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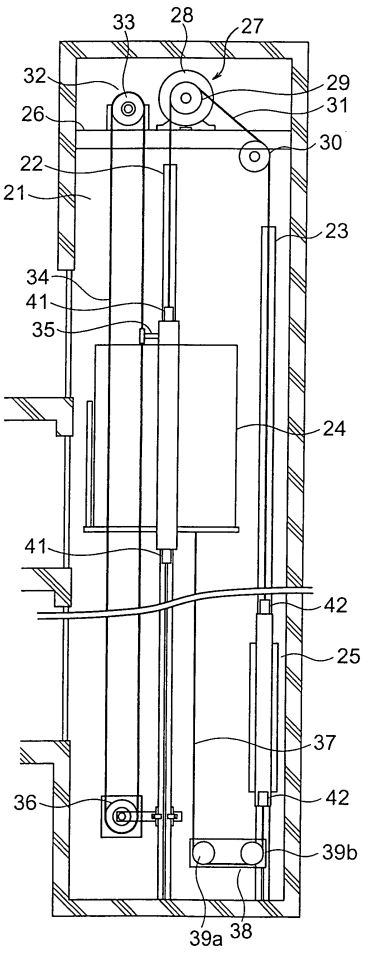
(54) ELEVATOR APPARATUS

(57) In an elevator apparatus, a car is suspended inside a hoistway by a main rope. A car guiding apparatus that engages with a car guide rail is disposed on the car. A speed governor sheave is disposed in an upper portion of the hoistway. A speed governor rope is wound around the speed governor sheave. The speed governor rope is cycled together with raising and lowering of the car. A resin-coated rope having a coating body constituted by a resin material disposed on an outer peripheral portion is used for the main rope and the speed governor rope. An oilless guiding apparatus is used for the car guiding apparatus.

FIG. 1



EP 1 795 483 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which a resin-coated rope having a coating body constituted by a resin material disposed on an outer peripheral portion is used for a main rope.

BACKGROUND ART

[0002] Main ropes of conventional elevator apparatuses are configured by laying a plurality of strands together. Each of the strands is configured by laying a plurality of steel wires together. Each of the wires is covered by a wire coating constituted by a resin. An outer peripheral portion of the entire main rope is also covered by a rope coating constituted by a resin (see Patent Literature 1, for example).

[0003] Patent Document 1: JP 2001-262482 A

DISCLOSURE OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0004] There has been a possibility that conventional resin-coated ropes such as those described above would not be able to generate predetermined traction force stably when used in normal elevator apparatuses without modification due to the influence of equipment inside a hoistway.

[0005] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus enabling required traction force to be generated stably while using a resin-coated rope.

MEANS FOR SOLVING THE PROBLEM

[0006] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator apparatus including: a car guide rail disposed inside a hoistway; a car raised and lowered inside the hoistway along the car guide rail; a car guiding apparatus disposed on the car so as to engage with the car guide rail; a main rope suspending the car; a speed governor sheave disposed in an upper portion of the hoistway; and a speed governor rope wound around the speed governor sheave and having two end portions connected to the car so as to be cycled together with raising and lowering of the car, a resin-coated rope having a coating body constituted by a resin material disposed on an outer peripheral portion being used for the main rope and the speed governor rope, and an oilless guiding apparatus being used for the car guiding apparatus.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Figure 1 is a structural diagram showing an elevator apparatus according to Embodiment 1 of the present invention;

Figure 2 is a cross section showing a first structural example of a resin-coated rope used in a main rope, a speed governor rope, and a compensating rope from Figure 1;

Figure 3 is a cross section showing a second structural example of a resin-coated rope used in the main rope, the speed governor rope, and the compensating rope from Figure 1; and

Figure 4 is a structural diagram showing an elevator apparatus according to Embodiment 2 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

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

Embodiment 1

[0009] Figure 1 is a structural diagram showing an elevator apparatus (a machine-roomless elevator) according to Embodiment 1 of the present invention. In the figure, a pair of car guide rails 22 and a pair of counterweight guide rails 23 are installed inside a hoistway 21. A car 24 is raised and lowered inside the hoistway 21 along the car guide rails 22. A counterweight 25 is raised and lowered inside the hoistway 21 along the counterweight guide rails 23.

[0010] A machine base (a supporting beam) 26 is fixed to an upper portion inside the hoistway 21. A driving machine (a hoisting machine) 27 generating a driving force for raising and lowering the car 24 and the counterweight 25 is supported on the machine base 26. The driving machine 27 has: a driving machine main body 28 including a motor and a brake; and a drive sheave 29 rotated by the driving machine main body 28. A rotatable deflection sheave 30 is mounted to the machine base 26.

[0011] A plurality of main ropes 31 (only one is shown in the figure) are wound around the drive sheave 29 and the deflection sheave 30. The main ropes 31 have: car end portions connected to an upper portion of the car 24; and counterweight end portions connected to an upper portion of the counterweight 25. Specifically, the car 24 and the counterweight 25 are suspended inside the hoistway 21 by the main ropes 31 using a one-to-one (1:1) roping method.

[0012] A speed governor 32 for detecting speed of the car 24 is supported on the machine base 26. The speed governor 32 has a speed governor sheave 33. A speed governor rope 34 is wound around the speed governor sheave 33. Two end portions of the speed governor rope

34 are connected to the car 24 by means of a safety operating mechanism 35 disposed on the car 24. Consequently, when the car 24 ascends and descends, the speed governor rope 34 is cycled, rotating the speed governor sheave 33.

[0013] A speed governor rope tension sheave 36 is disposed in a lower portion inside the hoistway 21. A lower end portion of the speed governor rope 34 is wound around the speed governor rope tension sheave 36.

[0014] A plurality of compensating ropes 37 (only one is shown in the figure) are suspended between the car 24 and the counterweight 25. The compensating ropes 37 have: car end portions connected to a lower portion of the car 24; and counterweight end portions connected to a lower portion of the counterweight 25.

[0015] A compensating apparatus 38 is disposed in a lower portion inside the hoistway 21. A plurality of compensating rope tension sheaves 39a and 39b are disposed on the compensating apparatus 38.

Lower end portions of the compensating ropes 37 are wound around the compensating rope tension sheaves 39a and 39b.

[0016] A resin-coated rope having a coating body constituted by a resin material disposed on an outer peripheral portion is used for the main ropes 31, the speed governor rope 34, and the compensating ropes 37. Diameters of the main ropes 31, the speed governor rope 34, and the compensating ropes 37 are equal to each other. In addition, cross-sectional constructions of the main ropes 31, the speed governor rope 34, and the compensating ropes 37 are similar to each other.

[0017] A plurality of car guiding apparatuses 41 that engage with the car guide rails 22 are mounted to upper portions and lower portions of the car 24. A plurality of counterweight guiding apparatuses 42 that engage with the counterweight guide rails 23 are mounted to upper portions and lowerportions of the counterweight 25. Oilless guiding apparatuses that do not require lubrication are used for the car guiding apparatuses 41 and the counterweight guiding apparatuses 42. Sliding guide shoes containing wax or polyethylene as a maj or constituent can be used for the oilless guiding apparatuses.

[0018] Figure 2 is a cross section showing a first structural example of a resin-coated rope used in the main ropes 31, the speed governor rope 34, and the compensating ropes 37 from Figure 1. In the figure, the resin-coated rope has: a core rope 1; and a second strand layer 11 surrounding an outer periphery of the core rope 1. The core rope 1 has: a centrally-positioned core strand 3; and a plurality of first strands 4 (in this case eight) laid together on an outer periphery of the core strand 3. The core strand 3 is constituted by three or more layers.

[0019] The core strand 3 has a plurality of steel core wires 5 laid together with each other. A plurality of wires having different diameters than each other are used for the core wires 5. Specifically, a plurality of large core wires 5a, and small core wires 5b having a smaller diameter than the large core wires 5a disposed in gaps between the large core wires 5a are used.

[0020] Each of the first strands 4 has: a plurality of steel first wires 6 (in this case a total of seven wires constituted by one central wire and six outer peripheral wires) laid together with each other; and a first strand coating body 7 made of a resin independently coated on an outer periphery of this group of first wires 6 laid together. The first strand coating bodies 7 are composed of a polyethylene resin, for example.

[0021] The second strand layer 11 has: a second strand layer main body 16; a plurality of auxiliary strands 13 (in this case eight) disposed on an outer peripheral portion of the second strand layer main body 16 in gaps between mutually-adjacent second strands 8; and a second strand layer coating body 12 made of a resin coating an outer periphery of the second strand layer main body 16 and the auxiliary strands 13.

[0022] A second strand layer main body 16 is constituted by a plurality of second strands 8 (in this case eight) laid together on an outer periphery of the core rope 1. Each of the second strands 8 has a plurality of steel second wires 9 laid together with each other. A plurality of wires having different diameters than each other are used for the second wires 9. Specifically, a plurality of large second wires 9a, and small second wires 9b having a smaller diameter than the large second wires 9a disposed in gaps between the large second wires 9a are used for the second wires 9.

[0023] The number of second strands 8 is equal to the number of first strands 4. The lay lengths of the second strands 8 are also equal to the lay lengths of the first strands 4. In addition, the second strands 8 are laid parallel to the first strands 4 so as to be in mutual line contact with adjacent first strands 4.

[0024] The second strand layer coating body 12 is constituted by a high-friction resin material having a coefficient of friction greater than or equal to 0.2, such as a polyurethane resin, for example.

[0025] Each of the auxiliary strands 13 has: a plurality of steel auxiliary strand wires 14 (in this case seven) laid together with each other; and an auxiliary strand coating body 15 made of a resin coated on an outer periphery. The auxiliary strand coating bodies 15 are composed of a polyethylene resin, for example. A diameter of the auxiliary strands 13 is set so as to be smaller than a diameter of the second strands 8. A lay length of the auxiliary strands 13 and a lay length of the second strands 8 are equal. In addition, the auxiliary strands 13 are laid parallel to the second strands 8 so as to be in mutual line contact with adjacent second strands 8.

[0026] Figure 3 is a cross section showing a second structural example of a resin-coated rope used in the main ropes 31, the speed governor rope 34, and the compensating ropes 37 from Figure 1. In this example, a resin-coated rope having a flat cross-sectional shape, in other words, a belt-shaped resin-coated rope (a flat belt), is shown. In the figure, a rope main body 51 has: seven strand assemblies 52; and a coating body 53 made of a

resin covering and integrating the strand assemblies 52.

[0027] The strand assemblies 52 are disposed side by side in a cross section (Figure 3) perpendicular to a longitudinal direction of the rope main body 51. Specifically, the seven strand assemblies 52 are disposed so as to line up in a straight line at a distance from each other in a width direction of the rope main body 51 in a cross section perpendicular to the longitudinal direction of the rope main body 51.

[0028] Each of the strand assemblies 52 respectively includes: a core material 54 made of a resin extending in a longitudinal direction of the rope main body 51; and three strands 55 disposed around the core material 54 and laid together with the core material 54. Each of the strands 55 includes: a steel core wire 56 functioning as a wire; and six outer peripheral wires 57 functioning as wires disposed around the core wire 56 and laid parallel to each other.

[0029] In each of the strand assemblies 52, the three strands 55 are disposed in a triangular cross-sectional shape around the core material 54. The strand assemblies 52 are disposed such that the disposed cross-sectional shapes of the strands 55 are alternately reversed in direction.

[0030] A thermoplastic resin such as a polypropylene resin, a polyethylene resin, or a vinyl, etc., or synthetic resin fibers such as high-strength aramid fibers or polypropylene fibers, etc., laid together at a high density, for example, can be used for the material of the core material 54.

[0031] The coating body 53 is composed of a thermoplastic ether-based polyurethane resin, for example. An adhesive 58 is applied to at least an outer peripheral portion of each of the strands 55 to integrate them with the coating body 53. That is, the strands 55 and the coating body 53 are bonded to each other by means of the adhesive 58.

[0032] In an elevator apparatus of this kind, because oilless guiding apparatuses are used for the car guiding apparatuses 41, lubricating oil is prevented from splattering, or dispersing, etc., from the car guiding apparatuses 41. For this reason, lubricating oil is prevented from splashing onto the surface of the resin-coated ropes, preventing traction force (frictional force) from being reduced due to adhesion of lubricating oil. Consequently, required traction force can be generated stably while using resin-coated ropes.

[0033] By using resin-coated ropes for the main ropes 31, reductions in size and improvements in traction capacity in the drive sheave 29, extension of service life of the main ropes 31, and extension of service life of the sheaves can be achieved.

[0034] In addition, even if a resin-coated rope is used for the speed governor rope 34, the resin-coated rope is prevented from slipping relative to the speed governor sheave 33, enabling car speed detecting precision to be improved.

[0035] If overspeeding (tripping speed) of the car 24 is detected by the speed governor 32, the speed governor rope 34 is braked by friction from rope catching by the speed governor 32, and emergency stopping apparatuses are activated, and by preventing splashing of lubricating oil onto the speed governor rope 34, which is a resin-coated rope, the speed governor rope 34 can be braked and stopped more reliably by a small friction braking force. For this reason, reductions in the size of the speed governor 32 can be achieved.

[0036] Since the resin-coated rope has superior flexibility over steel rope, reductions in diameter of the speed governor rope tension sheave 36 can also be achieved by using the resin-coated rope for the speed governor rope 34, enabling reductions in pit dimensions of the hoistway 21 to be achieved.

[0037] In addition, because oilless guiding apparatuses are also used for the counterweight guiding apparatuses 42, splashing of lubricating oil onto the resin-coated rope can be more reliably prevented.

[0038] Because diameters and cross-sectional constructions of the main ropes 31, the speed governor rope 34, and the compensating ropes 37 are similar to each other, rope accessories such as rope end fixtures, etc., installation tools, maintenance tools, and inspection jigs, etc., can be standardized.

Embodiment 2

[0039] Next, Figure 4 is a structural diagram showing an elevator apparatus according to Embodiment 2 of the present invention. In the figure, a counterbalancing chain 43 is suspended between a car 24 and a counterweight 25. The counterbalancing chain 43 has: a car end portion connected to a lower portion of the car 24; and a counterweight end portion connected to a lower portion of the counterweight 25. The rest of the configuration is similar to that of Embodiment 1.

[0040] Thus, the counterbalancing chain 43 can also be used instead of the compensating rope 37 if a hoisting zone for the car 24 is short, for example, enabling similar effects to those in Embodiment 1 to be achieved.

[0041] Moreover, Whisperflex (registered trademark), etc., may also be used instead of the compensating rope 37 and the counterbalancing chain 43.

In the above examples, the driving machine 27 was disposed in an upper portion inside the hoistway 21, but the driving machine is not limited to being disposed in a particular location, and may also be disposed inside a machine room, or in a lower portion of the hoistway, etc., for example.

[0042] In addition, types of oilless guiding apparatuses having guide rollers may also be used for the car guiding apparatuses and the counterweight guiding apparatuses.

Diameters and cross-sectional constructions of the main ropes, the speed governor rope, and the compensating ropes may also be different from each other.

The roping method is not limited to one-to-one (1:1) rop-

ing, and may also be two-to-one (2:1) roping, for example.

Claims

1. An elevator apparatus comprising:

   a car guide rail disposed inside a hoistway;
   a car raised and lowered inside the hoistway along the car guide rail;
   a car guiding apparatus disposed on the car so as to engage with the car guide rail;
   a main rope suspending the car;
   a speed governor sheave disposed in an upper portion of the hoistway; and
   a speed governor rope wound around the speed governor sheave and having two end portions connected to the car so as to be cycled together with raising and lowering of the car,
   characterized in that
   a resin-coated ropes having a coating body constituted by a resin material disposed on an outer peripheral portion are used for the main rope and the speed governor rope, and
   an oilless guiding apparatus is used for the car guiding apparatus.

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

   a counterweight guide rail disposed inside the hoistway;
   a counterweight suspended inside the hoistway by the main rope and raised and lowered inside the hoistway along the counterweight guide rail; and
   a counterweight guiding apparatus disposed on the counterweight so as to engage with the counterweight guide rail,
   characterized in that
   an oilless guiding apparatus is used for the counterweight guiding apparatus.

3. The elevator apparatus according to Claim 2, further comprising:

   a compensating rope suspended between the car and the counterweight,
   characterized in that
   a resin-coated rope is used for the compensating rope.

4. The elevator apparatus according to Claim 3, **characterized in that** a diameter and a cross-sectional construction of the main rope, the speed governor rope, and the compensating rope are similar to each other.

5. The elevator apparatus according to Claim 1, **characterized in that** a belt-shaped resin-coated rope having a flat cross-sectional shape is used for the main rope.

FIG. 1

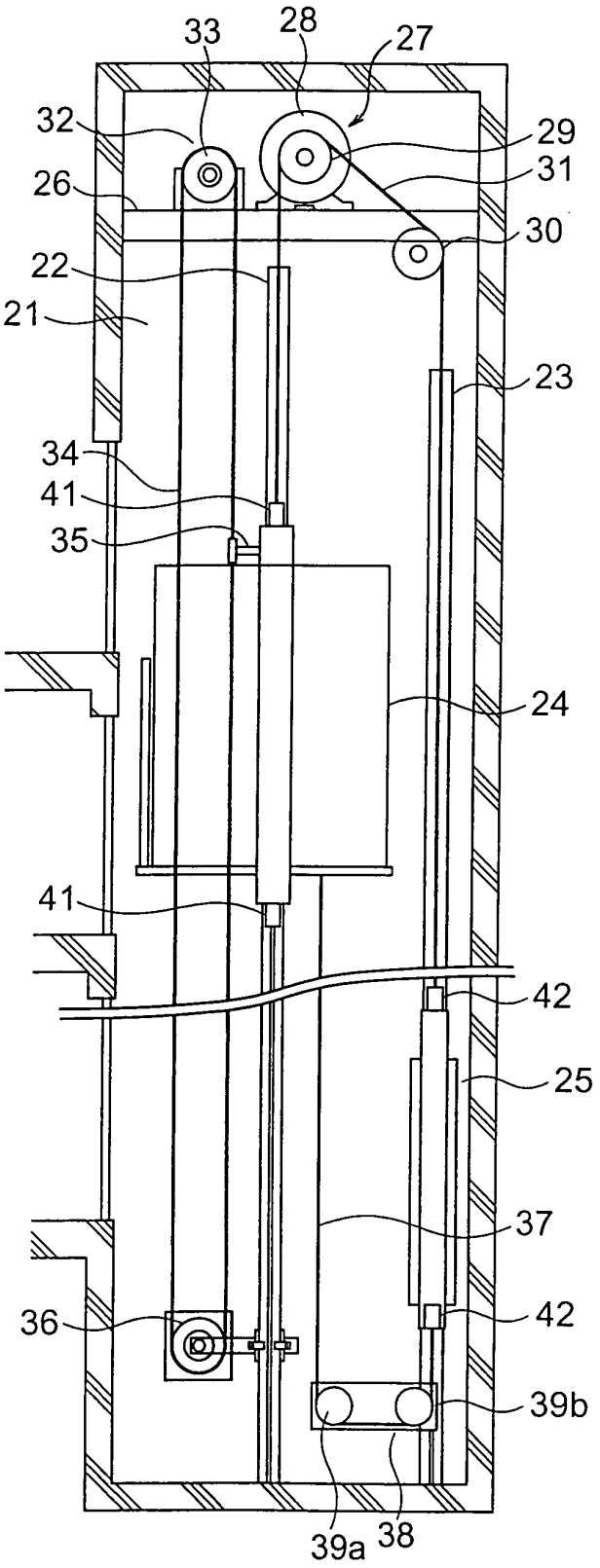

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FIG. 2

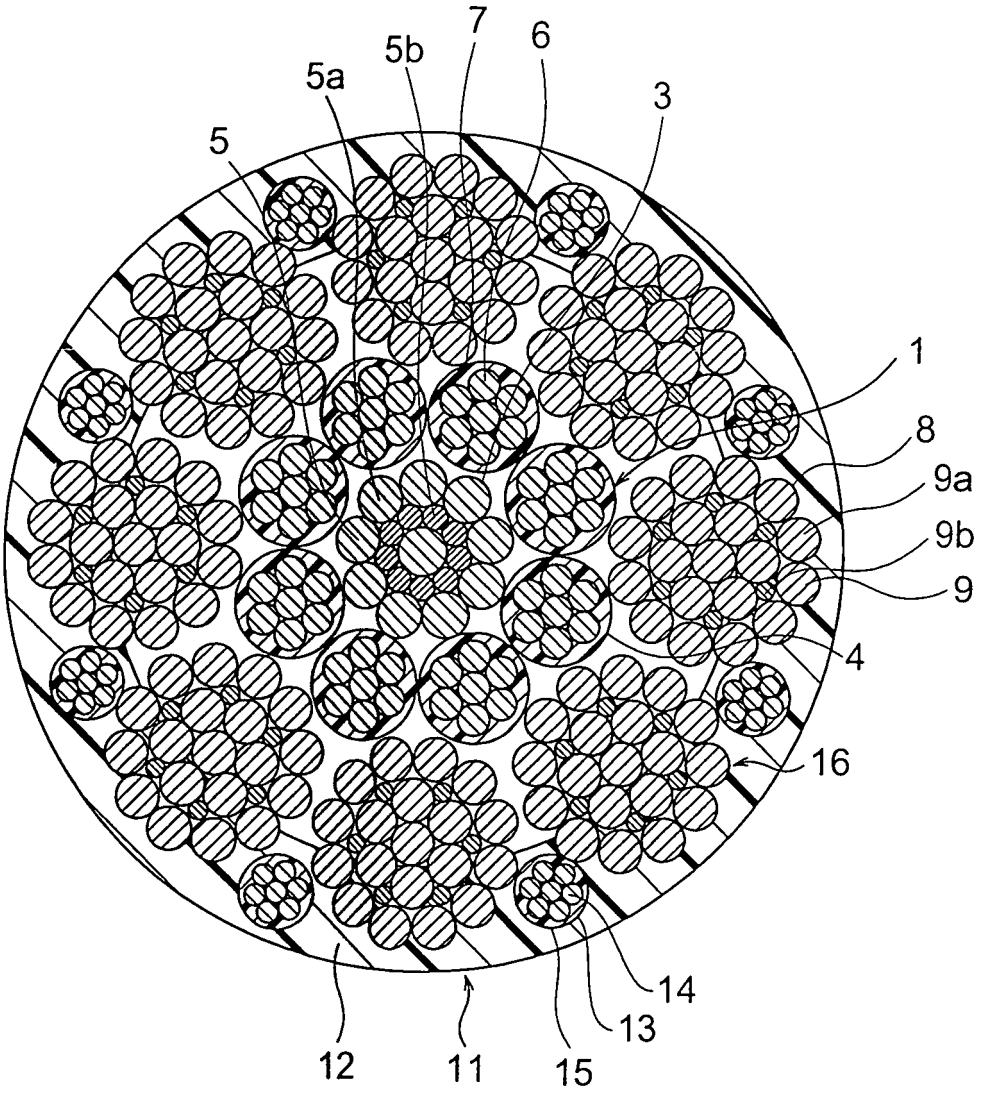


FIG. 3

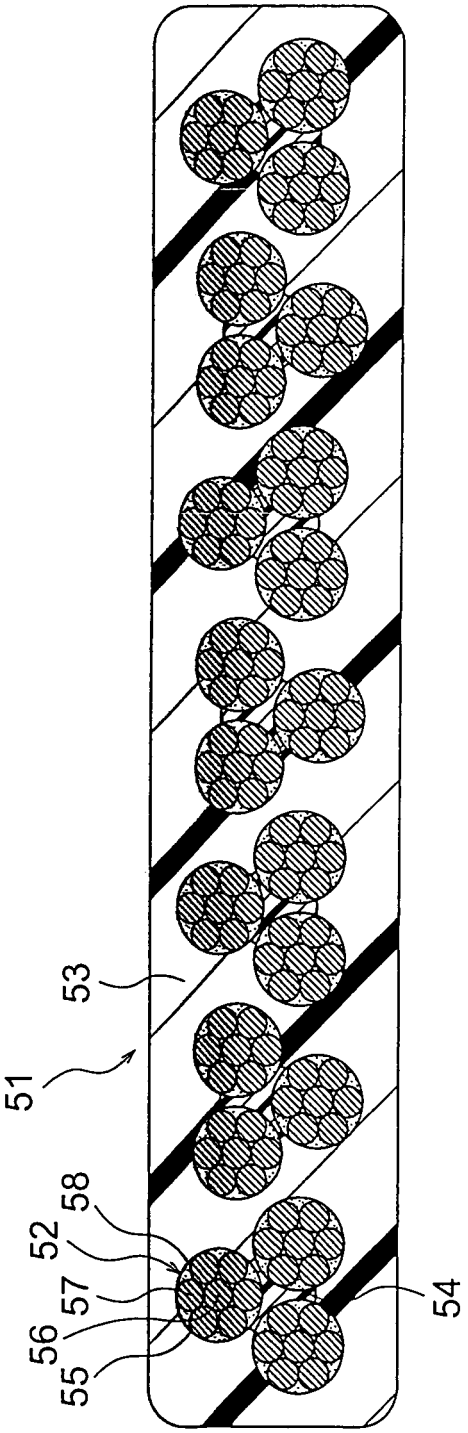
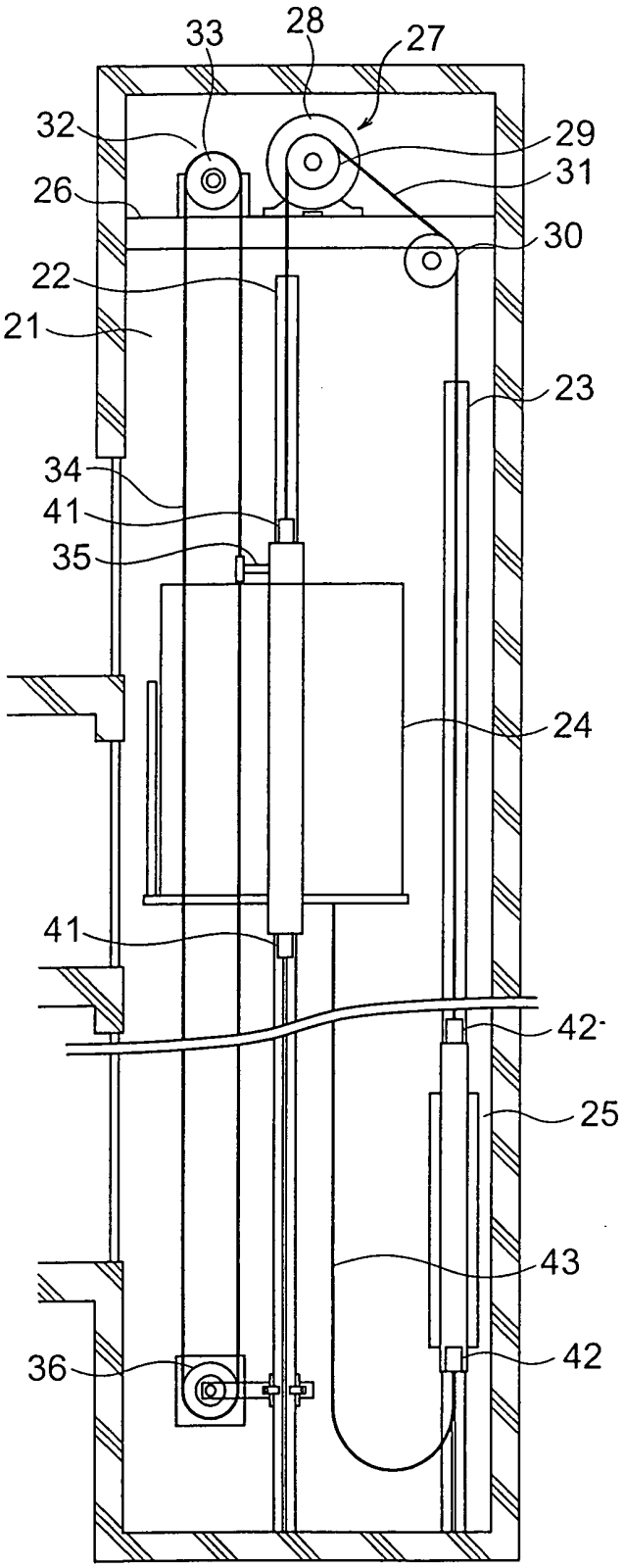


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/014337

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B7/04, 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] B66B5/00-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.
Y	WO 02/12108 A1 (Mitsubishi Electric Corp.), 14 February, 2002 (14.02.02), Pay attention to Claims 1 to 4; description; page 4, lines 1 to 4; Figs. 1 to 3 & EP 1327599 A1	1-5
Y	JP 2003-268685 A (Tokyo Rope Manufacturing Co., Ltd.), 25 September, 2003 (25.09.03), Pay attention to abstract; Par. No. [0010]; Figs. 1 to 3 (Family: none)	1-5

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

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Date of the actual completion of the international search	Date of mailing of the international search report
29 June, 2005 (29.06.05)	19 July, 2005 (19.07.05)
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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2004/014337

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2002-173280 A (Hitachi, Ltd.), 21 June, 2002 (21.06.02), Pay attention to Par. Nos. [0001] to [0002], [0008]; Fig. 3; Par. Nos. [0014] to [0016]; Fig. 1 (Family: none)	3-4
Y	WO 2004/043843 A1 (Mitsubishi Electric Corp.), 27 May, 2004 (27.05.04), Pay attention to Claim 1; Figs. 1 to 3 (Family: none)	5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001262482 A **[0003]**