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

(11) **EP 1 795 484 B1**

(12) **EUROPEAN PATENT SPECIFICATION**

(45) Date of publication and mention of the grant of the patent:
02.04.2014 Bulletin 2014/14

(21) Application number: **04788377.2**

(22) Date of filing: **30.09.2004**

(51) Int Cl.:
B66B 7/06 *(2006.01)*

(86) International application number:
PCT/JP2004/014349

(87) International publication number:
WO 2006/038256 (13.04.2006 Gazette 2006/15)

(54) **ELEVATOR APPARATUS**

AUFZUGSVORRICHTUNG

APPAREILLAGE D'ASCENSEUR

(84) Designated Contracting States:
DE

(43) Date of publication of application:
13.06.2007 Bulletin 2007/24

(73) Proprietor: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Chiyoda-ku, Tokyo 100-8310 (JP)

(72) Inventors:
- **IKEDA, Shiroh,**
  Mitsubishi Denki Kabushiki Kaisha
  Tokyo 1008310 (JP)
- **ANDO, Eiji,**
  Mitsubishi Denki Kabushiki Kaisha
  Tokyo 1008310 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

(56) References cited:
EP-A1- 1 329 412
CA-A1- 2 465 031
JP-A- 2002 173 279
WO-A1-03/104126
JP-A- 2000 255 933

Note: Within nine months of the publication of the mention of the grant of the European patent in the European Patent Bulletin, any person may give notice to the European Patent Office of opposition to that patent, in accordance with the Implementing Regulations. Notice of opposition shall not be deemed to have been filed until the opposition fee has been paid. (Art. 99(1) European Patent Convention).

EP 1 795 484 B1

Description

Technical Field

[0001] The present invention relates to an elevator apparatus having a structure in which a driving unit for raising/lowering a car and a counterweight is disposed in an upper portion of a hoistway.

Background Art

[0002] Conventionally, in order to shorten height dimension of a hoistway, there has been proposed an elevator apparatus having a structure in which a hoisting machine is disposed horizontally in an upper portion of the hoistway. A rotary shaft of a drive sheave of the hoisting machine is perpendicular to a horizontal plane. A main rope is horizontally wrapped around the drive sheave. Two turning sheaves for turning the direction of the main rope from a horizontal direction to a vertical direction are provided in the upper portion of the hoistway. A car and a counterweight are suspended within the hoistway by means of the main rope which has been turned by the turning sheaves (see Patent Document 1).

[0003] Patent Document 1: JP 2000-255933 A

[0004] Another elevator apparatus is also known e.g. from WO-A-03104126.

Disclosure of the Invention

Problem to be solved by the Invention

[0005] In the conventional elevator apparatus constructed as described above, however, the car and the counterweight are raised/lowered by the single hoisting machine, so the hoisting machine is increased in size as the elevator apparatus is increased in capacity. As a result, the entire elevator apparatus cannot be reduced in size.

[0006] The present invention has been made to solve the problem discussed above, and it is therefore an object of the invention to obtain an elevator apparatus allowing an overall size reduction.

Means for solving the Problem

[0007] An elevator apparatus of the present invention includes: a first driving unit including a first drive sheave and disposed in an upper portion of a hoistway so that a rotary shaft of the first drive sheave is perpendicular to a horizontal plane; a second driving unit including a second drive sheave and disposed in the upper portion of the hoistway so that a rotary shaft of the second drive sheave is perpendicular to the horizontal plane; a car for being raised/lowered within the hoistway by driving forces of the first driving unit and the second driving unit; a counterweight for being raised/lowered within the hoistway by driving forces of the first driving unit and the second driving unit; a main rope body, for suspending the car and the counterweight within the hoistway, including: a first main rope wrapped around the first drive sheave and including a first end and a second end that are connected to the upper portion of the hoistway; and a second main rope wrapped around the second drive sheave and including a third end and a fourth end that are connected to the upper portion of the hoistway; a first car sash pulley mounted to the car and having wrapped therearound a portion of the first main rope between the first drive sheave and the first end; a second car sash pulley mounted to the car and having wrapped therearound a portion of the second main rope between the second drive sheave and the third end; a first counterweight sash pulley mounted to the counterweight and having wrapped therearound a portion of the first main rope between the first drive sheave and the second end; and a second counterweight sash pulley mounted to the counterweight and having wrapped therearound a portion of the second main rope between the second drive sheave and the fourth end.

Brief Description of the Drawings

[0008]

Fig. 1 is a plan view showing an elevator apparatus according to Embodiment 1 of the present invention.
Fig. 2 is a front view showing the elevator apparatus of Fig. 1.
Fig. 3 is a plan view showing an elevator apparatus according to Embodiment 2 of the present invention.
Fig. 4 is a front view showing the elevator apparatus of Fig. 3.
Fig. 5 is a plan view showing an elevator apparatus according to Embodiment 3 of the present invention.
Fig. 6 is a front view showing the elevator apparatus of Fig. 5.
Fig. 7 is a plan view showing an elevator apparatus according to Embodiment 4 of the present invention.
Fig. 8 is a front view showing the elevator apparatus of Fig. 7.

Best Modes for carrying out the Invention

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

Embodiment 1

[0010] Fig. 1 is a plan view showing an elevator apparatus according to Embodiment 1 of the present invention. Fig. 2 is a front view showing the elevator apparatus of Fig. 1. Referring to Figs. 1 and 2, a pair of car guide rails (not shown) and a pair of counterweight guide rails (not shown) are installed within a hoistway 1. A car 2 is guided by the respective car guide rails to be raised/low-

ered within the hoistway 1, and a counterweight 3 is guided by the respective counterweight guide rails to be raised/lowered within the hoistway 1. In this example, a line connecting the respective car guide rails and a line connecting the respective counterweight guide rails are parallel to a line extending along a width direction of the hoistway 1 on a vertical projection plane thereof.

[0011] The car 2 has a first lateral face portion 2a, a second lateral face portion 2b, a front face portion 2c, and a back face portion 2d. The first lateral face portion 2a and the second lateral face portion 2b are opposed to each other between the respective car guide rails. The front face portion 2c is provided with a car doorway 4. The back face portion 2d is opposed to the front face portion 2c. The front face portion 2c is provided with a pair of car doors 5 for opening/closing the car doorway 4. In this example, a dimension of the car 2 in a width direction thereof (i.e., dimension between an outer face of the first lateral face portion 2a and an outer face of the second lateral face portion 2b) is larger than a dimension of the car 2 in a depth direction thereof (i.e., dimension between an outer face of the front face portion 2c and an outer face of the back face portion 2d).

[0012] The counterweight 3 is opposed to the back face portion 2d on the vertical projection plane of the hoistway 1. In other words, when the hoistway 1 is vertically projected, the counterweight 3 is disposed behind a region of the car 2 as to the depth direction of thereof.

[0013] A first driving unit (hoisting machine) 12 and a second driving unit (hoisting machine) 13 for raising/lowering the car 2 and the counterweight 3 are disposed in the upper portion within the hoistway 1. The first driving unit 12 and the second driving unit 13 are disposed apart from each other in the width direction of the hoistway 1. The first driving unit 12 and the second driving unit 13 are disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. Furthermore, the first driving unit 12 and the second driving unit 13 are disposed substantially at the same height.

[0014] The first driving unit 12 has a first driving unit body 14 including a motor and a brake, and a first drive sheave 15 rotated by the first driving unit body 14. The second driving unit 13 has a second driving unit body 16 including a motor and a brake, and a second drive sheave 17 rotated by the second driving unit body 16. The first driving unit 12 and the second driving unit 13 are designed as low-profile hoisting machines having an axial dimension that is smaller than a radial dimension of the first driving unit body 14 and the second driving unit body 16 or a radial dimension of the first drive sheave 15 and the second drive sheave 17.

[0015] The first driving unit 12 and the second driving unit 13 are disposed horizontally (or substantially horizontally) so that rotary shafts of the first drive sheave 15 and the second drive sheave 17 extend perpendicularly to a horizontal plane (including a substantially horizontal plane), respectively. The first driving unit 12 and the second driving unit 13 are disposed such that the first drive sheave 15 and the second drive sheave 17 are located above the first driving unit body 14 and the second driving unit body 16, respectively.

[0016] A main rope body 18 for suspending the car 2 and the counterweight 3 within the hoistway 1 is wrapped around the first drive sheave 15 and the second drive sheave 17. The main rope body 18 has a plurality of first main ropes 19 (only one of them is shown in the drawings) wrapped around the first drive sheave 15 substantially horizontally, and a plurality of second main ropes 20 (only one of them is shown in the drawings) wrapped around the second drive sheave 17 substantially horizontally.

[0017] A pair of first car sash pulleys 25 and 26 and a pair of second car sash pulleys 27 and 28 are provided on a lower portion of the car 2. The first main ropes 19 are wrapped around the first car sash pulleys 25 and 26, and the second main ropes 20 are wrapped around the second car sash pulleys 27 and 28. The first car sash pulley 25 and the second car sash pulley 27 are provided on the first lateral face portion 2a side on the lower portion of the car 2, and the first car sash pulley 26 and the second car sash pulley 28 are provided on the second lateral face portion 2b side on the lower portion of the car 2.

[0018] A first counterweight sash pulley 29 and a second counterweight sash pulley 30 are provided on an upper portion of the counterweight 3. The first main ropes 19 are wrapped around the first counterweight sash pulley 29, and the second main ropes 20 are wrapped around the second counterweight sash pulley 30. The first counterweight sash pulley 29 and the second counterweight sash pulley 30 are provided side by side in a width direction of the counterweight 3.

[0019] A first car side cleat portion 21, a second car side cleat portion 22, a first counterweight side cleat portion 23, and a second counterweight side cleat portion 24 are provided in the upper portion of the hoistway 1. The first car side cleat portion 21 is disposed above the first car sash pulley 26, and the second car side cleat portion 22 is disposed above the second car sash pulley 27. The first counterweight side cleat portion 23 is disposed above the first counterweight sash pulley 29, and the second counterweight side cleat portion 24 is disposed above the second counterweight sash pulley 30.

[0020] Each of the first main ropes 19 has a first end 19a connected to the first car side cleat portion 21, and a second end 19b connected to the first counterweight side cleat portion 23. Each of the second main ropes 20 has a third end 20a connected to the second car side cleat portion 22, and a fourth end 20b connected to the second counterweight side cleat portion 24.

[0021] That is, those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first end 19a are wrapped around the first car sash pulleys 25 and 26, and those portions of the second main ropes 20 which are located between the second drive sheave 17 and the third end 20a are wrapped around the second car sash pulleys 27 and 28. Those portions of the first main ropes 19 which are located between the

first drive sheave 15 and the second end 19b are wrapped around the first counterweight sash pulley 29, and those portions of the second main ropes 20 which are located between the second drive sheave 17 and the fourth end 20b are wrapped around the second counterweight sash pulley 30.

[0022] A first car side return pulley 31 for guiding the first main ropes 19 to the first car sash pulley 25, a first counterweight side return pulley 32 for guiding the first main ropes 19 to the first counterweight sash pulley 29, a second car side return pulley 33 for guiding the second main ropes 20 to the second car sash pulley 28, and a second counterweight side return pulley 34 for guiding the second main ropes 20 to the second counterweight sash pulley 30 are disposed in the upper portion of the hoistway 1. Respective rotary shafts of the first car side return pulley 31, the first counterweight side return pulley 32, the second car side return pulley 33, and the second counterweight side return pulley 34 are disposed horizontally (or substantially horizontally).

[0023] The first car side return pulley 31 is disposed above the first car sash pulley 25, and the second car side return pulley 33 is disposed above the second car sash pulley 28. The first counterweight return pulley 32 is disposed above the first counterweight sash pulley 29, and the second counterweight return pulley 34 is disposed above the second counterweight sash pulley 30.

[0024] The first main ropes 19 and the second main ropes 20, which extend from the first drive sheave 15 substantially horizontally, are turned to extend substantially vertically by means of the return pulleys 31 to 34. Thus, the return pulleys 31 to 34 are disposed substantially at the same height as the first driving unit 12 and the second driving unit 13.

[0025] A first turning sheave 35 and a second turning sheave 36 are disposed in the upper portion of the hoistway 1 . Those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first car side return pulley 31 are wrapped around the first turning sheave 35, and those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second car side return pulley 33 are wrapped around the second turning sheave 36. The first turning sheave 35 and the second turning sheave 36 are disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. Respective rotary shafts of the first turning sheave 35 and the second turning sheave 36 are disposed perpendicularly to the horizontal plane (including the substantially horizontal plane). Furthermore, the first turning sheave 35 and the second turning sheave 36 are disposed substantially at the same height as the first drive sheave 15 and the second drive sheave 17, respectively.

[0026] The car 2 and the counterweight 3 are suspended within the hoistway 1 according to a 2:1 roping method by means of the first main ropes 19 and the second main ropes 20. That is, each of the first main ropes 19, which extends from the first end 19a to the second end 19b, is sequentially wrapped around the first car sash pulleys 26 and 25, the first car side return pulley 31, the first turning sheave 35, the first drive sheave 15, the first counterweight side return pulley 32, and the first counterweight sash pulley 29. Each of the second main ropes 20, which extends from the third end 20a to the fourth end 20b, is sequentially wrapped around the second car sash pulleys 27 and 28, the second car side return pulley 33, the second turning sheave 36, the second drive sheave 17, the second counterweight side return pulley 34, and the second counterweight sash pulley 30.

[0027] The first driving unit 12 and the second driving unit 13 are disposed symmetrically to each other, and the first turning sheave 35 and the second turning sheave 36 are disposed symmetrically to each other, with respect to a centerline of the car 2 extending along the depth direction of the hoistway 1 on the vertical projection plane of the hoistway 1. A control device (not shown) for controlling the first driving unit 12 and the second driving unit 13 is provided within the hoistway 1.

[0028] Next, an operation will be described. The first driving unit 12 and the second driving unit 13 are driven in synchronization with each other by a signal from the control device. Thus, the first drive sheave 15 and the second drive sheave 17 are rotated in synchronization with each other, so the car 2 and the counterweight 3 are raised/lowered.

[0029] In the elevator apparatus constructed as described above, the car 2 and the counterweight 3 are raised/lowered within the hoistway 1 by driving forces of the first driving unit 12 and the second driving unit 13. The car 2 and the counterweight 3 are suspended within the hoistway 1 according to the 2:1 roping method by means of the first main ropes 19 and the second main ropes 20. Therefore, the loads applied to the first driving unit 12 and the second driving unit 13 can be lightened, and the first driving unit 12 and the second driving unit 13 can be reduced in size. Thus, the length of the hoistway 1 in the height direction thereof can be shortened, and the horizontal cross-sectional area of the hoistway 1 can be reduced. Accordingly, the entire elevator apparatus can be reduced in size. The degree of enlargement of the elevator apparatus resulting from an increase in the capacity thereof can also be reduced.

[0030] The return pulleys 31 to 34 for guiding the first main ropes 19 and the second main ropes 20 to the sash pulleys 25 to 30 respectively are provided in the upper portion of the hoistway 1. Therefore, the first main ropes 19 and the second main ropes 20, which extend substantially horizontally, can be turned to extend substantially vertically, so the first main ropes 19 and the second main ropes 20 can be guided from the first drive sheave 15 and the second drive sheave 17 to the return pulleys 31 to 34 respectively without interfering with the car 2 or the counterweight 3.

[0031] The first turning sheave 35, around which those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first car side return

pulley 31 are wound, is disposed in the upper portion of the hoistway 1. Therefore, winding angles of the first main ropes 19 with respect to the first drive sheave 15 and the first turning sheave 35 can be ensured, so an increase in traction ability can be achieved. Thus, a driving force of the first driving unit 12 can be transmitted to the first main ropes 19 more reliably, so the car 2 and the counterweight 3 can be raised/lowered more reliably.

[0032] The second turning sheave 36, around which those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second car side return pulley 33 are wound, is disposed in the upper portion within the hoistway 1. Therefore, winding angles of the second main ropes 20 with respect to the second drive sheave 17 and the second turning sheave 36 can be ensured, so an increase in traction ability can be achieved. Thus, a driving force of the second driving unit 13 can be transmitted to the second main ropes 20 more reliably, so the car 2 and the counterweight 3 can be raised/lowered more reliably.

[0033] The first driving unit 12 and the second driving unit 13 are disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. Therefore, the horizontal cross-sectional area of the hoistway 1 can further be reduced, so the entire elevator apparatus can further be reduced in size.

[0034] Although those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first car side return pulley 31 are wrapped around the first turning sheave 35 in the foregoing example, those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first counterweight side return pulley 32 may be wrapped around the first turning sheave 35. In this manner as well, winding angles of the first main ropes 19 with respect to the first drive sheave 15 and the first turning sheave 35 can be ensured, so an increase in traction ability can be achieved.

[0035] Although those portions of the secondmain ropes 20 which are located between the second drive sheave 17 and the second car side return pulley 33 are wrapped around the second turning sheave 36 in the foregoing example, those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second counterweight side return pulley 34 may be wrapped around the second turning sheave 36. In this manner as well, winding angles of the second main ropes 20 with respect to the second drive sheave 17 and the second turning sheave 36 can be ensured, so an increase in traction ability can be achieved.

Embodiment 2

[0036] Fig. 3 is a plan view showing an elevator apparatus according to Embodiment 2 of the present invention. Fig. 4 is a front view showing the elevator apparatus of Fig. 3. Referring to Figs. 3 and 4, the dimension of the car 2 in the width direction thereof is smaller than the dimension of the car 2 in the depth direction thereof. The first driving unit 12 and the second driving unit 13 are disposed apart from each other in the depth direction of the hoistway 1. Furthermore, those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first counterweight side return pulley 32 are wrapped around the first turning sheave 35. Still further, those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second counterweight side return pulley 34 are wrapped around the second turning sheave 36. Embodiment 2 of the present invention is identical to Embodiment 1 of the present invention in other constructional details.

[0037] As described above, even in the elevator apparatus that is structured such that the dimension of the car 2 in the depth direction thereof is larger than the dimension of the car 2 in the width direction thereof and that the counterweight 3 is disposed behind the region of the car 2, the first driving unit 12 and the second driving unit 13 can be disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. As a result, the horizontal cross-sectional area of the hoistway 1 can be reduced.

[0038] Although those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first counterweight side return pulley 32 are wrapped around the first turning sheave 35 in the foregoing example, those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first car side return pulley 31 may be wrapped around the first turning sheave 35.

[0039] Although those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second counterweight side return pulley 34 are wrapped around the second turning sheave 36 in the foregoing example, those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second car side return pulley 33 may be wrapped around the second turning sheave 36.

Embodiment 3

[0040] Fig. 5 is a plan view showing an elevator apparatus according to Embodiment 3 of the present invention. Fig. 6 is a front view showing the elevator apparatus of Fig. 5. Referring to Figs. 5 and 6, the dimension of the car 2 in the width direction thereof is larger than the dimension of the car 2 in the depth direction thereof. The counterweight 3 is opposed to the second lateral face portion 2b on the vertical projection plane of the hoistway 1. In other words, the counterweight 3 is disposed beside the region of the car 2 with respect to the width direction of the car 2 when the hoistway 1 is vertically projected. Furthermore, the first driving unit 12 and the second driving unit 13 are disposed offset from each other in the width direction of the hoistway 1 and the depth direction thereof.

[0041] The second car side cleat portion 22 is disposed above the second car sash pulley 28. The third end 20a of each of the secondmain ropes 20 is connected to the second car side cleat portion 22. The second car side return pulley 33 is disposed above the second car sash pulley 27. Each of the second main ropes 20, which extends from the third end 20a to the fourth end 20b, is sequentially wrapped around the second car sash pulley 28, the second car sash pulley 27, the second car side return pulley 33, the second turning sheave 36, the second drive sheave 17, the second counterweight side return pulley 34, and the second counterweight sash pulley 30. Embodiment 3 of the present invention is identical to Embodiment 1 of the present invention in other constructional details.

[0042] As described above, even in the elevator apparatus that is structured such that the dimension of the car 2 in the width direction thereof is larger than the dimension of the car 2 in the depth direction thereof and that the counterweight 3 is disposed beside the region of the car 2 in the width direction thereof, the first driving unit 12 and the second driving unit 13 can be disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. As a result, the horizontal cross-sectional area of the hoistway 1 can be reduced.

Embodiment 4

[0043] Fig. 7 is a plan view showing an elevator apparatus according to Embodiment 4 of the present invention. Fig. 8 is a front view showing the elevator apparatus of Fig. 7. Referring to Figs. 7 and 8, the dimension of the car 2 in the width direction thereof is smaller than the dimension of the car 2 in the depth direction thereof. The first driving unit 12 and the second driving unit 13 are disposed apart from each other in the depth direction of the hoistway 1. Embodiment 4 of the present invention is identical to Embodiment 3 of the present invention in other constructional details.

[0044] As described above, even in the elevator apparatus that is structured such that the dimension of the car 2 in the depth direction thereof is larger than the dimension of the car 2 in the width direction thereof and that the counterweight 3 is disposed beside the region of the car 2 in the width direction thereof, the first driving unit 12 and the second driving unit 13 can be disposed within the region of the car 2 on the vertical projection plane of the hoistway 1. As a result, the horizontal cross-sectional area of the hoistway 1 can be reduced.

[0045] Although those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first car side return pulley 31 are wrapped around the first turning sheave 35 in the foregoing Embodiments 3 and 4 of the present invention, those portions of the first main ropes 19 which are located between the first drive sheave 15 and the first counterweight side return pulley 32 may be wrapped around the first turning sheave 35.

[0046] Although those portions of the secondmain ropes 20 which are located between the second drive sheave 17 and the second car side return pulley 33 are wrapped around the second turning sheave 36 in the foregoing Embodiments 3 and 4 of the present invention, those portions of the second main ropes 20 which are located between the second drive sheave 17 and the second counterweight side return pulley 34 may be wrapped around the second turning sheave 36.

[0047] In the foregoing respective embodiments of the present invention, the first turning sheave 35 may be dispensed with as long as the winding angle of the first main ropes 19 with respect to the first drive sheave 15 can be ensured. In addition, the second turning sheave 36 may be dispensed with as long as the winding angle of the second main ropes 20 with respect to the second drive sheave 17 can be ensured.

[0048] Although the first driving unit 12 and the second driving unit 13 are installed such that the first drive sheave 15 and the second drive sheave 17 are disposed above the first driving unit body 14 and the second driving unit body 16 respectively in the foregoing respective embodiments of the present invention, the first driving unit 12 and the second driving unit 13 may be installed such that the first drive sheave 15 and the second drive sheave 17 are disposed below the first driving unit body 14 and the second driving unit body 16, respectively.

[0049] Although the car 2 and the counterweight 3 are raised/lowered within the hoistway 1 by the driving forces of the two driving units 12 and 13 in the foregoing respective embodiments of the present invention, they may be raised/lowered by driving forces of three or more driving units. In this case, the car 2 and the counterweight 3 are provided respectively with car sash pulleys and counterweight sash pulleys, which correspond to the respective driving units, and the upper portion of the hoistway 1 is provided respectively with car side return pulleys, counterweight side return pulleys, and turning sheaves, which correspond to the respective driving units. The car 2 and the counterweight 3 are suspended within the hoistway 1 by means of a main rope body having main ropes that are equal in number to the driving units.

Claims

1. An elevator apparatus **characterized in that** the elevator apparatus comprises:

   a first driving unit (12) including a first drive sheave (15) and disposed in an upper portion of a hoistway (1) so that a rotary shaft of the first drive sheave (15) is perpendicular to a horizontal plane;

   a second driving unit (13) including a second drive sheave (17) and disposed in the upper portion of the hoistway (1) so that a rotary shaft of the second drive sheave (17) is perpendicular

to the horizontal plane;
a car (2) for being raised/lowered within the hoistway (1) by driving forces of the first driving unit (12) and the second driving unit (13);
a counterweight (3) for being raised/lowered within the hoistway (1) by driving forces of the first driving unit (12) and the second driving unit (13);
a main rope body (18), for suspending the car (2) and the counterweight (3) within the hoistway (1), including:

a first main rope (19) wrapped around the first drive sheave (15) and including a first end (19a) and a second end (19b) that are connected to the upper portion of the hoistway (1); and
a second main rope (20) wrapped around the second drive sheave (17) and including a third end (20a) and a fourth end (20b) that are connected to the upper portion of the hoistway (1);

a first car sash pulley (25,26) mounted to the car (2) and having wrapped therearound a portion of the first main rope (19) between the first drive sheave (15) and the first end (19a);
a second car sash pulley (27,28) mounted to the car (2) and having wrapped therearound a portion of the second main rope (20) between the second drive sheave (17) and the third end (20a);
a first counterweight sash pulley (29) mounted to the counterweight (3) and having wrapped therearound a portion of the first main rope (19) between the first drive sheave (15) and the second end (19b); and
a second counterweight sash pulley (30) mounted to the counterweight (3) and having wrapped therearound a portion of the second main rope (20) between the second drive sheave (17) and the fourth end (20b).

2. The elevator apparatus according to Claim 1, **characterized in that** the elevator apparatus further comprises:

a first car side return pulley (31) disposed in the upper portion of the hoistway (1), for guiding the first main rope (19) from the first drive sheave (15) to the first car sash pulley (25);
a first counterweight side return pulley (32) disposed in the upper portion of the hoistway (1), for guiding the first main rope (19) from the first drive sheave (15) to the first counterweight sash pulley (29);
a second car side return pulley (33) disposed in the upper portion of the hoistway (1), for guiding the second main rope (20) from the second drive sheave (17) to the second car sash pulley (28); and
a second counterweight side return pulley (34) disposed in the upper portion of the hoistway (1), for guiding the second main rope (20) from the second drive sheave (17) to the second counterweight sash pulley (30).

3. The elevator apparatus according to Claim 2, **characterized in that** the elevator apparatus further comprises:

a first turning sheave (35) disposed in the upper portion of the hoistway (1) and having wrapped therearound at least one of a portion of the first main rope (19) between the first drive sheave (15) and the first car side return pulley (31), and a portion of the first main rope (19) between the first drive sheave (15) and the first counterweight sash pulley (32); and
a second turning sheave (36) disposed in the upper portion of the hoistway (1) and having wrapped therearound at least one of a portion of the second main rope (20) between the second drive sheave (17) and the second car side return pulley (33), and a portion of the second main rope (20) between the second drive sheave (17) and the second counterweight sash pulley (34).

4. The elevator apparatus according to any one of Claims 1 to 3, **characterized in that** the first driving unit (12) and the second driving unit (13) are disposed within a region of the car (2) on a vertical projection plane of the hoistway (1).

Patentansprüche

1. Aufzugvorrichtung, **dadurch gekennzeichnet, dass** die Aufzugvorrichtung aufweist:

eine erste Antriebseinheit (12), die eine erste Antriebsrolle (15) aufweist, und so in einem oberen Abschnitt eines Aufzugsschachts (1) angeordnet ist, dass eine Drehachse der ersten Antriebsrolle (15) senkrecht zu einer horizontalen Ebene verläuft;
eine zweite Antriebseinheit (13), die eine zweite Antriebsrolle (17) aufweist, und so in dem oberen Abschnitt des Aufzugsschachts (1) angeordnet ist, dass eine Drehachse der zweiten Antriebsrolle (17) senkrecht zu der horizontalen Ebene verläuft;
eine Kabine (2), um durch Antriebskräfte der ersten Antriebseinheit (12) und der zweiten Antriebseinheit (13) in dem Aufzugsschacht (1) an-

gehoben/abgesenkt zu werden;
ein Gegengewicht (3), um durch Antriebskräfte der ersten Antriebseinheit (12) und der zweiten Antriebseinheit (13) in dem Aufzugsschacht (1) angehoben/abgesenkt zu werden;
einen Hauptseilkörper (18), um die Kabine (2) und das Gegengewicht (3) innerhalb des Aufzugschachts (1) aufzuhängen, mit:

einem ersten Hauptseil (19), das um die erste Antriebsrolle (15) gewickelt ist, und ein erstes Ende (19a) und ein zweites Ende (19b), die mit dem oberen Abschnitt des Aufzugschachts (1) verbunden sind, aufweist; und
einem zweiten Hauptseil (20), das um die zweite Antriebsrolle (17) gewickelt ist, und ein drittes Ende (20a) und ein viertes Ende (20b), die mit dem oberen Abschnitt des Aufzugschachts (1) verbunden sind, aufweist;

eine erste Kabinenrahmenrolle (25, 26), die an der Kabine (2) angebracht ist und darum gewickelt einen ersten Abschnitt des Hauptseils (19) zwischen der ersten Antriebsrolle (15) und dem ersten Ende (19a) aufweist;
eine zweite Kabinenrahmenrolle (27, 28), die an der Kabine (2) angebracht ist, und darum gewickelt einen Abschnitt des zweiten Hauptseils (20) zwischen der zweiten Antriebsrolle (17) und dem dritten Ende (20a), aufweist;
eine erste Gegengewichtsrahmenrolle (29), die an dem Gegengewicht (3) angebracht ist und darum gewickelt einen Abschnitt des ersten Hauptseils (19) zwischen der ersten Antriebsrolle (15) und dem zweiten Ende (19b), aufweist; und
eine zweite Gegengewichtsrahmenrolle (30), die an dem Gegengewicht (3) angebracht ist und darum gewickelt einen Abschnitt des zweiten Hauptseils (20) zwischen der zweiten Antriebsrolle (17) und dem vierten Ende (20b), aufweist.

2. Aufzugsvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** die Aufzugvorrichtung ferner aufweist:

eine erste Kabinenseitenumlenkrolle (31), die in dem oberen Abschnitt des Aufzugschachts (1) angeordnet ist, um das erste Hauptseil (19) von der ersten Antriebsrolle (15) zu der ersten Kabinenrahmenrolle (25) zu führen;
eine erste Gegengewichtsseitenumlenkrolle (32), die in dem oberen Bereich des Aufzugschachts (1) angeordnet ist, um das erste Hauptseil (19) von der ersten Antriebsrolle (15) zu der ersten Gegengewichtsrahmenrolle (29) zu führen;
eine zweiten Kabinenseitenumlenkrolle (33), die in dem oberen Abschnitt des Aufzugschachts (1) angeordnet ist, um das zweite Hauptseil (20) von der zweiten Antriebsrolle (17) zu der zweiten Kabinenrahmenrolle (28) zu führen; und
eine zweite Gegengewichtsseitenumlenkrolle (34), die in dem oberen Bereich des Aufzugschachts (1) angeordnet ist, um das zweite Hauptseil (20) von der zweiten Antriebsrolle (17) zu der zweiten Gegengewichtsrahmenrolle (30) zu führen.

3. Aufzugvorrichtung nach Anspruch 2, **dadurch gekennzeichnet, dass** die Aufzugvorrichtung ferner aufweist:

eine erste Wenderolle (35), die im oberen Bereich des Aufzugschachts (1) angeordnet ist und darum gewickelt zumindest
einen Abschnitt des ersten Hauptseils (19) zwischen der ersten Antriebsrolle (15) und der ersten Kabinenseitenumlenkrolle (31) und/oder einen Abschnitt des ersten Hauptseils (19) zwischen der ersten Antriebsrolle (15) und der ersten Gegengewichtsrahmenrolle (32) aufweist; und
eine zweite Wenderolle (36), die im oberen Bereich des Aufzugschachts (1) angeordnet ist und darum gewickelt zumindest einen Abschnitt des zweiten Hauptseils (20) zwischen der zweiten Antriebsrolle (17) und der zweiten Kabinenseitenumlenkrolle (33) und/oder einen Abschnitt des zweiten Hauptseils (20) zwischen der zweiten Antriebsrolle (17) und der zweiten Gegengewichtsrahmenrolle (34) aufweist;

4. Aufzugsvorrichtung nach einem der Ansprüche 1 bis 3, **dadurch gekennzeichnet, dass**
die erste Antriebseinheit (12) und die zweite Antriebseinheit (13) innerhalb eines Bereichs der Kabine (2) in einer vertikalen Projektionsebene des Aufzugsschachts (1) angeordnet sind.

Revendications

1. Appareil formant ascenseur **caractérisé en ce que** l'appareil formant ascenseur comprend :

une première unité d'entraînement (12) incluant une première poulie d'entraînement (15) et disposée dans une portion supérieure d'une cage d'ascenseur (1) de sorte qu'un arbre rotatif de la première poulie d'entraînement (15) est perpendiculaire à un plan horizontal ;
une seconde unité d'entraînement (13) incluant

une seconde poulie d'entraînement (17) et disposée dans la portion supérieure de la cage d'ascenseur (1) de sorte qu'un arbre rotatif de la seconde poulie d'entraînement (17) est perpendiculaire au plan horizontal ;
une cabine (2) pour être élevée / abaissée à l'intérieur de la cage d'ascenseur (1) par des forces d'entraînement de la première unité d'entraînement (12) et de la seconde unité d'entraînement (13) ;
un contrepoids (3) pour être élevé / abaissé à l'intérieur de la cage d'ascenseur (1) par des forces d'entraînement de la première unité d'entraînement (12) et de la seconde unité d'entraînement (13) ;
un corps de câble principal (18), pour suspendre la cabine (2) et le contrepoids (3) à l'intérieur de la cage d'ascenseur (1), incluant :

un premier câble principal (19) enroulé autour de la première poulie d'entraînement (15) et incluant une première extrémité (19a) et une seconde extrémité (19b) qui sont reliées à la portion supérieure de la cage d'ascenseur (1) ; et
un second câble principal (20) enroulé autour de la seconde poulie d'entraînement (17) et incluant une troisième extrémité (20a) et une quatrième extrémité (20b) qui sont reliées à la portion supérieure de la cage d'ascenseur (1) ;

une première poulie de châssis de cabine (25, 26) montée sur la cabine (2) et ayant enroulée autour de celle-ci une portion du premier câble principal (19) entre la première poulie d'entraînement (15) et la première extrémité (19a) ;
une seconde poulie de châssis de cabine (27, 28) montée sur la cabine (2) et ayant enroulée autour de celle-ci une portion du second câble principal (20) entre la seconde poulie d'entraînement (17) et la troisième extrémité (20a) ;
une première poulie de châssis de contrepoids (29) montée sur le contrepoids (3) et ayant enroulée autour de celle-ci une portion du premier câble principal (19) entre la première poulie d'entraînement (15) et la seconde extrémité (1 9b) ; et
une seconde poulie de châssis de contrepoids (30) montée sur le contrepoids (3) et ayant enroulée autour de celle-ci une portion du second câble principal (20) entre la seconde poulie d'entraînement (17) et la quatrième extrémité (20b).

2. Appareil formant ascenseur selon la revendication 1, **caractérisé en ce que** l'appareil formant ascenseur comprend en outre :

une première poulie de retour côté cabine (31) disposée dans la portion supérieure de la cage d'ascenseur (1), pour guider le premier câble principal (19) depuis la première poulie d'entraînement (15) jusqu'à la première poulie de châssis de cabine (25) ;
une première poulie de retour côté contrepoids (32) disposée dans la portion supérieure de la cage d'ascenseur (1), pour guider le premier câble principal (19) depuis la première poulie d'entraînement (15) jusqu'à la première poulie de châssis de contrepoids (29) ;
une seconde poulie de retour côté cabine (33) disposée dans la portion supérieure de la cage d'ascenseur (1), pour guider le second câble principal (20) depuis la seconde poulie d'entraînement (17) jusqu'à la seconde poulie de châssis de cabine (28) ; et
une seconde poulie de retour côté contrepoids (34) disposée dans la portion supérieure de la cage d'ascenseur (1), pour guider le second câble principal (20) depuis la seconde poulie d'entraînement (17) jusqu'à la seconde poulie de châssis de contrepoids (30).

3. Appareil formant ascenseur selon la revendication 2, **caractérisé en ce que** l'appareil formant ascenseur comprend en outre :

une première poulie de retournement (35) disposée dans la portion supérieure de la cage d'ascenseur (1) et ayant enroulées autour de celle-ci au moins une d'une portion du premier câble principal (19) entre la première poulie d'entraînement (15) et la première poulie de retour côté cabine (31), et d'une portion du premier câble principal (19) entre la première poulie d'entraînement (15) et la première poulie de châssis de contrepoids (32) ; et
une seconde poulie de retournement (36) disposée dans la portion supérieure de la cage d'ascenseur (1) et ayant enroulées autour de celle-ci au moins une d'une portion du second câble principal (20) entre la seconde poulie d'entraînement (17) et la seconde poulie de retour côté cabine (33), et d'une portion du second câble principal (20) entre la seconde poulie d'entraînement (17) et la seconde poulie de châssis de contrepoids (34).

4. Appareil formant ascenseur selon l'une quelconque des revendications 1 à 3, **caractérisé en ce que** la première unité d'entraînement (12) et la seconde unité d'entraînement (13) sont disposées à l'intérieur d'une zone de la cabine (2) sur un plan de projection vertical de la cage d'ascenseur (1).

FIG. 1

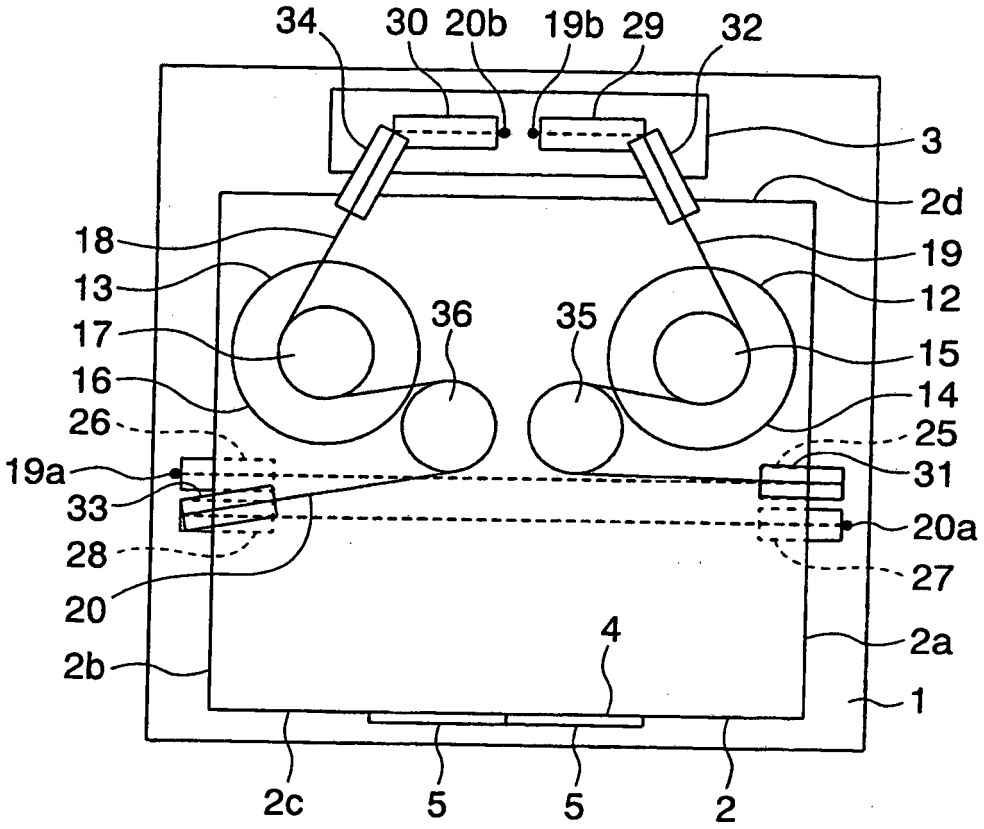

34
30
20b
19b
29
32
3
2d
18
19
13
12
36
35
17
15
16
14
26
25
19a
31
33
20a
28
27
20
4
2a
2b
1
2c
5
5
2

FIG. 2

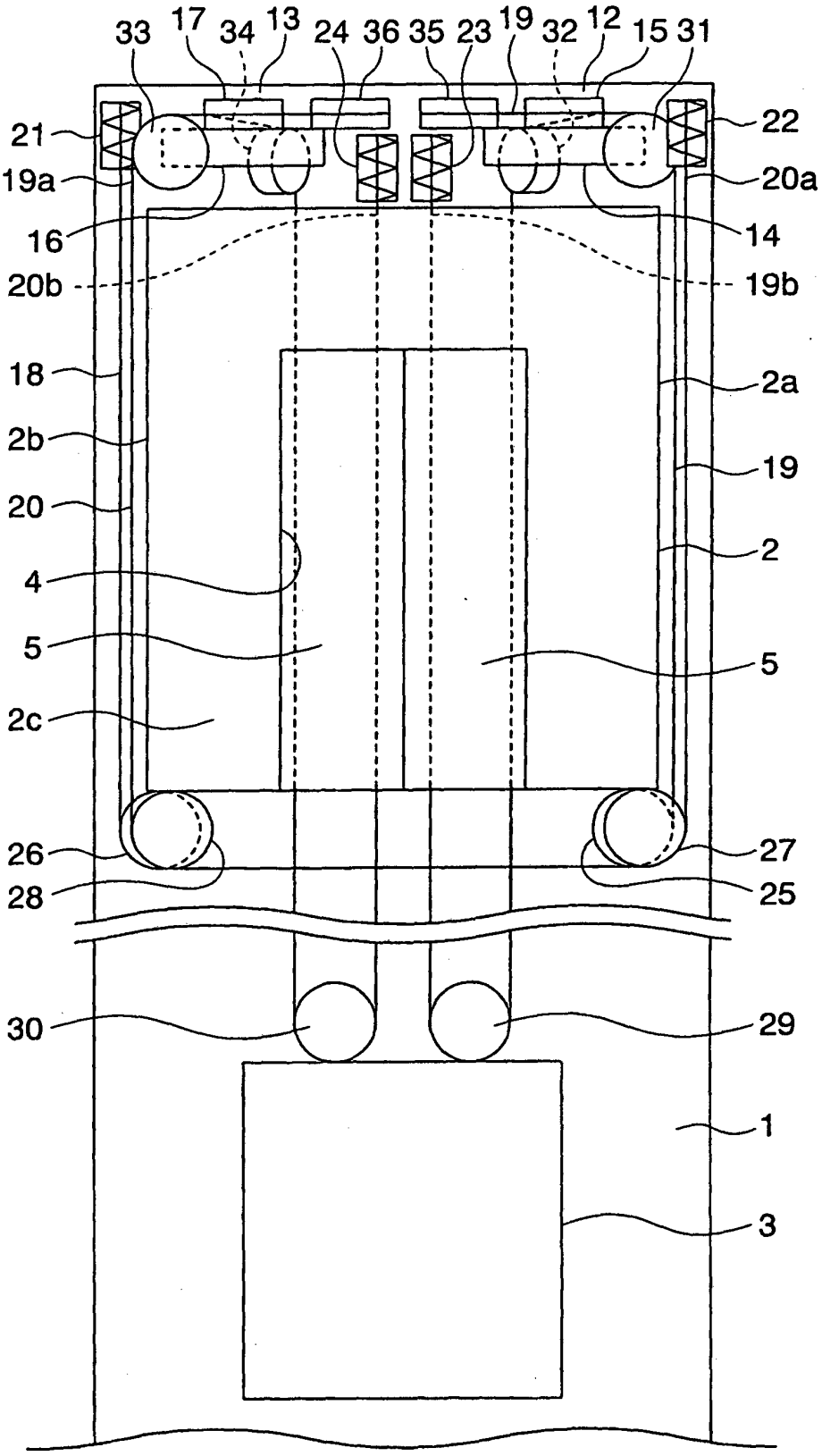

33
17
34
13
24
36
35
23
19
32
12
15
31
21
22
19a
20a
16
14
20b
19b
18
2a
2b
19
20
2
4
5
5
2c
26
27
28
25
30
29
1
3

FIG. 3

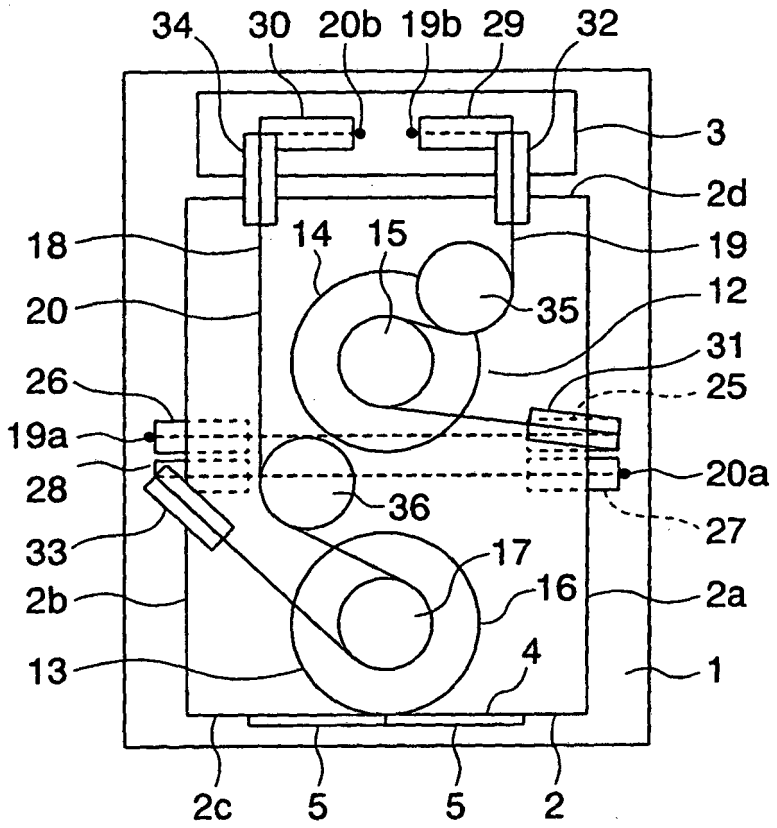

34
30
20b
19b
29
32
3
2d
18
14
15
19
20
35
12
31
26
25
19a
20a
28
36
27
33
17
2b
16
2a
13
4
1
2c
5
5
2

FIG. 4

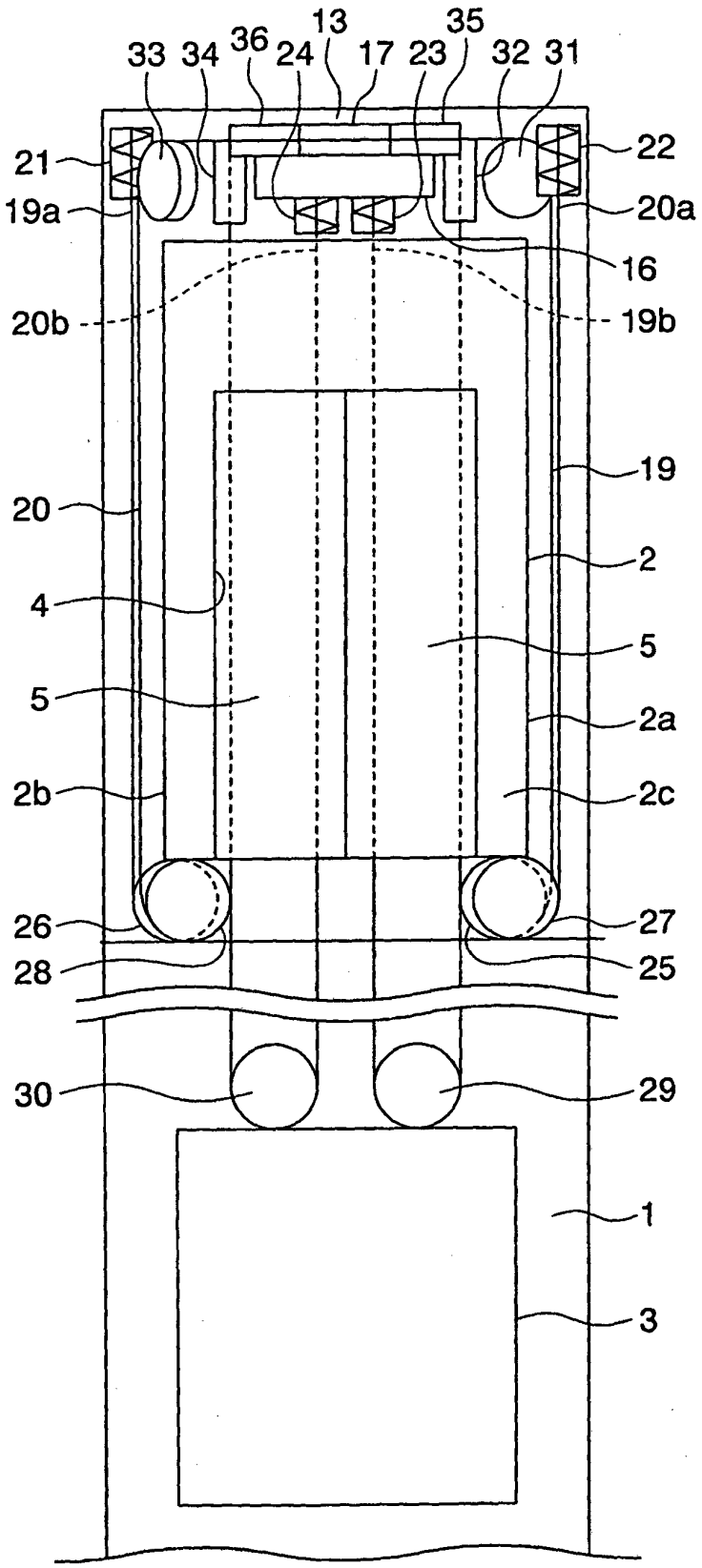

13
33
34
36
24
17
23
35
32
31
21
22
19a
20a
16
20b
19b
19
20
2
4
5
5
2a
2b
2c
26
27
28
25
30
29
1
3

FIG. 5

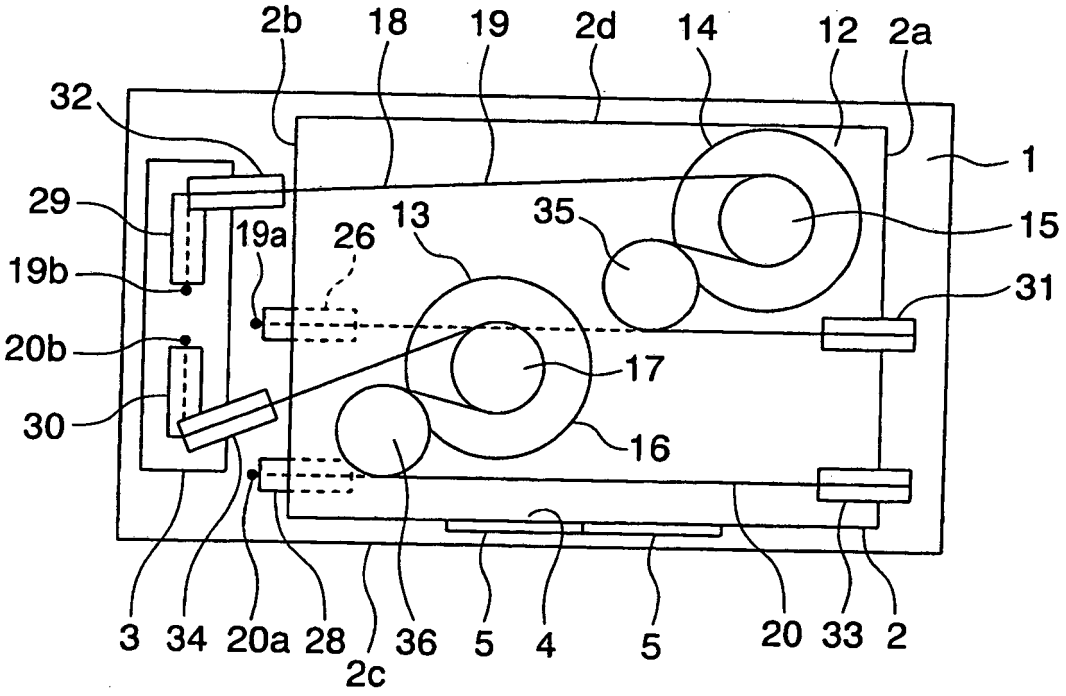

2b
18
19
2d
14
12
2a
32
1
29
19a
26
13
35
15
19b
31
20b
17
30
16
3
34
20a
28
2c
36
5
4
5
20
33
2

FIG. 6

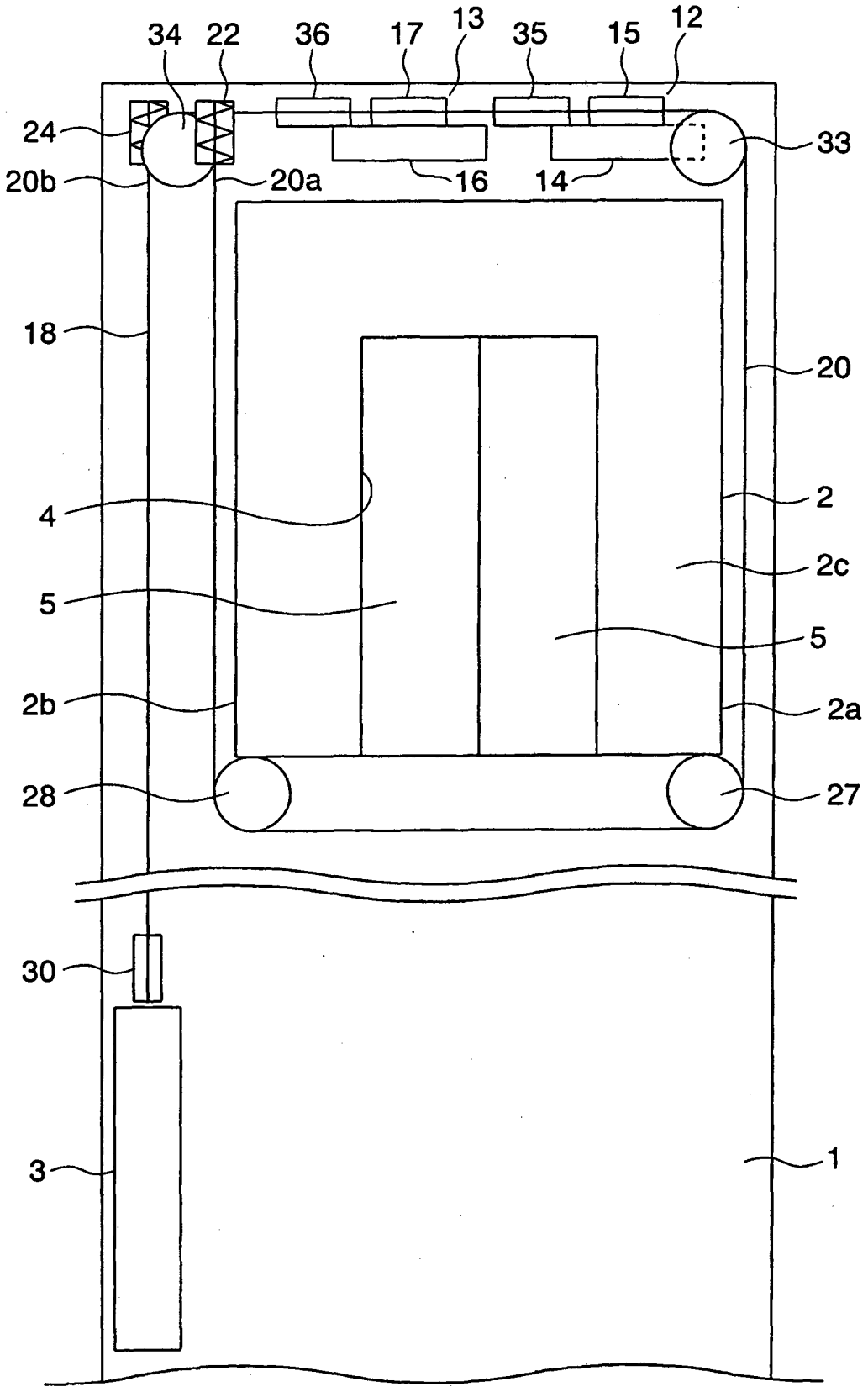

34
22
36
17
13
35
15
12
24
33
20b
20a
16
14
18
20
4
2
2c
5
5
2b
2a
28
27
30
3
1

FIG. 7

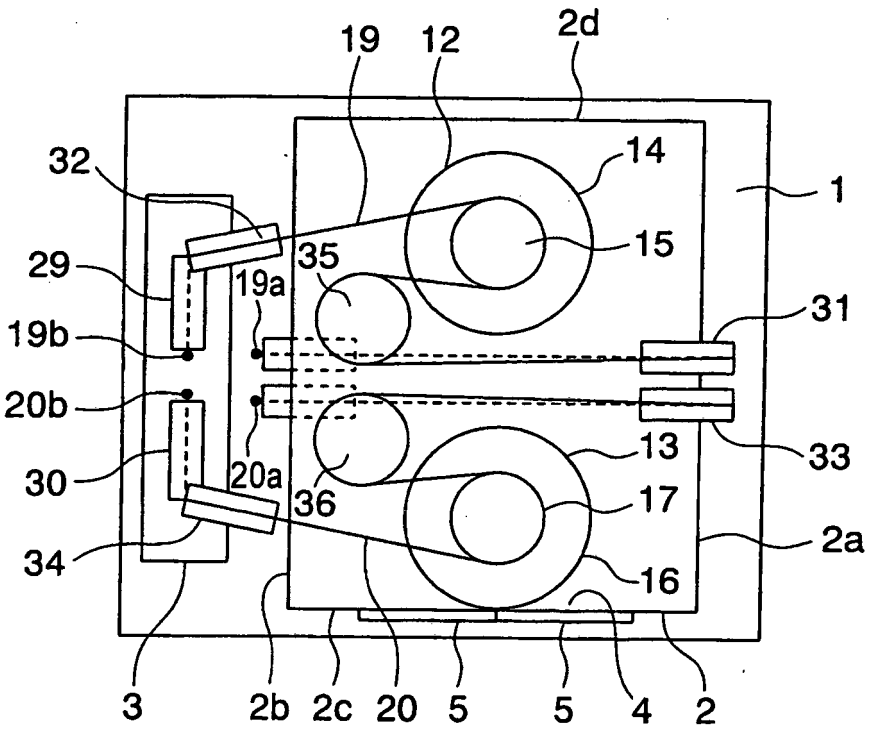
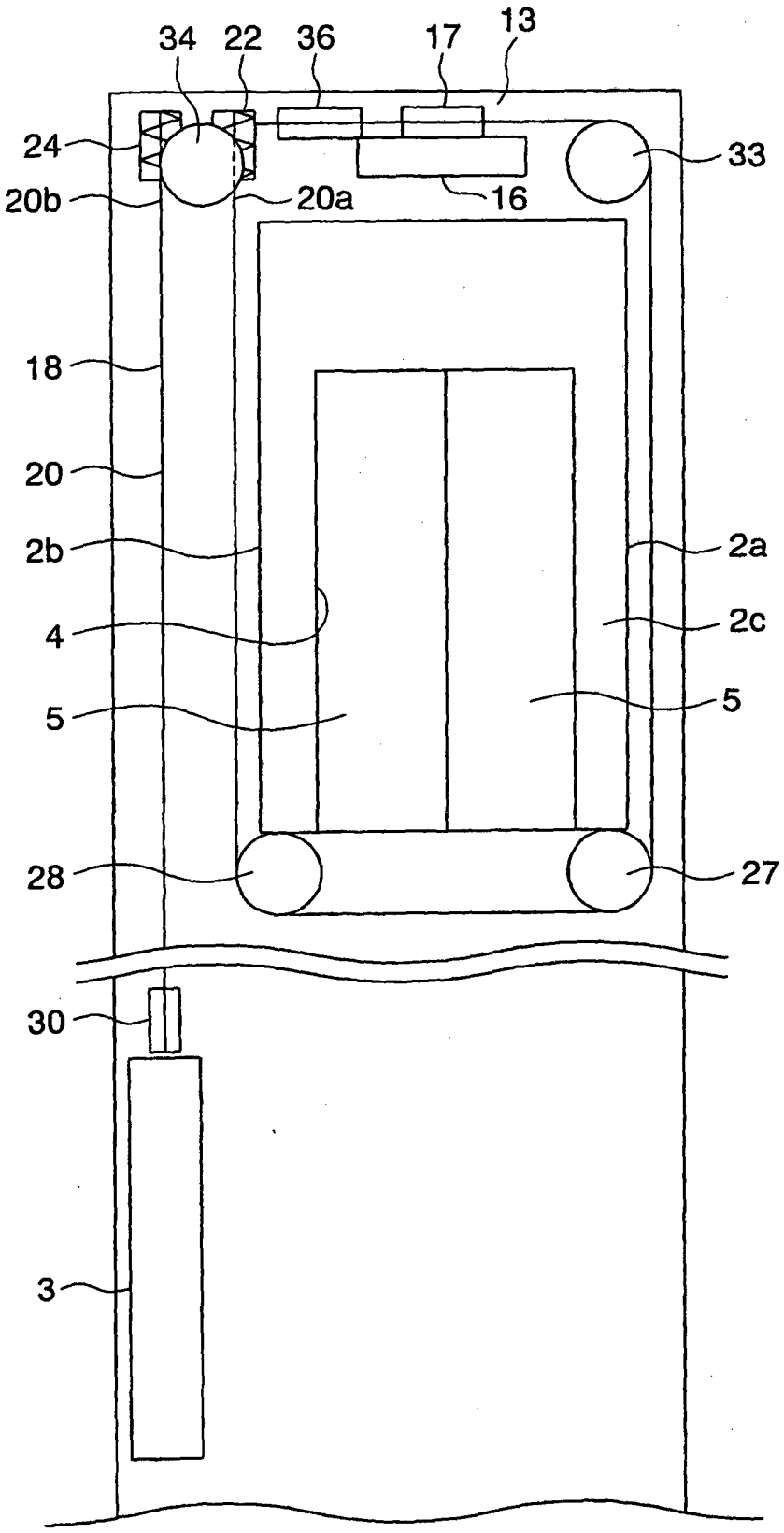

19
12
2d
32
14
1
15
29
35
19a
31
19b
20b
13
33
30
20a
36
17
2a
34
16
3
2b
2c
20
5
5
4
2

FIG. 8



REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2000255933 A **[0003]**
- WO 03104126 A **[0004]**