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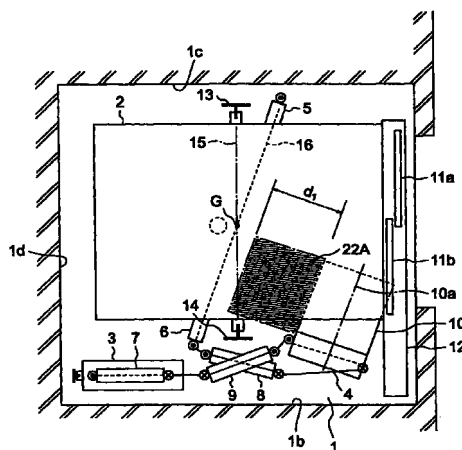
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(54) **ELEVATOR**

(57) In an elevator apparatus, a hoisting machine is provided at the bottom part of a hoistway. A straight line connecting a pair of car guide rails together passes the center of gravity of a car or the vicinity thereof when viewed from a vertical projection plane. A straight line connecting a pair of car suspension sheaves together diagonal with respect to the straight line between the car guide rails so as to intersect it at the center of gravity of the car or in the vicinity thereof. Thus, a maintenance area for the hoisting machine is provided on side of the straight line connecting the car suspension sheaves together.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which a hoisting machine is disposed on the bottom part of a hoistway.

BACKGROUND ART

[0002] Fig. 5 is a front view showing one example of a conventional elevator apparatus. Fig. 6 is a plan view showing the elevator apparatus shown in Fig. 5. Fig. 7 is an explanatory view showing the route of a rope of the elevator apparatus of Fig. 5 in a developing manner.

[0003] In the figures, the hoistway 1 of the elevator apparatus has a bottom part 1a, first and second side walls 1b and 1c facing each other, and a third side wall (back wall) 1d perpendicular to the first and second side walls 1b and 1c. In the hoistway 1, a car 2 and a counterweight 3 are suspended by a rope 4. A pair of car suspension sheaves 5 and 6 are provided in the lower part of the car 2. A counterweight suspension sheave 7 is provided on the upper part of the counterweight 3. In the upper part of the hoistway 1, first and second return pulleys 8 and 9 are provided.

[0004] On the bottom part 1a of the hoistway 1 a hoisting machine 10 is installed for alternately moving the car 2 and the counterweight 3 up and down with the rope 4. A part of the hoisting machine 10 overlaps the car 2 in a vertical projection plane as shown in Fig. 6. Further, the hoisting machine 10 is arranged so that its axis 10a extends along the direction intersecting at right angles with the first and second side walls 1b and 1c.

[0005] One end part 4a and the other end part 4b of the rope 4 are fixed to upper parts in the hoistway 1, respectively. As illustrated in Fig. 7, the rope 4 is successively wound around the car suspension sheaves 5 and 6, the first return pulley 8, the hoisting machine 10, the second return pulley 9 and the counterweight suspension sheave 7, from the one end part 4a side in the order stated.

[0006] Further, as shown in Fig. 6, the car 2 is provided with car doors 11a and 11b and a car sill 12 for guiding the opening and closing of the car doors 11a and 11b. The car 2 is moved up and down while being guided by a pair of guide rails 13 and 14 provided upright in parallel in the hoistway 1. The pair of car guide rails 13 and 14 are arranged so that a straight line 15 between the rails for connecting them together passes the center of gravity G of the car 2 or the vicinity thereof, when viewed from the vertical projection plane. This is to prevent a large eccentric load from being applied to the guide rails 13 and 14.

[0007] For the same reason, a pair of car suspension sheaves 5 and 6 are also arranged so that a straight line 16 connects the suspension sheaves together. In other words, the part of the rope 4 passing

through the lower part of the car 2 passes the center of gravity G or the vicinity thereof, when viewed from the vertical projection plane. Thus, in order to keep the car guide rails 13 and 14 from interfering with the car suspension sheaves 5 and 6, the straight line 16 between the car suspension sheaves is diagonal to the straight line 15 between the guide rails. The straight line 16 intersects the straight line 15 between the guide rails on the center of gravity G of the car 2 or in the vicinity thereof.

[0008] In this case, for carrying out maintenance of the hoisting machine 10, maintenance space is required at the periphery of the hoisting machine 10. This maintenance space includes a space to the height H above a maintenance area 21A provided on the bottom part 1a of the hoistway 1 and a space to the height h above the hoisting machine 10. The maintenance area 21A has a sufficient breadth for carrying out the maintenance work relative to the hoisting machine 10, for example, an area ranging 500 mm from one side surface of the hoisting machine 10. Further, the maintenance work area above the hoisting machine 10 generally has a range with a height h of 500 mm for the same reason. It is desirable that no equipment which could obstruct work in such a maintenance work area be present.

[0009] In the above mentioned conventional elevator apparatus, the hoisting machine 10 is arranged so that its axis 10a extends along a direction intersecting at right angles with the first and second side walls 1b and 1c of the hoistway (a direction parallel to the straight line 15 between the rails). Accordingly, when the car 2 is lowered to a lowermost travelling position to carry out maintenance work relative to the hoisting machine 10, the maintenance work area 21A is restricted by the underslung rope 4 passing under the lower part of the car 2. As a result, the dimension d0 shown in Fig. 6 is decreased, and it may be impossible to provide a sufficient maintenance work area.

[0010] In contrast to this, although it is conceivable to employ a method in which the hoisting machine 10 is simply disposed at a position apart from the rope, since a section of the rope 4 from the hoisting machine 10 to the second return pulley 9 interferes with the car sill 12, the installation position of the hoisting machine 10 is restricted. There is also method for separating the rope 4 from the hoisting machine 10 but, in this case, it is difficult to the underslung rope have through the vicinity of the center of gravity G. Accordingly, the car 2 is suspended in a deviated position, with the result that an eccentric load is applied to the car guide rail 13.

[0011] Fig. 8 is a plan view showing another example of a conventional elevator apparatus. Fig. 9 is an explanatory view showing the route of the rope in the apparatus of Fig. 8 in a developed manner. In this example, a hoisting machine 17 and a buffer 18 are disposed on the bottom part of a hoistway 1. A return pulley 19 is provided in the upper part of the hoistway 1. A rope 20 is wound around the return pulley 19. Then, one end

part 20a of the rope 20 is connected to the car 2, and the other end part 20b of the rope 20 is wound around a drum 17b of the hoisting machine 17.

[0012] The route of rope 20 of the conventional elevator apparatus described above is simpler than that of the rope 4 shown in Fig. 5. In addition, the rope 20 is not arranged at the lower part of the car 2. As a result, the rope 20 does not interfere with maintenance work relative to the hoisting machine 17 when the car 2 is at its lowermost travelling position. However, even in an elevator apparatus with such roping, since the buffer 18 stands on the bottom part 1a of the hoistway 1 as shown in Fig. 8 the maintenance area 21A and the space thereabove are restricted by the buffer 18 and a buffer receiver 18a. Therefore, there are times when a sufficient space for maintenance work can not be ensured.

[0013] On the other hand, Japanese Utility Model Publication No. 62-11894 discloses an elevator apparatus in which a machine room is provided in the lower part of a stairway adjacent to a hoistway, and a hoisting machine is disposed in the machine room. However, in the above elevator apparatus, since the machine room needs to be provided separately from the hoistway, the utilization efficiency in a building is undesirably deteriorated.

[0014] In addition, Japanese Patent Application laid-open No. 9-165172 discloses an elevator apparatus in which a driving device for a traction sheave is provided on a hoistway wall. However, in this elevator apparatus, it has been necessary to considerably reduce the thickness of the driving device in order to prevent the traction sheave from interfering with a car. As a result, a special driving device has been proposed which leads to an increase in cost. Further, when providing an ordinarily employed type hoisting machine, the area of the hoistway must be increased, thus lowering the utilization efficiency of a building.

DISCLOSURE OF THE INVENTION

[0015] The present invention has been made in order to solve the above described problems, and therefore has an object thereof to provide an elevator apparatus in which sufficient space can be secured for maintenance work relative to a hoisting machine disposed at the bottom part of a hoistway without increasing the area of the bottom part of the hoistway.

[0016] An elevator apparatus according to the present invention is comprised of a hoistway having a bottom part; a pair of car guide rails provided upright and in parallel with each other in the hoistway; a car which moves up and down while being guided by these guide rails; a pair of car suspension sheaves provided on the lower part of the car; a rope wound around the car suspension sheaves to suspend the car in the hoistway; and a hoisting machine disposed at the bottom part of the hoistway for moving the car up and down by the rope, a part of the hoisting machine overlapping the

car when viewed from a vertical projection plane, a straight line connecting the guide rails together passing the center of gravity of the car or the vicinity thereof, and a straight line connecting the pair of car suspension sheaves together being diagonal with respect to the straight line between the guide rails so as to intersect the straight line between the guide rails at the center of gravity of the car or in the vicinity thereof, wherein the hoisting machine is disposed so that its axis extending along the longitudinal direction of the hoisting machine is canted in the same direction as that of the straight line between the car suspension sheaves with respect to the straight line between the guide rails when viewed from the vertical projection plane, whereby a maintenance area is provided on a side of the straight line between the car suspension sheaves.

[0017] Further, an elevator apparatus according to the present invention is comprised of: a hoistway having a bottom part; a pair of car guide rails provided upright and in parallel with each other in the hoistway; a car which moves up and down while being guided through these guide rails; a rope for suspending the car in the hoistway, and a hoisting machine disposed on the bottom part of the hoistway for moving the car up and down by the rope, a part of the hoisting machine overlapping the car when viewed from a vertical projection plane, wherein the hoisting machine is disposed so that its axis extending along the longitudinal direction of the hoisting machine is diagonal to a straight line between the guide rails for connecting the pair of car guide rails together when viewed from a vertical projection plane, whereby a maintenance area is provided on a side of the hoisting machine.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

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

Fig. 2 is a schematic side view showing the apparatus of Fig. 1;

Fig. 3 is a plan view showing an elevator apparatus according to Embodiment 2 of the present invention;

Fig. 4 is a schematic side view showing the apparatus of Fig. 3;

Fig. 5 is a front view showing an example of a conventional elevator apparatus;

Fig. 6 is a plan view showing the apparatus of Fig. 5;

Fig. 7 is an explanatory view showing a route of a rope in the elevator apparatus of Fig. 5 in a developed manner;

Fig. 8 is a plan view showing another example of a conventional elevator apparatus; and

Fig. 9 is an explanatory view showing a route of the

rope in the apparatus of Fig. 8 in a developed manner.

BEST MODE FOR CARRYING OUT THE INVENTION

[0019] Now, preferred embodiments of the present invention will be described with reference to the drawings.

Embodiment 1

[0020] Fig. 1 is a plan view showing an elevator apparatus according to Embodiment 1 of the present invention. Fig. 2 is a schematic side view showing the apparatus of Fig. 1. Fig. 2 also shows a state in which a car 2 is lowered to its lowermost moving position.

[0021] In the drawings, a hoistway 1 has a bottom part 1a, first and second side walls 1b and 1c facing each other and a third side wall (back wall) 1d perpendicular to the first and second side walls 1b and 1c. In the hoistway 1, a car 2 and a counterweight 3 are suspended by a rope 4. A pair of car suspension sheaves 5 and 6 are provided at the lower part of the car 2. A counterweight suspension sheave 7 is provided on the upper part of the counterweight 3. In the upper part of the hoistway 1, first and second return pulleys 8 and 9 are provided.

[0022] On the bottom part 1a of the hoistway 1 is disposed a hoisting machine 10 for alternately moving the car 2 up and down and the counterweight 3 with the rope 4. A part of the hoisting machine 10 overlaps the car 2 when viewed from a vertical projection plane as shown in Fig. 1.

[0023] The one end part 4a and the other end part 4b of the rope 4 are secured to the upper parts in the hoistway 1, respectively. The rope 4 is successively wound around the car suspension sheaves 5 and 6, the first return pulley 8, the hoisting machine 10, the second return pulley 9 and the counterweight suspension sheave 7 in the order stated from the one end part 4a side.

[0024] Further, as shown in Fig. 1, the car 2 is provided with car doors 11a and 11b and a car sill 12 for guiding the opening and closing of the car doors 11a and 11b to open or close. The car 2 is moved up and down while being guided through a pair of guide rails 13 and 14 provided upright in parallel in by hoistway 1. The pair of car guide rails 13 and 14 are arranged so that a straight line 15 between the rails for connecting them together passes the center of gravity G of the car 2 or the vicinity thereof when viewed from the vertical projection plane. This is to prevent a large eccentric load from being applied to the guide rails 13 and 14.

[0025] For the same reason, a pair of car suspension sheaves 5 and 6 are also arranged so that a straight line 16 connects the car suspension sheaves together. In other words, the part of the rope 4 passing through the lower part of the car 2 passes the center of

gravity G of the car 2 or the vicinity thereof when viewed from the vertical projection plane. Thus, in order to keep the car guide rails 13 and 14 from interfering with the car suspension sheaves 5 and 6, the straight line 16 between the car suspension sheaves is diagonal to the straight line 15 between the guide rails, and intersects the straight line 15 between the guide rails on the center of gravity G of the car 2 or in the vicinity thereof.

[0026] Further, the axis 10a of the hoisting machine 10 extending in the longitudinal direction of the hoisting machine 10 is canted in the same direction as that of the straight line 16 between the car suspension sheaves (section of the rope 4 passing through the lower part of the car 2) with respect to the straight line 15 between the guide rails. According to Embodiment 1 of the invention, the hoisting machine 10 is disposed so that its axis 10a is parallel to the straight line 16 between the car suspension sheaves.

[0027] In the above-described elevator apparatus, for carrying out maintenance of the hoisting machine 10 while the car 2 is lowered to its lowermost position, the width d1 of a maintenance area 22A can be secured along the longitudinal direction of the hoisting machine 10. As a result, a space for the maintenance work for the hoisting machine 10 can be completely secured without increasing the area of the bottom part 1a of the hoistway 1. More specifically, the maintenance area 22A located within, for instance, 500 mm from one side surface of the hoisting machine 10 can be uniformly secured throughout the longitudinal direction of the hoisting machine 10. Therefore, a distance L between the hoisting machine 10 and the devices below the car can also be increased so that the area for the maintenance work can be enlarged.

Embodiment 2

[0028] Next, Fig. 3 is a plan view showing an elevator apparatus according to Embodiment 2 of the present invention, and Fig. 4 is a schematic side view showing the apparatus of Fig. 3.

[0029] In this embodiment, a hoisting machine 17 and a buffer 18 are installed at the bottom part of a hoistway 1. A return pulley 19 is provided in the upper part of the hoistway 1. A rope 20 is wound around the return pulley 19. Then, one end part 20a of the rope 20 is connected to a car 2, and the other end part 20b of the rope 20 is wound around the drum 17b of the hoisting machine 17.

[0030] Further, the hoisting machine 17 is arranged so that its axis 17a extending in the longitudinal direction of the hoisting machine 17 is canted with respect to a straight line 15 connecting a pair of car guide rails 13 and 14 in a direction away from the buffer 18 when viewed from a vertical projection plane.

[0031] In the above-described elevator apparatus, when maintenance is carried out on the hoisting machine 17 while the car 2 is lowered to its lowermost

travelling position, the width d1 of the maintenance area 22A can be maintained along the longitudinal direction of the hoisting machine 17. As a result, an area for the maintenance work for the hoisting machine 17 can be sufficiently secured without enlarging the area of the bottom part 1a of the hoistway. More specifically, the maintenance area located within, for instance, 500 mm from one side surface of the hoisting machine 17 can be uniformly secured entirely in the longitudinal direction of the hoisting machine 17. Therefore, a distance between the hoisting machine 20 and the devices below the car can be also increased, with the result that the area for the maintenance work can be enlarged.

[0032] In the above-described embodiment, description is made of a case in which the car 2 is suspended at the bottom by the rope. However, it should be noted that the present invention may also be applied to an elevator apparatus in which the car is suspended at the upper part by a rope.

Claims

1. An elevator apparatus comprising:

a hoistway having a bottom part;
 a pair of car guide rails provided upright and in parallel with each other in the hoistway;
 a car which moves up and down while being guided through these guide rails;
 a pair of car suspension sheaves provided on the lower part of the car;
 a rope wound around the car suspension sheaves to suspend the car in the hoistway;
 and
 a hoisting machine disposed at the bottom part of the hoistway for moving the car up and down by the rope, a part of said hoisting machine overlapping said car when viewed from a vertical projection plane, a straight line connecting the guide rails together passing the center of gravity of the car or the vicinity thereof, and a straight line connecting the pair of car suspension sheaves together being diagonal with respect to the straight line between the guide rails so as to intersect the straight line between the guide rails at the center of gravity of the car or in the vicinity thereof, wherein the hoisting machine is disposed so that its axis extending along the longitudinal direction of the hoisting machine is canted in the same direction as that of the straight line between the car suspension sheaves with respect to the straight line between the guide rails when viewed from the vertical projection plane, whereby a maintenance area is provided on a side of the straight line between the car suspension sheaves.

2. An elevator apparatus according to claim 1,

wherein said hoisting machine is arranged so that the axis of the hoisting machine is parallel to the straight line between the car suspension sheaves when viewed from the vertical projection plane.

3. An elevator apparatus comprising:

a hoistway having a bottom part;
 a pair of car guide rails provided upright and in parallel with each other in the hoistway;
 a car which moves up and down while being guided through these guide rails;
 a rope for suspending the car in the hoistway;
 and
 a hoisting machine disposed at the bottom part of the hoistway for moving the car up and down by the rope, a part of said hoisting machine overlapping said car when viewed from a vertical projection plane, wherein the hoisting machine is disposed so that its axis extending along the longitudinal direction of the hoisting machine is diagonal to a straight line between the guide rails for connecting the pair of car guide rails together when viewed from a vertical projection plane, whereby a maintenance area is provided on a side of the hoisting machine.

4. An elevator apparatus according to claim 3, wherein a buffer for bearing the car is provided on the bottom part of the hoistway, said hoisting machine being canted in a direction away from said buffer.

5. An elevator apparatus according to any one of claims 1 to 4, wherein said maintenance area is provided in a range of 500 mm or more from one side surface of said hoisting machine.

FIG. 1

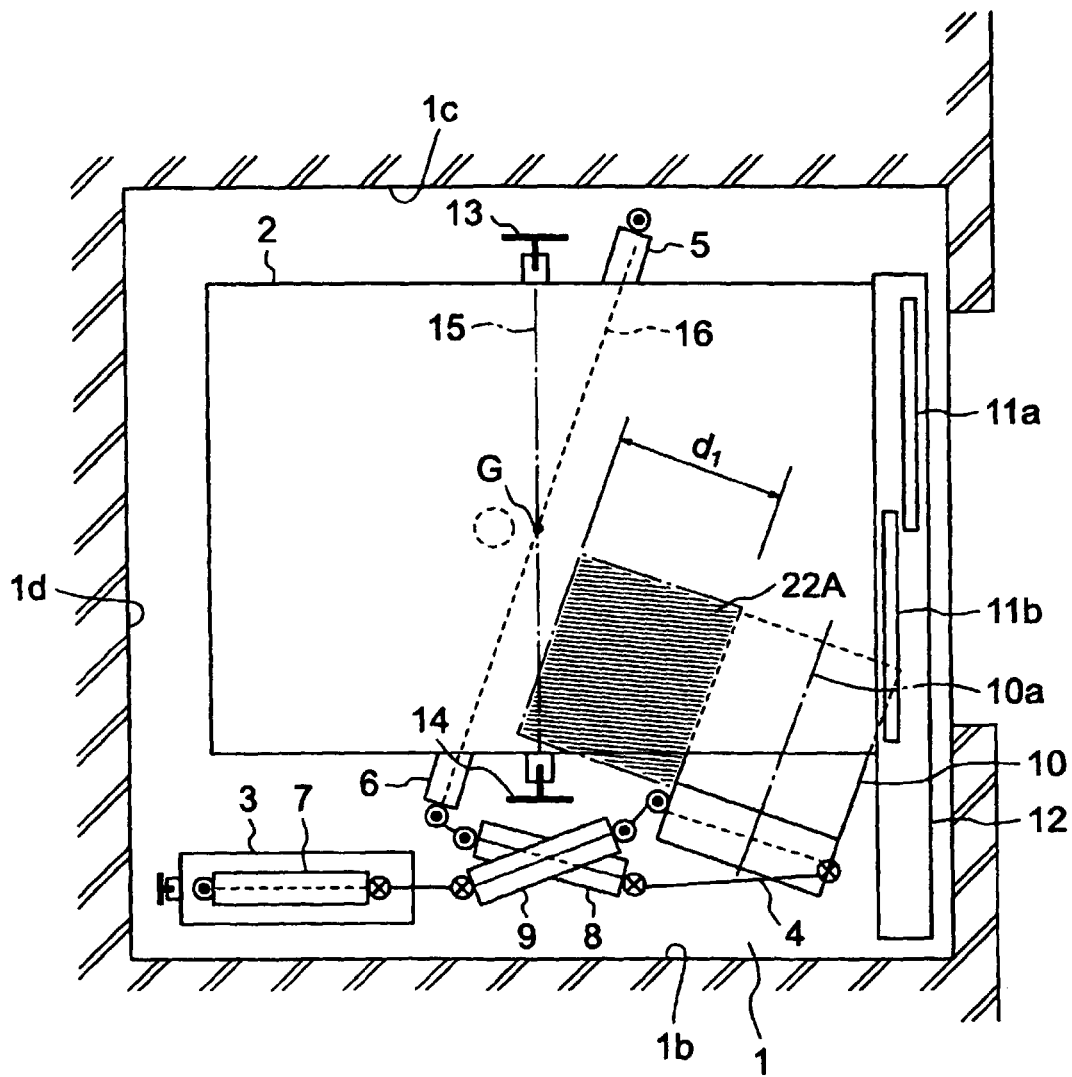


FIG. 2

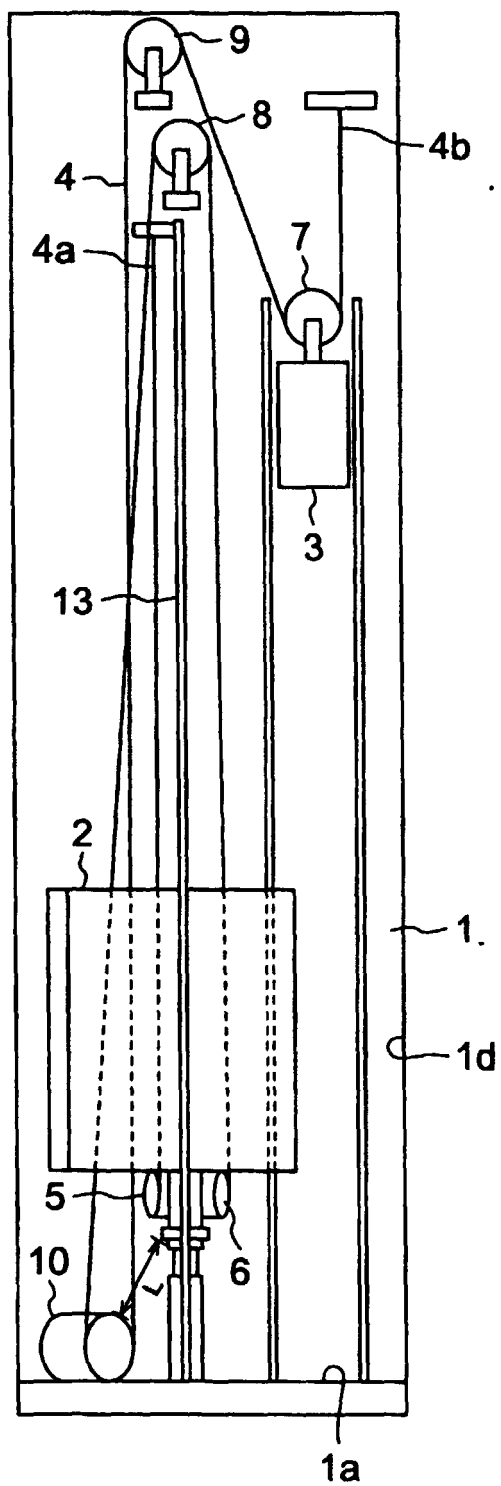


FIG. 3

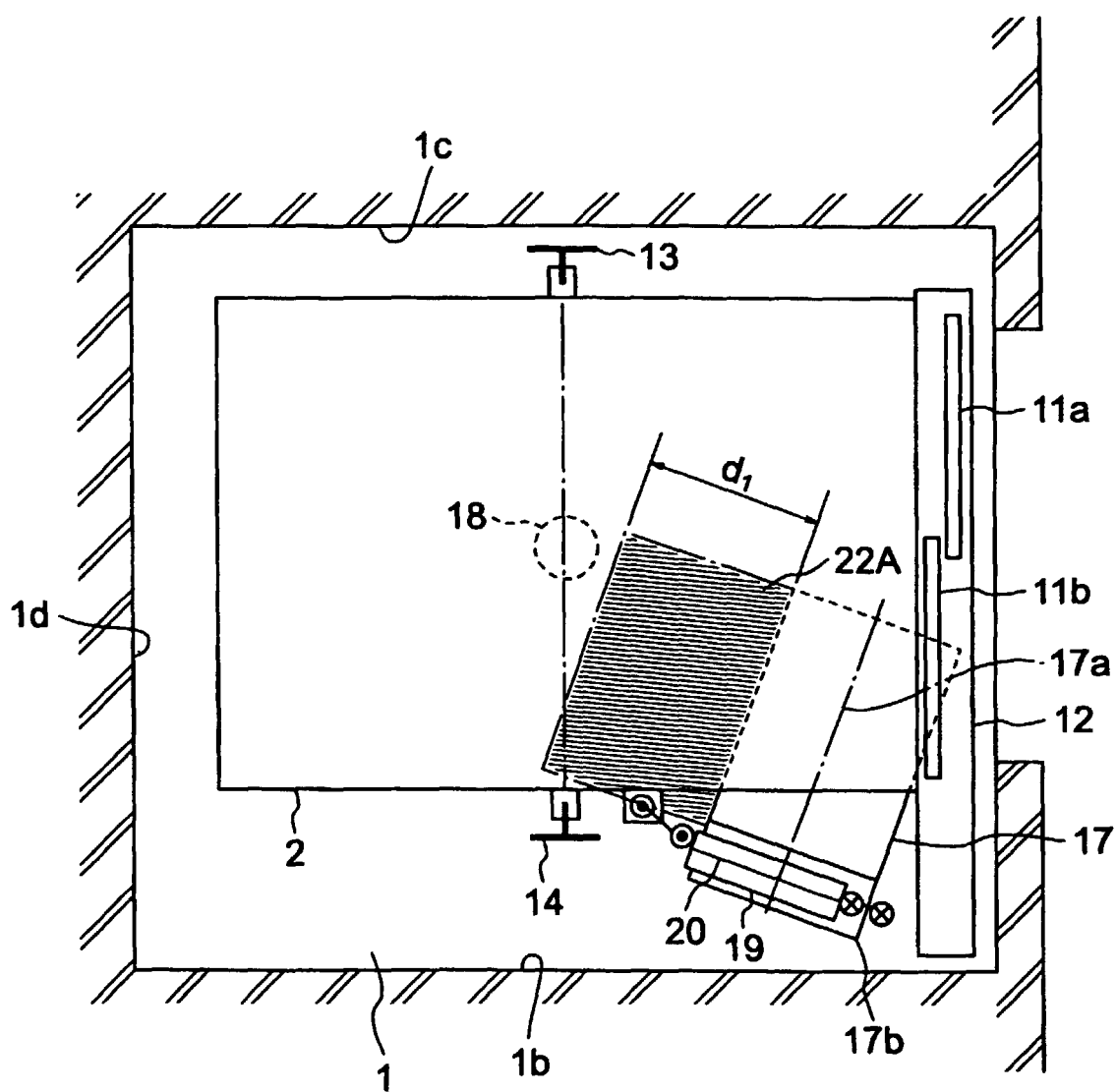


FIG. 4

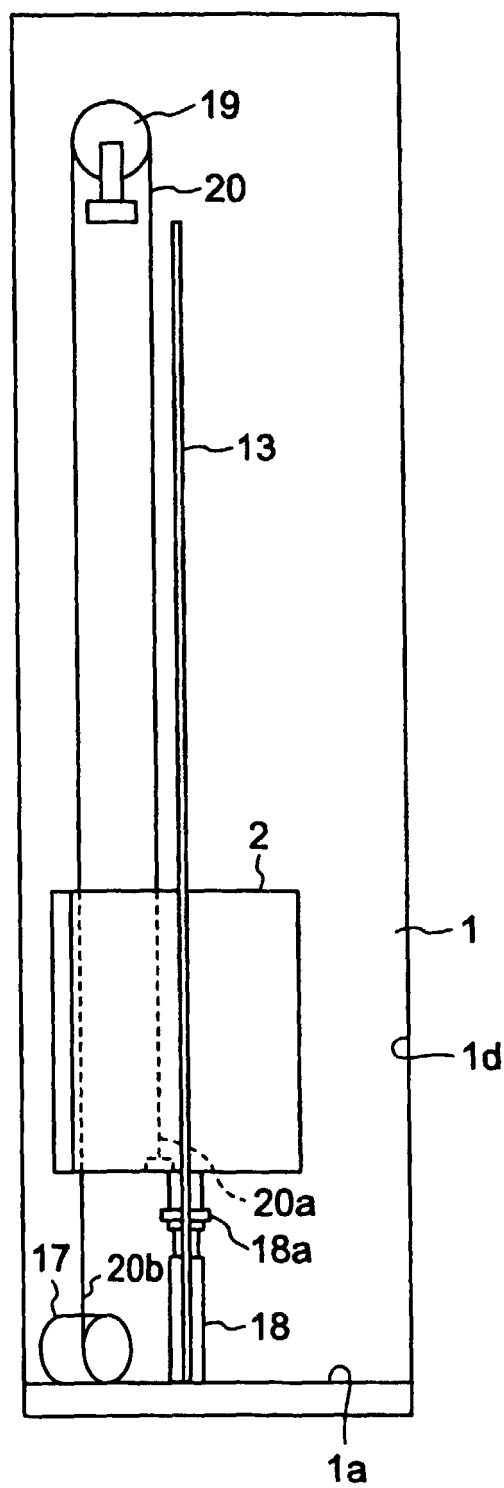


FIG. 5

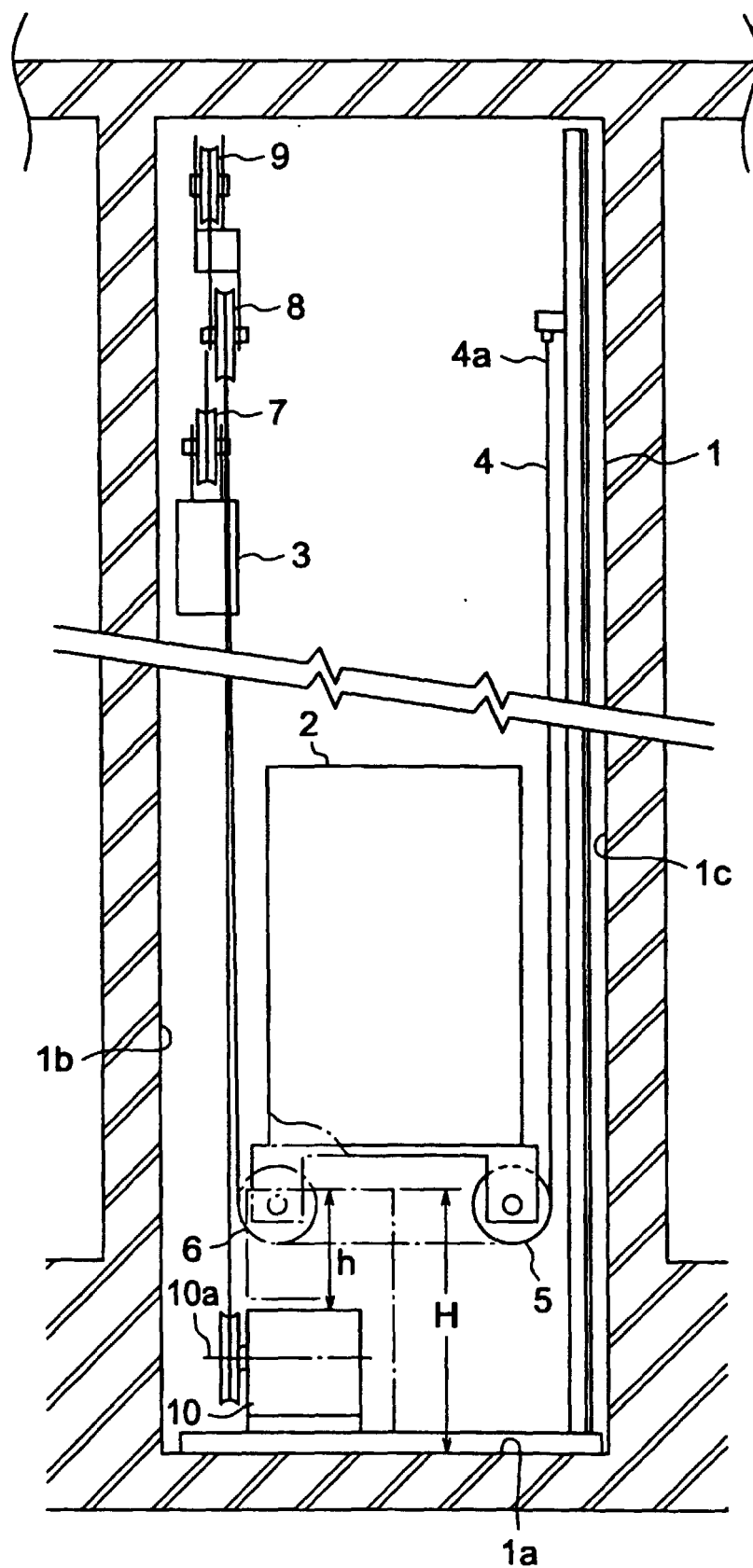


FIG. 6

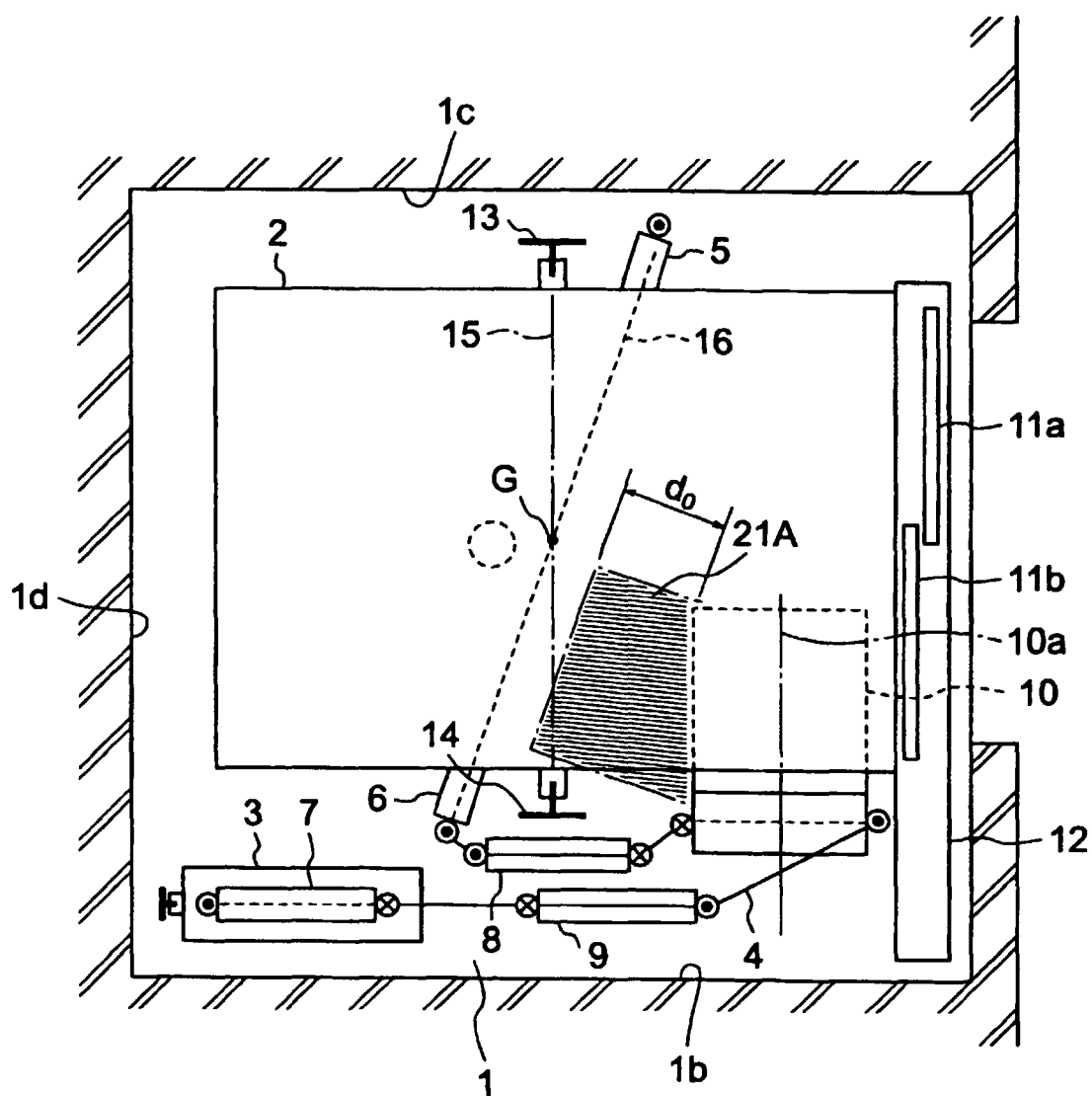


FIG. 7

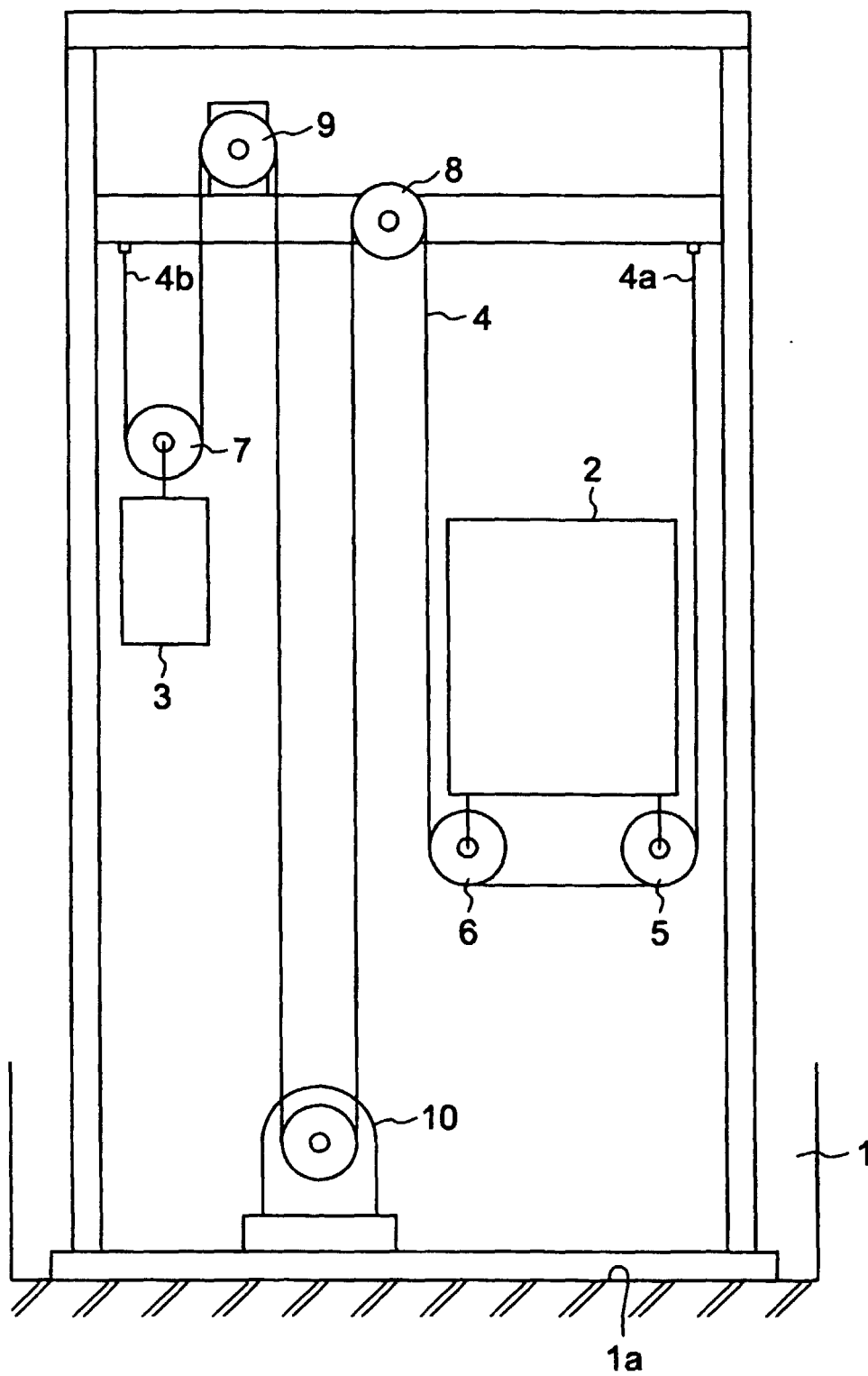


FIG. 8

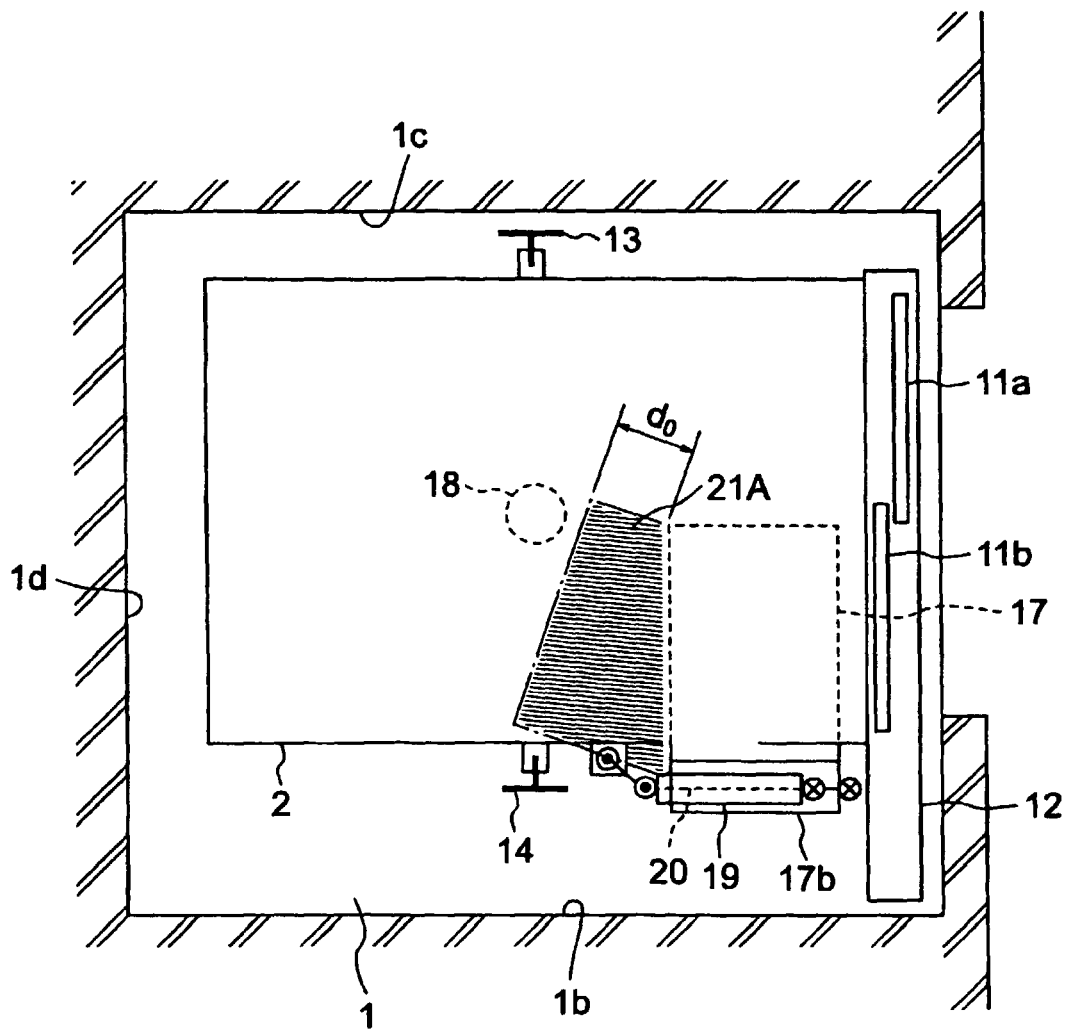
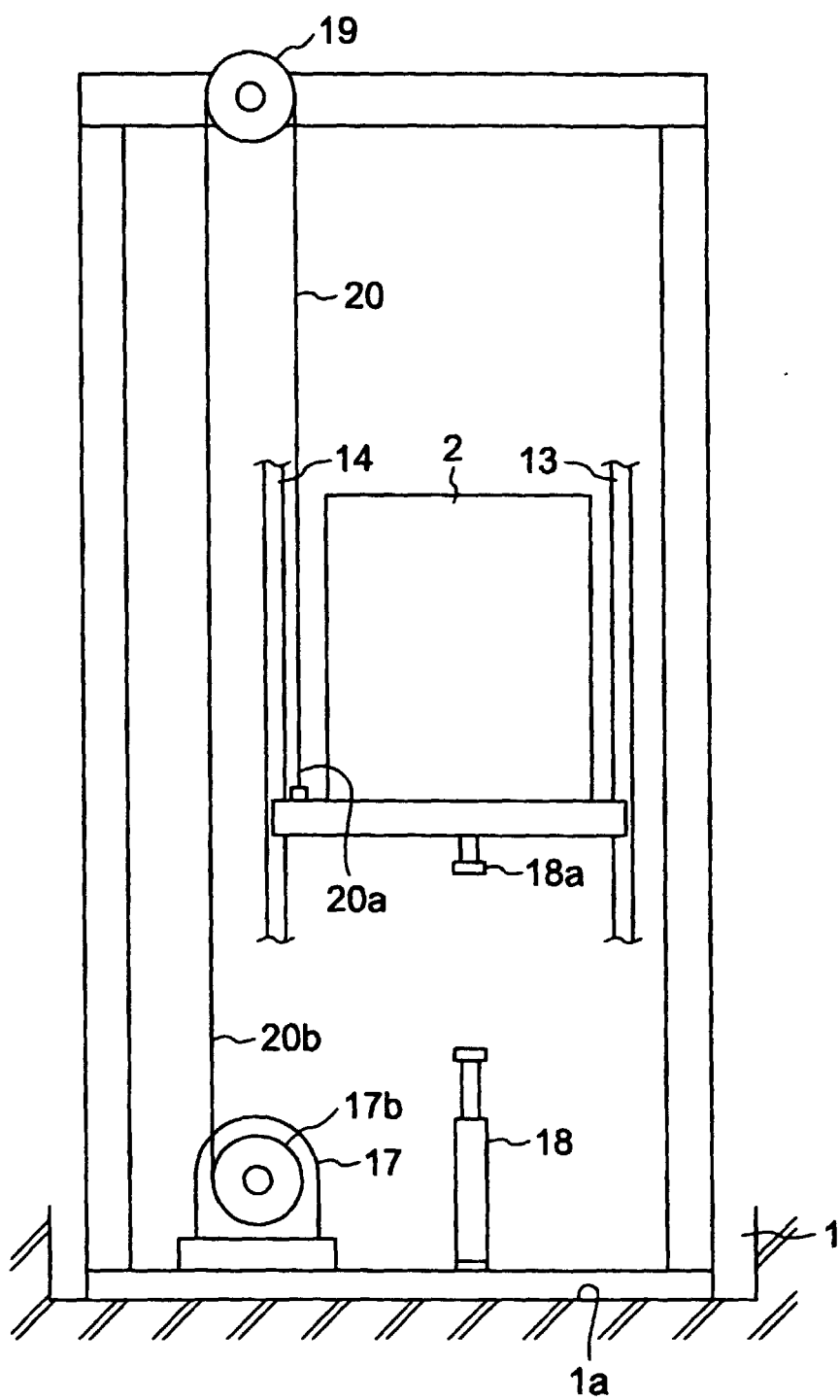


FIG. 9



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP98/05778

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁵ B66B7/00, 7/06, 11/08 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 ⁵ B66B7/00, 7/06, 11/08 Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1926-1999 Toroku Jitsuyo Shinan Koho 1994-1999 Kokai Jitsuyo Shinan Koho 1971-1999 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.
A	JP, 62-11894, Y2 (Mitsubishi Electric Corp.), 23 March, 1987 (23. 03. 87) (Family: none)	1-5
A	JP, 9-165172, A (Kone Oy), 24 June, 1997 (24. 06. 97) & EP, 749930, A2	1-5
A	JP, 9-165173, A (Kone Oy), 24 June, 1997 (24. 06. 97) & EP, 749931, A2	1-5
A	JP, 3-36184, A (Toshiba Corp.), 15 February, 1991 (15. 02. 91) (Family: none)	1-5
A	JP, 2-4875, U (Toshiba Corp.), 12 January, 1990 (12. 01. 90) (Family: none)	1-5
A	JP, 8-288, U (Toshiba Corp.), 16 February, 1996 (16. 02. 96) (Family: none)	1-5
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "Z" document member of the same patent family		
Date of the actual completion of the international search 17 March, 1999 (17. 03. 99)		Date of mailing of the international search report 30 March, 1999 (30. 03. 99)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

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