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

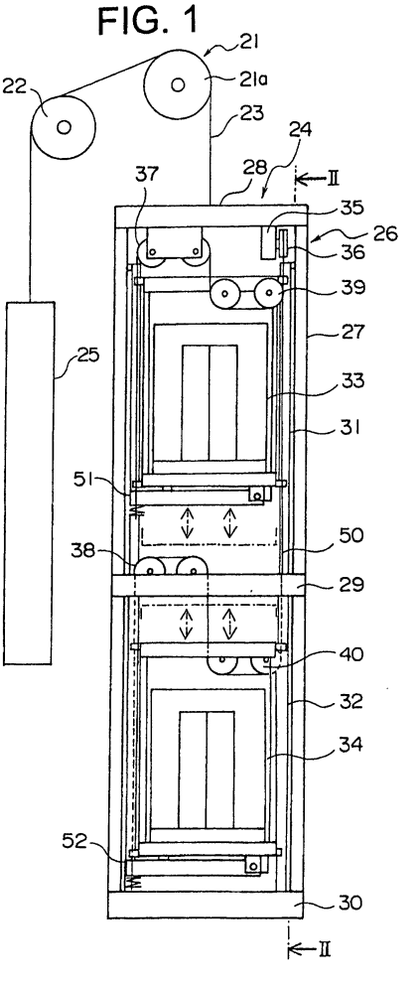
(72) Inventor: **MORITA, Susumu,**
Mitsubishi Denki Kabushiki Kaisha
Tokyo 100-8310 (JP)

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

(54) CAGE DEVICE FOR DOUBLE DECK ELEVATORS

(57) In a car apparatus for a double-deck elevator, an upper car and a lower car are suspended in a main frame by a suspending member. Also, the upper car and the lower car are suspended in relation to the main frame by an odd number roping method. The distance between the upper car and the lower car is adjusted by a car position adjusting driving machine according to distances between floors. The upper car and the lower car are provided with slack rope safeties that detect slack in the suspending member to fix the upper car and the lower car in relation to a guide rail, respectively.

FIG. 1



EP 1 357 075 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a car apparatus for a double-deck elevator in which an upper car and a lower car are supported by a main frame raised and lowered in a hoistway.

BACKGROUND ART

[0002] Fig. 6 is a block diagram showing a conventional car apparatus for a double-deck elevator such as disclosed, for example, in Japanese Patent Application Laid-Open No. Sho 48-76242. In the figure, a pair of guide rails 2a and 2b are provided in a main frame 1 which is raised and lowered in a hoistway. An upper car 3 and a lower car 4 are supported by the main frame 1 and raised and lowered along the guide rails 2a and 2b in the main frame 1. Because of this, the distance between the upper car 3 and the lower car 4 can be adjusted.

[0003] Rotatable first and second sprockets 5 and 6 are disposed at the upper portion of the main frame 1 and spaced from one another in a horizontal direction. First and second chains 7 and 8 are wound around the first and second sprockets 5 and 6.

[0004] First end portions of the first and second chains 7 and 8 are connected to the upper car 3, and second end portions of the first and second chains 7 and 8 are connected to the lower car 4. That is, the upper car 3 and the lower car 4 are suspended by the first and second chains 7 and 8.

[0005] Third and fourth sprockets 9 and 10 that rotate with the first and second sprockets 5 and 6 are fixed to the axles of the first and second sprockets 5 and 6. A rotatable fifth sprocket 11 is disposed at the main frame 1 in the vicinity of the fourth sprocket 10.

[0006] A car position adjusting driving machine 12 for changing the distance between the upper car 3 and the lower car 4 by raising and lowering the upper car 3 and the lower car 4 is mounted to the upper end portion of the main frame 1. The car position adjusting driving machine 12 has a car position adjusting driving sprocket 13. A loop-like third chain 14 is wound around the third to fifth sprockets 9 to 11 and the car position adjusting driving sprocket 13.

[0007] Next, the operation will be described. When the car position adjusting driving sprocket 13 is rotated by the driving force of the car position adjusting driving machine 12, the third chain 14 is circulated and the third and fourth sprockets 9 and 10 are rotated. Because of this, the first and second sprockets 5 and 6 are rotated. At this time, the rotational directions of the first and second sprockets 5 and 6 are opposite to one another. Accordingly, the upper car 3 and the lower car 4 are raised and lowered through the first and second chains 7 and 8.

[0008] Since the upper car 3 and the lower car 4 are suspended by the first and second chains 7 and 8, the lower car 4 is raised while the upper car 3 is lowered, and the upper car 3 is raised while the lower car 4 is lowered. Owing to this, the distance between the upper car 3 and the lower car 4 is changed, and irregular distances between floors can be dealt with.

[0009] In such a conventional car apparatus for a double-deck elevator, means for preventing the upper car 3 and the lower car 4 from falling in the main frame 1 in the event the first or second chains 7 and 8 suspending the upper car 3 or the lower car 4 are cut, are required.

DISCLOSURE OF THE INVENTION

[0010] The present invention is made to solve the problem mentioned above, and an object of the present invention is to provide a car apparatus for a double-deck elevator which can prevent an upper car and a lower car from falling when a suspending member suspending the upper car and the lower car is cut.

[0011] To this end, according to one aspect of the present invention, there is provided a car apparatus for a double-deck elevator comprising: a main frame having a guide rail, that is raised and lowered in a hoistway; an upper car disposed inside the main frame, the upper car capable of being raised and lowered along the guide rail; a lower car disposed inside the main frame below the upper car, the lower car capable of being raised and lowered along the guide rail; a car position adjusting driving machine mounted to the main frame and having a car position adjusting drive sheave, for changing a distance between the upper car and the lower car by raising and lowering the upper car and the lower car, and a flexible suspending member suspending the upper car and the lower car in relation to the main frame, wound around the car position adjusting drive sheave, wherein the upper car and the lower car are suspended in relation to the main frame by an odd number roping method, and the upper car and the lower car are provided with slack rope safeties for fixing the upper car and the lower car in relation to the guide rail, respectively, when a slack in the suspending member is detected.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012]

Fig. 1 is a front view showing a car apparatus for a double-deck elevator according to an embodiment of the present invention;

Fig. 2 is a cross-sectional view taken along the line II-II in Fig. 1;

Fig. 3 is a front view showing the slack rope safeties in Fig. 1;

Fig. 4 is a cross-sectional view taken along the line IV-IV in Fig. 3;

Fig. 5 is a perspective view showing a construction of the rope in Fig. 1; and

Fig. 6 is a block diagram showing an example of a conventional car apparatus for a double-deck elevator.

BEST MODE FOR CARRYING OUT THE INVENTION

[0013] Preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

[0014] Fig. 1 is a front view showing a car apparatus for a double-deck elevator according to an embodiment of the present invention, and Fig. 2 is a cross-sectional view taken along the line II-II in Fig. 1.

[0015] In the figures, a main driving machine (hoisting machine) 21 having a drive sheave 21a, and a deflector sheave 22 are disposed at an upper portion of a hoistway. A main rope 23 is wound around the drive sheave 21a and the deflector sheave 22. A car apparatus 24 is suspended at a first end portion of the main rope 23. A counterweight 25 is suspended at a second end portion of the main rope 23.

[0016] A main frame 26 of the car apparatus 24 has a pair of longitudinal columns 27, an upper beam 28, an intermediate beam 29, a lower beam 30, a pair of upper car guide rails 31, and a pair of lower car guide rails 32. The upper beam 28 is horizontally fixed between upper end portions of the longitudinal columns 27. The intermediate beam 29 is horizontally fixed between intermediate portions of the longitudinal columns 27. The lower beam 30 is horizontally fixed between lower end portions of the longitudinal columns 27.

[0017] The upper car guide rails 31 and the lower car guide rails 32 are fixed inside the main frame 26 in parallel with the longitudinal columns 27.

[0018] An upper car 33 is disposed between the upper beam 28 and the intermediate beam 29. The upper car 33 is capable of being raised and lowered along the upper car guide rails 31. A lower car 34 is disposed between the intermediate beam 29 and the lower beam 30. The lower car is capable of being raised and lowered along the lower car guide rails 32.

[0019] A car position adjusting driving machine 35 which changes the distance between the upper car 33 and the lower car 34 by raising and lowering the upper car 33 and the lower car 34 is supported by the upper beam 28. The car position adjusting driving machine 35 has a car position adjusting drive sheave 36.

[0020] A pair of rotatable upper beam pulleys 37 are mounted to the upper beam 28. A pair of rotatable intermediate beam pulleys 38 are mounted to the intermediate beam 29. A pair of rotatable upper car pulleys 39 are mounted to an upper portion of the upper car 33. A pair of rotatable lower car pulleys 40 are mounted to an upper portion of the lower car 34.

[0021] The upper car 33 and the lower car 34 are suspended in relation to the main frame 26 by a flexible rope 50 that is a suspending member. The rope 50 is composed of a synthetic fiber rope, for example. A first end portion of the rope 50 is connected to a lower portion of the upper car 33. A second end portion of the rope 50 is connected to a lower portion of the lower car 34.

[0022] The rope 50 is wound in sequence around, from the first end portion, the upper beam pulleys 37, the upper car pulleys 39, the car position adjusting drive sheave 36, the lower car pulleys 40 and the intermediate beam pulleys 38. Accordingly, the upper car 33 and the lower car 34 are suspended by a 3:1 roping method.

[0023] Slack rope safeties 51 and 52 which detect slack in the rope 50 to fix the upper car 33 and the lower car 34 in relation to corresponding guide rails 31 and 32 are provided at the lower portions of the upper car 33 and the lower car 34, respectively.

[0024] Fig. 3 is a front view showing the slack rope safeties 51 and 52 in Fig. 1, and Fig. 4 is a cross-sectional view taken along the line IV-IV in Fig. 3. In the figures, the end portions of the rope 50 are connected to tip portions of mounting arms 53. The mounting arms 53 are pivotably coupled with the lower portions of the upper car 33 and the lower car 34 about shafts 54. The shafts 54 are disposed at base end portions of the mounting arms 53.

[0025] The mounting arms 53 are urged downwardly in relation to the upper car 33 and the lower car 34 by compression springs 55. Grip members 56 are fixed to side portions of the upper car 33 and the lower car 34. The grip members 56 are provided with tapered groove portions 56a in which the guide rails 31 and 32 are inserted. Widths of the groove portions 56a broaden in the downward direction.

[0026] Levers 57 which are mechanically interlocked with pivoting of the mounting arms 53 to be pivoted are attached to the side portions of the upper car 33 and the lower car 34. Rollers 58 are provided at tip portions of the levers 57. When slack occurs in the rope 50 and the mounting arms 53 are pushed down by the compression springs 55, the rollers 58 are pushed between the groove portions 56a and the guide rails 31 and 32.

[0027] Each of the slack rope safeties 51 and 52 has a mounting arm 53, a shaft 54, a compression spring 55, a grip member 56, a lever 57 and a roller 58.

[0028] Fig. 5 is a perspective view showing a construction of the rope 50 in Fig. 1. In the figure, an inner strand layer 44 having a plurality of inner strands 42 and filler strands 43 disposed in gaps between these inner strands 42 is disposed around a core wire 41. Each of the inner strands 42 is composed of a plurality of aramid fibers and an impregnating material such as a polyurethane or the like. The filler strands 43 are composed of a polyamide, for example.

[0029] An outer strand layer 46 having a plurality of outer strands 45 is disposed around an outer circumference of the inner strand layer 44. Each of the outer strands 45 is composed of a plurality of aramid fibers and an impregnating material such as a polyurethane or the like in a similar manner to the inner strands 42.

[0030] A friction-reducing coating layer 47 for prevent-

ing abrasion of the strands 42 and 45 due to friction among the strands 42 and 45 is disposed between the inner strand layer 44 and the outer strand layer 46. A protective coating layer 48 is also disposed on an outer circumferential portion of the outer strand layer 46. A synthetic fiber rope of this kind has a high coefficient of friction compared to a steel rope and is superior in flexibility.

[0031] Next, the operation will be described. The car apparatus 24 and the counterweight 25 are raised and lowered by the driving force of the main driving machine 21. Although the upper car 33 and the lower car 34 simultaneously reach floors vertically abutting one another, the distances between the floors of the building are not always equal and there are some cases where the distances between the floors are different from each other depending upon the floor.

[0032] In such a case, the upper car 33 and the lower car 34 are raised and lowered in relation to the main frame 26 by the car position adjusting driving machine 35 to adjust the distance between the upper car 33 and the lower car 34. In other words, when the upper car 33 is lowered, the lower car 34 is raised to reduce the distance between the upper car 33 and the lower car 34. Also, when the upper car 33 is raised, the lower car 34 is lowered to increase the distance between the upper car 33 and the lower car 34.

[0033] In a car apparatus 24 of this kind, in the event that the rope 50 suspending the upper car 33 and the lower car 34 slackens or is cut, the slack rope safeties 51 and 52 prevent the upper car 33 and the lower car 34 from falling in the main frame 26.

[0034] In other words, the mounting arms 53 are pushed downwardly by the compression springs 55, and the levers 57 are interlocked and pivoted. Owing to this, the rollers 58 are pushed between the groove portion 56a and the guide rails 31 and 32. Accordingly, even if the rope 50 slackens or is cut, the upper car 33 and the lower car 34 are fixed in relation to the guide rails 31 and 32, thereby preventing the upper car 33 and the lower car 34 from falling in the main frame 26.

[0035] Further, since the car position adjusting driving machine 35 hoists only the difference between the weights of the upper car 33 and the lower car 34, output can be reduced. Additionally, if in the 3:1 roping method, since the car position adjusting driving machine 35 is required to support only one third of the total weight of the upper car 33 and the lower car 34, the car position adjusting driving machine 35 can be reduced in size and weight.

[0036] More, since the rope 50 composed of the synthetic fiber rope is used, the diameters of all the pulleys 37 to 40 can be reduced, and installation space for the pulleys 37 to 40 can be easily secured inside the main frame 26. Also, since the adjustment range between the maximum and minimum distances between the upper car 33 and the lower car 34 can be easily adjusted by only adjusting the length of the rope 50, structural restrictions are decreased.

[0037] It should be noted that, while, in the above embodiment, the rope 50 composed of the synthetic fiber rope is shown as a suspending member, ropes composed of other materials may also be used. Further, it is also possible that a belt is used as the suspending member. Furthermore, it is also possible that a chain is used as the suspending member sprockets are used instead of the pulleys.

[0038] More, while, the upper car 33 and the lower car 34 are suspended in the above embodiment by the 3:1 roping method in the main frame 26, odd number roping methods, for example, a 5:1 roping method and the like may also be applicable.

[0039] Moreover, while, the double-deck elevator in which the car apparatus 24 and the counterweight 25 are suspended by the 1:1 roping method is described in the above embodiment, the suspending method of the car apparatus 24 is not limited to this.

[0040] Further, the present invention is applicable to various types of double-deck elevators such as, for example, hydraulic elevators, roped linear motor elevators, or rope-less linear motor elevators.

Claims

1. A car apparatus for a double-deck elevator comprising:

a main frame having a guide rail and which is raised and lowered in a hoistway;
an upper car disposed inside said main frame, said upper car capable of being raised and lowered along said guide rail;
a lower car disposed inside said main frame below said upper car, said lower car capable of being raised and lowered along said guide rail;
a car position adjusting driving machine mounted to said main frame and having a car position adjusting drive sheave, for changing a distance between said upper car and said lower car by raising and lowering said upper car and said lower car, and
a flexible suspending member suspending said upper car and said lower car in relation to said main frame, wound around said car position adjusting drive sheave,

wherein said upper car and said lower car are suspended in relation to said main frame by an odd number roping method, and

said upper car and said lower car are provided with slack rope safeties for fixing said upper car and said lower car in relation to said guide rail, respectively when slack in said suspending member is detected.

2. The car apparatus for a double-deck elevator according to claim 1, wherein each slack rope safety has:

a mounting arm pivotably coupled respectively with said upper car or said lower car, to which one of first and second end portions of said suspending member are connected;
a spring urging said mounting arm downwardly in relation to said upper car and said lower car;
a grip member provided with a tapered groove portion in which said guide rail is inserted; and
a roller disposed in said groove portion, said roller being pushed between said groove portion and said guide rail when slack is generated in said suspending member and said mounting arm is pushed down by said spring.

3. The car apparatus for a double-deck elevator according to claim 1, wherein said suspending member is composed of a synthetic fiber rope.

4. The car apparatus for a double-deck elevator according to claim 1, wherein:

said main frame has a pair of longitudinal columns, an upper beam fixed between upper end portions of said longitudinal columns, an intermediate beam fixed between intermediate portions of said longitudinal columns, and a lower beam fixed between lower end portions of said longitudinal columns;
an upper beam pulley is mounted to said upper beam;
an intermediate beam pulley is mounted to said intermediate beam;
an upper car pulley is mounted to said upper car;
a lower car pulley is mounted to said lower car;
a first end portion of said suspending member is connected to said upper car;
a second end portion of said suspending member is connected to said lower car; and

said suspending member is wound in sequence round, said first end portion, said upper beam pulley, said upper car pulley , said car position adjusting drive sheave, said lower car pulley and said intermediate beam pulley.

FIG. 1

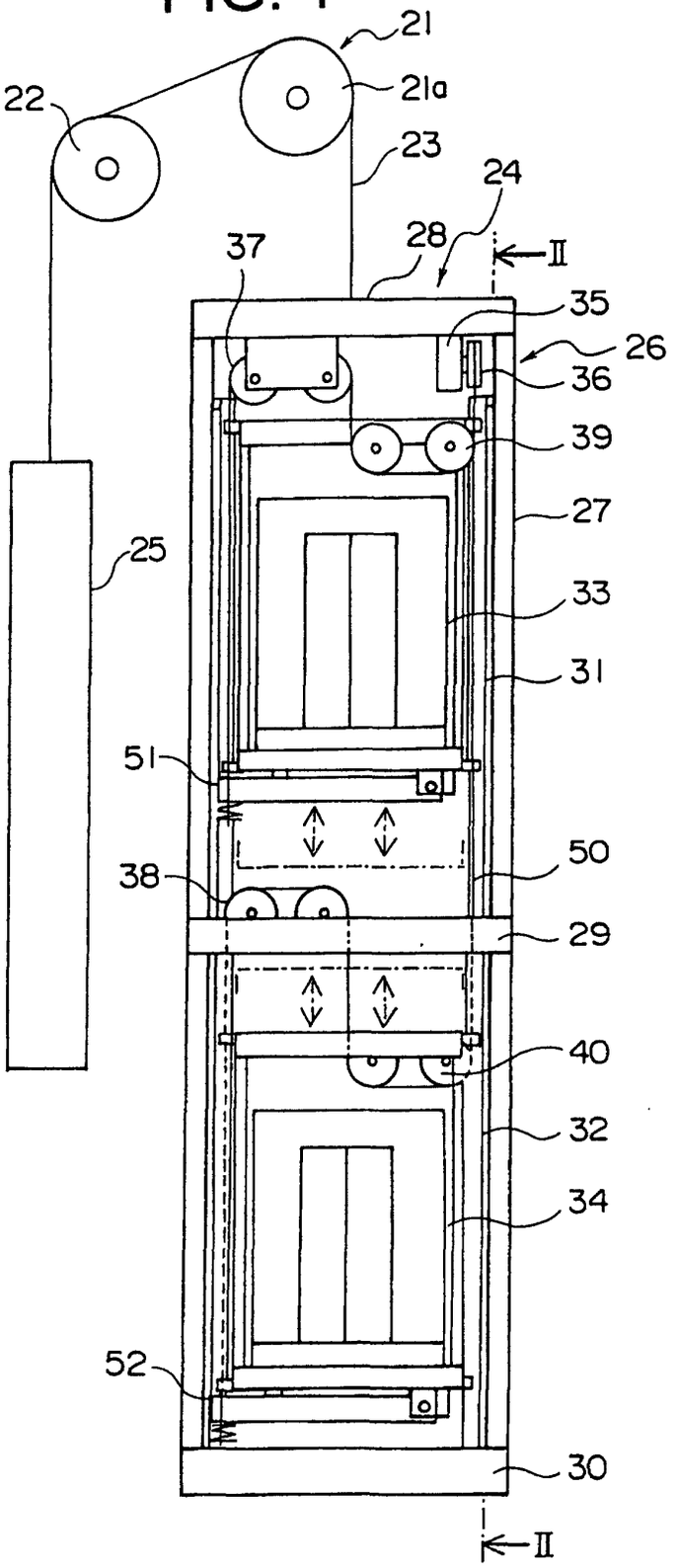

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FIG. 2

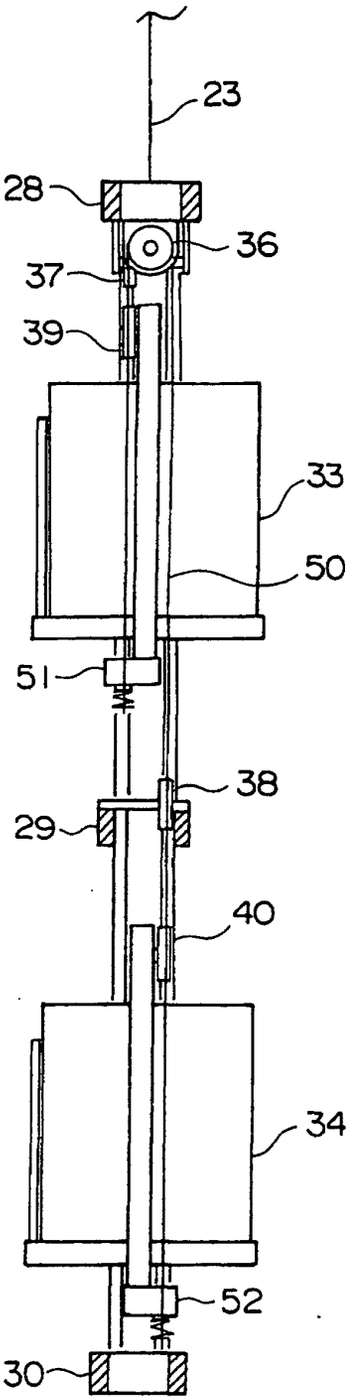
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FIG. 3

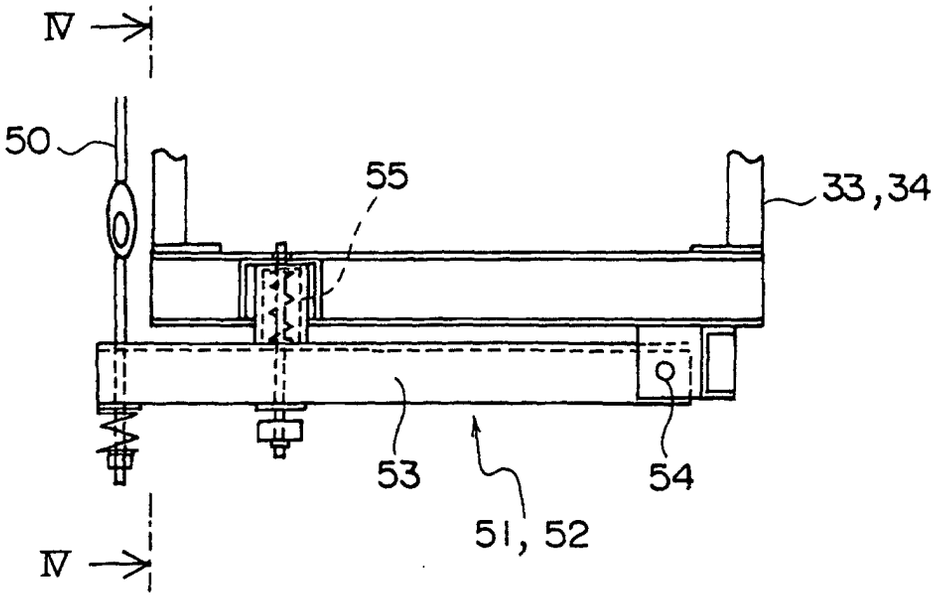


FIG. 4

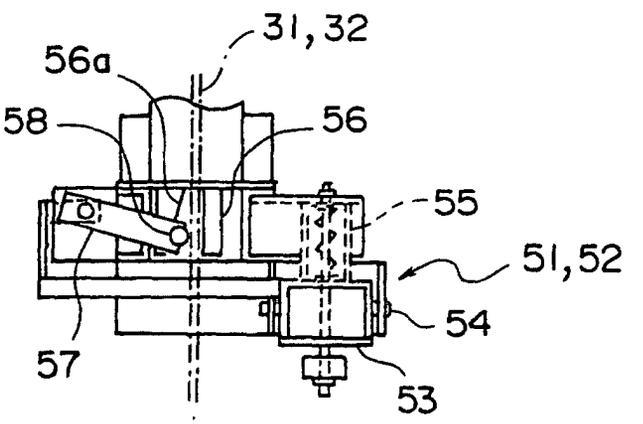


FIG. 5

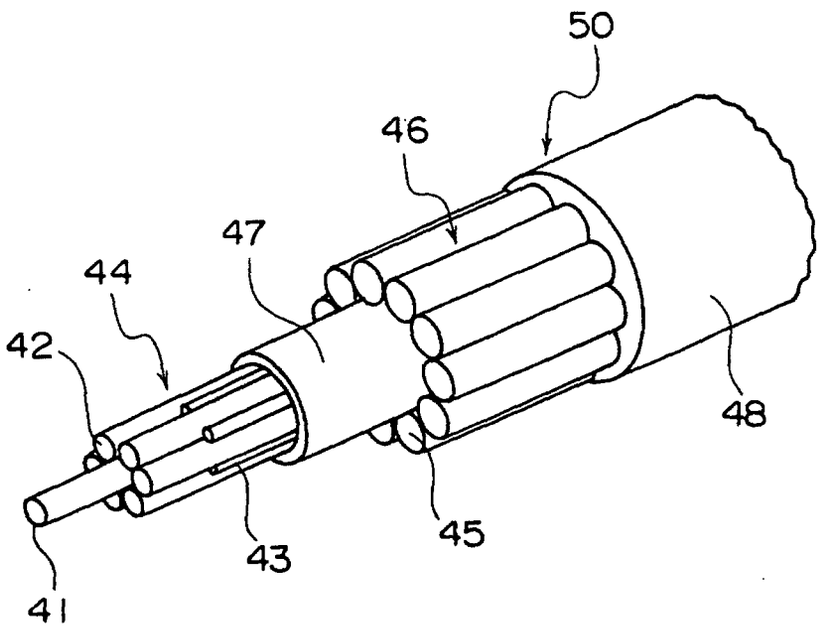
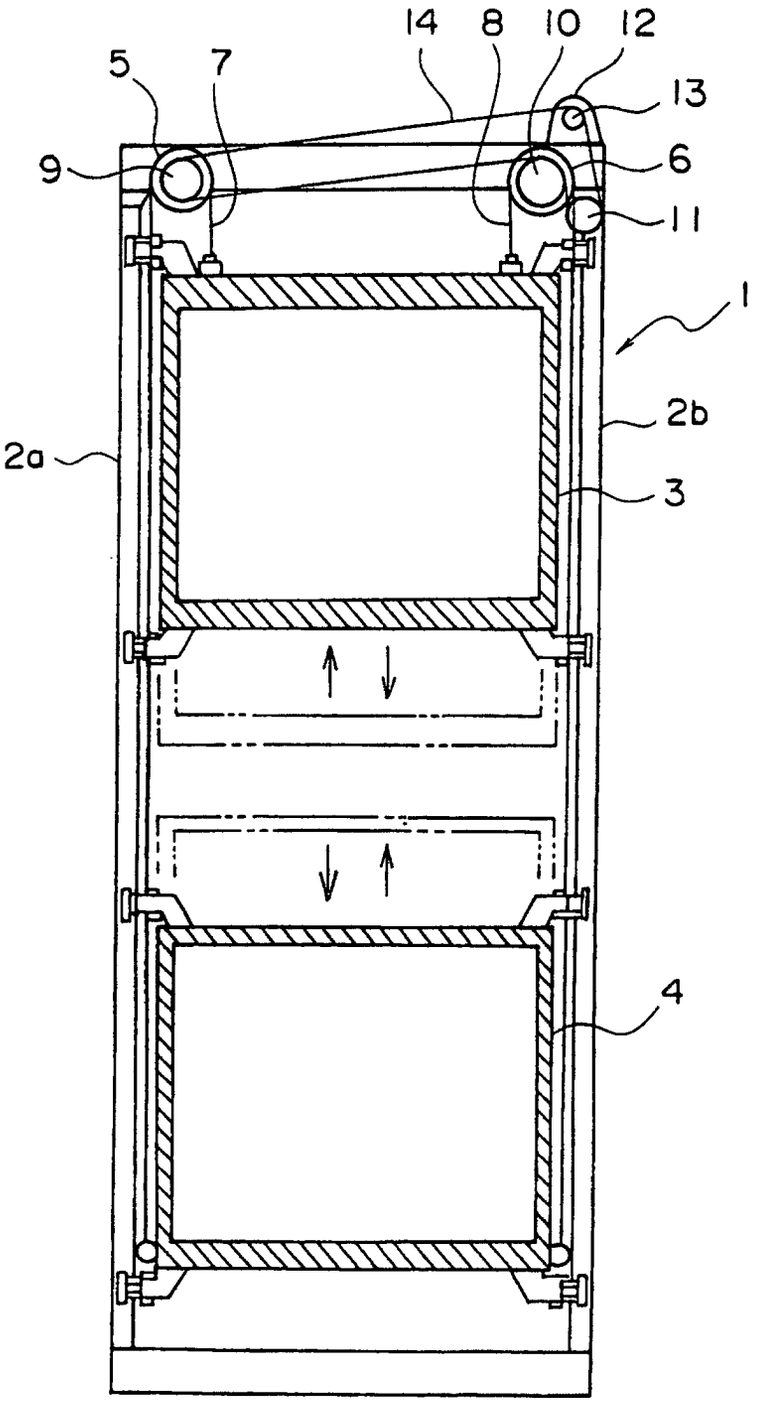


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/07846

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B11/02, B66B 1/42, B66B 5/12

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] B66B 1/00-B66B 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 1996-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Toroku Jitsuyo Shinan Koho 1994-2001

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 A	JP 2000-309482 A (Toshiba Corporation), 07 November, 2000 (07.11.00) (Family: none)	1-3 2,4
Y	JP 2000-296971 A (Toshiba Corporation), 24 October, 2000 (24.10.00) (Family: none)	1-3
Y	US 5566786 A (Inventio AG), 22 October, 1996 (22.10.96), & AU 1353495 A & AU 682743 B & BR 9500779 A & CA 2142072 A & CN 1121040 A & CZ 9500523 A & EP 0672781 A1 & FI 950936 A & HK 1011392 A & JP 7-267534 A & NO 950796 A & NZ 270477 A & PL 307384 A & PL 177759 B	3

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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
24 July, 2001 (24.07.01)	07 August, 2001 (07.08.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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