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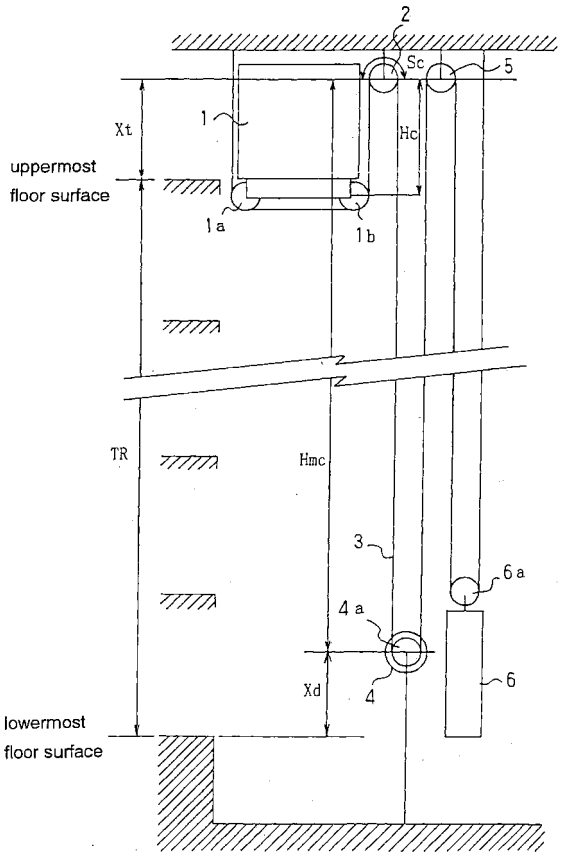
(54) Elevator apparatus

(57) A known traction type elevator apparatus, in which a hoist gear is arranged in a pit portion below a hoist way, is defective in that when water comes into the hoist way, the hoist gear is submerged in water and hence it becomes necessary to replace the submerged hoist gear with a new one. Otherwise, in order to make it possible to reuse the submerged hoist gear, it is required to provide a completely water-proof type hoist gear in advance, thus giving rise to a problem of increased production costs. In addition, if the hoist gear is arranged at too high a location, there would arise another problem in that the life time of the rope is shortened. The present invention is intended to obviate the problems as referred to above, and the life time of the hoist rope is ensured by arranging the hoist gear in the hoist way at a location above a surface of the lowermost floor in such a manner that the rope wrapped around a traction sheave of the hoist gear does not reach two or more return wheels arranged on a cage side and a weight side of the traction sheave.

FIG. 1



EP 1 911 714 A1

Description

TECHNICAL FIELD

[0001] The present invention relates to a traction type elevator apparatus, and more specifically, it relates to such a traction type elevator apparatus capable of improving the life time of a rope.

BACKGROUND ART

[0002] Fig. 4 is a longitudinal cross sectional view showing the construction of a known elevator apparatus of the traction type. In Fig. 4, the known traction type elevator apparatus includes a cage 1, sheaves 1 a and 1b (not shown) (hereinafter referred to as lower cage guide wheels) rotatably mounted on the cage 1, a cage side top sheave 2 (hereinafter referred to as a cage side return wheel), a rope 3, a hoist gear 4, a traction sheave 4a, a weight side top sheave 5 (hereinafter referred to as a weight side return wheel), a weight 6, and a weight hanger wheel 6a rotatably mounted on the weight 6.

[0003] The known traction type elevator apparatus in which the hoist gear 4 is arranged in a pit portion below a hoist way, as shown in Fig. 4, is defective in that when water comes into the hoist way, the hoist gear 4 is submerged in water and hence it becomes necessary to replace the submerged hoist gear 4 with a new one. Otherwise, in order to make it possible to reuse the submerged hoist gear 4, it is required to provide a completely water-proof type hoist gear in advance, thus giving rise to a problem of increased production costs. In addition, if the hoist gear 4 is arranged at too high a location, there would arise another problem in that the life time of the rope 3 is shortened.

[0004] Fig. 5 is a longitudinal cross sectional view illustrating the construction of another known traction type elevator apparatus with a weight falling in a lateral direction. In Fig. 5, this known traction type elevator apparatus with a laterally falling weight includes a cage 1, lower cage guide wheels 1a and 1b (not shown), a rope 3, a hoist gear 4, a traction sheave 4a, a weight 6, and a weight hanger wheel 6a. The hoist gear 4 is arranged at an upper portion of a hoist way without using return wheels, so the rope 3 wrapped around the traction sheave 4a is caused to move to the lower cage guide wheel 1 a and the lower cage guide wheel 1b (not shown) in accordance with the traveling of the cage 4. As a result, there is a problem that the life time of the rope 3 is extremely impaired.

[0005] Fig. 6 is a longitudinal cross sectional view illustrating the construction of a further known traction type elevator apparatus with a weight falling on a back side. In Fig. 6, this known traction type elevator apparatus with a backwardly falling weight includes a cage 1, lower cage guide wheels 1a and 1b (not shown), a cage side return wheel 2, a rope 3, a hoist gear 4, a traction sheave 4a, a return wheel 5, a weight 6, and a weight hanger wheel 6a. The hoist gear 4 is arranged at an upper portion of a hoist way, and the return wheel 5 is arranged below the hoist gear 4 in the very close vicinity thereof with the rope 3 being wrapped around them. With this arrangement, a portion of the rope 3 which is wrapped around the traction sheave 4a of the hoist gear 4 reaches the return wheel 5, the cage side return wheel 2, the lower cage guide wheel 1 a and the lower cage guide wheel 1b (not shown) in accordance with the traveling of the cage 4. As a result, there is a problem that the life time of the rope 3 is extremely impaired.

DISCLOSURE OF THE INVENTION

[0006] The present invention is intended to obviate the problems as referred to above, and an object of the present invention is to ensure the life time of a hoist rope by arranging a hoist gear in a hoist way at a location above a surface of the lowermost or bottom floor in such a manner that a rope wrapped around a traction sheave of the hoist gear does not reach two or more return wheels arranged on a cage side and a weight side of the traction sheave.

[0007] In order to achieve this object, an arrangement of the present invention is made to meet the following relation:

$$TR \leqq Hc + Sc + Hmc$$

where TR represents the length of the vertical stroke of an elevator; Hc represents the distance from a cage side top sheave to a cage mounting sheave when a cage is at the uppermost or top floor; Sc represents the length of a rope wrapping portion of the cage side top sheave; and Hmc represents the distance from the cage side top sheave to a hoist sheave.

[0008] In addition, another arrangement of the present invention may be made to establish the following relation:

$$TR \leqq Ho + So + Hmo$$

where TR represents the length of the vertical stroke of an elevator; Ho represents the distance from a weight side top sheave to a weight hanger wheel when a cage is at the lowermost or bottom floor; So represents the length of a rope wrapping portion of the weight side top sheave; and Hmo represents the distance from the weight side top sheave to a hoist sheave.

[0009] Moreover, the hoist sheave is arranged at a location above a surface of the lowermost floor, and said cage side top sheave is arranged at a location below a cage ceiling when said cage is at the uppermost floor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 is a longitudinal cross sectional view showing the construction of a traction type elevator apparatus according to a first embodiment of the present invention, in which there is illustrated a state of a cage 1 lying at the top floor.
Fig. 2 is a longitudinal cross sectional view showing the construction of the traction type elevator apparatus according to the first embodiment of the present invention, in which there is illustrated a state of the cage 1 lying at the bottom floor.
Fig. 3 is a longitudinal cross sectional view showing the construction of a traction type elevator apparatus according to a second embodiment of the present invention.
Fig. 4 is a longitudinal cross sectional view showing the construction of a known traction type elevator apparatus.
Fig. 5 is a longitudinal cross sectional view showing the construction of another known traction type elevator apparatus with a weight falling in a lateral direction.
Fig. 6 is a longitudinal cross sectional view showing the construction of a further known traction type elevator apparatus with a weight falling on the back side.

THE BEST MODE FOR IMPLEMENTING THE INVENTION

[0011] In the following, the present invention will be described in detail while referring to the accompanying drawings.

Embodiment 1.

[0012] A traction type elevator apparatus according to a first embodiment of the present invention will be described using Fig. 1. As shown in Fig. 1, the traction type elevator apparatus according to the present invention includes a cage 1, lower cage guide wheels 1 a and 1b (not shown), a cage side return wheel 2, a rope 3, a hoist gear 4, a traction sheave 4a, a weight side return wheel 5, a weight 6, and a weight hanger wheel 6a.

[0013] The hoist gear 4 is arranged at a location higher than the lowermost or bottom floor in a hoist way, so that if water comes into the hoist way, the water overflowing from a pit portion spreads into the outside from the bottom floor surface, thereby preventing the hoist gear 4 from being submerged in water.

[0014] The cage 1 is hung by the rope 3 which is wrapped around the guide wheels 1 a, 1 b and the cage side return wheel 2 arranged at the top of the hoist way. Further, the rope 3 extends from the hoist gear 4 arranged at a location higher than the lowermost floor surface so as to be wrapped around the hanger wheel 6a for the weight 6 through the weight side return wheel 5 arranged at the top of the hoist way.

[0015] In such a roping arrangement, it is known that the life time of the rope 3 depends on the number of bends caused by the respective return wheels and the shape of a rope groove formed in each return wheel. In general, a rope groove formed in the traction sheave 4a of the hoist gear 4 adopts a V shape or an under-cut shape so as to increase friction forces, and hence tends to shorten the life time of the rope 3 to from 1/2 to 1/3 times that of a rounded groove provided on the other return wheels.

[0016] In addition, bending greatly influences the rope 3 so that the rope 3 is alternately bent in opposite directions whenever it passes through each return wheel. Thus, the direction of bending stress is repeatedly reversed, thereby causing fatigue in the rope 3 and hence shortening the life time thereof. Accordingly, it is preferable to arrange the rope 3 in such a manner that the portion of the rope 3 which is wrapped around the traction sheave 4a is not applied to the other return wheels unnecessarily. Such an arrangement serves to increase the usable life of the rope 3.

[0017] As shown in Fig. 1, the portion of the rope 3 whose life time is shortened in a state of the cage 1 lying on the uppermost or top floor is a length of stroke or movement of the rope 3 caused in a direction from the traction sheave 4a to the weight side return wheel 5 in accordance with a downward motion of the cage 1. On the other hand, those portions

of the rope 3 which extend from the cage side return wheel 2 to the lower cage guide wheels 1a, 1b pass through the three sheaves but the life spans of those portions are not reduced since the three sheaves have rounded grooves.

[0018] However, if the hoist gear 4 is arranged at too high a location, the portion of the rope 3 wrapped around the traction sheave 4a passes through the cage side return wheel 2 to reach one lower cage guide wheel 1 b or further the other cage guide wheel 1 a, thereby impairing the life time thereof. Thus, in order to prevent the portion of the rope 3 wrapped around the traction sheave 4a from being applied to two or more return wheels, it is preferred that the position of the traction gear 4 be arranged or installed at a location above the lowermost floor surface in a range designated by the following expression:

$$TR \leqq Hc + Sc + Hmc$$

where TR represents the length of the vertical stroke or travel of the elevator; Hc represents the distance from the cage side return sheave 2 to the lower cage guide wheel 1b when the cage 1 is at the uppermost or top floor; Sc represents the length of a rope wrapping portion of the cage side return wheel 2; and Hmc represents the distance from the cage side return wheel 2 to the hoist gear 4.

[0019] Now, the installation range of the traction gear 4 will be calculated using concrete figures. Let us take the following figures for example. Here, note that the unit of measure is meter.

$$TR = 15,\ Hc = 2.5,\ Sc = 0.6$$

Assuming that the distance Xt from the uppermost floor surface to the cage return wheel 2 is 2 m, the height of the installation location Xd of the traction gear 4 from the lowermost floor is calculated as follows:

$$Hmc = TR + Xt - Xd$$

$$\therefore\ Hmc = TR + 2 - Xd$$

Accordingly,

$$TR \leqq Hc + Sc + TR + 2 - Xd$$

$$\therefore\ Xd \leqq 2.5 + 0.6 + 2 = 5.1$$

Thus, if the traction gear 4 is arranged at a location from the lowermost floor up to 5.1 m thereabove, the portion of the rope 3 wrapped around the traction sheave 4a of the traction gear 4 only reaches the cage side return wheel in the downward stroke of the cage, but not the lower cage guide wheel ahead thereof, thereby making it possible to improve the life time of the rope 3.

Embodiment 2.

[0020] Reference will now be made to a traction type elevator apparatus according to a second embodiment of the present invention while using Fig. 2. Fig. 2 illustrates the case in which the cage 1 is located at the lowermost floor in the traction type elevator apparatus as shown in Fig. 1.

[0021] As illustrated in Fig. 2, in a state of the cage 1 being located at the lowermost floor, the portion of the rope 3 whose life time is shortened is a length of stroke thereof extending in a direction from the traction sheave 4a to the cage return wheel, which reaches the traction sheave 4a in accordance with the upward motion of the cage 1.

[0022] The life time of the rope 3 is ensured or increased by reducing, as much as possible, the number of times that portion of the rope 3 which passes through the traction sheave 4a of the hoist gear 4 is applied to the other return wheels, and hence when considering a portion of the rope 3 which lies on the weight side from the hoist gear 4, it is preferred that the portion of the rope 3 is arranged within a range of the following expression:

$$TR \leqq Ho + So + Hmo$$

where TR represents the length of the vertical stroke of the elevator; Ho represents the distance from the weight side return wheel 5 to the weight hanger wheel 6a when the cage 1 is at the lowermost or bottom floor; So represents the length of a rope wrapping portion of the weight side return wheel 5; and Hmo represents the distance from the weight side return wheel 5 to the hoist gear 4. Now, the range of installation of the traction gear 4 will be calculated by using concrete figures, as in the first embodiment. The following figures are taken for example. In this regard, the unit of measure is meter.

$$TR = 15,\ Ho = 1,\ So = 0.6,\ Xt = 2$$

$$Hmo\ (= Hmc) = TR + Xt - Xd$$

Accordingly,

$$TR \leqq Ho + So + TR + 2 - Xd$$

$$\therefore\ Xd \leqq 1 + 0.6 + 2 = 3.6$$

Thus, if the traction gear 4 is arranged or installed at a location from the lowermost floor surface up to 3.6 m thereabove, the portion of the rope 3 wrapped around the traction sheave 4a of the traction gear 4 only reach the weight side return wheel in the upward stroke of the cage, but not the weight hanger wheel ahead thereof, thereby making it possible to improve the life time of the rope 3.

Embodiment 3.

[0023] A traction type elevator apparatus according to a third embodiment of the present invention will be described using Fig. 3. As shown in Fig. 3, the traction type elevator apparatus according to the present invention includes a cage 1, lower cage guide wheels 1a and 1b, a cage side return wheel 2, a rope 3, a hoist gear 4, a traction sheave 4a, a weight 6, a weight hanger wheel 6a, and a lower return wheel 7. In comparison with the arrangement of Fig. 2, Fig. 3 shows such an arrangement that the hoist gear 4 is arranged at the loacation of the weight side return wheel 5 in Fig. 2, and the lower return wheel 7 is arranged at the location of the hoist gear 4 in Fig, 2. There is a danger that the lower return wheel 7 would be submerged in water, but if the lower return wheel 7 is arranged at a location above the lowermost floor, as in the preceding examples, there will be no fear of submergence. Regarding the life time of the rope 3, if the following relation is satisfied,

$$TR \leqq Ho + So + Hmo,$$

it is possible to prevent the portion of the rope 3 wrapped around the traction sheave 4a of the traction gear 4 from being applied to two or more return wheels, thus making it possible to enhance the life time of the hoist rope 3. In addition, in Fig. 3, even if the hoist gear 4 and the return wheel 2 are interchanged with each other, there will be the same effects.

INDUSTRIAL APPLICABILITY

[0024] As described above, an elevator apparatus according to the present invention has a hoist gear and other return wheels arranged in consideration of the life time of a rope entrained therebetween, and hence is applicable to elevator apparatuses of the type using a hoist rope in general.

Claims

1. An elevator apparatus **characterized in that** the following relation is established:

$$TR \leqq Hc + Sc + Hmc$$

where TR represents the length of a vertical stroke of a cage (1); Hc represents the distance from a cage side top sheave (2) to said cage mounting sheave (1a or 1 b) when said cage (1) is at the uppermost floor; Sc represents the length of a rope wrapping portion of said cage side top sheave (2); and Hmc represents the distance from said cage side top sheave (2) to said hoist sheave (4a), in such a manner that a portion of a hoist rope (3) passing through said hoist sheave (4a), which is driven by a hoist gear (4) when said cage (1) is traveling between the uppermost floor and the lowermost floor, does not reach a cage mounting sheave (1 a or 1 b) rotatably mounted on said cage (1), said hoist sheave (4a) is arranged at a location above a surface of the lowermost floor, and said cage side top sheave (2) is arranged at a location below a cage ceiling when said cage (1) is at the uppermost floor.

2. An elevator apparatus **characterized in that** the following relation is established:

$$TR \leqq Ho + So + Hmo$$

where TR represents the length of a vertical stroke of a cage (1); Ho represents the distance from a weight side top sheave (5) to said weight hanger wheel (6a) when said cage (1) is at the lowermost floor; So represents the length of a rope wrapping portion of said weight side top sheave (5); and Hmo represents the distance from said weight side top sheave (5) to said hoist sheave (4a), in such a manner that a portion of a hoist rope (3) passing through said hoist sheave (4a), which is driven by a hoist gear (4) when said cage (1) is traveling between the uppermost floor and the lowermost floor, does not reach a weight hanger wheel (6a) rotatably mounted on a weight (6), said hoist sheave (4a) is arranged at a location above a surface of the lowermost floor, and said hoist sheave (4a) is arranged at a location above a lower end face of said weight (6) when said cage (1) is at the uppermost floor.

3. The elevator apparatus as set forth in claim 1, **characterized in that** said cage mounting sheave (1a or 1b) is arranged at a location below said cage (1).

4. The elevator apparatus as set forth in claims 1-3, **characterized in that** a groove formed in said hoist sheave (4a) is a V shape or an under-cut shape.

5. The elevator apparatus as set forth in claim 2, **characterized in that** the following relation is established:

$$X\,d > Ho$$

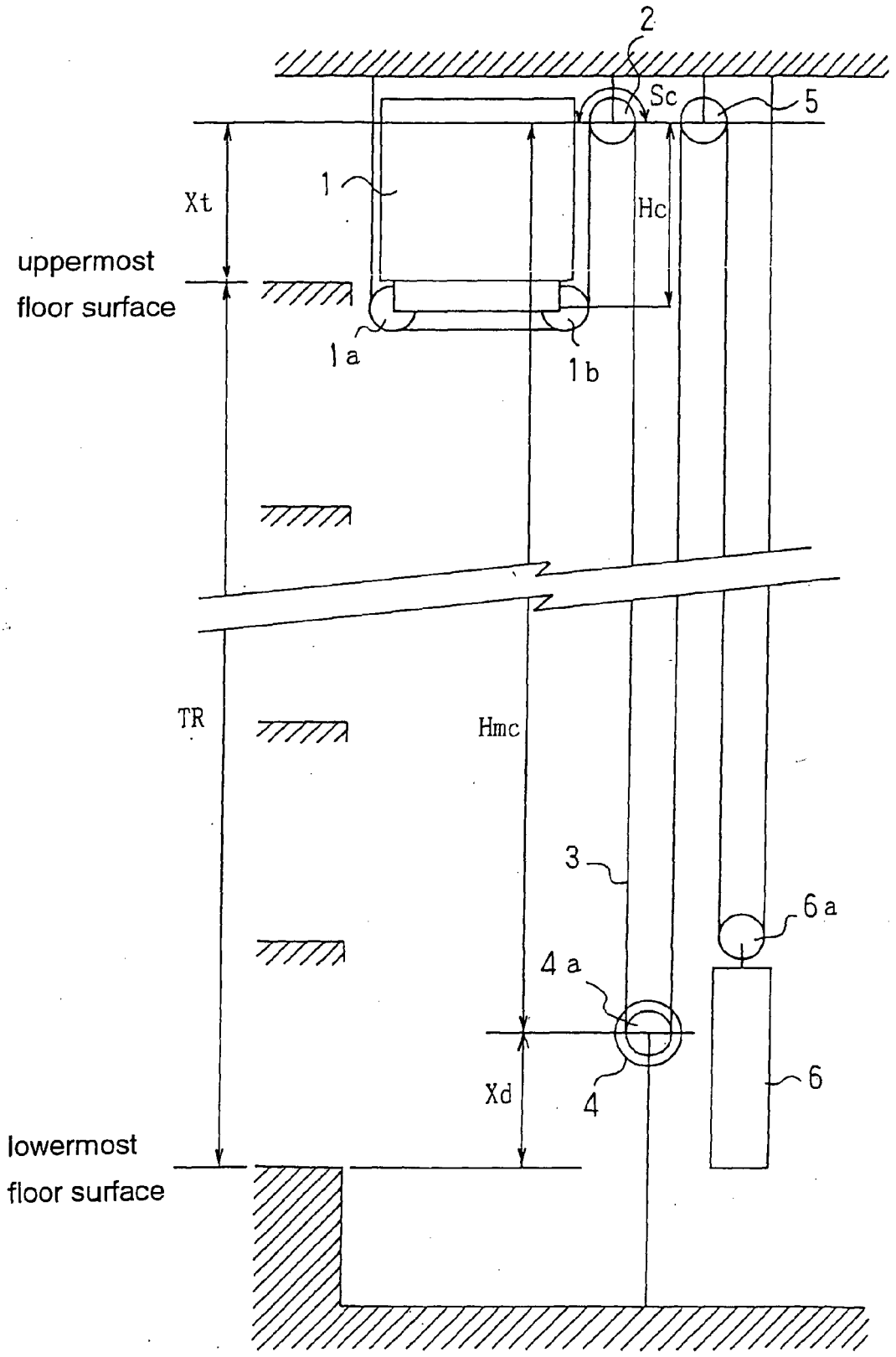
where Ho represents the distance from a weight side top sheave (5) to said weight hanger wheel (6a), and X d represents the distance from the lowermost floor surface to said hoist sheave (4a) when said cage (1) is at the uppermost floor.

6. An elevator apparatus **characterized in that** the following relation is established:

$$TR \leqq Ho + So + Hmo$$

where TR represents the length of a vertical stroke of a cage (1); Ho represents the distance from a weight side top sheave (5) to said weight hanger wheel (6a) when said cage (1) is at the lowermost floor; So represents the length of a rope wrapping portion of said weight side top sheave (5); and Hmo represents the distance from said weight side top sheave (5) to said hoist sheave (4a), in such a manner that a portion of a hoist rope (3) passing through said hoist sheave (4a), which is driven by a hoist gear (4) when said cage (1) is traveling between the uppermost floor and the lowermost floor, does not reach a weight hanger wheel (6a) rotatably mounted on a weight (6),
said hoist sheave (4a) is arranged at a location above a surface of the lowermost floor, and said cage side top sheave (2) is arranged at a location below a cage ceiling when said cage (1) is at the uppermost floor.

FIG. 1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Sc
5
1
Xt
Hc
uppermost
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1a
1b
TR
Hmc
3
6a
4a
Xd
4
6
lowermost
floor surface

FIG. 2

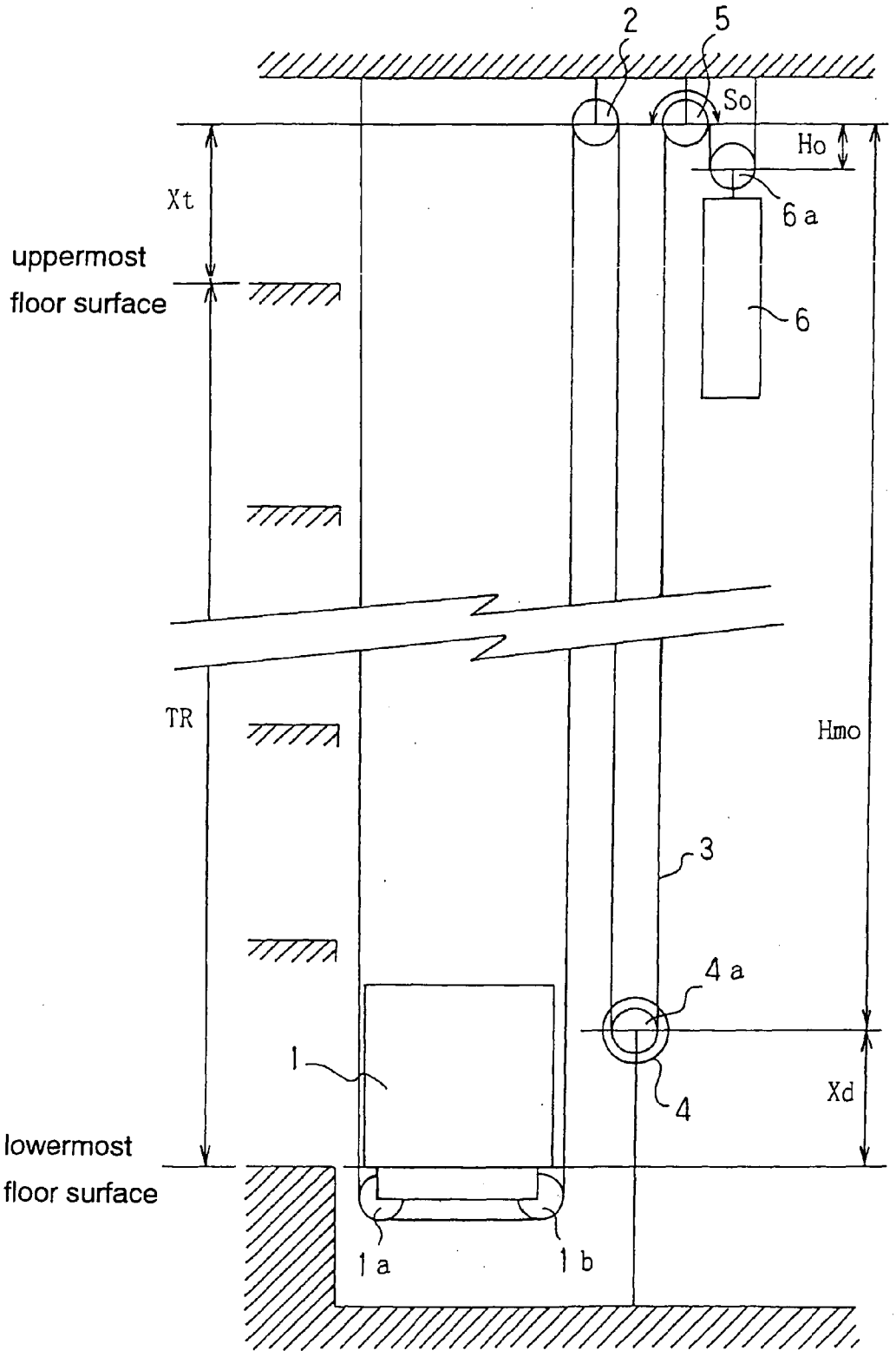
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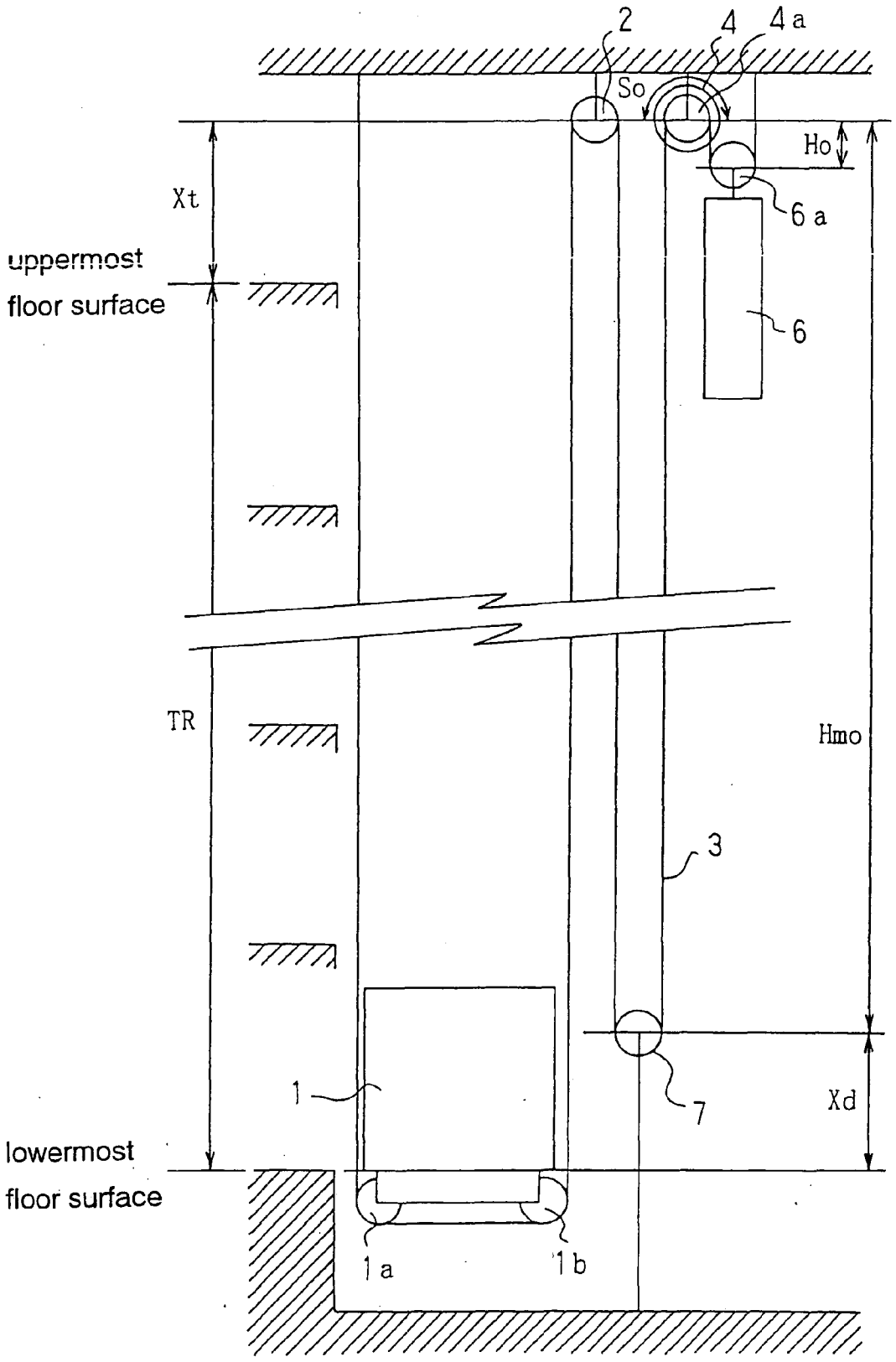
FIG. 3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floor surface
1a
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FIG. 4

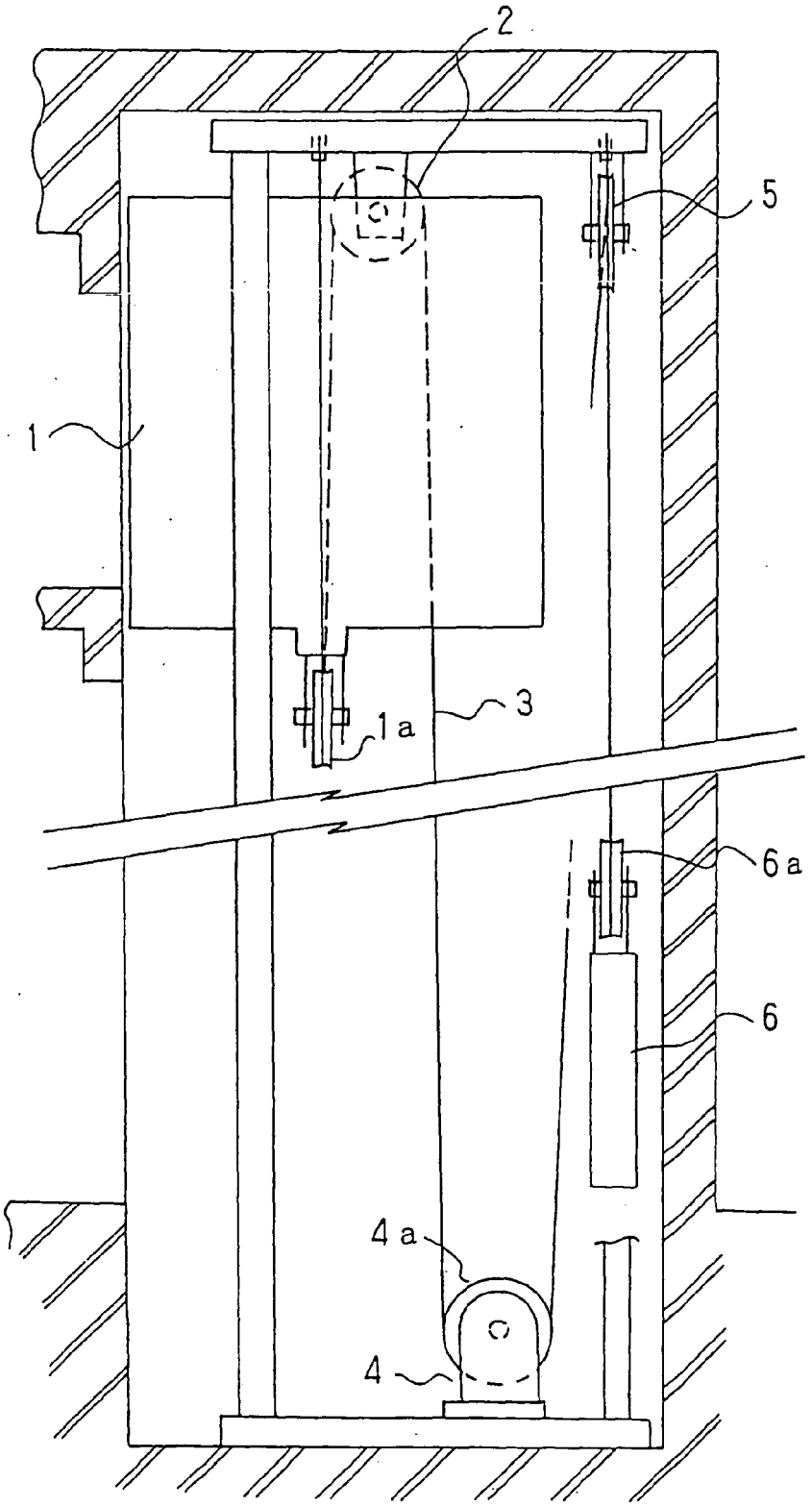


FIG. 5

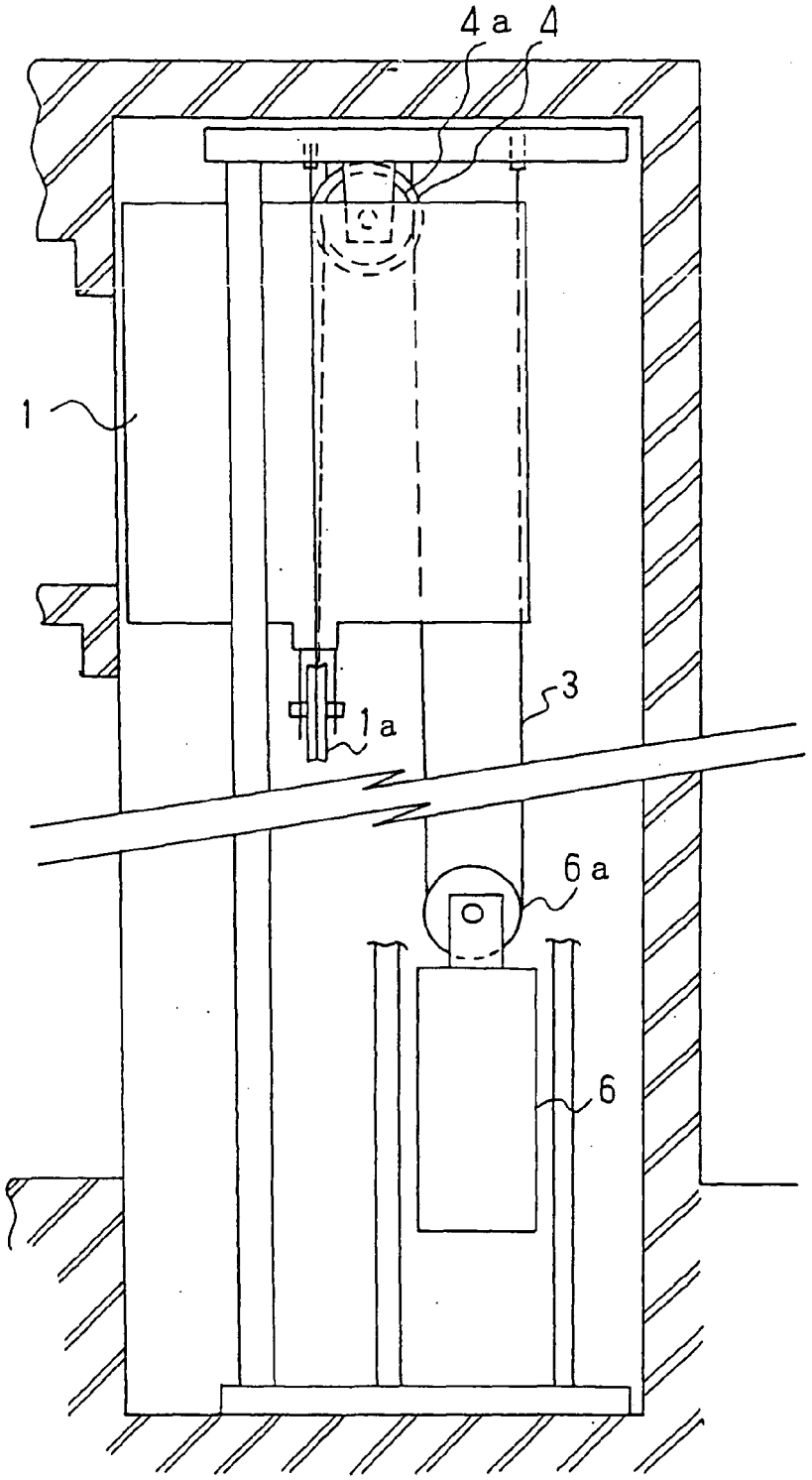
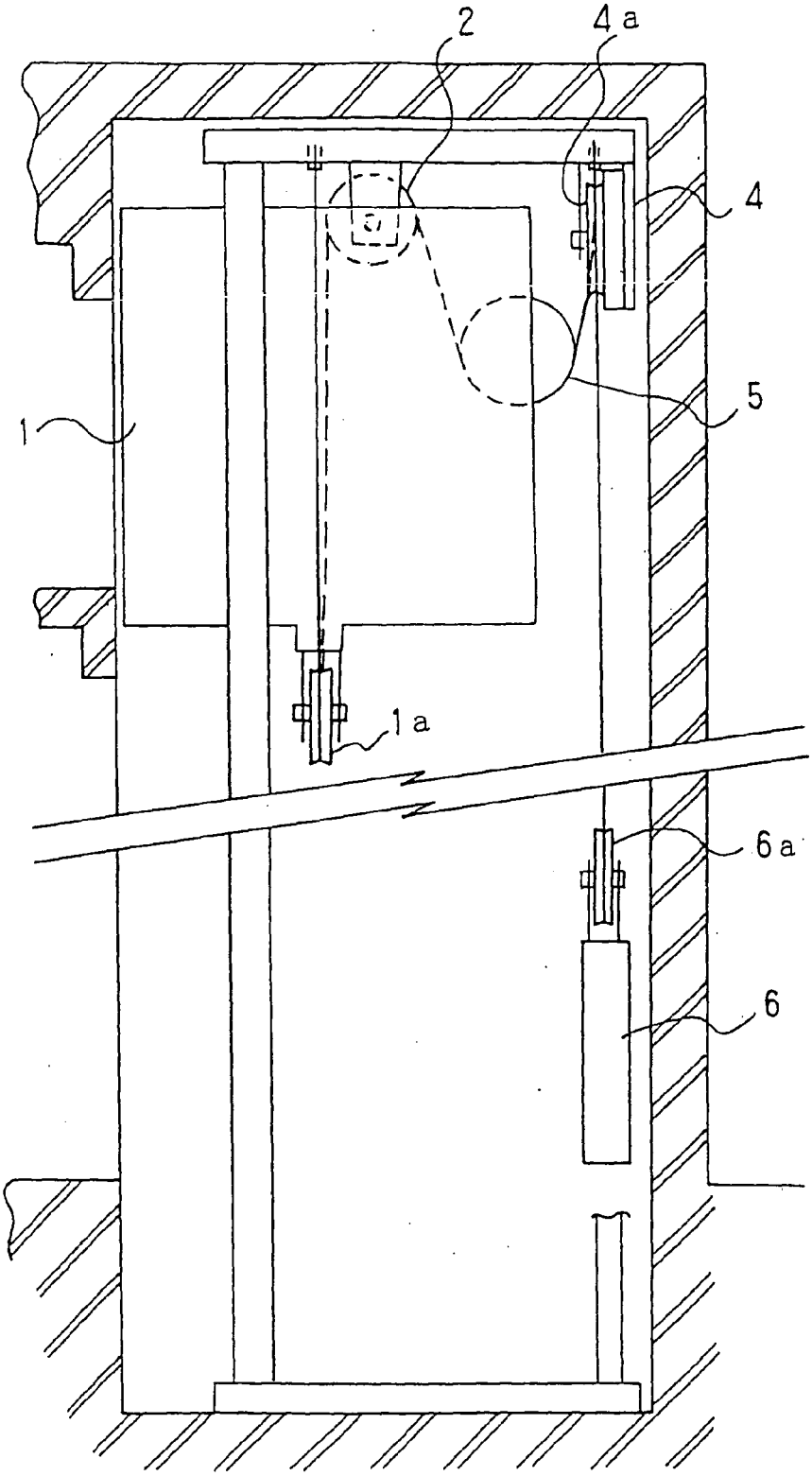


FIG. 6



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EUROPEAN SEARCH REPORT

Application Number
EP 08 00 0356

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	JP 2000 103583 A (FUJITEC KK) 11 April 2000 (2000-04-11) * abstract * * paragraph [0007] - paragraph [0009] * * figure 1 *	1-6	INV. B66B11/00
A	WO 99/43600 A (OTIS ELEVATOR CO [US]) 2 September 1999 (1999-09-02) * abstract * * page 8, line 20 - page 9, line 28 * * figure 3 *	1-6	
A	EP 0 749 930 A (KONE OY [FI] KONE CORP [FI]) 27 December 1996 (1996-12-27) * the whole document *	1-6	
E	EP 1 151 955 A (MITSUBISHI ELECTRIC CORP [JP]) 7 November 2001 (2001-11-07) * abstract * * paragraph [0027] - paragraph [0059] * * figures 1,4 *	1-6	TECHNICAL FIELDS SEARCHED (IPC)
L	EP 1 308 411 A (MITSUBISHI ELECTRIC CORP [JP]) 7 May 2003 (2003-05-07) * the whole document *	1-6	B66B
E	WO 03/042089 A (HITACHI LTD [JP]; TERAMOTO TAKASHI [JP]; FUJINO ATSUYA [JP]; NAGASE HI) 22 May 2003 (2003-05-22) * abstract * * paragraph [0023] * * figures 6,7 *	1-6	

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	7 March 2008	Oosterom, Marcel

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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07-03-2008

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP 2000103583 A	11-04-2000	JP 3800832 B2	26-07-2006
WO 9943600 A	02-09-1999	DE 69936206 T2	31-01-2008
		EP 1097101 A1	09-05-2001
		ES 2285850 T3	16-11-2007
EP 0749930 A	27-12-1996	CN 1143044 A	19-02-1997
		DE 69630081 D1	30-10-2003
		DE 69630081 T2	01-04-2004
		DE 69633347 D1	14-10-2004
		DE 69633347 T2	10-02-2005
		ES 2225324 T3	16-03-2005
		ES 2207659 T3	01-06-2004
		FI 953153 A	23-12-1996
		IN 188060 A1	10-08-2002
		JP 3168161 B2	21-05-2001
		JP 9165172 A	24-06-1997
		US 5906251 A	25-05-1999
EP 1151955 A	07-11-2001	CN 1515483 A	28-07-2004
		CN 1334779 A	06-02-2002
		DE 69935620 T2	06-12-2007
		DE 69936399 T2	28-02-2008
		WO 0142121 A1	14-06-2001
		JP 3489578 B2	19-01-2004
EP 1308411 A	07-05-2003	CN 1361746 A	31-07-2002
		WO 0189976 A1	29-11-2001
WO 03042089 A	22-05-2003	JP 3991657 B2	17-10-2007
		JP 2003146555 A	21-05-2003

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82