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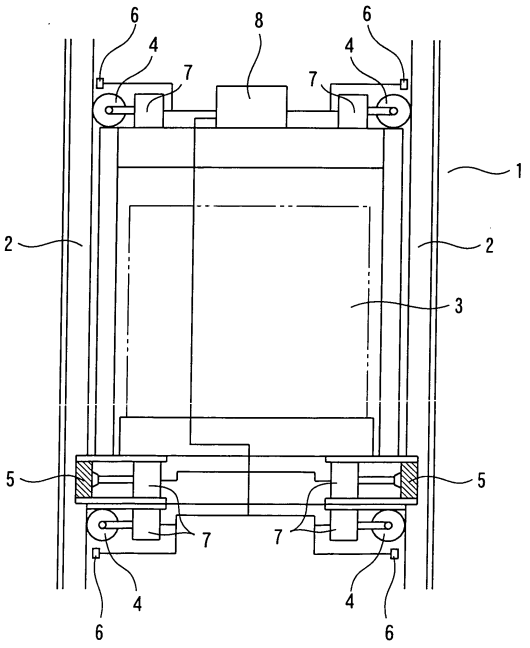
(54) ELEVATOR DEVICE

(57) There is obtained an elevator apparatus which can adapt to changes in the distance between guide rails and improves the ride comfort and safety of an elevator car and improves also the ease with which the guide rails are installed. The elevator apparatus is equipped with a car which ascends and descends in an elevator shaft, a pair of guide rails which are provided in the elevator shaft and whose mutual distance changes partially, a car guide device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, and constantly abuts against the guide rails by responding to changes in the mutual distance of the guide rails, and a safety gear device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, is constantly opposed to the guide rails with equal spacing therefrom by responding to changes in the mutual distance of the guide rails, and brings the car to an emergency stop by grasping the guide rails during a fall of the car at an overspeed.

Fig. 1



EP 1 972 593 A1

Description

Technical Field

[0001] The present invention relates to an elevator apparatus equipped with a guide device and a safety gear device of an elevator car, which adapt to changes in the distance between guide rails.

Background Art

[0002] In some conventional elevator apparatus, guide rails are installed in a shaft, a car ascends and descends in the shaft by being guided by the guide rails, and the car is equipped with a pair of safety gear devices mounted opposite to the guide rails.
Also, in some conventional elevator apparatus, there are self-propelled elevators which move in a plurality of shafts (refer to Patent Documents 1 and 2, for example).

[0003]

[Patent Document 1]: Japanese Patent Laid-Open No. 2000-185885
[Patent Document 2]: Japanese Patent Laid-Open No. 6-156939

Disclosure of the Invention

Problems to be Solved by the Invention

[0004] In conventional elevator apparatus, for guide rails which are fixed to wall surfaces of a shaft to guide the ascent and descent of a car, it was necessary that the mutual distance of the guide rails be vertically constant. In general, however, the accuracy of the vertical linearity of the wall surfaces of a shaft is low and the width is not vertically uniform. For this reason, it is general practice to install the guide rails accurately, with the guide rail interval kept constant, by adjusting the installed dimensions of the guide rails from the wall surfaces of a shaft. This adjustment of the installed dimensions of the guide rails is performed by adjusting the surfaces of supports which support the guide rails from the wall surfaces or the positions of the mounting surfaces for the guide rail surfaces, posing the problem that the installation time is enormous.
In the self-propelled elevator of the conventional elevator apparatus shown in Patent Document 2, the guide rails provided in each of the plurality of shafts serve all cars, and hence it is necessary that the distance between the guide rails be the same in all of the shafts. Therefore, in a case where the plurality of shafts do not have the same width for reasons ascribed to the building side, in order to make the distance between the guide rails constant, it was necessary that in part of the shafts, the gap of the guide rails from the walls be increased. At this time, there has arisen the problem that in order to support loads applied to the guide rails, the supports of the guide rails from the wall side must be robust.

Means for Solving the Problems

[0005] An elevator apparatus according to the present invention is equipped with a car which ascends and descends in an elevator shaft, a pair of guide rails which are provided in the elevator shaft and whose mutual distance changes partially, a car guide device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, and constantly abuts against the guide rails by responding to changes in the mutual distance of the guide rails, and a safety gear device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, is constantly opposed to the guide rails with equal spacing therefrom by responding to changes in the mutual distance of the guide rails, and brings the car to an emergency stop by grasping the guide rails during a fall of the car at an overspeed.

[0006] Also, an elevator apparatus according to the present invention is equipped with a car which ascends and descends in an elevator shaft, a pair of guide rails which are provided in the elevator shaft and whose mutual distance changes partially, a measuring device which measures the distance between the guide rails, a car guide device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, and constantly abuts against the guide rails by responding to changes in the mutual distance of the guide rails, a safety gear device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, is constantly opposed to the guide rails with equal spacing therefrom by responding to changes in the mutual distance of the guide rails, and brings the car to an emergency stop by grasping the guide rails during a fall of the car at an overspeed, and a controller which determines, from measurement results of the measuring device, the amounts of travel of the car guide device and the safety gear device in forward and backward movements.

[0007] The elevator apparatus according to the present invention is such that the car guide device and the safety gear device are displaced by an actuator.

[0008] The elevator apparatus according to the present invention is such that the elevator shaft comprises a plurality of shafts having different distances between the guide rails, and that the car is a self-propelled type and moves, ascends and descends in the plurality of elevator shafts.

[0009] The elevator apparatus according to the present invention is such that the safety gear device is equipped with a wedge which grips the guide rails by moving upward, thereby to brake the guide rails, and an actuator portion which fixes the wedge downward during a normal run of the car and moves the wedge upward during a fall of the car at an overspeed.

Advantages of the Invention

[0010] According to the present invention, it is possible to adapt to changes in the distance between guide rails and to improve the ride comfort and safety of an elevator car and to improve also the ease with which the guide rails are installed.

Brief Description of the Drawings

[0011]

Figure 1 is a front view which shows an elevator apparatus in Embodiment 1 of the present invention;
Figure 2 is a diagram which shows an elevator apparatus in which the distance between guide rails is changed, the figure corresponding to Figure 1;
Figure 3 is a diagram which shows the condition of a car approaching a place where the distance between guide rails is changed, the figure corresponding to Figure 2;
Figure 4 is a front view of an elevator apparatus in which the distance between guide rails is changed in a complex manner in Embodiment 1 of the present invention;
Figure 5 is a front view of a safety gear device provided in the elevator apparatus in Embodiment 1 of the present invention;
Figure 6 is a diagram which shows the condition in which the safety gear device has been actuated, the figure corresponding to Figure 1; and
Figure 7 is a sectional view of a shaft of an elevator apparatus in Embodiment 3 of the present invention.

Description of Symbols

[0012]

1	Shaft
1b	Communication passage
2	Guide rail
3	Car
4	Car guide device
5	Safety gear device
5a	Support of safety gear device
5b	Wedge
5c	Braking surface
5d	Wedge guide portion
5e	Actuator portion
5f	Magnet
5g	Electromagnet
5h	Spring
6	Measuring device
7	Actuator
8	Controller

Best Mode for Carrying Out the Invention

Embodiment 1

[0013] Figure 1 is a front view which shows an elevator apparatus in Embodiment 1 of the present invention. Figure 2 is a diagram which shows an elevator apparatus in which the distance between guide rails is changed, the figure corresponding to Figure 1. Figure 3 is a diagram which shows the condition of a car approaching a place where the distance between guide rails is changed, the figure corresponding to Figure 2. Figure 4 is a front view of an elevator apparatus in which the distance between guide rails is changed in a complex manner in Embodiment 1 of the present invention. Figure 5 is a front view of a safety gear device provided in the elevator apparatus in Embodiment 1 of the present invention. Figure 6 is a diagram which shows the condition in which the safety gear device has been actuated, the figure corresponding to Figure 5.
In the figures, the reference numeral 1 denotes an elevator shaft, and the reference numeral 2 denotes a pair of right and left guide rails which are fixed to both side walls of the elevator shaft respectively via supports (not shown), and whose relative distance changes partially. The reference numeral 3 denotes a car which is provided between the pair of right and left guide rails 2 and ascends and descends in the elevator shaft 1. The reference numeral 4 denotes car guide devices, which are provided in an upper part and a lower part of the car 3 in a protruding manner in both right and left directions and guide the ascent and descent of the car 3. The reference numeral 5 denotes safety gear devices which are provided in a protruding manner in both right and left directions of the lower part of the car 3 and are each opposed to the pair of right and left guide rails 2. The safety gear devices bring the car 3 to an emergency stop by grasping both side surfaces of each of the pair of right and left guide rails 2 during a fall of the car 3 at an overspeed. The reference numeral 6 denotes measuring devices which are provided in the upper part and lower part of the car 3 and measure any time the relative distance of the guide rails 2 in the upper part and lower part of the car. The reference numeral 7 denotes actuators, which are each provided in the car guide devices 4 and the safety gear devices 5 and cause the car guide devices 4 and the safety gear devices 5 to freely move laterally. The reference numeral 8 denotes a controller which is connected by control cables to the measuring devices 6 and each of the actuators 7. The controller gives directions for the amounts of travel to the actuators 7 on the basis of measurement results of the distance between the guide rails obtained by the measuring devices 6 and input data, such as the speed of the car 3. That is, the controller 8 provides directions for the amounts of travel of each of the actuators 7 so that each of the car guide devices 4 constantly abuts against the pair of right and left guide rails 2 even when the car 3 passes a place where the relative distance

of the guide rails 2 has changed, whereby the controller causes each of the car guide devices 4 to move forward and backward horizontally. Also, this ensures that the car 3 does not swing horizontally and that the posture of the car is prevented from becoming imbalanced. Similarly, the controller causes the safety gear devices 5 to be opposed to the pair of right and left guide rails 2 constantly with the same spacing.

[0014] An example of the operation of the elevator apparatus constructed as described above will be described by using Figures 2 and 3. In Figures 2 and 3, the car 3 is in the course of an ascent, and an extended portion 2a is provided on the upper right side of the guide rail 2 above the car 3.

First, when the car 3 is approaching the area 2a where the right side of the pair of right and left guide rails 2 has been extended, the upper right side of the measuring device 6 detects the extension of this area 2a and measures any time the distance between the guide rails. The measurement result is fed to the controller 8. Next, the controller 8 determines the travels and timing of the car guide device 4 and the safety gear device 5 by adding other data on speed of the car 3 and the like. Next, the controller 8 gives directions for the amounts of travel any time to the actuator 7. At the indication, as shown in Figure 3, the upper right side of the car guide device 5 first moves any time to any position, and next, the right side of the safety gear device 5 and the lower right side of the car guide device 4 move to any position.

[0015] According to the elevator apparatus constructed as described above, even in a case where the car 3 passes a place where the distance between the pair of right and left guide rails 2 has changed, the car guide device 4 can abut against the guide rails 2 constantly with a constant pressure. Therefore, the car 3 can ascend and descend at a prescribed position without swinging horizontally and with the posture not becoming imbalanced. Furthermore, because the safety gear device 5 can be opposed to the pair of right and left guide rails 2 always at a constant distance therefrom, the elevator apparatus can be made safe.

[0016] Similarly, according to this elevator apparatus, it is possible to adapt to changes in the distance between the pair of right and left guide rails 2, and hence in a case where the accuracy of the vertical linearity of the wall surfaces of the shaft is low and the width is not vertically uniform, it becomes unnecessary to install the guide rails 2 accurately, with the guide rail 2 interval kept constant, by adjusting the installed dimensions of the guide rails 2 from the wall surfaces of the shaft. That is, it is possible to make it unnecessary to adjust the surfaces of supports which support the guide rails 2 from the wall surfaces or the positions of the mounting surfaces for the guide rail 2 surfaces and the ease with which the guide rails 2 are installed is improved.

[0017] Incidentally, needless to say, even when the distance between the pair of right and left guide rails 2 changes in a complex manner as shown in Figure 4, it is possible to adapt to the changes by using the elevator apparatus of this embodiment.

[0018] Next, the construction of the pair of right and left safety gear devices 5 will be described with reference to Figures 5 and 6. The construction of the safety gear device 5 is the same as described in Embodiment 1 of Patent Document WO2004/083090A1.

The reference numeral 5a denotes supports which are fixed to the car 3 side, and the reference numeral 5b denotes a pair of laterally symmetrical, right and left wedges, which are provided above the supports 5a, the guide rail 2 being positioned therebetween, and which can move vertically. Each of the pair of wedges 5b is provided with an inner side surface, which is a barking surface 5c opposed to both side surfaces of the guide rail 2, and an outer side surface which is inclined in such a manner that the thickness relative to the inner side surface decreases upward. The reference numeral 5d denotes a pair of laterally symmetrical wedge guide portions which are provided on the supports 5a in a standing manner, the pair of wedges 5b being positioned therebetween, and each of the wedge guide portions has an inclined surface which is opposed in parallel to the outer side surface of the wedge 5b. As a result of this, when the pair of wedges 5b move upward, the outer side surfaces slide along the inclined surfaces of the wedge guide portions 5d, whereby the pair of wedges move also in the direction in which they approach each other and the braking surfaces 5c grip the guide rail 2.

The reference numeral 5e denotes a pair of actuator portions, which are each provided between the pair of wedges 5b and the supports 5a. The pair of wedges 5b is each provided with a magnet 5f at a bottom end, and the pair of actuator portions 5e is each constituted by an electromagnet 5g opposed to the magnet 5f and an urging spring 5h.

[0019] The operation of the safety gear device 5 constructed as described above will be described.

During an ordinary run of the car 3, the electromagnets 5g of the pair of actuators 5e are energized and excited, attract the magnets 5f of the pair of wedges 5b and compress the urging springs 5h and fix the urging springs to the support 5a side. At this time, the braking surfaces 5c of the pair of wedges 5b are away from the guide rail 2. When the car 3 falls at a speed higher than a prescribed speed, power to the electromagnets 5g is cut on the basis of an electrical signal indicating this and the electromagnets lose a magnetic force and the pair of wedges 5b are moved upward by the urging springs 5h. As a result of this, the braking surfaces 5c of the pair of wedges 5b grip both side surfaces of the guide rail 2, whereby braking is performed.

[0020] The safety gear device 5 constructed as described above does not require a connection mechanism (a pull rod or the like) to a governor any more as in a conventional safety gear device, and the device can be simplified.

Furthermore, because the safety gear device 5 operates

in accordance with the directions of an electrical signal, it is possible to brake the car 3 in a short time compared to a conventional safety gear device after the detection of a speed abnormality of the car 3 and it is possible to shorten the braking distance. It is possible to readily actuate the pair of right and left safety gear devices in synchronization with each other and the car 3 can be braked in a stable manner. Furthermore, it is possible to prevent malfunctions due to the swings of the car 3 and the like. Furthermore, during braking, an upward force is applied to the pair of wedges 5b also by a frictional force with the guide rail 2 and, therefore, the braking surfaces 5c are more strongly pressed against the guide rail, whereby it is possible to positively increase the braking force.

[0021] Incidentally, needless to say, in the elevator apparatus of this embodiment, it is possible to carry out the present invention by using a safety gear device provided with a connection mechanism (a pull rod or the like) to a governor as in a conventional safety gear device.

Embodiment 2

[0022] Although the measuring device 6 is provided in Embodiment 1, it is not necessary in Embodiment 2.
In Embodiment 2, the controller 8 is caused to store beforehand a place where the distance between the pair of right and left guide rails 2 in the shaft has changed and information on the distance between the guide rails 2 and the like and each of the actuators 7 is operated on the basis of this information. As a result of this, a measuring device becomes unnecessary and the construction and control of the elevator apparatus can be simplified.

Embodiment 3

[0023] Figure 7 is a sectional view of a shaft of an elevator apparatus in Embodiment 3 of the present invention.
In Figure 7, the reference numeral 3a denotes a car of a self-propelled elevator. The reference numeral 1a denotes two elevator shafts of self-propelled elevator, which have different distances between guide rails and in each of which a car 3a travels, ascends and descends. The reference numeral 1b denotes a communication passage which connects the two elevator shafts 1a, communication means which causes the cars 3a to move horizontally and travel between the two elevator shafts 1a. A safety gear device 5 has the same construction as described in Embodiment 1.

[0024] According to the safety gear device 5 provided in the elevator apparatus constructed as described above, the same effect as in Embodiment 1 is obtained and a connection mechanism (a pull rod or the like) to a governor required in a conventional safety gear device becomes unnecessary. Therefore, it is unnecessary to add a complex structure which enables also a connection mechanism to move because of the travel of the cars 3a between the plurality of elevator shafts 1a.

[0025] Needless to say, a construction which is such that by use of the measuring device 6 and the controller 8, the car guide devices 4 and the safety gear devices 5 are caused to move forward and backward to any lateral position, is effective not only for an elevator apparatus having a single shaft as described in Embodiment 1, in which the distance between the guide rails 2 has changed, but also for a self-propelled elevator as described in this embodiment, in which the self-propelled cars 3a travel between the plurality of elevator shafts 1a having different distances between the guide rails, and ascend and descend therein. As a result of this, it becomes unnecessary to make uniform the distances between guide rails of the plurality of shafts 1a and the ease with which the guide rails are installed is improved.

[0026] Also, it is needless to say that also in the elevator apparatus of this embodiment, the measuring device 6 can be made unnecessary. In this case, it is necessary only to add a construction which is such that in the communication passage 1b, the controller 8 is caused to recognize the distance between the guide rails 2 of the elevator shaft 1a to which the car is to be moved and in the communication passage 1b, the car guide device 4 and the safety gear device 5 are caused to move to any position. As a result of this, the construction and control of the elevator apparatus can be simplified.

Industrial Applicability

[0027] The present invention can be applied to guide rails guiding traveling things, in which there is a possibility that the distance between the guide rails changes.

Claims

1. An elevator apparatus, **characterized by** comprising a car which ascends and descends in an elevator shaft, a pair of guide rails which are provided in the elevator shaft and whose mutual distance changes partially, a car guide device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, and constantly abuts against the guide rails by responding to changes in the mutual distance of the guide rails, and a safety gear device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, is constantly opposed to the guide rails with equal spacing therefrom by responding to changes in the mutual distance of the guide rails, and brings the car to an emergency stop by grasping the guide rails during a fall of the car at an overspeed.

2. An elevator apparatus, **characterized by** comprising a car which ascends and descends in an elevator shaft, a pair of guide rails which are provided in the elevator shaft and whose mutual distance changes

partially, a measuring device which measures the distance between the guide rails, a car guide device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, and constantly abuts against the guide rails by responding to changes in the mutual distance of the guide rails, a safety gear device which is provided in the car, can freely move forward and backward to any horizontal position with respect to the car, is constantly opposed to the guide rails with equal spacing therefrom by responding to changes in the mutual distance of the guide rails, and brings the car to an emergency stop by grasping the guide rails during a fall of the car at an overspeed, and a controller which determines, from measurement results of the measuring device, amounts of travel of the car guide device and the safety gear device in forward and backward movements.

3. The elevator apparatus according to claim 1 or 2, **characterized in that** the car guide device and the safety gear device are displaced by an actuator.

4. The elevator apparatus according to any one of claims 1 to 3, **characterized in that** the elevator shaft comprises a plurality of shafts having different distances between the guide rails, and **in that** the car is a self-propelled type and moves, ascends and descends in the plurality of elevator shafts.

5. The elevator apparatus according to any one of claims 1 to 4, **characterized in that** the safety gear device comprises a wedge which grips the guide rails by moving upward, thereby to brake the guide rails, and an actuator portion which fixes the wedge downward during a normal run of the car and moves the wedge upward during a fall of the car at an overspeed.

Fig. 1

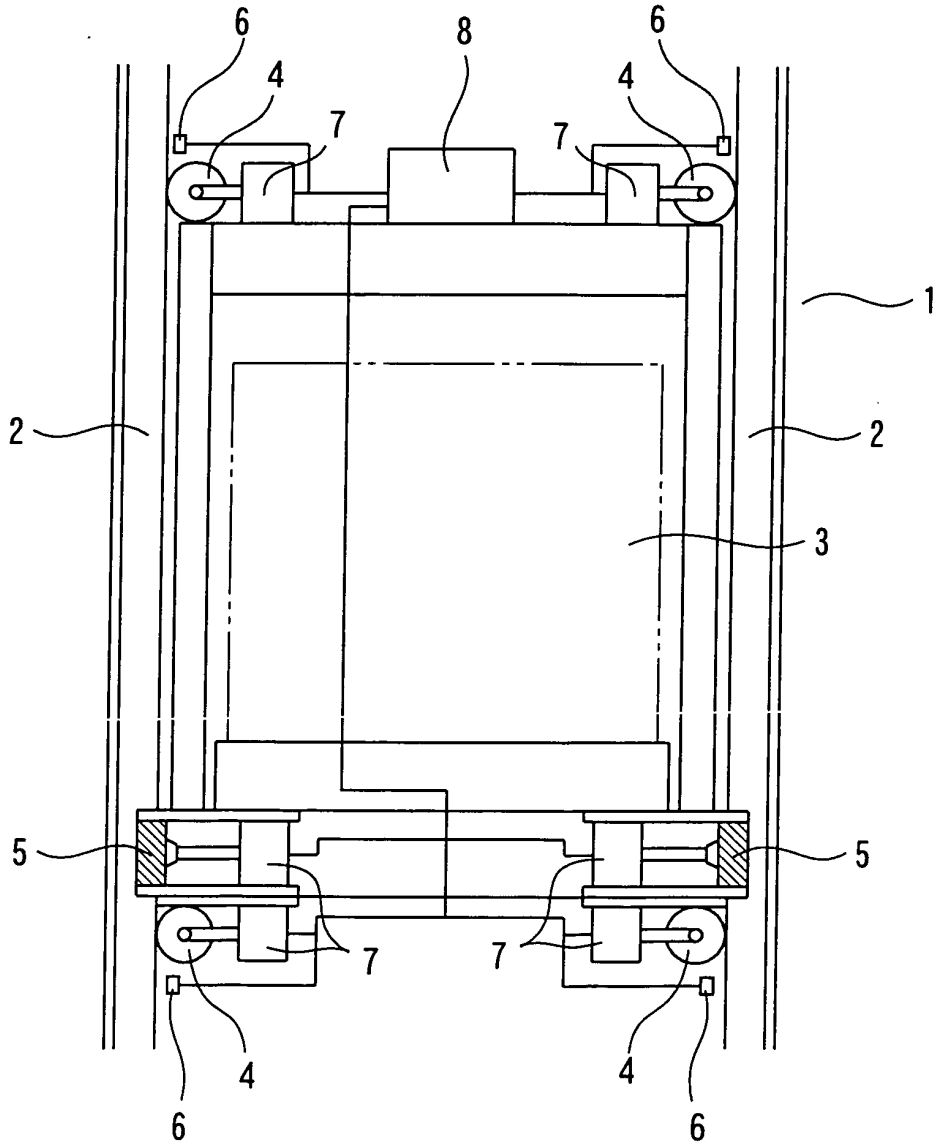


Fig. 2

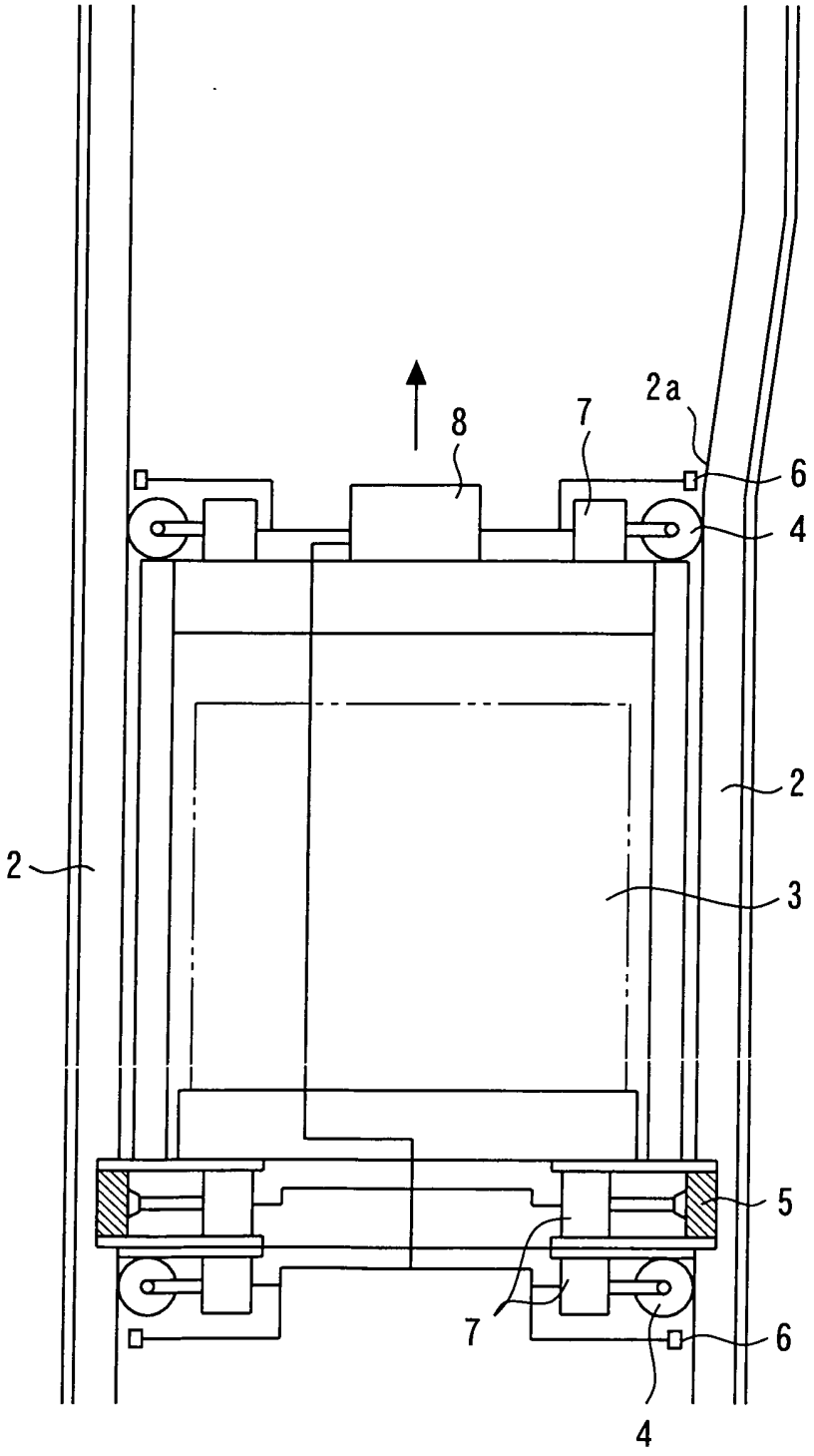


Fig. 3

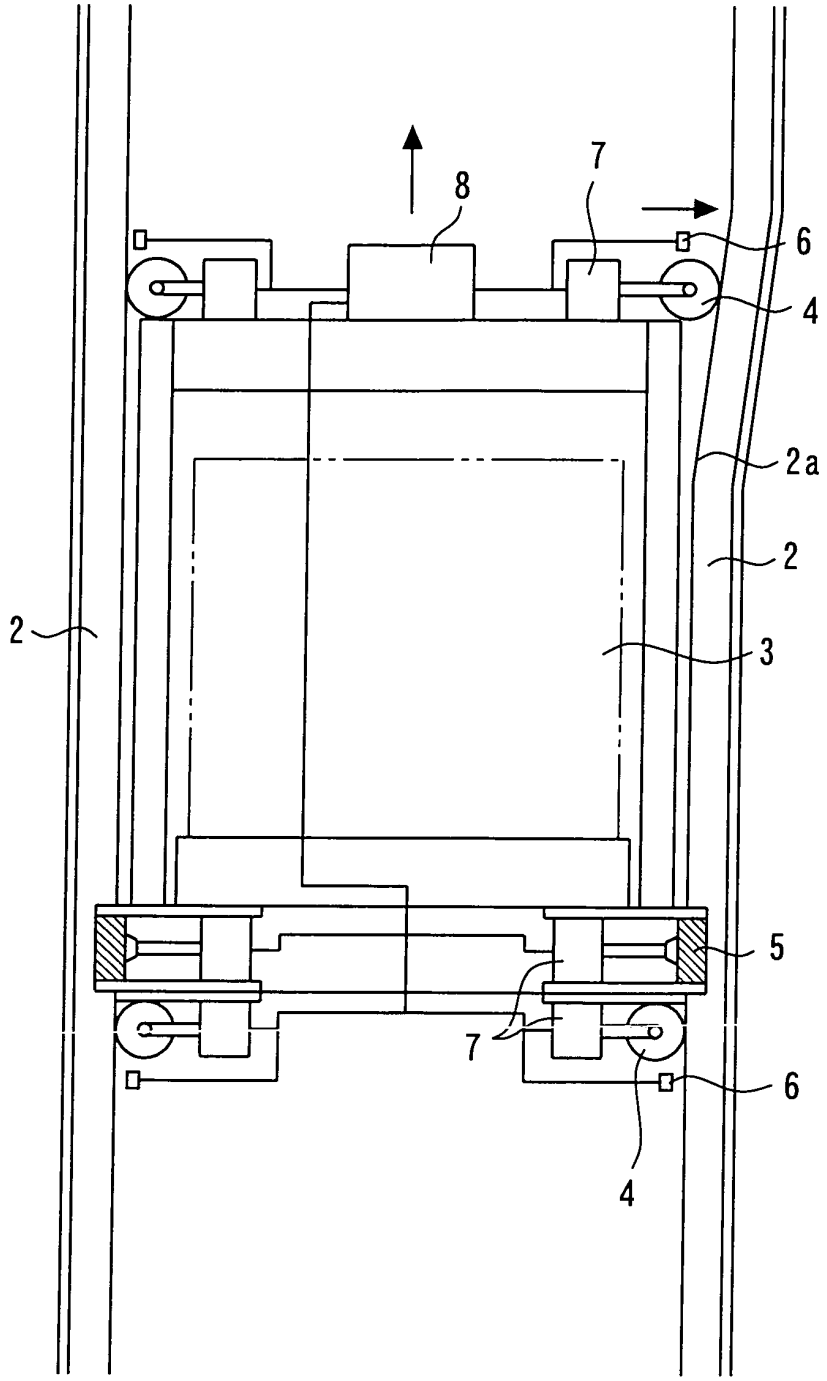


Fig. 4

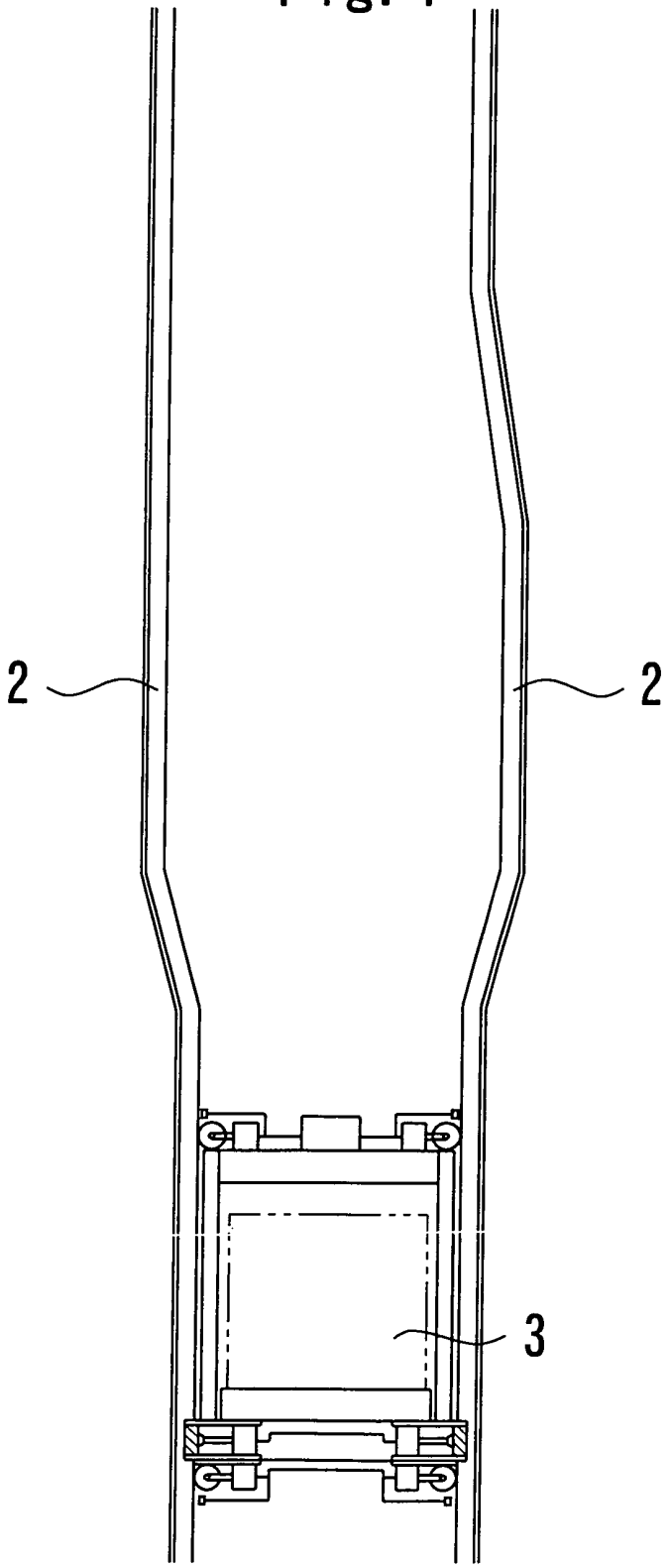


Fig. 5

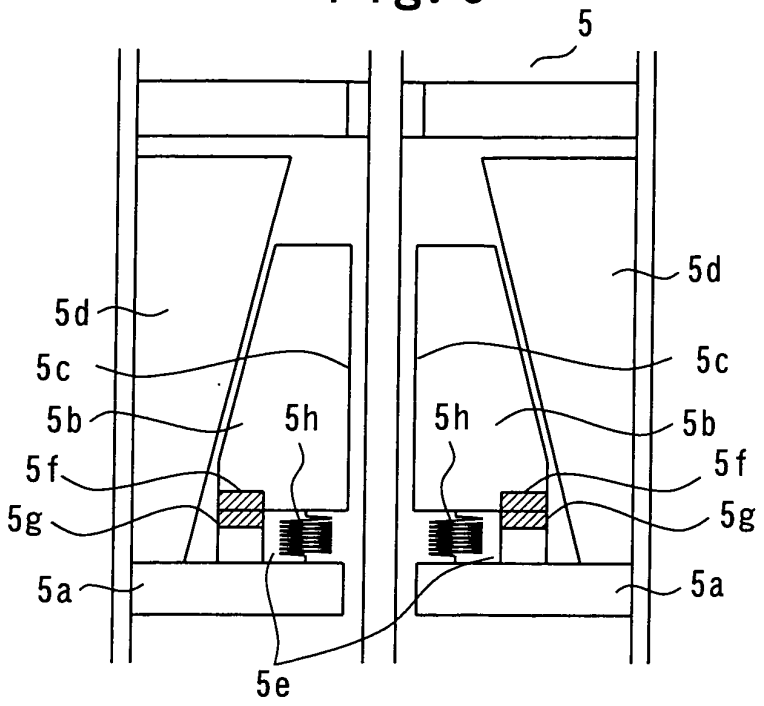

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Fig. 6

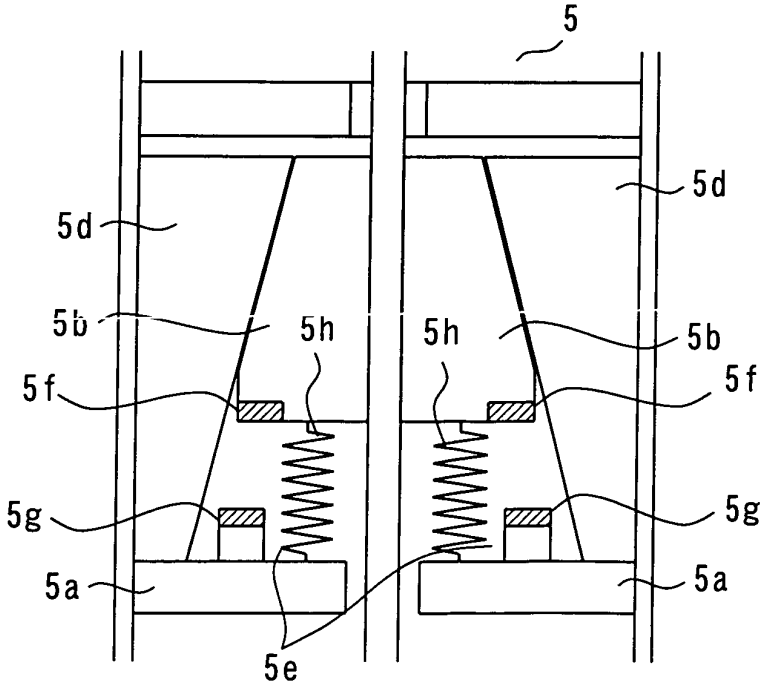
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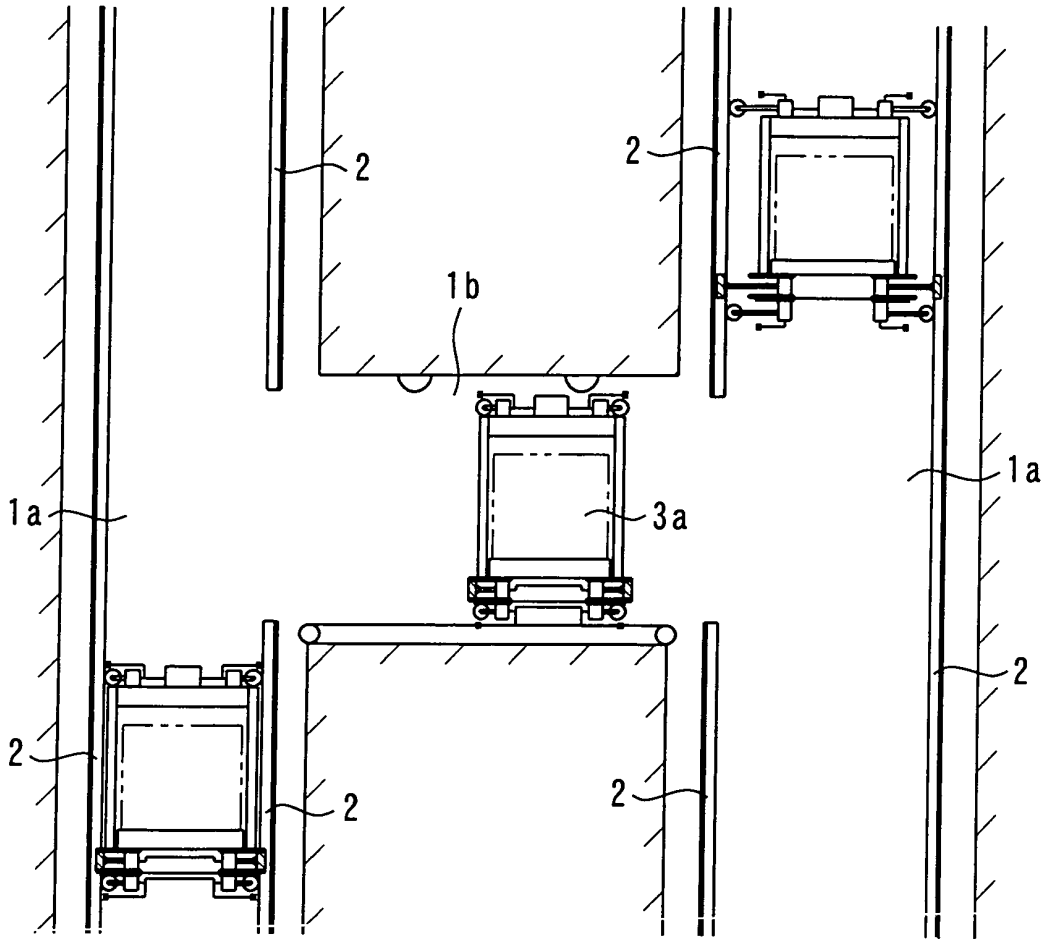
Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2006/300141

A. CLASSIFICATION OF SUBJECT MATTER
B66B7/04(2006.01)i, *B66B5/22*(2006.01)i, *B66B7/02*(2006.01)i, *B66B9/16*(2006.01)i

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)
B66B1/00-B66B20/00

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 1996-2006
Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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.
A	JP 2002-173284 A (Toshiba Corp.), 21 June, 2002 (21.06.02), (Family: none)	1-3
A	WO 2003/008317 A1 (Mitsubishi Electric Corp.), 30 January, 2003 (30.01.03), & US 2004/0262091 A1 & EP 1431230 A1 & CN 1449355 A	1-3
A	JP 06-263360 A (Toshiba Corp.), 20 September, 1994 (20.09.94), (Family: none)	4
A	WO 2004/083091 A1 (Mitsubishi Electric Corp.), 30 September, 2004 (30.09.04), & EP 1604935 A1	5

☐ 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
02 October, 2006 (02.10.06)	10 October, 2006 (10.10.06)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2000185885 A **[0003]**
- JP 6156939 A **[0003]**
- WO 2004083090 A1 **[0018]**