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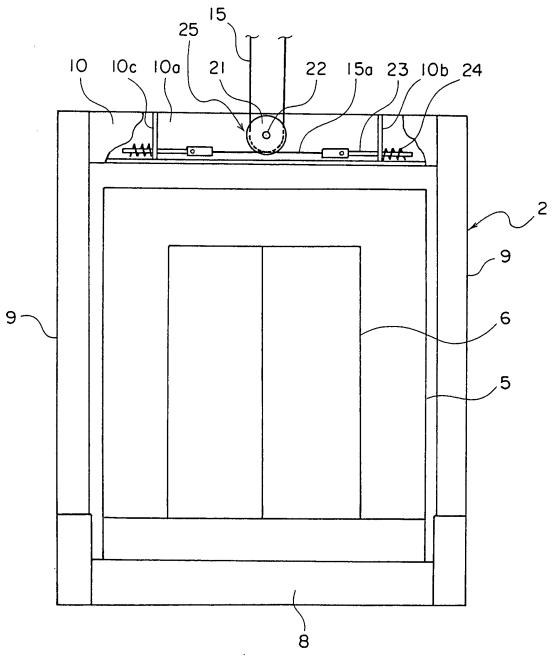
(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, a car is suspended inside a hoistway by a main rope body. The main rope body is connected to an upper beam of the car by a rope end connecting apparatus. The rope end connecting apparatus has: a deflecting member around which the main rope body is wound, the deflecting member changing orientation of an end portion of the main rope body; and a connecting rod disposed inside the upper beam, the connecting rod being connected between an end portion of the main rope body and the upper beam.

FIG. 2

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## Description

### TECHNICAL FIELD

**[0001]** The present invention relates to an elevator apparatus in which a car and a counterweight are suspended inside a hoistway by a main rope.

### BACKGROUND ART

**[0002]** In conventional elevator apparatuses, a car and a counterweight are suspended inside a hoistway by a plurality of main ropes. A car end portion of each of the main ropes is connected to a shackle rod. Each of the shackle rods is connected to an upper beam of the car. Furthermore, the shackle rods are disposed so as to be generally at a right angle to a longitudinal direction of the upper beam, and project above the upper beam (See Patent Literature 1, for example).

**[0003]**

Patent Literature 1
Japanese Patent Laid-Open No. 2000-351538 (Gazette)

**[0004]** In conventional elevator apparatuses configured as described above, since the shackle rods project above the upper beam, space for the shackle rods is required above the upper beam, increasing an overhead dimension (a vertical distance from a floor surface of a highest floor stopped at to a top portion of the hoistway), thereby increasing overall vertical dimensions of the hoistway. Furthermore, if a construction in which a pair of suspension sheaves around which the main ropes are wound are disposed below the car and the main ropes are passed below the car (a two-to-one (2:1) roping underslung method) is adopted in order to avoid this, configuration becomes complicated and the number of parts is increased, thereby increasing equipment costs and installation costs.

### DISCLOSURE OF THE INVENTION

**[0005]** The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus enabling an overhead dimension of a hoistway to be reduced by a simple construction.

**[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 having a cage; and an upper beam disposed above the cage, the car being raised and lowered inside a hoistway; a main rope body for suspending the car inside the hoistway; and a rope end connecting apparatus for connecting the main rope body to the upper beam, the rope end connecting apparatus having: a deflecting member around which the main rope body is wound, the deflecting member changing orientation of an end portion of the main rope body; and a connecting rod disposed inside the upper beam, the connecting rod being connected between the end portion of the main rope body and the upper beam.

### 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 front elevation showing a car from Figure 1;
Figure 3 is a front elevation showing part of Figure 2 enlarged;
Figure 4 is a cross section taken along line IV - IV in Figure 3;
Figure 5 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 2 of the present invention;
Figure 6 is a cross section taken along line VI - VI in Figure 5;
Figure 7 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 3 of the present invention;
Figure 8 is a cross section taken along line VIII - VIII in Figure 7;
Figure 9 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 4 of the present invention;
Figure 10 is a cross section taken along line X - X in Figure 9;
Figure 11 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 5 of the present invention;
Figure 12 is a cross section taken along line XII - XII in Figure 11;
Figure 13 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 6 of the present invention;
Figure 14 is a cross section taken along line XIV - XIV in Figure 13; and
Figure 15 is a plan showing part of a rope end connecting apparatus of an elevator apparatus according to Embodiment 7 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 side elevation showing an elevator apparatus according to Embodiment 1 of the present invention (in this example, a machine-roomless elevator). In the figure, a pair of car guide rails (not shown) and a pair of counterweight guide rails (not shown) are installed

inside a hoistway 1. A car 2 is guided by the car guide rails so as to be raised and lowered inside the hoistway 1. A counterweight 3 is guided by the counterweight guide rails so as to be raised and lowered inside the hoistway 1. The counterweight 3 is disposed behind the car 2 when viewed from a landing side so as to face a rear surface of the car 2 when positioned level with the car 2.

**[0010]** The car 2 has: a car frame 4; and a cage 5 supported by the car frame 4. A car entrance is disposed on a front surface of the cage 5. The car entrance is opened and closed by a pair of car doors 6. Landing entrances disposed on landings are opened and closed by pairs of landing doors 7. The car doors 6 and the landing doors 7 are opened and closed by a driving force from a door motor (not shown) mounted on the car 2.

**[0011]** The car frame 4 has: a lower frame 8; a pair of vertical stanchions 9 disposed on the lower frame 8; and an upper beam 10 fixed between upper end portions of the vertical stanchions 9. The cage 5 is supported on the lower frame 8. The vertical stanchions 9 are disposed vertically on two sides of the cage 5. The upper beam 10 is disposed horizontally so as to be parallel to a width direction of the cage 5.

**[0012]** A driving machine (a hoisting machine) 11 for generating a driving force for raising and lowering the car 2 and the counterweight 3 is disposed in an upper portion inside the hoistway 1. The driving machine 11 has: a driving machine main body 12 including a motor and a brake; and a drive sheave 13 rotated by the driving machine main body 12. The driving machine 11 is supported by a supporting beam (not shown) fixed to an upper portion inside the hoistway 1. The supporting beam may be supported by at least a portion of the car guide rails and the counterweight guide rails, or by a building. A deflection sheave 14 is also supported by the supporting beam.

**[0013]** A main rope body 150 including a plurality of main ropes 15 (only one is shown in Figure 1) is wound around the drive sheave 13 and the deflection sheave 14. Each of the main ropes 15 has: a car end portion 15a connected to the upper beam 10; and a counterweight end portion 15b connected to an upper portion of the counterweight 3. The car 2 and the counterweight 3 are suspended inside the hoistway 1 by the main ropes 15 using a one-to-one (1:1) roping method.

**[0014]** Figure 2 is a front elevation showing the car 2 from Figure 1, Figure 3 is a front elevation showing part of Figure 2 enlarged, and Figure 4 is a cross section taken along line IV - IV in Figure 3, and a portion of the upper beam 10 is shown cut away in Figures 2 and 3. A plurality of deflecting pulleys 21 (equal in number to the main ropes 15) functioning as a deflecting member are disposed at a central portion in a longitudinal direction of the upper beam 10. The deflecting pulleys 21 are each independently rotatable around a shaft 22 mounted to the upper beam 10.

**[0015]** A corresponding main rope 15 is wound around each of the deflecting pulleys 21. A rope groove into which a main rope 15 is inserted is disposed on an outer periphery of each of the deflecting pulleys 21. Orientations of the car end portions 15a of the main ropes 15 are deflected by 90 degrees or generally by 90 degrees as they wind around the deflecting pulleys 21.

**[0016]** An upper beam groove 10a is formed on the upper beam 10 in the longitudinal direction. The deflecting pulleys 21 are accommodated completely inside the upper beam groove 10a. In other words, the deflecting pulleys 21 are disposed inside the upper beam 10. A pair of flat rod connecting portions 10b and 10c are also fixed inside the upper beam groove 10a so as to face each other and be spaced apart from each other. The rod connecting portions 10b and 10c are disposed so as to be symmetrical or generally symmetrical relative to center in a width direction of the car 2. The rod connecting portions 10b and 10c are constituted by metal plates welded inside the groove 10a, for example.

**[0017]** A metal connecting rod 23 is connected to the car end portion 15a of each of the main ropes 15 and fastened. Each of the connecting rods 23 passes through one of the rod connecting portions 10b and 10c. The connecting rods 23 are accommodated inside the upper beam groove 10a. In other words, the connecting rods 23 are disposed inside the upper beam 10. The connecting rods 23 are also disposed horizontally or generally horizontally in the longitudinal direction of the upper beam 10.

**[0018]** Springs (shackle springs) 24 are disposed between end portions of the connecting rods 23 on an opposite side from the main ropes 15 and the rod connecting portions 10b and 10c.

**[0019]** A rope end connecting apparatus 25 according to Embodiment 1 includes the deflecting pulleys 21, the shaft 22, the connecting rods 23, and the springs 24. The main ropes 15 are connected to the upper beam 10 by the rope end connecting apparatus 25. The car end portions 15a of the main ropes 15 are distributed toward two sides in the width direction of the car 2 (the longitudinal direction of the upper beam 10) by the deflecting pulleys 21. In this example, four main ropes 15 are distributed as two pairs, as shown in Figure 4. It is preferable for the main ropes 15 to be distributed as uniformly as possible toward the two sides in the width direction of the car 2 in this manner. Consequently, if the number of main ropes 15 is odd, it is preferable for them to be distributed as n and n + 1.

**[0020]** In an elevator apparatus using a rope end connecting apparatus 25 of this kind, orientations of the car end portions 15a of the main ropes 15 are changed by the deflecting pulleys 21. Specifically, the main ropes 15 are vertical or generally vertical from the deflecting pulleys 21 toward the drive sheave 13, and the main ropes 15 are horizontal or generally horizontal from the deflecting pulleys 21 toward the connecting rods 23. For this reason, the connecting rods 23 can also be disposed horizontally or generally horizontally inside the upper beam 10.

**[0021]** Consequently, the connecting rods 23 do not

project upward from the upper beam 10, and it is not necessary to ensure space for disposal of the connecting rods 23 above the upper beam 10. Thus, overhead dimensions in the hoistway can be reduced, thereby enabling vertical dimensions of the entire hoistway 1 to be reduced. Because the car 2 and the counterweight 3 are suspended using a one-to-one (1:1) roping method, the overall configuration can be simplified.

**[0022]** Because all of the deflecting pulleys 21 are disposed coaxially, the number of parts can be reduced. In addition, since the deflecting pulleys 21 are rotatable around the shaft 22, the main ropes 15 can be prevented from sliding along outer peripheries of the deflecting pulleys 21, enabling deterioration of the main ropes 15 due to abrasion to be prevented.

Because the main ropes 15 are distributed as uniformly as possible toward two sides in the width direction of the car 2, eccentric loads from the main ropes 15 can be prevented from acting on the car 2, enabling the car 2 to be raised and lowered stably.

Embodiment 2

**[0023]** Next, Figure 5 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 2 of the present invention, and Figure 6 is a cross section taken along line VI - VI in Figure 5. An upper beam 31 is disposed on an upper portion of a car 2 (see Figure 1). The upper beam 31 has a pair of upper beam side surface portions 31a and 31b. The upper beam side surface portions 31a and 31b are disposed parallel to each other so as to be spaced apart from each other. The upper beam side surface portions 31a and 31b are disposed horizontally so as to be parallel to a width direction of the car 2.

**[0024]** A pair of flat rod connecting portions 32a and 32b are fixed between the upper beam side surface portions 31a and 31b so as to face each other and be spaced apart from each other. The rod connecting portions 32a and 32b are disposed so as to be symmetrical or generally symmetrical relative to center in the width direction of the car 2. The rod connecting portions 32a and 32b are constituted by metal plates welded between the upper beam side surface portions 31a and 31b, for example.

**[0025]** A cylindrical deflecting member 33 is disposed at a central portion in a longitudinal direction of the upper beam 31. The deflecting member 33 is fixed to the upper beam 31. The deflecting pulleys 21 according to Embodiment 1 were rotatable, but the deflecting member 33 according to Embodiment 2 is unrotatable.

**[0026]** Car end portions 15a of main ropes 15 are wound around the deflecting member 33. A plurality of rope grooves into which the main ropes 15 are inserted are disposed on an outer periphery of the deflecting member 33. Orientations of the car end portions 15a of the main ropes 15 are deflected by 90 degrees or generally by 90 degrees as they wind around the deflecting member 33.

**[0027]** A lower portion of the deflecting member 33 is disposed inside the upper beam 31, in other words, between the upper beam side surface portions 31a and 31b. A metal connecting rod 23 is connected by fastening to the car end portion 15a of each of the main ropes 15. Each of the connecting rods 23 passes through one of the rod connecting portions 32a and 32b. The connecting rods 23 are disposed inside the upper beam 31. The connecting rods 23 are also disposed horizontally or generally horizontally in the longitudinal direction of the upper beam 31.

**[0028]** Nuts 34 for preventing dislodging of the connecting rods 23 from the rod connecting portions 32a and 32b are screwed onto end portions of the connecting rods 23 on an opposite side from the main ropes 15. Tension from the main ropes 15 acting on the connecting rods 23 is borne by the rod connecting portions 32a and 32b through the nuts 34.

**[0029]** A rope end connecting apparatus 35 according to Embodiment 2 includes the deflecting member 33, the connecting rods 23, and the nuts 34. The main ropes 15 are connected to the upper beam 31 by the rope end connecting apparatus 35. The car end portions 15a of the main ropes 15 are distributed alternately toward two sides in the width direction of the car 2 by the deflecting member 33. A drive sheave 13 is also divided in two axially. Specifically, the drive sheave 13 has a first sheave portion 13a and a second sheave portion 13b. The rest of the configuration is similar to that of Embodiment 1.

**[0030]** If the connecting rods 23 are connected to the upper beam 31 without using springs in this manner, the deflecting member 33 may also be unrotatable. All of the main ropes 15 can thereby be wound around a shared deflecting member 33, enabling the number of parts to be reduced and also enabling costs to be reduced.

**[0031]** Reductions in overall size and weight of the drive sheave 13 can be made by dividing the drive sheave 13 into the first and second sheave portions 13a and 13b if the main ropes 15 rise up from two sides of the deflecting member 33.

Embodiment 3

**[0032]** Next, Figure 7 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 3 of the present invention, and Figure 8 is a cross section taken along line VIII - VIII in Figure 7. In this example, a plurality (a pair) of cylindrical deflecting members 36 and 37 are fixed to an upper beam 31. Main ropes 15 are wound around the deflecting members 36 and 37 so as to be distributed between them. The rest of the configuration is similar to that of Embodiment 2.

**[0033]** By using the deflecting members 36 and 37 in this manner, it is not necessary to divide the drive sheave 13 because the main ropes 15 rise up together from close positions between the deflecting members 36 and 37, enabling a normal drive sheave 13 to be used. Because

the number of main ropes 15 wound around each of the deflecting members 3 6 and 37 is reduced compared to Embodiment 2, axial dimensions of each of the deflecting members 36 and 37 can be made smaller than that of the deflecting member 33 according to Embodiment 2, enabling the deflecting members 36 and 37 to be easily disposed inside the upper beam 31.

Embodiment 4

**[0034]** Figure 9 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 4 of the present invention, and Figure 10 is a cross section taken along line X - X in Figure 9. In this example, a plurality of cylindrical deflecting members (equal in number to main ropes 15), i.e., first through fourth deflecting members 41 through 44, are fixed to an upper beam 31. The first deflecting member 41 and the second deflecting member 42 may be configured as an integrated part or may be configured as separate parts. Similarly, the third deflecting member 43 and the fourth deflecting member 44 may be configured as an integrated part or may be configured as separate parts.

**[0035]** A corresponding main rope 15 is wound around each of the deflecting members 41 through 44. Diameters (radii and radii of curvature of outer peripheral surfaces) of the deflecting members 41 through 44 are equal to each other. Positions of central axes of the first deflecting member 41 and the second deflecting member 42 are offset from each other such that rising positions of the main ropes 15 are offset. In addition, positions of central axes of the third deflecting member 43 and the fourth deflecting member 44 are also offset from each other.

**[0036]** Using offset deflecting members 41 through 44 of this kind, the main ropes 15 can be raised at appropriate positions relative to rope grooves of a drive sheave 13 positioned directly above the deflecting members 41 through 44, enabling fleet angles of the main ropes 15 to be reduced (to less than or equal to 2.5 degrees, for example). Thus, it is no longer necessary for the drive sheave 13 to be disposed in a high position just to reduce the fleet angles, enabling the overhead dimensions to be further reduced.

Embodiment 5

**[0037]** Next, Figure 11 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 5 of the present invention, and Figure 12 is a cross section taken along line XII- XII in Figure 11. In this example, a plurality of cylindrical deflecting members (equal in number to main ropes 15), i.e., first through fourth deflecting members 45 through 48, are fixed to an upper beam 31. The first deflecting member 45 and the second deflecting member 46 may be configured as an integrated part or may be configured as separate parts. Similarly, the third deflecting member 47 and the fourth deflecting member 48 may be configured as an integrated part or may be configured as separate parts.

**[0038]** A corresponding main rope 15 is wound around each of the deflecting members 45 through 48. Diameters (radii and radii of curvature of outer peripheral surfaces) of the first and third deflecting members 45 and 47 are equal to each other. Diameters of the second and fourth deflecting members 46 and 48 are equal to each other. In addition, the diameters of the second and the fourth deflecting member 46 and 48 are smaller than the diameters of the first and the third deflecting member 45 and 47.

**[0039]** The first deflecting member 45 and the second deflecting member 46 are disposed coaxially. The third deflecting member 47 and the fourth deflecting member 48 are also disposed coaxially.

**[0040]** A corresponding main rope 15 is wound around each of the deflecting members 45 through 48. The diameters of the first deflecting member 45 and the second deflecting member 46 differ from each other such that rising positions of the main ropes 15 are offset. In addition, the diameters of the third deflecting member 47 and the fourth deflecting member 48 also differ from each other.

**[0041]** Using stepped deflecting members 45 through 48 of this kind, the main ropes 15 can be raised at appropriate positions relative to rope grooves of a drive sheave 13 positioned directly above the deflecting members 45 through 48, enabling fleet angles of the main ropes 15 to be reduced (to less than or equal to 2.5 degrees, for example). Thus, it is no longer necessary for the drive sheave 13 to be disposed in a high position just to reduce the fleet angles, enabling the overhead dimensions to be further reduced.

Embodiment 6

**[0042]** Next, Figure 13 is a plan showing a rope end connecting apparatus of an elevator apparatus according to Embodiment 6 of the present invention, and Figure 14 is a cross section taken along line XIV - XIV in Figure 13. In this example, springs (compression springs) 24 are disposed between end portions of connecting rods 23 on an opposite side from main ropes 15 and rod connecting portions 10b and 10c in a similar manner to Embodiment 1. Deflecting members 36 and 37 are disposed on an upper beam 31 so as to be rotatable around horizontal shafts 49 and 50. The shafts 49 and 50 are disposed parallel to a depth direction of a car 2 (see Figure 1). Bearings (not shown) for the deflecting members 36 and 37 are disposed between the shafts 49 and 50 and the deflecting members 36 and 37.

**[0043]** In a rope end connecting apparatus of this kind, because the springs 24 expand and contract together with expansion and contraction of the main ropes 15, and the deflecting members 36 and 37 rotate even if the main ropes 15 move, the main ropes 15 do not slide relative to the deflecting members 36 and 37, enabling extension of service life of the main ropes 15.

Embodiment 7

**[0044]** Next, Figure 15 is a plan showing part of a rope end connecting apparatus of an elevator apparatus according to Embodiment 7 of the present invention. In this example, connecting rods 23 are connected to rod connecting portions 32a and 32b so as to be inclined. In other words, contact angles of main ropes 15 relative to a first deflecting member 36 differ from each other. Although not shown, contact angles of main ropes 15 relative to a second deflecting member 37 also differ from each other. The rest of the configuration is similar to that of Embodiment 6.

**[0045]** In a rope end connecting apparatus of this kind, because car end portions 15a are led out from the deflecting members 36 and 37 at different angles from each other, positions at which the connecting rods 23 are connected to the rod connecting portions 32a and 32b can be offset vertically, enabling a plurality of connecting rods 23 to be connected efficiently inside the narrow rod connecting portions 32a and 32b.

**[0046]** Moreover, a deflecting member does not need to have a cylindrical shape if it is unrotatable, and may also have a curved surface only on a portion around which a main rope is wound.

In the above examples, rope end connecting apparatuses for connecting a car end portion to an upper beam are shown, but the present invention may also be applied to rope end connecting apparatuses for connecting a counterweight end portion to an upper portion of a counterweight.

In addition, in the above examples, a counterweight is disposed behind a car, but a counterweight may also be disposed beside a car so as to face a side surface of the car when positioned level with the car.

In the above examples, a driving machine is disposed in an upper portion inside a hoistway, but a driving machine may also be disposed in a machine room in an upper portion of a hoistway.

## Claims

**1.** An elevator apparatus comprising:

a car having a cage and an upper beam disposed above the cage, the car being raised and lowered inside a hoistway;
a main rope body for suspending the car inside the hoistway; and
a rope end connecting apparatus for connecting the main rope body to the upper beam,

wherein the rope end connecting apparatus has:

a deflecting member around which the main rope body is wound, the deflecting member changing orientation of an end portion of the main rope body; and
a connecting rod disposed inside the upper beam, the connecting rod being connected between the end portion of the main rope body and the upper beam.

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

the connecting rod is connected to the upper beam by means of a spring; and
the deflecting member is rotatable around a horizontal rotating shaft.

**3.** The elevator apparatus according to Claim 2, wherein:

the main rope body includes a plurality of main ropes; and
the deflecting member includes a plurality of independently rotatable deflection pulleys around which the main ropes are respectively wound.

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

the main rope body includes a plurality of main ropes; and
the main ropes are distributed toward two longitudinal ends of the upper beam by the deflecting member.

**5.** The elevator apparatus according to Claim 4, wherein the main ropes are distributed by changing winding directions on the deflecting member.

**6.** The elevator apparatus according to Claim 1, wherein:

the main rope body includes a plurality of main ropes; and
the deflecting member is configured such that rising positions of the main ropes are offset.

FIG. 1

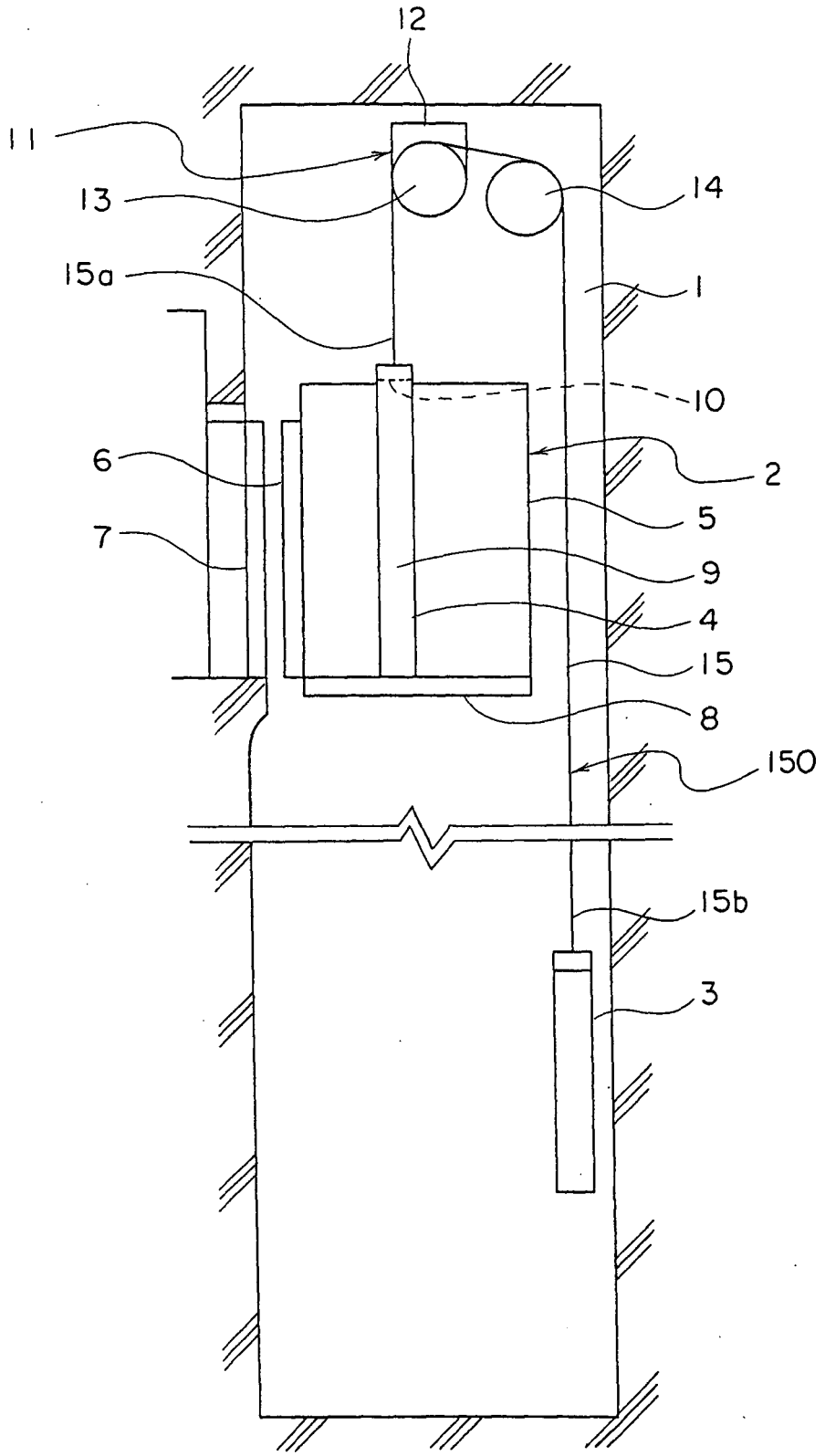


FIG. 2

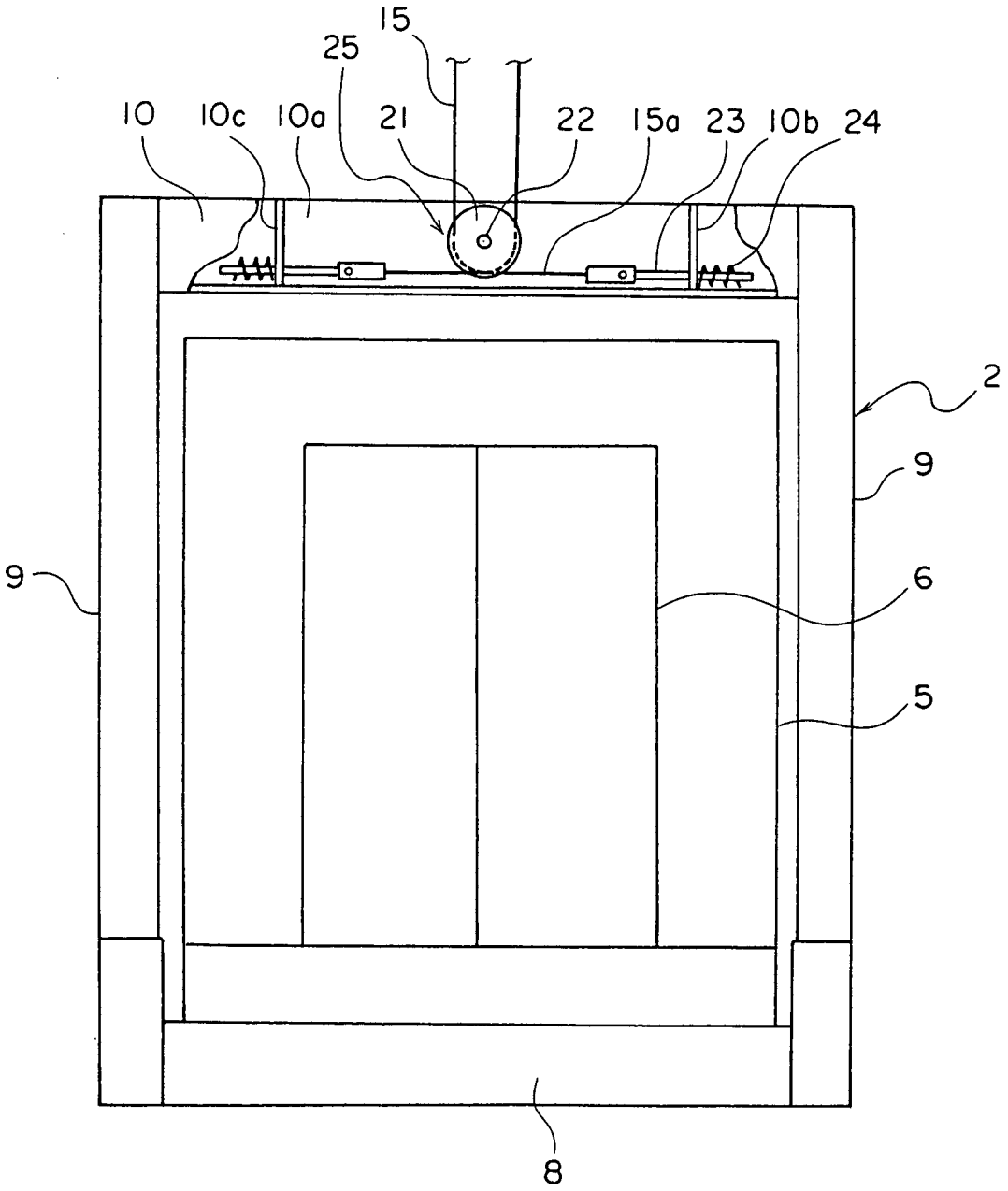


FIG. 3

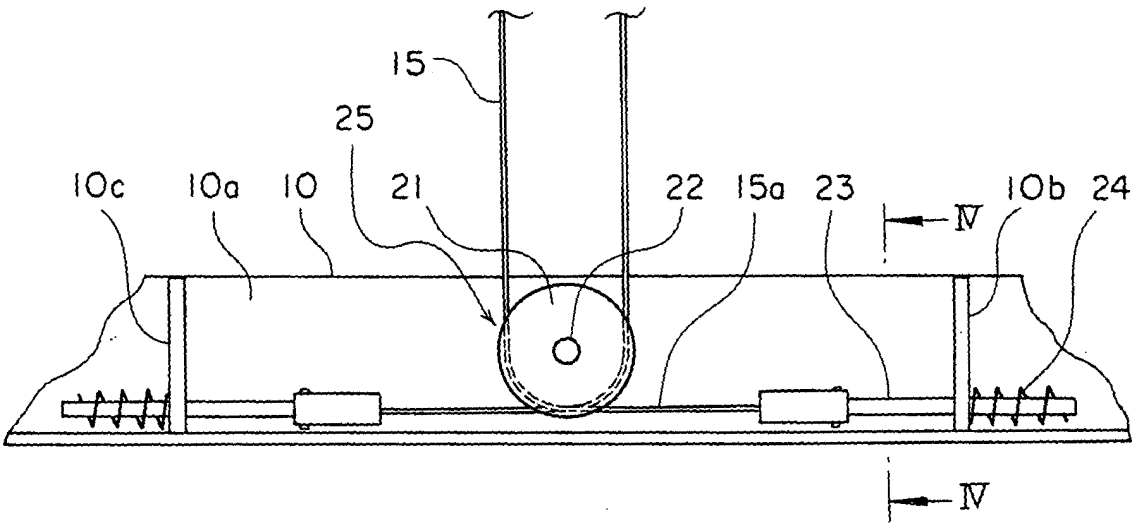



FIG. 4

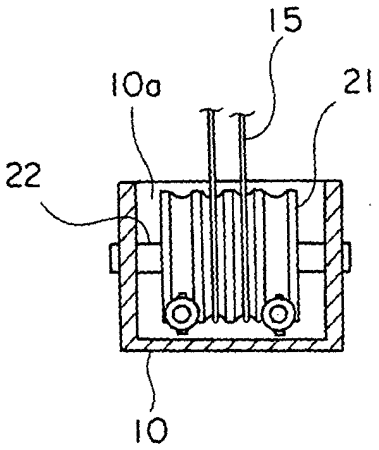
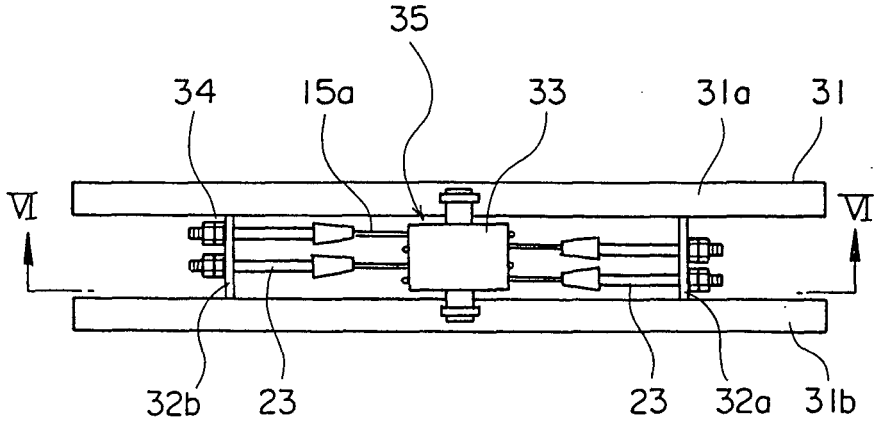


FIG. 5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31b

FIG. 6

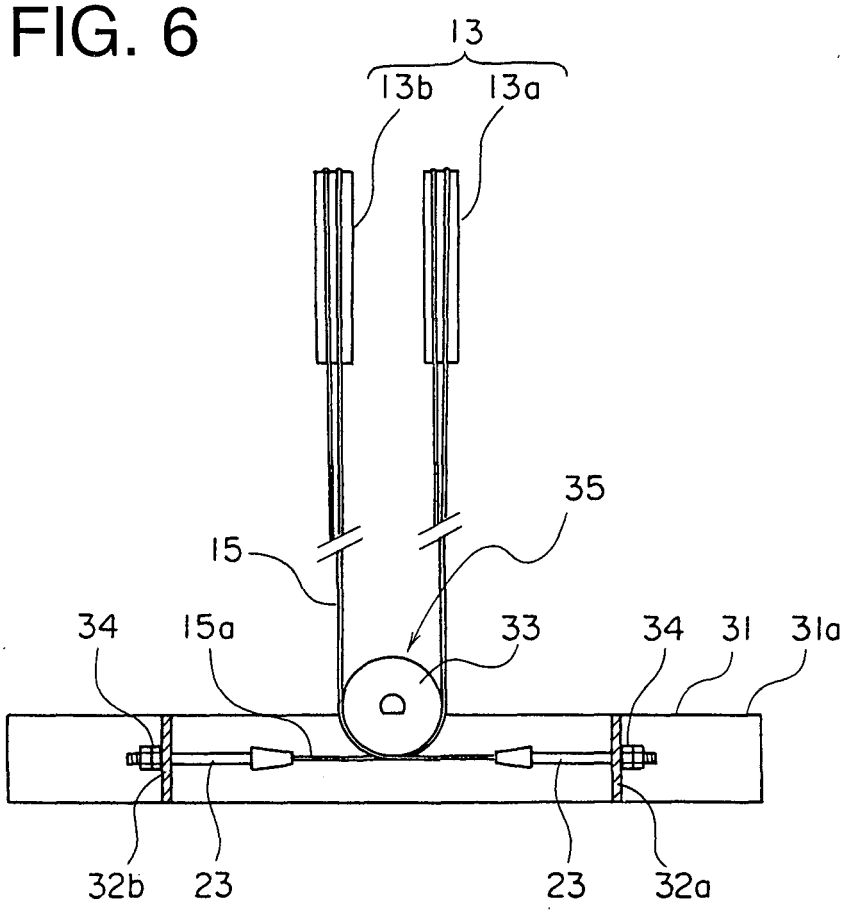
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FIG. 7

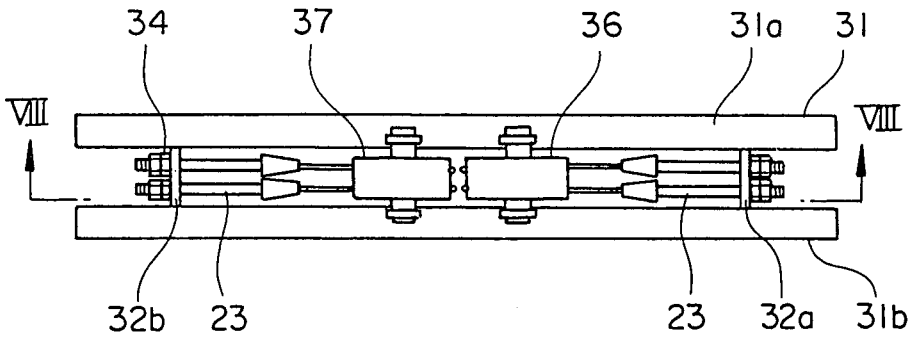
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FIG. 8

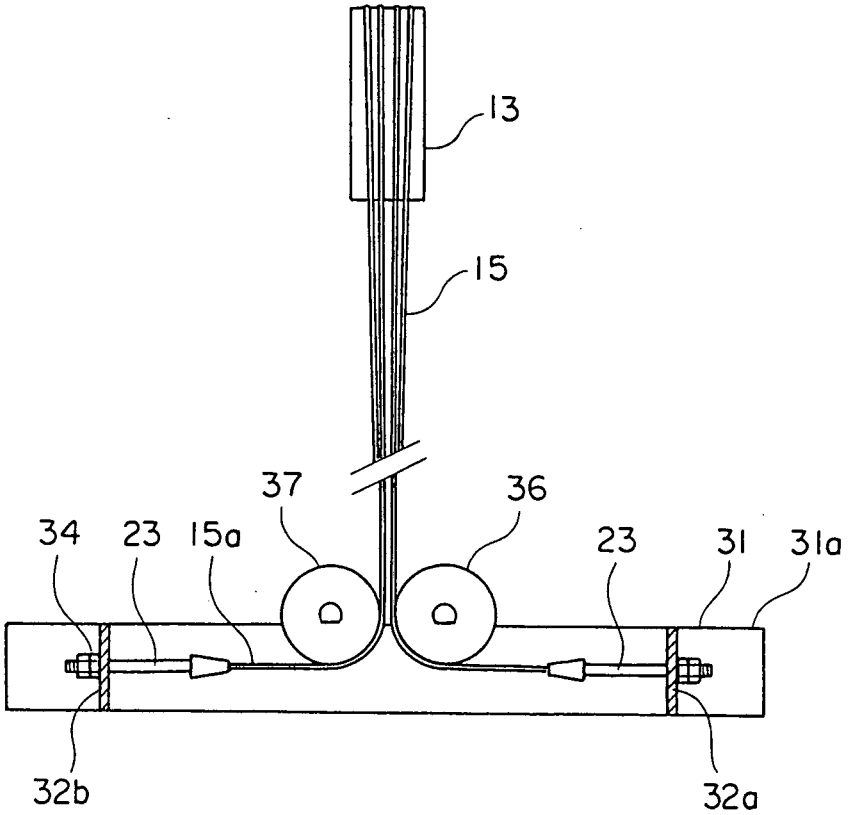
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FIG. 9

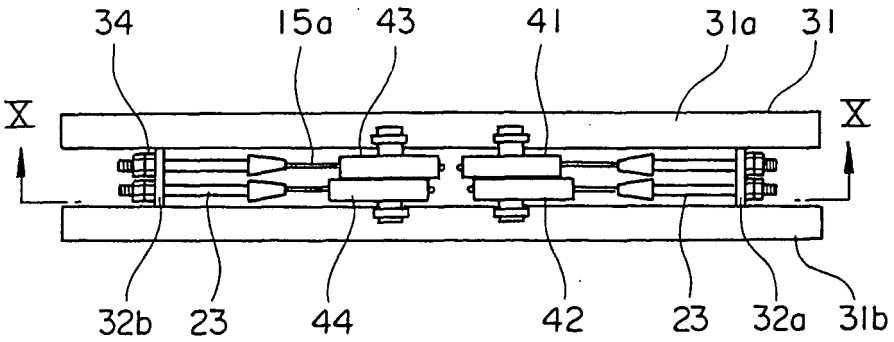
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FIG.10

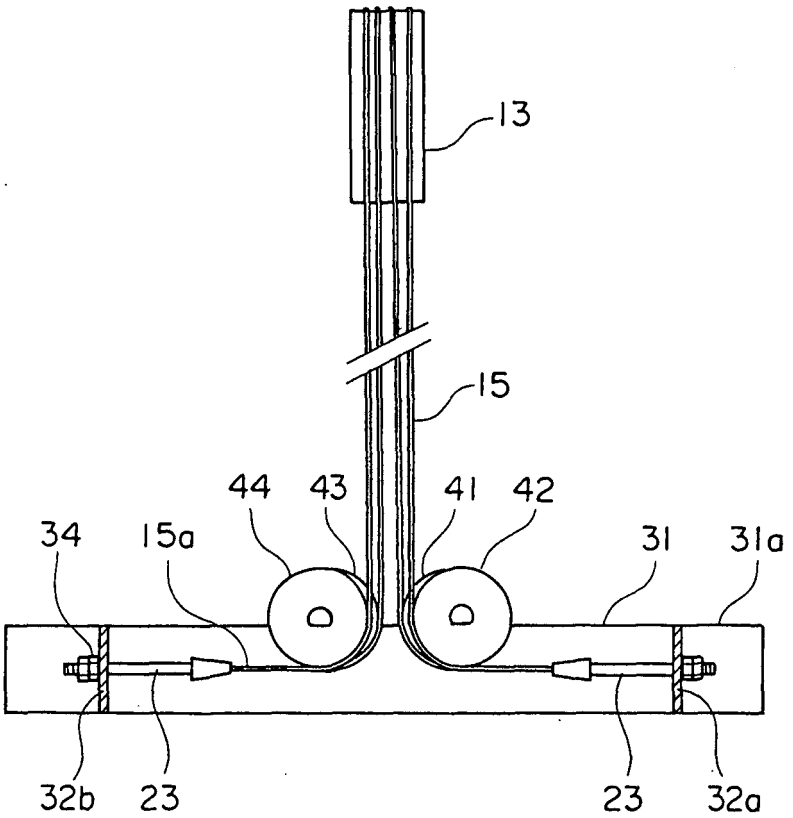
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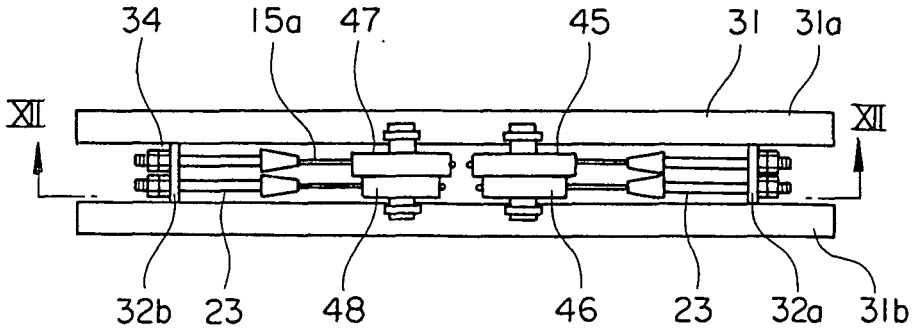
FIG.11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31a
XII
XII
32b
23
48
46
23
32a
31b

FIG.12

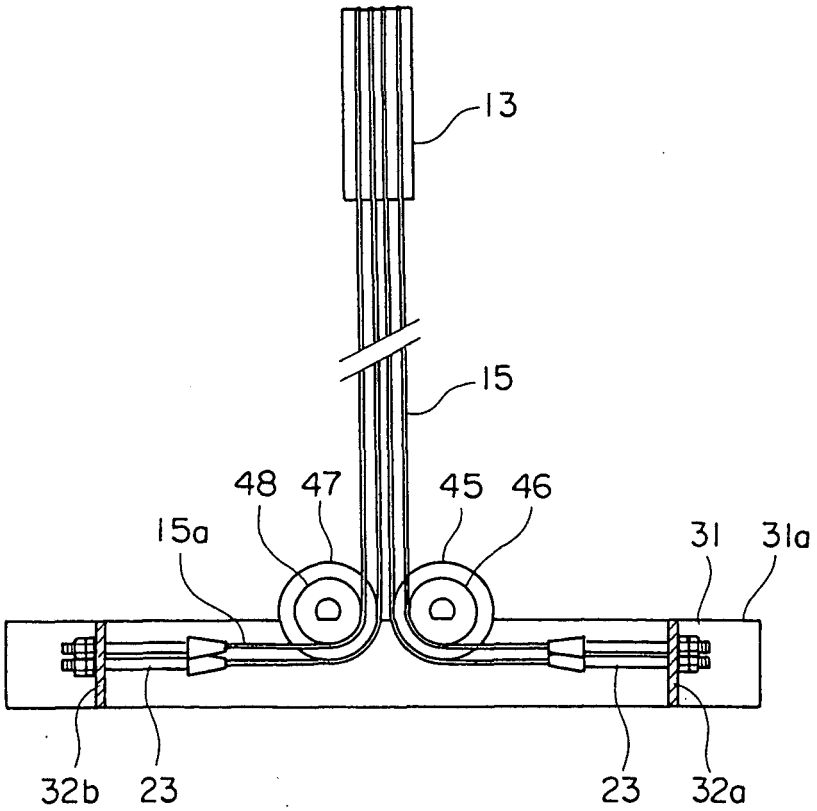

13
15
48
47
45
46
15a
31
31a
32b
23
23
32a

FIG.13

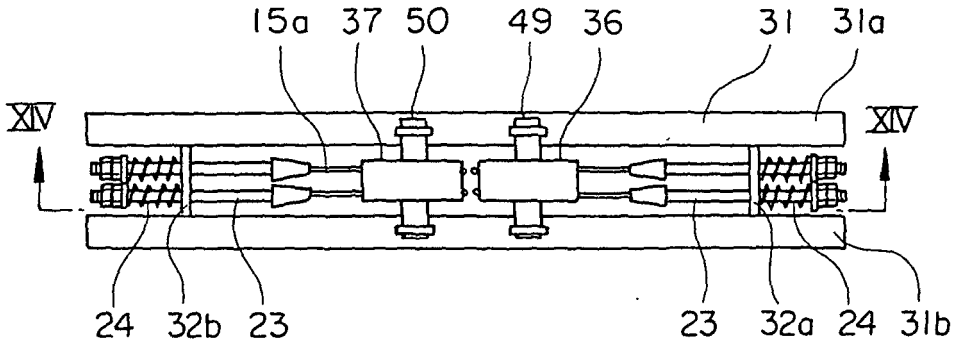

15a
37
50
49
36
31
31a
XIV
XIV
24
32b
23
23
32a
24
31b

FIG. 14

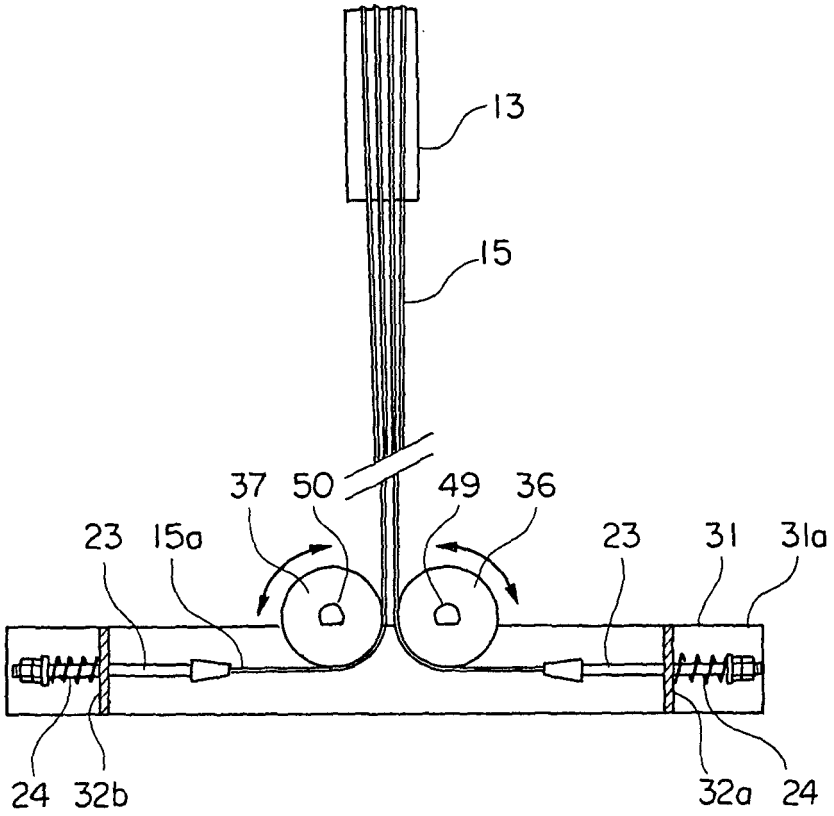
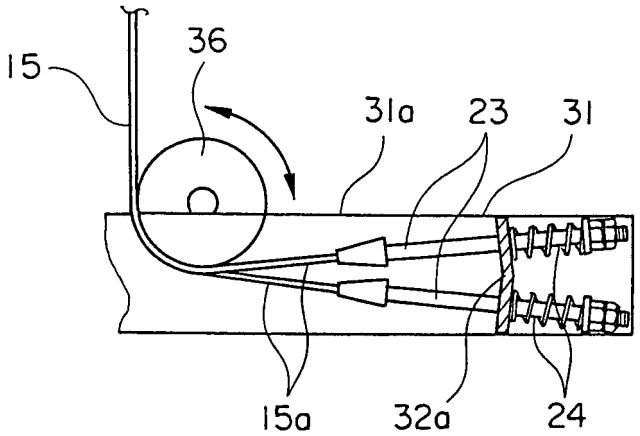

13
15
37
50
49
36
23
15a
23
31
31a
24
32b
32a
24

FIG.15



**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2004/011828

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B7/08

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-B66B7/12

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. |
|---|---|---|
| X | JP 2003-276966 A (Toshiba Elevator and Building Systems Corp.), 02 October, 2003 (02.10.03), Pay attention to Claim 1; Par. No. [0014]; Figs. 1 to 3 (Family: none) | 1-6 |
| A | JP 3-98974 A (Mitsubishi Electric Corp.), 24 April, 1991 (24.04.91), & GB 2236301 A | 2-6 |

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

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"&" 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 May, 2005 (17.05.05) | 31 May, 2005 (31.05.05) |
| Name and mailing address of the ISA/ Japanese Patent Office | Authorized officer |
| Facsimile No. | Telephone No. |

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## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


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