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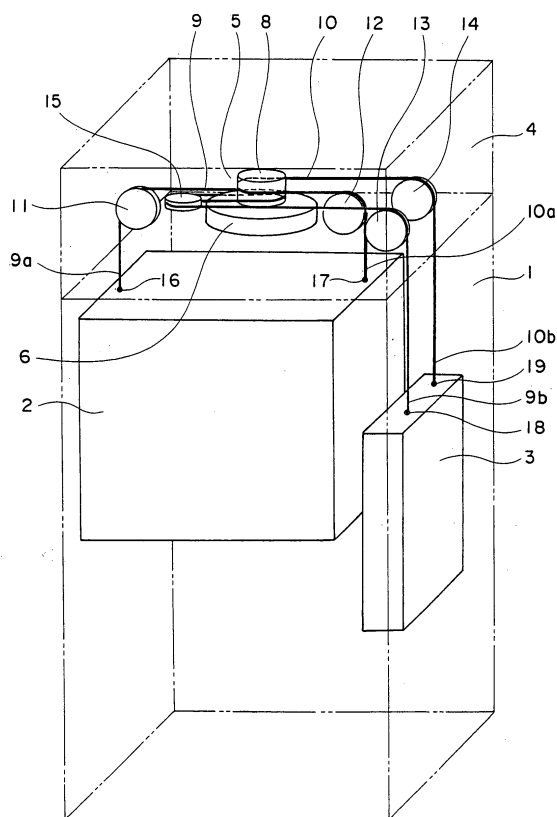
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ELEVATOR DEVICE

(57)

In an upper portion of a hoistway, there is arranged a drive unit having a drive sheave which is driven to rotate around a rotation shaft disposed along a vertical direction. First and second main ropes serve to hang a common car, and hang a common counterweight. In the upper portion of the hoistway, there are arranged a first car side deflection wheel that guides the first main ropes to the car, a second car side deflection wheel that guides the second main ropes to the car, a first weight side deflection wheel that guides the first main ropes to the counterweight, and a second weight side deflection wheel that guides the second main ropes to the counterweight. Also, a horizontal deflection wheel for deflecting the direction of the first main ropes is arranged at the upper portion of the hoistway. Portions of the first main ropes between the drive sheave and the first weight side deflection wheel are wrapped around the horizontal deflection wheel. The first and second main ropes are respectively wrapped around the drive sheave in such a manner that at least a part of a force received by the rotation shaft of the drive sheave from the first main ropes and at least a part of a force received by the rotation shaft of the drive sheave from the second main ropes are counteracted with each other.

FIG. 1



Description**[TECHNICAL FIELD]**

[0001] The present invention relates to an elevator apparatus of a traction type in which a car and a counterweight are driven to move up and down in a hoistway by means of the driving force of a drive unit.

[BACKGROUND ART]

[0002] In the past, there has been proposed an elevator apparatus that has a thin winch disposed in a horizontal mother at an upper portion of a hoistway in order to make the reduction in the height dimension of the hoistway. A drive sheave of the thin winch is driven to rotate around a rotation shaft disposed along a vertical direction by means of a flat thin motor. In addition, a first and a second deflection pulley are arranged at the upper portion of the hoistway in a horizontally spaced apart relationship with respect to the drive sheave. The car and the counterweight are hung from a plurality of main ropes wrapped around the first deflection pulley, the drive sheave, and the second deflection pulley in this order (see a first patent document).

[0003] [First Patent Document] Japanese patent application laid-open No. 2001-48450

[DISCLOSURE OF THE INVENTION]**[PROBLEMS TO BE SOLVED BY THE INVENTION]**

[0004] However, all the main ropes are wrapped around the individual deflection pulleys, so it is necessary to provide many grooves for wrapping of the individual main ropes on an outer periphery of each deflection pulley, and hence the thickness of each deflection pulley becomes large. Accordingly, regarding outside grooves, the main ropes come into these grooves while being inclined with respect to the direction along the grooves, so an interval or space between each deflection pulley and the drive sheave can not be made so small.

[0005] In addition, all the main ropes are wrapped around the outer periphery of the drive sheave at the same side thereof, so the directions of forces which the drive sheave receives from the individual main ropes become all the same direction. Accordingly, all the forces received from the individual main ropes should be supported by the rotation shaft of the drive sheave, thus resulting in an increase in size of the drive unit. From these reasons, it becomes difficult to achieve a space saving of the hoistway.

[0006] 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]

[0007] An elevator apparatus according to the present invention includes: a drive unit that has a drive sheave which is driven to rotate around a rotation shaft disposed along a vertical direction; a first main rope and a second main rope that are respectively wrapped around the drive sheave; a common car that is hung on the first main rope so as to be driven to move up and down in a hoistway in accordance with the rotation of the drive sheave; a common counterweight that is hung on the first main rope so as to be driven to move up and down in the hoistway in accordance with the rotation of the drive sheave; a first car side deflection wheel that guides the first main rope to the car; a second car side deflection wheel that guides the second main rope to the car; a first weight side deflection wheel that guides the first main rope to the counterweight; a second weight side deflection wheel that guides the second main rope to the counterweight; and a horizontal deflection wheel around which a portion of the first main rope between the drive sheave and the first weight side deflection wheel are wrapped so as to deflect the direction of the first main rope; wherein the first main rope and the second main rope are respectively wrapped around the drive sheave in such a manner that at least a part of a force received by the rotation shaft of the drive sheave from the first main rope and at least a part of a force received by the rotation shaft of the drive sheave from the second main rope are counteracted with each other.

[BRIEF DESCRIPTION OF THE DRAWINGS]**[0008]**

Fig. 1 is a perspective view showing an elevator apparatus according to a first embodiment of the present invention.

Fig. 2 is a top plan view of the elevator apparatus of Fig. 1.

Fig. 3 is a perspective view showing an elevator apparatus according to a second embodiment of the present invention.

Fig. 4 is a top plan view of the elevator apparatus of Fig. 3.

Fig. 5 is a top plan view showing an elevator apparatus according to a third embodiment of the present invention.

[BEST MODE FOR CARRYING OUT THE INVENTION]

[0009] Hereinafter, preferred embodiments of the present invention will be described in detail while referring to the accompanying drawings.

Embodiment 1.

[0010] Fig. 1 is a perspective view that shows an ele-

vator apparatus according to a first embodiment of the present invention. Also, Fig. 2 is a top plan view that shows the elevator apparatus of Fig. 1. In these figures, a car 2 and a counterweight 3 are arranged in a hoistway 1 so as to be movable up and down. A machine room 4 is arranged in an upper portion of the hoistway 1.

[0011] A drive unit 5 for generating a driving force to move the car 2 and the counterweight 3 up and down is arranged in the machine room 4. The drive unit 5 is designed to be a thin winch that is larger in its diametrical dimension than in its axial dimension. The drive unit 5 has a flat drive unit main body 6 including a thin motor, and a drive sheave 10 that is driven to rotate by the driving force of the drive unit main body 6. The drive sheave 8 is driven to rotate around a rotation shaft 7 (Fig. 2) that is disposed along a vertical direction. The drive unit 5 is disposed in a horizontal manner so that the rotation shaft 7 is disposed along the vertical direction. Also, the drive unit 5 is arranged such that the drive sheave 8 is at a location above the drive unit main body 6.

[0012] A plurality of first main ropes 9 and a plurality of second main ropes 10 are respectively wrapped around the drive sheave 8. Each of the individual first main ropes 9 has a first car hanging end portion 9a and a first weight hanging end portion 9b. Each of the individual second main ropes 10 has a second car hanging end portion 10a and a second weight hanging end portion 10b. The car 2 is hung on the first car hanging end portions 9a and the second car hanging end portions 10a, and the counterweight 3 is hung on the first weight hanging end portions 9b and the second weight hanging end portions 10b. That is, the individual first main ropes 9 and the individual second main ropes 10 serve to hang the common car 2, and hang the common counterweight 3.

[0013] In the machine room 4, there are arranged a first car side deflection wheel 11 that guides the individual first main ropes 9 to the car 2, a second car side deflection wheel 12 that guides the individual second main ropes 10 to the car 2, a first weight side deflection wheel 13 that guides the individual first main ropes 9 to the counterweight 3, and a second weight side deflection wheel 14 that guides the individual second main ropes 10 to the counterweight 3. In addition, in the machine room 4, there is also arranged a horizontal deflection wheel 15 that converts or deflects the direction of the individual first main ropes 9 into a horizontal direction.

[0014] The first car side deflection wheel 11 and the second car side deflection wheel 12 are disposed at locations above the car 2, and the first weight side deflection wheel 13 and the second weight side deflection wheel 14 are disposed at locations above the counterweight 3. In addition, the first car side deflection wheel 11, the second car side deflection wheel 12, the first weight side deflection wheel 13 and the second weight side deflection wheel 14 are respectively formed separately from one another, and are disposed in a horizontally spaced apart relation with respect to the drive sheave 8, respectively. Further, the first car side deflec-

tion wheel 11, the second car side deflection wheel 12, the first weight side deflection wheel 13; and the second weight side deflection wheel 14 are able to rotate around rotation shafts, respectively, which are disposed along the horizontal direction.

[0015] The horizontal deflection wheel 15 is able to rotate around a rotation shaft which is disposed along the vertical direction. In addition, portions of the individual first main ropes 9 between the drive sheave 8 and the first weight side deflection wheel 13 are wrapped around the horizontal deflection wheel 15. Further, the horizontal deflection wheel 15 is disposed at a location more away from the first weight side deflection wheel 13 than the drive sheave 8, in a vertical projection plane of the hoistway 1.

[0016] A first car rope stop member 16 and a second car rope stop member 17, being spaced in the horizontal direction from each other, are arranged at an upper portion of the car 2. The first and second car rope stop members 16, 17 are disposed in symmetry with respect to the center of the car 2 in the vertical projection plane of the hoistway 1 (Fig. 2). The first car hanging end portions 9a are connected with the first car rope stop member 16, and the second car hanging end portions 10a are connected with the second car rope stop member 17.

[0017] A first weight rope fastening member 18 and a second weight rope fastening member 19, being spaced in the horizontal direction from each other, are arranged at an upper portion of the counterweight 3. The first and second weight rope fastening members 18, 19 are disposed in symmetry with respect to the center of the counterweight 3 in the vertical projection plane of the hoistway 1 (Fig. 2). The first weight hanging end portions 9b are connected with the first weight rope fastening member 18, and the second weight hanging end portions 10b are connected with the second weight rope fastening member 19.

[0018] The individual first main ropes 9 are wrapped, from the first car hanging end portions 9a thereof, around the first car side deflection wheel 11, the drive sheave 8, the horizontal deflection wheel 15 and the first weight side deflection wheel 13 in this order to reach the first weight hanging end 9b thereof. Also, the individual second main ropes 10 are wrapped, from the second car hanging end portions 10a thereof, around the second car side deflection wheel 12, the drive sheave 8 and the second weight side deflection wheel 14 in this order to reach the second weight hanging end 10b thereof.

[0019] The portions of the first main ropes 9 wrapped around the horizontal deflection wheel 15 and the portions of the first main ropes 9 wrapped around the drive sheave 8 are bent in opposite directions with respect to each other. In addition, the first main ropes 9 are continuously wrapped around the first car side deflection wheel 11, the drive sheave 8, the horizontal deflection wheel 15 and the first weight side deflection wheel 13 in a continuous manner without crossing one another in the vertical projection plane of the hoistway 1 (Fig. 2).

[0020] Moreover, the first and second main ropes 9, 10 are wrapped around the drive sheave 8 in such a manner that the drive sheave 8 is clamped between the first and second main ropes 9, 10 in a plane of projection thereof along the rotation shaft of the drive sheave 8. That is, the first main ropes 9 are wrapped around an outer peripheral portion of the drive sheave 8 at a side opposite to an outer peripheral portion thereof around which the second main ropes 10 are wrapped. In addition, those portions 20 of the individual first main ropes 9 (contact wrap portions of the first main ropes 9) which are wrapped around the drive sheave 8 in contact therewith, and those portions 21 of the individual second main ropes 10 (contact wrap portions of the second main ropes 10) which are wrapped around the drive sheave 8 in contact therewith, become symmetry with respect to the rotation shaft 7 of the drive sheave 8 in the plane of projection along the rotation shaft of the drive sheave 8 (Fig. 2).

[0021] Here, note that the rotation shaft 7 of the drive sheave 8 receives forces acting in directions perpendicular to an axial direction of the rotation shaft 7 from the individual first main ropes 9 and the individual second main ropes 10, respectively, which are wrapped around the drive sheave 8. Thus, at least a part of the force which is received by the rotation shaft 7 from the individual first main ropes 9 and at least a part of the force which is received by the rotation shaft 7 from the individual second main ropes 10 are counteracted with each other due to the fact that the contact wrap portions 20 of the first main ropes 9 and the contact wrap portions 21 of the second main ropes 10 become symmetry with respect to the rotation shaft 7.

[0022] The individual first main ropes 9 and the individual second main ropes 10 are driven to move by the rotation of the drive sheave 8. The car 2 and the counterweight 3 are driven to move up and down in the hoistway 1 in accordance with the movements of the individual first main ropes 9 and the individual second main ropes 10.

[0023] In such an elevator apparatus, the first and second main ropes 9, 10 respectively wrapped around the drive sheave 8 are selectively wrapped around the individual deflection wheels 11 through 14, respectively, and the common car 2 and the common counterweight 3 are hung by the first and second main ropes 9, 10 by converting or deflecting the direction of the first main ropes 9 into the horizontal direction by means of the horizontal deflection wheel 15, as a consequence of which it is possible to prevent all the main ropes from being wrapped around each of the deflection wheels 11 through 14, thereby making it possible to reduce the number of main ropes wrapped around each of the individual deflection wheels 11 through 14. Thus, the number of grooves in each of the deflection wheels 11 through 14 can be reduced, and the thickness of each of the deflection wheels 11 through 14 can be decreased. Accordingly, the individual deflection wheels 11 through 14 can be brought closer to the drive sheave 8 while maintaining the angles

of approach of the main ropes to the grooves in the individual deflection wheels within a predetermined range, and the reduction in the horizontal dimension of the hoistway 1 can be made.

[0024] In addition, the first and second main ropes 9, 10 are respectively wrapped around the drive sheave 8 in such a manner that at least a part of the force received by the rotation shaft 7 from the individual first main ropes 9 and a part of the force received by the rotation shaft 7 from the individual second main ropes 10 are counteracted with each other. As a result, the load which is substantially supported by the rotation shaft 7 of the drive sheave 8 can be decreased, and the reduction in size of the drive unit 5 can be made. From these reasons, it is possible to achieve the space saving of the hoistway 1.

[0025] Moreover, the contact wrap portions 20 of the first main ropes 9 and the contact wrap portions 21 of the second main ropes 10 are disposed in symmetry with respect to the rotation shaft 7 of the drive sheave 8 in the plane of projection in a direction along the rotation shaft 7 of the drive sheave 8, so the force received by the rotation shaft 7 from the first main ropes 9 and the force received by the rotation shaft 7 from the second main ropes 10 can be counteracted with each other in an effective manner, thereby making it possible to further reduce the size of the drive unit 5.

[0026] Further, the first car rope stop member 16 with the first car hanging end portions 9a being connected therewith and the second car rope stop member 17 with the second car hanging end portions 10a being connected therewith are mounted on the car 2, and the first and second car rope stop members 16, 17 are disposed in symmetry with respect to the center of the car 2 in the vertical projection plane of the hoistway 1. With such an arrangement, it is possible to hang the car 3 in a stabilized manner.

Embodiment 2.

[0027] Fig. 3 is a perspective view that shows an elevator apparatus according to a second embodiment of the present invention. In this figure, a machine room like in the first embodiment is not provided in an upper portion of a hoistway 1. That is, the elevator apparatus according to the second embodiment is constructed as a machine room-less elevator. In addition, a drive unit 5, a first car side deflection wheel 11, a second car side deflection wheel 12, a first weight side deflection wheel 13, a second weight side deflection wheel 14 and a horizontal deflection wheel 15 are all arranged in the upper portion of the hoistway 1.

[0028] Fig. 4 is a top plan view of the elevator apparatus of Fig. 3. In these figures, portions of first main ropes 9 wrapped around the horizontal deflection wheel 15 and portions of the first main ropes 9 wrapped around a drive sheave 8 are bent in the same direction with respect to each other. In addition, portions of the first main ropes 9 between the drive sheave 8 and the first weight side de-

flection wheel 13 and portions of the first main ropes 9 between the drive sheave 8 and the first car side deflection wheel 11 cross each other in a vertical projection plane of the hoistway 1. In this example, portions of the first main ropes 9 between the horizontal deflection wheel 15 and the first weight side deflection wheel 13 and the portions of the first main ropes 9 between the drive sheave 8 and the first car side deflection wheel 11 cross each other.

[0029] The first and second main ropes 9, 10 are wrapped around the drive sheave 8 in such a manner that contact wrap portions 20 of the first main ropes 9 and contact wrap portions 21 of the second main ropes 10 clamp the rotation shaft 7 therebetween in the plane of projection in the direction along the rotation shaft 7. Here, note that in this example, the individual positions of the contact wrap portions 20 of the first main ropes 9 and the contact wrap portions 21 of the second main ropes 10 deviate from their completely symmetrical positions with respect to the rotation shaft 7. The construction of this embodiment other than the above is similar to that of the first embodiment.

[0030] In such an elevator apparatus, the portions of the first main ropes 9 between the horizontal deflection wheel 15 and the first weight side deflection wheel 13 and the portions of the first main ropes 9 between the drive sheave 8 and the first car side deflection wheel 11 cross each other in the vertical projection plane of the hoistway 1, so the portions of the first main ropes 9 wrapped around the horizontal deflection wheel 15 and the portions of the first main ropes 9 wrapped around the drive sheave 8 can be bent in the same direction with respect to each other, thereby making it possible to increase the life span of the first main ropes 9.

[0031] In addition, the drive unit 5, the first car side deflection wheel 11, the first car side deflection wheel 12, the first weight side deflection wheel 13, the second weight side deflection wheel 14 and the horizontal deflection wheel 15 are all arranged in the hoistway 1 at the upper portion thereof, so a machine room can be eliminated, and a further space saving of the hoistway 1 can be made.

Embodiment 3.

[0032] Fig. 5 is a top plan view that shows an elevator apparatus according to a third embodiment of the present invention. In this figure, portions of the first main ropes 9 between a drive sheave 8 and a horizontal deflection wheel 15 and portions of the first main ropes 9 between the drive sheave 8 and a first car side deflection wheel 11 cross each other in a vertical projection plane of a hoistway 1. In addition, contact wrap portions 20 of the first main ropes 9 and contact wrap portions 21 of the second main ropes 10 are only partially overlapped with each other as a main rope wrap portion 31 in the plane of projection in a direction along a rotation shaft 7. The construction of this embodiment other than the above is

similar to that of the second embodiment.

[0033] Thus, even if the portions of the first main ropes 9 between the drive sheave 8 and the horizontal deflection wheel 15 and the portions of the first main ropes 9 between the drive sheave 8 and the first car side deflection wheel 11 cross each other in the vertical projection plane of the hoistway 1, portions of the first main ropes 9 wrapped around the horizontal deflection wheel 15 and portions of the first main ropes 9 wrapped around the drive sheave 8 can be bent in the same direction with respect to each other. Accordingly, an increase in the life span of the first main ropes 9 can be achieved.

[0034] In addition, the contact wrap portions 20 of the first main ropes 9 and the contact wrap portions 21 of the second main ropes 10 are only partially overlapped with each other as a main rope wrap portion 31 in the plane of projection in the direction along the rotation shaft 7, so a contact area between each of the first and second main ropes 9, 10 and the drive sheave 8 can be made large. Accordingly, the prevention of slippage of the first and second main ropes 9, 10 with respect to the drive sheave 8 can be made.

[0035] Although in the above-mentioned respective embodiments, the car 2 and the counterweight 3 are hung by the first and second main ropes 9, 10 connected with the car 2 and the counterweight 3, a car hanging wheel and a weight hanging wheel may be provided on the car 2 and the counterweight 3, respectively, and the car 2 and the counterweight 3 may be hung by connecting the individual end portions of the first and second main ropes wrapped around the car hanging wheel and the weight hanging wheel, respectively, with an upper portion in the hoistway 1 and the machine room.

Claims

1. An elevator apparatus **characterized by** comprising:

a drive unit that has a drive sheave which is driven to rotate around a rotation shaft disposed along a vertical direction;

a first main rope and a second main rope that are respectively wrapped around the drive sheave;

a common car that is hung on the first main rope so as to be driven to move up and down in a hoistway in accordance with the rotation of the drive sheave;

a common counterweight that is hung on the first main rope so as to be driven to move up and down in the hoistway in accordance with the rotation of the drive sheave;

a first car side deflection wheel that guides the first main rope to the car;

a second car side deflection wheel that guides the second main rope to the car;

a first weight side deflection wheel that guides the first main rope;

a second weight side deflection wheel that guides the second main rope to the counterweight; and

a horizontal deflection wheel around which a portion of the first main rope between the drive sheave and the first weight side deflection wheel is wrapped so as to deflect the direction of the first main ropes;

wherein the first main ropes and the second main rope are respectively wrapped around the drive sheave in such a manner that at least a part of a force received by the rotation shaft of the drive sheave from the first main rope and at least a part of a force received by the rotation shaft of the drive sheave from the second main rope are counteracted with each other.

2 The elevator apparatus as set forth in claim 1, **characterized in that** the portion of the first main rope which is wrapped around the drive sheave in contact therewith, and the portion of the second main rope which is wrapped around the drive sheave in contact therewith, are disposed in symmetry with respect to the rotation shaft of the drive sheave in a plane of projection thereof along the rotation shaft of the drive sheave.

3 The elevator apparatus as set forth in claim 1, **characterized in that**

a first car rope stop member with the first main rope being connected therewith and a second car rope stop member with the second main rope being connected therewith are provided on the car; and

the first and second car rope stop members are disposed in symmetry with respect to a center of the car in a vertical projection plane of the hoistway.

4 The elevator apparatus as set forth in claim 1, **characterized in that** a portion of the first main rope between the drive sheave and the first weight side deflection wheel and a portion of the first main rope between the drive sheave and the first car side deflection wheel cross each other in a vertical projection plane of the hoistway.

5 The elevator apparatus as set forth in claim 1, **characterized in that** the portion of the first main rope which is wrapped around the drive sheave in contact therewith, and the portion of the second main rope which is wrapped around the drive sheave in contact therewith, are only partially overlapped with each other in a plane of projection along the rotation shaft of the drive sheave.

6 The elevator apparatus as set forth in claim 1, **characterized in that** the drive unit, the first car side deflection wheel, the first car side deflection

wheel, the first weight side deflection wheel, the second weight side deflection wheel and the horizontal deflection wheel are arranged in an upper portion of the hoistway.

FIG. 1

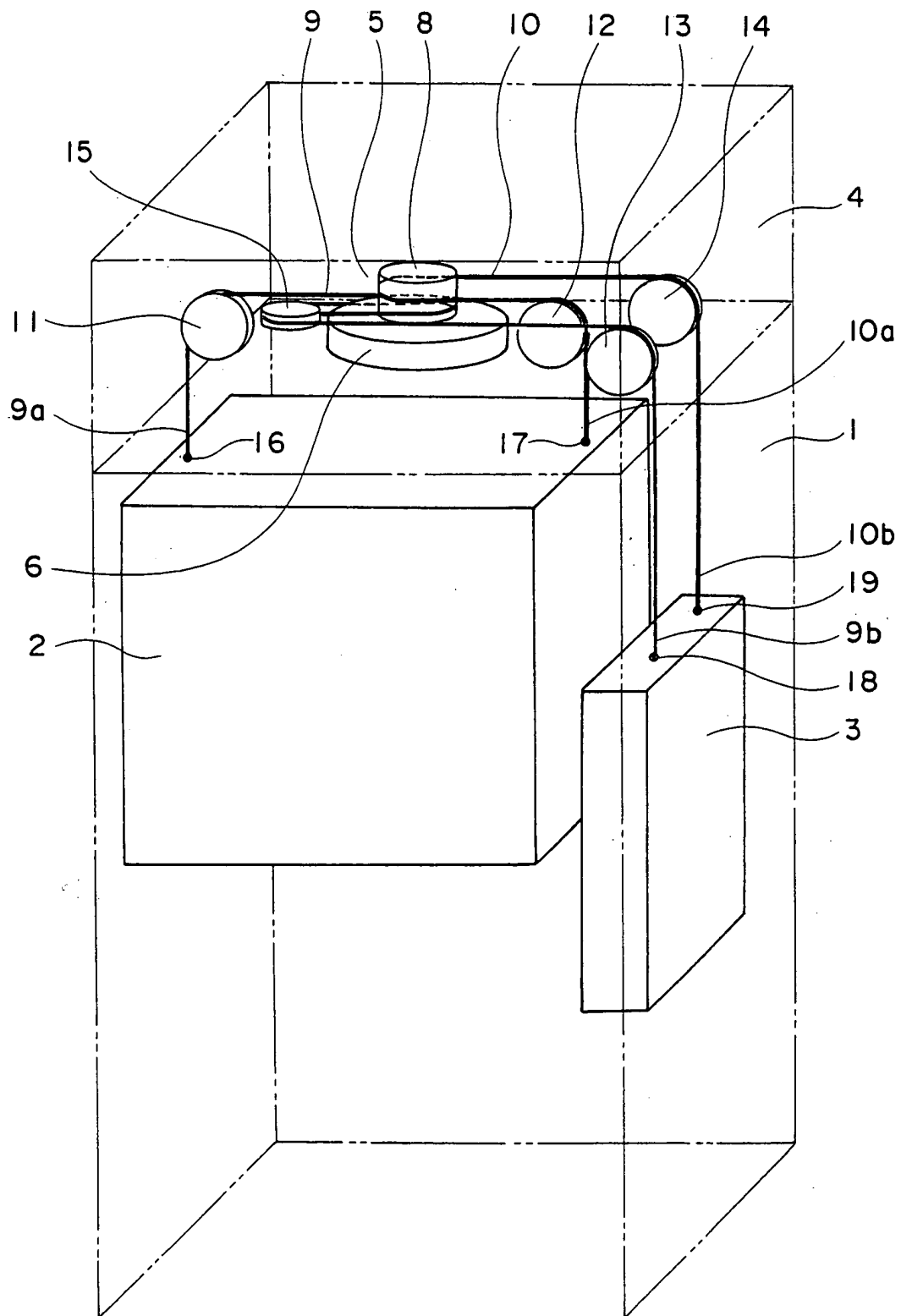


FIG. 2

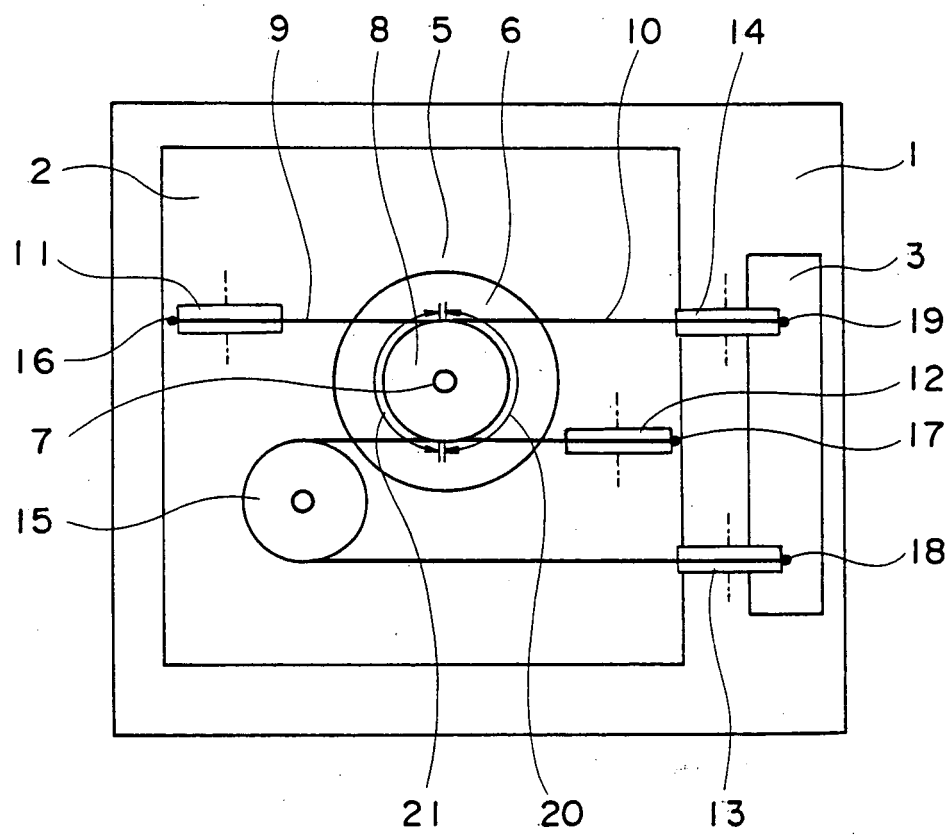


FIG. 3

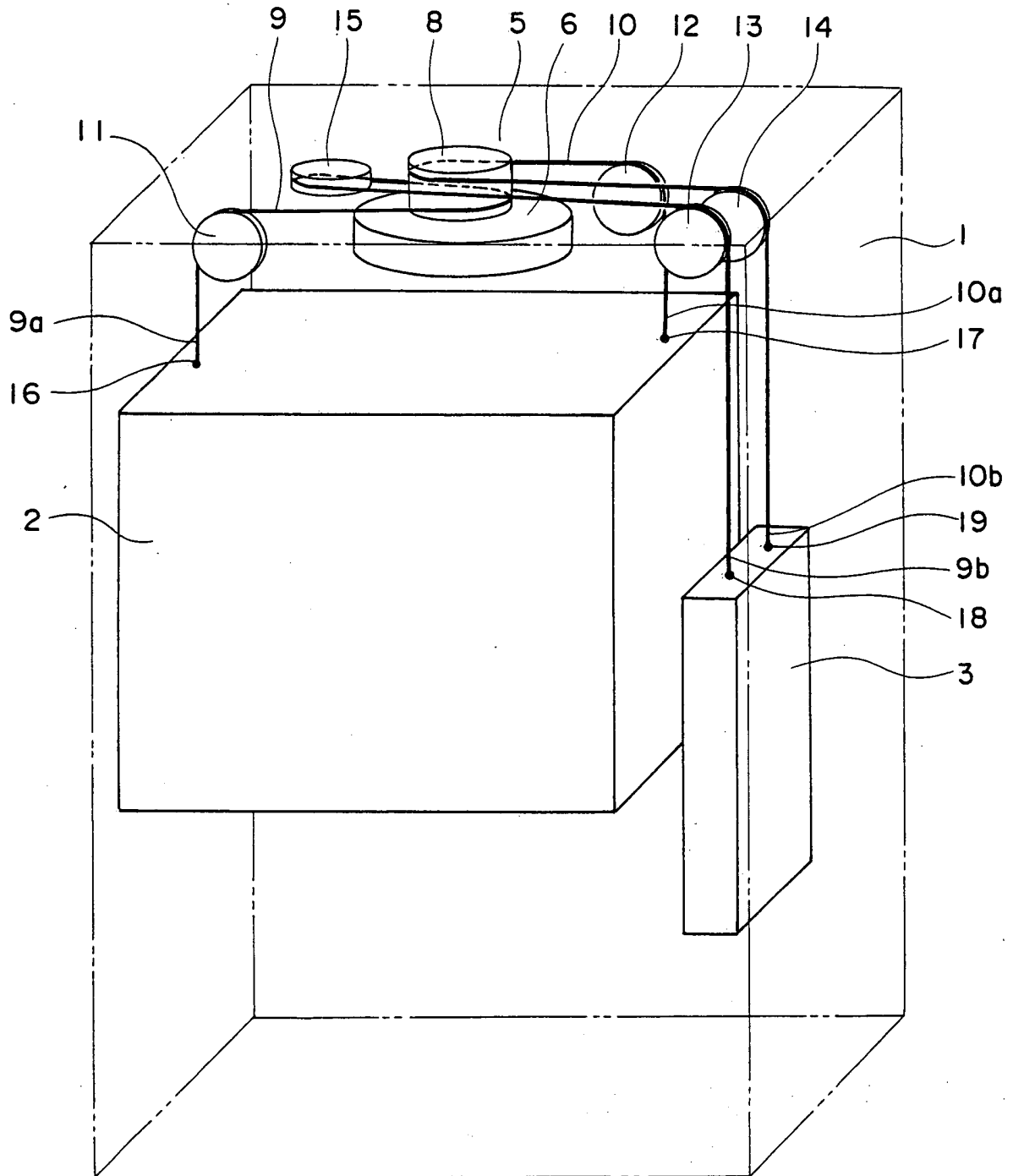


FIG. 4

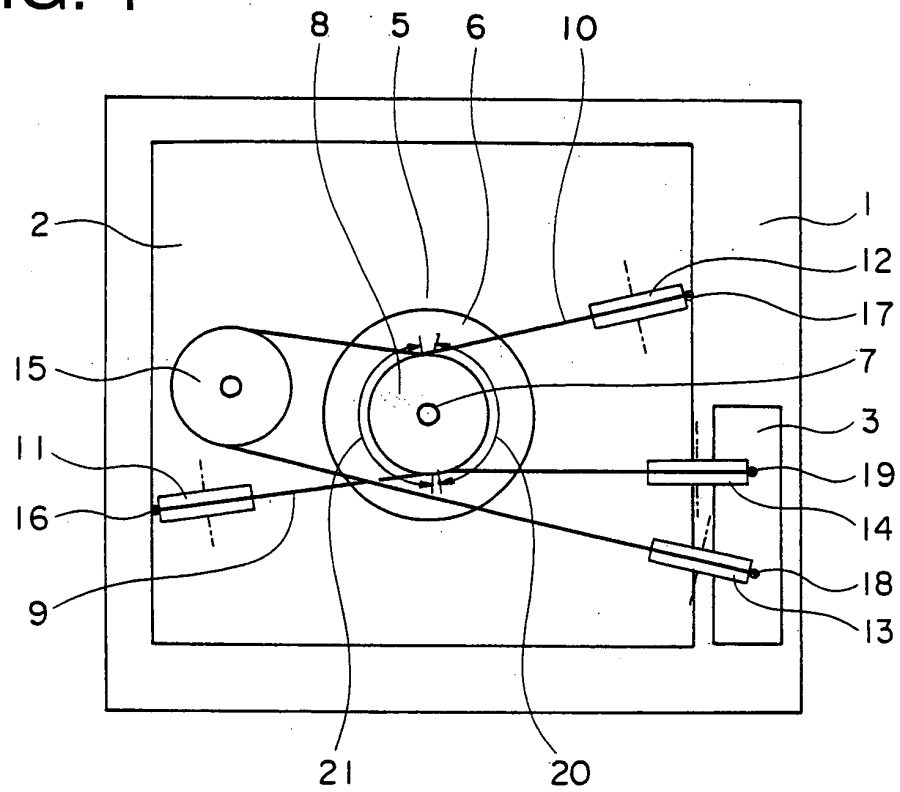
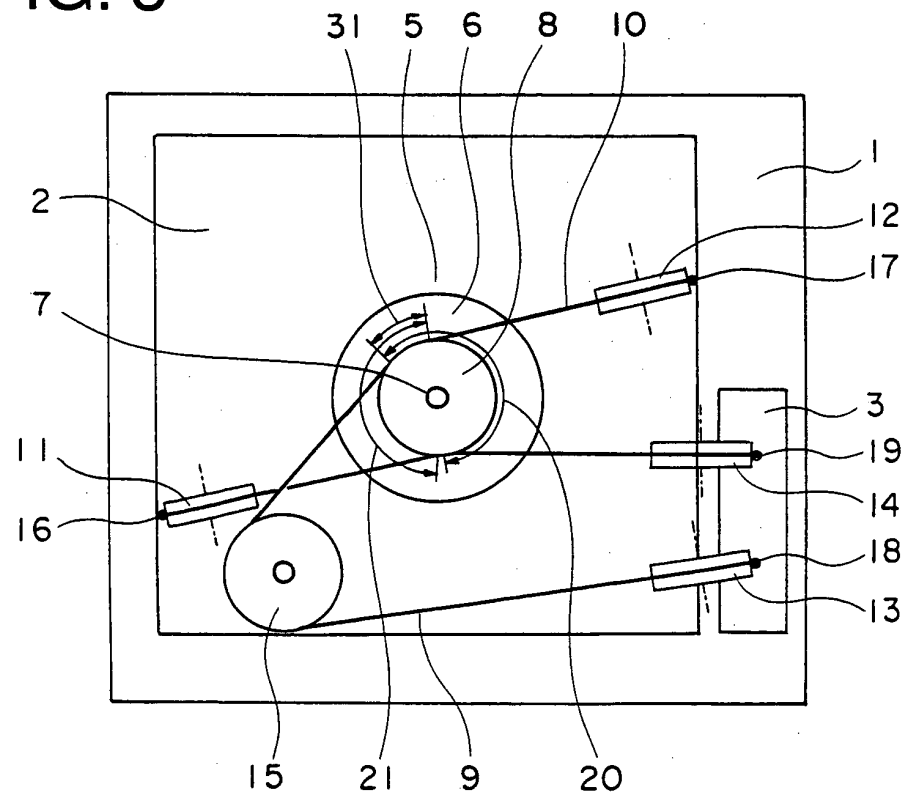


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/310991

A. CLASSIFICATION OF SUBJECT MATTER B66B11/08(2006.01)i, B66B7/00(2006.01)i, B66B7/06(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) B66B1/00-B66B20/00		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007 Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	WO 2006/033146 A1 (Mitsubishi Electric Corp.), 30 March, 2006 (30.03.06), Par. Nos. [0024] to [0032]; Figs. 5 to 6 (Family: none)	1-3, 6 4-5
Y	WO 2006/040813 A1 (Mitsubishi Electric Corp.), 20 April, 2006 (20.04.06), Par. Nos. [0033] to [0037]; Fig. 6 (Family: none)	4-5
<input type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
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Date of the actual completion of the international search 16 February, 2007 (16.02.07)		Date of mailing of the international search report 27 February, 2007 (27.02.07)
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