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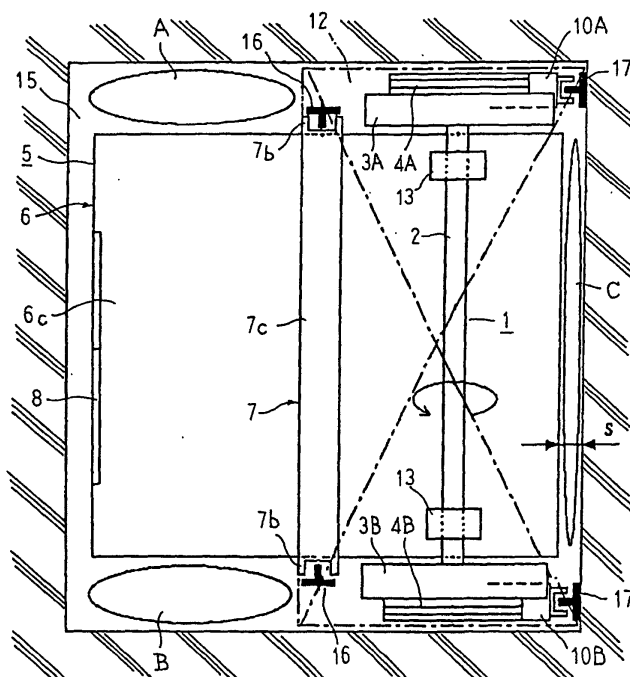
(54) **ELEVATOR WINCH AND ELEVATOR DEVICE**

(57) Disclosed are an elevator hoist apparatus and an elevator apparatus which allow omission of the machine room and a reduction in the dimension of the top portion of the hoistway.

The elevator hoist apparatus has a pair of drive mo-

tor portions and a pair of drive sheaves respectively arranged at the ends of a drive shaft. And, the hoist apparatus is arranged at the top portion of the hoistway such that the pair of drive motor portions and the pair of drive sheaves are respectively situated on the outer sides with respect to the car width direction.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a machine-room-less elevator apparatus and an elevator hoist apparatus applicable thereto.

BACKGROUND ART

[0002] For example, JP 20001-48445 A discloses a conventional elevator apparatus in which the hoist apparatus is arranged in the machine room at the top portion of the hoistway so as to overlap the car with respect to the direction in which the hoistway extends, with both ends of the rope being fixed to a rope end supported at a position below the machine beam. And, in this conventional elevator apparatus, there is no need to fix the rope end to the machine room, so that it is possible to reduce the size of the machine room space to approximately the size of the horizontal plane of projection of the hoistway. However, the hoist apparatus used is not a thin type one, which means the hoist apparatus is rather large, so that the machine room for installing the hoist apparatus has to be rather large, with the result that the machine room sticks out of the building.

[0003] Apart from this, JP 7-10434 A, for example, discloses a conventional elevator apparatus in which a hoist apparatus composed of a single thin type drive motor portion and a single drive sheave is arranged on the hoistway top portion side and in a gap between the car and the hoistway side wall. And, in this conventional elevator apparatus, there is no need for the machine room for installing the hoist apparatus, which is advantageous from the viewpoint of space saving for the building and which helps to prevent the hoistway top portion from sticking out of the building. However, since the apparatus is driven by a single drive motor portion, the drive motor portion becomes larger with an increase in the capacity and speed of the elevator. Further, since the ropes are run by a single drive sheave, the requisite number of ropes increases with an increase in the capacity and speed of the elevator, so that the thickness of the drive sheave increases. As a result, the total thickness of the hoist apparatus becomes rather large, making it impossible to arrange the hoist apparatus in the gap between the car and a hoistway side wall.

DISCLOSURE OF THE INVENTION

[0004] The present invention has been made with a view toward solving the above-mentioned problems in the prior art. The present invention aims to provide an elevator hoist apparatus having a pair of drive sheaves connected by a drive shaft and a thin type drive motor portion arranged at least at one of the ends of the drive shaft, in which it is possible to arrange the drive sheaves and the drive motor portion in the gaps between the lat-

eral peripheral walls of the car in the top portion of the hoistway and the wall surfaces of the hoistway, making it possible to omit the machine room and to reduce the dimension of the top portion of the hoistway.

[0005] Further, the present invention aims to provide an elevator apparatus in which a hoist apparatus having a pair of drive sheaves connected by a drive shaft and a thin type drive motor portion arranged at least at one of the ends of the drive shaft, is installed in the hoistway top portion such that the drive sheaves and the drive motor portion are situated in the gaps between the lateral peripheral walls of the car in the hoistway top portion and the wall surfaces of the hoistway to thereby omit the machine room and prevent the hoistway from sticking out of the building.

[0006] An elevator hoist apparatus according to the present invention includes: first and second drive sheaves coaxially opposed to each other; a drive shaft having a diameter smaller than that of the first and second sheaves and connecting the first and second drive sheaves to each other; and first and second drive motor portions respectively arranged at both ends of the drive shaft.

[0007] Further, an elevator hoist apparatus according to the present invention includes: first and second drive sheaves coaxially opposed to each other; a drive shaft having a diameter smaller than that of the first and second sheaves and connecting the first and second drive sheaves to each other; and a drive motor portion arranged at one end of the drive shaft so as to be adjacent to the first drive sheave.

[0008] Further, an elevator apparatus according to the present invention includes: a hoistway; a car arranged so as to be capable of ascending and descending while being guided by car rails extending in a direction in which the hoistway extends; first and second counter weights arranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends so as to be respectively situated in gaps between the car and the hoistway in a width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at a top portion of the hoistway. In the elevator apparatus, the hoist apparatus has first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and first and second drive motor portions which are respectively arranged at both ends of the drive shaft; and the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the first drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, and that the second drive sheave and the second drive motor portion are arranged close to the

wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends.

[0009] Further, an elevator apparatus according to the present invention includes: a hoistway; a car arranged so as to be capable of ascending and descending while being guided by car rails extending in a direction in which the hoistway extends; first and second counter weights arranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends so as to be respectively situated in gaps between the car and the hoistway in a width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at a top portion of the hoistway. In the elevator apparatus, the hoist apparatus has first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and a drive motor portion which is arranged at one end of the drive shaft so as to be adjacent to the first drive sheave; and the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, and that the second drive sheave is arranged close to the wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Fig. 1 illustrates the construction of an elevator hoist apparatus according to Embodiment 1 of the present invention.

Fig. 2 is a plan sectional view of an elevator apparatus according to Embodiment 1 of the present invention.

Fig. 3 is a longitudinal sectional view of the elevator apparatus according to Embodiment 1 of the present invention.

Fig. 4 is a sectional view taken along the arrow line IV-IV of Fig. 3.

Fig. 5 is a longitudinal sectional view of an elevator apparatus according to Embodiment 2 of the present invention.

Fig. 6 is a sectional view taken along the arrow line VI-VI of Fig. 5.

Fig. 7 is an enlarged view of portion D of Fig. 6.

Fig. 8 is a diagram illustrating a method of measuring the rope tension in the elevator apparatus of

Embodiment 2 of the present invention.

Fig. 9 illustrates the construction of an elevator hoist apparatus according to Embodiment 3 of the present invention.

Fig. 10 is a plan sectional view of an elevator apparatus according to Embodiment 3 of the present invention.

Fig. 11 is a longitudinal sectional view of the elevator apparatus according to Embodiment 3 of the present invention.

Fig. 12 is a sectional view taken along the arrow line XII-XII of Fig. 11.

Fig. 13 is a block diagram showing a control system for the elevator apparatus according to Embodiment 3 of the present invention.

Fig. 14 illustrates an elevator hoist apparatus according to Embodiment 4 of the present invention.

Fig. 15 is a plan sectional view of an elevator apparatus according to Embodiment 4 of the present invention.

Fig. 16 is a longitudinal sectional view of the elevator apparatus according to Embodiment 4 of the present invention.

Fig. 17 is a sectional view taken along the arrow line XVII-XVII of Fig. 16.

BEST MODE FOR CARRYING OUT THE INVENTION

[0011] Preferred embodiments of the present invention will now be described with reference to the drawings.

Embodiment 1

[0012] Fig. 1 illustrates the construction of an elevator hoist apparatus according to Embodiment 1 of the present invention, in which part (a) is a top view, and part (b) is a side view. Fig. 2 is a plan sectional view of an elevator apparatus according to Embodiment 1 of the present invention; Fig. 3 is a longitudinal sectional view of the elevator apparatus of Embodiment 1 of the present invention; and Fig. 4 is a sectional view taken along the arrow line IV-IV of Fig. 3.

[0013] First, the construction of the hoist apparatus of Embodiment 1 will be described with reference to Fig. 1.

[0014] This elevator hoist apparatus 1 is a so-called gearless hoist, and is composed of a drive shaft 2 constituting an intermediate portion, a first drive motor portion 3A arranged at one end of the drive shaft 2, a first drive sheave 4A secured to one end portion of the drive shaft 2 outside the first drive motor portion 3A, a second drive motor portion 3B arranged at the other end of the drive shaft 2, and a second drive sheave 4B secured to the other end portion of the drive shaft 2 outside the second drive motor portion 3B. And, the first and second drive motor portions 3A and 3B are of a thin structure with a relatively small thickness with respect to their width; it is desirable for their thickness to be not larger

than the thickness of a counter weight described below. The first and second drive motor portions 3A and 3B consist, for example, of electric motors, with the stators thereof being secured to a frame 3a and their rotors being secured to the drive shaft 2.

[0015] Note that the diameter of the drive shaft 2 is smaller than those of the first and second drive motor portions 3A and 3B, and the first and second drive sheaves 4A and 4B. Further, although not shown in the drawing, an operational brake is provided integrally with the drive motor portions 3A and 3B.

[0016] Next, the construction of the elevator apparatus of Embodiment 1 will be described with reference to Figs. 2 through 4. Here, for the sake of convenience in illustration, the direction in which the hoistway extends will be referred to as the vertical direction, and the depth direction and the width direction of the hoistway in a plane (plan sectional view) perpendicular to the direction in which the hoistway extends will be referred to as the longitudinal direction and the lateral direction, respectively. Note that the landing door side corresponds to the front portion of the hoistway.

[0017] A car 5 is composed of a car chamber 6 and a car frame 7. The car chamber 6 is formed as a box consisting of a car floor 6a, a peripheral wall 6b, and a ceiling 6c. The car frame 7 is formed as a frame surrounding the central portion with respect to the longitudinal direction of the car chamber 6 on the upper, lower, right-hand, and left-hand sides and consisting of a lower frame 7a, right and left longitudinal frames 7b, and an upper frame 7c. And, the car floor 6a is secured to the lower frame 7a so that the car chamber 6 and the car frame 7 may constitute an integral unit. Further, a car door 8 is provided in the peripheral wall 6b in the front portion of the car chamber 6, and first and second car sash pulleys 9A and 9B are rotatably mounted to the lower portions of the lateral ends of the car floor 6a.

[0018] There are provided first and second counter weights 10A and 10B, each of which is formed by stacking together a plurality of weight members 10a, arranging them on a steel frame member 10b, and securing them in position by means of a through-bolt (not shown). And, a second-counter-weight sash pulley 11B is rotatably mounted to the upper portion of the frame member 10b of the second counter weight 10B. Further, although not shown in the drawing, a first-counter-weight sash pulley is similarly rotatably mounted to the upper portion of the frame member 10b of the first counter weight 10A.

[0019] A machine base 12 is mounted to the ceiling of the hoistway 15 so as to substantially cover the rear half in plan view of the hoistway 15. And, car rails 16 are provided near the right-hand and left-hand wall surfaces of the hoistway 15, respectively, at a position substantially at the center with respect to the longitudinal direction, so as to extend in the vertical direction. Further, counter weight rails 17 are provided between the car rails 16 and the rear wall surface of the hoistway 15, in a pair and maintaining a predetermined distance in the

longitudinal direction, so as to extend in the vertical direction.

[0020] And, the car 5 is arranged inside the hoistway 15 so as to be capable of moving up and down by being guided by the pair of car rails 16, with the car door 8 facing the front side. Further, the first and second counter weights 10A and 10B are arranged inside the hoistway 15 so as to be capable of moving up and down by being guided by the pair of counter weight rails 17. Here, the first and second counter weights 10A and 10B are arranged adjacent to the right and left wall surfaces of the hoistway 15 so as not to vertically overlap the car 5, that is, situated outside the horizontal plane of projection of the car 5. The horizontal plane of projection of the car 5 refers to the face of the car 5 as seen from the direction in which the hoistway extends.

[0021] Further, the hoist apparatus 1 is mounted, with the drive shaft 2 being in lateral alignment, the frame 3a being secured to the lower surface of the machine base 12, and the drive shaft 2 being rotatably supported by a pair of mounting members 13 secured to the lower surface of the machine base 12. Here, the distance by which the mounting members 13 protrude from the machine base 12 is smaller than the distance by which the first and second drive motor portions 3A and 3B and the first and second drive sheaves 4A and 4B protrude from the machine base 12. Further, in the horizontal plane of projection of the car 5, the drive shaft 2 extends substantially parallel to the upper frame 7c of the car frame 7 and is situated on the rear side thereof with respect to the longitudinal direction. And, the first drive motor portion 3A and the first drive sheave 4A are arranged close to the wall surface of the hoistway 15 adjacent to the first counter weight 10A so as to be situated outside the horizontal plane of projection of the car 5 and above the first counter weight 10A. Similarly, the second drive motor portion 3B and the second drive sheave 4B are arranged close to the wall surface of the hoistway 15 adjacent to the second counter weight 10B so as to be situated outside the horizontal plane of projection of the car 5 and above the second counter weight 10B.

[0022] Further, one end of a hoist rope 18 is fixed to a first rope stop 19A above the first counter weight 10A on the top side of the hoistway 15. This hoist rope 18 is lowered from the first rope stop 19A, passed through the first-counter-weight sash pulley rotatably mounted to the upper portion of the first counter weight 10A, and then raised to the first drive sheave 4A. And, the hoist rope 18 is passed along the rope groove of the first drive sheave 4A before it is lowered to a level below the car 5. Then, the hoist rope 18 is passed through first and second car sash pulleys 9A and 9B mounted to the right and left lower portions of the car 5, and then raised up to the second drive sheave 4B. And, the hoist rope 18 is passed along the rope groove of the second drive sheave 4B, and then lowered to the second counter weight 10B. Further, the hoist rope 18 is passed through the second-counter-weight sash pulley 11B rotatably

mounted to the upper portion of the second counter weight 10B, and then raised. And, the other end of the hoist rope 18 is fixed to a second rope stop 19B secured in position above the second counter weight 10B on the top side of the hoistway 15.

[0023] Further, although not shown in the drawing, various apparatuses, such as a control device, speed governor, and position detecting device, are installed in spaces A, B, and C in Fig. 2.

[0024] In this elevator apparatus, constructed as described above, the first and second drive motor portions 3A and 3B of the hoist apparatus 1 are drive-controlled by the control device, and the first and second drive sheaves 4A and 4B are rotated with the drive shaft 2. Then, the hoist rope 18 is run by the first and second drive sheaves 4A and 4B, and the car 5 and the first and second counter weights 10A and 10B are guided by the car rails 16 and the counter weight rails 17 to ascend and descend within the hoistway 15.

[0025] In this way, the hoist apparatus 1 of Embodiment 1 allows shared driving by the first and second drive motor portions 3A and 3B arranged at the ends of the drive shaft 2, so that an increase in the capacity and speed of the elevator can be coped with without involving an increase in the size of the first and second drive motor portions 3A and 3B. Thus, even if the hoist apparatus is applied to an elevator of a large capacity and a high speed, it does not require an increase in the thickness of the first and second drive motor portions 3A and 3B and allows arrangement of the first and second drive motor portions 3A and 3B and the first and second drive sheaves 4A and 4B in the gaps between the right and left portions of the peripheral wall 6b of the car chamber 6 and the inner wall surfaces of the hoistway 15, thereby it is possible to realize a hoist apparatus in which the height of the top portion of the hoistway 15 is reduced.

[0026] Further, in the elevator apparatus of this Embodiment 1, the hoist apparatus 1 is mounted to the lower surface of the machine base 12 mounted to the ceiling of the hoistway 15 such that the first drive motor portion 3A and the first drive sheave 4A are situated between the left portion of the peripheral wall 6b of the car chamber 6 and the inner wall surface of the hoistway 15, and that the second drive motor portion 3B and the second drive sheave 4B are situated between the right portion of the peripheral wall 6b of the car chamber 6 and the inner wall surface of the hoistway 15. Thus, at the top portion of the hoistway 15, there is no interference between the car 5 and the first and second drive motor portions 3A and 3B and the first and second drive sheaves 4A and 4B, so that it is possible to raise the car 5 to the verge of interference with the drive shaft 2 and the mounting members 13, making it possible to reduce the height of the top portion of the hoistway 15. Further, since the spaces A, B, and C in Fig. 2 are empty, it is possible to easily install the requisite apparatuses for the elevator apparatus, such as the control device, speed governor, and position detecting device, by utiliz-

ing the spaces A, B, and C, and to restrain an increase in the plan sectional area of the hoistway 15 due to the installation of such apparatuses. Further, since the first and second counter weights 10A and 10B are arranged on the right and left sides of the car 5, it is possible to reduce the gap S between the rear portion of the peripheral wall 6b of the car chamber 6 and the inner wall surface of the hoistway 15, making it possible to reduce the plan sectional area of the hoistway 15.

[0027] Further, in this elevator apparatus, the drive shaft 2 (intermediate portion) of the hoist apparatus 1 is arranged so as not to overlap the car frame 7 (the portion protruding from the upper portion of the car chamber 6) of the car 5, so that there is no interference between the car frame 7 of the car 5 and the drive shaft 2, making it possible to make the height of the top portion of the hoistway 15 so much the less.

Embodiment 2

[0028] Fig. 5 is a longitudinal sectional view of an elevator apparatus according to Embodiment 2 of the present invention; Fig. 6 is a sectional view taken along the arrow line VI-VI of Fig. 5; Fig. 7 is an enlarged view of portion D of Fig. 6; and Fig. 8 is a diagram illustrating a method for measuring the rope tension in the elevator apparatus of Embodiment 2 of the present invention.

[0029] In Embodiment 2, the hoist rope is composed of a first hoist rope 18A for suspending the first counter weight 10A and a second hoist rope 18B for suspending the second counter weight 10B. Note that the hoist apparatus 1, the car 5, the first and second counter weights 10A and 10B, the car rails 16, the counter weight rails 17, etc. are arranged in the same way as in Embodiment 1.

[0030] Here, an illustration will be given of the way the hoist ropes are looped around with reference to Figs. 5 through 7.

[0031] First, one end of the first hoist rope 18A is fixed to the upper portion of the frame member 10b of the first counter weight 10A. And, this first hoist rope 18A is raised from the frame member 10b up to the first drive sheave 4A, and passed along the rope groove of the first drive sheave 4A before being lowered to a level below the car 5. Then, the first hoist rope 18A is fixed to a first car side rope fixation plate 20A mounted to the left lower portion of the car 5.

[0032] On the other hand, one end of the second hoist rope 18B is fixed to the upper portion of the frame member 10b of the second counter weight 10B. And, this second hoist rope 18B is raised from the frame member 10b up to the second drive sheave 4B, and passed along the rope groove of the second drive sheave 4B before being lowered to a level below the car 5. Then, the second hoist rope 18B is fixed to a second car side rope fixation plate 20B mounted to the right lower portion of the car 5.

[0033] As shown in Fig. 7, each of the terminals of the first and second hoist ropes 18A and 18B is connected

to a rope socket 21. And, the rope sockets 21 have rods 21a passed through through-holes 20a of the first and second car side rope fixation plates 20A and 20B, and piezoelectric elements 22 as tension detecting means and compression springs 23 are attached to the extensions of the rods 21a, with tension adjusting nuts 24 being threadably engaged with the rods 21a to form a tension adjusting mechanism. In this way, the first and second hoist ropes 18A and 18B are fixed to the first and second car side rope fixation plates 20A and 20B through the intermediation of the tension adjusting mechanisms.

[0034] As shown in Fig. 8, in this elevator apparatus, constructed as described above, the tensions of the first and second hoist ropes 18A and 18B are ascertained by measuring, by a tensiometer 25, the pressure applied to the piezoelectric elements 22 held between the first and second car side rope fixation plates 20A and 20B and the compression springs 23. For this purpose, the fastening force of the tension adjusting nuts 24 is adjusted beforehand by means of the tensiometer 25 to set the tension of each of the first and second hoist ropes 18A and 18B to a predetermined value. And, the first and second drive motor portions 3A and 3B of the hoist apparatus 1 are drive-controlled by the control device, and the first and second drive sheaves 4A and 4B are rotated with the drive shaft 2. Then, the first and second hoist ropes 18A and 18B are respectively run by the first and second drive sheaves 4A and 4B, and the car 5 and the first and second counter weights 10A and 10B are guided by the car rails 16 and the counter weight rails 17 to ascend and descend within the hoistway 15.

[0035] Further, at the time, for example, of periodical inspection, the tensions of the first and second hoist ropes 18A and 18B are measured by the tensiometer 25. And, when the tension of each of the first and second hoist ropes 18A and 18B is deviated from the predetermined value, a similar tension adjusting operation is conducted.

[0036] In this way, in addition to the effects of Embodiment 1, Embodiment 2 provides the following advantage: since the hoist rope is composed of the first hoist rope 18A for suspending the first counter weight 10A and the hoist rope 18B for suspending the second counter weight 10B, there is no need for the sash pulleys as required in Embodiment 1, thereby simplifying the construction and achieving a reduction in cost.

[0037] Further, in Embodiment 2, there is provided a rope tension adjusting mechanism composed of the piezoelectric elements 22, the compression springs 23, and the tension adjusting nuts 24, so that it is possible to adjust as needed the tension of each of the first and second hoist ropes 18A and 18B to a predetermined value. Thus, it is possible to prevent inequality in tension between the first and second hoist ropes 18A and 18B, so that there is no fear of the car 5 being tilted.

[0038] While in the above-described Embodiment 2 the tensions of the first and second hoist ropes 18A and

18B are measured by using the tensiometer 25, it is also possible to measure the tensions of the first and second hoist ropes 18A and 18B by a hitting method.

5 Embodiment 3

[0039] Fig. 9 illustrates the construction of an elevator hoist apparatus according to Embodiment 3 of the present invention, in which part (a) is a top view and part (b) is a side view. Fig. 10 is a plan sectional view of an elevator apparatus according to Embodiment 3 of the present invention; Fig. 11 is a longitudinal sectional view of the elevator apparatus of Embodiment 3 of the present invention;

10 Fig. 12 is a sectional view taken along the arrow line XII-XII of Fig. 11; and Fig. 13 is a block diagram showing a control system for the elevator apparatus of Embodiment 3 of the present invention.

[0040] As shown in Fig. 9, the hoist apparatus 1A of Embodiment 3 is composed of first and second drive shafts 2A and 2B constituting the intermediate portion, a first drive motor portion 3A arranged at one end of the first drive shaft 2A, a first drive sheave 4A secured to one end portion of the first drive shaft 2A outside the first drive motor portion 3A, a second drive motor portion 3B arranged at the other end of the second drive shaft 2B, a second drive sheave 4B secured to the other end portion of the second drive shaft 2B outside the second drive motor portion 3B, and a clutch 26 connecting the other end of the first drive shaft 2A to one end of the second drive shaft 2B.

[0041] And, as shown in Figs. 10 through 12, the elevator apparatus of Embodiment 3 is of the same construction as that of Embodiment 2 except that the hoist apparatus 1A is used instead of the hoist apparatus 1.

[0042] In this elevator apparatus, constructed as described above, the fastening force of the tension adjusting nuts 24 is adjusted beforehand by using the tensiometer 25, setting the tension of each of the first and second hoist ropes 18A and 18B to a predetermined value. And, the first and second drive motor portions 3A and 3B of the hoist apparatus 1 are drive-controlled by the control device, and the first and second drive sheaves 4A and 4B are rotated with the drive shaft 2. Then, the first and second hoist ropes 18A and 18B are respectively run by the first and second drive sheaves 4A and 4B, and the car 5 and the first and second counter weights 10A and 10B are guided by the car rails 16 and the counter weight rails 17 to ascend and descend within the hoistway 15.

[0043] And, as shown in Fig. 13, the control device 30 monitors output signals (rope tension signals) from the piezoelectric elements 22, computing the difference in tension between the first and second hoist ropes 18A and 18B on the basis of the output signals. And, when the difference in tension exceeds a set value, the control device 30 causes the clutch 26 to operate to cancel the connection between the first and second drive shafts 2A

and 2B, controlling the rotating angles of the first and the second drive motor portions 3A and 3B such that the difference in tension falls within the range of the set value. And, when the difference in tension has fallen within the range of the set value, the clutch 26 is operated to connect the first and second drive shafts 2A and 2B, and the first and second drive motor portions 3A and 3B are driven at the same rotating angle.

[0044] Further, at the time, for example, of periodical inspection, the tension of each of the first and second hoist ropes 18A and 18B is measured. And, when the tension of each of the first and second hoist ropes 18A and 18B is deviated from a predetermined value, a similar tension adjusting operation is conducted.

[0045] In this way, in Embodiment 3, when there is a difference in tension between the first and second hoist ropes 18A and 18B, the rotating angles of the first and second drive motor portions 3A and 3B are automatically controlled so that the tensions of the ropes may be equalized. Thus, it is possible to prevent the car 5 from ascending or descending in an inclined state, thus providing an elevator apparatus superior in terms of safety.

Embodiment 4

[0046] Fig. 14 illustrates an elevator hoist apparatus according to Embodiment 4 of the present invention, in which part (a) is a top view and part (b) is a side view. Fig. 15 is a plan sectional view of an elevator apparatus according to Embodiment 4 of the present invention; Fig. 16 is a longitudinal sectional view of the elevator apparatus of Embodiment 4 of the present invention; and Fig. 17 is a sectional view taken along the arrow line XVII-XVII of Fig. 16.

[0047] As shown in Fig. 14, the hoist apparatus 1B of Embodiment 4 is composed of the drive shaft 2 constituting an intermediate portion, the first drive motor portion 3A arranged at one end of the drive shaft 2, the first drive sheave 4A secured to one end portion of the drive shaft 2 outside the first drive motor portion 3A, and the second drive sheave 4B secured to the other end portion of the drive shaft 2.

[0048] And, as shown in Figs. 15 through 17, the elevator apparatus of this Embodiment 4 is of the same construction as that of Embodiment 2 except that the hoist apparatus 1B is used instead of the hoist apparatus 1.

[0049] As in Embodiment 2, in this elevator apparatus constructed as described above, the fastening force of the tension adjusting nuts 24 is adjusted beforehand by using the tensiometer 25, setting the tensions of the first and second hoist ropes 18A and 18B to a predetermined value. And, the first drive motor portion 3A of the hoist apparatus 1B is drive-controlled by the control device, and the first and second drive sheaves 4A and 4B are rotated with the drive shaft 2. Then, the first and second hoist ropes 18A and 18B are respectively run by the first and second drive sheaves 4A and 4B, and the car 5 and

the first and second counter weights 10A and 10B are guided by the car rails 16 and the counter weight rails 17 to ascend and descend within the hoistway 15.

[0050] Further, at the time, for example, of periodical inspection, the tension of each of the first and second hoist ropes 18A and 18B is measured by using the tensiometer 25. And, when the tension of each of the first and second hoist ropes 18A and 18B is deviated from a predetermined value, a similar tension adjusting operation is conducted.

[0051] The hoist apparatus 1B of Embodiment 4, in which the drive sheave is composed of the first and second drive sheaves 4A and 4B arranged at the ends of the drive shaft 2, allows shared running of a requisite number of ropes by the first and second drive sheaves 4A and 4B. Thus, even if the capacity and speed of the elevator and the requisite number of ropes increase, an increase in the thickness of the first and second drive sheaves 4A and 4B is restrained, so that it is possible to arrange the first drive motor portion 3A and the first and second drive sheaves 4A and 4B in the gaps between the right and left portions of the peripheral wall 6b of the car 5 and the wall surfaces of the hoistway 15.

[0052] Thus, in the elevator apparatus of Embodiment 1 also, the same effects as those of Embodiment 2 are achieved.

[0053] Further, in the hoist apparatus 1B of Embodiment 4, the drive motor portion is formed solely by the first drive motor portion 3A, whereby a reduction in cost is achieved.

[0054] As described above, in accordance with the present invention, there are provided first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and first and second drive motor portions which are respectively arranged at both ends of the drive shaft, whereby it is possible to obtain an elevator hoist apparatus in which the height of the top portion of the hoistway can be reduced.

[0055] Further, the drive shaft is divided into first and second drive shafts, which are connected together through the intermediation of a clutch, whereby it is possible to eliminate a difference in tension between the hoist ropes.

[0056] Further, there are provided first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and a drive motor portion which is arranged at one end of the drive shaft so as to be adjacent to the first drive sheave, whereby it is possible to obtain a low-priced elevator hoist apparatus which allows a reduction in the height of the top portion of the hoistway.

[0057] Further, there is provided an elevator apparatus including a hoistway; a car arranged as to be capable

of ascending and descending while being guided by car rails extending in the direction in which the hoistway extends; first and second counter weights arranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends and respectively situated in gaps between the car and the hoistway in the width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at the top portion of the hoistway, in which the hoist apparatus has first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and first and second drive motor portions which are respectively arranged at both ends of the drive shaft, and in which the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the first drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, and that the second drive sheave and the second drive motor portion are arranged close to the wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, whereby it is possible to obtain an elevator apparatus which allows a reduction in the height of the top portion of the hoistway.

[0058] Further, the hoist rope is composed of a first hoist rope looped around the first drive sheave and fixed to the car and the first counter weight, and a second hoist rope looped around the second drive sheave and fixed to the car and the second counter weight, whereby the number of sash pulleys is reduced, thereby achieving a reduction in cost.

[0059] Further, the drive shaft is composed of first and second drive shafts connected together through the intermediation of a clutch, and there are provided a tension detecting means that detects the respective tensions of the first and second hoist ropes; and a control device that monitors the tensions of the first and second hoist monitors on the basis of output signals from the tension detecting means and that cancels the connection of the first and second drive shafts through the clutch when there is a difference in tension between the first and second hoist ropes, controlling the rotating angles of the first and second drive motor portions such that the difference in tension falls within a permissible range, whereby it is possible to automatically eliminate the difference in tension between the first and second hoist ropes.

[0060] Further, there is provided an elevator apparatus including: a hoistway; a car arranged so as to be capable of ascending and descending while being guided by car rails extending in the direction in which the hoistway extends; first and second counter weights ar-

ranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends and respectively situated in the gaps between the car and the hoistway in the width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at the top portion of the hoistway, in which the hoist apparatus has first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and a drive motor portion which is arranged at one end of the drive shaft so as to be adjacent to the first drive sheave, and in which the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to direction in which the hoistway extends, and that the second drive sheave is arranged close to the wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, whereby it is possible to obtain a low-priced elevator apparatus which allows a reduction in the height of the top portion of the hoistway.

[0061] Further, the hoist apparatus is arranged such that the drive shaft does not overlap an upper protrusion of the car with respect to the direction in which the hoistway extends, whereby it is possible to further reduce the height of the top portion of the hoistway.

Claims

1. An elevator hoist apparatus **characterized by** comprising: first and second drive sheaves coaxially opposed to each other; a drive shaft having a diameter smaller than that of the first and second sheaves and connecting the first and second drive sheaves to each other; and first and second drive motor portions respectively arranged at both ends of the drive shaft.
2. An elevator hoist apparatus according to Claim 1, **characterized in that** the drive shaft is divided into first and second drive shafts, which are connected together through the intermediation of a clutch.
3. An elevator hoist apparatus **characterized by** comprising: first and second drive sheaves coaxially opposed to each other; a drive shaft having a diameter smaller than that of the first and second sheaves and connecting the first and second drive sheaves to each other; and a drive motor portion arranged at one end of the drive shaft so as to be adjacent to the first drive sheave.

4. An elevator apparatus comprising: a hoistway; a car arranged so as to be capable of ascending and descending while being guided by car rails extending in a direction in which the hoistway extends; first and second counter weights arranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends so as to be respectively situated in gaps between the car and the hoistway in a width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at a top portion of the hoistway, **characterized in that:**

the hoist apparatus comprises first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and first and second drive motor portions which are respectively arranged at both ends of the drive shaft; and the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the first drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, and that the second drive sheave and the second drive motor portion are arranged close to the wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends.

5. An elevator apparatus according to Claim 4, **characterized in that** the hoist rope comprises a first hoist rope looped around the first drive sheave and fixed to the car and the first counter weight, and a second hoist rope looped around the second drive sheave and fixed to the car and the second counter weight.

6. An elevator apparatus according to Claim 5, wherein the drive shaft is formed by connecting first and second drive shafts to each other through the intermediation of a clutch, and the apparatus further comprising a tension detecting means that detects the respective tensions of the first and second hoist ropes, and a control device that monitors the tensions of the first and second hoist ropes on the basis of output signals from the tension detecting means and cancels the connection of the first and second drive shafts through the clutch when there is a difference in tension between the first and second hoist ropes, controlling rotating angles of the first and second drive motor portions such that the dif-

ference in tension falls within a permissible range.

7. An elevator apparatus comprising: a hoistway; a car arranged so as to be capable of ascending and descending while being guided by car rails extending in a direction in which the hoistway extends; first and second counter weights arranged so as to be capable of ascending and descending while being guided by counter weight rails extending in the direction in which the hoistway extends so as to be respectively situated in gaps between the car and the hoistway in a width direction of the car; a hoist rope suspending the car and the first and second counter weights; and a hoist apparatus arranged at a top portion of the hoistway, **characterized in that:**

the hoist apparatus comprises first and second drive sheaves which are coaxially opposed to each other, a drive shaft which has a diameter smaller than that of the first and second drive sheaves and connects the first and second drive sheaves to each other, and a drive motor portion which is arranged at one end of the drive shaft so as to be adjacent to the first drive sheave; and

the hoist apparatus is arranged at the top portion of the hoistway such that the first drive sheave and the drive motor portion are arranged close to the wall surface of the hoistway adjacent to the first counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends, and that the second drive sheave is arranged close to the wall surface of the hoistway adjacent to the second counter weight and situated so as not to overlap the car with respect to the direction in which the hoistway extends.

8. An elevator apparatus according to any one of Claims 4 through 7, **characterized in that** the hoist apparatus is arranged such that the drive shaft is situated so as not to overlap a protrusion on an upper portion of the car with respect to the direction in which the hoistway extends.

FIG. 1

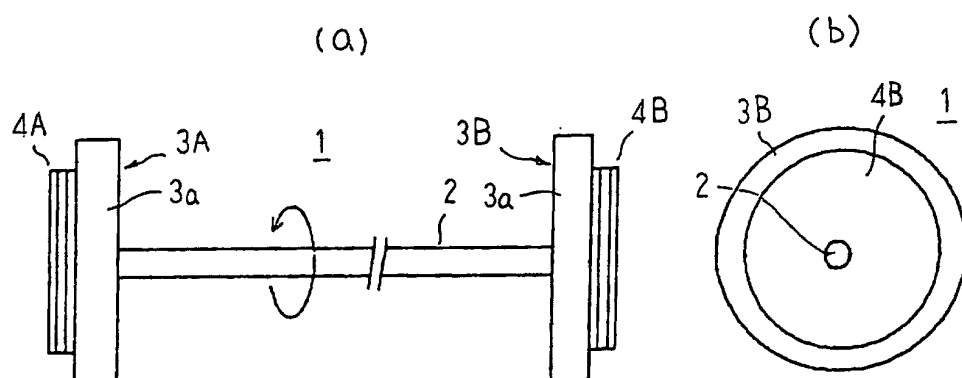


FIG. 2

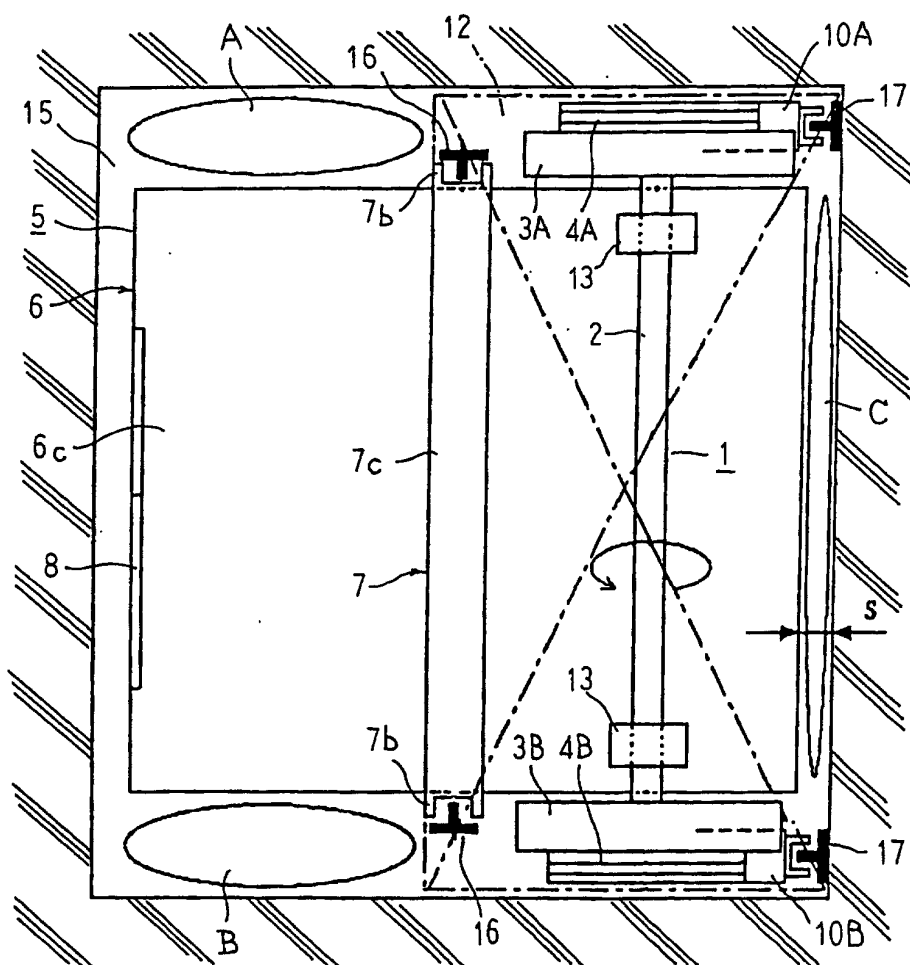


FIG. 3

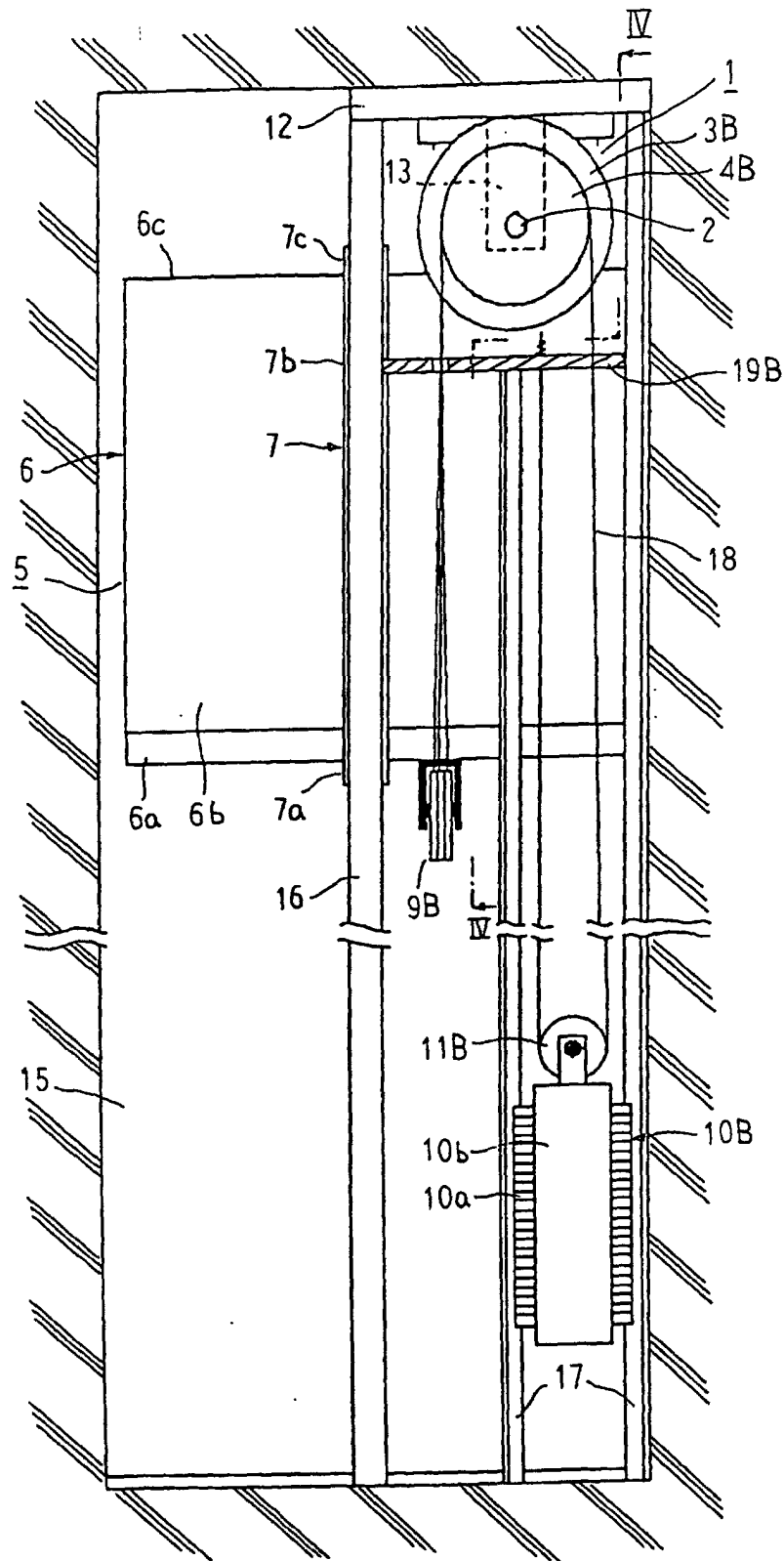


FIG. 4

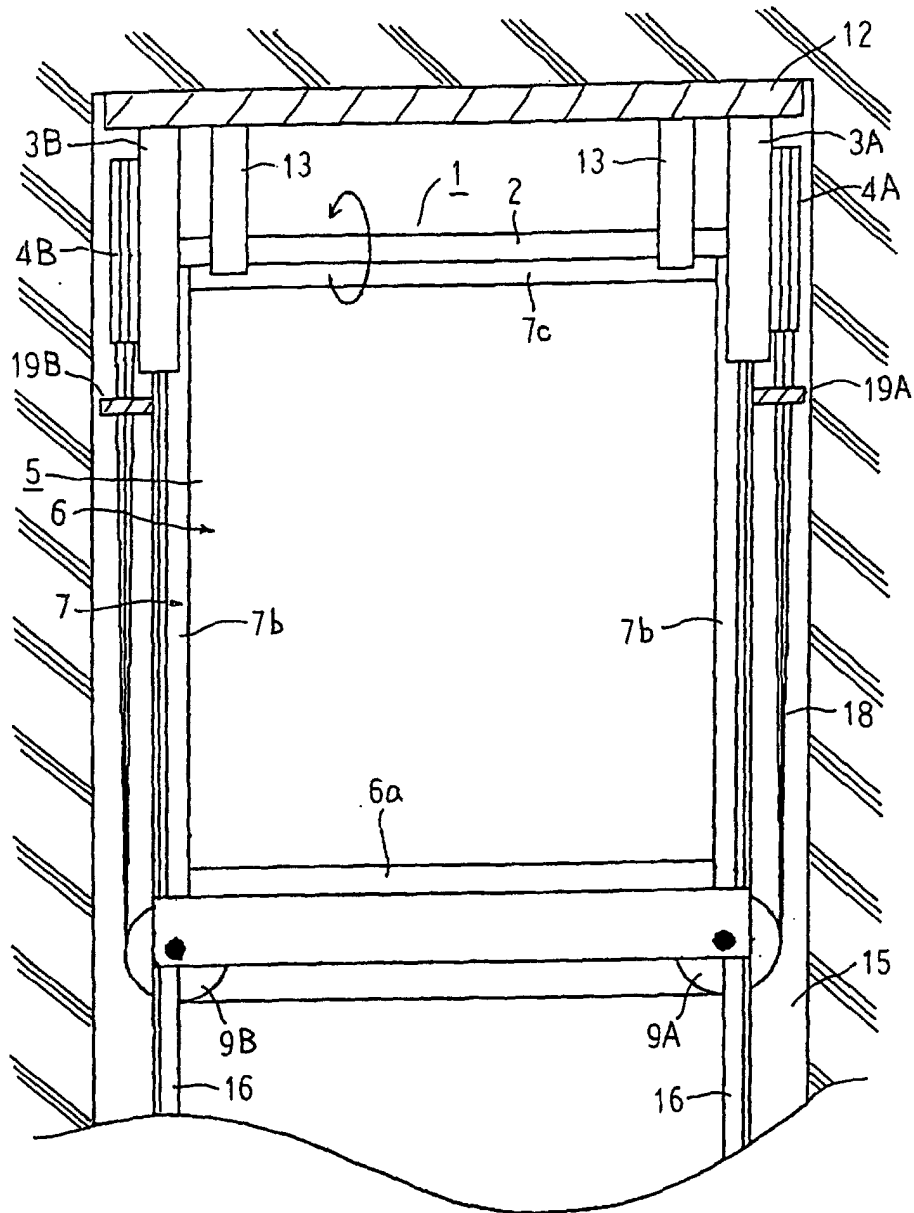


FIG. 5

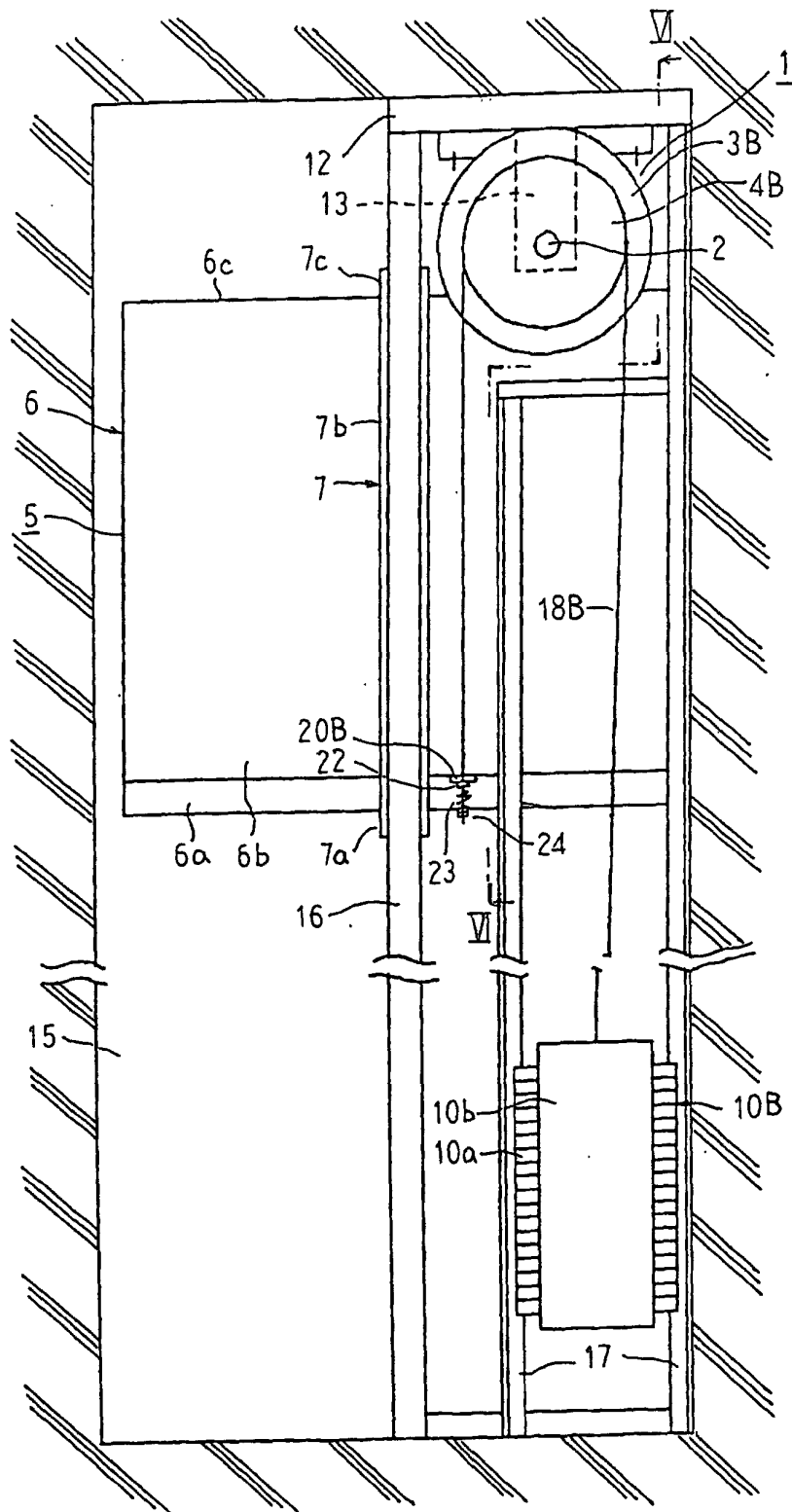


FIG. 6

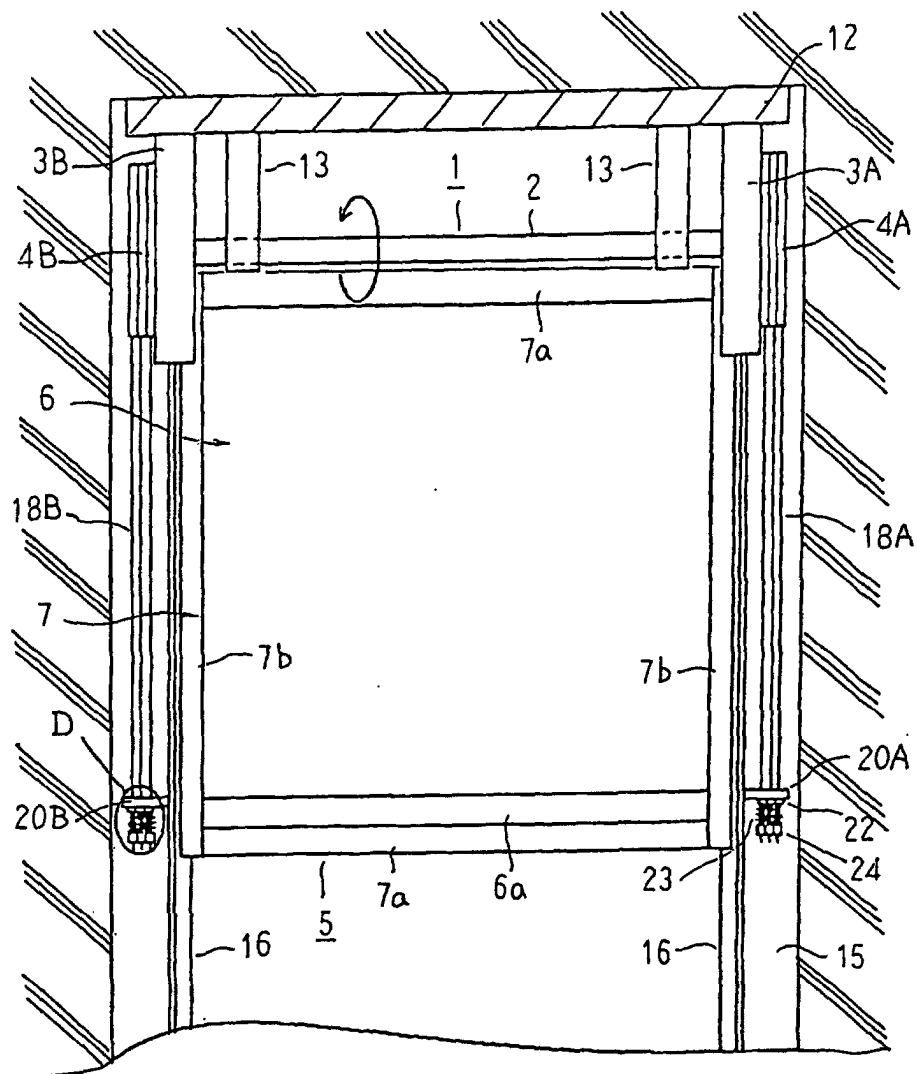


FIG. 7

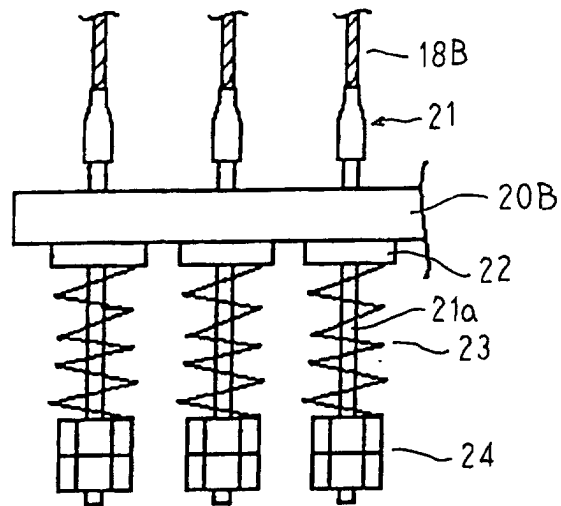


FIG. 8

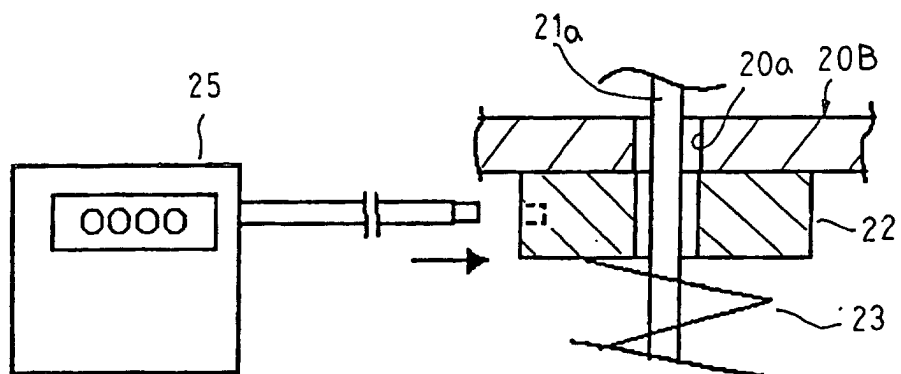


FIG. 9

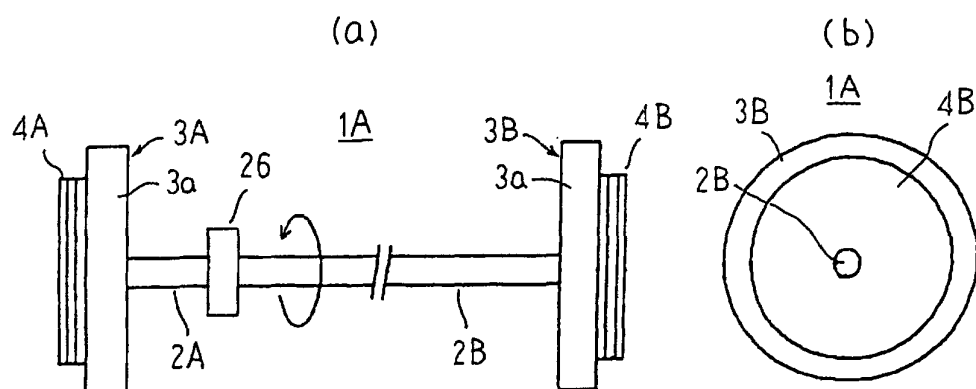


FIG. 10

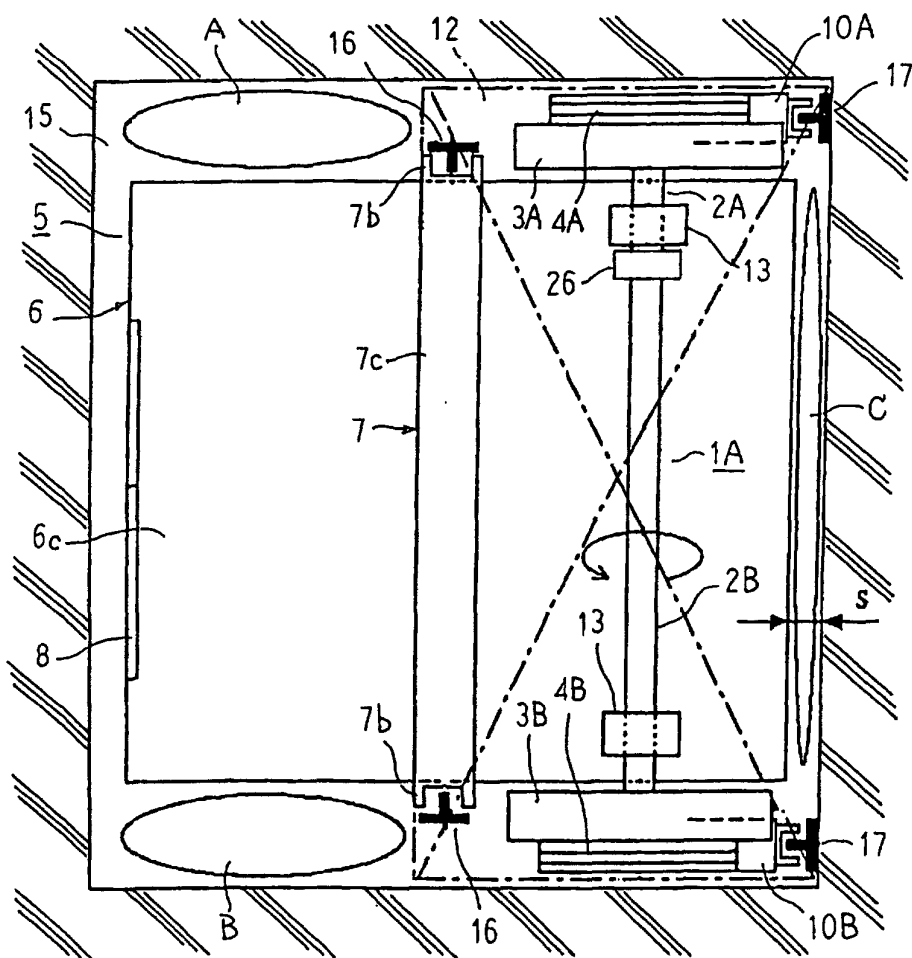


FIG. 11

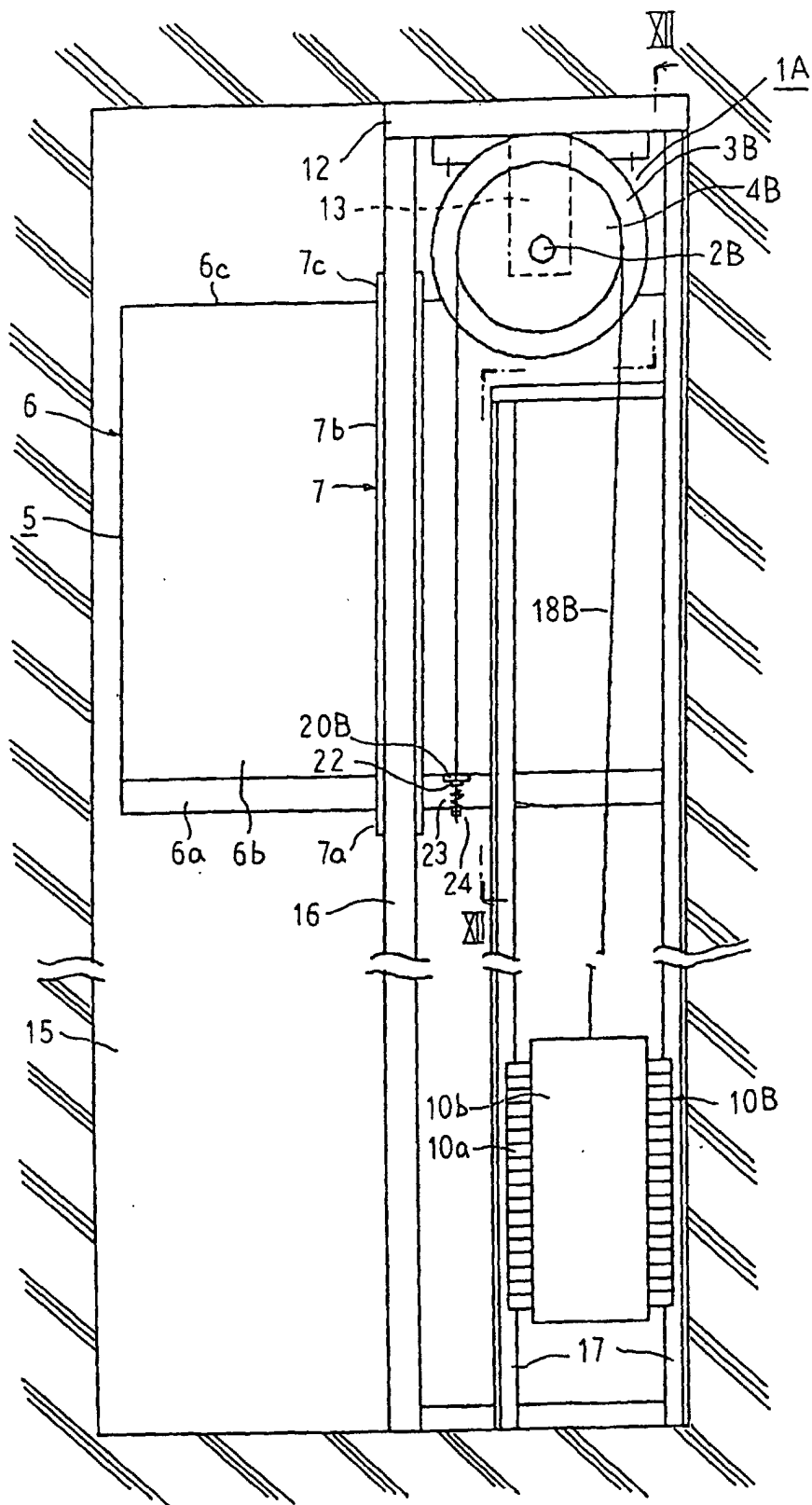


FIG. 12

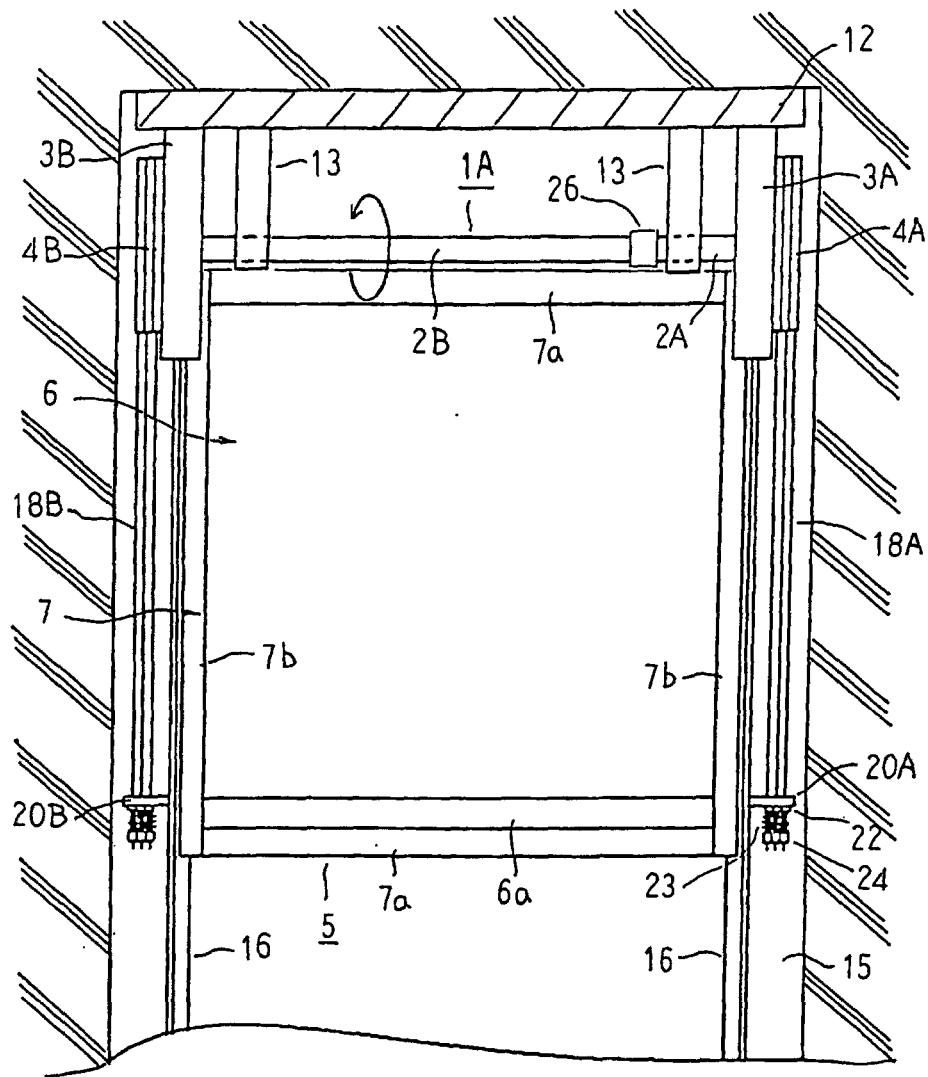


FIG. 13

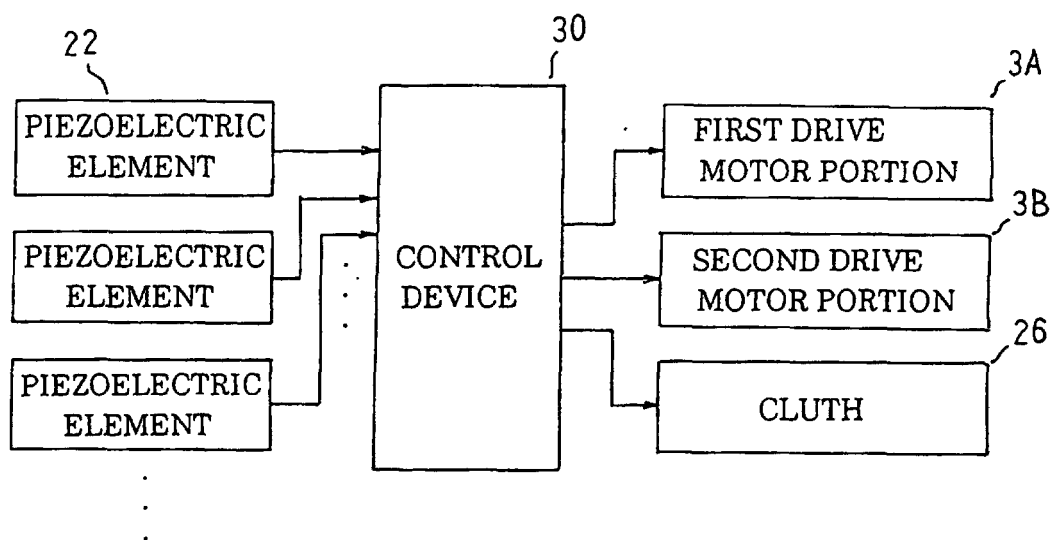


FIG. 14

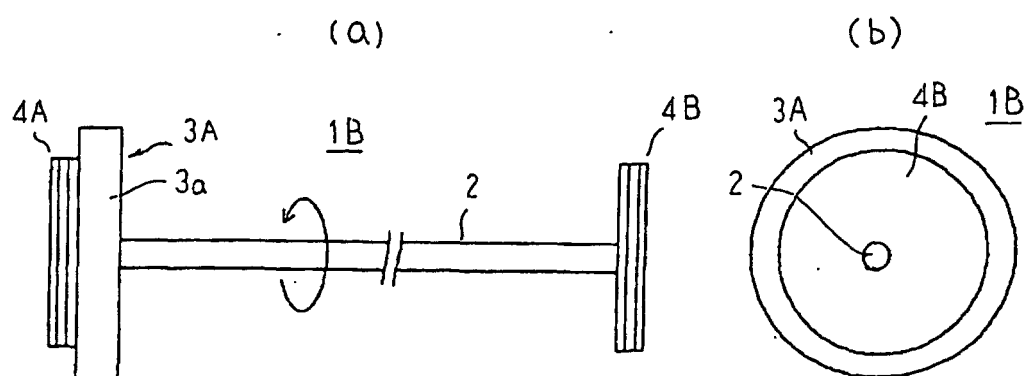


FIG. 15

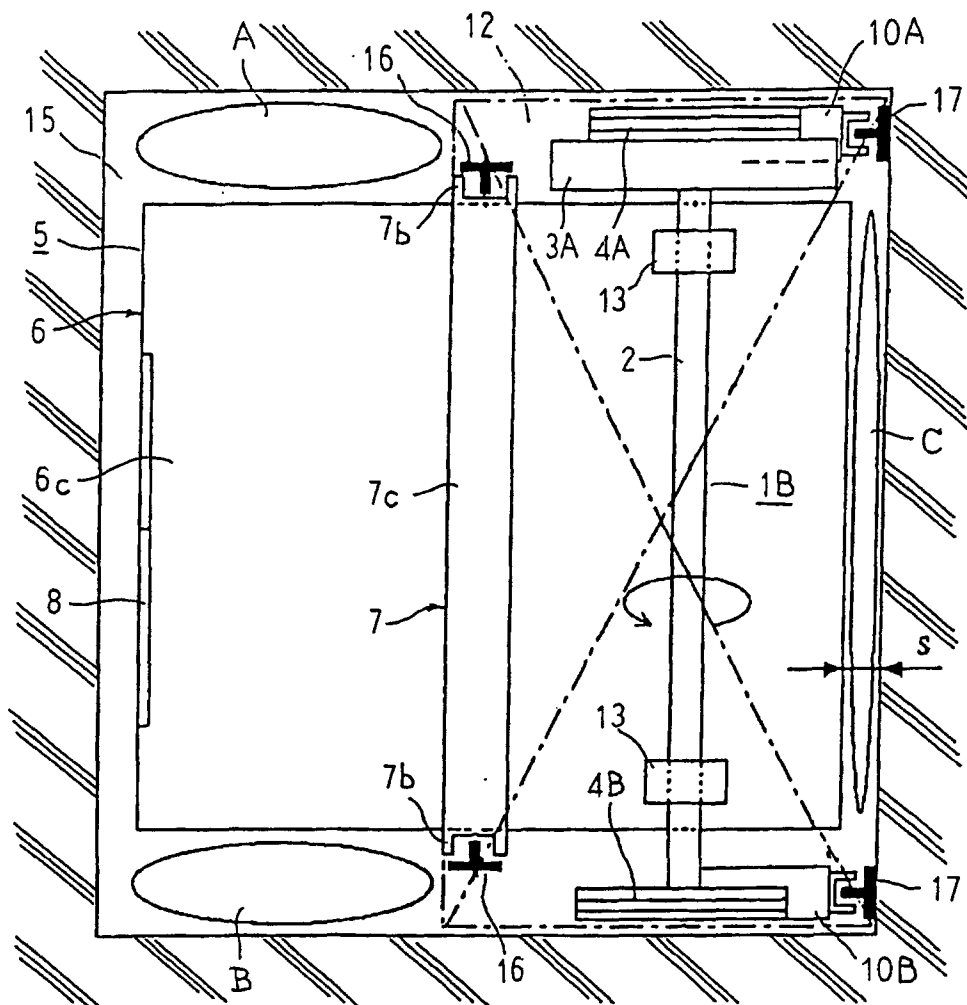


FIG. 16

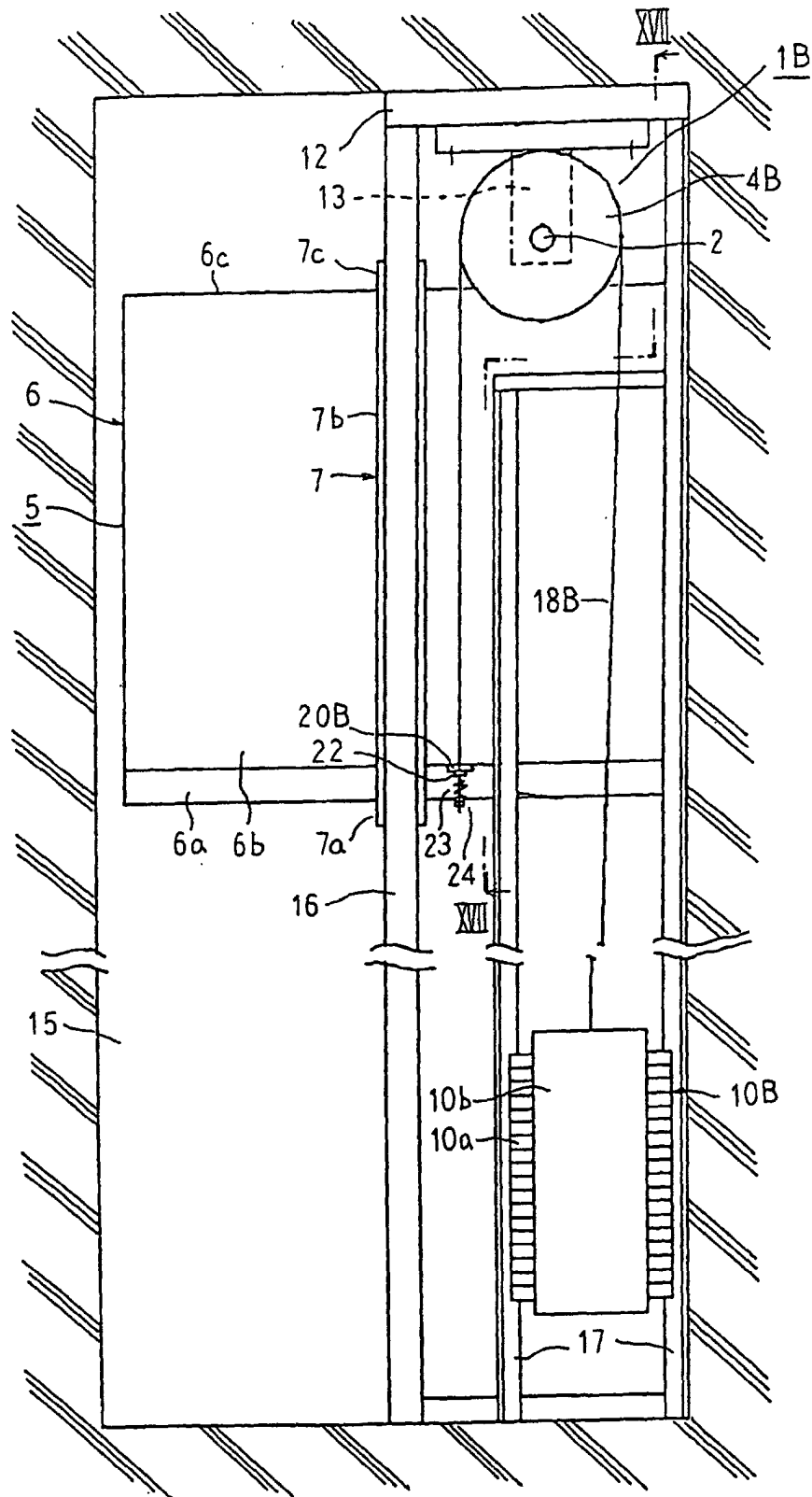
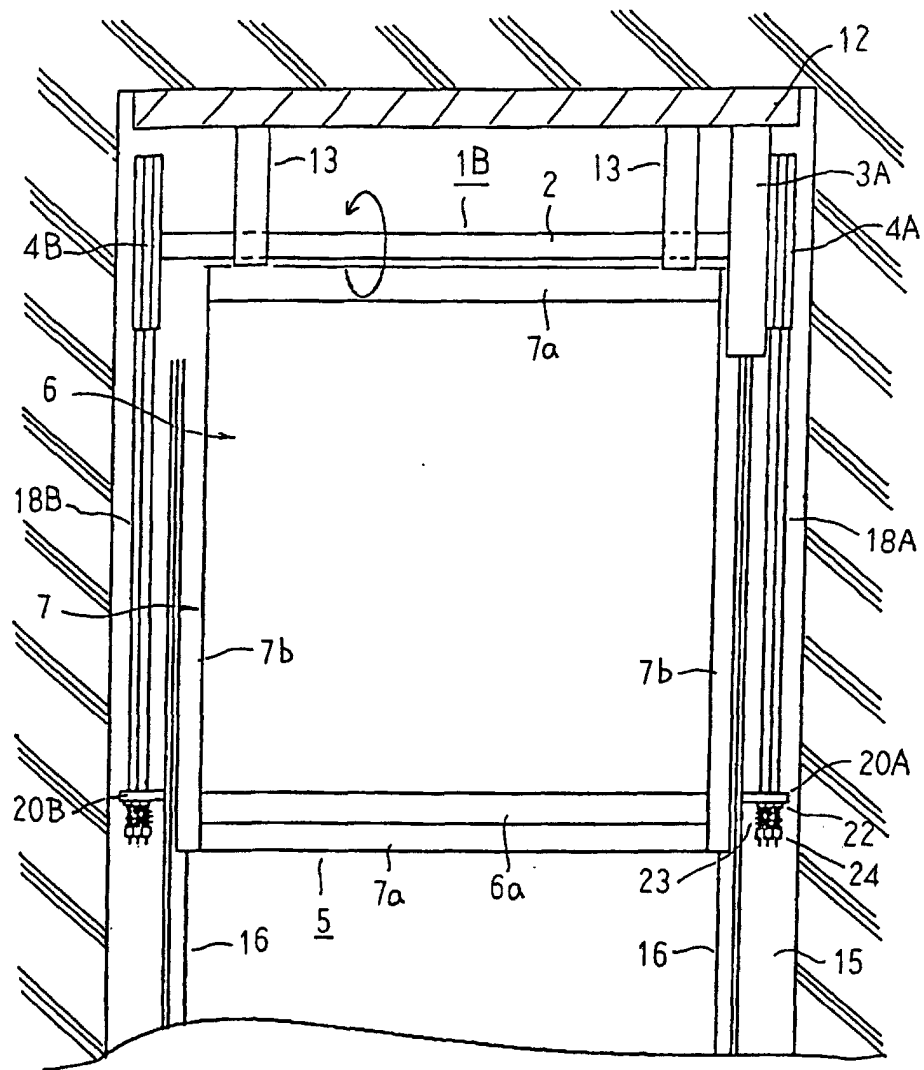


FIG. 17



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/02507

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ B66B11/08, 7/06		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁷ B66B1/00-11/08		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2002 Kokai Jitsuyo Shinan Koho 1971-2002 Toroku Jitsuyo Shinan Koho 1994-2002		
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	JP 3152034 B2 (Mitsubishi Electric Corp.),	1
Y	26 January, 2001 (26.01.01),	2-3
A	Par. Nos. [0048] to [0050]; Fig. 12 & JP 7-117957 A	4-8
Y	JP 46-14781 Y1 (Meidensha Corp.), 24 May, 1971 (24.05.71), (Family: none)	2
Y	JP 6-87595 A (C. Haushahn GmbH & Co.), 29 March, 1994 (29.03.94), & EP 0565893 A2	3
A	JP 5-70057 A (Hitachi Building System Eng. & Service Co., Ltd.), 23 March, 1993 (23.03.93), (Family: none)	4-8
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 10 December, 2002 (10.12.02)		Date of mailing of the international search report 24 December, 2002 (24.12.02)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/02507

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E, A	JP 2002-179358 A (Fujitec Co., Ltd.) 26 June, 2002 (26.06.02), (Family: none)	1-8
E, A	JP 2002-173279 A (Toshiba Corp.), 21 June, 2002 (21.06.02), (Family: none)	4-8

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