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(54) **ELEVATOR EQUIPMENT**

AUFZUGSEINRICHTUNG

EQUIPEMENT D'ELEVATEUR

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Description**TECHNICAL FIELD**

[0001] The present invention relates to a single-shaft multi-car elevator apparatus in which a plurality of cars are raised and lowered inside a shared hoistway.

BACKGROUND ART

[0002] An elevator apparatus is disclosed in Japanese Patent Laid-Open No. SHO 59-133188, for example, in which two cars are disposed vertically inside a shared hoistway. However, in this elevator apparatus, since two cars and two counterweights are suspended by two-to-one (2:1) roping, the construction of the apparatus is complex. Furthermore, since the rope speed and the rotational speed of the sheaves are twice those of one-to-one (1:1) roping, noise is increased, making it impossible to operate the cars at high speed. As a further prior art document, US 1,911,834 A discloses an elevator according to the preamble of present claim 1.

DISCLOSURE OF THE INVENTION

[0003] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator apparatus enabling an upper car and a first counterweight, and a lower car and a second counterweight, respectively, to be suspended by one-to-one (1:1) roping, thereby enabling noise to be reduced and the upper car and the lower car to be operated at high speed.

[0004] In order to achieve the above object an elevator apparatus according to claim 1 is provided.

BRIEF DESCRIPTION OF THE DRAWINGS**[0005]**

Figure 1 is a front elevation showing an elevator apparatus according to Embodiment 1 (not part of the present invention)

Figure 2 is a side elevation showing the elevator apparatus in Figure 1;

Figure 3 is a plan showing the elevator apparatus in Figure 1;

Figure 4 is a front elevation showing an upper portion of a hoistway from Figure 1 enlarged;

Figure 5 is a side elevation showing the upper portion of the hoistway from Figure 1 enlarged;

Figure 6 is a plan showing an elevator apparatus according to Embodiment 2 which is part of the present invention; and

Figure 7 is a plan showing an elevator apparatus according to Embodiment 3 (not part of the present invention)

BEST MODE FOR CARRYING OUT THE INVENTION

[0006] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0007] Figure 1 is a front elevation showing an elevator apparatus according to Embodiment 1, Figure 2 is a side elevation showing the elevator apparatus in Figure 1, Figure 3 is a plan showing the elevator apparatus in Figure 1, Figure 4 is a front elevation showing an upper portion of a hoistway from Figure 1 enlarged, and Figure 5 is a side elevation showing the upper portion of the hoistway from Figure 1 enlarged. Moreover, Figure 4 is a view in the direction of arrow IV in Figure 3, and Figure 5 is a view in the direction of arrow V in Figure 3.

[0008] In the figures, a first driving machine 3 having a first drive sheave 2 is disposed in an upper portion of a hoistway 1. An upper car 4 and a first counterweight 5 are raised and lowered inside the hoistway 1 by a driving force from the first driving machine 3.

[0009] A plurality of first main ropes 6 (only one is shown in the figures) for suspending the upper car 4 and the first counterweight 5 inside the hoistway 1 are wound around the first drive sheave 2. The first main ropes 6 have: first car end portions 6a connected to an upper portion of the upper car 4; and first counterweight end portions 6b connected to an upper portion of the first counterweight 5.

[0010] The upper car 4 is suspended by the first main ropes 6 at its center of gravity. The first counterweight 5 is also suspended by the first main ropes 6 at its center of gravity. In addition, the upper car 4 and the first counterweight 5 are suspended by a one-to-one (1:1) roping method.

[0011] The first driving machine 3 is disposed directly above the upper car 4 such that an axis of rotation of the first drive sheave 2 extends horizontally. A first deflection sheave 7 around which the first main ropes 6 are wound is disposed in an upper portion of the hoistway 1. The first deflection sheave 7 directs the first main ropes 6 from the first drive sheave 2 toward the first counterweight 5.

[0012] The first deflection sheave 7 is disposed such that an axis of rotation thereof extends parallel to the axis of rotation of the first drive sheave 2. In addition, the first main ropes 6 are wound around the first drive sheave 2 and the first deflection sheave 7 using a full winding method.

[0013] A second driving machine 9 having a second drive sheave 8 is disposed in an upper portion of the hoistway 1. A lower car 10 and a second counterweight 11 are raised and lowered inside the hoistway 1 by a driving force from the second driving machine 9. The lower car 10 is disposed below the upper car 4 inside the hoistway 1. The first and second counterweights 5 and 11 are disposed behind the upper car 4 and the lower

car 10 inside the hoistway 1 so as to line up in a direction of frontage of the upper car 4 and the lower car 10.

[0014] First and second lower car suspension portions 10a and 10b are disposed on first and second side portions of an upper end of the lower car 10. The first and second lower car suspension portions 10a and 10b are symmetrically disposed on opposite sides of the center of gravity of the lower car 10 from each other.

[0015] A plurality of second main ropes 12 (only one is shown in the figures) and a plurality of third main ropes 13 (only one is shown in the figures) for suspending the lower car 10 and the second counterweight 11 inside the hoistway 1 are wound around the second drive sheave 8.

[0016] The second main ropes 12 have: second car end portions 12a connected to the first lower car suspension portion 10a; and second counterweight end portions 12b connected to the second counterweight 11. The third main ropes 13 have: third car end portions 13a connected to the second lower car suspension portion 10b; and third counterweight end portions 13b connected to the second counterweight 11.

[0017] The lower car 10 is suspended by the second and third main ropes 12 and 13 at its center of gravity. The second counterweight 11 is also suspended by the second and third main ropes 12 and 13 at its center of gravity. In addition, the lower car 10 and the second counterweight 11 are suspended by a one-to-one (1:1) roping method.

[0018] A second deflection sheave 14 around which the second and third main ropes 12 and 13 are wound is disposed in an upper portion of the hoistway 1. The second and third main ropes 12 and 13 are wound around the second deflection sheave 14 using a full winding method.

[0019] First and second guide pulleys 15 and 16 are also disposed in an upper portion of the hoistway 1. The first guide pulley 15 is disposed directly above the first lower car suspension portion 10a and directs the second main ropes 12 from the second drive sheave 8 toward the first lower car suspension portion 10a. The second guide pulley 16 is disposed directly above the second lower car suspension portion 10b and directs the third main ropes 13 toward the second lower car suspension portion 10b. The second and third main ropes 12 and 13 pass along first and second sides of the upper car 4 so as not to interfere with the upper car 4 and are connected to the lower car suspension portions 10a and 10b.

[0020] In addition, first and second direction-changing pulleys 17 and 18 for directing the third main ropes 13 from the second drive sheave 8 toward the second guide pulley 16 are also disposed in an upper portion of the hoistway 1.

[0021] Axes of rotation of the second drive sheave 8, the second deflection sheave 14, and the first guide pulley 15 extend horizontally parallel to each other. An axis of rotation of the second guide pulley 16 extends horizontally parallel to the direction of frontage of the upper car 4 and the lower car 10. Axes of rotation of the first

and second direction-changing pulleys 17 and 18 extend vertically.

[0022] As shown in Figure 3, a pair of car guide rails 19 for guiding raising and lowering of the upper car 4 and the lower car 10, a pair of first counterweight guide rails 20 for guiding raising and lowering of the first counterweight 5, and a pair of second counterweight guide rails 21 for guiding raising and lowering of the second counterweight 11 are installed inside the hoistway 1.

[0023] The car guide rails 19 are disposed such that a straight line connecting them extends parallel to a direction of frontage of the upper car 4 and the lower car 10 and passes through the centers of gravity of the upper car 4 and the lower car 10 in a vertical plane of projection. Furthermore, the first lower car suspension portion 10a is disposed closer to a front surface of the lower car 10 than the car guide rails 19 in a vertical plane of projection, and the second lower car suspension portion 10b is disposed closer to a rear surface of the lower car 10 than the car guide rails 19.

[0024] In an elevator apparatus of this kind, because the lower car 10 and the second counterweight 11 are suspended by second and third main ropes 12 and 13, and a first lower car suspension portion 10a to which the second main ropes 12 are connected and a second lower car suspension portion 10b to which the third main ropes 13 are connected are disposed on first and second sides of the lower car 10, the upper car 4 and the lower car 10 can each be suspended by one-to-one (1:1) roping. Thus, noise from the first and second driving machines 3 and 9 is reduced, enabling the upper car 4 and the lower car 10 to be operated at high speed.

[0025] Because the first and second lower car suspension portions 10a and 10b are symmetrically disposed on opposite sides of the center of gravity of the lower car 10 from each other, the upper car 4 and the lower car 10 can each be suspended at positions of their centers of gravity, thereby preventing eccentric loads from acting on the upper car 4 and the lower car 10, and enabling the upper car 4 and the lower car 10 to be operated stably.

[0026] In addition, because the first guide pulley 15 is disposed directly above the first lower car suspension portion 10a, and the second guide pulley 16 was disposed directly above the second lower car suspension portion 10b, the second and third main ropes 12 and 13 can be directed to the first and second lower car suspension portions 10a and 10b by a simple construction, enabling the upper car 4 and the lower car 10 to be operated stably.

[0027] Furthermore, because direction-changing pulleys 17 and 18 are used to direct the third main ropes 13 from the second drive sheave 8 to toward the second guide pulley 16, the third main ropes 13 can be prevented from interfering with the first driving machine 3 by a simple construction.

[0028] Because the first and second counterweights 5 and 11 are disposed behind the upper car 4 and the lower car 10 inside the hoistway 1 so as to line up in a direction

of frontage of the upper car 4 and the lower car 10, space inside the hoistway 1 can be used effectively, enabling frontage dimensions of the hoistway 1 to be reduced.

Embodiment 2

[0029] Next, Figure 6 is a plan showing an elevator apparatus according to Embodiment 2 of the present invention. In Embodiment 1, the first and second counterweights 5 and 11 are disposed behind the upper car 4 and the lower car 10, but as shown in Figure 6, the first and second counterweights 5 and 11 may also be disposed beside the upper car 4 and the lower car 10 inside the hoistway 1.

[0030] In an elevator apparatus of this kind, because the first and second counterweights 5 and 11 are disposed beside the upper car 4 and the lower car 10 inside the hoistway 1 so as to line up in a depth direction of the upper car 4 and the lower car 10, space inside the hoistway 1 can be used effectively, enabling depth dimensions of the hoistway 1 to be reduced.

Embodiment 3

[0031] Next, Figure 7 is a plan showing an elevator apparatus according to Embodiment 3. In Embodiment 1, the car guide rails 19 are disposed at an intermediate portion in a depth direction of the upper car 4 and the lower car 10, but because eccentric loads will not act on the car guide rails 19 if the upper car 4 and the lower car 10 are suspended at their center of gravity, the position of installation of the car guide rails is not limited to that of Figure 3.

[0032] Consequently, as shown in Figure 7, for example, the lower car the suspension portions 10a and 10b may also be disposed at an intermediate portion in the depth direction of the lower car 10, and the car guide rails 19 disposed in a vicinity of corner portions in symmetrical positions relative to the centers of gravity of the upper car 4 and the lower car 10. In that case, the guide pulleys 15 and the direction-changing pulleys 18 in Figure 3 can be omitted, enabling the layout to be simplified.

[0033] Moreover, the driving machines 3 and 9, the deflection sheaves 7 and 14, the guide pulleys 15 and 16, and the direction-changing pulleys 17 and 18 may also be disposed in a machine room positioned in an upper portion of the hoistway 1, or they may also be disposed in an upper portion inside the hoistway 1. In other words, the present invention can be applied both to elevator apparatuses having a machine room, and to machine-roomless elevators.

[0034] Furthermore, in the above examples, the driving machines 3 and 9 are disposed such that the axes of rotation of the drive sheaves 2 and 8 extend horizontally, but driving machines may also be disposed such that axes of rotation of drive sheaves extend vertically.

[0035] In addition, in the above examples, one or two direction-changing pulleys are used, but three or more

may also be used in order to avoid interference between the third main ropes and other equipment in the upper portion of the hoistway.

[0036] Furthermore, in the above examples, the main ropes are wound around the drive sheaves and the deflection sheaves by a full winding method, but a half winding method may also be used provided that sufficient traction can be provided. The deflection sheaves may also be omitted provided that sufficient traction can be provided.

Claims

1. An elevator apparatus comprising:

a first driving machine (3) having a first drive sheave (2) disposed in an upper portion of a hoistway (1);

an upper car (4) and a first counterweight (5) raised and lowered inside the hoistway (1) by a driving force from the first driving machine (3); a first main rope (6) wound around the first drive sheave (2), the first main rope (6) having a first car end portion (6a) connected to the upper car (4), and a first counterweight end portion (6b) connected to the first counterweight (5);

a second driving machine (9) having a second drive sheave (8) disposed in an upper portion of the hoistway (1);

a lower car (10) having first and second lower car suspension portions (10a, 10b), the lower car (10) being disposed below the upper car (4) and raised and lowered inside the hoistway (1) by a driving force from the second driving machine (9);

a second counterweight (11) raised and lowered inside the hoistway (1) by a driving force from the second driving machine (9);

a second main rope (12) wound around the second drive sheave (8), the second main rope (12) having a second car end portion (12a) connected to the first lower car suspension portion (10a), and a second counterweight end portion (12b) connected to the second counterweight (11); and

a third main rope (13) wound around the second drive sheave (8), the third main rope (13) having a third car end portion (13a) connected to the second lower car suspension portion (10b), and a third counterweight end portion (13b) connected to the second counterweight (11), wherein the first and second lower car suspension portions (10a, 10b) are symmetrically disposed on opposite sides of a center of gravity of the lower car (10) from each other,

characterized in that the first and second counterweights (5, 11) are disposed beside the upper

car (4) and the lower car (10) inside the hoistway (1) so as to line up in a depth direction of the upper car (4) and the lower car (10).

2. The elevator apparatus according to Claim 1, wherein: 5

a first guide pulley (15) for directing the second main rope (12) toward the first lower car suspension portion (10a) is disposed in an upper portion of the hoistway (1) directly above the first lower car suspension portion (10a); and 10
a second guide pulley (16) for directing the third main rope (13) toward the second lower car suspension portion (10b) is disposed in an upper portion of the hoistway (1) directly above the second lower car suspension portion (10b). 15

3. The elevator apparatus according to Claim 1, wherein: 20

a guide pulley (16) for directing the third main rope (13) toward the second lower car suspension portion (10b) is disposed in an upper portion of the hoistway (1) directly above the second lower car suspension portion (10b); and 25
a direction-changing pulley (17, 18) for directing the third main rope (13) from the second drive sheave (8) toward the guide pulley (16) is disposed in an upper portion of the hoistway (1). 30

Patentansprüche

1. Aufzugsvorrichtung mit: 35

einer ersten Antriebsmaschine (3) mit einer ersten Antriebsrolle (2), die in einem oberen Abschnitt eines Schachts (1) vorgesehen ist, einer oberen Kabine (4) und einem ersten Gegengewicht (5), die innerhalb des Schachts (1) durch eine Antriebskraft von der ersten Antriebsmaschine (3) angehoben und abgesenkt werden, 40
einem ersten Hauptseil (6), das um die erste Antriebsrolle (2) herumgewickelt ist, wobei das erste Hauptseil (6) einen ersten Kabinenendabschnitt (6a) verbunden mit der oberen Kabine (4) und einen ersten Gegengewichtsendabschnitt (6b) verbunden mit dem ersten Gegengewicht (5) aufweist, 45
einer zweiten Antriebsmaschine (9) mit einer zweiten Antriebsrolle (8), die in einem oberen Abschnitt des Schachts (1) vorgesehen ist, einer unteren Kabine (10) mit ersten und zweiten unteren Kabinenaufhängungsabschnitten (10a, 10b), wobei die untere Kabine (10) unterhalb der oberen Kabine (4) vorgesehen ist und innerhalb 50

des Schachts (1) durch eine Antriebskraft von der zweiten Antriebsmaschine (9) angehoben und abgesenkt wird,
einem zweiten Gegengewicht (11), das innerhalb des Schachts (1) durch eine Antriebskraft von der zweiten Antriebsmaschine (9) angehoben und abgesenkt wird,
einem zweiten Hauptseil (12), das um die zweite Antriebsrolle (8) herumgewickelt ist, wobei das zweite Hauptseil (12) einen zweiten Kabinenendabschnitt (12a), verbunden mit dem ersten unteren Kabinenaufhängungsabschnitt (10a) und einen zweiten Gegengewichtsendabschnitt (12b) verbunden mit dem zweiten Gegengewicht (12) aufweist und
einem dritten Hauptseil (13), das um die zweite Antriebsrolle (8) gewickelt ist, wobei das dritte Hauptseil (13) einen dritten Kabinenendabschnitt (13a) verbunden mit dem zweiten unteren Kabinenaufhängungsabschnitt (10b) und einen dritten Gegengewichtsendabschnitt (13b) verbunden mit dem zweiten Gegengewicht (11) aufweist,
wobei der erste und zweite untere Kabinenaufhängungsabschnitt (10a, 10b) an gegenüberliegenden Seiten eines Schwerpunkts der unteren Kabine (10) zueinander symmetrisch vorgesehen sind,
dadurch gekennzeichnet, dass die ersten und zweiten Gegengewichte (5, 11) neben der oberen Kabine (4) und der unteren Kabine (10) innerhalb des Schachts (1) so vorgesehen sind, dass sie in einer Tiefenrichtung der oberen Kabine (4) und der unteren Kabine (10) ausgerichtet sind.

2. Aufzugsvorrichtung nach Anspruch 1, bei der:

eine erste Führungsrolle (15) zum Leiten des zweiten Hauptseils (12) zu dem ersten unteren Kabinenaufhängungsabschnitt (10a) hin in einem oberen Abschnitt des Schachts (1) direkt oberhalb des ersten unteren Kabinenaufhängungsabschnitts (10a) vorgesehen ist, und
eine zweite Führungsrolle (16) zum Leiten des dritten Hauptseils (13) zu dem zweiten unteren Kabinenaufhängungsabschnitt (10b) in einem oberen Abschnitt des Schachts (1) direkt oberhalb des zweiten unteren Kabinenaufhängungsabschnitts (10b) vorgesehen ist.

3. Aufzugsvorrichtung nach Anspruch 1, bei der:

eine Führungsrolle (16) zum Leiten des dritten Hauptseils (13) zu dem zweiten unteren Kabinenaufhängungsabschnitt (10b) in einem oberen Abschnitt des Schachts (1) direkt oberhalb des zweiten unteren Kabinenaufhängungsab-

schnitts (10b) vorgesehen ist und eine Richtungsveränderungsrolle (17, 18) zum Leiten des dritten Hauptseils (13) von der zweiten Antriebsrolle (8) zu der Führungsrolle (16) in einem oberen Abschnitt des Schachts (1) vorgesehen ist.

Revendications

1. Appareil d'ascenseur comprenant :

une première machine d'entraînement (3) ayant une première poulie d'entraînement (2) disposée dans une partie supérieure d'une cage d'ascenseur (1) ;
 une cabine supérieure (4) et un premier contrepoids (5) élevé et abaissé à l'intérieur de la cage d'ascenseur (1) par une force d'entraînement provenant de la première machine d'entraînement (3) ;
 un premier câble principal (6) enroulé autour de la première poulie d'entraînement (2), le premier câble principal (6) ayant une première partie d'extrémité de cabine (6a) reliée à la cabine supérieure (4) et une première partie d'extrémité de contrepoids (6b) reliée au premier contrepoids (5) ;
 une seconde machine d'entraînement (9) ayant une seconde poulie d'entraînement (8) disposée dans une partie supérieure de la cage d'ascenseur (1) ;
 une cabine inférieure (10) ayant des première et seconde parties de suspension de cabine inférieure (10a, 10b), la cabine inférieure (10) étant disposée au-dessous de la cabine supérieure (4) et élevée et abaissée à l'intérieur de la cage d'ascenseur (1) par une force d'entraînement provenant de la seconde machine d'entraînement (9) ;
 un second contrepoids (11) élevé et abaissé à l'intérieur de la cage d'ascenseur (1) par une force d'entraînement provenant de la seconde machine d'entraînement (9) ;
 un deuxième câble principal (12) enroulé autour de la seconde poulie d'entraînement (8), le deuxième câble principal (12) ayant une seconde partie d'extrémité de cabine (12a) reliée à la première partie de suspension de cabine inférieure (10a) et une seconde partie d'extrémité de contrepoids (12b) reliée au second contrepoids (11) ; et
 un troisième câble principal (13) enroulé autour de la seconde poulie d'entraînement (8), le troisième câble principal (13) ayant une troisième partie d'extrémité de cabine (13a) reliée à la seconde partie de suspension de cabine inférieure (10b) et une troisième partie d'extrémité de con-

trepoids (13b) reliée au second contrepoids (11),

dans lequel les première et seconde parties de suspension de cabine inférieure (10a, 10b) sont disposées de façon symétrique sur les côtés opposés d'un centre de gravité de la cabine inférieure (10) l'un de l'autre,

caractérisé en ce que les premier et second contrepoids (5, 11) sont disposés à côté de la cabine supérieure (4) et de la cabine inférieure (10) à l'intérieur la cage d'ascenseur (1) afin de s'aligner dans le sens de la profondeur de la cabine supérieure (4) et de la cabine inférieure (10).

2. Appareil d'ascenseur selon la revendication 1, dans lequel :

une première poulie de guidage (15) pour diriger le deuxième câble principal (12) vers la première partie de suspension de cabine inférieure (10a) est disposée dans une partie supérieure de la cage d'ascenseur (1) directement au-dessus de la première partie de suspension de cabine inférieure (10a) ; et

une seconde poulie de guidage (16) pour diriger le troisième câble principal (13) vers la seconde partie de suspension de cabine inférieure (10b) est disposée dans une partie supérieure de la cage d'ascenseur (1) directement au-dessus de la seconde partie de suspension de cabine inférieure (10b).

3. Appareil d'ascenseur selon la revendication 1, dans lequel :

une poulie de guidage (16) pour diriger le troisième câble principal (13) vers la seconde partie de suspension de cabine inférieure (10b) est disposée dans une partie supérieure de la cage d'ascenseur (1) directement au-dessus de la seconde partie de suspension de cabine inférieure (10b) ; et

une poulie de changement de direction (17, 18) pour diriger le troisième câble principal (13) de la seconde poulie d'entraînement (8) vers la poulie de guidage (16) est disposée dans une partie supérieure de la cage d'ascenseur (1).

FIG. 1

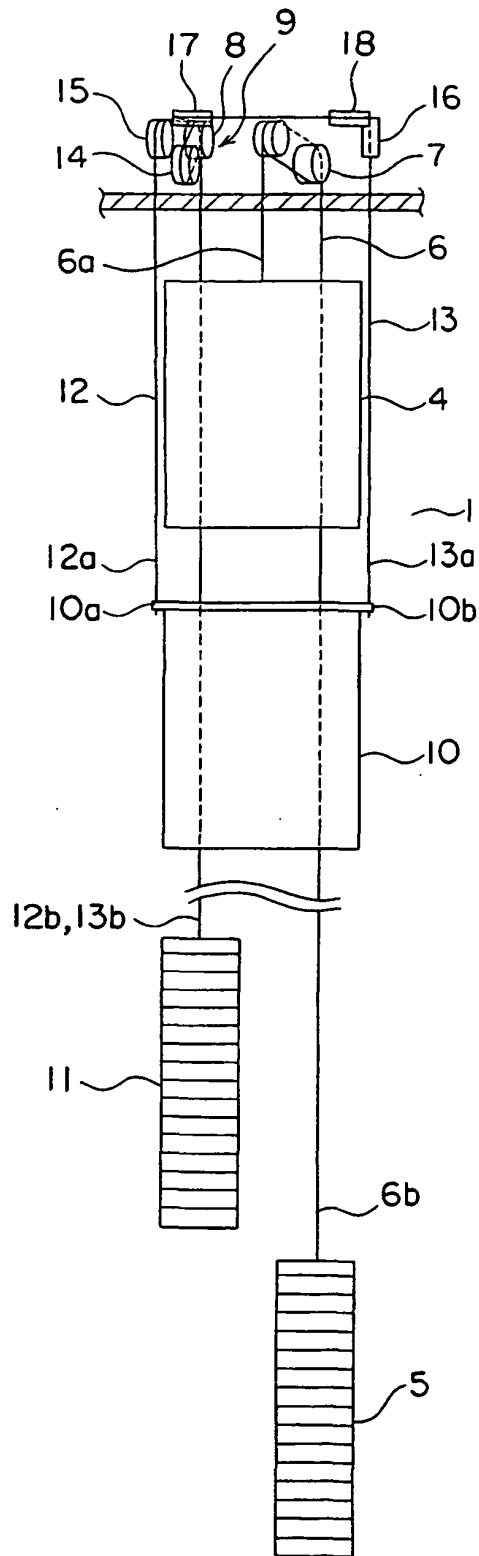


FIG. 2

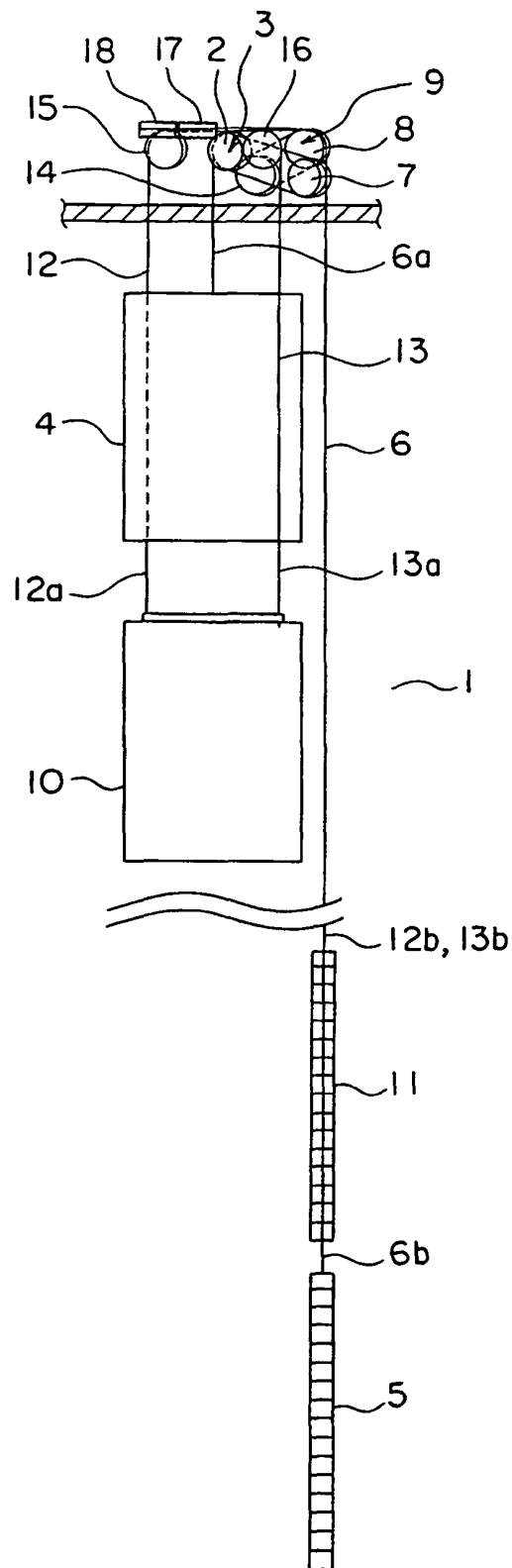


FIG. 3

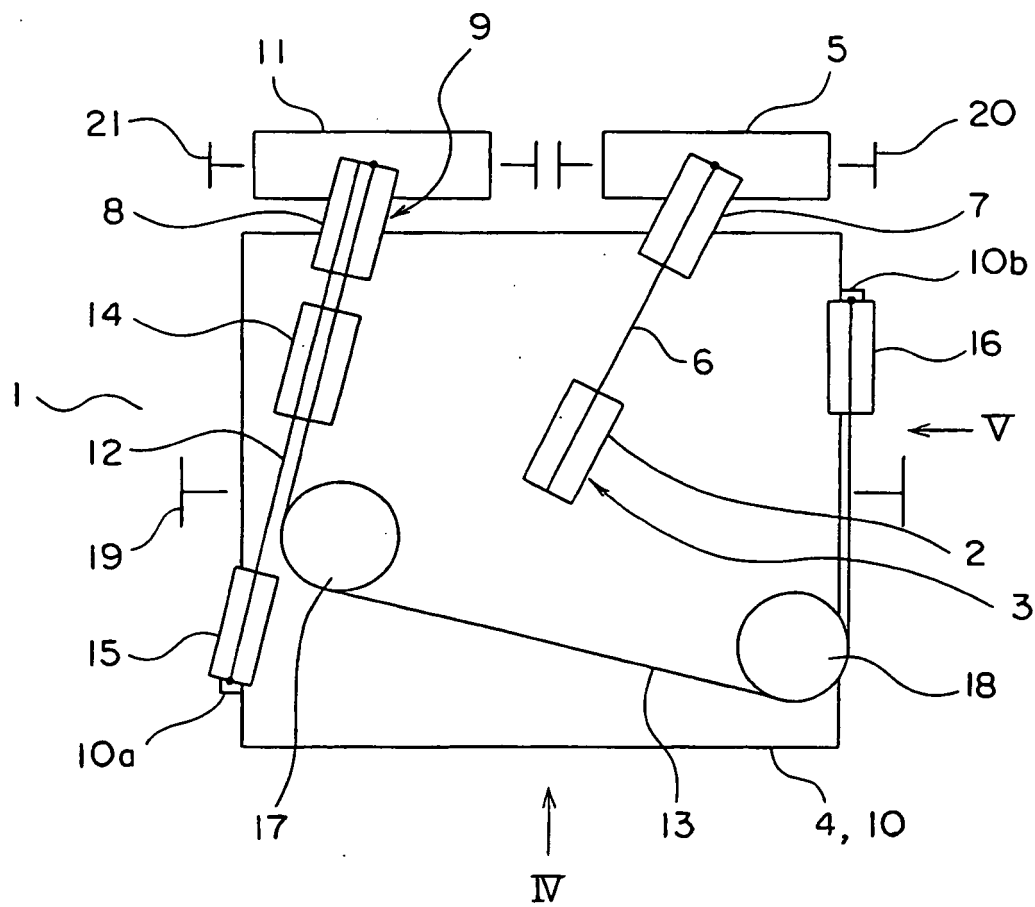


FIG. 4

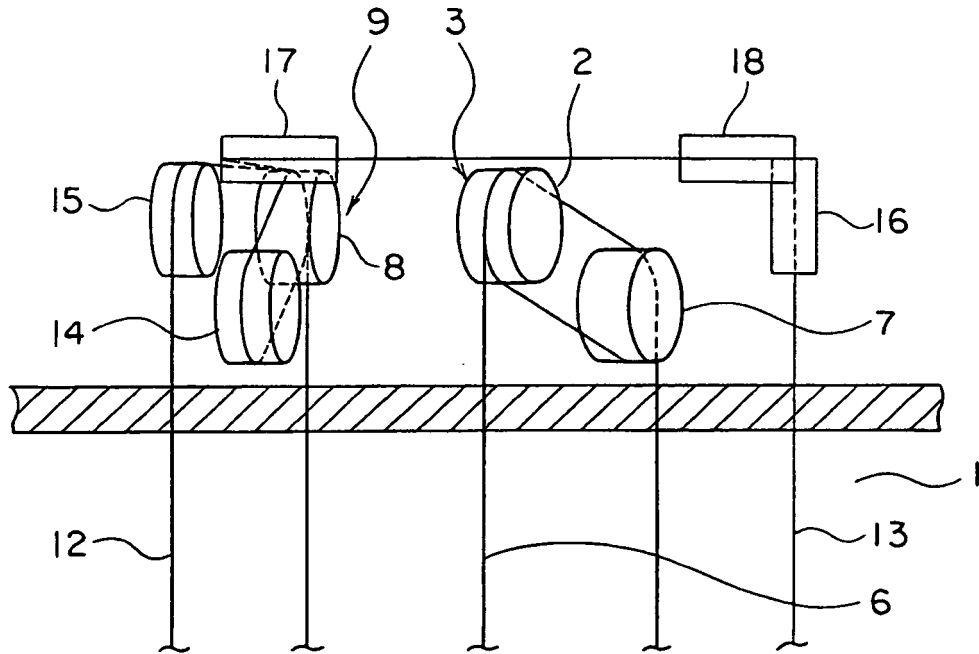


FIG. 5

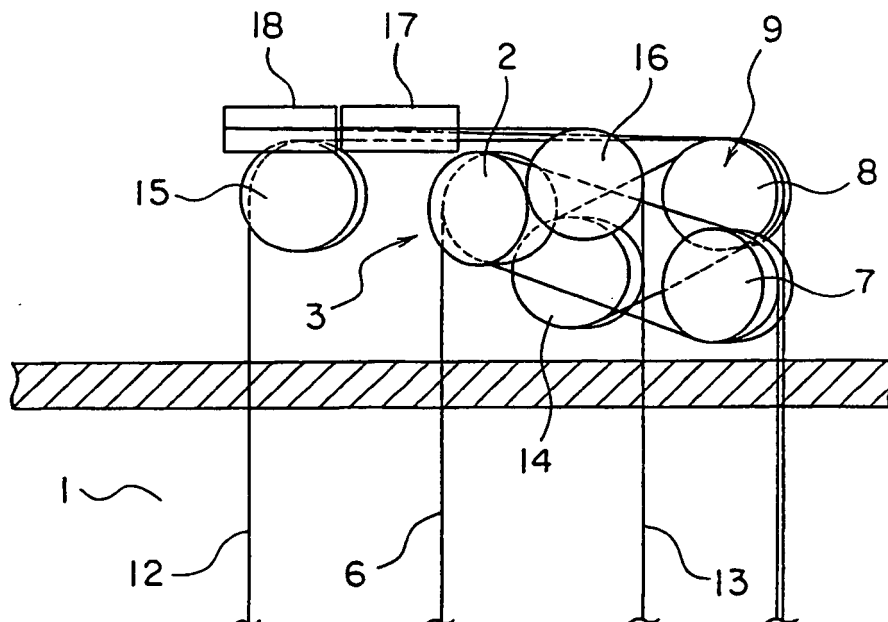


FIG. 6

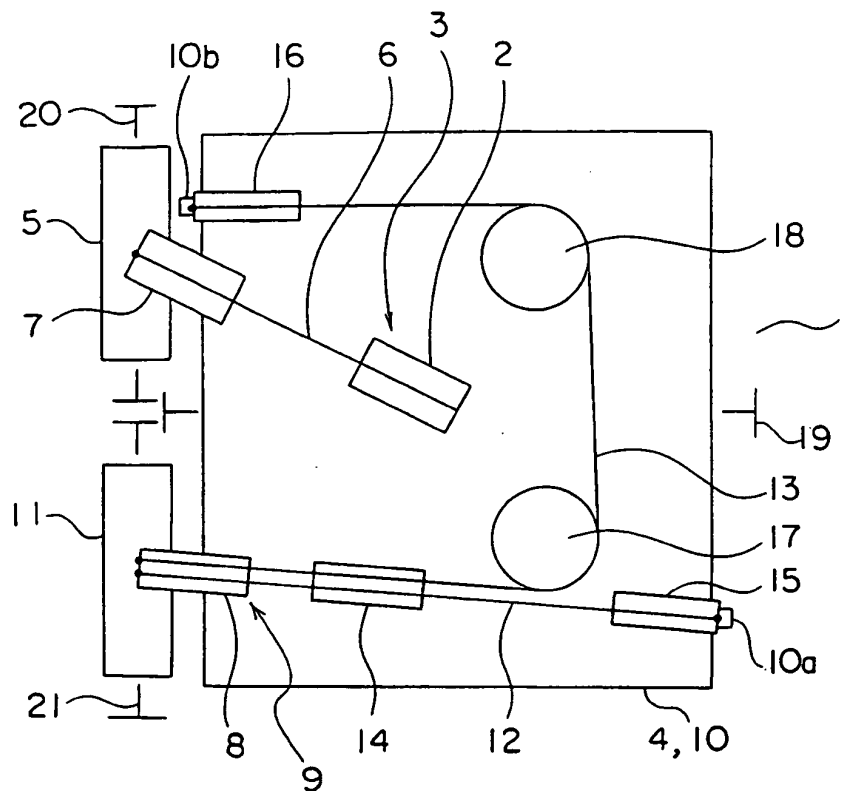
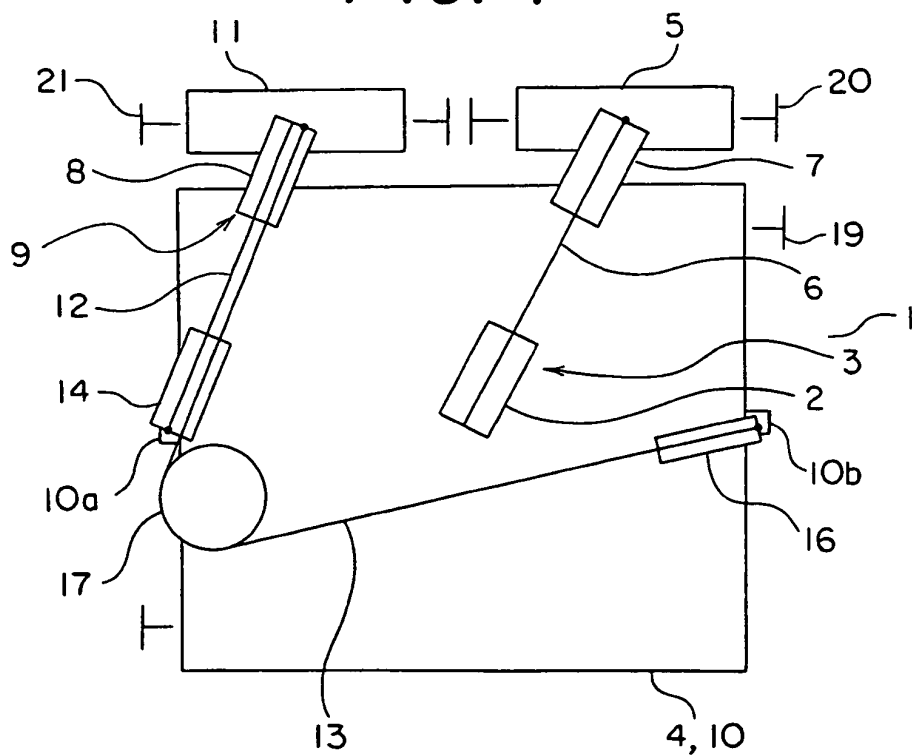


FIG. 7



REFERENCES CITED IN THE DESCRIPTION

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