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(54) **Elevator speed governor**
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Description

Field of the Invention

[0001] The invention relates to an elevator system, wherein a governor operates when an ascent/descent speed of a car has exceeded a rated speed and reached an overspeed and wherein an emergency stopper is activated by means of operation of the governor, thereby braking operation of the car.

Background Art

[0002] Figs. 8 through 14 are views showing a conventional elevator system. An example is given in the US-A-1581459. Fig. 8 is a longitudinal cross-sectional view schematically showing a conventional elevator system. Fig. 9 is an enlarged view of a car shown in Fig. 8. Fig. 10 is a front view of a governor provided on the elevator system shown in Fig. 8. Fig. 11 is a side view of the governor shown in Fig. 10. Fig. 12 is a view similar to Fig. 10, showing operating condition of the governor shown in Fig. 10. Fig. 13 is a graph showing an operating speed characteristic of the elevator system shown in Fig. 8. Fig. 14 is a view similar to Fig. 8, showing an operating condition of a buffer of the elevator system shown in Fig. 8.

[0003] Throughout the drawings, reference numeral 1 designates a hoistway of the elevator system; 2 designates the top of the hoistway 1; and 201 to 203 designate end floor elevator halls located at positions closer to the top 2, wherein 201 designates a first top elevator hall provided at the top section; 202 designates a second top elevator hall provided below the first top elevator hall 201; and 203 designates a third top elevator hall provided below the second top elevator hall 202.

[0004] Reference numeral 3 designates a bottom of the hoistway 1; 301 to 303 designate end floor elevator halls located close to the bottom section 3, wherein 301 designates a first bottom elevator hall provided at the lowermost section; 302 designates a second bottom elevator hall located above the first bottom elevator hall 301; and 303 designates a third bottom elevator hall located above the second bottom elevator hall 302.

[0005] Reference numeral 4 designates a machine room disposed at an elevated position with respect to the hoistway 1; 5 designates a control panel provided in the machine room 4; 6 designates a hoisting machine provided in the machine room 4; and 7 designates a main rope which is passed around the hoisting machine 6 and connected at one end to a car 8 and at the other end to a counterweight 9. Reference numeral 10 designates an emergency stopper provided on a lower section of the car 8. The emergency stopper 10 is activated in the event of an emergency, to thereby engage a guide rail 100 which is provided in an upright position in the hoistway 1 and guides vertical movement of the car 8 and to effect braking action.

[0006] Reference numeral 101 designates a pedestal provided on a lower surface of the car 8; and 102 designates a lever. One end of the lever is rotatably supported by the pedestal 101, and a brake shoe 103 of the emergency stopper 10 provided opposite the guide rail 100 is attached to the other end of the lever. Reference numeral 11 designates a buffer provided in an upright position on the bottom section 3 of the hoistway 1 and opposite the car 8. Reference numeral 12 designates a governor provided in the machine room 4, which will be described in detail later.

[0007] Reference numeral 13 designates a governor rope which is formed into an endless shape and passed around the governor 12 and whose one end is held on the car 8; that is, at an intermediate location on the lever 102 in a longitudinal direction thereof. Reference numeral 14 designates a tension pulley which is provided on the bottom section 3 of the hoistway 1 and extends across a downwardly-curved hanging portion of the governor rope 13, thus imparting tensile force to the governor rope 13.

[0008] Reference numeral 15 designates a frame of the governor 12; 16 designates a governor wheel which is rotatably supported by the frame 15 via a horizontal axis and around which the governor rope 13 is passed; 17 designates a plumb shaft rotatably attached to the frame 15; 18 designates a bevel gear mechanism for transmitting rotation of the governor wheel 16 to the plumb shaft 17; 19 designates a slidable sleeve which is clearance-fitted to the plumb shaft 17 and disposed at a position above the frame 15; and 191 designates a reactively-movable sleeve which is clearance-fitted to the plumb shaft 17, is retained so as to be rotatable relative to the slidable sleeve 19, and is vertically displaced along with the slidable sleeve 19.

[0009] Reference numeral 20 designates a support arm fixed to the upper end of the plumb shaft 17; 21 designates pivotal arms which are rotatably attached to respective ends of the support arm 20 and provided on both sides of the support arm 20; 22 designates weights attached to respective lower ends of the pivotal arms 21; 23 designates joint arms, each of which is rotatably connected at one end thereof to any point on the corresponding pivotal arm 21 with respect to a longitudinal direction thereof and at the other end thereof to the upper end of the slidable sleeve 19; and 24 designates a forcing member which is clearance-fitted to the plumb shaft 17 and formed from a compression coil spring located between the slidable sleeve 19 and the support arms 20.

[0010] Reference numeral 25 designates an operation arm rotatably attached to the side surface of the reactively-movable sleeve 191; 26 designates hooking hardware having a hook 27 provided at a lower end thereof, wherein an upper left-side portion of the hooking hardware shown in Fig. 10 is rotatably attached to the frame 15; 28 designates a support link which is rotatably connected at one end to a point close to the upper end of the frame 15 and at the other end to one end of the op-

eration arm 25; and 29 designates an operation link whose one end is rotatably connected to the other end of the operation arm 25 and whose other end is connected to an upper right-side portion of the hooking hardware 26 shown in Fig. 10.

[0011] Reference numeral 30 designates a rope receiver which is provided opposite one row of the governor rope 13 and at a position close to a lower outside portion of the frame 15; and 31 designates a bearing member which is disposed at a lower portion of the frame 15 and between the two rows of the governor rope 13 and rotatably retains a rotatable shaft 32 whose longitudinal portion is arranged horizontally. Reference numeral 33 designates a rope suppressing member which is disposed at a lower portion of the frame 15, between the two rows of the governor rope 13, and opposite the rope receiver 30 via one of the two rows of the governor rope 13.

[0012] Reference numeral 34 designates a hook receiving section which is formed at an upper portion of the rope suppressing member 33 and engages with the hook 27; 35 designates a support shaft whose longitudinal portion is arranged horizontally and rotatably supported by the rope suppressing member 33; and 36 designates a connecting rod whose longitudinal portion is arranged so as to become orthogonal to the longitudinal portion of the support shaft 35 and which is fixed at one end to the support shaft 35 and clearance-fitted at the other end to the rotatable shaft 32 of the bearing member 31.

[0013] Reference numeral 37 designates a brake spring formed from a compression coil spring clearance-fitted to the connecting rod 36. Spring receivers 38 are provided at respective ends of the brake spring and clearance-fitted to the connecting rod 36, and the brake spring is interposed between the shaft bearing member 31 and the rope suppressing member 33 by way of the spring receivers. Reference 39 designates a restraint mechanism for hooking the governor rope 13, which is formed from the rope receiver 30, the shaft bearing member 31, the rope suppressing member 33, and the brake spring 37, all being taken as primary members.

[0014] In Fig. 13, reference numeral 40 designates a top deceleration position set at a position lower than the position of the third top elevator hall 203. Reference symbol A denotes a predetermined top end region formed between the top deceleration position 40 and the first top elevator hall 201; and B designates a predetermined deceleration characteristic line in the predetermined top end region A. Reference numeral 41 designates a bottom deceleration position set at a position higher than the third bottom elevator hall 303; reference symbol C denotes a predetermined bottom end region defined between the bottom deceleration position 41 and the first bottom elevator hall 301; and D denotes a predetermined deceleration characteristic line in the predetermined bottom end region C.

[0015] V0 denotes a rated speed of an elevator; and Vs denotes the speed of the car 8 at which the emergency stopper 10 performs braking operation through operation

of the governor 12 when the elevator 8 has ascended/descended at a speed in excess of the rated speed of the car 8 as a result of occurrence of an anomaly in the elevator system. The overspeed Vs is usually set to about 130% of the rated speed V0.

[0016] The related-art elevator system is constructed in the manner mentioned above. Under normal circumstances, the hook receiving section 34 of the restraint mechanism 39 in the governor 12 engages with the hook 27 of the hooking hardware 26, whereby the rope suppressing member 33 is retained at an elevated position, as shown in Fig. 10. In this state, the governor rope 13 is arranged between the rope receiver 30 and the rope suppressing member 33 without making contact therewith.

[0017] When the hoisting machine 6 is energized by means of operation of the control panel 5, the main rope 7 is driven, whereupon the car 8 and the counterweight 9 are moved vertically in opposite directions. In a case where the car and the counterweight are moved vertically between, e.g., the top deceleration position 40 and the bottom deceleration position 41, without stoppage, the car and the counterweight are moved at the rated speed V0. Further, when the car is driven to the first top elevator hall 201 or the first bottom elevator hall 301 in the predetermined end region A or C; that is, when the car is driven toward the terminals, deceleration of the car is controlled in accordance with the predetermined deceleration characteristic B or D.

[0018] As a result of ascending or descending of the car 8, the governor rope 13 is driven, whereby the governor wheel 16 of the governor 12 is rotated. As a result, the plumb shaft 17 is rotated, whereupon the weights 22 are rotated around the line of the plumb shaft. The weights 22 are vertically displaced in accordance with centrifugal force stemming from an increase in the rotating speed of the plumb shaft 17. Through pivotal movement of the pivotal arms 21 stemming from upward displacement of the weights 22, the slidable sleeve 19 and the reactively-movable sleeve 191 are vertically displaced against the restoration force of the forcing member 24.

[0019] The operation arm 25 is pivoted in a clockwise direction in Fig. 10 by means of upward displacement of the reactively-movable sleeve 191 caused as a result of the lowering speed of the car 8 having reached the overspeed Vs; that is, upward displacement of the slidable sleeve 19 in excess of a predetermined position. By means of pivotal movement of the operation arm 25, the hooking hardware 26 is pivoted in a counterclockwise direction in Fig. 10 by way of the operation link 29. As a result, the hook 27 is disengaged from the hook receiving section 34 of the rope suppressing member 33, whereupon the rope suppressing member 33 is lowered under its own weight and enters a state shown in Fig. 12.

[0020] In this state, the governor rope 13 is pinched between the rope receiver 30 and the rope suppressing member 33 under the pressing force of the brake spring

37, thereby restraining movement of the governor rope 13. However, lowering of the car 8 still continues, and hence the lever 102 which is provided on the car 8 and retains the governor rope 13 is pivoted in a clockwise direction in Fig. 9.

[0021] Although detailed explanations are omitted, the brake shoe 103 of the emergency stopper 10 is engaged with the guide rail 100 by pivotal displacement of the lever 102, thus effecting braking action. As a result, lowering action of the car 8 at the overspeed V_s is braked and brought to a stop.

[0022] A stopping distance SA of the car 8 achieved by the braking operation of the emergency stopper 10 is defined as Stopping distance $SA = \text{Overspeed } V_s^2 / (2 \times 9.8 \text{ m/s}^2)$. Moreover, a buffering distance SB of the buffer 11 achieved when the car 8 has collided with the buffer 11 at the overspeed V_s is substantially the same as the stopping distance SA of the car 8 achieved by the braking operation of the emergency stopper 10.

[0023] When being lowered and operated toward the first bottom elevator hall 301 in the predetermined end region C, the car 8 is subjected to deceleration control in accordance with the predetermined deceleration characteristic line D. Therefore, under normal conditions the governor 12 is not actuated, and interruption of power to the control panel 5 and the hoisting machine 6 and braking action of the emergency stopper 10 do not arise. Therefore, the buffering distance SB of the buffer 11 can be shortened.

[0024] However, in consideration of an assumption of a failure in a brake (not shown) of the hoisting machine 6 and a scenario of the car 8 colliding with the buffer 11 at a speed just under the overspeed V_s even in the predetermined end region C, the buffer 11 has the previously-described buffering distance SB. For this reason, in the case of a high-speed elevator having a buffering distance SB of more than 10 m, a free height of the buffer 11 exceeds 20 m. Therefore, a depth from the first bottom elevator hall 301 to the surface of the bottom 3 of the hoistway 1 exceeds 20 m.

[0025] Under a situation where the car 8 has collided with the buffer 11 for reasons of a failure and the buffer 11 remains compressed, the car 8 will lower from the first bottom elevator hall 301 over a distance corresponding to the buffering distance SB in such a manner as shown in Fig. 14. In this state, the counterweight 9 further ascends from an ascent position assumed in an normal condition, over a distance corresponding to the buffering distance SB in the manner as shown in Fig. 14.

[0026] In such a conventional elevator system, the buffer 11 having a longer height is required in association with an increase in the rated speed of the elevator. In association with the height of the buffer 11, a depth from the first bottom elevator hall 301 to the surface of the bottom 3 of the hoistway 1; that is, a pit depth of the hoistway 1, becomes considerably greater. In addition, in association with the pit depth of the hoistway 1, an ascending height allowance of the counterweight 9 at the

top 2 in the hoistway 1 must be set large.

[0027] Therefore, there arises a problem of an increase in the cost of constructing the hoistway 1 and that of manufacturing the buffer 11. Further, acquisition of the ascending height allowance of the counterweight 9 at the top 2 of the hoistway 1 becomes more difficult. Therefore, ensuring the first top elevator hall 201 and the second top elevator hall 202 will become impossible, thereby posing a problem in the plan of a building where the elevator is to be installed.

[0028] The invention has been conceived to solve the problem and is aimed at providing an elevator system which shortens a buffer ascending/descending distance of a car at ends of a hoistway of an elevator to be operated at high speed.

Summary of the Invention

[0029] The invention provides a first governor which restricts circulatory movement of a governor rope suspended in a hoistway, to thereby cause an emergency stopper engaging a guide rail to perform braking operation, when the speed of a car which ascends or descends while being guided by a guide rail has reached a first overspeed in excess of a rated speed. The invention also provides a second governor which causes an emergency stopper to perform braking operation when the speed of a car has exceeded the rated speed and reached a second overspeed lower than the first overspeed. Moreover, end region drive means is provided at an end region of the hoistway, and the second governor is activated when the car ascends or descends across the end region.

[0030] By means of such a construction, when the ascent/descent speed of the car has exceeded the rated speed, the emergency stopper performs braking operation in the end regions of the hoistway at an overspeed lower than an emergency braking overspeed which would be achieved in an intermediate region of the hoistway. By means of such a braking operation, a buffer ascending/descending distance at ends of the hoistway for the car can be shortened, thereby curtailing the cost of constructing a hoistway and the cost of manufacturing a buffer and diminishing restrictions on the design of a building where an elevator is to be installed.

Brief Description of the Drawings

[0031]

Fig. 1 is a longitudinal cross-sectional view schematically showing an elevator system according to a first embodiment of the invention;

Fig. 2 is a graph showing an operating speed characteristic of the elevator system shown in Fig. 1;

Fig. 3 is an enlarged view of a car shown in Fig. 1;

Fig. 4 is a view similar to Fig. 3, showing an operating state of a governor shown in Fig. 3;

Fig. 5 is a view similar to Fig. 3, showing a state in

which the car shown in Fig. 1 ascends/descends across an intermediate region of a hoistway; Fig. 6 is a view of a second embodiment of the invention similar to Fig. 5, showing a state in which the car ascends/descends across the intermediate region of the hoistway;

Fig. 7 is a view similar to Fig. 3, showing a state in which the car shown in Fig. 6 ascends/descends across an end region of the hoistway;

Fig. 8 is a longitudinal cross-sectional view schematically showing a conventional elevator system;

Fig. 9 is an enlarged view of a car shown in Fig. 8;

Fig. 10 is a front view of a governor provided in the elevator system shown in Fig. 8;

Fig. 11 is a side view of Fig. 10;

Fig. 12 is a view similar to Fig. 10, showing the operating state of a governor shown in Fig. 10;

Fig. 13 is a graph showing an operating speed characteristic of the elevator system shown in Fig. 8; and

Fig. 14 is a view similar to Fig. 8, showing the operating state of a buffer of the elevator system shown in Fig. 8.

Best Modes for Implementing the Invention

[0032] In order to describe the invention in more detail, the invention will be described by reference to the accompanying drawings.

[0033] Figs. 1 through 5 are views showing a first embodiment of the invention. Fig. 1 is a longitudinal view schematically showing an elevator system; Fig. 2 is a graph showing an operating speed characteristic of the elevator system shown in Fig. 1; Fig. 3 is an enlarged view of a car shown in Fig. 1; Fig. 4 is a view similar to Fig. 3, showing an operating state of a governor shown in Fig. 3; and Fig. 5 is a view similar to Fig. 3, showing a state in which the car shown in Fig. 1 ascends/descends across an intermediate region of the hoistway.

[0034] Throughout the drawings, reference numeral 1 designates a hoistway of the elevator system; 2 designates the top of the hoistway 1; and 201 to 203 designate end floor elevator halls located at positions closer to the top 2, wherein 201 designates a first top elevator hall provided at the top; 202 designates a second top elevator hall provided below the first top elevator hall; and 203 designates a third top elevator hall provided below the second top elevator hall 202.

[0035] Reference numeral 3 designates a bottom section of the hoistway 1; 301 to 303 designate end floor elevator halls provided close to the bottom section 3, wherein 301 designates a first bottom elevator hall provided at the lowermost section; 302 designates a second bottom elevator hall provided above the first bottom elevator hall 301; and 303 designates a third bottom elevator hall provided above the second bottom elevator hall 302.

[0036] Reference numeral 4 designates a machine room disposed at an elevated position with respect to the hoistway 1; 5 designates a control panel provided in the

machine room 4; 6 designates a hoisting machine provided in the machine room 4; and 7 designates a main rope which is passed around the hoisting machine 6 and connected at one end to a car 8 and at the other end to a counterweight 9. Reference numeral 10 designates an emergency stopper provided on a lower section of the car 8. Although detailed explanations are omitted, the emergency stopper 10 is activated in the event of an emergency, to thereby engage a guide rail 100 which is provided in an upright position in the hoistway 1 and guides vertical movement of the car 8 and to effect braking action.

[0037] Reference numeral 101 designates a pedestal provided on a lower surface of the car 8; and 102 designates a lever. One end of the lever is rotatably supported by the pedestal 101, and a brake shoe 103 of the emergency stopper 10 provided opposite the guide rail 100 is attached to the other end of the lever. Reference numeral 121 designates a first governor provided in the machine room 4 which is similar in structure to the governor 12 shown in Fig. 10. Hence, detailed explanations of the first governor are omitted.

[0038] Reference numeral 111 designates a buffer provided in an upright position in the bottom section 3 of the hoistway 1 and opposite to the car 8. Reference numeral 13 designates a governor rope which is formed into an endless shape and passed around a first governor 121 and whose one end is held on the car 8; that is, at an intermediate location on a lever 102 in a longitudinal direction thereof. Reference numeral 14 designates a tension pulley which is provided in the bottom section 3 of the hoistway 1 and extends across a downwardly-curved hanging portion of the governor rope 13, thus imparting tensile force to the governor rope 13.

[0039] Reference numeral 42 designates a second governor attached to the car 8. The second governor 42 is equipped with a governor wheel 45 which is rotatably supported on a shaft 44 of a mount plate 43 and is formed from a frictional wheel; fly weights 47 which are rotatably attached to a side surface of the governor wheel 45 and at positions symmetrical about the shaft 44 by means of pins 46; a link 48 whose both ends are rotatably attached to the mutually-opposing fly weights 47 and which transmits pivotal movement of one fly weight 47 to the other fly weight 47; and a ratchet wheel 50 which is clearance-fitted to the shaft 44 and disposed on the side surface of the governor wheel 45 and corresponds to latches 49 provided at respective ends of the fly weights 47.

[0040] The second governor 42 is provided with an operation arm 51 whose one end is secured on the ratchet wheel 50 and projects toward the car 8; a connecting rod 52 whose one end is rotatably attached to a projecting end of the operation arm 51 and whose other end is rotatably attached to an end of the lever 102 opposite the end at which the brake shoe 103 is provided; and a forcing member 53 which is formed from a compression coil, whose one end is connected to an end of the fly weight 47 facing the ratchet 49, whose other end is retained on

the side surface of the governor wheel 45, and which forces the latch 49 in the direction away from the ratchet wheel 50.

[0041] Reference numeral 54 designates a threaded frictional member. A lower end of the threaded frictional member 54 is provided at an upright position in the bottom section 3 of the hoistway 1 and interposed between the third bottom elevator hall 303 and the second bottom elevator hall 302. Reference numeral 55 designates end region drive means which is formed from the governor wheel 45 and the threaded frictional member 54 and provided in the end region of the hoistway 1. In the end region, the governor wheel 45 comes into contact with the threaded frictional member 54, and the governor wheel 45 is rotated through ascending/descending operation of the car 8, thereby driving the second governor 42.

[0042] Under normal conditions, the fly weights 47 hold the latches 49 at predetermined locations away from the ratchet wheel 50 by means of restoration force of the forcing member 53 and revolve along with the governor wheel 45 by means of rotation of the governor wheel 45. When the ascent/descent speed of the car 8 has reached a second overspeed to be described later, the fly weights rotate against restoration force of the forcing member 53, whereupon the latches 49 engage the ratchet wheel 50. As a result, the operation arm 51 rotates, and the emergency stopper 10 is caused to perform braking operation by means of operation of the second governor 42.

[0043] In Fig. 2, reference numeral 40 designates a top deceleration position set at a position lower than the position of the third top elevator hall 203. Reference symbol A denotes a predetermined top end region formed between the top deceleration position 40 and the first top elevator hall 201; and B designates a predetermined deceleration characteristic line to be achieved in the predetermined end region A. Reference numeral 41 designates a bottom deceleration position set at a position higher than the third bottom elevator hall 303; reference symbol C denotes a predetermined end region defined between the bottom deceleration position 41 and the first bottom elevator hall 301; and D denotes a predetermined deceleration characteristic line to be achieved in the predetermined end region C.

[0044] Reference symbol E denotes an upper end position of the threaded frictional member 54 of the end region drive means 55 in the hoistway 1; V_0 denotes a rated speed of an elevator; and V_s denotes the speed of the car 8 at which the emergency stopper 10 performs braking operation through operation of the restraint mechanism 39 for restraining the governor rope 13 of the first governor 121 when the car 8 has ascended/descended at a first overspeed V_s in excess of the rated speed as a result of an anomaly having arisen in the elevator system at the first overspeed. The first overspeed V_s is usually set to about 130% of the rated speed V_0 .

[0045] Reference symbol V_t denotes the speed of the car 8 at which the emergency stopper 10 performs braking action through the latches 49 of the second governor

42 actuated by the end region drive means 55 engaging the ratchet wheel 50 when the car 8 has ascended/descended across the end region at a speed exceeding the rated speed as a result of occurrence of an anomaly in the elevator system at a second overspeed; that is, when the car 8 has descended at the speed exceeding the speed represented by the predetermined deceleration characteristic line D. The second overspeed V_t is set so as to become lower than the first overspeed V_s .

[0046] In relation to the elevator system constructed in the manner mentioned above, under normal circumstances, a hook receiving section 34 of a restraint mechanism 39 of the first governor 121 engages with a hook 27 of hooking hardware 26, whereby a rope suppressing member 33 is retained at an elevated position, as shown in Fig. 10. In this state, the governor rope 13 is arranged between a rope receiver 30 and the rope suppressing member 33 without any contact therewith. Moreover, in normal times, the fly weights 47 of the second governor 42 are retained at positions where the latches 49 are prevented from coming into contact with the ratchet wheel 50, by means of the forcing member 53.

[0047] When the hoisting machine 6 is energized by means of operation of the control panel 5, the main rope 7 is driven, whereupon the car 8 and the counterweight 9 are moved vertically in opposite directions. In a case where the car and the counterweight are moved vertically between, e.g., the top deceleration position 40 and the bottom deceleration position 41, without stoppage, the car is moved at a rated speed V_0 . Further, when the car 8 is driven to the first top elevator hall 201 or the first bottom elevator hall 301 in the predetermined end region A or C; that is, when the car is driven toward an end, deceleration of the car is controlled in accordance with the predetermined deceleration characteristic line B or D.

[0048] Regardless of an ascent/descent position of the car 8 in the hoistway 1, the governor rope 13 is driven by means of ascending/descending operation of the car 8, to thereby rotate the governor wheel 16 of the first governor 121. As a result, the plumb shaft 17 is rotated, whereupon the weights 22 are rotated around the line of the plumb shaft. The weights 22 are vertically displaced in accordance with centrifugal force stemming from an increase in the rotating speed of the plumb shaft 17. Through pivotal movement of the pivotal arms 21 stemming from upward displacement of the weights 22, the slidable sleeve 19 and the reactively-movable sleeve 191 are vertically displaced against the restoration force of the forcing member 24.

[0049] The operation arm 25 is pivoted in a clockwise direction in Fig. 10 by means of upward displacement of the reactively-movable sleeve 191 caused as a result of the lowering speed of the car 8 having reached the first overspeed V_s ; that is, upward displacement of the reactively-movable sleeve 191 in excess of a predetermined position. By means of pivotal movement of the operation arm 25, the hooking hardware 26 is pivoted in a counter-clockwise direction in Fig. 10 by way of the operation link

29. As a result, the hook 27 is disengaged from the hook receiving section 34 of the rope suppressing member 33, whereupon the rope suppressing member 33 is lowered under its own weight and enters a state shown in Fig. 12.

[0050] In this state, the governor rope 13 is pinched between the rope receiver 30 and the rope suppressing member 33 under the pressing force of the brake spring 37, thereby restraining movement of the governor rope 13. However, lowering of the car 8 still continues, and hence the lever 102 which is provided on the car 8 and retains the governor rope 13 is pivoted in a clockwise direction in Fig. 9. Although detailed explanations are omitted, the brake shoe 103 of the emergency stopper 10 is engaged with the guide rail 100 by pivotal displacement of the lever 102, thus effecting braking action. As a result, lowering action of the car 8 at the first overspeed Vs is braked and brought to a stop.

[0051] Under circumstances where the car 8 is ascending/descending across a range in the predetermined end region C of the hoistway 1, in which the second governor 42 is driven by the end region drive means 55, if the lowering speed of the car 8, the car being operated toward the end in accordance with the predetermined deceleration characteristic line D, has exceeded the second overspeed Vt for reasons of a failure, the second governor 42 will be activated in the following manner.

[0052] More specifically, when the ascent/descent speed of the car 8 in the predetermined end region C has exceeded the second overspeed Vt, the fly weights 47 rotate with respect to the governor wheel 45 against restoration force of the forcing member 53, whereupon the latches 49 engage the ratchet wheel 50. As a result, the operation arm 51 is pivoted; that is, the second governor 42 is operated, and the emergency stopper 10 performs braking operation. As a result, lowering of the car 8 at the second overspeed Vt is braked and stopped.

[0053] Briefly speaking, when the ascent/descent position of the car 8 is higher than the upper end of the end region drive means 55; that is, when the ascent/descent position is in an intermediate region of the hoistway 1, the second governor 42 is not activated. In this state, when the speed of the car 8 has exceeded the first overspeed Vs, the first governor 121 is activated, whereupon the emergency stopper 10 performs braking operation.

[0054] In contrast, when the ascent/descent position of the car 8 is lower than the upper end of the end region drive means 55; that is, when the ascent/descent position is in the end region of the hoistway 1, the second governor 42 is activated. Consequently, when the speed of the car 8 has exceeded the second overspeed Vt which is lower than the first overspeed Vs, the second governor 42 is activated, whereupon the emergency stopper 10 performs braking operation.

[0055] The upper end position of the threaded frictional member 54 of the end region drive means 55 is set in the following manner. Specifically, a height difference existing between the position of the car 8 achieved when the governor wheel 45 of the second governor 42 has

opposed the upper end of the threaded frictional member 54 and the position of the car 8 achieved when the lower portion of the car 8 comes into contact with the buffer 111 is taken as La. $La = (\text{First Overspeed } V_s^2 - \text{Second Overspeed } V_t^2) / (2 \times 9.8 \text{ m/s}^2)$.

[0056] As a result, the car 8 reaches the first overspeed Vs at a position close to the upper end position of the threaded frictional member 54. Even when the emergency stopper 10 performs braking operation as a result of activation of the first governor 121, the car 8 can be decelerated to the second overspeed Vt until the lowering car 8 presses the buffer 111.

[0057] Therefore, in lieu of a buffer 111 having the function corresponding to the first overspeed Vs, there can be employed a buffer 111 having a function corresponding to the second overspeed Vt lower than the first overspeed; that is, a buffer which is shorter in the buffering distance SB shown in Fig. 14 than the buffer having the function corresponding to the first overspeed Vs. Therefore, the depth from the first bottom elevator hall 301 to the surface of the bottom section 3 of the hoistway 1; that is, the pit depth of the hoistway 1, can be made shallow.

[0058] The speed of the car 8 achieved when the car comes into contact with the buffer 111 becomes slow, whereby the buffering distance SB can also be shortened. Hence, an ascending height allowance of the counterweight 9 at the top section 2 of the hoistway 1 can also be made small. Consequently, the cost of constructing the hoistway 1 and the cost of manufacturing the buffer 11 can be curtailed.

[0059] Since an ascending allowance of the counterweight 9 at the top section 2 of the hoistway 1 becomes small, the first top elevator hall 201 and the second top elevator hall 202 can be readily set, thereby improving the degree of freedom of design of a building in which an elevator is to be installed. Moreover, there is no necessity for feeding power to activate the second governor 42 from the outside. An overspeed can be detected without a problem even in the event of power failure. Further, the emergency stopper 10 can be caused to perform braking operation.

[0060] Figs. 6 and 7 are views showing a second embodiment of the invention. Fig. 6 is a view similar to Fig. 5, showing an ascending/descending state of the car across an intermediate region of the hoistway. Fig. 7 is a view similar to Fig. 3, showing the ascending/descending state of the car shown in Fig. 6 across the end region of the hoistway. The elevator system is similar in construction to the elevator system described in connection with the embodiment shown in Figs. 1 through 5, except for the structure shown in Figs. 6 and 7.

[0061] Throughout the drawings, those reference numerals which are the same as those shown in Figs. 1 through 5 designate counterpart elements. Reference numeral 56 designates a governor wheel of the second governor 42, the wheel being formed from a pinion rotatably supported on the shaft 44 of the mount plate 43. Reference numeral 57 designates a rack rod whose lon-

gitudinal portion is arranged in the perpendicular direction and which meshes with the governor wheel 56. Reference numeral 58 designates a block member provided at an upper end of the rack rod 57.

[0062] Reference numeral 59 designates two support arms which are connected at one end to the car 8 and whose projections are vertically separated from each other and which at remaining ends thereof retain the rack rod 57 in a vertically slidable manner. Reference numeral 60 designates a buffer which is provided on the surface of the bottom section 3 of the hoistway 1 and opposite the lower end of the rack rod 57.

[0063] Reference numeral 61 designates end region drive means formed from the governor wheel 56 and the rack rod 57, which are taken as primary members. As shown in Fig. 6, when the car 8 ascends/descends across the intermediate region of the hoistway 1, the block member 58 comes into contact with the support arms 59, whereupon the rack rod 57 is retained in a descending position relative to the car 8. When the car 8 ascends/descends across the intermediate region of the car 8, the rack rod 57 also ascends/descends while remaining in such a state shown in Fig. 6, in conjunction with the car 8. The rack rod is not displaced relative to the governor wheel 56, and hence the governor wheel 56 is not driven.

[0064] When the car 8 has lowered across the end region C close to the bottom section 3 of the hoistway 1, the rack rod 57 comes into contact with and becomes supported on the buffer 60. If the car 8 continues lowering operation, the rack rod 57 is displaced relative to the governor wheel 56 in a state shown in Fig. 7, thereby driving the governor wheel 56.

[0065] In the elevator system having the foregoing construction, when the car 8 ascends/descends with the rack rod 57 of the end region drive means 61 not being supported on the buffer 60; that is, when the ascent/descent position of the car 8 is in the intermediate region of the hoistway 1, the second governor 42 is not driven.

[0066] In contrast, when the car 8 ascends/descends with the rack rod 57 of the end region drive means 61 being supported on the buffer 60; that is, when the ascent/descent position of the car 8 lowers across the end region C close to the bottom section 3 of the hoistway 1, the governor wheel 56 of the second governor 42 is displaced relative to the rack rod 57.

[0067] As a result, the governor wheel 56 is driven, and the emergency stopper 10 performs braking operation when the speed of the car 8 has exceeded the second overspeed V_t . Consequently, although detailed explanations are omitted, the embodiment shown in Figs. 6 and 7 also yields the same advantage as that yielded by the embodiment shown in Figs. 1 through 5.

[0068] As a result of lowering of the car 8, the rack rod 57 comes into contact with the buffer 60 provided on the surface of the bottom section 3 of the hoistway 1. Therefore, vibration which would arise when the rack rod 57 has come into contact with the surface of the bottom surface 3 of the hoistway 1 can be dampened, thereby im-

proving the accuracy of detection of the second overspeed V_t performed by the second governor 42.

[0069] When the car 8 ascends with the rack rod 57 being supported on the buffer 60, the rack rod 57 rotates the governor wheel 56 in the state shown in Fig. 7, thereby lowering the rack rod 57 with respect to the car 8. As a result of the block member 58 having come into contact with the support arm 59, lowering of the rack rod 57 with respect to the car 8 is stopped, and the rack rod 57 ascends in conjunction with the car 8.

Industrial Applicability

[0070] As has been mentioned, an elevator system of the invention guides ascending/descending operation of a car through use of a guide rail provided at an upright position in a hoistway. Further, a governor rope-which assumes an endless shape and moves in a circulatory manner along a predetermined path in association with ascending/descending operation of the car is suspended in the hoistway. An emergency stopper which operates in the event of emergency and engages the guide rail, to thereby perform braking operation, is provided on the car, and one end of the governor rope is connected to the emergency stopper.

[0071] Further, there is provided a first governor which restrains the circulatory movement of the governor rope when the speed of the car has reached a first overspeed in excess of a rated speed, thereby causing the emergency stopper to perform braking operation. The car is provided with a second governor. When the speed of the car has exceeded the rated speed and reached a second overspeed lower than the first overspeed, the circulatory movement of the governor rope is restrained, thereby causing the emergency stopper to perform braking operation. Moreover, end region drive means is provided in an end region of the hoistway, whereby the second governor is driven in the end region.

[0072] As a result, when the ascent/descent speed of the car has exceeded the rated speed, the emergency stopper performs braking operation in the end region of the hoistway at an overspeed lower than an emergency braking overspeed which would be achieved in an intermediate region of the hoistway. Therefore, a buffer ascending/descending distance of the car at the end of the hoistway can be shortened, thereby reducing the height of the hoistway. The elevator is suitable for construction of an elevator system which yields an advantage of curtailing the cost for constructing a hoistway and the cost for manufacturing a buffer.

Claims

1. An elevator system comprising:

a car(8) which ascends/descends through a hoistway (1) while being guided by a guide rail

(100) provided at an upright position in the hoistway (1) ;

an emergency stopper (10) which is provided on the said car (8) and which operates in the event of emergency and engages the said guide rail (100), to thereby perform braking operation;

a governor rope (13) which assumes an endless shape, which is suspended in the said hoistway (1) and connected at one end thereof to the said emergency stopper (10), and which moves in a circulatory manner along a predetermined path in association with ascending/descending operation of the said car (8) ;

a first governor (12) which restrains circulatory movement of the said governor rope (13) when the speed of the said car (8) has reached a first overspeed (Vs) in excess of a rated speed (Vo), to thereby cause the said emergency stopper (10) to perform braking operation;

a second governor (42) which restrains the circulatory movement of the said governor rope (13) when the speed of the said car (8) has exceeded the rated speed (Vo) and reached a second overspeed (Vt) lower than said first overspeed (Vs), to thereby cause the said emergency stopper (10) to perform braking operation; and

end region drive means (55) which is provided in an end region of said hoistway (1) and drives said second governor (42) in the end region.

2. The elevator system according to claim 1, wherein the end region drive means (55) is constituted of a threaded frictional member (54) provided at an upright position in a bottom section of the hoistway (1), and a frictional wheel (45) which constitutes a governor wheel of the second governor (42), comes into contact with the said threaded frictional member (54) in the end region of the hoistway (1), and is driven by ascending/descending operation of the car (8).

3. The elevator system according to claim 1, wherein the end region drive means (55) is constituted of a pinion (56) constituting a governor wheel of the second governor (42) ; and wherein a rack rod (57) whose longitudinal portion is provided in a perpendicular direction; which meshes with the said pinion (56) ; which is retained by a support arm (59) projecting from the car (8) so as to be slidable in a vertical direction and located at a lowered position with respect to the said second governor (42) ; whose lower end is supported on a bottom section of the hoistway (1) as a result of lowering of the car (8) across the end region of the hoistway (1) ; and which ascends relative to the said second governor (42) , thereby driving the pinion (56) .

4. The elevator system according to claim 3, further

comprising:

a buffer (60) which is provided in the bottom section of the hoistway (1) and opposite the lower end of the rack rod (57) .

Patentansprüche

1. Aufzugssystem mit:

einer Kabine (8), die durch einen Schacht (1) angehoben/abgesenkt wird, während sie von einer Führungsschiene (100) geführt wird, die bei einer aufrechten Position im Schacht (1) vorgesehen ist;

einem Notfallanhalter (10), der an der Kabine (8) vorgesehen ist und der im Fall eines Notfalls betrieben wird und mit der Führungsschiene (100) in Eingriff kommt, um dadurch einen Bremsbetrieb durchzuführen;

einem Regelungsseil (13), welches eine endlose Form annimmt, das in dem Schacht (1) hängt und an einem Ende mit dem Notfallanhalter (10) verbunden ist und das sich umlaufend entlang eines vorher festgelegten Wegs in Zusammenhang mit einem Anstiegs-/Absenkbetrieb der Kabine (8) bewegt;

einem ersten Regler (12), der die Umlaufbewegung des Regelungsseils (13) einschränkt wenn die Geschwindigkeit der Kabine (8) eine erste Übergeschwindigkeit (Vs) größer als eine zugelassene Geschwindigkeit (Vo) erreicht hat, um dadurch den Notfallanhalter (10) dazu zu bringen, einen Bremsbetrieb durchzuführen;

einem zweiten Regler (42), der die Umlaufbewegung des Regelungsseils (13) einschränkt, wenn die Geschwindigkeit der Kabine (8) die zugelassene Geschwindigkeit (Vo) überschritten und eine zweite Übergeschwindigkeit (Vt) erreicht hat, die niedriger ist als die erste Übergeschwindigkeit (Vs), um dadurch den Notfallanhalter (10) dazu zu bringen, einen Bremsbetrieb durchzuführen; und

einer Endbereichsantriebseinrichtung (55), die in einem Endbereich des Schachts (1) vorgesehen ist und den zweiten Regler (42) im Endbereich antreibt.

2. Aufzugssystem nach Anspruch 1, bei dem die Endbereichsantriebseinrichtung (55) aus einem mit einer Windung versehenen Reibelement (54), das an einer aufrechten Position in einem unteren Abschnitt des Schachts (1) vorgesehen ist, und einem Reibrad (45) besteht, welches ein Reglerad des zweiten Reglers (42) bildet, mit dem das mit einer Windung versehene Reibelement (54) im Endbereich des Schachts (1) in Kontakt tritt und das durch einen An-

hebe/Absenkbetrieb der Kabine (8) angetrieben wird.

3. Aufzugssystem nach Anspruch 1, bei dem die Endbereichsantriebseinrichtung (55) aus einem Zahnrad (56), das ein Reglerad des zweiten Reglers (42) bildet, und einer Zahnstange (57) besteht, deren Längsabschnitt in einer senkrechten Richtung vorgesehen ist, die mit dem Zahnrad (56) kämmt, die durch einen Abstützarm (59), der von der Kabine (8) hervorsteht, so gehalten wird, dass sie in einer vertikalen Richtung verschiebbar ist und die an einer unteren Position in Bezug auf den zweiten Regler (42) so vorgesehen ist, dass ihr unteres Ende auf einem unteren Abschnitt des Schachts (1) als ein Ergebnis des Absenkens der Kabine (8) über den Endbereich des Schachts (1) hinaus abgestützt wird, und die in Bezug auf den zweiten Regler (42) angehoben wird, wodurch das Zahnrad (56) angetrieben wird.

4. Aufzugssystem nach Anspruch 3, ferner mit:

einem Puffer (60), der in dem unteren Abschnitt des Schachts (1) und gegenüber dem unteren Ende der Zahnstange (57) vorgesehen ist.

Revendications

1. Système d'ascenseur comprenant :

une cabine (8) qui monte / descend à travers une cage d'ascenseur (1) tout en étant guidée par un rail de guidage (100) disposé au niveau d'une position verticale dans la cage d'ascenseur (1) ;
un dispositif d'arrêt d'urgence (10) qui est disposé sur ladite cabine (8) et qui opère en cas d'urgence et met en prise ledit rail de guidage (100), pour effectuer de ce fait une opération de freinage ;
un câble de régulateur (13) qui prend une forme infinie, qui est suspendu dans ladite cage d'ascenseur (1) et relié à une extrémité de celui-ci audit dispositif d'arrêt d'urgence (10), et qui se déplace d'une façon circulaire le long d'un chemin prédéterminé en association avec une opération de montée / descente de ladite cabine (8) ;
un premier régulateur (12) qui restreint un mouvement circulaire dudit câble de régulateur (13) lorsque la vitesse de ladite cabine (8) a atteint une première survitesse (V_s) dépassant une vitesse nominale (V_o), pour amener de ce fait ledit dispositif d'arrêt d'urgence (10) à effectuer une opération de freinage ;
un second régulateur (42) qui restreint le mou-

vement circulaire dudit câble de régulateur (13) lorsque la vitesse de ladite cabine (8) a dépassé la vitesse nominale (V_o) et a atteint une seconde survitesse (V_t) inférieure à ladite première survitesse (V_s), pour amener de ce fait ledit dispositif d'arrêt d'urgence (10) à effectuer une opération de freinage ; et
un moyen d'entraînement de région d'extrémité (55) qui est disposé dans une région d'extrémité de ladite cage d'ascenseur (1) et entraîne ledit second régulateur (42) dans la région d'extrémité.

2. Système d'ascenseur selon la revendication 1, dans lequel le moyen d'entraînement de zone d'extrémité (55) est constitué d'un élément de friction fileté (54) disposé au niveau d'une position verticale dans une section de fond de la cage d'ascenseur (1), et d'une roue de friction (45) qui constitue une roue de régulateur du second régulateur (42), entre en contact avec ledit élément de friction fileté (54) dans la zone d'extrémité de la cage d'ascenseur (1), et est entraîné par l'opération de montée / descente de la cabine (8).

3. Système d'ascenseur selon la revendication 1, dans lequel le moyen d'entraînement de zone d'extrémité (55) est constitué d'un pignon (56) constituant une roue de régulateur du second régulateur (42) ; et dans lequel une tige de crémaillère (57) dont la partie longitudinale est disposée dans une direction perpendiculaire ; qui met en prise ledit pignon (56) ; qui est retenu par un bras de support (59) dépassant de la cabine (8) de façon à pouvoir coulisser dans une direction verticale et situé au niveau d'une position abaissée par rapport audit second régulateur (42) ; dont l'extrémité inférieure est supportée sur une section de fond de la cage d'ascenseur (1) suite à un abaissement de la cabine (8) d'un bout à l'autre de la région d'extrémité de la cage d'ascenseur (1) ; et qui monte par rapport audit second régulateur (42), entraînant de ce fait le pignon (56).

4. Système d'ascenseur selon la revendication 3, comprenant en outre :

un amortisseur (60) qui est disposé dans la section de fond de la cage d'ascenseur (1) et en face de l'extrémité inférieure de la tige de crémaillère (57).

Fig. 1

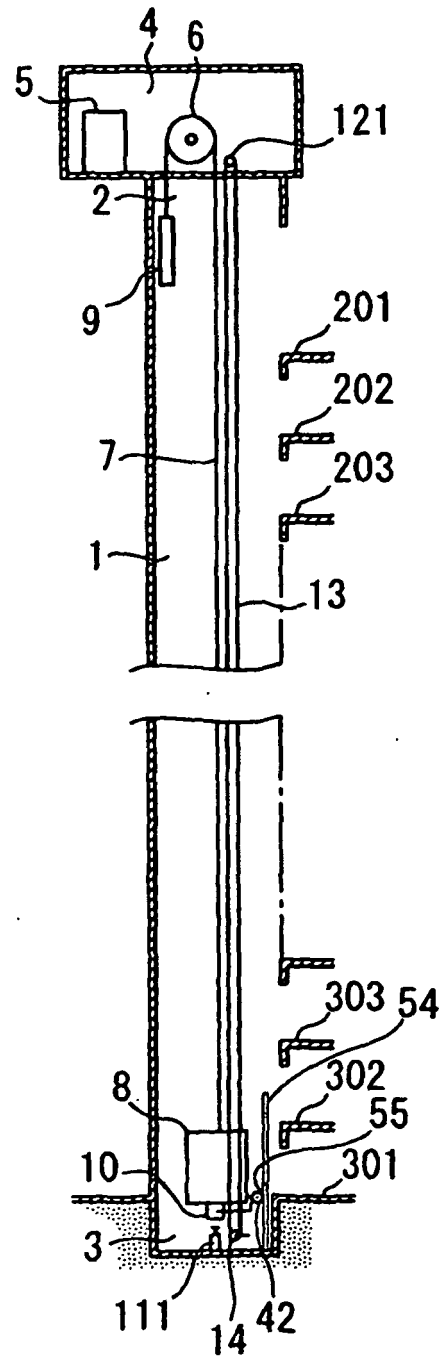


Fig. 2

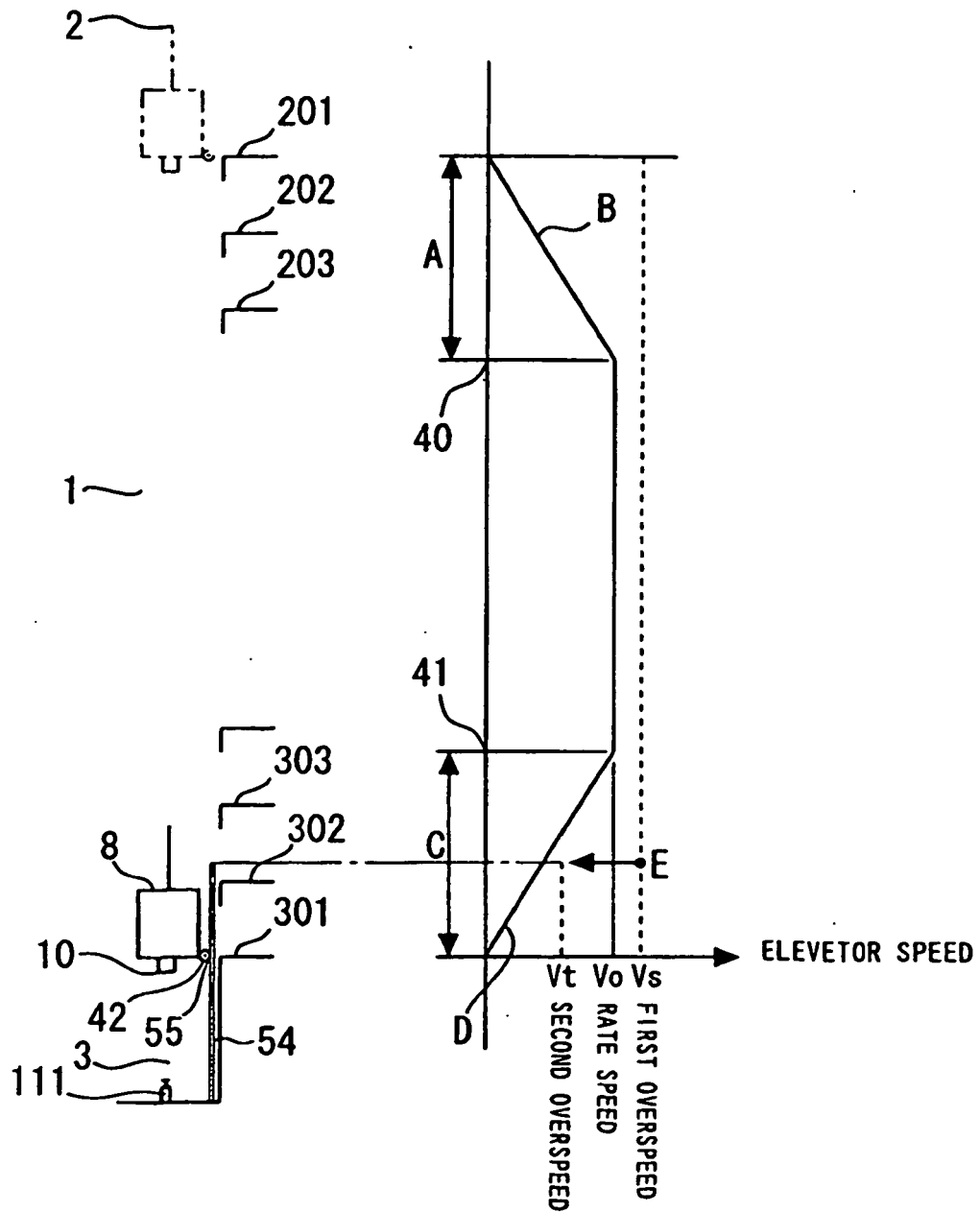


Fig. 3

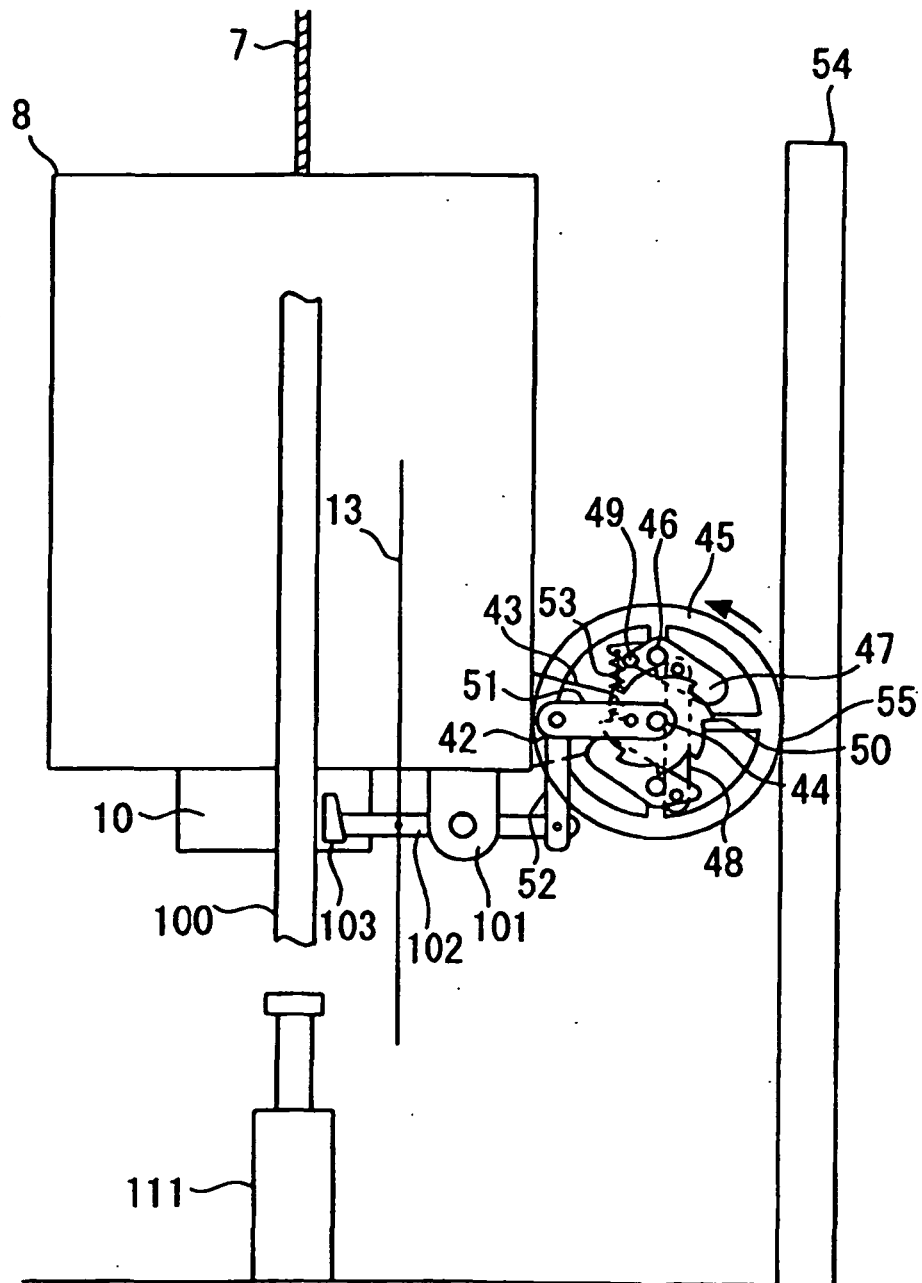


Fig. 4

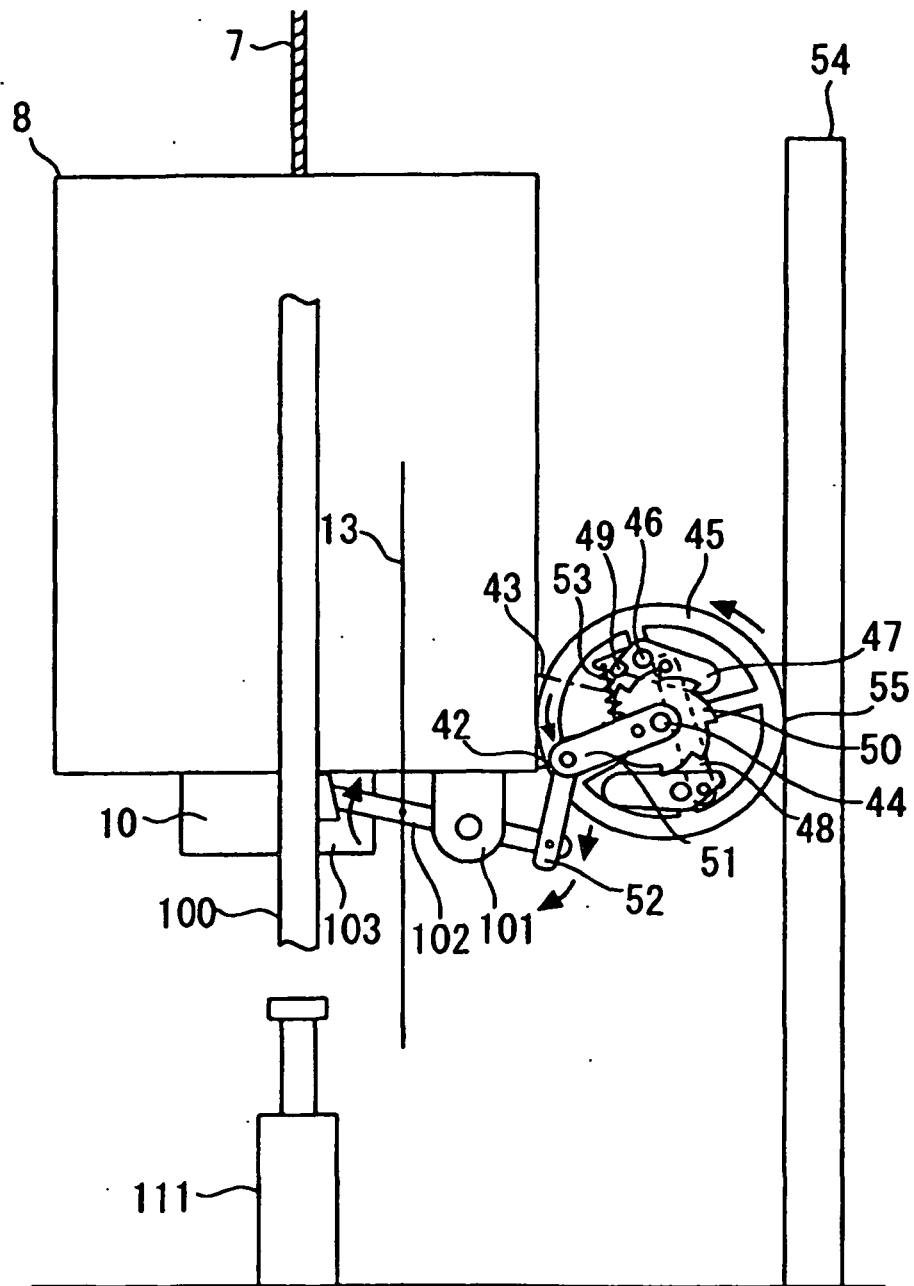


Fig. 5

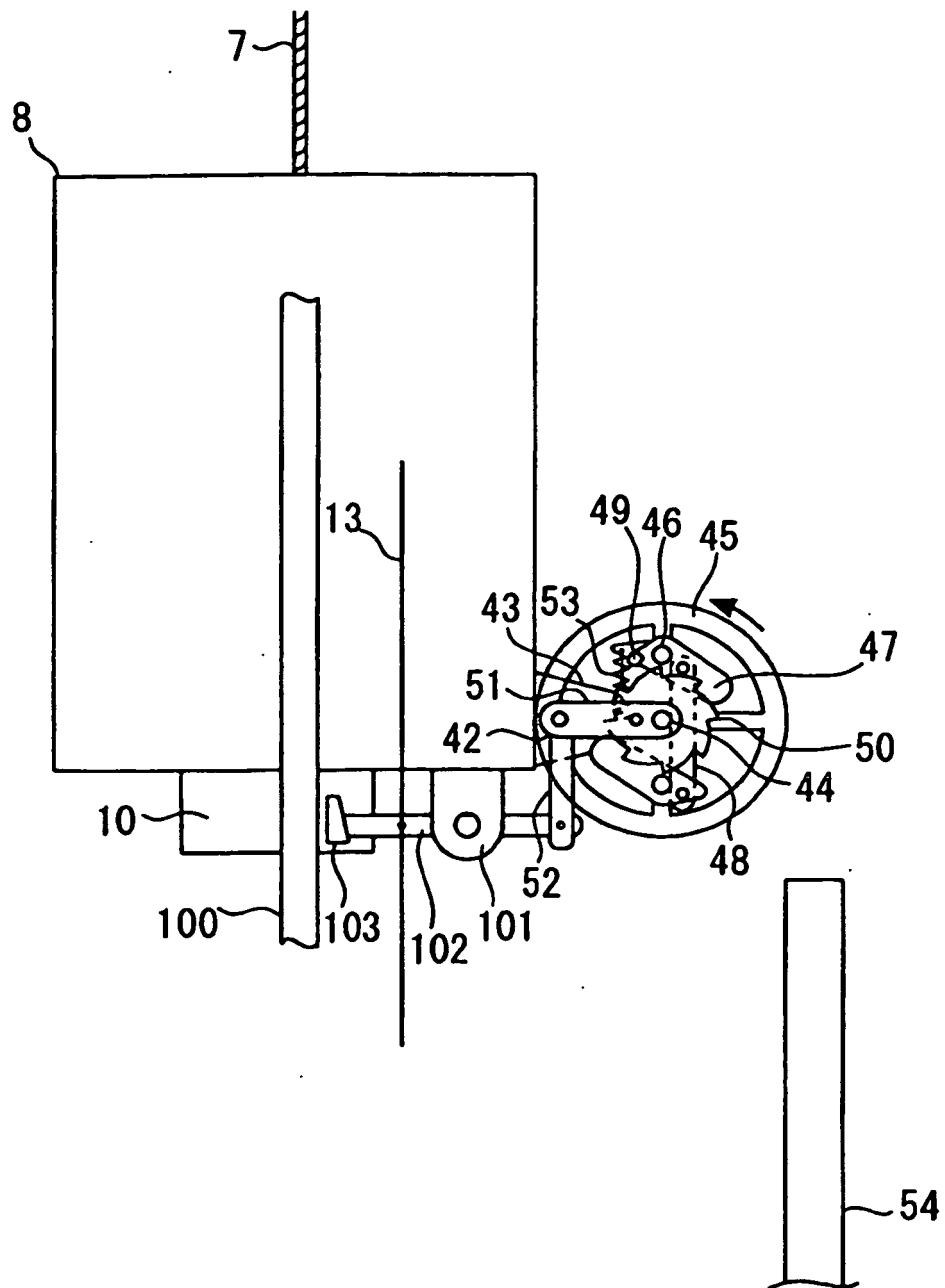


Fig. 6

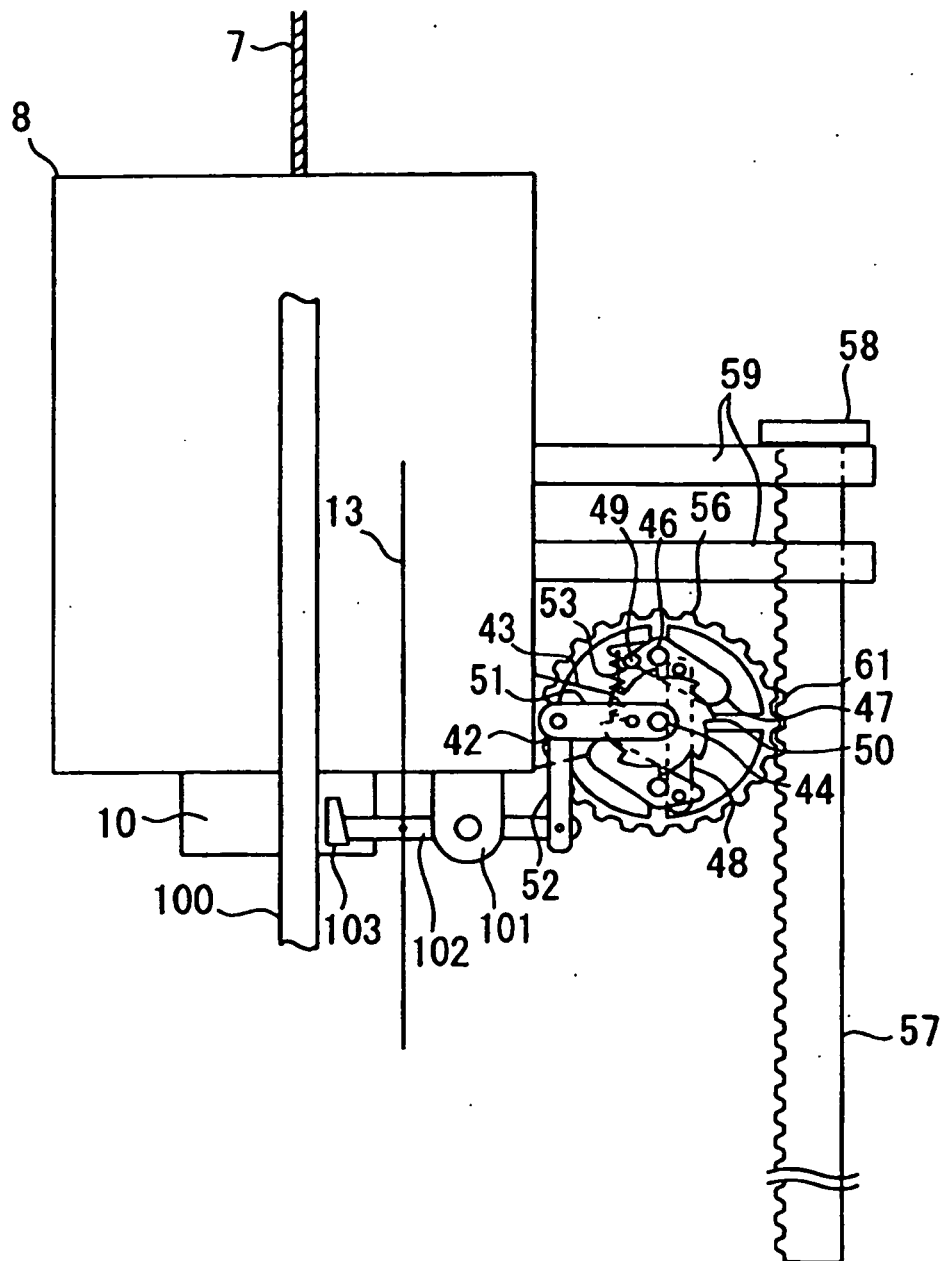


Fig. 7

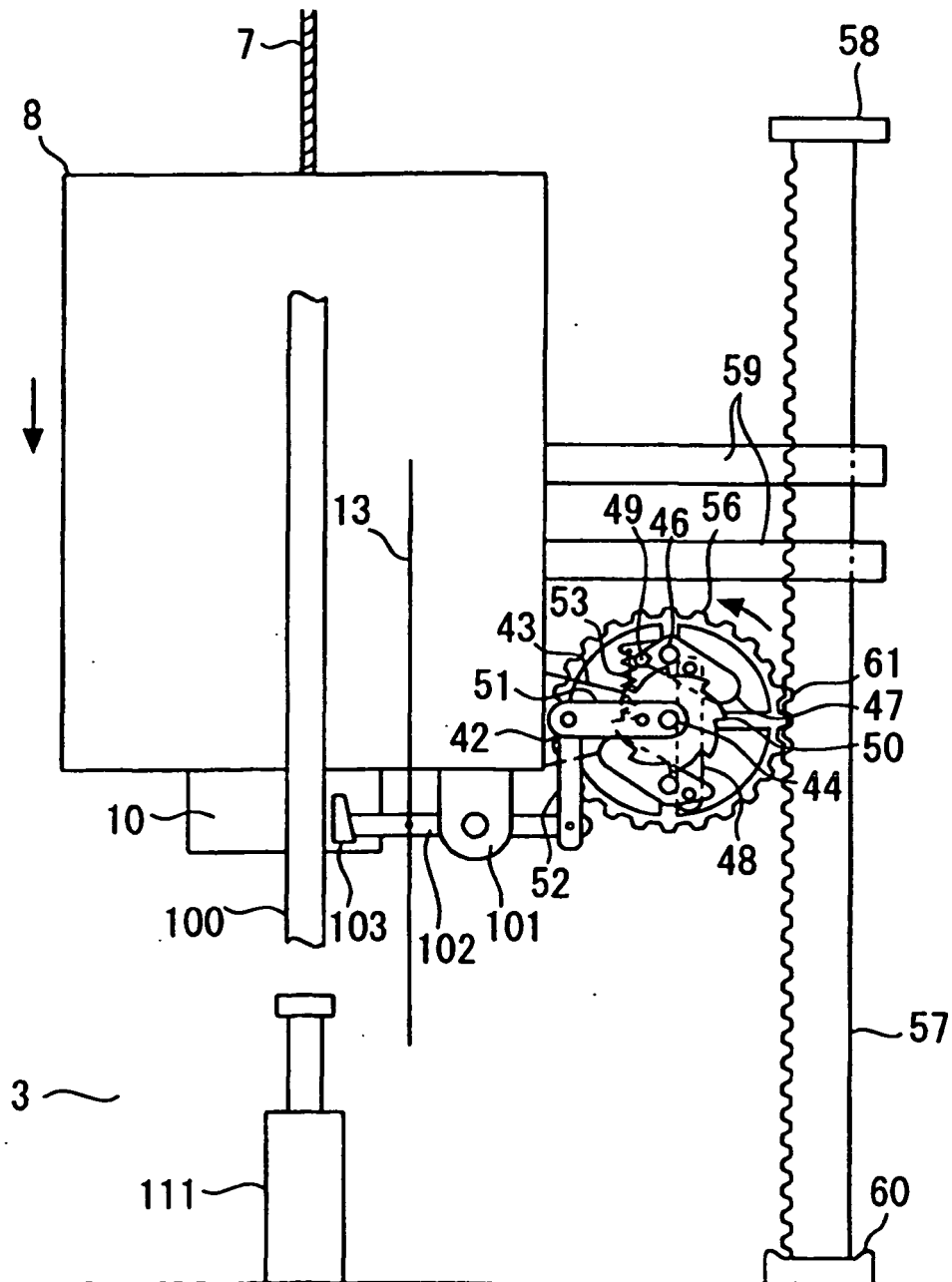


Fig. 8

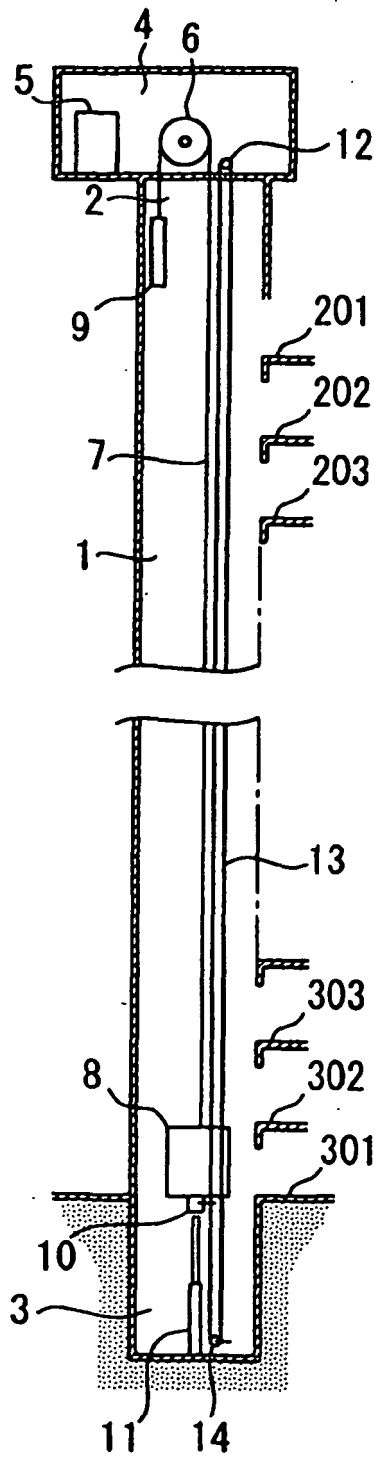


Fig. 9

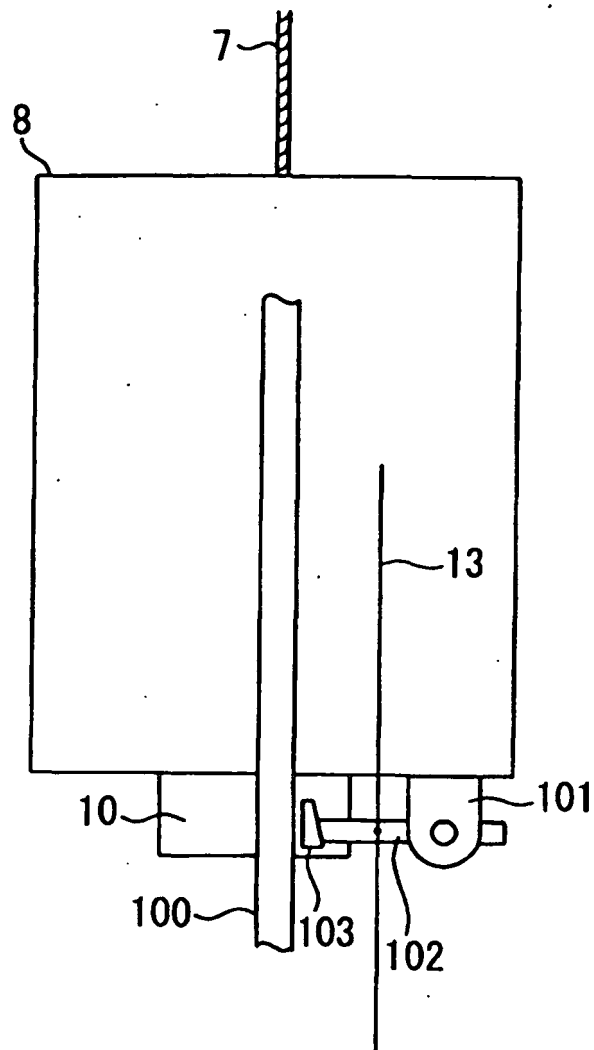


Fig. 10

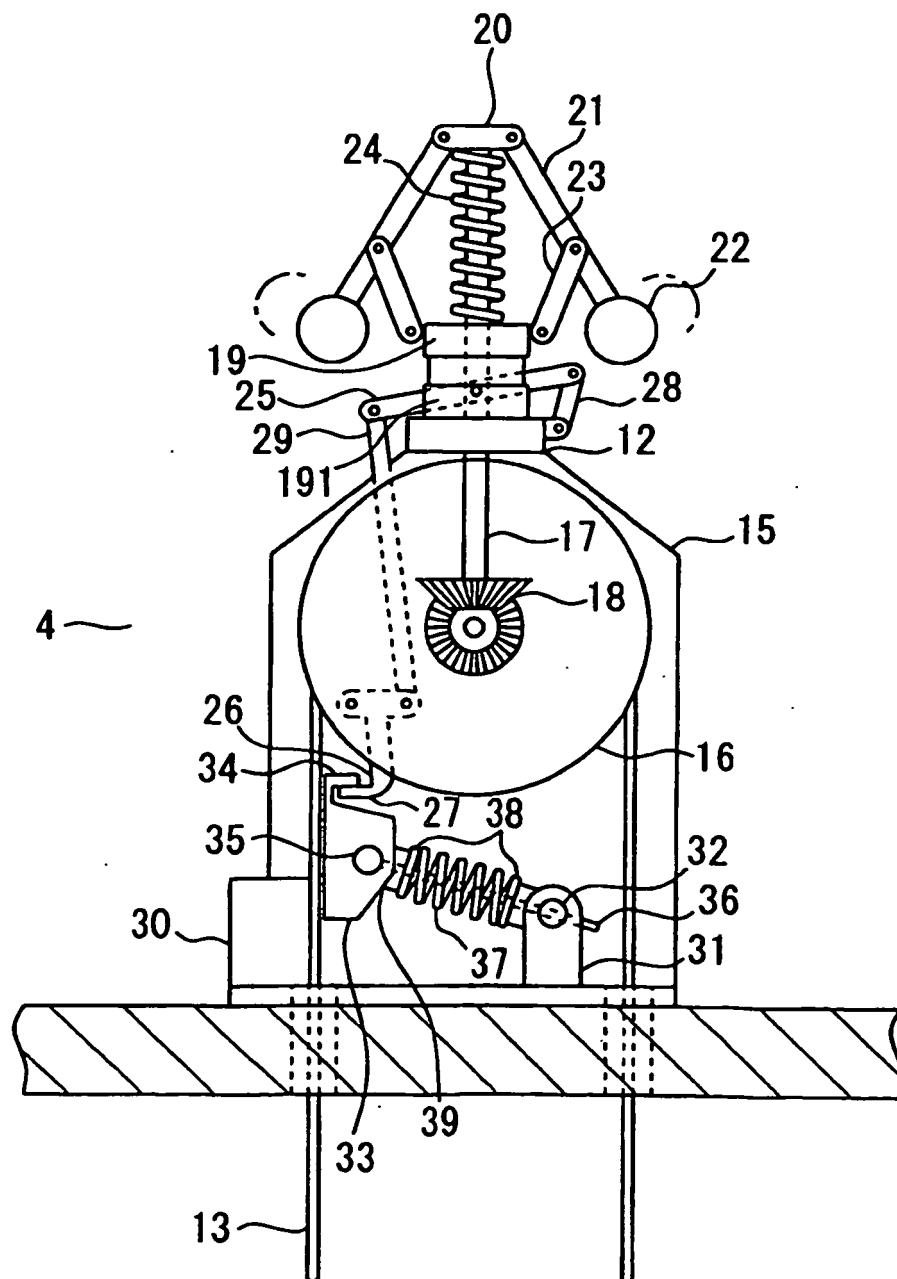


Fig. 11

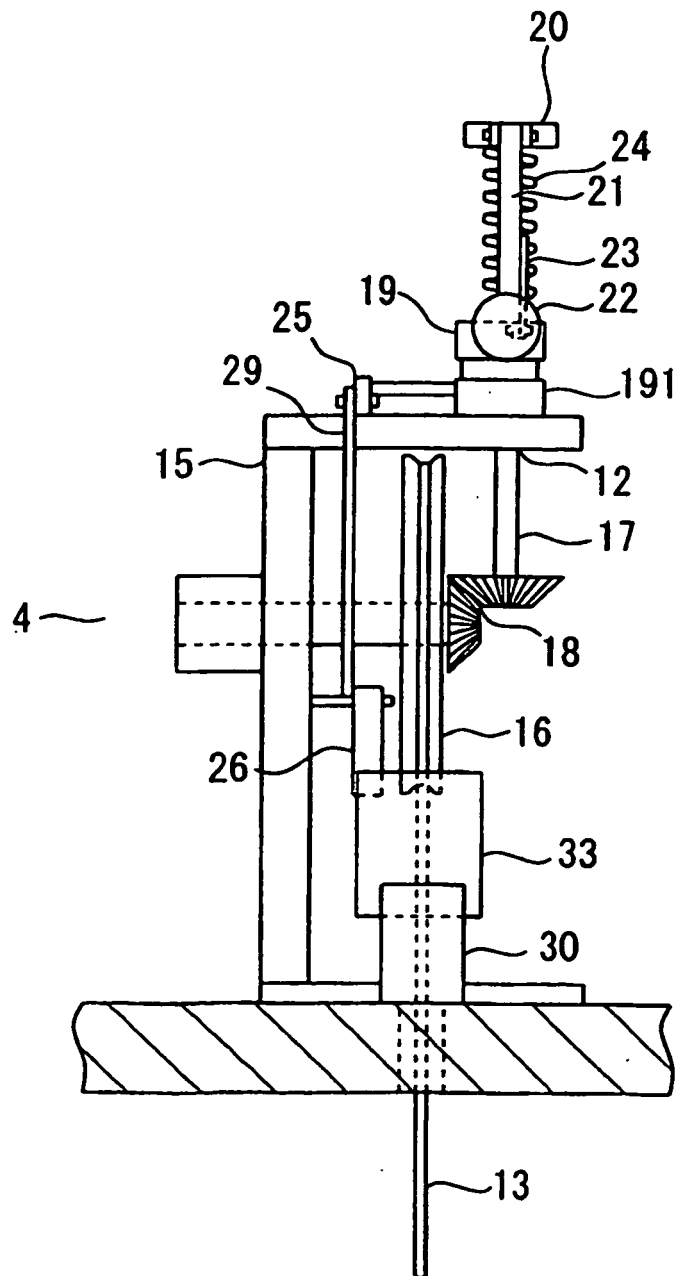


Fig. 12

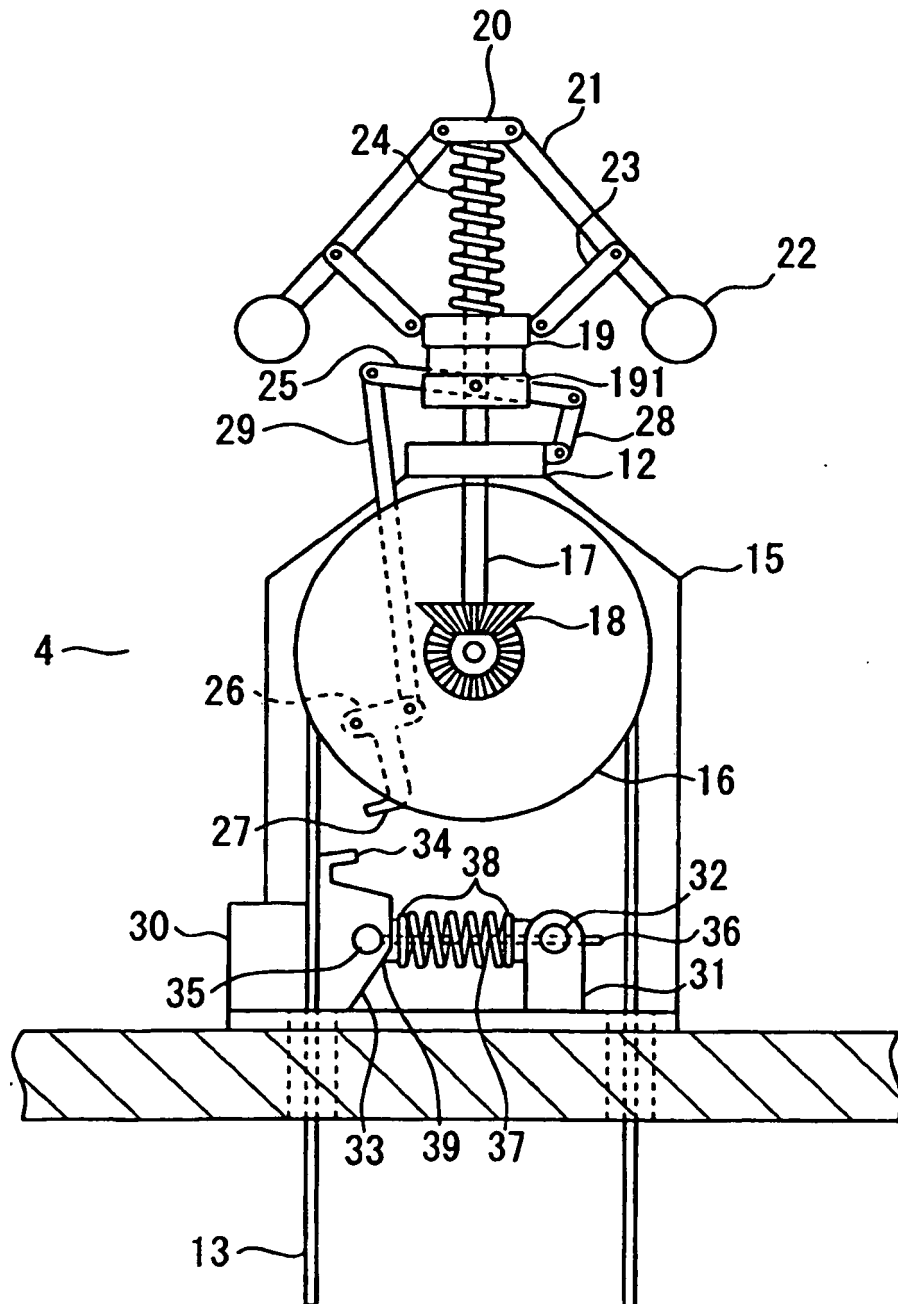


Fig. 13

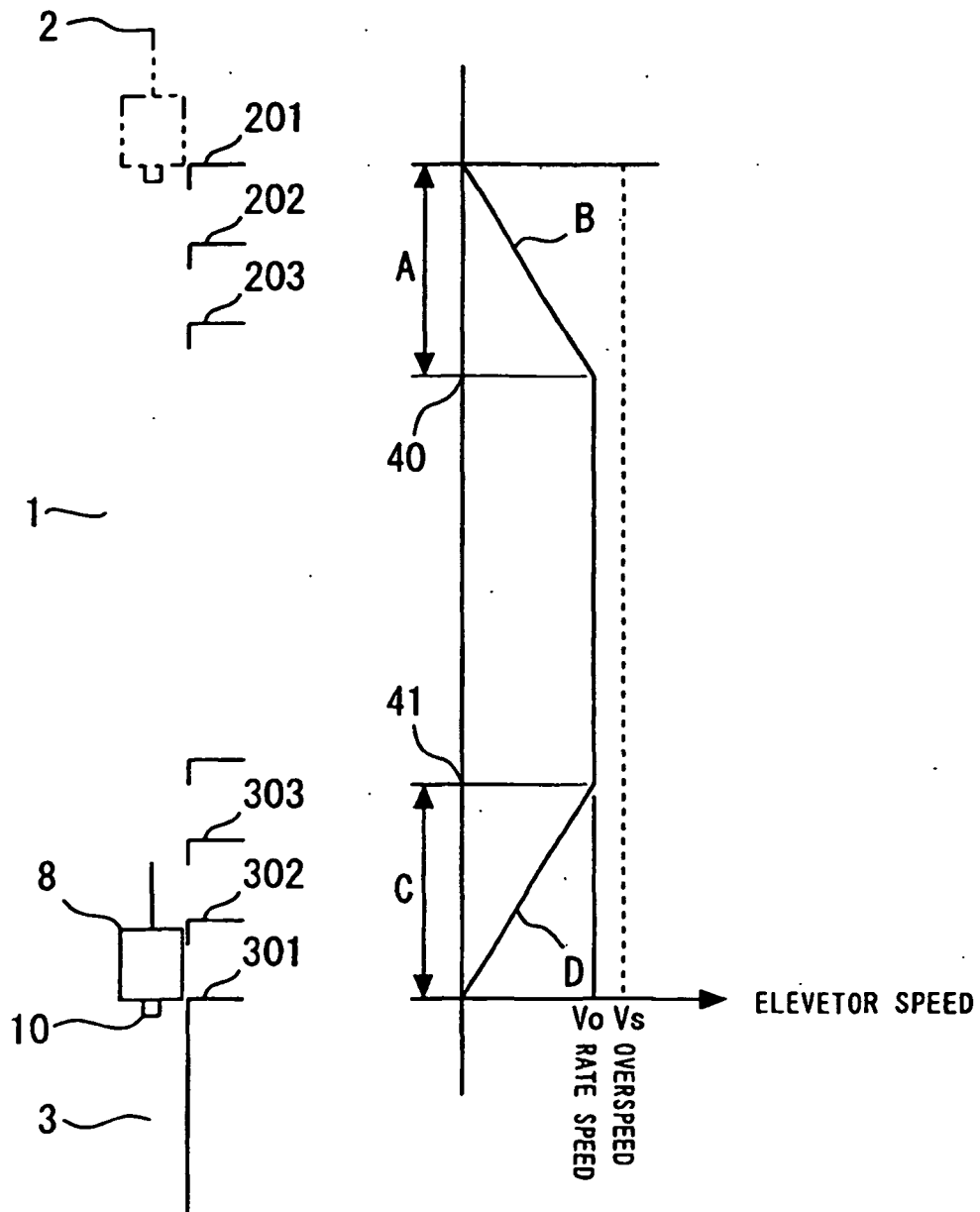
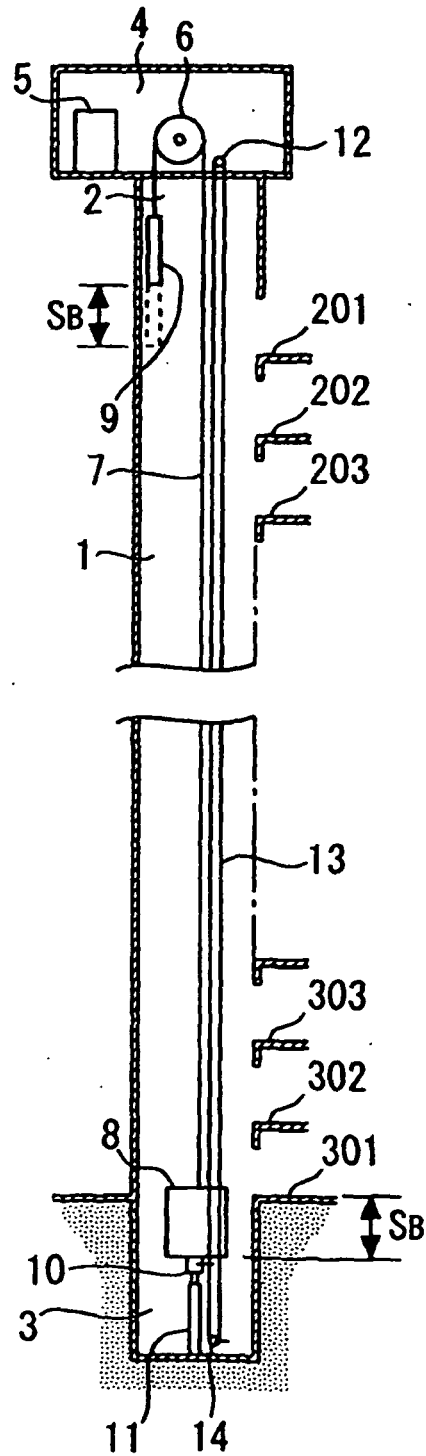


Fig. 14



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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