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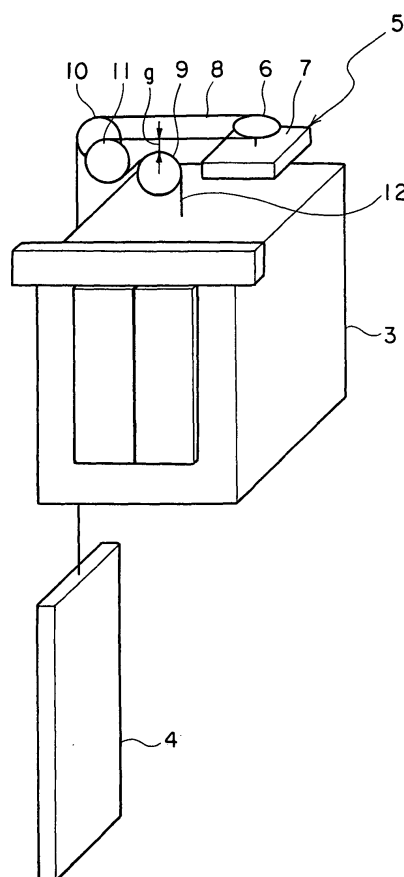
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(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, a driving machine is disposed in an upper portion of a hoistway such that a rotating shaft of a drive sheave is vertical. A car return sheave, a counterweight return sheave, and a deflecting sheave around which a suspending means is wound are disposed in an upper portion of the hoistway. Respective rotating shafts of the car return sheave, the counterweight return sheave, and the deflecting sheave are horizontal. A direction of flexure of the suspending means at the car return sheave and a direction of flexure of the suspending means at the deflecting sheave are mutually opposite directions.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which a driving machine is disposed in an upper portion of a hoistway such that a rotating shaft of a drive sheave is vertical.

BACKGROUND ART

[0002] In conventional elevator apparatuses, a driving machine is disposed in an upper portion of a hoistway such that a rotating shaft of a drive sheave is vertical. First and second main ropes are wound around the drive sheave. First and second main rope connecting portions are disposed on the car. A first end portion of the first main rope is connected to the first main rope connecting portion, and a second end portion of the first main rope is connected to a counterweight. A first end portion of the second main rope is connected to the second main rope connecting portion, and a second end portion of the second main rope is connected to the counterweight.

[0003] Disposed in an upper portion of the hoistway are: a first car return sheave that directs the first main rope to the first main rope connecting portion; a first counterweight return sheave that directs the first main rope to the counterweight; a second car return sheave that directs the second main rope to the second main rope connecting portion; a second counterweight return sheave that directs the second main rope to the counterweight; and a direction-changing pulley that directs the second main rope from the drive sheave to the second car return sheave (see Patent Literature 1, for example).

[0004] [Patent Literature 1]
WO/2003/074409

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0005] In conventional elevator apparatuses such as that described above, since mounted angles of the sheaves change if car dimensions are changed, accommodating car dimension modifications has been troublesome, making productivity low.

[0006] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus that can facilitate accommodation of car dimension modifications, and that can improve productivity.

MEANS FOR SOLVING THE PROBLEM

[0007] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator apparatus including: a driving machine that has: a drive sheave; and a driving machine main body

that rotates the drive sheave, the driving machine being disposed in an upper portion of a hoistway such that a rotating shaft of the drive sheave is vertical; a suspending means that is wound around the drive sheave; a car and a counterweight that are suspended inside the hoistway by the suspending means, and that are raised and lowered by the driving machine; a car return sheave that is disposed above the car, around which the suspending means is wound on a first side of the drive sheave, and that directs the suspending means to the car; a counterweight return sheave that is disposed above the counterweight, around which the suspending means is wound on a second side of the drive sheave, and that directs the suspending means to the counterweight; and a deflecting sheave that is disposed in an upper portion of the hoistway, and around which the suspending means is wound between the drive sheave and the car return sheave, wherein: respective rotating shafts of the car return sheave, the counterweight return sheave, and the deflecting sheave are horizontal; and a direction of flexure of the suspending means at the car return sheave and a direction of flexure of the suspending means at the deflecting sheave are mutually opposite directions.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Figure 1 is a plan that shows an elevator apparatus according to Embodiment 1 of the present invention; Figure 2 is a perspective that shows part of the elevator apparatus from Figure 1;

Figure 3 is a perspective that shows part of the elevator apparatus from Figure 2 enlarged;

Figure 4 is a plan that shows a car return sheave and a deflecting sheave from Figure 3;

Figure 5 is a plan that shows a layout in a case in which a size of the car from Figure 1 has been modified;

Figure 6 is a plan that shows an elevator apparatus according to Embodiment 2 of the present invention;

Figure 7 is a plan that shows a layout in a case in which a size of a car from Figure 6 has been modified;

Figure 8 is a plan that shows an elevator apparatus according to Embodiment 3 of the present invention;

Figure 9 is a plan that shows an elevator apparatus according to Embodiment 4 of the present invention;

Figure 10 is a perspective that shows part of an elevator apparatus according to Embodiment 5 of the present invention; and

Figure 11 is a plan that shows the elevator apparatus from Figure 10.

BEST MODE FOR CARRYING OUT THE INVENTION

[0009] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0010] Figure 1 is a plan that shows an elevator apparatus according to Embodiment 1 of the present invention, and Figure 2 is a perspective that shows part of the elevator apparatus from Figure 1.

[0011] In the figures, a pair of car guide rails 1a and 1b, and a pair of counterweight guide rails 2a and 2b are installed in a hoistway. A car 3 is guided by the car guide rails 1a and 1b so as to be raised and lowered inside the hoistway. A counterweight 4 is guided by the counterweight guide rails 2a and 2b so as to be raised and lowered inside the hoistway. The counterweight 4 is disposed to one side of the car 3 in a width direction (left-to-right in Figure 1) so as to face a side surface of the car 3 when positioned level with the car 3.

[0012] A driving machine 5 is disposed in an upper portion inside the hoistway. The driving machine 5 has: a drive sheave 6; and a driving machine main body 7 that rotates the drive sheave 6. The driving machine 5 is disposed such that a rotating shaft of the drive sheave 6 is vertical (or nearly vertical). The driving machine main body 7 has a motor that rotates the drive sheave 6; and a brake that brakes the rotation of the drive sheave 6.

[0013] A thin hoisting machine in which an axial dimension is less than a dimension that is perpendicular to an axial direction is used as the driving machine 5. In addition, the driving machine 5 is disposed directly above the car 3 so as to overlap with the car 3 in a vertically projected plane. The drive sheave 6 is disposed on an upper portion of the driving machine main body 7. In other words, the drive sheave 6 faces a hoistway ceiling.

[0014] A suspending means that suspends the car 3 and the counterweight 4 is wound around the drive sheave 6. The suspending means includes a plurality of main ropes 8. The car 3 and the counterweight 4 are suspended inside the hoistway by the main ropes 8 using a one-to-one (1:1) roping method, and are raised and lowered by a driving force from the driving machine 5.

[0015] A car return sheave 9, a counterweight return sheave 10, and a deflecting sheave 11 are disposed in an upper portion inside the hoistway. The car return sheave 9 is disposed above the car 3, and directs the main ropes 8 to an upper portion of the car 3. The main ropes 8 are wound around the car return sheave 9 on a first side of the drive sheave 6. The counterweight return sheave 10 is disposed above the counterweight 4, and directs the main ropes 8 to an upper portion of the counterweight 4. The main ropes 8 are wound around the counterweight return sheave 10 on a second side of the drive sheave 6. The main ropes 8 are wound around the deflecting sheave 11 between the drive sheave 6 and the car return sheave 9.

[0016] The respective rotating shafts of the car return sheave 9, the counterweight return sheave 10, and the deflecting sheave 11 are horizontal, and are mutually parallel. In other words, the rotating shafts of the car return sheave 9, the counterweight return sheave 10, and the

deflecting sheave 11 are parallel to a depth direction of the car 3 (a vertical direction in Figure 1).

[0017] A direction of flexure of the main ropes 8 at the car return sheave 9 and a direction of flexure of the main ropes 8 at the deflecting sheave 11 are mutually opposite directions. The car return sheave 9 is disposed directly below a portion of the main ropes 8 between the drive sheave 6 and the deflecting sheave 11. A gap g is disposed between the car return sheave 9 and the main ropes 8 that are positioned directly above it.

[0018] A main rope connecting portion 12 that functions as a suspending means connecting portion that connects the main ropes 8 to the car 3 is disposed on a central portion of an upper surface (in a vicinity of a center of gravity) of the car 3. The driving machine 5 and the deflecting sheave 11 are disposed on opposite sides of the main rope connecting portion 12 from each other in a vertically projected plane. The car return sheave 9 is disposed in closer proximity to the driving machine 5 than the deflecting sheave 11.

[0019] The main ropes 8 are disposed so as to be horizontal (or nearly horizontal) in an interval from the drive sheave 6 to the deflecting sheave 11 and in an interval from the drive sheave 6 to the counterweight return sheave 10. A portion of the main ropes 8 from the drive sheave 6 to the deflecting sheave 11 and a portion of the main ropes 8 from the drive sheave 6 to the counterweight return sheave 10 are disposed so as to be parallel to the width direction of the car 3.

[0020] The driving machine 5, the car return sheave 9, the counterweight return sheave 10, and the deflecting sheave 11 are unitized as a driving machine unit 14, and are mounted to a common rectangular supporting frame 13. The supporting frame 13 has first through fourth supporting beams 13a through 13d that constitute four sides of a rectangle. The supporting frame 13 is mounted to upper portions of the car guide rails 1a and 1b and the counterweight guide rails 2a and 2b inside the hoistway.

[0021] Figure 3 is a perspective that shows part of the elevator apparatus from Figure 2 enlarged, and Figure 4 is a plan that shows the car return sheave 9 and the deflecting sheave 11 from Figure 3. A plurality of car return sheave grooves 9a, 9b, and 9c into which the main ropes 8 are inserted are disposed on the car return sheave 9 so as to have a predetermined spacing. The plurality of counterweight return sheave grooves 10a, 10b, and 10c into which the main ropes 8 are inserted are disposed on the counterweight return sheave 10 so as to have a predetermined spacing. A plurality of deflecting sheave grooves 11a, 11b, and 11c into which the main ropes 8 are inserted are disposed on the deflecting sheave 11 so as to have a predetermined spacing.

[0022] Spacing P1 between the car return sheave grooves 9a, 9b, and 9c is greater than spacing P2 between the deflecting sheave grooves 11a, 11b, and 11c. Spacing P3 between the main ropes 8 in the main rope connecting portion 12 is greater than the spacing P1 between the car return sheave grooves 9a, 9b, and 9c (P2

< $P1 < P3$). An angle θ_1 at which a portion of the main ropes 8 between the main rope connecting portion 12 and the car return sheave 9 enters a groove 9a when the car 3 is positioned at the uppermost floor is greater than an angle θ_2 at which a portion of the main ropes 8 between the car return sheave 9 and the deflecting sheave 11 enters grooves 11a and 9a.

[0023] Since the rotating shaft of the drive sheave 6 is vertical, and the orientation of the rotating shaft of the deflecting sheave 11 is horizontal, the main ropes 8 have a shape that is pinched (twisted) between the drive sheave 6 and the deflecting sheave 11. Because of this, spacing between the main ropes 8 at an intermediate point between the drive sheave 6 and the deflecting sheave 11 is smaller than the spacing P2 between the deflecting sheave grooves 11a, 11b, and 11c. Consequently, the spacing P2 is set to the smallest dimension at which the main ropes 8 do not contact each other at the intermediate point between the drive sheave 6 and the deflecting sheave 11.

[0024] In an elevator apparatus of this kind, since the rotating shafts of the car return sheave 9, the counterweight return sheave 10, and the deflecting sheave 11 are all horizontal, and the direction of flexure of the main ropes 8 at the car return sheave 9 and the direction of flexure of the main ropes 8 at the deflecting sheave 11 are reverse directions to each other, accommodation of car dimension modifications can be facilitated, enabling productivity to be improved.

[0025] For example, Figure 5 is a plan that shows a layout in a case in which a size of the car 3 from Figure 1 has been modified (reduced), wherein distances between the driving machine 5, the car return sheave 9, the counterweight return sheave 10, and the deflecting sheave 11 have simply been changed without having to modify the angles of disposition of the main ropes 8. In other words, size modifications to the car 3 can be accommodated simply by changing a longitudinal dimension of the driving machine unit 14.

[0026] Since the driving machine 5, the car return sheave 9, the counterweight return sheave 10, and the deflecting sheave 11 are unitized as a driving machine unit 14, they can be integrated before being dispatched from a factory and can be raised together and fixed to the supporting frame 13 during installation work, enabling installation work operations to be simplified.

[0027] In addition, since the supporting frame 13 onto which the driving machine unit 14 has been mounted is fixed to the car guide rails 1a and 1b and the counterweight guide rails 2a and 2b, vertical load due to gravitational forces that act on the car 3 and the counterweight 4 can be supported uniformly by the four rails 1a, 1b, 2a, and 2b, enabling rails 1a, 1b, 2a, and 2b that have small cross sections to be used.

[0028] Because the car return sheave 9 is disposed directly below a portion of the main ropes 8 between the drive sheave 6 and the deflecting sheave 11, a height dimension of the driving machine unit 14 can be reduced

by reducing the gap g.

Because the driving machine 5 is disposed directly above the car 3 so as to overlap with the car 3 in a vertically projected plane, and the drive sheave 6 is disposed on the upper portion of the driving machine main body 7, maintenance work on the driving machine main body 7 can be performed easily from on top of the car 3.

[0029] Now, the spacing P3 between the main ropes 8 in the main rope connecting portion 12 is determined by the magnitude of the main rope connecting portion 12, and is considerably greater than the spacing P2 between the deflecting sheave grooves 11a, 11b, and 11c. Because of this, the approach angles (the fleet angles) θ_1 and θ_2 of the main ropes 8 are increased if the spacing P1 between the car return sheave grooves 9a, 9b, and 9c is reduced, or clearance between the car 3 and the car return sheave 9 when the car 3 is positioned at the uppermost floor is reduced, etc. For example, if P1 were hypothetically made to equal P2, the approach angle θ_1 would be considerably larger than the state in Figure 3. If P1 were hypothetically made to equal P3, the approach angle θ_2 would be considerably larger than the state in Figure 4.

[0030] In contrast to that, in Embodiment 1, since $P2 < P1 < P3$ the approach angles θ_1 and θ_2 can be kept small. Thus, the main ropes 8 are prevented from disengaging from the car return sheave grooves 9a and 9c, the surfaces of the main ropes 8 are prevented from being worn, etc. Horizontal dimensions of the driving machine unit 14 can be also reduced. In addition, a vertical gap between the car 3 and the driving machine unit 14 when the car 3 is positioned at the uppermost floor can be reduced, enabling overall dimensions of the elevator apparatus to be reduced.

Embodiment 2

[0031] Next, Figure 6 is a plan that shows an elevator apparatus according to Embodiment 2 of the present invention. In the figure, a counterweight 4 is disposed behind a car 3 so as to face a back surface of the car 3 when positioned level with the car 3. Rotating shafts of a car return sheave 9, a counterweight return sheave 10, and a deflecting sheave 11 are parallel to a width direction of the car 3.

[0032] A portion of main ropes 8 from a drive sheave 6 to the deflecting sheave 11 and a portion of the main ropes 8 from the drive sheave 6 to the counterweight return sheave 10 are disposed so as to be parallel to a depth direction of the car 3. An aperture 13e through which passes a portion of the main ropes 8 between the counterweight return sheave 10 and the counterweight 4 is disposed on a fourth supporting beam 13d. The rest of the configuration is similar to that of Embodiment 1.

[0033] Thus, even if the counterweight 4 is disposed behind the car 3, size modifications to the car 3 can be accommodated simply by changing a longitudinal dimension of the driving machine unit 14 as shown in Figure 7,

for example.

Embodiment 3

[0034] Next, Figure 8 is a plan that shows an elevator apparatus according to Embodiment 3 of the present invention. In this example, two driving machine units 14A and 14B are supported by a supporting frame 13. That is, a driving machine according to Embodiment 3 includes: a first driving machine 5A that has a first drive sheave 6A and a first driving machine main body 7A; and a second driving machine 5B that has a second drive sheave 6B and a second driving machine main body 7B.

[0035] A suspending means includes: a plurality of first main ropes that are wound around the first drive sheave 6A; and a plurality of second main ropes 8B that are wound around the second drive sheave 6B. A car return sheave includes: a first car return sheave 9A around which the first main ropes 8A are wound; and a second car return sheave 9B around which the second main ropes 8B are wound.

[0036] A counterweight return sheave includes: a first counterweight return sheave 10A around which the first main ropes 8A are wound; and a second counterweight return sheave 10B around which the second main ropes 8B are wound. A deflecting sheave includes: a first deflecting sheave 11A around which the first main ropes 8A are wound; and a second deflecting sheave 11B around which the second main ropes 8B are wound.

[0037] The first driving machine 5A, the first car return sheave 9A, the first counterweight return sheave 10A, and the first deflecting sheave 11A are unitized as a first driving machine unit 14A and mounted to the supporting frame 13. The second driving machine 5B, the second car return sheave 9B, the second counterweight return sheave 10B, and the second deflecting sheave 11B are unitized as a second driving machine unit 14B and mounted to the supporting frame 13.

[0038] Positions of disposition of the second driving machine 5B, the second car return sheave 9B, the second counterweight return sheave 10B, and the second deflecting sheave 11B in the second driving machine unit 14B are symmetrical to positions of disposition of the first driving machine 5A, the first car return sheave 9A, the first counterweight return sheave 10A, and the first deflecting sheave 11A in the first driving machine unit 14A.

[0039] An aperture 13e through which passes a portion of the first main ropes 8A between the first counterweight return sheave 10A and the counterweight 4, and an aperture 13f through which passes a portion of the second main ropes 8B between the second counterweight return sheave 10B and the counterweight 4 are disposed on a fourth supporting beam 13d. The rest of the configuration is similar to that of Embodiment 2.

[0040] Thus, even if two driving machine units 14A and 14B are used, size modifications to the car 3 can be accommodated simply by changing longitudinal dimensions of the driving machine units 14A and 14B.

Embodiment 4

[0041] Next, Figure 9 is a plan that shows an elevator apparatus according to Embodiment 4 of the present invention. Positions of disposition of a second driving machine 5B, a second car return sheave 9B, a second counterweight return sheave 10B, and a second deflecting sheave 11B in a second driving machine unit 14B are identical to positions of disposition of a first driving machine 5A, a first car return sheave 9A, a first counterweight return sheave 10A, and a first deflecting sheave 11A in a first driving machine unit 14A. The rest of the configuration is similar to that of Embodiment 3.

[0042] Thus, even if two driving machine units 14A and 14B that have identical configurations are used, size modifications to the car 3 can be accommodated simply by changing longitudinal dimensions of the driving machine units 14A and 14B.

[0043] Moreover, in Embodiments 3 and 4, the counterweight 4 was disposed behind the car 3, but the counterweight 4 may also be disposed beside the car 3 in a similar manner to that of Embodiment 1.

In Embodiments 3 and 4, the first and second main ropes 8A and 8B are connected to a common counterweight 4, but the counterweight 4 may also be divided into two.

Embodiment 5

[0044] Next, Figure 10 is a perspective that shows part of an elevator apparatus according to Embodiment 5 of the present invention, and Figure 11 is a plan that shows the elevator apparatus from Figure 10. In the figures, a driving machine 15 is disposed in an upper portion inside a hoistway. The driving machine 15 has: a drive sheave 16; and a driving machine main body 17 that rotates the drive sheave 16. The driving machine 15 is disposed such that a rotating shaft of the drive sheave 16 is vertical (or nearly vertical). The driving machine main body 17 has a motor that rotates the drive sheave 16; and a brake that brakes the rotation of the drive sheave 16.

[0045] A long, slender hoisting machine in which an axial dimension is greater than a dimension that is perpendicular to an axial direction is used as the driving machine 15. In addition, the driving machine 15 is disposed outside a region of the car 3 in a vertically projected plane. Specifically, the driving machine main body 17 is disposed in a gap between a side surface on an opposite side of the car 3 from the counterweight 4 and a hoistway wall in the vertically projected plane. The drive sheave 16 is disposed on an upper portion of the driving machine main body 17. In other words, the drive sheave 16 faces a hoistway ceiling.

[0046] The driving machine 15, a car return sheave 9, a counterweight return sheave 10, and a deflecting sheave 11 are unitized as a driving machine unit 14, and are mounted to a common rectangular supporting frame 13. The rest of the configuration is similar to that of Embodiment 1.

[0047] In an elevator apparatus of this kind, size modifications to the car 3 can be accommodated simply by changing a longitudinal dimension of the driving machine unit 14, and overall dimensions of the elevator apparatus can be reduced.

[0048] Moreover, in the above examples, constructions in which the supporting frame 13 is supported by the guide rails 1a, 1b, 2a, and 2b have been assumed, but the supporting frame 13 may also be supported by building beams, etc.

The main ropes 8 may be ropes that have circular cross sections, or may also be belt-shaped ropes.

In addition, the rotating shafts of the drive sheaves do not need to be perfectly vertical, and may be inclined to a certain extent (less than 30 degrees relative to a vertical line, for example).

In the above examples, elevator apparatuses that use a one-to-one (1:1) roping method have been shown, but are not limited to this, and a two-to-one (2:1) roping method can also be adopted, for example, by disposing a car suspension sheave on an upper portion of the car 3 and disposing a counterweight suspension sheave on an upper portion of the counterweight 4.

Claims

1. An elevator apparatus comprising:

a driving machine that has: a drive sheave; and a driving machine main body that rotates the drive sheave, the driving machine being disposed in an upper portion of a hoistway such that a rotating shaft of the drive sheave is vertical;

a suspending means that is wound around the drive sheave;

a car and a counterweight that are suspended inside the hoistway by the suspending means, and that are raised and lowered by the driving machine;

a car return sheave that is disposed above the car, around which the suspending means is wound on a first side of the drive sheave, and that directs the suspending means to the car;

a counterweight return sheave that is disposed above the counterweight, around which the suspending means is wound on a second side of the drive sheave, and that directs the suspending means to the counterweight; and

a deflecting sheave that is disposed in an upper portion of the hoistway, and around which the suspending means is wound between the drive sheave and the car return sheave,

wherein:

respective rotating shafts of the car return sheave, the counterweight return sheave, and the deflecting sheave are horizontal; and

a direction of flexure of the suspending means at the car return sheave and a direction of flexure of the suspending means at the deflecting sheave are mutually opposite directions.

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

rotating shafts of the car return sheave, the counterweight return sheave, and the deflecting sheave are mutually parallel; and the car return sheave is disposed directly below a portion of the suspending means between the drive sheave and the deflecting sheave.

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

a suspending means connecting portion that connects the suspending means to the car is disposed on a central portion of an upper surface of the car;

the driving machine and the deflecting sheave are disposed on mutually opposite sides of the suspending means connecting portion in a vertically projected plane; and

the car return sheave is disposed in closer proximity to the driving machine than the deflecting sheave.

4. An elevator apparatus according to Claim 1, wherein:

the suspending means is disposed so as to be horizontal in an interval from the drive sheave to the deflecting sheave, and in an interval from the drive sheave to the counterweight return sheave.

5. An elevator apparatus according to Claim 1, wherein:

the suspending means includes a plurality of main ropes;

a plurality of car return sheave grooves into which the main ropes are inserted are disposed on the car return sheave so as to have a predetermined spacing;

a plurality of deflecting sheave grooves into which the main ropes are inserted is disposed on the deflecting sheave so as to have a predetermined spacing; and

the spacing between the car return sheave grooves is greater than the spacing between the deflecting sheave grooves.

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

a main rope connecting portion that connects the main ropes to the car is disposed on an upper portion of the car; and

a spacing between the main ropes in the main

rope connecting portion is greater than the spacing between the car return sheave grooves.

7. An elevator apparatus according to Claim 1, wherein the drive sheave is disposed on an upper portion of the driving machine main body. 5
8. An elevator apparatus according to Claim 7, wherein the driving machine is a thin hoisting machine in which an axial dimension is less than a dimension that is perpendicular to an axial direction, and is disposed so as to overlap with the car in a vertically projected plane. 10
9. An elevator apparatus according to Claim 7, wherein the driving machine is a long, slender hoisting machine in which an axial dimension is greater than a dimension that is perpendicular to an axial direction, and is disposed outside a region of the car in a vertically projected plane. 15
10. An elevator apparatus according to Claim 1, wherein the driving machine, the car return sheave, the counterweight return sheave, and the deflecting sheave are unitized as a driving machine unit, and are mounted to a common supporting frame. 20
11. An elevator apparatus according to Claim 10, further comprising a plurality of guide rails that are installed inside the hoistway, and that guide raising and lowering of the car and the counterweight, and the supporting frame is mounted to the guide rails inside the hoistway. 25
12. An elevator apparatus according to Claim 1, wherein: 30

the driving machine includes: a first driving machine that has a first drive sheave and a first driving machine main body; and a second driving machine that has a second drive sheave and a second driving machine main body; 40

the suspending means includes: a first main rope that is wound around the first drive sheave; and a second main rope that is wound around the second drive sheave; 45

the car return sheave includes: a first car return sheave around which the first main rope is wound, and a second car return sheave around which the second main rope is wound; 50

the counterweight return sheave includes: a first counterweight return sheave around which the first main rope is wound, and a second counterweight return sheave around which the second main rope is wound; 55

the deflecting sheave includes: a first deflecting sheave around which the first main rope is wound, and a second deflecting sheave around which the second main rope is wound;

the first driving machine, the first car return sheave, the first counterweight return sheave, and the first deflecting sheave are unitized as a first driving machine unit; and
the second driving machine, the second car return sheave, the second counterweight return sheave, and the second deflecting sheave are unitized as a second driving machine unit.

13. An elevator apparatus according to Claim 12, wherein positions of disposition of the second driving machine, the second car return sheave, the second counterweight return sheave, and the second deflecting sheave in the second driving machine unit are symmetrical relative to positions of disposition of the first driving machine, the first car return sheave, the first counterweight return sheave and the first deflecting sheave in the first driving machine unit.
14. An elevator apparatus according to Claim 12, wherein positions of disposition of the second driving machine, the second car return sheave, the second counterweight return sheave, and the second deflecting sheave in the second driving machine unit are identical to positions of disposition of the first driving machine, the first car return sheave, the first counterweight return sheave and the first deflecting sheave in the first driving machine unit.

FIG. 1

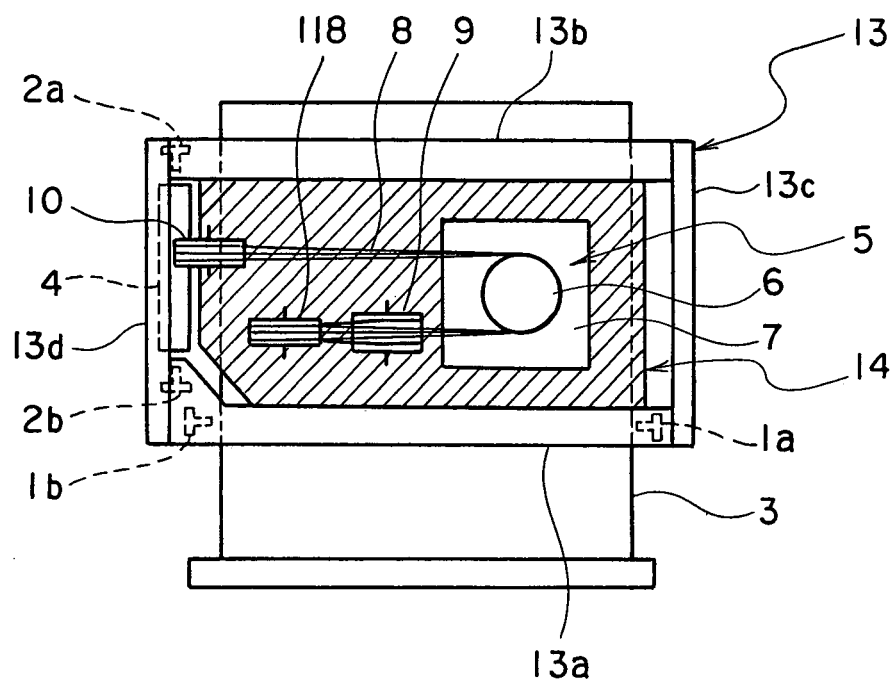


FIG. 2

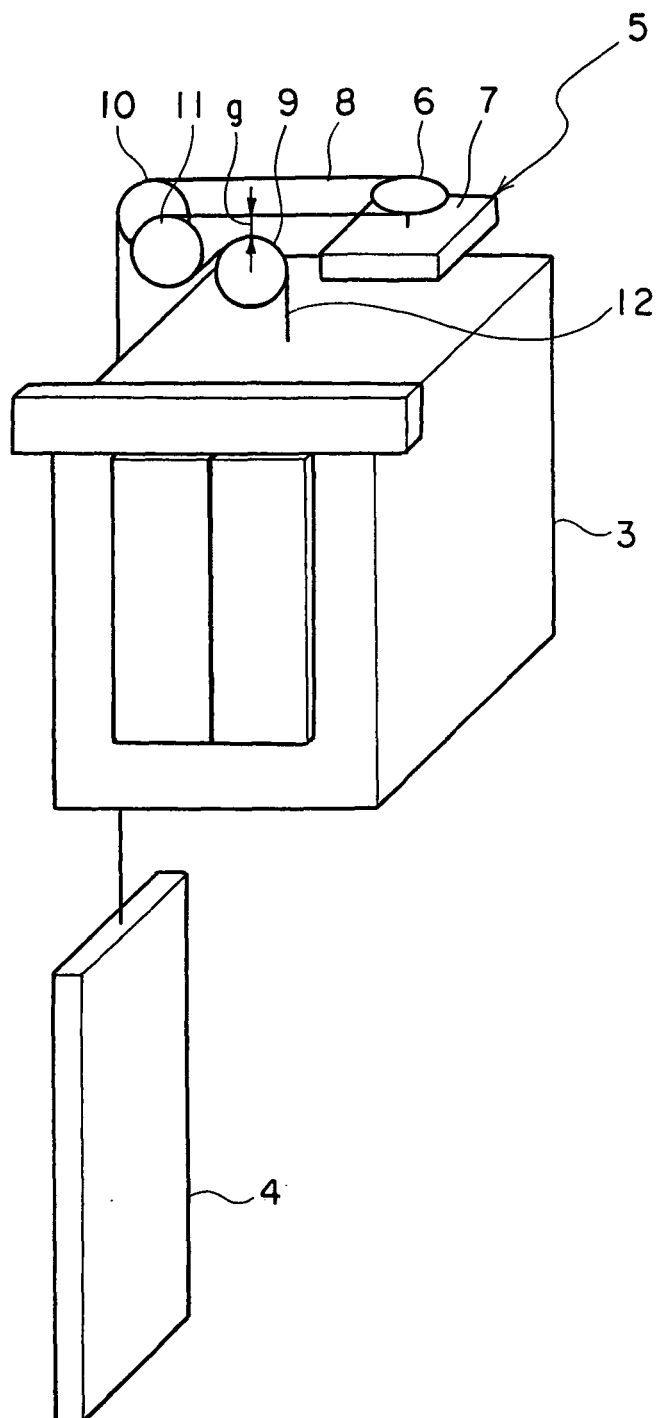


FIG. 3

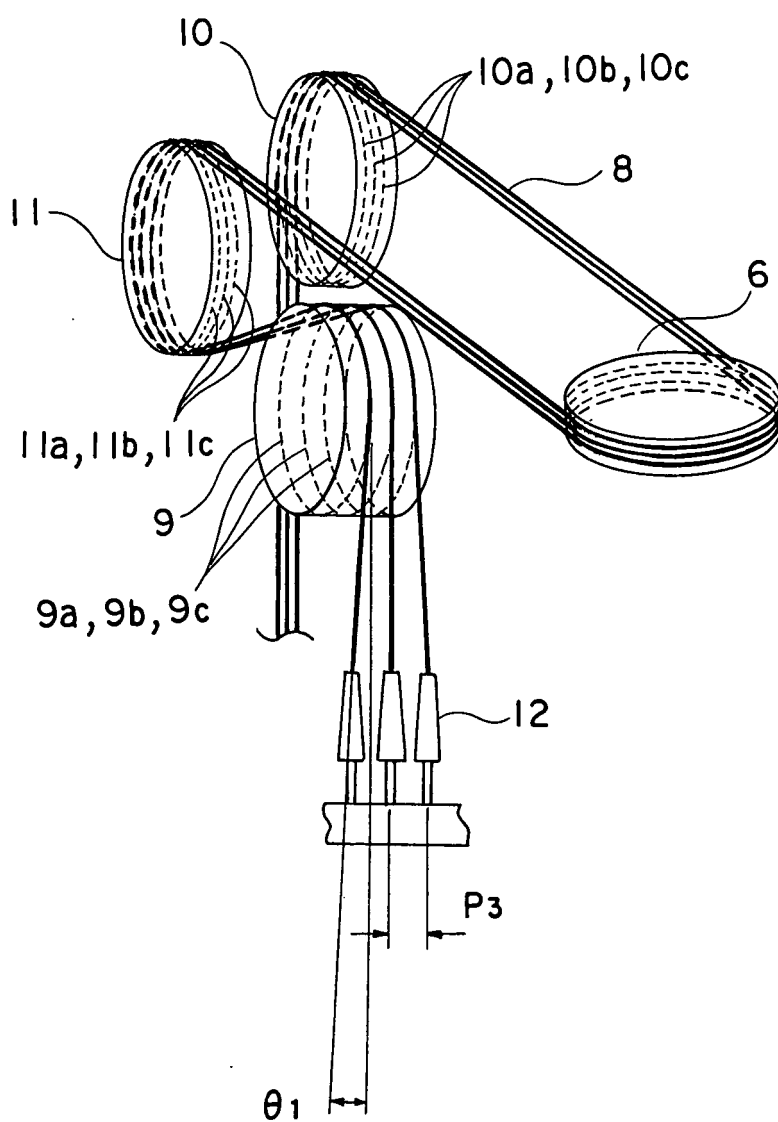


FIG. 4

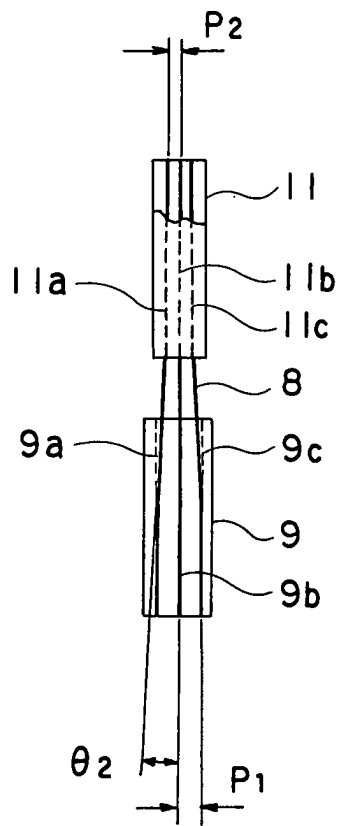


FIG. 5

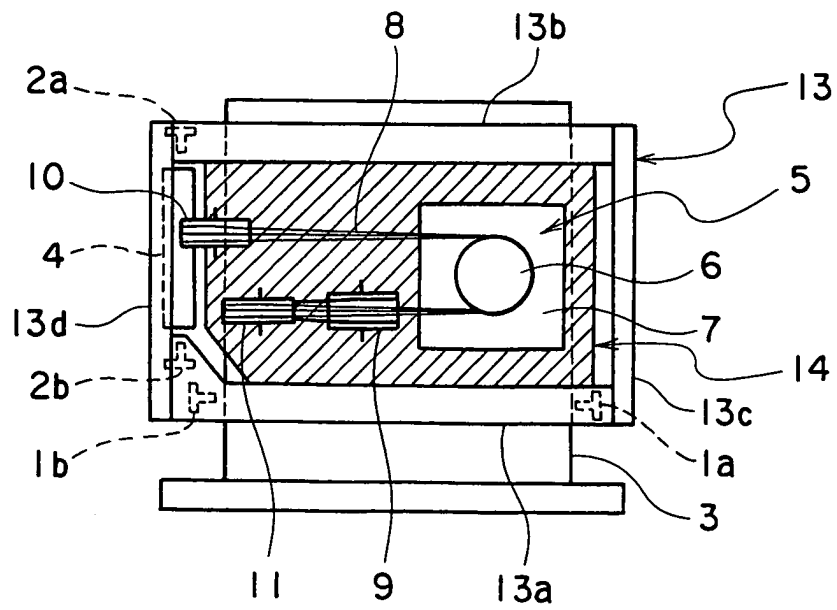


FIG. 6

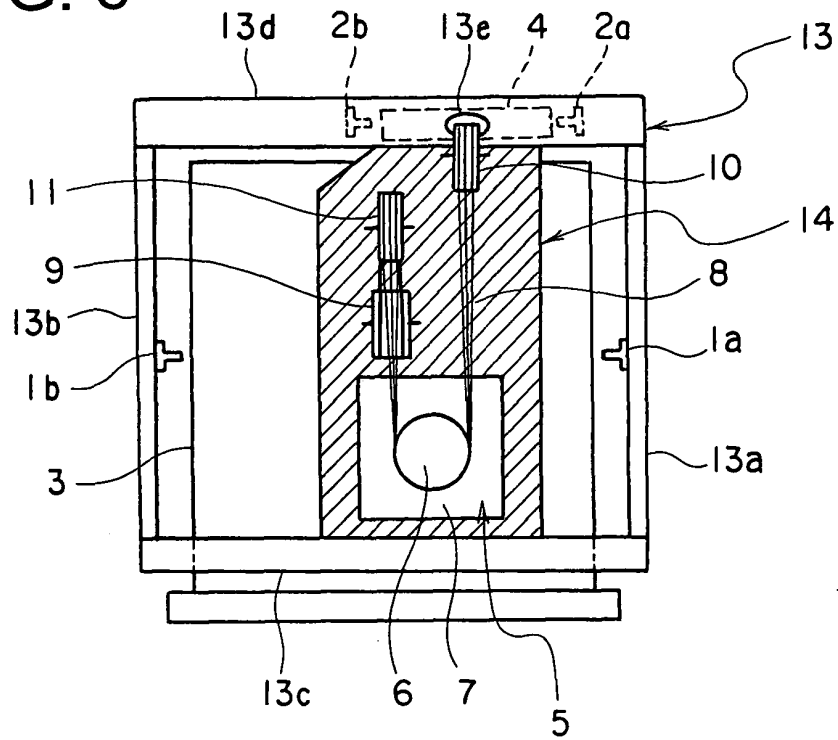


FIG. 7

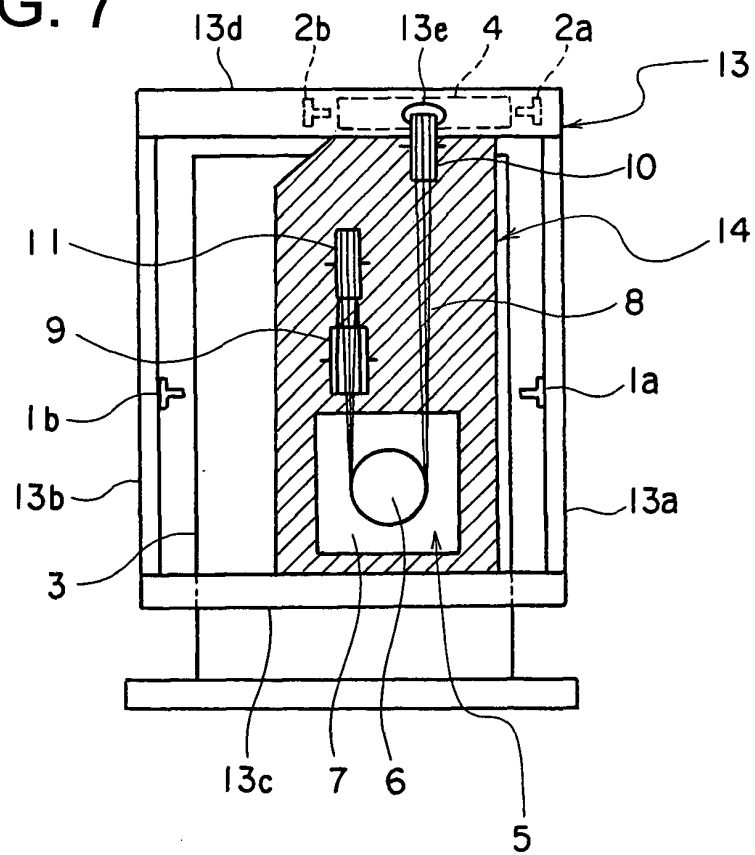


FIG. 8

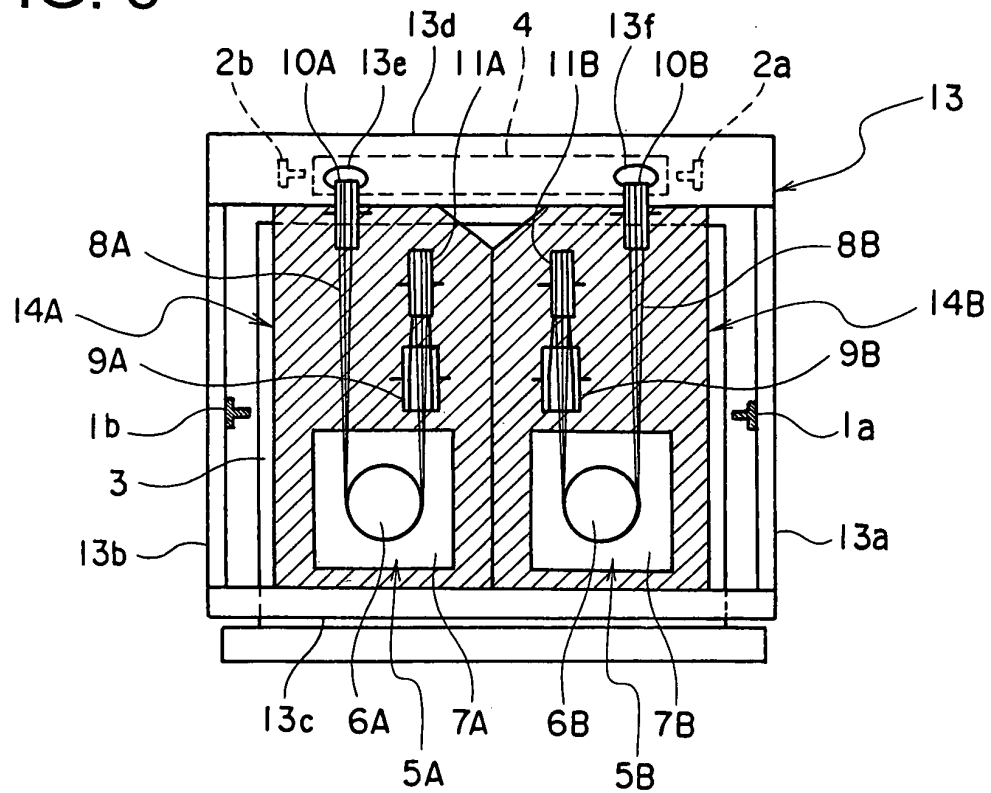


FIG. 9

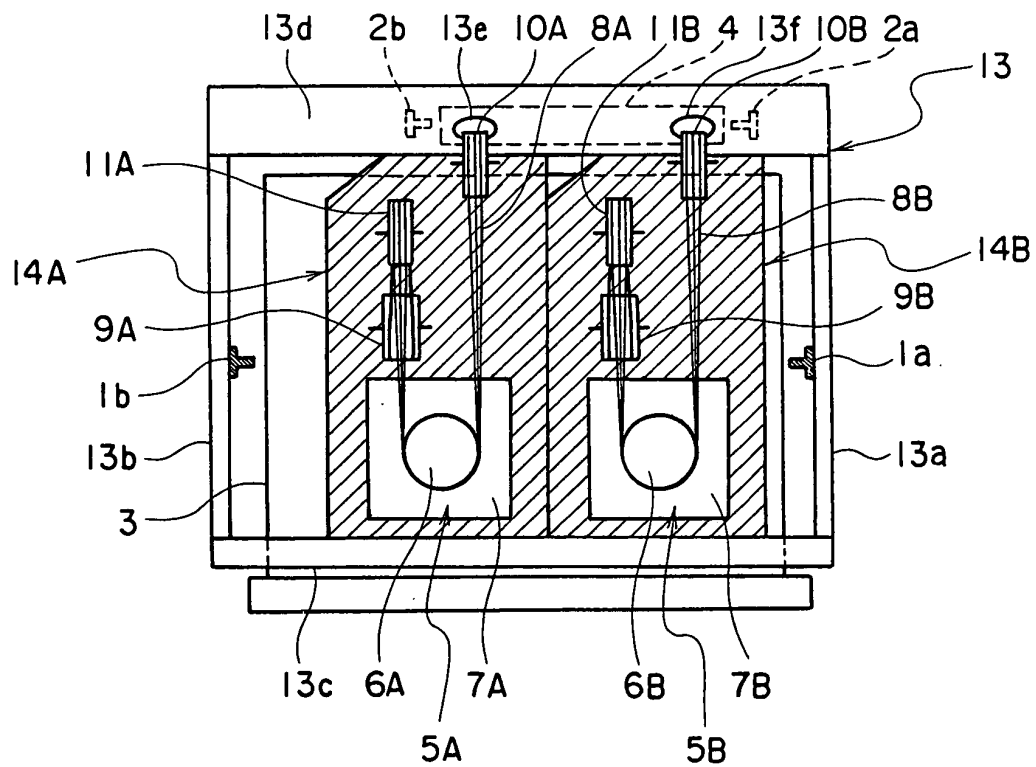


FIG.10

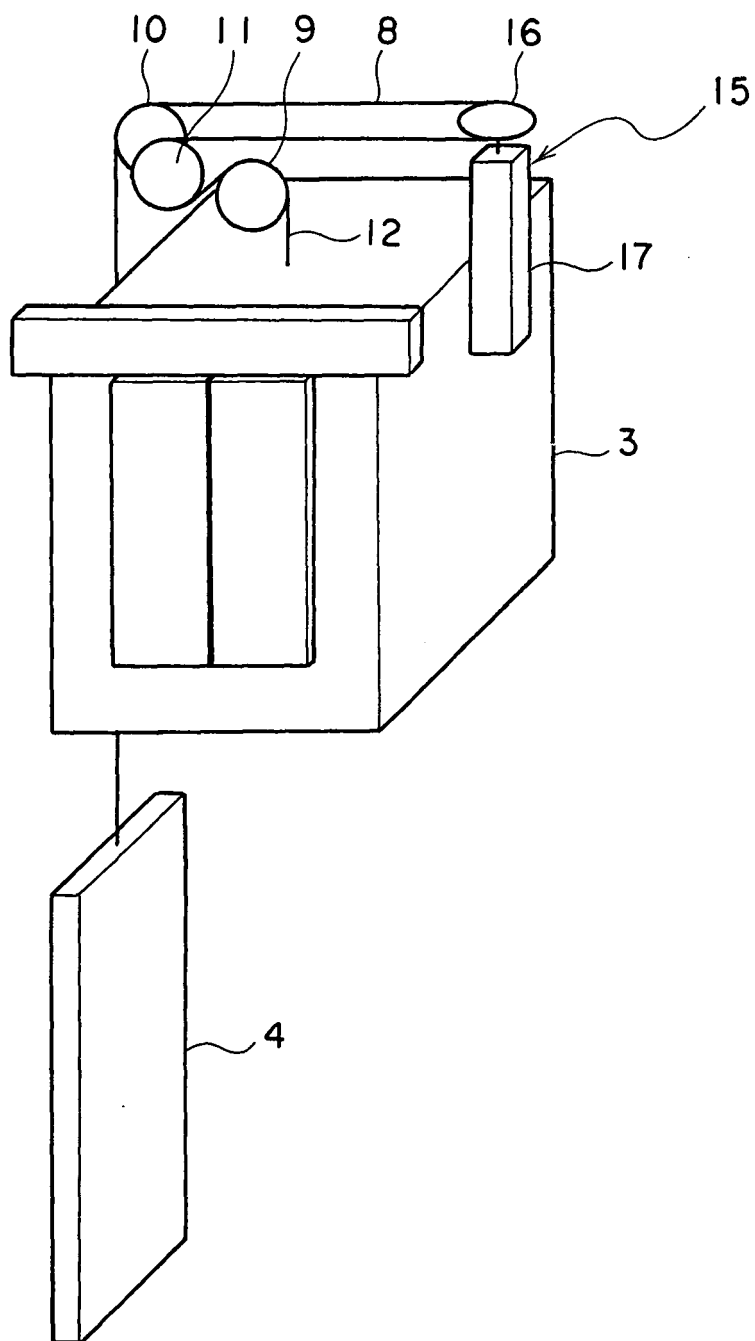
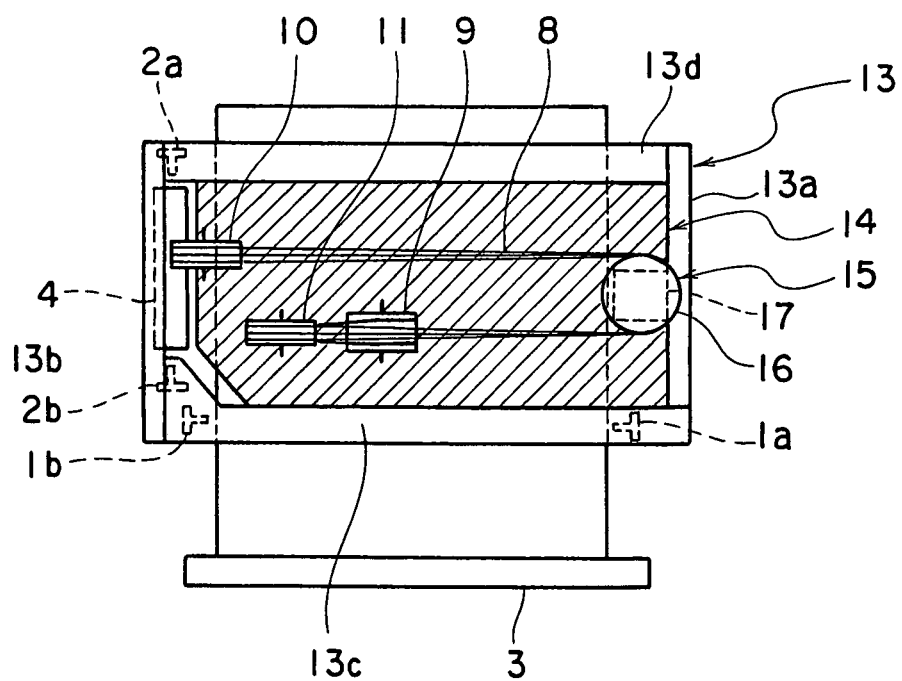


FIG.11



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/061165

A. CLASSIFICATION OF SUBJECT MATTER

B66B11/08 (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)

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 1996-2008

Kokai Jitsuyo Shinan Koho 1971-2008 Toroku Jitsuyo Shinan Koho 1994-2008

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.
A	JP 2004-168518 A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 17 June, 2004 (17.06.04), (Family: none)	1-14
A	WO 2002/018256 A1 (Mitsubishi Electric Corp.), 07 March, 2002 (07.03.02), Description, page 3, lines 8 to 17; Fig. 3 & EP 1327596 A1 & CN 1382100 A	1
A	JP 2006-168978 A (Hitachi, Ltd.), 29 June, 2006 (29.06.06), Par. Nos. [0073] to [0080]; Figs. 8 to 9 (Family: none)	1, 3



Further documents are listed in the continuation of Box C.



See patent family annex.

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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

15 February, 2008 (15.02.08)

Date of mailing of the international search report

26 February, 2008 (26.02.08)

Name and mailing address of the ISA/

Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/061165

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2002/018257 A1 (Mitsubishi Electric Corp.), 07 March, 2002 (07.03.02), Description, page 5, lines 9 to 21; Figs. 5 to 6 & EP 1314680 A & CN 1382099 A	2
A	WO 2004/005177 A1 (Mitsubishi Electric Corp.), 15 January, 2004 (15.01.04), Example 4; Fig. 8 & EP 1520830 A1 & CN 1582251 A	5
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 167058/1981 (Laid-open No. 075268/1983) (Hitachi, Ltd.), 21 May, 1983 (21.05.83), Description, page 2, lines 14 to 16; Fig. 1 (Family: none)	6
A	WO 2002/098782 A1 (Mitsubishi Electric Corp.), 12 December, 2002 (12.12.02), Claims & EP 1396457 A1 & CN 1457315 A	7,10-11
A	JP 2004-018170 A (Toshiba Elevator and Building Systems Corp.), 22 January, 2004 (22.01.04), Abstract; Fig. 1 & US 2004/0206580 A1 & EP 1514827 A1 & WO 2003/0106320 A1 & CN 1545479 A	9
A	WO 2005/056455 A1 (Mitsubishi Electric Corp.), 23 June, 2005 (23.06.05), Modes 11 to 12 for carrying out the invention; Figs. 14 to 17 & US 2006/0175138 A1 & EP 1693328 A1	12-13

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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