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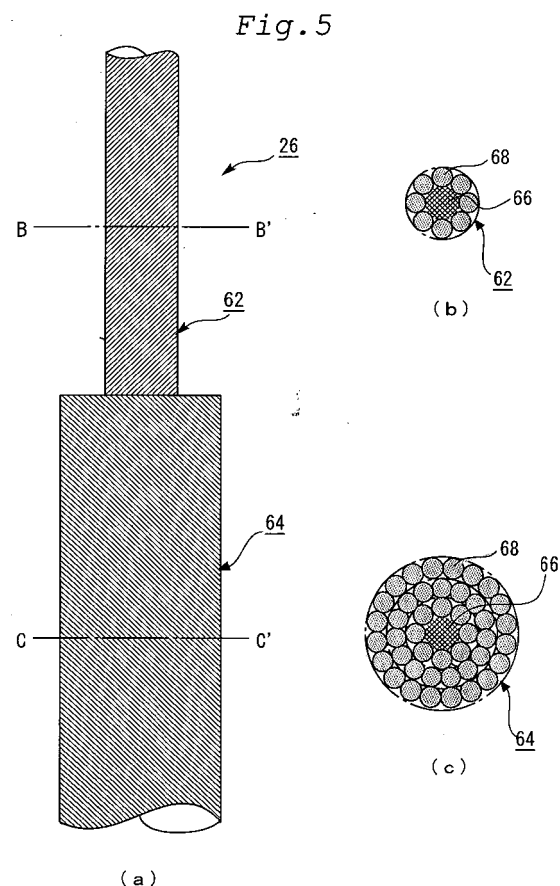
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(54) **ELEVATOR APPARATUS AND SPEED ADJUSTING ROPE**

(57) An elevator system (100), in which a car (6) moves up and down in an elevator shaft (2) by being guided by guide rails (12) erected in the elevator shaft (2), includes a speed governor (22), a speed governor rope (26), and an emergency stopping device (28). The speed governor (26) stops the movement of the car (6) according to the movement speed of the car (6). Also, the emergency stopping device (28) is provided on the car (6) and is connected to one location of the speed governor rope (26) to stop the movement of the car (6) according to the operation of the speed governor rope (26). The speed governor rope (26) is formed into an endless shape and is wound on the speed governor (22). Further, the speed governor rope (26) is formed by changing the cross-sectional shape thereof, and thereby the operation speed of the speed governor (22) is changed according to the position of the car (6).



Description

Technical Field

[0001] The present invention relates to an elevator system and a speed governor rope. More particularly, it relates to an elevator system provided with an emergency stopping device and a speed governor, and a speed governor rope used in this system.

Background Art

[0002] Generally, an elevator system is provided with various devices such as a speed governor, emergency stopping device, and shock absorber to ensure safety.

[0003] For example, if the movement speed of a car reaches a predetermined first overspeed V_s in the elevator system, the speed governor detects this fact to shut off the electric power for a hoist motor. When the power for a hoist is shut off, a hoist brake operates to stop the rotation of hoist, by which the upward and downward movement of car is stopped.

[0004] There may be a case where the downward movement of car cannot be stopped by the hoist brake due to, for example, a trouble such that a rope connected to the car is broken. In this case, the downward movement speed of car increases further. If the downward movement speed of car reaches a predetermined second overspeed V_t , the rotation of a sheave provided on the speed governor is compulsorily stopped. When the rotation of sheave is stopped, friction is applied to the movement of a speed governor rope, so that an emergency stopping device connected to a part of the speed governor rope operates. Specifically, the tension of speed governor rope turns a lever of the emergency stopping device, by which a shoe is pressed on a guide rail. Thereby, the downward movement of car is stopped.

[0005] Generally, for safety within the car, the deceleration caused by the emergency stopping device is set so that the average deceleration of car is within 1 G. Here, G designates gravitational acceleration, being about 9.8 m/s^2 .

[0006] Considering a case where the car moves down beyond the lowest floor from any cause, the shock absorber is provided at the lower part of an elevator shaft. The shock absorber alleviates a shock when the car collides with the bottom of elevator shaft. The shock absorber is set, like the emergency stopping device, so that the average deceleration of car is within 1 G. When the downward movement speed of car does not reach the second overspeed V_t and hence the emergency stopping device does not operate even if the car comes to the lowest floor, the speed at which the car collides with the shock absorber may become the second overspeed V_t at the maximum. Considering this case, a shock absorbing operation distance SB until the car is stopped by the shock absorber is set so as to have the

same length as a stopping distance SA at which the car is stopped by the emergency stopping device.

[0007] However, when the shock absorbing operation distance SB is secured in this manner, the shock absorber itself becomes undesirably very long. In particular, for a high-speed elevator, the shock absorbing operation distance SB of shock absorber sometimes exceeds 10 m. In this case, the total height of shock absorber exceeds 20 m.

[0008] The increase in height of the shock absorber itself increases the manufacturing cost of shock absorber, and hence increases the building cost of elevator system.

[0009] Also, a space for installing a tall shock absorber having such a height must be secured at a part lower than the lowest floor of the elevator system. Further, if the car collides with the shock absorber at the speed V_t , the car goes downward further from the lowest floor by the shock absorbing operation distance SB. At this time, a balancing weight goes upward further from the highest floor by the shock absorbing operation distance SB. Therefore, at the upper part of the elevator shaft, a space corresponding to the shock absorbing operation distance SB must be provided as a space for allowing the rise of balancing weight. That is to say, in the elevator system, a space corresponding to the height of shock absorber must be provided at the lower part of elevator shaft, and a space corresponding to the shock absorbing operation distance SB must be provided at the upper part thereof.

[0010] Therefore, the size of elevator system increases, and thus the building cost and manufacturing cost may increase. Also, since such spaces necessary for the installation and operation of shock absorber are secured, the highest floor and the lowest floor cannot possibly be installed.

[0011] To solve these problems, for example, an elevator system can be thought in which the movement speed of car is controlled so as to be decreased compulsorily at the lower part of elevator shaft. According to this elevator system, the maximum speed at the time when the car collides with the shock absorber can be decreased, so that the necessary shock absorbing operation distance SB of shock absorber can be shortened.

[0012] However, in cases such as when the hoist brake itself breaks down or when the rope breaks, deceleration control as described above cannot be carried out. Therefore, considering such a case, the shock absorbing operation distance SB is preferably secured considering a case where the car collides with the shock absorber at the second overspeed V_t .

Disclosure of the Invention

[0013] Accordingly, the present invention proposes an elevator system that is improved so as to solve the above problems, to shorten a shock absorber while a

necessary shock absorbing operation distance is secured, and to decrease a necessary space in the upper and lower portions in an elevator shaft.

[0014] Therefore, an elevator system in accordance with the present invention includes a car moving up and down in an elevator shaft by being guided by a guide rail erected in the elevator shaft; a speed governor for stopping the movement of the car according to the movement speed of the car; a speed governor rope which is formed into an endless shape and is wound on the speed governor; and an emergency stopping device which is provided on the car and is connected to one location of the speed governor rope to stop the movement of the car according to the operation of the speed governor rope. Also, the speed governor rope is formed by changing the cross-sectional shape thereof, and thereby the operation speed of the speed governor is changed according to the position of the car.

[0015] Thereby, the movement speed of the car can be adjusted as necessary when the movement of the car is stopped or the emergency stopping device is operated. Therefore, the shock absorbing operation distance of the shock absorber can be shortened, and hence the necessary space at the upper and lower parts of the elevator system can be decreased.

Brief Descriptions of Drawings

[0016]

Figure 1 is a schematic view for illustrating an elevator system in accordance with an embodiment of the present invention.

Figure 2 is a schematic view for illustrating the speed governor provided for elevator system in accordance with the embodiment of the present invention.

Figure 3 is a schematic sectional view of the speed governor, taken along the line A-A' of Figure 2.

Figure 4 is a schematic view for illustrating a state in which the speed governor is working, the view corresponding to Figure 2.

Figure 5 is a schematic view for illustrating the speed governor rope in accordance with the embodiment of the present invention.

Figure 6 is a schematic view for illustrating the emergency stopping device in accordance with the embodiment of the present invention.

Figure 7 is a graph showing the movement speed of the car in accordance with the embodiment of the present invention.

Best Mode for Carrying Out the Invention

[0017] An embodiment of the present invention will now be described with reference to the accompanying drawings. In the drawings, the same reference numerals are applied to the same or equivalent elements, and the

explanation thereof will be simplified or omitted.

[0018] Figure 1 is a schematic view for illustrating an elevator system 100 in accordance with an embodiment of the present invention.

[0019] As shown in Figure 1, the elevator system 100 is constructed so as to include an elevator shaft 2 and a machine room 4. In Figure 1, the elevator shaft 2 is provided with stages 2A₁, 2A₂ and 2A₃ arranged in that order from the highest part 2a of elevator shaft, and is provided with stages 2B₁, 2B₂ and 2B₃ arranged in that order from the lowest part 2b thereof.

[0020] In the elevator shaft 2, a car 6 and a balancing weight 8 are hung down by a rope 10. Also, in the elevator shaft 2, two guide rails 12 are erected. Each of two side walls, which are opposed to each other, of the car 6 are in contact with the guide rails 12. The car 6 moves up and down in the elevator shaft 2 by being guided by the guide rails 12.

[0021] In the machine room 4, a hoist 14 is provided. The rope 10 is wound on the hoist 14. The hoist 14 moves the rope 10 by means of the rotation thereof, by which the car 6 and the balancing weight 8 fixed to the rope 10 are moved up and down. Also, in the machine room 4, a control panel 16 is provided. The control panel 16 is connected to the hoist 14 to electrically control the hoist 14.

[0022] Also, in the machine room 4, a speed governor 22 is provided. On the other hand, on the floor of the elevator shaft 2, a tension pulley 24 is provided. An endless speed governor rope 26, which is formed into a loop shape, is set around the speed governor 22 and the tension pulley 24. That is, the speed governor rope 26 is provided on the speed governor 22 and the tension pulley 24 under tension. Also, on the bottom of the car 6, an emergency stopping device 28 is provided. The emergency stopping device 28 is connected to one location of the speed governor rope 26. Further, on the floor of the elevator shaft 2, a shock absorber 30 is provided under the car 6.

[0023] Figure 2 is a schematic view for illustrating the speed governor 22 in accordance with the embodiment of the present invention. Figure 3 is a schematic sectional view of the speed governor 22, taken along the line A-A' of Figure 2. Also, Figure 4 is a schematic view for illustrating a state in which the rotation of the speed governor 22 is stopped, the view corresponding to Figure 2. In Figures 2 to 4, see-through portions are indicated by dotted lines.

[0024] As shown in Figures 2 to 4, the speed governor 22 is constructed so that a sheave 32 is rotatably supported on a sheave base 36 by a sheave shaft 34 provided at the center of the sheave 32. On the side surface of the sheave 32, a pair of flyweights 38a and 38b are arranged at positions symmetrical with respect to the sheave shaft 34, and they each are installed to the sheave 32 with a pin 40 so as to be rotatable around the pin 40. Also, the flyweights 38a and 38b are connected to each other by a link 42. Further, on one flyweight 38a,

an actuating claw 46 is provided. The sheave base 36 is provided with a car stopping switch 48, and the car stopping switch 48 is provided with a switch lever 50. The switch lever 50 is arranged at a position at which it is operated by the actuating claw 46. At an end of the flyweight 38a, which is on the opposite side to the position at which the actuating claw 46 is provided, one end of a balancing spring 52 is fixed. The other end of the balancing spring 52 is fixed to the sheave 32. Near a portion of the flyweight 38a where the balancing spring 52 is fixed, a latch 54 is provided. The sheave base 36 is provided with a ratchet 56 that engages with the latch 54 as necessary.

[0025] When the sheave 32 rotates, a centrifugal force toward the outside is applied to the flyweights 38a and 38b by the rotation of the sheave 32. On the other hand, the balancing spring 52 is set so that the elastic force thereof acts in the direction opposed to the centrifugal force applied to the flyweight 38a. Further, the elastic force of the balancing spring 52 is adjusted so that when the angular velocity of rotation of the sheave 32 reaches ω_s , the actuating claw 46 of the flyweight 38a pushes the switch lever 50, and when the angular velocity thereof reaches ω_t , the latch 54 engages with the ratchet 56.

[0026] Figure 5 is a schematic view for illustrating the speed governor rope 26. Figure 5(a) is a front view, and Figures 5(b) and 5(c) are sectional views taken along the lines B-B' and C-C' of Figure 5(a), respectively.

[0027] As shown in Figure 5, the speed governor rope 26 is formed so as to include a small-diameter region 62, in which the rope diameter is small, and a large-diameter region 64. The small-diameter region 62 is formed by providing a core 66 in the center and by arranging a total of eight strands 68 in one layer around the core 66 and twisting them. The core 66 is formed of fibers such as hemp, and is impregnated with oil (grease) etc. to prevent the rope from rusting. The strand 68 is formed by twisting thin steel wires called element wires. The large-diameter region 64 is a region connected to the small-diameter region 62 as it is. The large-diameter region 64 is formed by arranging strands 68 in two layers around the small-diameter region 62 and by twisting them. Referring to Figure 1, the speed governor rope 26 is formed in an endless shape by connecting the ends thereof to each other into a loop form. The speed governor rope 26 moves in synchronism with the upward and downward movement of the car 6. When the car 6 is located above a speed governor rope diameter change point C in Figure 1, the large-diameter region 64 of the speed governor rope 26 is wound on the sheave 32 of the speed governor 22, and when the car 6 is located below the speed governor rope diameter change point C, the small-diameter region 62 is wound thereon.

[0028] Figure 6 is a schematic view for illustrating the emergency stopping device 28.

[0029] As shown in Figure 6, the emergency stopping

device 28 is provided on the bottom of the car 6. The emergency stopping device 28 includes a shaft support 72, a lever 74 arranged so as to be rotatable with respect to the shaft support 72, and a brake shoe 78 provided so as to be opposed to the guide rail 12. A part of the lever 74 is connected to one location of the speed governor rope 26 so as to be rotated in association with the movement of the speed governor rope 26 as necessary.

[0030] Next, the operation of stoppage in an emergency of the elevator system configured as described above will be described.

[0031] The hoist 14 is controlled by the control panel 16. When a current flows in the hoist 14, the hoist 14 begins to rotate, and hence the rope 10 moves. Thereby, the car 6 and the balancing weight 8 are moved up or down in the elevator shaft 2.

[0032] Figure 7 is a graph showing the movement speed of the car 6. As shown in Figure 7, the control is carried out so that when normal operation is performed and the car 6 does not stop at a midway floor, the car 6 begins to decelerate at point A near the stage 2A₃, which is the third stage from the upper side, and at point B near the stage 2B₃, which is the third stage from the lower side, and when the bottom of the car 6 comes to the stage 2A₁ of the highest floor or the stage 2B₁ of the lowest floor, the car 6 is stopped.

[0033] Also, tension is applied to the speed governor rope 26 between the tension pulley 34 and the speed governor 22, so that the speed governor rope 26 moves in synchronism with the movement of the car 6. The speed governor 22 begins to rotate along with the movement of the speed governor rope 26. Referring to Figure 7, when the car 6 is located below the speed governor rope diameter change point C, the small-diameter region 62 of the speed governor rope 26 is wound on the sheave 32, and when the car 6 is located above the speed governor rope diameter change point C, the large-diameter region 64 is wound thereon.

[0034] Referring to Figure 2, when the sheave 32 rotates, the flyweights 38a and 38b receive a centrifugal force proportional to the angular velocity of the sheave 32. However, when the movement speed of the car 6 is within a rated speed V_0 , the flyweights 38a and 38b are in a state of being substantially fixed to the sheave 32 of the speed governor 22 because the elastic force of the balancing spring 52 is adjusted so as to be higher than the centrifugal force.

[0035] As the movement speed of the car 2 increases, the angular velocity of the sheave 32 also increases. Along with this, the centrifugal force applied to the flyweights 38a and 38b increases, so that the flyweights 38a and 38b move outward gradually with the pin 40 being the axis of rotation against the elastic force of the balancing weight 52. When the angular velocity of the sheave 32 reaches ω_s , the actuating claw 46 provided at one end of the flyweight 38a hits the switch lever 50, so that the switch lever 50 is pushed. When the switch lever 50 is pushed, the car stopping switch 48 cuts off

the current of the hoist 14. Thereby, the brake of the hoist 14 is operated to stop the rotation of the hoist 14, and hence the movement of the car 6 is stopped. Also, synchronously, the movement of the speed governor rope 26 is stopped, and the rotation of the sheave 32 of the speed governor 22 is also stopped.

[0036] However, when the downward movement of the car 6 does not stop from any cause such as breakage of the rope 10 or a failure of the hoist 14, the downward movement speed of the car 6 increases, and the rotational speed of the speed governor 22 also increases. Thereby, the centrifugal force is further applied to the flyweights 38a and 38b, and thus the flyweights 38a and 38b further open to the outside. When the angular velocity of the speed governor 22 reaches ω_t , the latch 54 of the flyweight 38a engages with the ratchet 56 provided on the sheave 32 as shown in Figure 4. Thereby, the rotation of the sheave 32 is compulsorily stopped.

[0037] When the rotation of the speed governor 22 is compulsorily stopped, the movement of the speed governor rope 26 is stopped by a frictional force. Referring to Figure 6, when the movement of the speed governor rope 26 is stopped, the lever turns in the arrow-marked direction with the shaft support 74 of the emergency stopping device 28 provided on the bottom of the cargo 6 being an axis. When the lever 76 turns, the shoe brake 78 is pressed on the guide rail 12, and hence the downward movement of the car 6 is stopped by the wedge effect. The angular velocity ω of the sheave 32 of the speed governor 22 is expressed by Equation (1).

$$\omega = V/R \quad (1)$$

[0038] Where, V is the movement speed of the car 6, i.e., the movement speed of the speed governor rope 26, and R is the distance from the center of the sheave 32 to the center of the speed governor rope 26.

[0039] Referring to Figure 3, the distance from the center of the sheave 32 to the center of the speed governor rope 26 in the case where the small-diameter region 62 of the speed governor rope 26 is wound on the sheave is taken as R_1 , and the distance from the center of the sheave 32 to the center of the speed governor rope 26 in the case where the large-diameter region 64 thereof is wound on the sheave 32 is taken as R_2 .

[0040] The angular velocity of the sheave 32 at the time when the power for the hoist 14 is shut off has a fixed value that is adjusted and determined by the balancing spring 52 of the speed governor 22 etc. and refers to as ω_s . Also, taking the movement speed of the car 6 corresponding to the angular velocity ω_s in the case where the car 6 is located below the speed governor rope diameter change point C, that is, where the small-diameter region 62 is wound on the sheave 32 as V_{s1} and taking the movement speed of the car 6 corresponding to the angular velocity ω_s in the case where the car 6 is located above the speed governor rope di-

ameter change point C, that is, where the large-diameter region 64 is wound on the sheave 32 as V_{s2} , Equation (2) can be obtained from Equation (1).

$$\omega_s = V_{s1}/R_1 = V_{s2}/R_2 \quad (2)$$

[0041] Therefore, the movement speed V_{s1} of the car 6 in the case where the small-diameter region 62 is wound on the sheave 32 can be expressed by Equation (3).

$$V_{s1} = V_{s2} (R_1/R_2) \quad (3)$$

[0042] Similarly, the angular velocity of the sheave 32 at the time when the speed governor 22 compulsorily stops the rotation of the sheave 32 has a fixed value that is adjusted and determined by the balancing spring 52, being ω_t . At this time, taking the movement speed of the car 6 corresponding to the angular velocity ω_t in the case where the car 6 is located below the speed governor rope diameter change point C, that is, where the small-diameter region 62 is wound on the sheave 32 as V_{t1} and taking the movement speed of the car 6 corresponding to the angular velocity ω_t in the case where the car 6 is located above the speed governor rope diameter change point C, that is, where the large-diameter region 64 is wound on the sheave 32 as V_{t2} , Equation (4) can be obtained from Equation (1).

$$\omega_t = V_{t1}/R_1 = V_{t2}/R_2 \quad (4)$$

[0043] Therefore, the movement speed V_{t1} of the car 6 in the case where the small-diameter region 62 is wound on the sheave 32 can be expressed by Equation (5).

$$V_{t1} = V_{t2} (R_1/R_2) \quad (5)$$

[0044] R_1 is the distance in the case where the small-diameter region 62 is wound on the sheave 32, and R_2 is the distance in the case where the large-diameter region is wound on the sheave 32. Therefore, the relationship expressed by Equation (6) holds.

$$R_1 < R_2 \quad (6)$$

[0045] From Equations (3), (5) and (6), it can be seen that V_{s1} and V_{t1} in the case where the small-diameter region 62 is wound are lower than V_{s2} and V_{t2} in the case where the large-diameter region 64 is wound. That is to say, when the car 6 is located below the speed governor rope diameter change point C, comparing with the

case where the car 6 is located above the speed governor rope diameter change point C, the shutoff of power for the hoist 14 due to the speed governor 22 and the operation of the emergency stopping device 28 due to the speed governor 22 are carried out at a stage at which the movement speed of the car 6 is low.

[0046] Thus, when the car 6 is located at a lower part of the elevator shaft 2, the brake of the hoist 14 or the emergency stopping device 28 can be operated at a relatively early stage, and hence the collision of the car 6 with the shock absorber 30 can be restrained. Also, even when the downward movement speed of the car 6 does not reach a speed at which the emergency stopping device operates even if the car 6 reaches the lowest floor and when the emergency stopping device 28 does not operate until the car 6 reaches the lowest floor, the speed at which the car 6 collides with the shock absorber is V_{t1} at the maximum.

[0047] Further, the speed governor rope diameter change point C is determined as described below. When the difference in height between the position of the car 6 at the time when the bottom of the car 6 reaches the speed governor rope diameter change point C and the position of the car 6 at the time when the car 6 collides with the shock absorber 28 is taken as L, L is set as expressed by Equation (7).

$$L = (V_{t2}^2 - V_{t1}^2) / 2 \times G \quad (7)$$

[0048] Where, G is deceleration due to the emergency stopping device 28, which is about 9.8 m/s^2 , being the same value as the gravitational acceleration.

[0049] Thus, even when the speed of the car 6 reaches V_{t2} just above the speed governor rope diameter change point C and the emergency stopping device 28 is operated by the operation of the speed governor 22, the speed of the car 6 can be decreased to V_{t1} before the car 6 collides with the shock absorber 30.

[0050] Therefore, the shock absorber 30 can be one corresponding to the lower speed V_{t1} , not corresponding to the speed V_{t2} , so that a shock absorbing operation distance SB of the shock absorber 30 can be shortened.

[0051] As described above, according to this embodiment, unlike the conventional elevator system, the shock absorbing operation distance SB of the shock absorber 30 can be shortened without especially adding an electrical control mechanism. Therefore, the shock absorber 30 can be shortened, and hence a space necessary for installing the shock absorber 30 at the lowest part 2b of the elevator system can be decreased. Also, since the shock absorbing operation distance SB can be shortened, a space at the highest part 2a for the rise of the balancing weight 8 can be decreased. Therefore, the elevator system can be made small in size. Also, since the emergency stopping device 28 can be operated when the speed of the car 6 is relatively low, even

if the shock absorbing operation distance SB of the shock absorber 30 is short, a trouble such as a failure of the hoist 22 or breakage of the rope can be overcome properly.

[0052] In the present invention, the shape of the speed governor 22 is not limited to one explained in the embodiment. Also, the shape of the emergency stopping device 28 is not limited to one explained in the embodiment if the emergency stopping device 28 can be operated in association with the speed governor rope. Although the deceleration due to the emergency stopping device 28 and the shock absorber 30 is 1 G in this embodiment, in the present invention, the deceleration is not limited to this value if safety within the car 6 can be ensured.

[0053] In this embodiment, the small-diameter region 62 of the speed governor rope 26 is formed by twisting a total of eight strands 68 in one layer, and the large-diameter region thereof is formed by twisting the strands 68 in three layers. However, in the present invention, the speed governor rope is not limited to this. The speed governor rope may have a difference in diameter between the small-diameter region 62 and the large-diameter region 64 considering the necessary strength, the width of a portion in which the rope passes on the sheave 32 of the speed governor 22, the space for installing the shock absorber, and the like.

[0054] In the present invention, a position near the termination corresponds, for example, to a position below the speed governor rope diameter change point C in this embodiment. Also, in the present invention, the operation speed of the speed governor means the speed of the car 6 at the time when the speed governor shuts off the power for the hoist or operates the emergency stopping device, and corresponds, for example, V_{s1} , V_{s2} or V_{t1} , V_{t2} in this embodiment.

Industrial Applicability

[0055] As described above, in the present invention, the speed governor rope is formed by changing the cross-sectional shape thereof, and thereby the operation speed of the speed governor is changed according to the position of the car. Thereby, the movement speed of the car in the case where the movement of the car is stopped or the emergency stopping device is operated as necessary can be adjusted. Therefore, the shock absorbing operation distance of the shock absorber can be shortened, and hence the necessary space at the upper and lower parts of the elevator system can be decreased. Thereupon, the present invention is useful as the elevator system.

Claims

1. An elevator system comprising:

a car moving up and down in an elevator shaft by being guided by a guide rail erected in said elevator shaft;

a speed governor for stopping the movement of said car according to the movement speed of said car; 5

a speed governor rope which is formed into an endless shape and is wound on said speed governor; and

an emergency stopping device which is provided on said car and is connected to one location of said speed governor rope to stop the movement of said car according to the operation of said speed governor rope, 10

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wherein said speed governor rope is formed by changing the cross-sectional shape thereof, and thereby the operation speed of said speed governor is changed according to the position of said car. 20

2. The elevator system according to claim 1, wherein said speed governor rope moves in synchronism with the movement of said car, and

when said car is located at a position near the termination of said elevator shaft, a portion in which the cross section is thin is wound on said hoist. 25

3. The elevator system according to claim 1 or 2, wherein said speed governor rope has a circular cross-sectional shape the diameter of which changes. 30

4. A speed governor rope comprises: a portion formed into one layer by a plurality of strands and a portion formed into two or more layers by a plurality of strands, which is connected to said one-layer portion. 35

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Fig. 1

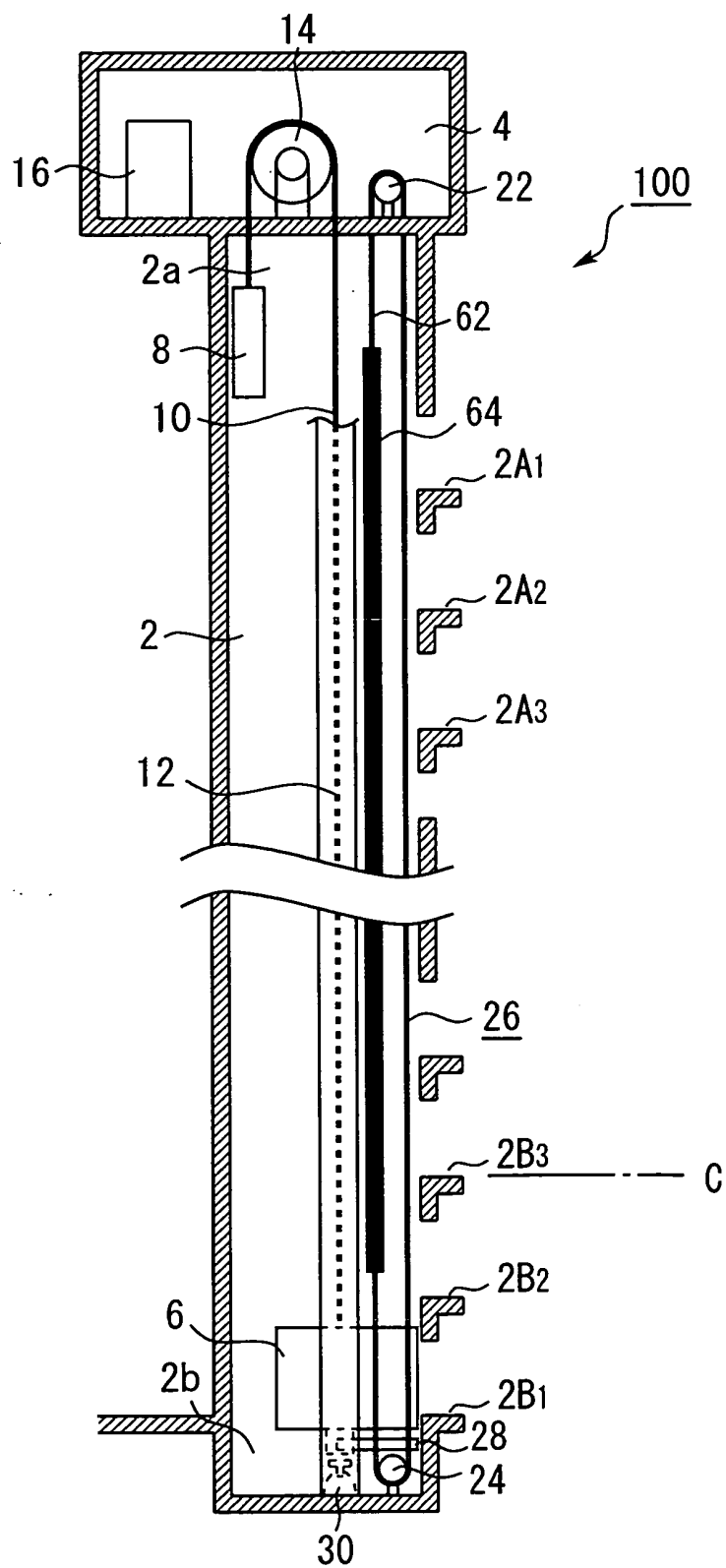


Fig. 2

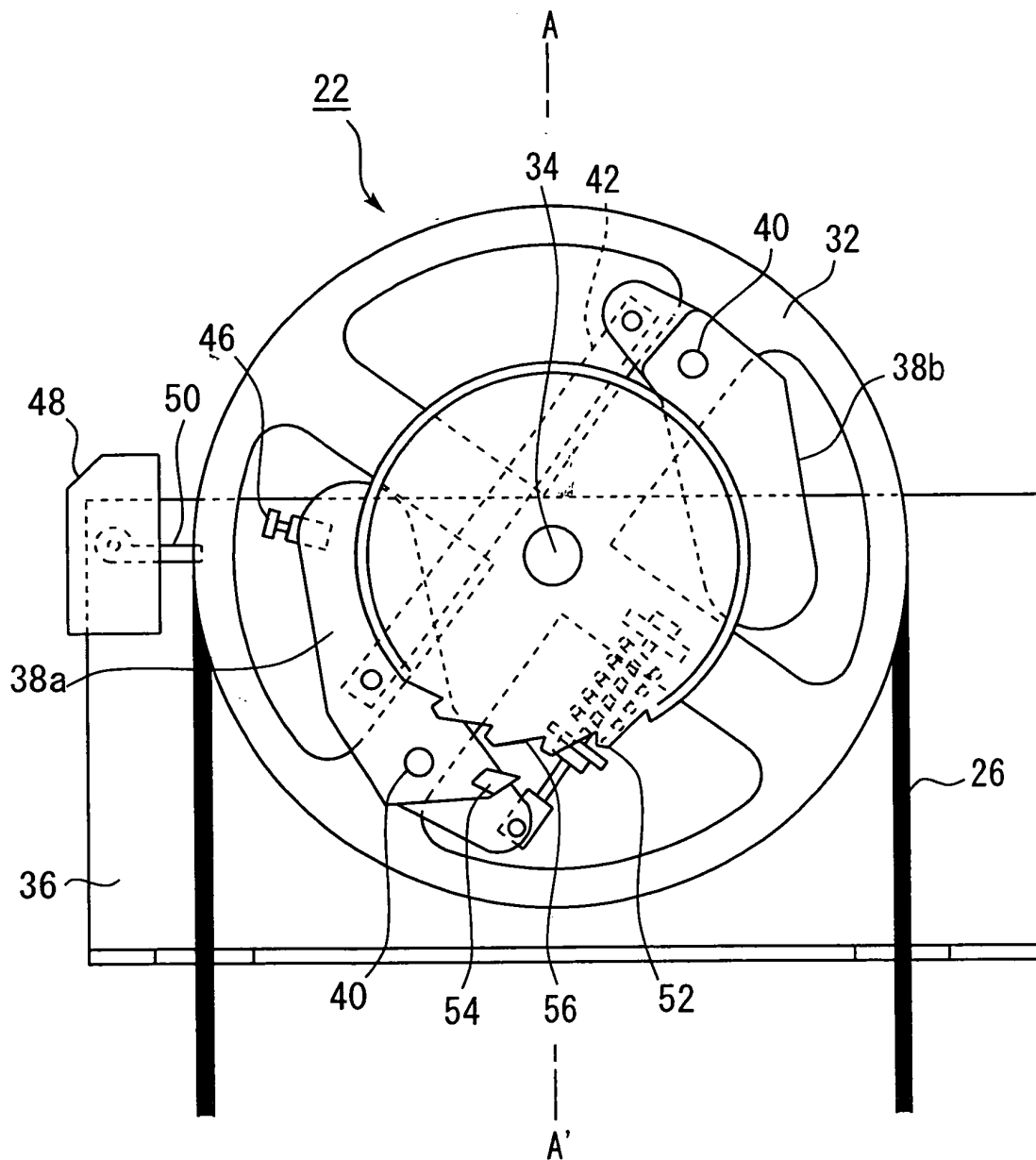


Fig. 3

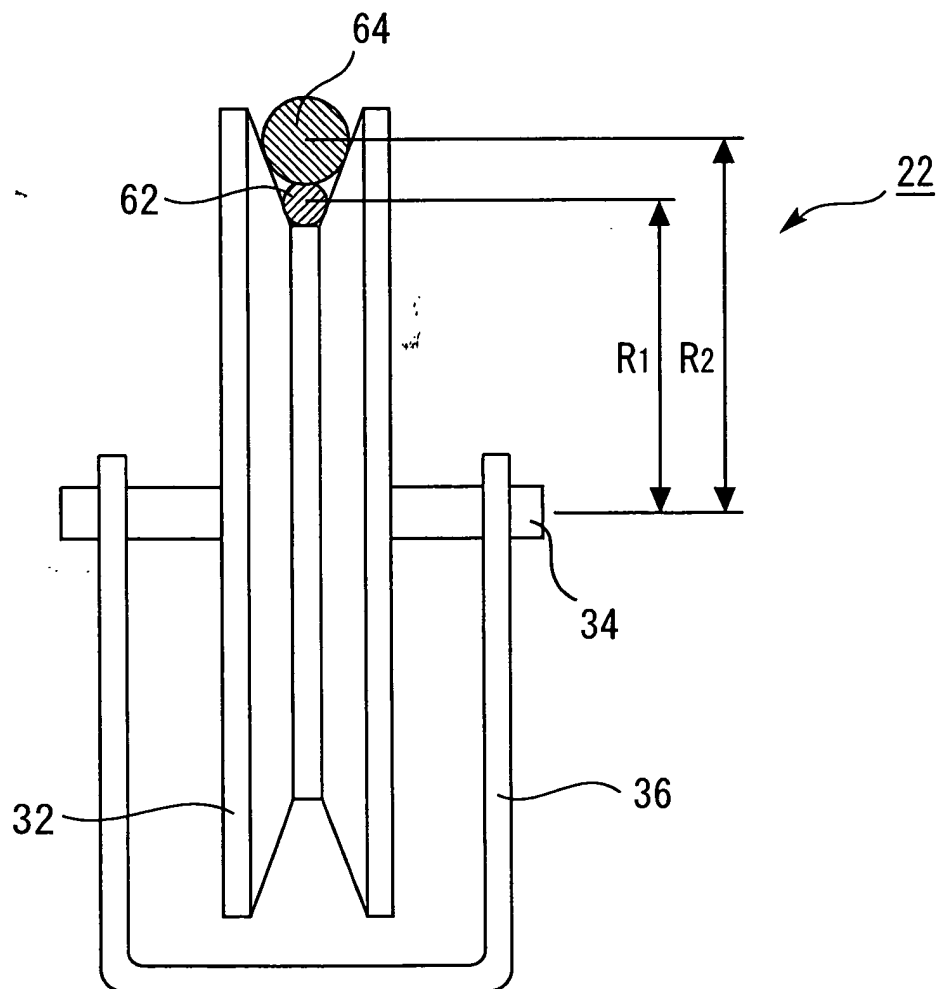


Fig. 4

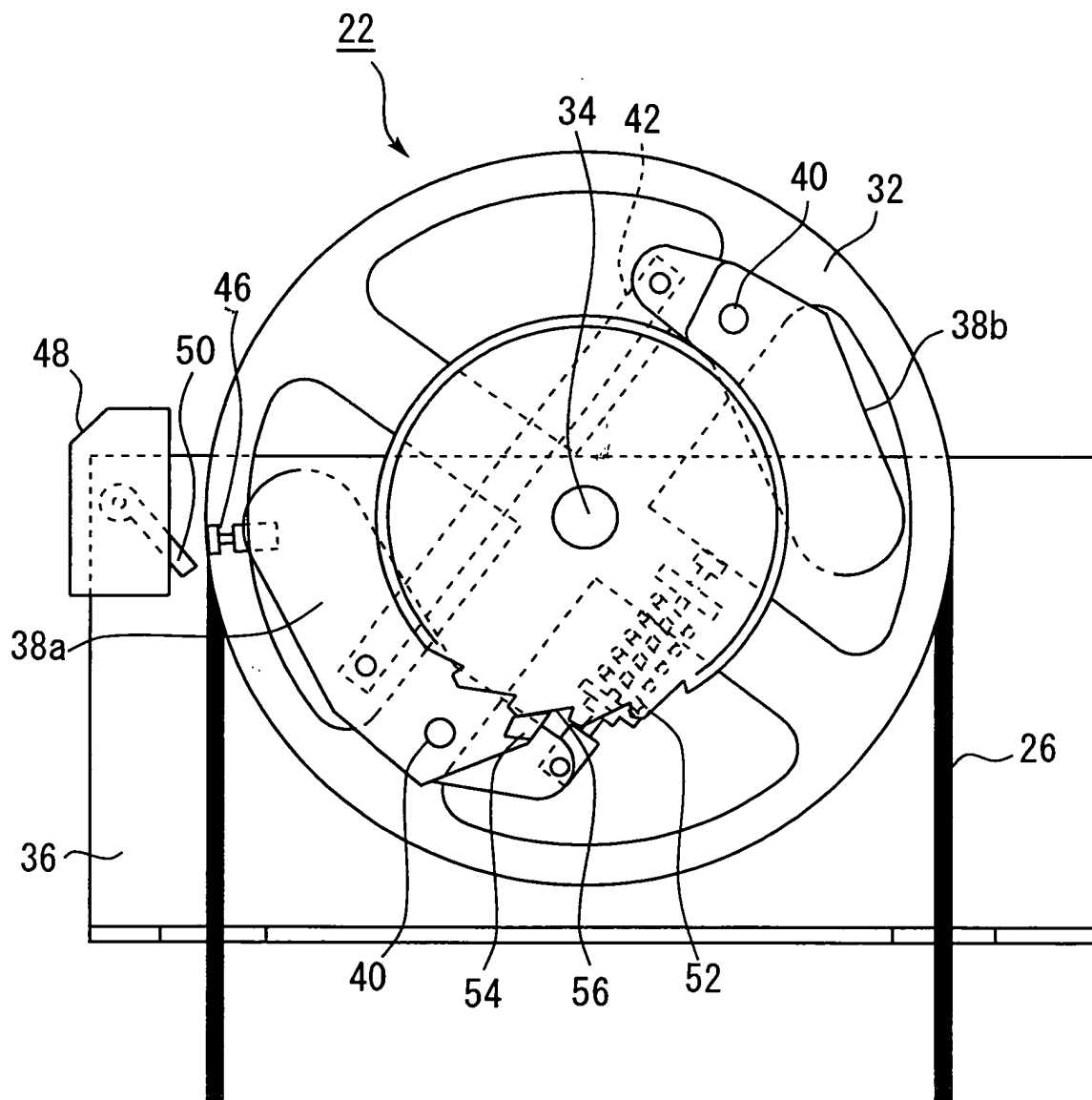


Fig. 5

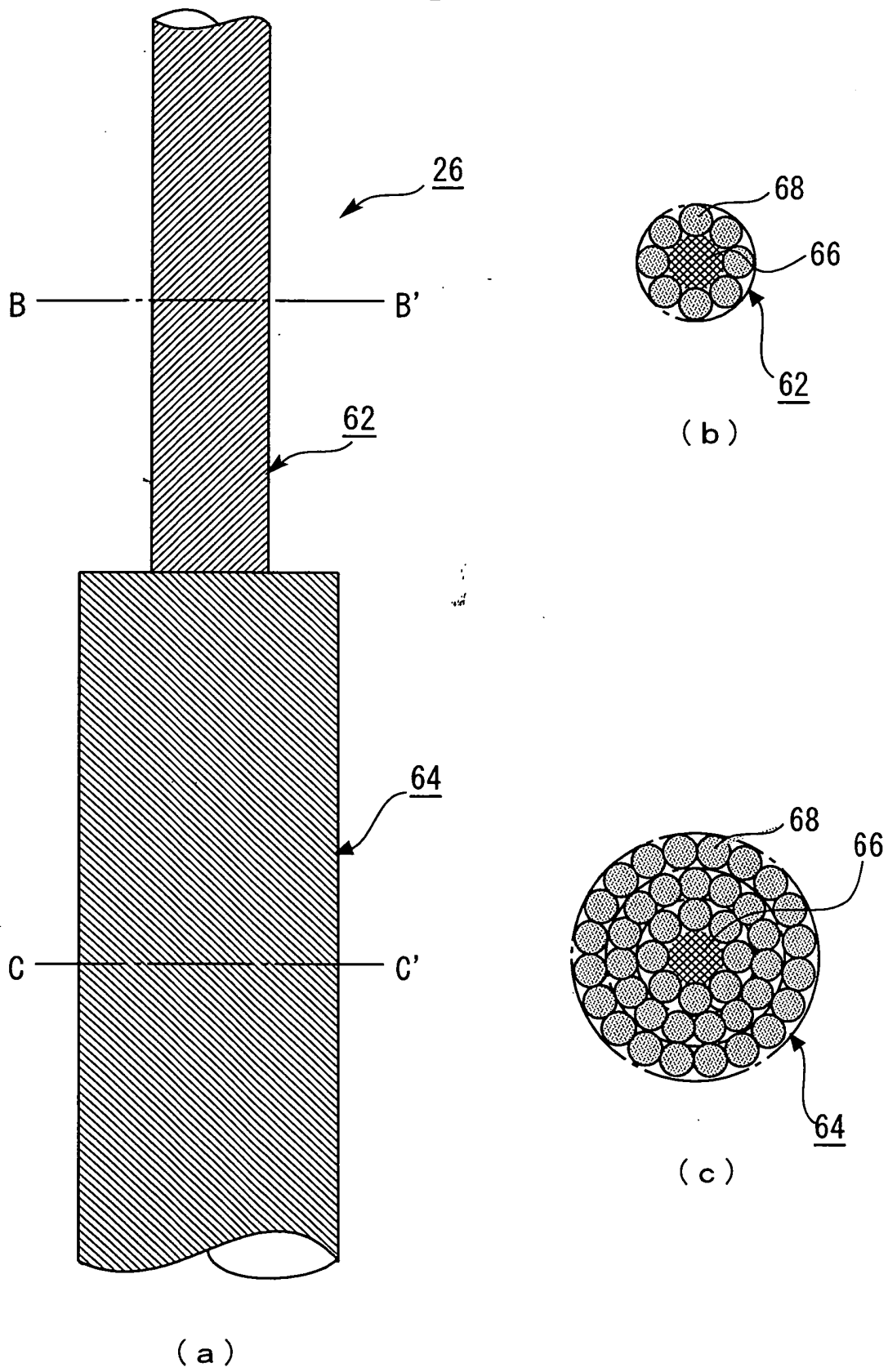


Fig. 6

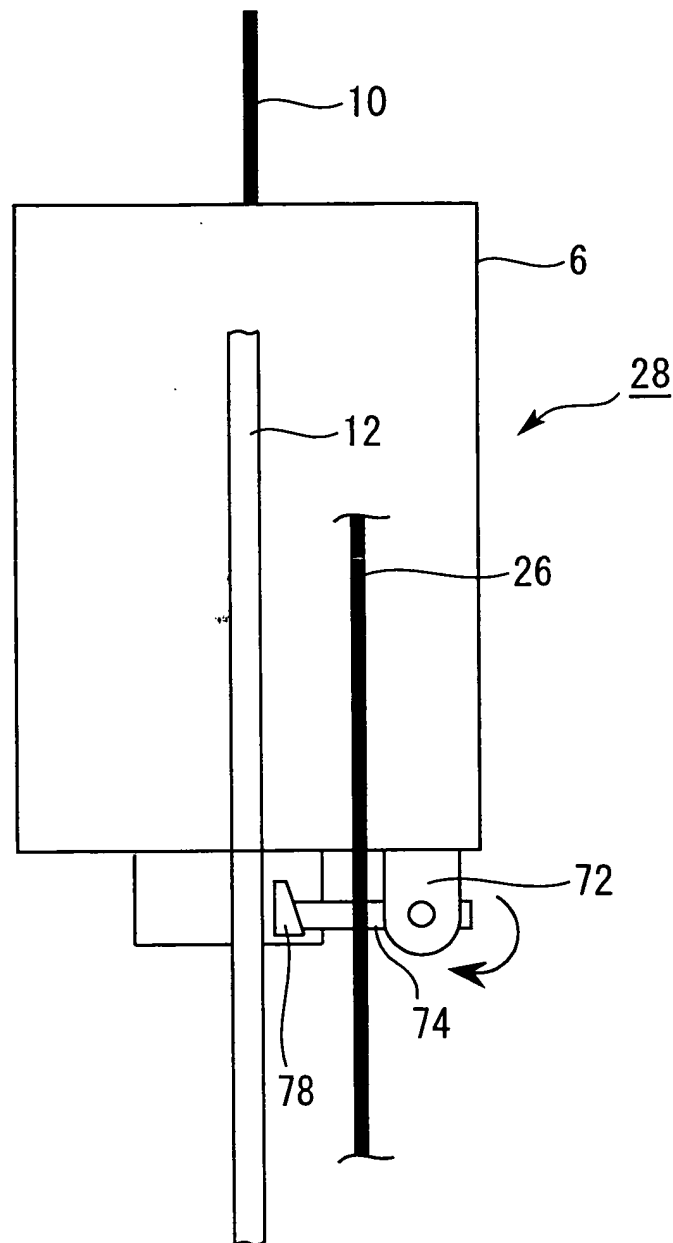
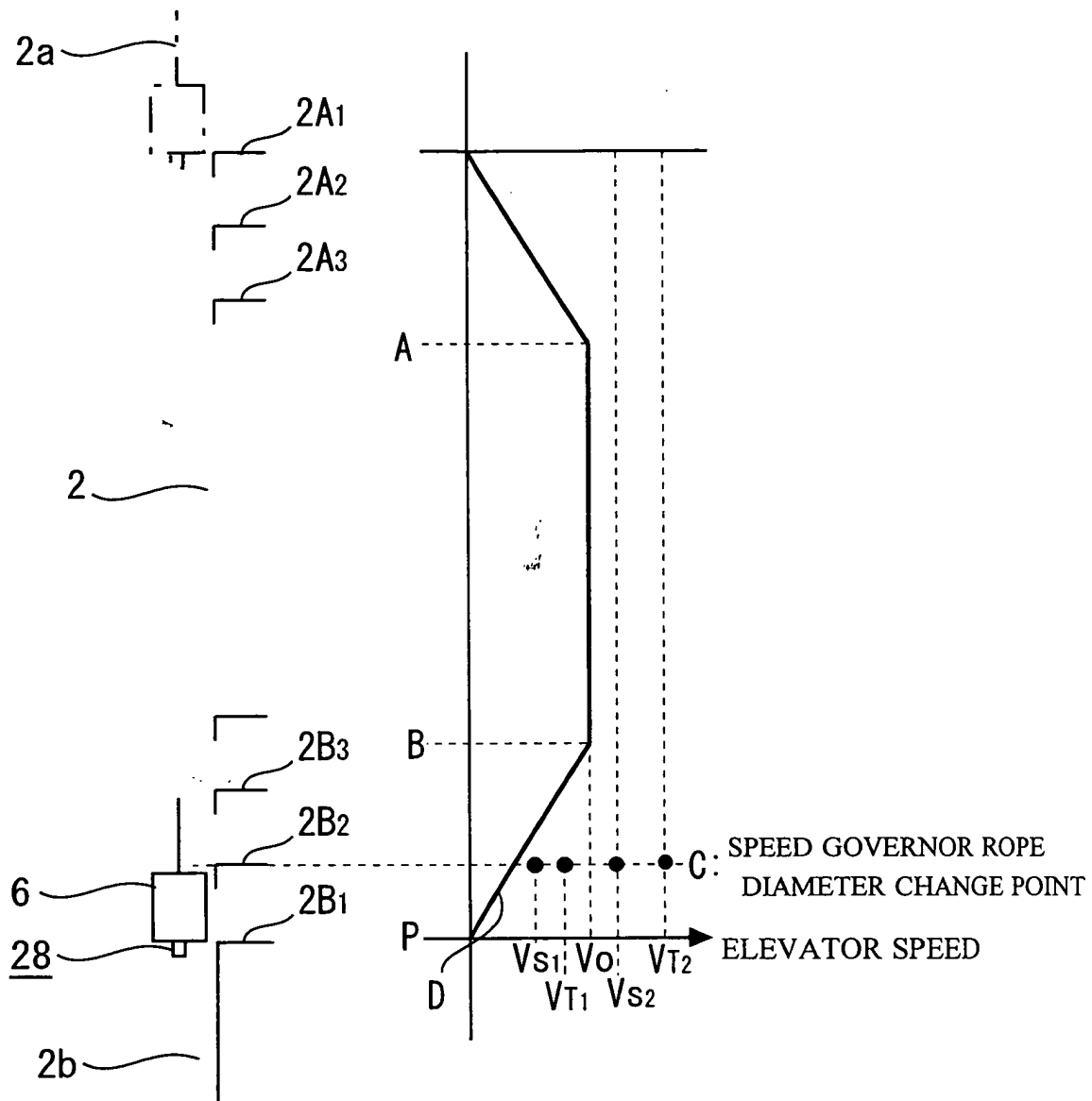


Fig. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP02/13515

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ B66B5/04		
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 B66B5/00-5/28		
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 1996-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Toroku Jitsuyo Shinan Koho 1994-2003		
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 2001-354372 A (Mitsubishi Electric Corp.), 25 December, 2001 (25.12.01), (Family: none)	1-4
A	JP 8-67447 A (Mitsubishi Electric Building Techno-Service Co., Ltd.), 12 March, 1996 (12.03.96), (Family: none)	1-4
A	JP 11-124284 A (Toshiba FA System Engineering Kabushiki Kaisha), 11 May, 1999 (11.05.99), (Family: none)	1-4
A	JP 2727876 B2 (Mitsubishi Electric Corp.), 12 December, 1997 (12.12.97), (Family: none)	1-4
☐ 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 "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 07 April, 2003 (07.04.03)		Date of mailing of the international search report 22 April, 2003 (22.04.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
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