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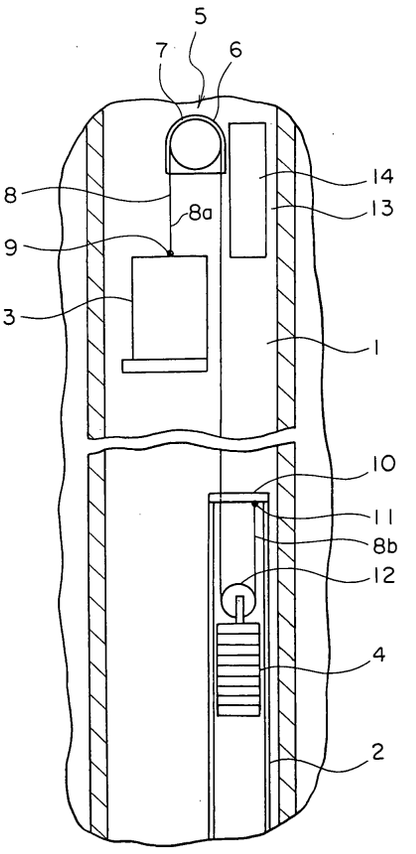
(54) ELEVATOR EQUIPMENT

(57) In an elevator apparatus, a car and a counterweight are suspended at mutually-differing roping ratios such that a hoisting zone of the counterweight is shorter than a hoisting zone of the car, and an equipment installation space is secured inside a hoistway by making use of the difference between the hoisting zone of the car and the counterweight.

FIG. 1



EP 1 544 150 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which equipment is installed inside a hoistway.

BACKGROUND ART

[0002] A machine-roomless elevator in which a machine room is not disposed in an upper portion of a hoistway is disclosed in Japanese Patent Laid-Open No. HEI 7-10434 (Gazette), for example. In machine-roomless elevators of this kind, a driving machine and a control panel, etc., are disposed using vacant space inside the hoistway.

[0003] However, in conventional machine-roomless elevators, since the vacant space inside the hoistway is restrictive, it is difficult to dispose the driving machine and the control panel there, and the driving machine and the control panel are subject to constraints on size and shape. Consequently, it has been difficult to apply machine-roomless elevators to highly-functional, high-performance elevators using large hoisting machines, control panels, etc., or using a plurality of control panels, etc.

DISCLOSURE OF THE INVENTION

[0004] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus enabling a large equipment installation space to be secured inside a hoistway.

[0005] 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 having a drive sheave; a main rope wound onto the driving-machine; and a car and a counterweight suspended inside a hoistway by the main rope so as to be raised and lowered inside the hoistway by a driving force from the driving machine, wherein: the car and the counterweight are suspended at mutually-differing roping ratios such that a hoisting zone of the counterweight is shorter than a hoisting zone of the car; and an equipment installation space is secured inside the hoistway by making use of the difference between the hoisting zone of the car and the hoisting zone of the counterweight.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Figure 1 is a schematic structural diagram showing an elevator apparatus according to Embodiment 1 of the present invention;
Figure 2 is a front elevation showing an elevator apparatus according to Embodiment 2 of the present invention;
Figure 3 is a plan showing the elevator apparatus in Figure 2;
Figure 4 is a schematic structural diagram showing an elevator apparatus according to Embodiment 3 of the present invention;
Figure 5 is a front elevation showing an elevator apparatus according to Embodiment 4 of the present invention;
Figure 6 is a plan showing the elevator apparatus in Figure 5;
Figure 7 is a schematic structural diagram showing an elevator apparatus according to Embodiment 5 of the present invention; and
Figure 8 is a schematic structural diagram showing an elevator apparatus according to Embodiment 6 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0007] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0008] Figure 1 is a schematic structural diagram showing an elevator apparatus according to Embodiment 1 of the present invention. In the figure, a pair of car guide rails (not shown) and a pair of counterweight guide rails 2 are installed inside a hoistway 1. A car 3 is guided by the car guide rails so as to be raised and lowered inside the hoistway 1. A counterweight 4 is guided by the counterweight guide rails 2 so as to be raised and lowered inside the hoistway 1.

[0009] A driving machine (a hoisting machine) 5 for raising and lowering the car 3 and the counterweight 4 is disposed in an upper portion inside the hoistway 1. The driving machine 5 has: a driving machine main body 6 including a motor; and a drive sheave 7 rotated by the driving machine main body 6.

[0010] A plurality of main ropes 8 (only one is shown in the figure) for suspending the car 3 and the counterweight 4 are wound around the drive sheave 7. The main ropes 8 have car end portions 8a and counterweight end portions 8b. The car end portions 8a are connected to an upper portion of the car 3 by means of car rope fasteners 9.

[0011] A rope end supporting beam 10 is fixed to an upper end portion of the counterweight guide rails 2. The counterweight end portions 8b are connected to the rope end supporting beam 10 by means of counterweight rope fasteners 11. A counterweight suspension sheave 12 around which the main ropes 8 are wound is disposed on an upper portion of the counterweight 4.

[0012] The car 3 is suspended inside the hoistway 1 using a 1:1 roping method. The counterweight 4 is suspended inside the hoistway 1 using a 2:1 roping method.

Thus, the hoisting zone of the counterweight 4 is shorter than the hoisting zone of the car 3 (approximately half). In other words, the counterweight 4 is raised and lowered below an intermediate portion in a vertical direction of the hoistway 1.

[0013] An equipment installation space 13 is secured above the counterweight 4 inside the hoistway 1 by making use of the difference between the hoisting zone of the car 3 and the hoisting zone of the counterweight 4. A control panel 14 constituting equipment for controlling activation of the driving machine 5 is disposed in this equipment installation space 13. A portion of the driving machine 5 is also disposed in the equipment installation space 13.

[0014] In an elevator apparatus of this kind, because the equipment installation space 13 is secured inside the hoistway 1 by suspending the car 3 and the counterweight 4 at mutually-differing roping ratios such that the hoisting zone of the counterweight 4 is shorter than the hoisting zone of the car 3 and making use of the difference between the hoisting zones, a large equipment installation space 13 can be secured inside the hoistway 1. Consequently, a large driving machine 5 and control panel 14 can be disposed, or a plurality of control panels can be disposed, etc., enabling the range of applications for machine-roomless elevators to be broadened.

[0015] Because the counterweight end portions 8b are connected to the rope end supporting beam 10, the main ropes 8 do not pass through the equipment installation space 13, and equipment such as the control panel 14, etc., disposed in the equipment installation space 13 and the main ropes 8 will not interfere with each other.

[0016] Moreover, in the above example, the car 3 is suspended by a 1:1 roping method and the counterweight 4 is suspended by a 2:1 roping method, but the hoisting zone of the counterweight 4 need only be shorter than the hoisting zone of the car 3 and the roping ratios are not limited to this combination. For example, the car 3 side may also be made 1:1 and the counterweight 4 side 4:1, or the car 3 side made 2:1 and the counterweight 4 side 4:1, etc.

[0017] However, in order to make the hoisting zone of the counterweight 4 shorter than the hoisting zone of the car 3, if the roping ratio for the car 3 is n:1 and the roping ratio for the counterweight 4 is m:1, n should be set to less than m ($n < m$), where n and m are natural numbers.

[0018] An elevator apparatus such as that described above is particularly effective for application to machine-roomless elevators but can also be applied to elevator apparatuses having a machine room, enabling various kinds of equipment to be disposed in a large equipment installation space.

Embodiment 2

[0019] Figure 2 is a front elevation showing an elevator apparatus according to Embodiment 2 of the present invention, and Figure 3 is a plan showing the elevator apparatus in Figure 2. In the figures, a pair of upper portion supporting beams 15 and 16 are fixed horizontally in an upper portion inside a hoistway 1. A driving machine 5 is supported on one of the upper portion supporting beams 15 directly above a car 3. The driving machine 5 is disposed such that a rotating shaft of a drive sheave 7 extends horizontally generally parallel to a direction of frontage of the car 3 (left-to-right in Figures 2 and 3).

[0020] A rotatable deflection sheave 17 for directing main ropes 8 from the drive sheave 7 to a counterweight suspension sheave 12 is supported by the upper portion supporting beams 15 and 16. The deflection sheave 17 is disposed such that a rotating shaft thereof extends parallel to the rotating shaft of the drive sheave 7. The deflection sheave 17 is also disposed so as to overlap with the car 3 and a counterweight 4 in a vertical plane of projection.

[0021] An equipment installation space 13 is secured above the counterweight 4 inside the hoistway 1 by making use of a difference between a hoisting zone of the car 3 and a hoisting zone of the counterweight 4. First and second control panels 18 and 19 constituting equipment for controlling activation of the driving machine 5 are disposed in this equipment installation space 13. The first and second control panels 18 and 19 are fixed to a wall portion of the hoistway 1 at a distance from each other in the direction of frontage of the car 3. The rest of the construction is similar to that of Embodiment 1.

[0022] By disposing first and second control panels 18 and 19 in an equipment installation space 13 above a counterweight 4 in this manner, increased functionality and performance can be achieved in an elevator apparatus. By dividing the control panel into a plurality of parts, each individual control panel can be reduced in size, enabling loading and mounting work during installation to be facilitated.

[0023] Moreover, three or more control panels can also be disposed in an equipment installation space depending on the size of the equipment installation space.

Embodiment 3

[0024] Next, Figure 4 is a schematic structural diagram showing an elevator apparatus according to Embodiment 3 of the present invention. In this example, a resin-coated rope is used for main ropes 21. An outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion of the resin-coated rope. The outer layer coating body is constituted by a high-friction resin material having a coefficient of friction greater than or equal to 0.2, such as a polyurethane resin, for example. A rotatable deflection sheave 22 for directing the main ropes 21 from a drive sheave 7 to a counterweight suspension sheave 12 is disposed in an upper portion inside a hoistway 1. The

rest of the construction is similar to that of Embodiment 1.

[0025] In an elevator apparatus of this kind, because a resin-coated rope is used for the main ropes 21, ample traction capacity can be obtained even if a contact angle of the main ropes 21 on the drive sheave 7 is small.

Embodiment 4

[0026] Figure 5 is a front elevation showing an elevator apparatus according to Embodiment 4 of the present invention, and Figure 6 is a plan showing the elevator apparatus in Figure 5. In the figures, a driving machine 5 is disposed in an upper portion inside a hoistway 1 such that a rotating shaft of a drive sheave 7 extends generally parallel to a depth direction of a car 3. In a vertical plane of projection, a driving machine main body 6 overlaps partially with the car 3, and the drive sheave 7 is disposed between the car 3 and a hoistway wall.

[0027] A lower portion return pulley 23 for turning around main ropes 21 extending downward from the drive sheave 7 and directing them upward is disposed at a position that is lower than the driving machine 5 inside the hoistway 1. In a vertical plane of projection, the lower portion return pulley 23 is disposed in line with the drive sheave 7 between the car 3 and the hoistway wall. A deflection sheave 24 for adjusting an approach angle of the main ropes 21 to the drive sheave 7 is disposed between the drive sheave 7 and the lower portion return pulley 23.

[0028] A pair of upper portion supporting beams 25 and 26 are fixed horizontally in an upper portion inside the hoistway 1. The upper portion supporting beams 25 and 26 are installed so as to be oblique relative to a direction of frontage of the car 3. First and second upper portion return pulleys 27 and 28 for turning around the main ropes 21 extending upward from the lower portion return pulley 23 and directing them toward the car 3 are supported by the upper portion supporting beams 25 and 26. The rest of the construction is similar to that of Embodiment 3.

[0029] In an elevator apparatus of this kind, the driving machine 5 is disposed in an upper portion inside the hoistway 1, and main ropes 21 extending downward from the drive sheave 7 are turned around by the lower portion return pulley 23 to extend upward, and the main ropes 21 extending upward from the lower portion return pulley 23 are turned around by the first and second upper portion return pulleys 27 and 28 and directed toward the car 3. Consequently, a degree of freedom in the disposition of the driving machine 5 can be increased while suspending the car 3 by 1:1 roping. The car 3 is also suspended at a center of gravity, enabling it to be raised and lowered stably.

[0030] In addition, the contact angle of the main ropes 21 on the drive sheave 7 can be increased, enabling traction capacity to be increased. Thus, a diameter of the drive sheave 7 can also be reduced, enabling installation space for the driving machine 5 to be reduced.

Embodiment 5

[0031] Next, Figure 7 is a schematic structural diagram showing an elevator apparatus according to Embodiment 5 of the present invention. In the figure, a car compensating apparatus 31 is disposed between a lower portion of a car 3 and a hoistway wall. A counterweight compensating apparatus 32 is disposed between a lower portion of a counterweight 4 and a hoistway wall. The compensating apparatuses 31 and 32 have a compensating rope or a counterbalancing chain, for example, and compensate for weight imbalances in main ropes 8 depending on positions of the car 3 and the counterweight 4.

[0032] In an elevator apparatus of this kind, because the car compensating apparatus 31 and the counterweight compensating apparatus 32 are disposed separately, weight imbalances in the main ropes 8 can be compensated for by a simple construction.

Embodiment 6

[0033] Next, Figure 8 is a schematic structural diagram showing an elevator apparatus according to Embodiment 6 of the present invention. In the figure, a compensating rope fastener 33 is fixed to a lower portion of a counterweight guide rail 2. A rotatable compensating rope suspension sheave 34 is mounted to a lower portion of a counterweight 4. A compensating rope 35 is wound around the compensating rope suspension sheave 34. The compensating rope 35 has: a first end portion 35a connected to a lower portion of a car 3; and a second end portion 35b connected to the compensating rope fastener 33.

[0034] A portion of the compensating rope 35 between the first end portion 35a and the compensating rope suspension sheave 34 is suspended in a lower portion inside a hoistway 1 so as to describe a U shape. A guide member 36 for preventing excessive swinging of the U-shaped portion is disposed in a lower portion inside the hoistway 1. The guide member 36 is disposed so as to pass through the inside of the U-shaped portion of the compensating rope 35.

[0035] A compensating apparatus according to Embodiment 6 includes: the compensating rope fastener 33; the compensating rope suspension sheave 34; the compensating rope 35; and the guide member 36. The compensating rope 35 is connected to the car 3 by a 1:1 roping method, and connected to the counterweight 4 by a 2:1 roping method, in a similar manner to main ropes 21. The rest of the construction is similar to that of Embodiment 3.

[0036] In an elevator apparatus of this kind, because the compensating rope 35 are connected to the car 3 and the counterweight 4 at roping ratios similar to those of the main ropes 21, weight imbalances in the main

ropes 8 can be compensated more reliably.

Claims

1. An elevator apparatus comprising:

   a driving machine having a drive sheave;
   a main rope wound onto said driving machine; and
   a car and a counterweight suspended inside a hoistway by said main rope so as to be raised and lowered inside said hoistway by a driving force from said driving machine,

   wherein:

   said car and said counterweight are suspended at mutually-differing roping ratios such that a hoisting zone of said counterweight is shorter than a hoisting zone of said car; and
   an equipment installation space is secured inside said hoistway by making use of said difference between said hoisting zone of said car and said hoisting zone of said counterweight.

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

   a counterweight suspension sheave around which said main rope is wound is disposed on said counterweight;
   a counterweight guide rail for guiding raising and lowering of said counterweight is installed inside said hoistway;
   a rope end supporting beam is secured to an upper portion of said counterweight guide rail;
   said main rope has a car end portion and a counterweight end portion;
   said car end portion is connected to said car; and
   said counterweight end portion is connected to said rope end supporting beam.

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

   a plurality of control panels for controlling operation of said car are disposed in said equipment installation space.

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

   said driving machine is disposed directly above said car inside said hoistway; and
   a control panel for controlling operation of said car is disposed in said equipment installation space.

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

   a resin-coated rope in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion is used for said main rope.

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

   said driving machine is disposed in an upper portion inside said hoistway;
   a lower portion return pulley for turning around and directing upward said main rope extending downward from said drive sheave is disposed at a position that is lower than said driving machine inside said hoistway; and
   first and second upper portion return pulleys for turning around and directing toward said car said main rope extending upward from said lower portion return pulley are disposed in an upper portion inside said hoistway.

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

   a car compensating apparatus and a counterweight compensating apparatus for compensating for weight imbalances in said main rope are disposed separately on said car and said counterweight.

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

   a compensating apparatus for compensating for weight imbalances in said main rope, said compensating apparatus having a compensating rope connected to said car and said counterweight at roping ratios similar to said roping ratios of said main rope.

FIG. 1

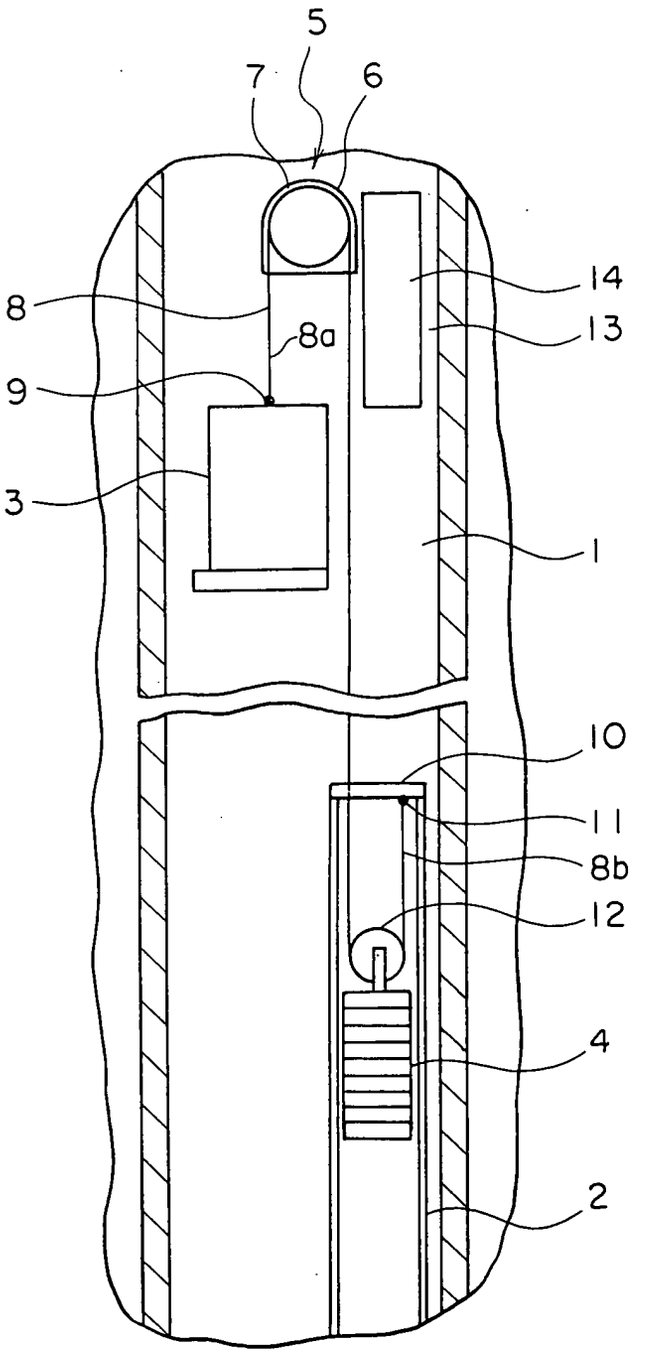


FIG. 2

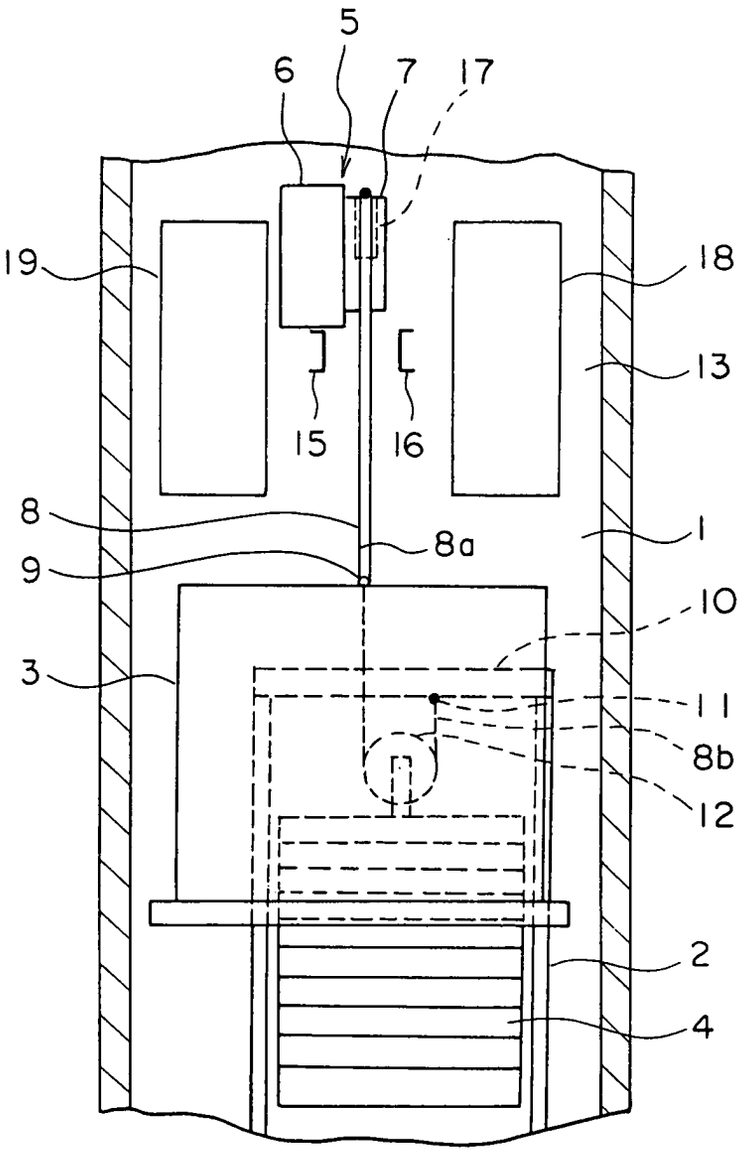


FIG. 3

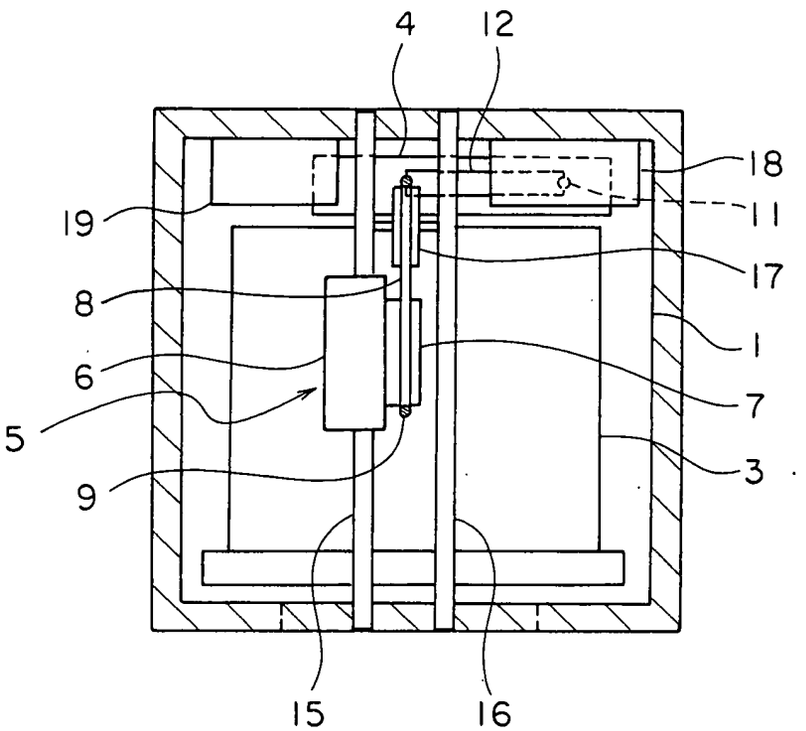


FIG. 4

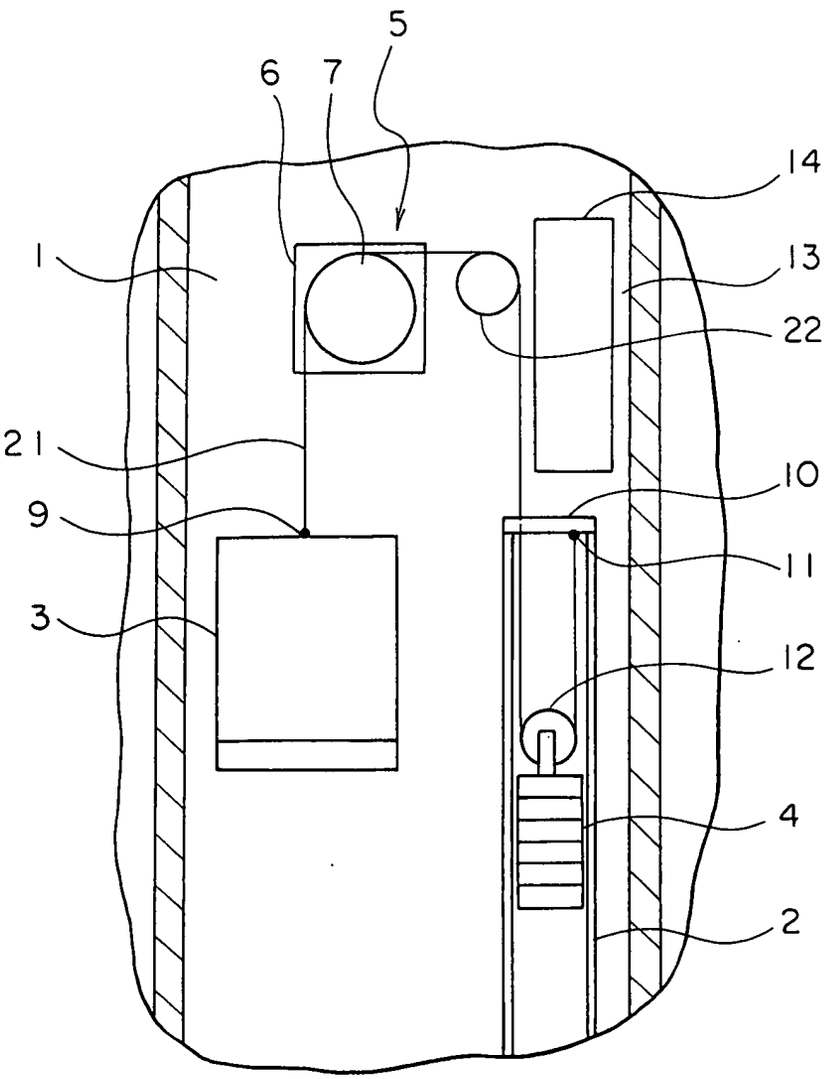


FIG. 5

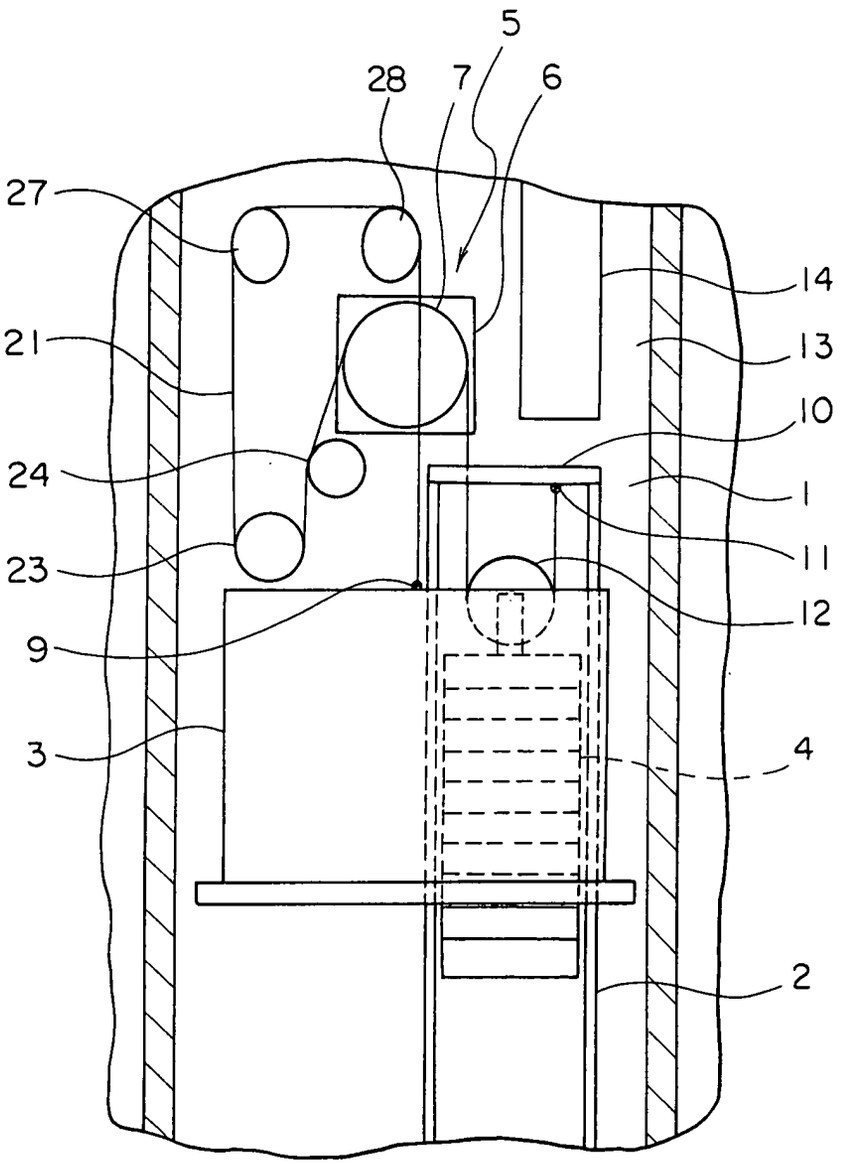


FIG. 6

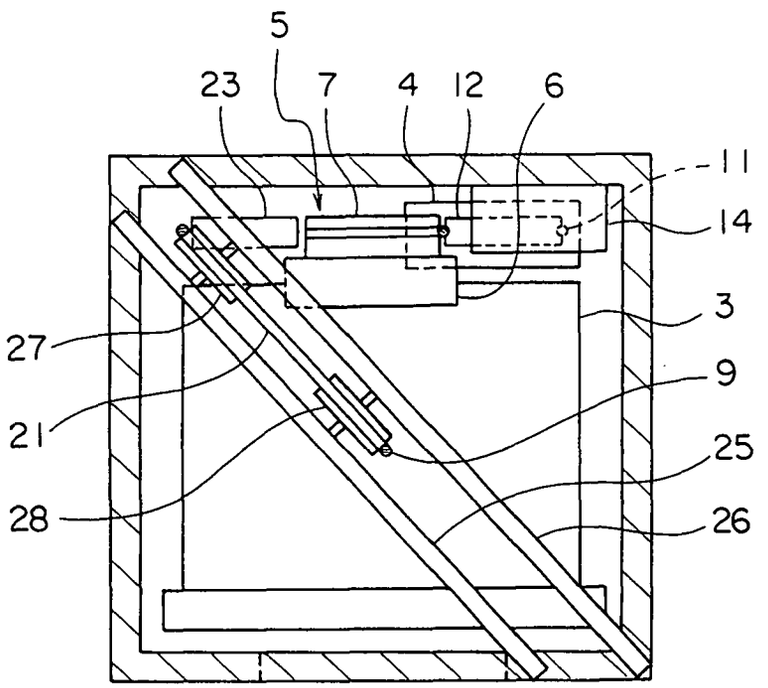


FIG. 7

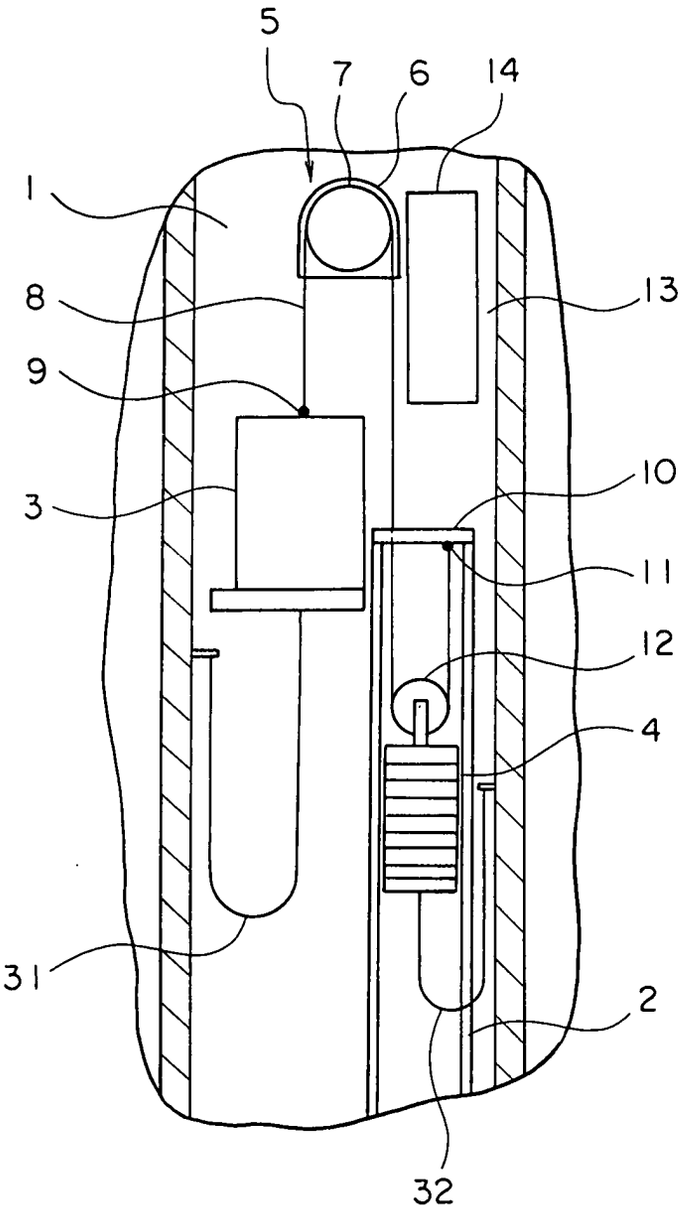
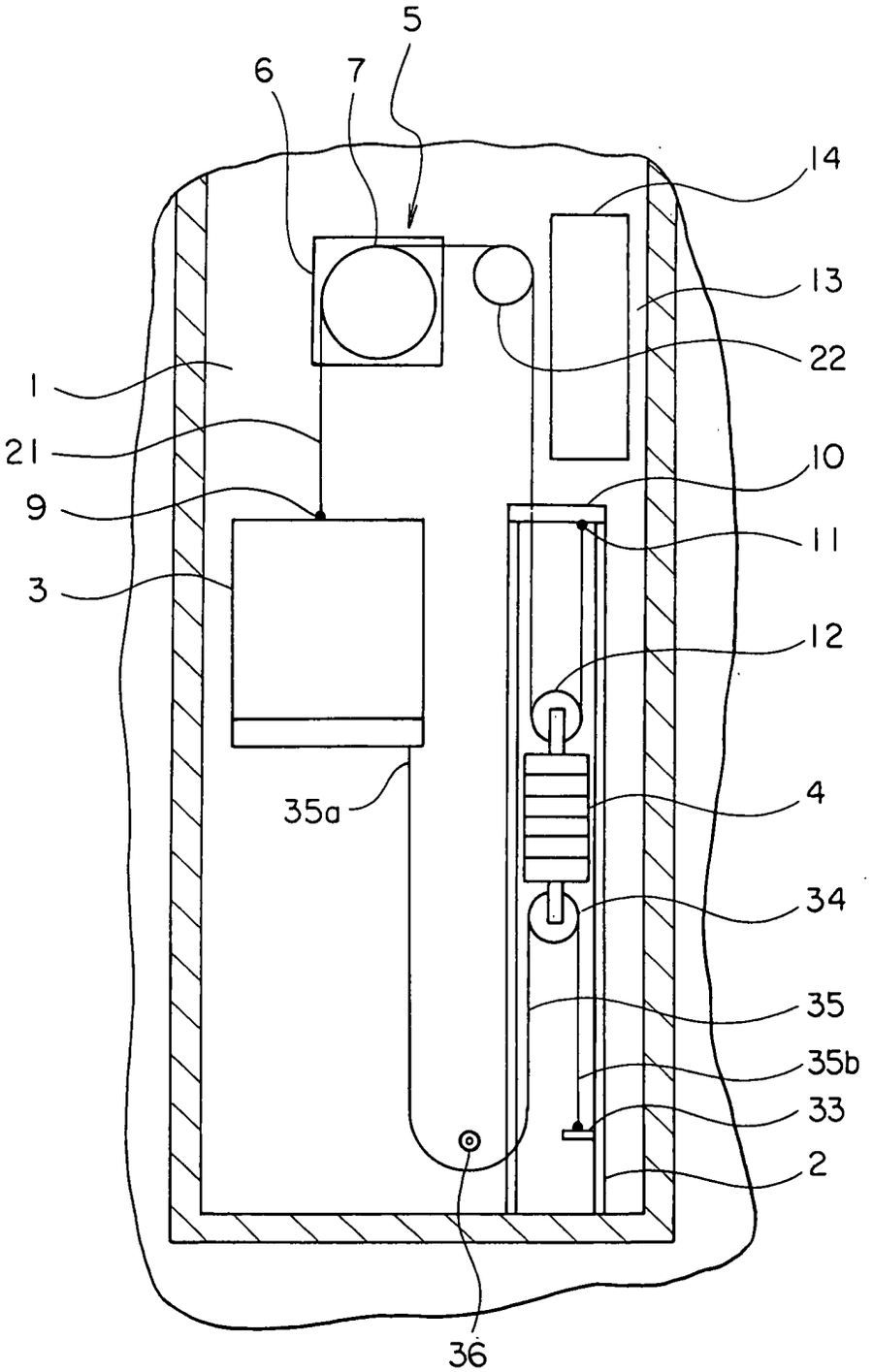


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09764

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B7/06

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] B666B7/00-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.
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X Y	JP 11-60117 A (Hitachi, Ltd.), 02 March, 1999 (02.03.99), (Family: none)	1 3-4
X	JP 62-264188 A (Jun'ichi GO), 17 November, 1987 (17.11.87), (Family: none)	1
Y	JP 54-53446 A (Shimizu Corp.), 26 April, 1979 (26.04.79), (Family: none)	4

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

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Date of the actual completion of the international search	Date of mailing of the international search report
09 June, 2003 (09.06.03)	24 June, 2003 (24.06.03)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/09764

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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