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(54) ELEVATOR DEVICE

(57) The invention relates to an elevator system in which a hoisting machine (4) is mounted in the vicinity of a top section (3) within a hoistway (1) and at a position close to a side surface side and a rear surface side in the hoistway (1) when viewed from the top, so as not to interfere with a passenger car (7). As a result, there is achieved an elevator system in which the passenger car (7) and the counterweight (8) are arranged in a depthwise direction. The elevator system requires a comparatively small number of parts, a lower cost, and a smaller installation space, entails fewer failures in the event of flooding, and enables sufficient distribution of load, thereby lessening deformation of the car guide rail (9).

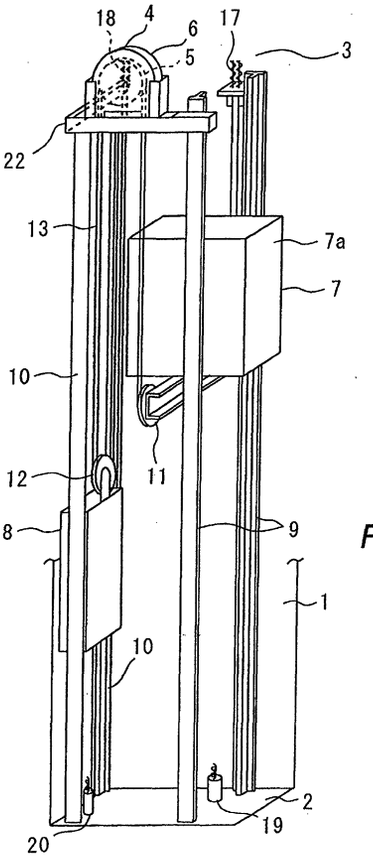

Fig. 1

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Description

THCHNICALE FIELD

[0001] The invention relates to an elevator system which causes a passenger car and a counterweight to ascend and descend by driving a pull rope, and more particularly, to an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction.

BACKGROUND ART

[0002] There has hitherto been known an elevator system in which a counterweight is placed at a rear side of a hoistway—provided that the side of the hoistway with which a door of a passenger car is aligned is taken as a front side.

[0003] A known elevator system will now be described by reference to Fig. 9. Fig. 9 is a schematic perspective view of a known elevator system.

[0004] As illustrated, the elevator system is primarily constituted of a passenger car 7 into which passengers enter by way of a door 7a and which ascends or descends within a hoistway 1; a counterweight 8 which is disposed at a rear side of the hoistway 1 and ascends and descends in the direction opposite the moving direction of the passenger car 7; a pull rope 13 which suspends at one end thereof the passenger car 7 and at the other end thereof the counterweight 8; a hoisting machine 4 which has a drive sheave 5 and a motor section 6 and drives the pull rope 13 extending from the drive sheave 5; two car guide rails 9 for guiding ascending and descending actions of the passenger car 7; and two counterweight guide rails 10 for guiding ascending and descending actions of the counterweight 8.

[0005] The hoisting machine 4 is mounted on a bit (bottom) section 2 within the hoistway 1 by way of a support bench 21 (machinery bench). Installed on the pit section 2 are a shock absorber bench 19 for receiving the load of the passenger car 7 and a shock absorber bench 20 for receiving the load of the counterweight 8.

[0006] A beam member 14 is provided at one side of a top section 3 within the hoistway 1. One end of the beam member 14 is supported by one of the car guide rails 9, and the other end of the same is supported by one of the counterweight guide rails 10, both rails being disposed at one side surface of the hoistway 1. The beam member 14 is provided with a car turnaround pulley 15 for turning, toward the passenger car 7, the pull rope 13 extending from the drive sheave 5; and a weight turnaround pulley 16 for turning, toward the counterweight 8, the pull rope 13 extending from the drive sheave 5.

[0007] Installed on the top section 3 within the hoistway 1 are a car-cable anchoring section 17 for anchoring one end of the pull rope 13 extending from the passenger car 7; and a weight-cable anchoring section 18 for fastening the other end of the pull rope 13 extending from the counterweight 8. The car-cable anchoring section 17 is provided on the remaining car guide rail 9 which does not support the beam member 14, by way of a support member. Further, the weight-cable anchoring section 18 is provided on the remaining counterweight guide rail 10 which does not support the beam member 14, by way of a support member.

[0008] Two car suspension pulleys 11—around which the pull rope 13 extending from the car turnaround pulley 15 is to be passed—are fixed on the bottom section of the passenger car 7. The two car suspension pulleys 11 are arranged on the bottom of the passenger car 7 such that the pull rope 13 passes through a position substantially directly below the centroid of the passenger car 7. The pull rope 13 extending from the car turnaround pulley 15 is extended toward the car-cable anchoring section 17 by way of the two car suspension pulleys 11.

[0009] A counterweight suspension pulley 12 around which the pull rope 13 extending from the weight turnaround pulley 16 is to be passed is secured on a top surface of the counterweight 8. The pull rope 13 extending from the weight turnaround pulley 16 is extended toward the weight-cable anchoring section 18 by way of the weight suspension pulley 12.

[0010] The elevator system having the foregoing construction operates as an elevator system of so-called 2-to-1 rope arrangement. When the hoisting machine 4 is activated, the drive sheave 5 is rotated in a predetermined direction, whereby the pull rope 13 is moved by means of traction (i.e., frictional transmission). Movement of the pull rope 13 is transmitted to the passenger car 7 and the counterweight 8 by way of the car turnaround pulley 15 and the counterweight turnaround pulley 16. As a result, the passenger car 7 and the counterweight 8 are caused to ascend and descend in opposite directions while propagating over a distance half that over which the pull rope 13 moves.

[0011] The foregoing known elevator system has the following drawbacks.

[0012] First, the arrangement of the pull rope 13 is complicated, and the pull rope 13 is long. The number of parts associated with the rope arrangement is large, and hence an installation space of certain extension must be provided within the hoistway 1. Specifically, a first problem of the known elevator system lies in a comparatively high cost and difficulty in achieving space savings.

[0013] In the event of occurrence of flooding, the pit section 2 provided in the hoistway 1 is flooded, and the hoisting machine 4 installed in the pit section 2 may be damaged. In such a case, the damaged hoisting machine 4 is replaced with a new one. In other words, a second problem of the known elevator system lies in difficulty in avoiding submersion of the hoisting machine 4 in the event of flooding.

[0014] The turnaround pulley 15 is placed at a position on the beam member 14 comparatively close to the car

guide rail 9. Hence, the car guide rail 9 is liable to deform under the influence of the weight exerted on the car turnaround pulley 15. If such a deformation has arisen in the car guide rail 9, the ride comfort of the passenger car 7 will be deteriorated. Specifically, a third problem of the known elevator system lies in insufficient layout of a support section in the system, on which the weight of the passenger car 7 and that of the counterweight 8 are exerted.

[0015] Those problems are not negligible for an elevator system intended for reducing an installation space in a direction in which the door of the passenger car 7 is opened and closed (i.e., a widthwise direction); that is, an elevator system in which the passenger car 7 and the counterweight 8 are arranged in a depthwise direction of the hoistway 1 (i.e., a direction orthogonal to the widthwise direction).

[0016] The invention has been conceived to solve the drawbacks set forth and aims at providing an elevator system which involves use of a comparatively small number of parts; which is less expensive; which involves consumption of comparatively small installation space; which avoids occurrence of flooding damage; and which realizes sufficient distribution of load, to thereby prevent deformation of a car guide rail.

DISCLOSURE OF THE INVENTION

[0017] The invention provides an elevator system, wherein a hoisting machine is placed in the vicinity of a top section within a hoistway and at a position close to a side surface side and a rear surface side within the hoistway when viewed from the top, so as not to interfere with a passenger car. As a result, even an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction requires a comparatively small number of parts, lower cost, and a smaller installation space, and enables avoidance of a failure in the event of flooding and sufficient distribution of load so as to reduce deformation of a car guide rail.

[0018] In the improved elevator system of the invention, ahoisting machine is mounted on a support bench supported on a car guide rail and a counterweight guide rail, both rails being placed along one interior side surface of the hoistway, such that a rotational surface of the drive sheave becomes substantially parallel to the side surface. As a result , even an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction requires a comparatively small number of parts, lower cost, and a smaller installation space, and enables avoidance of a failure in the event of flooding and sufficient distribution of load so as to reduce deformation of a car guide rail.

[0019] In the improved elevator system of the invention, a deflector pulley is provided on the support bench for relaying a pull rope extended from the hoisting machine to the passenger car with involvement of a directional change. As a result, even an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction enables the pull cable to pass across a position below the centroid of the passenger car without fail, thereby improving ride comfort of the passenger car.

[0020] In the improved elevator system of the invention, the hoisting machine is supported on the support bench with a damping member sandwiched therebetween. As a result, even an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction enables a reduction in the vibration propagating to the car guide rail from the hoisting machine, thereby improving ride comfort of the passenger car much further.

[0021] In the improved elevator system of the invention, auxiliary support plates support both side surfaces of the hoisting machine with damping members sandwiched between the respective support plates and the side surfaces. As aresult, even an elevator system in which a passenger car and a counterweight are arranged in a depthwise direction enables prevention of horizontal vibration developing in the hoisting machine from propagating to the car guide rail, thereby improving ride comfort of the passenger car much further.

[0022] In the improved elevator system of the invention, a counterweight is provided with a plurality of suspension pulleys. As a result, even an elevator system in which a large-sized passenger car and a large-sized counterweight are arranged in a depthwise direction enables ascending and descending of the counterweight in a stable attitude.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a schematic perspective view showing a first preferred elevator system of the invention;
Fig. 2 is a schematic top view of the elevator system shown in Fig. 1;
Fig. 3 is a fragmentary enlarged view of the vicinity of a hoisting machine of the elevator system shown in Fig. 1;
Fig. 4 is a fragmentary enlarged view of the vicinity of the hoisting machine of the elevator system shown in Fig. 2;
Fig. 5 is a schematic perspective view showing a second preferred elevator system of the invention;
Fig. 6 is a schematic top view of the elevator system shown in Fig. 5;
Fig. 7 is a schematic perspective view showing a third preferred elevator system of the invention;
Fig. 8 is a schematic top view of the elevator system shown in Fig. 7; and
Fig. 9 is a schematic perspective view showing a known elevator system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0024] The invention will be described in more detail by reference to the accompanying drawings.

[0025] An elevator system according to a first embodiment of the invention will be described by reference to Figs. 1 through 4. Fig. 1 is a schematic perspective view showing an elevator system according to a first embodiment of the invention.

[0026] As shown in Fig. 1, an elevator system is primarily constituted of a passenger car 7 into which passengers enter by way of a door 7a and which ascends and descends within a hoistway 1; a counterweight 8 which is disposed on the rear side of the hoistway 1 and ascends and descends in the direction opposite that in which the passenger car 7 moves; a pull rope 13 which suspends at one end thereof the passenger car 7 and at the other end thereof the counterweight 8; a hoisting machine 4 which is equipped with a drive sheave 5 and a motor section 6 and drives the pull rope 13 while the pull rope 13 is passed around the drive sheave 5; two car guide rails 9 for guiding ascending and descending movements of the passenger car 7; and two counterweight guide rails 10 for guiding ascending and descending movements f the counterweight 8.

[0027] Here, a car shock absorber 19 for receiving the load of the passenger car 7 and a weight shock absorber 20 for receiving the load of the counterweight 8 are provided on a pit section 2 within the hoistway 1.

[0028] The hoisting machine 4 is mounted on a top section 3 within the hoistway 1 by way of a support bench 22. Specifically, when viewed from the front (or side), the hoisting machine 4 is mounted at an upper-limit position within the ascending-and-descending range of the passenger car 7 or at a position higher than that position.

[0029] One end of the support bench 22 of the top section 3 within the hoistway 1 is supported by one of the car guide rails 9, and the other end of the same is supported by one of the counterweight guide rails 10, both guide rails being disposed along one side surface of the hoistway 1. The internal surface of the hoistway 1 opposing the door 7a of the passenger car 7 is taken as a front surface.

[0030] A car-cable anchoring section 17 and a weight-cable anchoring section 18 are provided on the top section 3 within the hoistway 1. The car-cable anchoring section 17 anchors one end of the pull rope 13 extending from the passenger car 7, and the weight-cable anchoring section 18 anchors the other end of the pull rope 13 extending from the counterweight 8. The car-cable anchoring section 17 is mounted on the remaining car guide rail 9 which does not support the support bench 22, by way of a support member. The weight-cable anchoring section 18 is mounted on the remaining counterweight guide rail 10 which does not support the support bench 22, by way of a support member.

[0031] Two car suspension pulleys 11 around which the pull rope 13 extending from the drive sheave 5 is to be passed are fastened to the bottom of the passenger car 7. The two car suspension pulleys 11 are arranged on the bottom of the passenger car 7 such that the pull rope 13 passes through a position substantially directly below the centroid of the passenger car 7. The pull rope 13 extending from the drive sheave 5 is extended toward the car-cable anchoring section 17 byway of the two car suspension pulleys 11.

[0032] A counterweight suspension pulley 12 around which the pull rope 13 extending from the drive sheave 5 is to be passed is secured on a top surface of the counterweight 8. The pull rope 13 extending from the drive sheave 5 is extended toward the weight-cable anchoring section 18 by way of the weight suspension pulley 12.

[0033] As mentioned above, the elevator system of the embodiment avoids submersion of the hoistingmachine 4, which would otherwise occur in the event of flooding, by placement of the hoisting machine 4 in the vicinity of the top section 3 of the hoistway 1. The pull rope 13 is passed directly around the car suspension pulley 11 of the passenger car 7 and directly around the weight suspension pulley 12 of the counterweight 8. The pull rope 13 becomes shorter, and members such as turnaround pulleys become obviated. Hence, there can be provided a low- cost elevator system involving use of fewer parts.

[0034] Fig. 2 is a schematic top view of the elevator system shown in Fig. 1.

[0035] As shown in Fig. 2, when the elevator system shown in Fig. 1 is viewed from top (or from the top section 3), the hoisting machine 4 is disposed at a position along a side surface 1c and closer to the rear surface 1b within the hoistway 1 as well as outside a projected area of the passenger car 7. Here, the projected area of the passenger car 7 means the range of the passenger car 7 in the drawing. The rear surface 1b and the side surface 1c within the hoistway 1 are defined while the side of the hoistway 1 facing the door 7a of the passenger car 7 is taken as a front surface 1a.

[0036] The hoisting machine 4 is disposed such that a motor section 6 is placed close to the side surface 1c and such that the drive sheave 5 is placed close to the passenger car 7. The rotational center axis of the drive sheave 5 is set so as to become substantially orthogonal to the side surface 1c within the hoistway 1. As in the case of the hoisting machine 4, the support bench 22 is disposed at a position along the side surface 1c and closer to the rear surface 1b within the hoistway 1 as well as outside a projected area of the passenger car 7. In this way, the hoisting machine 4 is formed so as to assume a comparatively lower profile in the direction of the rotational center axis so that the machine can be placed in a clearance defined between the passenger car 7 and the side surface 1c of the hoistway 1 in the widthwise direction thereof.

[0037] The drive sheave 5 of the hoisting machine 4 and the weight suspension pulley 12 of the counterweight 8 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 crosses another plane in which the pull rope 13 is passed around the weight suspension pulley 12 when viewed from the top. The pull rope 13 is extended from the drive sheave 5 to the weight suspension pulley 12 in avertical direction. Moreover, thedrive sheave 5 of the hoisting machine 4 and one of the car suspension pulleys 11 of the passenger car 7 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 crosses another plane in which the pull rope 13 is passed around the car suspension pulley 11 when viewed from the top. Specifically, the pull rope 13 is extended from the drive sheave 5 to the car suspension pulley 11 in a vertical direction. Further, the two car suspension pulleys 11 of the passenger car 7 are placed in positions close to a diagonal line of the passenger car 7 when viewed from the top. Specifically, the pull rope 13 passes through a position substantially directly below the centroid of the passenger car 7, on the bottom thereof.

[0038] As mentioned above, the elevator system of the first embodiment has the hoisting machine 4 spaced apart from the car guide rail 9, thereby diminishing the load exerted on the car guide rail 9. Hence, there can be prevented deformation of the car guide rail 9, which would otherwise be caused by the load of the passenger car 7 and that of the counterweight 8.

[0039] Fig. 3 is a fragmentary enlarged view of the vicinity of the hoisting machine of the elevator system shown in Fig. 1. Fig. 4 is a fragmentary enlarged view of the vicinity of the hoisting machine of the elevator system shown in Fig. 2 (i.e., the top view corresponding to Fig. 3).

[0040] As shown in Figs. 3 and 4, the hoisting machine 4 is mounted on the support bench 22 via a damping member 25. Here, the damping member 25 is formed from, e.g., anti-vibration rubber, andabsorbs vertical (heightwise) vibration energy which propagates directly from the hoisting machine 4 to the support member 22. An auxiliary support plate 24 for supporting the side surface of the hoisting machine 4 parallel to the rotational center axis of the drive sheave 5 is provided on either side of the hoisting machine 4 via a damping member 23. The damping member 23 is formed from, e.g., anti-vibration rubber, and absorbs vibration developing in a direction extending between side surfaces (i. e., a horizontal direction) produced by driving of the hoisting machine 4.

[0041] As shown in Fig. 4, the car guide rail 9 supports the support bench 22 via a removable clipping member. The counterweight guide rail 10 supports the support member via a removable clipping member 10a.

[0042] As mentioned above, the elevator system of the first embodiment can effectively absorb the vibration produced by driving of the hoisting machine 4 mounted at the top section in the hoistway 1. Hence, vibration propagating to the passenger car 7 by way of the car guide rail 9 can be dampened, thereby providing an elevator system in which the passenger car 7 provides superior ride comfort.

[0043] The elevator system having the foregoing construction operates as an elevator of so-called 2-to-1 rope arrangement. Specifically, when the hoisting machine 4 is driven, the drive sheave 5 rotates in a predetermined direction, whereby the pull rope 13 is moved by means of traction. Movement of the pull rope 13 is transmitted to the passenger car 7 and the counterweight 8. As a result, the passenger car 7 and the counterweight 8 ascend and descend in opposite directions while propagating across a distance half that across which the pull rope 13 moves.

[0044] As has been described, the elevator system of the first embodiment requires use of fewer parts and has a comparatively simple construction. Hence, there can be provided an elevator system which requires a smaller installation space; particularly, a smaller installation space in a widthwise direction. Further, the hoisting machine 4 is mounted at a position in the proximity to the top section 3 of the hoistway 1 and spaced from the car guide rail 9. Consequently, there can be provided an elevator system which entails occurrence of fewer failures in the event of flooding and less deformation of the car guide rail 9 and which provides superior reliability and ride comfort. Further, vibration produced by driving of the hoisting machine 4 can be reduced effectively, and hence there can be provided an elevator system in which the passenger car 7 provides superior ride comfort.

[0045] An elevator system according to a second embodiment of the invention will be described by reference to Figs. 5 and 6. Fig. 5 is a schematic perspective view showing an elevator system of the second embodiment. A major structural difference between the first and second embodiments lies in that a deflector pulley 28 is interposed between the hoisting machine 4 and the passenger car 7.

[0046] As shown in Fig. 5, as in the case of the first embodiment, the elevator system primarily comprises the passenger car 7, the counterweight 8, the pull rope 13, the hoisting machine 4 having the drive sheave 5, the car guide rails 9, and the counterweight guide rails 10.

[0047] The hoisting machine 4 is mounted on the top section 3 within the hoistway 1 bywayof the support bench 22. Specifically, when viewed from front, the hoisting machine 4 is mounted at an upper limit position within the range of ascending and descending movement of the passenger car 7 or a position higher than that position. Both sides of the hoisting machine 4 are supported by the auxiliary support plates 24 mounted on the support bench 22 by way of a damping member which absorbs horizontal vibration of the hoisting machine 4.

[0048] One end of the support bench 22 of the top section 3 within the hoistway 1 is supported by one of the car guide rails 9, and the other end of the same is supported by one of the counterweight guide rails 10, both guide rails being disposed along one side surface of the hoistway 1.

[0049] The deflector pulley 28 is mounted on the support bench 22 of the top section 3 at a position closer to the car guide rail 9 than to the location of the hoisting machine 4. The deflector pulley 28 relays the pull rope 13 passed around the drive sheave 5 to the car suspension pulley 11 of the passenger car 7. Specifically, the pull rope 13 passed around the drive sheave 5 is extended toward the deflector pulley 28 diagonally with respect to the vertical direction. The direction of the pull rope 13 passed around the deflector pulley 28 is changed by the deflector pulley 28, and the pull rope 13 is extended to the car suspension pulley 11 in a vertical direction. The pull rope 13 passes across the bottom of the passenger car 7 and is extended toward the car-cable anchoring section 17. The end of the pull rope 13 is supported by the car anchoring section 17.

[0050] Fig. 6 is a schematic top view of the elevator system shown in Fig. 5.

[0051] As shown in Fig. 6, the hoisting machine 4 is mounted at a position closer to the side surface 1c and to the rear surface 1b within the hoistway 1 as well as outside the projected area of the passenger car 7 when the elevator system shown in Fig. 5 is viewed from the top.

[0052] The hoisting machine 4 is mounted such that the drive sheave 5 is located close to the passenger car 7 and such that the rotational center axis of the drive sheave 5 is substantially orthogonal to the side surface 1c. The drive sheave 5 and the weight suspension pulley 12 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 crosses another plane in which the pull rope 13 is passed around the weight suspension pulley 12 when viewed from the top. The pull rope 13 is extended from the drive sheave 5 to the weight suspension pulley 12 in a vertical direction. Moreover, the drive sheave 5 and the deflector pulley 28 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 becomes parallel to another plane in which the pull rope 13 is passed around the deflector pulley 28 when viewed from the top. Specifically, the pull rope 13 is extended from the drive sheave 5 to the deflector pulley 28 in a diagonal direction. The deflector pulley 28 and one of the car suspension pulleys 11 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 crosses another plane in which the pull rope 13 is passed around the cart suspension pulley 11 when viewed from the top. The pull rope 13 is extended from the drive sheave 5 to the car suspension pulley 11 in a vertical direction. The pull rope 13 passed around the two car suspension pulleys 11 passes across substantially the position of centroid of the passenger car 7.

[0053] As mentioned above, in the elevator system of the second embodiment, the pull rope 13 can be extended so as to pass across a position below the centroid of the passenger car 7 without fail, by use of the deflector pulley 28 even when the passenger car 7 is long in a depthwise direction.

[0054] The elevator system having the foregoing construction operates in the following manner as in the case of the first embodiment. When the hoisting machine 4 is driven, the drive sheave 5 is rotated in a predetermined direction, whereby the pull rope 13 is moved by means of traction. Movement of the traction rope 13 is transmitted to the passenger car 7 via the deflector pulley 28 and directly to the counterweight 8. As a result, the passenger car 7 and the counterweight 8 are caused to ascend and descend in opposite directions.

[0055] As has been described, the elevator system of the second embodiment requires use of fewer parts and has a comparatively simple construction, as in the case of the first embodiment. Hence, there can be provided an elevator system which is low cost, requires a smaller installation space, entails occurrence of fewer failures in the event of flooding and less deformation of the car guide rail 9, and provides superior reliability and ride comfort. As a result of use of the deflector pulley 28, the degree of freedom of rope arrangement of the pull rope 13 extending from the hoisting machine 4 to the passenger car 7 is improved. Hence, the pull cable can pass across a position below the centroid of the passenger car 7 having a floor area. As a result, the passenger car 7 is caused to ascend and descend in a balanced manner while being guided by the car guide rails 9. Therefore, there can be provided an elevator system in which the passenger car 7 provides good ride comfort.

[0056] An elevator system of a third embodiment of the invention will now be described by reference to Figs. 7 and 8. Fig. 7 is a schematic perspective view showing an elevator system of the third embodiment. The third embodiment greatly differs from the first embodiment in that the counterweight 8 is provided with a plurality of weight suspension pulleys 12.

[0057] As shown in Fig. 7, as in the case of the first embodiment, the elevator system primarily comprises the passenger car 7, the counterweight 8, the pull rope 13, the hoisting machine 4 having the drive sheave 5, the car guide rails 9, and the counterweight guide rails 10.

[0058] As in the case of the foregoing embodiments, the hoisting machine 4 is mounted on the top section 3 within the hoistway 1 by way of the support bench 22. One end of the support bench 22 is supported by the car guide rail 9, and the other end of the same is supported by the counterweight guide rail 10, both being provided along one side surface of the hoistway 1.

[0059] Moreover, the weight-cable anchoring section 18 for anchoring one end of the pull rope 13 fastened to the counterweight 8 is provided at the top section 3 within the hoistway 1. Here, the weight-cable anchoring sec-

tion 18 is placed on the remaining counterweight guide rail 10 which does not support the support bench 22, by way of a support member.

[0060] As in the case of the embodiments, two car suspension pulleys 11 around which the pull rope 13 extending from the drive sheave 5 is to be passed are fixed on the bottom of the passenger car 7.

[0061] Two weight suspension pulleys 12 around which the pull rope 13 extending from the drive sheave 5 is to be passed are fixed on the upper surface of the counterweight 8. The pull rope 13 extending from the drive sheave 5 is extended toward the weight-anchoring section 18 by way of the two weight suspension pulleys 12.

[0062] Fig. 8 is a schematic top view of the elevator system shown in Fig. 7.

[0063] As shown in Fig. 8, the hoisting machine 4 is mounted at a position close to the side surface 1c and the rear surface 1b within the hoistway 1 and outside the projection area of the passenger car 7 when the elevator system shown in Fig. 7 is viewed from the top.

[0064] The hoisting machine 4 is mounted such that the drive sheave 5 is located close to the passenger car 7 and such that the rotational center axis of the drive sheave 5 is substantially orthogonal to the side surface 1c. The drive sheave 5 and one of the weight suspension pulleys 12 are arranged such that a plane in which the pull rope 13 is passed around the drive sheave 5 crosses another plane in which the pull rope 13 is passed around the weight suspension pulley 12 when viewed from the top. The pull rope 13 is extended from the drive sheave 5 to one of the weight suspension pulleys 12 in a vertical direction. Moreover, the two weight suspension pulleys 12 are provided on the counterweight 8 such that the planes in which the pull rope 13 is passed around the two weight suspension pulleys 12 become substantially parallel to each other. In other words, the pull rope 13 is extended in a horizontal direction from one weight suspension pulley 12 to another weight suspension pulley 12.

[0065] As mentioned above, even when the counterweight 8—which is large in a direction in which the two counterweight-guide rails 10 are spaced apart from each other—is used, a plurality of weight-suspension pulleys 12 are provided on the counterweight 8, and the pull rope 13 is passed around the pulleys 12, thereby enabling balanced suspension of the counterweight 8.

[0066] The elevator system having the foregoing construction operates in the same manner as in the respective embodiments. When the hoisting machine 4 is driven, the drive sheave 5 is rotated in a predetermined direction, whereby the pull rope 13 is moved through traction. Movement of the pull rope 13 is transmitted to the passenger car 7 and the counterweight 8. As a result, the passenger car 7 and the counterweight 8 are caused to ascend and descend in opposite directions.

[0067] As has been described, as in the case of the first embodiment, the elevator system of the third embodiment enables provision of an elevator which is low cost; which requires a smaller installation space; which prevents a failure in the event of flooding; which requires fewer deformation of the car guide rails 9; and which provides high reliability and good ride comfort. Further, as a result of use of the plurality of weight-suspension pulleys 12, there can be provided an elevator system which enables balanced ascending and descending movement of the large-sized, heavy counterweight 8.

[0068] It is obvious that the invention is not limited to the embodiments and susceptible to modifications other than those suggested in the embodiments, as required, within the technical scope of the invention. The number, positions, and geometries of the constituent members are not limited to those mentioned in the embodiments. The preferred number, positions, and geometries may be assumed in carrying out the invention. Throughout the drawings, like constituent elements are assigned like constituent reference numerals.

INDUSTRIAL APPLICABILITY

[0069] As has been described, in the elevator system of the invention, a hoisting machine is disposed in the vicinity of the top section within a hoistway and at a position close to a side surface and a rear surface within the hoistway when viewed from the top so as not to interfere with a passenger car. The elevator system is useful as an elevator which requires a comparatively small number of parts, low cost, and a smaller installation space; which enables avoidance of a failure in the event of flooding and occurrence of little deformation of a car guide rail; and in which a passenger car and a counterweight are arranged in a depthwise direction.

[0070] In the elevator system of the invention, a hoisting machine is mounted on a support bench supported on a car guide rail and a counterweight guide rail, both rails being placed along one interior side surface of the hoistway, such that a rotational surface of the drive sheave becomes substantially parallel to the side surface. Hence, the elevator system is useful as an elevator which requires a comparatively small number of parts, a low cost, and a smaller installation space; which enables avoidance of a failure in the event of flooding and occurrence of little deformation of a car guide rail; and in which a passenger car and a counterweight are aligned with each other in a depthwise direction.

[0071] In the elevator system of the invention, a deflector pulley is provided on the support bench for relaying a pull rope extended from the hoisting machine to the passenger car with involvement of a directional change. As a result, the pull cable can pass across a position located below the centroid of the passenger car without fail. The elevator system is useful as an elevator equippedwith a passenger car which provides superior ride comfort and has a large floor area as a result of the passenger car and the counterweight being arranged in a depthwise direction.

[0072] In the elevator system of the invention, the hoisting machine is supported on the support bench with a damping member sandwiched therebetween. As a result, the vibration propagating to the car guide rail from the hoisting machine is reduced. The elevator system is useful as an elevator which provides much superior ride comfort and in which the passenger car and the counterweight are arranged in a depthwise direction.

[0073] In the elevator system of the invention, auxiliary support plates support both side surfaces of the hoisting machine with damping members sandwiched between the respective support plates and the side surfaces. As a result, horizontal vibration developing in the hoisting machine does not propagate to the car guide rail. Thus, the elevator system is useful as an elevator which provides much superior ride comfort and in which the passenger car and the counterweight are arranged in a depthwise direction.

[0074] In the elevator system of the invention, a counterweight is provided with a plurality of suspension pulleys. As a result, the elevator system is useful as an elevator which causes a large-sized, heavy counterweight corresponding to a large-sized passenger car to ascend and descend in a stable attitude and in which the passenger car and the counterweight are arranged in a depthwise direction.

Claims

1. An elevator system having:

a passenger car which is caused to ascend and descend within a hoistway while being guided by a plurality of car guide rails;
a counterweight which is guided by a plurality of counterweight guide rails and caused to ascend and descend along a rear surface side of the inside of the hoistway while a side of the hoistway opposing a door of the passenger is taken as a front side; and
a hoisting machine which is mounted in the hoistway, which causes the passenger car and the counterweight to ascend and descend in opposite directions by means of driving the pull rope through rotation of the drive sheave, the pull rope suspending at one end thereof the passenger car and at the other end thereof the counterweight and a part of the pull rope being passed around the rotatable drive sheave, wherein
the hoisting machine is placed at an upper-limit position within the range of ascending and descending movement of the passenger car or at a position higher than that when viewed from the front and outside a projection area of the passenger car, the position being close to a side surface side and a rear surface side in the hoistway when viewed from the top.

2. The elevator system according to claim 1, wherein one of the plurality of car guide rails and one of the plurality of counterweight guide rails are placed along a side surface within the hoistway; and
the hoisting machine is mounted on a support bench supported by the car guide rail and the counterweight guide rail, both rails being placed along a side surface side in the hoistway such that a rotational center axis of the drive sheave becomes substantially orthogonal to the side surface in the hoistway.

3. The elevator system according to claim 2, wherein the support bench is further provided with a deflector pulley for relaying the pull rope passed around the drive sheave of the hoisting machine toward the passenger car.

4. The elevator system according to claim 2 or 3, wherein the hoisting machine is mounted on the support bench via a damping member for absorbing vibration stemming from driving of the hoisting machine.

5. The elevator system according to claim 4, wherein the support bench has auxiliary support plates for supporting both side surfaces of the hoisting machine parallel to the rotational center axis of the drive sheave; and the auxiliary support plates support the hoisting machine via a damping member for absorbing vibration developing in a direction extending between side surfaces of the hoisting machine stemming from driving of the hoisting machine.

6. The elevator system according to any one of claims 1 through 5, wherein the counterweight has a plurality of suspension pulleys around which the pull rope extending from the drive sheave of the hoisting machine are to be passed.

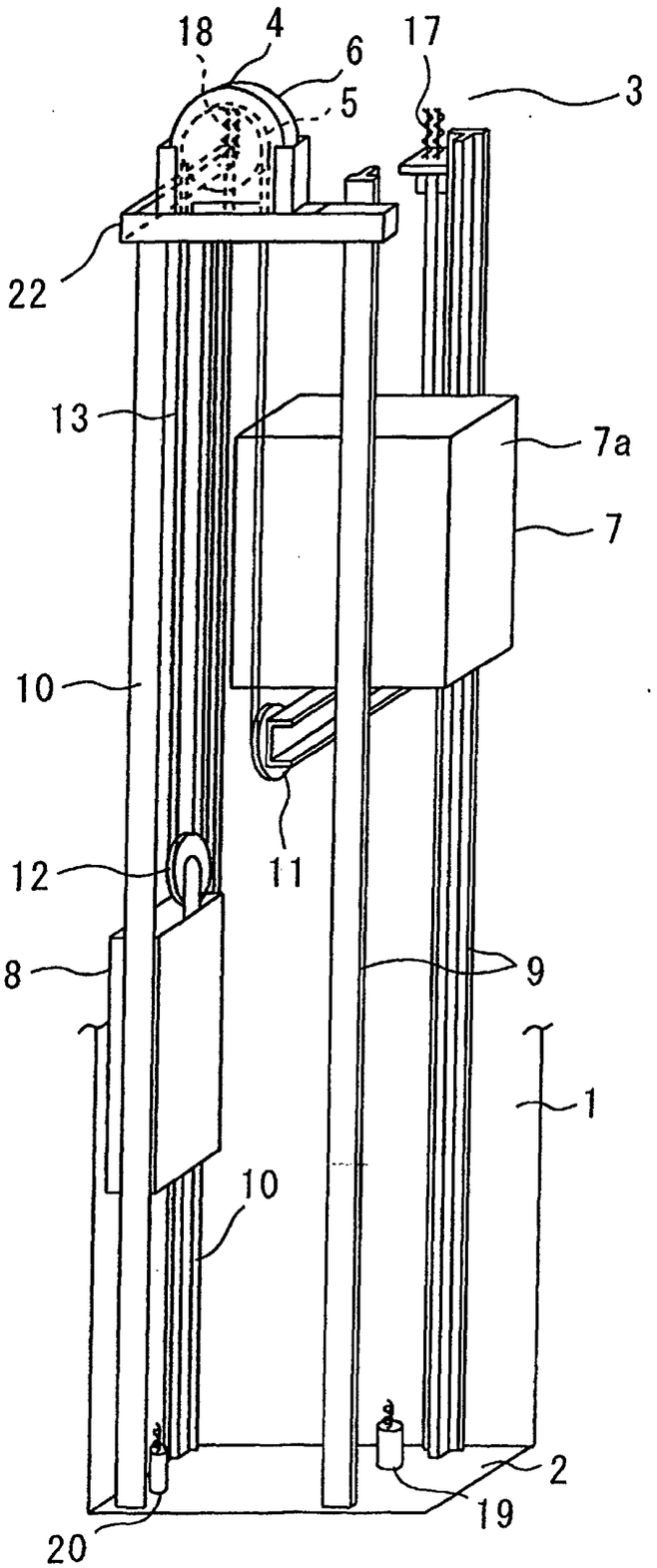
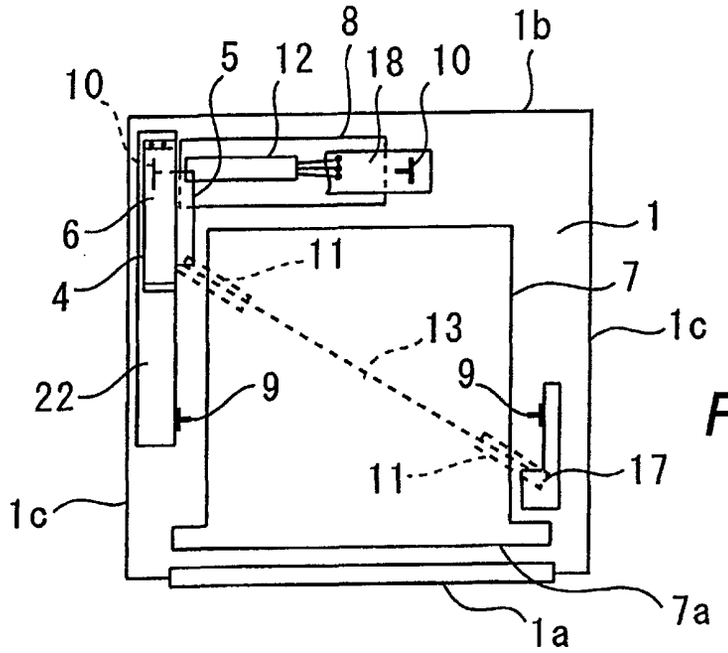


Fig. 1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1a

Fig. 2

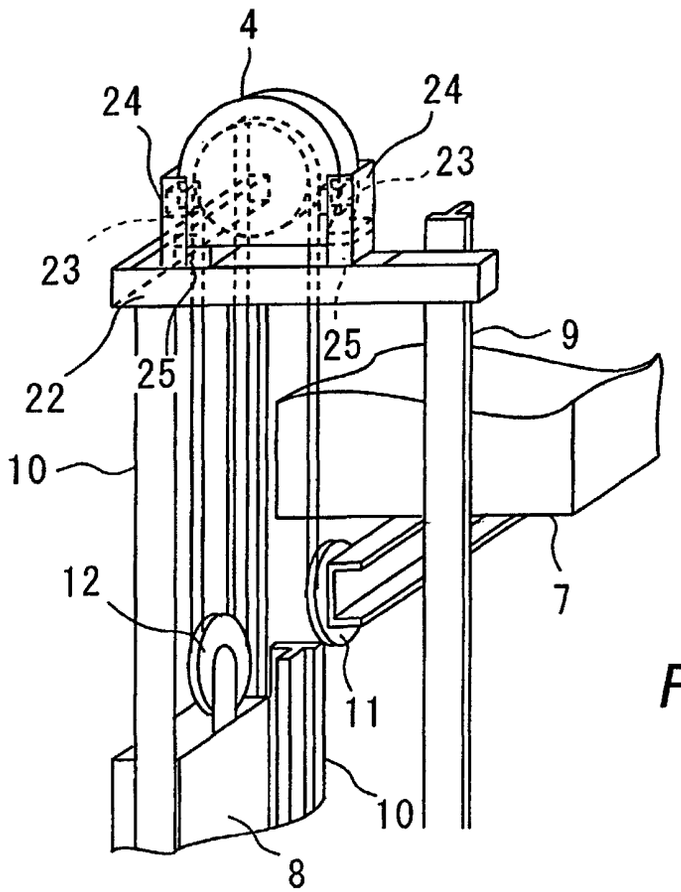
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Fig. 3

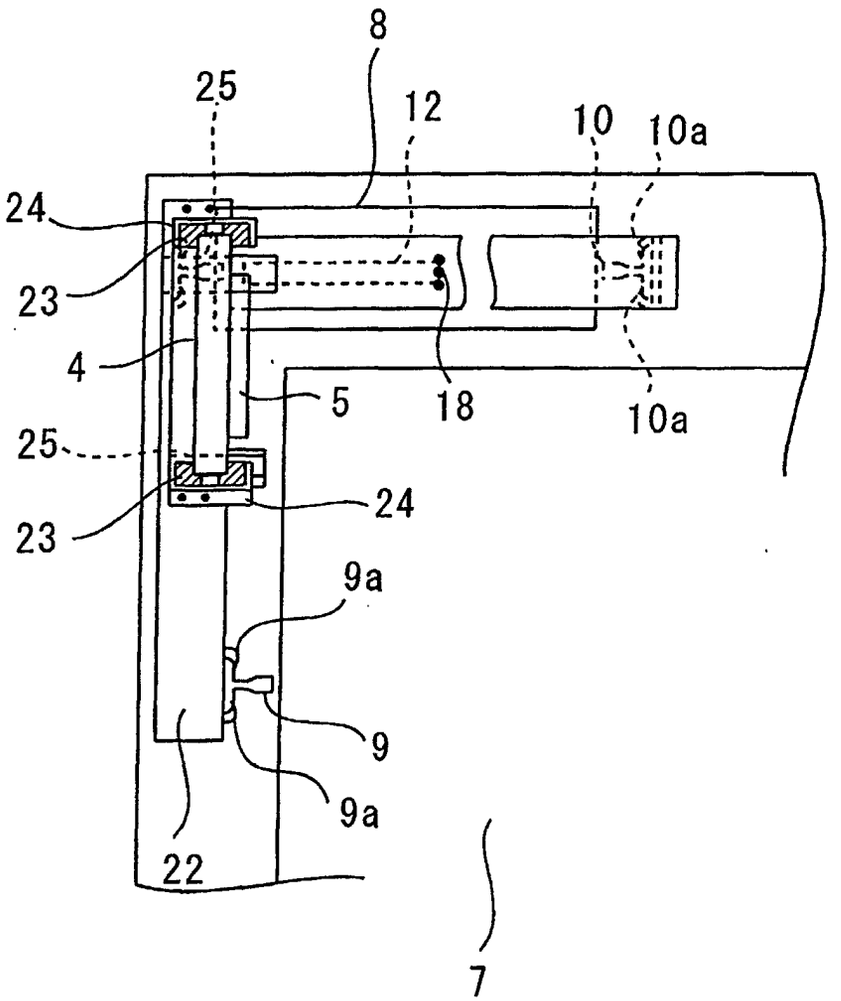

Fig. 4

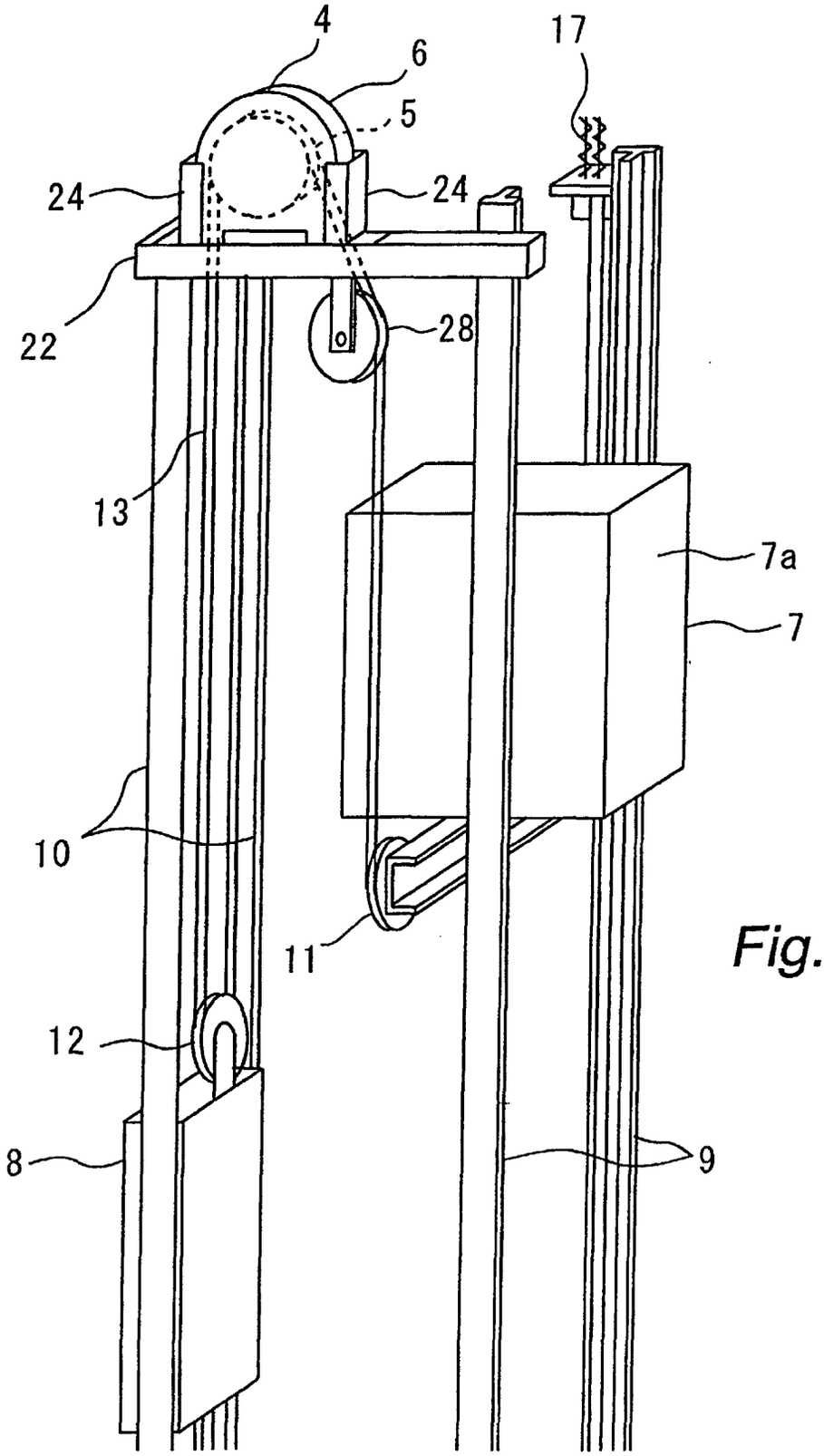

Fig. 5

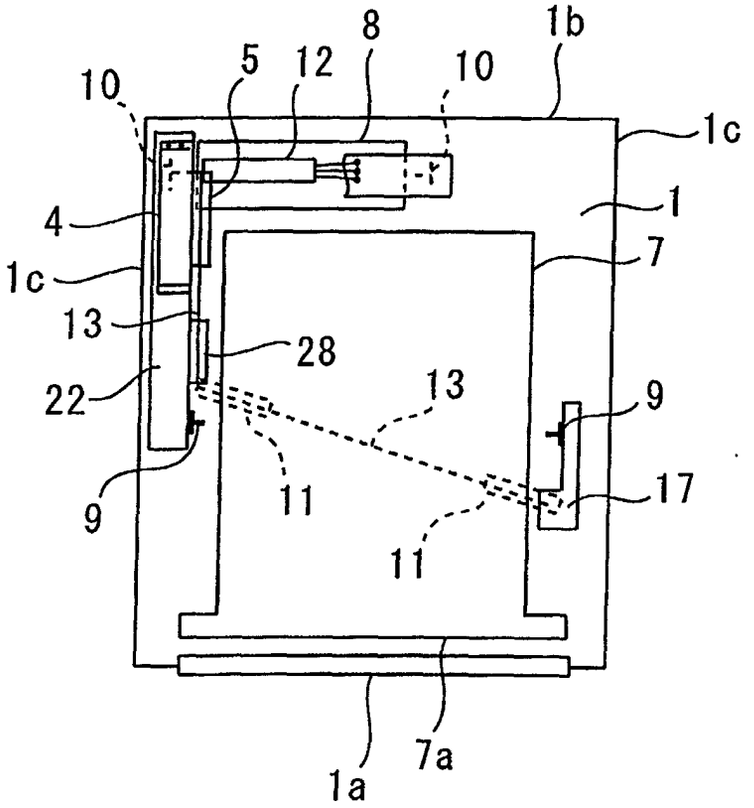

Fig. 6

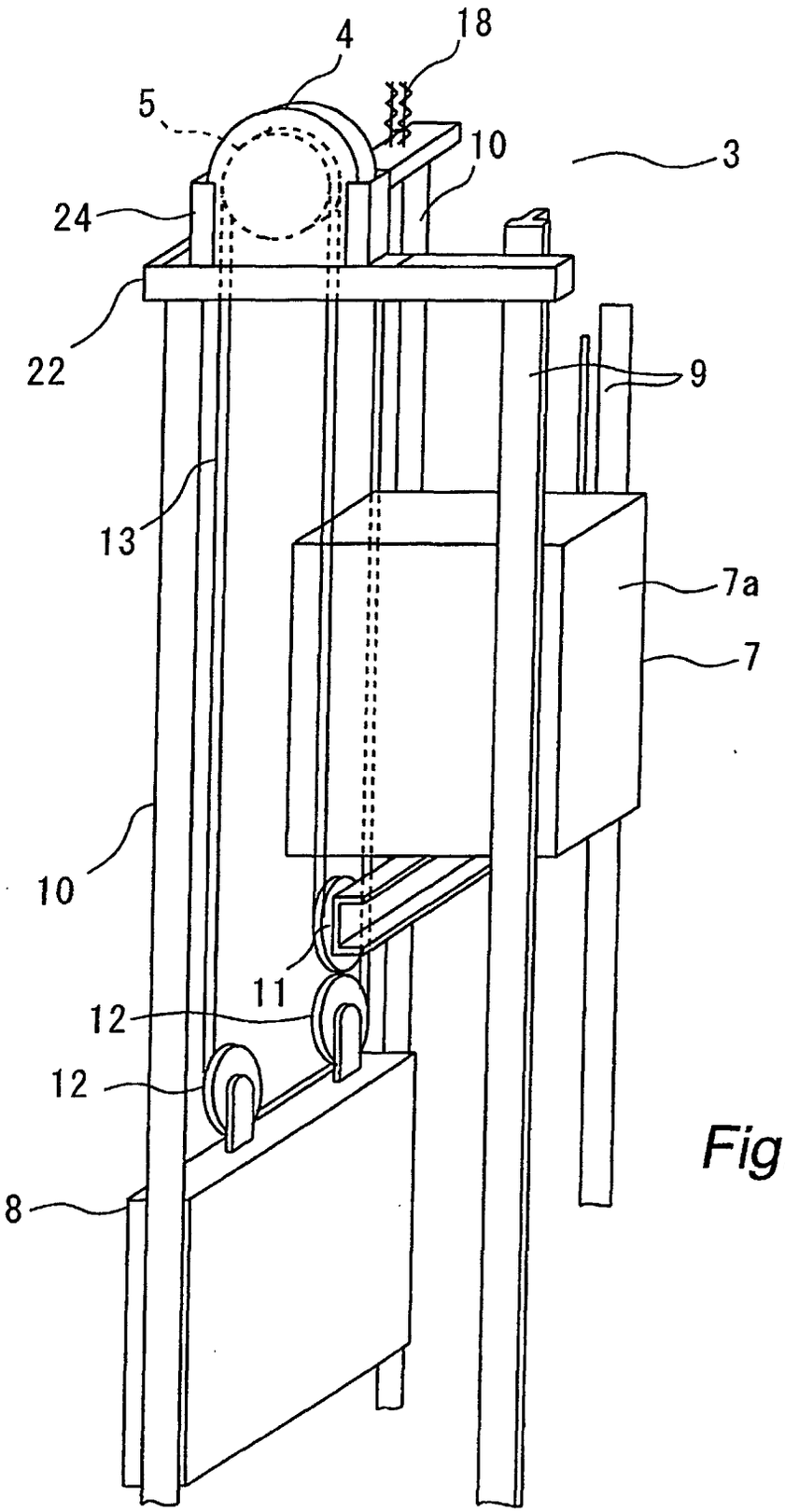

Fig. 7

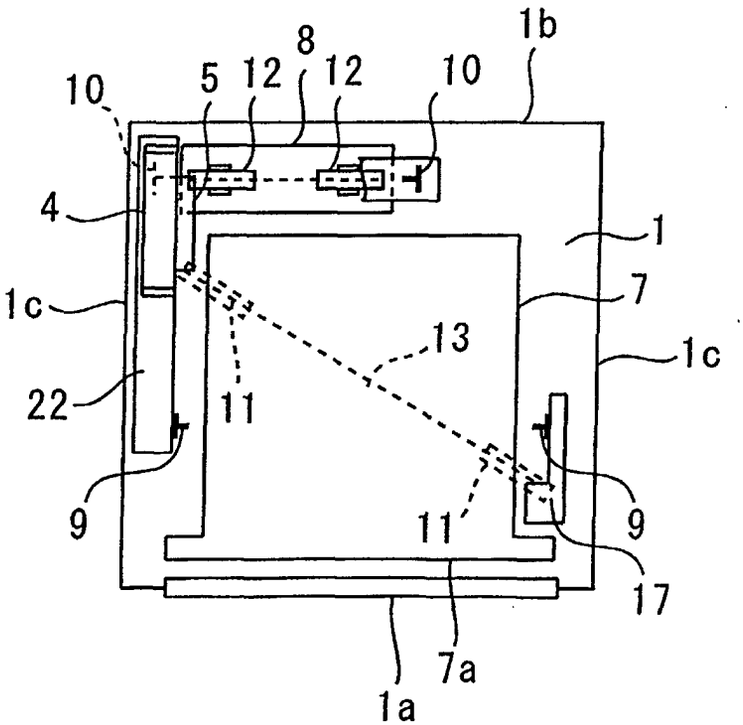

Fig. 8

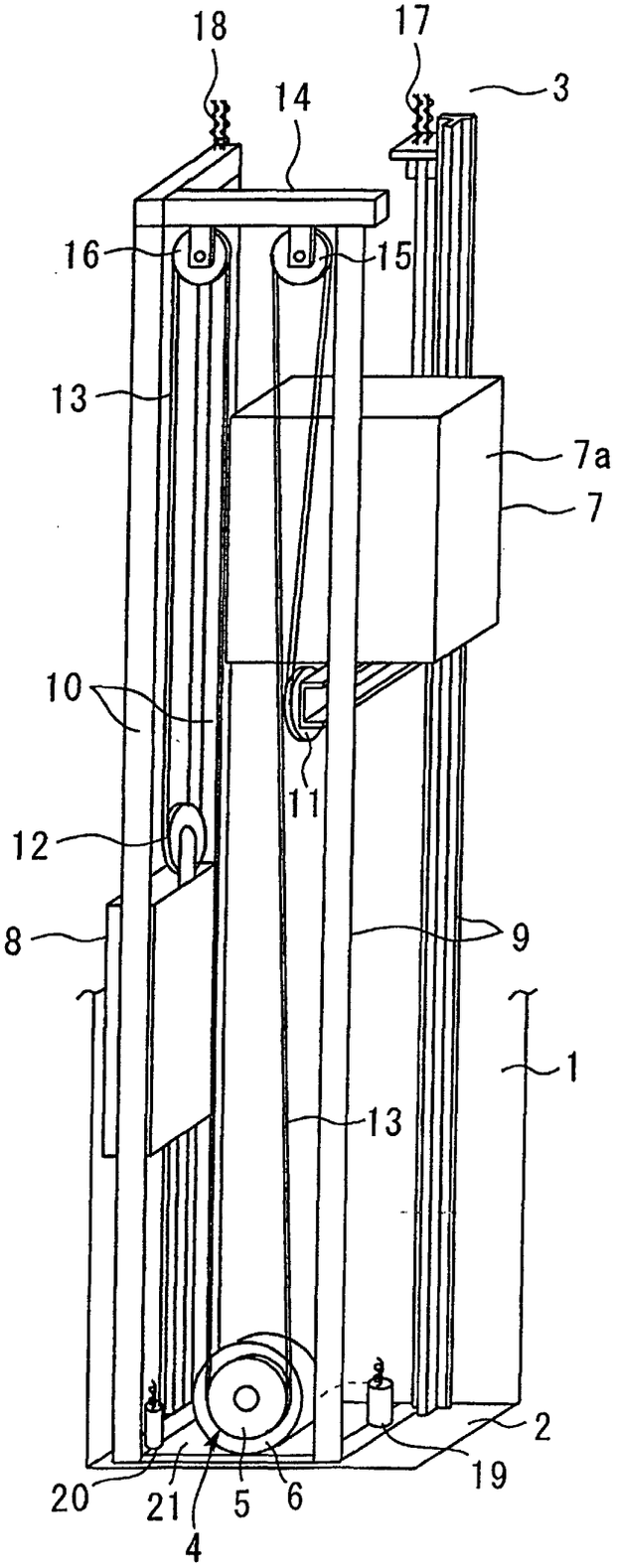

Fig. 9

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/05993

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B7/00, B66B11/04, B66B11/08

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-B66B11/08

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 Y	JP, 10-182041, A (Otis Elevator Co.), 07 July, 1998 (07.07.98), & EP 0849209 A1 & US 5899300 A	1 2,4-6
Y	JP, 2000-318948, A (Toshiba Corp.), 21 November, 2000 (21.11.00), (Family: none)	2,4-5
Y	JP, 2000-153973, A (Nippon erebeta Seizo K.K.), 06 June, 2000 (06.06.00), (Family: none)	4-5
X Y	JP, 2000-318946, A (Toshiba Corp.), 21 November, 2000 (21.11.00), (Family: none)	1,6 6
E,X	JP, 2001-261257, A (Mitsubishi Electric Corp.), 26 September, 2001 (26.09.01), (Family: none)	1-3

☐ Further documents are listed in the continuation of Box C. ☐ See patent family annex.

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"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
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"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	Date of mailing of the international search report
26 March, 2002 (26.03.02)	09 April, 2002 (09.04.02)
Name and mailing address of the ISA/ Japanese Patent Office Facsimile No.	Authorized officer Telephone No.

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