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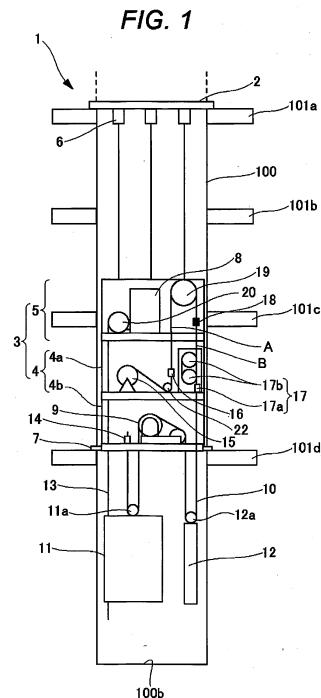
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**(54) CONSTRUCTION ELEVATOR AND METHOD FOR EXTENDING MAIN ROPE OF CONSTRUCTION ELEVATOR**

(57) A construction elevator includes a rope reel, an elevating body, a pulley, a first rope gripper, and a second rope gripper. The pulley is disposed on the main rope between the rope reel and the elevating body and wrapped with the main rope drawn from the rope reel. The first rope gripper releasably grips the main rope on the rope reel side of the pulley. The second rope gripper releasably grips the main rope on the elevating body side of the pulley. Furthermore, the pulley is supported so as to be movable along the direction in which the elevating body moves vertically.



**Description****Technical Field**

**[0001]** The present invention relates to a construction elevator and a method for extending the main rope of the construction elevator.

**Background Art**

**[0002]** In recent years, a construction elevator has been proposed as an elevator that is provided in a building structure under construction so as to transport materials and people. In this construction elevator, a machine room unit having a hoisting machine, a control panel, and the like, is raised according to the progress of the construction of the building structure, thereby expanding the range in which a car moves vertically, that is, the operable range. In addition, as the vertical movement range of the car is expanded, the work of extending a main rope connected to the car is also performed.

**[0003]** Conventional construction elevators include, for example, one as disclosed in PTL 1. In the technology disclosed in PTL 1, the main rope is gripped with a predetermined force by a gripping device in order to prevent the main rope from being drawn from a main rope reel against the intention of the operator under its own weight when raising the machine room unit. Then, by raising the machine room unit, the main rope slides on the gripping device and the main rope is extended.

**Citation List****Patent Literature**

**[0004]** PTL 1: JP 2001-287881 A

**Summary of Invention****Technical Problem**

**[0005]** However, in the technology disclosed in PTL 1, since the main rope slides on the gripping device during the extension of the main rope, there is a possibility that the main rope will be scratched or worn due to the friction between the main rope and the gripping device. In addition, since the main rope is gripped by the gripping device, there is also a problem that the force for lifting the machine room unit increases. As a result, the technology disclosed in PTL 1 has a problem that it becomes complicated to adjust the force for gripping the main rope with the gripping device during the extension of the main rope.

**[0006]** In view of the above problems, an object of the present invention is to provide a construction elevator that enables main rope extension work without damaging the main rope, and a method for extending the main rope of the construction elevator.

**Solution to Problem**

**[0007]** In order to address the above problems and achieve the object, this construction elevator includes a rope reel, an elevating body, a pulley, a first rope gripper, and a second rope gripper. A main rope is wound around the rope reel. The elevating body is wrapped with the main rope drawn from the rope reel, and moves vertically in a hoistway of a building structure. The pulley is disposed on the main rope between the rope reel and the elevating body and wrapped with the main rope drawn from the rope reel. The first rope gripper releasably grips the main rope on the rope reel side of the pulley. The second rope gripper releasably grips the main rope on the elevating body side of the pulley. Furthermore, the pulley is supported so as to be movable along the direction in which the elevating body moves vertically.

**[0008]** In addition, a method for extending the main rope of the construction elevator having the above-described configuration includes the following steps (1) to (4):

- (1) gripping the main rope with the second rope gripper;
- (2) releasing the gripping of the main rope by the first rope gripper, raising the pulley to a predetermined height along a direction in which the elevating body moves vertically, and drawing the main rope from the rope reel;
- (3) after raising the pulley to the predetermined height, gripping the main rope with the first rope gripper and releasing the gripping of the main rope by the second rope gripper; and
- (4) raising a machine room unit in which the second rope gripper is installed to a predetermined height.

**Advantageous Effects of Invention**

**[0009]** With the construction elevator having the above configuration, the machine room unit can be easily installed without damaging the main rope.

**Brief Description of Drawings**

**[0010]**

[FIG. 1] FIG. 1 is a schematic configuration diagram illustrating a construction elevator according to a first embodiment.

[FIG. 2] FIG. 2 illustrates a method for extending a main rope of the construction elevator according to the first embodiment, and illustrates a state in which a second machine room is being moved.

[FIG. 3] FIG. 3 illustrates a method for extending the main rope of the construction elevator according to the first embodiment, and illustrates a state in which a first machine room is being moved.

[FIG. 4] FIG. 4 illustrates a method for extending the

main rope of the construction elevator according to the first embodiment, and illustrates a state after a machine room unit is moved.

[FIG. 5] FIG. 5 is a schematic configuration diagram illustrating a construction elevator according to a second embodiment.

[FIG. 6] FIG. 6 illustrates a method for extending the main rope of the construction elevator according to the second embodiment, and illustrates a state in which a second machine room is being moved.

[FIG. 7] FIG. 7 illustrates a method for extending the main rope of the construction elevator according to the second embodiment, and illustrates a state in which a first machine room is being moved.

[FIG. 8] FIG. 8 is a schematic configuration diagram illustrating a construction elevator according to a third embodiment.

[FIG. 9] FIG. 9 illustrates a method for extending the main rope of the construction elevator according to the third embodiment, and illustrates a state in which a pulley is being moved.

[FIG. 10] FIG. 10 illustrates a method for extending the main rope of the construction elevator according to the third embodiment, and illustrates a state in which a machine room unit is being moved.

[FIG. 11] FIG. 11 is a schematic configuration diagram illustrating a construction elevator according to a fourth embodiment.

[FIG. 12] FIG. 12 is a schematic configuration diagram illustrating a construction elevator according to a fifth embodiment.

## Description of Embodiments

[0011] Hereinafter, a construction elevator and a method for extending a main rope according to embodiments will be described with reference to FIGS. 1 to 12. Note that in the drawings, common members are denoted by the same reference signs.

### 1. First Embodiment

#### 1-1. Configuration Example of Construction Elevator

[0012] First, the configuration of a construction elevator according to a first embodiment (hereinafter referred to as the "present example") will be described with reference to FIG. 1.

[0013] FIG. 1 is a schematic configuration diagram illustrating the construction elevator according to the present example.

[0014] The elevator illustrated in FIG. 1 is a construction elevator that is provided in a building structure under construction and used for transporting materials and people. As shown in FIG. 1, a construction elevator 1 is equipped with a support member 2 disposed at the top of a hoistway 100 of the building structure, a machine room unit 3, and a lifting device 6 for lifting the machine

room unit 3. The construction elevator 1 is also equipped with a hoisting machine 9, a main rope 10, a car 11 on which people and materials are loaded, and a counterweight 12. The car 11 and the counterweight 12 illustrate examples of elevating bodies. Note that the positional relationship between the car 11 and the counterweight 12 may be reversed. That is, in FIG. 1, the counterweight may correspond to reference sign 11, and the car may correspond to reference sign 12. Hereinafter, the direction in which the car 11 and the counterweight 12 serving as elevating bodies move vertically is defined as the vertical direction.

[0015] A car-side pulley 11a is provided at the top of the car 11. In addition, a weight-side pulley 12a is provided at the top of the counterweight 12. The main rope 10 is wrapped around the car-side pulley 11a and the weight-side pulley 12a. The main rope 10 is also wrapped around the sheave of the hoisting machine 9 installed in the machine room unit 3 to be described later.

[0016] The main rope 10 is wound around a rope reel 15 provided in the machine room unit 3 to be described later, and is drawn from the rope reel 15. Furthermore, the end of the main rope 10 on the opposite side from the rope reel 15 is fixed to a rope-fixing portion 14 in the machine room unit 3. Furthermore, the main rope 10 is wrapped from the rope reel 15, through a pulley 19 to be described later, to the weight-side pulley 12a, the hoisting machine 9, and the car-side pulley 11a in this order, and the end of the main rope 10 is fixed to the rope-fixing portion 14. Then, when the hoisting machine 9 is driven, the car 11 and the counterweight 12 move vertically in the hoistway 100.

[0017] The support member 2 is installed on a beam 101a provided at the uppermost portion of the hoistway 100 or a recess provided in the wall surface of the hoistway 100. The lifting device 6 is provided to the support member 2. The machine room unit 3 is disposed below support member 2 in the vertical direction. Furthermore, the machine room unit 3 is suspended from the support member 2 with the lifting device 6 therebetween. The machine room unit 3 is supported by the lifting device 6 so as to be liftable (movable). Note that the lifting device 6 may be provided in a first machine room 4 and a second machine room 5 of the machine room unit 3 to be described later, and the lifting rope of the lifting device 6 may be provided in the support member 2.

[0018] The machine room unit 3 has the first machine room 4 and the second machine room 5. The first machine room 4 is disposed below the second machine room 5 in the vertical direction. The first machine room 4 and the second machine room 5 are separably coupled, and are each independently lifted by the lifting device 6.

[0019] A movable support mechanism 7 is provided at the bottom of the first machine room 4 in the vertical direction. The movable support mechanism 7 is configured so as to be stretchable from the first machine room 4 toward the wall surface of the hoistway 100. Furthermore, the movable support mechanism 7 is placed on beams

101b, 101c, and 101d provided in the hoistway 100 or a recess provided in the wall surface of the hoistway 100. The movable support mechanism 7 supports the machine room unit 3 or the first machine room 4 at a predetermined position in the hoistway 100. Note that the movable support mechanism 7 is not limited to the above-described one, and various other fixing mechanisms, such as an engaging member that engages with a guide rail for supporting the car 11 in a vertically movable manner or the wall surface of the hoistway 100, and a fastening member that is fastened to the wall surface, may be applied.

**[0020]** The first machine room 4 has an upper machine room 4a and a lower machine room 4b. The upper machine room 4a is installed at the top of the lower machine room 4b in the vertical direction. Furthermore, the second machine room 5 is installed at the top of the upper machine room 4a in the vertical direction. The hoisting machine 9 is installed in the lower machine room 4b. Furthermore, the rope-fixing portion 14 for fixing the end of the main rope 10 is installed in the lower machine room 4b.

**[0021]** Note that in the present example, the configuration in which the first machine room 4 is divided into two, the upper machine room 4a and the lower machine room 4b has been described. However, the first machine room 4 may be a single machine room or may be divided into three or more machine rooms. Also note that in the present example, the second machine room 5 is described as a single machine room, but may be divided into two or more machine rooms similarly to the first machine room 4.

**[0022]** In the upper machine room 4a, the rope reel 15 around which the main rope 10 is wound, a first rope gripper 16, a second rope gripper 17, and a deflector 22 are installed. The main rope 10 for extension is wound around the rope reel 15. Then, when raising the machine room unit 3, the main rope 10 for extension is drawn from the rope reel 15. Note that in the present example, the rope reel 15 is installed in the machine room unit 3, but the present invention is not limited thereto, and the rope reel 15 may be installed in a pit 100b, which is the bottom of the hoistway 100, or outside the hoistway 100.

**[0023]** The deflector 22 is disposed near the rope reel 15. The deflector 22 changes the direction of the main rope 10 drawn from the rope reel 15 to the direction toward the second machine room 5.

**[0024]** The first rope gripper 16 is provided near the deflector 22 and the rope reel 15. The first rope gripper 16 releasably grips the main rope 10, the direction of which has been changed by the deflector 22. In addition, the first rope gripper 16 grips the main rope 10 on the rope reel side (hereinafter, simply referred to as the "first side") A of the pulley 19 to be described later in the main rope 10. Furthermore, the first rope gripper 16 grips the main rope 10, thereby restricting the movement of the main rope 10. Note that the first rope gripper 16 may be provided to the rope reel 15 or the deflector 22.

**[0025]** The second rope gripper 17 is disposed on the main rope 10 on the elevating body side, that is, the counterweight 12 and car 11 side (hereinafter, simply referred to as the "second side") B, of the pulley 19 to be described later. The second rope gripper 17 has a grip portion 17a and a rope drum 17b. Similarly to the first rope gripper 16, the grip portion 17a releasably grips the main rope 10. Furthermore, the grip portion 17a grips the main rope 10, thereby restricting the movement of the main rope 10.

**[0026]** The rope drum 17b is disposed above the grip portion 17a in the vertical direction. Furthermore, the rope drum 17b is disposed closer to the pulley 19 than the grip portion 17a. Therefore, the grip portion 17a is disposed closer to the elevating body side than the rope drum 17b, that is, closer to the counterweight 12 and car 11 side. The rope drum 17b is supported in such a manner that the rotation thereof can be locked and released. The rope drum 17b is wrapped with N or more turns (N is 1 or more) of the main rope 10. When the rotation of the rope drum 17b is locked, frictional force is generated between the rope drum 17b and the main rope 10.

**[0027]** As described above, the first machine room 4 has the two-story structure of the upper machine room 4a and the lower machine room 4b, so that the horizontal space in the hoistway 100 can be reduced. Note that the first machine room 4 is not limited to the two-story structure of the upper machine room 4a and the lower machine room 4b, but may have a single-story structure in which the hoisting machine 9, the rope-fixing portion 14, the rope reel 15, the first rope gripper 16, and the second rope gripper 17 are installed in a single machine room.

**[0028]** Next, the second machine room 5 will be described.

**[0029]** The second machine room 5 is separably coupled to the top of the upper machine room 4a in the first machine room 4. In the second machine room 5, a control panel 8 that controls the hoisting machine 9, the car 11, and the like, the pulley 19, and a third rope gripper 18 are installed.

**[0030]** The control panel 8 and the car 11 are electrically connected through a tail cord 13. In addition, a tail cord reel 20 is installed near the control panel 8. The tail cord 13 for extension is wound around the tail cord reel 20. Then, when raising the second machine room 5, the tail cord 13 is drawn from the tail cord reel 20.

**[0031]** The pulley 19 is rotatably supported in the second machine room 5. The pulley 19 is disposed between the rope reel 15, and the car 11 and counterweight 12 that represent the elevating bodies. The main rope 10 drawn from the rope reel 15 is wrapped around the pulley 19. Furthermore, the pulley 19 changes the direction in which the main rope 10 extends from up to down.

**[0032]** The third rope gripper 18 is disposed near the pulley 19. The third rope gripper 18 is disposed on the main rope 10 on the second side B of the pulley 19. In addition, the third rope gripper 18 is disposed closer to the pulley 19 than the rope drum 17b of the second rope gripper 17. Similarly to the first rope gripper 16, the third

rope gripper 18 releasably grips the main rope 10.

**[0033]** In the drawings, in the first rope gripper 16, the grip portion 17a of the second rope gripper 17, and the third rope gripper 18, the state in which the main rope 10 is gripped is illustrated in black, and the state in which the main rope 10 is released is illustrated in white.

**[0034]** As illustrated in FIG. 1, during the operation of the construction elevator 1, the third rope gripper 18 operates to grip the main rope 10, and the first rope gripper 16 and the grip portion 17a of the second rope gripper 17 are released. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the third rope gripper 18.

**[0035]** In addition, the rope drum 17b of the second rope gripper 17 is non-rotatably fixed. As described above, since the main rope 10 is wrapped around the rope drum 17b, frictional force is generated between the rope drum 17b and the main rope 10. The frictional force generated between the rope drum 17b and the main rope 10 can reduce the load applied to the third rope gripper 18. As a result, the force (gripping force) with which the third rope gripper 18 grips the main rope 10 can be reduced, and damage to the main rope 10 due to the gripping of the third rope gripper 18 can be suppressed. As the number of windings of the main rope 10 around the rope drum 17b increases, the gripping force of the third rope gripper 18 can be reduced.

**[0036]** Note that in the present example, the third rope gripper 18 grips the main rope 10 to fix the other end of the main rope 10, but the present invention is not limited thereto. For example, the third rope gripper 18 may be released, the main rope 10 may be gripped by the first rope gripper 16, and the other end of the main rope 10 may be fixed by the first rope gripper 16. At least it is sufficient if the other end of the main rope 10 is fixed by gripping the main rope 10 between the rope drum 17b of the second rope gripper 17 and the rope reel 15. Therefore, the other end of the main rope 10 may be fixed at the rope reel 15.

## 1-2. Main Rope Extension Method

**[0037]** Next, a method for extending the main rope 10 of the construction elevator 1 having the above-described configuration, that is, a method for extending the operation floor by raising the machine room unit 3 will be described with reference to FIGS. 2 to 4.

**[0038]** FIGS. 2 to 4 are explanatory diagrams illustrating a method for extending the main rope 10.

**[0039]** As illustrated in FIG. 2, when extending the main rope 10, first, the car 11 and the first machine room 4 are coupled by a chain 201, and the car 11 is fixed. In addition, the counterweight 12 is lowered to the pit 100b, and the counterweight 12 is placed on a buffer (not illustrated) installed in the pit 100b. Thus, tension from the car 11 and the counterweight 12 is not applied to the main rope 10.

**[0040]** Next, the main rope 10 is gripped by the grip

portion 17a of the second rope gripper 17, and the gripping of the main rope 10 by the third rope gripper 18 is released. Note that if the first rope gripper 16 is gripping the main rope 10, the gripping of the main rope 10 by the first rope gripper 16 is released. Then the first machine room 4 and the second machine room 5 are divided.

**[0041]** Next, the lifting device 6 coupled to the second machine room 5 is operated to raise only the second machine room 5 to a predetermined height (the beam 101b in the example illustrated in FIG. 2). Note that since the main rope 10 is folded back by the pulley 19, the length (height) for raising the second machine room 5 only needs to be about half the length of the extension of the main rope 10. As the second machine room 5 rises, the pulley 19 provided in the second machine room 5 also rises. When the second machine room 5 is raised to the predetermined height, the lifting device 6 is stopped, and the second machine room 5 and the pulley 19 are temporarily fixed using the lifting device 6, a second machine room support mechanism (not illustrated), or the like.

**[0042]** Here, one end of the main rope 10 is fixed by the grip portion 17a of the second rope gripper 17, but the other end of the main rope 10, that is, the rope reel 15 side, is not fixed. Therefore, as the second machine room 5 and the pulley 19 rise, the main rope 10 on the rope reel 15 side is pulled, and the main rope 10 for extension is drawn from the rope reel 15. Thus, the raising operation of the second machine room 5 and the pulley 19 and the operation of drawing out the main rope 10 from the rope reel 15 can be performed simultaneously.

**[0043]** When moving the second machine room 5, the other end of the main rope 10 is fixed by the grip portion 17a of the second rope gripper 17 provided in the first machine room 4. Therefore, the main rope 10 is not drawn vertically downward from the first machine room 4. Thus, even during the movement of the second machine room 5, the hoisting machine 9 can be driven to use the car 11.

**[0044]** Next, as shown in FIG. 3, the main rope 10 is gripped by the first rope gripper 16, and the gripping of the main rope 10 by the grip portion 17a of the second rope gripper 17 is released. In addition, the fixing of the rope drum 17b of the second rope gripper 17 is released, thereby allowing the rope drum 17b to rotate. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the first rope gripper 16.

**[0045]** Next, the movable support mechanism 7 is retracted to release the support of the first machine room 4 by the movable support mechanism 7. Then the lifting device 6 coupled to the first machine room 4 is operated to raise the first machine room 4 to a predetermined height (the beam 101c in the example illustrated in FIGS. 3 and 4). Thus, the main rope 10 for extension drawn from the rope reel 15 in the operation illustrated in FIG. 2 is sent out toward the counterweight 12 and car 11 side through the pulley 19 and the second rope gripper 17.

**[0046]** When the first machine room 4 rises to the pre-

determined height, the lifting device 6 is stopped. Then, as illustrated in FIG. 4, the movable support mechanism 7 is extended to place the movable support mechanism 7 on the beam 101c. In addition, the first machine room 4 and the second machine room 5 are coupled. Thus, the machine room unit 3, which is composed of the first machine room 4 and the second machine room 5, can be raised to the predetermined height.

**[0047]** Next, the rotation of the rope drum 17b of the second rope gripper 17 is locked, and the main rope 10 is gripped by the third rope gripper 18. When locking the rotation of the rope drum 17b, it is preferable to adjust the phase of the rope drum 17b. Therefore, before locking the rotation of the rope drum 17b, the main rope 10 is first gripped by the grip portion 17a of the second rope gripper 17. Thus, the weight of the main rope 10 is not applied to the rope drum 17b of the second rope gripper 17, so that the rope drum 17b can be easily rotated, and the work of adjusting the phase of the rope drum 17b can be easily performed. Then, when the work of adjusting the phase of the rope drum 17b is completed, the rotation of the rope drum 17b is locked.

**[0048]** In addition, when the work of locking the rotation of the rope drum 17b is completed, the main rope 10 is gripped by the third rope gripper 18. Thereafter, the gripping of the main rope 10 by the grip portion 17a of the second rope gripper 17 is released. As described above, the main rope 10 is once gripped by the grip portion 17a of the second rope gripper 17, whereby it is possible to prevent the counterweight 12 from falling or the main rope 10 from falling under its own weight.

**[0049]** Next, the gripping of the main rope 10 by the first rope gripper 16 is released. Then the coupling between the car 11 and the first machine room 4 is released, and the counterweight 12 is pulled up from the buffer (not illustrated). By performing such steps, the work of extending the main rope 10 and the work of expanding the operation floor of the construction elevator 1 are completed.

**[0050]** With the construction elevator 1 and the method for extending the main rope 10 according to the present example, the main rope 10 can be extended without sliding the main rope 10 on the rope grippers 16 and 18 and the grip portion 17a. Thus, wear of the main rope 10 can be prevented, and the gripping force of the rope grippers 16 and 18 and the grip portion 17a can be easily adjusted.

**[0051]** In addition, the machine room unit 3 is divided into the first machine room 4 and the second machine room 5, each of which is independently lifted. Thus, the weight applied to the lifting device 6 can be reduced, and the lifting device 6 can be prevented from increasing in size.

## 2. Second Embodiment

**[0052]** Hereinafter, a construction elevator according to a second embodiment will be described with reference to FIGS. 5 to 7.

**[0053]** FIG. 5 is a schematic configuration diagram illustrating the construction elevator according to the second embodiment, and FIGS. 6 and 7 illustrate a method for extending the main rope of the construction elevator according to the second embodiment.

**[0054]** The construction elevator according to the second embodiment is different from the construction elevator 1 according to the first embodiment in the configuration of the machine room unit. Therefore, here, the same reference signs are given to portions common to the construction elevator 1 according to the first embodiment, and redundant description will be omitted.

**[0055]** As illustrated in FIG. 5, a construction elevator 1B has a machine room unit 3B composed of a first machine room 4B and a second machine room 5B. In the first machine room 4B, the hoisting machine 9, the rope-fixing portion 14 for fixing the end of the main rope 10, the rope reel 15, the first rope gripper 16, and a second rope gripper 27 are installed. In the second machine room 5B, the control panel 8, the tail cord reel 20, and the pulley 19 are installed.

**[0056]** Since the configurations of the control panel 8, the hoisting machine 9, the rope-fixing portion 14, the rope reel 15, the first rope gripper 16, the pulley 19, and the tail cord reel 20 are similar to those of the construction elevator 1 according to the first embodiment, the description thereof will be omitted. A detailed configuration of the second rope gripper 27 will be described later.

**[0057]** The second machine room 5B is disposed above the first machine room 4B in the vertical direction. Furthermore, similarly to the first machine room 4B, a movable support mechanism 21 is provided in the second machine room 5B. The movable support mechanism 21 is configured so as to be stretchable from the second machine room 5B toward the wall surface of the hoistway 100. Furthermore, the movable support mechanism 21 is placed on the beams 101b, 101c, and 101d provided in the hoistway 100 or a recess provided in the wall surface of the hoistway 100. The movable support mechanism 21 supports the machine room unit 3 or the second machine room 5B at a predetermined position in the hoistway 100.

**[0058]** The third rope gripper 18 is not provided in the second machine room 5B according to the second embodiment.

**[0059]** The second rope gripper 27 has a lower grip portion 27a, a rope drum 27b, and an upper grip portion 27c. Since the configurations of the lower grip portion 27a and the rope drum 27b are similar to those of the grip portion 17a and the rope drum 17b of the second rope gripper 17 according to the first embodiment, the description thereof will be omitted.

**[0060]** The upper grip portion 27c is disposed above the rope drum 27b in the vertical direction. That is, the upper grip portion 27c is disposed closer to the pulley 19 than the rope drum 27b. Similarly to the first rope gripper 16 and the lower grip portion 27a, the upper grip portion 27c releasably grips the main rope 10. The upper grip

portion 27c has similar operation and effect to the third rope gripper 18 according to the first embodiment.

**[0061]** As illustrated in FIG. 5, during the operation of the construction elevator 1B, the upper grip portion 27c of the second rope gripper 27 operates to grip the main rope 10, and the first rope gripper 16 and the lower grip portion 27a of the second rope gripper 27 are released. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the upper grip portion 27c of the second rope gripper 27.

**[0062]** In addition, since the rope drum 27b of the second rope gripper 27 is non-rotatably fixed, the load applied to the upper grip portion 27c can be reduced.

**[0063]** Note that also in the construction elevator 1B according to the second embodiment, the upper grip portion 27c of the second rope gripper 27 may be released, the main rope 10 may be gripped by the first rope gripper 16, and the other end of the main rope 10 may be fixed by the first rope gripper 16.

**[0064]** Next, a method of extending the main rope 10 of the construction elevator 1B according to the second embodiment will be described with reference to FIGS. 6 and 7.

**[0065]** First, as illustrated in FIG. 6, the car 11 and the first machine room 4 are coupled by the chain 201, and the car 11 is fixed. In addition, the counterweight 12 is lowered to the pit 100b, and the counterweight 12 is placed on a buffer (not illustrated) installed in the pit 100b.

**[0066]** Next, while the main rope 10 is gripped by the upper grip portion 27c of the second rope gripper 27, the movable support mechanism 21 is retracted to release the support of the second machine room 5B by the movable support mechanism 21. The lifting device 6 coupled to the second machine room 5B is operated to raise only the second machine room 5B to a predetermined height (the beam 101b in the example illustrated in FIG. 2). As the second machine room 5B rises, the pulley 19 provided in the second machine room 5B also rises.

**[0067]** As illustrated in FIG. 7, when the second machine room 5B is raised to the predetermined height, the lifting device 6 is stopped, and the movable support mechanism 21 is extended to place the movable support mechanism 21 on the beam 101b. In addition, as the second machine room 5B and the pulley 19 rise, the main rope 10 on the rope reel 15 side is pulled, and the main rope 10 for extension is drawn from the rope reel 15. Thus, the raising operation of the second machine room 5B and the pulley 19 and the operation of drawing out the main rope 10 from the rope reel 15 can be performed simultaneously.

**[0068]** As illustrated in FIG. 6, when moving the second machine room 5B, the other end of the main rope 10 is fixed by the upper grip portion 27c of the second rope gripper 27 provided in the first machine room 4B. Therefore, the main rope 10 is not drawn vertically downward from the first machine room 4B. Thus, even during the movement of the second machine room 5B, the hoisting

machine 9 can be driven to use the car 11. That is, the construction elevator 1B can be moved even during the work of extending the main rope 10, thereby allowing an improvement in the work of installing the construction elevator 1B and building structure construction work.

**[0069]** Note that when moving the second machine room 5B, the other end of the main rope 10 may be fixed by the lower grip portion 27a of the second rope gripper 27 provided in the first machine room 4B. Also in this case, the main rope 10 is not drawn vertically downward from the first machine room 4B.

**[0070]** Next, as illustrated in FIG. 7, the main rope 10 is gripped by the first rope gripper 16, and the gripping of the main rope 10 by the upper grip portion 27c of the second rope gripper 27 is released. In addition, the fixing of the rope drum 27b of the second rope gripper 27 is released, thereby allowing the rope drum 27b to rotate. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the first rope gripper 16.

**[0071]** Next, the movable support mechanism 7 is retracted to release the support of the first machine room 4B by the movable support mechanism 7. Then the lifting device 6 coupled to the first machine room 4B is operated to raise the first machine room 4B to a predetermined height (the beam 101c in the example illustrated in FIG. 7). Then, when the first machine room 4B is raised to the predetermined height, the lifting device 6 is stopped, and the movable support mechanism 7 is extended to place the movable support mechanism 7 on the beam 101c. Thus, the first machine room 4B and the second machine room 5B can be raised to the predetermined height.

**[0072]** Next, the rotation of the rope drum 27b of the second rope gripper 27 is locked, and the main rope 10 is gripped by the upper grip portion 27c. Here, before locking the rotation of the rope drum 27b, the main rope 10 is first gripped by the lower grip portion 27a of the second rope gripper 27. Then the phase of the rope drum 27b is adjusted, and the rotation of the rope drum 27b is locked. When the work of locking the rotation of the rope drum 27b is completed, the main rope 10 is gripped by the upper grip portion 27c. Thereafter, the gripping of the main rope 10 by the lower grip portion 27a is released.

**[0073]** Next, the gripping of the main rope 10 by the first rope gripper 16 is released. Then the coupling between the car 11 and the first machine room 4B is released, and the counterweight 12 is pulled up from the buffer (not illustrated). Thus, the work of extending the main rope 10 and the work of expanding the operation floor of the construction elevator 1B are completed.

**[0074]** The other configurations are similar to those of the construction elevator 1 according to the first embodiment, and thus the description thereof will be omitted. The construction elevator 1B according to the second embodiment can also provide similar operational effects to those of the construction elevator 1 according to the first embodiment described above.

## 3. Third Embodiment

**[0075]** Hereinafter, a construction elevator according to a third embodiment will be described with reference to FIGS. 8 to 10.

**[0076]** FIG. 8 is a schematic configuration diagram illustrating the construction elevator according to the third embodiment, and FIGS. 9 and 10 illustrate a method for extending the main rope of the construction elevator according to the third embodiment.

**[0077]** The construction elevator according to the third embodiment is different from the construction elevator 1 according to the first embodiment in the configuration of the machine room unit. Therefore, here, the same reference signs are given to portions common to the construction elevator 1 according to the first embodiment, and redundant description will be omitted.

**[0078]** As illustrated in FIG. 8, a construction elevator 1C has a machine room unit 3C composed of a first machine room 4C and a second machine room 5C, and a pulley 19C. The first machine room 4C and the second machine room 5C are integrally formed. In the first machine room 4C, the hoisting machine 9, the rope-fixing portion 14 for fixing the end of the main rope 10, the rope reel 15, the first rope gripper 16, and the second rope gripper 17 are installed. In the second machine room 5B, the control panel 8, the tail cord reel 20, and the third rope gripper 18 are installed.

**[0079]** Since the configurations of the control panel 8, the hoisting machine 9, the rope-fixing portion 14, the rope reel 15, the first rope gripper 16, the second rope gripper 17, the third rope gripper 18, and the tail cord reel 20 are similar to those of the construction elevator 1 according to the first embodiment, the description thereof will be omitted.

**[0080]** The pulley 19C is supported by a pulley lifting device 6C so as to be liftable (movable) along the vertical direction. That is, the pulley 19C is moved independently from the machine room unit 3C by the pulley lifting device 6C. In addition, the pulley 19C is rotatably supported, and the main rope 10 is wrapped therearound. The first rope gripper 16 is disposed on the main rope 10 on the rope reel 15 side, that is, the first side A, of the pulley 19C. Furthermore, the second rope gripper 17 and the third rope gripper 18 are arranged on the main rope on the counterweight 12 and car 11 side, that is, the second side B, of the pulley 19C.

**[0081]** As illustrated in FIG. 9, during the operation of the construction elevator 1C, the third rope gripper 18 operates to grip the main rope 10, and the first rope gripper 16 and the grip portion 17a of the second rope gripper 17 are released. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the third rope gripper 18. In addition, since the rope drum 17b of the second rope gripper 17 is non-rotatably fixed, the load applied to the third rope gripper 18 can be reduced.

**[0082]** Note that also in the construction elevator 1C

according to the third embodiment, the third rope gripper 18 may be released, the main rope 10 may be gripped by the first rope gripper 16, and the other end of the main rope 10 may be fixed by the first rope gripper 16.

**[0083]** Next, a method of extending the main rope 10 of the construction elevator 1C according to the third embodiment will be described with reference to FIGS. 9 and 10.

**[0084]** First, as illustrated in FIG. 9, the car 11 and the machine room unit 3C are coupled by the chain 201, and the car 11 is fixed. In addition, the counterweight 12 is lowered to the pit 100b, and the counterweight 12 is placed on a buffer (not illustrated) installed in the pit 100b.

**[0085]** Next, the pulley lifting device 6C coupled to the pulley 19C is driven to raise only the pulley 19C to a predetermined height. At this time, the main rope 10 on the second side B of the pulley 19C is fixed by the third rope gripper 18. Therefore, the main rope 10 can be drawn from the rope reel 15 by raising the pulley 19C. In addition, since the main rope 10 is folded back by the pulley 19C, the length (height) for raising the pulley 19C only needs to be about half the length of the extension of the main rope 10.

**[0086]** Note that although the example in which the main rope 10 is gripped by the third rope gripper 18 has been described, the present invention is not limited to this. The third rope gripper 18 may be released, and the main rope 10 may be fixed by the grip portion 17a of the second rope gripper 17. When the pulley 19C is raised to the predetermined height, the lifting device 6 is stopped and the pulley 19C is temporarily fixed in the hoistway 100.

**[0087]** In the example illustrated in FIG. 9, the car 11 and the machine room unit 3C are coupled and the counterweight 12 is placed on the buffer, but the present invention is not limited thereto. Here, one end of the main rope 10 on the second side B during the raising operation of the pulley 19C is fixed to the rope-fixing portion 14, and the other end thereof on the second side B is fixed to the third rope gripper 18. Therefore, even during the movement of the pulley 19C, it is not necessary to couple the car 11 to the machine room unit 3C and place the counterweight 12 on the buffer. Furthermore, even during the movement of the pulley 19C, the hoisting machine 9 may be driven to use the car 11.

**[0088]** Next, when raising the machine room unit 3C, as illustrated in FIG. 10, the main rope 10 is gripped by the first rope gripper 16, and the gripping of the main rope 10 by the third rope gripper 18 is released. In addition, the fixing of the rope drum 17b of the second rope gripper 17 is released, thereby allowing the rope drum 17b to rotate. Therefore, one end of the main rope 10 is fixed to the rope-fixing portion 14, and the other end of the main rope 10 is fixed to the first rope gripper 16.

**[0089]** Here, in a case where the car 11 is not coupled to the machine room unit 3C and the counterweight 12 is not placed on the buffer, the car 11 and the machine room unit 3C are coupled and the counterweight 12 is

placed on the buffer before the above-described work (step).

**[0090]** Next, the movable support mechanism 7 is retracted to release the support of the machine room unit 3C by the movable support mechanism 7. Then the lifting device 6 coupled to the machine room unit 3C is operated to raise the machine room unit 3C to a predetermined height. Then, when the machine room unit 3C is raised to the predetermined height, the lifting device 6 is stopped, and the movable support mechanism 7 is extended to place the movable support mechanism 7 on the beam 101c. Thus, the machine room unit 3C can be raised to the predetermined height.

**[0091]** Next, the rotation of the rope drum 17b of the second rope gripper 17 is locked, and the main rope 10 is gripped by the third rope gripper 18. Here, before locking the rotation of the rope drum 17b, the main rope 10 is first gripped by the grip portion 17a of the second rope gripper 17. Then the phase of the rope drum 17b is adjusted, and the rotation of the rope drum 17b is locked. When the work of locking the rotation of the rope drum 17b is completed, the main rope 10 is gripped by the third rope gripper 18. Thereafter, the gripping of the main rope 10 by the grip portion 17a of the second rope gripper 17 is released.

**[0092]** Next, the gripping of the main rope 10 by the first rope gripper 16 is released. Then the coupling between the car 11 and the machine room unit 3C is released, and the counterweight 12 is pulled up from the buffer (not illustrated). Thus, the work of extending the main rope 10 and the work of expanding the operation floor of the construction elevator 1C are completed.

**[0093]** The other configurations are similar to those of the construction elevator 1 according to the first embodiment, and thus the description thereof will be omitted. The construction elevator 1C according to the third embodiment can also provide similar operational effects to those of the construction elevator 1 according to the first embodiment described above.

**[0094]** In addition, in the construction elevator 1 according to the first embodiment and the construction elevator 1B according to the second embodiment, the pulley 19 rises together with the second machine room 5, 5B, so that the main rope 10 is drawn from the rope reel 15. That is, in the construction elevator 1 according to the first embodiment and the construction elevator 1B according to the second embodiment, the lifting device 6 for lifting the machine room unit 3, 3B serves as a pulley lifting device. Meanwhile, in the construction elevator 1C according to the third embodiment, only the pulley 19C rises independently of the machine room unit 3C, so that the main rope 10 is drawn from the rope reel 15.

#### 4. Fourth Embodiment

**[0095]** Next, a construction elevator according to a fourth embodiment will be described with reference to FIG. 11.

**[0096]** FIG. 11 is a schematic configuration diagram illustrating the construction elevator according to the fourth embodiment.

**[0097]** The construction elevator according to the fourth embodiment is different from the construction elevators according to the first and third embodiments in the order in which the main rope is looped over the car and the counterweight. Therefore, here, the same reference signs are given to portions common to the construction elevators 1 and 1C according to the first and third embodiments, and redundant description will be omitted.

**[0098]** As illustrated in FIG. 11, a construction elevator 1D has a machine room unit 3D, the car 11, and the counterweight 12. The rope reel 15 around which the main rope 10 is wound, the hoisting machine 9, and the like are arranged in the machine room unit 3D.

**[0099]** In the construction elevator 1D according to the fourth embodiment, the main rope 10 is wrapped from the rope reel 15, through the pulley 19, to the car-side pulley 11a provided on the car 11, the hoisting machine 9, and the weight-side pulley 12a provided on the counterweight 12, in this order. Furthermore, one end of the main rope 10 extending from the weight-side pulley 12a is fixed to the rope-fixing portion 14 of the machine room unit 3D.

**[0100]** The other configurations are similar to those of the construction elevators 1 and 1C according to the first and third embodiments, and thus the description thereof will be omitted. The construction elevator 1D according to the fourth embodiment can also provide similar operational effects to those of the construction elevators 1 and 1C according to the first and third embodiments described above.

#### 5. Fifth Embodiment

**[0101]** Next, a construction elevator according to a fifth embodiment will be described with reference to FIG. 12.

**[0102]** FIG. 12 is a schematic configuration diagram illustrating the construction elevator according to the fifth embodiment.

**[0103]** The construction elevator according to the fifth embodiment is different from the construction elevator according to the second embodiment in the order in which the main rope is looped over the car and the counterweight. Therefore, here, the same reference signs are given to portions common to the construction elevator 1B according to the second embodiment, and redundant description will be omitted.

**[0104]** As illustrated in FIG. 12, a construction elevator 1E has a machine room unit 3E, the car 11, and the counterweight 12. The rope reel 15 around which the main rope 10 is wound, the hoisting machine 9, and the like are arranged in the machine room unit 3E.

**[0105]** In the construction elevator 1E according to the fifth embodiment, the main rope 10 is wound from the rope reel 15, through the pulley 19, to the car-side pulley 11a provided on the car 11, the hoisting machine 9, and

the weight-side pulley 12a provided on the counterweight 12, in this order. Furthermore, one end of the main rope 10 extending from the weight-side pulley 12a is fixed to the rope-fixing portion 14 of the machine room unit 3E.

**[0106]** The other configurations are similar to those of the construction elevator 1B according to the second embodiment, and thus the description thereof will be omitted. The construction elevator 1E according to the fifth embodiment can also provide similar operational effects to as the construction elevator 1B according to the second embodiment described above.

**[0107]** Note that the present invention is not limited to the embodiments described above and illustrated in the drawings, and various modifications can be made without departing from the gist of the invention described in the claims.

**[0108]** Note that in the present specification, words such as "parallel" and "orthogonal" are used, but these do not mean only strictly "parallel" and "orthogonal", and may include "parallel" and "orthogonal" and even be in a state of "substantially parallel" or "substantially orthogonal" within the range in which the functions can be exhibited.

#### Reference Signs List

#### **[0109]**

- 1, 1B, 1C, 1D, 1E construction elevator
- 2 support member
- 3, 3B, 3C, 3D, 3E machine room unit
- 4, 4B, 4C first machine room
- 4a upper machine room
- 4b lower machine room
- 5, 5B, 5C second machine room
- 6 lifting device
- 6C pulley lifting device
- 7, 21 movable support mechanism
- 8 control panel
- 9 hoisting machine
- 10 main rope
- 11 car (elevating body)
- 11a car-side pulley
- 12 counterweight (elevating body)
- 12a weight-side pulley
- 13 tail cord
- 14 rope-fixing portion
- 15 rope reel
- 16 first rope gripper
- 17, 27 second rope gripper
- 17a grip portion
- 17b rope drum
- 18 third rope gripper
- 19, 19C pulley
- 20 tail cord reel
- 27a lower grip portion
- 27b rope drum
- 27c upper grip portion

100 hoistway  
100b pit  
101a, 101b, 101c, 101d beam

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#### Claims

##### 1. A construction elevator comprising:

a rope reel around which a main rope is wound; an elevating body around which the main rope drawn from the rope reel is wrapped and that moves vertically in a hoistway of a building structure; a pulley that is disposed on the main rope between the rope reel and the elevating body and around which the main rope drawn from the rope reel is wrapped; a first rope gripper that releasably grips the main rope on a rope reel side of the pulley; and a second rope gripper that releasably grips the main rope on an elevating body side of the pulley, wherein the pulley is supported so as to be movable along a direction in which the elevating body moves vertically.

##### 2. The construction elevator according to claim 1, wherein the second rope gripper has

a grip portion that releasably grips the main rope, and a rope drum around which the main rope is wrapped at least once, the rope drum being supported in such a manner that rotation can be locked and released.

##### 3. The construction elevator according to claim 2, further comprising a third rope gripper that releasably grips the main rope on the elevating body side of the pulley, wherein the third rope gripper is disposed closer to the pulley than the rope drum of the second rope gripper.

##### 4. The construction elevator according to claim 2, wherein the grip portion has

an upper grip portion disposed closer to the pulley than the rope drum, and a lower grip portion disposed closer to the elevating body than the rope drum.

##### 5. The construction elevator according to claim 1, further comprising:

a machine room unit in which a rope-fixing portion for fixing an end of the main rope is provided; and a lifting device that supports the machine room

unit in a liftable manner.

6. The construction elevator according to claim 5,  
wherein the machine room unit has:

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a first machine room in which the rope-fixing portion is provided; and  
a second machine room that is disposed above the first machine room in a vertical direction and in which the pulley is disposed.

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7. The construction elevator according to claim 6,  
wherein the first machine room and the second machine room are separably coupled.

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8. The construction elevator according to claim 7,  
wherein the pulley is rotatably supported in the second machine chamber, and is supported so as to be liftable together with the second machine chamber by the lifting device.

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9. The construction elevator according to any one of claims 6 to 8, wherein the second rope gripper is disposed in the first machine room.

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10. A method for extending a main rope of a construction elevator equipped with: a rope reel around which the main rope is wound; an elevating body around which the main rope drawn from the rope reel is wrapped and that moves vertically in a hoistway of a building structure; a pulley that is disposed on the main rope between the rope reel and the elevating body and around which the main rope drawn from the rope reel is wrapped; a first rope gripper that releasably grips the main rope on a rope reel side of the pulley; and a second rope gripper that releasably grips the main rope on an elevating body side of the pulley, the method comprising the steps of:

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gripping the main rope with the second rope gripper;

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releasing the gripping of the main rope by the first rope gripper, raising the pulley to a predetermined height along a direction in which the elevating body moves vertically, and drawing the main rope from the rope reel;

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after raising the pulley to the predetermined height, gripping the main rope with the first rope gripper and releasing the gripping of the main rope by the second rope gripper; and

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raising a machine room unit in which the second rope gripper is installed to a predetermined height.

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FIG. 1

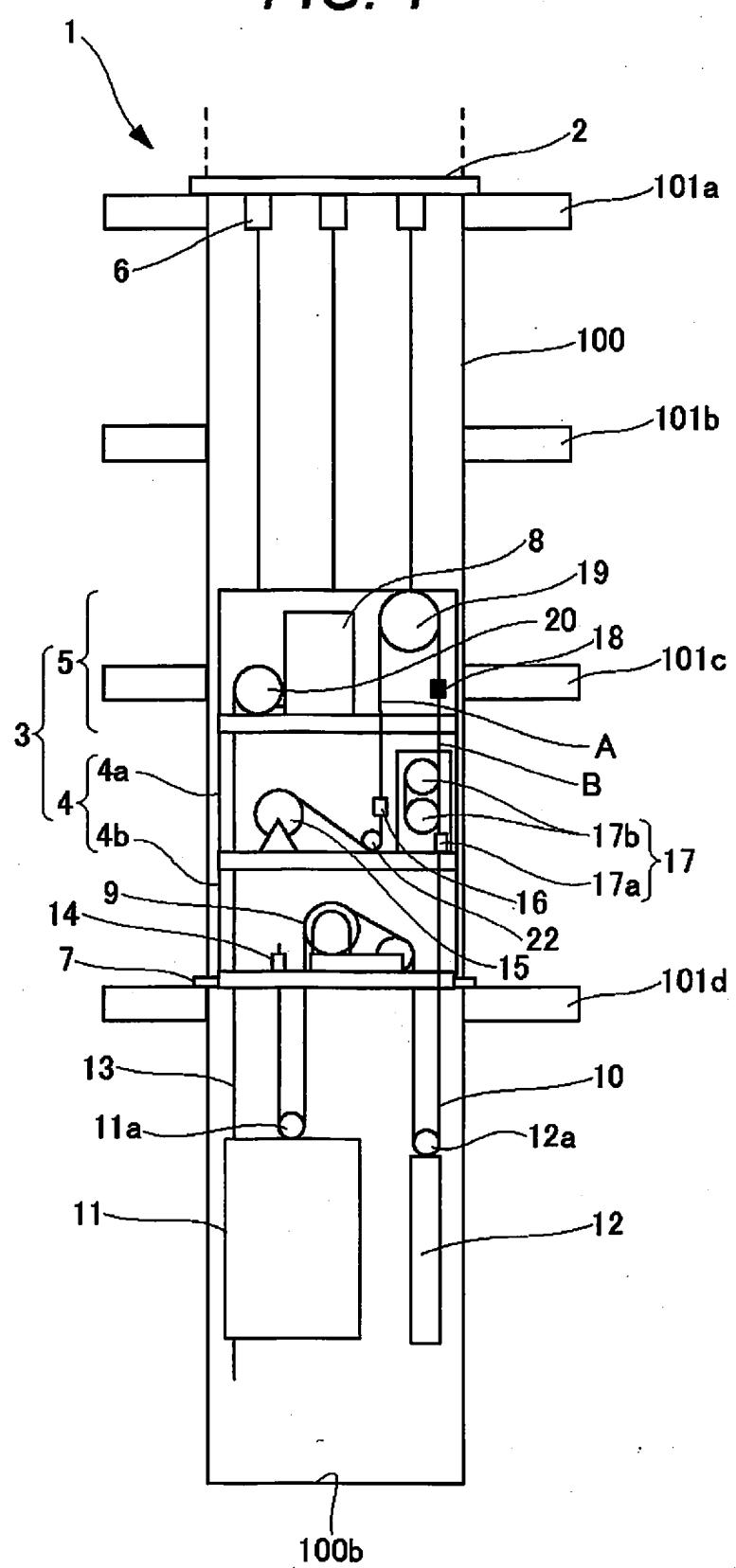


FIG. 2

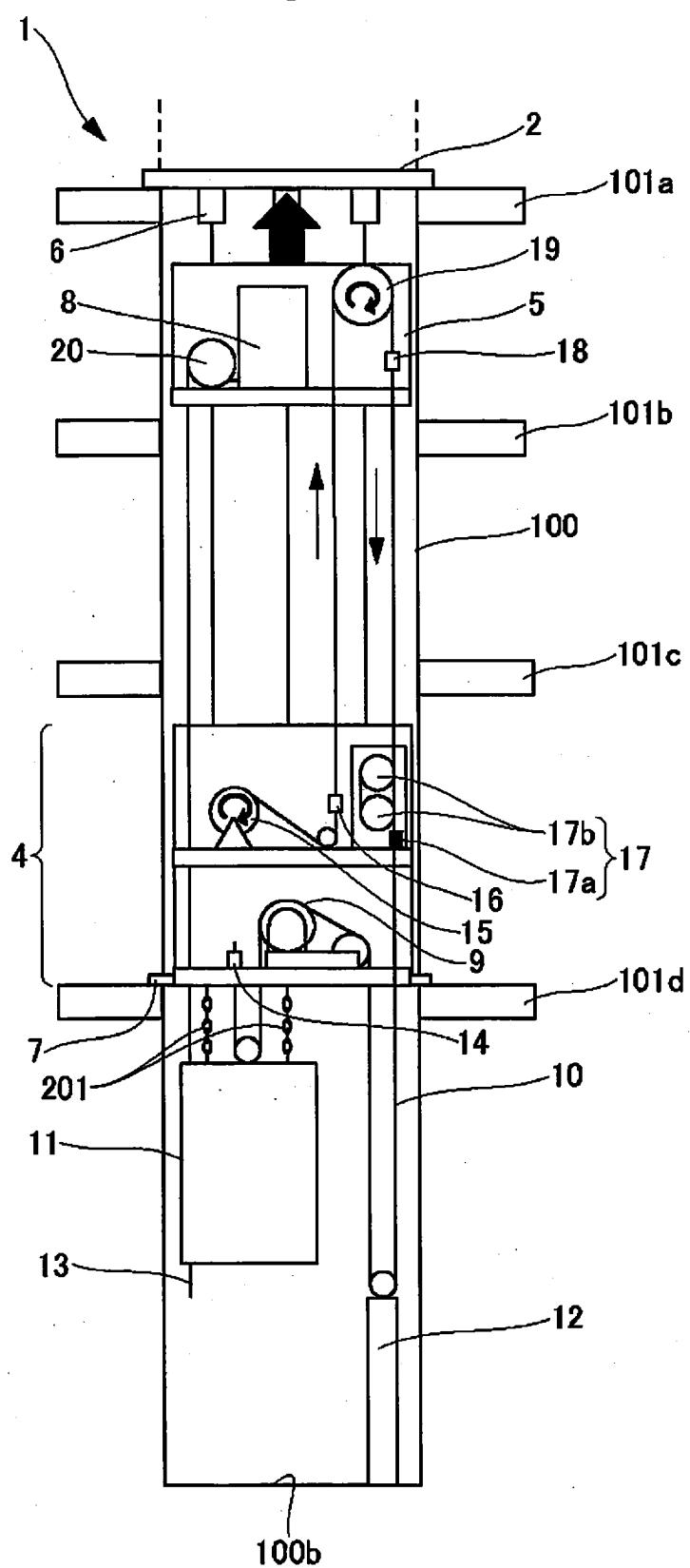


FIG. 3

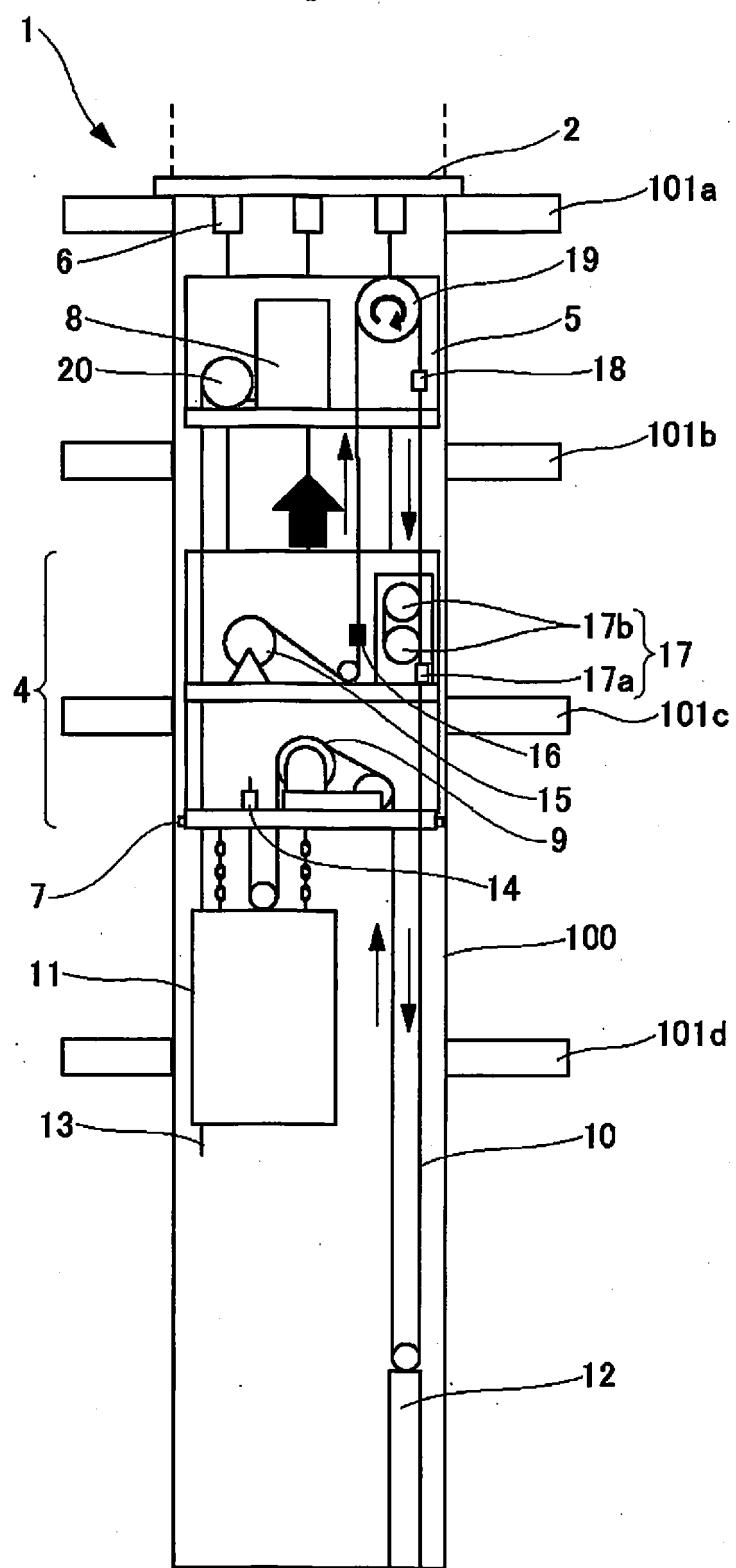


FIG. 4

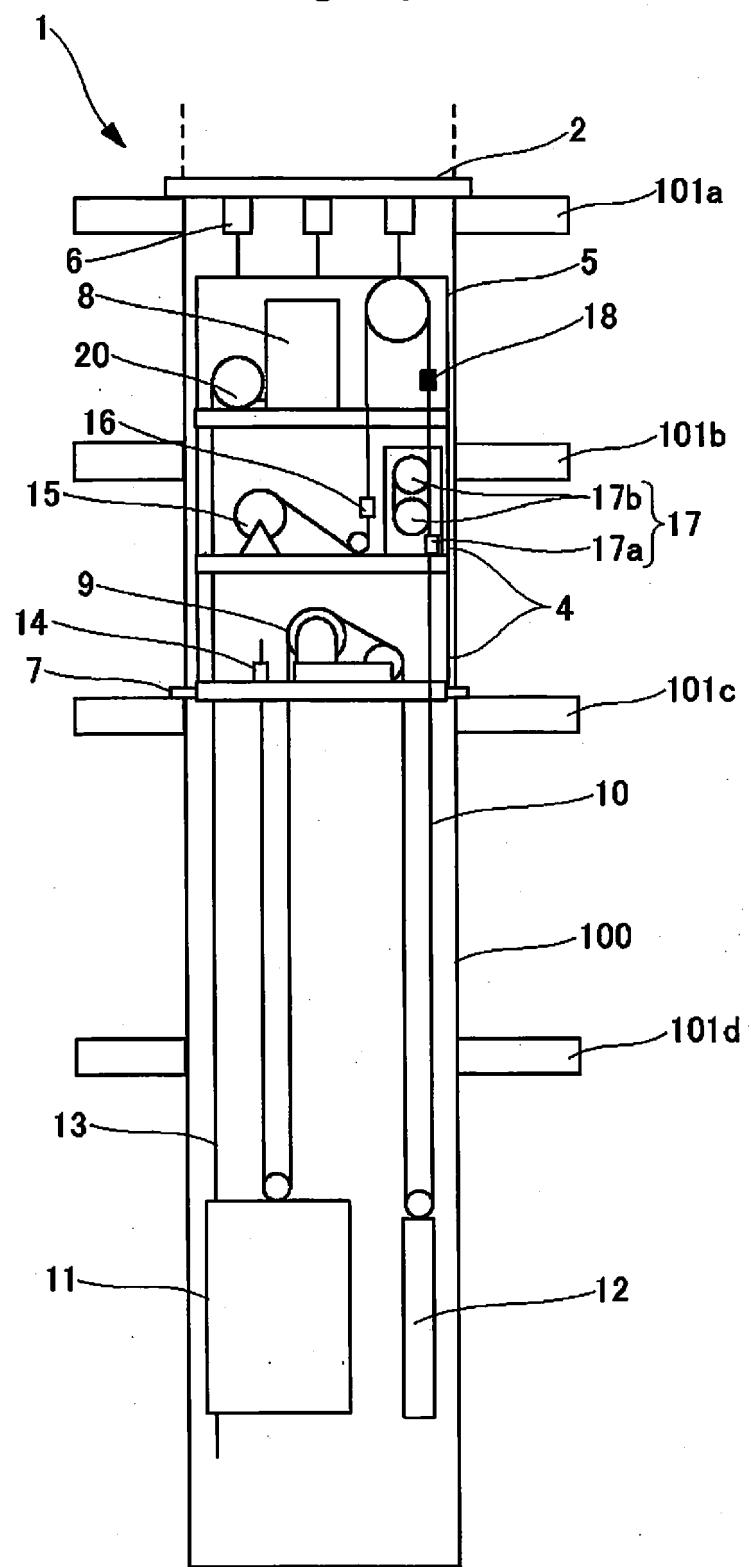


FIG. 5

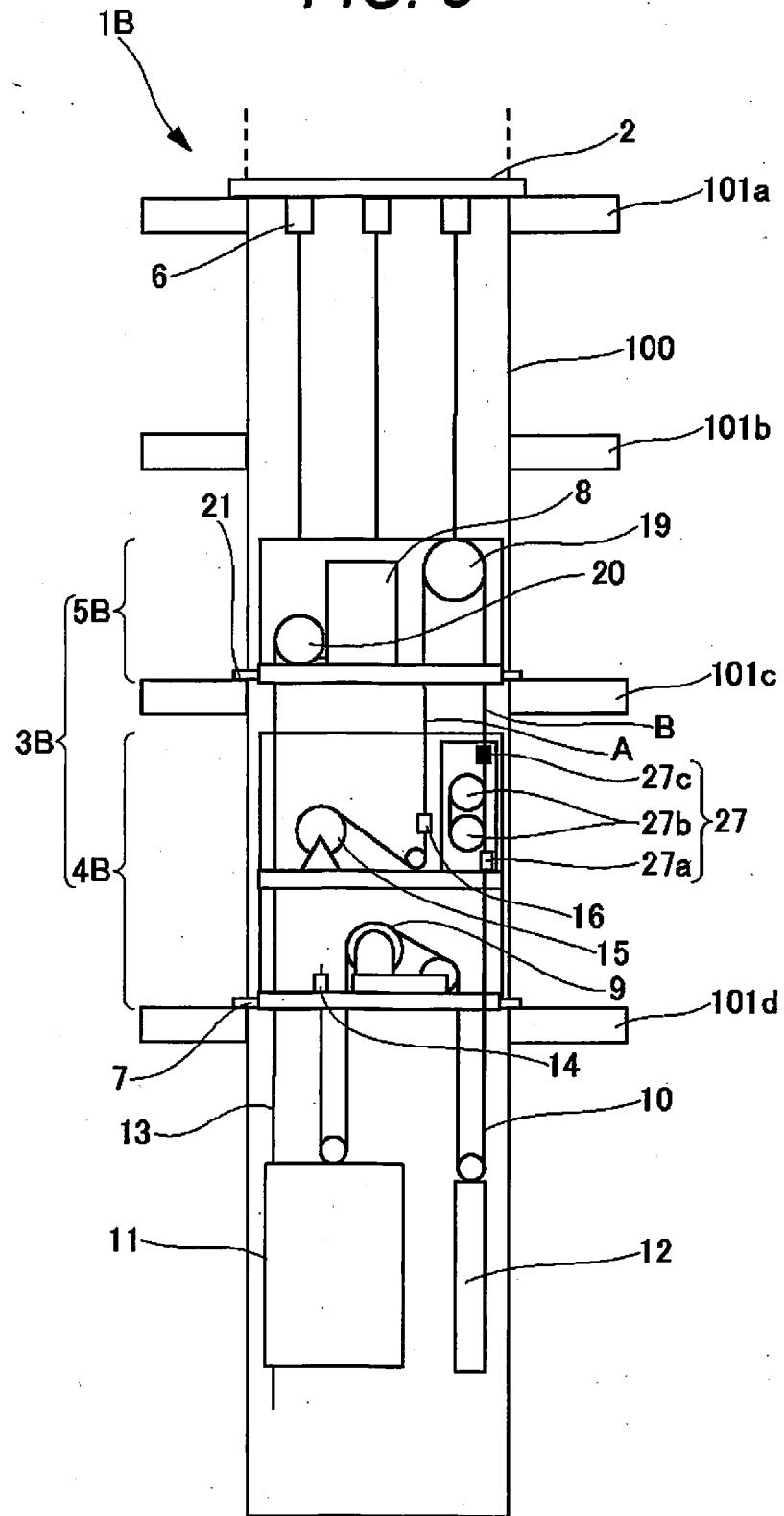


FIG. 6

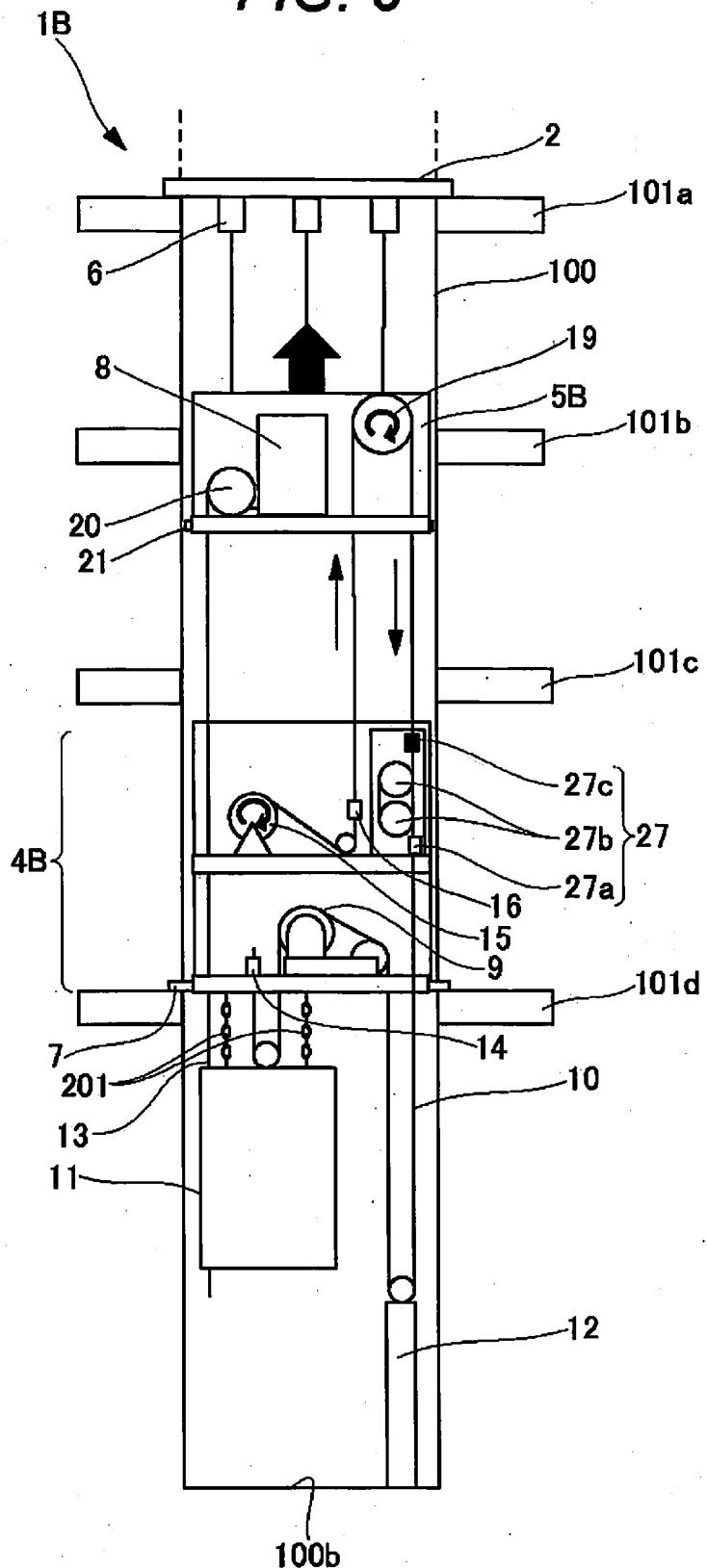


FIG. 7

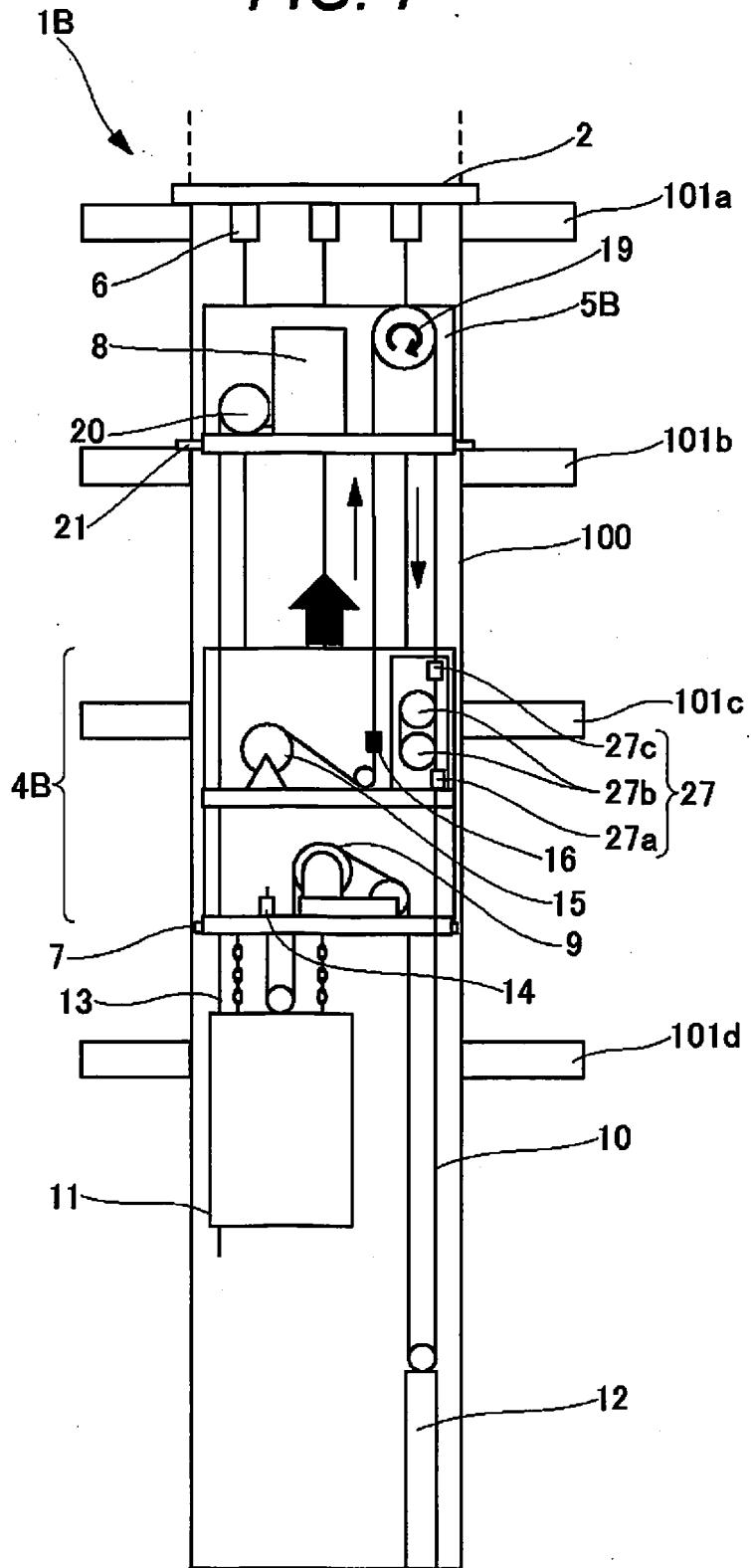


FIG. 8

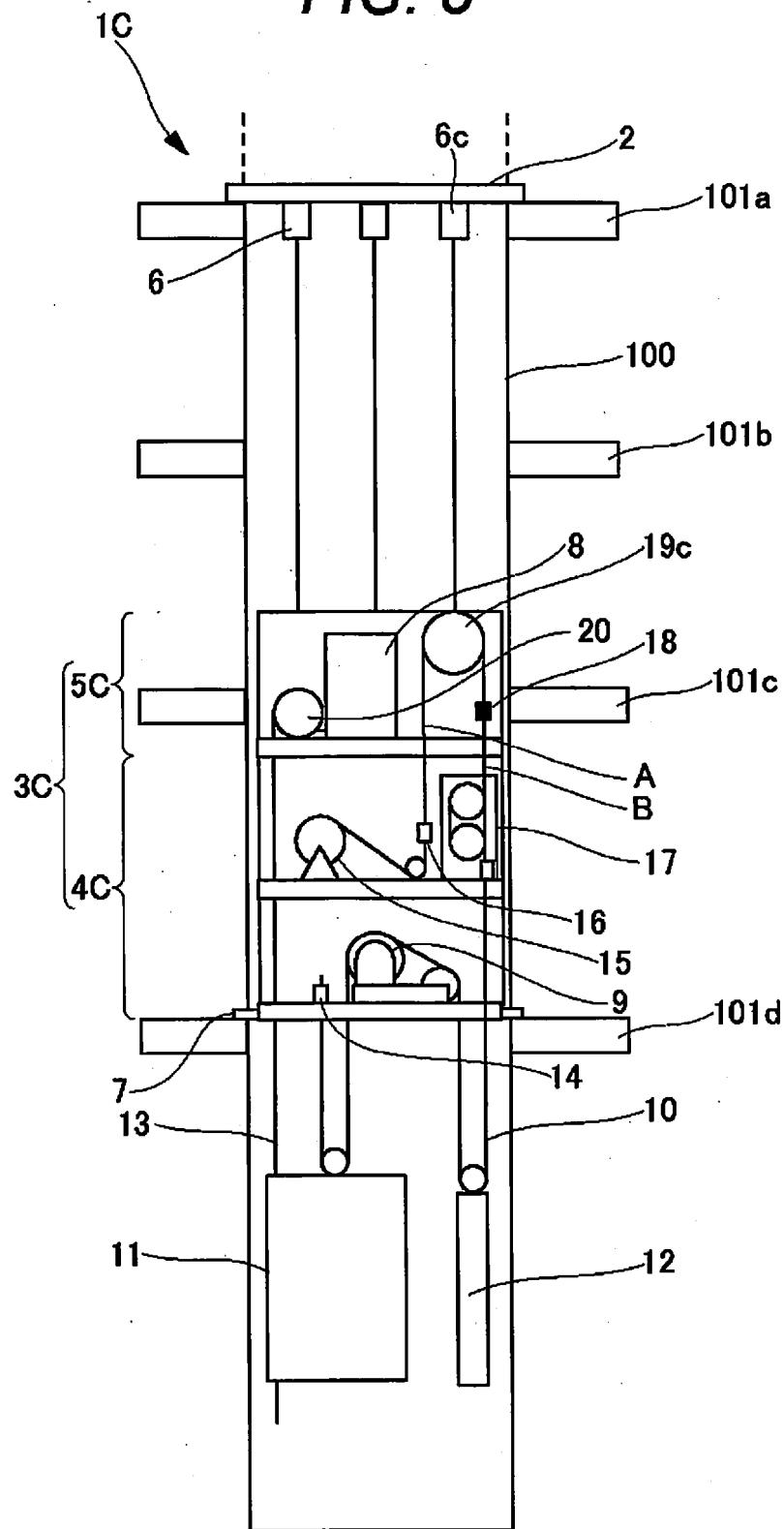


FIG. 9

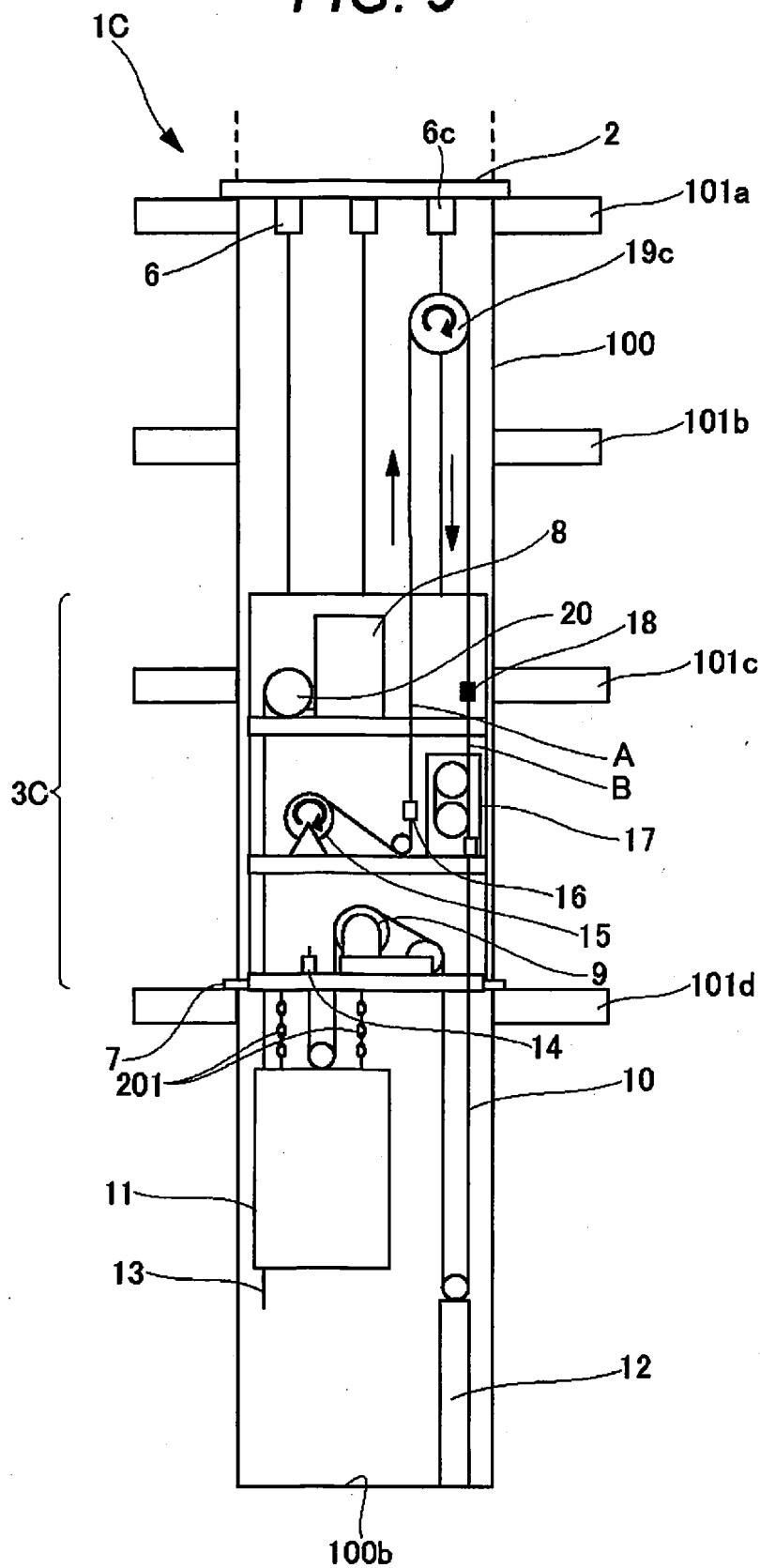


FIG. 10

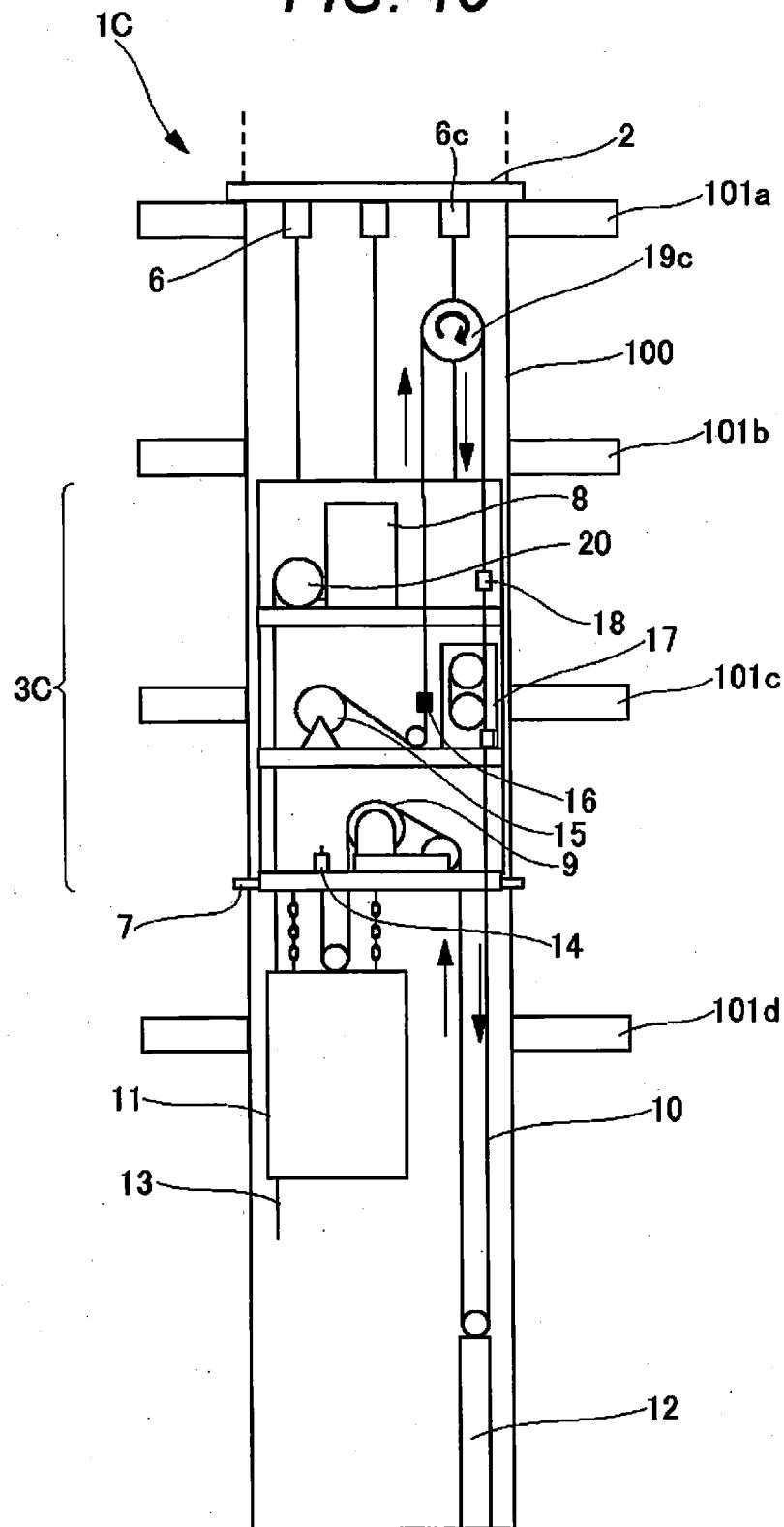


FIG. 11

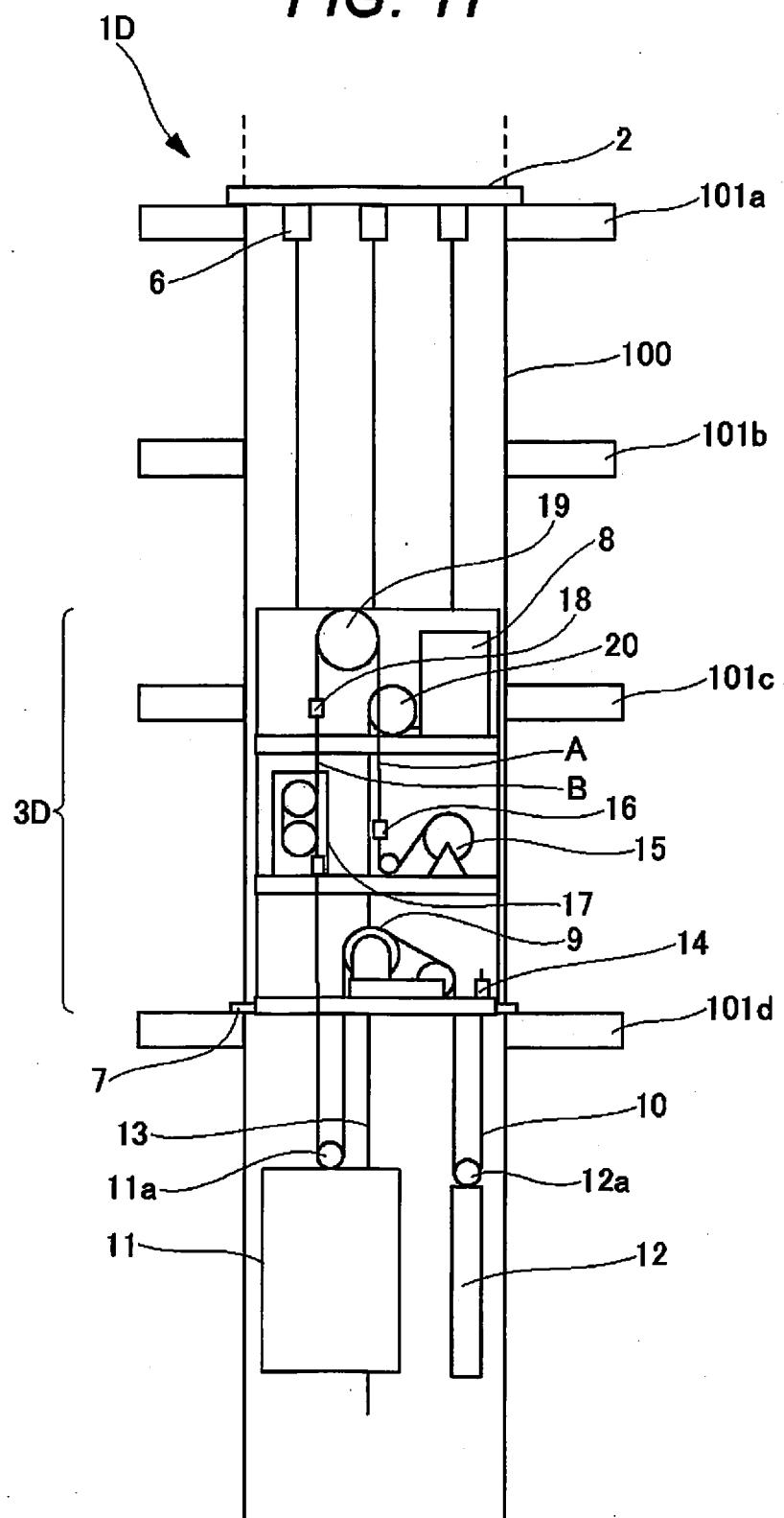
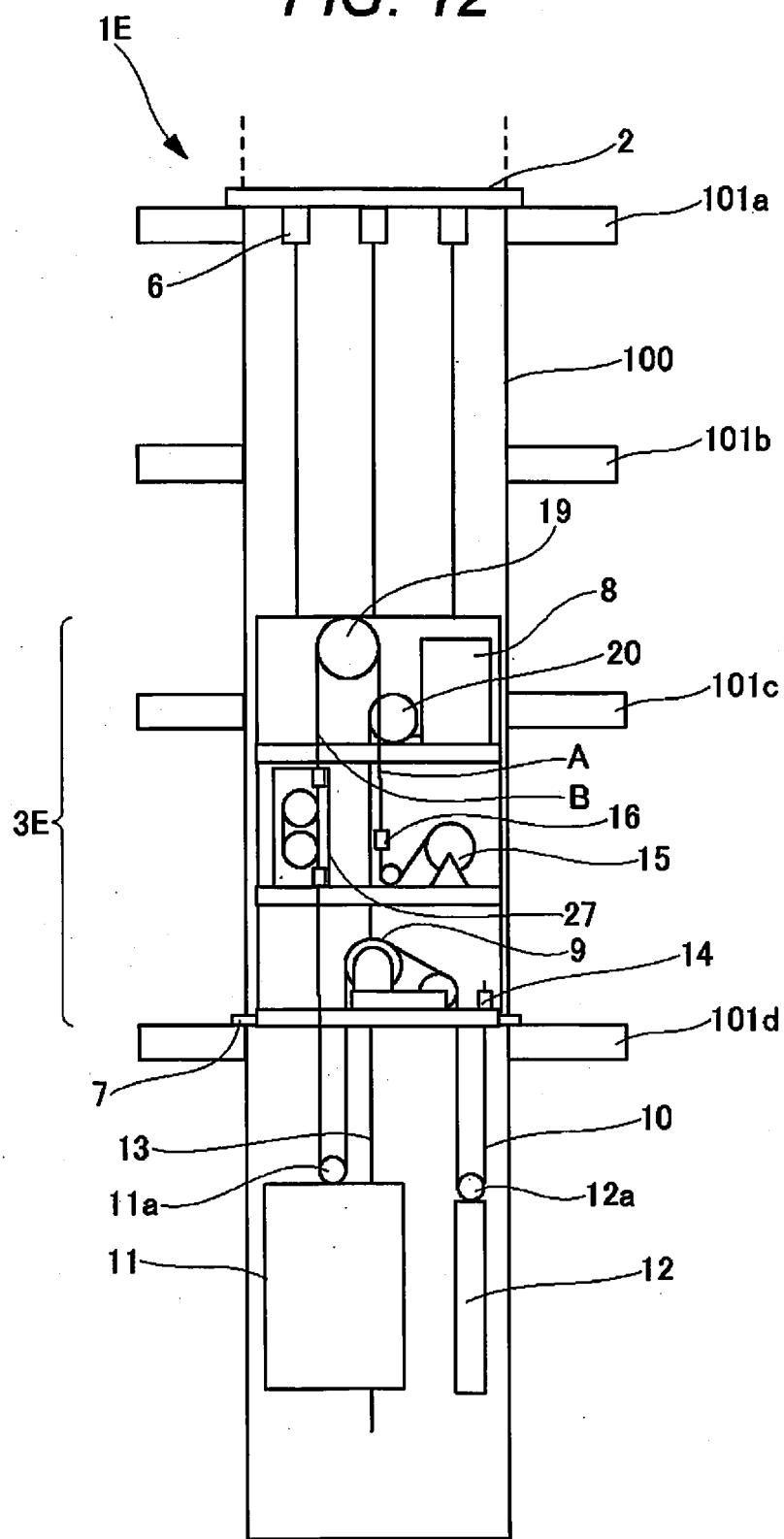


FIG. 12



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## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/039315

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A. CLASSIFICATION OF SUBJECT MATTER  
 Int. Cl. B66B9/187 (2006.01) i  
 FI: B66B9/187 D

According to International Patent Classification (IPC) or to both national classification and IPC

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## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)  
 Int. Cl. B66B9/187, B66B7/00

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Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996  
 Published unexamined utility model applications of Japan 1971-2020  
 Registered utility model specifications of Japan 1996-2020  
 Published registered utility model applications of Japan 1994-2020

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

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## C. DOCUMENTS CONSIDERED TO BE RELEVANT

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Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	JP 56-51995 B2 (TOKYO SHIBAURA ELECTRIC CO., LTD.)	1, 5
Y	09 December 1981 (1981-12-09), column 2, line 7 to column 6, line 14, fig. 1-4	6, 9
Y	JP 2001-287881 A (HITACHI BUILDING SYSTEMS CO., LTD.) 16 October 2001 (2001-10-16), paragraphs [0032]-[0035], fig. 2	6, 9
A	WO 2020/044444 A1 (MITSUBISHI ELECTRIC CORP.) 05 March 2020 (2020-03-05)	1-10
A	US 2014/0367205 A1 (KONE CORPORATION) 18 December 2014 (2014-12-18)	1-10

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<input checked="" type="checkbox"/>	Further documents are listed in the continuation of Box C.	<input checked="" type="checkbox"/>	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	"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
"E"	earlier application or patent but published on or after the international filing date	"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
"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)	"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
"O"	document referring to an oral disclosure, use, exhibition or other means	"&"	document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed		

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Date of the actual completion of the international search 08.12.2020	Date of mailing of the international search report 22.12.2020
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer  Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/039315

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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Information on patent family membersInternational application No.  
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WO 2020/044444 A1	05.03.2020	(Family: none)	
US 2014/0367205 A1	18.12.2014	WO 2013/107932 A1 EP 2804828 A1 FI 20125045 A CN 104066670 A HK 1200156 A1	
JP 8-133634 A	28.05.1996	(Family: none)	

Form PCT/ISA/210 (patent family annex) (January 2015)

**REFERENCES CITED IN THE DESCRIPTION**

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