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

(11) EP 1 508 544 A1

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

(43) Date of publication:
23.02.2005 Bulletin 2005/08

(21) Application number: **02733257.6**

(22) Date of filing: **30.05.2002**

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

(86) International application number:
PCT/JP2002/005304

(87) International publication number:
WO 2003/101876 (11.12.2003 Gazette 2003/50)

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE TR
Designated Extension States:
AL LT LV MK RO SI

(71) Applicant: **MITSUBISHI DENKI KABUSHIKI KAISHA**
Tokyo 100-8310 (JP)

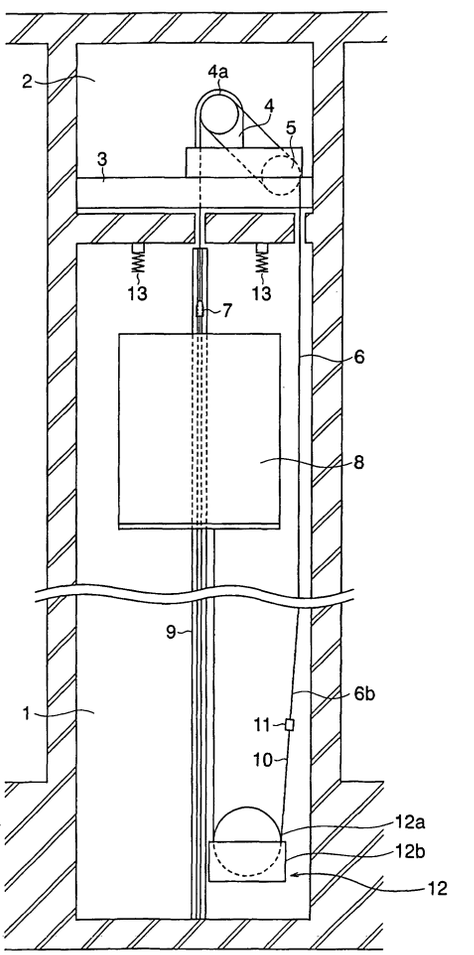
(72) Inventor: **Mitsui, Atsushi, Mitsubishi Denki K. K.**
Tokyo 100-8310 (JP)

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

(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, main ropes are wound around a drive sheave of a driving machine. A car is suspended by the main ropes and raised and lowered inside a hoistway by the driving machine. Traction capacity is ensured without using a counterweight by using as the main ropes resin-coated ropes in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion.

FIG. 1



EP 1 508 544 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a traction elevator apparatus for raising and lowering a car by means of friction between a drive sheave of a driving machine and a main rope suspending the car.

BACKGROUND ART

[0002] Conventionally, a traction elevator apparatus in which traction capacity is ensured by the weight of a car and the weight of a main rope and a counterweight is omitted is disclosed in Japanese Patent Publication No. HEI 7-55780 (Gazette), for example. In an elevator apparatus of this kind, counterweight guide rails for guiding raising and lowering of the counterweight can also be omitted, enabling planar dimensions of the hoistway to be reduced.

[0003] However, if a main rope made of a steel rope is used, it is necessary to use a main rope having a weight greater than or equal to six times the loadage of the car in order to achieve sufficient traction capacity without a counterweight. Because of this, the technique can be applied to an elevator apparatus having a high lift range, but application to an elevator apparatus having a short lift range is difficult.

DISCLOSURE OF THE INVENTION

[0004] The present invention aims to solve the above problems and an object of the present invention is to provide a enabling an elevator apparatus enabling a counterweight to be omitted and also enabling planar dimensions of a hoistway to be reduced even if a lifting range is comparatively short.

[0005] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator apparatus including: a hoistway; a driving machine having a drive sheave; a main rope wound around the drive sheave; and a car suspended by the main rope and raised and lowered inside the hoistway by the driving machine, wherein traction capacity is ensured without using a counterweight by using as the main rope a resin-coated rope in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion.

[0006] According to another aspect of the present invention, there is provided an elevator apparatus including: a hoistway; a driving machine having a drive sheave; a main rope wound around the drive sheave; and an upper car suspended by one end of the main rope relative to the drive sheave and raised and lowered inside the hoistway by the driving machine, wherein a resin-coated rope in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion is used as the main rope, and a lower car raised and lowered inside the hoistway by the driving machine is suspended at the other end of the main rope relative to the drive sheave and is disposed below the upper car so as to overlap with the upper car in a vertical plane of projection.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007]

Figure 1 is a side elevation showing an elevator apparatus according to Embodiment 1 of the present invention;
Figure 2 is a cross section of a main rope from Figure 1;
Figure 3 is a side elevation showing an elevator apparatus according to Embodiment 2 of the present invention;
Figure 4 is a side elevation showing an elevator apparatus according to Embodiment 3 of the present invention;
Figure 5 is a plan showing part of the elevator apparatus in Figure 4;
Figure 6 is a side elevation showing an elevator apparatus according to Embodiment 4 of the present invention; and
Figure 7 is a plan showing part of the elevator apparatus in Figure 6.

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 side elevation showing an elevator apparatus according to Embodiment 1 of the present invention. In the figure, a machine room 2 is disposed in an upper portion of a hoistway 1. A machine base 3 is secured inside the machine room 2. A driving machine (a hoisting machine) 4 and a rotatable deflection sheave 5 are mounted on the machine base 3. The driving machine 4 has a drive sheave 4a.

[0010] A plurality of main ropes 6 (only one is shown in the Figure 1) are wound around the drive sheave 4a and the deflection sheave 5. Each of the main ropes 6 has a first end portion 6a and a second end portion 6b. A car 8 is suspended on the first end portions 6a of the main ropes 6 by means of rope shackles 7. Specifically, the first end portions 6a are connected to an upper portion of the car 8 by means of the rope shackles 7. A pair of car guide rails 9 for guiding the raising and lowering of the car 8 are installed inside the hoistway 1.

[0011] Compensating ropes 10 for compensating for weight balance fluctuations in the main ropes 6 which depend on the position of the car 8 are connected between a lower portion of the car 8 and the second end portions 6b of the main ropes 6. The compensating ropes 10 are connected to the second end portions 6b by means of a coupling 11. The number of compensating ropes 10 may be different from the number of main ropes 6. Furthermore, here, the "compensating ropes" has a broad meaning and may be counterbalancing chains, for example.

[0012] A tension pulley apparatus 12 for applying a tensile force to the main ropes 6 and the compensating ropes 10 is disposed in a bottom portion inside the hoistway 1. The tension pulley apparatus 12 has: a tension pulley 12a around which the compensating ropes 10 are wound; and a weight 12b.

[0013] A plurality of upper portion buffers 13 for alleviating mechanical shock if the car 8 collides with a ceiling portion of the hoistway 1 are disposed in an upper portion inside the hoistway 1. Lower portion buffers (not shown) for alleviating mechanical shock if the car 8 collides with a bottom portion of the hoistway 1 are disposed on the bottom portion inside the hoistway 1.

[0014] A plurality of rope grooves (not shown) into which the main ropes 6 are inserted are disposed on the drive sheave 4a. In addition, cross sections of the main ropes 6 are circular, cross-sectional shapes of bottom portions of the rope grooves being semicircular. Specifically, the rope grooves are U grooves (round grooves) having no undercut. Furthermore, the main ropes 6 are wound around the drive sheave 4a and the deflection sheave 5 using a full winding method. The contact angle of the main ropes 6 on the drive sheave 4a (the total angle over which each main rope 6 is in contact with the drive sheave 4a) is 320 to 350 degrees (320° - 350°).

[0015] Next, Figure 2 is a cross section of a main rope from Figure 1. In the figure, an inner layer rope 21 has: a core rope 22; and a plurality of inner layer strands 23 disposed on outer peripheral portions of the core rope 22. The core rope 22 has a plurality of core strands 24. Each of the core strands 24 is constructed by twisting a plurality of steel wires 25 together with each other. The core strands 24 are twisted together with each other, and the inner layer strands 23 are twisted in a reverse direction to the core strands 24.

[0016] The inner layer strands 23 are constructed by twisting a plurality of steel wires 26 together with each other. The cross-sectional structure of the inner layer strands 23 is Warrington-type (Japanese Industrial Standards (JIS) G 3525). Furthermore, there are gaps between adjacent core strands 24 and between the core strands 24 and the inner layer strands 23, but these gaps are eliminated or reduced by tensile forces acting on the main ropes 6 during use.

[0017] An inner layer coating body 27 made of a resin is coated on an outer periphery of the inner layer rope 21. The inner layer coating body 27 is composed of a polyethylene resin, for example.

[0018] An outer layer 28 is disposed on an outer peripheral portion of the inner layer coating body 27. The outer layer 28 has a plurality of outer layer strands 29. Each of the outer layer strands 29 is constituted by: a central wire 30 disposed in the center; and six outer peripheral wires 31 disposed on an outer periphery of the central wire 30. The outer layer strands 29 are twisted in a reverse direction to the inner layer strands 23.

[0019] An outer layer coating body 60 is coated on an outer periphery of the outer layer 28. The outer layer coating body 60 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.

[0020] The diameters of all of the wires 25, 26, 30, and 31 are set to less than or equal to 1/400 the diameter of the sheave they are used on, that is, the sheave the main ropes 6 are wound around.

[0021] In an elevator apparatus of this kind, by using resin-coated ropes in which an outer layer coating body 60 composed of a high-friction resin material is disposed on an outer peripheral portion as the main ropes 6, traction capacity is ensured without using a counterweight.

[0022] Let us assume, for example, that in an elevator apparatus having a capacity of 1,600 kg, the weight of the car 8 is twice the capacity (3,200 kg), acceleration-deceleration α/g is 0.08, the unit weight, of the main ropes 6 is 0.494 kg/m, and the number of main ropes 6 is eight. The unit weight of the above main ropes 6 is equivalent to a ϕ 12 rope (8 x S (19)) employed in a conventional elevator apparatus. Furthermore, the weight of the compensating ropes 10 is assumed to be approximately equal to the main ropes 6, and the presence of the tension pulley apparatus 12 has been ignored. Thus, the traction ratio is:

$$\{(3{,}200 + 1{,}600 + 8 \times 0.494 \times TR) \times (1 + 0.08)\} / \{(8 \times 0.494 \times TR) \times (1 - 0.08)\}$$

where TR is the raising and lowering zone (the lifting range).

[0023] Here, it is assumed that a urethane having a hardness of approximately 90 degrees, for example, is used as the material for the outer layer coating body 60, that the coefficient of friction μ is greater than or equal to 0.6, and that the contact angle θ on the drive sheave 4a is 320 degrees (320°). Since the rope grooves of the drive sheave 4a are U grooves, the shape coefficient K_2 of the rope grooves is 1.19. In this case, the traction capacity = $e^{(\mu K2\theta)}$ = 53.9. Consequently, when a raising and lowering zone TR satisfying the expression (traction capacity) is greater than or equal to (traction ratio) is calculated, it is found that the present invention can be applied where TR is greater than or equal to 25 m.

[0024] In other words, the counterweight can be omitted and the planar dimensions of the hoistway 1 can be reduced even if the lifting range is comparatively short.

[0025] Furthermore, the presence of the tension pulley apparatus 12 has been ignored in the above expression, but using the tension pulley apparatus 12, if the weight of the weight 12b thereof is set to twice the sum of the weights of the main ropes 6 and the compensating ropes 10, the present invention can be applied where TR is greater than or equal to 12.5 m.

[0026] When the safety factor of the main ropes 6 is calculated with the breaking force of the main ropes 6 in this case being 69.2 kN, which is equivalent to that of a ϕ 12A class rope (8 x S (19)), it is found that (69.2/9.8 x 1,000 x 8) / (4,800 + 12.5 x 8 x 0.494 + (2 x 12.5 x 8 x 0.494) / 2) is approximately equal to 11. In other words, the safety factor is greater than or equal to 10, thereby also enabling satisfactory strength.

[0027] It goes without saying that the applicable raising and lowering zone can be changed by altering the coefficient of friction and the contact angle of the main ropes 6 and changing the deadweight and capacity of the car 8, the strength and the number of the main ropes 6, and the weight of the weight 12b to suit the elevator apparatus.

[0028] In an elevator apparatus of this kind, since a counterweight is not used, it is conceivable that the load torque and the braking torque acting on the driving machine 4 may increase. However, by using resin-coated ropes in which the outer layer coating body 60 composed of a high-friction resin material is disposed on an outer peripheral portion as the main ropes 6, the diameter of the drive sheave 4a can be reduced and increases in load torque and braking torque suppressed.

[0029] Using main ropes 6 having a cross-sectional construction such as that shown in Figure 2, the packing density of the steel wires 25, 26, 30, and 31 can be increased while suppressing the overall diameter, enabling increases in strength. Furthermore, since the contact pressure between the rope grooves of the drive sheave 4a and the main ropes 6 can be reduced, sufficient service life of the main ropes 6 can be maintained while keeping a ratio of the diameter D of the drive sheave 4a to the diameter d of the main ropes 6 (D/d) at equal to or less than 30.

[0030] In Embodiment 1, because the compensating ropes 10 are connected between the lower portion of the car 8 and the second end portions 6b of the main ropes 6, the length of the expensive main ropes 6 can be shortened, enabling costs to be reduced.

[0031] In addition, because the upper portion buffers 13 are disposed in the upper portion inside the hoistway 1, mechanical shock can be alleviated if the car 8 collides with the ceiling portion of the hoistway 1.

[0032] Furthermore, because the rope grooves are shaped as U grooves, damage to the main ropes 6 can be prevented and sufficient friction can be ensured compared to rope grooves having undercuts.

[0033] Moreover, in Embodiment 1, the compensating ropes 10 are connected between the lower portion of the car 8 and the second end portions 6b of the main ropes 6, but the entire length may also be constituted solely by main ropes composed of the resin-coated rope, the first end portions of the main ropes being connected to the upper portion of the car, and the second end portions of the main ropes being connected to the lower portion of the car. In that case, the number of parts is reduced, enabling installation to be facilitated.

[0034] In Embodiment 1, a resin-coated rope including steel wires is used, but a synthetic fiber rope having a rope main body including synthetic fibers such as aramid fibers, etc., and an outer layer coating body composed of a high-friction resin material, for example, may also be used.

Embodiment 2

[0035] Next, Figure 3 is a side elevation showing an elevator apparatus according to Embodiment 2 of the present invention. In the figure, a plurality of main ropes 32 (only one is shown in the Figure 3) are wound around a drive sheave 4a and a deflection sheave 5. The main ropes 32 have a cross-sectional construction similar to that in Figure 2.

[0036] Each of the main ropes 32 has a first end portion 32a and a second end portion 32b. The first end portions 32a are connected to a machine base 3 in an upper portion of a hoistway 1 by means of rope shackles 33. The second end portions 32b are connected to a fixed beam 35 in a bottom portion of the hoistway 1 by means of rope shackles 34.

[0037] An upper traveling block 36 around which the main ropes 32 are wound is disposed on an upper portion of a car 8. A lower traveling block 37 around which the main ropes 32 are wound is disposed on a lower portion of the car 8. The rest of the construction is similar to that of Embodiment 1.

[0038] Using an elevator apparatus of this kind, the counterweight can also be omitted and the planar dimensions of the hoistway 1 can also be reduced even if the lifting range is comparatively short. Furthermore, since the main ropes 32 are wound around the upper traveling block 36 and the lower traveling block 37 disposed on the car 8, the torque acting on the driving machine 4 can be reduced to approximately half that of Embodiment 1.

Embodiment 3

[0039] Next, Figure 4 is a side elevation showing an elevator apparatus according to Embodiment 3 of the present invention, and Figure 5 is a plan showing part of the elevator apparatus in Figure 4. In the figure, a machine room 42 is disposed in an upper portion of a hoistway 41. A machine base 43 is secured inside the machine room 42. A driving machine (a hoisting machine) 44 and a rotatable deflection sheave 45 are mounted on the machine base 43. The driving machine 44 has a drive sheave 44a.

[0040] A plurality of main ropes 46 are wound around the drive sheave 44a and the deflection sheave 45. Each of the main ropes 46 has a first end portion 46a and a second end portion 46b. Furthermore, the main ropes 46 have a cross-sectional construction similar to that in Figure 2.

[0041] An upper car 47 and a lower car 48 are disposed inside the hoistway 41. The upper car 47 is suspended at one end of the main ropes 46 relative to the drive sheave 44a. Specifically, the first end portions 46a of the main ropes 46 are connected to an upper portion of the upper car 47 by means of rope shackles 50. The second end portions 46b of the main ropes 46 are connected to the machine base 43 in the upper portion of the hoistway 41 by means of rope shackles 51.

[0042] The lower car 48 is disposed below the upper car 47 so as to overlap with the upper car 47 in a vertical plane of projection. A car suspension sheave apparatus 49 is disposed on a lower portion of the lower car 48. The car suspension sheave apparatus 49 has a pair of car suspension sheaves (traveling blocks) 49a and 49b. Portions of the main ropes 46 between the drive sheave 44a and the second end portions 46b are wound around the car suspension sheaves 49a and 49b. In other words, the lower car 48 is suspended at the other end of the main ropes 46 relative to the drive sheave 44a.

[0043] A pair of car guide rails 52 for guiding the raising and lowering of the cars 47 and 48 are installed inside the hoistway 41. A plurality of rope grooves (not shown) into which the main ropes 46 are inserted are disposed on the drive sheave 44a. In addition, cross sections of the main ropes 46 are circular, the rope grooves being U grooves (round grooves) having no undercut. Furthermore, the main ropes 46 are wound around the drive sheave 44a and the deflection sheave 45 using a full winding method. The contact angle of the main ropes 46 on the drive sheave 44a is 320 to 350 degrees (320 - 350 °).

[0044] In an elevator apparatus of this kind, the upper car 47 and the lower car 48 are suspended by a 2:1 roping method, and since the lower car 48 runs over only half the operating range of the upper car 47, applications are limited to a certain extent. However, since the lower car 48 functions in a similar manner to a conventional counterweight, the counterweight can be omitted regardless of the lifting range, enabling the planar dimensions of the hoistway 41 to be reduced.

[0045] Here, if the upper car 47 and the lower car 48 have the same weight and the same capacity, there may be a large imbalance in cases where the upper car 47 has a full load (i.e., is full to capacity) and the lower car 48 has no load (i.e., is empty), making it difficult to ensure traction capacity. However, in this case, sufficient traction capacity can also be ensured even if there is a large imbalance by using the resin-coated ropes in which the outer layer coating body 60 composed of a high-friction resin material is disposed on the outer peripheral portion as the main ropes 46.

[0046] In other words, load fluctuations in the lower car 48 can also be accounted for to ensure sufficient traction capacity while using the lower car 48 instead of a counterweight by using resin-coated ropes as the main ropes 46. The diameter of the drive sheave 44a can also be reduced and increases in load torque and braking torque suppressed.

Embodiment 4

[0047] Figure 6 is a side elevation showing an elevator apparatus according to Embodiment 4 of the present invention, and Figure 7 is a plan showing part of the elevator apparatus in Figure 6. In the figure, a car suspension sheave apparatus 49 is mounted to a lower portion of a lower car 48. The car suspension sheave apparatus has: a pair of rotatable first car suspension sheaves 49a and 49b; and a pair of rotatable second car suspension sheaves 49c and 49d.

[0048] The car suspension sheaves 49a, 49b, 49c, and 49d are rotatable about rotating shafts (not shown) extending in a depth direction of the lower car 48. Furthermore, the first car suspension sheaves 49a and 49b and the second car suspension sheaves 49c and 49d are symmetrically disposed in a vertical plane of projection on mutually opposite sides of a straight line connecting a pair of car guide rails 52.

[0049] A rotatable return sheave 53 is disposed in an upper portion inside a hoistway 41. The return sheave 53 may be supported by a car guide rails 52, for example. Main ropes 46 are wound in sequence from first end portions 46a

around a drive sheave 44a, a deflection sheave 45, the drive sheave 44a, the deflection sheave 45, the first car suspension sheaves 49a and 49b, the return sheave 53, and the second car suspension sheaves 49d and 49c to second end portions 46b. The rest of the construction is similar to that of Embodiment 3.

[0050] In an elevator apparatus of this kind, the upper car 47 and the lower car 48 are suspended by a 4:1 roping method, and since the lower car 48 functions in a similar manner to a conventional counterweight, the counterweight can be omitted regardless of the lifting range, enabling the planar dimensions of the hoistway 41 to be reduced.

[0051] Moreover, it is preferable to make the coefficient of friction μ of the outer layer coating body 60 in Embodiments 3 and 4 greater than or equal to 0.3.

[0052] In Embodiments 3 and 4, the main ropes 46 are fully wound onto the drive sheave 44a, but the present invention is not limited to this configuration, and either full winding or half winding can be appropriately selected depending on the weight and capacity of the upper car 47 and the lower car 48, and the coefficient of friction of the main ropes 46, etc.

[0053] In addition, in the elevator apparatuses according to Embodiments 3 and 4, the ranges of movement of the upper car 47 and the lower car 48 are different. For example, the range of movement of the lower car 48 might be from the first floor to the twentieth floor, and the range of movement of the upper car 47 might be from the twenty-first floor to the uppermost floor. In that case, the present invention can be applied to a building having facilities such as restaurants, etc., on the twentieth floor, and having an observation platform on the uppermost floor, for example.

[0054] Furthermore, in Embodiments 3 and 4, the range of movement of the lower car 48 is smaller than the range of movement of the upper car 47, but the range of movement of the lower car 48 may be made greater instead.

[0055] Specifically, the lower car need merely be suspended from the first end portions of the main ropes, the car suspension sheave apparatus mounted to an upper portion or a lower portion of the upper car, and the second end portions connected to an upper portion of the hoistway. In that case, by dividing the plurality of main ropes in two directions at an upper portion of the hoistway and connecting the two sets of branched main ropes to both sides of the lower car, interference between the upper car and the main ropes can be avoided and the lower car can be suspended in a well-balanced manner.

Claims

1. An elevator apparatus comprising:

a hoistway;
a driving machine having a drive sheave;
a main rope wound around said drive sheave;
and
a car suspended by said main rope and raised and lowered inside said hoistway by said driving machine,

wherein traction capacity is ensured without using a counterweight by using as said main rope a resin-coated rope in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion.

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

a coefficient of friction of said outer layer coating body is greater than or equal to 0.6.

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

an upper portion buffer is disposed in an upper portion inside said hoistway, for alleviating mechanical shock if said car collides with a ceiling portion of said hoistway.

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

said main rope has a first end portion and a second end portion;
said car is suspended by said first end portion of said main rope; and
a compensating rope is connected between a lower portion of said car and said second end portion of said main rope, for compensating for weight balance fluctuations in said main rope dependent on a position of said car.

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

said main rope has a first end portion connected to an upper portion of said hoistway and a second end portion connected to a bottom portion of said hoistway;
an upper traveling block around which said main rope is wound is disposed on an upper portion of said car, and a lower traveling block around which said main rope is wound is disposed on a lower portion of said car; and
a tension pulley apparatus having a tension pulley around which said main rope is wound is disposed in a bottom portion inside said hoistway, for applying a tensile force to said main rope.

6. An elevator apparatus comprising:

a hoistway;
a driving machine having a drive sheave;
a main rope wound around said drive sheave;
and
an upper car suspended by one end of said main rope relative to said drive sheave and raised and lowered inside said hoistway by said driving machine,

wherein a resin-coated rope in which an outer layer coating body composed of a high-friction resin material is disposed on an outer peripheral portion is used as said main rope,
and
a lower car raised and lowered inside said hoistway by said driving machine is suspended at the other end of said main rope relative to said drive sheave and is disposed below said upper car so as to overlap with said upper car in a vertical plane of projection.

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

said main rope has a first end portion connected to an upper portion of said upper car and a second end portion connected to an upper portion inside said hoistway;
a car suspension sheave apparatus is disposed on a lower portion of said lower car; and
a portion of said main rope between said drive sheave and said second end portion is wound around said car suspension sheave apparatus.

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

said car suspension sheave apparatus has a plurality of rotatable first car suspension sheaves and a plurality of rotatable second car suspension sheaves;
a rotatable return sheave is disposed on an upper portion inside said hoistway; and
said main rope is wound in sequence from said first end portion around said drive sheave, said first car suspension sheaves, said return sheave, and said second car suspension sheaves to said second end portion.

FIG. 1

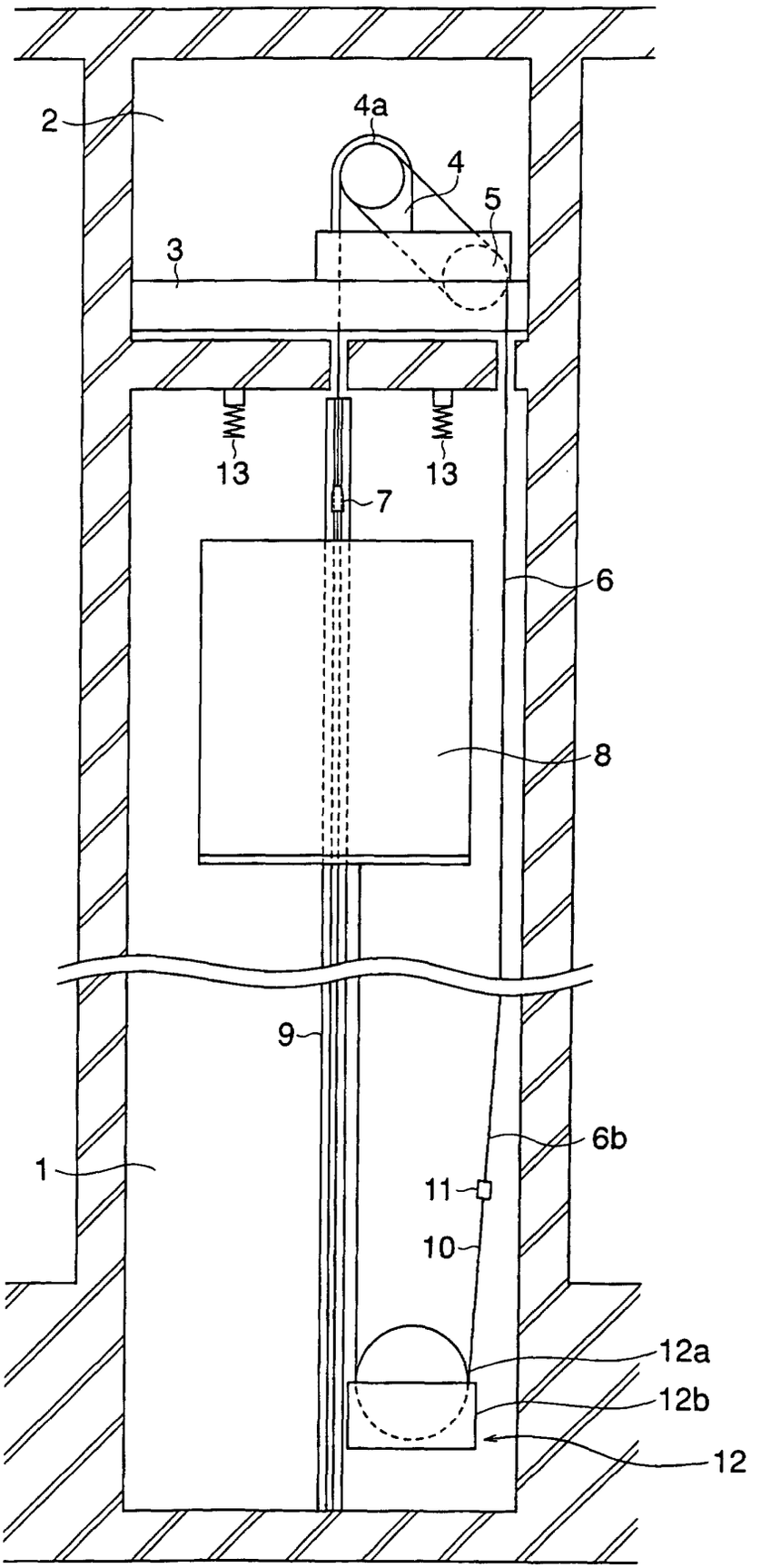


FIG. 2

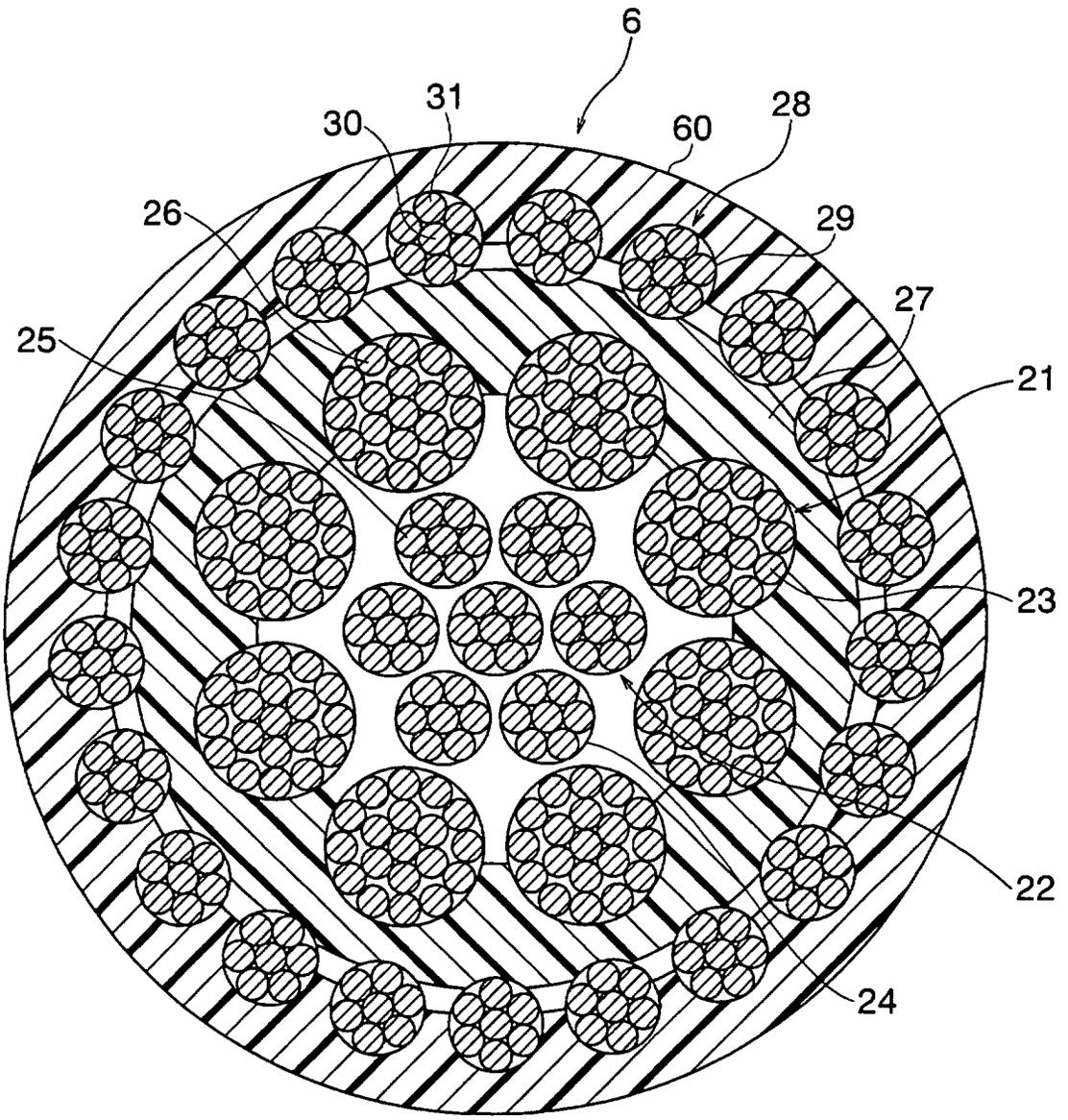


FIG. 3

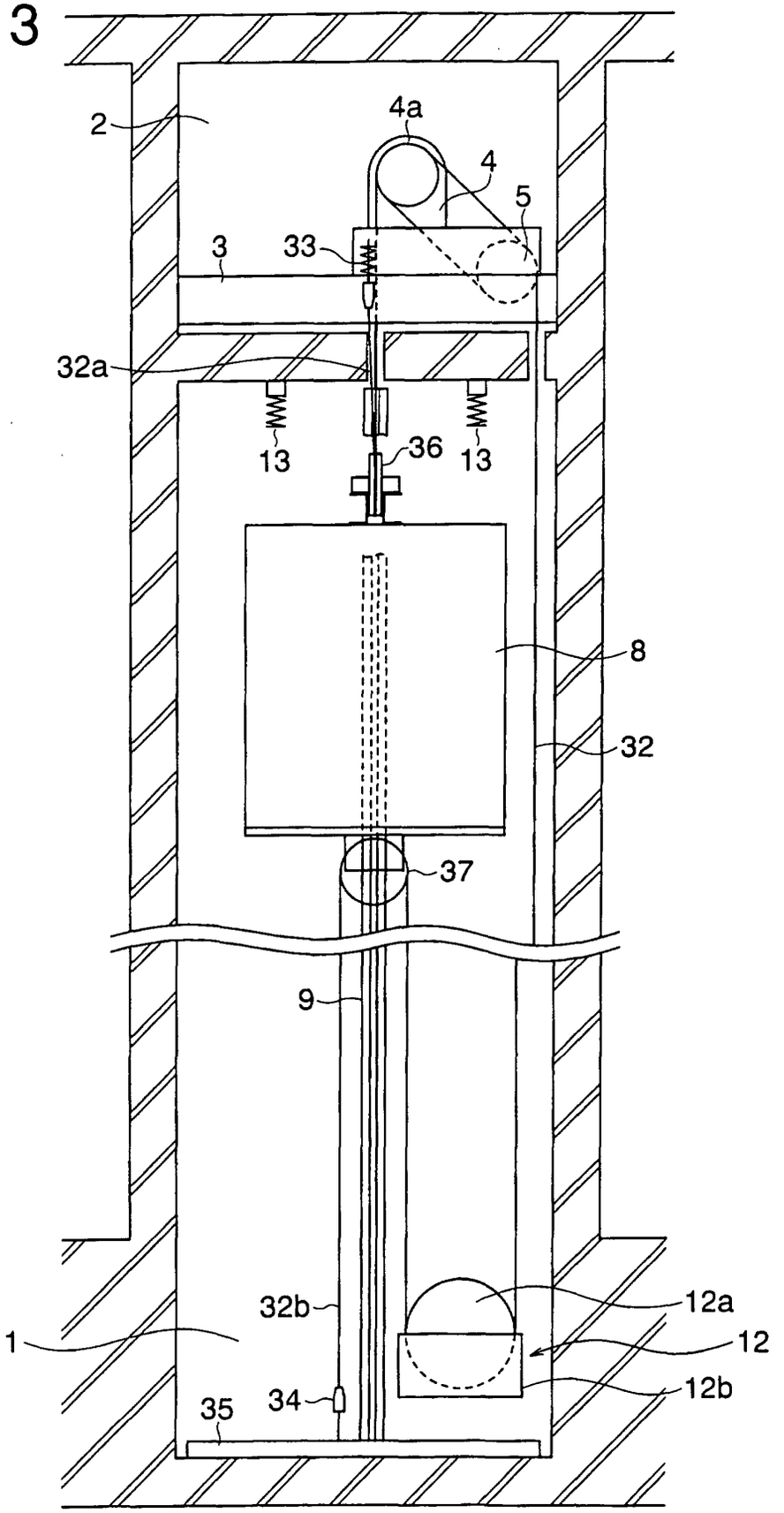
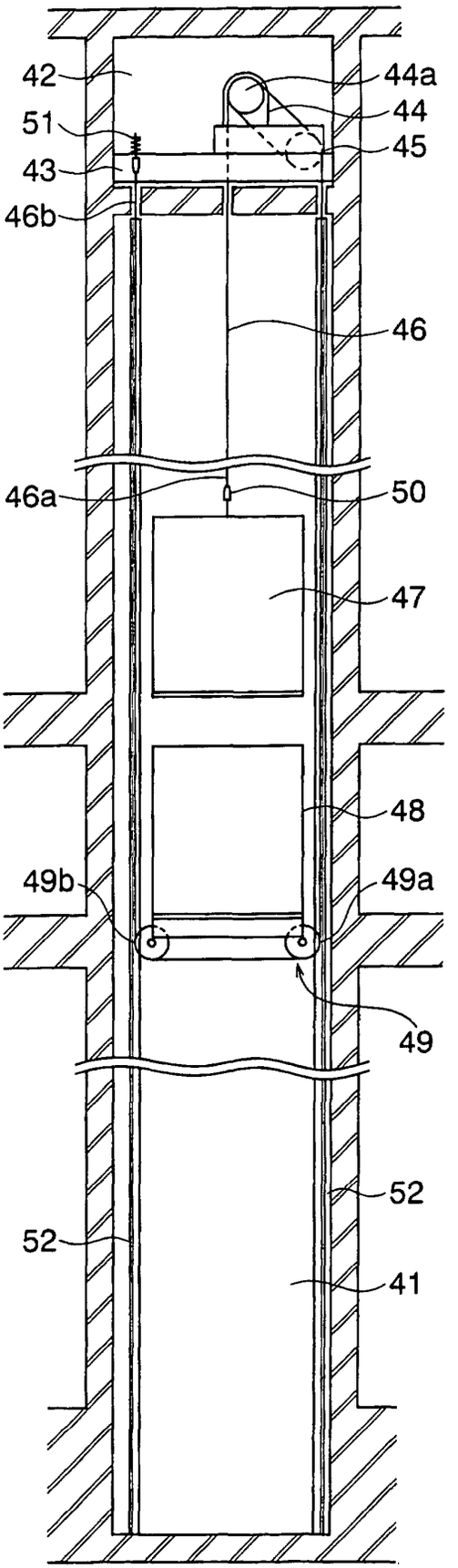


FIG. 4



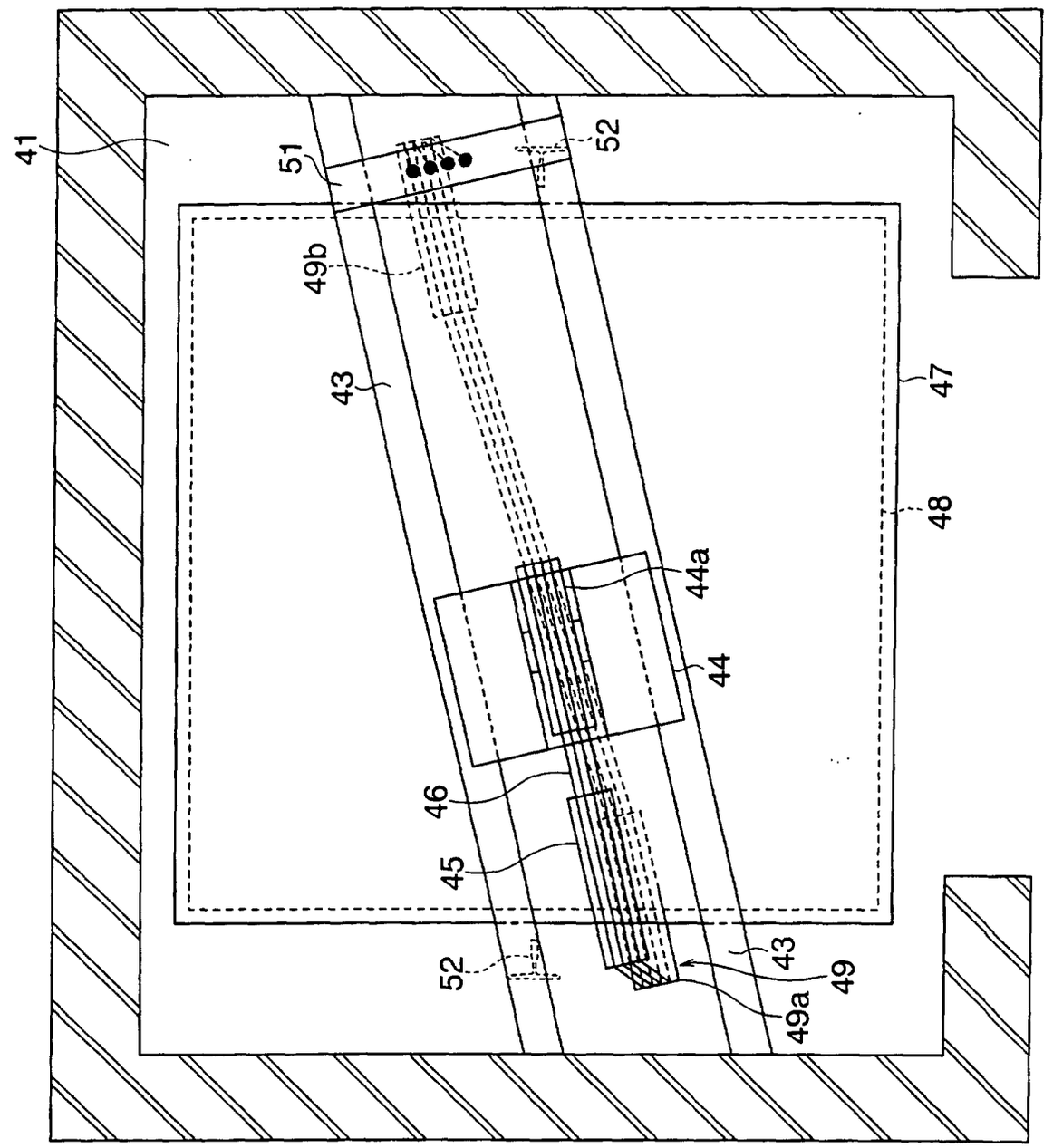


FIG. 5

FIG. 6

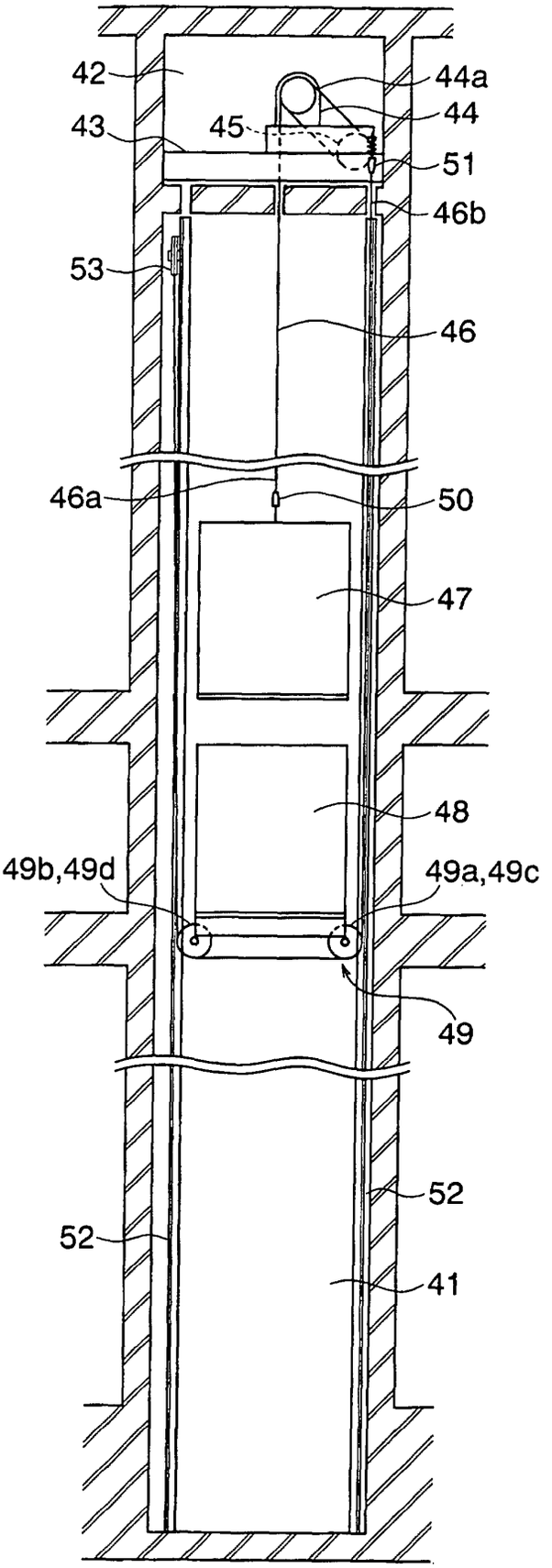
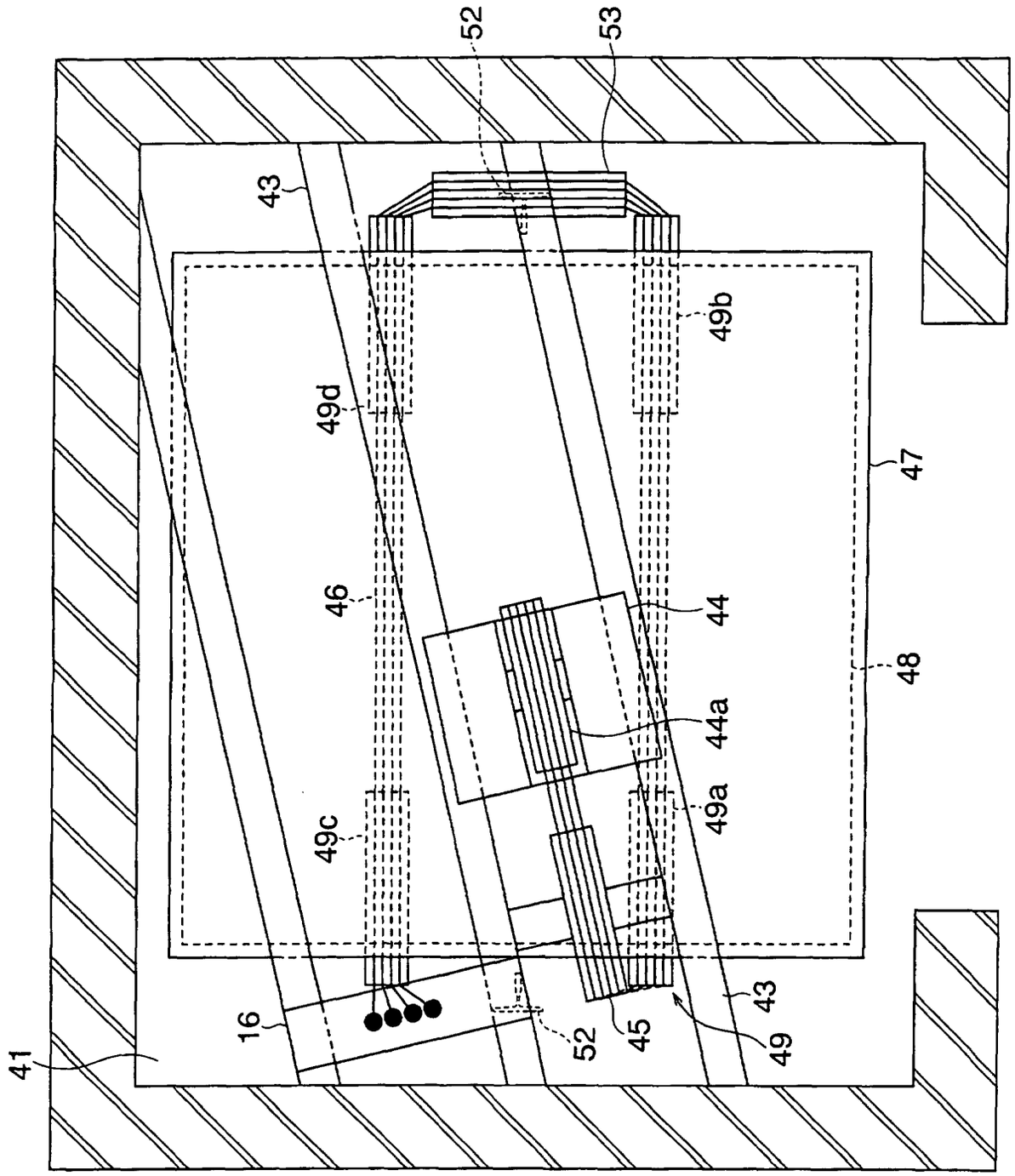


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/05304

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] B66B1/00-B66B19/06

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2003
Kokai Jitsuyo Shinan Koho	1971-2003	Toroku Jitsuyo Shinan Koho	1994-2003

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	JP 2002-145556 A (Mitsubishi Electric Corp.), 22 May, 2002 (22.05.02), Par. Nos. [0014] to [0019], [0024] to [0027]; Figs. 5 to 6 (Family: none)	1 2-3
Y A	WO 01/68973 A1 (Hitachi, Ltd.), 20 September, 2001 (20.09.01), Description, page 3, line 27 to page 8, line 19; Figs. 1 to 3 & JP 2001-262482 A & EP 1273695 A1	1-6 7-8
Y	JP 4-19021 Y2 (Fujitec Co., Ltd.), 28 April, 1992 (28.04.92), Column 1, lines 1 to 9, 19 to 22 & JP 1-70773 U	3

[X] Further documents are listed in the continuation of Box C. [ ] See patent family annex.

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
"E" earlier document but published on or after the international filing date
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)
"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
17 February, 2003 (17.02.03)	04 March, 2003 (04.03.03)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP02/05304

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 61-169475 A (Mitsubishi Electric Corp.), 31 July, 1986 (31.07.86), Page 1, left column, lines 4 to 11 (Family: none)	3
Y	JP 7-55780 B2 (Mitsubishi Electric Corp.), 14 June, 1995 (14.06.95), & JP 3-177288 A	1-5
Y A	JP 7-172716 A (Mitsubishi Electric Corp.), 11 July, 1995 (11.07.95), Par. Nos. [0126] to [0134]; Figs. 32 to 35 (Family: none)	6 7-8
A	JP 2002-128420 A (Dätwyler AG. Schweizerische Kabel-, Gummi- und Kunststoffwerke), 09 May, 2002 (09.05.02), & EP 1199276 A1 & US 2002/0046908 A1 & WO 02/34659 A1	4-5
A	JP 60-19679 A (Toshiba Corp.), 31 January, 1985 (31.01.85), Figs. 1 to 2 (Family: none)	7-8
A	JP 58-63666 A (Mitsubishi Electric Corp.), 15 April, 1983 (15.04.83), Drawings (Family: none)	7-8

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