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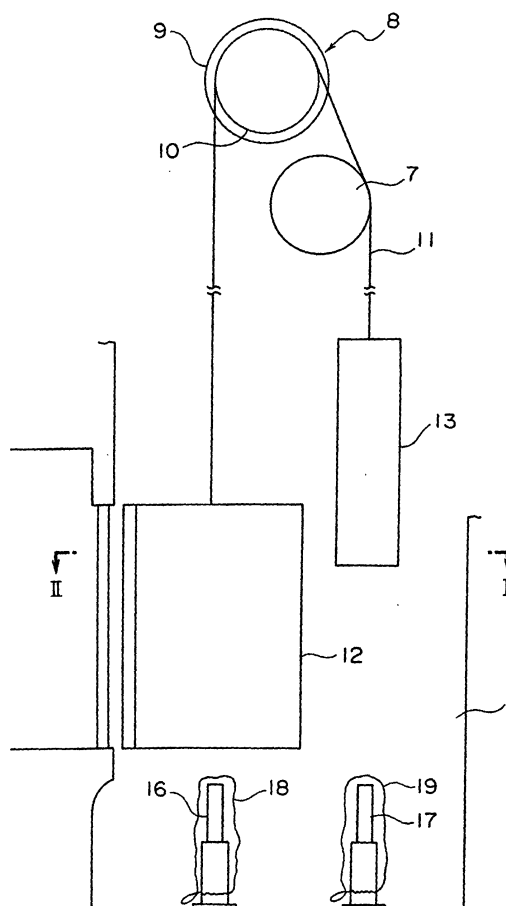
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(54) **ELEVATOR DEVICE**

(57) In an elevator apparatus, a main rope which has a main rope body, and a covering member made of resin and covering an outer periphery of the main rope body is used. A driving sheave of a driving machine has a sheave body in the outer peripheral surface of which a groove is formed, with a rope receiving member provided along the inner surface of the groove. The rope receiving member is made of a material with a higher frictional coefficient than the sheave body.

FIG. 1



Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus using a main rope a surface of which is covered with a covering member made of a material with a high frictional coefficient.

BACKGROUND ART

[0002] Conventionally, for example, Japanese Patent Application Laid-Open No. Hei 7-267534 shows a main rope for an elevator which is composed of a synthetic fiber rope. The synthetic fiber rope has a rope body and a covering member covering an outer periphery of the rope body. The rope body is constructed by twisting a plurality of strands each of which is composed of aramid fibers and an impregnating agent such as polyurethane. The covering member is made of, for example, polyurethane.

[0003] In the case of using such a main rope, greater transmission efficiency of the driving force between a driving sheave of a driving machine and the main rope is sought. Accordingly, there is a need to ensure high frictional force between the driving sheave and the main rope, and to avoid the adhesion of foreign objects to the covering member which reduce the frictional force and damage the covering member.

DISCLOSURE OF THE INVENTION

[0004] The present invention is made to solve the problems mentioned above, and an object of the present invention is to provide an elevator apparatus in which the transmission efficiency of driving force between a driving sheave and a main rope can be further improved.

[0005] To this end, according to one aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave and having a main rope body and a covering member made of resin, the covering member covering an outer periphery of the main rope body; and a car suspended in the hoistway by the main rope and raised and lowered by the driving machine; wherein the driving sheave has a sheave body and a rope receiving member made of a material with a higher frictional coefficient than the sheave body, the sheave body having a groove in which the main rope is inserted formed at an outer peripheral surface thereof, and the rope receiving member is provided along an inner surface of the groove.

[0006] According to another aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a guide rail provided in the hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave and having a main rope body and a covering member made of resin, the

covering member covering an outer periphery of the main rope body; and a car suspended in the hoistway by the main rope and raised and lowered along the guide rail by the driving machine; wherein a non-lubricated type guiding device engaging with the guide rail is attached to the car.

[0007] According to a still further aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave and having a main rope body and a covering member made of resin, the covering member covering an outer periphery of the main rope body; a car suspended in the hoistway by the main rope and raised and lowered by the driving machine; and an oil buffer for buffering an impact of the car, provided at a bottom portion of the hoistway; wherein the oil buffer is surrounded by a flexible cover for preventing dispersion of oil in the oil buffer to the surrounding area.

[0008] According to a still further aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a guide rail provided in the hoistway; a rail bracket for fixing the guide rail to the hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave and having a main rope body and a covering member made of resin, the covering member covering an outer periphery of the main rope body; and a car suspended in the hoistway by the main rope and raised and lowered along the guide rail by the driving machine; wherein the rail bracket is fixed in the hoistway by a non-welding process using a fastening device.

[0009] According to a still further aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave, a surface of the main rope being covered by a covering member made of resin; and a car suspended in the hoistway by the main rope and raised and lowered by the driving machine; wherein a surface portion of the driving sheave contacting the main rope is composed of conductive material; a conductive member is provided inside of the covering member; and a detecting apparatus is connected to the surface portion and the conductive member, for detecting damage to the covering member when the surface portion becomes electrically conductive with the conductive member.

[0010] According to a still further aspect of the present invention, there is provided an elevator apparatus comprising: a hoistway; a driving machine having a driving sheave; a main rope wound around the driving sheave and having a main rope body and a covering member made of resin, the covering member covering an outer periphery of the main rope body; and a car suspended in the hoistway by the main rope and raised and lowered by the driving machine; the elevator apparatus further comprising a brake device for braking the car by directly gripping the main rope.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011]

Fig. 1 is a side view showing an elevator apparatus according to a first 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 cross-sectional view of the main rope in Fig. 1;

Fig. 4 is a cross-sectional view of an essential portion of the driving sheave in Fig. 1;

Fig. 5 is a structural view showing an elevator apparatus according to a second embodiment of the present invention; and

Fig. 6 is a structural view showing an elevator apparatus according to a third embodiment of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0012] Preferred embodiments of the present invention will be described below with reference to the accompanying drawings.

First Embodiment

[0013] Fig. 1 is a side view showing an elevator apparatus according to a first embodiment of the present invention, and Fig. 2 is a cross-sectional view taken along the line II-II in Fig. 1. In the figures, a pair of car guide rails 2 and a pair of counterweight guide rails 3 are installed in a hoistway 1.

[0014] The guide rails 2 and 3 are fixed through a plurality of rail brackets 5 to building side fittings 4 fixed to a building. The rail brackets 5 are fixed to the building side fittings 4 by a non-welding process using a plurality of bolts 6 as a fastening device. The guide rails 2 and 3 are fastened to the rail brackets 5 by a plurality of rail clips (not shown).

[0015] A deflector sheave 7 and a driving machine (hoisting machine) 8 are disposed at an upper portion of the hoistway 1. The driving machine 8 has a driving machine body 9 and a driving sheave 10 rotated by the driving machine body 9. A plurality of main ropes 11 are wound around the driving sheave 10 and the deflector sheave 7.

[0016] A car 12 is suspended at one end portion of the main ropes 11. A counterweight 13 is suspended at the other end portion of the main ropes 11. The car 12 is guided by the car guide rails 2 to be raised and lowered in the hoistway 1. The counterweight 13 is guided by the counterweight guide rails 3 to be raised and lowered in the hoistway 1.

[0017] A plurality of car guide shoes 14 and a plurality of counterweight guide shoes 15 as non-lubricated type guiding devices which engage with the guide rails 2 and

3 are attached to the car 12 and the counterweight 13. The guide shoes 14 and 15 are sliding guide shoes which are predominantly composed of wax or polyethylene and do not need to be supplied oil.

[0018] A car side buffer 16 buffering the shock of an impact by the car 12 and a counterweight side buffer 17 buffering the shock of an impact by the counterweight 13 are installed at a bottom portion (pit) 1a of the hoistway 1. These buffers 16 and 17 are oil buffers. The buffers 16 and 17 are surrounded by flexible covers 18 and 19 to prevent dispersion of oil in the oil buffers 16 and 17 to the surrounding area.

[0019] Fig. 3 is a cross-sectional view of the main rope 11 in Fig. 1. The main rope 11 has a rope body 21 composed of high strength synthetic fibers, a plurality of conductive members 22 disposed into a spiral on the outer periphery of the rope body 21, and a covering member 23 covering the outer periphery of the rope body 21 and the conductive members 22. The rope body 21 is constructed by twisting a plurality of strands 24 composed of aramid fibers and an impregnating agent such as polyurethane or the like around each other.

[0020] Further, the conductive members 22 are composed of, for example, carbon fibers, iron or copper. More, the covering member 23 is composed of, for example, polyurethane, polyethylene or the like.

[0021] Fig. 4 is a cross-sectional view of an essential portion of the driving sheave 10 in Fig. 1. In the figure, the driving sheave 10 has a sheave body 25 made of metal at the outer peripheral surface of which grooves 25a are formed, rope receiving members 26 provided along the inner surfaces of the grooves 25a, and groove entrance members 27 provided at the edge portions of the opening portions of the grooves 25a. The main ropes 11 are inserted in the grooves 25a. The rope receiving members 26 are made of a material with a higher frictional coefficient than the sheave body 25. The groove entrance members 27 are made of a material with a lower frictional coefficient than the rope receiving members 26. Further, in this embodiment, the rope receiving members 26 are made of the same material as the covering member 23.

[0022] In such an elevator apparatus, since the rope receiving members 26 having a high frictional coefficient are provided in the grooves 25a of the driving sheave 10, the transmission efficiency of the driving force between the driving sheave 10 and the main ropes 11 can be improved. Further, since the rope receiving members 26 are made of the same material as the covering member 23, the frictional force between the driving sheave 10 and the main ropes 11 can be improved effectively. Furthermore, since the groove entrance members 27 made of low frictional coefficient material are disposed at the edge portions of the opening portions of the grooves 25a, the friction when the main ropes 11 are inserted in and moved out from the grooves 25a is reduced, thereby preventing damage to the main ropes 11 and prolonging the life of the main ropes 11.

[0023] Moreover, since roller guide shoes which need to be supplied oil are not used, and the non-lubricated and sliding type guide shoes 14 and 15 are used as the guiding devices, the surfaces of the main ropes 11 are prevented from being stained by oil, thereby maintaining the transmission efficiency of the driving force between the driving sheave 10 and the main ropes 11.

[0024] Further, the buffers 16 and 17 are surrounded by covers 18 and 19, so dispersion of oil in the buffers 16 and 17 to the surrounding area is prevented, to also prevent the surfaces of the main ropes 11 from being stained by oil, thereby maintaining the transmission efficiency of the driving force between the driving sheave 10 and the main ropes 11.

[0025] Furthermore, the rail brackets 5 are fixed in the hoistway 1 by a non-welding process using the bolts 6, so the main ropes 11 are prevented from being damaged by sparks generated during welding, thereby maintaining the transmission efficiency of the driving force between the driving sheave 10 and the main ropes 11.

Second Embodiment

[0026] Next, Fig. 5 is a structural view showing an elevator apparatus according to a second embodiment of the present invention. In the figure, a machine base 32 is installed at an upper portion of the hoistway 31. A driving machine 33 and a deflector sheave 34 are mounted to the machine base 32. The driving machine 33 has a driving sheave 35. A main rope 36 is wound around the driving sheave 35 and the deflector sheave 34. The cross sectional structure of the main rope 36 is the same as in Fig. 3, and the conductive members 22 are provided inside the covering member 23. Further, the surface portion of the driving sheave 35 contacting the main rope 36 is composed of conductive material.

[0027] A car 37 and a counterweight 38 are suspended in the hoistway 1 by the main rope 36. A detecting apparatus 39 is installed on the machine base 32. The detecting apparatus 39 is electrically connected to the surface portion of the driving sheave 35 and the conductive members 22 through wires 40, so any damage to the covering member 23 is detected by electrical continuity between the surface portion of the driving sheave 35 and the conductive members 22.

[0028] In such an elevator apparatus, if damage of the covering member 23 is detected by the detecting apparatus 39, the car 37 is moved to the nearest floor and stopped, where the operation of the elevator is halted. Thereafter, maintenance and replacement of the main rope 36 are performed. Accordingly, the transmission efficiency of the driving force between the driving sheave 35 and the main rope 36 can be maintained.

Third Embodiment

[0029] Next, Fig. 6 is a structural view showing an elevator apparatus according to a third embodiment of the

present invention. In the figure, a driving machine 42 and a deflector sheave 43 are disposed at an upper portion of a hoistway 41. The driving machine 42 has a driving sheave 44. A main rope 45 is wound around the driving sheave 44 and the deflector sheave 43. The cross sectional structure of the main rope 45 is the same as in Fig. 3, and its surface is covered by the covering member 23 made of high frictional coefficient material.

[0030] A car 46 is suspended at one end portion of the main rope 45. A counterweight 47 is suspended at the other end portion of the main rope 45. A brake device 48 for braking the car 46 by directly gripping the main rope 45 is disposed at the upper portion of the hoistway 41.

[0031] Although, lining material having a frictional coefficient of about 0.3 are used in brake devices of conventional elevators, since the covering member 23 made of polyurethane, polyethylene or the like has a frictional coefficient of about 0.4 to 0.6, a reduction in brake device size is possible by using the brake device 48 which directly grips the main rope 45.

Claims

1. An elevator apparatus comprising:

a hoistway;
a driving machine having a driving sheave;
a main rope wound around said driving sheave and having a main rope body and a covering member made of resin, said covering member covering an outer periphery of said main rope body; and
a car suspended in said hoistway by said main rope and raised and lowered by said driving machine;

wherein said driving sheave has a sheave body and a rope receiving member made of a material with a higher frictional coefficient than said sheave body, said sheave body having a groove in which said main rope is inserted formed at an outer peripheral surface thereof, and said rope receiving member is provided along an inner surface of said groove.

2. An elevator apparatus as defined in claim 1, wherein said rope receiving member is made of the same material as said covering member.

3. An elevator apparatus as defined in claim 1, wherein a groove entrance member made of a material with a lower frictional coefficient than said rope receiving member is provided at an edge portion of an opening portion of said groove.

4. An elevator apparatus comprising:

a hoistway;
 a guide rail provided in said hoistway;
 a driving machine having a driving sheave;
 a main rope wound around said driving sheave
 and having a main rope body and a covering
 member made of resin, said covering member
 covering an outer periphery of said main rope
 body; and
 a car suspended in said hoistway by said main
 rope and raised and lowered along said guide
 rail by said driving machine;

wherein a non-lubricated type guiding device
 engaging with said guide rail is attached to said car.

5. An elevator apparatus comprising:

a hoistway;
 a driving machine having a driving sheave;
 a main rope wound around said driving sheave
 and having a main rope body and a covering
 member made of resin, said covering member
 covering an outer periphery of said main rope
 body;
 a car suspended in said hoistway by said main
 rope and raised and lowered by said driving
 machine; and
 an oil buffer for buffering an impact of said car,
 provided at a bottom portion of said hoistway;

wherein said oil buffer is surrounded by a flex-
 ible cover for preventing dispersion of oil in said oil
 buffer to the surrounding area.

6. An elevator apparatus comprising:

a hoistway;
 a guide rail provided in said hoistway;
 a rail bracket for fixing said guide rail to said
 hoistway; a driving machine having a driving
 sheave;
 a main rope wound around said driving sheave
 and having a main rope body and a covering
 member made of resin, said covering member
 covering an outer periphery of said main rope
 body; and
 a car suspended in said hoistway by said main
 rope and raised and lowered along said guide
 rail by said driving machine;

wherein said rail bracket is fixed in said hoist-
 way by a non-welding process using a fastening de-
 vice.

7. An elevator apparatus comprising:

a hoistway;
 a driving machine having a driving sheave;

a main rope wound around said driving sheave,
 a surface of said main rope being covered by a
 covering member made of resin; and
 a car suspended in said hoistway by said main
 rope and raised and lowered by said driving
 machine;

wherein a surface portion of said driving
 sheave contacting said main rope is composed of
 conductive material;

a conductive member is provided inside of said
 covering member; and
 a detecting apparatus is connected to said sur-
 face portion and said conductive member, for
 detecting damage to said covering member
 when said surface portion becomes electrically
 conductive with said conductive member.

8. An elevator apparatus comprising:

a hoistway;
 a driving machine having a driving sheave;
 a main rope wound around said driving sheave
 and having a main rope body and a covering
 member made of resin, said covering member
 covering an outer periphery of said main rope
 body; and
 a car suspended in said hoistway by said main
 rope and raised and lowered by said driving
 machine;
 said elevator apparatus further comprising a
 brake device for braking said car by directly
 gripping said main rope.

**9. An elevator apparatus as defined in any one of
 claims 1 to 8, wherein said main rope body is com-
 posed of high strength synthetic fibers.**

FIG. 1

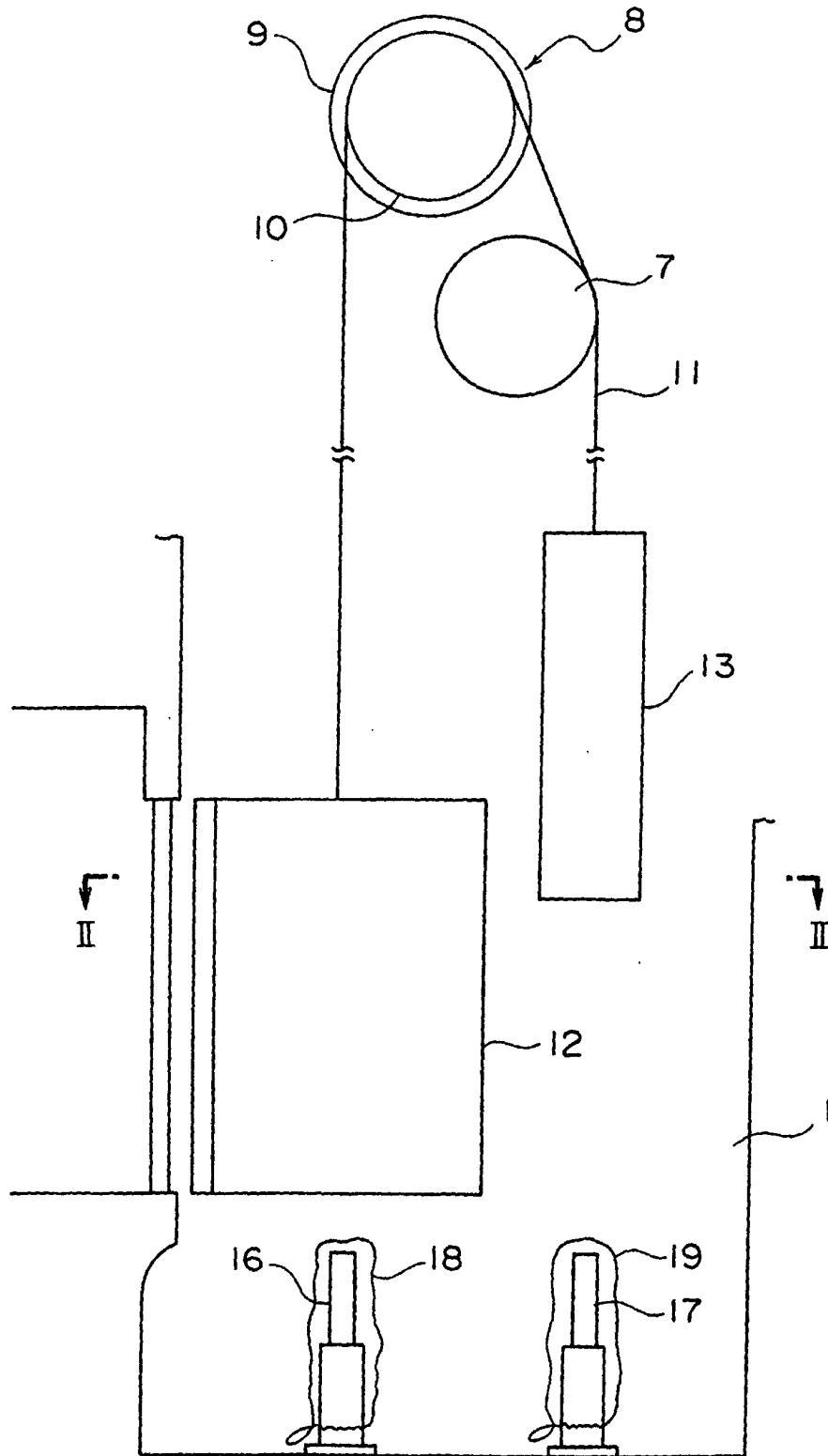


FIG. 2

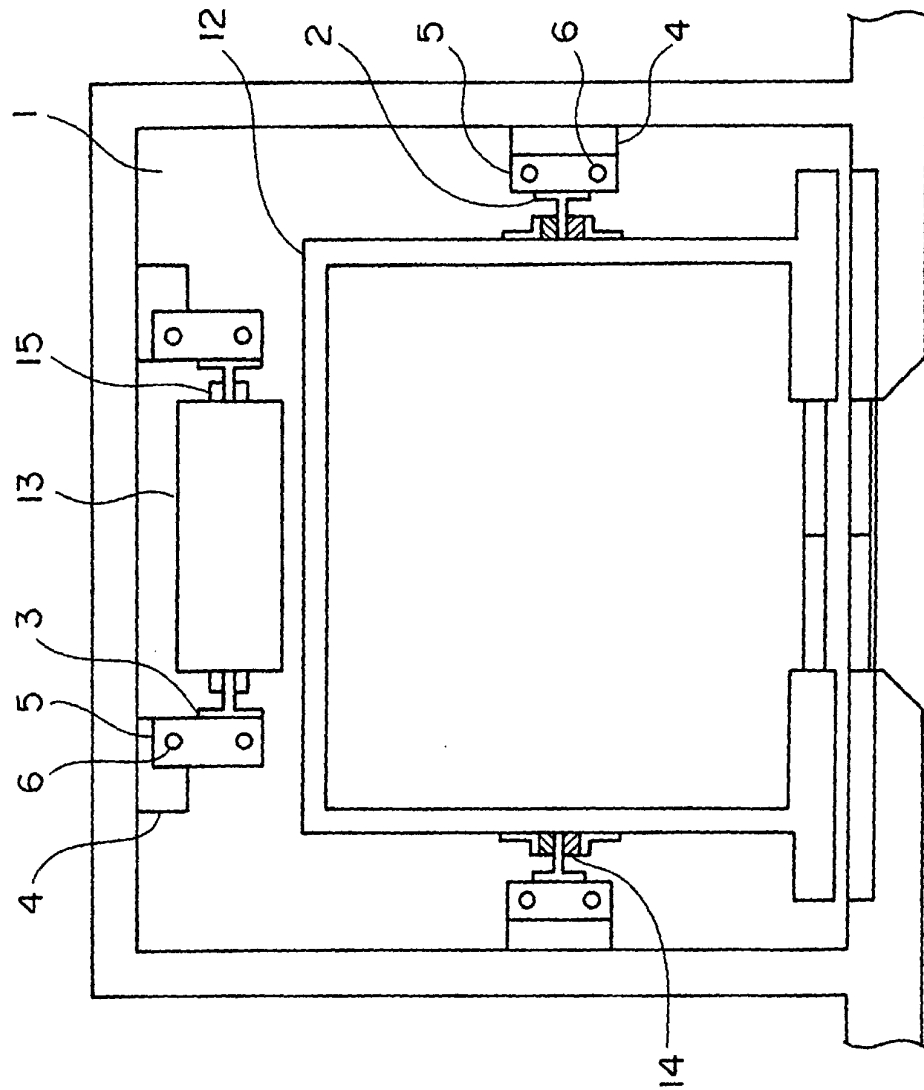


FIG. 3

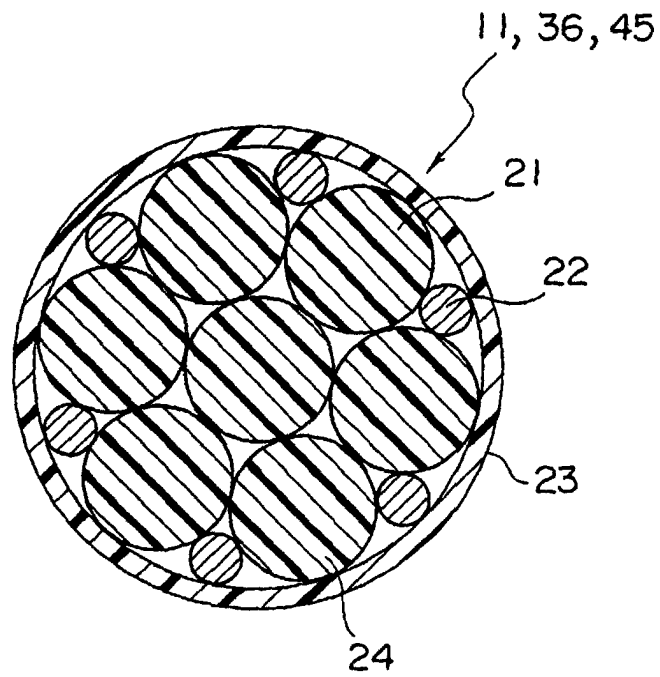


FIG. 4

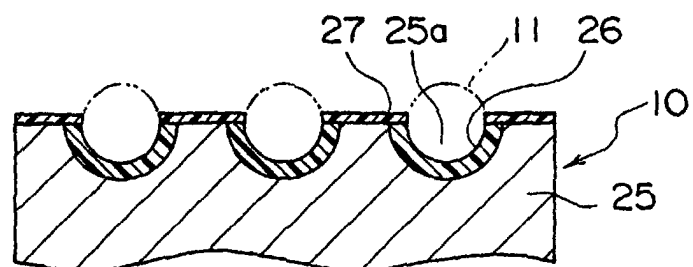


FIG. 5

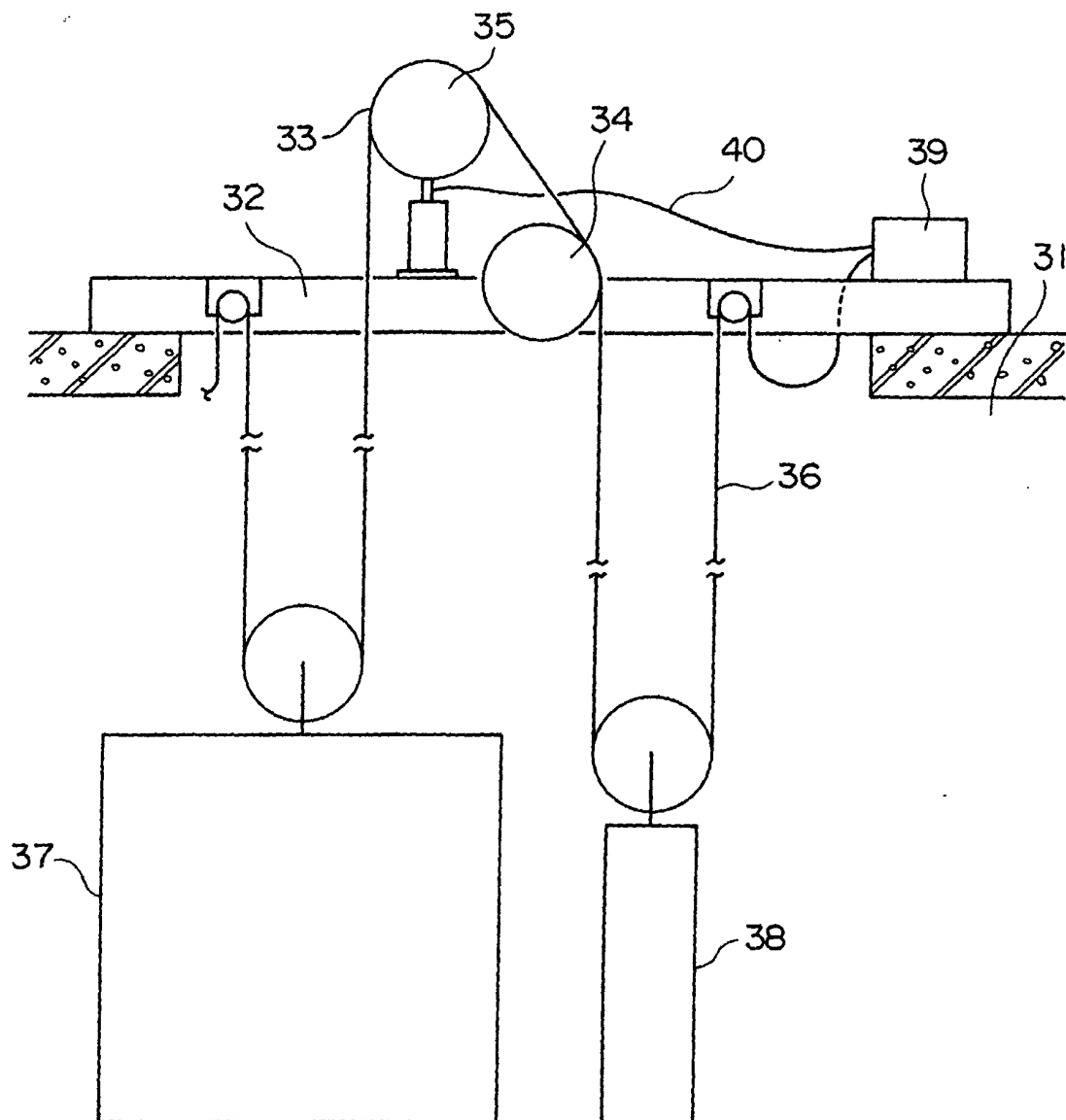
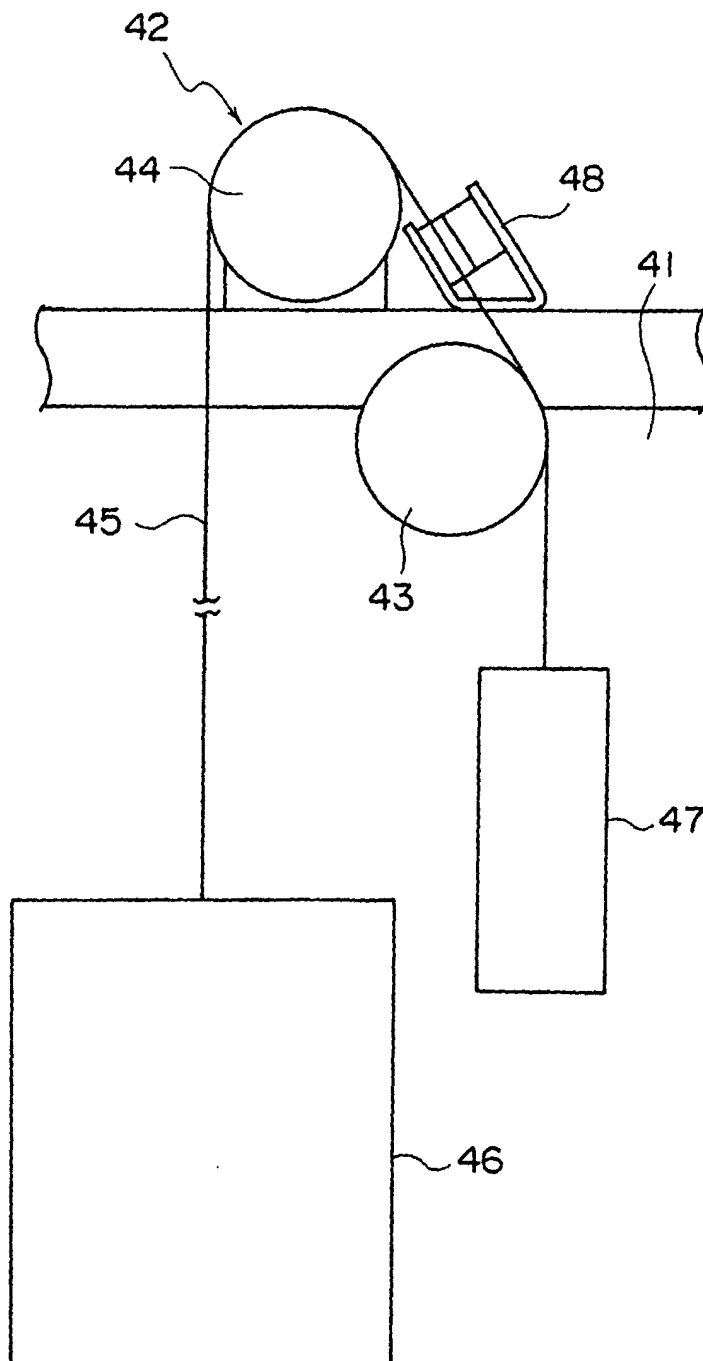


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/05335

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ B66B11/08, 7/04, 5/28, 7/02, 5/02, 7/06		
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 B66B 1/00-B66B11/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jutsiyo 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.
X	WO 98/16681 A2 (Otis Elevator Company),	1-2
Y	23 April, 1998 (23.04.98), & BR 9712302 A & CN 1233302 A & JP 2001-502385 A & US 5881843 A	3-9
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 56740/1992 (Laid-open No. 18371 /1984) (Otis Elevator Company), 08 March, 1994 (08.03.94) (Family: none)	3
Y	JP 55-151479 A (Hitachi, Ltd.), 26 November, 1980 (26.11.80) (Family: none)	4
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 109777/1990 (Laid-open No. 68082/1992) (Hitachi Elevator Service), 16 June, 1992 (16.06.92) (Family: none)	5
☒ 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 23 April, 2001 (23.04.01)		Date of mailing of the international search report 01 May, 2001 (01.05.01)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/05335

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 9-110334 A (Hitachi Building System Co., Ltd.), 28 April, 1997 (28.04.97) (Family: none)	6
Y	US 4434873 A (Mitsubishi Electric Corporation), 06 March, 1984 (06.03.84), & CA 1187220 A & JP 57-170370 A	7
Y	JP 52-109251 A (Mitsubishi Electric Corporation), 13 September, 1977 (13.09.77) (Family: none)	8
Y	US 5855254 A (Inventio AG), 05 January, 1999 (05.01.99), column 1, lines 24-33, & CN 1126171 A EP 0699618 A1 & JP 8-67455 A	9
A	US 5566786 A (Inventio AG), 22 October, 1996 (22.10.96), & AU 682743 A & AU 1353495 A & 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	1-9
A	JP 59-4589 A (Hitachi, Ltd.), 11 January, 1984 (11.01.84) (Family: none)	1
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No.48215/1985 (Laid-open No.165978/1986) 15 October, 1986 (15.10.86) (Family: none)	1
A	JP 2000-212885 A (Inventio AG), 02 August, 2000 (02.08.00), & AU 1350200 A & BR 0000139 A & CN 1262357 A & EP 1029973 A1	7

Form PCT/ISA/210 (continuation of second sheet) (July 1992)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP00/05335

Box I Observations where certain claims were found unsearchable (Continuation of item 1 of first sheet)

This international search report has not been established in respect of certain claims under Article 17(2)(a) for the following reasons:

1. ☐ Claims Nos.:
because they relate to subject matter not required to be searched by this Authority, namely:
2. ☐ Claims Nos.:
because they relate to parts of the international application that do not comply with the prescribed requirements to such an extent that no meaningful international search can be carried out, specifically:
3. ☐ Claims Nos.:
because they are dependent claims and are not drafted in accordance with the second and third sentences of Rule 6.4(a).

Box II Observations where unity of invention is lacking (Continuation of item 2 of first sheet)

This International Searching Authority found multiple inventions in this international application, as follows:

A common matter pertaining to Claims 1 to 9 is the point that a main cable comprises a resin coating material coated on the outer peripheral surface of a main cable body.

However, it is clear that this point is not novel as disclosed in the document JP, 7-267534, A (Inventio Aktiengesellschaft), Oct. 17, 1995 (17.10.95). As a result, because the above point is still at a level of a prior art, in the meaning of the second sentence of PCT rule 13.2, this common matter (above point) is not a special technical matter. Therefore, there is common matter pertaining to all the Claims.

On the other hand, a common matter pertaining to Claims 1-3 and 9 is the point that a main cable comprises a rope supporting material made of a material higher in coefficient of friction than the material of the sheave main body.

Then, in the meaning of the second sentence of PCT rule 13.2, there is no other common matter considered to be a special technical matter. Therefore, a technical relationship in the meaning of PCT rule 13 cannot be found between these inventions different from each other.

As a result, it is clear that Claims 1 to 9 do not fulfill the requirement of unity of invention, and the number of the inventions is six.

1. ☒ As all required additional search fees were timely paid by the applicant, this international search report covers all searchable claims.
2. ☐ As all searchable claims could be searched without effort justifying an additional fee, this Authority did not invite payment of any additional fee.
3. ☐ As only some of the required additional search fees were timely paid by the applicant, this international search report covers only those claims for which fees were paid, specifically claims Nos.:
4. ☐ No required additional search fees were timely paid by the applicant. Consequently, this international search report is restricted to the invention first mentioned in the claims; it is covered by claims Nos.:

Remark on Protest ☐ The additional search fees were accompanied by the applicant's protest.
☒ No protest accompanied the payment of additional search fees.

Form PCT/ISA/210 (continuation of first sheet (1)) (July 1992)