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(84) Designated Contracting States: AT BE BG CH CY CZ DE DK EE ES FI FR GB GR IE IT LI LU MC NL PT SE SK TR	(72) Inventor: HAMAGUCHI, Shuki, c/o Mitsubishi Denki K. K. Tokyo 100-8310 (JP)
(71) Applicant: MITSUBISHI DENKI KABUSHIKI KAISHA Tokyo 100-8310 (JP)	(74) Representative: HOFFMANN - EITLE Patent- und Rechtsanwälte Arabellastrasse 4 81925 München (DE)

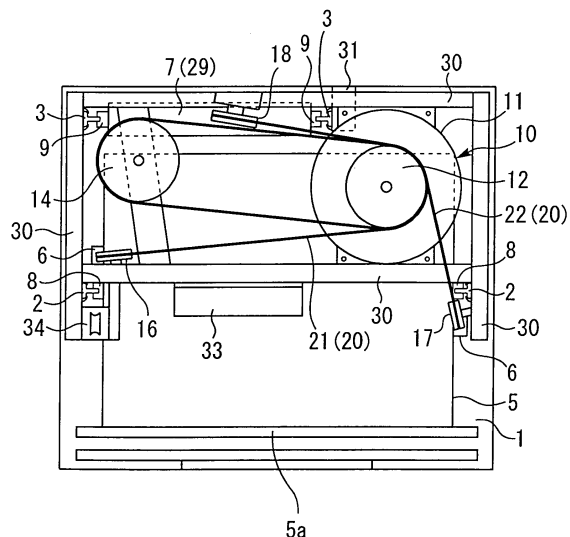
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ELEVATOR DEVICE

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In the elevator system in the present invention, on a support bench (30) disposed at an upper portion of the hoistway (1), there are arranged a driving device (10) and an idler pulley (14), so that the axis of rotation of a drive sheave (12) and the idler pulley (14) is vertical. A main rope (20) has two parallel paths and has independent ropes, a first rope (21) for the first path, and a second rope (22) for the second path; one of the ends of the ropes are connected together to a counter weight (7) and made to change direction by the deflector sheave (18) for the counter weight; the middle part is passed around the driving device (10), and passed around the driving device (10) again via the idler pulley (14); and the other end is made to change direction respectively by the first deflector sheave (16) for the car and the second deflector sheave (17) for the car, and are respectively connected to the sides of the car (5) at positions opposite to each other.

Fig. 1



Description

Technical Field

[0001] The present invention relates to an elevator system in which a driving device is disposed at an upper portion in a hoistway.

Background Art

[0002] In recent years, due to the limitation in installation space of elevators according to the external appearance or height of buildings, elevators that do not require a machineroom, e.g., elevators that have the driving device and the control panel arranged inside the hoistway without having a machineroom, have come into wide use. Hence it is required to arrange the elevator equipment such as the driving device and the control panel properly, using the space efficiently. For example, in PCT international publication No. WO 02/16247 A1, a 1:1 roping elevator which has its driving device arranged at an upper portion of the hoistway, is disclosed. However, in conventional elevator systems, as the hoisting angle of the main rope to the drive sheave is small, special types of ropes using a high-priced synthetic fiber of which the surface consists of a high-friction material have been used as a means to secure frictional force between the drive sheave and the main rope, and sometimes also the drive sheave has been provided with a special undercut groove having a notch to intensify the friction between the main ropes. This poses the problem that the main rope bites into the undercut groove, thus shortening its life.

[0003] Furthermore, as the conventional car is supported at one place by an upper beam mounted on top of the car, this poses the problem that the vertical dimension equivalent to that of the suspension part needs to be secured in the hoistway.

[0004] This invention was devised to solve problems such as those mentioned above, and has its object to secure a low-priced and stable life of the main rope, by using general -purpose ropes. Another object is to minimize the length of the hoistway by contriving ways of suspending the car.

Disclosure of the Invention

[0005] The elevator system in the present invention comprises: a driving device provided on a support bench disposed in an upper part of a hoistway, the driving device including a drive sheave with a main elevator rope passed around and an electric motor for rotating the drive sheave, with at least the rotation axis of the drive sheave arranged in vertical direction; and a car and a counter weight suspended by the main rope in the hoistway and ascended and descended by the driving device. This elevator system comprises: an idler pulley with its axis of rotation arranged vertically at a predeter-

mined distance from the driving device; and a main rope with one end connected to the counter weight, the middle part passed around the drive sheave, then around the idler pulley and again around the drive sheave, and the other end connected to the car. Furthermore, there are provided a deflector sheave for the car that is disposed on a support bench and changes the direction of the part of the main rope extending from the drive sheave to the car from the horizontal direction to the vertical direction, and a deflector sheave for the counter weight that is similarly disposed on a support bench and changes the direction of the part of the main rope extending from the drive sheave to the counter weight from the horizontal direction to the vertical direction. Moreover, this driving device is formed so as to be thinner in the rotational axis direction compared to the radial direction in outer shape, and the drive sheave has a U-groove around which the main rope is passed, and the diameter of the semicircle at the bottom part of this U-groove is made so as to approximate the diameter of the main rope. Also, the driving device is arranged near the corner of the back part of the hoistway.

[0006] Furthermore, there are two parallel paths for the main rope, and there is a first rope for the first path, and a second rope for the second path, both ropes independent of one another. There is a first deflector sheave for the car for the first rope, and a second deflector sheave for the car for the second rope, and they are arranged so that they are apart from each other and that at least one part of them overlaps the car in vertical projection area in the hoistway. Also, at least one part of the deflector sheave for the counter weight overlaps the counter weight in vertical projection area in the hoistway. Here, one end of both the first rope and the second rope are made to change direction from the drive sheave by the deflector sheave for the counter weight, and are connected to the counter weight. As for the other end of the first and second ropes, they are made to change direction from the drive sheave respectively by a first deflector sheave for the car and a second deflector sheave for the car, and the ends of the first and second ropes are both connected to the car at lower parts of the sides of the car that are opposite to each other. Preferably, the two ends are connected at positions that are opposite to each other across the center of gravity of the car.

[0007] Moreover, in the elevator system in the present invention, the idler pulley is arranged so that it is placed between a part of the main rope extending from the drive sheave to the deflector sheave for the car and a part of the main rope extending from the drive sheave to the deflector sheave for the counter weight.

[0008] Furthermore, the elevator system in the present invention comprises a control panel to control the car and a governor, and the control panel, the governor and the idler pulley are positioned not to exceed the range of the maximum height dimension of any of the driving device, or the deflector sheave for the car and the deflector sheave for the counter weight.

[0009] Moreover, the elevator system in the present invention comprises main guide rails to guide the car and sub-guide rails to guide the counter weight, and the support bench is supported by at least any of: the main guide rails and the sub-guide rails, or the hoistway wall.

As a preferable example, the support bench is disposed interposing an anti-vibration material between the main guide rails and the sub-guide rails, or the hoistway wall.

[0010] According to the aforementioned invention, since the idler pulley is arranged at a predetermined position from the driving device, it is possible to increase the degrees of the hoisting angle of the main rope to the drive sheave, and it becomes easier to secure frictional force between the main rope and the drive sheave. Therefore, a general-purpose rope can be used without the necessity to use a special high-friction main rope, and it is possible to secure a low-priced and stable life of the main ropes, and moreover, it facilitates maintenance and inspection of the main rope.

Brief Description of the Drawings

[0011]

Figure 1 shows an example of an arrangement of the elevator system in accordance with the first embodiment of the present invention, and is a plan view of the elevator system viewed from the upper side.

Figure 2 shows an example of an arrangement of the elevator system in accordance with the first embodiment of the present invention, and is a partial elevation of the elevator system viewed from the horizontal direction.

Figure 3 are sectional views showing conventional and present-invention drive sheave grooves over which the main rope used in the present invention passes.

Figure 4 is a plan view showing an example of an arrangement of the elevator system in accordance with the second embodiment of the present invention.

Figure 5 is a plan view showing an example of an arrangement of the elevator system in accordance with the third embodiment of the present invention.

Figure 6 is a plan view showing an example of an arrangement of the elevator system in accordance with the third embodiment of the present invention.

Best Mode for Carrying out the Invention

[0012] To describe the present invention in more detail, the invention will be described below by referring to the accompanying drawings.

Embodiment 1

[0013] Figures 1 and 2 are views showing an example

of an arrangement of the machineroom-less elevator system in accordance with the first embodiment of the present invention; Figure 1 is a plan view of the elevator system viewed from the upper side, Figure 2 is a partial elevation of the elevator system viewed from the horizontal direction, and both are conceptual maps showing the major components of the elevator system.

[0014] In the figure, in a hoistway 1, supported by rail brackets 4 fixed to the wall of the hoistway 1, there are mounted a pair of main guide rails 2 (for the car) and another pair of sub-guide rails 3 (for the counter weight). A car 5 is made to ascend and descend throughout the hoistway 1 guided by the main guide rails 2, and a counter weight 7 is made to ascend and descend throughout the hoistway 1 guided by the sub-guide rails 3.

[0015] The car 5 has an entrance 5a at the front part of the hoistway as shown in the plan view of Figure 1; the main guide rails 2 are disposed near both sides of the surfaces that are orthogonal to the entrance surface, and the sub-guide rails 3 are disposed near the side of the rear surface that is opposite to the car entrance. Moreover, a plurality of guide shoes 8 that are coupled to the main guide rails 2 are disposed on the car 5, and a plurality of guide shoes 9 that are engaged with the sub-guide rails 3 are disposed on the counter weight 7. On each of the upper ends of the main guide rails 2 and the sub-guide rails 3, support bench brackets 31 are mounted for fixing support benches 30, and the support bench 30 is fixed to the support bench brackets 31 via an anti-vibration material 32. The support bench 30 may be fixed directly to the support bench brackets 31, but in order to prevent vibration generated by the driving device 10 from being transmitted to the building from the hoistway walls via the main guide rails 2, the sub-guide rails 3 and the rail brackets 4, it is preferable to be used with an anti-vibration material 32 interposed between the support bench brackets 31.

[0016] The drive sheave 12, around which the main rope 20 is passed and is constructed so that the rotation axis is in the vertical direction, and the driving device 10, which comprises an electric motor 11 that rotates and drives the drive sheave 12, are thin-type, formed so as to be thinner in the rotational axis direction compared to the radial direction in outer shape. The idler pulley 14 is arranged so that the rotation axis is in the vertical direction, as is the drive sheave 12. The driving device 10 and the idler pulley 14 are loaded on the support bench 30, the driving device 10 is mounted on an upper part of the car 5, and the idler pulley 14 is arranged at a predetermined distance from the driving device 10. That is, the driving device 10 is positioned near a corner of the hoistway 1, and the idler pulley 14 is positioned near another corner of the hoistway 1. Moreover, in Figure 1, the driving device 10 is in a desirable position (a position in which there is no fear of crossing of the main rope and occurrence of interference through the process of passing the main rope around the sheaves) from the viewpoint of roping, i.e. near a corner at the rear part of

the hoistway.

[0017] In this embodiment, an example in which the idler pulley 14 is mounted on the same support bench 30 as the driving device 10 is shown, however, the idler pulley 14 may also be mounted on a support bench provided separately from the support bench 30.

[0018] Next, the main rope 20 has two parallel paths which includes a first independent rope 21 and a second independent rope 22, and the first rope 21 and the second rope 22 both comprise a set of unit ropes made of a plurality of ropes.

[0019] The intermediate part of the main rope 20, which includes the first rope 21 and the second rope 22, is passed around the drive sheave 12, then around the idler pulley 14, and again around the drive sheave 12. One end of the main rope 20 is made to change direction from the horizontal direction to the vertical direction by the deflector sheave 18 for the counter weight, and extends from the drive sheave 12 to the counter weight 7. That is, the first rope 21 and the second rope 22 are parallel to each other and form a main rope 20 while being passed around the idler pulley 14 from the drive sheave 12, being passed around the drive sheave 12, and then being passed over to the counter weight 7 from the deflector sheave 18 for the counter weight.

[0020] Moreover, one end of both the first rope 21 and the second rope 22 are connected to an upper beam 29 of the counter weight 7 interposing a rope shackle 26 and a buffer material 27 using a coil spring

[0021] Further, as for the other end of the main rope 20, that is, the end that extends from the drive sheave 12 to the car 5, the first rope 21 and the second rope 22 become separate, and the first rope 21 and the second rope 22 are made to change direction from the horizontal direction to the vertical direction respectively by a first deflector sheave 16 for the car and a second deflector sheave 17 for the car, and are connected to a predetermined part of the car 5. At this other end of the rope, each of the first rope 21 and the second rope 22 are connected to two car brackets 6 which are provided at the bottom portions of the car 5 that are opposite to each other across the center of gravity of the car 5, via a rope shackle 24 and a buffer material 25 using a coil spring.

[0022] Accordingly, it is not necessary to mount a suspension part on top of the car 5 as in conventional elevators, so it is possible to shorten the vertical dimension of the hoistway 1 by the space of the suspension part of the car 5. Furthermore, compared with the one-point support by the upper portion of the conventional car 5, in this invention, a two-point support by the bottom portions of the car 5 is attained, thus making it possible to reduce the strength of the structural members of the upper portion of the car 5, and also to reduce the weight and the manufacturing cost of the car 5.

[0023] In this embodiment, an example in which the car 5 is supported by the bottom portion of the car 5 is shown as preferable, however, as the reduction in vertical dimension of the hoistway 1 may be realized by

supporting the car 5 at two points lower than the top surface of the car, the supporting positions may be anywhere as long as they are in the sides of the car 5 that are opposite to each other.

[0024] Next, in this embodiment as described above, as a deflector sheave for the car, a first deflector sheave 16 for the car and a second deflector sheave 17 for the car are provided respectively to the first rope 21 and the second rope 22, and they are arranged so that they are apart from each other, and also that at least one part of them overlap the car 5 in vertical projection area in the hoistway 1. Furthermore, the first deflector sheave 16 for the car and the second deflector sheave 17 for the car are arranged at an upper portion of the rope shackle 24. That is, a large part of the first deflector sheave 16 for the car and the second deflector sheave 17 for the car overlaps the car 5 in vertical projection area, thus they are arranged so that there is no necessity to secure a long distance between the car 5 and the hoistway wall (so that there is no necessity to enlarge the plane of the hoistway 1).

[0025] The deflector sheave 18 for the counter weight is provided so that at least one part of it overlaps the counter weight 7 in vertical projection area in the hoistway 1. The first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight are mounted on the support bench 30.

[0026] Here, the idler pulley 14 is arranged so that it is between the main rope 20 (the first rope 21) extending from the drive sheave 12 to the first deflector sheave 16 for the car, and the main rope 20 extending from the drive sheave 12 to the deflector sheave 18 for the counter weight.

[0027] That is, it is possible to arrange the drive sheave 12, the idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car, and the deflector sheave 18 for the counter weight so that there is no fear of crossing of the main rope 20 and occurrence of interference during the process of passing the main rope 20 around them in the order of structure. Further, upon the situation in that the car 5 is to be suspended by the sides of the car 5 that are opposite to each other, it is preferable to suspend the car 5 at positions that are opposite to each other across the center of gravity of the car 5, and in that case, the two suspension points of the car 5 will be near the side walls of almost the middle of the hoistway 1 (near the main guide rails 2) at vertical direction view of the hoistway 1, as shown in Figure 1. Therefore, arranging the idler pulley 14 in the abovementioned manner makes it possible to store apparatus provided at the upper part of the hoistway such as the driving device 10, idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight which are mounted on the support bench 30 at one side of the hoistway when viewed in vertical projection area in one side of the hoistway 1,

based on a line obtained by connecting the attaching positions of the first deflector sheave 16 for the car and the second deflector 17 for the car as a standard line, and this secures saving of space at the upper part of the hoistway 1, reduces the size of the support bench 30 and secures space for maintenance.

[0028] Furthermore, the aforementioned is an example in which the idler pulley 14 is arranged in a suitable manner, however, depending on the layout of the elevator system, the idler pulley 14 may also be arranged so that it becomes between the main rope 20 extending from the drive sheave 12 to the second deflector sheave 17 for the car (the second rope 22), the main rope 20 extending from the drive sheave 12 to the deflector sheave 18 for the counterweight (specifically, between the main rope 20 extending from the drive sheave 12 to the deflector sheave 16 for the car (the first rope 21), the main rope 20 extending from the drive sheave 12 to the second deflector 17 for the car (the second rope 22)).

[0029] Moreover, in this elevator system, a control panel 33 for controlling ascents and descents of the car 5 and a governor 34 are mounted on the support bench 30, and the control panel 33, the governor 34 and the idler pulley 14 are provided so that they fit in the maximum height dimension of any of the driving device 10, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight. In Figure 2, they are positioned so that they stay within the height range of the driving device 10.

[0030] Figure 3 are sectional views showing the conventional and the present invention's drive sheaves grooves.

[0031] In Figure 3, in the drive sheave 13 in the conventional drive sheave, there has been arranged a special groove known by the name of undercut groove at the part where the main rope 23 contacts it, and the frictional force can be increased by the rope's biting in the groove, however, there is a problem that the abrasion of the rope is large and that the life of the main rope 23 is short. Therefore, the drive sheave 12 in the present application has a U-groove around which the main rope 20 is passed, and the diameter of the semicircular bottom part of this U-groove is formed so that it is approximate to the diameter of the main rope 20. Accordingly, as the contact of the drive sheave 12 and the main rope 20 becomes large, it is possible to reduce the surface pressure and is also advantageous to the life of the main rope 20.

[0032] According to the explanation above, in this embodiment, after the main rope 20 is passed around the drive sheave 12, it is passed around the idler pulley 14, and then passed around the drive sheave 12 again, thus making the hoisting angle which indicates the contact amount of the drive sheave 12 and the main rope 20 increase, and making it easy to obtain the predetermined traction.

[0033] Therefore, compared to the method using a conventional main rope 23 of a special type of rope of a synthetic fiber of high-friction material and also with a combination of a drive sheave 13 with a special undercut groove to provide traction, the present invention has a steel general-purpose main rope 20 and a drive sheave 12 with a U-groove around which the main rope 20 passes and of which the diameter of the semicircle at the bottom part is made so as to approximate the diameter of the main rope 20, thus making it possible that the necessary traction can be provided, and this leads to long life of the main rope 20 and moreover, to reduction of the cost at the time of manufacturing and inspection.

[0034] Further, in this embodiment, the driving device 10 is disposed on an upper part of a corner of the car 5, and the diameter of the idler pulley 14 is generally the same as the diameter of the drive sheave 12 or around 90% of it, and the idler pulley 14 is disposed at a predetermined distance from the driving device 10. That is, as the drive sheave 12 is placed at a corner in the hoistway 1 so that it would be the utmost far position from the other sheaves (i.e., the idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight), it is possible to keep a sufficient distance to relieve the twist between the drive sheave 12 and the other sheaves which are different in axial direction, and also to secure a sufficient angle of hoisting for the drive sheave 12.

[0035] Furthermore, in this embodiment, the control panel 33, the governor 34, the idler pulley 14, and in addition, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight are disposed so that they do not exceed the maximum height dimension of the driving device 10, besides, the support bench 30 may also be disposed in the abovementioned dimension, thus miniaturizing the upper part of the hoistway 1. Moreover, it is not only the driving device 10 that indicates the maximum height dimension; for example, one of the first deflector 16 for the car, the second car 17 for the car and the deflector sheave 18 for the counter weight could also be so.

[0036] Moreover, in the present invention, it is possible to gain traction easily by using a general-purpose rope, however, instead of a general-purpose rope, a high-tension thin rope may be used to obtain further traction ability. Here, under the laws and regulations, the relation between the diameter of the sheave and the diameter of the main rope is diameter of the sheave/diameter of the main rope ≥ 40 , so, by using a high-tension rope which is smaller in diameter than the conventional main rope, sheaves such as the drive sheave 12, the idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car and the deflector sheave 18 for the counter weight may be miniaturized, and also the driving device 10 may be miniaturized, so space-saving in the upper part of the hoistway

1 will improve.

Embodiment 2

[0037] Figure 4 is a plan view showing an example of an arrangement of the machineroom-less elevator system in accordance with the second embodiment of the present invention. In Embodiment 1, the counter weight 7 is disposed behind the car 5 in the hoistway 1, however, as in Figure 4, a counter weight 7 is disposed at one side of the car 5 in the hoistway 1. That is, when the counter weight 7 is viewed from an entrance 5a of the car 5, the counter weight 7 is made to ascend and descend along one side of the car 5, so also the sub-guide rails 3 are disposed at a side of the hoistway (in this case, the left side) when viewed from an entrance of the hoistway. In accordance to these changes, the form of the support bench 30 also changes. However, other structures and movements are basically the same as those in the First Embodiment, so the same numerals will be applied to the same or corresponding parts and the explanation will be omitted. Also in this Second Embodiment, the idler pulley 14 is arranged so that it is between the main rope 20 (the first rope 21) extending from the drive sheave 12 to the first deflector sheave 16 for the car, and the main rope 20 extending from the drive sheave 12 to the deflector sheave 18 for the counter weight.

[0038] Also in this embodiment, after the main rope 20 is passed around the drive sheave 12, it is passed around the idler pulley 14, and then passed around the drive sheave 12 again, thus making the hoisting angle which indicates the contact amount of the drive sheave 12 and the main rope 20 increase, and making it easy to obtain the predetermined traction.

[0039] As a result of this, from the method of increasing traction by using a special main rope using a synthetic high-friction fiber as the conventional main rope 23 and also a drive sheave 13 having a special undercut groove, it is possible to gain an equal traction by using a steel general-purpose rope 20 and a drive sheave 12 with a U-groove around which the main rope 20 passes and of which the diameter of the semicircular bottom part is made so as to approximate the diameter of the main rope 20, therefore lengthening the life of the main rope 20 and further, reducing the manufacture and inspection costs.

[0040] Moreover, as in conventional examples, there is no necessity to dispose a suspension part on top of the car 5, so it is possible to shorten the vertical dimension of the hoistway 1. Further, compared to the one-point support on top of the car 5 in conventional elevators, in the present invention, the car 5 is supported below at two points below the car 5, thus making it possible to reduce the strength of the structural members of the upper portion of the car 5, and also to reduce the weight and the manufacturing cost of the car 5.

[0041] Other similar effects can be obtained as in the

First Embodiment.

Embodiment 3

[0042] Figures 5 and 6 are plan views showing an example of an arrangement of the machineroom-less elevator system in accordance with the third embodiment of the present invention.

[0043] In the First Embodiment, the main rope 20 is comprised of a first rope 21 and a second rope 22, and is made to change direction of the part of the rope extending from the drive sheave 12 to the deflector sheave 16 for the car, and from the drive sheave 12 to deflector sheave 17 for the car, and the car 5 is supported by two brackets 6 at the bottom of the car 5. However, the present invention is not limited only to these features. In Figure 5, a main rope 20 of only one path is passed around a drive sheave 12, passed around the idler pulley 14, and then passed around the drive sheave 12. One end of the main rope 20 is made to change direction from the horizontal direction to the vertical direction by a deflector 18 for the counter weight, and extends to the counter weight 18. The other end of the main rope 20 extending from the drive sheave 12 to the car 5 is changed from the direction of the horizontal direction to the vertical direction by the deflector 15 for the car, and is connected to an upper beam 28 of the car 5 via a rope shackle 24 and a buffer material 25 (figure omitted).

[0044] As aforementioned, the present invention may be applied also to a roping method in which the car 5 is supported by only point of the upper beam 28. For this, as it is possible to secure a sufficient angle of hoisting and facilitates to secure the necessary traction (as in PCT international publication No. WO 02/16247 A1,) without using a special high-friction main rope 23 and a drive sheave 13 with an undercut groove, the use of general-purpose rope 20 becomes possible, thus making the life of the main rope longer, and reducing the manufacturing and inspection costs lower.

[0045] Furthermore, in Figure 5, the counter weight 7 is provided behind the car 5 in the hoistway 1, however, the present invention is also applicable for elevator systems in which the counter weight 7 is provided on the side of the car 5 in the hoistway 1, as shown in Figure 6.

[0046] In the above embodiments 1 to 3, as a preferred example, the support bench 30 on which the driving device 10, the idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car (the deflector sheave 15 for the car) and the deflector sheave 18 for the counter weight are disposed, is fixed to the support bench brackets 31 provided on the main guide rails 2 and the sub-guide rails 3, via the anti-vibration material 32. Here, normally, hoistway walls are formed so as to be strength members, and as an example of variants of these embodiments, the support bench 30 on which the driving device 10, the idler pulley 14, the first deflector sheave 16 for the car, the second deflector sheave 17 for the car (the deflector

sheave 15 for the car) and the deflector sheave 18 for the counter weight are disposed, may also be supported by a hoistway wall (figure omitted). Further, by putting an anti-vibration rubber material 32 between the support bench 30 and the hoistway wall, it is possible to prevent the vibration generated by the driving device 10 from transmitting to the wall.

Industrial Applicability

[0047] The present invention is composed as explained above and has the following effects.

[0048] According to the present application, by disposing the idler pulley at a predetermined place from the driving device, it is possible to increase the hoisting angle of the main rope to the drive sheave, and the friction between the main rope and the drive sheave, so it is possible to use a general-use rope instead of using a special high-friction main rope, thus securing a low-priced and stable life of a main rope. Also, it facilitates maintenance and inspection of the main ropes. Moreover, usage of a high-tension fine main rope may be used to miniaturize the diameters of the drive sheave, idler pulley and the deflector sheaves.

[0049] Moreover, as the car is supported by two points at the bottom of the sides, compared to the conventional suspension system, it is possible to reduce the strength of the structural members of the upper portion of the car, and also to reduce the manufacturing cost and the weight, and also to reduce vertical dimension at the upper part of the hoistway, thus making more improvement in saving of space, which is a merit of machinerom-less elevators. For this reason, the present invention is suitable for elevators which are to be provided at difficult social conditions of a location where there are limitations such as the appearance or the outlook in installation space of elevators due to the external appearance or height of buildings.

Claims

1. An elevator system comprising a driving device provided on a support bench disposed in an upper part of a hoistway, said driving device including a drive sheave with a main elevator rope passed around and an electric motor for rotating said drive sheave, with at least the rotation axis of said drive sheave arranged in vertical direction; and a car and a counter weight suspended by said main rope in said hoistway and ascended and descended by said driving device; **characterized by** comprising:

an idler pulley disposed at a predetermined distance from said driving device, its rotation axis being arranged in vertical direction;
a main rope with one end connected to said counter weight, a middle part of which is passed

around said drive sheave, and then around said idler pulley, and again around said drive sheave and then the other end connected to said car; at least one deflector sheave for a car provided on said support bench to change the direction of said main rope extending from said drive sheave to said car from the horizontal direction to the vertical direction; and
a deflector sheave for a counter weight provided on said support bench to change the direction of said main rope extending from said drive sheave to said counter weight from the horizontal direction to the vertical direction.

2. The elevator system according to claim 1, **characterized in that** said main rope comprises two parallel paths having independently a first rope and a second rope, and deflector sheaves for said car including a first deflector sheave for said car and a second deflector sheave for said car which are disposed apart from each other; and that of said main rope extending from said drive sheave to said car, said first rope extends to a predetermined part of said car via said first deflector sheave for said car, said second rope extends to another predetermined part of said car via said second deflector sheave for said car.
3. The elevator system according to claim 2, **characterized in that** ends of said first rope and said second rope are connected to said car at the opposite sides of said car.
4. The elevator system according to claim 2, **characterized in that** ends of said first rope and said second rope are connected to said car at positions that are opposite to each other across the center of gravity of said car.
5. The elevator system according to claim 1, **characterized in that** said driving device is formed so as to be thinner in rotational axis direction compared to radial direction.
6. The elevator system according to claim 1, **characterized in that** said drive sheave has a U-groove around which said main rope is passed over, and a diameter of the semicircle at the bottom part of this U-groove is made so as to approximate the diameter of said main rope.
7. The elevator system according to claim 1 or claim 2, **characterized in that** said idler pulley is arranged so that it is placed between said main rope from said drive sheave to said deflector sheave for said car and said main rope from said drive sheave to said deflector sheave for said counter weight.

8. The elevator system according to claim 1, **characterized in that** it is arranged so that at least one part of said deflector for said car and said deflector for said counter weight overlap in vertical projection area in said hoistway. 5
9. The elevator system according to claim 1, **characterized in that** said driving device is in a position near a corner at the rear part of said hoistway. 10
10. The elevator system according to claim 1, **characterized in** comprising a control panel to control said car and a governor, and said control panel, said governor and said idler pulley are positioned not to exceed the range of the maximum height dimension of any of said driving device, or said deflector sheave for said car and said deflector sheave for said counter weight. 15
11. The elevator system according to claim 1, **characterized in** comprising main guide rails to guide said car and sub-guide rails to guide said counter weight, and said support bench is supported by at least any of said main guide rails and said sub-guide rails, or a hoistway wall. 20 25
12. The elevator system according to claim 11, **characterized in that** said support bench has an anti-vibration material interposed between said main guide rails and said sub-guide rails, or said hoistway wall. 30

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Fig. 1

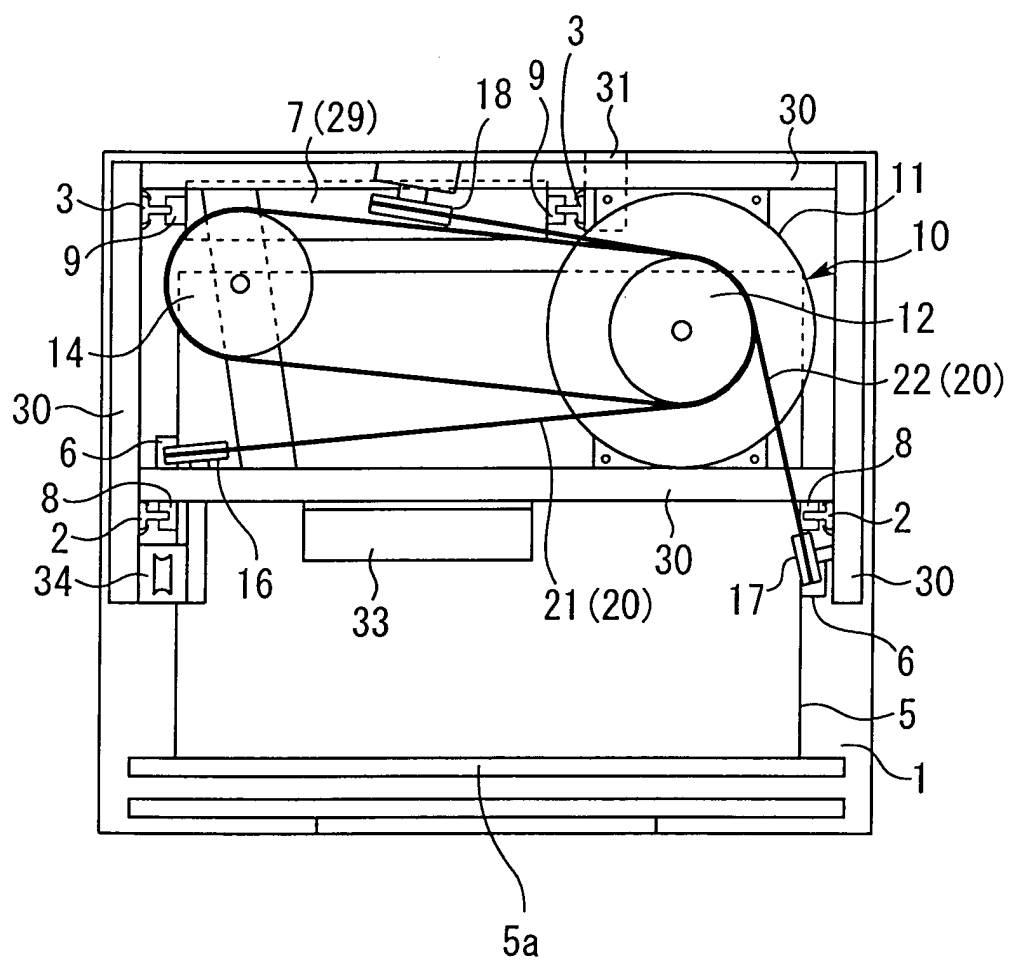


Fig. 2

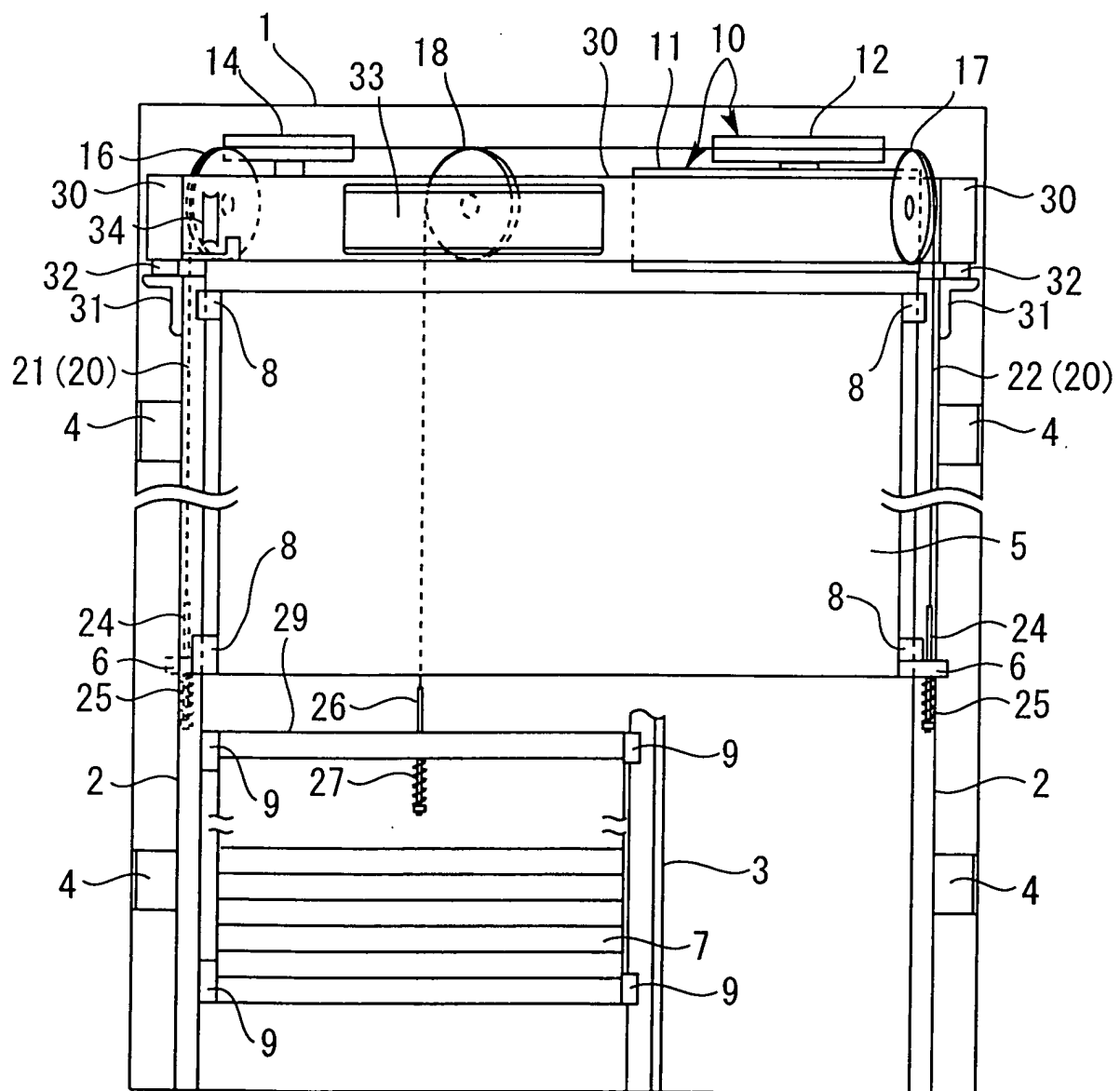


Fig. 3

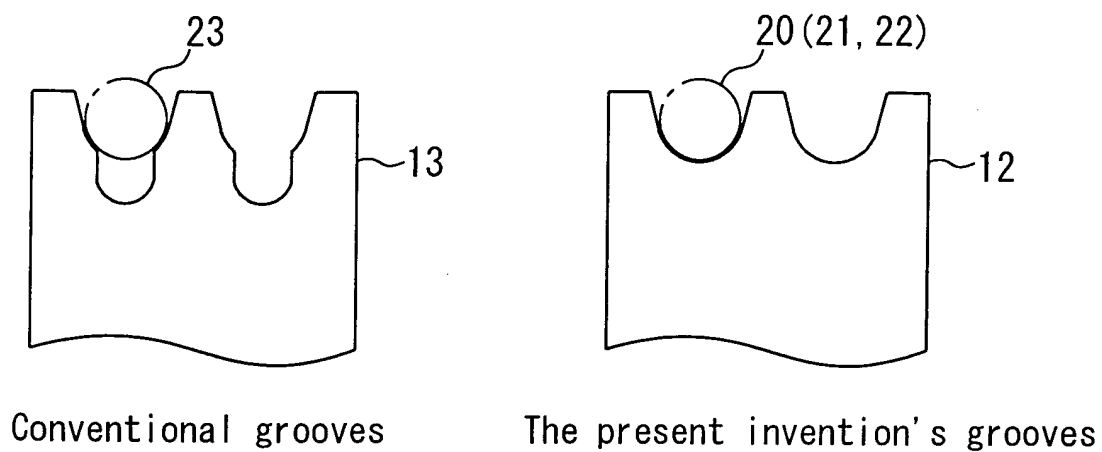


Fig. 4

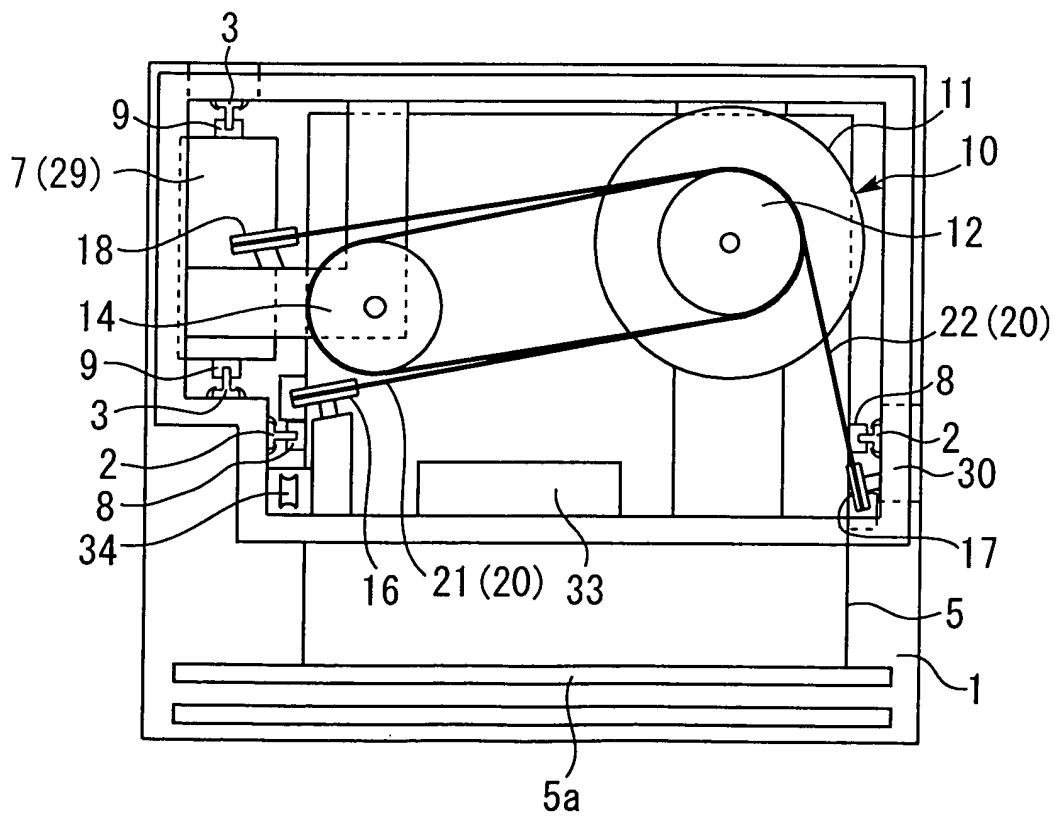


Fig. 5

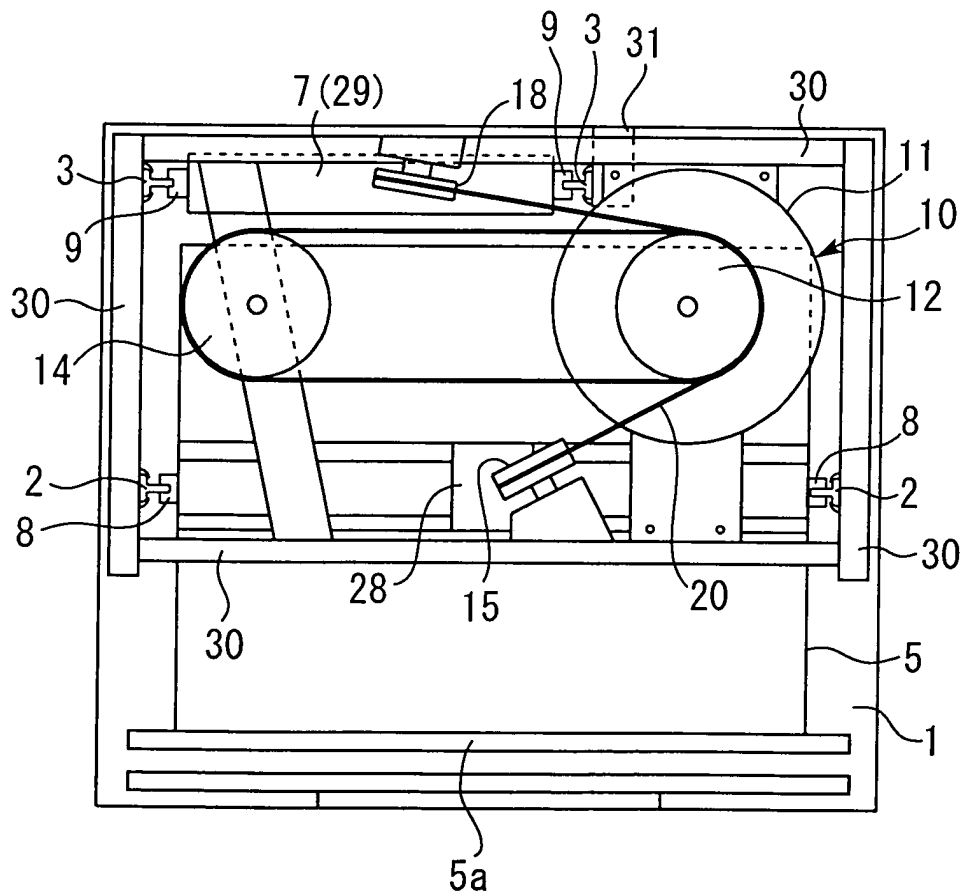
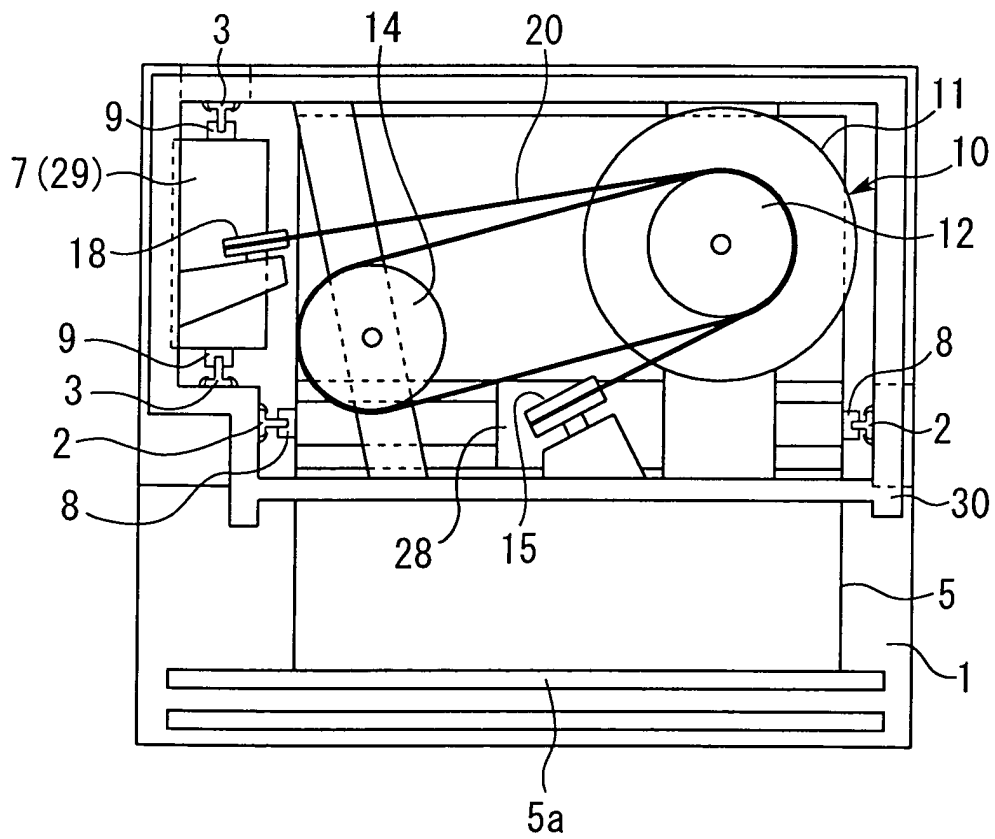


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/08914

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ B66B11/08, B66B7/06		
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 B66B7/00-B66B11/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Toroku Jitsuyo Shinan Koho 1994-2003		
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	WO 02/16247 A1 (MITSUBISHI DENKI KABUSHIKI KAISHA), 28 February, 2002 (28.02.02), & EP 1312573 A1	1-12
A	JP 10-139321 A (Inventio AG), 26 May, 1998 (26.05.98), & CA 2220582 A & EP 0841283 A1 & US 606865 A	1-12
A	JP 50-9703 Y1 (Hitachi Zosen Corp.), 25 March, 1975 (25.03.75), (Family: none)	1-12
☒ 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 28 May, 2003 (28.05.03)		Date of mailing of the international search report 10 June, 2003 (10.06.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/08914

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2664619 B2 (KONE Elevator GmbH), 15 October, 1997 (15.10.97), & AU 4175793 A & FI 923113 A & CA 2099858 A & EP 0578237 A1 & BR 9302786 A & CN 1086788 A & JP 6-156952 A & US 5370205 A	1-12
A	US 4566562 A (MITSUBISHI DENKI KABUSHIKI KAISHA), 28 January, 1986 (28.01.86), & FR 2521117 A & GB 2114528 A & CA 1194430 A & HK 93586 A & SG 67886 A & MY 1987 A & JP 58-117476 U	1-12
A	JP 50-48646 A (Hitachi, Ltd.), 30 April, 1975 (30.04.75), & AU 7303574 A & DE 2441992 A & CH 572436 A	1-12
A	GB 1313214 A (TURE HEDSTROM), 11 April, 1973 (11.04.73), & SE 327071 B & DE 2034305 A & NO 123055 B	1-12