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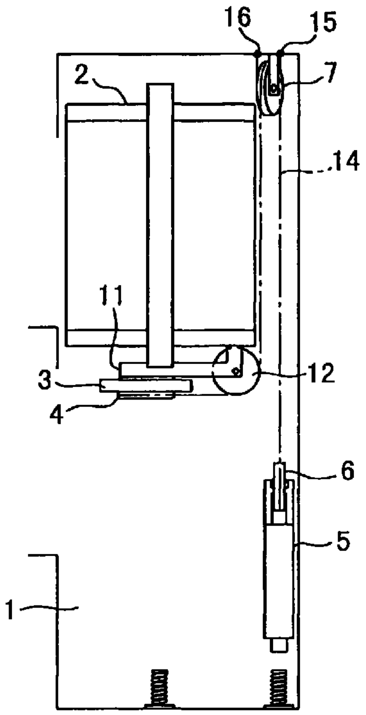
(54) Elevator system

(57) There is described an elevator system in which a hoist is provided on a car and which can be provided within a shaft corresponding to the height of the top floor of a building. A hoist is placed in the plane orthogonal to a path along which a car is to move vertically. The rotor axis of a sheave is oriented in the vertical direction, and the height of the hoist is arranged so as to become smaller than the diameter of the sheave. The hoist is energized, to thereby move the car vertically by way of a main cable wound around the sheave. The top clearance insured between the lower surface of the top of the shaft and the upper surface of the car when the car is stopped at the top floor can be diminished. The lower surface of the top of the shaft can be made lower than the height of the top floor of a building, thus diminishing construction cost required to ensure 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, wherein a main cable connected to a car and a counterweight is driven by means of a hoist mounted on the car.

Background Art

[0002] FIG. 13 is a longitudinal cross-sectional view conceptually showing a conventional elevator system described in, for example, Japanese Utility Model Publication No. Hei-3-48142. In the drawing, reference numeral 1 designates a shaft; 2 designates a car which moves vertically along a predetermined path within the shaft 1; and 3 designates a traction hoist mounted on a lower side of an upper frame of the car 2. A sheave 4 of the hoist 3 is arranged such that the rotor axis of the sheave 4 is oriented horizontally.

[0003] Reference numeral 5 designates a counterweight which moves vertically along another predetermined path within the shaft 1, and a counterweight pulley 6 is provided in the counterweight 5. Reference numeral 7 designates a top pulley which is attached to the top of the shaft 1 such that the rotor axis of the pulley is oriented horizontally. Reference numeral 8 designates a main cable whose one end is connected to the upper end portion of the shaft 1 by means of an anchor 9 and whose remaining end is connected to the upper end portion of the shaft 1 by means of another anchor 10. The main cable 8 is coiled around the counterweight pulley 6, the top pulley 7, and the sheave 4.

[0004] In the conventional elevator system having the aforementioned configuration, the hoist 3 is energized and driven so as to rotate the sheave 4, whereupon the car 2 and the counterweight 3 are moved vertically in opposite directions. Since the hoist 3 is mounted on the car 2, a machinery room, which would otherwise be independently provided in a position above the shaft 1, is omitted, thus reducing the space occupied by the elevator system within an un-illustrated building.

[0005] In the foregoing conventional elevator system, the hoist 3 is mounted on the car 2, and the rotor axis of the sheave 4 is oriented horizontally, thus resulting in an increase in the height of the car 2. When such a car 2 is stopped at the top floor of the building, a top clearance to be insured between the lower surface of the top of the shaft 1 and the top of the car 2 must be made longer. For this reason, the lower surface of the top of the shaft 1 must be made higher than the height of the top floor of the building. Thus, ensuring a space for installing the elevator system adds to construction costs. Here, the angle at which the main cable 8 is wound around the sheave 4 exceeds 90°, and the diameter of the sheave 4 should be made more than 40 times the diameter of the main cable 8.

[0006] The present invention has been conceived to solve the problems involved in the background art, and the object of the present invention is to provide an elevator system in which a hoist is mounted on a car and which can be installed in a shaft accommodated within the height of the top floor of a building.

Summary of the Invention

[0007] According to one aspect of the present invention, as elevator system comprises a car which moves vertically along a predetermined path within a shaft. A counterweight is provided which moves vertically along another predetermined path within the shaft. A hoist is provided in a plane orthogonal to the predetermined path of the car. The hoist includs a sheave of which rotor axis is oriented in the vertical direction. The hoist is configured such that the height of the hoist is smaller than the diameter of the sheave. A first and a second turning pulleys are provided on the same side of the car with said hoist. The rotor axis of the first and second turning pulleys are oriented horizontally. The first and second turning pulleys are positioned to faces a circumferential edge of the sheave. The rim surface of said first and a second turning pulleys project beyond the edge of the car. A top pulley is provided which is attached to the top of the shaft in a rotatable manner such that the rotor axis of the top pulley is oriented horizontally. Further, a main cable is wound around a pulley of the counterweight, the top pulley, the first and second turning pulleys and the sheave. Each end of said main cable is connected to the upper end of the shaft.

[0008] Other and further objects, features and advantages of the invention will appear more fully from the following description.

Brief Description of the Drawings

[0009]

FIG. 1 is a longitudinal cross-sectional view conceptually showing an elevator system according to a first embodiment of the present invention;
FIG. 2 is a transverse cross-sectional view showing the principal elements shown in FIG. 1;
FIG. 3 is a perspective view showing the principal elements shown in FIG. 1;
FIG. 4 is a longitudinal cross-sectional view conceptually showing an elevator system according to a second embodiment of the present invention;
FIG. 5 is a transverse cross-sectional view showing the principal elements shown in FIG. 4;
FIG. 6 is a partial front view showing the principal elements of the elevator according to a third embodiment of the present invention;

FIG. 7 is a bottom view of the elements shown in FIG. 6;

FIG. 8 is a longitudinal cross-sectional view conceptually showing an elevator system according to a fourth embodiment of the present invention;

FIG. 9 is a transverse cross-sectional view showing the principal elements shown in FIG. 8;

FIGS. 10 through 12 show a fifth embodiment.

FIG. 10 is a longitudinal view conceptually showing an elevator system according to a fifth embodiment of the present invention;

FIG. 11 is a transverse cross-sectional plan view showing the principal elements shown in FIG. 10;

FIG. 12 is a perspective view showing the principal elements shown in FIG. 10; and

FIG. 13 is a longitudinal cross-sectional view conceptually showing a conventional elevator system.

Detailed Description of the Preferred Embodiments

[0010] The preferred embodiments of the present invention will be described with reference to the accompanying drawings, in which same or corresponding portions are indicated by same reference numerals.

First Embodiment

[0011] FIGS. 1 through 3 illustrate a first embodiment of the present invention. FIG. 1 is a longitudinal cross-sectional view conceptually showing an elevator system; FIG. 2 is a transverse cross-sectional view showing the principal elements shown in FIG. 1; and FIG. 3 is a perspective view showing the principal elements shown in FIG. 1. In the drawings, reference numeral 1 designates a shaft; 2 designates a car which moves vertically along a predetermined path within the shaft 1; and 3 designates a traction hoist. A mount arm 11 is provided on the lower surface of the car 2; that is, a plane orthogonal to the predetermined path of the car 2, and the traction hoist 3 is mounted on the mount arm 11. Further, a sheave 4 is attached to the hoist 3 such that the rotor axis of the sheave 4 is oriented in the vertical direction. The height of the traction hoist 3 is designed to be smaller than the diameter of the sheave 4.

[0012] Reference numeral 5 designates a counterweight which moves vertically along another path within the shaft 1, and a counterweight pulley 6 is provided on the counterweight 5. Reference numeral 7 designates a top pulley which is attached to the top of the shaft 1 in a rotatable manner such that the rotor axis of the top pulley 7 is oriented horizontally. When viewed within a horizontal plane of projection, the top pulley 7 is interposed between the car 2 and the shaft 1 such that the side surfaces of the top pulley 7 are arranged along the wall surface of the shaft 1. Reference numeral 12 designates a first turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the first turning pulley 12 is oriented horizontally. A rim surface of the first turning pulley 12 projects beyond the edge of the car 2, and the first turning pulley 12 is arranged so as to face one circumferential edge of the sheave 4.

[0013] Reference numeral 13 designates a second turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the second turning pulley 13 is oriented horizontally. A rim surface of the second turning pulley 13 projects beyond the edge of the car 2, and the second turning pulley 13 is arranged so as to face a circumferential edge of the sheave 4. The first turning pulley 12 and the second turning pulley 13 are disposed in parallel on the mount arm 11.

[0014] Reference numeral 14 designates a main cable. One end of the main cable 14 is connected to the upper end of the shaft 1 by means of an anchor 15, and the other end of the main cable 14 is connected to the upper end of the shaft 1 by means of an anchor 16. The main cable 14 is wound around the counterweight pulley 6, the top pulley 7, the first turning pulley 12, the sheave 4, and the second turning pulley 13, in this sequence.

[0015] In the elevator system having the foregoing configuration, when the hoist 3 is energized so as to rotate the sheave 4, the car 2 and the counterweight 3 are moved vertically in opposite directions by means of the main cable 14 wound around the first turning pulley 12, the second turning pulley 13, the top pulley 7, and the counterweight pulley 6, in this sequence.

[0016] The hoist 3 is provided within the plane orthogonal to the predetermined path of the car 2, and the rotor axis of the sheave 4 is oriented in the vertical direction. Further, the height of the hoist 3 is designed to be smaller than the diameter of the sheave 4.

[0017] Accordingly, the height of the car 2 becomes smaller. When such a car 2 is stopped at the top floor of a building, the top clearance to be insured between the lower surface of the top of the shaft 1 and the top of the car 2 can be made shorter. The lower surface of the top of the shaft 1 can be made lower than the height of the top floor of the building, thereby preventing an increase in construction cost, which would otherwise be caused by ensuring a space for installing an elevator system.

[0018] The main cable 14 is wound around the first turning pulley 12 and the second turning pulley 13 at an angle of about 90°. The diameter of the first and second turning pulleys 12 and 13 can be about 36 times the diameter of the main cable 14, thus diminishing the height of the first and second turning pulleys 12 and 13. Therefore, the height of the car 2 can be reduced, which in turn results in a reduction in the height of the shaft 1. Since both the height of the car 2 and the height of the shaft 1 are reduced, expenses required for constructing a space for installing the elevator system can be diminished.

Second Embodiment

[0019] FIGS. 4 and 5 show a second embodiment of the present invention, wherein FIG. 4 is a longitudinal cross-sectional view conceptually showing an elevator system according to the second embodiment, and FIG. 5 is a transverse cross-sectional view showing the principal elements shown in FIG. 4. In these drawings, those reference elements which are the same as those provided in FIGS. 1 through 3 designate corresponding elements. Reference numeral 17 designates a deflector wheel provided on the lower surface of the car 2; that is, in a plane perpendicular to the path of the car 2 within the shaft 1. The deflector wheel 17 is mounted on the mount arm 11 such that the rotor axis of the deflector wheel 17 is oriented in the vertical direction. The deflector wheel 17 is positioned such that one circumferential edge of the deflector wheel 17 faces to one circumferential edge of the sheave 4.

[0020] Reference numeral 12 designates a first turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the first turning pulley 12 is oriented horizontally. The rim surface of the first turning pulley 12 projects beyond the edge of the car 2, and the first turning pulley 12 is placed so as to face the circumferential edge of the sheave 4. Reference numeral 13 designates a second turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the second turning pulley 13 is oriented horizontally. The rim surface of the second turning pulley 13 projects beyond the edge of the car 2, and the second turning pulley 13 is placed so as to face the circumferential edge of the deflector wheel 17.

[0021] Reference numeral 14 designates a main cable whose one end is connected to the upper end of the shaft 1 by means of the anchor 15 and whose other end is connected to the upper end of the shaft 1 by means of the anchor 16. The main cable 14 is wound around the counterweight pulley 6, the top pulley 7, the first turning pulley 12, the sheave 4, the deflector pulley 17, and the second turning pulley 13, in this sequence.

[0022] In the elevator system having the foregoing configuration, the hoist 3 is mounted on the plane orthogonal to the predetermined path of the car 2. The rotor axis of the sheave 4 is oriented in the vertical direction, and the height of the hoist 3 is designed to be smaller than the diameter of the sheave 4. When the hoist 3 is energized, the car 2 and the counterweight 5 are moved vertically in opposite directions by way of the main cable 14.

[0023] Although detailed description of the working-effects of the second embodiment is no duplicatedd, the second embodiment shown in FIGS. 4 and 5 yields the same advantageous working-effects as those yielded by the first embodiment shown in FIGS. 1 through 3.

[0024] Further, the first turning pulley 12 having the main cable 14 wound therearound and the second turning pulley 13 having the main cable 14 wound therearound are disposed within the plane of the car 2 substantially symmetrically. This configuration enables suspension of the area in the vicinity of the center of mass of the car 2, thus improving the riding comfort of the car 2.

Third Embodiment

[0025] FIGS. 6 and 7 show a third embodiment of the present invention, wherein FIG. 6 is a partial front view showing the principal elements of the elevator, and FIG. 7 is a bottom view of the elements shown in FIG. 6. The remaining portion of the elevator system other than shown in FIGS. 6 and 7 is the same in configuration as that shown in FIGS. 4 and 5. In these drawings, those reference numerals which are the same as those used in FIGS. 4 and 5 designate corresponding elements. Reference numeral 4 designates a sheave around which a plurality of main cables 14 are wound in parallel to one another. The sheave 4 is provided on the lower surface of the car 2 such that the rotor axis of the sheave 4 is inclined at an angle. One circumferential edge of the sheave 4 faces the lower circumferential edge of the first turning pulley 12, and the other circumferential edge of the sheave 4 is placed in an elevated position than the one edge.

[0026] Reference numeral 17 designates a deflector wheel which is provided on the lower surface of the car 2 such that the rotor axis of the deflector 17 is inclined at an angle. One circumferential edge of the deflector wheel 17 faces the other circumferential edge of the sheave 4 placed in the elevated position. The remaining circumferential edge of the deflector wheel 17 faces the lower circumferential edge of the second turning pulley 13.

[0027] In the elevator system having the foregoing configuration, the hoist 3 is placed in the plane orthogonal to the predetermined path of the car 2. The rotor axis of the sheave 4 is inclined, and the height of the hoist 3 is designed to be smaller than the diameter of the sheave 4. Further, the first turning pulley 12 having the main cable 14 wound therearound and the second turning pulley 13 having the main cable 14 wound therearound are disposed in a same plane under the car 2 substantially symmetrically. When the hoist 3 is energized, the car 2 and the counterweight 5 are moved vertically in opposite directions by way of the main cable 14.

[0028] Although detailed description of working-effects of the third embodiment is not duplicated, the third embodiment shown in FIGS. 6 and 7 also yields the same advantageous working-effects as those yielded by the second embodiment shown in FIGS. 4 and 5.

[0029] In the second embodiment shown in FIGS. 4 and 5, the first turning pulley 12 and the sheave 4 are arranged at right angles to each other, as are the deflector wheel 17 and the second turning pulley 13, thus making the fleet angle of the main cable 14 large. In contrast, in the third embodiment shown in FIGS. 6 and 7, the sheave 4 and the deflector wheel 17 are inclined at angles, as shown in FIG. 6.

[0030] The rim surface of the sheave 4 and the rim surface of the deflector wheel 17 cross each other at an angle of 60°, thus imparting a fleet angle to the main cable 14. However, the rim surface of the first turning pulley 12 and the rim surface of the sheave 4 cross each other at angle of 60°, and the rim surface of the deflector 17 and the rim surface of the second turning pulley 13 cross each other at an angle of 60°. Consequently, the fleet angle of the main cable 14 is diminished, and hence wear of the main cable 14 is diminished, thus prolonging the life of the main cable 14.

Fourth Embodiment

[0031] FIGS. 8 and 9 show a fourth embodiment of the present invention, wherein FIG. 8 is a longitudinal cross-sectional view conceptually showing an elevator system according to the fourth embodiment, and FIG. 9 is a transverse cross-sectional view showing the principal elements shown in FIG. 8. The remaining portion of the elevator system other than shown in FIGS. 8 and 9 are the same in configuration as shown in FIGS. 4 and 5. In these drawings, those reference numerals which are the same as those used in FIGS. 4 and 5 designate corresponding elements.

[0032] Reference numeral 12 designates a first turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the first turning pulley 12 is oriented horizontally. The first turning pulley 12 is interposed between the car 2 and the wall surface of the shaft 1. When viewed in the plane of vertical projection, the side surface of the car 2 and the side surface of the first turning pulley 12 partially overlap. Reference numeral 13 designates a second turning pulley which is mounted on the mount arm 11 in a rotatable manner such that the rotor axis of the second turning pulley 13 is oriented horizontally. The second turning pulley 13 is interposed between the car 2 and the wall surface of the shaft 1. When viewed in the plane of vertical projection, the side surface of the car 2 and the side surface of the second turning pulley 13 partially overlap.

[0033] In the elevator system having the foregoing configuration, the hoist 3 is placed in a plane orthogonal to the predetermined path of the car 2. The rotor axis of the sheave 4 is vertical, and the height of the hoist 3 is designed to be smaller than the diameter of the sheave 4. Further, the first turning pulley 12 having the main cable 14 wound therearound and the second turning pulley 13 having the main cable 14 wound therearound are disposed substantially symmetrically in a plane under the car 2. When the hoist 3 is energized, the car 2 and the counterweight 5 are moved vertically in opposite directions by way of the main cable 14.

[0034] Although detailed description of working-effects of the fourth embodiment is not duplicated, the fourth embodiment shown in FIGS. 8 and 9 also yields the same advantageous working-effects as those yielded by the second embodiment shown in FIGS. 4 and 5.

[0035] In the fourth embodiment shown in FIGS. 8 and 9, the first turning pulley 12 and the second turning pulley 13 are interposed between the wall surface of the shaft 1 and the car 2, such that an overlap exists between the side surfaces of the car 2 and the first and second turning pulleys 12 and 13.

[0036] Accordingly, the height of the car 2 can be diminished by a height corresponding to the space occupied by the first and second turning pulleys 12 and 13, thus shortening the height of the shaft 1. Such reductions in the height of the shaft 1 and the height of the car 2 prevent an increase in construction cost, which would otherwise be caused by ensuring a space for installing an elevator system.

Fifth Embodiment

[0037] FIGS. 10 through 12 show a fifth embodiment of the present invention. FIG. 10 is a longitudinal view conceptually showing an elevator system according to the fifth embodiment; FIG. 11 is a transverse cross-sectional plan view showing the principal elements shown in FIG. 10; and FIG. 12 is a perspective view showing the principal elements shown in FIG. 10. In the drawings, those reference numerals which are the same as those provided in FIGS. 1 through 3 designate corresponding elements. Reference numeral 3 designates a traction hoist. The mount arm 11 is provided on the upper surface of the car 2; that is, in a plane orthogonal to the predetermined path of the car 2, and the traction hoist 3 is mounted on the mount arm 11. Further, the sheave 4 is provided on the traction hoist 3 such that the rotor axis of the sheave 4 is oriented in the vertical direction, and the hoist 3 is configured such that the height of the hoist 3 is smaller than the diameter of the sheave 4.

[0038] Reference numeral 12 designates a first turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the first turning pulley 12 is oriented horizontally. The first turning pulley 12 is positioned so as to face one circumferential edge of the sheave 4. The rim surface of the first turning pulley 12 is positioned at the edge of the car 2. Reference numeral 13 designates a second turning pulley which is attached to the mount arm 11 in a rotatable manner such that the rotor axis of the second turning pulley 13 is oriented horizontally. The second turning pulley 12 is positioned so as to face other circumferential edge of the sheave 4. The rim surface of the second turning pulley 13 is positioned at the edge of the car 2. The first turning pulley 12 and the second turning pulley

13 are disposed in parallel.

[0039] In the elevator system having the foregoing configuration, the hoist 3, the first turning pulley 12, and the second turning pulley 13 are provided on the upper surface of the car 2. In such a configuration, the hoist 3 is placed in a plane orthogonal to the predetermined path of the car 2. The rotor axis of the sheave 4 is oriented in the vertical direction, and the height of the hoist 3 is arranged to be smaller than the diameter of the sheave 4.

[0040] When the hoist 3 is energized, the car 2 and the counterweight 5 are moved vertically in opposite directions by way of the main cable 14.

[0041] Although detailed description of working-effects of the fifth embodiment is not duplicated, the fifth embodiment shown in FIGS. 10 through 12 also yields the same advantageous working-effects as those yielded by the first embodiment shown in FIGS. 1 through 3.

[0042] The structures and the advantages of the present invention may be summarized as follows.

[0043] In one aspect, as has been described above, the present invention provides an elevator system comprising the components as follows. A car moves vertically along a predetermined path within a shaft. A counterweight moves vertically along another predetermined path within the shaft. A hoist is provided which includes a sheave such that the rotor axis of the sheave is oriented in the vertical direction. The hoist is provided in a plane orthogonal to the predetermined path of the car. The hoist is configured such that the height of the hoist is smaller than the diameter of the sheave. A second turning pulley and a second turning pulley are provided on the same side of the car on which the hoist is placed, and the rotor axis of pulleys are oriented horizontally. The first and the second turning pulley are disposed to face a circumferential edge of the sheave respectively, and the rim surface projects beyond the edge of the car. A top pulley is attached to the top of the shaft in a rotatable manner such that the rotor axis of the top pulley is oriented horizontally. Further, a main cable is wound around a pulley of the counterweight, the top pulley, either the first or second turning pulley, the sheave, and the remaining turning pulley, and both ends of a main cable are connected to the upper end of the shaft.

[0044] In the above structure, the hoist is placed in a plane orthogonal to the predetermined path of the car. The rotor axis of the sheave is oriented in the vertical direction, and the height of the hoist is arranged to be smaller than the diameter of the sheave. Accordingly, the height of the car becomes smaller. When such a car is stopped at the top floor of a building, the top clearance to be insured between the lower surface of the top of the shaft and the top of the car can be made shorter. Therefore, the lower surface of the top of the shaft can be made lower than the height of the top floor of the building, thereby an increase in construction cost is prevented, which would otherwise be caused by ensuring a space for installing an elevator system.

[0045] In another aspect, as described above, a deflector wheel is preferably provided on the same side of the car on which the hoist is placed, such that the rotor axis of the deflector wheel is oriented in the vertical direction. One circumferential edge of the deflector wheel is positioned so as to face one circumferential edge of the sheave, and the other circumferential edge of the deflector wheel is positioned so as to face the circumferential edge of either the first or second turning pulley.

[0046] In the above structure, the hoist is placed in a plane orthogonal to the predetermined path of the car. The rotor axis of the sheave is oriented in the vertical direction, and the height of the hoist is arranged to be smaller than the diameter of the sheave. Accordingly, the height of the car becomes smaller. When such a car is stopped at the top floor of a building, the top clearance to be insured between the lower surface of the top of the shaft and the top of the car can be made shorter. Therefore, the lower surface of the top of the shaft can be made lower than the height of the top floor of the building, thereby an increase in construction cost prevented, which would otherwise be caused by ensuring a space for installing an elevator system.

[0047] By means of the deflector wheel, the first turning pulley having the main cable wound thereаround and the second turning pulley having the main cable wound therearound are disposed in a plane of the car symmetrically. This configuration enables suspension of the area in the vicinity of the center of mass of the car, thus the riding comfort of the car is improved.

[0048] In further aspect, as described previously, the rotor axis of the sheave, around which a plurality of main cables are wound in parallel to one another, is tilted at an angle, and, one circumferential edge of the sheave is positioned so as to face the lower circumference of the first turning pulley and the opposite circumferential edge of the sheave is position so as to be positioned in a location closer to the car. Further, the deflector wheel is tilted at an angle, and, one circumferential edge of the deflector wheel is positioned so as to face the upper circumferential edge of the sheave positioned in the location close to the car, and the opposite circumferential edge of the deflector wheel is positioned so as to face the lower circumference of the second turning pulley.

[0049] In the above structure, the hoist is placed in a plane orthogonal to the predetermined path of the car. The rotor axis of the sheave is oriented in the vertical direction, and the height of the hoist is arranged to be smaller than the diameter of the sheave. Accordingly, the height of the car becomes smaller. When such a car is stopped at the top floor of a building, the top clearance to be insured between the lower surface of the top of the shaft and the top of the car can be made shorter. Therefore, the lower surface of the top of the shaft can be made lower than the height of the top floor of the building, thereby an increase in construction cost is prevented, which would otherwise be caused by ensuring a space for installing an elevator system.

[0050] By means of the deflector wheel, the first turning pulley having the main cable wound therearound and the second turning pulley having the main cable wound therearound are disposed in a plane of the car and symmetrically. This configuration enables suspension of the area in the vicinity of the center of mass of the car, thus the riding comfort of the car is improved. The sheave and the deflector wheel are arranged such that their rotor axes are inclined at an angle, thereby diminishing the fleet angle of the main cable formed between the first turning pulley and the sheave and the fleet angle of the main cable formed between the sheave and the second turning pulley. Consequently, wear of the main cable is prevented, thus prolonging the life of the main cable.

[0051] In still further aspect, as described previously, the first and second turn pulleys are interposed between the car and the wall surface of the shaft such that, when viewed in the plane of vertical projection, a partial overlap exists between the first turning pulley and the side surface of the car and between the second turning pulley and the side surface of the car.

[0052] In the above structure, the hoist is placed in a plane orthogonal to the predetermined path of the car. The rotor axis of the sheave is oriented in the vertical direction, and the height of the hoist is arranged to be smaller than the diameter of the sheave. Accordingly, the height of the car becomes smaller. When such a car is stopped at the top floor of a building, the top clearance to be insured between the lower surface of the top of the shaft and the top of the car can be made shorter. Therefore, the lower surface of the top of the shaft can be made lower than the height of the top floor of the building, thereby preventing an increase in construction cost, which would otherwise be caused by ensuring a space for installing an elevator system.

[0053] Further, by means of the deflector wheel, the first turning pulley having the main cable wound therearound and the second turning pulley having the main cable wound therearound are disposed in a plane of the car and symmetrically. This configuration enables suspension of the car at the area in the vicinity of the center of mass of the car, thus the riding comfort of the car is improved.

[0054] Further, the first turning pulley and the second turning pulley are positioned between the wall surface of the shaft and the car, such that a partial overlap exists between the side surface of the car and the first and second turning pulleys. Accordingly, the height of the car can be diminished by a height corresponding to the space occupied by the first and second turning pulleys, thus shortening the height of the shaft. Such reductions in the height of the shaft and the height of the car prevent an increase in construction cost, which would otherwise be caused by ensuring a space for installing an elevator system.

[0055] 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.

[0056] The entire disclosure of a Japanese Patent Application No. 11-033083, filed on February 10, 1999 including specification, claims, drawings and summary, 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 which moves vertically along another predetermined path within the shaft;
> a hoist provided in a plane orthogonal to the predetermined path of the car, said hoist including a sheave of which rotor axis is oriented in the vertical direction, said hoist being configured such that the height of the hoist is smaller than the diameter of the sheave;
> a first and a second turning pulleys provided on the same side of the car with said hoist, the rotor axis of the first and second turning pulleys being oriented horizontally, said first and second turning pulleys being positioned to faces a circumferential edge of the sheave, the rim surface of said first and a second turning pulleys projecting beyond the edge of the car;
> a top pulley which is attached to the top of the shaft in a rotatable manner such that the rotor axis of the top pulley is oriented horizontally; and
> a main cable wound around a pulley of the counterweight, the top pulley, the first and second turning pulleys and the sheave, each end of said main cable being connected to the upper end of the shaft.

2. The elevator system according to claim 1, further comprising a deflector wheel provided on the same side of the with said hoist, the rotor axis of the deflector wheel being oriented in the vertical direction, one circumferential edge of the deflector wheel being positioned so as to face one circumferential edge of the sheave, and the opposite circumferential edge of the deflector wheel being positioned so as to face the circumferential edge of either the first or second turning pulley.

3. The elevator system as defined in claim 2, wherein

the rotor axis of the sheave is tilted at an angle, one circumferential edge of the sheave being positioned so as to face the lower circumference of the first turning pulley, the opposite circumferential edge of the sheave being position to be closer to the car; and

the rotor axis of the deflector wheel is tilted at an angle, one circumferential edge of the deflector wheel is positioned so as to face the upper circumferential edge of the sheave, the opposite circumferential edge of the deflector wheel being positioned to face the lower circumference of the second turning pulley.

4. The elevator system according to either claim 2 or 3, wherein the first and second turn pulleys are disposed substantially between the car and the wall surface of the shaft.

FIG. 1

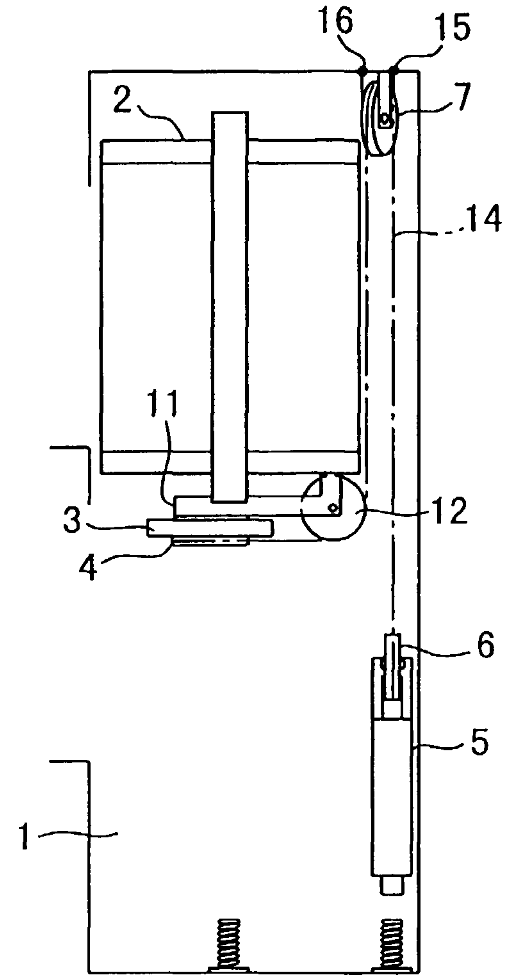

FIG. 2

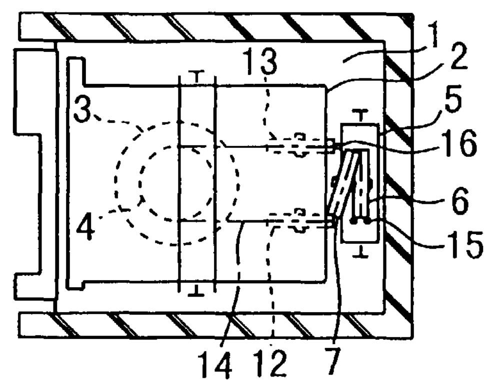

FIG. 3

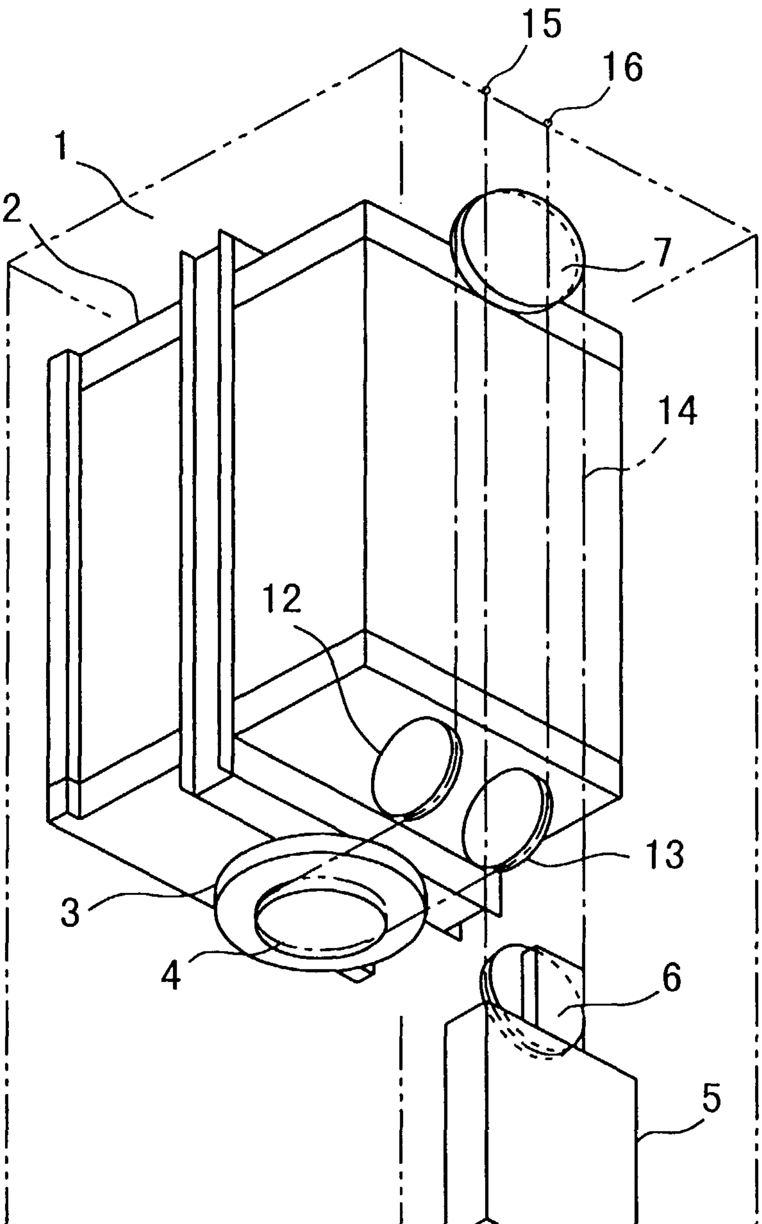

FIG. 4

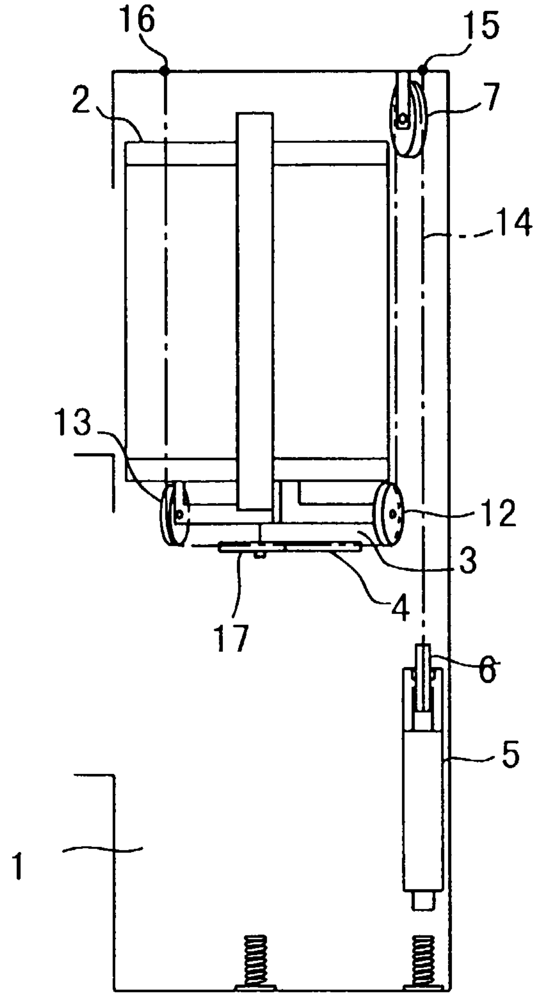

FIG. 5

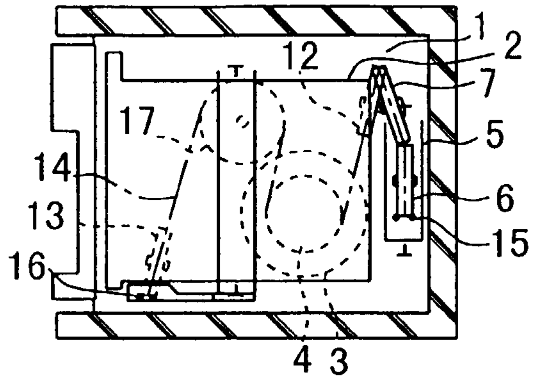

FIG. 6

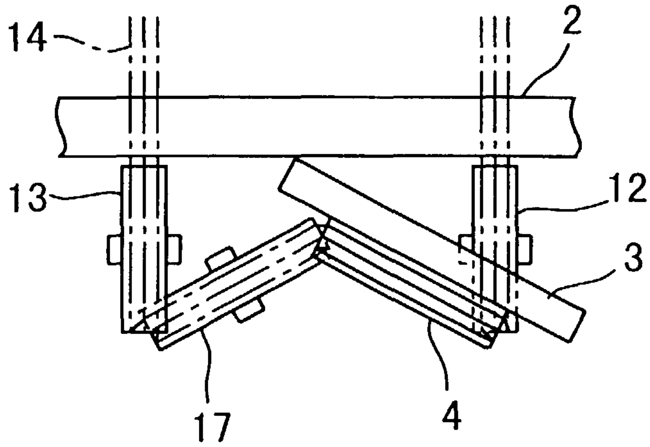

FIG. 7

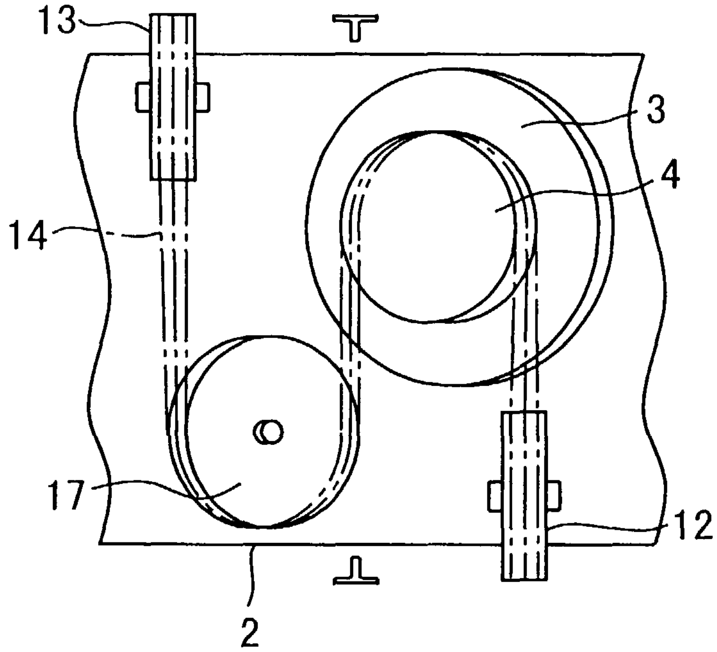

FIG. 8

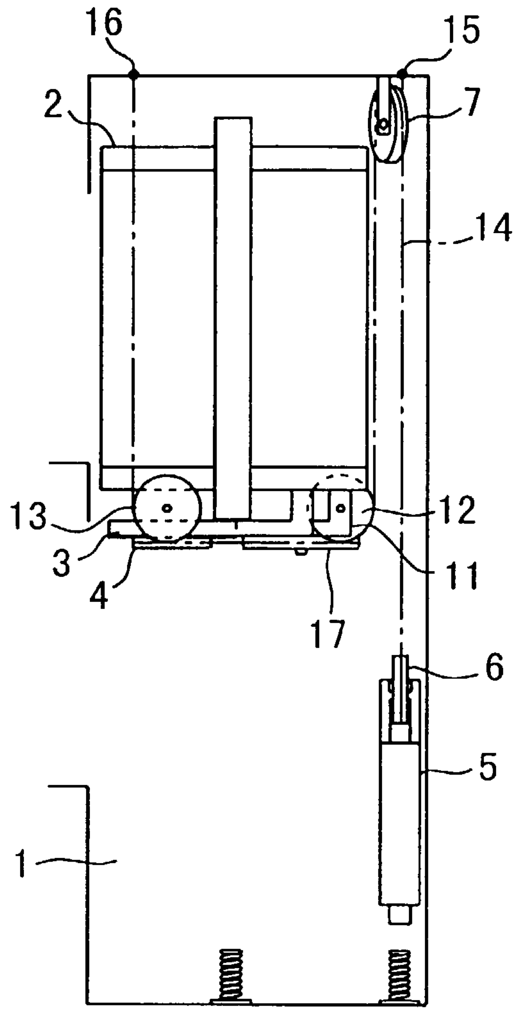

FIG. 9

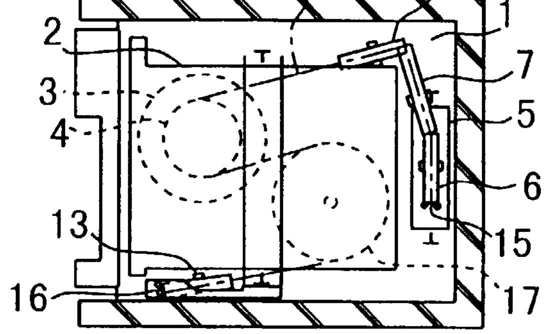

FIG. 10

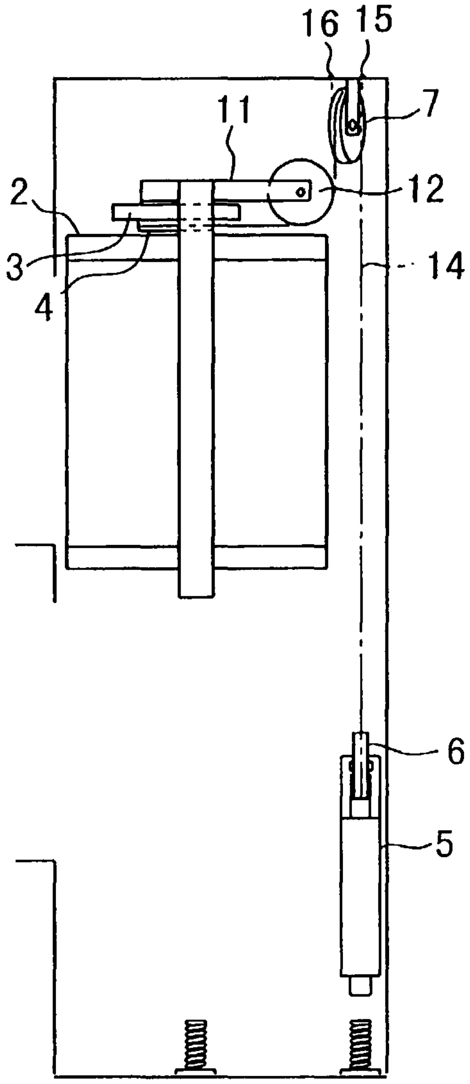

FIG. 11

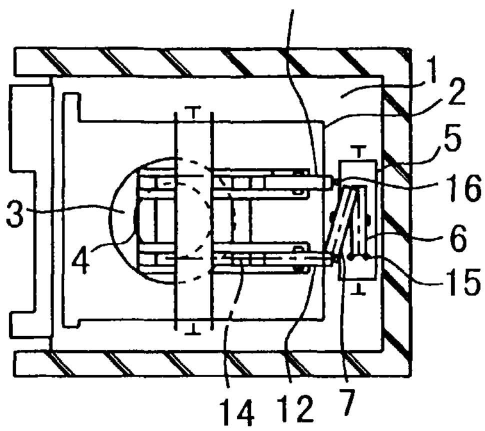

FIG. 12

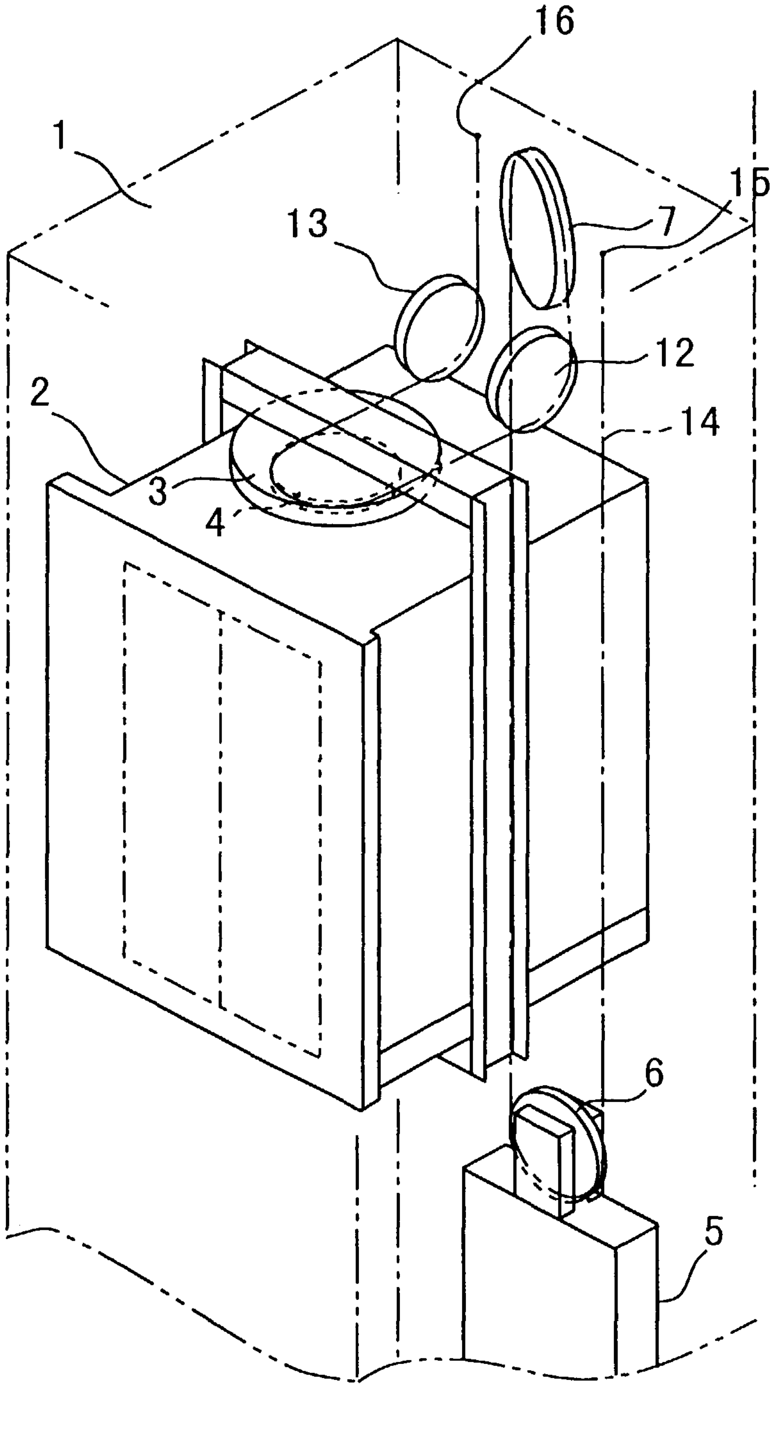

FIG. 13