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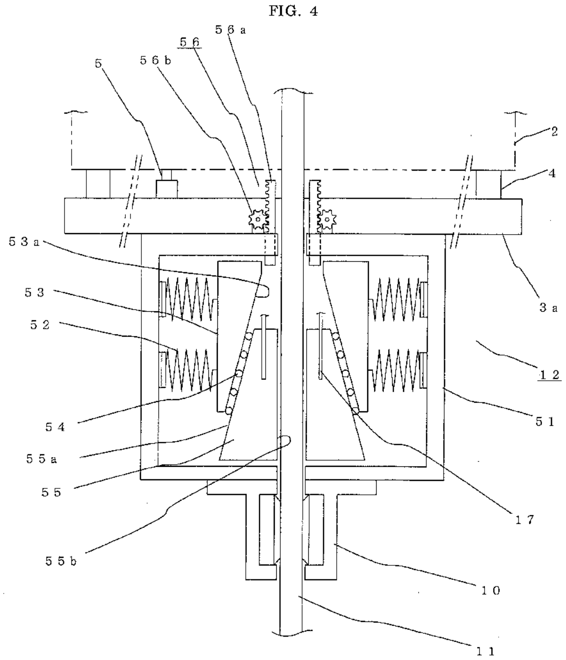
(54) Elevator safety device

(57) An object of the present invention is to obtain an elevator safety device that does not make passengers feel uncomfortable and nor causes damage to ascending/descending body and counterweight by reducing deceleration during braking operation with a simple structure and without a complicated control. To realize this object, the elevator safety device comprises an ascending/descending body that travels up and down along guide rails 11 and has a passenger car 2 for accommodating passengers therein and frame members 3 for supporting the passenger car; a wedge 55 that is provided on the ascending/descending body and shifts in an emergency upward relative to the ascending/descending body along the guide rail; a pressing member 53 for pressing by using an elastic member 52 the wedge onto the guide rail; a pressing-force-adjusting means for setting pressing force to be smaller when the ascending/descending body load mass, which fluctuates with passengers getting on and off, becomes larger, and to be larger when the load mass becomes smaller.

FIG. 4



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Description

ELEVATOR SAFETY DEVICE

Technical Field

[0001] The present invention relates to elevator safety devices for braking an ascending/descending body descending at overspeed.

Background Art

[0002] A conventional elevator safety device provided on an ascending/descending body that is suspended by a suspending member(main wire rope) and travels up and down along guide rails, includes wedges shifting upward relative to the ascending/descending body along the guide rails, pressing members that press the wedges onto the guide rails by use of elastic members, and a frame that houses these components. The pressing member is formed with a slope facing that of the wedge, parallel thereto, and rollers are interposed between the slopes of the wedge and the pressing member so as to roll on those slopes. In an emergency, that is, when the ascending/descending body happens to descend exceeding its rated speed due to control unit failures, main wire breakage, or the like, so that its speed reaches a predetermined overspeed, the wedge is shifted upward relative to the ascending/descending body, so as to pushingly expand the pressing member against a biasing force of the elastic member, by the wedge action; the reaction against this biasing force presses the wedge onto the guide rail and creates a braking force, which brakes the ascending/descending body. At this moment, since the top of the wedge is brought into contact with the frame, which stops upward shifting of the wedge, the pressing force proportional to the biasing force of the elastic member at that moment remains intact (e.g., refer to Patent Document 1).

[0003] Another conventional elevator safety device includes, in addition to the above-described configuration, a pressing-force-adjusting means disposed parallel to the elastic member, for adjusting a biasing force of an elastic member, a control means for controlling the pressing-force-adjusting means, and a deceleration detecting device for detecting the deceleration of an ascending/descending body. The control means is configured so as to control the pressing-force-adjusting means to decrease the pressing force by weakening the elastic force of the elastic member when the deceleration of the ascending/descending body exceeds a predetermined value, and to increase the pressing force by strengthening the elastic force when the deceleration falls below the predetermined value (e.g., refer to Patent Document 2).

[0004] Furthermore, still another conventional elevator safety device is provided with a fluid-filled pressure vessel, instead of the elastic member described above. Varying the pressing force by adjusting the sort of fluid and the fluid pressure inside the pressure vessel, an ascending/descending body is stopped so as to prevent the deceleration from increasing. (e.g., refer to Patent Document 3).

[0005]

Patent Document 1 : Japanese Patent Laid-Open No. S56-155178 (p. 1, Fig. 2)
Patent Document 2 : Japanese Patent Laid-Open No. 2001-341957 (p. 4 and 6, Fig. 5)
Patent Document 3 : Japanese Patent Laid-Open No. 2001-2342 (p. 5 through 9, Fig. 1)

Disclosure of Invention

[0006] In a conventional elevator safety device, since the top of the wedge is brought into contact with the frame so as to stop upward shifting of the wedge, the pressing force proportional to the biasing force of the elastic member at that moment remains intact. Consequently, there have been problems described below.

[0007] In an ordinary elevator, an ascending/descending body having a passenger car and a counterweight is suspended by a suspending member(main wire rope), and travels up and down in a jig-back way by driving the suspending member. The Building Standard Law Enforcement Order of Japan and the EN Standard specify that the elevator safety device must stop the ascending/descending body at an average deceleration of not more than 1.0 G under braking condition so as not to cause passengers to feel uncomfortable nor damage to the ascending/descending body and the counterweight during braking operation. The braking force by the elevator safety device is ordinarily set so that the ascending/descending body is braked at an average deceleration of 0.6 G under the condition of the passenger car of the ascending/descending body loaded with the rated mass, in the event of free fall of the ascending/descending body due to suspending member breakage or the like. This setting of the braking force is accomplished by setting the pressing force at a predetermined value that is the biasing force of the elastic member at the moment that the top of the wedge has been brought into contact with the frame to stop upward shifting of the wedge.

[0008] Therefore, since the pressing force by the wedge is set at a constant value so that the deceleration by the braking force becomes 0.6 G under the rated load mass condition, irrespective of the actual load mass of the ascending/descending body, the deceleration under braking is increased when the actual load mass is smaller than the rated load mass. The greater the deceleration under braking operation becomes, the bigger its shock becomes, which can make passengers feel uncomfortable and cause damage to the ascending/descending body and the counterweight. Besides, prevention of the ascending/descending body and the counterweight from being damaged requires enhancement of shock resistance by strengthening the structure of the ascending/descending body, increasing the ascending/descending body weight and costs uneconomically.

[0009] While the above is described about a case of the ascending/descending body freely falling in the event of suspending member breakage, when the safety device is put into operation in a case where the descending speed of the ascending/descending body exceeds its rated speed and attains a predetermined overspeed due to control unit failures or the like, under the condition of the ascending/descending body and the counterweight being suspended by the suspending member that is not broken, the deceleration under braking operation becomes larger because the ascending/descending body is subject to an upward force proportional to the counterweight mass through the suspending member.

[0010] Another conventional elevator safety device includes elastic members, a pressing-force-adjusting means disposed parallel to the elastic member, for adjusting the pressing force, a control means for controlling the pressing-force-adjusting means, and a deceleration detecting device for detecting the deceleration of an ascending/descending body. Thereby, the control means controls the pressing force proportional to the ascending/descending body deceleration fluctuating every moment, which leads to a requirement of complicated control. Furthermore, since the pressing-force-adjusting means has such a structure that does not adjust the elastic member but the elastic member biasing force itself, the safety device becomes complicated, causing it to be uneconomical. Moreover, equipping the safety device with the deceleration detecting device that detects the ascending/descending body deceleration, which is not necessary for ordinary elevator, also brings it to be uneconomical.

[0011] Furthermore, since still another conventional elevator safety device is provided with the fluid-filled pressure vessel, instead of an elastic member so that the pressing force is adjusted by varying the pressure inside the vessel and the viscosity of the fluid, the pressure vessel is always subject to the fluid pressure, causing a necessity of maintenance against the fluid pressure leakage or the like.

[0012] The present invention is made in order to solve the above-discussed problems, and an object of the invention is to obtain an elevator safety device that mitigates the deceleration during braking operation with a simple structure without any complicated control, so as not to cause passengers to feel uncomfortable nor damage to the ascending/descending body and the counterweight.

[0013] Another object of the invention is to obtain an elevator safety device that mitigates the deceleration during braking operation depending on whether or not an ascending/descending body is suspended by a suspending member, so as not to cause passengers to feel uncomfortable and nor damage to the ascending/descending body and the counterweight as well.

[0014] An elevator safety device according to the present invention comprises an ascending/descending body that travels up and down along guide rails and has a passenger car for accommodating passengers therein and frame members for supporting the passenger car; a wedge that is provided on the ascending/descending body and shifts, in an emergency, upward relative to the ascending/descending body along the guide rail; a pressing member for pressing by using an elastic member the wedge onto the guide rail; a pressing-force-adjusting means for setting pressing force to be small when the ascending/descending body load mass, which fluctuates with passengers getting on and off, becomes large, and to be large when the load mass becomes small.

[0015] The present invention can realize a braking operation at a desired deceleration in accordance with load conditions of an ascending/descending body, which mitigates shock during the braking and causes passengers not to feel uncomfortable for passengers as well as no damage to the ascending/descending body and the counterweight.

Brief Description of Drawings

[0016]

Fig. 1 is a view illustrating a schematic structure of an elevator system that uses an elevator safety device according to Embodiment 1 of the invention;
Fig. 2 is a view illustrating a major portion of a passenger car door in the closed state;
Fig. 3 is a view illustrating a major portion of a passenger car door in the open state;
Fig. 4 is a view illustrating a major portion of an elevator safety device according to Embodiment 1 of the invention;
Fig. 5 is a view illustrating an operation of the elevator safety device according to Embodiment 1 of the invention;
Fig. 6 is a view illustrating another operation of the elevator safety device according to Embodiment 1 of the invention;
Fig. 7 is a view illustrating an elevator safety device according to Embodiment 2 of the invention;

Fig. 8 is a view illustrating a major portion of an elevator safety device according to Embodiment 3 of the invention;
Fig. 9 is an overall view from Arrow "C" of Fig. 8, illustrating an engaging-member-operating mechanism and the door in the open state;
Fig. 10 is an overall view from Arrow "C" of Fig. 8, illustrating an engaging-member-operating mechanism and the door in the close state;
Fig. 11 is a view illustrating an elevator safety device according to Embodiment 4 of the invention;
Fig. 12 is a view illustrating an operation of the elevator safety device according to Embodiment 4 of the invention;
Fig. 13 is a view illustrating an elevator safety device according to Embodiment 5 of the invention;
Fig. 14 is a view illustrating an operation of the elevator safety device according to Embodiment 5 of the invention;
Fig. 15 is a view illustrating an elevator safety device according to Embodiment 6 of the invention; and
Fig. 16 is a view illustrating an operation of the elevator safety device according to Embodiment 6 of the invention.

Reference Numerals

[0017] 1 ascending/descending body, 2 passenger car, 3 frame member, 3a car floor frame, 4 elastic member, 5 load-weighting sensor, 6 counterweight, 7 suspending member, 7a shackle spring, 8 traction sheave, 9 deflection sheave, 10 guide shoe, 11 guide rail, 12, 12a, and 12b safety devices, 13 governor, 14 governor wire rope, 15 tension pulley, 16 safety-link, 17 lifting-rod, 18 door open/close device, 19a and 19b doors, 20 doorsill, 21 door driving device, 22 door motor, 23 belt, 24 diverting pulley, 25a and 25b door hangers, 26 door open/close switch, 27 dog, 51 frame, 52 elastic member, 53 pressing member, 53a pressing member slope, 54 roller, 55 wedge, 55a wedge slope, 55b wedge braking surface, 56 wedge-position-adjusting means, 56a stop, 56b actuator, 57 wedge-position-adjusting means, 57a stop, 57b actuator, 58 nut, 59 belt, 60 pulley, 70 engaging member, 70a pivot, 70b engaging portion, 71 engaging-member-operating mechanism, 72a and 72b wires, 73a and 73b winding pulleys, 74a first diverting pulley, 74b third diverting pulley, 75a second diverting pulley, 80 wedge position adjusting means, 80a, stop, 80b stop connecting member, 81a first link, 81b second link, 82 support member, 83 linking mechanism, 90 wedge-position-adjusting means, 90a stop, 90b stop connecting member, 91 first link, 92 connecting member, 93 support member, 94 linking mechanism, and 100 switch.

Best Mode for Carrying Out the Invention

[0018] Preferred embodiments of the present invention will be described below with reference to the drawings.

Embodiment 1

[0019] Figures 1 through 6 illustrate an elevator safety device according to Embodiment 1 for embodying the present invention. Fig. 1 is a view showing a schematic structure of an elevator system, Fig. 2 and 3 are views showing a major portion of a passenger car door, Fig. 4 is a view showing a major portion of the elevator safety device, and Fig. 5 and 6 are views illustrating the operation of the elevator safety device.

[0020] Referring to Fig. 1, an ascending/descending body 1 has a passenger car 2 that passengers get on and off and a frame member 3 that supports the passenger car 2. A car floor frame 3a is provided on the lower portion of the frame member 3, and elastic members 4 made of rubber, for example, is interposed between the passenger car 2 and the car floor frame 3 in order to prevent vibration from propagating from the frame member 3 to the passenger car 2 during ascending/descending. A load-weighting sensor 5 is also interposed between the passenger car 2 and the car floor frame 3 to measure load mass, i.e., the mass of passengers getting on and off the passenger car 2. Elevators are generally equipped with the load-weighting sensor 5 so as not to be operated with load mass exceeding its rated load value. The load-weighting sensor 5, which is composed of a differential transformer, equivalently measures load mass by measuring with the differential transformer in the load-weighting sensor 5 a distorted amount of the elastic member 4 attached on the passenger car 2, due to load mass fluctuation with passengers getting on and off. It is noted that the load-weighting sensor 5 is not limited to a differential transformer but may be composed of any other devices such as a laser displacement sensor, for example, as long as they are able to measure interspace distance.

[0021] The passenger car 1 and the counterweight 6 are hangingly attached to a suspending member 7. The suspending member 7 is wound around a traction sheave 8 and a deflection pulley 9, in order to increase the space between the ascending/descending body 1 and the counterweight 6, and suspends the ascending/descending body 1. Thus, the ascending/descending body 1 and the counterweight 6 travel up and down in a jig-back way by driving the traction sheave 8. A shackle spring 7a, which elastically supports the ascending/descending body 1, is attached to the coupling portion of the ascending/descending body 1 and the suspending member 7 in order to block vibration propagating through the suspending member 7 during elevator operation.

[0022] Guide shoes 10 are attached to four corners of both top and bottom of the ascending/descending body 1, so that the ascending/descending body 1 travels up and down along guide rails 11 by engaging the guide shoes 10 with the guide rails 11. Furthermore, at the bottom portion of the ascending/descending body 1, a pair of safety devices 12 is interposed between the guide shoe 10 and the ascending/descending body 1, so as to brake to stop the ascending/descending body 1 in the event of an emergency such as control unit failures or suspending member breakage. Installed at the top of an elevator shaft is a governor 13 that detects the speed of the ascending/descending body 1. A tension pulley 15 is installed at the lower portion of the shaft in order to stretch along the shaft a governor rope 14 that is wound around the governor 13. Thus, the governor rope 14 is stretched across the governor 13 and the tension pulley 15.

[0023] Moreover, the governor 13 is provided with a grasping portion (not shown) that operates to grasp the governor rope 14 if ascending/descending body 1 speed exceeds its rated speed and reaches a predetermined overspeed. The governor rope 14 is connected to the ascending/descending body 1 through a safety link 16, and the safety link 16 is connected to the safety devices 12 through lifting-rods 17 disposed on both lateral sides of the ascending/descending body 1.

[0024] The passenger car 2 is provided with a door open/close device 18. The door open/close device 18 will be explained with reference to Fig. 2. Referring to Fig. 2, the door open/close device 18 is equipped with a left-and-right pair of doors 19a and 19b, a door sill 20 that slidably engages the lower portion of the doors 19a and 19b, and a door driving device 21 that is mounted on the upper portion of the elevator car 2 and actuates the doors 19a and 19b to open and close. The door driving device 21 has a door motor 22 and a diverting pulley 24 that stretches a belt 23 wound around the door motor 22. Door hangers 25a and 25b each attached to the top of the doors 19a and 19b, are attached to the upper and lower portions of the belt 23, respectively. The door driving device 21 is equipped with a door open/close switch 26 to detect open/close states of the doors 19a and 19b, and the switch 26 is put into operation by contacting a dog 27 attached to the door 19b, one of the doors.

[0025] Here, the operation of doors 19a and 19b will be explained. Fig. 2 shows the closed state of the doors 19a and 19b, and Fig. 3 shows the open state. In Fig. 2, the door hangers 25a and 25b, and the doors 19a and 19b each are actuated in the directions to be opened with the belt 23 being driven by driving the door motor 22 to rotate counterclockwise, which leads the doors to the open state as shown in Fig. 3. The switch 26 performs an on-off operation in response to whether or not the switch contacts the dog 27 attached to the door 19b by opening/closing the doors 19a and 19b. Incidentally, an elevator is generally equipped with above described components.

[0026] Next, the configuration of the safety device 12 will be explained. Figure 4 is a view, viewed from Arrow "A", illustrating a major portion of the elevator safety device 12. Referring to Fig. 4, the safety device 12 has a frame 51 mounted on the underside of the car floor frame 3a, and in the frame 51, are provided coil springs 52 that are elastic members attached to the frame 51; pressing members 53 each fixed on the coil springs 52 and having a pressing member slope 53a that forms a wedge shape narrowing toward the bottom; rollers 54 that roll on the slope 53a of the pressing member 53; and wedges 55 each interposed between the guide rail 11 and the rollers 54 and having a wedge slope 55a that forms a wedge shape narrowing toward the top and faces the slope 53a of the pressing member 53. The wedge 55 has a braking surface 55b on the opposite side of the slope 55a, and the braking surface 55b faces a side of the guide rail 11. Moreover, a lifting-rod 17 is attached to the wedge 55. The guide shoe 10 is fixed on the underside of the frame 51 of the safety device 12 and is engaged with the guide rail 11.

[0027] Furthermore., the safety device 12 is provided with a wedge-position-adjusting means 56. The wedge-position-adjusting means 56 is composed of a stop 56a that slides to travel upward and downward with respect to the frame 51 and contacts the top of the wedge 55; an actuator 56b that actuates the stop 56a upward and downward. The stop 56a is composed of a rack having teeth formed thereon, and the actuator 56b is composed of a pinion engaged with the rack teeth of the stop 56a and a motor (not shown) that drives the pinion. The motor, which is not shown, is provided with a braking device that is a stop-fixing means in order to fix a vertical position of the stop 56a. Here, the coil spring 52, the pressing member 53, roller 54, the wedge 55, stop 56a, and actuator 56b each, which are described above, are configured in pairs on the left and right of the guide rail 11.

[0028] Next, the operation will be explained. Under normal elevator operations, the traction sheave 8 drives the suspending member 7, so as to operate the ascending/descending body 1 and the counterweight 6, which are suspended by the suspending member 7, to travel up and down in jig-back way. The ascending/descending body 1 travels up and down in the elevator shaft along the guide rails 11 engaged with the guide shoe 10. The governor rope 14, which is connected to the ascending/descending body 1 through the safety-link 16, moves along with the ascending/descending body 1 ascending/descending, to rotate the governor 13 that is wound around with the governor rope 14. The safety device 12 retains a state where the wedge 55 stays in a lower position, so that the braking surface 55a remains off from the guide rail 11, as shown in Fig. 4. When the ascending/descending body 1 happens to descend exceeding the rated speed due to control unit failures, suspending member 7 breakage, or the like, so that its speed reaches a predetermined overspeed, since the governor rope 14 is grasped by the governor 13 through a grasping portion, which is not shown, the safety-link 16 is pivoted, so that the lifting-rod 17 stops prior to the ascending/descending body 1; namely, the lifting-rod 17 is shifted upward relative to the ascending/descending body 1.

[0029] Consequently, the wedge 55 connected to the lifting-rod 17 is shifted upward relative to the ascending/descending body 1. Since the pressing member 53 and the wedge 55 have pressing member slopes 53a and 55a formed in a wedge shape, the more upward the wedge 55 is shifted, the closer the wedge comes to the guide rail 11, by the wedge action, being guided by the roller 54, so that the braking surface 55b goes into contact with the guide rail 11. Then, the wedge 55 is further shifted upward, so as to pushingly expand the pressing member 53 against the biasing force of the coil springs 52; thereby, the reaction against the biasing force presses the wedge 55 onto the guide rail 11 to create a braking force, which brakes the ascending/descending body 1. Then, the top of the wedge 55 is brought into contact with the stop 56a, so as to stop upward shifting, as illustrated in Fig. 5. Hereinafter, the position where the wedge 55 stops upward shifting, refers to as "upward-shift stop position". The coil spring 52 biasing force created by the wedge 55 in the upward-shift stop position, becomes pressing force, i.e., the braking force that brakes the ascending/descending body 1.

[0030] Next, the operation of the wedge-position-adjusting means 56 will be explained with reference to Fig. 4, Fig. 5, and Fig. 6. When the mass of the ascending/descending body 1 becomes larger, the braking force should be set to be larger accordingly, and when the mass of the ascending/descending body 1 becomes smaller, the braking force should be set to be smaller accordingly in order to perform braking operations at a predetermined deceleration. Therefore, the braking force should be set in accordance with load mass of the elevator car 2.

[0031] As described above, load mass of the passenger car 2 is measured by the load-weighting sensor 5 measuring the distorted amount of the elastic member 4 due to load mass fluctuation with passengers getting on and off. When the maximum load mass, i.e., the rated load mass, is measured by the load-weighting sensor 5, for instance, the wedge-position-adjusting means 56 shifts the stop 56a to the highest position by the actuator 56b as shown in Fig. 4, so that upward shifting of the wedge 55 is stopped in its highest position during braking. At this moment, the pressing member 53 is pushingly expanded at its maximum against the coil spring 52, so that the biasing force by the coil spring 52 becomes maximum as shown in Fig. 5. Thereby, the pressing force, i.e., the braking force also becomes maximum. Next, the case with the minimum load mass, i.e., the case with one passenger, is explained with reference to Fig. 6. In this case, the wedge-position-adjusting means 56 shifts the stop 56a to the lowest position by the actuator 56b, so that the wedge 55 stops upward shifting in its lowest position when braking as shown in Fig. 6. At this moment, the pressing member 53 is pushingly expanded at its minimum against the coil spring 52, so that the biasing force of the coil springs 52 becomes minimum. Thereby, the pressing force, i.e., the braking force also becomes minimum. When load mass is between at its maximum and minimum, vertical position of the stop 56a is adjusted in accordance with the load mass, so that the pressing force by the wedge 55 is set by setting the upward-shift stop position of the wedge 55.

[0032] Next, the cooperative operation between the door open/close device 18 and the wedge-position-adjusting means 56 will be explained. When the ascending/descending body 1 is parked on a floor level, the doors 19a and 19b are opened by the door open/close device 18 in order for passengers to get on and off. At this moment, detecting the ON-state of the door open/close switch 26, i.e., the doors 19a and 19b being in the open state, the wedge-position-adjusting means 56 adjusts vertical position of the stop 56a in accordance with passengers mass, i.e., load mass by deactivating the braking device of the actuator 56a and activating the motor thereof, as described before, so as to set in accordance with the load mass the pressing force by the wedge 55, acting during braking operation. When passengers have finished getting on and off and the doors 19a and 19b have been closed, detecting the OFF-state of the door open/close switch 26, i.e., the doors 19a and 19b being in the closed state, the wedge-position-adjusting means 56 fixes vertical position of the stop 56a in accordance with the load mass by deactivating the motor and activating the braking device of the actuator 56b. Thereby, the stop 56a is retained in the state of being fixed in the adjusted vertical position during ascending/descending of the ascending/descending body 1 in the state loaded with passengers.

[0033] Next, the braking force by the elevator safety device will be explained. Braking force F is generally expressed by the following equation, denoting ascending/descending body mass without load as W, load mass as Wc, an upward force acting on the ascending/descending body by a counterweight as Fb, and average deceleration during braking as α:

$$F = \{ (W + Wc) + (W + Wc) \alpha \} g - Fb \qquad \text{Eq.1},$$

where g represents the acceleration of gravity. Namely, the braking force F is obtained by subtracting the upward force acting on the ascending/descending body by the counterweight Fb from the sum of a force bearing the total mass (W + Wc) itself to be ascended/descended and a force decelerating the total mass at a deceleration of α.

[0034] The Building Standard Law Enforcement Order of Japan and the EN Standard specify that the elevator safety device must stop the ascending/descending body at an average deceleration of not more than 1.0 G under braking operation so as not to cause passengers to feel uncomfortable nor damage to the ascending/descending body and the counterweight during braking operation. The braking force by the elevator safety device is ordinarily set at the average deceleration of 0.6 G, in the event of free fall of the ascending/descending body under the rated load condition, due to suspending member breakage or the like. Hence, denoting the rated load mass as W1, the relations of Fb = 0, α = 0.6 G, and Wc = W1 are held, which gives the expression for a braking force Fs as below:

$$Fs = \{ (W + W1) + (W + W1) * 0.6 \} g \qquad Eq.2.$$

[0035] In the case of the ascending/descending body with no load in the passenger car, designating by α the average deceleration of the safety device during braking operation, the following relation is obtained:

$$Fs = \{ W + W * \alpha \} g \qquad Eq.3.$$

Here, assuming unloaded ascending/descending body mass W is equal to the rated load W1, i.e., W = W1, for example, the following equation is derived from Equation 2, Equation 3, and W = W1:

$$\{ W + W * \alpha \} g = \{ (W + W) + (W + W) * 0.6 \} g \qquad Eq.4,$$

giving an average deceleration α of 2.2 G, which is larger than the average deceleration of 0.6 G in the case with the ascending/descending body loaded with the rated load mass, and exceeds 1.0 G that is specified in the Building Standard Law Enforcement Order of Japan and the EN Standard. As discussed above, if the pressing force by the wedge is set to such a constant value as a braking force that makes the deceleration be 0.6 G under the rated load mass condition, irrespective of the amount of the ascending/descending body load mass, the smaller the load mass becomes, the larger deceleration becomes.

[0036] The elevator safety device of this embodiment, denoting a desired average deceleration as αc, can set the average deceleration of the ascending/descending body 1 during braking to a desired average deceleration αc (e.g., 0.6 G), irrespective of load condition of the passenger car 2, by setting the pressing force by the wedge 55 by adjusting vertical position of the stop 56a so that the braking force Fc is set by the following equation given below, in the event of the ascending/descending body 1 falling freely due to suspending member breakage, for example:

$$Fc = \{ (W + Wc) + (W + Wc) * \alpha c \} g \qquad Eq.5.$$

[0037] Thus, this embodiment provides an elevator safety device having a pressing-force-adjusting means for setting the pressing force by the wedge 55, i.e., the braking force in accordance with load mass by setting the upward-shift stop position of the wedge 55 with the wedge-position-adjusting means 56 adjusting vertical position of the stop 56a in accordance with passenger car 2 load mass measured by the load-weighting sensor 5.

[0038] As described above, an elevator safety device of this embodiment can perform braking operation at a desired deceleration in accordance with load conditions of the ascending/descending body 1; thereby, shock during braking is reduced, causing passengers not to feel uncomfortable as well as no damage to the ascending/descending body 1 and the counterweight 6, because load mass of the ascending/descending body is measured by the load-weighting sensor 5 so that the pressing force by the wedge 55 is set so as to decelerate at a desired deceleration during braking in accordance with the measured load mass. Moreover, since the ascending/descending body 1 does not need to be structured so rigid as to enhance the shock resistance, an economical elevator safety device can be obtained without increasing ascending/descending body 1 weight. Furthermore, since shock during braking can be reduced by quite a simple structure using devices such as the elastic member 4 and the load-weighting sensor 5 that are used in ordinary elevators, without requiring a deceleration detecting device nor taking complicated control, an elevator safety device can be obtained that does not make passengers feel uncomfortable as well as causes no damage to the ascending/descending body 1 and the counterweight 6. Although elevator safety devices are scarcely put into operation in normal elevator operations, the average deceleration during braking operation is specified to be not more than 1.0 G by the

Building Standard Law Enforcement Order of Japan and the EN Standard. In this embodiment, an elevator safety device can be obtained that conforms to the regulations with quite a simple structure, and without taking complicated control.

[0039] Moreover, since the pressing-force-adjusting means of this embodiment adjusts the pressing force by the wedge 55 in accordance with load mass by use of the wedge-position-adjusting means 56 that sets the upward-shift stop position of the wedge 55, which eliminates the need for devices that adjust the biasing force itself of the coil spring 52, i.e., the elastic member, an economical elevator safety device can be obtained that can be configured with quite a simple structure such as the wedge-position-adjusting means 56 that sets the upward-shift stop position of the wedge 55. Furthermore, the wedge-position-adjusting means 56 can be configured with such a simple structure that the upward-shift stop position of the wedge 55 is set by adjusting vertical position of the stop 56a. Furthermore, since a pressing-force-applying means is not a fluid-filled pressure vessel but an elastic member used in ordinary elevators, an easy-to-maintain elevator safety device can be obtained without need for any maintenance against fluid pressure leakage or the like. Furthermore, since this embodiment is equipped with a braking device that is a stop-fixing means for fixing a vertical position of the stop 56a, the stop 56a retains in its adjusted vertical position during ascending/descending body 1 ascending/descending by keeping the adjusted vertical position of the stop 56a fixed after passengers have finished getting on and off the elevator car 2 and the doors 19a and 19b have been closed, a highly reliable elevator stopping device can be obtained that is able to perform braking operations while keeping the braking force in accordance with load mass

[0040] In addition, while the elastic member is formed with the coil spring 52, the elastic member is not limited to this but may be formed with, for example, a U-shape leaf spring, both sides of which are engaged with the pressing member 53 to press the wedge 55. Moreover, while the pressing-force-adjusting means of this embodiment is structured such that the wedge-position-adjusting means 56 sets the upward-shift stop position of the wedge 55, it is not limited to this; the pressing-force-adjusting means may be structured such that it is disposed parallel to, for example, the elastic member, i.e., the coil spring 52 so as to adjust the coil spring 52 biasing force itself, and then the biasing force is adjusted in accordance with load mass measured by the load-weighting sensor 5. In this case however, although the deceleration detecting device is not needed, which eliminates the need for complicated control, a structure is required by which the coil spring 52 biasing force itself is adjusted, which causes the safety device to increase in size.

Embodiment 2

[0041] Figure 7 illustrates an elevator safety device according to Embodiment 2 for embodying the present invention. In this embodiment, the wedge-position-adjusting means 56 of Embodiment 1 has been modified to be structured with the actuator 56b and the stop 56a formed with the rack-and-pinion mechanism. Referring to Fig. 7, a wedge-position-adjusting means 57 of an safety device 12a of this embodiment is equipped with a stop 57a that can be slid and vertically shifted with respect to the frame 51 to contact the top of the wedges 55, and an actuator 57b that actuates the stop 57a. The stop 57a is in a rod shape and formed with a thread thereon. The wedge-position-adjusting means 57 is further equipped with a nut 58 that is screwed onto the stop 57a, a belt 59 that is wound around the nut 58, and a pulley 60 around which the belt 59 rotated by the actuator 57b is wound. Incidentally, items with the same reference symbols as those in Embodiment 1 and other components are the same as those in Embodiment 1.

[0042] Next, the operation will be explained. The actuator 57b rotates the pulley 60, so that the belt 59 is driven to rotate the nut 58. The stop 57a is shifted upward and downward by screw action with the nut 58 being rotated. Vertical position of the stop 57a is adjusted such that the pressing force by the wedge in accordance with load mass measured by the load-weighting sensor 5, similarly to Embodiment 1.

[0043] The configuration described above can also bring about the same effect as that of Embodiment 1. In this embodiment, while the upward-shift stop position of the wedge 55 is set in accordance with load mass by adjusting stop 57a vertical position so that the top of the wedge 55 is brought into contact with the stop 57a; however, the configuration is not limited to this. For example, the upward-shift stop position of the wedge 55 may be set by providing inside the wedge 55 with a mechanism that varies the space between the sloped surface 55a and the braking surface 55b of the wedge 55 to adjust the space in accordance with load mass. This case, however, needs a mechanism, housed inside the wedge 55, to vary the space between the sloped surface 55a and the braking surface 55b of the wedge 55, causing the elevator safety device to become bulky.

Embodiment 3

[0044] Figure 8, 9 and 10 illustrate an elevator safety device according to Embodiment 3 for embodying the present invention. Figure 8 shows a major portion of the elevator safety device of Embodiment 3. Referring to Fig. 8, this embodiment is equipped with engaging members 70 for engaging the stop 56a, and an engaging-member-operating mechanism 71 for actuating the engaging member 70; reference symbols that are the same as those in Embodiment 1 refer to equivalent items. The engaging member 70 is L-shaped; one end thereof is pivotally supported on a pivot 70a and the other end has an engaging portion 70b that is formed so as to engage with the teeth of the actuator 56b. The actuator 56b is engaged with the engaging portion 70b engaging with the teeth of the actuator 56b; thereby, the stop 56a is latched. It is noted that the engaging member 70 is provided with a restoring means for restoring the engaging portion 70b in such a way that the engaging portion moves in a direction away from the actuator 56b, i.e., in the direction indicated by Arrow "B" in Fig. 8. Any means may be employed as long as it is configured to restore by the restoring force of the torsion spring the engaging portion 70b in the direction indicated by Arrow "B", by providing, for example, a torsion spring on the pivot 70a. The stop 56a, the actuator 56b, and engaging member 70 each described above are disposed in pairs on the left and right of the guide rail, as shown in Fig. 8. Beside, the safety device 12b structured with these components is mounted on both sides of the ascending/descending body 1, similarly to that in Fig. 1.

[0045] Next, the configuration of the engaging-member-operating mechanism 71 will be explained. Figure 9 is an overall view, viewed from Arrow "C" in Fig. 8, illustrating the engaging-member-operating mechanism 71. Referring to Fig. 8 and 9, the engaging-member-operating mechanism 71 is provided with at least two or more wires 72a. One end of the wires 72a is pivotally connected to the right and left engaging members 70 and the other end thereof is wound up around the winding pulley 73a coaxially attached to the rotating shaft of the door motor 22. Wires 72a are stretched across a first diverting pulley 74a and a second diverting pulley 75a that are attached to the car floor frame 3a. The same configuration of the engaging-member-operating mechanism 71 as that described above is arranged on both sides of the passenger car 2, as shown in Fig. 9. Namely, the engaging-member-operating mechanism 71 is also provided with at least two or more wires 72b; one end of the wires 72b is pivotally connected to the right and left engaging members 70, respectively, and the other end thereof is wound up around the winding pulley 72b coaxially attached to rotating shaft of the diverting pulley 24. Wires 72b are also stretched across a third diverting pulley 74b and a forth diverting pulley that is not shown in the figures. Additionally, the forth diverting pulley, which is not shown in the figures, is equivalent to the second diverting pulley 75a.

[0046] Next, the operation of the engaging-member-operating mechanism 71 will be explained using Figs. 8, 9, and 10. The operation of setting the upward-shift stop position of the wedge 55 by the wedge-position-adjusting means 56 and the braking operation of the safety device 12b are the same as those of Embodiment 1. In Embodiment 1, detecting by the door switch 26 open/close of the doors 19a and 19b of the passenger car 2, the wedge-position-adjusting means 56 sets, in accordance with load mass, the pressing force by the wedge 55 in braking operation by adjusting vertical position of the stop 56a after deactivating the braking device and activating the motor of actuator 56b when the doors 19a and 19b are open. When the doors 19a and 19b are closed, the wedge-position-adjusting means 56 deactivating the motor and activating the braking device of actuator 56b so as to fix a vertical position of the stop 56a adjusted in accordance with the load mass.

[0047] In this embodiment, in contrast to the above, when the doors 19a and 19b are closed, vertical position of the stop 56b is fixed by the engaging member 70 and the engaging-member-operating mechanism 71, as well as the stop 56a is fixed by the braking device of the actuator 56b. When the doors 19a and 19b are open as shown in Fig. 9, the wedge-position-adjusting means 56 adjusts vertical position of the wedge 55 in accordance with load mass, as described above. At this moment, the engaging-member-operating mechanism 71 retains wires 72a and 72b in a stretched state by the restoring means of engaging member 70, and the engaging portion 70b remains in the state being apart from the pinion of the actuator 56b as indicated by the dotted line in Fig. 8

[0048] When the doors 19a and 19b are closed as shown in Fig. 10, the wedge-position-adjusting means 56, as described above, fixes a vertical position of the stop 56a by fixing rotation of the pinion of the actuator 56b in a predetermined position by urging the braking device of the actuator 56b. At this moment, the engaging-member-operating mechanism 71 windingly stretches the wires 72a and 72b with the winding pulleys 73a and 73b rotated in cooperation with rotational drive by the door motor 22. Thereby, the engaging member 70 is pivoted against the restoring force of the restoring means so that the engaging portion 70b is engaged with the pinion of the actuator 56b. Then, the engaging member 70 fixes a vertical position of the stop 56a by fixing the pinion rotation of the actuator 56b with engaging portion 70b engaged with the pinion of the actuator 56b when the doors 19a and 19b are closed. The engaging member 70 and engaging-member-operating mechanism 71 operate in the sequence reverse of the above when the doors 19a and 19b are opened.

[0049] In addition, while the engaging member 70 fixes a vertical position of the stop 56a by engaging itself with the pinion of the actuator 56b, the engaging member 70 is not limited to this but may be directly engaged with the teeth formed on the stop 56a. Moreover, teeth may be formed on the nut 58 or the pulley 60 of the wedge-position-adjusting means 57 of Embodiment 2 so as to engage the engaging member 70 with the stop 57a; any other means may be employed as long as it can engage the stop. Furthermore, while the stop 56a is fixed in cooperation with the braking device of the actuator 56b, the stop 56a may be fixed by the engaging member 70 only.

[0050] As described above, because this embodiment is provided with an engaging member 70 for engaging the stop 56a, and an engaging operation mechanism 71 for actuating the engaging member 70 in response to the doors 19a and 19b movement of the passenger car 2, by engaging the adjusted vertical position of the stop 56a after passengers have finished getting on and off and the doors 19a and 19b have been closed, a highly reliable elevator safety device can be obtained that retains the stop 56a firmly in its adjusted vertical position during ascending or descending of the ascending/descending body 1, so as to be able to perform braking operation while securely keeping the braking force in accordance with load mass. Moreover, being also provided with the braking device that is the fixing means for fixing the stop 56a, a highly reliable elevator safety device can be obtained that can perform braking operation while more securely keeping the braking force in accordance with load mass, by fixing the stop 56a by means of the braking device as well as by engaging the stop 56a by means of the engaging member 70 engaging the stop 56a.

Embodiment 4

[0051] Figure 11 illustrates an elevator safety device according to Embodiment 4 for embodying the present invention. Figure 12 is a view illustrating the operation of an elevator safety device of this embodiment. A wedge-position-adjusting means in this embodiment is modified from that in Embodiment 1. Referring to Fig. 11, the wedge-position-adjusting means 80 is equipped with a pair of stops 80a that extends loosely through the frame 51, a stop connecting member 80b that connects and fixes the pair of stops 80a, a first link 81a one side of which is pivotally connected to either one of the pair of the stops 80a, and a second link 81b one side of which is pivotally connected to the other side of the first link 81a. The other side of the second link 81b is fixed to the bottom portion of the passenger car 2. The first link 81a is pivotally supported to a support member 82 in a position between the one side and the other side, and the support member 82 is fixed to the frame 51. A link mechanism 83 is structured with the first link 81a, the second link 81b, and the support member 82. Reference symbols other than the above, which are the same as those in Embodiment 1, refer to equivalent items.

[0052] Next, the operation will be explained. While in Embodiment 1, the upward-shift stop position of the wedge 55 is set by electrically adjusting vertical position of the stop 56a in accordance with load mass of the passenger car 2, detected by the load-weighting sensor 5, the upward-shift stop position of the wedge 55 in this embodiment is set by mechanically adjusting vertical position of the stop 80a with the link mechanism 83 in accordance with load mass of passenger car 2 without use of the load-weighting sensor 5. In cases of small load mass, which is illustrated in Fig. 11, since the underside of the passenger car 2 is located upward with respective to the car floor frame 3a due to a small amount of distortion of the elastic member 4, the second link 81b fixed to the bottom portion of the passenger car 2, is also located upward. Thereby, the first link 81a, the other side of which is pivotally connected to the second link 81b, is put into a state where the one side is pivoted downward with centering on the pivotally connected portion of the support member 82, bringing also into a downward-shifted state the stop 80a that is pivotally connected to the one side of the first link 81a.

[0053] In cases of large load mass as shown in Fig. 12, with the passenger car 2 shifted downward due to a large amount of distortion of the elastic member 4, the second link 81b is also shifted downward. The first link 81a is put into a state where one side thereof is pivoted upward with centering on pivotally connected portion of the support member 82, bringing also the stop 80a into an upward-shifted state. In this way, in accordance with load mass of the passenger car 2, vertical shifting of the passenger car 2 due to distortion of the elastic member 4 is converted by the link mechanism 83 into vertical position of the stop 80a in accordance with the load mass. Thereby, the top of the wedge 55 is brought into contact with the stop 80a whose vertical position is adjusted in accordance with load mass, similarly to Embodiment 1, so that the pressing force, i.e., the braking force during braking is set in accordance with the load mass.

[0054] Incidentally, in this embodiment, forming teeth on a side of the stop 80a, and providing the engaging member 70 and engaging-member-operating mechanism 71 similarly to Embodiment 3, the stop 80a whose vertical position has been adjusted in accordance with load mass, may be engaged by the engaging member 70.

[0055] As described above, this embodiment is provided with an elastic member 4 for elastically supporting the passenger car 2 to the car floor frame 3a so as to set the stop 80a in a vertical position by the link mechanism 83 in accordance with vertical shift of the passenger car 2 shifted vertically due to distortion of the elastic member 4 distorted by load mass of passengers getting on and off the passenger car 2. Therefore, an elevator safety device can be obtained in which the pressing force by the wedge 55 can be mechanically set in accordance with the load mass, without any device that needs electric power, so as to be able to reduce shock during braking with quite a simple structure and without any electrical control, not making passengers feel uncomfortable and nor causing damage to the ascending/descending body 1as well as the counterweight 6.

[0056] Moreover, by engaging the stop 80a whose vertical position is adjusted by means of the engaging member 70, in accordance with load mass, a highly reliable elevator safety device can be obtained in which the stop 80a firmly maintains its adjusted vertical position during ascending or descending of the ascending/descending body 1, so as to be able to perform braking operation, while securely keeping the braking force in accordance with load mass.

Embodiment 5

[0057] Figure 13 illustrates an elevator safety device according to Embodiment 5 for embodying the present invention.

In this embodiment, the pressing force by the wedge 55 is set depending on whether or not the ascending/descending body 1 is suspended by the suspending member 1. In Fig. 13, the device is provided with a pair of stops 90a that is extended loosely through the frame 51, a stop connecting member 90b that connects the pair of stops 90a with each other and fixes them, a first link 91 one side of which is pivotally connected to either of the pair of stops 90a, and a connecting member 92 one side of which is pivotally connected to the other side of the first link 91. The other side of the connecting member 92 is pivotally connected to the shackle spring 7a. The first link 91 is pivotally connected to a support member 93 in a position between the one side and the other side thereof, and the support member 93 is fixed on the frame 51. A link mechanism 94 is indicated by the first link 91, the connecting member 92, and the support member 93, and a wedge-position-adjusting means 90 is configured with the stops 90a, the stop connecting member 90b, and the link mechanism 94. Other than those, the entire elevator configuration is the same as that of Embodiment 1 and reference symbols that are the same as those in Embodiment 1 refer to equivalent items.

[0058] Next, the operation will be explained. Figure 13 illustrates a state where the ascending/descending body 1 is suspended normally by the suspending member 7, and Figure 14 illustrates a state where the ascending/descending body 1 is not suspended by the suspending member 7 due to suspending member breakage or the like. First, as in Fig. 13, when the suspending member 7 normally suspends the ascending/descending body 1, the shackle spring 7a is put into a compressed state by hanging load, so that the connecting member 92 puts the other side of the first link 91 into a state of being pivoted upward about the pivot of support member 93 and the one side of the first link 91 into a state of being pivoted downward with centering on the pivot of support member 93. The stop 90a pivotally connected to the one side of the first link 91 is also put into a downward-shifted state. This brings the upward-shift stop position of the wedge 55 into a state of being set in a lower position, so that the pressing force by the wedge 55, that is, the braking force during braking is set to be small.

[0059] On the other hand, as in Fig. 14, when the ascending/descending body 1 becomes unsuspended by the suspending member 7, the shackle spring 7a is released from the hanging load and put into an expanded state by the elastic force; thereby, the connecting member 92 puts the other side of the first link 91 into a state of being pivoted downward with centering on the pivot of support member 93 and the one side of the first link 91 into a state of being pivoted upward with centering on the pivot of support member 93. The stop 90a pivotally connected to the one side of the first link 91 is also put into an upward-shifted state. This brings the upward-shift stop position of the wedge 55 into a state of being set in an upper position, so that the pressing force by the wedge 55, that is, the braking force during braking is set to be large. As described above, this embodiment is provided with the wedge-position-adjusting means 90 having the link mechanism 94;, that is, the pressing-force-adjusting means that sets the braking force to be small when the ascending/descending body 1 is suspended by the suspending member 7, and, on the contrary, sets the braking force to be large when the ascending/descending body 1 becomes unsuspended by the suspending member 7.

[0060] Since this embodiment is so configured as described above, Embodiment can perform braking operation at a desired descending speed depending on whether or not the ascending/descending body 1 is suspended by the suspending member 7, so as to reduce shock without increasing descending speed during breaking, under any overspeed-descending conditions of the ascending/descending body 1, such as descending at overspeed due to control unit failures in a suspended state of the ascending/descending body 1 by the suspending member 7 or descending at overspeed by free fall of the ascending/descending body 1 due to breakage of the suspending member 7, an elevator safety device can be obtained that does not make passengers feel uncomfortable as well as causes no damage to the ascending/descending body 1 and the counterweight.

Embodiment 6

[0061] Figure 15 illustrates an elevator safety device according to Embodiment 6 for embodying the present invention. In this embodiment, a function is added to Embodiment 1 in which the pressing force is set depending on whether or not the ascending/descending body 1 is suspended by the suspending member 7. Referring to Fig. 15, this embodiment is provided with a switch 100 that operates when the shackle spring 7a is expanded to contact the switch 100; other than those, the entire elevator configuration is the same as that of Embodiment 1 and reference symbols that are the same as those in Embodiment 1 refer to equivalent items.

[0062] Next, the operation will be explained. Figure 15 shows a state of the ascending/descending body 1 normally suspended by the suspending member 7, and Figure 16 shows a state of the ascending/descending body 1 not suspended by the suspending member 7 due to its breakage. First, as Fig. 15, when the suspending member 7 normally suspends the ascending/descending body 1, the shackle spring 7a is put into a compressed state by the suspending load, so that the switch 100 is in the non-operating state. At this moment, the upward-shift stop position of the wedge is set by adjusting vertical position of the stop 56a in accordance with its load mass after passengers getting on and off the passenger car 2, as in Embodiment 1, so that the pressing force, i.e., the braking force is set in accordance with the load mass. In this case, however, since the counterweight 6 is also suspended, so that upward force Fb equal to the mass of the counterweight 6 is acting on the ascending/descending body 1 through the suspending member 7, the pressing force is set by subtracting the force Fb. Namely, the pressing force is set by setting the upward-shift stop position of the wedge so that the braking force Fc is given as bellow:

$$Fc = \{ (W + Wc) + (W + Wc) * \alpha c \} g - Fb \qquad Eq.6,$$

where W denotes the mass of the ascending/descending body 1 without load, Wc, load mass, αc, a desired average deceleration during braking, which is, for example, 0.6 G.

[0063] On the other hand, if it happens that the suspending member 7 does not suspend the ascending/descending body 1, the shackle spring 7a is released from the suspended load and is put into a stretched state by the elastic force, as in Fig. 16; thereby, the switch 100 goes into action by contacting the shackle spring 7a, so as to detect that the suspending member 7 has come into a not suspending state. Since the upward force equal to the mass of the counter-weight 6 is not in action, the upward-shift stop position of the wedge is set by adjusting vertical position of the stop 56a in accordance with the load mass except for the force Fb, so that the pressing force, i.e., the braking force is set in accordance with the load mass. Namely, the pressing force is set by setting the upward-shift stop position of the wedge 55 so that the braking force Fc is given as bellow:

$$Fc = \{ (W + Wc) + (W + Wc) * \alpha c \} g \qquad Eq.7.$$

[0064] As described above, this embodiment is provided with the switch 100 that detects whether or not the suspending member 7 suspends the ascending/descending body 1, and the pressing-force-adjusting means that sets the pressing force by setting the upward-shift stop position of the wedge 55, depending on whether or not the suspending member suspends the ascending/descending body, in accordance with load mass. Incidentally, the pressing force may be set by setting the upward-shift stop position of the wedge 55 depending only on whether or not the suspending member suspends the ascending/descending body. Moreover, while this embodiment is configured with the wedge-position-adjusting means 56 having the rack-and-pinion mechanism, it can be configured with the wedge-position-adjusting means 57 having a threaded stop 57a as in Embodiment 2.

[0065] Since this embodiment is so configured as described above, Embodiment can perform braking operation at a desired deceleration depending on whether or not the ascending/descending body 1 is suspended by the suspending member 7, so as to reduce shock without increasing deceleration during breaking, under any overspeed-descending conditions of the ascending/descending body 1 such as descending at overspeed due to control unit failures in a state of the ascending/descending body 1 suspended by the suspending member 7 or descending at overspeed by free fall of the ascending/descending body 1 due to breakage of the suspending member 7. Furthermore, since this embodiment can perform braking operation at a desired deceleration in accordance with load mass of the ascending/descending body 1, so as to reduce shock during breaking, under any load conditions and descending of ascending/descending body 1 at overspeed, an elevator safety device can be obtained that does not make passengers feel uncomfortable as well as causes no damage to the ascending/descending body 1 and the counterweight.

Industrial Applicability

[0066] As described above, an elevator safety device according to the present invention, which reduces shock during braking when braking ascending/descending body descending at overspeed, so as not to make passengers feel uncomfortable as well as to cause no damage to the ascending/descending body and the counterweight, is suitable for use in devices that stop an ascending/descending body.

PREFERRED EMBODIMENTS

[0067]

1. An elevator safety device(12), comprising:

an ascending/descending body(1) for traveling up and down along guide rails(11), the ascending/descending body(1) having a passenger car(2) for accommodating passengers therein, and frame members(3) for supporting

the passenger car;
a wedge(55), provided on the ascending/descending body(1), for, in an emergency, shifting along the guide rail (11) upward relative to the ascending/descending body(1);
a pressing member(53) for pressing, under the urging force of an elastic member(52), the wedge(55) onto the guide rail(11);
a pressing-force-adjusting means for setting pressing force on the wedge(55) to be small when the ascending/descending body(1) load mass, fluctuating with passengers getting on and off, becomes large, and for setting pressing force on the wedge(55) to be large when the load mass becomes small.

2. An elevator safety device(12), comprising:

an ascending/descending body(1), suspended by a suspending member(7), for traveling up and down along guide rails(11), the ascending/descending body(1) having a passenger car(2) for accommodating passengers therein, and frame members(3) for supporting the passenger car;
a wedge(55), provided on the ascending/descending body(1), for, in an emergency, shifting along the guide rail (11) upward relative to the ascending/descending body(1);
a pressing member(53) for pressing, under the urging of the elastic member(52), the wedge(55) onto the guide rail(11);
a pressing-force-adjusting means for setting pressing force on the wedge(55) to be small when the ascending/descending body(1) is suspended by the suspending member(7), and for setting pressing force on the wedge to be large when the ascending/descending body(1) becomes unsuspended.

3. An elevator safety device(12), comprising:

an ascending/descending body(1), suspended by a suspending member(7), for traveling up and down along guide rails(11), the ascending/descending body(1) having a passenger car(2) for accommodating passengers therein, and frame members(3) for supporting the passenger car(2);
a wedge(55), provided on the ascending/descending body(1), for, in an emergency, shifting along the guide rail (11) upward relative to the ascending/descending body(1);
a pressing member(53) for pressing, under the urging force of an elastic members(52), the wedge(55) onto the guide rail(11);
a pressing-force-adjusting means for setting pressing force on the wedge(55) in accordance with mass of the load on the ascending/descending body(1) fluctuating with passengers getting on and off, and to whether or not the ascending/descending body(1) is hanging tight on the suspending member(7).

4. The elevator safety device(12) as recited in any of 1 through 3, wherein the pressing-force-adjusting means includes a wedge-position-adjusting means(56,57,80) for setting an upward-shift stop position of the wedge(55) so as to set the pressing force on the wedge(55) depending on the upward-shift stop position of the wedge(55).

5. The elevator safety device(12) as recited in 4, wherein the wedge-position-adjusting means(56,57,80) sets the upward-shift stop position of the wedge(55) by adjusting vertical position where a stop abuts on the upper portion the wedge(55).

6. The elevator safety device(12) as recited in 5, further comprising a stop fixing means for fixing the stop in its adjusted vertical position.

7. The elevator safety device(12) as recited in 6, wherein the stop fixing means fixes the stop when the passenger car door has been closed.

8. The elevator safety device(12) as recited in any of 5 through 7, further comprising:

an engaging member(70) for engaging the stop in its adjusted vertical position;
an engaging member(70) operation mechanism for operating the engaging member(70) in cooperation with the passenger car door(19).

9. The elevator safety device(12) as recited in 4, wherein:

the ascending/descending body(1) is provided with elastic members(4) for elastically supporting the passenger

car(2) on the frame members(3); and
the wedge-position-adjusting means(56,57,80) sets the upward-shift stop position of the wedge(55) in accordance with the amount that the passenger car shifts vertically due to distortion of the elastic members(4) caused by load mass fluctuation with passengers getting on and off the passenger car(2).

10. The elevator safety device(12) as recited in 9, wherein:

the amount of passenger car vertical shift due to distortion of the elastic member(4) is measured by a load-weighting sensor(5); and

the vertical position of the stop is adjusted in accordance with the load-weighting sensor(5) measurement.

11. The elevator safety device(12) as recited in 9, wherein a link mechanism(83) is used to adjust the vertical position of the stop, in accordance with the vertical shift of the passenger car(2) due to distortion of the elastic member(4).

Claims

1. An elevator safety device (12), comprising:

an ascending/descending body (1), suspended by a suspending member (7), for traveling up and down along guide rails (11), the ascending/descending body (1) having a passenger car (2) for accommodating passengers therein, and frame members (3) for supporting the passenger car;
a wedge (55), provided on the ascending/descending body (1), for, in an emergency, shifting along the guide rail (11) upward relative to the ascending/descending body (1);
a pressing member (53) for pressing, under the urging of the elastic member (52), the wedge (55) onto the guide rail (11);
a pressing-force-adjusting means for setting pressing force on the wedge (55) to be small when the ascending/descending body (1) is suspended by the suspending member (7), and for setting pressing force on the wedge to be large when the ascending/descending body (1) becomes unsuspended.

2. An elevator safety device (12), comprising:

an ascending/descending body (1), suspended by a suspending member (7), for traveling up and down along guide rails (11), the ascending/descending body (1) having a passenger car (2) for accommodating passengers therein, and frame members (3) for supporting the passenger car (2);
a wedge (55), provided on the ascending/descending body (1), for, in an emergency, shifting along the guide rail (11) upward relative to the ascending/descending body(1);
a pressing member (53) for pressing, under the urging force of an elastic members (52), the wedge (55) onto the guide rail (11);
a pressing-force-adjusting means for setting pressing force on the wedge (55) in accordance with mass of the load on the ascending/descending body (1) fluctuating with passengers getting on and off, and to whether or not the ascending/descending body (1) is hanging tight on the suspending member (7).

3. The elevator safety device (12) as recited in any of claims 1 through 2, wherein the pressing-force-adjusting means includes a wedge-position-adjusting means (56, 57, 80) for setting an upward-shift stop position of the wedge (55) so as to set the pressing force on the wedge (55) depending on the upward-shift stop position of the wedge (55).

4. The elevator safety device (12) as recited in claim 3, wherein the wedge-position-adjusting means (56, 57, 80) sets the upward-shift stop position of the wedge (55) by adjusting vertical position where a stop abuts on the upper portion of the wedge (55).

5. The elevator safety device (12) as recited in claim 4, further comprising a stop fixing means for fixing the stop in its adjusted vertical position.

6. The elevator safety device (12) as recited in claim 5, wherein the stop fixing means fixes the stop when the passenger car door has been closed.

7. The elevator safety device (12) as recited in any of claims 4 through 6, further comprising:

an engaging member (70) for engaging the stop in its adjusted vertical position;
an engaging member (70) operation mechanism for operating the engaging member (70) in cooperation with the passenger car door (19).

8. The elevator safety device (12) as recited in claim 3, wherein:

the ascending/descending body (1) is provided with elastic members (4) for elastically supporting the passenger car (2) on the frame members (3); and
the wedge-position-adjusting means (56, 57, 80) sets the upward-shift stop position of the wedge (55) in accordance with the amount that the passenger car shifts vertically due to distortion of the elastic members (4) caused by load mass fluctuation with passengers getting on and off the passenger car (2).

9. The elevator safety device (12) as recited in claim 8, wherein:

the amount of passenger car vertical shift due to distortion of the elastic member (4) is measured by a load-weighting sensor (5); and
the vertical position of the stop is adjusted in accordance with the load-weighting sensor (5) measurement.

10. The elevator safety device (12) as recited in claim 8, wherein a link mechanism (83) is used to adjust the vertical position of the stop, in accordance with the vertical shift of the passenger car (2) due to distortion of the elastic member (4).

FIG. 1

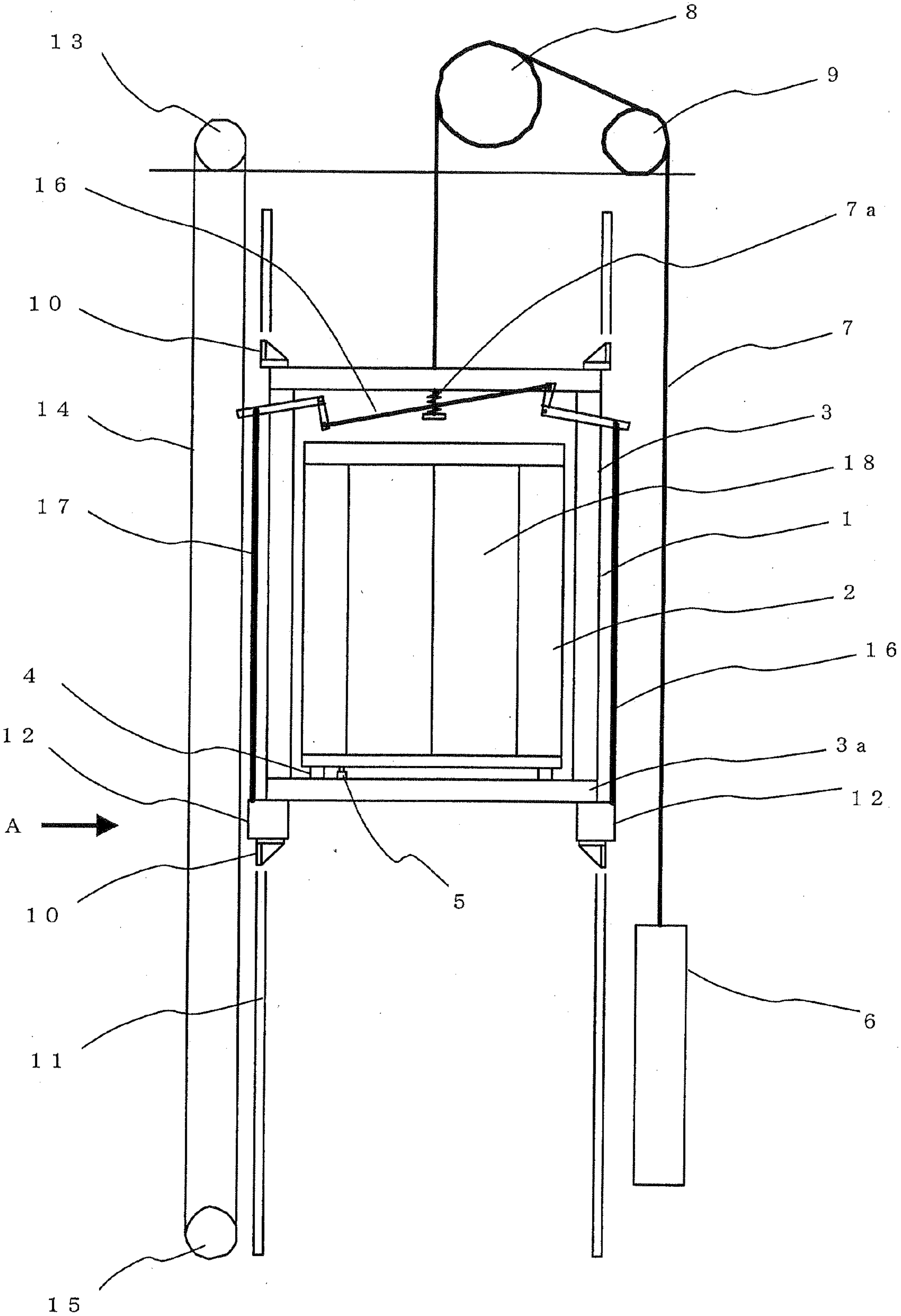


FIG. 2

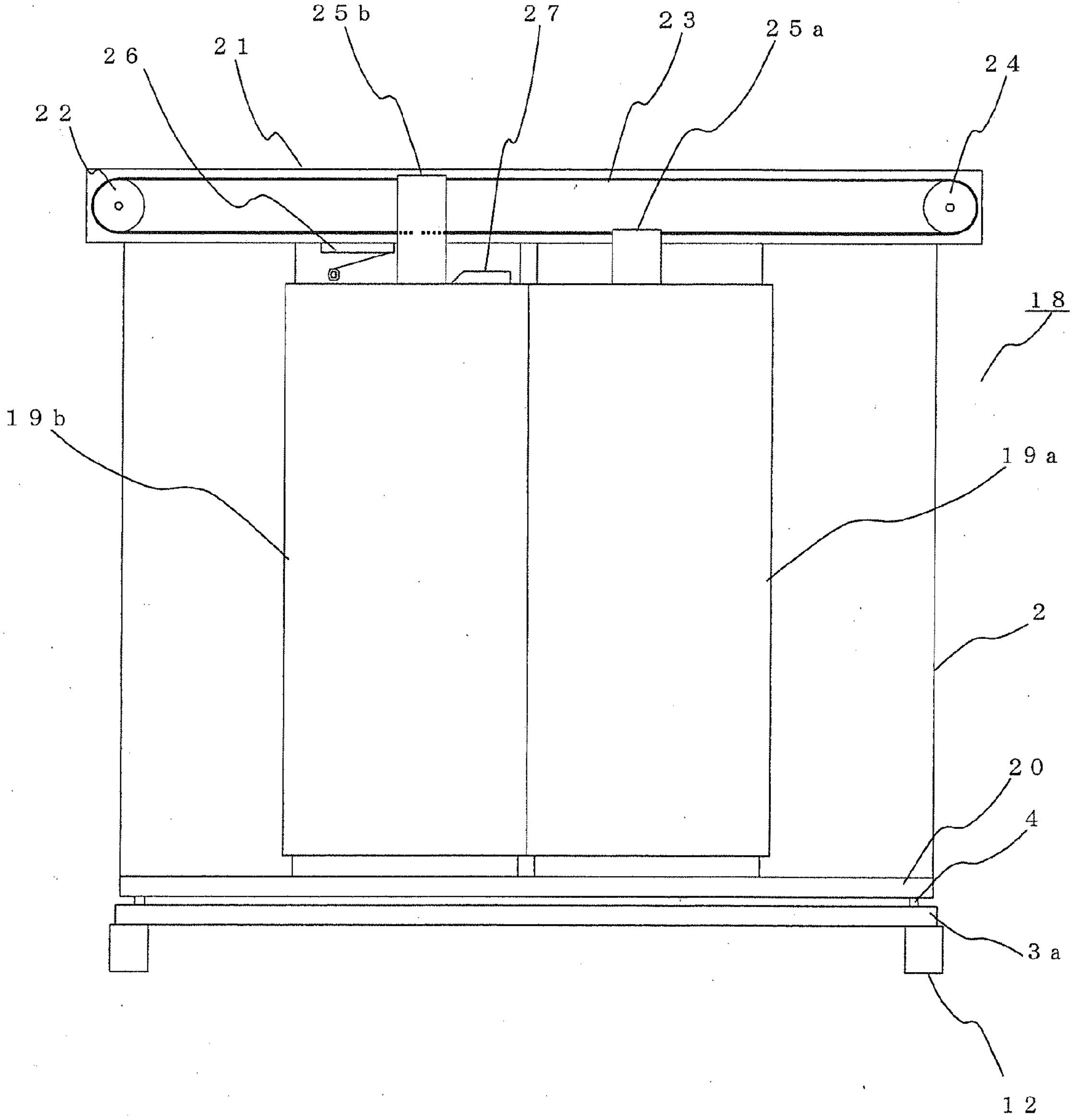


FIG. 3

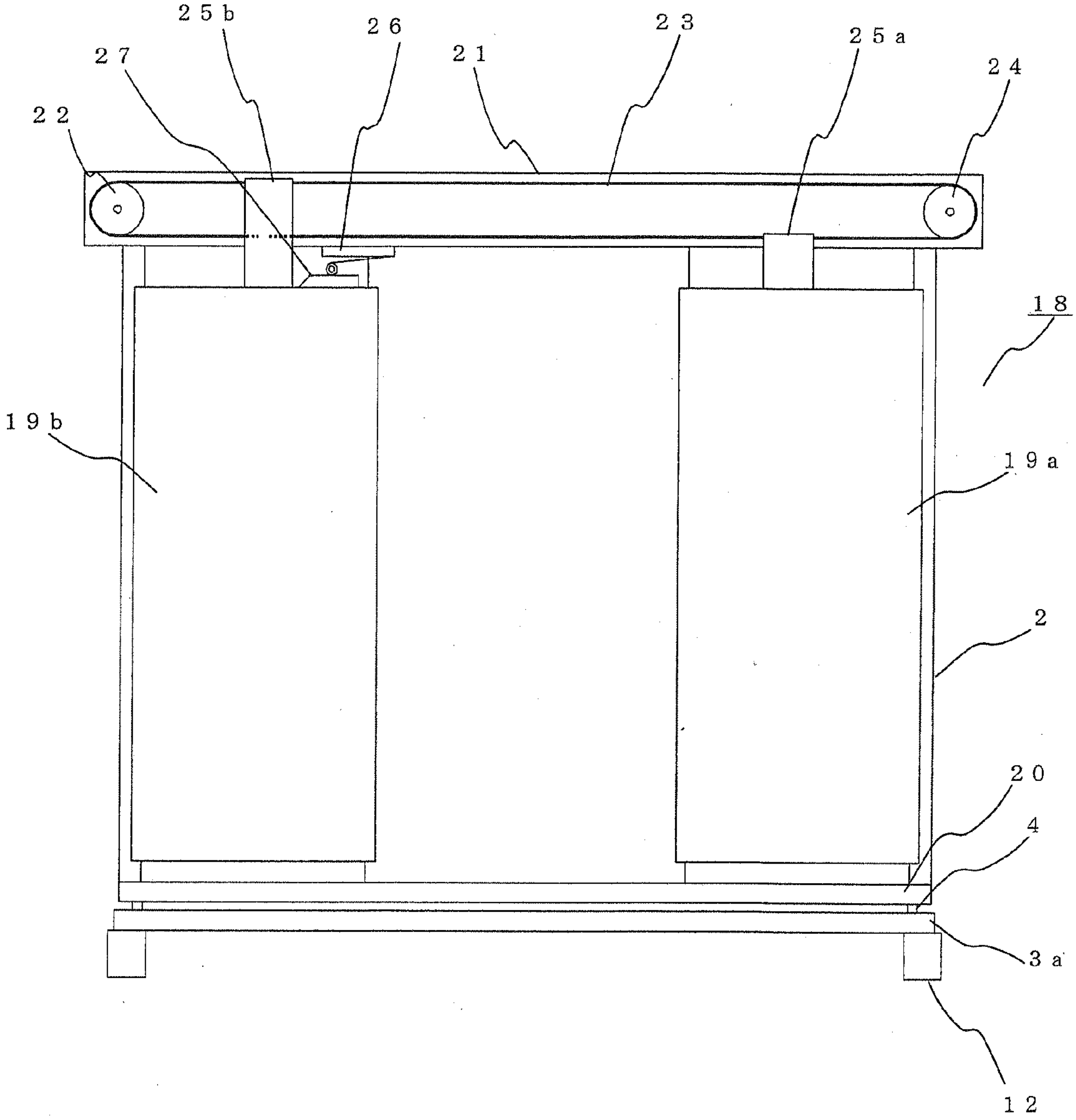


FIG. 4

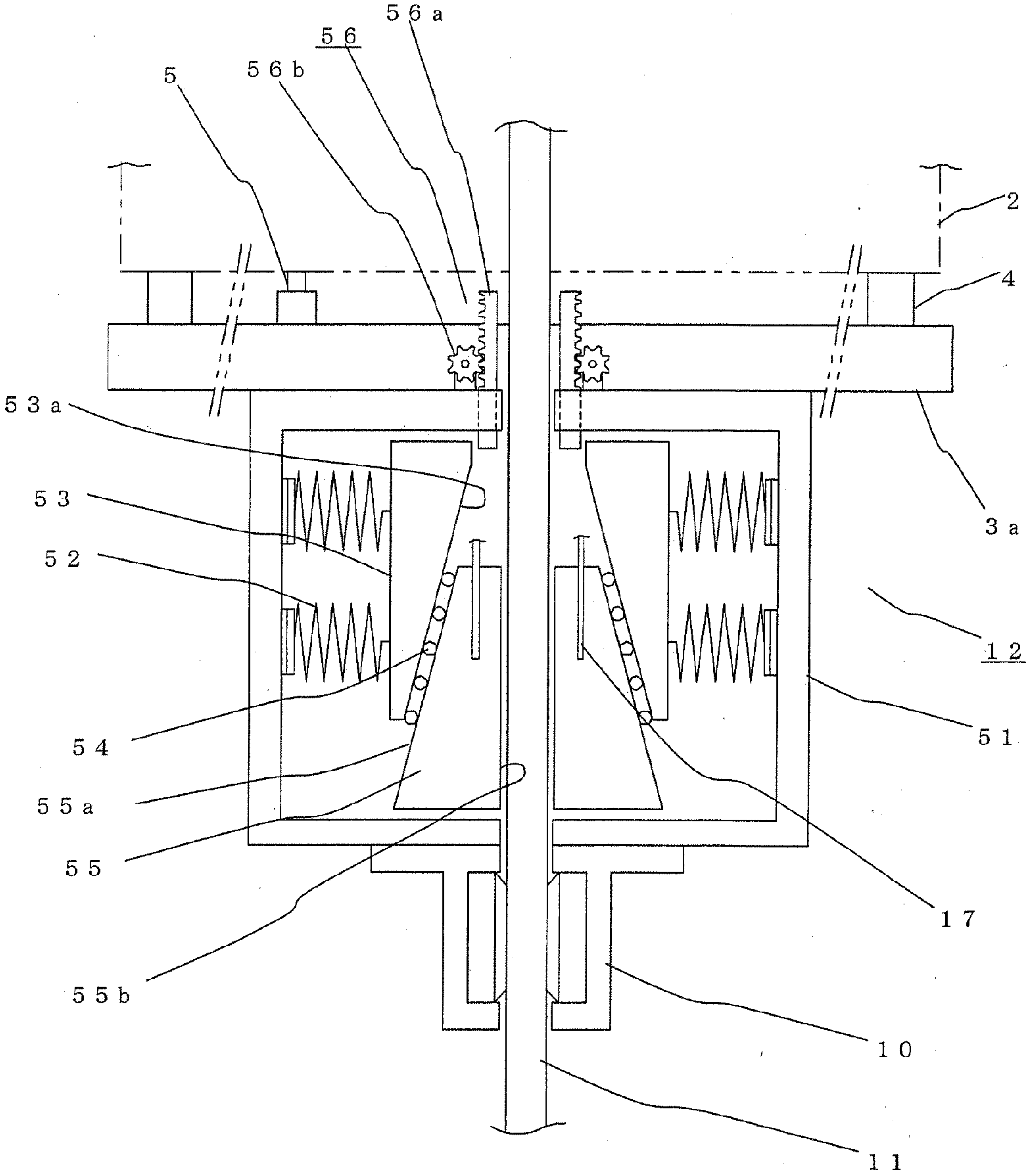


FIG. 5

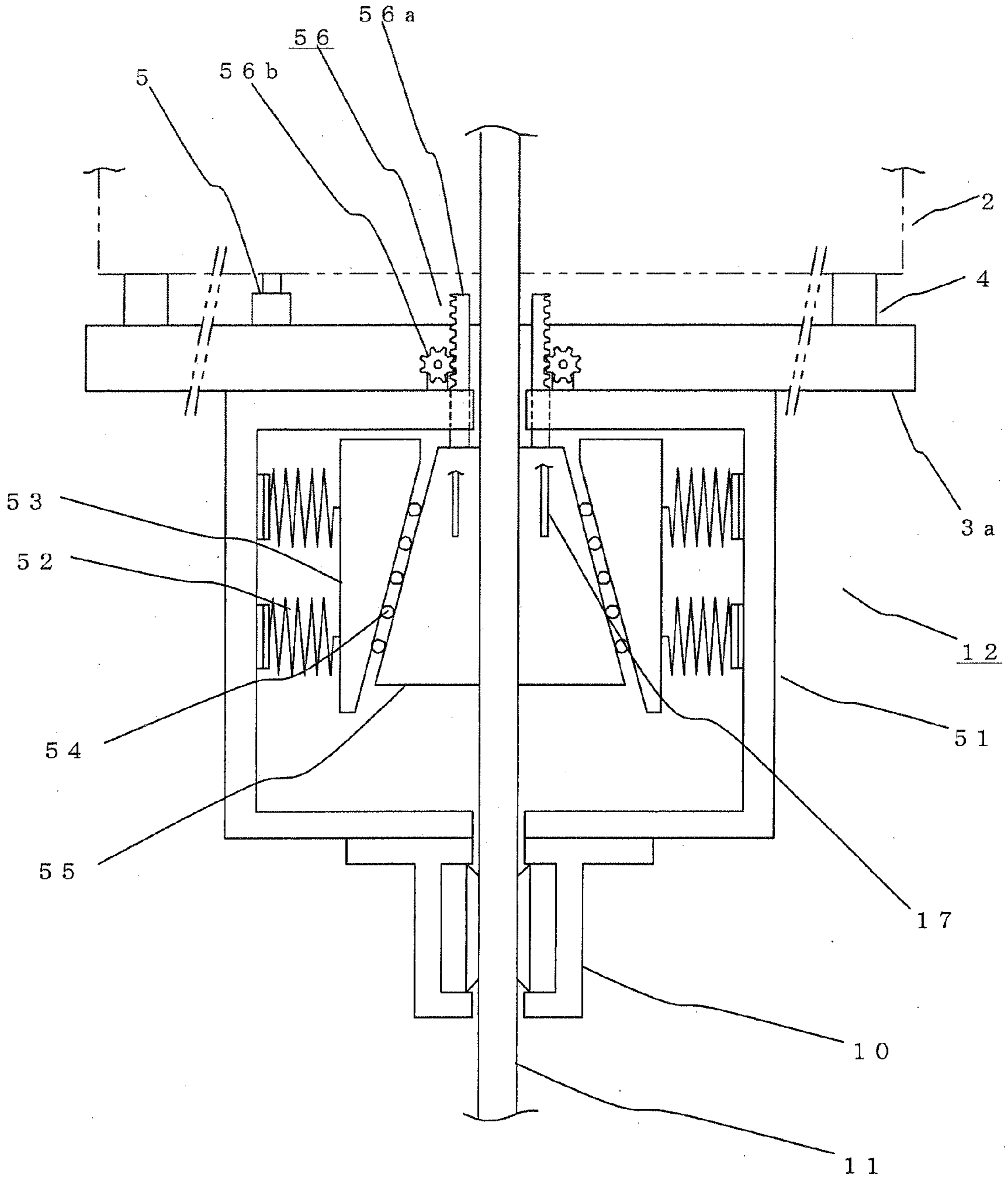


FIG. 6

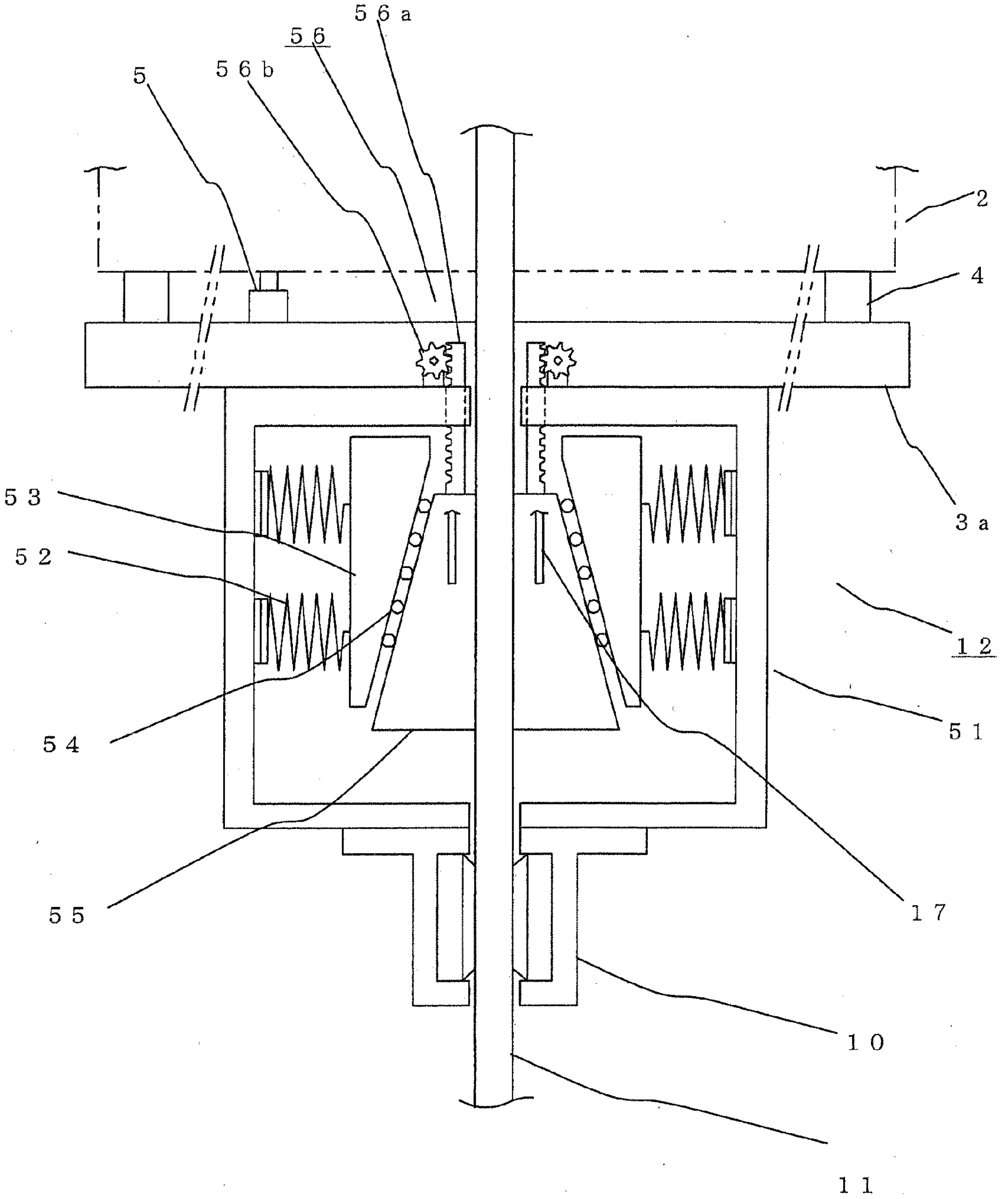


FIG. 7

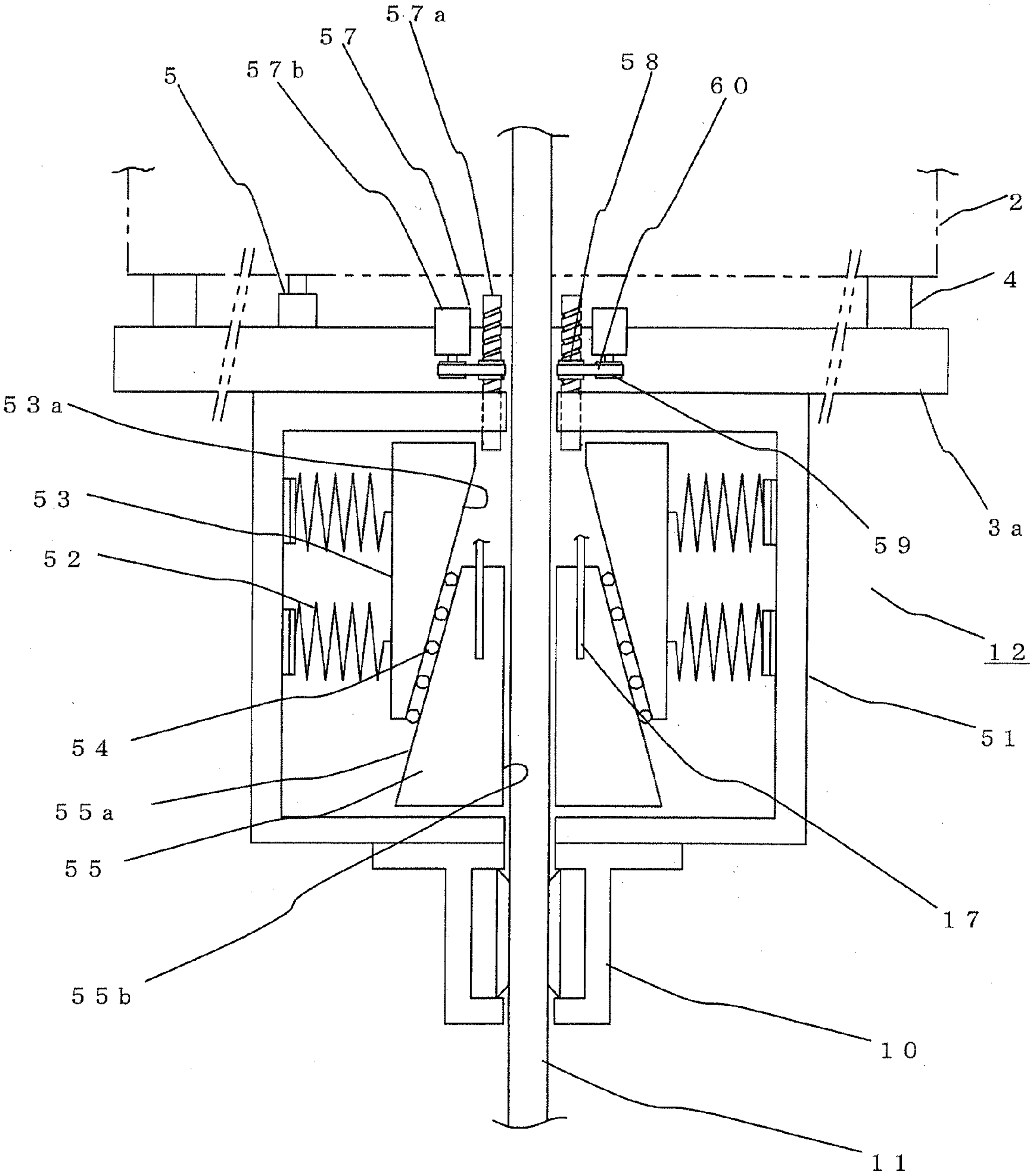
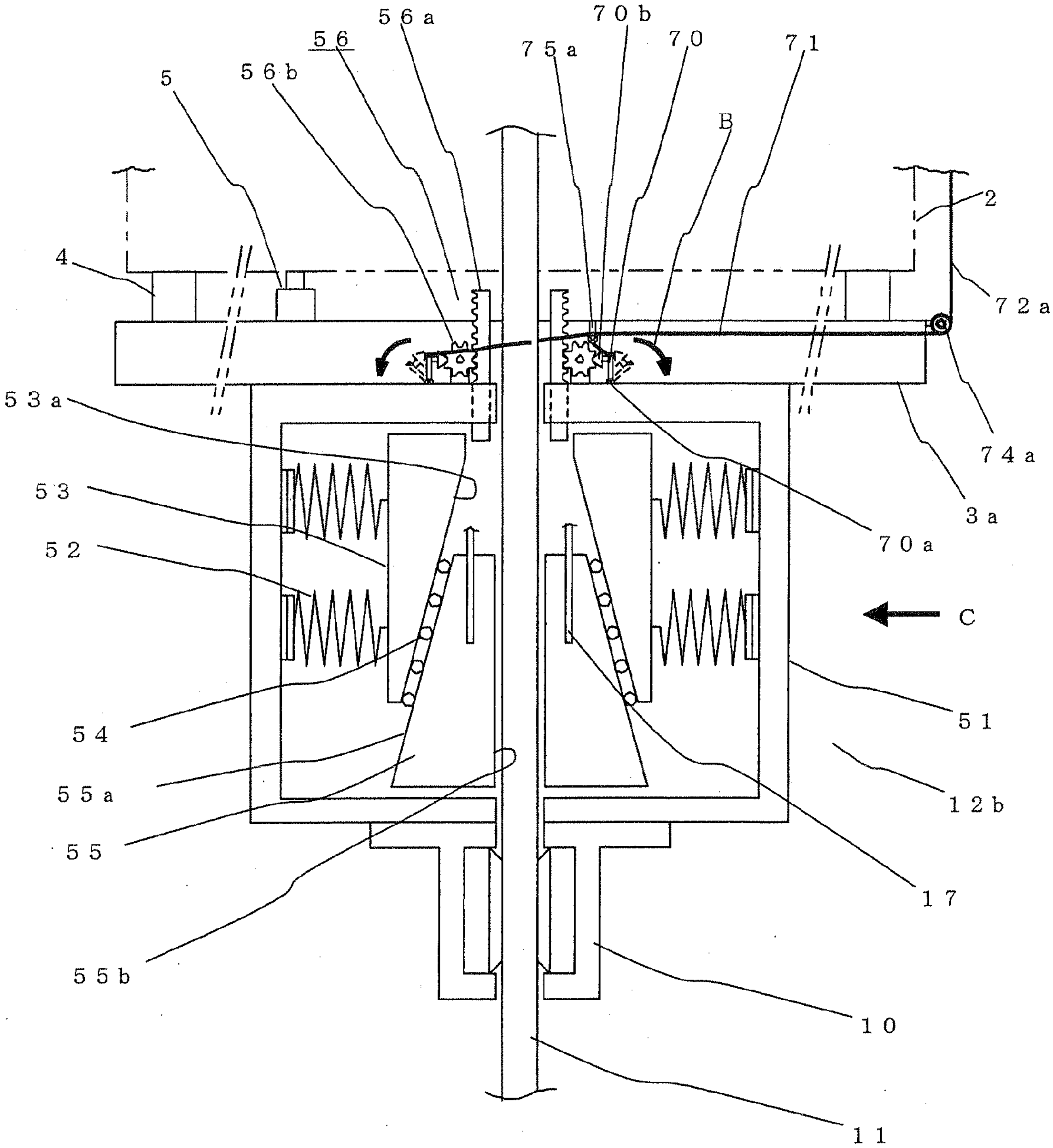


FIG. 8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7 0 b
5 6
7 5 a
7 0
7 1
5
5 6 b
B
2
4
7 2 a
5 3 a
7 4 a
5 3
3 a
7 0 a
5 2
C
5 1
5 4
1 2 b
5 5 a
5 5
1 7
5 5 b
1 0
1 1

FIG. 9

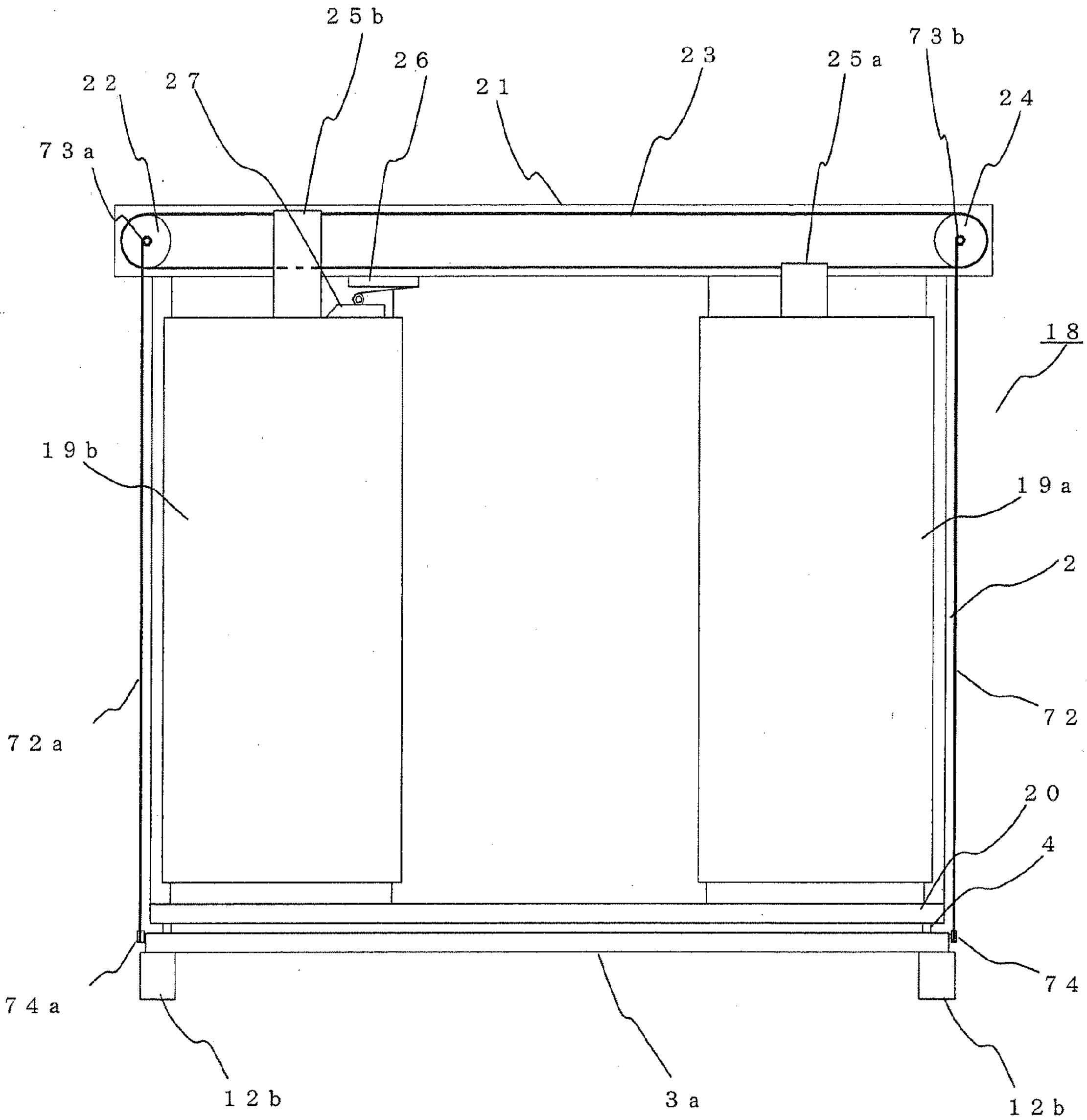
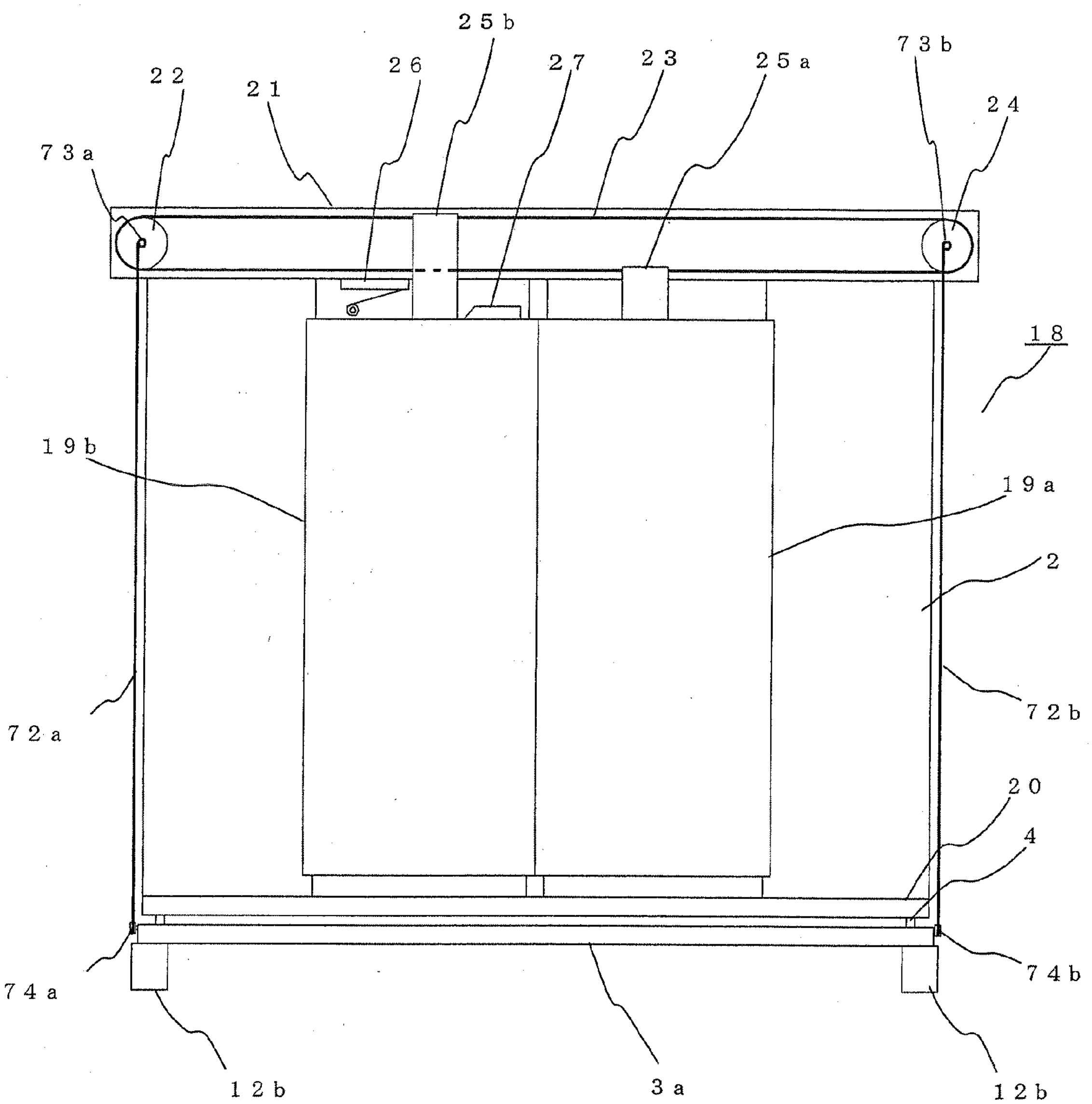

25b
26
23
25a
73b
22
27
21
24
73a
18
19b
19a
2
72a
72b
20
4
74a
74b
12b
3a
12b

FIG. 10


25b
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21
26
27
23
25a
73b
24
73a
18
19b
19a
2
72a
72b
20
4
74a
74b
12b
3a
12b

FIG. 11

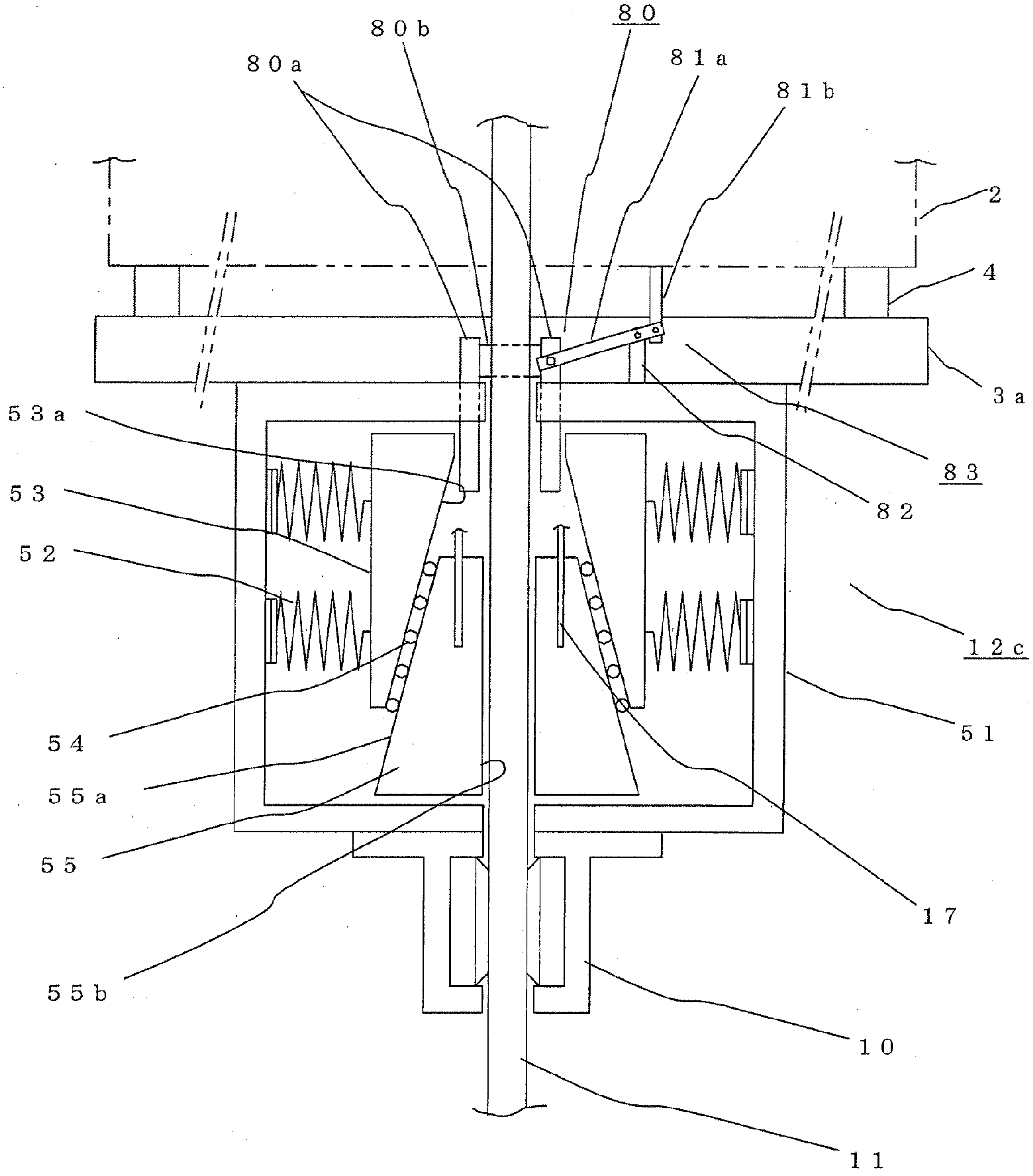
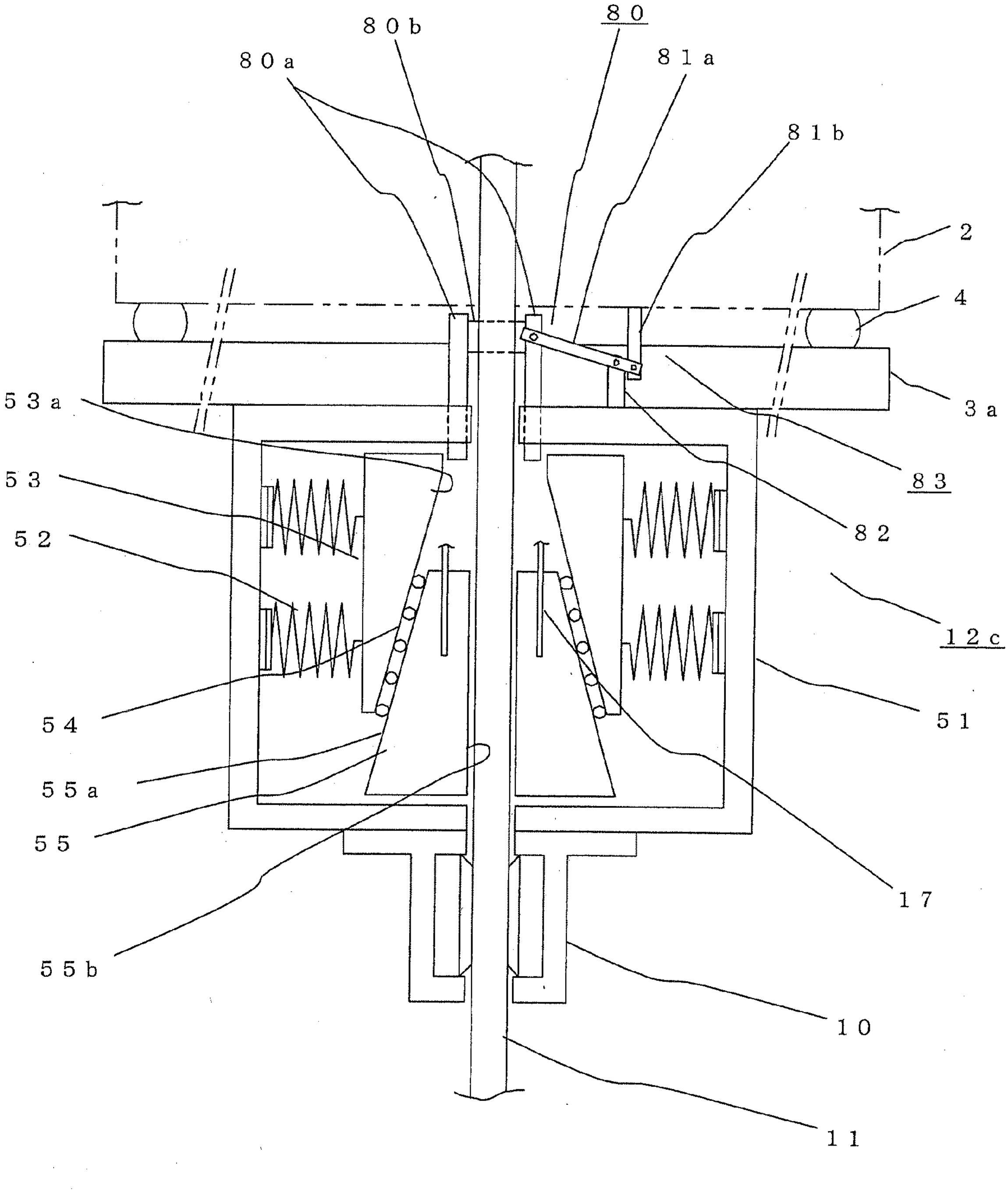

80
80b
81a
80a
81b
2
4
3a
53a
83
53
82
52
12c
51
54
55a
55
17
55b
10
11

FIG. 12



80b
80
80a
81a
81b
2
4
3a
53a
53
83
82
52
12c
51
54
55a
55
17
55b
10
11

FIG. 13

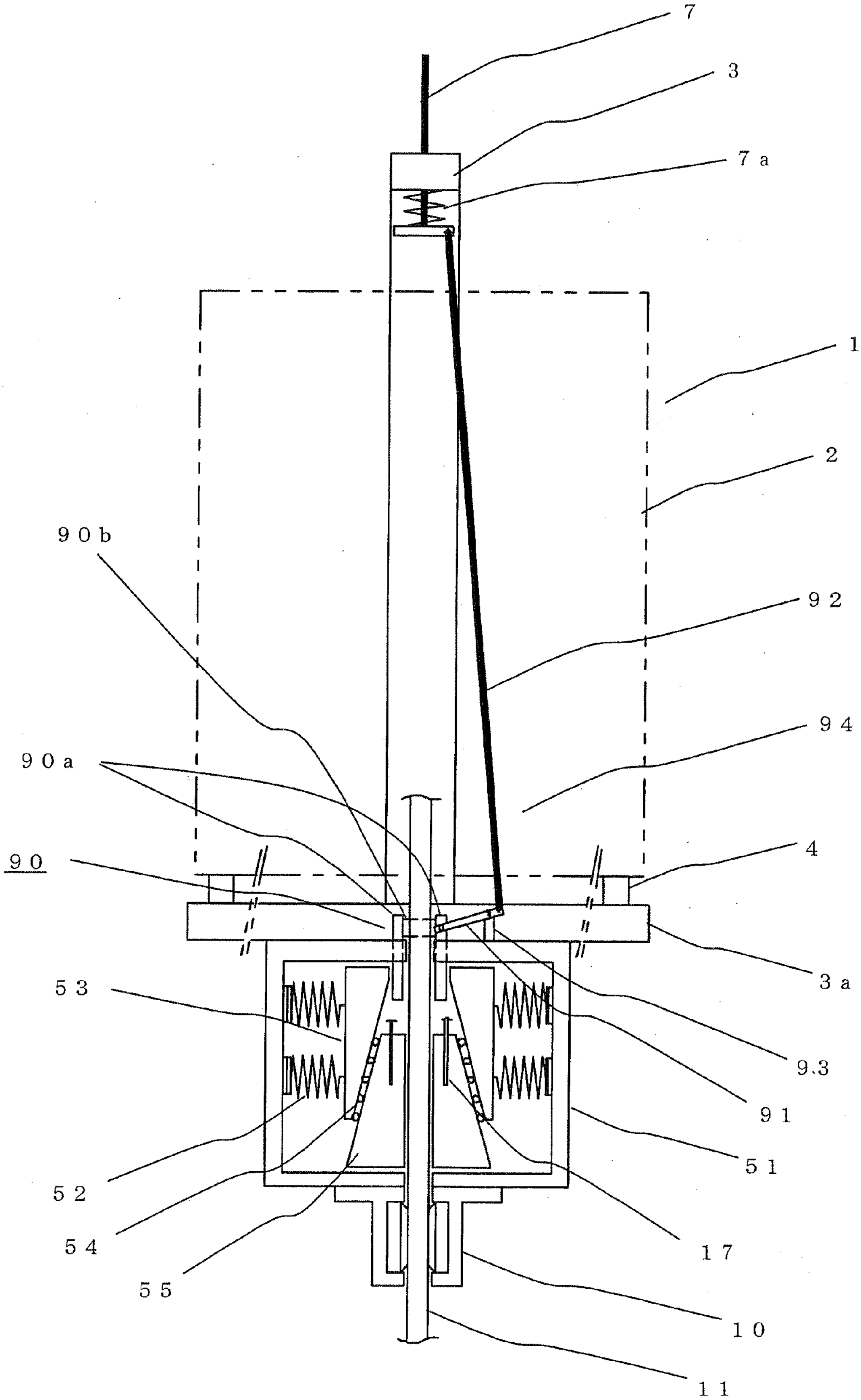


FIG. 14

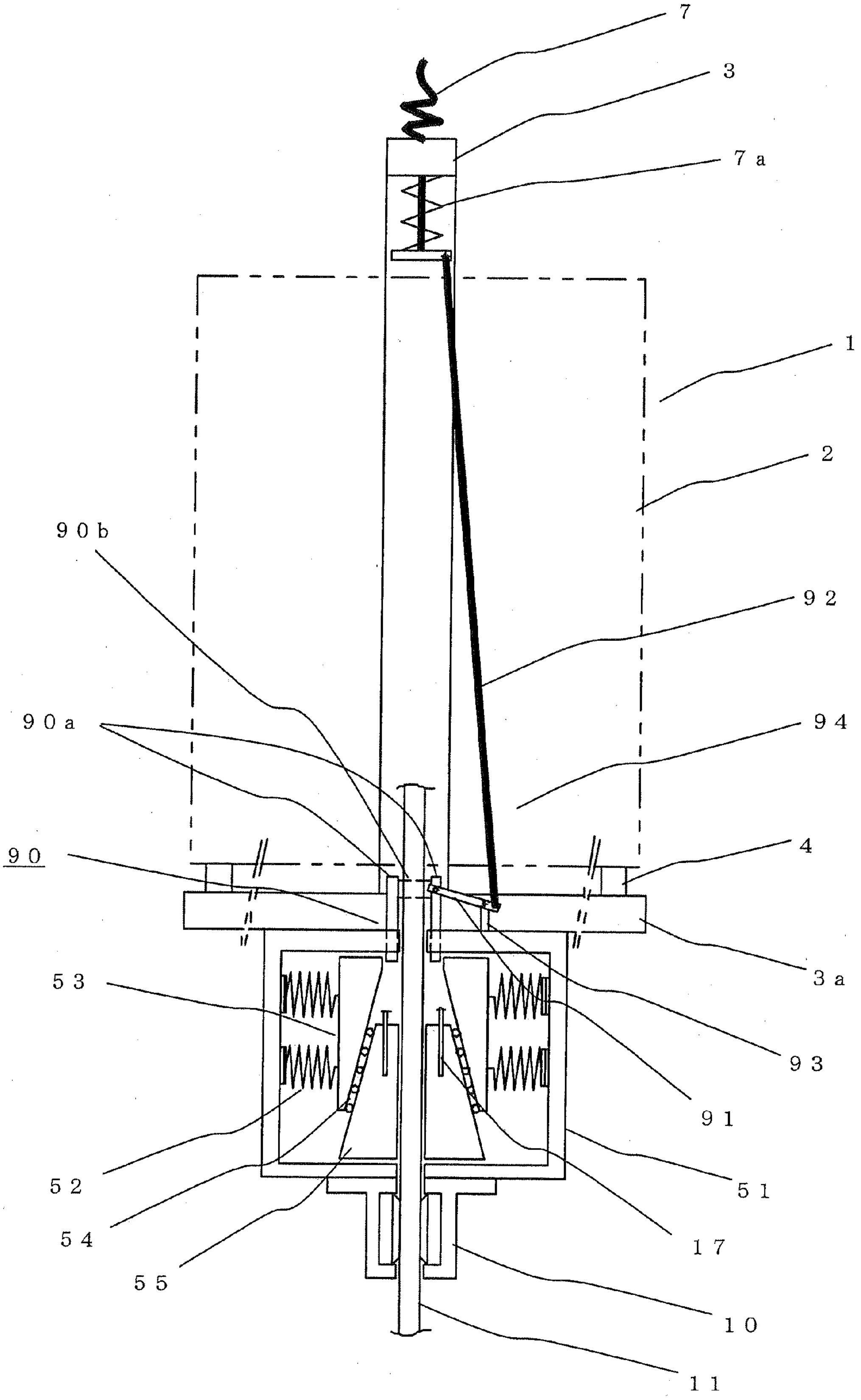


FIG. 15

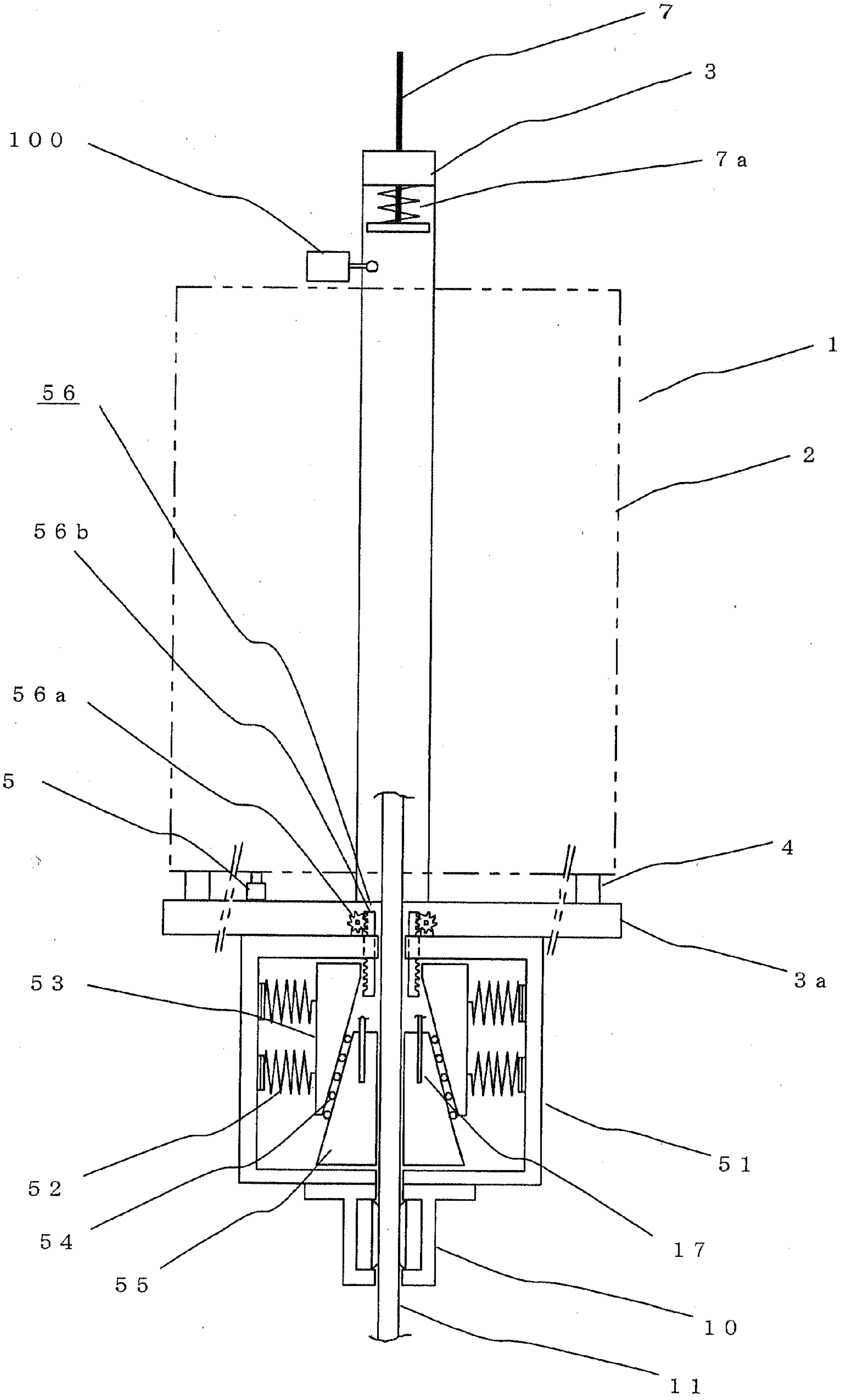
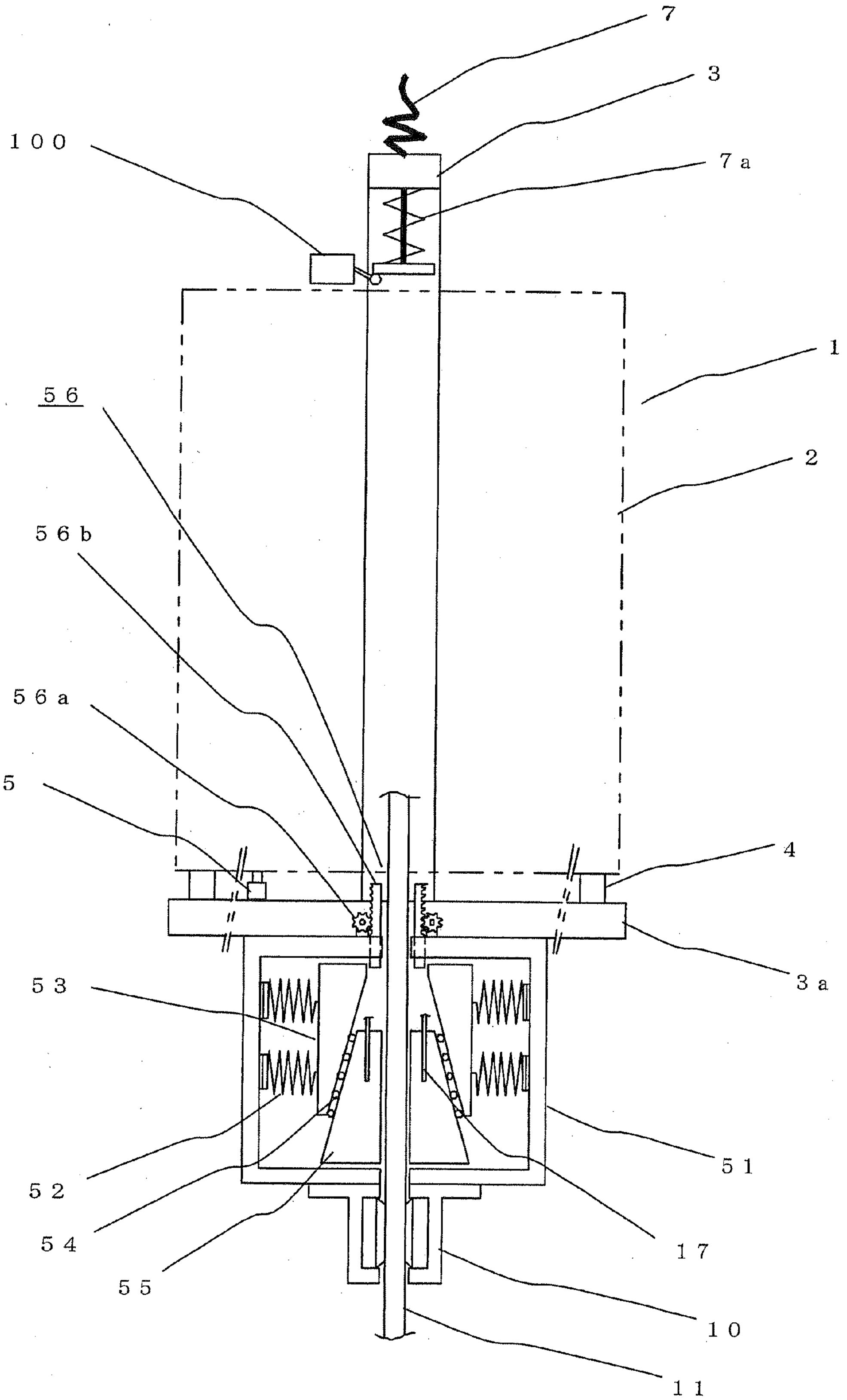


FIG. 16



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Application Number
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Place of search	Date of completion of the search	Examiner
The Hague	21 September 2012	Miklos, Zoltan

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