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(71) Applicant: **Mitsubishi Denki Kabushiki Kaisha**
Chiyoda-ku
Tokyo, 100-8310 (JP)

(72) Inventors:
- **Hashiguchi, Naoki**
  Mitsubishi Denki Kabushiki Kaisha
  Tokyo 100-8310 (JP)
- **Katou, Kunio**
  Mitsubishi Electric Engineering Co., Ltd.
  Tokyo 100-0004 (JP)
- **Yoshikawa, Kazuhiro**
  Mitsubishi Electric Engineering Co., Ltd.
  Tokyo 100-0004 (JP)

(74) Representative: **HOFFMANN EITLE**
Patent- und Rechtsanwälte
Arabellastrasse 4
81925 München (DE)

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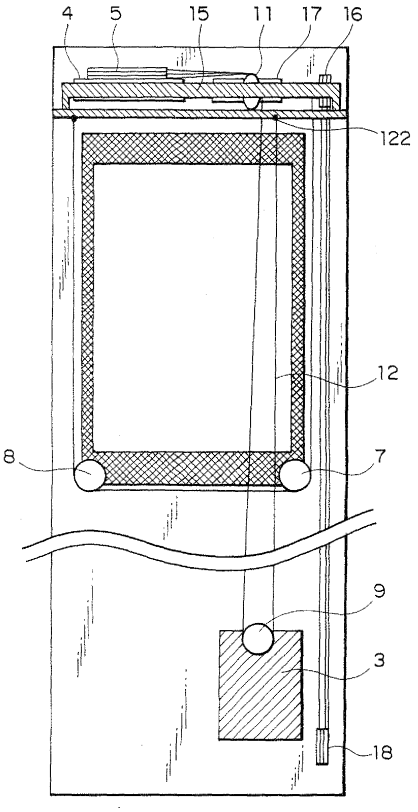
(54) Elevator apparatus

(57) An elevator apparatus comprises a cage (2) which is reciprocatively movable up and down within an elevator shaft (1); a counterweight (3) which is reciprocatively movable up and down within said elevator shaft (1); a main rope (12) suspending said cage (2) and said counterweight (3); and a hoisting machine (4) having a drive sheave (5) around which said main rope (12) is wound, wherein said cage (2) and said counterweight (3) are reciprocatively moved up and down by said main rope (12) upon rotation of said drive sheave. The elevator apparatus further comprises a mounting platform (15) disposed between the ceiling of said cage (2) and that of said elevator shaft (1) when said cage (2) has reached said topmost level; a first turning pulley (10) mounted on said mounting platform (15) and around which a portion of said main rope (12) extends from said cage (2) to said drive sheave (5) is wound; and a second turning pulley (11) on said mounting platform (15) and around which other portion of said main rope (12) extending from said drive sheave (5) to said counterweight (3) is wound.

FIG. 1



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator apparatus in which a hoisting machine 4 having a drive sheave is installed at a top portion of an elevator shaft such that a rotational plane of the drive sheave is disposed substantially horizontally.

BACKGROUND TECHNIQUES

[0002] Figure 14 is a view showing a hitherto known or conventional elevator apparatus disclosed in Japanese Patent Application Laid-open Publication No. 139321/1998 (JP-A-10-139321). Figure 15 is a top plan view of an elevator shaft of the elevator apparatus shown in Fig. 14.

[0003] Referring to the figures, reference numeral 1 denotes an elevator shaft, numeral 2 denotes a cage operated to move up and down within the elevator shaft 1 along a predetermined path, numeral 3 denotes a counterweight disposed within the elevator shaft 1 at one side in a horizontal plane thereof, and numeral 4 denotes a hoisting machine which is disposed on a lower surface of a ceiling of the vertical elevator shaft, being supported by a suspending member 20 mounted at a top portion of the elevator shaft 1, wherein the hoisting machine is provided with a drive sheave 5 rotatably mounted on a vertical shaft.

[0004] Reference numeral 7 denotes a first cage-mounted pulley mounted on a bottom portion of the cage 2 at one side thereof, numeral 8 denotes a second cage-mounted pulley mounted on the bottom portion of the cage 2 at the other side, numeral 9 denotes a counterweight-mounted pulley mounted on a top portion of the counterweight 3, and numeral 10 denotes a cage-associated reversing or turning pulley which is disposed at a position vertically aligned with the second cage-mounted pulley 8, the pulley 10 being rotatably supported by means of a horizontal shaft at a top portion of the elevator shaft 1, and numeral 11 denotes a counterweight-associated reversing or turning pulley which is disposed at a top portion of the elevator shaft 1 at a position vertically aligned with the counterweight-mounted pulley 9, the pulley 11 being rotatably supported by means of a horizontal shaft. Incidentally, it is to be mentioned that the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 are disposed such that they partially extend over the cage 2 as viewed in the top plan view shown in Fig. 15.

[0005] Further, reference numeral 12 denotes a main rope having one end portion fixedly connected to a top portion of the elevator shaft 1 by means of a first rope anchor 121 mounted on the ceiling of the elevator shaft 1 at a position vertically aligned with the first cage-mounted pulley 7, wherein the main rope 12 extends vertically downwardly from the first rope anchor 121, being then partially wound around the first cage-mounted pulley 7 and the second cage-mounted pulley 8 to extend vertically upwardly to be partially wound around the cage-associated turning pulley 10 and hence extend horizontally to be wound around the drive sheave 5 and hence around the counterweight-associated turning pulley 11, the main rope then extending vertically downwardly to be partially wound around the counterweight-mounted pulley 9 to extend again vertically upwardly to be finally connected fixedly to the top portion of the elevator shaft 1 by means of a second rope anchor 122 mounted on the ceiling of the elevator shaft 1 at a position vertically aligned with the counterweight-mounted pulley 9.

[0006] In the conventional elevator apparatus of the structure described above, the cage 2 and the counterweight 3 are moved up and down in the mutually opposite directions, i.e., one is moved upwardly with the other being moved downwardly, when the hoisting machine 4 is driven to thereby put into rotation the drive sheave 5. It is noted that the hoisting machine 4 is disposed at the top portion within the elevator shaft 1 with a machine room being spared, whereby the space for installing the elevator in a building is correspondingly reduced.

[0007] In Japanese Patent Application Laid-Open Publication No. 139321/1998 (JP-A-10-139321), however, no consideration is paid to the disposition of a control console or panel and a speed governor although description is found concerning the disposition of the hoisting machine 4, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11.

[0008] Since it is unnecessary to provide the machine room separately from the elevator shaft, the control panel and the speed governor will have to be disposed internally of the elevator shaft in the conventional elevator apparatus. However, the space in which the control panel and the speed governor can be accommodated is limited to a space portion which is not covered by the space in which the cage 2 and the counterweight 3 are moved up and down and the space occupied by the guide rails. Of course, the control panel and the speed governor have to be disposed at such positions where no interference with other machinery components can take place.

[0009] In general, in the elevator apparatus, the size of the elevator shaft, the size of the cage and the sizes or dimensions of the counter-weight guide rail and the cage guide rail will change in dependence on the number of passengers which the elevator cage is capable of carrying or transporting, the operation speed thereof etc., which in turn means that the unoccupied space available within the elevator shaft will change correspondingly. Consequently, there arises the necessity of changing the positions for installation of the speed governor and the control panel in dependence on the competence or capacity of the elevator apparatus.

[0010] It should additionally be pointed out that in the case of the elevator apparatus disclosed in Japanese Patent Application Laid-Open Publication No. 139321/1998, no consideration is paid to the vibration

isolating structures for the hoisting machine 4, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 either.

DISCLOSURE OF THE INVENTION

[0011] The present invention has been made for the purpose of solving the problems described above, and an object of the invention is to dispose aggregatively or collectively the hoisting machine, the speed governor and the control panel without involving interference with other machineries.

[0012] Further, another object of the present invention is that the load imposed on the hoisting machine, the cage-associated turning pulley and the counterweight-associated turning pulley with the guide rails while suppressing transmission of vibrations generated by these machineries to the guide rails.

[0013] An elevator apparatus according to the present invention includes a cage reciprocatively movable up and down within an elevator shaft, a counterweight reciprocatively movable up and down within the elevator shaft, a main rope suspending the cage and the counterweight, a hoisting machine having a drive sheave around which the main rope is wound, the drive sheave being disposed between a ceiling of the cage and that of the elevator shaft when the cage has reached a position corresponding to a topmost level, the cage and the counterweight being reciprocatively moved up and down through the medium of the main rope upon rotation of the drive sheave, a speed governor for detecting up/down speed of the cage, a control panel having disposed therein a device for controlling operation of the hoisting machine, and a mounting platform disposed between the ceiling of the cage and that of the elevator shaft when the cage has reached the topmost level, wherein the hoisting machine, the speed governor and the control panel are installed on the mounting platform.

[0014] The elevator apparatus may further include a first turning pulley which is mounted on the mounting platform and around which a portion of the main rope extending from the cage to the drive sheave is wound, and a second turning pulley which is mounted on the mounting platform and around which other portion of the main rope extending from the drive sheave to the counterweight is wound.

[0015] The hoisting machine may be implemented in a thin structure having a size in thickness which is smaller than a size in width and disposed such that when the cage reaches the topmost level, the hoisting machine can be accommodated in thicknesswise orientation between the ceiling of the cage and that of the elevator shaft.

[0016] The control panel may be disposed between a portion of the main rope extending from the first turning pulley to the drive sheave and other portion of the main rope extending from the drive sheave to the second turning pulley as viewed in a plan view (in a same plane orthogonal to a longitudinal axis of the elevator shaft).

[0017] Further, a pulley of the speed governor may be installed between the cage and a wall of the elevator shaft as viewed in a plan view (in a same plane orthogonal to longitudinal axis of said elevator shaft). and disposed such that a rotational plane of the pulley extends approximately in parallel with a wall of the elevator shaft.

[0018] Further, the control panel and the speed governor may be disposed in a space extending from a bottom end of the mounting platform to a top end of the hoisting machine as viewed in a side elevational view (in a same plane parallel to a longitudinal axis of the elevator shaft).

[0019] Furthermore, a cover covering the hoisting machine, the control panel and the speed governor may be mounted on the mounting platform.

[0020] An elevator apparatus according to the present invention includes a cage reciprocatively movable up and down within an elevator shaft, being guided by a plurality of cage guide rails, a counterweight reciprocatively movable up and down within the elevator shaft, being guided by a plurality of counterweight guide rails, a main rope suspending the cage and the counterweight, a hoisting machine having a drive sheave around which the main rope is wound, the drive sheave being disposed such that when the cage has reached a position corresponding to a topmost level, a rotational plane of the drive sheave is positioned substantially horizontally between a ceiling of the cage and that of the elevator shaft, the cage and the counterweight being reciprocatively moved up and down through the medium of the main rope upon rotation of the drive sheave, a first turning pulley around which a portion of the main rope extending from the cage to the drive sheave is wound, a second turning pulley around which other portion of the main rope extending from the drive sheave to the counterweight is wound, first and second beams secured fixedly to the cage guide rail and/or the counterweight guide rail, and a member on which the hoisting machine, the first turning pulley and the second turning pulley are mounted, wherein the member is fixedly secured to the first beam and the second beam through the medium of a vibration isolation member.

[0021] The first beam and the second beam may be hanged on the cage guide rail and/or the counterweight guide rail.

[0022] Further, the member mentioned above may be provided with a lifting pulley for lifting the hoisting machine.

[0023] Further, the above-mentioned member may be comprised of a third beam on which the first turning pulley is mounted and a fourth beam on which the second turning pulley is mounted, wherein at least one of the third beam and the fourth beam constitutes a pulley cover for the turning pulley.

[0024] Furthermore, the member may constitute a rope duct covering at least one of a portion of the main rope which extends from the drive sheave of the hoisting machine to the first turning pulley and other portion of the main rope which extends from the drive sheave of

the hoisting machine to the second turning pulley.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Figure 1 is a front view of an elevator apparatus according to a first embodiment of the present invention.
Figure 2 is a side elevational view of the elevator apparatus according to the first embodiment.
Figure 3 is a top plan view of the elevator apparatus according to the first embodiment.
Figure 4 is a view showing the state in which machineries are disposed on a mounting platform 15.
Figure 5 is a perspective view of an elevator apparatus according to a second embodiment of the present invention.
Figure 6 is a plan view showing a top portion of an elevator shaft shown in Fig. 5.
Figure 7 is a front view of a section taken along a line A-A indicated in Fig. 6.
Figure 8 is a front view of a section taken along a line B-B indicated in Fig. 6.
Figure 9 is a right-hand side view of a section taken along a line C-C indicated in Fig. 6.
Figure 10 is a left-hand side view of a section taken along a line D-D indicated in Fig. 6.
Figure 11 is a sectional view of a section taken along a line E-E indicated in Fig. 6.
Figure 12 is a sectional view of a section taken along a line F-F indicated in Fig. 6.
Figure 13 is a view showing a structure of a mounting platform 15 according to a third embodiment of the present invention.
Figure 14 is a view showing a structure of a hitherto known elevator apparatus.
Figure 15 is a plan view showing a top portion of an elevator shaft shown in Fig. 14.

BEST MODES FOR CARRYING OUT THE INVENTION

[0026] In the following, present invention will be described in conjunction with modes for carrying out the invention, i.e., exemplary embodiments thereof.

Embodiment 1

[0027] Figures 1 to 4 are views showing an exemplary embodiment of the present invention, wherein Fig. 1 is a front view, Fig. 2 is a side elevational view of an elevator apparatus shown in Fig. 1, and Fig. 3 is a plan view showing a top portion of an elevator shaft of the elevator apparatus shown in Fig. 1. Figure 4 is a view showing locations or positions at which machineries are disposed, wherein Fig. 4 (a) is a plan view showing the disposition of the machineries on a mounting platform 15, Fig. 4(b) is a side elevational view as viewed in the direction indicated by an arrow B in Fig. 4 (a), and Fig. 4(c) is a side elevational view as viewed in the direction indicated by an arrow C in Fig. 4(a).

[0028] Referring to the figures, numeral 1 denotes an elevator shaft, numeral 2 denotes a cage operated to move up and down reciprocatively within the elevator shaft 1 along a predetermined path, numeral 3 denotes a counterweight disposed within the elevator shaft 1 at one side in a horizontal plane thereof so as to be reciprocatively movable upward and down within the elevator shaft 1.

[0029] Further, reference numeral 4 denotes a hoisting machine which is disposed at a position beneath a ceiling of the elevator shaft 1 and which includes a drive sheave 5 around which a main rope 12 is wound. The drive sheave 5 is so designed that the rotational plane thereof extends horizontally (or approximately horizontally) and hence extends in parallel (or approximately parallel) to the ceiling of the elevator shaft 1. Thus, the drive sheave 5 is disposed in opposition to the ceiling of the elevator shaft 1. The drive sheave 5 has a diameter smaller than an outer diameter of the hoisting machine 4. Further, the hoisting machine 4 is implemented in a thin structure having a thickness smaller the length in the widthwise direction so that when the cage 2 reaches the topmost level or floor, the thickness of the hoisting machine 4 can be accommodated within the clearance space defined between the ceiling of the cage 2 and that of the elevator shaft 1.

[0030] Reference numeral 6 denotes a door installed at the cage, numeral 7 denotes a first cage-mounted pulley installed on a bottom of the cage 2 at one side thereof, numeral 8 denotes a second cage-mounted pulley installed on the bottom of the cage 2 at the other side. Reference numeral 9 denotes a counterweight-mounted pulley installed on a top portion of the counterweight 3, numeral 10 denotes a cage-associated direction reversing or turning pulley which is rotatably supported by means of a horizontal shaft at a top portion of the elevator shaft 1 above the second cage-mounted pulley 7.

[0031] Reference numeral 11 denotes a counterweight-associated turning pulley which is disposed at a top portion of the elevator shaft 1 and rotatably supported by means of a horizontal shaft above the counterweight-mounted pulley 9. The cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 are so arranged that when the cage 2 reaches the top story or level, these pulleys 10 and 11 can be accommodated within the clearance space defined between the ceiling of the cage 2 and that of the elevator shaft 1.

[0032] Reference numeral 12 denotes a main rope having one end portion fixedly connected to the mounting platform 15 by means of a first rope anchor 121, wherein the main rope 12 extends vertically downwardly from the first rope anchor 121, being then partially wound around the first cage-mounted pulley 7 and the second cage-mounted pulley 8 to extend vertically upwardly to be partially wound around the cage-associated turning pulley

10 and hence extend horizontally to be wound around the drive sheave 6 and hence around the counterweight-associated turning pulley 11, the main rope then extending vertically downwardly to be partially wound around the counterweight-mounted pulley 9 to extend again vertically upwardly to be finally connected fixedly to the mounting platform 15 by means of a second rope anchor 122 at the other end portion of the rope.

[0033] Reference numeral 13 denotes counterweight guide rails for guiding up/down move of the counterweight 3, wherein these rails are disposed at both sides of the counterweight 3, respectively. Numeral 14 denotes cage guide rails for guiding up/down move of the cage 2, wherein these rails are disposed at both sides of the cage 2, respectively. Numeral 15 denotes a mounting platform on which the hoisting machine 4 is installed, the platform being implemented in a structure including a plurality of longitudinal members and a plurality of transverse members interconnected. The mounting platform 15 is fixedly connected to the counterweight guide rails 13 and the cage guide rails 14. Alternatively, the mounting platform 15 may be fixedly mounted on the wall.

[0034] Reference numeral 16 denotes a speed governor for detecting the up/down speed of the cage, numeral 17 denotes a control console or panel in which an operation control unit and a motor control unit are incorporated, numeral 18 denotes a governor flywheel which is disposed rotatably at a bottom portion of the elevator shaft, wherein an endless governor rope is spanned between a pulley of the speed governor 16 and the governor flywheel 18. The pulley of the speed governor 16 is caused to rotate in accompany with the up/down move of the cage 2. By detecting the rotation speed of the pulley of the speed governor 16, speed control or regulation is performed.

[0035] Next, detailed description will be made as to the manner in which the hoisting machine 4, the speed governor 16, the control panel 17, etc. are installed.

[0036] The hoisting machine 4, the speed governor 16 and the control panel 17 are installed on the mounting platform 15. Additionally, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 are also disposed on the platform 15. More specifically, the speed governor 16 is so disposed as to be positioned between the cage 2 and the wall of the elevator shaft 1 as viewed in the plan view such that the rotational plane of the pulley of the speed governor extends in parallel with the wall of the elevator shaft 1 and the cage 2. Such disposition is favorable in view of that the clearance space defined between the cage 2 and the wall of the elevator shaft 1 can be diminished.

[0037] Further, as can be seen in Fig. 4 (a),the control panel 17 is disposed between a portion of the main rope 12 which extends from the cage-associated turning pulley 10 to the drive sheave 5 and another portion of the main rope 12 which extends from the drive sheave 5 to the counterweight-associated turning pulley 11. With the disposition of the control panel 17 described above, the control panel 17 can be disposed in close vicinity to the hoisting machine 4. At the same time, the disposition mentioned above is advantageous in making available the space for installing the control panel 17.

[0038] Further, as can be seen in Fig. 4(c), the speed governors 16 and the control panels 17 are disposed between a bottom end of the mounting platform 15 and a top end of the hoisting machine 4. Accordingly, for installing the speed governor 16 and the control panel 17, any extraneous space is not required in the heightwise direction. In that case, the control panel 17 is disposed in such orientation that the dimensionally smallest one of the longitudinal side, the transverse side and the side thicknesswise of the control panel is positioned heightwise within the space defined between the ceiling of the cage and the ceiling of the elevator shaft.

[0039] Disposed above the mounting platform 15 is a cover 19 for covering the hoisting machine 4, the speed governor 16 and the control panels 17. With the arrangement mentioned above, necessity of providing a casing for the control panel 17 can be evaded.

[0040] Moreover, since the hoisting machine 4, the speed governor 16 and the control panel 17 are installed on the mounting platform 15, these machineries need not be installed separately or individually in the elevator shaft upon construction of the elevator system, as a result of which the time required for constructing the whole elevator system can be shortened.

[0041] In the elevator apparatus constructed as described above, the drive sheave 5 is rotated by driving the hoisting machine 4, whereby the cage 2 is moved upwardly with the counterweight 3 being moved downwardly or vice versa, i.e., the cage and the counterweight are moved in the opposite directions, respectively. As described previously, the hoisting machine 4 is installed at the top portion in the elevator shaft 1. Accordingly, the machine room to be otherwise provided can be spared. This in turn means that the space afforded by a building for installing the elevator system can be reduced. Additionally, construction cost required for ensuring the space for accommodating installation of the elevator system can be reduced. In addition to the advantageous effects mentioned above, the height of the building can correspondingly be decreased, whereby such undesirable situation can be evaded that neighbors' right to sunshine is possibly injured.

[0042] Furthermore, since the speed governor 16 and the control panel 17 which are major equipment installed internally of the elevator shaft are disposed by making use of the vertical space required for installing the hoisting machine 4 (i.e., the space defined between the ceiling of the cage and the ceiling of the elevator shaft when the cage 2 is positioned at the highest level), very effective utilization of the space available within the elevator shaft can be realized. Besides, the hoisting machine 4, the speed governor 16 and the control panel 17 can aggregatively or collectively be disposed without interfering with other machineries. More specifically, since the hoist-

ing machine, the speed governor and the control panel are installed in the space at the top portion of the elevator shaft (i.e. , the space defined between the ceiling of the cage and that of the elevator shaft when the cage 2 is positioned at the topmost level), the major machineries such as the hoisting machine 4, the speed governor 16, the control panel 17 and others can aggregatively be arranged, whereby the space defined between the wall of the elevator shaft 1 and the cage 2 can be reduced.

[0043] In the elevator apparatus, the size of the elevator shaft, the size of the counterweight, the size of the cage and the dimensions of the counterweight guide rails and the cage guide rails change in dependence on the number of passengers that the elevator cage can transport, the transportation speed and the like. Consequently, vacant space within the elevator shaft 1 will correspondingly change. In the conventional elevator apparatus equipped with no machine room, the layout of the speed governor 16 and the control panel 17 has to be altered or modified remarkably in dependence on the capacity or capability of the elevator. In this conjunction, it is however noted that in the case of the elevator apparatus described above as the embodiment of the present invention, the speed governor 16 and the control panel 17 are aggregatively or collectively disposed by making use of the space available between the ceiling of the cage and that of the elevator shaft when the cage 2 reaches the topmost level or floor. This space is less susceptible to the influence of the changes in respect to the size of the counterweight, the size of the cage and the dimensions of the counterweight guide rails and the cage guide rails. Consequently, remarkable change of the layout of the machineries in dependence on the capacity of the elevator system is not required, differing from the conventional elevator.

[0044] It should further be added that since the hoisting machine 4, the speed governor 16 and the control panel 17 are assembled on the mounting platform 15, it is possible to mount in advance these machineries on the mounting platform 15 in the factory and transport the assembly to the relevant construction field. Thus, time and labor required for installing individually these machineries at the building site can be saved.

[0045] Moreover, transportation of these machineries can be much facilitated because they are packaged on the mounting platform 15 (being blanketed with the cover 19). Of course, time and labor otherwise required for packing up the individual machineries can be saved.

[0046] In the elevator apparatus according to the instant embodiment of the invention, the cage 2 is suspended by the main rope 12 spanned through the first cage-mounted pulley 7 and the second cage-mounted pulley 8 with the counterweight 3 being suspended by winding the main rope around the counterweight-mounted pulley 9. However, such arrangement can equally be adopted that the cage 2 and the counterweight 3 are connected to each other directly by the main rope 12.

Embodiment 2

[0047] A second embodiment of the invention is similar to the preceding embodiment 1 in respect to the basic structure. Accordingly, the following description will be made by putting emphasis on the differences. Except for the differences, the second embodiment is same as the embodiment 1.

[0048] Figure 5 is a perspective view of an elevator apparatus according to the present invention, Fig. 6 is a top plan view of a top portion of an elevator shaft of the elevator apparatus shown in Fig. 5. Figure 7 is a front view of a section of the same taken along a line A-A indicated in Fig. 6, Fig. 8 is a front view of a section taken along a line B-B indicated in Fig. 6, Fig. 9 is a right-hand side view of a section taken along a line C-C indicated in Fig. 6, Fig. 10 is a left-hand side view of a section taken along a line D-D indicated in Fig. 6, Fig. 11 is a sectional view taken along a line E-E indicated in Fig. 6, and Fig. 12 is a sectional view taken along a line F-F indicated in Fig. 6.

[0049] In the case of the elevator apparatus according to the instant embodiment of the invention, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 are so disposed that the rotational planes thereof extend in parallel with each other. Further, a portion of the main rope 12 which extends from the cage-associated turning pulley 10 to the drive sheave 5 lies in parallel with a portion of the main rope 12 which extends from the drive sheave 5 to the counterweight-associated turning pulley 11. This arrangement is advantageous in that the contact angle of the main rope 12 wound around the drive sheave 5 can be increased.

[0050] In the elevator apparatus according to the instant embodiment, the counterweight-associated turning pulley 11 is disposed between the cage 2 and the elevator shaft wall as viewed in the plan view. Thus, the rotational plane of the counterweight-associated turning pulley 11 is also in parallel with the wall of the elevator shaft.

[0051] Next, by referring to Fig. 6 to Fig. 8, description will be made of a method of securing fixedly the mounting platform 15.

[0052] The mounting platform 15 is a structure which is constituted by a first beam 151, a second beam 152, a third beam 153 for connecting these two beams 151 and 152, a fourth beam 154 and a fifth beam.

[0053] The first and second beams 151 and 152 are fixedly secured to the cage guide rail 14 by means of a suspending member 20. More specifically, the cage guide rail 14 and the suspending member 20 are fixedly secured with a top bent portion of the suspending member 20 being securely hanged on a top end of the cage guide rail 14, as is illustrated in Fig. 8. Further, the first beam 151 or the second beam 152 is securely hanged on a bottom bent portion of the suspending member 20. In this manner, the beams 151 and 152 are held, being suspended from the top end of the cage guide rail 14.

[0054] Further, the third beam has one end portion

which is fixedly secured to the first beam 151 through an interposed rubber vibration isolator 22 and the other end portion which is fixedly secured to the second beam 152 through an interposed rubber vibration isolator 22, as is illustrated in Fig. 7.

[0055] The fourth beam 154 has one end portion fixedly secured to the fifth beam 155 which interconnects the first beam 151 and the second beam 152 with a rubber vibration isolator 22 being interposed therebetween, while the other end portion of the fourth beam 154 is fixedly secured to the second beam 152 with a rubber vibration isolator 22 being interposed therebetween, as illustrated in Fig. 8. In this manner, the fourth beam 154 is also integrally combined with the second beam 152 through the medium of the rubber vibration isolator 22.

[0056] The speed governor 16 is fixedly mounted on the second beam 152, the cage-associated turning pulley 10 is fixedly mounted on the third beam 153 and the counterweight-associated turning pulley 11 is fixedly mounted on the fourth beam 154.

[0057] The hoisting machine 4 is securely mounted on both the third beam 153 and the fourth beam 154. Parenthetically, the first rope anchor 121 is fixedly mounted on the second beam 152 with the second rope anchor 122 being fixedly mounted on the fifth beam 155.

[0058] In the case of the structure described above, the hoisting machine 4, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 fixedly mounted on the third beam 153 and the fourth beam 154 are supported as an integral unit of an anti-vibration structure. The third beam 153 and the fourth beam 154 represent a member on which the hoisting machine 4, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 are mounted. The member mentioned above is fixedly secured to the first beam 151 and the second beam 152 through interposition of a vibration isolation member. Thus, the load imposed on the hoisting machine, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 can be supported or sustained by the guide rails while transmission of vibrations generated by these machineries to the guide rails 14 can be suppressed. The arrangement described above is advantageous in that transmission of vibrations and noise to rooms located adjacent to the elevator system can be suppressed and thus elevator system of high quality can be realized. Furthermore, the vibrations of the hoisting machine 4, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 can be suppressed from being transmitted to the cage guide rails 14, whereby comfortableness in riding on the cage can be enhanced.

[0059] with the securing or mounting method described above, it is possible in the state where the cage guide rails 14 are mounted upstanding within the elevator shaft 1 to mount the individual components sequentially, i.e., the first and second beams 151 and 152, the third to fifth beams 153 to 155, the hoisting machine 4 and then the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11 orderly in this sequence by using the suspending member 20. Since all of the components mentioned above are of weight not exceeding 30 kg except for the hoisting machine 4, the work of construction on a large scale such as installation by using a crane mounted in advance on the to of the relevant building, transportation of the components for disposition at respective locations through a hole provided in the ceiling of the elevator shaft and so forth are rendered unnecessary.

[0060] The third beam 153 and the fourth beam 154 serve not only for the installation of the machineries described above but also for the functions which will be described below.

[0061] As shown in Figs. 7 to 9, the third beam 153 and the fourth beam 154 cover both of the side surfaces and the top surface of the cage-associated turning pulley 10 or the counterweight-associated turning pulley 11. In other words, the beam mentioned above constitutes a turning pulley cover. Besides, the third beam 153 and the fourth beam 154 cooperate to constitute a rope duct which covers the portion of the main rope 12 which extends from the drive sheave 5 to the cage-associated turning pulley 10 or the counterweight-associated turning pulley 11.

[0062] By virtue of the feature mentioned above, protection can be ensured for the main rope 12, the cage-associated turning pulley 10 and the counterweight-associated turning pulley 11. Besides, the effect of noise isolation can be realized.

[0063] Furthermore, retainers 23 are mounted on the member including the third beam 153 and the fourth beam 154, as can be seen in Fig. 10. The retainers 23 serve for preventing the main rope 12 wound around the drive sheave 5 from slipping out from a rope groove formed in the drive sheave 5. Owing to this arrangement, it is possible to mount and adjust the main rope 12 without any substantial difficulty from the front side even through the main rope is disposed deeply out of reach in the elevator shaft, which means that maintenance is facilitated.

[0064] Besides, a noise-proof cover 24 is mounted on the member including the third beam 153 and the fourth beam 154. More specifically, the noise-proof cover 24 is so disposed as to project downwardly from the third/fourth beam for thereby enclosing the side surfaces of the hoisting machine 4 whose top is additionally covered with the member including the third beam 153 and the fourth beam 154. Thus, the cover structure can be simplified with the installation and the maintenance being facilitated.

[0065] It is further noted that a plurality of lifting pulleys 25 are mounted on the mounting platform 15. Upon installation of the hoisting machine 4, it is possible to lift the hoisting machine 4 up to the top portion of the elevator shaft 1 with the aid of these lifting pulleys 25. Consequently, when the hoisting machine 4 is installed, the work of construction on a large scale such as installation

of a crane on the building top in advance, transportation for disposition of the components through a hole provided in the ceiling of the elevator shaft and so forth are rendered unnecessary.

[0066] Furthermore, a provisional support beam 26 for the hoisting machine 4 is also disposed on the mounting platform 15. Upon installation of the hoisting machine 4, the hoisting machine 4 is first lifted onto the provisional support beam 26 from the bottom portion of the elevator shaft by means of a conventional winch to be positioned provisionally on the provisional support beam 26, whereon the hoisting machine is lifted to the proper installation position with the aid of the lifting pulleys 25.

[0067] The cage-associated turning pulley 10 is mounted on the third beam 153 in the manner described previously.

[0068] The cage-associated turning pulley 10 is provided with a hollow shaft 28. By inserting a solid shaft 29 through the hollow shaft 28, the third beam 153 and the cage-associated turning pulley 10 can be secured together. By virtue of this mounting structure, the cage-associated turning pulley 10 can easily be mounted on the third beam 153 even in the case where the mounting platform of the third beam 153 for mounting thereon the cage-associated turning pulley 10 is shaped in a deep-drawn form so as to constitute a part of the noise-proof cover. Thus, not only the manufacturability but also the assemblability in the field can be enhanced. The counterweight-associated turning pulley 11 can be mounted on the fourth beam 154 in the similar manner.

[0069] Parenthetically, in the instant embodiment of the invention, description has been made on the presumption that the mounting platform 15 is fixedly secured to the cage guide rail 14. It should however be appreciated that the mounting platform 15 may also be fixedly secured to the counterweight guide rail 13. Alternatively, it is equally possible to fixedly secure the mounting platform 15 only to the counterweight guide rail 13.

[0070] Besides, the third beam 153 and the fourth beam 154 constitute the turning pulley covers and the rope ducts. However, either one of these beams may be designed to serve for these purposes.

Embodiment 3

[0071] An embodiment 3 of the present invention partially differs from the embodiment 2 in respect to the structure of the mounting platform 15. Accordingly, the following description will be made on the differences. Except for the differences, the third embodiment is similar to the embodiment 1 or 2 and thus repeated description will be omitted.

[0072] Figure 13 is a view showing a structure of the mounting platform 15 according to the third embodiment of the invention. This figure corresponds to Fig. 8 referenced in the course of description of the second embodiment.

[0073] According to the third embodiment of the invention, the third beam 153 and the fourth beam 154 have one end portions which are fixedly secured to the first beam 151 through the interposed rubber vibration isolator 22 and the other end portions which are fixedly secured to a housing of the hoisting machine 4. Further, the housing of the hoisting machine 4 is fixedly secured to the second beam 152 through the interposed rubber vibration isolator 22. With this arrangement, the housing of the hoisting machine 4 also constitutes a part of the mounting platform 15.

[0074] The elevator apparatus according to the present invention includes a cage reciprocatively movable up and down within an elevator shaft, a counterweight reciprocatively movable up and down within the elevator shaft, a main rope suspending the cage and the counterweight, a hoisting machine having a drive sheave around which the main rope is wound, the drive sheave being disposed between a ceiling of the cage and that of the elevator shaft when the cage has reached a position corresponding to a topmost level, the cage and the counterweight being reciprocatively moved up and down through the medium of the main rope upon rotation of the drive sheave, a speed governor for detecting up/down speed of the cage, a control panel having disposed therein a device for controlling operation of the hoisting machine, and a mounting platform disposed between the ceiling of the cage and that of the elevator shaft when the cage has reached the topmost level, wherein the hoisting machine, the speed governor and the control panel are installed on the mounting platform. By virtue of the arrangement described above, the hoisting machine, the speed governor and the control panel can aggregatively be disposed without involving interference with other machineries within the elevator shaft.

[0075] The elevator apparatus further includes a first turning pulley which is mounted on the mounting platform and around which a portion of the main rope extending from the cage to the drive sheave is wound, and a second turning pulley which is mounted on the mounting platform and around which other portion of the main rope extending from the drive sheave to the counterweight is wound, whereby effective utilization of the space available at the top portion of the elevator shaft can be realized.

[0076] Further, the hoisting machine is implemented in a thin structure having a size in thickness which is smaller than a size in width and disposed such that when the cage reaches the topmost level, the hoisting machine can be accommodated in thicknesswise orientation between the ceiling of the cage and that of the elevator shaft, whereby more effective utilization of the space available at the top portion of the elevator shaft can be achieved.

[0077] Furthermore, the control panel is disposed between a portion of the main rope extending from the first turning pulley to the drive sheave and other portion of the main rope extending from the drive sheave to the second turning pulley as viewed in a plan view (in a same plane orthogonal to a longitudinal axis of the elevator

shaft), whereby the control panel can be disposed in close vicinity to the hoisting machine and hence the space for installation of the control panel can be ensured.

[0078] Further, a pulley of the speed governor is installed between the cage and a wall of the elevator shaft as viewed in a plan view (in a same plane orthogonal to a longitudinal axis of the elevator shaft) and disposed such that a rotational plane of the pulley extends approximately in parallel with a wall of the elevator shaft, whereby the size of the clearance space required for installing the speed governor between the cage and the wall of the elevator shaft can be reduced.

[0079] Further, the control panel and the speed governor are disposed in a space extending from a bottom end of the mounting platform to a top end of the hoisting machine as viewed in a side elevational view (in a same plane parallel to a longitudinal axis of the elevator shaft), whereby the extra vertical space for disposing the speed governor and the control panel is not required.

[0080] Furthermore, a cover covering the hoisting machine, the control panel and the speed governor are mounted on the mounting platform, whereby the housing or casing for the control panel can be spared.

[0081] The elevator apparatus according to the present invention includes a cage reciprocatively movable up and down within an elevator shaft, being guided by a plurality of cage guide rails, a counterweight reciprocatively movable up and down within the elevator shaft, being guided by a plurality of counterweight guide rails, a main rope suspending the cage and the counterweight, a hoisting machine having a drive sheave around which the main rope is wound, the drive sheave being disposed such that when the cage has reached a position corresponding to a topmost level, a rotational plane of the drive sheave is positioned substantially horizontally between a ceiling of the cage and that of the elevator shaft, the cage and the counterweight being reciprocatively moved up and down through the medium of the main rope upon rotation of the drive sheave, a first turning pulley around which a portion of the main rope extending from the cage to the drive sheave is wound, a second turning pulley around which other portion of the main rope extending from the drive sheave to the counterweight is wound, first and second beams secured fixedly to the cage guide rail and/or the counterweight guide rail, and a member on which the hoisting machine, the first turning pulley and the second turning pulley are mounted, wherein the member is fixedly secured to the first beam and the second beam through the medium of a vibration isolation member. By virtue of the arrangement described above, the load imposed by the hoisting machine, the above-mentioned first turning pulley and the above-mentioned second turning pulley can be supported by the guide rails, while transmission of vibrations taking place in these machineries to the guide rails can be suppressed.

[0082] Further, the first beam and the second beam are hanged on the cage guide rail and/or the counterweight guide rail. Owing to this arrangement, the space or installing the above-mentioned first beam the second beam is not required above the guide rails.

[0083] Further, since the member mentioned above is provided with a lifting pulley for lifting the hoisting machine, installation of the hoisting machine can be facilitated.

[0084] Further, because the above-mentioned member includes a third beam on which the first turning pulley is mounted and a fourth beam on which the second turning pulley is mounted, wherein at least one of the third beam and the fourth beam constitutes a pulley cover for the turning pulley, it is possible to protect the turning pulleys.

[0085] Furthermore, because the above-mentioned member constitutes a rope duct covering at least one of a portion of the main rope which extends from the drive sheave of the hoisting machine to the first turning pulley and other portion of the main rope which extends from the drive sheave of the hoisting machine to the second turning pulley, protection of the main rope can be realized.

INDUSTRIAL APPLICABILITY

[0086] As is apparent from the foregoing description, the present invention finds application to the elevator apparatus which includes a cage reciprocatively movable up and down within an elevator shaft, a counterweight reciprocatively movable up and down within the elevator shaft, a main rope suspending the cage and the counterweight, a hoisting machine having a drive sheave around which the main rope is wound, the drive sheave being disposed such that when the cage has reached a position corresponding to a topmost level, a rotational plane of the drive sheave is positioned substantially horizontally between a ceiling of the cage and that of the elevator shaft, the cage and the counterweight being reciprocatively moved up and down through the medium of the main rope upon rotation of the drive sheave, a speed governor for detecting up/down speed of the cage, a control panel having disposed therein a device for controlling operation of the hoisting machine.

[0087] The following numbered paragraphs reveal further aspects of the present invention.

paragraphs

[0088]

1. An elevator apparatus, characterized in that said elevator apparatus comprises:

   a cage (2) reciprocatively movable up and down within an elevator shaft (1);
   a counterweight (3) reciprocatively movable up and down within said elevator shaft (1);
   a main rope (12) suspending said cage (2) and said counterweight (3);

a hoisting machine (4) having a drive sheave (5) around which said main rope (12) is wound, said drive sheave (5) being disposed such that when said cage (2) has reached a position corresponding to a topmost level, a rotational plane of said drive sheave (5) is positioned substantially horizontally between a ceiling of said cage (2) and that of said elevator shaft (1), said cage (2) and said counterweight (3) being reciprocatively moved up and down through the medium of said main rope (12) upon rotation of said drive sheave;
a speed governor (16) for detecting up/down speed of said cage (2);
a control panel (17) having disposed therein a device for controlling operation of said hoisting machine (4); and
a mounting platform (15) disposed between the ceiling of said cage (2) and that of said elevator shaft (1) when said cage (2) has reached said topmost level,

wherein both of said speed governor (16) and said control panel (17) or alternatively either one of said speed governor (16) and said control panel (17) and said hoisting machine (4) are installed on said mounting platform (15).

2. An elevator apparatus set forth in paragraph 1, characterized in that said elevator apparatus further comprises:

a first turning pulley (10) which is mounted on said mounting platform (15) and around which a portion of said main rope (12) extending from said cage (2) to said drive sheave (5) is wound; and
a second turning pulley (11) which is mounted on said mounting platform (15) and around which other portion of said main rope (12) extending from said drive sheave (5) to said counterweight (3) is wound.

3. An elevator apparatus set forth in paragraph 1, characterized in that said hoisting machine (4) is implemented in a thin structure having a size in thickness which is smaller than a size in width and disposed such that when said cage (2) reaches the topmost level, said hoisting machine (4) can be accommodated in thicknesswise orientation between the ceiling of said cage (2) and that of said elevator shaft (1).

4. An elevator apparatus set forth in paragraph 2, characterized in that said control panel (17) is disposed between a portion of said main rope (12) extending from said first turning pulley (10) to said drive sheave (5) and other portion of said main rope (12) extending from said drive sheave (5) to said second turning pulley (11) as viewed in a plan view (in a same plane orthogonal to longitudinal axis of said elevator shaft).

5. An elevator apparatus set forth in paragraph 1, characterized in that a pulley of said speed governor (16) is installed between said cage (2) and a wall of said elevator shaft (1) as viewed in a plan view (in a same plane orthogonal to longitudinal axis of said elevator shaft) and disposed such that a rotational plane of said pulley extends approximately in parallel with a wall of said elevator shaft (1).

6. An elevator apparatus set forth in any one of paragraphs 1 to 5, characterized in that said control panel (17) and said speed governor (16) are disposed in a space extending from a bottom end of said mounting platform (15) to a top end of said hoisting machine (4) as viewed in a side elevational view (in a same plane parallel to a longitudinal axis of said elevator shaft).

7. An elevator apparatus set forth in paragraph 1, characterized in that both of said control panel (17) and said speed governor (16) or alternatively either said control panel (17) or said speed governor (16) and a cover covering said hoisting machine (4) are mounted on said mounting platform (15).

8. An elevator apparatus, characterized in that said elevator apparatus comprises:

a cage (2) reciprocatively movable up and down within an elevator shaft (1), being guided by a plurality of cage guide rails (14);
a counterweight (3) reciprocatively movable up and down within said elevator shaft (1), being guided by a plurality of counterweight guide rails (13);
a main rope (12) suspending said cage (2) and said counterweight (3);
a hoisting machine (4) having a drive sheave (5) around which said main rope (12) is wound, said drive sheave (5) being disposed such that when said cage (2) has reached a position corresponding to a topmost level, a rotational plane of said drive sheave (5) is positioned substantially horizontally between a ceiling of said cage (2) and that of said elevator shaft (1), said cage (2) and said counterweight (3) being reciprocatively moved up and down through the medium of said main rope (12) upon rotation of said drive sheave;
a first turning pulley (10) around which a portion of said main rope (12) extending from said cage (2) to said drive sheave (5) is wound;
a second turning pulley (11) around which other

portion of said main rope (12) extending from said drive sheave (5) to said counterweight (3) is wound;
first and second beams (151; 152) secured fixedly to said cage guide rail (14) and/or said counterweight guide rail (13); and
a member (153; 154) on which said hoisting machine (4), said first turning pulley (10) and said second turning pulley (11) are mounted,

wherein said member (153; 154) is fixedly secured to said first beam (151) and said second beam (152) through the medium of a vibration isolation member (22).

9. An elevator apparatus set forth in paragraph 8, characterized in that said first beam (151) and said second beam (152) are hanged on said cage guide rail (14) and/or said counterweight guide rail (13).

10. An elevator apparatus set forth in paragraph 8, characterized in that said member (153; 154) is provided with a lifting pulley (25) for lifting said hoisting machine (4).

11. An elevator apparatus set forth in paragraph 8, characterized in that said member includes a third beam (153) on which said first turning pulley (10) is mounted and a fourth beam (154) on which said second turning pulley (11) is mounted, wherein at least one of said third beam (153) and said fourth beam (154) constitutes a pulley cover for said turning pulley (10; 11).

12. An elevator apparatus set forth in paragraph 8, characterized in that said member (153, 154) constitutes a rope duct covering at least one of a portion of said main rope (12) which extends from said drive sheave (5) of said hoisting machine (4) to said first turning pulley (10) and other portion of said main rope (12) which extends from said drive sheave (5) of said hoisting machine (4) to said second turning pulley (11).

Claims

1. An elevator apparatus, **characterized in that** said elevator apparatus comprises:

a cage (2) reciprocatively movable up and down within an elevator shaft (1);
a counterweight (3) reciprocatively movable up and down within said elevator shaft (1);
a main rope (12) suspending said cage (2) and said counterweight (3);
a hoisting machine (4) having a drive sheave (5) around which said main rope (12) is wound, said drive sheave (5) being disposed such that when said cage (2) has reached a position corresponding to a topmost level, a rotational plane of said drive sheave (5) is positioned substantially horizontally between a ceiling of said cage (2) and that of said elevator shaft (1), said cage (2) and said counterweight (3) being reciprocatively moved up and down through the medium of said main rope (12) upon rotation of said drive sheave;
a mounting platform (15) disposed between the ceiling of said cage (2) and that of said elevator shaft (1) when said cage (2) has reached said topmost level;
a first turning pulley (10) which is mounted on said mounting platform (15) and around which a portion of said main rope (12) extending from said cage (2) to said drive sheave (5) is wound; and
a second turning pulley (11) which is mounted on said mounting platform (15) and around which other portion of said main rope (12) extending from said drive sheave (5) to said counterweight (3) is wound.

FIG. 1

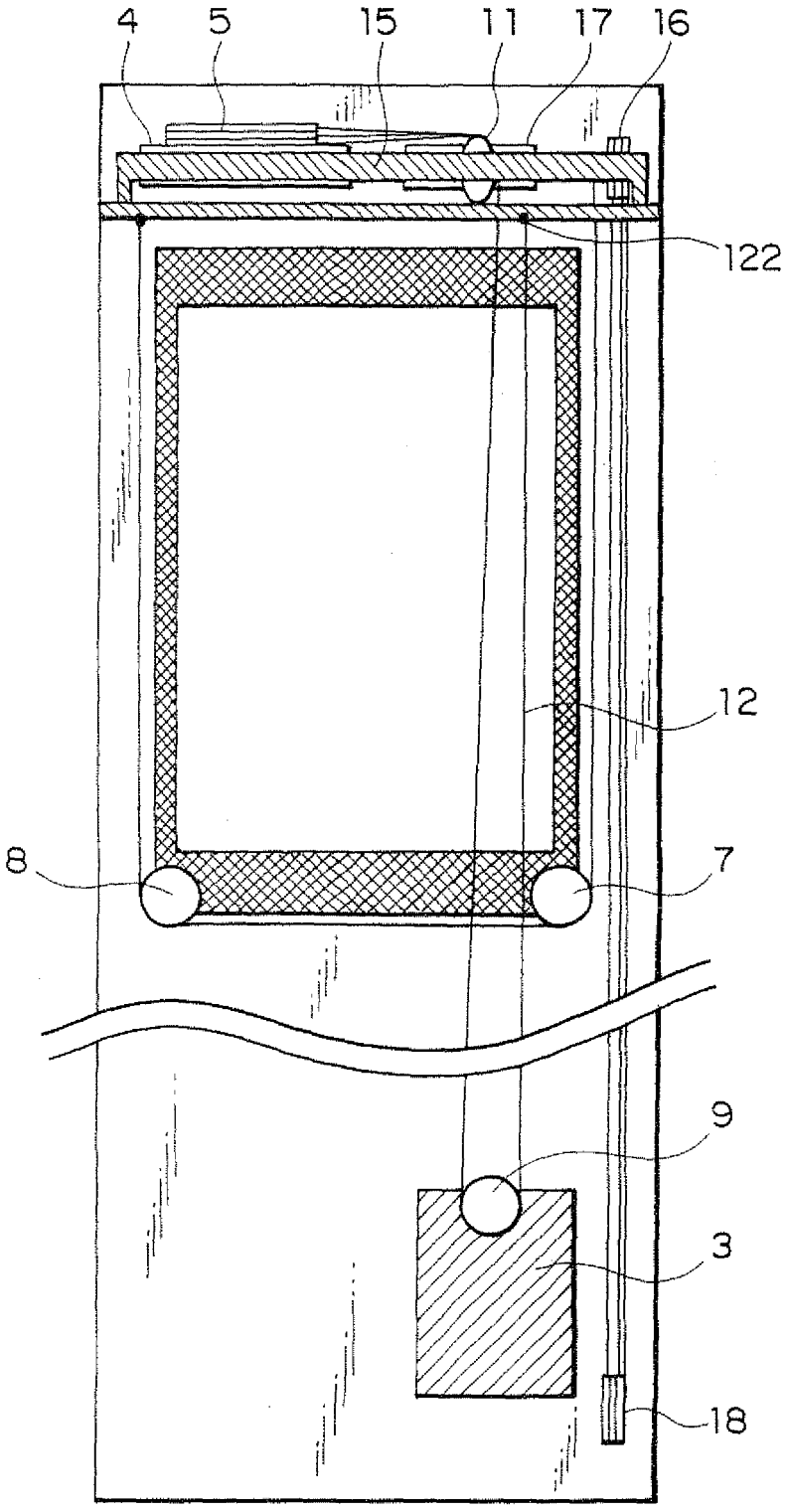


FIG. 2

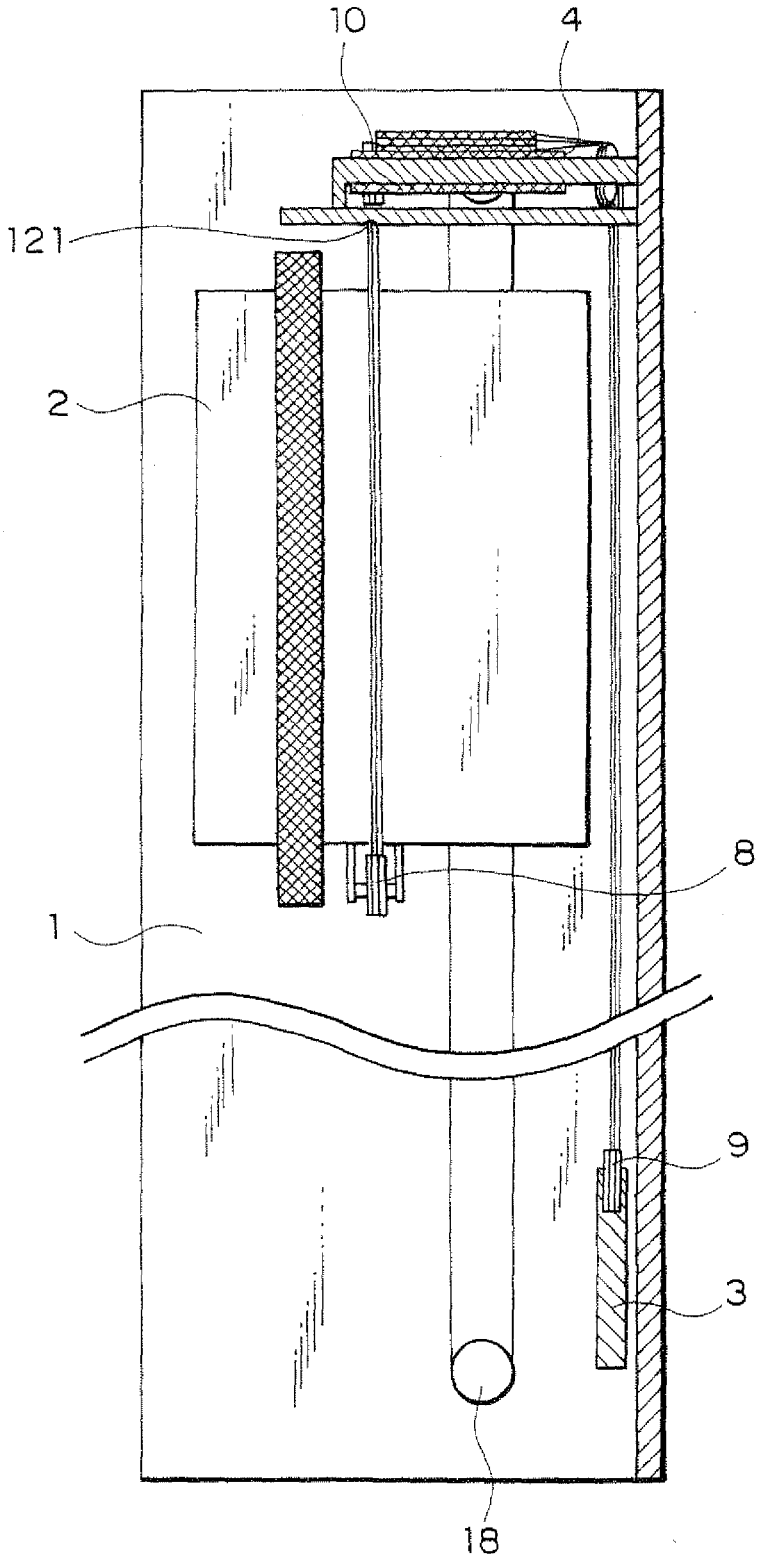


FIG. 3

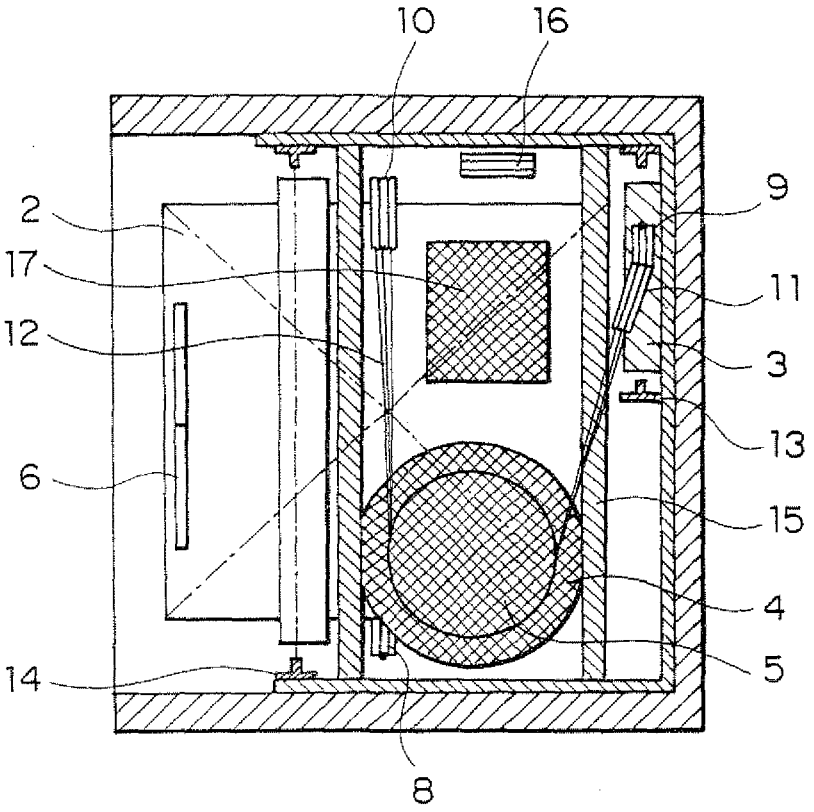


FIG. 4A

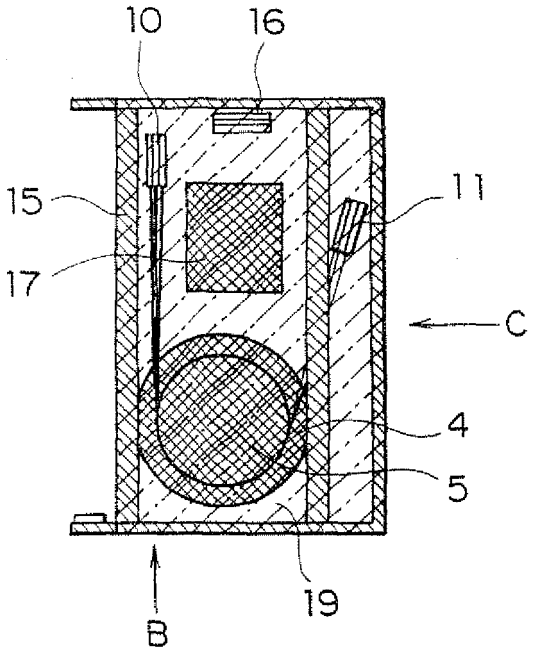


FIG. 4B

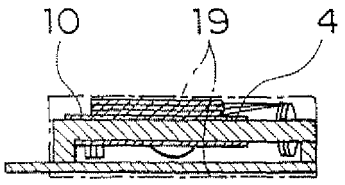


FIG. 4C

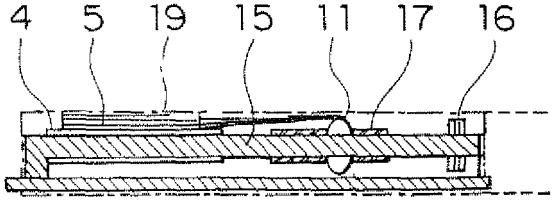


FIG. 5

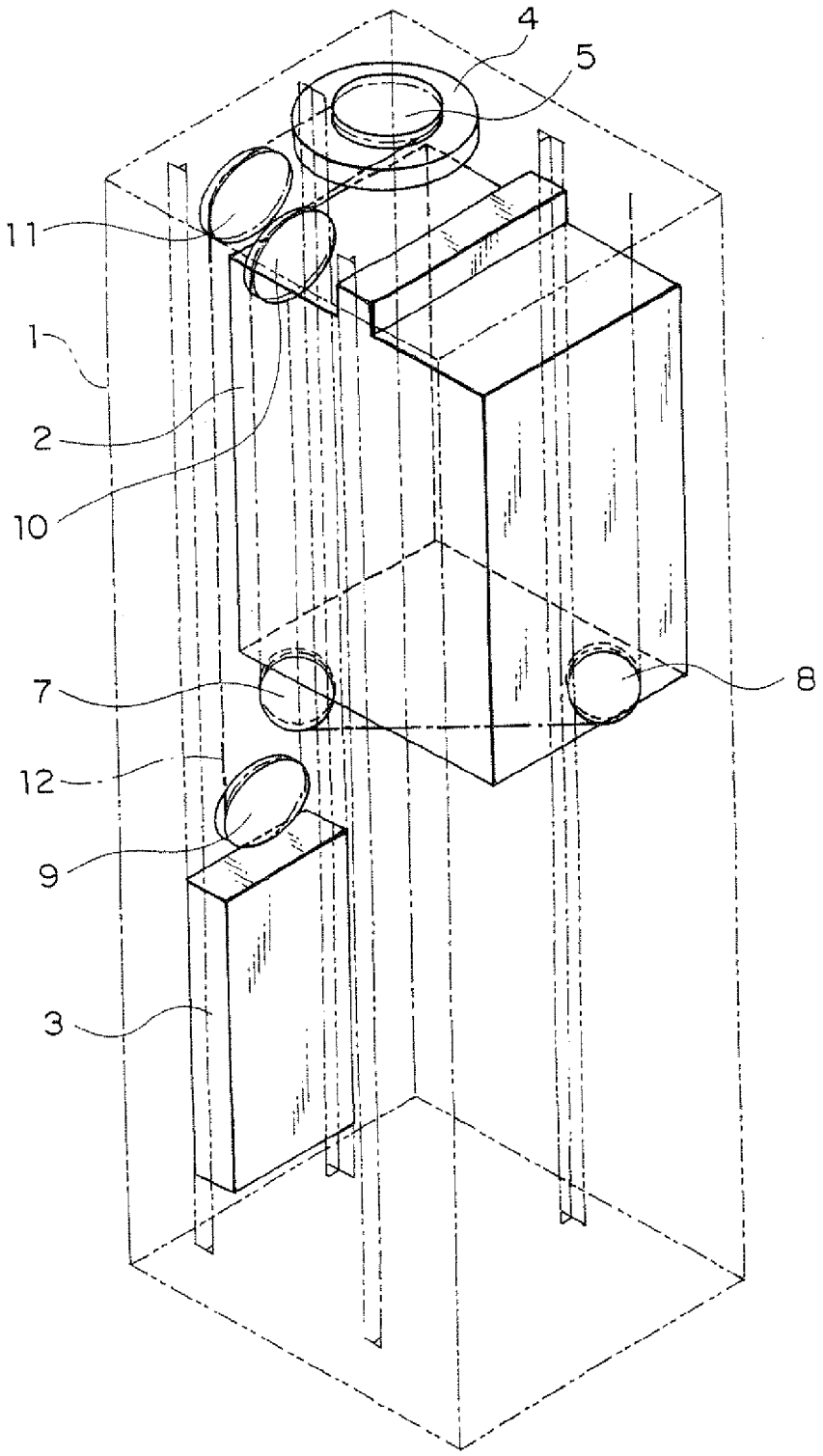


FIG. 6

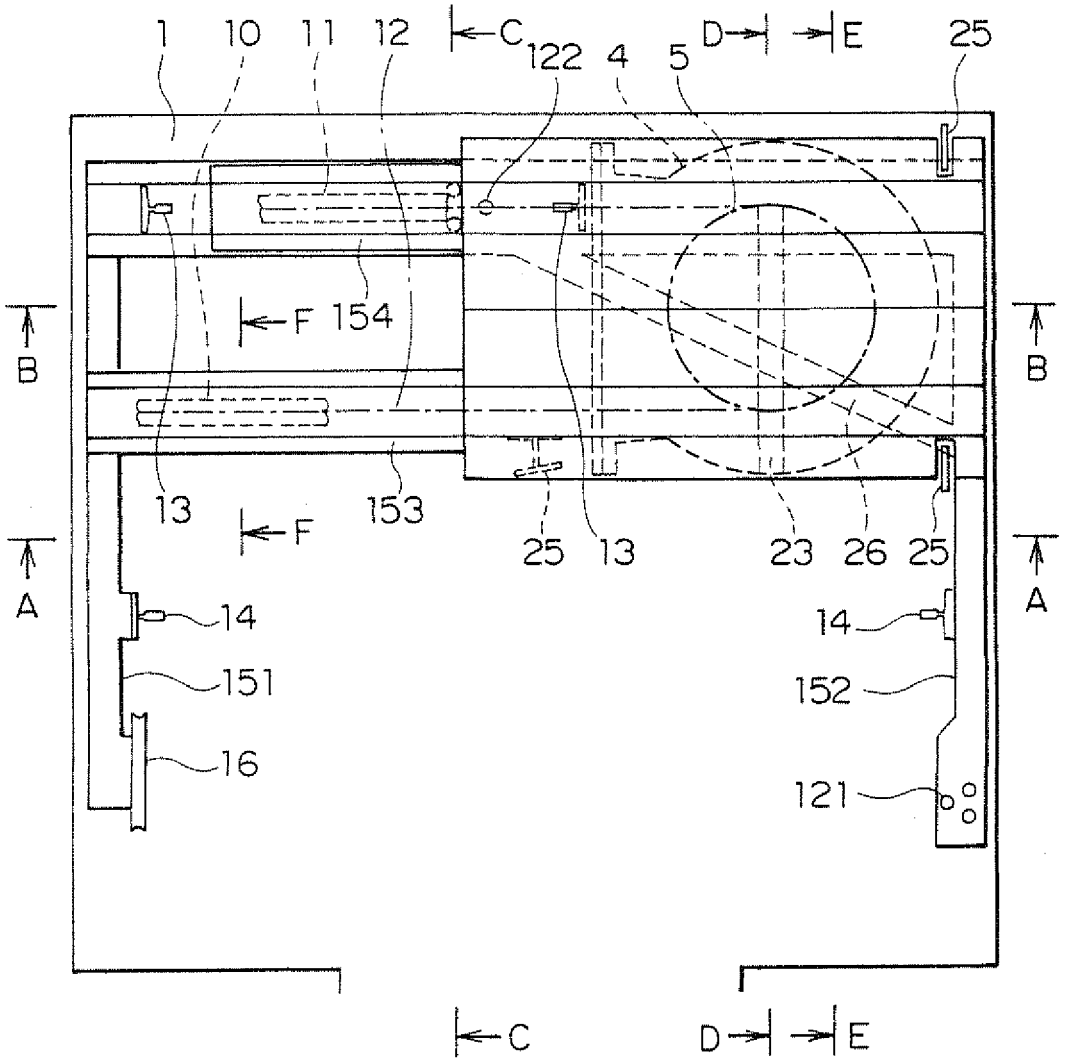

1
10
11
12
C
122
4
5
D
E
25
B
F
154
B
13
F
153
25
13
23
26
25
A
A
14
14
151
152
16
121
C
D
E

FIG. 7

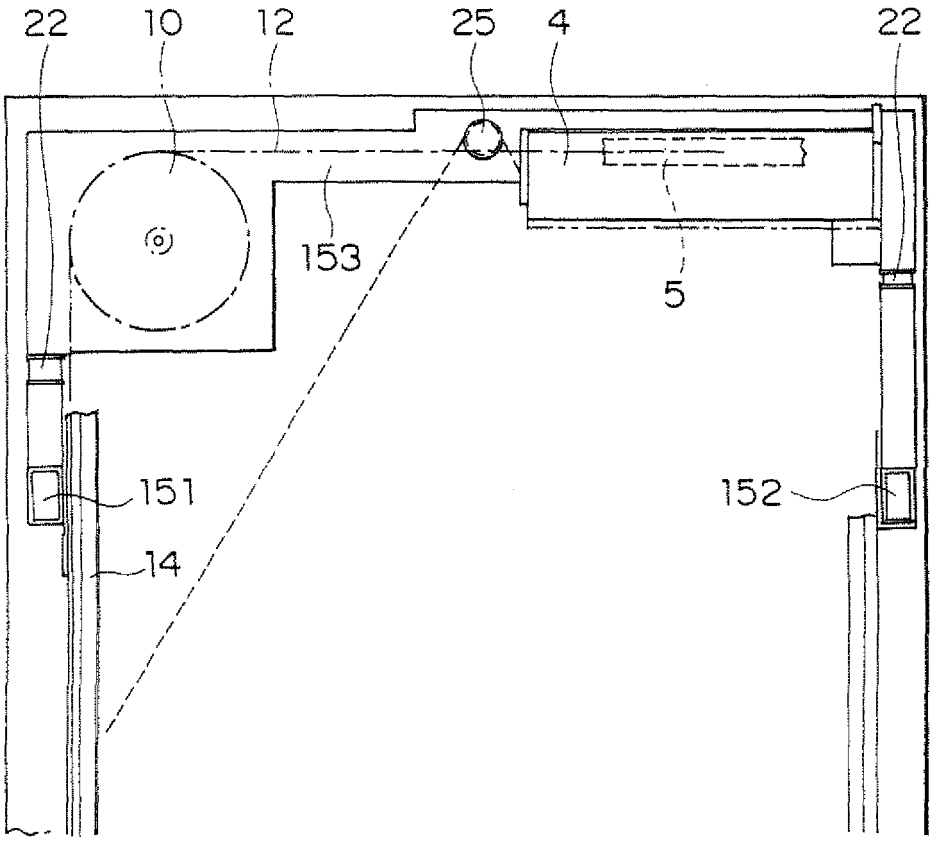


FIG. 8

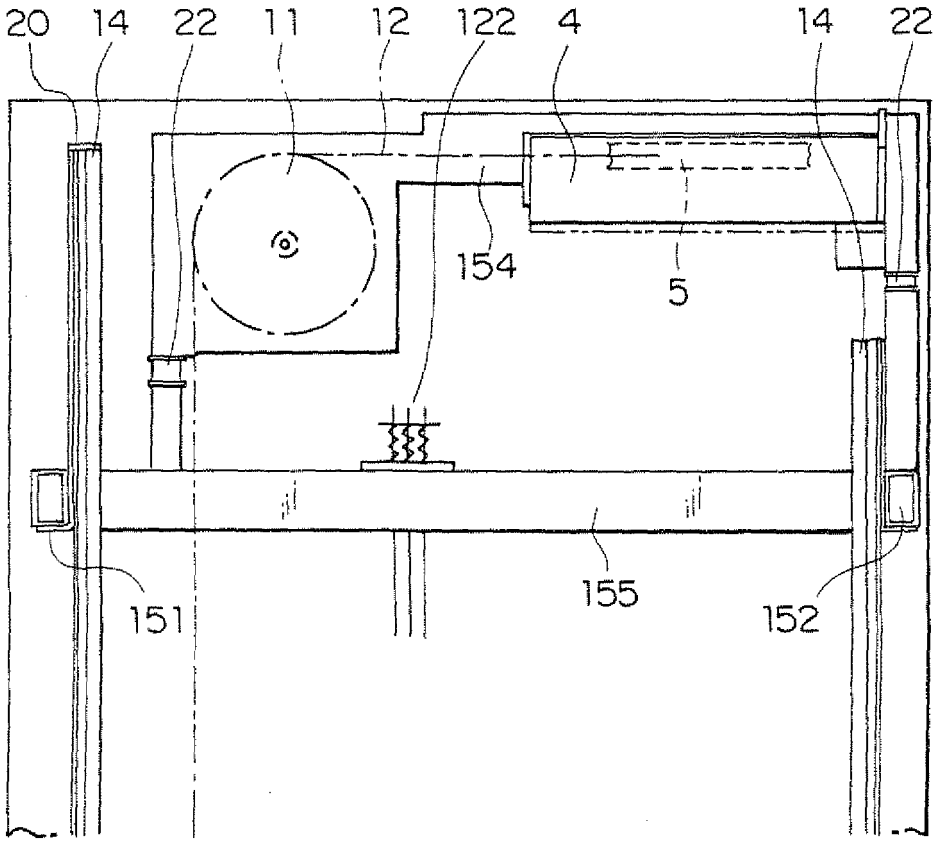


FIG. 9

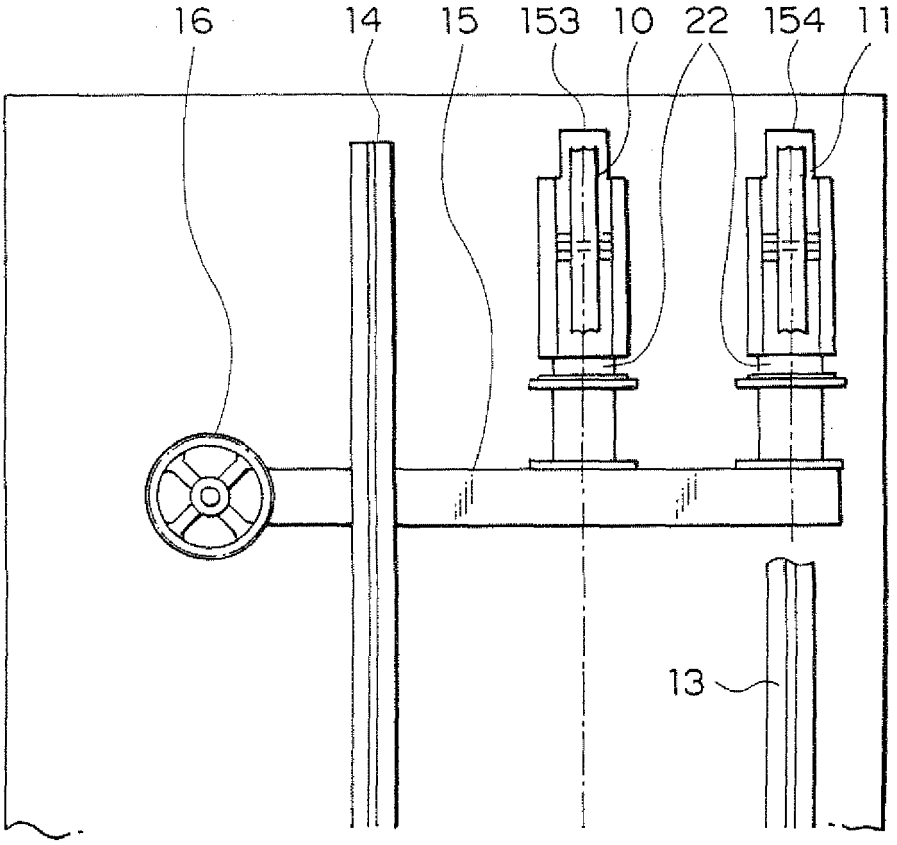


FIG. 10

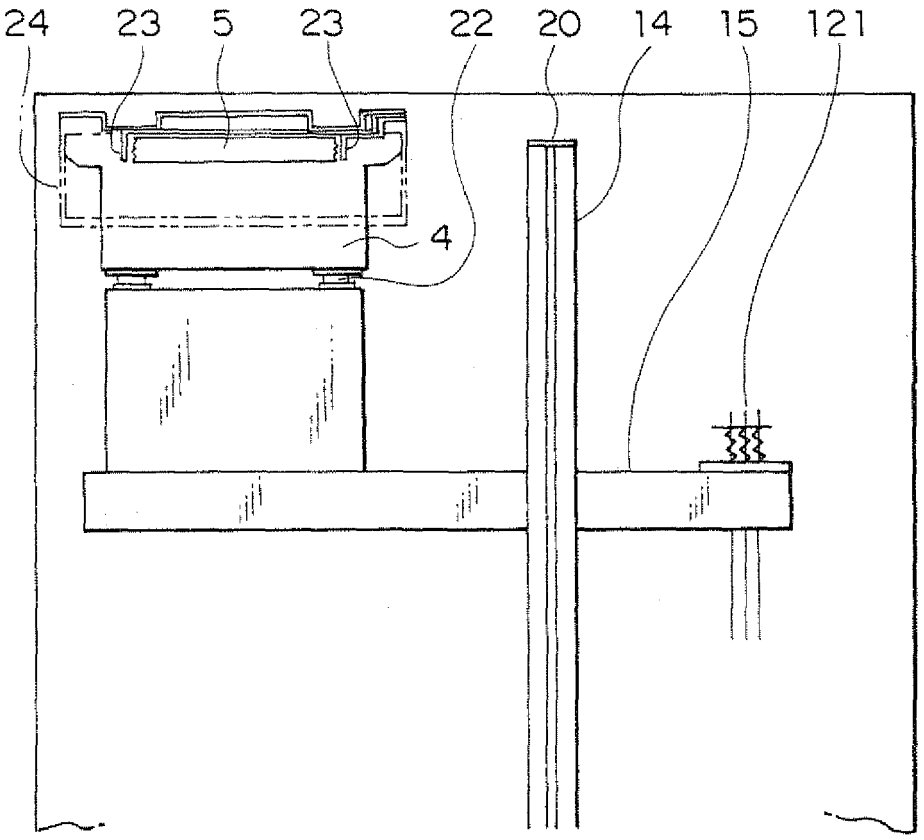


FIG. 11

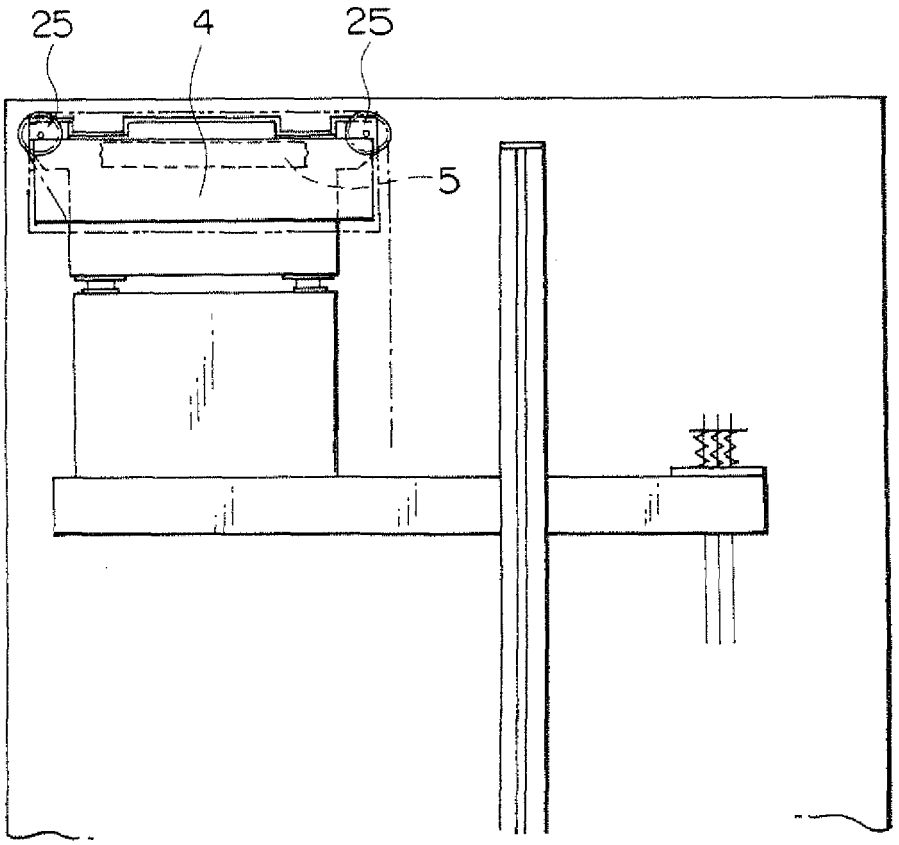


FIG. 12

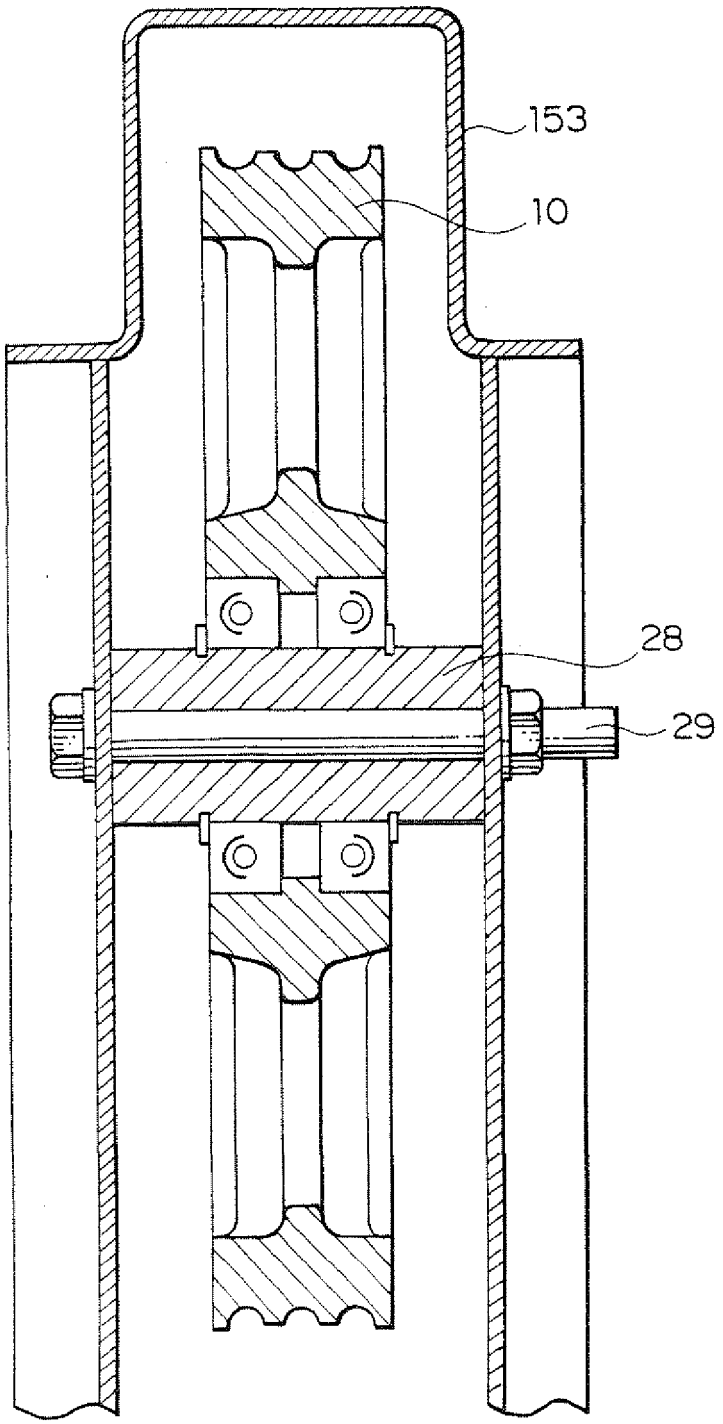


FIG. 13

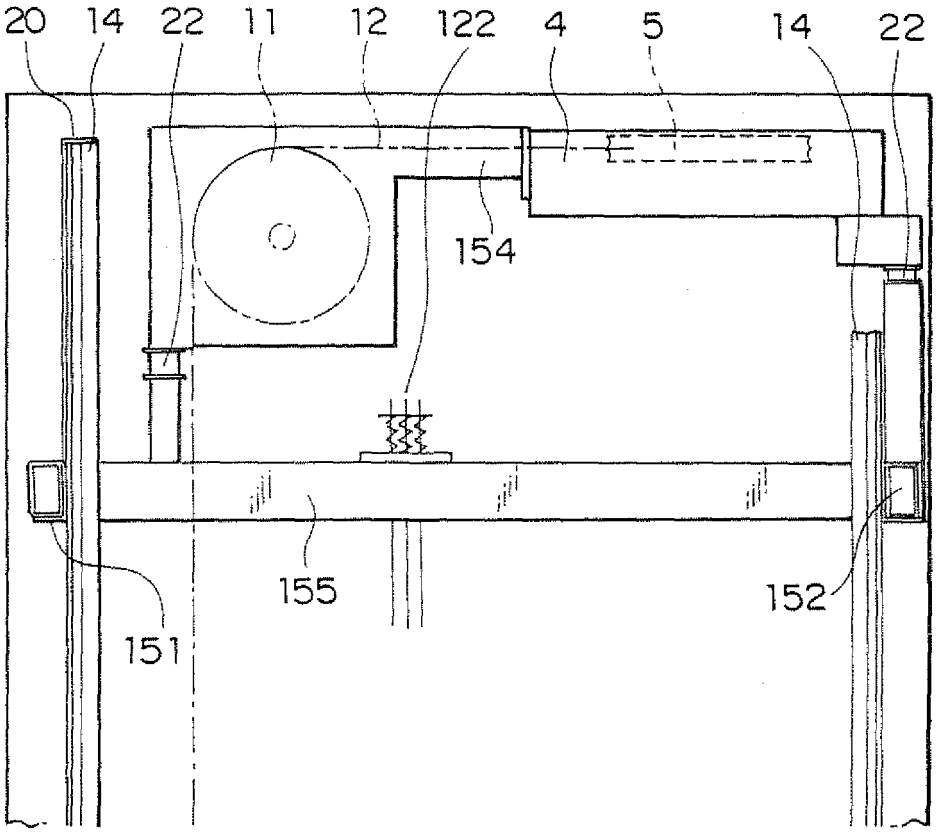


FIG. 14

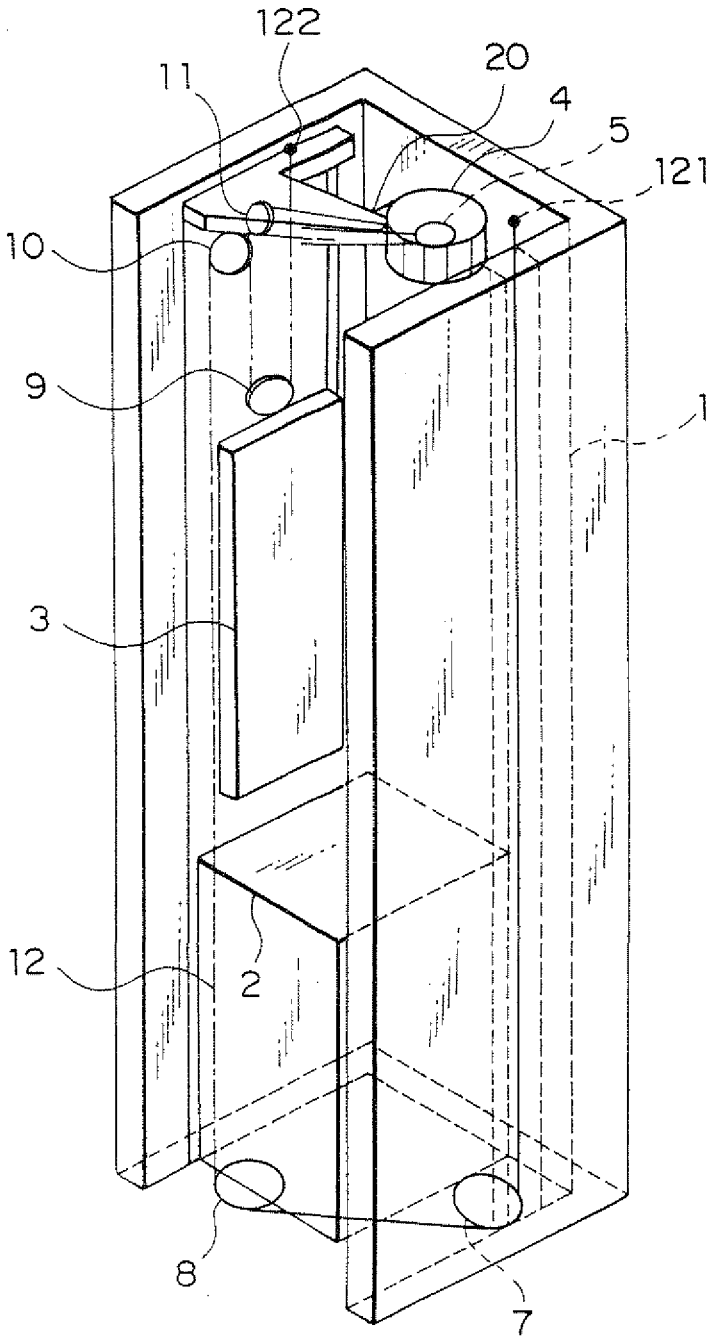
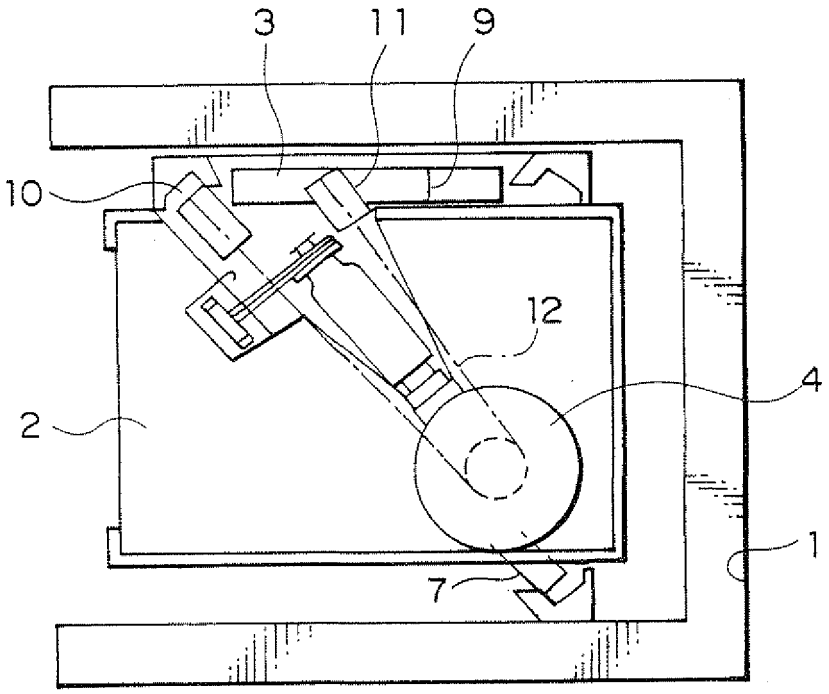


FIG. 15



REFERENCES CITED IN THE DESCRIPTION

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