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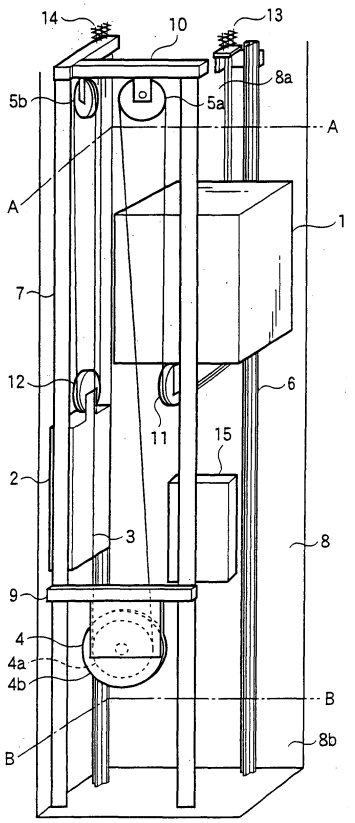
(54) Elevator apparatus

(57) In an elevator apparatus having no machine room, a thin type traction machine is arranged at a height, from which a top and a pit section of an elevating path are excluded, on a projection face of a horizontal cross-section of the elevating path between a cage and an elevating path wall, and direction-change-pulleys are arranged at upper positions of the traction machine on a projection face of a horizontal cross-section of the elevating path being inclined with respect to the elevating path wall.

FIG.1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus, in the elevating path of which there are provided a cage, counterweight, rope for suspending both the cage and the counterweight, traction machine for driving the rope, and direction-change-pulley for changing the suspending direction of the rope.

BACKGROUND ART

[0002] Figs. 12 and 13 are respectively a plan view and side view showing a conventional elevator apparatus which are illustrated in Figs. 2 and 1 in the official gazette of Japanese Unexamined Patent Publication No. 9-165172.

[0003] In the drawings, reference numeral 1 is a cage in which passengers or goods are carried, reference numeral 2 is a counterweight for compensating the weight of the cage 1, reference numeral 3 is a rope for suspending the cage 1 and counterweight 2, reference numeral 4 is a thin type traction machine for driving and elevating the cage 1 and counterweight 2 via the rope 3, reference numeral 4a is a sheave of the traction machine, reference numerals 5a, 5b are direction-change-pulleys for changing the suspending direction of the rope 3, reference numeral 6 is a guide rail for guiding the cage, reference numeral 7 is a guide rail for guiding the counterweight, reference numeral 8 is an elevating path, reference numeral 11 is a hanging pulley for hanging the cage 1, reference numeral 12 is a hanging pulley for hanging the counterweight 2, reference numeral 13 is a rope fixing device for fixing the rope on the cage side, and reference numeral 14 is a rope fixing device for fixing the rope on the counterweight side.

[0004] Next, referring to Figs. 12 and 13, the conventional elevator apparatus will be explained below.

[0005] The cage 1 of the elevator and the counterweight 2 are elevated via the rope 3 suspended by the sheave 4a of the traction machine 4. At this time, the guide rail 6 for the cage restricts a movement of the cage 1 in the horizontal direction, and the guide rail 7 for the counterweight restricts a movement of the counterweight 2 in the horizontal direction. Therefore, the cage 1 and the counterweight 2 neither come into contact nor interfere with other equipment arranged in the elevating path and the elevating path itself. In this case, vertical projections of the cage 1, counterweight 2 and traction machine 4 are separated from each other, and the traction machine 4 is located in parallel with one wall face adjacent to the traction machine.

[0006] Concerning the recent elevator apparatus, in order to minimize an occupation space of the elevator apparatus, various types of elevator apparatus are proposed in which no machine room is provided and the traction machine is housed in the elevating path. Specifically, the following three systems are proposed.

(1) System in which a thin type traction machine is arranged in an upper portion of the upper limit of elevation of a counterweight

(2) System in which a traction machine is arranged at the top of an elevating path, that is, the traction machine is arranged at an upper position of the ceiling of a cage which has stopped at the uppermost floor

(3) System in which a traction machine is arranged in a pit section of an elevating path, that is, the traction machine is arranged at a lower position of the floor of a cage which has stopped at the lowermost floor

[0007] Items (1) and (2) described above have the following disadvantages. Height of the elevating path must be larger than the necessary minimum height of elevating path which is necessary for the elevator to be elevated. Further, there is a possibility that the ceiling of the elevating path unexpectedly strikes a maintenance worker on his head when he conducts maintenance work of the traction machine on the cage at the top of the elevating path. Therefore, it is necessary to take countermeasure for protecting the maintenance worker. Item (2) is disadvantageous in that heat generated by the traction machine stays at the top of the elevating path and temperature is raised, so that the traction machine tends to become out of order. Item (3) is disadvantageous in that the elevator apparatus must be provided with a protection means for protecting the traction machine because the traction machine is arranged in the pit which is most likely to be covered with water. According to the elevator apparatus disclosed in the above Japanese Unexamined Patent Publication No. 9-165172, the problems described in item (1) can be solved. However, the elevator apparatus disclosed in the above Japanese Unexamined Patent Publication No. 9-165172 creates a new disadvantage in which unused spaces are generated all over the height of the elevating path in the upper and the lower portion on the vertical projection face of the traction machine.

[0008] As described above, the conventional elevating apparatus creates a disadvantage in which unused spaces are generated all over the height of the elevating path in the upper and the lower portion on the vertical projection face of the traction machine.

DISCLOSURE OF THE INVENTION

[0009] The present invention has been accomplished to solve the above problems. It is an object of the present invention to provide an elevator apparatus characterized in that: generation of unused spaces in the elevating path is suppressed; breakdown of the traction machine caused by a raise in the temperature is suppressed; the traction machine is not damaged even if the elevating

path is covered with water; and it is unnecessary to provide a protective means for protecting a maintenance worker when the cage is unexpectedly elevated in the process of maintenance.

[0010] In order to accomplish the above object, the present invention provides an elevator apparatus comprising: a cage elevating in an elevating path; a counterweight moving in an opposite direction to the cage; a guide rail for the cage to restrict a movement of the cage in the horizontal direction; a guide rail for the counterweight to restrict a movement of the counterweight in the horizontal direction; a rope for suspending the cage and counterweight; a traction machine, round which the rope is wound, for elevating the cage and counterweight via the rope in the elevating path, the traction machine being formed into a thin type, the traction machine being arranged in parallel with one wall face in the horizontal cross-section of the elevating path at an upper position of the floor face of the cage when the cage stops at the lowermost floor of the elevating path and at a lower position of the ceiling of the cage when the cage stops at the uppermost floor; and a direction-change-pulley arranged obliquely with respect to the wall face at an upper position of the traction machine.

[0011] The present invention also provides an elevator apparatus in which at least one of the traction machine and the direction-change-pulley is fixed to a beam supported by the guide rail for the cage or the guide rail for the counterweight.

[0012] The present invention also provides an elevator apparatus in which a lower end of the traction machine is arranged at an upper position of the floor face of the cage in the elevating path when the cage stops at the lowermost floor.

[0013] The present invention also provides an elevator apparatus in which a lower end of the traction machine is arranged at an upper position of the first floor face.

[0014] The present invention also provides an elevator apparatus in which the traction machine is arranged at an upper position of the reference floor face.

[0015] The present invention also provides an elevator apparatus in which the traction machine is arranged at an upper position of the uppermost floor face.

[0016] The present invention also provides an elevator apparatus in which the traction machine is attached to a beam for supporting the direction-change-pulley from the lower side.

[0017] The present invention also provides an elevator apparatus in which the traction machine is attached to a beam for supporting the direction-change-pulley from the lower side, and the beam has a vibration proof structure.

[0018] The present invention also provides an elevator apparatus in which at least a portion of the traction machine and a portion of the direction-change-pulley are arranged being put on each other on a projection face of a horizontal cross-section of the elevating path.

[0019] The present invention also provides an elevator apparatus in which a sheave or motor of the traction machine protrudes from the back face of the guide rail to the cage side on a horizontal cross-section of the elevating path.

[0020] The present invention also provides an elevator apparatus in which a control panel for controlling the traction machine is arranged at the substantially same level as that of the traction machine or right above or right below the traction machine close to it.

[0021] The present invention also provides an elevator apparatus in which a lower end of the control panel is arranged at an upper position of the floor face of the cage in the elevating path when the cage stops at the lowermost floor.

[0022] The present invention also provides an elevator apparatus in which a lower end of the control panel is arranged at an upper position of the first floor face in the elevating path.

[0023] The present invention also provides an elevator apparatus in which one of the direction-change-pulleys is composed of a drive unit.

[0024] The present invention also provides an elevator apparatus in which an inclination angle of the direction-change-pulley with respect to the wall face of the elevating path is made variable or a distance between the direction-change-pulleys on a horizontal cross-section of the elevating path is made variable.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 is a perspective view of the elevator apparatus of Embodiment 1 of the present invention.

Fig. 2 is a plan view of the elevator apparatus of Embodiments 1 and 4 of the present invention.

Fig. 3 is a schematic illustration of "the back face" of the guide rail used in Embodiments 1 to 5 of the present invention.

Fig. 4 is a perspective view of the elevator apparatus of Embodiment 2 of the present invention.

Fig. 5 is a plan view of the elevator apparatus of Embodiment 2 of the present invention.

Fig. 6 is a perspective view of the elevator apparatus of Embodiment 3 of the present invention.

Fig. 7 is a plan view of the elevator apparatus of Embodiment 3 of the present invention.

Fig. 8 is a perspective view of the elevator apparatus of Embodiment 4 of the present invention.

Fig. 9 is a view showing a primary portion of the elevator apparatus of Embodiment 4 of the present invention.

Fig. 10 is a view showing a primary portion of the elevator apparatus of Embodiment 4 of the present invention.

Fig. 11 is a perspective view of the elevator apparatus of Embodiment 5 of the present invention.

Fig. 12 is a plan view of the conventional elevator apparatus shown in Japanese Unexamined Patent

Publication No. 9-165172.

Fig. 13 is a side view of the conventional elevator apparatus shown in Japanese Unexamined Patent Publication No. 9-165172.

BEST MODE FOR CARRYING OUT THE INVENTION

[0026] Embodiments of the present invention will be explained as follows.

(EMBODIMENT 1)

[0027] Referring to Figs. 1 to 3, Embodiment 1 of the elevator apparatus of the present invention will be explained below.

[0028] Fig. 1 is a perspective view of the elevator apparatus of Embodiment 1 of the present invention, and Fig. 2 is a plan view. This is an example in which the counterweight is arranged at the rear of the cage with respect to the entrance of the elevator and the traction machine is arranged on the side of the cage.

[0029] In the drawings, reference numeral 1 is a cage in which passengers or goods are carried, reference numeral 2 is a counterweight for compensating the weight of the cage 1, reference numeral 3 is a rope for suspending the cage 1 and counterweight 2, reference numeral 4 is a thin type traction machine for driving and elevating the cage 1 and counterweight 2 via the rope 3, reference numeral 4a is a sheave of the traction machine, reference numeral 4b is a motor of the traction machine, reference numerals 5a, 5b are direction-change-pulleys for changing the suspending direction of the rope 3, reference numeral 6 is a guide rail for guiding the cage, reference numeral 7 is a guide rail for guiding the counterweight, reference numeral 8 is an elevating path, reference numeral 8a is a top portion of the elevating path 8, reference numeral 8b is a pit section of the elevating path, reference numeral 9 is a beam for supporting the traction machine 4, reference numeral 10 is a beam for supporting the direction-change-pulley 5, reference numeral 11 is a hanging pulley for hanging the cage 1, reference numeral 12 is a hanging pulley for hanging the counterweight 2, reference numeral 13 is a rope fixing device for fixing the rope on the cage side, reference numeral 14 is a rope fixing device for fixing the rope on the counterweight side, and reference numeral 15 is a control panel. In this connection, one-dotted chain line A in Fig. 1 shows a height of the ceiling of the cage when it stops at the uppermost floor. That is, an upper portion of this one-dotted chain line A is a top portion. One-dotted chain line B in Fig. 1 shows a height of the floor of the cage when it stops at the lowermost floor. That is, a lower portion of this one-dotted chain line B is a pit portion.

[0030] As shown in the drawing, the lower end of the traction machine 4 is located at an upper position of one-dotted chain line B. That is, the traction machine 4 is arranged at a lower position of the ceiling of the cage when the cage stops at the uppermost floor, and the lower end of the traction machine is arranged at an upper position of the floor face of the cage when the cage stops at the lowermost floor. The traction machine 4 is arranged in parallel with one wall adjacent to the traction machine 4.

[0031] Further, a portion of the direction-change-pulley 5a is arranged being put on the traction machine 4 on the projection face of a horizontal cross-section of the elevating path 8. The direction-change-pulley 5b is arranged being inclined with respect to the wall face.

[0032] Further, the traction machine 4 is fixed to the lower side of the beam 9 which is supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight. The sheaves 4a of the traction machine 4 is located on the cage side with respect to the back face of the guide rail 6 for the cage on a horizontal cross-section of the elevating path 8. In this case, the back face of the guide rail is defined as a portion C shown in Fig. 3. In this embodiment, the traction machine 4 is directly fixed to the beam 9, however, it is possible to attach the traction machine 4 to the beam 9 via an elastic body so that a vibration proof structure can be provided. It is possible to arrange an elastic body between the beam 9 and the guide rail 6 for the cage and also it is possible to arrange an elastic body between the beam 9 and the guide rail 7 for the counterweight.

[0033] The direction-change-pulleys 5a, 5b are fixed to the beam 10 which is supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight. In this embodiment, the direction-change-pulleys 5a, 5b are directly fixed to the beam 10, however, it is possible to attach the direction-change-pulleys 5a, 5b to the beam 10 via an elastic body so that a vibration proof structure can be provided. It is possible to arrange an elastic body between the beam 10 and the guide rail 6 for the cage and also it is possible to arrange an elastic body between the beam 10 and the guide rail 7 for the counterweight.

[0034] Further, the control panel 15 is arranged in such a manner that the lower end of the control panel 15 is located at an upper position of the floor of the cage when the cage stops at the lowermost floor, that is, the control panel 15 is located at the substantially same height as that of the traction machine 4.

[0035] A direction of the rope 3 suspended by the sheave 4a of the traction machine 4, which is driven by the control panel 15, is changed by the direction-change-pulleys 5a, 5b. Due to the foregoing, the cage 1 and the counterweight 2 can be elevated via the hanging pulley 11 of the cage and the hanging pulley 12 of the counterweight. At this time, the guide rail 6 for the cage and the guide rail 7 for the counterweight restrict horizontal movements of the cage 1 and the counterweight 2.

[0036] The direction-change-pulley 5a is arranged in such a manner that a portion of the direction-change-pulley. 5a is put on the traction machine 4 on the projection face of a horizontal cross-section of the elevating path 8 and further the sheave 4a of the traction machine 4 is located on the cage side with respect to the back

face of the guide rail 6 for the cage in a horizontal cross-section of the elevating path 8. Therefore, an occupation area occupied by the traction machine 4 on the projection face of the horizontal cross-section of the elevating path 8 is reduced. Accordingly, an unused space with respect to the entire height of the elevating path can be reduced. Further, a wrapping angle of the rope wound round the sheave 4a of the traction machine becomes larger than 180°. Therefore, the traction capacity can be enhanced. Furthermore, since the traction machine 4 is arranged at a lower position of the ceiling of the cage when the cage stops at the uppermost floor, there is no possibility that the ceiling of the elevating path unexpectedly strikes a maintenance worker on his head when he conducts maintenance work of the traction machine on the cage at the top of the elevating path. Therefore, it is unnecessary to take countermeasure for protecting the maintenance worker. Heat generated by the traction machine is emitted upward to the ceiling of the elevating path. Accordingly, there is no possibility that the traction machine becomes out of order by a raise in the temperature. Since the direction-change-pulley 5b is inclined with respect to the wall face of the elevating path 8, an entering angle of the rope 3, by which the rope 3 enters the rope groove 3 of the sheave 4a, becomes small, so that the rope can be prevented from being damaged.

[0037] Since the traction machine 4 is attached to a lower portion of the beam 9 and the direction-change-pulleys 5a, 5b are attached to the beam 10, an upward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 9 and a downward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 10 are canceled inside the guide rails, so that the force given to a building can be reduced.

[0038] Further, the lower end of the traction machine 4 and the lower end of the control panel 15 are respectively located at upper positions of the floor face of the cage when the cage stops at the lowermost floor and also located at lower positions of the face of the ceiling of the cage. Therefore, even if the pit is covered with water, there is no possibility that the traction machine 4 and the control panel 15 are damaged by water.

[0039] In this type elevator apparatus having no machine room, depth of the pit is approximately 1.2 m to 1.5 m. When the traction machine and the control panel are arranged at these positions, a maintenance worker can reach the traction machine and the control panel with his hands when he stands on the pit floor, for example, the traction machine and the control panel are located at the height from 1.2 m to 1.7 m (When the cage stops at the lowermost floor, the height of the floor of the cage is 1.7 m from the pit floor.). Therefore, it is easy for the worker to conduct the maintenance work.

[0040] In this connection, when the lower end of the traction machine 4 and the lower end of the control panel 15 are arranged at upper positions of the face of the floor of the cage when the cage stops at the first floor and also arranged at lower positions of the face of the ceiling of the cage, there is no possibility that the traction machine 4 and the control panel 15 are damaged even if not only the pit but also the entire underground floor is covered with water.

[0041] In the case where the lower end of the traction machine 4 is arranged at an upper position of the face of the floor of the cage when the cage stops at the reference floor and also the lower end of the traction machine 4 is arranged at a lower position of the face of the ceiling of the cage and further the control panel 15 is arranged at the substantially same height, maintenance work can be easily performed according to the operation management of the elevator apparatus.

[0042] When the lower end of the traction machine 4 is arranged at an upper position of the face of the floor of the cage when the cage stops at the uppermost floor and also the lower end of the traction machine 4 is arranged at a lower position of the face of the ceiling of the cage, the traction machine 4 and the direction-change-pulleys 5a, 5b are closely located with respect to the height. Therefore, both the traction machine 4 and the direction-change-pulleys 5a, 5b can be conveniently inspected for maintenance.

[0043] It is possible to save the material and reduce the space by integrating the beams for supporting both the traction machine 4 and the direction-change-pulleys 5a, 5b.

(EMBODIMENT 2)

[0044] Referring to Figs. 4 and 5, Embodiment 2 of the elevator apparatus of the present invention will be explained below.

[0045] Fig. 4 is a perspective view of Embodiment 2 of the elevator apparatus of the present invention. Fig. 5 is a plan view. This is an example in which the counterweight is arranged at the rear of the cage with respect to the entrance of the elevator and the traction machine is arranged on the side of the elevating space of the counterweight. In the drawing, like reference characters are used to indicate like parts, and explanations are omitted here.

[0046] As shown in the drawing, the lower end of the traction machine 4 is located at an upper position of one-dotted chain line B. That is, the traction machine 4 is arranged at a position lower than the ceiling of the cage when the cage stops at the uppermost floor, and the lower end of the traction machine 4 is arranged at an upper position of the floor face of the cage when the cage stops at the lowermost floor. The traction machine 4 is arranged in parallel with one wall adjacent to it.

[0047] Further, the direction-change-pulleys 5a, 5b are arranged in such a manner that portions of the direction-change-pulleys 5a, 5b are put on the traction machine 4 on a projection face of a horizontal cross-section of the elevating path 8. Since the direction-change-pulley 5b is

inclined with respect to the wall face of the elevating path 8, an entering angle of the rope 3 with respect to the rope groove of the sheave 4a becomes small. Therefore, the rope can be prevented from being damaged.

[0048] Further, the traction machine 4 is fixed to the beam 9, which is supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight, from the lower side. In this embodiment, the traction machine 4 is directly fixed to the beam 9, however, it is possible that the traction machine 4 is fixed to the beam via an elastic body so that a vibration proof structure can be provided. Further, the beam 9 can be attached to the guide rail 6 for the cage and the guide rail 7 for the counterweight via elastic bodies.

[0049] The direction-change-pulley 5 is fixed to the beam 10 supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight. In this embodiment, the direction-change-pulley 5 is directly fixed to the beam 10, however, the direction-change-pulley 5 may be fixed to the beam 10 via an elastic body so that a vibration proof structure can be provided. Further, the beam 10 can be attached to the guide rail 6 for the cage and the guide rail 7 for the counterweight via elastic bodies.

[0050] Further, the control panel 15 is arranged at a position right above or right below very close to the traction machine 4 where a projection face of the control panel 15 is put on the traction machine 4 on a horizontal cross-section of the elevating path 8.

[0051] A direction of the rope 3 suspended by the sheave 4a of the traction machine 4, which is driven by the control panel 15, is changed by the direction-change-pulley 5. Due to the foregoing, the cage 1 and the counterweight 2 can be elevated via the hanging pulley 11 of the cage and the hanging pulley 12 of the counterweight. At this time, the guide rail 6 for the cage and the guide rail 7 for the counterweight restrict horizontal movements of the cage 1 and the counterweight 2.

[0052] The direction-change-pulley 5a is arranged in such a manner that a portion of the direction-change-pulley 5a is put on the traction machine 4 on the projection face, of a horizontal cross-section of the elevating path 8 and further the control panel 15 is arranged at a position right above or right below very close to the traction machine 4 where a projection face of the control panel 15 is put on the traction machine 4 on a horizontal cross-section of the elevating path 8. Therefore, an occupation area occupied by the traction machine 4 on the projection face of the horizontal cross-section of the elevating path 8 is reduced. Furthermore, since the traction machine 4 is arranged at a lower position of the ceiling of the cage when the cage stops at the uppermost floor, there is no possibility that the ceiling of the elevating path unexpectedly strikes a maintenance worker on his head when he is conducting maintenance work of the traction machine on the cage at the top of the elevating path. Therefore, it is unnecessary to take countermeasure for protecting the maintenance worker. Heat generated by the traction machine is emitted upward to the ceiling of the elevating path. Accordingly, there is no possibility that the traction machine becomes out of order by a raise in the temperature.

[0053] Since the traction machine 4 is attached to a lower portion of the beam 9 and the direction-change-pulleys 5a, 5b are attached to the beam 10, an upward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 9 and a downward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 10 are canceled inside the guide rails, so that a force given to a building can be reduced.

[0054] Further, the lower end of the traction machine 4 is located at an upper position of the floor face of the cage when the cage stops at the lowermost floor and further the control panel 15 is arranged at a position right above or right below very close to the traction machine 4 where a projection face of the control panel 15 is put on the traction machine 4 on a horizontal cross-section of the elevating path 8. Therefore, even if the pit is covered with water, there is no possibility that the traction machine 4 and the control panel 15 are damaged by water.

[0055] In this type elevator apparatus having no machine room, depth of the pit is approximately 1.2 m to 1.5 m. When the traction machine and the control panel are arranged at these positions, a maintenance worker can reach the traction machine and the control panel with his hands when he stands on the pit floor, for example, the traction machine and the control panel are located at the height from 1.2 m to 1.7 m (When the cage stops at the lowermost floor, the height of the floor of the cage is 1.7 m from the pit floor.). Therefore, it is easy for the worker to conduct the maintenance work.

[0056] In this connection, when the lower end of the traction machine 4 is arranged at an upper position of the floor face of the cage when the cage stops at the first floor and also arranged at' a lower position of the face of the ceiling of the cage and also when the control panel 15 is arranged at a position right above or right below very close to the traction machine 4 where a projection face of the control panel 15 is put on the traction machine 4 on a horizontal cross-section of the elevating path 8, there is no possibility that the traction machine 4 and the control panel 15 are damaged even if not only the pit but also the entire underground floor is covered with water.

[0057] When the lower end of the traction machine 4 is arranged at an upper position of the floor face of the cage when the cage stops at the reference floor and also when the control panel 15 is arranged at a position right above or right below very close to the traction machine 4 where a projection face of the control panel 15 is put on the traction machine 4 on a horizontal cross-section of the elevating path 8, maintenance work can be easily performed according to the operation management of the elevator apparatus.

[0058] When the lower end of the traction machine 4

is arranged at an upper position of the face of the floor of the cage when the cage stops at the uppermost floor and also arranged at a lower position of the face of the ceiling of the cage, the traction machine 4 and the direction-change-pulleys 5a, 5b are closely located with respect to the height. Therefore, both the traction machine 4 and the direction-change-pulleys 5a, 5b can be conveniently inspected.

[0059] It is possible to save the material and reduce the space by integrating the beams for supporting both the traction machine 4 and the direction-change-pulleys 5a, 5b.

(EMBODIMENT 3)

[0060] Referring to Figs. 6 and 7 and also referring to Fig. 3, Embodiment 3 of the elevator apparatus of the present invention will be explained below.

[0061] Fig. 6 is a perspective view of Embodiment 3 of the elevator apparatus of the present invention. Fig. 7 is a plan view. This is an example in which the counterweight is arranged on the side of the cage with respect to the entrance of the elevator and the traction machine is arranged on the same side as that of the counterweight so that a projection face of the traction machine can not be put on the counterweight on a horizontal cross-section of the elevating path. In the drawing, like reference characters are used to indicate like parts, and explanations are omitted here.

[0062] As shown in the drawing, the lower end of the traction machine 4 is located at an upper position of one-dotted chain line B. That is, the traction machine 4 is arranged at a position lower than the ceiling of the cage when the cage stops at the uppermost floor, and the lower end of the traction machine 4 is arranged at an upper position of the floor face of the cage when the cage stops at the lowermost floor. The traction machine 4 is arranged in parallel with one wall adjacent to it.

[0063] Further, the direction-change-pulley 5a is arranged in such a manner that a portion of the direction-change-pulley 5a is put on the traction machine 4 on a projection face of a horizontal cross-section of the elevating path 8. Since the direction-change-pulleys 5a, 5b are inclined with respect to the wall face of the elevating path 8, an entering angle of the rope 3 with respect to the sheave 4a becomes small. Therefore, the rope can be prevented from being damaged. Further, the traction machine 4 is fixed to the beam 9, which is supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight, from the lower side. The motor 4b of the traction machine 4 is located on the cage side of the back face of the guide rail 6 for the cage on a horizontal cross-section of the elevating path 8. In this case, the back face of the guide rail is defined as a portion C in Fig. 3. In this embodiment, the traction machine 4 is directly fixed to the beam 9, however, it is possible that the traction machine 4 is fixed to the beam via an elastic body so that a vibration proof structure can be provided. Further, the beam 9 can be attached to the guide rail 6 for the cage and the guide rail 7 for the counterweight via elastic bodies.

[0064] The direction-change-pulley 5 is fixed to the beam 10 supported by the guide rail 6 for the cage and the guide rail 7 for the counterweight. In this embodiment, the direction-change-pulley 5 is directly fixed to the beam 10, however, the direction-change-pulley 5 may be fixed to the beam 10 via an elastic body so that a vibration proof structure can be provided. Further, the beam 10 can be attached to the guide rail 6 for the cage and the guide rail 7 for the counterweight via elastic bodies.

[0065] A direction of the rope 3 suspended by the sheave 4a of the traction machine 4, which is driven by the control panel 15, is changed by the direction-change-pulley 5. Due to the foregoing, the cage 1 and the counterweight 2 can be elevated via the hanging pulley 11 of the cage and the hanging pulley 12 of the counterweight. At this time, the guide rail 6 for the cage and the guide rail 7 for the counterweight restrict horizontal movements of the cage 1 and the counterweight 2.

[0066] The direction-change-pulley 5a is arranged in such a manner that a portion of the direction-change-pulley 5a is put on the traction machine 4 on the projection face of a horizontal cross-section of the elevating path 8 and further the motor 4b of the traction machine 4 is located on the cage side with respect to the back face of the guide rail 6 for the cage in a horizontal cross-section of the elevating path 8. Therefore, an occupation area occupied by the traction machine 4 on the projection face of the horizontal cross-section of the elevating path 8 is reduced. Further, since the traction machine 4 is arranged at a lower position of the ceiling of the cage when the cage stops at the uppermost floor, there is no possibility that the ceiling of the elevating path unexpectedly strikes a maintenance worker on his head who is conducting maintenance work of the traction machine on the cage at the top of the elevating path. Therefore, it is unnecessary to take countermeasure for protecting the maintenance worker. Heat generated by the traction machine is emitted upward to the ceiling of the elevating path. Accordingly, there is no possibility that the traction machine becomes out of order by a raise in the temperature.

[0067] Since the traction machine 4 is attached to a lower portion of the beam 9 and the direction-change-pulleys 5a, 5b are attached to the beam 10, an upward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 9 and a downward force caused by the tension of the rope 3 acting on the guide rail 6 for the cage and the guide rail 7 for the counterweight via the beam 10 are canceled inside the guide rails, so that a force given to a building can be reduced.

[0068] Further, the lower end of the traction machine 4 and the lower end of the control panel 15 are respectively located at upper positions of the floor face of the cage when the cage stops at the lowermost floor and

also located at lower positions of the face of the ceiling of the cage. Therefore, even if the pit is covered with water, there is no possibility that the traction machine 4 and the control panel 15 are damaged by water.

[0069] In this type elevator apparatus having no machine room, depth of the pit is approximately 1.2 m to 1.5 m. When the traction machine and the control panel are arranged at these positions, a maintenance worker can reach the traction machine and the control panel with his hands when he stands on the pit floor, for example, the traction machine and the control panel are located at the height from 1.2 m to 1.7 m (When the cage stops at the lowermost floor, the height of the floor of the cage is 1.7 m from the pit floor.). Therefore, it is easy for the worker to conduct the maintenance work.

[0070] In this connection, when the lower end of the traction machine 4 is arranged at an upper position of the floor face of the cage when the cage stops at the first floor and the upper end of the traction machine 4 is arranged at a lower position of the ceiling face of the cage and also when the control panel 15 is arranged at the substantially same level as that of the traction machine 4, there is no possibility that the traction machine 4 and the control panel 15 are damaged even if not only the pit but also the entire underground floor is covered with water.

[0071] In the case where the lower end of the traction machine 4 is arranged at an upper position of the face of the floor of the cage when the cage stops at the reference floor and the upper end of the traction machine 4 is arranged at a lower position of the face of the ceiling of the cage and further the control panel 15 is arranged at the substantially same height, maintenance work can be easily performed according to the operation management of the elevator apparatus.

[0072] When the lower end of the traction machine 4 is arranged at an upper position of the face of the floor of the cage when the cage stops at the uppermost floor and also the upper end of the traction machine 4 is arranged at a lower position of the face of the ceiling of the cage, the traction machine 4 and the direction-change-pulleys 5 are closely located with respect to the height. Therefore, both the traction machine 4 and the direction-change-pulleys 5 can be conveniently inspected for maintenance.

(EMBODIMENT 4)

[0073] Referring to Figs. 8 to 10, Embodiment 4 of the elevator apparatus of the present invention will be explained below.

[0074] Fig. 8 is a perspective view of Embodiment 4 of the elevator apparatus of the present invention. Fig. 2 is a plan view. Figs. 9 and 10 are views showing a primary portion. This is an example in which the counterweight is arranged at the rear of the cage with respect to the entrance of the elevator, and the traction machine is arranged on the side of the cage on the lower side of the beam to support the direction-change-pulleys right below the height of the ceiling of the cage when the cage stops at the uppermost floor. Like reference characters are used to indicate like parts and explanations are omitted here.

[0075] In the drawing, reference numeral 16 is an elastic body for absorbing vibration of the beam 10. In this case, inclination angles of the direction-change-pulleys 5 with respect to the elevating path wall are variable, and the interval between the two direction-change-pulleys 5 is also variable. The variable structure can be realized, for example, when the beam 10 and the frame of the direction-change-pulleys 5 are fastened to each other with bolts, and the fastening holes are formed into long holes. However, it should be noted that the variable structure is not limited to the above specific embodiment. This variable structure can be also applied to Embodiments 1 to 3.

[0076] Since the traction machine 4 is attached to a lower portion of the beam 10 for supporting the direction-change-pulleys 5, a force acting upward on the sheave 4a of the traction machine 4 by tension and a force acting downward on the direction-change-pulleys 5 are canceled to each other, that is, the forces acting on the beam 10 as inner forces are canceled to each other. Therefore, an intensity of the force acting on the guide rails can be reduced.

[0077] Since the traction machine 4 and the direction-change-pulleys 5 are attached to the same beam 10, the relative positions of the traction machine 4 and the direction-change-pulleys 5 can be easily adjusted.

[0078] Since the traction machine 4 and the direction-change-pulleys 5 are attached to the same beam 10 and further the beam 10 is attached to the guide rail 6 for the cage and the guide rail 7 for the counterweight via the elastic body 16, vibration of the traction machine 4 and the direction-change-pulleys 5 can be effectively insulated.

[0079] Further, inclination angles of the direction-change-pulleys 5 with respect to the elevating path wall are variable and the interval between the two direction-change-pulleys 5 is also variable. Therefore, the same design can be applied even if the size of the cage 1 is different so that the positional relation between the cage hanging pulley 12 and the counterweight hanging pulley 13 on the elevating path plane is changed.

(EMBODIMENT 5)

[0080] Referring to Fig. 11, an embodiment of the elevator apparatus relating to the present invention will be explained below.

[0081] Fig. 11 is a view showing Embodiment 5 of the elevator apparatus of the present invention. Like reference characters are used to indicate like parts in this view and the views described before. In the view, reference numeral 17 is a drive unit with which one of the direction-change-pulleys 5 is replaced. In this connection, this re-

placement can be applied to any of Embodiments 1 to 4.

[0082] When one of the two direction-change-pulleys 5a, 5b is replaced with the drive unit 17 and synchronously driven by the traction machine 4, the drive capacity can be enhanced, so that this structure can be applied to an elevator apparatus of a large capacity.

[0083] Since the elevator apparatus of the present invention is composed as described above, the following effects can be provided.

[0084] The present invention provides an elevator apparatus comprising: a cage elevating in an elevating path; a counterweight moving in an opposite direction to the cage; a guide rail for the cage to restrict a movement of the cage in the horizontal direction; a guide rail for the counterweight to restrict a movement of the counterweight in the horizontal direction; a rope for suspending the cage and counterweight; a traction machine, round which the rope is wound, for elevating the cage and counterweight via the rope in the elevating path, the traction machine being formed into a thin type, the traction machine being arranged in parallel with one wall face in the horizontal cross-section of the elevating path at an upper position of the floor face of the cage when the cage stops at the lowermost floor of the elevating path and at a lower position of the ceiling of the cage when the cage stops at the uppermost floor; and a direction-change-pulley arranged obliquely with respect to the wall face at an upper position of the ceiling of the cage when the cage stops at the uppermost floor in the elevating path. Therefore, an area occupied by the traction machine on a projection face of a horizontal cross-section of the elevating path is small, so that an unused space with respect to the entire height of the elevating path can be reduced. Since an entering angle at which the rope enters the rope groove of the sheave of the traction machine is small, the rope can be prevented from being damaged.

[0085] At least one of the traction machine and the direction-change-pulley is fixed to a beam supported by the guide rail for the cage or the guide rail for the counterweight. Therefore, an upward force caused by rope tension acting on the traction machine and a downward force acting on the direction-change-pulley are canceled to each other in the guide rails. Therefore, a force given to a building can be reduced.

[0086] A lower end of the traction machine is arranged at an upper position of the floor face of the cage when the cage stops at the lowermost floor in the elevating path. Therefore, even if the pit is covered with water, there is no possibility that the traction machine is damaged.

[0087] A lower end of the traction machine is arranged at an upper position of the first floor face. Therefore, even if the pit is covered with water, there is no possibility that the traction machine is damaged.

[0088] The traction machine is arranged at an upper position of the reference floor face. Therefore, inspection work can be easily conducted according to operation of the elevator.

[0089] The traction machine is arranged at an upper position of the uppermost floor face. Therefore, positional adjustment of the direction-change-pulley and the traction machine can be easily conducted, and inspection can be conveniently performed.

[0090] The traction machine is attached to a beam for supporting the direction-change-pulley from the lower side. Therefore, forces acting on the guide rails can be reduced. Therefore, positional adjustment of the direction-change-pulley and the traction machine can be easily conducted, and inspection can be conveniently performed.

[0091] The traction machine is attached to a beam for supporting the direction-change-pulley from the lower side, and the beam has a vibration proof structure. Therefore, vibration of the traction machine and the direction-change-pulleys can be effectively insulated.

[0092] At least a portion of the traction machine and a portion of the direction-change-pulley are arranged being put on each other on a projection face of a horizontal cross-section of the elevating path. Therefore, the elevating space can be reduced.

[0093] A sheave or motor of the traction machine protrudes from the back face of the guide rail to the cage side on a horizontal cross-section of the elevating path. Therefore, the elevating space can be reduced.

[0094] A control panel for controlling the traction machine is arranged at the substantially same level as that of the traction machine or right above or right below the traction machine close to it. Therefore, the traction machine and the control panel can be easily inspected.

[0095] A lower end of the control panel is arranged at an upper position of the floor face of the cage in the elevating path when the cage stops at the lowermost floor. Therefore, even if the pit is covered with water, the control panel is not damaged.

[0096] A lower end of the control panel is arranged at an upper position of the first floor face in the elevating path. Therefore, even if the underground floor is covered with water, the control panel is not damaged.

[0097] One of the direction-change-pulley is composed of a drive unit. Therefore, this structure can be applied to an elevator of a large capacity.

[0098] An inclination angle of the direction-change-pulley with respect to the wall face of the elevating path is made variable or a distance between the direction-change-pulleys on a horizontal cross-section of the elevating path is made variable. Therefore, the same design can be applied even if the cage size is different.

INDUSTRIAL POSSIBILITY

[0099] As described above, the elevator apparatus of the present invention is suitably applied to an elevator apparatus comprising: a cage elevating in an elevating path; a counterweight moving in an opposite direction to the cage; a guide rail for the cage to restrict a movement of the cage in the horizontal direction; a guide rail for the

counterweight to restrict a movement of the counterweight in the horizontal direction; a rope for suspending the cage and counterweight; a traction machine, round which the rope is wound, for elevating the cage and counterweight via the rope in the elevating path, the traction machine being formed into a thin type, the traction machine being arranged in parallel with one wall face in the horizontal cross-section of the elevating path at an upper position of the floor face of the cage when the cage stops at the lowermost floor of the elevating path and at a lower position of the ceiling of the cage when the cage stops at the uppermost floor; and a direction-change-pulley arranged obliquely with respect to the wall face at an upper position of the traction machine.

[0100] Example 1: An elevator apparatus comprising a cage elevating in an elevating path, a counterweight moving in an opposite direction to said cage, a guide rail for said cage to restrict a movement of said cage in the horizontal direction, a guide rail for said counterweight to restrict a movement of said counterweight in the horizontal direction, a rope for suspending said cage and counterweight, a traction machine, round which said rope is wound, for elevating said cage and counterweight via said rope in the elevating path, said traction machine being formed into a thin type, said traction machine being arranged in parallel with one wall face in the horizontal cross-section of the elevating path at an upper position of the floor face of said cage when said cage stops at the lowermost floor of the elevating path and at a lower position of the ceiling of said cage when said cage stops at the uppermost floor, and a direction-change-pulley arranged obliquely with respect to the wall face at an upper position of said traction machine.

[0101] Example 2: The elevator apparatus according to Example 1, wherein at least one of said traction machine and said direction-change-pulley is fixed to a beam supported by said guide rail for said cage or said guide rail for said counterweight.

[0102] Example 3: The elevator apparatus according to Example 1 or 2, wherein a lower end of said traction machine is arranged at an upper position of the floor face of said cage in the elevating path when said cage stops at the lowermost floor.

[0103] Example 4: The elevator apparatus according to Example 1 or 2, wherein a lower end of said traction machine is arranged at an upper position of the first floor face.

[0104] Example 5: The elevator apparatus according to Example 1 or 2, wherein said traction machine is arranged at an upper position of the reference floor face.

[0105] Example 6: The elevator apparatus according to Example 1 or 2, wherein said traction machine is arranged at an upper position of the uppermost floor face.

[0106] Example 7: The elevator apparatus according to one of Examples 1 to 6, wherein said traction machine is attached to a beam for supporting said direction-change-pulley from the lower side.

[0107] Example 8: The elevator apparatus according to Example 7, wherein said traction machine is attached to a beam for supporting said direction-change-pulley from the lower side, and said beam has a vibration proof structure.

[0108] Example 9: The elevator apparatus according to one of Examples 1 to 8, wherein at least a portion of said traction machine and a portion of said direction-change-pulley are arranged being put on each other on a projection face of a horizontal cross-section of the elevating path.

[0109] Example 10: The elevator apparatus according to one of Examples 1 to 9, wherein a sheave or motor of said traction machine protrudes from the back face of said guide rail to said cage side on a horizontal cross-section of the elevating path.

[0110] Example 11: The elevator apparatus according to one of Examples 1 to 10, wherein a control panel for controlling said traction machine is arranged at the substantially same level as that of said traction machine or right above or right below said traction machine close thereto.

[0111] Example 12: The elevator apparatus according to one of Examples 1 to 11, wherein a lower end of said control panel is arranged at an upper position of the floor face of said cage in the elevating path when said cage stops at the lowermost floor.

[0112] Example 13: The elevator apparatus according to one of Examples 1 to 11, wherein a lower end of said control panel is arranged at an upper position of the first floor face in the elevating path.

[0113] Example 14: The elevator apparatus according to one of Examples 1 to 13, wherein one of said direction-change-pulley is a drive unit.

[0114] Example 15: The elevator apparatus according to one of Examples 1 to 13, wherein an inclination angle of said direction-change-pulley with respect to the wall face of the elevating path is made variable or a distance between said direction-change-pulleys on a horizontal cross-section of the elevating path is made variable.

Claims

1. An elevator apparatus comprising:

a cage (1) elevating in an elevating path (8);
a counterweight (2) elevating in an opposite direction to said cage (1) in the elevating path (8);
a guide (6) for said cage (1) to restrict a movement of said cage (1) in the horizontal direction;
a guide (7) for said counterweight (2) to restrict a movement of said counterweight (2) in the horizontal direction;
a rope (3) for suspending said cage (1) and said counterweight (2);
a traction machine (4; 4a, 4b) having a sheave (4a), around which said rope (3) is wound, and a motor (4b) for driving said sheave (4a), said

traction machine (4; 4a, 4b) elevating said cage (1) and counterweight (2) via said rope (3) by rotating said sheave (4a), said traction machine (4; 4a, 4b) disposed in the elevating path (8) ;

a first direction-change pulley 5a, around which said rope (3) extending from said sheave (4a) of said traction machine (4; 4a, 4b) to said cage (1) is wound, for changing a direction of said rope (3), said first direction-change pulley (5a) disposed in the elevating path (8); and

a second direction-change pulley (5b), around which said rope (3) extending from said sheave (4a) of said traction machine (4; 4a, 4b) to said counterweight (8) is wound, for changing a direction of said rope (3), said second direction-change pulley (5b) disposed in the elevating path (8);

characterized in that

said cage (1) has an entrance and a hanging pulley (11);

said guide for said cage (1) and the guide for said counterweight (2) is a guide rail (6, 7), respectively;

said counterweight (2) is arranged at a side of said cage (1) with respect to the entrance in the horizontal cross-section of the elevating path (8), said counterweight (2) having a hanging pulley (12);

said rope (3) suspends said cage (1) via said hanging pulley (11) of said cage (1) and said counterweight (2) via said hanging pulley (12) of said counterweight (2);

said traction machine (4; 4a, 4b) has an outer dimension along a direction of a rotational shaft of said sheave (4a), the outer dimension being smaller than an outer dimension of said traction machine (4; 4a, 4b) along a direction perpendicular to the rotational shaft;

said traction machine (4; 4a, 4b) is arranged adjacent to said counterweight (2) along one wall face of the elevating path (8) positioned at a side of said cage (1) where said counterweight (2) is arranged;

said traction machine (4; 4a, 4b) is arranged to be separate from said counterweight (2) and said cage (1) in the horizontal cross-section of the elevating path (8), and positioned at an upper position of the floor face of said cage (1) when said cage (1) stops at the lowermost floor of the elevating path (8) and at a lower position of the ceiling of said cage (1) when said cage (1) stops at the uppermost floor;

said sheave (4a) is arranged to be opposed to said one wall face of said elevating path (8), and to be closer to said one wall face of said elevating path than said pulley (12) of said counterweight (2) in the horizontal cross-section of the elevating path (8);

said motor (4b) is arranged to be opposed to said cage (1);

said first direction-change pulley (5a) is positioned above said traction machine (4; 4a, 4b), and put on at least a portion of said motor (4b) to overlap and across said motor (4b) from said hanging pulley (11) of said cage (1) to a space between said cage (1) and said sheave (4a) in the horizontal cross-section of the elevating path (8), so that said rope (3) extends to said pulley (11) of said cage (1) via a space between said cage (1) and said sheave (4a) in the horizontal cross-section of the elevating path (8);

said first direction-change pulley (5a) has a first rotational face that is oblique with respect to said one wall face of the elevating path (8);

said first rotational face of said first direction-change pulley (5a) includes a first side where said rope (3) is extended to said pulley (11) of said cage (1) and a second side where said rope (3) is extended from said sheave (4a);

said first side is arranged more distant from said entrance of said cage (1) than said second side in the horizontal cross-section of the elevating path (8);

said second direction-change pulley (5b) has a second rotational face that is oblique with respect to said one wall face of the elevating path (8);

said second rotational face of said second direction-change pulley (5b) includes a third side where said rope (3) is extended to said pulley (12) of said counterweight (2) and a fourth side where said rope (3) is extended from said sheave (4a); and

said third side is arranged closer to said cage (1) than said fourth side in the horizontal cross-section of the elevating path (8).

FIG.1

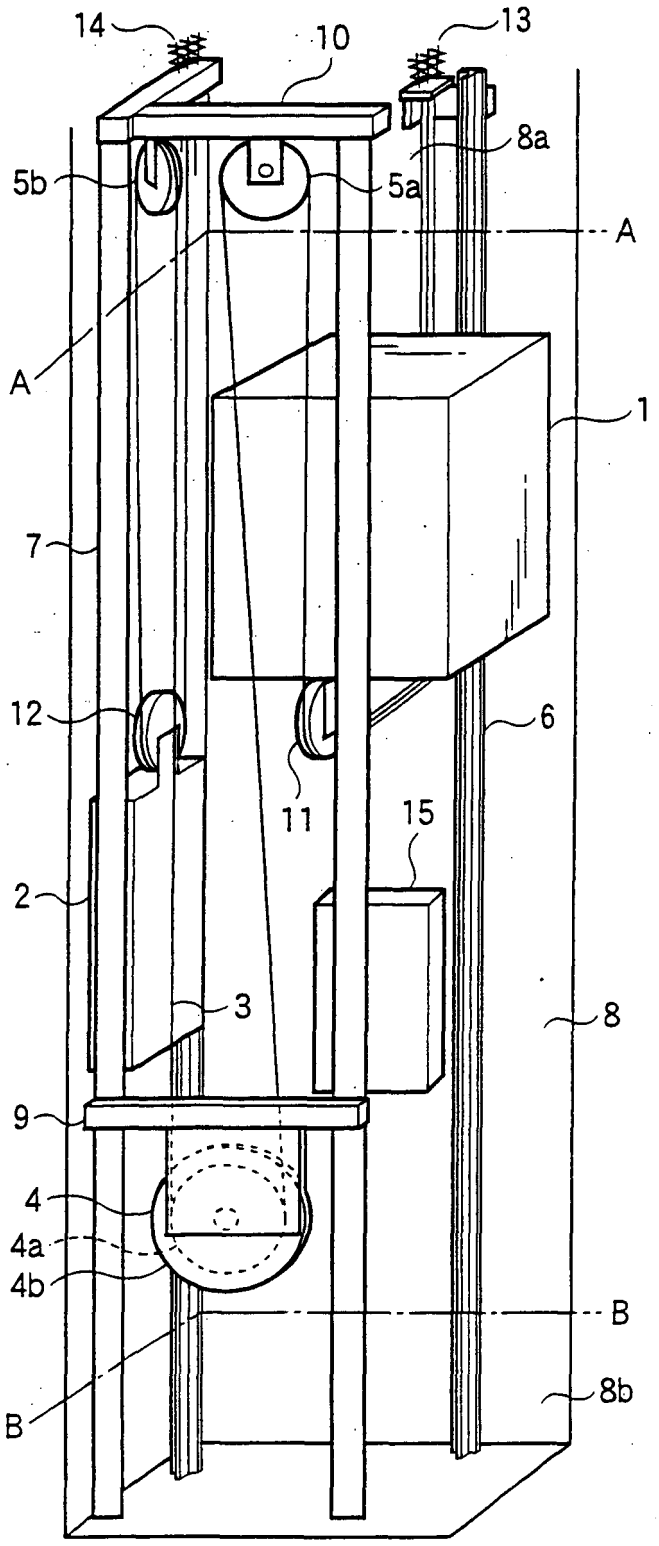


FIG.2

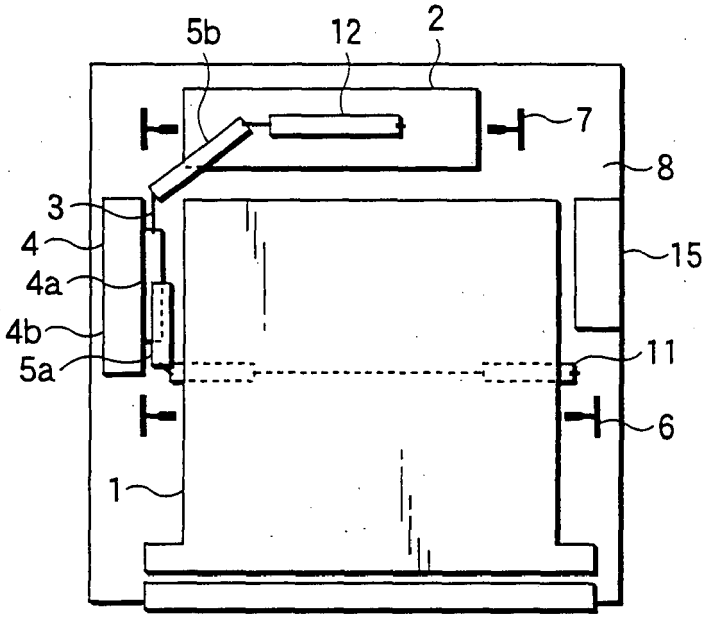


FIG.3

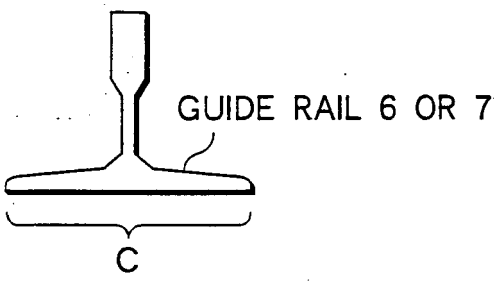


FIG.4

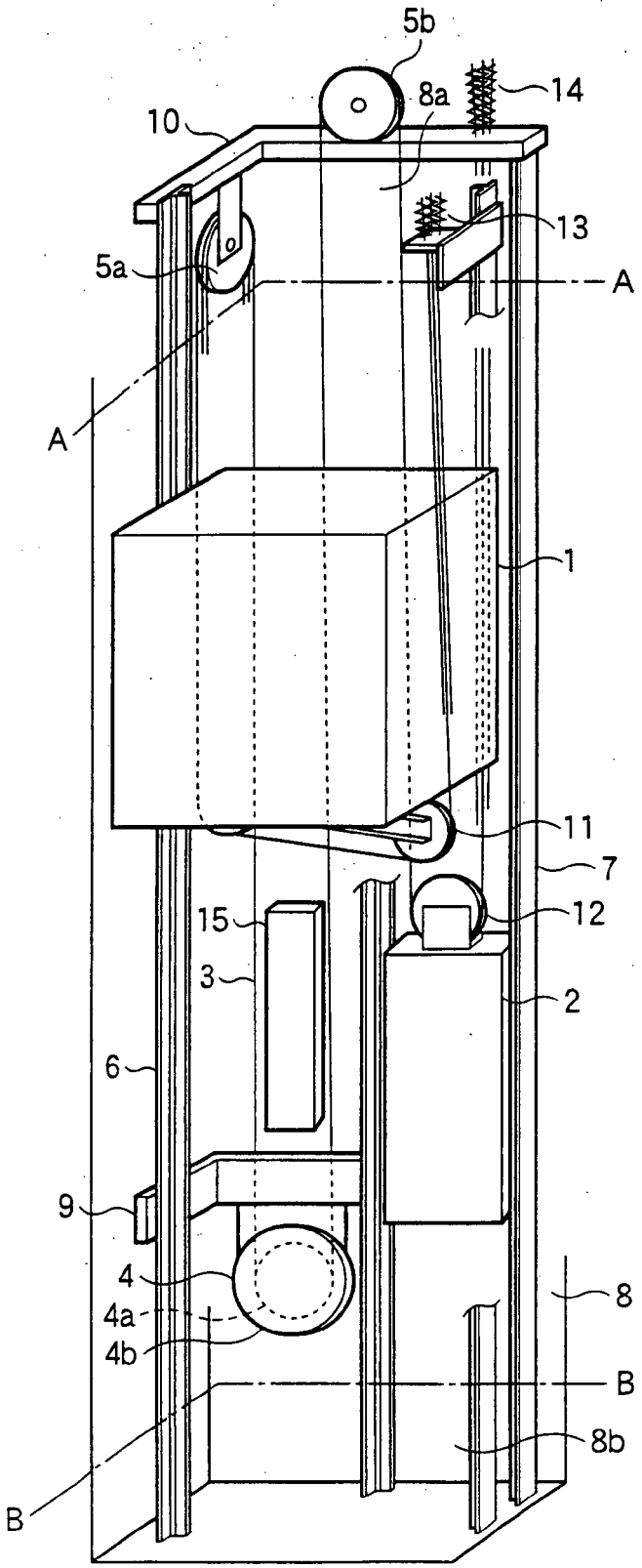


FIG.5

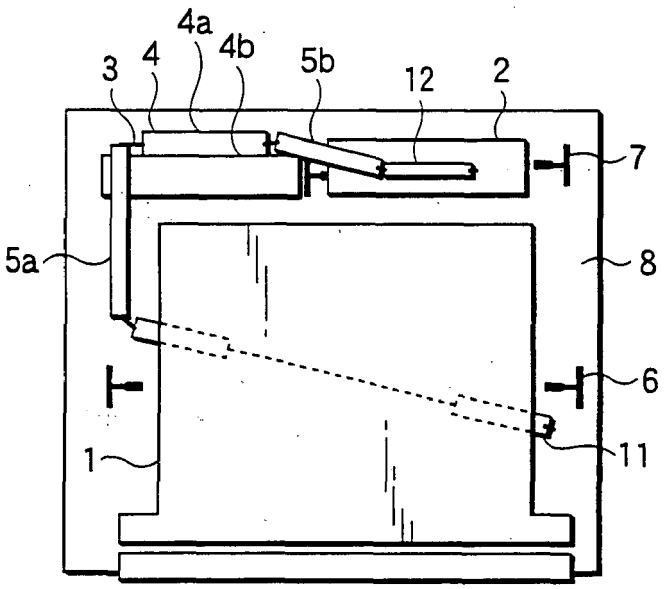


FIG.6

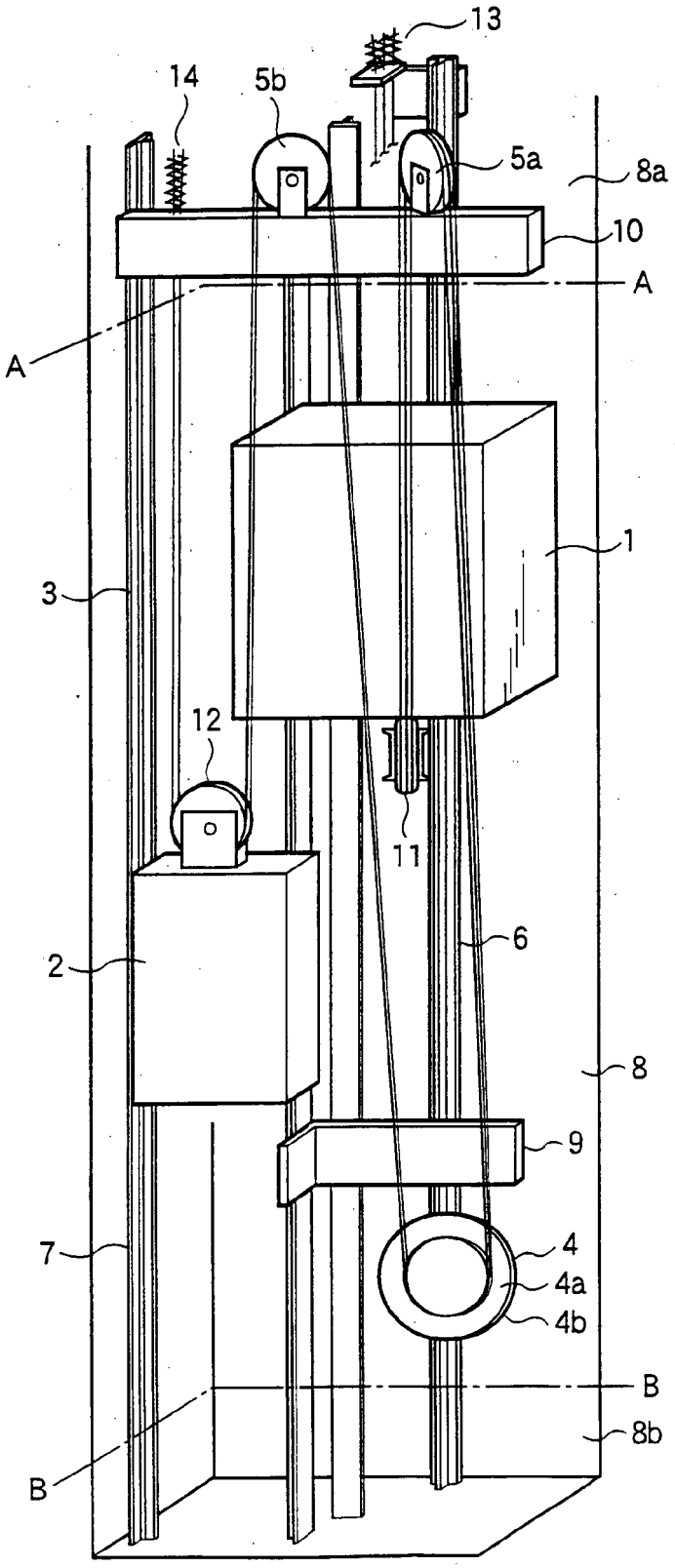


FIG.7

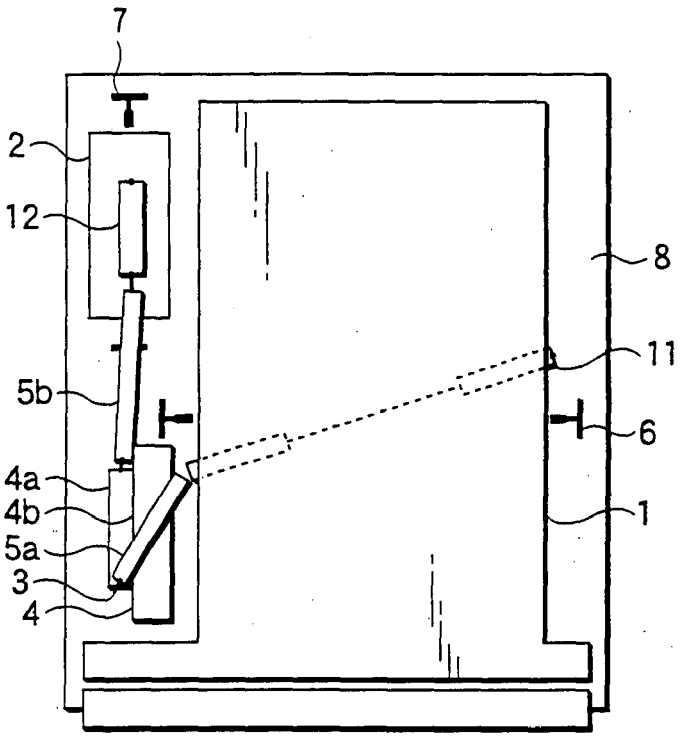


FIG.8

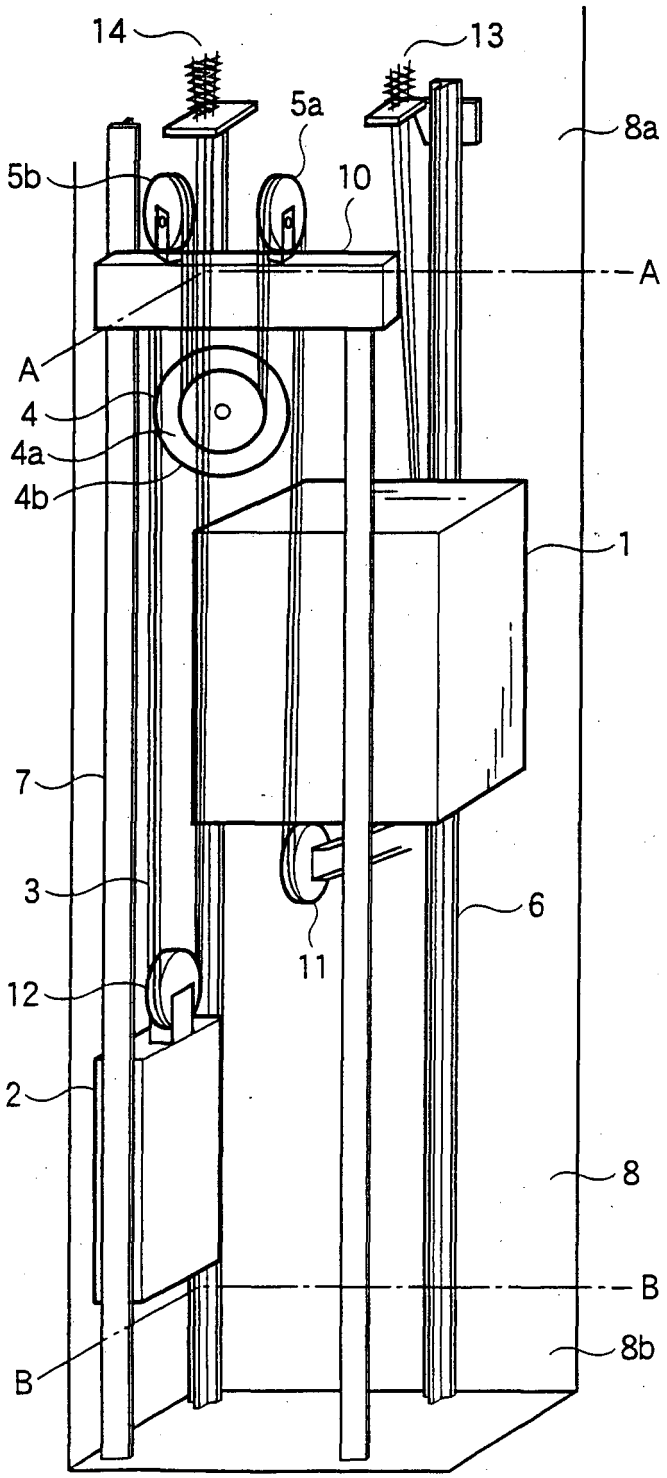


FIG.9

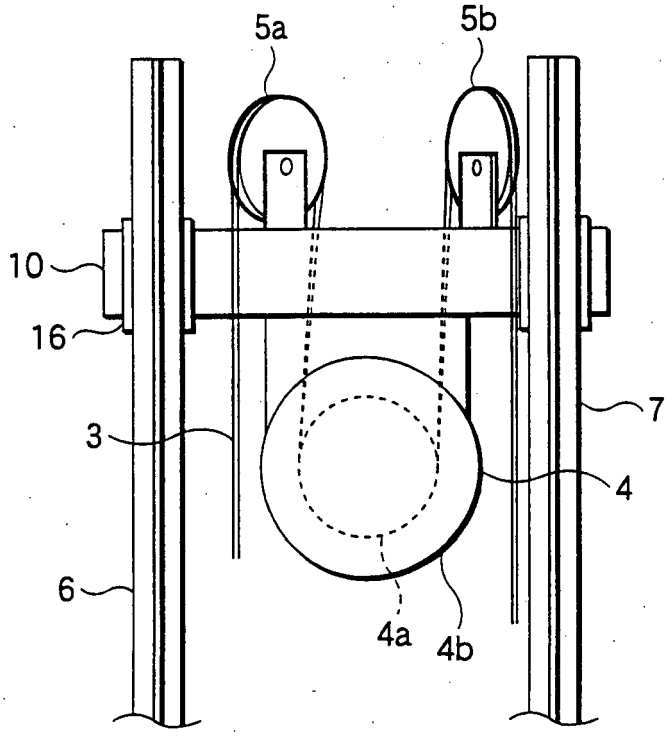


FIG.10

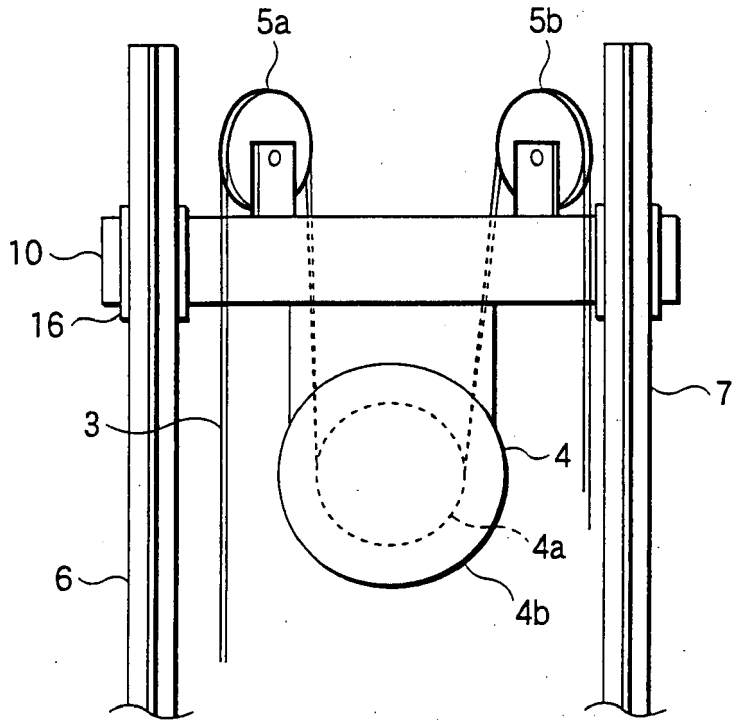


FIG.11

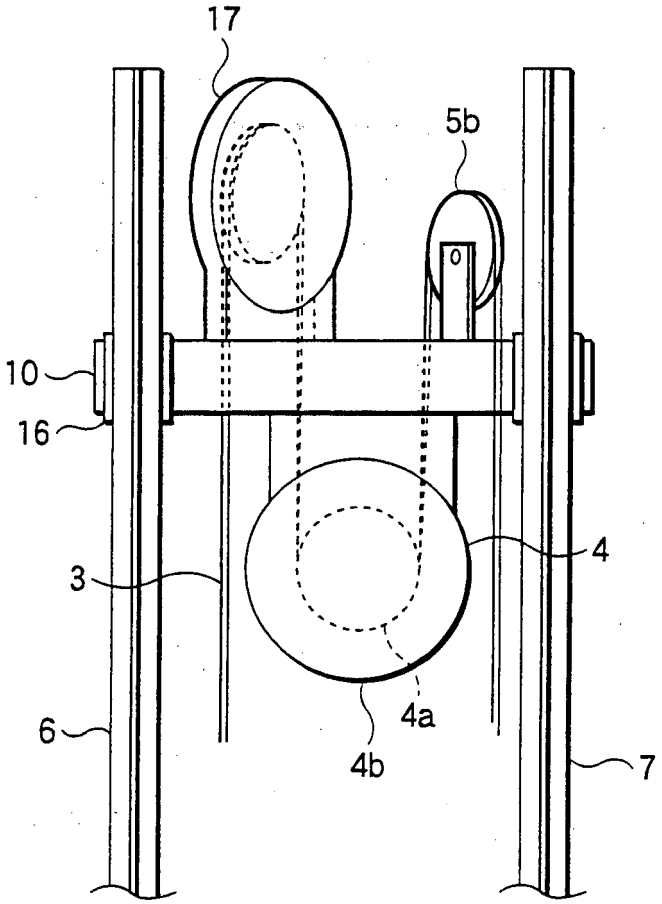


FIG.12

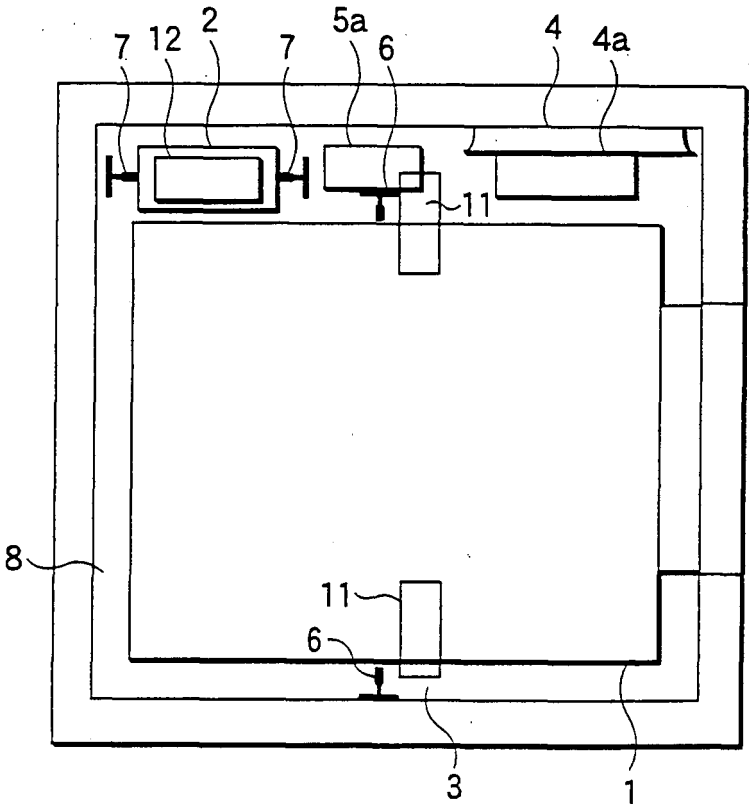
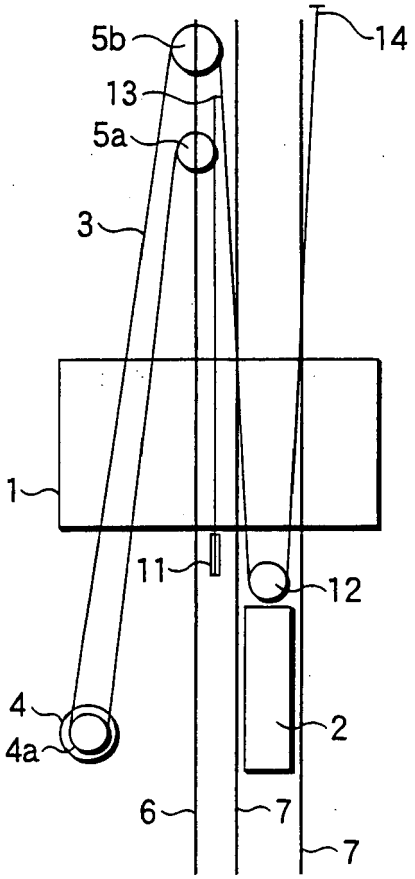


FIG.13



European Patent Office

EUROPEAN SEARCH REPORT

Application Number
EP 07 00 6531

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
The Hague	16 May 2007	Nelis, Yves

CATEGORY OF CITED DOCUMENTS

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16-05-2007

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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