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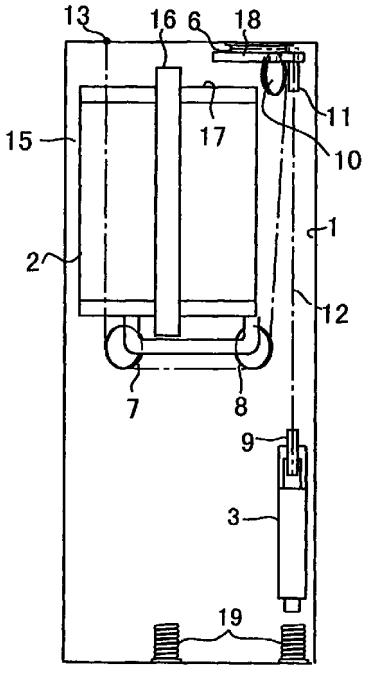
(54) Cable guide and drive machinery position for elevator

(57) There is described an elevator system which can be installed in a shaft accommodated within the height of the top floor of a building and in which a hoisting machine can be disposed within the shaft. A couple of turning pulleys for changing a main cable extending between a car and a counterweight from a vertical direction to a horizontal direction are provided in a space between the edge of the car and the interior wall surface of a shaft. A hoisting machine on which a drive sheave is provided in a rotatable manner such that the rotor axis of the drive sheave is oriented vertically is provided at the upper end of the shaft, such that the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. As a result, the hoisting machine can be disposed in the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the car and the hoisting machine. The elevator system can be installed within the shaft accommodated within the height of the top floor, thereby diminishing construction cost required for ensuring a space for installing the elevator system.

FIG. 1



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Description

Background of the Invention

Field of the Invention

[0001] The present invention relates to an elevator system, in which a hoisting machine for driving a main cable connecting a car with a counterweight is disposed within a shaft.

Background Art

[0002] FIGS. 18 and 19 show a conventional elevator system described in, for example, Japanese Patent Application Laid-Open No. Hei-10-139321, wherein FIG. 18 is a perspective view conceptually showing the elevator system and FIG. 19 is a transverse plan view showing the principal elements of the elevator system shown in FIG. 18.

[0003] In the drawings, reference numeral 1 designates a shaft; 2 designates a car which travels vertically along a predetermined path within the shaft 1; 3 designates a counterweight provided on one side of and within the shaft 1 when viewed from the top; and 4 designates a hoisting machine which is provided on the ceiling by means of a support member 5 provided at the upper portion of the shaft 1 and on which a drive sheave 6 is provided such that the rotor axis thereof is oriented vertically.

[0004] Reference numeral 7 designates a first car pulley provided along ode side of the lower surface of the car 2; 8 designates a second car pulley provided along one of the remaining sides of the lower surface of the car 2; 9 designates a counterweight pulley provided on the top of the counterweight 3; 10 designates a turning pulley (hereinafter referred to as a "car-side turning pulley") which is provided on the upper portion of the shaft 1 in a rotatable manner so as to correspond to the position of the second car pulley 8, such that the rotor axis of the turning pulley 10 is oriented horizontally; and 11 designates a turning pulley which is provided on the top of the shaft 1 in a rotatable manner by means of a horizontally-extending pivot so as to correspond to the position of the counterweight pulley 9 (hereinafter referred to as a "counterweight-side turning pulley"). When viewed within a horizontal plane of projection, an overlap exists between the car 2 and the car-side turning pulley 10 and the counterweight-side turning pulley 11.

[0005] Reference numeral 12 designates a main cable whose one end is connected to the upper portion of the shaft 1 by means of a first cable anchor 13 provided on the ceiling of the shaft 1 so as to correspond to the first car pulley 7 and whose remaining end is connected to the upper portion of the shaft 1 by means of a second cable anchor 14 provided on the ceiling of the shaft 1 so as to correspond to the counterweight pulley 9. The main cable 12 is wound around the first car pulley 7, the second car pulley 8, the car-side turning pulley 10, the drive sheave 6, the counterweight-side turning pulley 11, and the counterweight pulley 9, in the sequence given.

[0006] In the conventional elevator system having the aforementioned configuration, the hoisting machine 4 is energized and driven so as to rotate the drive sheave 6, whereupon the car 2 and the counterweight 3 are moved vertically in opposite directions by way of the main cable 12. The hoisting machine 4 is provided at the upper portion of and within the shaft 1, thereby obviating a machinery room, which would otherwise be independently provided at a position above the shaft 1, and reducing the total space occupied by the elevator system within a building.

[0007] In the foregoing conventional elevator system, the hoisting machine 4 is mounted on the ceiling of the shaft 1 by means of the support member 5 provided at the upper portion of the shaft 1. Further, the main cable 12 extends across the position above the center of the car 2. For these reasons, the ceiling of the shaft 1 must be made higher than the top floor of the building. Thus, ensuring a space for installing the elevator system adds to construction cost.

[0008] The present invention has been conceived to solve such a problem in the conventional elevator system, and the object of the present invention is to provide an elevator system which can be installed in a shaft accommodated within the height of the top floor of a building and in which a hoisting machine can be disposed within the shaft.

Summary of the Invention

[0009] According to one aspect of the present invention, an elevator system comprises a car which moves vertically along a predetermined path within a shaft. A counterweight is provided in a space between an interior wall surface of the shaft and the car. A pair of turning pulleys are provided on the upper end of the shaft so as to correspond to the car and the counterweight respectively. The pair of turning pulleys are provided, in a horizontal plane of projection, within the space between the car and the interior wall surface of the shaft. A hoisting machine is provided which includes a drive sheave mounted thereon with the rotor axis thereof oriented vertically. The hoisting machine is disposed at the upper end of the shaft and is located at a position higher than the lower edges of the pair of turning pulleys. Further, a main cable is provided whose one end is connected to the car and whose remaining end is connected to the counterweight. The main cable is wound around the pair of turning pulleys, and extends between the pair of turning pulleys while being wound around the drive sheave.

[0010] Other and further objects, features and advantages of the invention will appear more fully from

the following description.

Brief Description of the Drawings

[0011]

FIG. 1 is a longitudinal cross-sectional view conceptually showing an elevator system when viewed from the side front according to the first embodiment of the present invention;
FIG. 2 is a longitudinal cross-sectional view of the elevator system shown in FIG. 1 when viewed from the rear side front;
FIG. 3 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 1 and 2;
FIG. 4 is a perspective view of the elevator system shown in FIGS. 1 thorough 3;
FIG. 5 is a longitudinal cross-sectional view conceptually showing an elevator system when viewed from the side front according to the second embodiment of the present invention;
FIG. 6 is a longitudinal cross-sectional view of the elevator system shown in FIG. 5 when viewed from the rear side;
FIG. 7 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 5 and 6;
FIG. 8 is a perspective view of the elevator system shown in FIGS. 5 thorough 7;
FIG. 9 is a longitudinal cross-sectional view conceptually showing an elevator system when viewed from the side front according to the third embodiment of the present invention;
FIG. 10 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 9;
FIG. 11 is a perspective view of the elevator system shown in FIGS. 9 and 10;
FIG. 12 is a longitudinal cross-sectional view conceptually showing an elevator system when viewed from the side front according to the fourth embodiment of the present invention;
FIG. 13 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 12;
FIG. 14 is a perspective view of the elevator system shown in FIGS. 12 and 13;
FIG. 15 is a longitudinal cross-sectional view conceptually showing an elevator system when viewed from the side front according to the fifth embodiment of the present invention;
FIG. 16 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 15;
FIG. 17 is a perspective view of the elevator system shown in FIGS. 15 and 16;
FIG. 18 is a perspective view conceptually showing the elevator system in a conventional art; and
FIG. 19 is a transverse plan view showing the principal elements of the elevator system shown in FIG. 18.

Detailed Description of the Preferred Embodiments

[0012] Detailed description of the preferred embodiments will be given with reference to the accompanying drawings, in which same reference numerals indicate same or corresponding portions.

First Embodiment

[0013] FIGS. 1 through 4 illustrate an elevator system according to a first embodiment of the present invention. FIG. 1 is a longitudinal cross-sectional view conceptually showing an elevator system according to the first embodiment when viewed from the side front; FIG. 2 is a longitudinal cross-sectional view of the elevator system shown in FIG. 1 when viewed from the side; FIG. 3 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 1 and 2; and FIG. 4 is a perspective view of the elevator system shown in FIGS. 1 thorough 3.

[0014] In the drawings, reference numeral 1 designates a shaft; and 2 designates a car which moves vertically along a predetermined path within the shaft 1. The car 2 is provided with a door 15 and an upper beam 16. The upper surface of the roof of the car 2 is lower than the upper surface of the upper beam 16, thus constituting a recessed surface 17.

[0015] Reference numeral 3 designates a counterweight provided along one of the four interior sides of the shaft 1. Reference numeral 18 designates a hoisting machine provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. A drive sheave 6 is provided on the hoisting machine 18 in a rotatable manner such that the rotor axis of the drive sheave 6 is oriented vertically. Reference numeral 7 designates a first car pulley provided on one side of the lower surface of the car 2; and 8 designates a second car pulley provided on another side of the lower surface of the car 2 substantially opposite the first car pulley 7.

[0016] Reference numeral 9 designates a counterweight pulley provided on the top of the counterweight 3, and 10 designates a turning pulley (hereinafter referred to as a "car-side turning pulley"). When viewed within a horizontal plane of projection, the car-side turning pulley 10 is located within a space between the interior wall surface of the shaft 1 and the car 2 so as to correspond to the position of the second car pulley 8. The car-side turning pulley 10 is attached to the upper portion of the shaft 1 in a rotatable manner such that the rotor axis of the turning pulley 10 is oriented horizontally.

[0017] Reference numeral 11 designates a turning

pulley (hereinafter referred to as a "counterweight-side turning pulley"). When viewed within a horizontal plane of projection, the counterweight-side turning pulley 11 is located within a space between the interior wall surface of the shaft 1 and the car 2 so as to correspond to the position of the counterweight pulley 9. The counterweight-side turning pulley 11 is attached to the upper portion of the shaft 1 in a rotatable manner such that the rotor axis of the turning pulley 11 is oriented horizontally. Reference numeral 19 designates shock absorbers disposed on the bottom surface of the shaft 1 so as to correspond to the car 2 and the counterweight 3, respectively.

[0018] Reference numeral 12 designates a main cable whose one end is connected to the upper portion of the shaft 1 by means of a first cable anchor 13 provided in an upper portion of the shaft 1 so as to correspond to the first car pulley 7, and whose remaining end is connected to the upper portion of the shaft 1 by means of a second cable anchor 14 provided in the upper portion of the shaft 1 so as to correspond to the counterweight pulley 9. The main cable 12 is wound around the first car pulley 7, the second car pulley 8, the car-side turning pulley 10, the drive sheave 6, the counterweight-side turning pulley 11, and the counterweight pulley 9, in the sequence given.

[0019] In the elevator system having the aforementioned configuration, the hoisting machine 18 is energized and driven so as to rotate the drive sheave 6, whereupon the car 2 and the counterweight 3 are moved vertically in opposite directions by way of the main cable 12. The hoisting machine 18 is provided at the upper portion of and within the shaft 1, thereby obviating a machinery room, which would otherwise be independently provided at a position above the shaft 1, and reducing the total space occupied by the elevator system within a building.

[0020] The lower end of the hoisting machine 18 disposed at the upper end of the shaft 1 is located at a position higher than the lower ends of the turning pulleys 10 and 11. The hoisting machine 18 is provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. Further, the car-side turning pulley 10 and the counterweight-side turning pulley 11 are provided within a gap between the edge of the car 2 and the interior wall surface of the shaft 1.

[0021] The drive sheave 6 is provided on the hoisting machine 18, and the main cable 12 extends horizontally with respect to the drive sheave 6. As a result, the hoisting machine 18 is disposed and the main cable 12 can extend within the shaft 1 accommodated within the height of the top floor (not shown) of the building.

[0022] Since the car 2 can approach the ceiling of the shaft 1, a necessity for making the ceiling of the shaft 1 higher than the top floor of the building is obviated, thus diminishing construction cost required for ensuring a space for installing the elevator system. Moreover, since the height of the building can be reduced, there may be prevented occurrence of a problem; for example, a problem of blocking sunlight from the neighboring buildings and spaces.

[0023] As shown in FIG. 1 and other drawings, the drive sheave 6 is disposed on the hoisting machine 18 such that the side surface of the drive sheave 6 faces the ceiling of the shaft 1. Compared with the configuration of the elevator system in which the drive sheave 6 is provided below the hoisting machine 18, the configuration of the elevator system of the present embodiment yields the advantage of enabling provision of un-illustrated equipments other than the upper beam 16 on the roof of the car 2 or the top of the car 2.

[0024] There must be ensured that the main cable 12 wound around the drive sheave 6 should be prevented from colliding with the equipments provided on the car 2 when the car 2 has reached the highest position. To this end, the drive sheave 6 is provided on the hoisting machine 18, as a result of which the highest position of the car 2 where the car 2 avoids the hoisting machine 18 may be set higher than in a case where the drive sheave 6 is provided below the hoisting machine 18. Consequently, the space in the upper end of the shaft 1 can be effectively utilized, and construction cost required for building the shaft 1 can be diminished.

[0025] As shown in FIG. 1 and other drawings, when viewed within a horizontal plane of projection, the hoisting machine 18 and the car 2 are disposed so as to overlap at least partially. The space of the shaft 1 when viewed within a horizontal plane of projection can be effectively utilized, thereby diminishing construction cost required for building the shaft 1.

Second Embodiment

[0026] FIGS. 5 through 8 illustrate an elevator system according to a second embodiment of the present invention. FIG. 5 is a longitudinal cross-sectional view conceptually showing an elevator system according to the second embodiment when viewed from the side front; FIG. 6 is a longitudinal cross-sectional view of the elevator system shown in FIG. 5 when viewed from the side; FIG. 7 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 5 through 7; and FIG. 8 is a perspective view of the elevator system shown in FIGS. 5 thorough 7.

[0027] Throughout the drawings, those reference numerals which are the same as those provided in FIGS. 1 through 4 designate the corresponding elements.

[0028] Reference numeral 20 designates a hoisting machine provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. The drive sheave 6 is provided on the hoisting machine 20 in a rotatable manner such that the rotor axis of the drive sheave 6 is oriented vertically. An electric drive motor 21 is provided on the lower

surface of the hoisting machine 20 so as to protrude downward within the space between the edge of the car 2 and the interior wall surface of the shaft 1.

[0029] Even in the above-described elevator system, the hoisting machine 20 is disposed on the upper end of the shaft 1, and the lower end of the hoisting machine 20 is located at a position higher than the lower end of the turning pulleys 10 and 11. Although the electric drive motor 21 is attached to the lower surface of the hoisting machine 20 so as to protrude downward, the electric drive motor 21 is located within the space between the edge of the car 2 and the interior wall surface of the shaft 1. Further, the hoisting machine 20 is provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15.

[0030] Further, the car-side turning pulley 10 and the counterweight-side turning pulley 11 are disposed in the gap between the edge of the car 2 and the interior wall surface of the shaft 1. Further detailed description will be omitted to avoid duplication. Thus, the second embodiment shown in FIGS. 5 through 8 also yields the same advantageous results as those yielded by the first embodiment shown in FIGS. 1 through 4.

Third Embodiment

[0031] FIGS. 9 through 11 illustrate an elevator system according to a third embodiment of the present invention. FIG. 9 is a longitudinal cross-sectional view conceptually showing an elevator system according to the third embodiment when viewed from the side front; FIG. 10 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 9 ; and FIG. 11 is a perspective view of the elevator system shown in FIGS. 9 and 10.

[0032] Throughout the drawings, those reference numerals which are the same as those provided in FIGS. 1 through 4 designate the corresponding elements.

[0033] Reference numeral 22 designates a main cable whose one end is connected to the lower edge of the car 2 opposite the door 15 and whose remaining end is connected to the top of the counterweight 3. The main cable 22 is wound around the car-side turning pulley 10, the drive sheave 6, and the counterweight-side turning pulley 11, in the sequence given.

[0034] Even in the above-described elevator system, the hoisting machine 18 is disposed on the upper end of the shaft 1, and the lower end of the hoisting machine 18 is located at a position higher than the lower end of the turning pulleys 10 and 11. The hoisting machine 18 is provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. Moreover, the car-side turning pulley 10 and the counterweight-side turning pulley 11 are disposed within a space between the edge of the car 2 and the interior wall surface of the shaft 1. Consequently, although detailed description will be omitted to avoid duplication, the third embodiment shown in FIGS. 9 through 11 also yields the same advantageous results as those yielded by the first embodiment shown in FIGS. 1 through 4.

Fourth Embodiment

[0035] FIGS. 12 through 14 illustrate an elevator system according to a fourth embodiment of the present invention. FIG. 12 is a longitudinal cross-sectional view conceptually showing an elevator system according to the fourth embodiment when viewed from the side front; FIG. 13 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 12; and FIG. 14 is a perspective view of the elevator system shown in FIGS. 12 and 13.

[0036] Throughout the drawings, those reference numerals which are the same as those provided in FIGS. 1 through 4 designate the corresponding elements.

[0037] Reference numeral 23 designates a deflector wheel mounted on the ceiling of the shaft 1 such that the rotor axis of the deflector wheel 23 is oriented vertically. The deflector wheel 23 pulls the main cable 12, which is extending between the drive sheave 6 and the car-side turning pulley 10, toward the interior surface of the shaft 1

[0038] Even in the above-described elevator system, the hoisting machine 18 is disposed on the upper end of the shaft 1, and the lower end of the hoisting machine 18 is located at a position higher than the lower end of the turning pulleys 10 and 11. The hoisting machine 18 is provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. Moreover, the car-side turning pulley 10 and the counterweight-side turning pulley 11 are disposed within the space between the edge of the car 2 and the interior wall surface of the shaft 1.

[0039] Consequently, although not described in detail, the fourth embodiment shown in FIGS. 12 through 14 also yields the same advantageous results as those yielded by the first embodiment shown in FIGS. 1 through 4.

[0040] In the fourth embodiment shown in FIGS. 12 through 14, the deflector wheel 23 pulls the main cable 12 extending between the drive sheave 6 and the car-side turning pulley 10, in the horizontal direction toward the interior surface of the shaft 1. As a result, the side surface of the car-side turning pulley 10 can be provided in parallel with the interior surface of the shaft 1. Consequently, the width of the space between the edge of the car 2 and the interior wall surface of the shaft 1 can be diminished, thus reducing the total space to be occupied by the elevator system within the building to a much greater extent.

Fifth Embodiment

[0041] FIGS. 15 through 17 illustrate an elevator system according to a fifth embodiment of the present invention. FIG. 15 is a longitudinal cross-sectional view conceptually showing an elevator system according to the fifth embodiment when viewed from the side front; FIG. 16 is a transverse cross-sectional view showing the principal elements of the elevator system shown in FIG. 15; and FIG. 17 is a perspective view of the elevator system shown in FIGS. 15 and 16.

[0042] Throughout the drawings, those reference numerals which are the same as those provided in FIGS. 1 through 4 designate the corresponding elements.

[0043] Reference numeral 24 designates a counterweight provided within the space between the edge of one of the lateral sides of the car 2 and the interior wall surface of the shaft 1.

[0044] Even in the above-described elevator system, the hoisting machine 18 is disposed on the upper end of the shaft 1, and the lower end of the hoisting machine 18 is located at a position higher than the lower end of the turning pulleys 10 and 11. The hoisting machine 18 is provided on the ceiling of the shaft 1 at a position above a portion of the recessed surface 17 located away from the door 15. Moreover, the car-side turning pulley 10 and the counterweight-side turning pulley 11 are disposed within the space between the edge of the car 2 and the interior wall surface of the shaft 1.

[0045] The deflector wheel 23 pulls the main cable 12, which is extending between the drive sheave 6 and the car-side turning pulley 10, in the horizontal direction toward the interior surface of the shaft 1. As a result, the side surface of the car-side turning pulley 10 can be provided in parallel with the interior surface of the shaft 1.

[0046] Consequently, although not described in detail, the fifth embodiment shown in FIGS. 15 through 17 also yields the same advantageous results as those yielded by the fourth embodiment shown in FIGS. 12 through 14.

[0047] The features and the advantages of the present invention may be summarized as follows.

[0048] As has been described above, in one aspect, the present invention provides an elevator system which comprises a car, a counterweight, turning pulleys, a main cable, and a hoisting machine which includes a drive sheave. A car has a door at one end thereof and moves vertically along a predetermined path within a shaft. A counterweight is provided within a space between an interior wall surface of the shaft and the car. A pair of turning pulleys are provided on the upper end of the shaft in a rotatable manner so as to correspond to the car and the counterweight, respectively, within the space between the car and the interior wall surface of the shaft when viewed within a horizontal plane of projection. A main cable is provided and whose one end is connected to the car and whose remaining end is connected to the counterweight. The main cable is provided within the shaft and is wound around the turning pulleys. A hoisting machine is disposed at the upper end of the shaft and is located at a position higher than the lower edges of the turning pulleys. A drive sheave is provided on the hoisting machine in a rotatable manner such that the rotor axis of the drive sheave is oriented vertically. The main cable extends between the turning pulleys while being wound around the drive sheave.

[0049] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. The car-side turning pulley and the counterweight-side turning pulley are provided within a space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system.

[0050] In another aspect, the hoisting machine is disposed at a position corresponding to a recess formed in the upper surface of the car as has been described previously.

[0051] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. Further, the hoisting machine is placed at a position corresponding to a recess formed in the upper surface of the car. The car-side turning pulley and the counterweight-side turning pulley are provided within the space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system.

[0052] In another aspect, an electric motor is provided on the hoisting machine so as to protrude downward from the lower surface of the hoisting machine and within the space between the edge of the car and the interior wall surface of the shaft as has been described previously.

[0053] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. The electric motor is provided on the

hoisting machine so as to protrude downward from the lower surface of the hoisting machine and provided within the space between the edge of the car and the interior wall surface of the shaft, and the car-side turning pulley and the counterweight-side turning pulley are provided within the space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system.

[0054] In another aspect, a deflector wheel is provided on the roof of the shaft in a rotatable manner such that the rotor axis of the deflector wheel is oriented vertically. The deflector wheel pulls the main cable extending between the drive sheave and the turning pulley in a direction toward the interior wall surface of the shaft as has been described previously.

[0055] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. The car-side turning pulley and the counterweight-side turning pulley are provided in a space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system.

[0056] Further, the deflector wheel pulls the main cable extending between the drive sheave and the car-side turning pulley, such that the main cable runs in the direction parallel with the interior surface of the shaft. As a result, the side surface of the car-side turning pulley can be provided in horizontal direction parallel with the interior surface of the shaft. Consequently, the width of the space between the edge of the car and the interior wall surface of the shaft can be diminished. The present invention yields an advantage of reducing the space to be occupied by the elevator system within the building to a much greater extent and of diminishing construction cost required for ensuring the total space for installing the elevator system.

[0057] In another aspect, the drive sheave is provided on the hoisting machine such that the side surface of the drive sheave faces the ceiling of the shaft as has been described previously.

[0058] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. The car-side turning pulley and the counterweight-side turning pulley are provided within the space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system. Further, since the drive sheave is provided on the hoisting machine, the highest position of the car where the car avoids the hoisting machine may be set higher than in a case where the drive sheave is provided below the hoisting machine. Consequently, the space in the upper end of the shaft can be effectively utilized, and construction cost required for building the shaft can be diminished.

[0059] In another aspect, the hoisting machine and the car overlap at least partially when viewed within a horizontal plane of projection as has been described previously.

[0060] By means of the foregoing configuration, the hoisting machine is disposed at the upper end of the shaft, and the lower end of the hoisting machine is located at a position higher than the lower edges of the turning pulleys. The car-side turning pulley and the counterweight-side turning pulley are provided within the space between the edge of the car and the interior wall surface of the shaft. The hoisting machine is provided within the shaft accommodated within the height of the top floor of a building, and the main cable can extend between the hoisting machine and the car. Consequently, there is obviated a necessity for making the ceiling of the shaft higher than the top floor of the building, thus diminishing construction cost required for ensuring a space for installing the elevator system. The hoisting machine and the car overlap at least partially when viewed within a horizontal plane of projection. The space of the shaft when viewed within a horizontal plane of projection can be effectively utilized, thereby diminishing construction cost required for building the shaft.

[0061] Obviously many modifications and variations of the present invention are possible in the light of the above teachings. It is therefore to be understood that within the scope of the appended claims the invention may by practiced otherwise than as specifically described.

[0062] The entire disclosure of a Japanese Patent Application No. 11-002647, filed on January 8, 1999 and a Japanese Patent Application No. 11-231673, filed on August 18, 1999 including specifications, claims, drawings and summaries, on which the Convention priority of the present application is based, are incorporated herein by reference in its entirety.

Claims

1. An elevator system comprising:

   a car which moves vertically along a predetermined path within a shaft;
   a counterweight provided in a space between an interior wall surface of said shaft and said car;
   a pair of turning pulleys which are provided on the upper end of the shaft so as to correspond to said car and said counterweight respectively, said pair of turning pulleys being provided, in a horizontal plane of projection, within the space between said car and the interior wall surface of the shaft;
   a hoisting machine including a drive sheave provided thereon with the rotor axis thereof oriented vertically, said hoisting machine being disposed at the upper end of the shaft and is located at a position higher than the lower edges of said pair of turning pulleys; and
   a main cable whose one end is connected to said car and whose remaining end is connected to said counterweight, said main cable being wound around said pair of turning pulleys; said main cable extending between said pair of turning pulleys while being wound around said drive sheave.

2. The elevator system according to claim 1, wherein said hoisting machine is disposed at a position corresponding to a recess formed in the upper surface of said car.

3. The elevator system according to claim 1 or 2, wherein an electric drive motor is provided on said hoisting machine so as to protrude downward from the lower surface of said hoisting machine and within the space between the edge of said car and the interior wall surface of the shaft.

4. The elevator system according to either of claims 1 to 3, further comprising a deflector wheel which is provided on the ceiling of the shaft in a rotatable manner such that the rotor axis of said deflector wheel is oriented vertically, said deflector wheel pulling the main cable extending between said drive sheave and said turning pulley in a horizontal direction toward the interior wall surface of the shaft.

5. The elevator system according to either of claims 1 to 4, wherein said drive sheave is provided in the upper portion of said hoisting machine such that the upper side surface of said drive sheave faces the ceiling of the shaft.

6. The elevator system according to either of claims 1 to 5, wherein said hoisting machine and said car overlap at least partially in a horizontal plane of projection.

FIG. 1

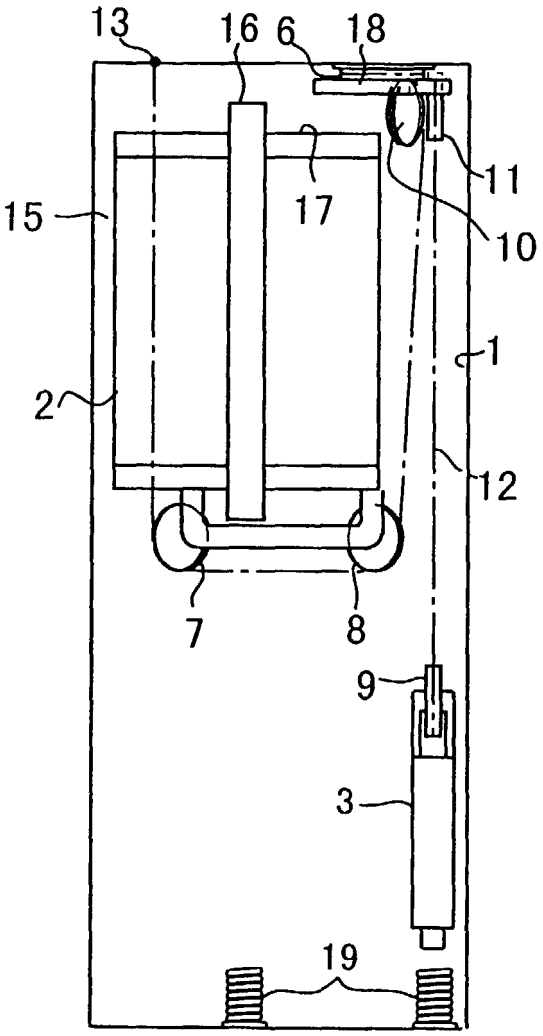

FIG. 2

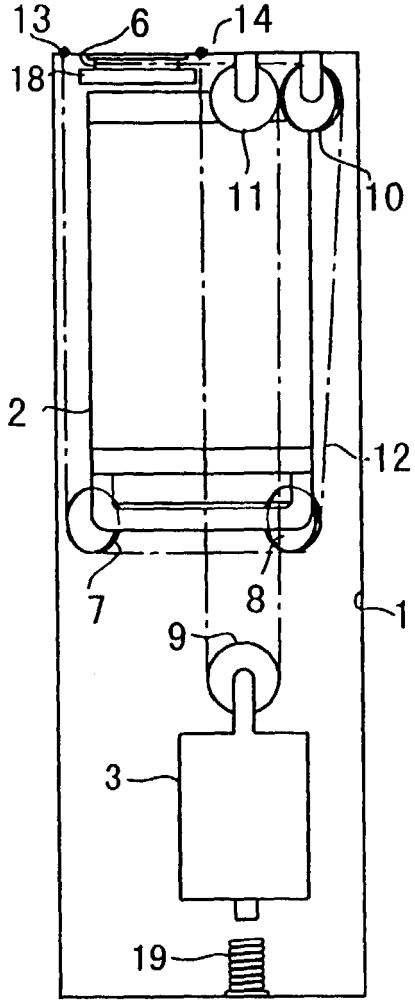

FIG. 3

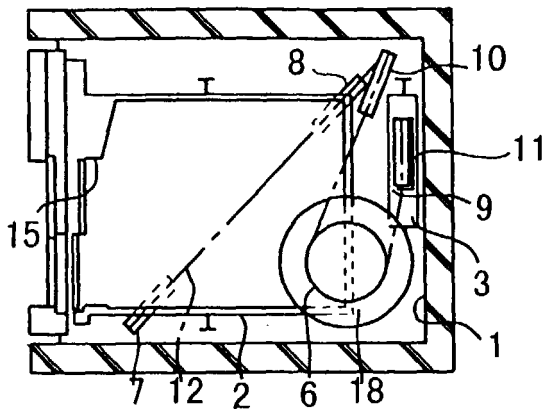

FIG. 4

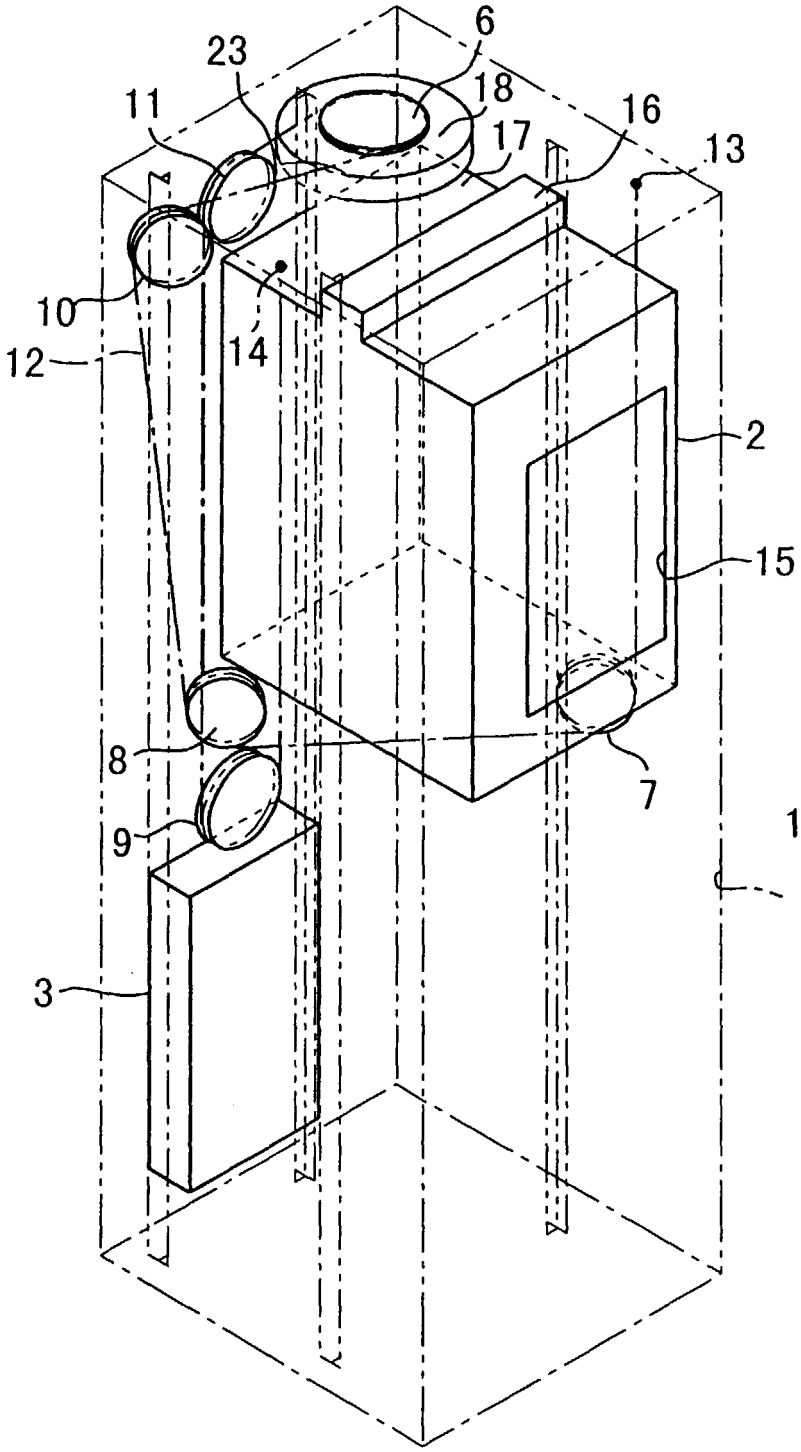

FIG. 5

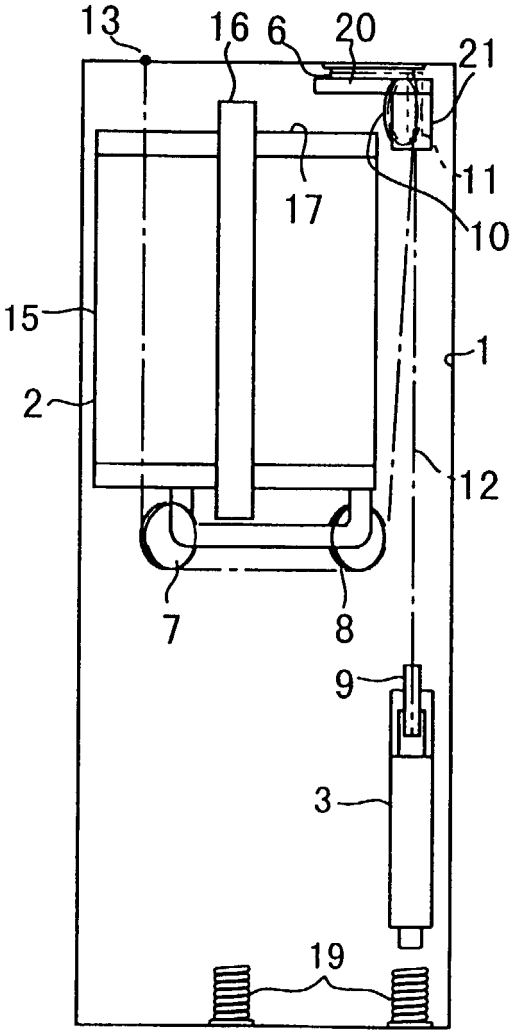

FIG. 6

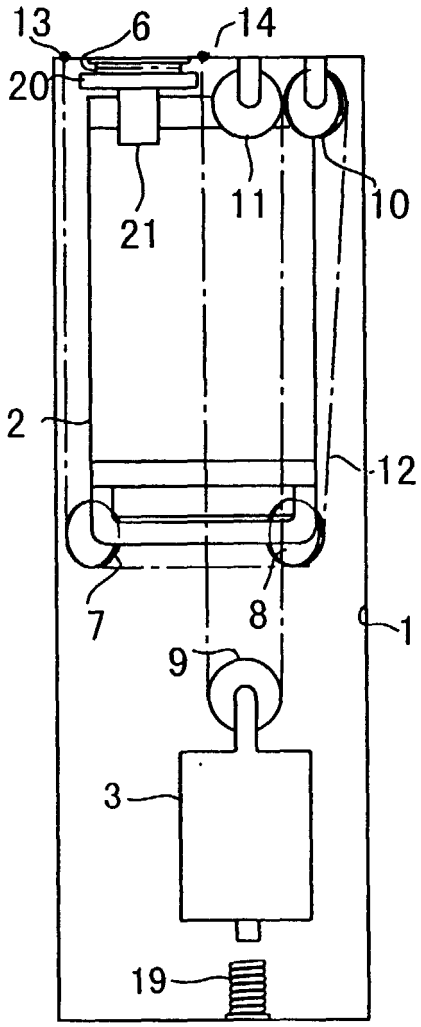

FIG. 7

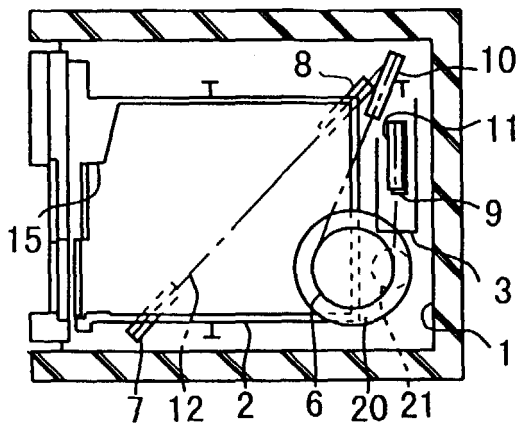

FIG. 8

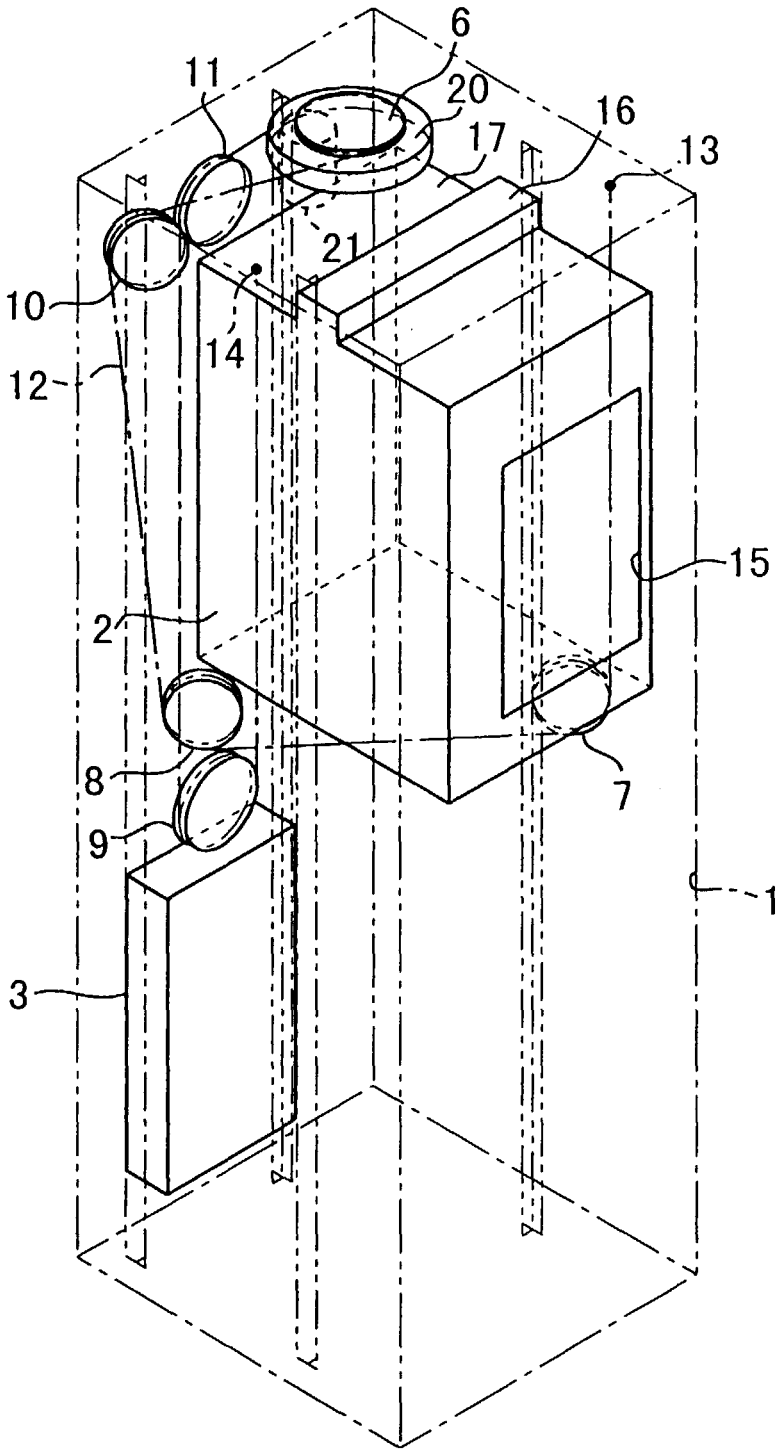

FIG. 9

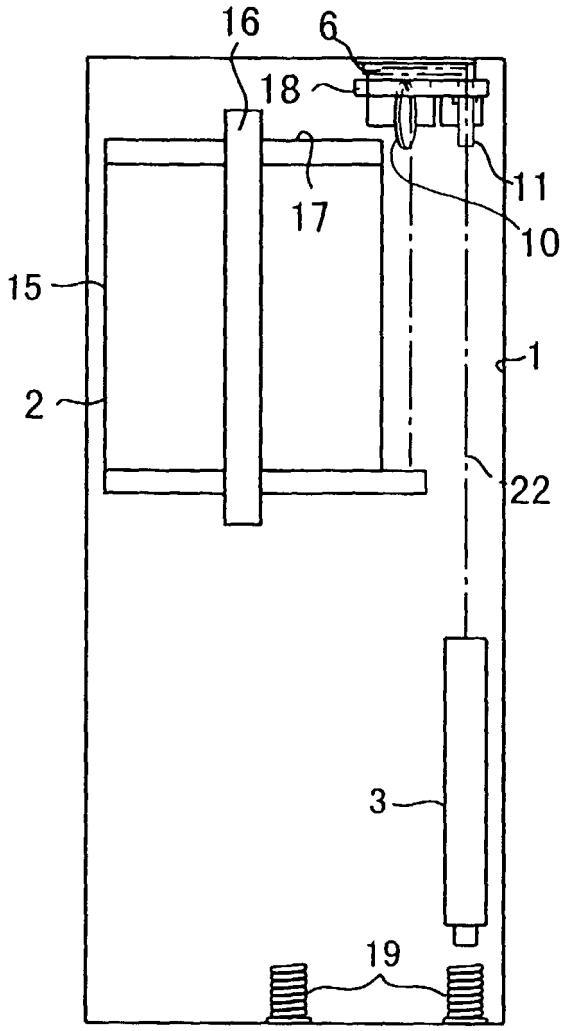

FIG. 10

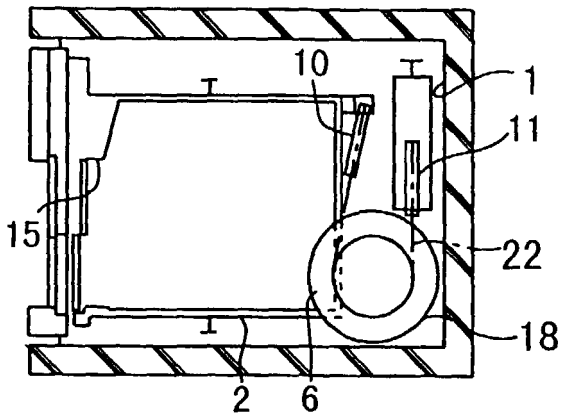

FIG. 11

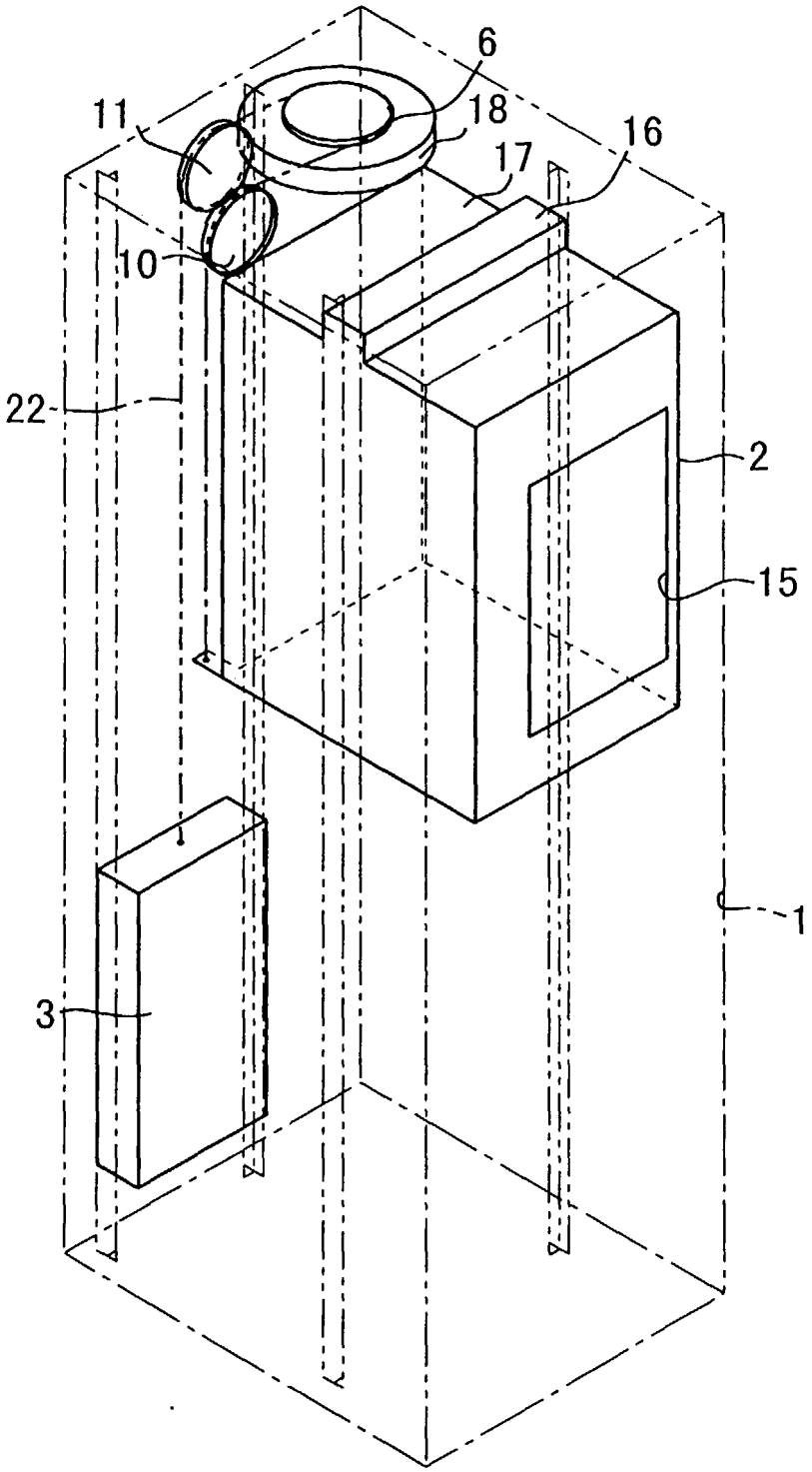

FIG. 12

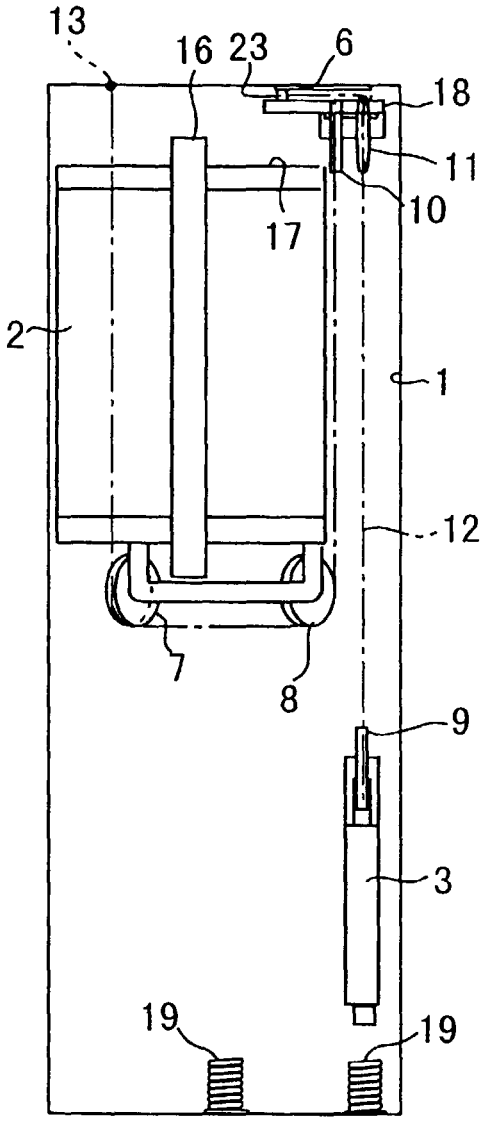

FIG. 13

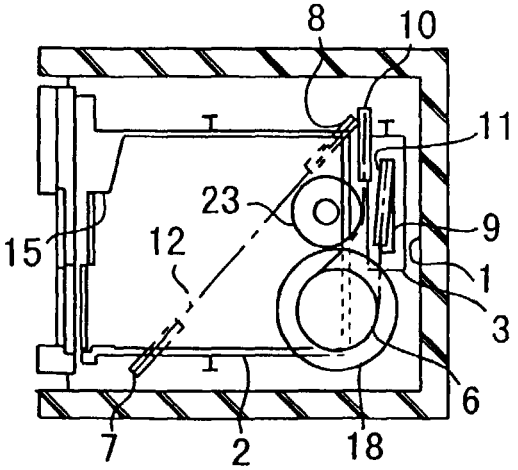

FIG. 14

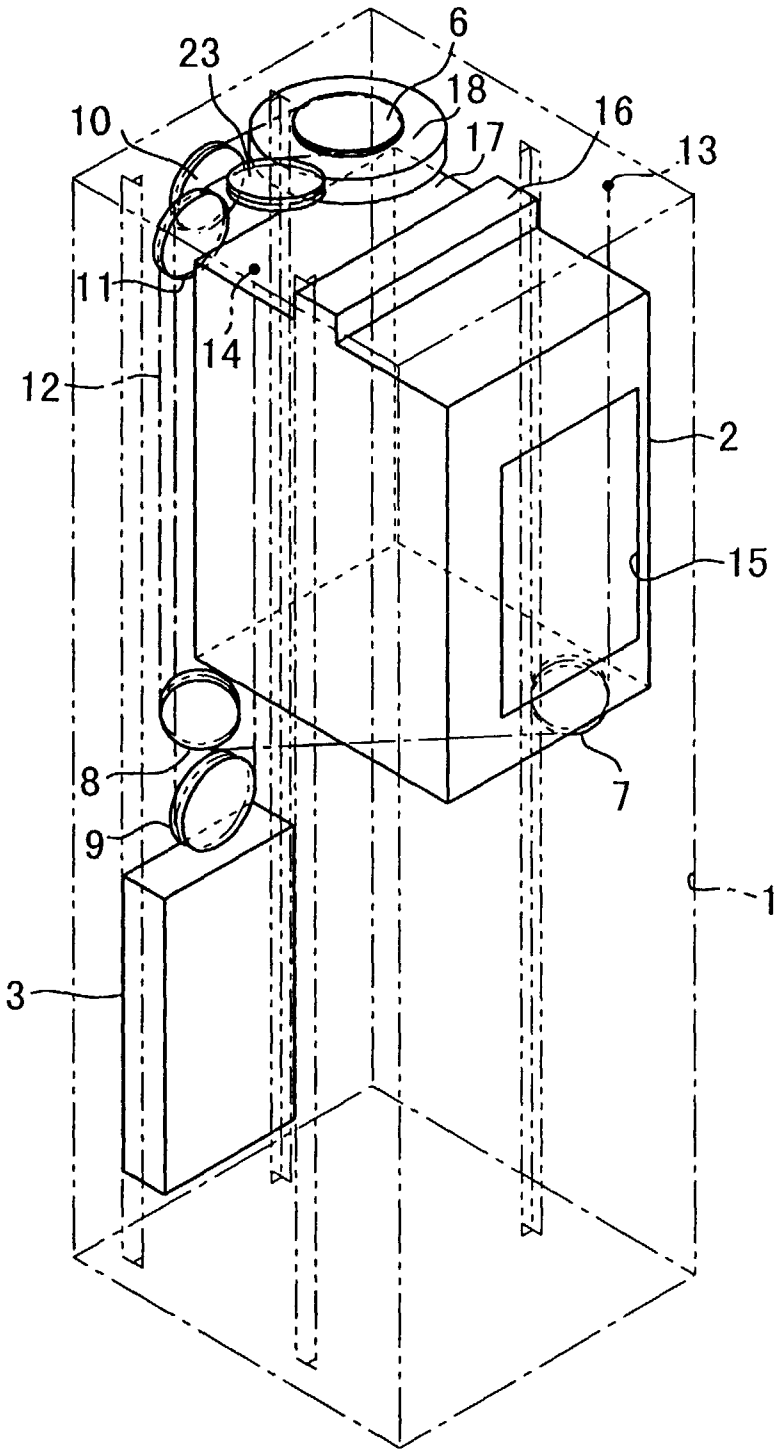

FIG. 15

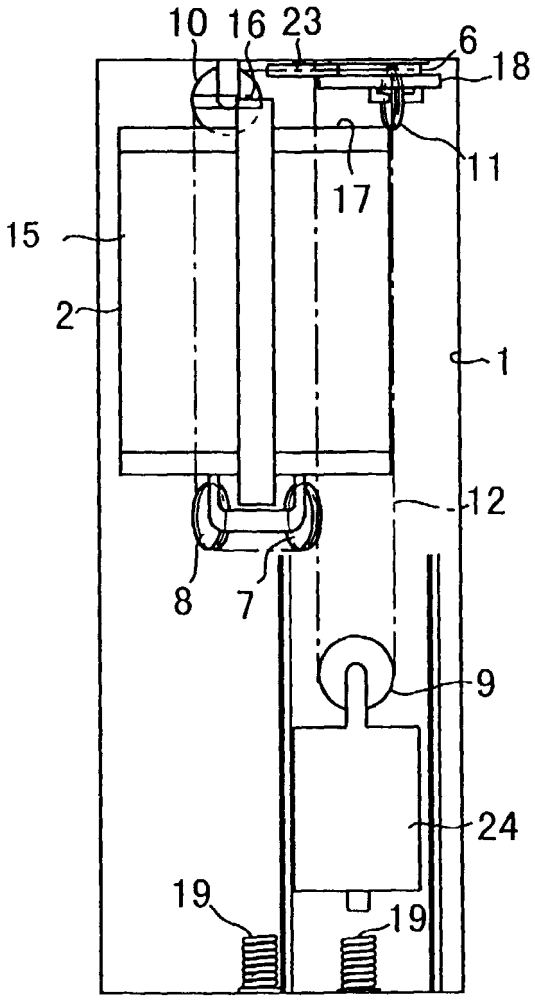

FIG. 16

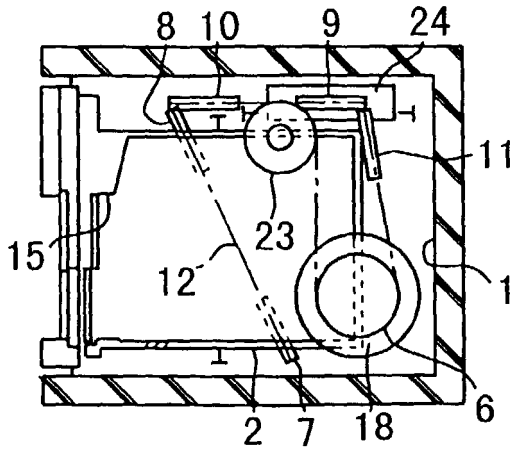

FIG. 17

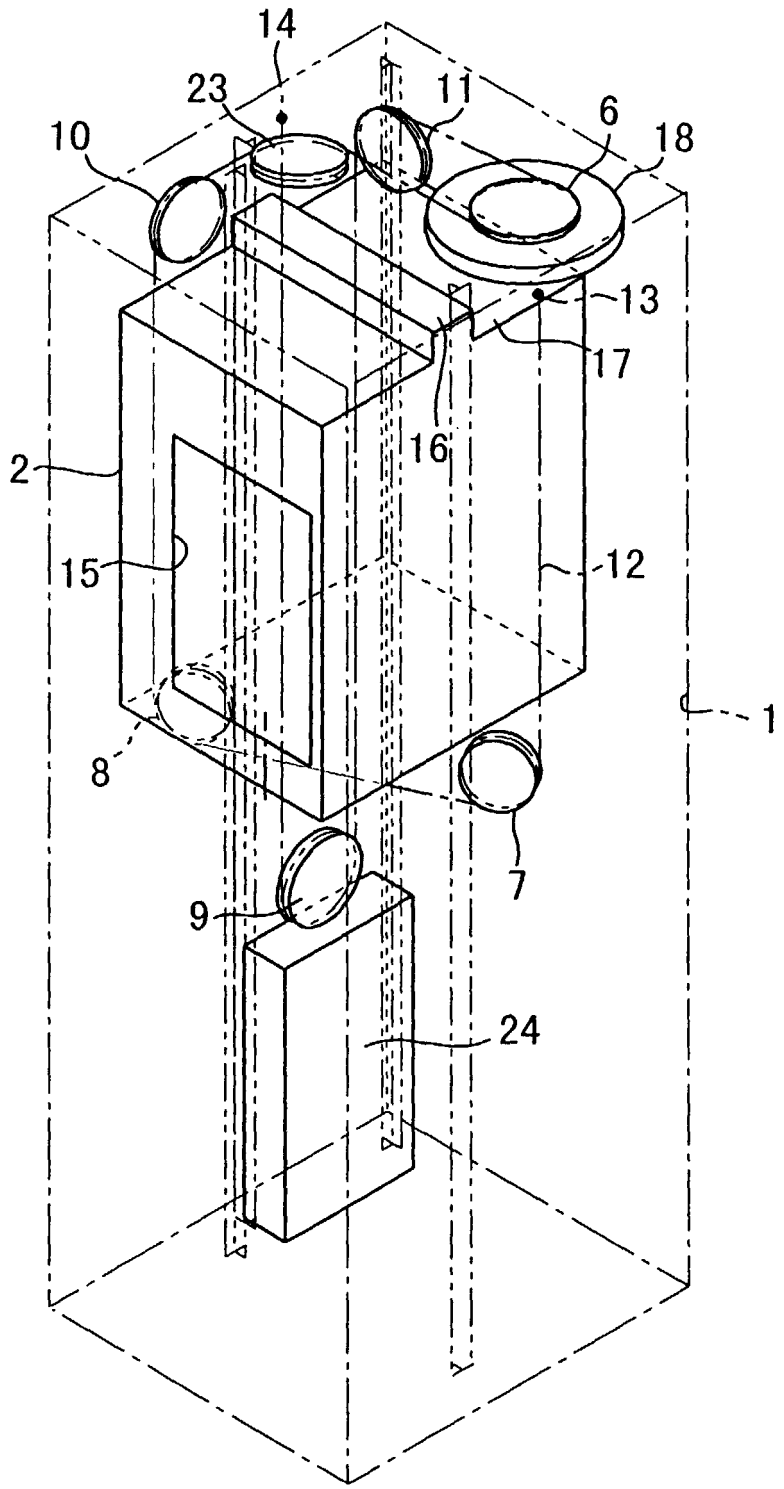

FIG. 18

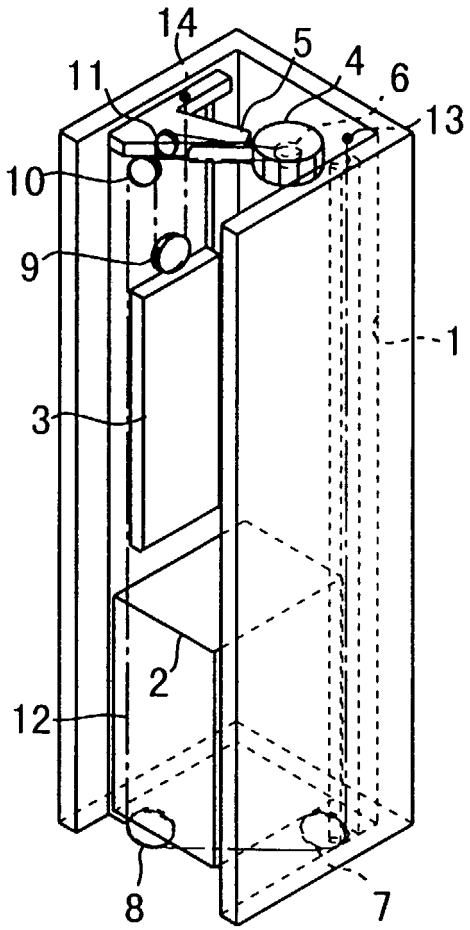

FIG. 19