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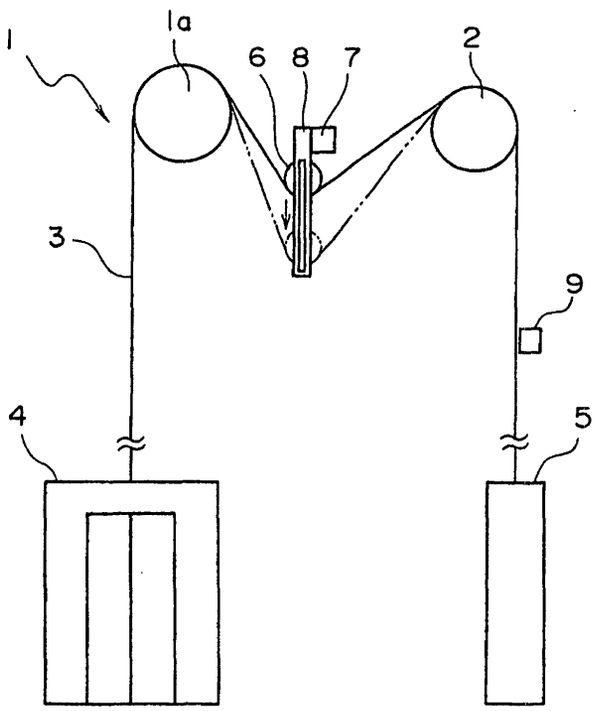
(54) MAIN ROPE ELONGATION COMPENSATING DEVICE FOR ELEVATOR

(57) In an elevator main rope elongation compensating apparatus, a rotatable adjusting sheave contacting a main rope is displaceably disposed between a drive sheave and a deflection sheave. Elongation of the main rope is absorbed by displacing the adjusting sheave to changed a length of the main rope between the drive sheave and the deflection sheave.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator main rope elongation compensating apparatus disposed in an elevator using a synthetic fiber rope for a main rope, the elevator main rope elongation compensating apparatus maintaining an appropriate positional relationship between a car and a counterweight in response to changes in the length of the main rope due to seasonal fluctuations, etc.

BACKGROUND ART

[0002] Conventionally, in elevators using a steel rope for a main rope, since the amount of elongation and contraction of the main rope due to seasonal fluctuations, etc., is minute relative to the replacement cycle of the main rope, length adjustment has been performed at an end portion of the main rope when required.

[0003] However, when using a synthetic fiber rope for the main rope, elongation due to the effects of humidity, etc., is large compared to the steel rope, requiring frequent length adjustment. Hence, it is not possible to cope adequately by adjustment at the end portion of the main rope alone.

DISCLOSURE OF THE INVENTION

[0004] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator main rope elongation compensating apparatus capable of coping adequately with changes in the length of a main rope composed of a synthetic fiber rope.

[0005] According to one aspect of the present invention, there is provided an elevator main rope elongation compensating apparatus disposed in an elevator in which a main rope for suspending a car and a counterweight is composed of a synthetic fiber rope and is wound around a drive sheave of a driving machine and a deflection sheave, including a rotatable adjusting sheave displaceably disposed between the drive sheave and the deflection sheave so as to be in contact with the main rope, a length of the main rope between the drive sheave and the deflection sheave being adjusted by displacing the rotatable adjusting sheave.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Figure 1 is a structural diagram showing an elevator having a main rope elongation compensating apparatus according to Embodiment 1 of the present invention;

Figure 2 is a perspective showing a construction of a main rope from Figure 1;

Figure 3 is a structural diagram showing an elevator having a main rope elongation compensating apparatus according to Embodiment 2 of the present invention; and

Figure 4 is a structural diagram showing an elevator having a main rope elongation compensating apparatus according to Embodiment 3 of the present invention.

BEST MODE FOR CARRYING OUT THE INVENTION

[0007] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0008] Figure 1 is a structural diagram showing an elevator having a main rope elongation compensating apparatus according to Embodiment 1 of the present invention.

[0009] In the figure, a driving machine 1 and a deflection sheave 2 are installed in an upper portion of a hoistway. A main rope 3 composed of a synthetic fiber rope is wound around a drive sheave 1a of the driving machine 1 and the deflection sheave 2. A car 4 is suspended from a first end portion of the main rope 3. A counterweight 5 is suspended from a second end portion of the main rope 3.

[0010] A rotatable adjusting sheave 6 contacting the main rope 3 is disposed between the drive sheave 1a and the deflection sheave 2. The adjusting sheave 6 is displaced by a driving force from a sheave driving machine 7 having a reduction gear so as to be guided by a guide apparatus 8 and slide linearly. A length of the main rope 3 between the drive sheave 1a and the deflection sheave 2 is changed by the displacement of the adjusting sheave 6.

[0011] Furthermore, the adjusting sheave 6 is disposed on an opposite side of the main rope 3 from the drive sheave 1a and the deflection sheave 2.

[0012] A detector apparatus 9 for detecting changes in the length of the main rope 3 is disposed in the hoistway. For example, a detector apparatus detecting the position of a marking disposed on the main rope 3, or a detector apparatus detecting the position of the counterweight 5 when the car 4 is positioned at a predetermined floor, etc., is used for the detector apparatus 9. Furthermore, the position of the marking or the counterweight 5 can be detected, for example, by means of an optical switch, or a mechanical micro switch, etc.

[0013] In Embodiment 1, the sheave driving machine 7 is driven in response to a signal from the detector apparatus 9, automatically adjusting the position of the adjusting sheave 6. The main rope elongation compensating apparatus includes the adjusting sheave 6, the sheave driving machine 7, the guide apparatus 8, and

the detector apparatus 9.

[0014] Figure 2 is a perspective showing a construction of the main rope 3 from Figure 1. In the figure, an inner strand layer 24 having a plurality of inner strands 22 and filler strands 23 disposed in gaps between these inner strands 22 is disposed around a core wire 21. Each of the inner strands 22 is composed of a plurality of aramid fibers and an impregnating material such as a polyurethane or the like. The filler strands 23 are composed of a polyamide, for example.

[0015] An outer strand layer 26 having a plurality of outer strands 25 is disposed around an outer circumference of the inner strand layer 24. Each of the outer strands 25 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 22.

[0016] A friction-reducing coating layer 27 for preventing abrasion of the strands 22 and 25 due to friction among the strands 22 and 25 is disposed between the inner strand layer 24 and the outer strand layer 26. A protective coating layer 28 is also disposed on an outer circumferential portion of the outer strand layer 26.

[0017] The synthetic fiber rope having the above construction has a high coefficient of friction compared to a steel rope and is superior in flexibility.

[0018] In a main rope elongation compensating apparatus of this kind, when expansion of the main rope 3 is detected by the detector apparatus 9, the sheave driving machine 7 is driven automatically in response to a signal from the detector apparatus 9, sliding the adjusting sheave 6 downward in Figure 1 along the guide apparatus 8. Hence, the length of the main rope 3 between the drive sheave 1a and the deflection sheave 2 is increased as indicated by the double-dotted chain lines in Figure 1, absorbing an amount equal to the elongation over the entire main rope 3. Then, when the positional relationship between the car 4 and the counterweight 5 returns to an appropriate state, movement of the adjusting sheave 6 is stopped automatically.

[0019] On the other hand, when contraction of the main rope 3 is detected, the length of the main rope 3 between the drive sheave 1a and the deflection sheave 2 is shortened by displacing the adjusting sheave 6 upward in Figure 1, letting out an amount equal to the contraction over the entire main rope 3.

[0020] Consequently, according to the above main rope elongation compensating apparatus, the positional relationship between the car 4 and the counterweight 5 is maintained in an appropriate state even if expansion or contraction arises in the main rope 3 composed of the synthetic fiber rope. Furthermore, because the adjusting sheave 6 is guided by the guide apparatus 8 so as to slide linearly, the adjusting sheave 6 can be displaced stably.

[0021] In addition, since the adjusting sheave 6 is displaced automatically by the sheave driving machine 7 when expansion or contraction of the main rope 3 is detected by the detector apparatus 9, time spent adjusting the length of the main rope 3 can be reduced significantly.

[0022] Furthermore, since the adjusting sheave 6 is disposed on the opposite side of the main rope 3 from the drive sheave 1a and the deflection sheave 2, when elongation arises in the main rope 3, the adjusting sheave 6 is displaced in a direction that increases the contact angle of the main rope 3 on the drive sheave 1a, preventing traction between the main rope 3 and the drive sheave 1a from being reduced due to the displacement of the adjusting sheave 6.

Embodiment 2

[0023] Figure 3 is a structural diagram showing an elevator having a main rope elongation compensating apparatus according to Embodiment 2 of the present invention. In the figure, the adjusting sheave 6 is mounted to a tip portion of a pivotable arm 11. The arm 11 is pivoted about a base end portion by a sheave driving machine 12. The adjusting sheave 6 is displaced by the pivoting of the arm 11. The rest of the construction is similar to that of Embodiment 1.

[0024] In a main rope elongation compensating apparatus of this kind, when expansion of the main rope 3 is detected by the detector apparatus 9, the sheave driving machine 12 is driven automatically in response to a signal from the detector apparatus 9, displacing the adjusting sheave 6 downward in Figure 3 by pivoting the arm 11 counterclockwise in Figure 3. Hence, the length of the main rope 3 between the drive sheave 1a and the deflection sheave 2 is increased as indicated by the double-dotted chain lines in Figure 3, absorbing an amount equal to the elongation over the entire main rope 3. Then, when the positional relationship between the car 4 and the counterweight 5 returns to an appropriate state, the pivoting of the arm 11 is stopped automatically.

[0025] On the other hand, when contraction of the main rope 3 is detected, the length of the main rope 3 between the drive sheave 1a and the deflection sheave 2 is shortened by displacing the adjusting sheave 6 upward in Figure 3 by pivoting the arm 11 clockwise in Figure 3, thereby letting out an amount equal to the contraction over the entire main rope 3.

[0026] Consequently, according to the above main rope elongation compensating apparatus, the positional relationship between the car 4 and the counterweight 5 is maintained in an appropriate state even if expansion or contraction arises in the main rope 3 composed of the synthetic fiber rope.

[0027] Moreover, in Embodiments 1 and 2, the adjusting sheave 6 is displaced automatically but may be displaced manually, for example, using a ball screw or the like.

[0028] Furthermore, in addition to expansion and contraction of the main rope 3 due to seasonal fluctuations, when further elongation of the main rope 3, due to age-related elongation of the main rope 3, etc., is detected

despite the adjusting sheave 6 being displaced to a maximum, a control room, etc., may also be alerted and a maintenance inspection operation performed by maintenance personnel.

[0029] In addition, in Embodiments 1 and 2, the adjusting sheave 6 is disposed on the opposite side of the main rope 3 from the drive sheave 1a and the deflection sheave 2, but the adjusting sheave 6 may also be disposed on the same side of the main rope 3 as the drive sheave 1a and the deflection sheave 2.

Embodiment 3

[0030] Now, if the traction between the drive sheave 1a and the main rope 3 is too large, there is a possibility that, due to a malfunction, the main rope 3 might not slip on the drive sheave 1a and the car 4 may be hoisted even after the counterweight 5 has collided with a buffer (not shown) on a hoistway bottom portion.

[0031] In order to prevent situations of this kind, it is necessary to suppress the traction between the drive sheave 1a and the main rope 3 to equal to or less than a tolerance value. For that reason, it is undesirable for the contact angle of the main rope 3 on the drive sheave 1a to be increased by displacement of the adjusting sheave 6 if the traction is already close to the tolerance value when the adjusting sheave 6 is at an initial position.

[0032] Consequently, in such cases, it is suitable to dispose the adjusting sheave 6 on the same side of the main rope 3 as the drive sheave 1a and the deflection sheave 2, as shown in Figure 4, for example. According to this construction, since the traction is decreased when the adjusting sheave 6 is displaced upward in the figure, it will not exceed the tolerance value.

[0033] In this case, it goes without saying that a minimum required traction is ensured even when the adjusting sheave 6 is displaced to a maximum.

Claims

1. An elevator main rope elongation compensating apparatus disposed in an elevator in which a main rope for suspending a car and a counterweight is composed of a synthetic fiber rope and is wound around a drive sheave of a driving machine and a deflection sheave,

   said elevator main rope elongation compensating apparatus comprising a rotatable adjusting sheave displaceably disposed between said drive sheave and said deflection sheave so as to be in contact with said main rope, a length of said main rope between said drive sheave and said deflection sheave being adjusted by displacing said rotatable adjusting sheave.

2. The elevator main rope elongation compensating apparatus according to Claim 1 further comprising:

   a guide apparatus for guiding linear displacement of said adjusting sheave; and
   a sheave driving machine for sliding said adjusting sheave along said guide apparatus.

3. The elevator main rope elongation compensating apparatus according to Claim 1 further comprising:

   a pivotable arm mounted with said adjusting sheave; and
   a sheave driving machine for displacing said adjusting sheave by pivoting said arm.

4. The elevator main rope elongation compensating apparatus according to Claim 1 further comprising a detector apparatus for detecting changes in a length of said main rope, said adjusting sheave being displaced automatically in response to information from said detector apparatus.

5. The elevator main rope elongation compensating apparatus according to Claim 1 wherein said adjusting sheave is disposed on an opposite side of said main rope from said drive sheave and said deflection sheave.

6. The elevator main rope elongation compensating apparatus according to Claim 1 wherein said adjusting sheave is disposed on a like side of said main rope as said drive sheave and said deflection sheave.

Amended claims under Art. 19.1 PCT

1. An elevator main rope elongation compensating apparatus disposed in an elevator in which a main rope (3) for suspending a car (4) and a counterweight (5) is composed of a synthetic fiber rope and is wound around a drive sheave (1a) of a driving machine (1) and a deflection sheave (2),

characterized by comprising a rotatable adjusting sheave (6) displaceably disposed between said drive sheave (1a) and said deflection sheave (2) so as to be in contact with said main rope (3), a length of said main rope (3) between said drive sheave (1a) and said deflection sheave (2) being adjusted by displacing said rotatable adjusting sheave (6).

2. The elevator main rope elongation compensating apparatus according to claim 1 further comprising:

a guide apparatus (8) for guiding linear displacement of said adjusting sheave (6); and
a sheave driving machine (7) for sliding said ad-

justing sheave (6) along said guide apparatus (8).

3. The elevator main rope elongation compensating apparatus according to claim 1 further comprising:

a pivotable arm (11) mounted with said adjusting sheave (6); and
a sheave driving machine (12) for displacing said adjusting sheave (6) by pivoting said arm (11).

4. The elevator main rope elongation compensating apparatus according to any one of claims 1 to 3 further comprising a detector apparatus (9) for detecting changes in a length of said main rope (3), said adjusting sheave (6) being displaced automatically in response to information from said detector apparatus (9).

5. The elevator main rope elongation compensating apparatus according to any one of claims 1 to 4 wherein said adjusting sheave (6) is disposed on an opposite side of said main rope (3) from said drive sheave (1a) and said deflection sheave (2).

6. The elevator main rope elongation compensating apparatus according to any one of claims 1 to 4 wherein said adjusting sheave (6) is disposed on a like side of said main rope (3) as said drive sheave (1a) and said deflection sheave (2).

FIG. 1

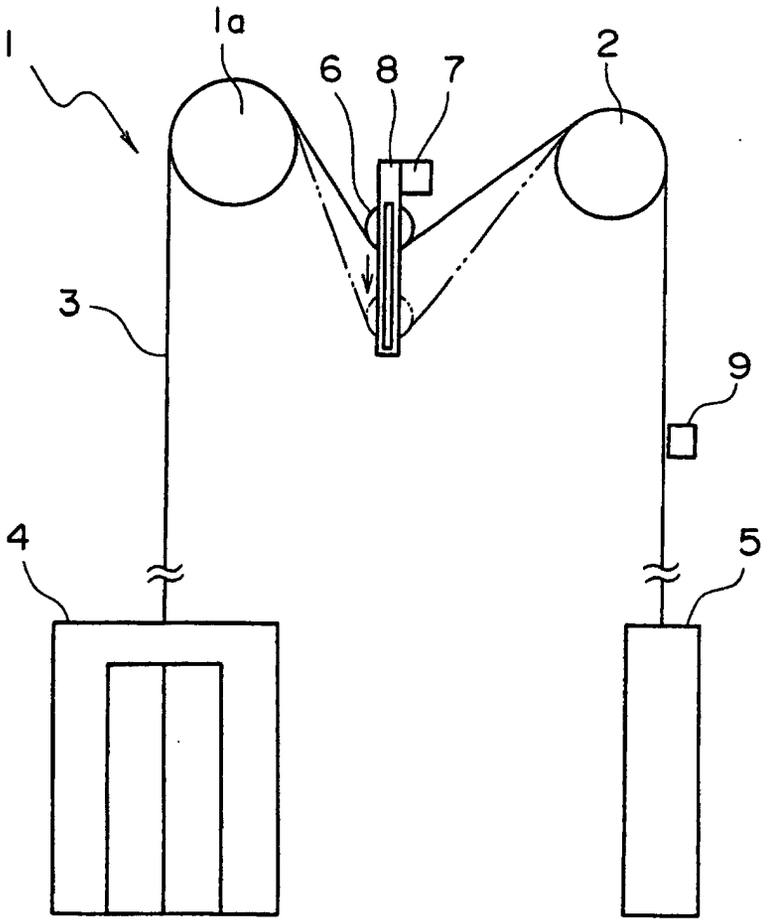


FIG. 2

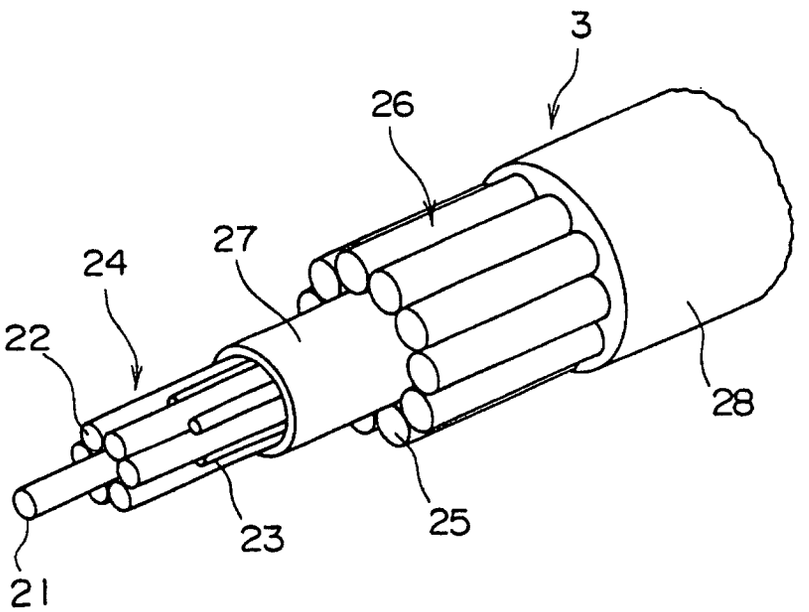


FIG. 3

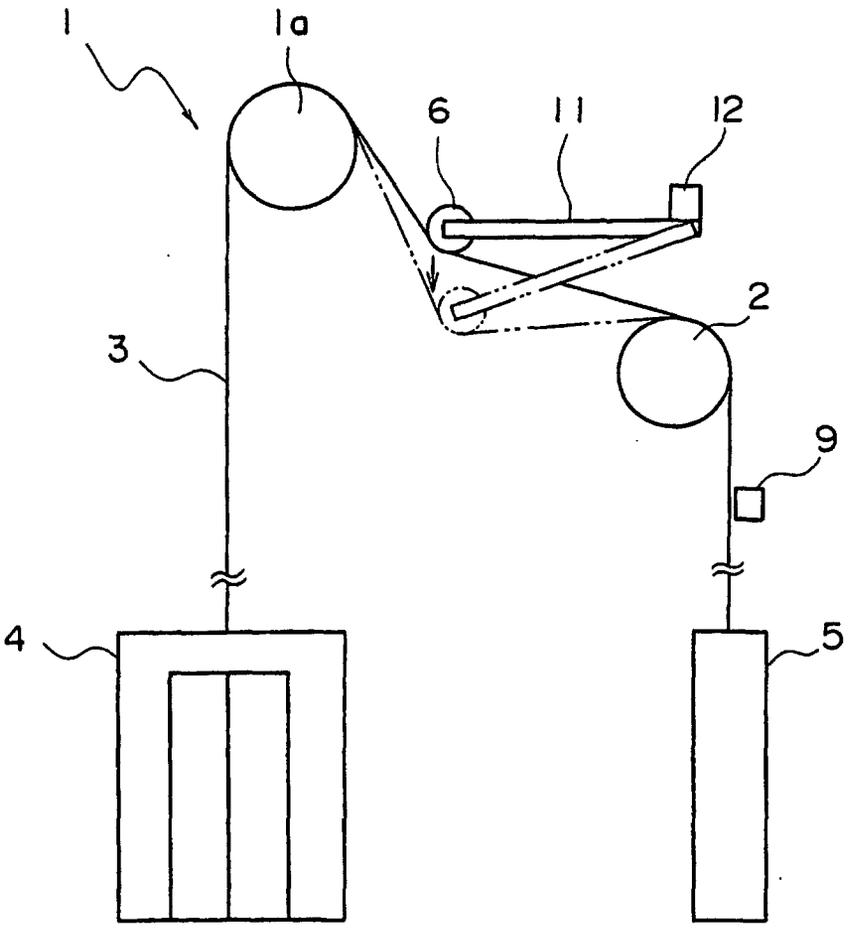
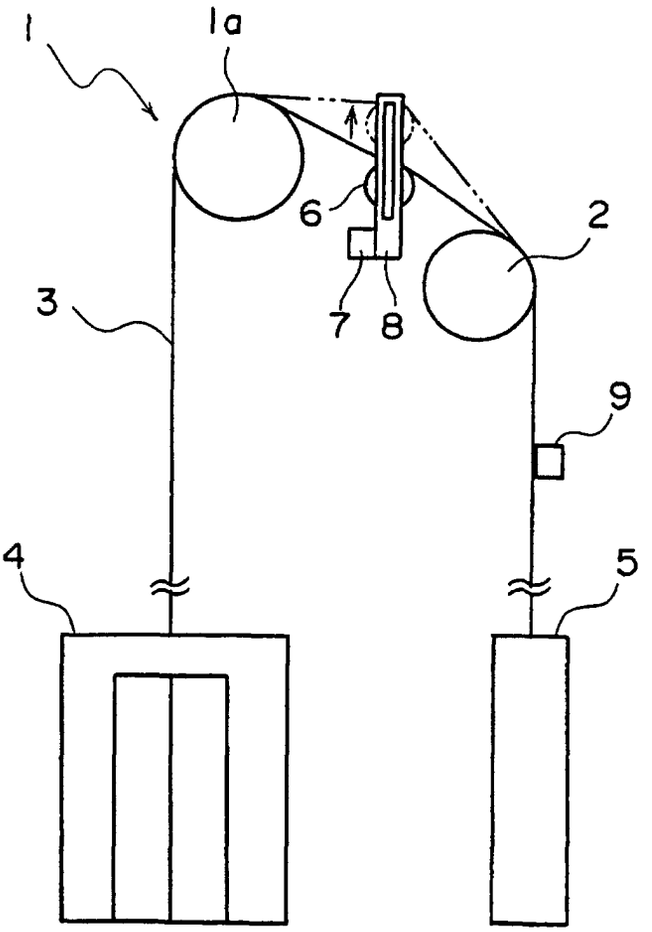


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/07847

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B 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 1/00-19/06

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 1996-2001
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	JP 2000-118914 A (Hitachi Building Systems Co., Ltd.), 25 April, 2000 (25.04.00) (Family: none)	1-2,4-5
Y	JP 8-59106 A (Mitsubishi Denki Bill Techno Service K.K.), 05 March, 1996 (05.03.96) (Family: none)	1,3,5
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 23880/1974 (Laid-open No. 114862/1975), (Tokyo Shibaura Denki K.K.), 19 September, 1975 (19.09.75), description, page 5, lines 2 to 12; Fig. 3 (Family: none)	1,6

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

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Date of the actual completion of the international search	Date of mailing of the international search report
05 July, 2001 (05.07.01)	17 July, 2001 (17.07.01)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP00/07847

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	US 5566786 A (Inventio AG), 22 October, 1996 (22.10.96), & AU 682743 A & AU 1353495 A & BR 9500779 A & CA 2142072 A & CH 690010 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 & ZA 9501692 A	1-6

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