION

[0011] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0012] Figure 1 is a developed structural diagram showing an elevator apparatus according to Embodiment 1 of the present invention, and Figure 2 is a plan showing the elevator apparatus in Figure 1. Moreover, in Figure 2, a horizontal layout of major equipment is shown with a floor of a machine room omitted.

[0013] In the figures, a machine room 2 is disposed in an upper portion of a hoistway 1. First and second driving machines 3 and 4 are installed in the machine room 2. The first driving machine 3 has: a first driving machine main body 3A including a motor and a brake; and a first drive sheave 5 rotated by the first driving machine main body 3A. The second driving machine 4 has: a second driving machine main body 4A including a motor and a brake; and a second drive sheave 6 rotated by the second driving machine main body 4A.

[0014] The first and second driving machines 3 and 4 are disposed such that the first driving machine main body 3A and the second driving machine main body 4A face each other, that is, such that the first and second drive sheaves 5 and 6 face outward. The first and second drive sheaves 5 and 6 are disposed such that rotating shafts thereof extend horizontally in a direction of frontage of the hoistway 1 (left-to-right in Figure 2). Moreover, the orientation of the driving machines 3 and 4 in Figure 1 is different from that in Figure 2 because Figure 1 is a developed view.

[0015] A main rope body 20 which is a composite body of main ropes is wound around the first drive sheave 5 and the second drive sheave 6. The main rope body 20 has: a plurality of first main ropes 21 wound around the first drive sheave 5; and a plurality of second main ropes 22 wound around the second drive sheave 6.

[0016] Each of the first main ropes 21 has: a first car end portion 21a; and a first counterweight end portion 21b. Each of the second main ropes 22 has: a second car end portion 22a; and a second counterweight end portion 22b. A first counterweight 8 is suspended by the first counterweight end portions 21b. A second counterweight 9 is suspended by the second counterweight end portions 22b. The first and second counterweight end portions 21b and 22b are connected to the first and second counterweights 8 and 9 by means of rope terminal springs 15 and 16.

[0017] A car 10 is suspended by the first and second car end portions 21a and 22a. A balance mechanism 23 is mounted to a lower portion of the car 10. The balance mechanism 23 has: a pivoting shaft 24 extending horizontally in a depth direction of the car 10 (top-to-bottom in Figure 2); and a balance main body 25 that is pivotable around the pivoting shaft 24.

[0018] The balance main body 25 has: a first rope connection portion 25a positioned at one longitudinal end portion; and a second rope connection portion 25b positioned on an opposite side of the pivoting shaft 24 from the first rope connection portion 25a, that is, at another longitudinal end portion. The first car end portions 21a are connected to the first rope connection portion 25a. The second car end portions 22a are connected to the second rope connection portion 25b.

[0019] Absorption springs 26 and 27 for absorbing changes in connection angle between the first and second rope connection portions 25a and 25b and the first and second car end portions 21a and 22a due to inclination of the balance main body 25 are disposed between the first rope connection portion 25a and the first car end portions 21a and between the second rope connection portion 25b and the second car end portions 22a, respectively.

[0020] A pair of car guide rails 28 for guiding ascent and descent of the car 10, a pair of first counterweight guide rails 29 for guiding ascent and descent of the first counterweight 8, and a pair of second counterweight guide rails 30 for guiding ascent and descent of the second counterweight 9 are installed inside the hoistway 1. The first and second counterweights 8 and 9 are disposed so as to be positioned on mutually opposite sides of the car 10 on left and right sides of the car 10 .

[0021] In an elevator apparatus of this kind, because the car 10 is suspended by means of the balance mechanism 23, tilting is prevented from arising in the car 10 due to differences between the first and second driving machines 3 and 4, enabling reductions in operating performance to be prevented. In other words, even if differences arise in the rotational speed or the sheave diameter of the first and second drive sheaves 5 and 6, the car 10 is not tilted, and the differences can be absorbed by the balance main body 25 inclining independently.

[0022] Furthermore, by using two driving machines 3 and 4, enlargement of each of the driving machines 3 and 4 can be prevented compared to when a single driving machine is used, enabling the driving machines to be standardized for elevator apparatuses having a small

car capacity through to large elevator apparatuses.

[0023] In addition, because absorption springs 26 and 27 are disposed between the first and second rope connection portions 25a and 25b and the first and second car end portions 21a and 22a, respectively, changes in connection angle between the first and second rope connection portions 25a and 25b and the first and second car end portions 21a and 22a due to inclination of the balance main body 25 are absorbed, and rods of the first and second car end portions 21a and 22a, the balance main body 2, etc., are not subjected to unbearable force, enabling the generation of stress to be suppressed.

Embodiment 2

[0024] Next, Figure 3 is a developed structural diagram showing an elevator apparatus according to Embodiment 2 of the present invention. In this example, a balance mechanism 23 similar to that of Embodiment 1 is mounted to an upper portion of a car 10. The rest of the construction is similar to that of Embodiment 1.

[0025] When a balance mechanism 23 is mounted to an upper portion of the car 10 in this manner, tilting is also prevented from arising in the car 10 due to differences between the first and second driving machines 3 and 4, enabling reductions in operating performance to be prevented.

Embodiment 3

[0026] Figure 4 is a plan showing an elevator apparatus according to Embodiment 3 of the present invention, and Figure 5 is a cross section taken along line V - V in Figure 4. Moreover, in Figure 4, a horizontal layout of major equipment is shown with a floor of a machine room omitted.

[0027] In the figures, first and second driving machines 3 and 4 are disposed such that rotating shafts of first and second drive sheaves 5 and 6 extend horizontally so as to be inclined relative to a direction of frontage of a hoistway 1.

[0028] A car 10 is suspended on first and second car end portions 21a and 22a of first and second main ropes 21 and 22 by means of a balance mechanism 23, in a similar manner to Embodiment 1. A counterweight 31 is suspended on first and second counterweight end portions 21b and 22b of the first and second main ropes 21 and 22 by means of a balance mechanism 23 that is similar to that for the car 10.

[0029] In Embodiment 1, two counterweights 8 and 9 are used, but in Embodiment 2, only one counterweight 31 is used. The balance mechanism 23 for the counterweight 31 may be somewhat different from the balance mechanism 23 for the car 10 in size, etc., but because it is similar in function, it has been allocated an identical numeral in the figures for simplicity.

[0030] The balance mechanism 23 for the counterweight 31 is mounted to an upper portion of the counterweight 31. The first counterweight end portions 21b of the first main ropes 21 are connected to the first rope connection portion 25a of the balance main body 25 for the counterweight 31 by means of an absorption spring 33. The second counterweight end portions 22b of the second main ropes 22 are connected to the second rope connection portion 25b of the balance main body 25 for the counterweight 31 by means of an absorption spring 34.

[0031] A pair of counterweight guide rails 32 for guiding ascent and descent of the counterweight 31 are installed inside the hoistway 1. The counterweight 31 is disposed behind the car 10. A first deflection sheave 35 for leading the first main ropes 21 to the counterweight 31 and a second deflection sheave 36 for leading the second main ropes 22 to the counterweight 31 are disposed in a machine room 2 (See Figure 1). The rest of the construction is similar to that of Embodiment 1.

[0032] According to an elevator apparatus of this kind, a single counterweight 31 can be used and thus a single set of counterweight guide rails 32 is sufficient, enabling simplification of the overall construction. Furthermore, because the counterweight 31 is suspended by means of a balance mechanism 23, tilting can be prevented from arising in the counterweight 31 due to differences between the first and second driving machines 3 and 4, enabling the counterweight 31 to be raised and lowered smoothly.

[0033] Moreover, the balance mechanism 23 for the counterweight 31 may also be mounted to a lower portion of the counterweight 31.

Embodiment 4

[0034] Figure 6 is a front elevation showing part of an elevator apparatus according to Embodiment 4 of the present invention, and Figure 7 is a cross section taken along line VII - VII in Figure 6. In the figures, a pivoting shaft 24 is pivoted together with a balance main body 25. A pivoting sensor 41 for detecting pivoting of the balance main body 25 by detecting rotation of the pivoting shaft 24 is engaged with the pivoting shaft 24. First and second dampers 42 and 43 are disposed between the car 10 and the balance main body 25.

[0035] Figure 8 is a block diagram showing a control system of the elevator apparatus in Figure 6. A drive control portion 45 connected to the first and second driving machines 3 and 4, an angle of inclination detecting portion 46 connected to the pivoting sensor 41, an inclination determining portion 47 connected to the drive control portion 45 and the angle of inclination detecting portion 46, and an inclination correcting portion 48 connected to the drive control portion 45 and the inclination determining portion 47 are disposed in the control apparatus 44.

[0036] The drive control portion 45 controls activation of the first and second driving machines 3 and 4 sepa-

rately. The angle of inclination detecting portion 46 detects the angle of inclination of the balance main body 25 by a signal from the pivoting sensor 41. The inclination determining portion 47 determines whether or not the angle of inclination of the balance main body 25 is less than or equal to a preset set value, and also calculates the speed of change in the angle of inclination of the balance main body 25 and determines whether or not the speed of change is less than or equal to a preset set value. The inclination correcting portion 48 calculates a signal to cancel out the inclination of the balance main body 25 and outputs it to the drive control portion 45.

[0037] The rest of the construction is similar to that of Embodiment 1.

[0038] Next, operation will be explained. Action of the balance mechanism 23 is similar to that of Embodiment 1. Figure 9 is a flowchart showing the operation of the control apparatus 44 in Figure 8. When a call is registered with the car 10 stopped at a landing floor and a movement command is input into the control apparatus 44, the inclination determining portion 47 determines whether or not the angle of inclination of the balance main body 25 is less than or equal to the set value (Step S1). If the angle of inclination is less than or equal to the set value (i.e., horizontal or generally horizontal), a movement permission command is output from the inclination determining portion 47 to the drive control portion 45 (Step S2), and the first and second driving machines 3 and 4 are activated.

[0039] If the angle of inclination has exceeded the set value, a signal for canceling out the inclination of the balance main body 25 is calculated by the inclination correcting portion 48 and output to the drive control portion 45. Thus, at least one of the first and second driving machines 3 and 4 is activated so as to cancel out the inclination of the balance main body 25 (Step S3). Then, the inclination determining portion 47 determines whether or not the angle of inclination is less than or equal to the set value, and if it is less than or equal to the set value, a movement permission command is output (Step S2).

[0040] If the angle of inclination still exceeds the set value despite inclination removal control having been carried out, it is deemed that there is some abnormality in the control system or the drive system, activation of the first and second driving machines 3 and 4 is terminated, and an abnormality detection signal is output to an elevator control room, etc. (Step S5).

[0041] When a movement permission command is output and the car 10 is actually moving, the inclination determining portion 47 calculates the speed of change in the angle of inclination of the balance main body 25 and determines whether or not the speed of change is less than or equal to a set value (Step S6). If the speed of change in the angle of inclination has exceeded the set value, that is, if the balance main body 25 has inclined suddenly, it is deemed that removal of the inclination is difficult, and the car 10 is decelerated and stopped or is stopped at a nearby floor (Step S7). Then, an abnormality detection signal is output to the elevator control room, etc.

[0042] If there is no abnormality in the speed of change in the angle of inclination, a determination is made as to whether or not the magnitude of the angle of inclination is less than or equal to the set value (Step S8). The set value constituting the criterion at this time may be the same as the set value when the car 10 is at rest or it may be different. After determining the angle of inclination, a check is made as to whether or not the car 10 has finished moving (Step S9), determination of the speed of change and magnitude of the angle of inclination being performed continuously or periodically while the car 10 is moving.

[0043] If the magnitude of the angle of inclination exceeds the set value while the car 10 is moving, a signal for canceling out the inclination of the balance main body 25 is calculated by the inclination correcting portion 48 and output to the drive control portion 45. Thus, the first and second driving machines 3 and 4 are activated so as to cancel out the inclination of the balance main body 25 (Step S10).

[0044] In an elevator apparatus of this kind, because a pivoting sensor 41 for detecting pivoting of the balance main body 25 is used, the angle of inclination of the balance main body 25 can be easily monitored for the presence of abnormalities, enabling reliability to be improved.

[0045] Because first and second dampers 42 and 43 are disposed between the car 10 and the balance main body 25, unstable operation of the balance main body 25 can be prevented, enabling output from the pivoting sensor 41 to be stabilized.

[0046] In addition, because at least one of the first and second driving machines 3 and 4 is controlled so as to cancel out the inclination of the balance main body 25 in response to information from the pivoting sensor 41 when the car 10 at rest, the balance main body 25 can be maintained in a neutral state (i.e., horizontal) at the commencement of hoisting, enabling the operating performance of the car 10 to be further improved.

[0047] Furthermore, because the first and second driving machines 3 and 4 are controlled so as to cancel out the inclination of the balance main body 25 in response to information from the pivoting sensor 41 while the car 10 is moving, the balance main body 25 can also be maintained in a neutral state while the car 10 is moving, enabling the operating performance of the car 10 to be further improved.

[0048] Because the speed of change in the angle of inclination of the balancemain body 25 is detected from information from the pivoting sensor 41 while the car 10 is moving, and a determination is made as to whether or not the speed of change is less than or equal to a set value, abnormalities in the drive system and the control system can be detected earlier.

[0049] In addition, because the car 10 is decelerated and stopped or is stopped at a nearby floor and an abnormality detection signal is output when the speed of change in the angle of inclination of the balance main body 25 has exceeded a set value, action can be taken immediately if abnormalities occur.

Embodiment 5

[0050] Next, Figure 10 is a front elevation showing part of an elevator apparatus according to Embodiment 5 of the present invention. In the figure, two pivoting sensors 49a and 49b for detecting pivoting of a balance main body 25 by detecting distances between a car 10 and a balance main body 25 are disposed between the car 10 and the balance main body 25. The pivoting sensors 49a and 49b are disposed equidistantly from a pivoting shaft 24. The rest of the construction is similar to that of Embodiment 4.

[0051] Thus, the angle of inclination of the balance main body 25 can also be easily monitored for the presence of abnormalities using pivoting sensors 49a and 49b of a type that detects the distance between the car 10 and the balance main body 25, enabling reliability to be improved.

[0052] Moreover, in Embodiment 4, determination of the angle of inclination of the balance main body 25 is made immediately before the car 10 starts moving, but a determination may also be made immediately after arrival at a floor, and determinations may also be made continuously while at rest.

[0053] In Embodiment 4, a determination of the speed of change in the angle of inclination of the balance main body 25 is made from information from the pivoting sensor 41, but the car 10 may also be decelerated and stopped or stopped at a nearby floor if a preset limiting value for the pivoting angle is reached. In addition, a limit switch activated when the balance main body 25 has inclined to a limiting value may also be disposed separately from the pivoting sensor.

[0054] In addition, in Embodiment 5, a determination is made from the angle of inclination of the balance main body 25 found from distances between the car 10 and the balance main body 25, but a determination may also be made directly from the distances without finding the angle of inclination.

[0055] Furthermore, in Embodiments 1 to 5, elevator apparatuses are shown in which first and second driving machines 3 and 4 are installed in a machine room 2, but the present invention can also be applied to machine-roomless elevators in which the first and second driving machines are disposed inside a hoistway. In machine-roomless elevators, the first and second driving machines may be supported by a supporting beam secured to an upper portion inside the hoistway, or a supporting beam secured to upper portions of guide rails.

Claims

1. An elevator apparatus comprising:

a first driving machine having a first drive sheave;
a second driving machine having a second drive sheave;
a main rope body wound around the first and second drive sheaves; and
a car and a counterweight suspended inside a hoistway by the main rope body so as to be raised and lowered inside the hoistway by a driving force from the first and second driving machines,

wherein:

a balance mechanism having a pivoting shaft extending horizontally and a balance main body that is pivotable around the pivoting shaft is mounted to the car;
the balance main body has a first rope connection portion, and a second rope connection portion positioned on an opposite side of the pivoting shaft from the first rope connection portion;
the main rope body has a first main rope wound around the first drive sheave, and a second main rope wound around the second drive sheave;
the first main rope has a first car end portion connected to the first rope connection portion, and a first counterweight end portion connected to the counterweight; and
the second main rope has a second car end portion connected to the second rope connection portion, and a second counterweight end portion connected to the counterweight.

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

the balance mechanism is also mounted to the counterweight;
the first counterweight end portion is connected to the first rope connection portion of the balance main body for the counterweight; and
the second counterweight end portion is connected to the second rope connection portion of the balance main body for the counterweight.

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

absorption springs for absorbing changes in connection angle between the first and second rope connection portions and the first and sec-

ond car end portions due to inclination of the balance main body are disposed between the first and second rope connection portions and the first and second car end portions, respectively.

4. The elevator apparatus according to Claim 2, wherein:

absorption springs for absorbing changes in connection angle between the first and second rope connection portions and the first and second counterweight end portions due to inclination of the balance main body are disposed between the first and second rope connection portions and the first and second counterweight end portions, respectively.

5. The elevator apparatus according to Claim 1 or Claim 2, further comprising:

a pivoting sensor for detecting pivoting of the balance main body.

6. The elevator apparatus according to Claim 5, wherein:

a damper is disposed between the balance main body and the car.

7. The elevator apparatus according to Claim 5, further comprising:

a control apparatus for controlling at least one of the first and second driving machines so as to cancel out the inclination of the balance main body in response to information from the pivoting sensor when the car is at rest.

8. The elevator apparatus according to Claim 5, further comprising:

a control apparatus for controlling the first and second driving machines so as to cancel out the inclination of the balance main body in response to information from the pivoting sensor when the car is moving.

9. The elevator apparatus according to Claim 5, further comprising:

a control apparatus for detecting a speed of change in an angle of inclination of the balance main body from information from the pivoting sensor and determining whether or not the speed of change is less than or equal to a preset set value when the car is moving.

10. The elevator apparatus according to Claim 9, wherein:

the control apparatus stops the car at a nearby floor and outputs an abnormality detection signal when the speed of change in the angle of inclination of the balance main body exceeds the set value.

FIG. 1

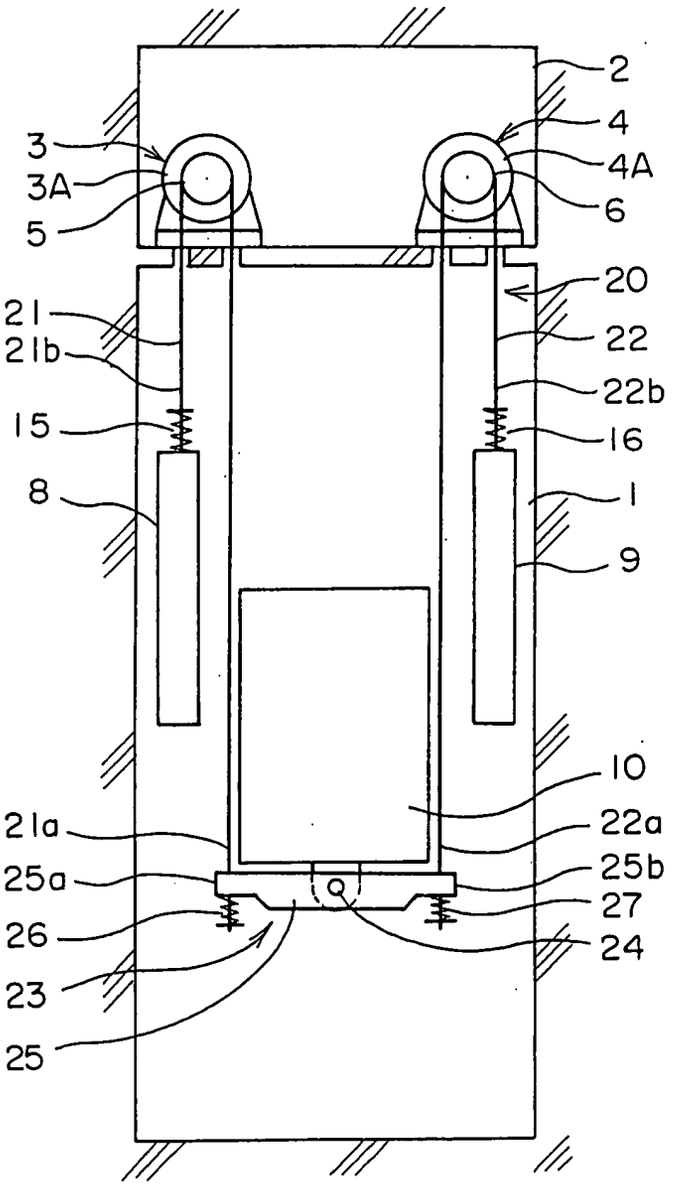

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FIG. 2

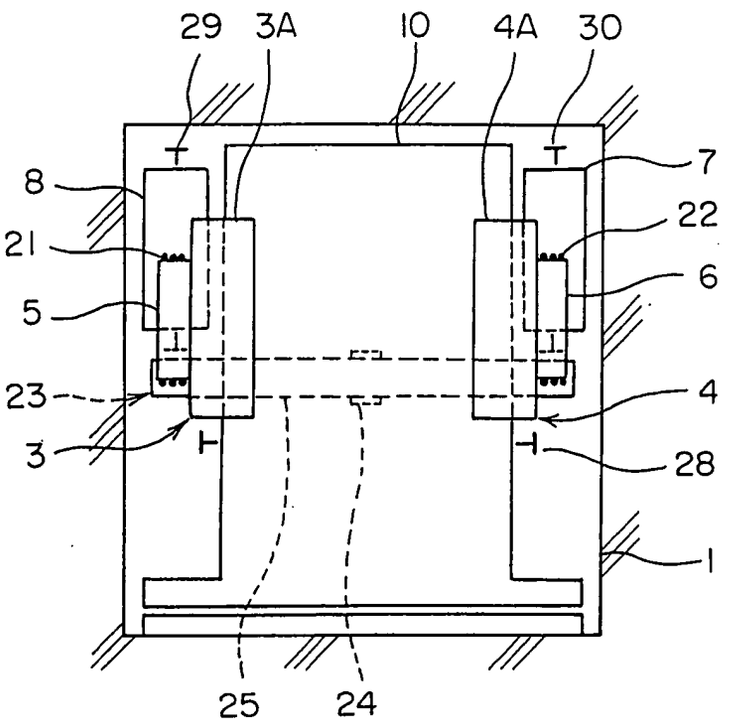

FIG. 3

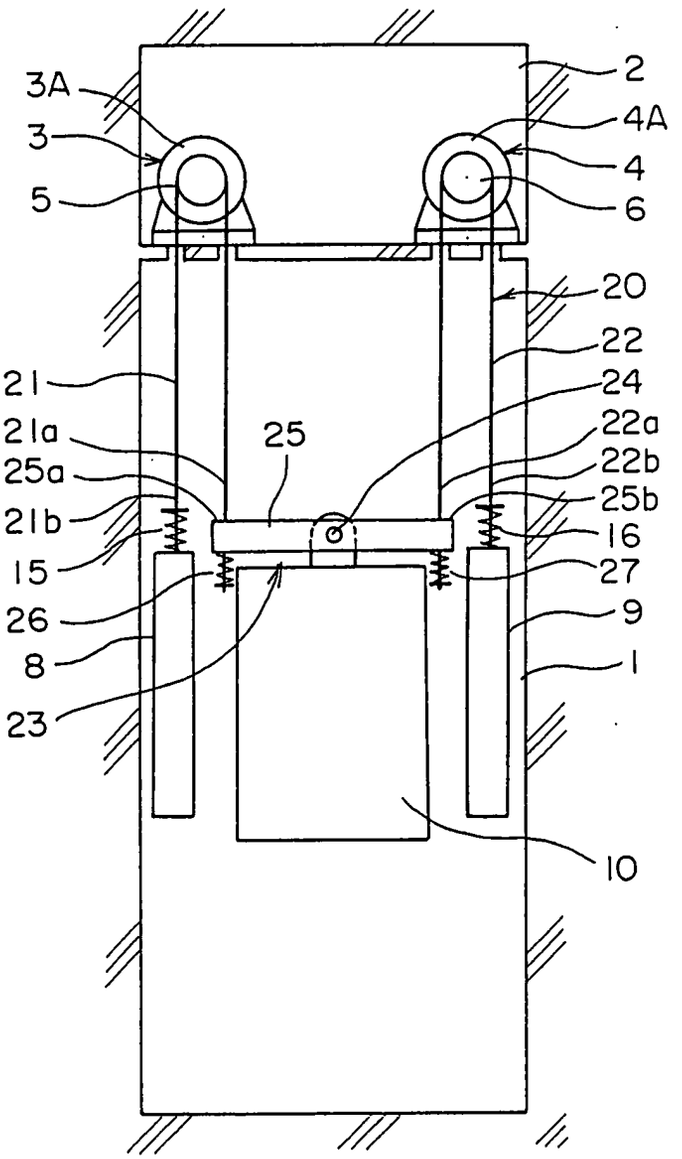
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FIG. 4

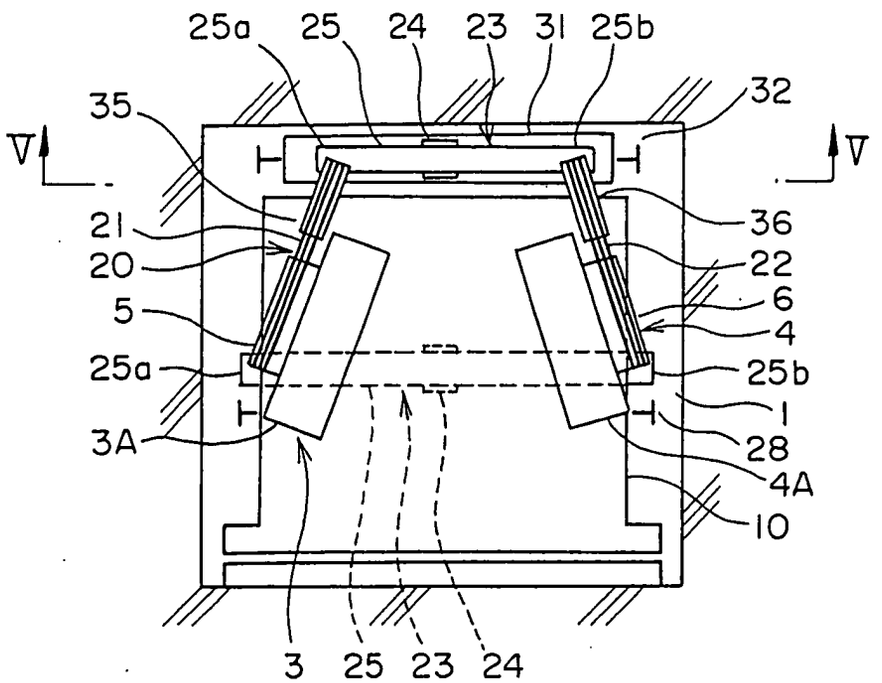
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FIG. 5

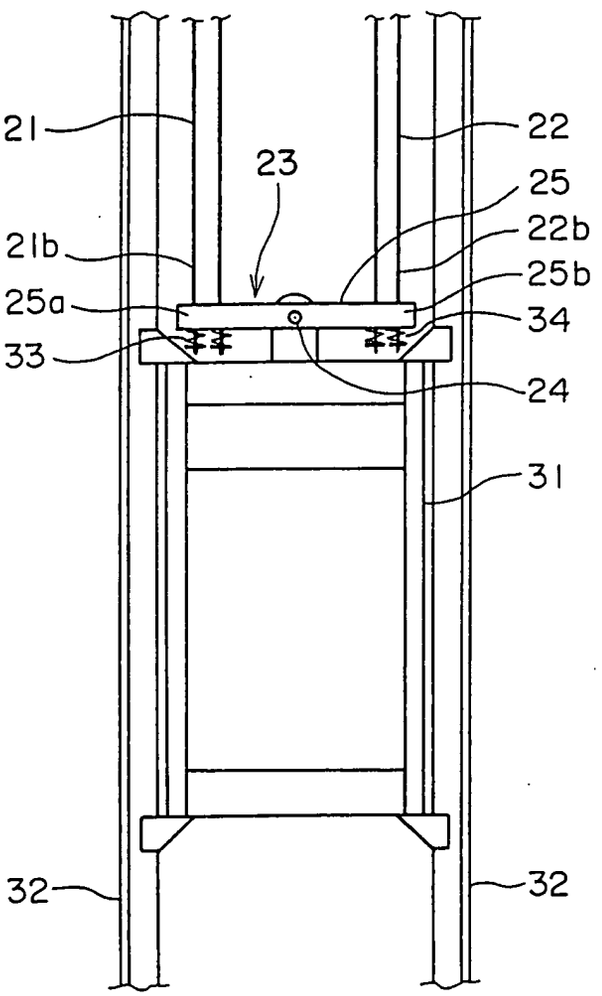


FIG. 6

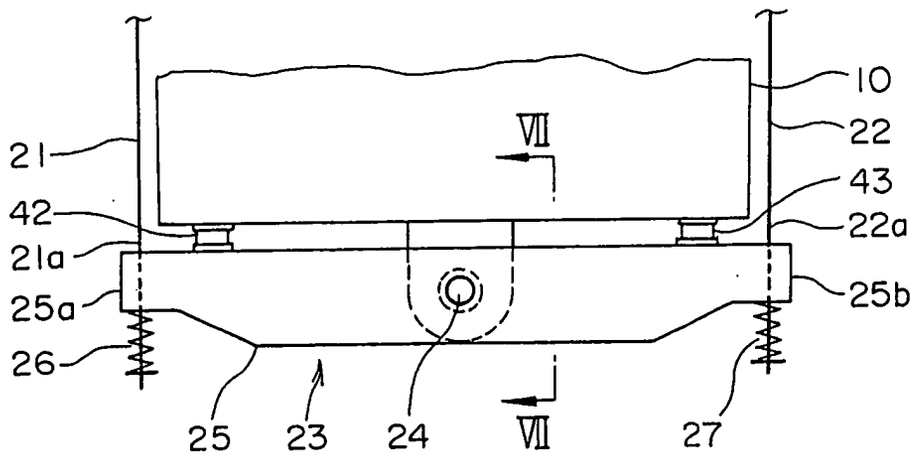


FIG. 7

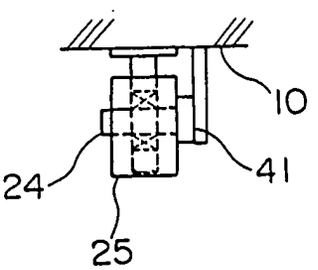


FIG. 8

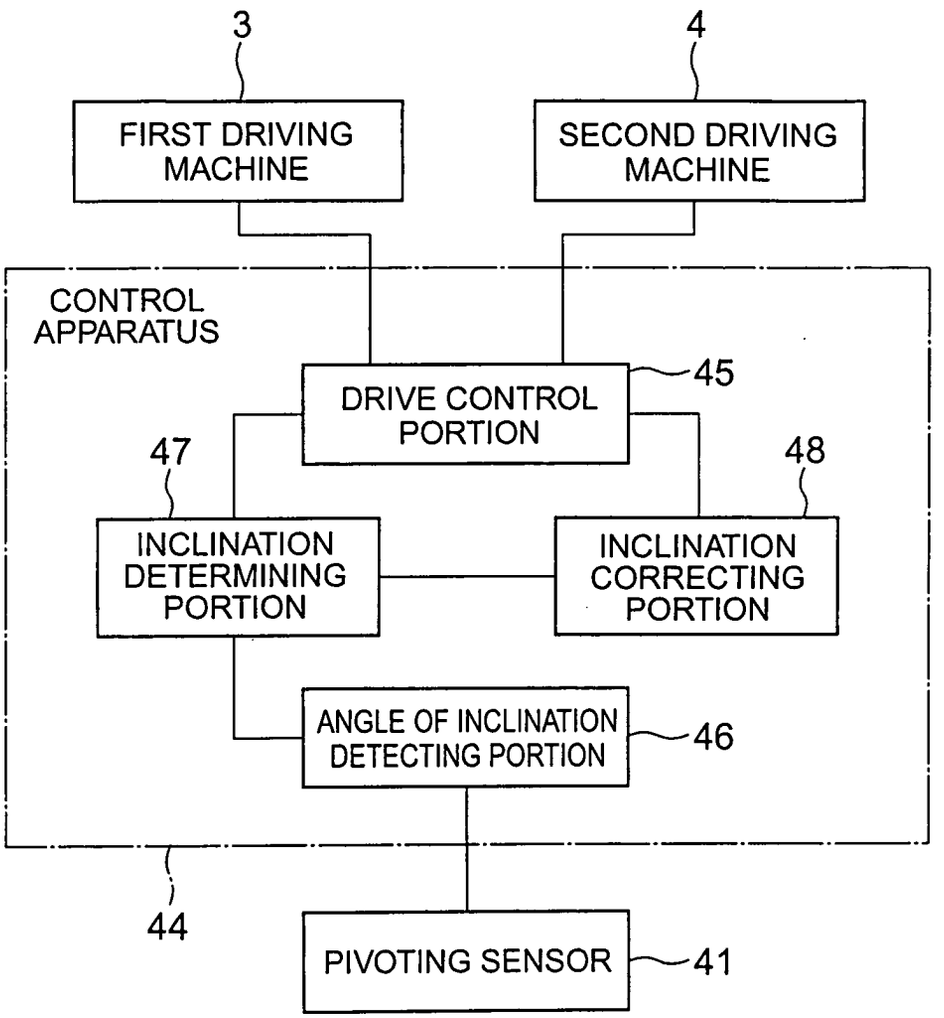

3
4
FIRST DRIVING MACHINE
SECOND DRIVING MACHINE
CONTROL APPARATUS
DRIVE CONTROL PORTION
45
47
48
INCLINATION DETERMINING PORTION
INCLINATION CORRECTING PORTION
ANGLE OF INCLINATION DETECTING PORTION
46
44
PIVOTING SENSOR
41

FIG. 9

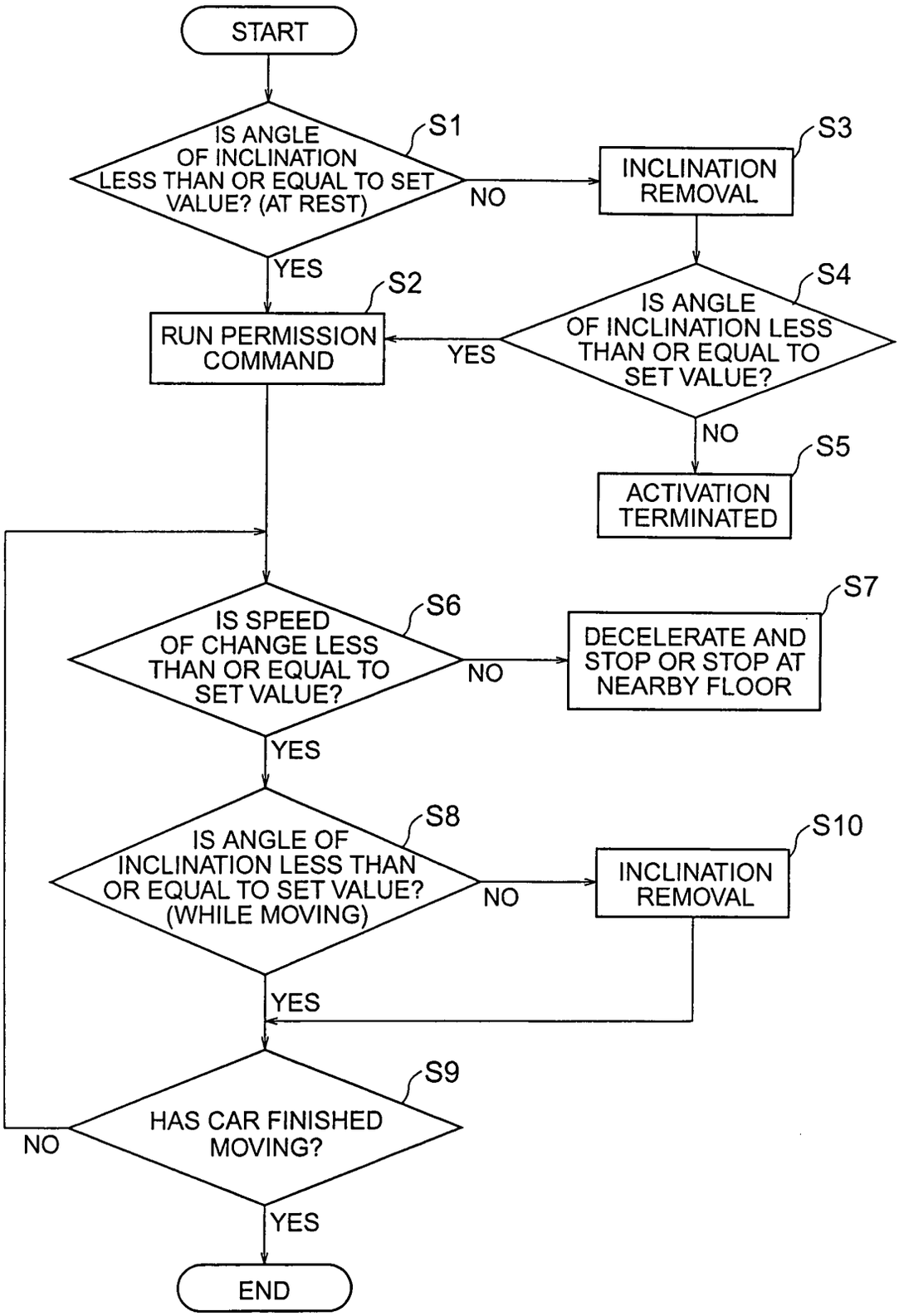

START
IS ANGLE OF INCLINATION LESS THAN OR EQUAL TO SET VALUE? (AT REST)
S1
NO
INCLINATION REMOVAL
S3
YES
RUN PERMISSION COMMAND
S2
YES
IS ANGLE OF INCLINATION LESS THAN OR EQUAL TO SET VALUE?
S4
NO
ACTIVATION TERMINATED
S5
IS SPEED OF CHANGE LESS THAN OR EQUAL TO SET VALUE?
S6
NO
DECELERATE AND STOP OR STOP AT NEARBY FLOOR
S7
YES
IS ANGLE OF INCLINATION LESS THAN OR EQUAL TO SET VALUE? (WHILE MOVING)
S8
NO
INCLINATION REMOVAL
S10
YES
HAS CAR FINISHED MOVING?
S9
NO
YES
END

FIG. 10

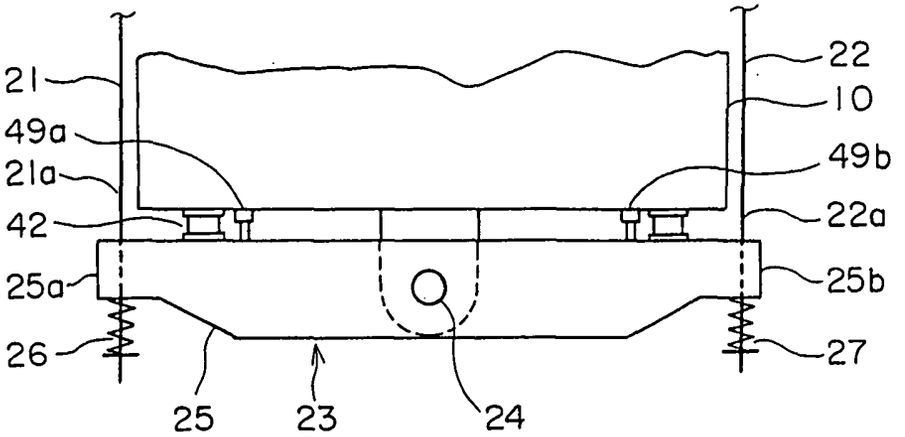
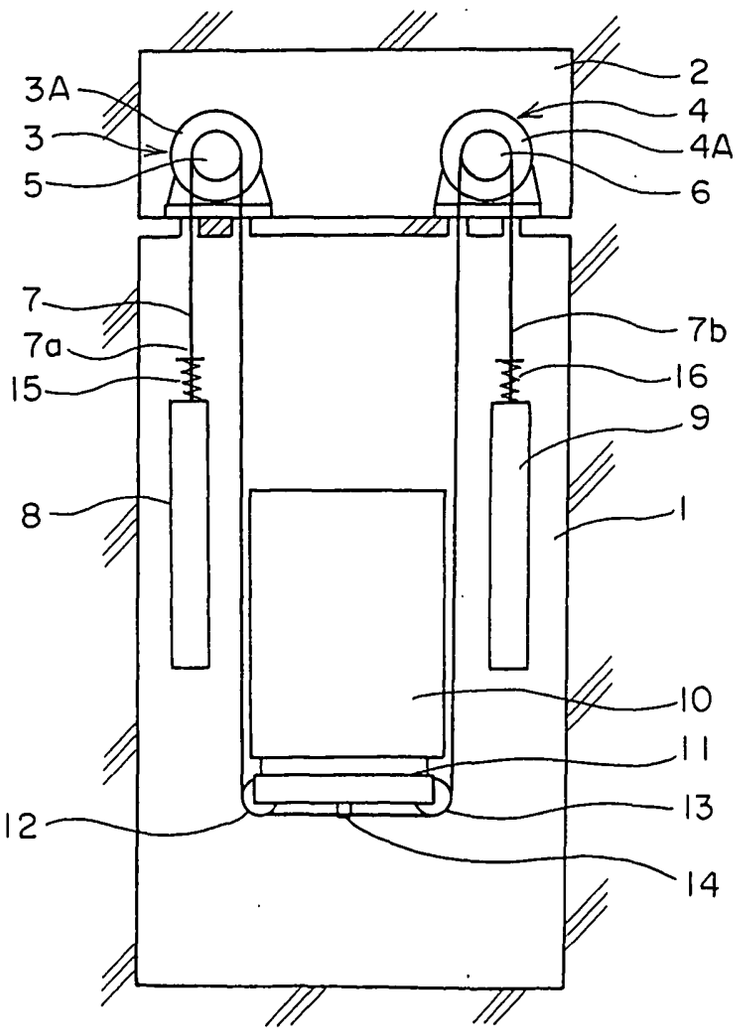

21
49a
21a
42
25a
26
25
23
24
22
10
49b
22a
25b
27

FIG. 11


3A
3
5
7
7a
15
8
12
2
4
4A
6
7b
16
9
1
10
11
13
14

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09624

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B7/08

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)
Int.Cl[7] B66B7/00-B66B11/08

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	1996-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Toroku Jitsuyo Shinan Koho	1994-2003

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 2002-179358 A (Fujitec Co., Ltd.), 26 June, 2002 (26.06.02), (Family: none)	1-10
Y	JP 2001-261257 A (Mitsubishi Electric Corp.), 26 September, 2001 (26.09.01), (Family: none)	1-10
Y	JP 60-213676 A (Toshiba Shokoki Service Kabushiki Kaisha), 25 October, 1985 (25.10.85), (Family: none)	1-10
Y	JP 5-201657 A (Nissei Build Kogyo Kabushiki Kaisha), 10 August, 1993 (10.08.93), & IL 104381 A	2,4

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

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"E" earlier document but published on or after the international filing date
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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
05 June, 2003 (05.06.03)	24 June, 2003 (24.06.03)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09624

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	EP 1006071 A1 (INVENTIO AG.), 07 June, 2000 (07.06.00), (Family: none)	3-4
Y	JP 7-25553 A (Mitsubishi Electric Corp.), 27 January, 1995 (27.01.95), (Family: none)	5-10

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