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(54) **ELEVATOR DEVICE**

AUFZUGSVORRICHTUNG

DISPOSITIF D'ASCENSEUR

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(73) Proprietor: **MITSUBISHI ELECTRIC CORPORATION**
Chiyoda-ku
Tokyo 100-8310 (JP)

(72) Inventor: **HIDA, Masahiko**
Tokyo 100-8310 (JP)

(74) Representative: **Hoffmann Eitle**
Patent- und Rechtsanwälte PartmbB
Arabellastraße 30
81925 München (DE)

(56) References cited:
EP-A2- 1 028 082
WO-A1-2004/067430
WO-A1-2006/040813
JP-A- 2002 068 641
JP-A- 2002 068 641
JP-A- 2002 145 544
JP-A- 2006 513 116
US-A1- 2005 217 945

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Description

[TECHNICAL FIELD]

[0001] The present invention relates to an elevator apparatus of a self-propelled type in which a car with a drive unit mounted thereon is driven to move up and down in a hoistway.

[BACKGROUND ART]

[0002] In the past, there has been proposed a self-propelled type elevator apparatus in which a drive unit is mounted on a car at a lower portion thereof in order to save the space of a hoistway. In such a known elevator apparatus, a first sheave and a second sheave having individual rotation shafts in parallel to each other are mounted on the lower portion of the car, with the rotation shafts of the individual sheaves being disposed in a horizontal manner, respectively. The car is hung by means of a first rope and a second rope that are continuously wrapped around the individual sheaves, respectively. One of the sheaves is driven to rotate by the driving force of the drive unit, so that the car is caused to move up and down in the hoistway in accordance with the rotation of the sheaves under the action of the driving force of the drive unit (see a first patent document).

[0003] The second patent document discloses an elevator apparatus with a drive unit mounted on a lower portion of a car, in order to save space in the vertical direction of the hoistway. The elevator apparatus comprises two main ropes, both attached to an upper end portion of the hoistway, carrying said car, wound around a first pulley, a driving sheave of the drive unit, a second pulley and being connected to rope stop sticks near the bottom of the hoistway.

[0004] Patent document 3 discloses a traction drive elevator system including a tension device to maintain tension on the portion of a low bearing assembly that is below an elevator car. A weight, springs and a pressurized actuator for maintaining a desired amount of tension on the low bearing assembly are given as examples for a tension device.

[0005]

[First Patent Document] Japanese patent application laid-open No. H 10-273274
[Second Patent Document] Japanese patent JP 2002-068641 A
[Third Patent Document] WO 2004/067430 A1

[DISCLOSURE OF THE INVENTION]

[PROBLEMS TO BE SOLVED BY THE INVENTION]

[0006] However, the rotation shafts of the sheaves being driven to rotate by the driving force of the drive unit are disposed in the horizontal manner, so the dimension in a heightwise direction of the entire car becomes larger in accordance with the increasing outer diameter of the drive unit or the each sheave. As a result, it becomes difficult to make the space saving of the hoistway, and the elevator apparatus is made large-sized.

[0007] The present invention is intended to obviate the problems as referred to above, and has for its object to obtain an elevator apparatus which is capable of making the space saving of a hoistway.

[MEANS FOR SOLVING THE PROBLEMS]

[0008] An elevator apparatus according to the present invention includes a car being movable up and down in a hoistway, and a first driving and hanging unit and a second driving and hanging unit including: a main rope unit that has first and second main ropes, with individual upper end portions of the first and second main ropes being fixedly attached to an upper portion of the hoistway so as to hang the car; a pair of car hanging pulleys that are mounted on the car so as to guide the first and second main ropes from the individual upper end portions in horizontal directions, respectively; a drive unit that is mounted on the car and includes a drive sheave around which the first and second main ropes from the individual car hanging pulleys are respectively wrapped; and a pair of wrap pulleys that are mounted on the car so as to guide the first and second main ropes from the drive sheave in directions downwardly of the car, respectively, whereby the car is caused to move up and down in accordance with the rotation of the drive sheave; wherein the drive sheave is driven to rotate around a rotation shaft that is disposed along a vertical direction, wherein the first driving and hanging unit is disposed at a lower portion of the car and the second driving and hanging unit is disposed at an upper portion of the car, wherein the rotational direction of the drive sheave of the first driving and hanging unit and the rotational direction of the drive sheave of the second driving and hanging unit are opposite to each other.

[BRIEF DESCRIPTION OF THE DRAWINGS]

[0009]

Fig. 1 is a perspective view showing an elevator apparatus according to a first embodiment
Fig. 2 is a top plan view of the elevator apparatus of Fig. 1.
Fig. 3 is a side elevational view of the elevator apparatus of Fig. 1.
Fig. 4 is an enlarged view of a lower portion of a car of Fig. 3.
Fig. 5 is a top plan view showing an elevator apparatus according to the present invention.
Fig. 6 is a side elevational view of the elevator apparatus of Fig. 5.

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0010] Hereinafter, preferred embodiment of the present invention will be described in detail while referring to the accompanying drawings.

Embodiment 1, not forming a part of the present invention

[0011] Fig. 1 is a perspective view that shows an elevator apparatus according to a first embodiment. Also, Fig. 2 is a top plan view that shows the elevator apparatus of Fig. 1. In these figures, a pair of guide rails 2, 3 are installed in a hoistway 1 (Fig. 2). A car 4 is disposed between the individual guide rails 2, 3 so as to be movable up and down.

[0012] The car 4 is hung in the hoistway 1 by mean of a main rope unit 7 that has a plurality of first main ropes 5 and a plurality of second main ropes 6. An upper end portion 5a of each first main rope 5 and an upper end portion 6a of each second main rope 6 are fixedly attached to upper portions of the hoistway 1, respectively. In addition, a lower end portion 5b of each first main rope 5 and a lower end portion 6b of each second main rope 6 are respectively dropped downwardly of the car 4. Here, note that in the figures, the first and second main ropes 5, 6 are shown as one, respectively, for the sake of simplicity.

[0013] A winch (drive unit) 8 for generating a driving force to move the car 4 up and down is mounted on the center of a lower portion of the car 4. The winch 8 has a drive unit main body 9 including a motor, and a drive sheave 10 that is arranged downwardly of the drive unit main body 9 and is driven to rotate by the driving force of the drive unit main body 9. The drive sheave 10 is driven to rotate around a rotation shaft that is disposed along a vertical direction. That is, the winch 8 is disposed in a horizontal manner. Also, the winch 8 is designed to be a thin one having a diametrical dimension larger than an axial dimension.

[0014] A pair of car hanging pulleys 11, 12 for guiding the first and second main ropes 5, 6 from the individual upper end portions 5a, 6a in horizontal directions, respectively, and a pair of wrap pulleys 13, 14 for guiding the first and second main ropes 5, 6 extended in the horizontal directions downwardly of the car 2, respectively, are mounted on a lower edge portion of the car 4. The first and second main ropes 5, 6 from the individual car hanging pulleys 11, 12 are respectively wrapped around the drive sheave 10. In addition, the first and second main ropes 5, 6 from the drive sheave 10 are guided downwardly of the car 2 by means of the individual wrap pulleys 13, 14, respectively.

[0015] That is, each first main rope 5 is wrapped from its upper end portion 5a around the one car hanging pulley 11, the drive sheave 10 and the one wrap pulley 13 in this order to extend to reach its lower end portion 5b. Also, each second main rope 6 is wrapped from its upper end portion 6a around the other car hanging pulley 12, the drive sheave 10 and the other wrap pulley 14 in this order to extend to reach its lower end portion 6b.

[0016] The individual car hanging pulleys 11, 12 and the individual wrap pulleys 13, 14 are rotatable around their individual rotation shafts, respectively, which are arranged in the horizontal manner. In addition, the individual car hanging pulleys 11, 12 are arranged in symmetry with respect to the rotation shaft of the drive sheave 10. Further, the individual wrap pulleys 13, 14 are also arranged in symmetry with respect to the rotation shaft of the drive sheave 10 (Fig. 2). With such arrangements, the loads, which are received by the rotation shaft of the drive sheave 10 from the individual first main ropes 5, and the loads, which are received by the rotation shaft of the drive sheave 10 from the individual second main ropes 6, are counterbalanced or offset with each other, so reduction in the size of the winch 8 can be made.

[0017] In addition, in a vertical projection plane of the hoistway 1, an angle formed by two straight lines, one connecting the center of the one car hanging pulley 11 and the rotation shaft of the drive sheave 10, the other connecting the center of the one wrap pulley 13 and the rotation shaft of the drive sheave 10, becomes an acute angle. Further, in a vertical projection plane of the hoistway 1, an angle formed by two straight lines, one connecting the center of the other car hanging pulley 12 and the rotation shaft of the drive sheave 10, the other connecting the center of the other wrap pulley 14 and the rotation shaft of the drive sheave 10, also becomes an acute angle (Fig. 2). As a result, appropriate individual wrap angles of the first and second main ropes 5, 6 with respect to the drive sheave 10 can be ensured.

[0018] A first weight 15 in the form of a tension unit for applying a tension to the first main ropes 5 is hung on the first main ropes 5. The first weight 15 is arranged at the lower end portions 5b of the first main ropes 5. Also, a second weight 16 in the form of a tension unit for applying a tension to the second main ropes 6 is hung on the second main ropes 16. The second weight 16 is arranged at the lower end portions 6b of the second main ropes 6. In this example, the first and second weights 15, 16 are arranged for the first and second main ropes 5, 6, respectively, independently of each other.

[0019] Fig. 3 is a side elevational view that shows the elevator apparatus of Fig. 1. In addition, Fig. 4 is an enlarged view that shows a lower portion of the car 4 of Fig. 3. As shown in these figures, the vertical positions of the one car hanging pulley 11 and the one wrap pulley 13 with respect to the car 4 are adjusted in such a manner that the portions of the first main ropes 5 being wrapped around the drive sheave 10 are arranged to be horizontal. That is, the car hanging pulley 11 and the wrap pulley 13 are disposed in such a manner that the height of a lower portion of the car hanging pulley 11 and the height of an upper portion of the wrap pulley 13 coincide with each other.

[0020] In addition, the vertical positions of the other car hanging pulley 12 and the other wrap pulley 14 with re-

spect to the car 4 are adjusted in such a manner that the portions of the second main ropes 6 being wrapped around the drive sheave 10 are arranged to be horizontal. That is, the car hanging pulley 12 and the wrap pulley 14 are disposed in such a manner that the height of a lower portion of the car hanging pulley 12 and the height of an upper portion of the wrap pulley 14 coincide with each other.

[0021] Here, a driving and hanging unit 17 has the main rope unit 7, the winch 8, the pair of car hanging pulleys 11, 12, and a pair of wrap pulleys 13, 14.

[0022] Now, the operation of this embodiment will be described below. When the car 4 is to be moved in an upward direction, the drive sheave 10 is driven to rotate in a counterclockwise direction (a direction to pull the first and second main ropes 5, 6 from the individual car hanging pulleys 11, 12 to the drive sheave 10, i.e., a direction A), as shown in Fig. 2. As a result, the first and second main ropes 5, 6 are respectively caused to move from the individual car hanging pulleys 11, 12 to the drive sheave 10 (i.e., move in a direction B), and further move from the drive sheave 10 to the individual wrap pulleys 13, 14, respectively (i.e., move in a direction C). In this manner, the car 4 is driven to move in the upward direction.

[0023] When the car 4 is to be moved in a downward direction, the drive sheave 10 is driven to rotate in a direction opposite to the above-mentioned direction. As a result, an operation opposite to the above-mentioned one is carried out, so that the car 4 is driven to move in the downward direction.

[0024] Here, a driving torque Tq, being generated by the winch 8 so as to move the car 4, is represented by the following expression (1).

$$Tq = (Wc + CAP) \cdot D \quad \cdots (1)$$

[0025] Here, note that Wc is the mass of the car 4, CAP is the loading mass of the car 4, and D is the diameter of the drive sheave 10.

[0026] As can be seen from expression (1), the driving torque Tq becomes larger in accordance with the increasing mass Wc and the loading mass CAP of the car 4. In addition, because a horizontal thrust force is applied to the guide rails 2, 3 from the car 4 in accordance with the rotation of the drive sheave 10, so when the driving torque Tq increases, the contact resistance of the car 4 and the guide rails 2, 3 becomes larger, and hence the running resistance of the car 4 also becomes large. Such being the case, in this first embodiment, it is desirable to construct the elevator apparatus such that the carrying capacity of the car 4 is relatively small.

[0027] In such an elevator apparatus, the car 4 is provided with the winch 8 that has the drive sheave 10 to be rotated about its rotation shaft disposed along the vertical direction, the pair of car hanging pulleys 11, 12 that guide the first and second main ropes 5, 6 from the individual upper end portions 5a, 6a thereof in the horizontal direction, and the pair of wrap pulleys 13, 14 that guide the first and second main ropes 5, 6 wrapped from the individual car hanging pulleys 11, 12 around the drive sheave 10 downwardly of the car 4. With such an arrangement, it is possible to dispose the drive sheave 10 in an horizontal altitude with respect to the car 4 while maintained the horizontal dimension of the hoistway 1, whereby the dimension in the heightwise direction of the car 4 as a whole can be decreased. As a result, the space saving of the hoistway 1 can be made.

[0028] In addition, the individual car hanging pulleys 11, 12 are disposed in symmetry with respect to the rotation shaft of the drive sheave 10, and the individual wrap pulleys 13, 14 are also disposed in symmetry with respect to the rotation shaft of the drive sheave 10, so the loads, which are received by the rotation shaft of the drive sheave 10 from the first and second main ropes 5, 6, respectively, can be counterbalanced or offset with each other. As a result, the loads applied to the rotation shaft of the drive sheave 10 can be reduced, and the reduction in the size of the winch 8 can be made.

[0029] Moreover, tensions are applied to the first and second main ropes 5, 6 by the first and second weights 15, 16, so it is possible to prevent the first and second main ropes 5, 6 from coming off the drive sheave 10, the individual car hanging pulleys 11, 12 and the individual wrap pulleys 13, 14, respectively. In addition, the slippage of the drive sheave 10 with respect to the first and second main ropes 5, 6 can be prevented, so the driving force of the winch 8 can be transmitted to the first and second main ropes 5, 6 in an efficient manner.

[0030] Further, the first and second weights 15, 16 are hung on the first and second main ropes 5, 6, so tension can be given to the first and second main ropes 5, 6 with a simple construction.

[0031] In addition, the first and second weights 15, 16 are arranged at the individual lower end portions 5b, 6b of the first and second main ropes 5, 6, respectively, independently of each other, so even when a difference occurs in expansion of the individual main ropes 5, 6 for example, tensions can be independently given to the individual main ropes 5, 6, respectively, whereby it is possible to prevent the occurrence of an offset in the individual tensions of the first and second main ropes 5, 6.

[0032] Moreover, the winch 8 is arranged at the lower portion of the car 4, so the overhead dimensions of the hoistway 1 can be decreased.

[0033] Although in the above-mentioned example, the individual tensions can be given to the first and second main ropes 5, 6, respectively, by means of mutually independent first and second weights 15, 16, tension(s) may be given to the first and second main ropes 5, 6, respectively, by means of a common weight (tension unit) which is connected with the first and second main ropes 5, 6. In addition, tension(s) may be given to the first and second main ropes 5, 6, respectively, by pulling the in-

dividual main ropes 5, 6 by means of a resilient member(s) (tension unit) such as, for example, a spring(s) arranged in the hoistway 1.

Embodiment 2.

[0034] Although in the above-mentioned example, the car 4 is caused to move up and down by means of the single driving and hanging unit 17, the car 4 may be driven to move up and down by means of a pair of driving and hanging units.

[0035] Fig. 5 is a top plan view that shows an elevator apparatus according to the present invention. In addition, Fig. 6 is a side elevational view that shows the elevator apparatus of Fig. 5. In these figures, a pair of driving and hanging units 17, 21 are arranged in a hoistway 1. A car 4 is hung in the hoistway 1 by means of the individual driving and hanging units 17, 21 so as to be thereby driven to move up and down in the hoistway 1. The one driving and hanging unit 17 is of a construction similar to that of the driving and hanging unit 17 of the first embodiment.

[0036] The other driving and hanging unit 21 has a main rope unit 7', a winch 8' (drive unit), a pair of car hanging pulleys 11', 12', and a pair of wrap pulleys 13', 14', which are similar to the main rope unit 7, the winch 8, the individual car hanging pulleys 11, 12, and the individual wrap pulleys 13, 14, respectively, of the first embodiment. The winch 8', the individual car hanging pulleys 11', 12', and the individual wrap pulleys 13', 14' are arranged at an upper portion of the car 4.

[0037] The main rope unit 7' has first and second main ropes 5', 6' that are disposed in the hoistway 1 in a manner so as to avoid first and second main ropes 5, 6. The first and second main ropes 5', 6' have their individual upper end portions 5'a, 6'a that are fixedly attached to an upper portion of the hoistway 1, and the first and second main ropes 5', 6' have their individual lower end portions 5'b, 6'b that are dropped downwardly of the car 4.

[0038] The winch 8' is disposed in the center of the upper portion of the car 4. The winch 8' has a drive unit main body 9', and a drive sheave 10' that is arranged upwardly of the drive unit main body 9' and is driven to rotate by the driving force of the drive unit main body 9'. The drive sheave 10' is driven to rotate around a rotation shaft that is disposed along a vertical direction. In addition, when the car 4 is moved up and down, the drive sheave 10' is driven to rotate in a direction opposite to the rotational direction of the drive sheave 10.

[0039] The individual car hanging pulleys 11', 12', and the individual wrap pulleys 13', 14' are arranged at the upper portion of the car 4. In addition, the individual car hanging pulleys 11', 12' are arranged in symmetry with respect to the rotation shaft of the drive sheave 10'. Further, the individual wrap pulleys 13', 14' are also arranged in symmetry with respect to the rotation shaft of the drive sheave 10' (Fig. 5). With such arrangements, the loads, which are received by the rotation shaft of the drive sheave 10' from the individual first main ropes 5', and the loads, which are received by the rotation shaft of the drive sheave 10' from the individual second main ropes 6', are counterbalanced or offset with each other, so reduction in the size of the winch 8' can be made. The respective rotation shafts of the individual car hanging pulleys 11', 12' and the individual wrap pulleys 13', 14' are arranged in a horizontal manner.

[0040] Each first main rope 5' is wrapped from its upper end portion 5a' around the one car hanging pulley 11', the drive sheave 10' and the one wrap pulley 13' in this order to extend to reach its lower end portion 5b'. Also, each second main rope 6' is wrapped from its upper end portion 6a' around the other car hanging pulley 12', the drive sheave 10' and the other wrap pulley 14' in this order to extend to reach its lower end portion 6b'.

[0041] The direction in which the first main ropes 5' are wrapped from the car hanging pulley 11' around an outer peripheral portion of the drive sheave 10' and the direction in which the first main ropes 5 are wrapped from the car hanging pulley 11 around an outer peripheral portion of the drive sheave 10 are opposite to each other. Also, the direction in which the second main ropes 6' are wrapped from the car hanging pulley 12' around the outer peripheral portion of the drive sheave 10' and the direction in which the second main ropes 6 are wrapped from the car hanging pulley 12 around the outer peripheral portion of the drive sheave 10 are opposite to each other.

[0042] Here, note that in this example, the car hanging pulley 11 and the wrap pulley 13 are disposed in a vertical projection plane of the hoistway 1 between the one car hanging pulley 11' and the one wrap pulley 13'. Also, the car hanging pulley 12 and the wrap pulley 14 are disposed in the vertical projection plane of the hoistway 1 between the other car hanging pulley 12' and the other wrap pulley 14'.

[0043] A first weight (tension unit) 15' for applying a tension to the first main ropes 5' is hung at the lower end portions 5b' of the first main ropes 5'. A second weight (tension unit) 16' for applying a tension to the second ropes 6' is hung at the lower end portions 6b' of the second main ropes 6'.

[0044] Here, in the other driving and hanging unit 21, too, the vertical positions of the one car hanging pulley 11' and the one wrap pulley 13' with respect to the car 4 are adjusted in such a manner that the portions of the first main ropes 5' being wrapped around the drive sheave 10' are arranged to be horizontal, and the vertical positions of the other car hanging pulley 12' and the other wrap pulley 14' with respect to the car 4 are adjusted in such a manner that the portions of the second main ropes 6' being wrapped around the drive sheave 10' are arranged to be horizontal (Fig. 6).

[0045] Now, the operation of this embodiment will be described below. When the car 4 is to be moved in an upward direction, the drive sheave 10 of the one driving and hanging unit 17 is driven to rotate in a counterclockwise direction (direction A), as shown in Fig. 5, and at the same time, the drive sheave 10' of the other driving

and hanging unit 21 is driven to rotate in a clockwise direction (i.e., a direction opposite to the rotational direction of the drive sheave 10, a direction A').

[0046] In accordance with the rotation of the drive sheave 10, the first and second main ropes 5, 6 are respectively caused to move from the individual car hanging pulleys 11, 12 to the drive sheave 10 (i.e., move in a direction B), and further move from the drive sheave 10 to the individual wrap pulleys 13, 14, respectively (i.e., move in a direction C). Also, in accordance with the rotation of the drive sheave 10', the first and second main ropes 5', 6' are respectively caused to move from the individual car hanging pulleys 11', 12' to the drive sheave 10' (i.e., move in a direction B'), and further move from the drive sheave 10' to the individual wrap pulleys 13', 14', respectively (i.e., move in a direction C'). In this manner, the car 4 is driven to move in the upward direction.

[0047] When the car 4 is to be moved in a downward direction, the drive sheaves 10, 10' are driven to rotate in directions opposite to the above-mentioned directions. As a result, operations opposite to the above-mentioned ones are carried out, so that the car 4 is driven to move in the downward direction.

[0048] Here, the car 4 is caused to move by the driving forces of the two winches 8, 8', so a driving torque Tq', which is generated by each of the winches 8, 8', is represented by the following expression (2).

$$Tq' = Tq/2 \quad \cdots (2)$$

[0049] In addition, the drive sheaves 10, 10' are driven to rotate in the opposite directions with respect to each other, so the driving torques Tq' of the individual winches 8, 8 counteract each other. As a result, the reduction in the running resistance of the car 4 can be made. Here, note that the twist generated in the car 4 becomes larger in accordance with an increasing distance in the heightwise direction of the car 4 between the winches 8, 8', so it is desirable to decrease the distance between the winches 8, 8'.

[0050] In such an elevator apparatus, the pair of driving and hanging units 17, 21 are arranged in the hoistway 1, and the rotational direction of the drive sheave 10 of the one driving and hanging unit 17 and the rotational direction of the drive sheave 10' of the other driving and hanging unit 21 are opposite to each other, so it is possible to make the driving torques Tq' of the individual winches 8, 8 counteract each other. As a result, the reduction in the running resistance of the car 4 can be made. In addition, the driving torque of each of the winches 8, 8' is reduced by half, so the sizes of the winches 8, 8' can also be further reduced, and the space saving of the hoistway 1 can be further made.

[0051] In the above example, the winch 8 is arranged at the lower portion of the car 4, and the winch 8' is arranged at the upper portion of the car 4.

[0052] Although in the above-mentioned example, individual tensions can be given to the first and second main ropes 5, 6, respectively, by means of mutually independent first and second weights 15', 16', tension(s) may be given to the first and second main ropes 5', 6', respectively, by means of a common weight (tension unit) which is connected with the first and second main ropes 5', 6'. In addition, tension(s) may be given to the first and second main ropes 5', 6', respectively, by pulling the individual main ropes 5', 6' by means of a resilient member(s) (tension unit) such as, for example, a spring(s) arranged in the hoistway 1.

Claims

1. An elevator apparatus comprising:

a car (4) being movable up and down in a hoistway (1); and

a first driving and hanging unit (17) and a second driving and hanging unit (21) including: a main rope unit (7, 7') that has first and second main ropes (5, 5', 6, 6'), with individual upper end portions (5a, 5a', 5b, 5b') of the first and second main ropes (5, 5', 6, 6') being fixedly attached to an upper portion of the hoistway (1) so as to hang the car (4); a pair of car hanging pulleys (11, 11', 12, 12') that are mounted on the car (4) so as to guide the first and second main ropes (5, 5', 6, 6') from the individual upper end portions (5a, 5a', 5b, 5b') in horizontal directions, respectively; a drive unit (8, 8') that is mounted on the car (4) and includes a drive sheave (10, 10') around which the first and second main ropes (5, 5', 6, 6') from the individual car hanging pulleys (11, 11', 12, 12') are respectively wrapped; and a pair of wrap pulley (13, 13', 14, 14') that are mounted on the car (4) so as to guide the first and second main ropes (5, 5', 6, 6') from the drive sheave (10, 10') in directions downwardly of the car (4), respectively, whereby the car (4) is caused to move up and down in accordance with the rotation of the drive sheave (10, 10');

wherein the drive sheave (10, 10'), is driven to rotate around a rotation shaft that is disposed along a vertical direction,

characterized in that

the first driving and hanging unit(17) is disposed at a lower portion of the car (1) and the second driving and hanging unit (21) is disposed at an upper portion of the car(1),

wherein the rotational direction of the drive sheave (10) of the first driving and hanging unit (17) and the rotational direction of the drive sheave (10') of the second driving and hanging unit (21) are opposite to each other.

2. The elevator apparatus as set forth in claim 1, **characterized in that** the pair of car hanging pulleys (11, 11', 12, 12') are disposed in symmetry with respect to the rotation shaft of the drive sheave (10, 10'), and the pair of individual wrap pulleys (13, 13', 14, 14')are also disposed in symmetry with respect to the rotation shaft of the drive sheave(10, 10').

3. The elevator apparatus as set forth in claim 1, **characterized in that** a tension unit is provided on the first and second main ropes for applying tension to the first and second main ropes, respectively.

4. The elevator apparatus as set forth in claim 3, **characterized in that** the tension unit comprises weights (15, 15', 16, 16') that are hung on the first and second main ropes (5, 5', 6, 6').

5. The elevator apparatus as set forth in claim 4, **characterized.in that** the weights (15, 15', 16, 16') are arranged at individual lower end portions (5b, 5b', 6b, 6b') of the first and second main ropes (5, 5', 6, 6') independently of each other.

Patentansprüche

1. Aufzugvorrichtung, umfassend:

eine Kabine (4), die in einem Schacht auf und ab bewegt werden kann; und
eine erste Antriebs- und Aufhängungseinheit (17) und eine zweite Antriebs- und Aufhängungseinheit (21), beinhaltend: eine Hauptseileinheit (7,7'), die erste und zweite Hauptseile (5, 5', 6, 6') aufweist, wobei einzelne obere Endabschnitte (5a, 5a', 5b, 5b') der ersten und zweiten Hauptseile (5, 5', 6, 6') fixiert an einem oberen Abschnitt des Schachts (1) angebracht sind, sodass die Kabine aufgehangen (4) ist; ein Paar Kabinen aufhängender Rollen (11, 11', 12, 12'), die an der Kabine (4) angebracht sind, um die ersten und zweiten Hauptseile (5, 5', 6, 6') von den einzelnen oberen Endabschnitten (5a, 5a', 5b, 5b') jeweils in horizontalen Richtungen zu führen; eine Antriebseinheit (8, 8'), die an der Kabine (4) montiert ist und eine Antriebslaufrolle (10, 10') beinhaltet, um welche die ersten und zweiten Hauptseile (5, 5', 6, 6') von den einzelnen Kabinen aufhängenden Rollen (11, 11', 12, 12') jeweils gewickelt sind; und ein Paar Wickelrollen (13, 13', 14, 14'), die an der Kabine (4) montiert sind, sodass die ersten und zweiten Hauptseile (5, 5', 6, 6') von den Antriebslaufrollen (10, 10') in Richtungen abwärts der Kabine (4) jeweils geführt werden, wobei die Kabine (4) dazu gebracht wird, sich in Übereinstimmung mit der Antriebslaufrolle (10, 10') auf und ab zu bewegen;
wobei die Antriebslaufrolle (10, 10') angetrieben wird, um sich um eine Welle zu drehen, die in einer vertikalen Richtung angeordnet ist,
dadurch gekennzeichnet, dass
die erste Antriebs- und Aufhängungseinheit (17) an einem unteren Abschnitt der Kabine (1) angeordnet ist und die zweite Antriebs- und Aufhängungseinheit (21) an einem oberen Abschnitt der Kabine (1) angeordnet ist,
wobei die Rotationsrichtung der Antriebslaufrolle (10) der ersten Antriebs- und Aufhängungseinheit (17) und die Rotationsrichtung der Antriebslaufrolle (10') der zweiten Antriebs- und Aufhängungseinheit (21) entgegengesetzt zueinander sind.

2. Aufzugvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** das Paar Kabinen aufhängender Rollen (11, 11', 12, 12') symmetrisch bezüglich der Welle der Antriebslaufrolle (10, 10') angeordnet ist und das Paar getrennter Wickelrollen (13, 13', 14, 14') auch symmetrisch bezüglich der Welle der Antriebslaufrolle (10, 10') angeordnet ist.

3. Aufzugvorrichtung nach Anspruch 1, **dadurch gekennzeichnet, dass** eine Spanneinheit an den ersten und zweiten Hauptseilen zum jeweiligen Anlegen einer Spannung an den ersten und zweiten Hauptseilen bereitgestellt ist.

4. Aufzugvorrichtung nach Anspruch 3, **dadurch gekennzeichnet, dass** die Spanneinheit Gewichte (15, 15', 16, 16') umfasst, die an den ersten und zweiten Hauptseilen (5, 5', 6, 6') aufgehängt sind.

5. Aufzugvorrichtung nach Anspruch 4, **dadurch gekennzeichnet, dass** die Gewichte (15, 15', 16, 16') an einzelnen unteren Endabschnitten (5b, 5b', 6b, 6b') der ersten und zweiten Hauptseile (5, 5', 6, 6') unabhängig voneinander angeordnet sind.

Revendications

1. Dispositif formant ascenseur comprenant :

une cabine (4) mobile vers le haut et le bas dans une cage (1) ; et
une première unité d'entraînement et de suspension (17) et une seconde unité d'entraînement et de suspension (21) incluant : une unité de câbles principaux (7, 7') qui a des premier et second câbles principaux (5, 5', 6, 6'), des portions d'extrémité supérieure individuelles (5a, 5a', 5b, 5b') des premier et second câbles principaux (5, 5', 6, 6') étant solidement fixées à une portion supérieure de la cage (1) de sorte à sus-

pendre la cabine (4) ; une paire de poulies de suspension de cabine (11, 11', 12, 12') qui sont montées sur la cabine (4) de façon à guider les premier et second câbles principaux (5, 5', 6, 6') provenant des portions d'extrémité supérieure individuelles (5a, 5a', 5b, 5b') respectivement dans des sens horizontaux; une unité d'entraînement (8, 8') qui est montée sur la cabine (4) et qui inclut une poulie d'entraînement (10, 10') autour de laquelle les premier et second câbles principaux (5, 5', 6, 6') provenant des poulies de suspension de cabine individuelles (11, 11', 12, 12') sont respectivement enroulés ; et une paire de poulies d'enroulement (13, 13', 14, 14') qui sont montées sur la cabine (4) de façon à guider les premier et second câbles principaux (5, 5', 6, 6') provenant de la poulie d'entraînement (10, 10') respectivement dans des sens vers le bas de la cabine (4), moyennant quoi la cabine (4) est amenée à monter et à descendre en fonction de la rotation de la poulie d'entraînement (10, 10') ;

dans lequel la poulie d'entraînement (10, 10') est entraînée pour tourner autour d'un arbre de rotation qui est disposé le long d'une direction verticale,

caractérisé en ce que

la première unité d'entraînement et de suspension (17) est disposée au niveau d'une portion inférieure de la cabine (1) et la seconde unité d'entraînement et de suspension (21) est disposée au niveau d'une portion supérieure de la cabine (1), dans lequel le sens de rotation de la poulie d'entraînement (10) de la première unité d'entraînement et de suspension (17) et le sens de rotation de la poulie d'entraînement (10') de la seconde unité d'entraînement et de suspension (21) sont opposés l'un à l'autre.

2. Dispositif formant ascenseur selon la revendication 1, **caractérisé en ce que** la paire de poulies de suspension de cabine (11, 11', 12, 12') est disposée de manière symétrique par rapport à l'arbre de rotation de la poulie d'entraînement (10, 10') et la paire de poulies d'enroulement individuelles (13, 13', 14, 14') est également disposée de manière symétrique par rapport à l'arbre de rotation de la poulie d'entraînement (10, 10').

3. Dispositif formant ascenseur selon la revendication 1, **caractérisé en ce qu'**une unité de tension est prévue sur les premier et second câbles principaux pour appliquer une tension respectivement aux premier et second câbles principaux.

4. Dispositif formant ascenseur selon la revendication 3, **caractérisé en ce que** l'unité de tension comprend des poids (15, 15', 16, 16') qui sont suspendus aux premier et second câbles principaux (5, 5', 6, 6').

5. Dispositif formant ascenseur selon la revendication 4, **caractérisé en ce que** les poids (15, 15', 16, 16') sont agencés au niveau de portions d'extrémité inférieure individuelles (5b, 5b', 6b, 6b') des premier et second câbles principaux (5, 5', 6, 6') indépendamment les uns des autres.

FIG. 1

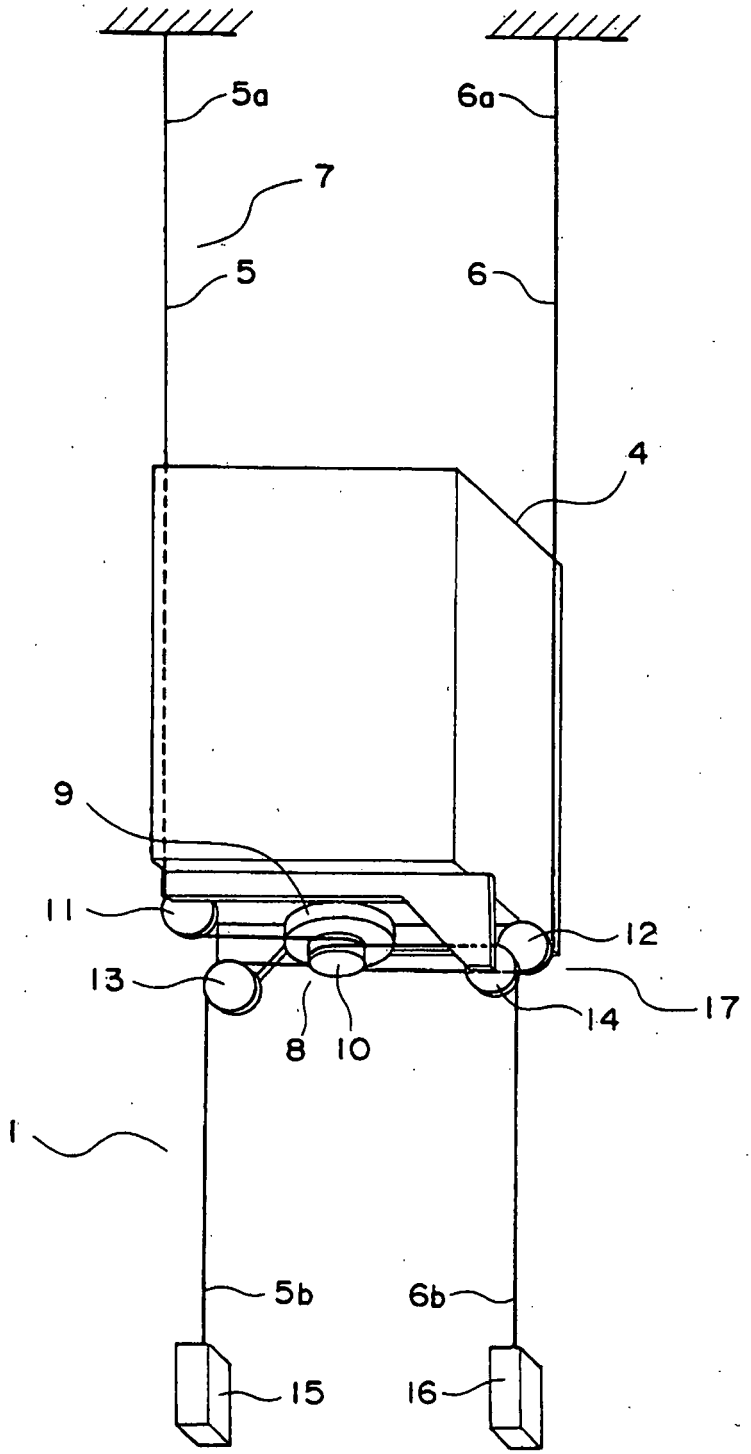


FIG. 2

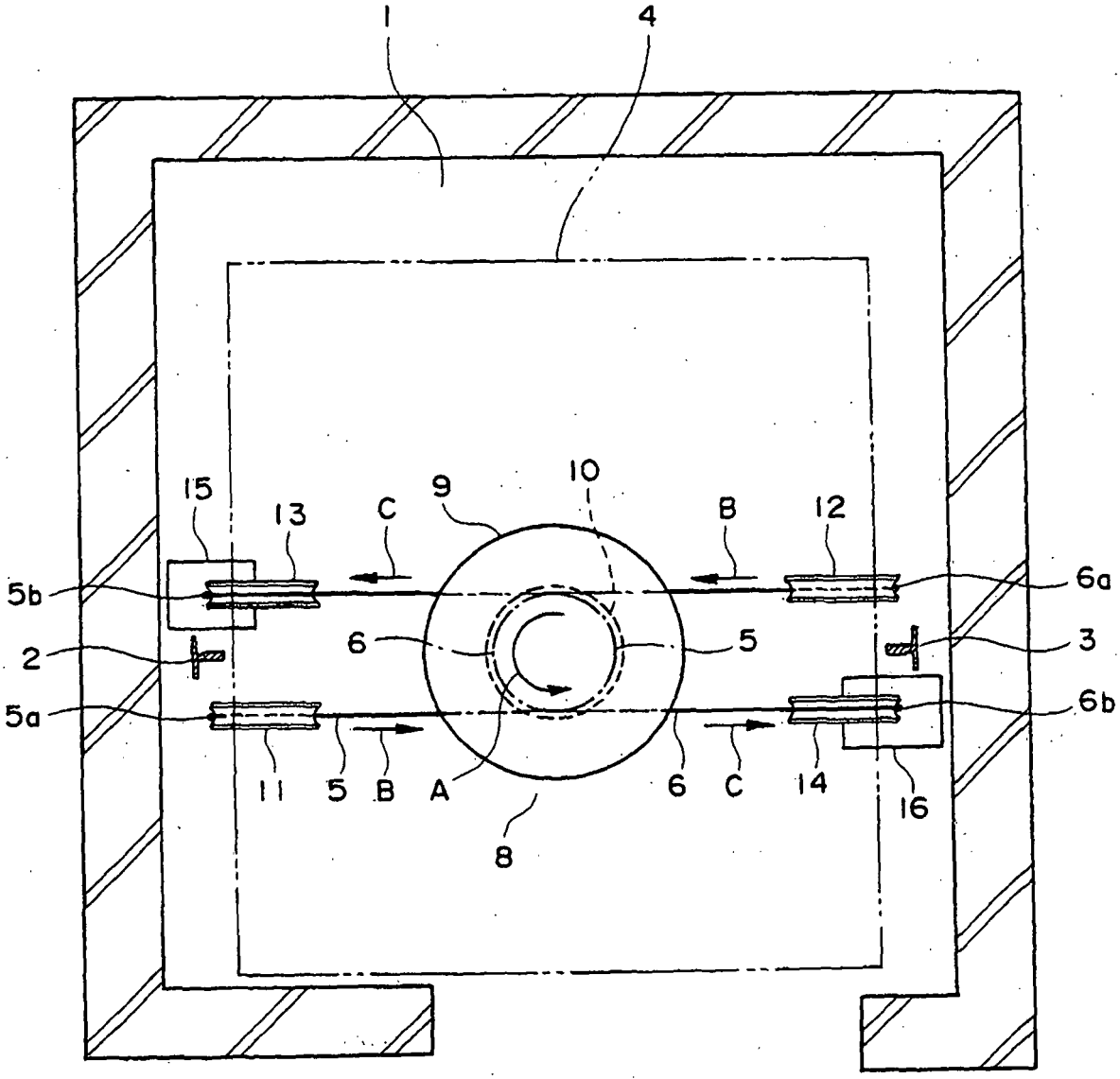


FIG. 3

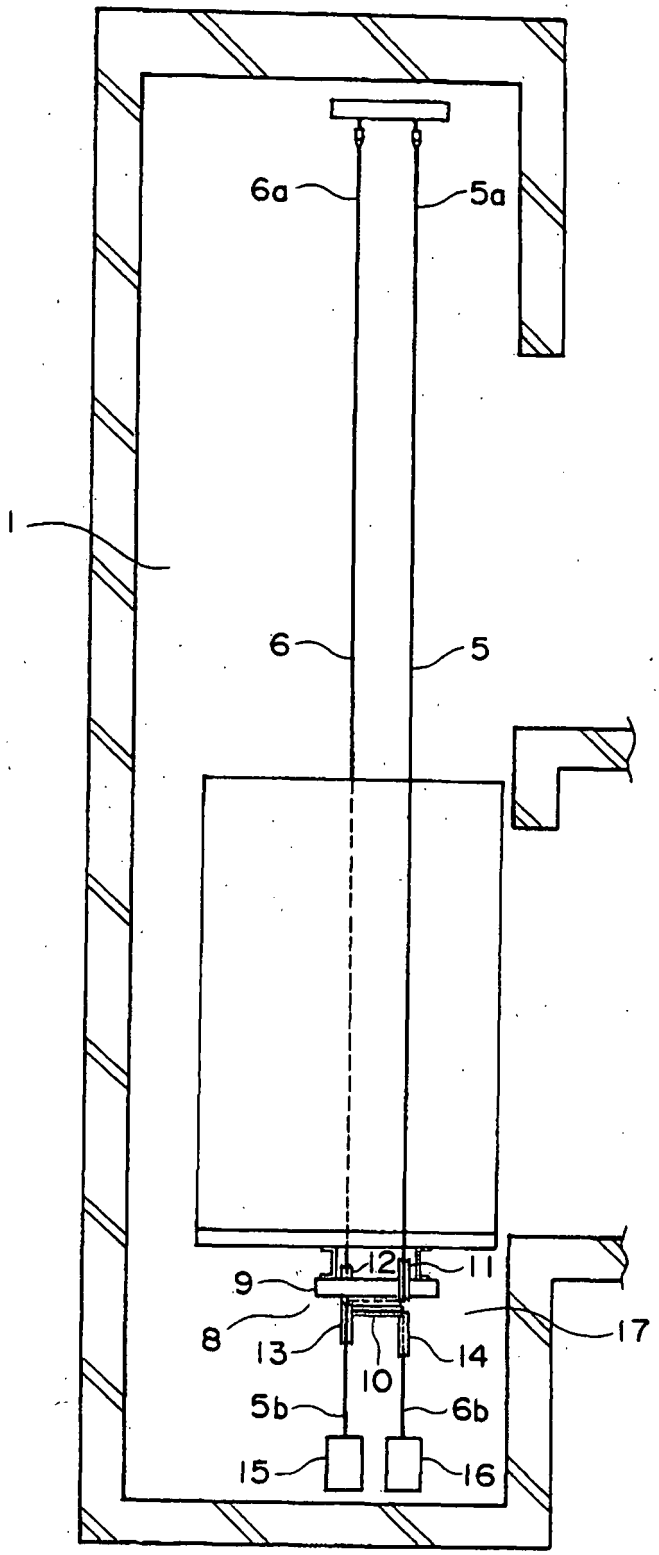


FIG. 4

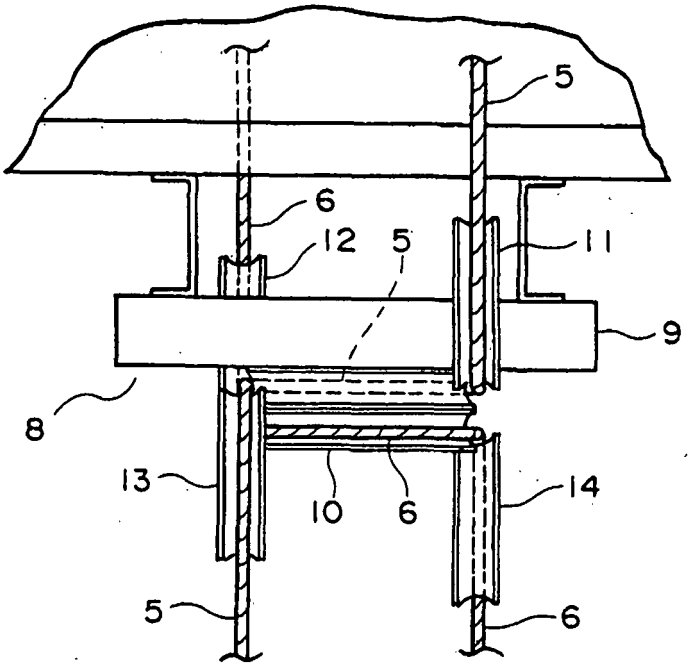


FIG. 5

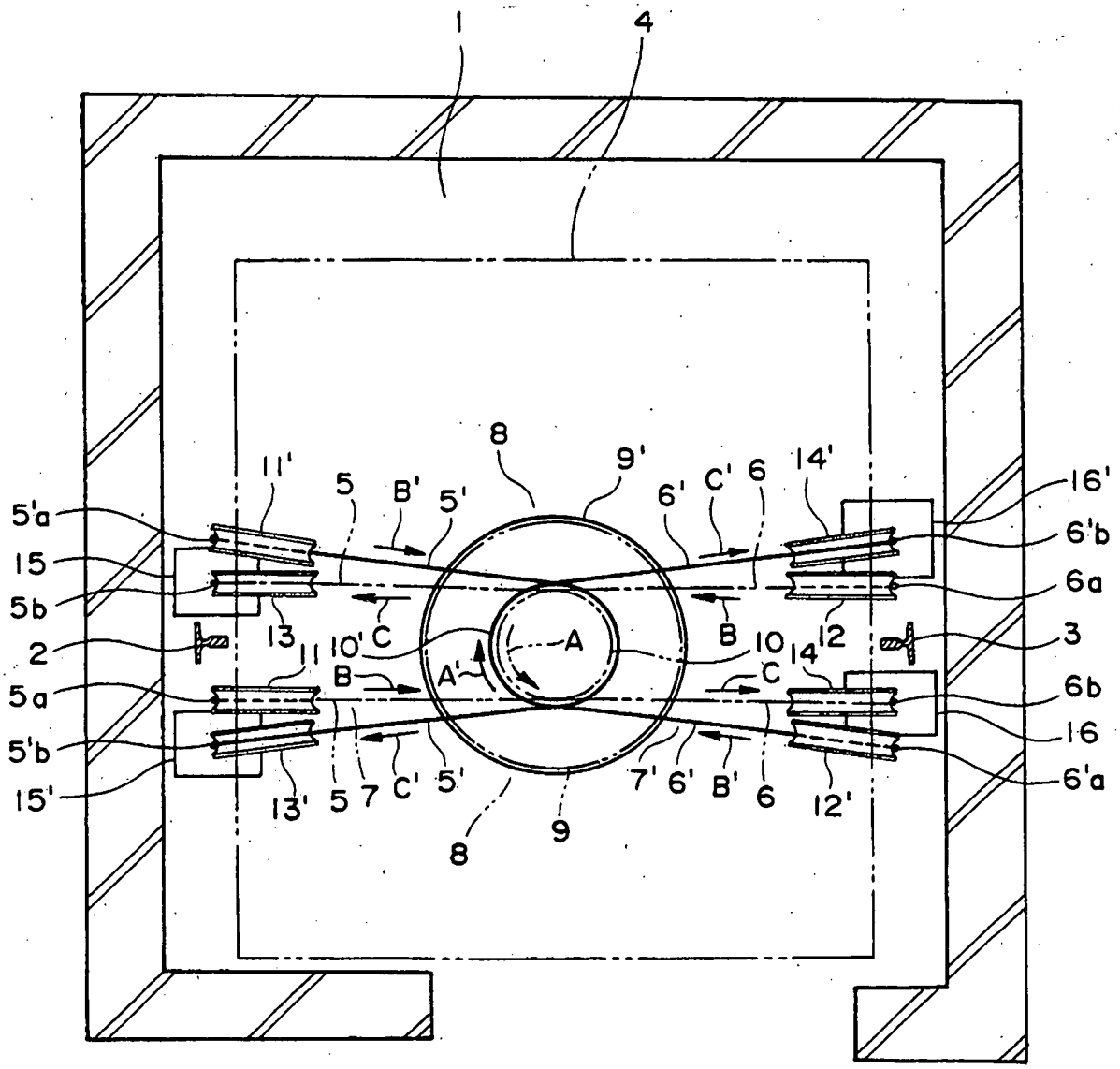
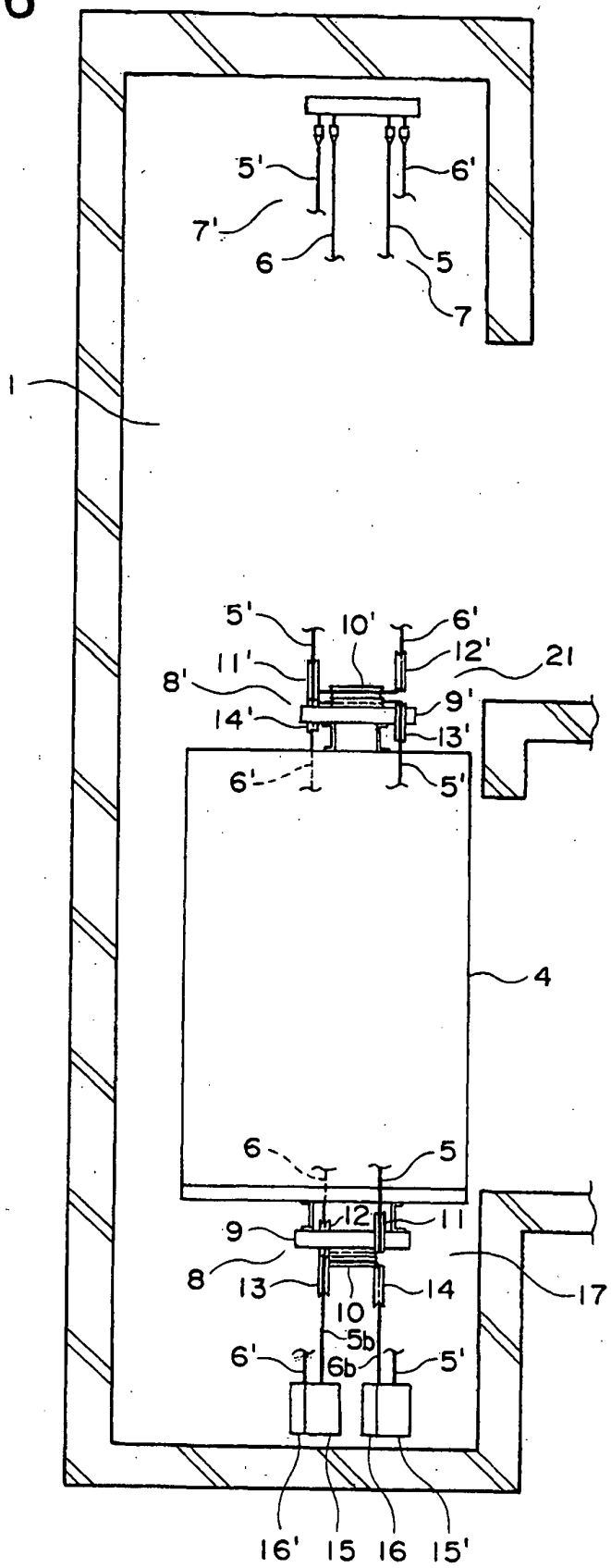

1
4
8
9'
11'
5
B'
5'
6'
C'
6
14'
16'
5'a
6'b
15
6a
5b
13
C
10'
A
B
10
14
12
3
2
11
B
A'
C
6b
5a
16
5'b
6'a
15'
13'
5
7
C'
5'
7'
6'
B'
6
12'
9
8

FIG. 6


5'
6'
7'
6
5
7
1
5'
10'
6'
12'
21
11'
8'
9'
14'
13'
6'
5'
4
6
5
12
11
9
8
13
14
17
10
5b
6'
6b
5'
16'
15
16
15'

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H10273274 A **[0005]**
- JP 2002068641 A **[0005]**
- WO 2004067430 A1 **[0005]**