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

(11) **EP 1 795 484 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 158(3) EPC

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

(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)

(84) Designated Contracting States:
DE

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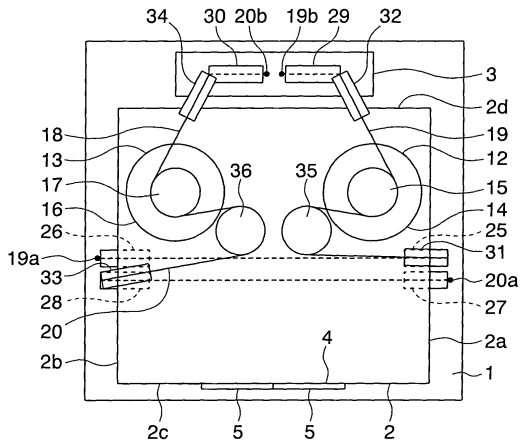
(54) ELEVATOR APPARATUS

(57) In an elevator apparatus, a car and a counterweight are raised/lowered within a hoistway by drive forces of a first driving unit and a second driving unit. The first driving unit and the second driving unit are respectively arranged at an upper portion of the hoistway so that rotation shafts of a first drive sheave and a second drive sheave are vertical to a horizontal plane. The car and the counterweight are suspended by a main rope body including a first main rope wrapped around the first drive sheave and a second main rope wrapped around the second drive sheave. The first main rope includes a first end and a second end connected to the upper portion of the hoistway, and the second main rope includes a third end and a fourth end connected to the upper portion of the hoistway. A first car sash pulley and a second car sash supply, around which the first main rope and the second main rope are wrapped, respectively, are mounted to the car. A first counterweight sash pulley and a second counterweight sash pulley, around which the first main rope and the second main rope are wrapped, respectively, are mounted to the counterweight.

FIG. 1



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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

Disclosure of the Invention

Problem to be solved by the Invention

[0004] 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.

[0005] 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

[0006] 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

[0007]

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

[0008] Preferred embodiments of the present invention will be described hereinafter with reference to the drawings.

Embodiment 1

[0009] 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/lowered 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.

[0010] 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).

[0011] 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.

[0012] 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.

[0013] 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.

[0014] 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.

[0015] 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.

[0016] 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.

[0017] 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.

[0018] 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.

[0019] 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.

[0020] 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.

[0021] 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).

[0022] 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.

[0023] 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.

[0024] 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.

[0025] 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.

[0026] 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.

[0027] 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.

[0028] 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.

[0029] 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.

[0030] The first turning sheave 35, around which those portions of the first main ropes 19 which are located be-

tween 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] 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

[0035] 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.

[0036] 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.

[0037] 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.

[0038] 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

[0039] 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.

[0040] 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.

[0041] 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

[0042] 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.

[0043] 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.

[0044] 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.

[0045] Although 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 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.

[0046] 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.

[0047] 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.

[0048] 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 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 pulleymounted to the counterweight and having wrapped therearound a portion of the second main rope between the second drive sheave and the fourth end.

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

a first car side return pulley disposed in the upper portion of the hoistway, for guiding the first main rope from the first drive sheave to the first car sash pulley;
a first counterweight side return pulley disposed in the upper portion of the hoistway, for guiding the first main rope from the first drive sheave to the first counterweight sash pulley;
a second car side return pulley disposed in the upper portion of the hoistway, for guiding the second main rope from the second drive sheave to the second car sash pulley; and
a second counterweight side return pulley disposed in the upper portion of the hoistway, for guiding the second main rope from the second drive sheave to the second counterweight sash pulley.

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

a first turning sheave disposed in the upper portion of the hoistway and having wrapped therearound at least one of a portion of the first main rope between the first drive sheave and the first car side return pulley, and a portion of the first main rope between the first drive sheave and the first counterweight sash pulley; and
a second turning sheave disposed in the upper portion of the hoistway and having wrapped therearound at least one of a portion of the second main rope between the second drive sheave and the second car side return pulley, and a portion of the second main rope between the second drive sheave and the second counterweight sash pulley.

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

FIG. 1

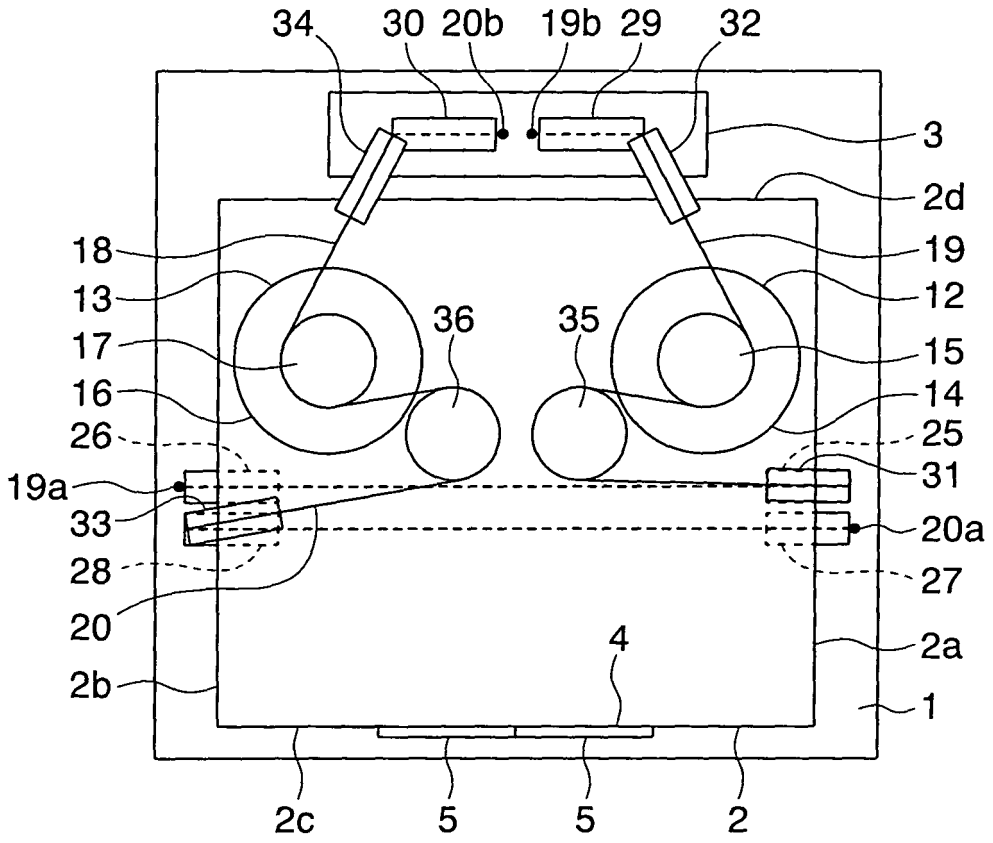
34
30
20b
19b
29
32
3
2d
18
19
13
12
36
35
17
15
16
14
26
25
19a
31
33
20a
28
27
20
4
2a
2b
1
2c
5
5
2

FIG. 2

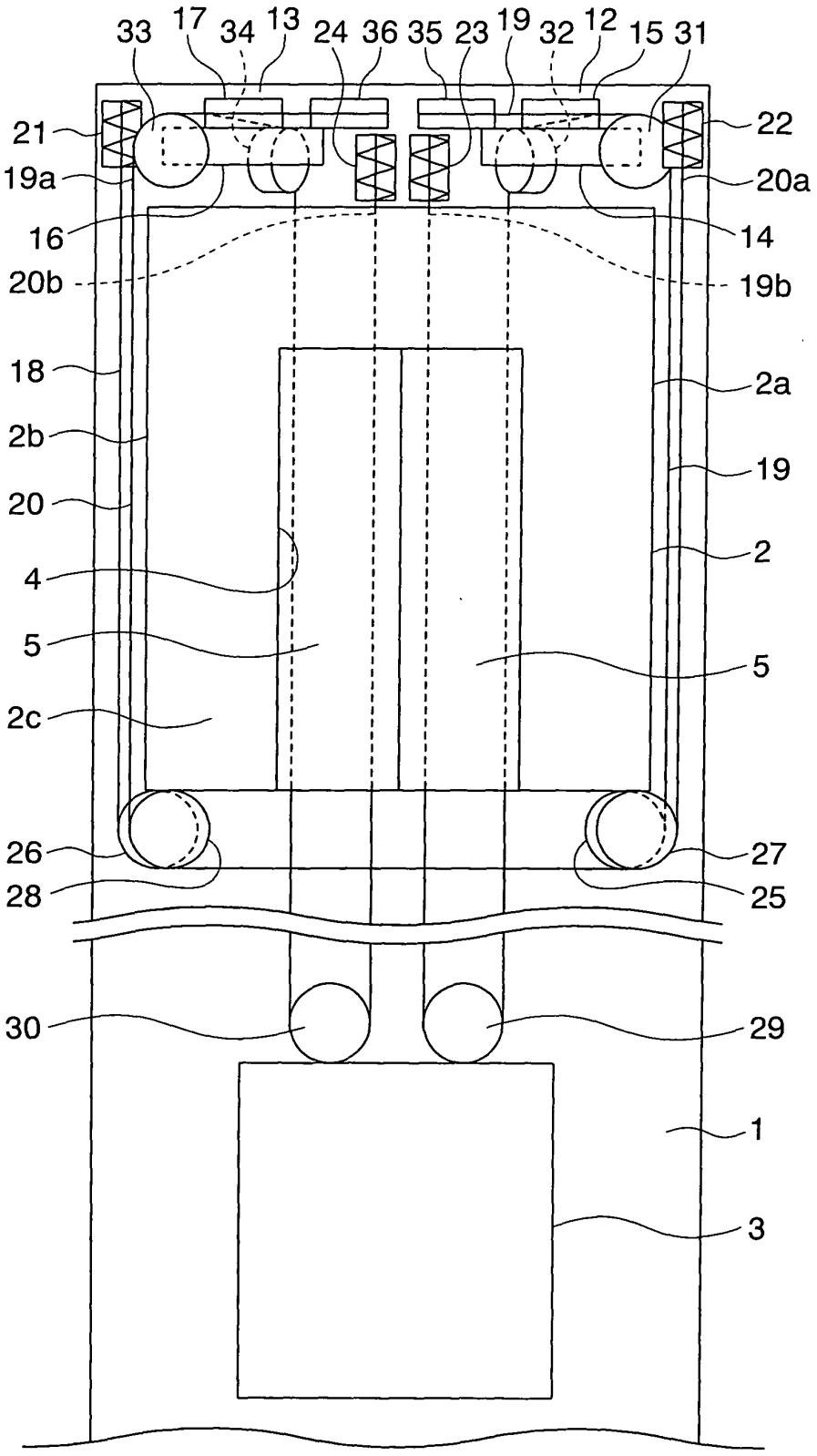
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FIG. 3

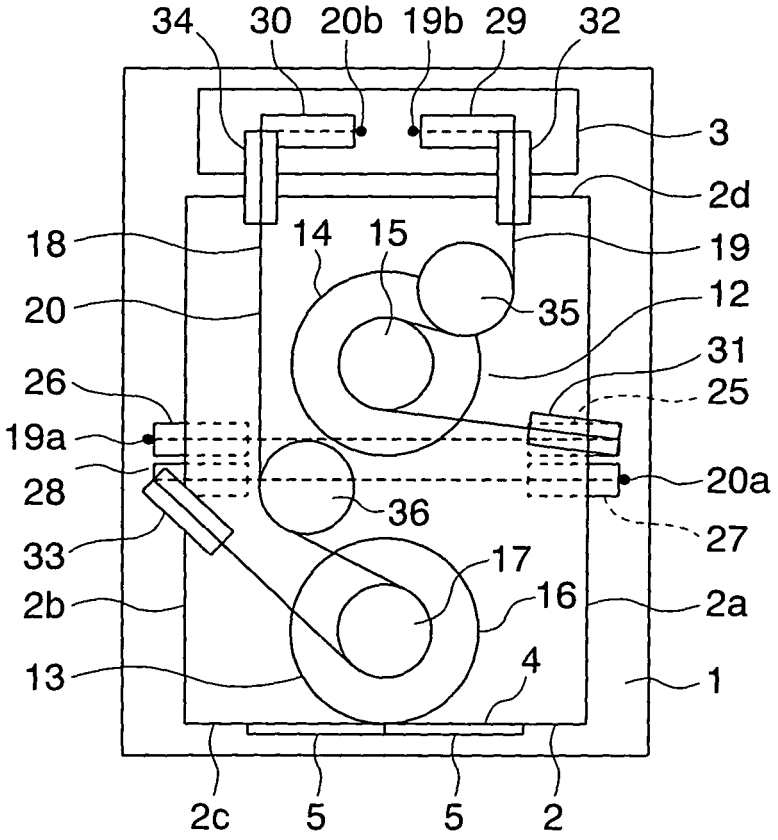
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FIG. 4

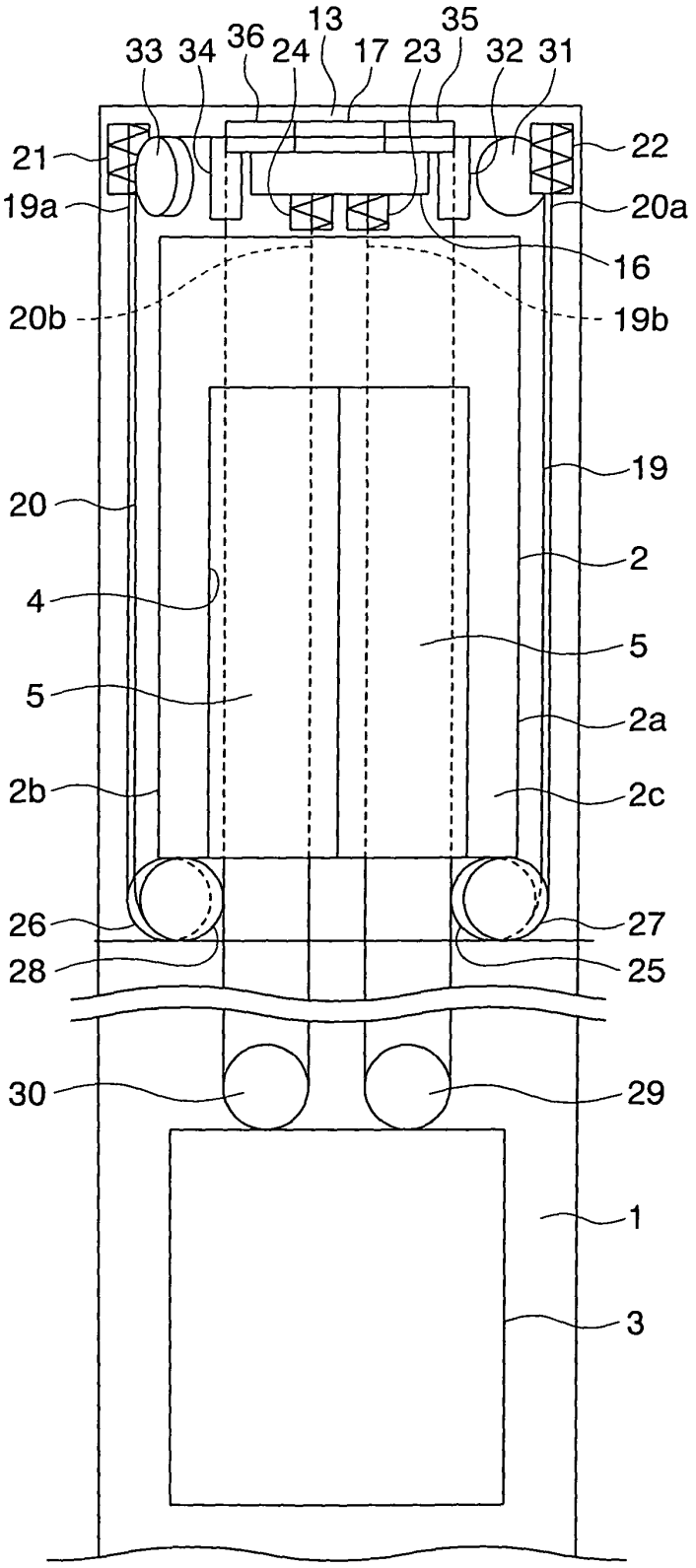
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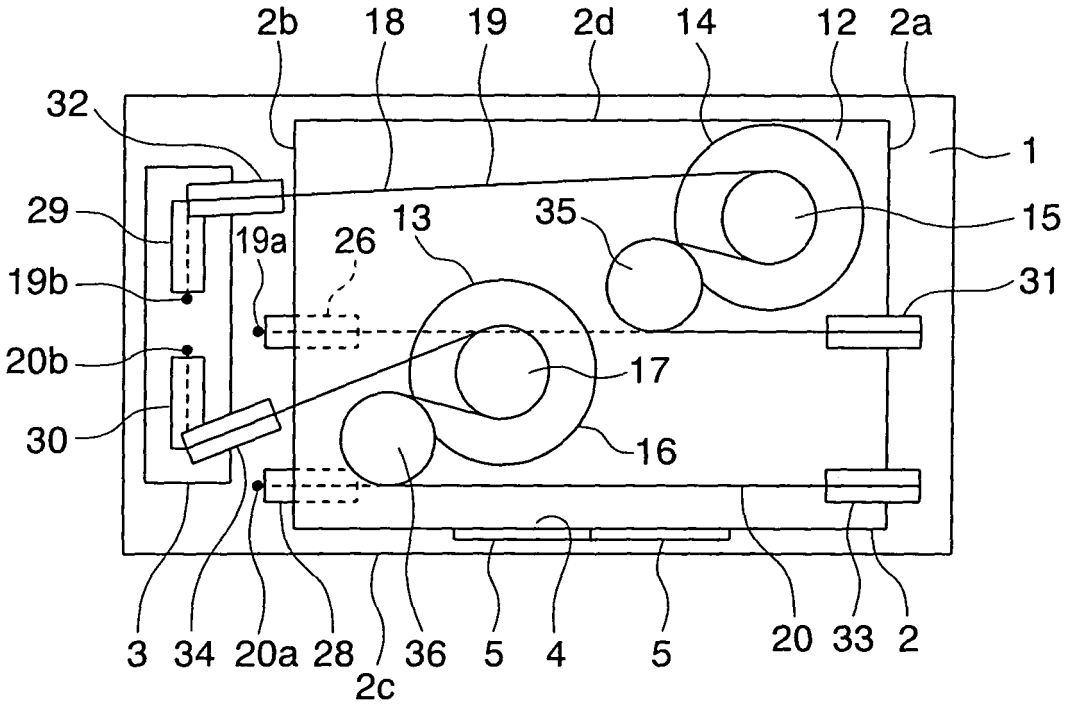
FIG. 5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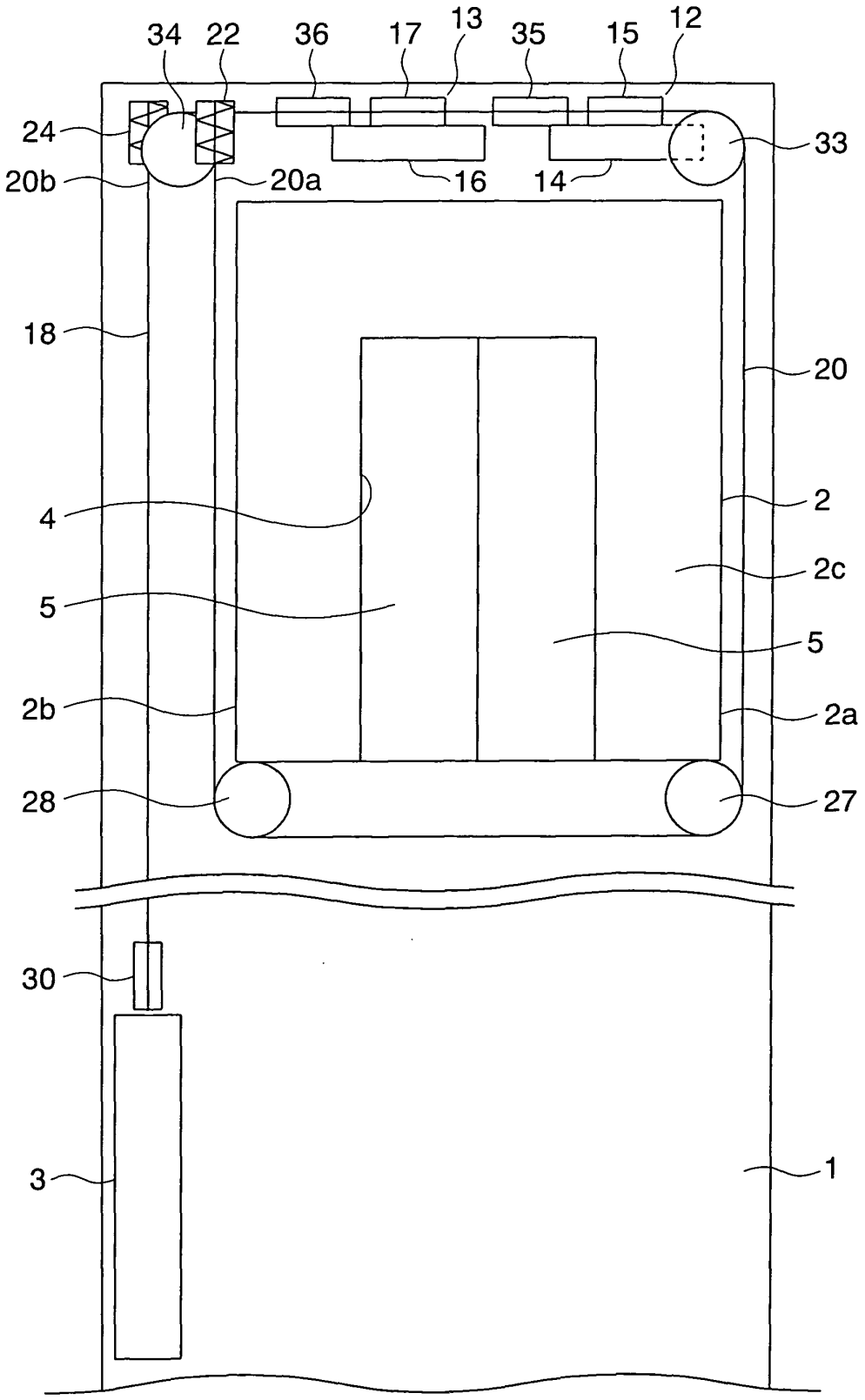
33
2

FIG. 6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2a
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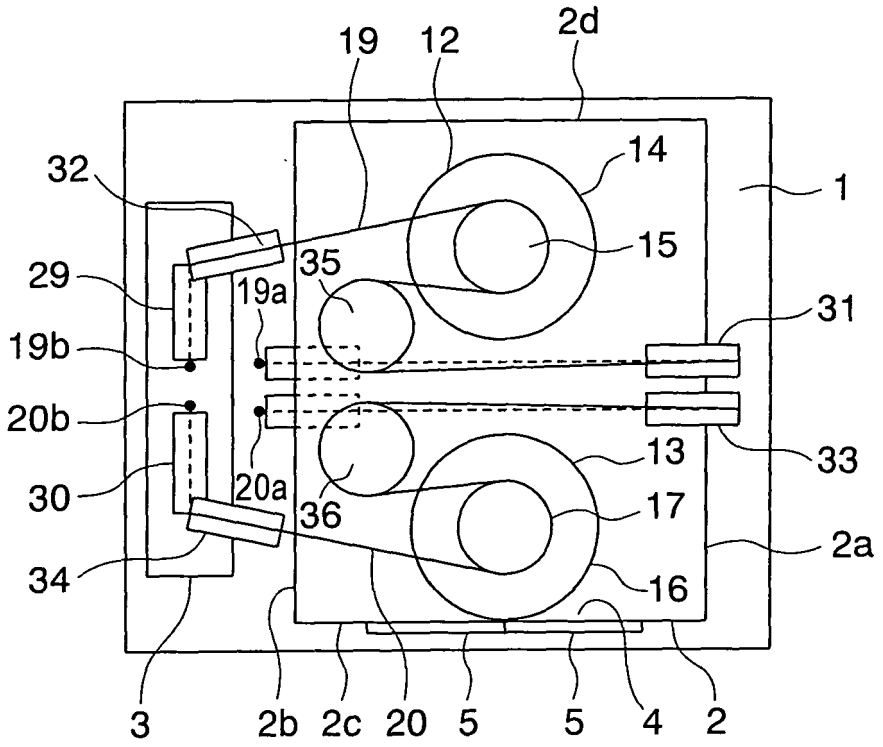
1

FIG. 7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2c
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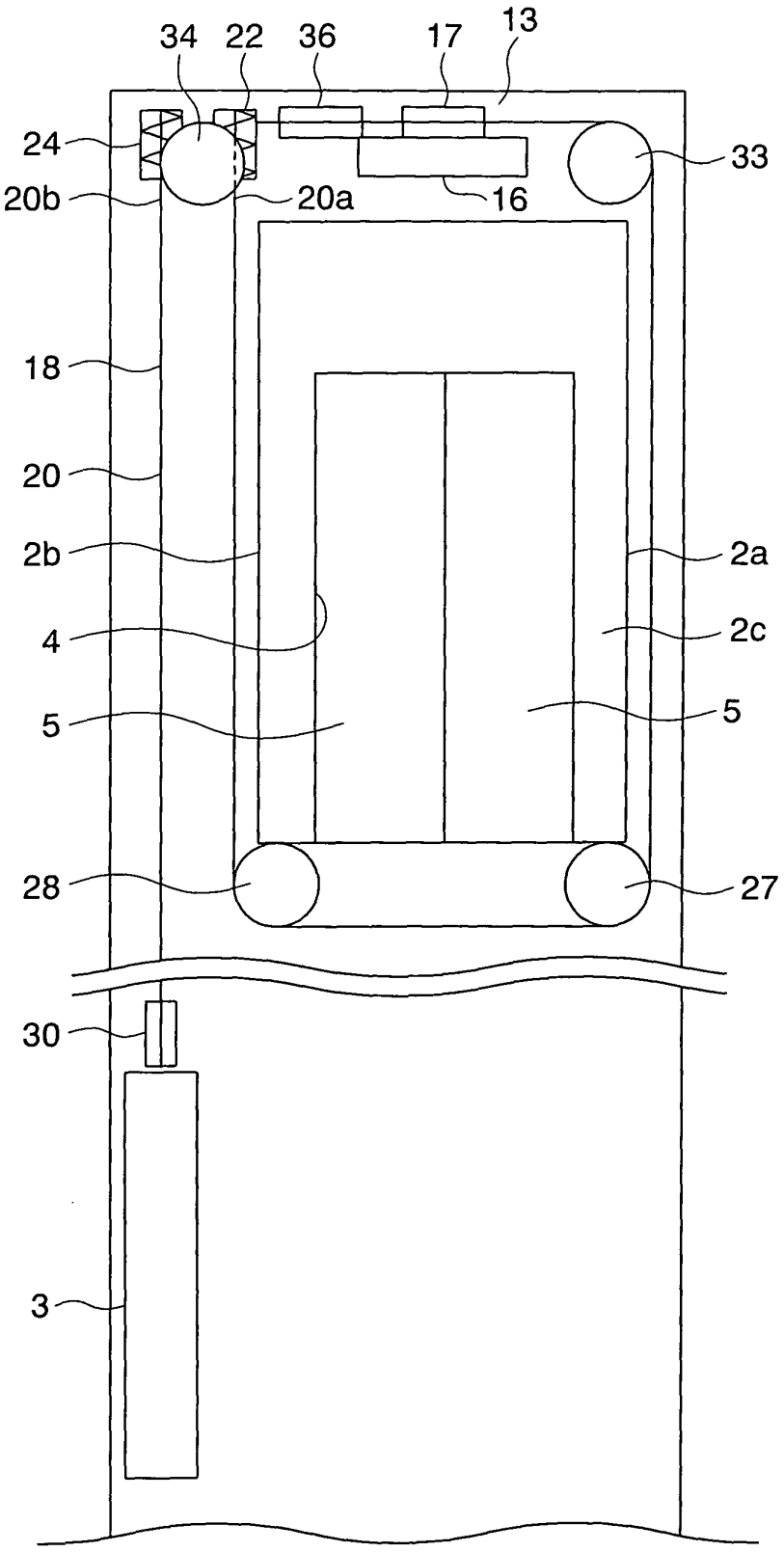
FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/014349

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] 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 1996-2005
Kokai Jitsuyo Shinan Koho 1971-2005 Toroku Jitsuyo Shinan Koho 1994-2005

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	WO 03/104126 A1 (Mitsubishi Electric Corp.), 18 December, 2003 (18.12.03), & EP 1512652 A1 & CN 1522219 A	1-4
A	JP 2000-255933 A (Mitsubishi Electric Corp.), 19 September, 2000 (19.09.00), Pay attention to Par. Nos. [0014] to [0025]; Figs. 1 to 4 (Family: none)	1-4
A	JP 2002-173279 A (Toshiba Corp.), 21 June, 2002 (21.06.02), Pay attention to Par. Nos. [0028] to [0041]; Figs. 1 to 4 (Family: none)	1-4

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Date of the actual completion of the international search	Date of mailing of the international search report
29 June, 2005 (29.06.05)	19 July, 2005 (19.07.05)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/014349

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	CA 2465031 A1 (INVENTIO AG), 27 April, 2004 (27.04.04), & WO 03/043922 A1 & EP 1446348 A1 & JP 2005-509578 A	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000255933 A **[0003]**