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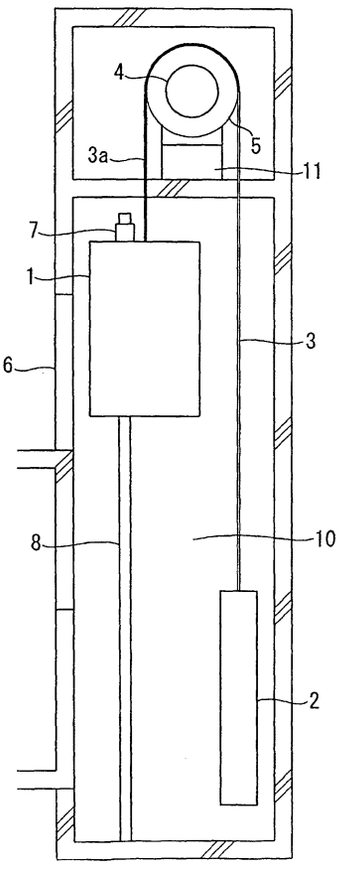
(54) ELEVATOR DEVICE

(57) In an elevator system of the invention, when a passenger car (1) attempts to ascend or descend beyond a predetermined range in a hoistway (10), a pulley (5) of a hoisting machine (4) is arranged to run idle with respect to the pull cable (3). As a result, even when the passenger car (1) attempts to ascend or descend beyond a predetermined range in the hoistway (10), ascending or descending of the passenger car 1 beyond the predetermined range can be prevented. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members (1, 3, 4, 8) of the system.

Fig. 1



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Description

THCHNICAL FIELD

[0001] The invention relates to an elevator system which causes a passenger car and a counterweight to ascend or descend by driving a pull cable with a hoisting machine.

BACKGROUND ART

[0002] There has hitherto been known an elevator system which prevents apassenger car from becoming dislodged from guide rails, which would otherwise be caused when the passenger car has moved upward beyond an elevator hall at the highest floor in excess of a predetermined range within a hoistway.

[0003] A known elevator system will now be described by reference to Fig. 4. Fig. 4 is a schematic cross-sectional view showing the known elevator system.

[0004] As illustrated, the elevator system primarily comprises: a passenger 1 into which passengers enter and which ascends and descends within a hoistway 10; a counterweight 2 which ascends or descends in a direction opposite a direction in which the passenger car 1 ascends or descends; a pull cable 3 (main cable) which suspends at one end thereof the passenger car 1 and suspends at the other end thereof the counterweight 2; a hoisting machine 4 (a hoisting motor) which is equipped with a pulley 5 and drives the pull cable 3 passed around the pulley 5; car guide rails 8 for guiding ascending and descending operations of the passenger car 1; and unillustrated counterweight guide rails for guiding ascending or descending the counterweight 2. The hoisting machine 4 is supported on a support bench 11 mounted at the top section of the hoistway 10.

[0005] Here, an upper guide device 7 (guide device) having a roller section or the like is fastened to an upper portion of the passenger car 1. The roller section of the upper guide device 7 remains in contact with the surfaces of the guide rails 8. Stoppers 9 for preventing the upper guide device 7 from becoming dislodged from the guide rails 8 are provided at upper ends of the respective guide rails 8 that guide ascending and descending operations of the passenger car 1.

[0006] In the elevator system having the foregoing construction, the passenger car 1 ascends or descends along the passenger car guide rails 8 within a predetermined range in the hoistway 10 by means of driving of the pull cable 3 stemming from frictional transmission of the pulley 5. Here, the predetermined range within the hoistway 10 means an ordinary range of ascending and descending operations of the passenger car 1; that is, a range from an unillustrated elevator hall at the lowest floor to an elevator hall 6 at the highest floor.

[0007] For example, if a brake is applied to the pulley 5 with a delay as a result of a failure having arisen in a brake system of the hoisting machine 4, the passenger car 1 may exceed the predetermined range within the hoistway 10, thereby further moving upward beyond the elevator hall 6 at the top floor. At this time, the upper guide device 7 comes into contact with the stopper 9, thereby preventing dislodgment of the passenger car 1 from the guide rails 8.

[0008] However, the foregoing known elevator system has a potential risk of glitches arising in constituent members of the system, which could be caused when the upper guide device 7 comes into contact with the stopper 9 as a result of the passenger car 1 having exceeded the predetermined range within the hoistway 10. For instance, in the event that a brake system of the hoisting machine 1 has not functioned at all, the pulley 5 rotates at the same speed as in normal ascending and descending operations without deceleration of a rotation speed. Hence, in such a case, the upper guide device 7 collides with the stopper 9 at the same speed as that at which the passenger car 1 ascends or descends under normal operation. There is the possibility that impact force stemming from collision inflicts damage on the upper guide device 7 or the stopper 9, thereby deforming the guide rails 8. As a result of the upper guide device 7 having come into contact with the stopper 9, the pull cable 3 may be subjected to tensile force greater than that to which the pull cable 3 is to be subjected under normal operation, thereby inflicting damage on the hoisting machine 4 or the pull cable 3. In the event of occurrence of such a failure, the failure will deteriorate the durability of the system, as well as affect the ride comfort of the passenger car 1.

[0009] In particular, many recent elevator systems appear to be designed such that the length of the guide rails 8 is set to a minimum required length within the hoistway in order to satisfy demand for space savings. In other words, the length of the guide rails 8 is set so as to become slightly longer than the position of the elevator hall 6 at the top floor, thereby minimizing the height of the hoistway 10. Consequently, allowance for dislodgment of the passenger car 1 from the guide rails 8 becomes smaller as the length of the guide rails 8 becomes shorter. Hence, the foregoing problem comes further to the forefront.

[0010] The invention has been conceived to solve the problem set forth and aims at providing a high-quality, highly reliable elevator system which does not inflict any deformation or damage on constituent members of the system even when a passenger car ascends or descends beyond a predetermined range within a hoistway.

DISCLOSURE OF THE INVENTION

[0011] The invention is directed to an elevator system, wherein, when a passenger car attempts to ascend or descend beyond a predetermined range in a hoistway, a pulley of a hoisting machine is arranged to run idle with respect to the pull cable. As a result, even when the

passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, ascending or descending of the passenger car 1 beyond the predetermined range can be prevented, thus avoiding inflicting of deformation or damage to constituent members of the system.

[0012] Further, in the improved elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, a low friction area of a pull cable is passed around a pulley of a hoisting machine. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable by means of friction, thereby preventing ascending or descending of the passenger car in excess of the predetermined range and inflicting of deformation or damage to constituent members of the system.

[0013] Further, according to the improved elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, an angle of contact between the pulley of the hoisting machine and the pull cable is reduced. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable by means of friction, thereby preventing ascending or descending of the passenger car in excess of the predetermined range and inflicting of deformation or damage to constituent members of the system.

[0014] Moreover, according to the improved elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, an engagement section of the pull cable is disengaged from a pulley and the pull cable is passed around the pulley having irregularities. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable by means of engagement, thereby preventing ascending or descending of the passenger car in excess of the predetermined range and inflicting of deformation or damage to constituent members of the system.

BRIEF DESCRIPTION OF THE DRAWINGS

[0015]

Fig. 1 is a schematic cross-sectional view showing a first preferable elevator system according to the invention;

Fig. 2 is a schematic cross-sectional view showing a second preferable elevator system according to the invention;

Fig. 3 is a schematic cross-sectional view showing a third preferable elevator system according to the invention; and

Fig. 4 is a schematic cross-sectional view showing a known elevator system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0016] The invention will be described in more detail by reference to the accompanying drawings.

[0017] Fig. 1 is a schematic cross-sectional view showing a first preferable elevator system according to the invention.

[0018] As illustrated, the elevator system of the first embodiment is in principle constituted of a passenger car 1 which ascends and descends within a hoistway 10; a counterweight 2 which ascends or descends in a direction opposite the direction in which the passenger car 1 ascends or descends; a pull cable 3 which suspends at one end thereof the passenger car 1 and suspends at the other end thereof the counterweight 2; a hoisting machine 4 which is equipped with a pulley 5 and drives the pull cable 3 passed around the pulley 5; car guide rails 8 for guiding ascending and descending operations of the passenger car 1; and unillustrated counterweight guide rails for guiding ascending or descending operations of the counterweight 2. The hoisting machine 4 is supported on a support bench 11 mounted at the top section of the hoistway 10. Here, an upper guide device 7 is fastened to an upper portion of the passenger car 1. The upper guide device 7 remains in contact with the guide rails 8.

[0019] Here, a low friction area 3a having a low coefficient of friction is formed in aportion of the pull cable 3 in a longitudinal direction thereof (i.e., a direction corresponding to the length of the cable). Specifically, the pull cable 3 is constituted of an area having an ordinary coefficient of friction required for the pulley 5 to effect friction transmission, and the low friction area 3a having a coefficient of friction lower than that of the area. The pull cable 3 having the low friction area 3a is formed by means of filming or coating a desired location on the ordinary pull cable 3. Further, the low friction area 3a is formed at a position close to the passenger car 2 in the longitudinal direction of the pull cable 3. A coefficient of friction of the low friction area 3a is set to a value sufficient for causing the pulley 5 to perform idle run when the low friction area 3a is passed around the pulley 5.

[0020] In the elevator system of the first embodiment having the foregoing construction, when the passenger car 1 moves upward beyond an elevator hall 6 at the top floor in excess of a predetermined range in the hoistway 10, the low friction area 3a of the pull cable 3 is passed around the pulley 5 of the hoisting machine 4. When the low friction area 3a has been passed around the pulley 5 of the hoisting machine 4, the pulley 5 undergoes relative sliding with respect to the pull cable 3, thereby hindering transmission of frictional drive force to the pull cable 3. As a result, even when the passenger car 1 attempts to move beyond the predetermined range in the

hoistway 10, the passenger car 1 does not move upward beyond the elevator hall 6 at the top floor, or exceeds the hall by only a nominal distance, thereby reliably hindering the passenger car 1 from becoming dislodged from the guide rails 8.

[0021] As has been described, according to the elevator system of the first embodiment, even when the passenger car 1 attempts to ascend or descend beyond a predetermined range in the hoistway 10, the pulley 5 runs idle with respect to the pull cable 3. Thus, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members such as the guide rails 8, the passenger car 1, the hoisting machine 4, and the pull cable 3.

[0022] The first embodiment has described the elevator system in which the hoisting machine 4 is mounted at the top section of the hoistway 10. However, the invention can also be applied to an elevator system in which the hoisting machine 4 is mounted at another location; for example, the bottom of the hoistway 10. In such a case, the position of the low friction area 3a of the pull cable 3 is located at a corresponding position. Thus, there can be yielded the same advantage as that yielded in the first embodiment.

[0023] In the first embodiment, a case where the passenger car 1 exceeds a predetermined range within the hoistway 10 means a case where the passenger car 1 moves beyond the top floor. The first embodiment can also be applied to a case where the passenger car 1 is moved downward beyond the lowest floor. In such a case, the low friction area 3a of the pull cable 3 is provided at a position closer to the counterweight 2, thereby yielding the same advantage as that yielded in the first embodiment.

[0024] Fig. 2 is a schematic cross-sectional view showing a second preferable elevator system of the invention.

[0025] As illustrated, as in the case of the first embodiment, the elevator system of the second embodiment is constituted of the passenger car 1; the counterweight 2; the pull cable 3; the hoisting machine 4 having the pulley 5; the passenger car guide rail 8; and an unillustrated counterweight guide rail.

[0026] A pedestal 12 for receiving the load of the counterweight 2 is positioned at the bottom in the hoistway 10. The pedestal 12 is formed so as to come into contact with the counterweight 2 in the event that the passenger car 1 has moved beyond the elevator hall 6 at the top floor in excess of a predetermined range in the hoistway 10 and the counterweight 2 has moved downward beyond a predetermined range. With a view toward dampening impact which would arise when the counterweight 2 comes into contact with the pedestal 12, the pedestal 12 is formed from material having an impact absorption characteristic; e.g., vibration-proof rubber.

[0027] Disposed in the top section of the hoistway 10 where the hoisting machine 4 is installed are a follower pulley 16 which remains in contact with the pull cable 3 at a position between the pulley 5 and the counterweight 2, and a tension spring 15 which supports at one end thereof the follower pulley 16 and is at the other end thereof supported on a wall of the hoistway 10. The tension spring 15 for supporting the follower pulley 16 has spring force sufficient for drawing the pull cable 3 toward the wall of the hoistway 10 when the tensile force exerted on the pull cable 3 by the counterweight 2 has become smaller than ordinary force.

[0028] In an elevator system of the second embodiment having the foregoing construction, when the passenger car 1 ascends or descends within a predetermined range in the hoistway 10, the follower pulley 16 comes into contact with the pull cable 3 at a predetermined location (i.e., a position designated by a two-dot chain line in the drawing), thereby sustaining an angle of contact between the pull cable 3 and the pulley 5 at an angle of about 180°. In contrast, when the passenger car 1 has ascended or descended beyond a predetermined range in the hoistway 10, the follower pulley 16 moves from the predetermined position under the spring force of the tensile spring 15 (i.e., toward a position designated by a solid line in a direction indicated by an arrowhead), thereby reducing the angle of contact between the pull cable 3 and the pulley 5. Here, the angle of contact signifies that a range of the pull cable 3 passed around the pulley 5 is designated by an angle when viewed from the rotational center of the pulley 5.

[0029] When the passenger car 1 moves upward beyond the elevator hall 6 at the highest floor in excess of a predetermined range in the hoistway 10, the pedestal 12 receives the load of the counterweight 2, thereby reducing the tensile force of the pull cable 3 exerted by the counterweight 2. By means of the spring force of the tensile spring 15, the follower pulley 16 draws the portion of the pull cable 3 close to the counterweight 2 whose tensile force has been reduced, in a direction in which the angle of contact between the pulley 5 and the pull cable 3 is to be reduced. The portion of the pull cable 3 close to the counterweight 2 is subjected to tensile force substantially equal to that exerted on the passenger car 1.

[0030] In this way, when the angle of contact between the pulley 5 of the hoisting machine 4 and the pull cable 3 is reduced, a contact surface existing between the pulley 5 and the pull cable 3 becomes smaller than that existing under normal operation. Hence, the pulley 5 slides relative to the pull cable 3, thereby hindering transmission of drive force, which would otherwise be caused by friction of the pull cable 3. Therefore, even when the passenger car 1 attempts to move beyond the predetermined range in the hoistway 10, the passenger car 1 does not move beyond the elevator, hall 6 at the top floor, or moves over only a nominal distance. Thus, dislodgment of the passenger car 1 from the guide rail 8 can be prevented without fail.

[0031] As has been described, according to the ele-

vator system of the second embodiment, when the passenger car 1 attempts to ascend or descend beyond the predetermined range in the hoistway 10, the pulley 5 runs idle with respect to the pull cable 3. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members such as the guide rails 8, the passenger car 1, the hoisting machine 4, and the pull cable 3.

[0032] Fig. 3 is a schematic cross-sectional view showing a third preferable elevator system of the invention.

[0033] As illustrated, similar to the case of the previous embodiments, the elevator system of the third embodiment is constituted of the passenger car 1; the counterweight 2; a pull cable 19 which suspends the passenger car 1 and the counterweight 2 at the ends; the hoisting machine 4 having the pulley 18 around which the pull cable is passed; the passenger car guide rail 8; and an unillustrated counterweight guide rail.

[0034] Here, a pulley 18 of the hoisting machine 4 is formed from, e.g., a sprocket, in a circumference of which irregularities are formed at uniform pitches. The pull cable 19 is a belt, in a portion of which in a longitudinal direction an engagement section 19b to mesh the irregularities of the pulley 18 is formed; for example, a toothed belt matching a toothed shaped of the sprocket. A non-engagement section 19a which does not engage the irregularities of the pulley 18 is formed in a portion of the pull cable 19 close to the passenger car 1.

[0035] In the elevator system of the third embodiment having the foregoing construction, when the passenger car 1 is ascending or descending within a predetermined range in the hoistway 10, the engagement section 19b of the pull cable 19 engages irregularities of the pulley 18. The pulley 18 actuates the pull cable 19 by means of engagement transmission, thus causing the passenger car 1 and the counterweight 2 to ascend or descend.

[0036] In contrast, if the passenger car 1 moves upward beyond the elevator hall 6 at the top floor in excess of the predetermined range in the hoistway 10, the non-engagement section 19a of the pull cable 19 is passed around the pulley 18 of the hoisting machine 4. When the non-engagement section 19a is passed around the pulley 18, the pull cable 19 comes into contact with only protrusions of the pulley 18. Hence, the pulley 18 slides relative to the pull cable 19, thereby hindering transmission of drive force, which would otherwise be caused by engagement of the pull cable 19. As a result, even when the passenger car 1 attempts to move beyond a predetermined range in the hoistway 10, the passenger car does not move beyond the elevator hall 6 at the top floor or moves over only a nominal distance, thereby reliably preventing dislodgment of the passenger car 1 from the guide rails 8.

[0037] As has been described, in the elevator system of the third embodiment, when the passenger car 1 attempts to ascend or descend beyond a predetermined range in the hoistway 10, the pulley 18 runs idle with respect to the pull cable 19. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members such as the guide rails 8, the passenger car 1, the hoisting machine 4, and the pull cable 19.

[0038] It is obvious that the invention is not limited to the embodiments and is susceptible to modifications other than those suggested in the embodiments, as required, within the technical scope of the invention. The number, positions, and geometries of the constituent members are not limited to those mentioned in the embodiments. The preferred number, positions, and geometries may be determined in carrying out the invention. Throughout the drawings, like constituent elements are assigned like constituent reference numerals.

INDUSTRIAL APPLICABILITY

[0039] As has been described, in the elevator system of the invention, according to an elevator system of the invention, when a passenger car attempts to ascend or descend beyond a predetermined range in a hoistway, a pulley of a hoisting machine is arranged to run idle with respect to the pull cable. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, ascending or descending of the passenger car 1 beyond the predetermined range can be prevented. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members of the system.

[0040] Further, according to the elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, a low friction area of a pull cable is passed around a pulley of a hoisting machine. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable by means of friction, thereby preventing ascending or descending of the passenger car in excess of the predetermined range. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members of the system.

[0041] Further, according to the elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, an angle of contact between the pulley of the hoisting machine and the pull cable is reduced. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable by means of friction, thereby preventing ascending or descending of the passenger car in excess of the predetermined range. Hence, there can be provided a high-quality, highly reliable elevator system which does

not inflict deformation or damage to constituent members of the system.

[0042] Moreover, according to the elevator system of the invention, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, an engagement section of the pull cable is disengaged from a pulley and the pull cable is passed around the pulley having irregularities. As a result, even when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, drive force is not transmitted from the pulley to the pull cable bymeans of engagement, thereby preventing ascending or descending of the passenger car in excess of the predetermined range. Hence, there can be provided a high-quality, highly reliable elevator system which does not inflict deformation or damage to constituent members of the system.

Claims

1. An elevator system comprising:

a pull cable which suspends at one end thereof a passenger car and at the other end thereof a counterweight, the passenger car and the counterweight ascending or descending along corresponding guide rails within a predetermined range in a hoistway; and
a hoisting machine which has a rotatable pulley and drives the pull cable passed around the pulley, wherein,
when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, the pulley of the hoisting machine is arranged to run idle with respect to the pull cable.

2. The elevator system according to claim 1, wherein a low friction area is provided in a portion of the pull cable in a longitudinal direction thereof; and wherein, when the passenger car attempts to ascend or descend beyond a predetermined range in the hoistway, the low friction area of the pull cable is passed around the pulley.

3. The elevator system according to claim 1 or 2, further comprising:

a pedestal which reduces tensile force of the pull cable exerted by the counterweight by receiving the load of the counterweight when the passenger car ascends or descends beyond a predetermined range in the hoistway; and
a follower pulley which causes the portion of the pull cable which is close to the counterweight and whose tensile force has been reduced to be dislodged in a direction in which an angle of contact between the pulley and the pull cable is to be reduced.

4. The elevator system according to any one of claims 1 through 3, wherein the pulley has irregularities formed in a circumferential direction thereof at uniform pitches;

the pull cable has an engagement section which meshes with irregularities of the pulley and is formed in a portion of the pull cable in a longitudinal direction thereof; and,
when the passenger car ascends or descends beyond the predetermined range in the hoistway, the engagement section is disengaged from the pull cable and the pull cable is passed around the pulley.

Fig. 1

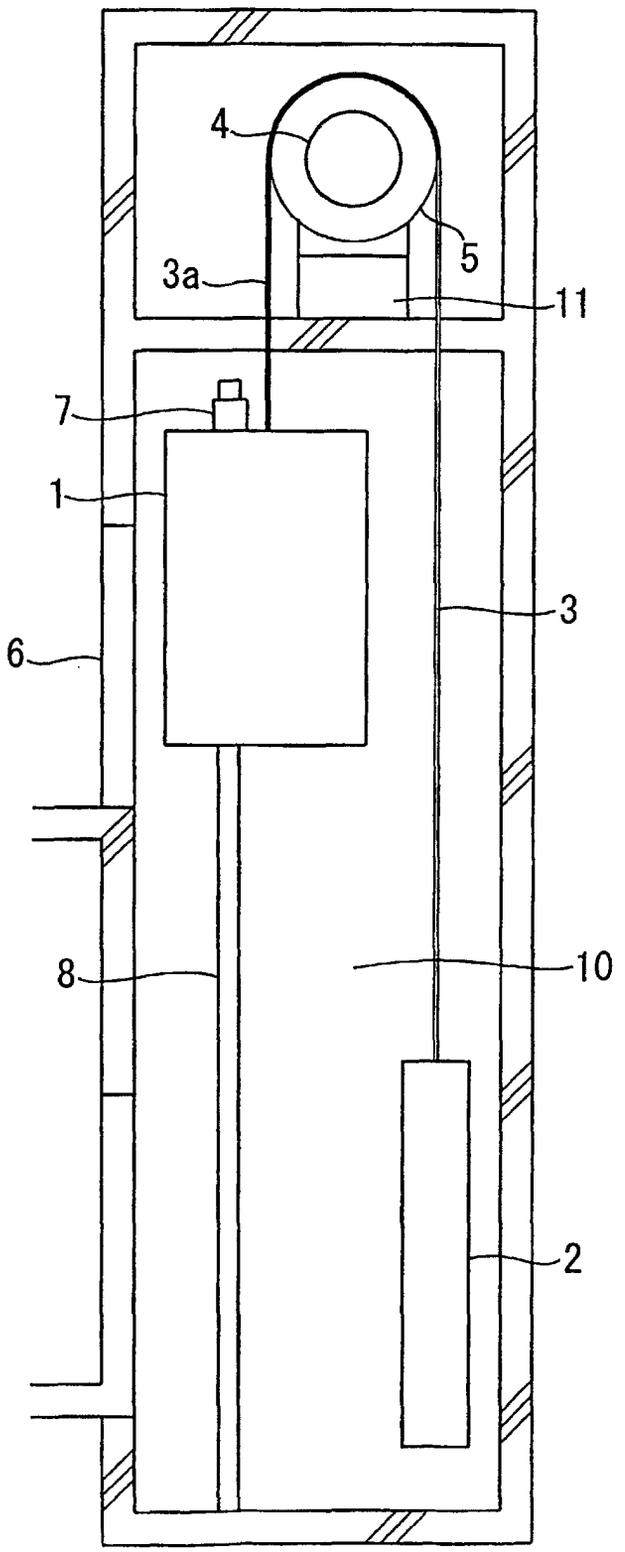


Fig. 2

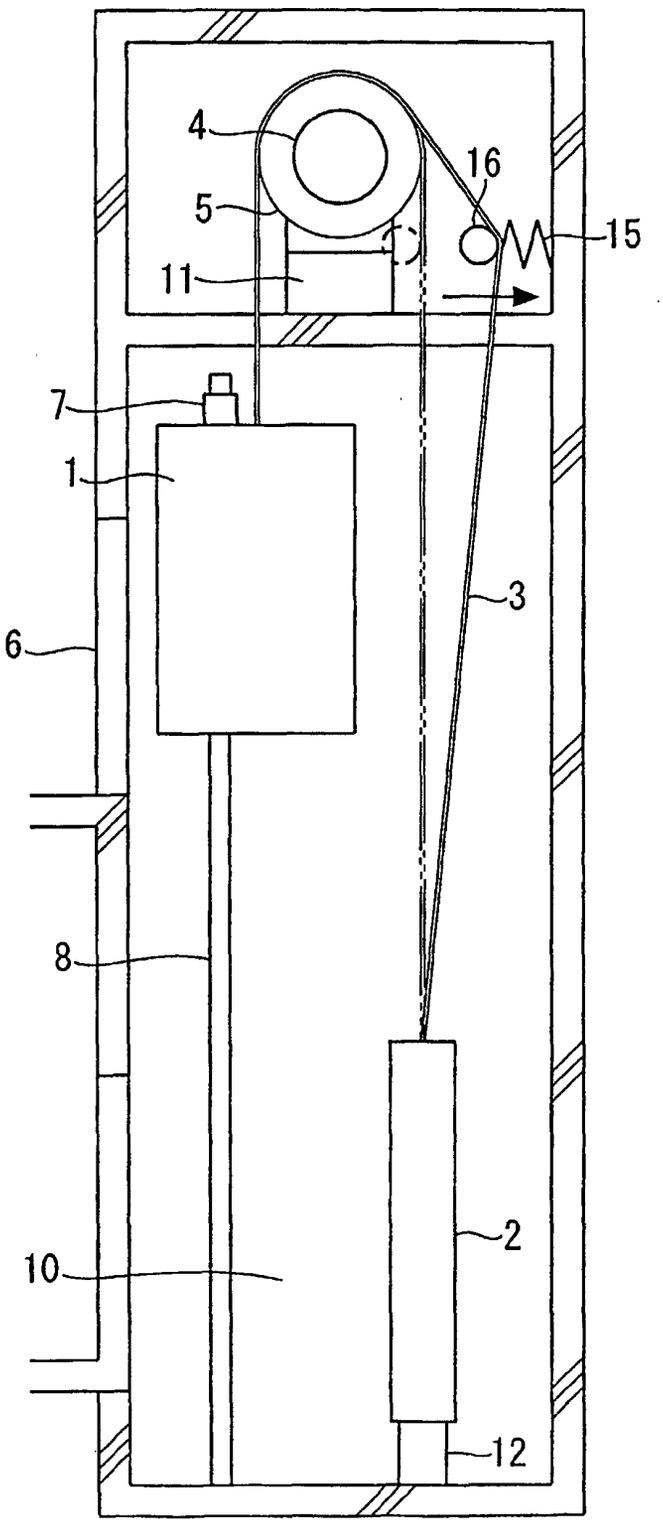


Fig. 3

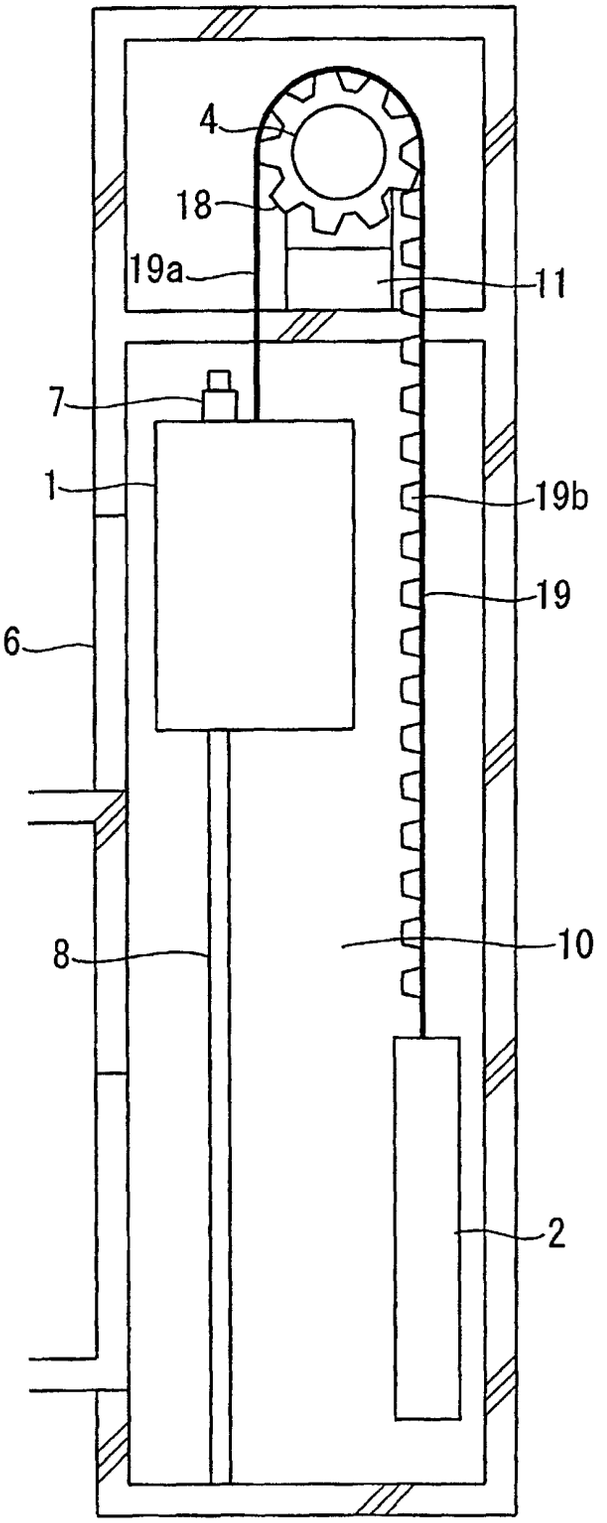
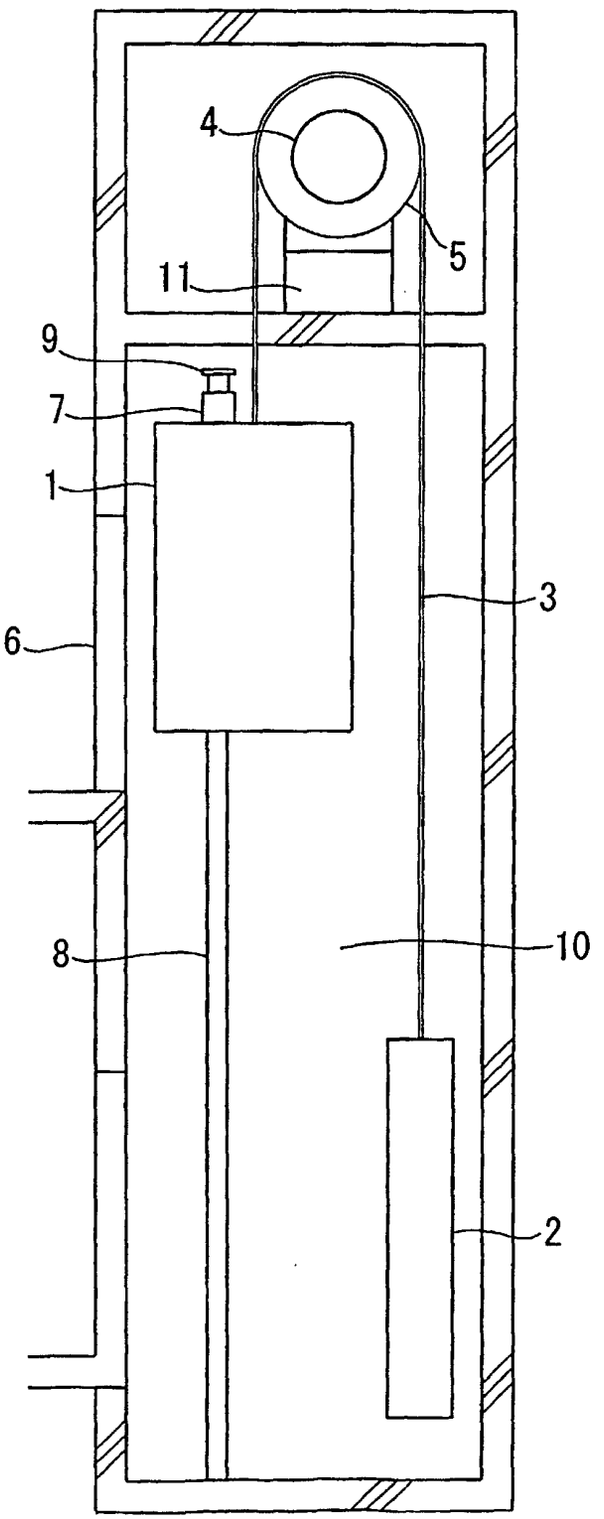


Fig. 4



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/06079

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] B66B11/08, B66B7/06

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] B66B1/00-B66B11/08, F16H19/00-F16H19/08

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2002
Kokai Jitsuyo Shinan Koho	1971-2002	Toroku Jitsuyo Shinan Koho	1994-2002

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 7-237853, A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 12 September, 1995 (12.09.95), (Family: none)	1-4
A	JP, 2000-46137, A (Sanyo Electric Co., Ltd.), 18 February, 2000 (18.02.02), (Family: none)	1-4
A	JP, 7-305277, A (Teijin Ltd.), 21 November, 1995 (21.11.95), (Family: none)	2
A	JP, 2000-118914, A (Hitachi Building Systems Co., Ltd.), 25 April, 2000 (25.04.00), (Family: none)	3
A	JP, 8-217366, A (Hitachi, Ltd.), 27 August, 1996 (27.08.96), (Family: none)	4

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

* Special categories of cited documents:
"A" document defining the general state of the art which is not considered to be of particular relevance
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Date of the actual completion of the international search	Date of mailing of the international search report
26 March, 2002 (26.03.02)	09 April, 2002 (09.04.02)
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
Facsimile No.	Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/06079

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP, 3-93573, A (Canon Inc.), 18 April, 1991 (18.04.91), (Family: none)	4

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