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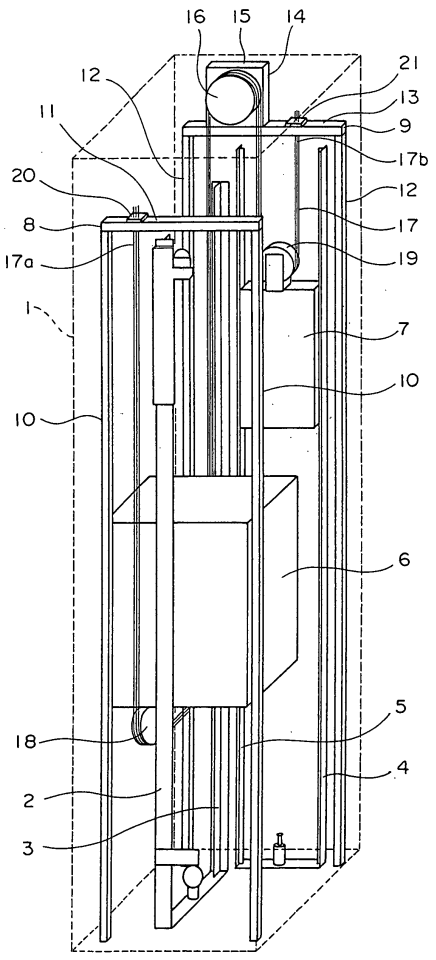
(54) **ELEVATOR**

(57) In an elevator apparatus, guide rails for guiding a car and a counterweight,respectively,arearrangedin a hoistway. Further, a support structure is arranged in the hoistway separately from the car guide rail and the counterweight guide rail. The support structure has a support column extending upwardly from a bottom portion of the hoistway, and a support beam fixed to an upper end portion of the support column. A drive device having a drive sheave is fixed to the support beam. A main rope is wound around the drive sheave. The car and the counterweight are suspended by the main rope. Accordingly, the guide rails can be reduced in size, making it possible to reduce the manufacturing cost of the guide rails.

FIG. 1



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Description

Technical Field

[0001] The present invention relates to an elevator apparatus in which a drive device (hoisting machine) for raising and lowering a car and a counterweight is arranged in a hoistway (so-called machine room-less elevator apparatus).

Background Art

[0002] Heretofore, in order to reduce the space occupied by an elevator apparatus in a building, there has been proposed a so-called machine room-less elevator apparatus in which a hoisting machine is arranged in a hoistway. In the conventional machine room-less elevator apparatus disclosed in JP 8-208152 A, a guide rail for guiding a car and a counterweight is arranged in the hoistway. The hoisting machine is fixed to an upper end portion of the guide rail. The hoisting machine has a rotatable drive sheave. The car and the counterweight are suspended in the hoistway by means of a main rope wound around the drive sheave.

[0003] In the conventional elevator apparatus, however, since the hoisting machine is fixed to the guide rail, all of the loads of the hoisting machine, car, and counterweight are placed on the guide rail, which necessarily increases the requisite size of the guide rail. Accordingly, the increased size of the guide rail hinders space saving and a reduction in the cost of the elevator apparatus.

Disclosure of the Invention

[0004] The present invention has been made in view of the above-mentioned problem, and therefore it is an obj ect of the present invention to provide an elevator apparatus capable of achieving a reduction in manufacturing cost and space saving.

[0005] An elevator apparatus according to the present invention includes: a car and a counterweight that are capable of being raised and lowered in a hoistway; guide rails arranged in the hoistway, for guiding the car and the counterweight respectively; a support structure having a support column extending upwardly from a bottom portion of the hoistway, the support structure being arranged in the hoistway separately from the guide rails; a drive device having a drive sheave and supported by the support structure; and a main rope wound around the drive sheave, for suspending the car and the counterweight.

Brief Description of the Drawing

[0006]

Fig. 1 is a perspective view showing an elevator apparatus according to Embodiment 1 of the present invention;

Fig. 2 is a perspective view showing an elevator apparatus according to Embodiment 2 of the present invention.

Best Mode for carrying out the Invention

[0007] Hereinbelow, preferred embodiments of the present invention are described with reference to the drawings.

Embodiment 1

[0008] Fig. 1 is a perspective view showing an elevator apparatus according to Embodiment 1 of the present invention.

[0009] Referring to Fig. 1, a pair of car guide rails 2, 3, and a pair of counterweight guide rails 4, 5 are arranged in a hoistway 1. A car 6 is raised and lowered in the hoistway 1 while being guided by the car guide rails 2, 3, and a counterweight 7 is raised and lowered in the hoistway 1 while being guided by the counterweight guide rails 4, 5. It should be noted that the car 6 and the counterweight 7 are arranged adjacent to each other with respect to the width direction of the car 6 within the vertical projection plane of the hoistway 1. Further, as seen in the vertical projection of the hoistway 1, the line connecting between the car guide rails 2, 3 is perpendicular to the line connecting between the counterweight guide rails 4, 5.

[0010] Arranged on one and the other side portions of the hoistway 1 are support structures 8, 9 for supporting the loads of the car 6 and counterweight 7, respectively. The support structures 8, 9 are arranged separately and independently from the car guide rails 2, 3 and the counterweight guide rails 4, 5, respectively. It should be noted that a die steel member used for construction is used as each of the support structures 8, 9.

[0011] The support structure 8 has a pair of (two) support columns 10 extending upwardly from the bottom portion of the hoistway 1, and a support beam 11 horizontally arranged between the support columns 10 and fixed to an upper end portion of each support column 10. The support columns 10 are spaced apart from each other with respect to the depth direction of the car 6. The support beam 11 extends in the depth direction of the car 6 and is arranged at a top portion of the hoistway 1.

[0012] The support structure 9 has a pair of (two) support columns 12 extending upwardly from the bottom portion of the hoistway 1, and a support beam 13 that is horizontally arranged between the support columns 12 and fixed to an upper end portion of each support column 12. The support columns 12 are spaced apart from each other with respect to the depth direction of the car 6. The support beam 13 extends in the depth direction of the car 6 and is arranged at a top portion of the hoistway 1. In this example, the pair of counterweight guide rails 4, 5 is arrangedbetween the support columns 12. Further, the support beam 13 is arranged above the counter-

weight guide rails 4,5 and the counterweight 7.

[0013] Fixed on the support beam 13 is a drive device (hoisting machine) 14 for raising and lowering the car 6 and the counterweight 7. The drive device 14 has a drive device main body 15 including a motor, and a drive sheave 16 that is rotated by the drive device main body 15. A plurality of main ropes 17 are wound around the drive sheave 16. The car 6 and the counterweight 7 are suspended in the hoistway 1 by means of the main ropes 17.

[0014] A pair of car suspension sheaves 18 is provided at a lower end portion of the car 6. A counterweight suspension sheave 19 is provided at an upper end portion of the counterweight 7. Further, a first rope securing portion 20 is fixed to the support beam 11. A second rope securing portion 21 is fixed to the support beam 13. Each main rope 17 has a first end portion 17a connected to the first rope securing portion 20, and a second end portion 17b connected to the second rope securing portion 21. Starting from the first end portion 17a, each main rope 17 is wound around the car suspension sheaves 18, the drive sheave 16, and the counterweight suspension sheave 19 in the stated order before reaching the second end portion 17b.

[0015] In the elevator apparatus as described above, the drive device 14 is supported by the support structure 9 that is arranged in the hoistway 1 separately from the car guide rails 2, 3 and the counterweight guide rails 4, 5, whereby the load of each of the car 6 and the counterweight 7 can be at least partially supported by the support structure 9, thereby making it possible to reduce the requisite support strengths of the car guide rails 2, 3 and counterweight guide rails 4, 5. This allows each of the car guide rails 2, 3 and counterweight guide rails 4, 5 to be reduced in size, making it possible to achieve a reduction in the manufacturing cost of each of the car guide rails 2, 3 and the counterweight guide rails 4, 5. Here, the manufacturing cost of the support structures 8, 9, which are used solely for the purpose of supporting load, is low, and the increase in cost attributable to the manufacturing cost of the support structures 8, 9 is small relative to the decrease in cost attributable to the reduced sizes of the car guide rails 2, 3 and counterweight guide rails 4, 5, thereby achieving a reduction in the manufacturing cost of the elevator apparatus as a whole. Further, the horizontal sectional area of the hoistway 1 can be made smaller by adjusting the arrangement and horizontal sectional configuration of each of the support structures 8, 9, making it possible to achieve saving of space in the elevator apparatus.

[0016] The first end portion 17a of each main rope 17 is connected to the support structure 8, and the second end portion 17b of each main rope 17 is connected to the support structure 9, whereby the loads of the car 6 and counterweight 7 can be supported by the support structures 8, 9, respectively. Accordingly, in the same manner as described above, the manufacturing cost of the elevator apparatus can be reduced, and space saving can be achieved for the elevator apparatus.

[0017] Further, an inexpensive steel member used for construction is used as each of the support structures 8, 9, thus enabling a further reduction in the manufacturing cost of the support structures 8, 9.

[0018] While in the above-described example the present invention is applied to an elevator apparatus of a type (2:1 roping) in which the car 6 and the counterweight 7 are suspended by winding the main ropes 17 around the car suspension sheaves 18 and the counterweight suspension sheave 19, respectively, the present invention is also applicable to an elevator apparatus of a type (1: 1 roping) in which the car 6 and the counterweight 7 are suspended by connecting the first end portion 17a of each main rope 17 to the car 6 and connecting the second end portion 17b of each main rope 17 to the counterweight 7, respectively.

[0019] Further, while in the above-described example the number of support columns 10 is two, the number of support columns 10 may be three or more. In this case, the support columns 10 are arranged at a spacing from each other in the depth direction of the car 6.

[0020] Further, while in the above-described example the number of support columns 12 is two, the number of support columns 12 may be three or more. In this case, the support columns 12 are arranged at a spacing from each other in the depth direction of the car 6 so as to avoid interference with the counterweight guide rails 4, 5 and the counterweight 7.

Embodiment 2

[0021] Fig. 2 is a perspective view showing an elevator apparatus according to Embodiment 2 of the present invention. In this example, a car 6 and a counterweight 7 are arranged adjacent to each other with respect to the depth direction of the car 6 as seen in the vertical projection plane of a hoistway 1. Further, as seen in the vertical projection of the hoistway 1, the line connecting between car guide rails 2, 3 is parallel to the line connecting between counterweight guide rails 4, 5.

[0022] In the hoistway 1, a support structure 31 for supporting the loads of the car 6 and counterweight 7 is arranged separately from the car guide rails 2, 3 and the counterweight guide rails 4, 5. The support structure 31 has: four support columns 32a through 32d extending upwardly from the four bottom corners of the hoistway 1; a bottom support beam 33 provided at a lower end portion of each of the two support columns 32b, 32c, which are arranged on the counterweight 7 side of the car 6, for supporting the support columns 32b, 32c; and a top support beam 34 provided at an upper end portion of each of the four support columns 32a through 32d and arranged horizontally. Further, the support structure 31 is prepared by a die steel member used for construction.

[0023] The bottom support beam 33 extends in the width direction of the car 6 and is fixed to the bottom portion of the hoistway 1. The lower end portions of the

counterweight guide rails 4, 5 are fixed onto the bottom support beam 33. Further, a drive device 14 for raising and lowering the car 6 and the counterweight 7 is fixed to the bottom support beam 33 through the intermediation of a fixing member 35.

[0024] The drive device 14 is arranged at a lower portion of the hoistway 1. Further, the drive device 14 has a drive device main body 15 including a motor, and a drive sheave 16 that is rotated by the drive device main body 15. A main rope group 36, which suspends the car 6 and the counterweight 7, is wound around the drive sheave 16. The main rope group 36 includes a first main rope 37 and a second main rope 38.

[0025] The top support beam 34 has a lateral beam portion 34a extending in the width direction of the car 6 between the support columns 32b, 32c, a pair of (two) vertical beam portions 34b extending from the opposite ends of the lateral beam portion 34a in the depth direction of the car 6, and a bridging beam portion 34c arranged horizontally between the vertical beam portions 34b.

[0026] A pair of counterweight-side return pulleys 39 is provided to the bridging beam portion 34c. A first car-side return pulley 40 is provided to each of one vertical beam portion 34b and the bridging beam portion 34c. A second car-side return pulley 41 is provided to each of the other vertical beam portion 34b and the bridging beam portion 34c. That is, the counterweight-side return pulleys 39, the first car-side return pulleys 40, and the second car-side return pulleys 41 are arranged at a top portion of the hoistway 1 while being supported by the support structure 31. It should be noted that a top portion of the car guide rail 2 is fixed to the one vertical beam portion 34b, and a top portion of the car guide rail 3 is fixed to the other vertical support portion 34b.

[0027] Provided in both side portions of the car 6 are a first rope securing portion 42 and a second rope securing portion 43 that extend outwards in the width direction of the car 6. The first main rope 37 has a first end portion 37a connected to the first rope securing portion 42, and a second end portion 37b connected to the upper end portion of the counterweight 7. Further, the second main rope 38 has a first end portion 38a connected to the second rope securing portion 43, and a second end portion 38b connected to an upper end portion of the counterweight 7.

[0028] Starting from the first end portion 37a, the first main rope 37 is wound around the first car-side return pulleys 40, the drive sheave 16, and the counterweight-side return pulleys 39 in the stated order before reaching the second end portion 37b. Further, starting from the first end portion 38a, the second main rope 38 is wound around the second car-side return pulleys 41, the drive sheave 16, and the counterweight-side return pulleys 39 in the stated order before reaching the second end portion 38b. That is, the car 6 and the counterweight 7 are suspended by the first main rope 37, which is continuously wound around the first car-side return pulleys 40, the drive sheave 16, and the counterweight-side return pulleys 39, and by the second main rope 38, which is continuously wound around the second car-side return pulleys 41, the drive sheave 16, and the counterweight-side return pulleys 39. Otherwise, Embodiment 2 is of the same construction as Embodiment 1.

[0029] In the elevator apparatus as described above, the counterweight-side return pulleys 39, the first car-side return pulleys 40, and the second car-side return pulleys 41 are supported by the support structure 31 arranged in the hoistway 1 separately from the car guide rails 2, 3 and the counterweight guide rails 4, 5. Accordingly, the respective loads of the car 6 and counterweight 7 can be at least partially supported by the support structure 31, thus making it possible to reduce the requisite support strengths of the car guide rails 2, 3 and counterweight guide rails 4, 5. Thus enables a reduction in the size of each of the car guide rails 2, 3 and the counterweight guide rails 4, 5, thereby achieving a reduction in the manufacturing cost of each of the car guide rails 2, 3 and the counterweight guide rails 4, 5. Therefore, in the same manner as in Embodiment 1, the manufacturing cost of the elevator apparatus as a whole can be reduced. Further, space saving can also be achieved for the elevator apparatus by adjusting the arrangement and configuration of the support structure 31.

[0030] Further, since the drive device 14 is supported by the support structure 31, the respective loads of the car 6 and counterweight 7 can be at least partially supported by the support structure 31, whereby, in the manner as described above, the manufacturing cost of the elevator apparatus can be reduced and the space saving can be achieved for the elevator apparatus.

[0031] Further, the car guide rails 2, 3 and the counterweight guide rails 4, 5 are fixed to the support structure 31, whereby positioning of the drive device 14 and the return pulleys 39, 40, and 41 with respect to the car guide rails 2, 3 and the counterweight guide rails 4, 5 can be performed with ease and enhanced reliability. Further, the support structure 31, the car guide rails 2, 3, and the counterweight guide rails 4, 5 can be integrated into a unit, thereby facilitating installation of the elevator apparatus in a building.

[0032] While in the above-described example the present invention is applied to the elevator apparatus of the type (1:1 roping) in which the car 6 and the counterweight 7 are suspended by connecting one end portion of the main rope group 36 to the car 6 and the other end portion of the main rope group 36 to the counterweight 7, the present invention is also applicable to an elevator apparatus of a type (1:1 roping) in which the counterweight suspension sheave is provided to the counterweight 7 and the car suspension sheave is provided to the car 6, with the car 6 and the counterweight 7 being suspended by continuously winding the main rope group 36 around the counterweight suspension sheave and the car suspension sheave.

[0033] Further, while in the above-described example the present invention is applied to the 1:1 roping type

elevator apparatus in which the car 6 is suspended at two points on both sides thereof, the present invention may also be applied to a 1 : 1 roping type elevator apparatus in which the car 6 is suspended at one point at the top thereof.

Claims

1. An elevator apparatus **characterized by** comprising:

   a car and a counterweight that are capable of being raised and lowered in a hoistway;
   guide rails arranged in the hoistway, for guiding the car and the counterweight respectively;
   a support structure having a support column extending upwardly from a bottom portion of the hoistway, the support structure being arranged in the hoistway separately from the guide rails;
   a drive device having a drive sheave and supported by the support structure; and
   a main rope wound around the drive sheave, for suspending the car and the counterweight.

2. An elevator apparatus **characterized by** comprising:

   a car and a counterweight that are capable of being raised and lowered in a hoistway;
   guide rails arranged in the hoistway, for guiding the car and the counterweight respectively;
   a support structure having a support column extending upwardly from a bottom portion of the hoistway, the support structure being arranged in the hoistway separately from the guide rails;
   a drive device having a drive sheave and supported by the support structure;
   a return pulley arranged at a top portion of the hoistway and supported by the support structure; and
   a main rope that is continuously wound around the drive sheave and the return pulley, for suspending the car and the counterweight.

3. An elevator apparatus **characterized by** comprising:

   a car and a counterweight that are capable of being raised and lowered in a hoistway;
   guide rails arranged in the hoistway, for guiding the car and the counterweight respectively;
   a support structure having a support column extending upwardly from a bottom portion of the hoistway, the support structure being arranged in the hoistway separately from the guide rails;
   a drive device having a drive sheave and supported by the support structure; and
   a main rope for suspending the car and the counterweight, the main rope having a first end portion and a second end portion and being wound around the drive sheave, the first end portion and the second end portion being connected to the support structure.

4. An elevator apparatus according to Claim 2 or 3, **characterized in that** the drive device is supported by the support structure.

5. An elevator apparatus according to any one of Claims 1 through 4, **characterized in that** the guide rails are fixed to the support structure.

6. An elevator apparatus according to any one of Claims 1 through 5, **characterized in that** the support structure comprises a die steel member used for construction.

FIG. 1

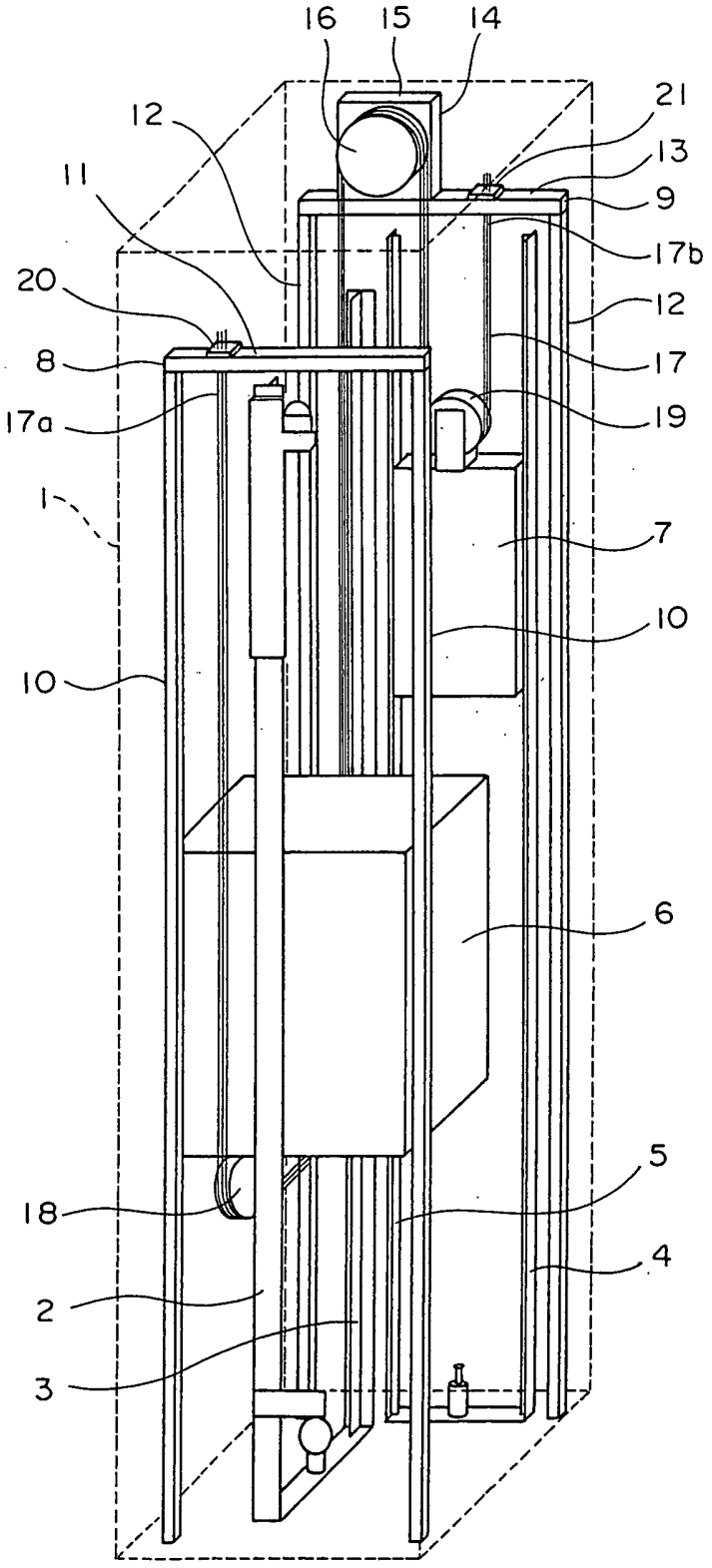
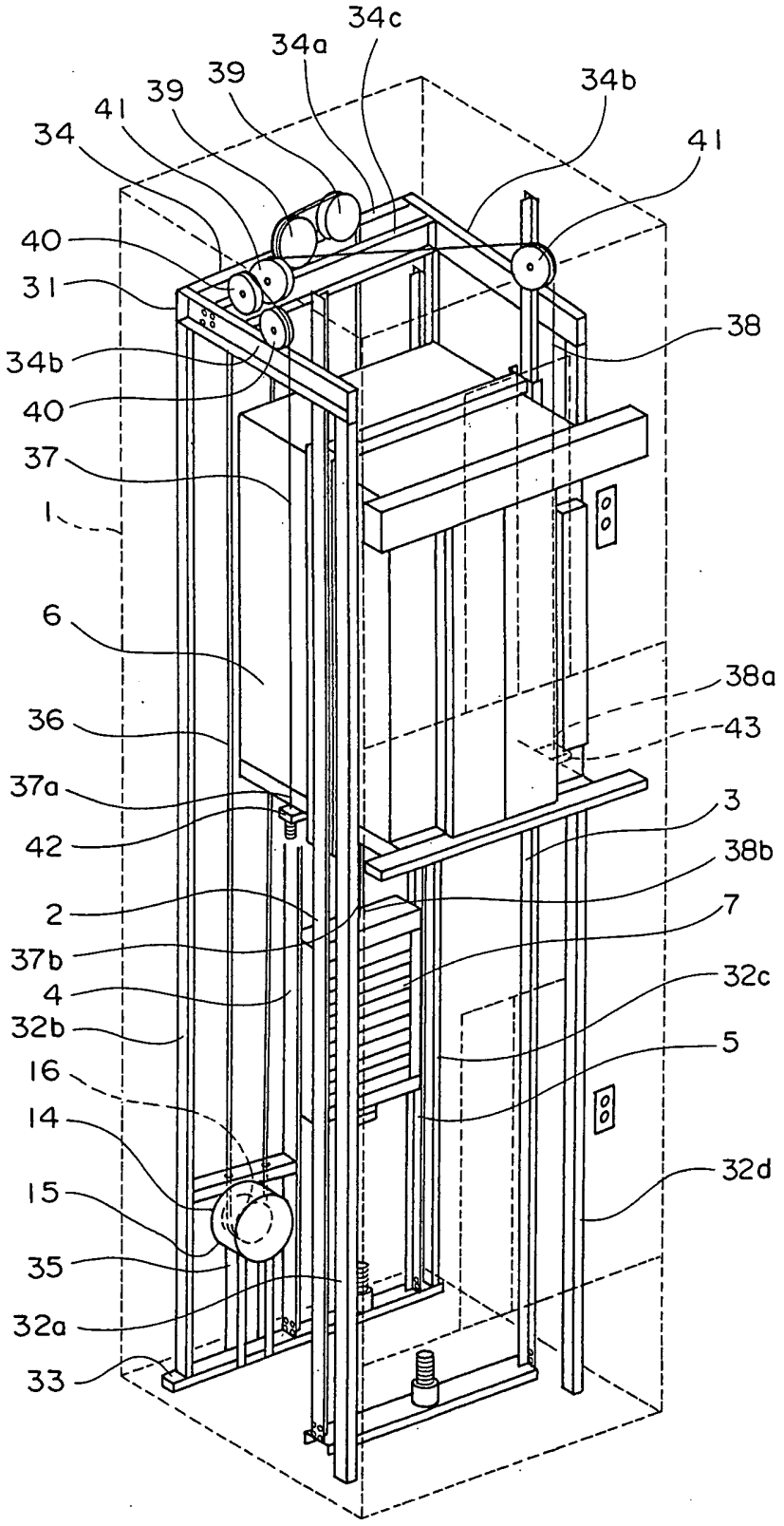


FIG. 2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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/001808

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B11/04, 7/00

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] B66B7/00-11/08

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	1996-2004
Kokai Jitsuyo Shinan Koho	1971-2004	Toroku Jitsuyo Shinan Koho	1994-2004

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.
X	JP 1-267286 A (Hitachi, Ltd.), 25 October, 1989 (25.10.89), Pay attention to page 2, upper right column, line 6 to lower left column, line 6; Figs. 1 to 2 (Family: none)	1,3-6
X	EP 0913353 A1 (VESTNER Paul), 06 May, 1999 (06.05.99), Pay attention to Par. Nos. [0033] to [0040]; Fig. 1 & DE 297018047 U1	2
A	JP 10-7343 A (Hitachi, Ltd.), 13 January, 1998 (13.01.98), Pay attention to Par. No. [0009]; Fig. 1 (Family: none)	1,4

☐ 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 16 November, 2004 (16.11.04)	Date of mailing of the international search report 30 November, 2004 (30.11.04)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 8208152 A **[0002]**