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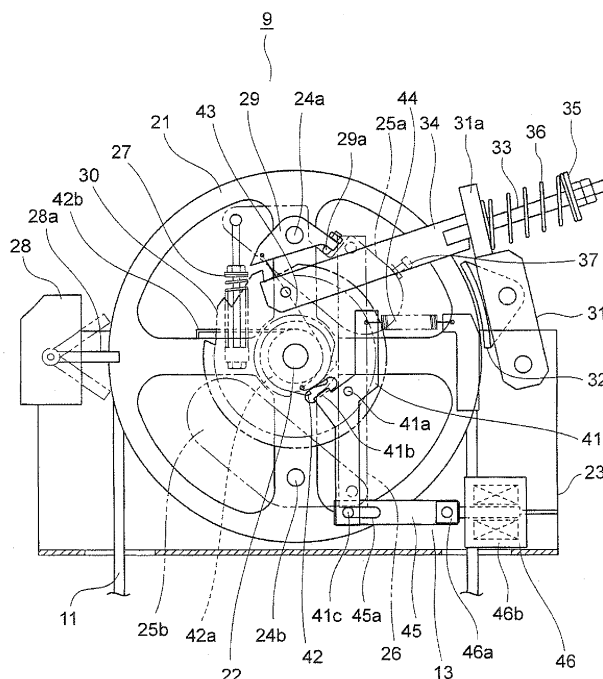
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(54) **SAFETY DEVICE FOR ELEVATOR**

(57) In an elevator safety system, an engagement disc with a small diameter, which is rotated integrally with a rotary body, is provided coaxially with the rotary body. The engagement disc is rotatable relative to the rotary body. However, the engagement disc is rotated integrally with the rotary body under normal conditions. The rotation of the engagement disc is mechanically stopped by

an engagement-disc stopping mechanism. The engagement-disc stopping mechanism is operated by an actuator. When the rotation of the engagement disc is stopped by the engagement-disc stopping mechanism, the rotation of the rotary body relative to the engagement disc is transmitted to a rotary-body stopping mechanism by an interlocking mechanism. Then, the rotary body is stopped by the rotary-body stopping mechanism.

FIG. 2



Description

Technical Field

[0001] The present invention relates to an elevator safety system for operating emergency stop means by driving an actuator.

Background Art

[0002] In a conventional emergency stop system for an elevator, a pressing shoe for restraining a speed governor rope is displaced between a disengaged position and a restraining position by an electromagnetic actuator (for example, see Patent Literature 1, FIGS. 12 and 13) .

[0003] In another conventional emergency stop system for an elevator, a latch is pivotably mounted to a movable base which is horizontally displaceable with respect to a frame body. The latch is pivoted by an electromagnetic actuator so as to be engaged with a ratchet which is rotated integrally with a speed governor sheave. When the latch is engaged with the ratchet, the movable base is displaced by the rotation of the ratchet to displace the pressing shoe to the restraining position interlockingly with the movable base. As a result, the speed governor rope is restrained (for example, see Patent Literature 1, FIG. 14) .

[0004] Patent Literature 1: WO 2005-102899

Disclosure of the Invention

Problem to Be Solved by the Invention

[0005] In the system using the method for displacing the pressing shoe by the electromagnetic actuator among the conventional emergency stop systems like the above-mentioned one, the amount of movement for returning the pressing shoe from the restraining position to the disengaged position is large. Therefore, the electromagnetic actuator is increased in size.

[0006] Moreover, in the system using the method for using the electromagnetic actuator to pivot the latch so as to engage the latch with the ratchet, the latch is directly pivoted by the electromagnetic actuator. Therefore, it is necessary to move the latch back to the disengaged position by the electromagnetic actuator alone for the return operation. Therefore, the electromagnetic actuator is increased in size. Further, the latch is subjected to a turning force of the speed governor sheave and the latchet, and therefore needs to be deeply and firmly engaged with the ratchet. As a result, a distance of the return movement of the latch from the engaged position to the disengaged position is increased, which increases the electromagnetic actuator in size.

[0007] The present invention has been made to solve the problem described above, and therefore has an object to provide an elevator safety system capable of quickly operating emergency stop means by an actuator and

reducing the actuator in size.

Means for Solving the Problem

[0008] An elevator safety system according to the present invention includes: a rotary body which is rotated along with rising and lowering of a car; a rotary-body stopping mechanism for mechanically stopping rotation of the rotary body; emergency stop means for bringing the car to an emergency stop by stop of the rotation of the rotary body; an engagement disc provided coaxially with the rotary body, the engagement disc being rotatable relative to the rotary body, having a smaller diameter than that of the rotary body, and being rotated integrally with the rotary body under normal conditions; an engagement-disc stop mechanism for mechanically stopping rotation of the engagement disc; an actuator for operating the engagement-disc stopping mechanism to stop the rotation of the engagement disc; and an interlocking mechanism for operating the rotary-body stopping mechanism interlockingly with the rotation of the rotary body relative to the engagement disc so as to stop the rotary body when the rotation of the engagement disc is stopped by the engagement-disc stopping mechanism.

Brief Description of the Drawings

[0009]

FIG. 1 is a configuration diagram illustrating an elevator according to Embodiment 1 of the present invention.

FIG. 2 is a front view illustrating a speed governor illustrated in FIG. 1.

FIG. 3 is a front view illustrating an operation of an upper starting device when an electromagnetic actuator illustrated in FIG. 2 is de-energized.

FIG. 4 is a front view illustrating a state of a stage subsequent to that illustrated in FIG. 3.

FIG. 5 is a front view illustrating a state of a stage subsequent to that illustrated in FIG. 4.

FIG. 6 is a front view illustrating a state in which the speed governor illustrated in FIG. 2 is performing a return operation.

FIG. 7 is a front view illustrating a state in which flyweights of the speed governor illustrated in FIG. 2 are pivoted outward.

FIG. 8 is a front view illustrating a principal part of a speed governor according to Embodiment 2 of the present invention.

FIG. 9 is a front view illustrating a principal part of a speed governor according to Embodiment 3 of the present invention.

FIG. 10 is a configuration diagram illustrating a state in which a trip lever and a trigger plate illustrated in FIG. 9 are engaged with each other.

FIG. 11 is a front view illustrating an operation of an upper starting device when an electromagnetic ac-

tuator illustrated in FIG. 9 is de-energized.

FIG. 12 is a front view illustrating a state of a stage subsequent to that illustrated in FIG. 11.

FIG. 13 is a front view illustrating a principal part of an elevator safety system according to Embodiment 4 of the present invention.

Best Modes for Carrying Out the Invention

[0010] Hereinafter, preferred embodiments of the present invention are described referring to the drawings.

Embodiment 1

[0011] FIG. 1 is a configuration diagram illustrating an elevator according to Embodiment 1 of the present invention. In the drawing, a driving device 2 is provided in an upper part of a hoistway 1. A main rope 3 corresponding to suspension means is looped around a driving sheave 2a of the driving device 2. A car 4 is suspended from one end of the main rope 3, whereas a counterweight 5 is connected to the other end of the main rope 3. A pair of car guide rails 6 for guiding raising and lowering of the car 4 and a pair of weight guide rails (not shown) for guiding raising and lowering of the counterweight 5 are provided in the hoistway 1.

[0012] A safety gear 7 corresponding to emergency stop means which comes into engagement with the car guide rails 6 to bring the car 4 to an emergency stop is provided to a lower part of the car 4. A speed governor supporting member 8 is fixed to the vicinity of upper ends of the car guide rails 6. A speed governor 9, which detects an overspeed of the car 6 to operate the safety gear 7, is supported on the speed governor supporting member 8.

[0013] In the vicinity of a pit of the hoistway 1, a tension sheave device 10 is provided. An upper end portion of a speed governor rope 11 is looped around the speed governor 9, whereas a lower end portion thereof is looped around the tension sheave device 10. The speed governor rope 11 is connected to the safety gear 7 through an intermediation of a lever 12 and is circulated with the raising and lowering of the car 4.

[0014] An upper starting device 13 for operating the safety gear 7 in response to a stop command signal is provided to the speed governor 9. A lower starting device 14 for operating the safety gear 7 in response to a stop command signal is provided to the tension sheave device 10.

[0015] FIG. 2 is a front view illustrating the speed governor 9 illustrated in FIG. 1. In the drawing, a sheave 21 corresponding to a rotary body, around which the speed governor rope 11 is looped, is supported on a base 23 so as to be rotatable about a sheave shaft 22. The sheave 21 is rotated along with the raising and lowering of the car 4. The sheave 21 is rotated at a speed corresponding to a running speed of the car 4 in a direction corresponding to a running direction of the car 4.

[0016] On a side surface of the sheave 21, a first flyweight 25a pivotable about a pin 24a and a second flyweight 25b pivotable about a pin 24b are mounted. The flyweights 25a and 25b are connected to each other by a link 26.

[0017] An operating piece 37 is fixed to one end portion of the first flyweight 25a. The first flyweight 25a and the second flyweight 25b are pivoted by a centrifugal force generated by the rotation of the sheave 21. As a result, the operating piece 37 is displaced outward in a radial direction of the sheave 21. A balance spring 27 acting against the centrifugal force is provided between the other end portion of the first flyweight 25a and the sheave 21.

[0018] A car stop switch 28 for operating a brake device (not shown) for the driving device 2 is mounted to the base 23. The car stop switch 28 includes a switch lever 28a to be operated by the operating piece 37.

[0019] An engagement disc (small ratchet) 42 which is rotatable relative to the sheave 21 is provided to the sheave shaft 22. The engagement disc 42 has a smaller diameter than that of the sheave 21. Moreover, the engagement disc 42 is rotated integrally with the sheave 21 under normal conditions. A plurality of teeth are continuously provided on an outer circumferential portion of the engagement disc 42 over the entire circumference. A cylindrical guide portion 42a surrounding the sheave shaft 22 is provided onto one side surface of the engagement disc 42.

[0020] A rotation restricting portion 42b is provided to the guide portion 42a. The rotation restricting portion 42b projects from an outer circumferential portion of the guide portion 42a in a tangent direction. A distal end portion of the rotation restricting portion 42b is bent at a right angle to be held in abutment against a spoke portion of the sheave 21 under normal conditions. As a result, the counterclockwise rotation (FIG. 2) of the engagement disc 42 relative to the sheave 21 is restricted, whereas only the clockwise rotation (FIG. 2) relative thereto is allowed.

[0021] A claw 29 pivotable about the pin 24a is provided onto a side surface of the sheave 21. A base end portion of an L-shaped spring wire 43 corresponding to a transmission member is wound at about 90 degrees around the guide portion 42a. A distal end portion of the spring wire 43 is connected to one end portion of the claw 29.

[0022] An abutting piece 29a which is held in abutment against the first flyweight 25a is provided to the other end portion of the claw 29. As a result, the claw 29 pivots in a counterclockwise direction interlockingly with the pivoting of the first flyweight 25a in the counterclockwise direction (FIG. 2).

[0023] A main ratchet (large ratchet) 30 rotatable about the sheave shaft 22 is provided to the base 23. The main ratchet 30 has a larger diameter than that of the engagement disc 42. A plurality of teeth are continuously provided on an outer circumferential portion of the main ratchet 30 over the entire circumference. When the first

flyweight 25a is pivoted by a preset amount during the rotation of the sheave 21 in the counterclockwise direction (FIG. 2), the claw 29 comes into engagement with one of the teeth of the main ratchet 30.

[0024] A locking arm 41 pivotable about a shaft 41a is mounted on the main ratchet 30. The shaft 41a is provided in a longitudinally middle portion of the locking arm 41. A stopper portion 41b which comes into engagement with one of the teeth of the engagement disc 42 is provided in the middle portion of the engagement arm 41, that is, in the vicinity of the shaft 41a. A tension spring 44 is provided between the base 23 and an end portion (upper end portion) of the locking arm 41. The tension spring 44 biases the locking arm 41 in a direction (clockwise direction of FIG. 2) in which the stopper 41b is brought into engagement with one of the teeth of the engagement disc 42.

[0025] A pin 41c is provided in the other end portion (lower end portion) of the locking arm 41. A link plate 45 corresponding to a link member is connected to the pin 41c. A distance between the shaft 41a to the pin 41c is larger than a distance from the shaft 41a to a connected portion of the tension spring 44.

[0026] An elongated hole 45a in which the pin 41c is inserted is provided through the link plate 45. An electromagnetic actuator 46 is fixed onto the base 23. The electromagnetic actuator 46 includes a movable element 46a connected to the link plate 45 and an electromagnetic magnet 46b for attracting the movable element 46a.

[0027] The movable element 46a is horizontally displaceable between a normal position (FIG. 2) where the movable element is attracted toward the electromagnetic magnet 46b and a stop position (FIG. 3) where the movable element projects from the electromagnetic magnet 46b to bring the stopper portion 41b into engagement with the engagement disc 42.

[0028] Further, the electromagnetic actuator 46 has capability of attracting only an extremely small sliding load of the movable element 46a in a state in which the link plate 45 is situated close to the electromagnetic magnet (actuator main body) 46b at a distance of about 5 mm or less and a load of the tension spring 44 does not act on the movable element 46a. The electromagnetic actuator 46 has a retention force for retaining the movable element 46a so that the locking arm 41 does not pivot in the clockwise direction of the drawing against the load of the tension spring 44 under a state in which the movable element 46a is held in close contact with the electromagnetic magnet 46b.

[0029] The upper starting device 13 includes the locking arm 41, the engagement disc 42, the spring wire 43, the tension spring 44, the link plate 45, and the electromagnetic actuator 46. A structure of the lower starting device 14 is the same as that of the upper starting device 13.

[0030] A shoe 32 to be pressed against the speed governor rope 11 is pivotably mounted to an arm 31 pivotably mounted onto the base 23. A spring shaft 33 passes

through a spring bearing portion 31a of the arm 31. A connection lever 34 is connected between one end portion of the spring shaft 33 and the main ratchet 30. A spring bearing member 35 is provided to the other end portion of the spring shaft 33. A rope gripping spring 36 for pressing the shoe 32 against the speed governor rope 11 is provided between the spring bearing portion 31a and the spring bearing member 35.

[0031] In Embodiment 1, a rotary-body stopping mechanism for mechanically stopping the rotation of the sheave 21 includes the arm 31, the shoe 32, the spring shaft 33, the connection lever 34, the spring bearing member 35, and the rope gripping spring 36.

[0032] An engagement-disc stopping mechanism for mechanically stopping the rotation of the engagement disc 42 includes the engagement arm 41, the tension spring 44, and the link plate 45. The electromagnetic actuator 46 operates the engagement-disc stopping mechanism to stop the rotation of the engagement disc 42.

[0033] An interlocking mechanism includes the main ratchet 30, the claw 29, and the spring wire 43. When the rotation of the engagement disc 42 is stopped by the engagement-disc stopping mechanism, the interlocking mechanism operates the rotary-body stopping mechanism interlockingly with the rotation of the sheave 21 relative to the engagement disc 42 to stop the sheave 21.

[0034] More specifically, the rotation of the main ratchet 30 operates the rotary-body stopping mechanism. The claw 29 is engaged with the main ratchet 30 by the rotation of the sheave 21 relative to the engagement disc 42 to rotate the main ratchet 30 together with the sheave 21. The spring wire 43 pivots the claw 29 in a direction in which the claw 29 is brought into engagement with the main ratchet 30 as a result of the rotation of the sheave 21 relative to the engagement disc 42.

[0035] Moreover, a stop-operation transmission mechanism includes the engagement-disc stopping mechanism, the interlocking mechanism, and the engagement disc 42 described above, and returns the movable element 46a toward the normal position along with the rotation of the sheave 21 from the displacement of the movable element 46a to the stop position until the sheave 21 is stopped.

[0036] Next, an operation is described. The electromagnetic actuator 46 is placed constantly in an energized state while the car 4 is running under normal conditions and is in a stop state. On the other hand, in the case where the car 4 is unintentionally moved by load unbalance due to the occurrence of a failure in the brake for the driving device 2 or disappearance of a traction force between the main rope 3 and the driving sheave 2a for some reason or in the case where it is detected that the main rope 3 has been broken, the stop command signal is issued from a control system to de-energize the electromagnetic actuator 46.

[0037] FIGS. 3 to 5 are front views illustrating an operation of the upper starting device 13 when the electromagnetic actuator 46 illustrated in FIG. 2 is de-energized.

In FIGS. 3 to 5, the sheave 21 is rotated in the counter-clockwise direction of the drawings so as to correspond to a travel direction of the car 4 when the abnormality is detected.

[0038] When the electromagnetic actuator 46 is de-energized, the locking arm 41 is pivoted in the clockwise direction of the drawing under the load of the tension spring 44 as illustrated in FIG. 3 so as to displace the movable element 46a to the stop position and to engage the stopper portion 41b with one of the teeth of the engagement disc 42.

[0039] Then, the sheave 21 is further continuously rotated in the counterclockwise direction of the drawings by the movement of the car 4. Therefore, as illustrated in FIG. 4, the spring wire 43 is curved along an outer circumferential surface of the guide portion 42a to pivot the claw 29 in the counterclockwise direction of the drawing. As a result, the distal end of the claw 29 comes into engagement with one of the teeth of the main ratchet 30. Moreover, the rotation restricting portion 42b moves away from the spoke portion of the sheave 21.

[0040] When the claw 29 comes into engagement with the main ratchet 30, the rotation of the sheave 21 is transmitted to the main ratchet 30 through an intermediation of the claw 29. As a result, as illustrated in FIG. 5, the main ratchet 30 is rotated in the counterclockwise direction of the drawing. The rotation of the main ratchet 30 is transmitted to the arm 31 through an intermediation of the connection lever 34, the spring shaft 33, the spring bearing member 35, and the rope gripping spring 36. As a result, the arm 31 is pivoted in the counterclockwise direction of the drawing.

[0041] As a result, the shoe 32 is brought into abutment against the speed governor rope 11. In addition, the shoe 32 is pressed against the speed governor rope 11 by the rope gripping spring 36. When the shoe 32 is pressed against the speed governor rope 11 as described above, the circulating movement of the speed governor rope 11 is stopped. Then, the lever 12 is operated by the movement of the car 4. As a result, the safety gear 7 is operated.

[0042] When the main ratchet 30 is rotated in the counterclockwise direction of the drawings, the position of the shaft 41a of the locking arm 41 is also moved in the counterclockwise direction of the drawings. At this time, the locking arm 41 is moved under a state in which the stopper portion 41b is held in engagement with the engagement disc 42. As a result, the link plate 45 is moved toward the electromagnetic actuator 46 by the pin 41c. The movable element 46a is pressed toward the electromagnetic magnet 46b to reach the vicinity of the normal position through an intermediation of the link plate 45.

[0043] Next, a return operation after an emergency stop is described. FIG. 6 is a front view illustrating a state of the speed governor 9 illustrated in FIG. 2 during the return operation. When safety is ensured after the emergency stop, the electromagnetic magnet 46b is first excited to attract and retain the movable element 46a in the

normal position.

[0044] At this time, the stopper portion 41b is pressed against the engagement disc 42 under the load of the tension spring 44. Therefore, the load of the tension spring 44 does not act on the movable element 46a. Accordingly, a force required to move the movable element 46a and the link plate 45 toward the electromagnetic actuator main body is merely as small as the extremely small sliding loss load. Moreover, only a short length is required for the movement of the movable element 46a because the movable element 46a is pressed into the electromagnetic actuator main body when the emergency stop is made.

[0045] Then, the car 4 is moved in a direction opposite to the travel direction for emergency braking while the movable element 46a is retained with the small attracting force. In this manner, the safety gear 7 is returned. At this time, the sheave 21 and the main ratchet 30 are rotated in the clockwise direction of FIG. 6. The claw 29 is disengaged from the corresponding one of teeth of the main ratchet 30 by a restoring force of the spring wire 43.

[0046] Moreover, the movable element 46a and the link plate 45 are retained with an appropriate retention force of the electromagnetic magnet 46b. Therefore, when the pin 41c comes into abutment with a left end portion of the elongated hole 45a of the link plate 45, the stopper portion 41b starts being disengaged from the engagement disc 42 so that the load of the tension spring 44 starts acting on the pin 41c. Then, the car 4 is further moved in a return direction to rotate the sheave 21 in the clockwise direction of FIG. 6. As a result, the speed governor 9 is returned to a state illustrated in FIG. 2.

[0047] When the rotation restricting portion 42b is brought into abutment against the spoke portion of the sheave 21, the engagement disc 42 is forced to rotate in the clockwise direction of the drawing in synchronization with the sheave 21. Therefore, the stopper portion 41b is more reliably disengaged from the engagement disc 42.

[0048] In the elevator safety system as described above, the engagement disc 42, which is rotatable relative to the sheave 21 and is rotated integrally with the sheave 21 under normal conditions, is provided coaxially with the sheave 21. When the electromagnetic actuator 46 stops the rotation of the engagement disc 42 through an intermediation of the engagement-disc stopping mechanism, the rotation of the sheave 21 is stopped interlockingly with the rotation of the sheave 21 relative to the engagement disc 42. As a result, the safety gear 7 performs a braking operation. Therefore, the operation of the safety gear 7 can be immediately started by the electromagnetic actuator 46.

[0049] Moreover, the electromagnetic actuator 46 does not directly operate the rotary-body stop mechanism which stops the rotation of the sheave 21 but merely operates the engagement-disc stopping mechanism to stop the engagement disc 42. Therefore, the return movement of the movable element 46a does not need

to be performed by the electromagnetic actuator 46 alone. In addition, the return operation of the claw 29 does not need to be performed directly by the electromagnetic actuator 46. Therefore, the electromagnetic actuator 46 can be reduced in size, which allows the electromagnetic actuator 46 to be provided on an inner side of the base 23 for space saving.

[0050] Further, the engagement-disc stopping mechanism includes the locking arm 41 including the stopper portion 41b provided in the middle portion, the tension spring 44 connected to the one end portion of the locking arm 41, and the link plate 45 connected between the other end portion of the locking arm 41 and the electromagnetic actuator 46. Thus, the engagement disc 42 can be stopped with a simple configuration. As a result, the electromagnetic actuator 46 can be reduced in size.

[0051] Further, the locking arm 41 is mounted on the side surface of the main ratchet 30. When the locking arm 41 is displaced by the rotation of the main ratchet 30, the movable element 46a is returned toward the normal position through an intermediation of the link plate 45. Therefore, with a simple configuration, the distance of the return movement of the movable element 46a by the electromagnetic magnet 46b can be reduced. Accordingly, the electromagnetic actuator 46 can be reduced in size.

[0052] Moreover, the interlocking mechanism includes the main ratchet 30, the claw 29, and the spring wire 43 provided between the engagement disc 42 and the claw 29. Therefore, with a simple configuration, the rotary-body stopping mechanism can be operated interlockingly with the rotation of the sheave 21 relative to the engagement disc 42.

[0053] Further, the guide portion 42a is provided to the engagement disc 42. The spring wire 43 is used as the transmission member. Therefore, the return operation of the claw 29 can be easily performed.

[0054] Further, even if the movable element 46a remains retained on the electromagnetic actuator main body side as illustrated in FIG. 7, the claw 29 is pivoted by the flyweight 25a to engage the distal end of the claw 29 with the main ratchet 30 when a speed of the car 4 reaches a preset overspeed. As a result, the main ratchet 30 is rotated in the counterclockwise direction of the drawing to operate the safety gear 7 in the same manner as that described above.

[0055] At this time, the spring wire 43 is merely displaced so as to be moved away from the outer circumferential surface of the guide portion 42a, as illustrated in FIG. 7. Therefore, the electric operation mechanism and the mechanical operation mechanism can be both provided at relatively low cost by using the claw 29 commonly used for the above-mentioned two mechanisms.

[0056] Therefore, when the speed of the car 4 reaches the overspeed in the case where the electromagnetic actuator 46 remains energized or in the case where the movable element 46a or the locking arm 41 does not move for some failure even after the electromagnetic ac-

tuator 46 is de-energized, the safety gear 7 can be operated as in the case of the conventional devices by the pivoting of the flyweight 25a, which is caused by the centrifugal force.

[0057] Moreover, if the lower starting device 14 provided to the tension sheave device 10 is configured so that the safety gear 7 is operated when the car 4 is moved upward, the operation of the safety gear 7 can be electrically started for both the upward and downward movements of the car.

[0058] Further, if the electromagnetic actuator 46 is de-energized not only when the abnormality is detected but also for an inspection, a performance test of the safety gear 7 can be easily carried out.

Embodiment 2

[0059] Next, FIG. 8 is a front view illustrating a principal part of a speed governor according to Embodiment 2 of the present invention. The overall configuration of the elevator is the same as that of Embodiment 1. In the drawing, a rope groove, in which the speed governor rope 11 is to be inserted, is provided on an outer circumferential portion of a sheave 70 corresponding to a rotary body. In Embodiment 2, the rope groove has a V-shaped sectional shape. As a result, a friction force with the speed governor rope 11 is increased.

[0060] Therefore, a mass of the tension sheave device 10 is increased to ensure an appropriate tension of the speed governor rope 11. As a result, a friction force between the sheave 70 and the speed governor rope 11, which is required to start the safety gear 7, can be ensured by stopping the rotation of the sheave 70.

[0061] For the reasons described above, the components for gripping the speed governor rope 11 in Embodiment 1 (FIG. 2), specifically, the arm 31, the shoe 32, the spring shaft 33, the connection lever 34, the spring bearing member 35, the rope gripping spring 36, and the like are omitted. Moreover, in contrast to Embodiment 1, in order to stop the rotation of the sheave 70, a main ratchet 77 is fixed so as not to rotate relative to the sheave shaft 22 corresponding to a fixed shaft.

[0062] An engagement disc (small ratchet) 72 rotatable relative to the sheave 70 is provided to the sheave shaft 22 of the sheave 70. A plurality of teeth are continuously provided on an outer circumferential portion of the engagement disc 72 over the entire circumference. A cam plate 71 having a shape for pivoting a first flyweight 74a and a second flyweight 74b outward by the rotation relative to the sheave 70 is integrally provided to the engagement disc 72.

[0063] A rotatable roller 75a is provided to the flyweight 74a, whereas a rotatable roller 75b is provided to the flyweight 74b. A torsion spring 73 for constantly holding the cam plate 71 in abutment against the rollers 75a and 75b is mounted to the engagement disc 72.

[0064] A locking arm 76 pivotable about a shaft 76a is provided to the base 23 (FIG. 2). A stopper portion 76b

to be engaged with one of the teeth of the engagement disc 72 is provided to the locking arm 76. The stopper portion 76b projects in an axial direction of the engagement disc 72 in parallel thereto. The tension spring 44 (FIG. 2) is provided between an upper end portion of the locking arm 76 and the base 23. The tension spring 44 biases the locking arm 76 in a direction in which the stopper portion 76b comes into engagement with one of the teeth of the engagement disc 72 (clockwise direction of FIG. 8).

[0065] A pin 76c is provided in a lower end portion of the locking arm 76. The link plate 45 is rotatably connected to the pin 76c. The electromagnetic actuator 46 is fixed to the base 23. The electromagnetic actuator 46 includes the movable element 46a connected to the link plate 45. The electromagnetic actuator 46 pivots the locking arm 41 in a direction in which the stopper portion 41b is disengaged from a corresponding one of the teeth of the engagement disc 42 (counterclockwise direction of FIG. 8) against the tension spring 44.

[0066] In Embodiment 2, a rotary-body stopping mechanism for stopping the rotation of the sheave 70 includes a main ratchet 77 and the claw 29. An interlocking mechanism includes the cam plate 71, the flyweights 74a and 74b, and the rollers 75a and 75b.

[0067] When the rotation of the engagement disc 72 is stopped by the engagement-disc stopping mechanism, the rotation of the cam plate 71 is also stopped. The rotation of the sheave 70 relative to the engagement disc 72 displaces the rollers 75a and 75b outward in a radial direction of the sheave 70 along the cam plate 71. As a result, the flyweights 74a and 74b are pivoted to operate the rotary-body stopping mechanism, specifically, to engage the claw 29 with the main ratchet 77. The remaining configuration is the same as that of Embodiment 1.

[0068] Next, an operation is described. The electromagnetic actuator 46 is placed constantly in an energized state while the car 4 is running under normal conditions and is in a stop state. On the other hand, in the case where the car 4 is unintentionally moved by load unbalance due to the occurrence of a failure in the brake for the driving device 2 or disappearance of a traction force between the main rope 3 and the driving sheave 2a for some reason or in the case where it is detected that the main rope 3 has been broken, the stop command signal is issued from a control system to de-energize the electromagnetic actuator 46.

[0069] When the electromagnetic actuator 46 is de-energized, the locking arm 76 pivots in the clockwise direction of FIG. 8 under the load of the tension spring 44. As a result, the stopper portion 76b is brought into engagement with one of the teeth of the engagement disc 72.

[0070] Then, the sheave 70 is further continuously rotated in the counterclockwise direction of FIG. 8 by the movement of the car 4. At this time, the roller 75a of the flyweight 74a and the roller 75b of the flyweight 74b are held in contact with the cam plate 71. Therefore, the fly-

weights 74a and 74b pivot in the counterclockwise direction of FIG. 8 respectively about the pins 24a and 24b to be pivoted outward.

[0071] As a result of the outward pivoting of the flyweight 74a, the claw 29 is pivoted in the counterclockwise direction of FIG. 8 to engage the distal end of the claw 29 with one of the teeth of the main ratchet 77. As a result, the rotation of the sheave 70 is stopped. The speed governor rope 11 is frictionally retained by the friction force between the speed governor rope 11 and the rope groove of the sheave 70 to operate the safety gear 7.

[0072] Even with the elevator safety system described above, the operation of the safety gear 7 can be immediately started by the electromagnetic actuator 46. In addition, the electromagnetic actuator 46 can be reduced in size. Moreover, the electric operation mechanism and the mechanical operation mechanism can both be provided at relatively low cost by using the claw 29 commonly used for the above-mentioned two mechanisms.

Embodiment 3

[0073] Next, FIG. 9 is a front view illustrating a principal part of a speed governor according to Embodiment 3 of the present invention. In the drawing, a trip lever 62 pivotable about a shaft 61, which is parallel to the pin 24a, is mounted on the side surface of the sheave 21. The trip lever 62 includes a projecting portion 62a to be engaged with the claw 29.

[0074] The trip lever 62 has a portion which is held in abutment against the first flyweight 25a (FIG. 2), and therefore is pivoted about the shaft 61 by the pivoting of the flyweight 25a. A torsion spring 63 for biasing the trip lever 62 in a direction in which the trip lever 62 is brought into abutment against the flyweight 25a (clockwise direction of FIG. 9) is provided to the shaft 61.

[0075] A tension spring 64 for biasing the claw 29 in a direction in which the claw 29 comes into engagement with the main ratchet 30 is provided between the claw 29 and the sheave 21. The claw 29 held in engagement with the projecting portion 62a of the trip lever 62 to be separated away from the main ratchet 30 under normal conditions. However, when the claw 29 is disengaged from the trip lever 62, the claw 29 is pivoted by a spring force of the tension spring 64 to be brought into engagement with the main ratchet 30.

[0076] An engagement disc 65 rotatable relative to the sheave 21 is provided to the sheave shaft 22. The engagement disc 65 rotates integrally with the sheave 21 under normal conditions. A plurality of teeth are continuously provided on an outer circumferential portion of the engagement disc 65 over the entire circumference. On one side surface of the engagement disc 65, a cylindrical guide portion 65a surrounding the sheave shaft 22 is provided.

[0077] A first rotation restricting portion 65b and a second rotation restricting portion 65c are provided to the guide portion 65a. The first rotation restricting portion 65b

comes into abutment against a spoke portion of the sheave 21 to restrict the rotation of the engagement disc 65 in the counterclockwise direction of FIG. 9 relative to the sheave 21. The second rotation restricting portion 65c comes into abutment against a spoke portion, which is different from the spoke portion against which the first rotation restricting portion 65b comes into abutment, to restrict the rotation of the engagement disc 65 in the clockwise direction of FIG. 9 relative to the sheave 21.

[0078] Therefore, the engagement disc 65 is rotatable relative to the sheave 21 within a predetermined angle range (acute-angle range). Under normal conditions, the first rotation restricting portion 65b is held in abutment against the spoke portion, whereas the second rotation restricting portion 65c is separated away from the corresponding spoke portion.

[0079] A trigger plate 66 corresponding to a transmission member formed by a thin plate spring is assembled between the projecting portion 62a of the trip lever 62 and the guide portion 65a. A base end portion of the trigger plate 66 is fixed to the guide portion 65a. A rectangular opening portion 66a is provided through a distal end portion of the trigger plate 66, as illustrated in FIG. 10. The projecting portion 62a of the trip lever 62 is inserted into the opening portion 66a.

[0080] A locking arm 51 is provided on a side surface of the main ratchet 30 so as to be pivotable about a shaft 51a. The shaft 51a is provided in a longitudinally middle portion of the locking arm 51. A stopper portion 51b to be brought into engagement with one of the teeth of the engagement disc 65 is provided in the longitudinally middle portion of the locking arm 51. The stopper portion 51b projects from one side surface of the locking arm 51 in parallel to the sheave shaft 22.

[0081] A tension spring 54 for biasing the stopper portion 51b in a direction, in which the stopper portion 51b is brought into engagement with the engagement disc 65, is mounted between one end portion (left end portion) of the locking arm 51 and the main ratchet 30. A guide plate 55 which pivots about a pivot shaft 55a is provided to the base 23 (FIG. 2). An elongated hole 55b is provided through the guide plate 55.

[0082] An engagement projection 51c of the locking arm 51 is inserted into the elongated hole 55b. The engagement projection 51c projects from the other side surface of the locking arm 51 in parallel to the sheave shaft 22. Further, the engagement projection 51c is provided at the same position as that of the stopper portion 51b of the locking arm 51 in the longitudinal direction. The stopper portion 51b and the engagement projection 51c are provided between the shaft 51a and the other end portion of the locking arm 51.

[0083] An electromagnetic actuator 56 is assembled into the base 23. The electromagnetic actuator 56 includes a movable element 56a which is held in abutment against an upper surface of the locking arm 51 and an electromagnetic magnet 56b for attracting the movable element 56a.

[0084] The movable element 56a is displaceable between a normal position (FIG. 9) where the movable element projects downward from the electromagnetic magnet 56b by a long distance and a stop position (FIG. 3) where the movable element is displaced upward from the normal position to engage the stopper portion 51b with the engagement disc 65. A surface (lower end surface) of the movable element 56a, which is held in contact with the locking arm 51, is hemispherical.

[0085] When the movable element 56a is in the normal position, the movable element 56a is held in abutment against the other end portion of the locking arm 51 to retain the stopper portion 51b in a position apart from the engagement disc 65 against the tension spring 54.

[0086] In Embodiment 3, an engagement-disc stopping mechanism includes the locking arm 51 and the tension spring 54. An interlocking mechanism includes the trigger plate 66, the trip lever 62, the claw 29, the tension spring 64, and the main ratchet 30.

[0087] When the rotation of the engagement disc 65 is stopped by the engagement-disc stopping mechanism, the rotation of the trigger 66 is also stopped. Then, by the rotation of the sheave 70 with respect to the trigger plate 66, the trip lever 62 is disengaged from the claw 29. As a result, the claw 29 comes into engagement with the main ratchet 30 to rotate the main ratchet 30 together with the sheave 21 to operate the rotary-body stopping mechanism.

[0088] Moreover, the stop-operation transmission mechanism includes the engagement-disc stopping mechanism, the interlocking mechanism, and the engagement disc 65 described above, and returns the movable element 56a toward the normal position along with the rotation of the sheave 21 from the displacement of the movable element 56a to the stop position until the sheave 21 is stopped. At this time, the stop-operation transmission mechanism uses a weight of the movable element 56a to return the movable element 56a toward the normal position. The remaining configuration is the same as that of Embodiment 1.

[0089] Next, an operation is described. The electromagnetic actuator 56 is placed constantly in an energized state while the car 4 is running under normal conditions and is in a stop state. On the other hand, in the case where the car 4 is unintentionally moved by load unbalance due to the occurrence of a failure in the brake for the driving device 2 or disappearance of a traction force between the main rope 3 and the driving sheave 2a for some reason or in the case where it is detected that the main rope 3 has been broken, the stop command signal is issued from a control system to de-energize the electromagnetic actuator 56.

[0090] When the electromagnetic actuator 56 is de-energized, the locking arm 51 is pivoted by the tension spring 54 in the counterclockwise direction of the drawing as illustrated in FIG. 11, and the movable element 56a is displaced to the stop position. As a result, the stopper portion 51b comes into engagement with the engage-

ment disc 65 to stop the rotation of the engagement disc 65.

[0091] When the rotation of the engagement disc 65 is stopped, the sheave 21 is continuously rotated in the counterclockwise direction of FIG. 11. When the projecting portion 62a of the trip lever 62 is caught by the opening portion 66a of the trigger plate 66 so that the spring force of the trigger plate 66 overwhelms the spring force of the torsion spring 63, the trip lever 62 is rotated about the shaft 61 in the counterclockwise direction of FIG. 11.

[0092] As a result, the projecting portion 62a and the claw 29 are disengaged from each other. Then, the claw 29 is brought into engagement with the main ratchet 30 under the load of the tension spring 64. Then, as illustrated in FIG. 12, the main ratchet 30 is rotated to incline the lever 31. At the same time, the shoe 32 is pressed against the speed governor rope 11 to stop the circulation of the speed governor rope 11. As a result, the safety gear 7 is operated.

[0093] When the main ratchet 30 is rotated, the locking arm 51 is rotated together with the main ratchet 30. At this time, the guide plate 55 is pivoted about the shaft 55a in the clockwise direction of the drawing with respect to the base 23. Therefore, the stopper portion 51b is held in the elongated hole 55b of the guide plate 55 to be disengaged from the corresponding one of teeth of the engagement disc 65. In this state, the spring force of the tension spring 54 acts on an edge portion of the elongated hole 55b. Moreover, a contact point at which an axis (vertical direction) of the movable element 56a and the locking arm 51 cross each other moves downward. The movable element 56a moves to the vicinity of the normal position under its own weight.

[0094] Specifically, after the electromagnetic actuator 56 is de-energized, the movable element 56a temporarily moves upward under the load of the tension spring 54. However, when the main ratchet 30 is rotated to the position where the circulation of the speed governor rope 11 is stopped, the locking arm 51 retracts to a position which is below a position under normal conditions. Therefore, the movable element 56a moves downward under its own weight.

[0095] As described above, when the main ratchet 30 is rotated, the stopper portion 51b of the locking arm 51 is disengaged from the corresponding one of the teeth of the engagement disc 65. At the same time, the movable element 56a returns to the normal position under its own weight. Therefore, the electromagnetic magnet 56b is not required to attract the movable element 56a over a long distance.

[0096] Moreover, during the return operation after the operation of the safety gear 7, the claw 29 is brought into engagement with the trip lever 62 again under a state in which the electromagnetic actuator 56 is energized to retain the movable element 56a in the normal position (for example, see JP 2002-370879 A).

[0097] Even with the elevator safety system described above, the operation of the safety gear 7 can be imme-

diately started by the electromagnetic actuator 56. In addition, the electromagnetic actuator 56 can be reduced in size. Further, the electric operation mechanism and the mechanical operation mechanism can be both provided at relatively low cost by using the claw 29 commonly used for the above-mentioned two mechanisms.

Embodiment 4

[0098] Next, FIG. 13 is a front view illustrating a principal part of an elevator safety system according to Embodiment 4 of the present invention. In Embodiment 4, the mechanical speed governor 9, which is the same as the conventional ones, for operating the safety gear 7 only when the car 4 is running downward, is provided in the upper part of the hoistway 1. A first electric starting device 81a for operating the safety gear 7 when the car 4 is running upward and a second electric starting device 81b for operating the safety gear 7 when the car 4 is running downward are provided to the tension sheave device 10.

[0099] A mounting plate 82 is fixed to rear surfaces of the car guide rails 6. A horizontal shaft 83 for supporting the tension sheave device 10 is provided to the mounting plate 82. A base end portion of a mounted arm 84 is pivotably mounted to the shaft 83. A plurality of teeth 84a are partially provided on an outer circumferential portion of the base end portion of the mounted arm 84.

[0100] A stopper 86 which is engageable with one of the teeth 84a is provided to the mounting plate 82. The stopper 86 is pivotably mounted to a stopper shaft 85 which is parallel to the shaft 83. The shapes and positions of the teeth 84a and the stopper 86 are set so as to allow the pivoting of the mounted arm 84 in the clockwise direction of FIG. 13 and to restrict the pivoting thereof in the counterclockwise direction.

[0101] As a result, when the speed governor rope 11 extends, the tension sheave device 10 moves downward. In this manner, the tension of the speed governor rope 11 can be maintained. In addition, the upward movement of the tension sheave device 10 is prevented.

[0102] Next, a configuration of the tension sheave device 10 is described. A base 80 is mounted to a lower part of the mounted arm 84. A sheave 87 corresponding to a second rotary body, around which the speed governor rope 11 is looped, is mounted to the base 80. An upper end portion of the speed governor rope 11 is looped around the sheave 21 (FIG. 2) of the speed governor 9 corresponding to the first rotary body. The sheaves 87 and 21 are rotated along with the raising and lowering of the car 4. A weight 80a for providing a sufficient tension to the speed governor rope 11 is assembled to a lower part of the base 80.

[0103] The first starting device 81a is provided mainly on one side surface of the sheave 87, whereas the second starting device 81b is provided mainly on the other side surface of the sheave 87. The first starting device 81a stops the rotation of the sheave 87 in the counter-

clockwise direction of FIG. 13. The second starting device 81b stops the rotation of the sheave 87 in the clockwise direction of FIG. 13. The configuration of the first starting device 81a and the second starting device 81b are the same as that of the upper starting device 13 of Embodiment 1. Therefore, the specific description thereof is herein omitted.

[0104] However, the flyweights are not provided to the sheave 87 because the mechanically operating speed governor 9 is separately provided. Moreover, an abutment portion, against which a stopper portion 88a of a claw 89a and a stopper portion 88b of a claw 89b abut under normal conditions, is provided to the sheave 87.

[0105] Next, an operation is described. First, during the downward movement of the car 4, the sheave 87 is rotated in the counterclockwise direction of FIG. 13. When the stop command signal is issued from the control system, electromagnetic actuators (first and second actuators) 106a and 106b are simultaneously de-energized. As a result, stopper portions of locking arms 101a and 101b respectively come into abutment against engagement discs 102a and 102b.

[0106] The engagement discs 102a and 102b are rotated in the counterclockwise direction of FIG. 13. Therefore, the locking arm 101a comes into engagement with one of the teeth of the engagement disc 102a to stop rotating. However, the locking arm 101b repeats a motion of sliding on a gentle slope of one of the teeth and then descending into a valley under a state in which the locking arm 101b is held in contact with an outer circumference of the engagement disc 102b, and therefore is not engaged with the teeth. Thus, only the claw 89a is engaged with the main ratchet 90a, and hence the shoe 92a is pressed against the speed governor rope 11 present on the sheave 87.

[0107] If the car 4 continues moving downward in this state, the speed governor rope 11 is going to rotate the mounted arm 84 in the counterclockwise direction of FIG. 13. However, the rotation is prevented by the stopper 86. Therefore, the lever 12 is inclined upward relative to the car 4. As a result, the safety gear 7 is operated.

[0108] Next, a return operation after the operation of the safety gear 7 is described. First, the energization of the electromagnetic actuators 106a and 106b is started. At this time, a movable element of the electromagnetic actuator 106a is returned to the normal position side by the rotation of the main ratchet 90a, and therefore is retained in the normal position by the energization. On the other hand, the movable element of the electromagnetic actuator 106b is moved to the stop position and remains there.

[0109] Then, the car 4 is moved upward to rotate the sheave 87 in the clockwise direction of FIG. 13 so as to disengage the safety gear 7 from the car guide rails 6. As a result, the locking arm 101a is returned to a normal position. At almost the same time, for the locking arm 101b, the claw 89b is brought into engagement with one of the teeth of the main ratchet 90b to rotate the main

ratchet 90b in the clockwise direction of FIG. 13 so as to restrain the rotation of the engagement disc 102b. As a result, the movable element of the electromagnetic actuator 106b is returned toward the normal position and is retained in the normal position by an attracting force of the electromagnetic actuator 106b.

[0110] Then, by moving the car 4 in the opposite direction, that is, downward again, the locking arm 101b is returned to the normal position to complete the return operations of the safety gear 7 and the starting devices 81a and 81b.

[0111] On the other hand, during the upward movement of the car 4, the sheave 87 is rotated in the clockwise direction of FIG. 13. In this case, when a stop command is issued from the control system, the electromagnetic actuators 106a and 106b are simultaneously de-energized. As a result, the stopper portions of the locking arms 101a and 101b come into abutment against the engagement discs 102a and 102b, respectively.

[0112] The engagement discs 102a and 102b are rotated in the clockwise direction of FIG. 13. Therefore, the locking arm 101b comes into engagement with one of the teeth of the engagement disc 102b to stop rotating, whereas the locking arm 101a is not engaged with the engagement disc 102a. Therefore, only the claw 89b is engaged with the main ratchet 90b to press the shoe 92b against the speed governor rope 11 present on the sheave 87.

[0113] If the car 4 continues moving upward in this state, the speed governor rope 11 is going to rotate the mounted arm 84 in the counterclockwise direction of FIG. 13. However, the rotation is prevented by the stopper 86. Therefore, the lever 12 is inclined downward relative to the car 4. As a result, the safety gear 7 is operated. The return operation is the same as that described above.

[0114] Even with the elevator safety system described above, the operation of the safety gear 7 can be immediately started by the electromagnetic actuators 106a and 106b. In addition, the electromagnetic actuators 106a and 106b are reduced in size. Moreover, the starting devices 81a and 81b are provided to the tension sheave device 10. Thus, the electric operation mechanism and the mechanical operation mechanism can be easily provided.

[0115] Further, the first starting device 81a and the second starting device 81b for operating the safety gear 7 bidirectionally are provided in one area on the tension sheave device 10 side in a concentrated manner. Therefore, a wiring and a controller for the electromagnetic actuators 106a and 106b can be provided in one area in a concentrated manner. As a result, the device configuration can be further simplified.

[0116] Although not shown in Embodiment 4, means for detecting the retention of the movable elements of the electromagnetic actuators 106a and 106b in the normal positions can also be used. In this case, efficiency of the return operation can be improved by stopping the movement of the car 4 simultaneously with the detection

of the retention of the movable elements. Therefore, the car guide rails 6 can be prevented from being damaged. As a result, needless efforts for repairing the car guide rails 6 can be saved.

[0117] Further, in Embodiment 4, the speed governor 9 is provided in the upper part of the hoistway 1, whereas the first starting device 81a and the second starting device 81b are provided in the lower part of the hoistway 1. However, the locations, where the above-mentioned components are provided, may be interchanged.

[0118] Further, the electromagnetic actuators are described as an actuator in Embodiments 1 to 4. However, the actuator is not limited thereto.

Claims

1. An elevator safety system, comprising:

a rotary body which is rotated along with raising and lowering of a car;
 a rotary-body stopping mechanism for mechanically stopping rotation of the rotary body;
 emergency stop means for bringing the car to an emergency stop by stop of the rotation of the rotary body;
 an engagement disc provided coaxially with the rotary body, the engagement disc being rotatable relative to the rotary body, having a smaller diameter than that of the rotary body, and being rotated integrally with the rotary body under normal conditions;
 an engagement-disc stop mechanism for mechanically stopping rotation of the engagement disc;
 an actuator for operating the engagement-disc stopping mechanism to stop the rotation of the engagement disc; and
 an interlocking mechanism for operating the rotary-body stopping mechanism interlockingly with the rotation of the rotary body relative to the engagement disc so as to stop the rotary body when the rotation of the engagement disc is stopped by the engagement-disc stopping mechanism.

2. An elevator safety system according to claim 1, wherein:

the actuator includes a movable element displaceable between a normal position and a stop position where the engagement-disc stopping mechanism is operated; and
 the movable element is returned toward the normal position interlockingly with the rotation of the rotary body relative to the engagement disc when the rotation of the engagement disc is stopped by the engagement-disc stopping

mechanism.

3. An elevator safety system according to claim 1, wherein the engagement-disc stopping mechanism includes:

a locking arm including a stopper portion for coming into engagement with the engagement disc to stop the rotation of the engagement disc, the stopper portion being provided in a middle portion, the locking arm being pivotable about the middle portion;
 a spring connected to one end portion of the locking arm, for biasing the locking arm in a direction in which the stopper portion comes into engagement with the engagement disc; and
 a link member connected between the other end portion of the locking arm and the actuator.

4. An elevator safety system according to claim 3, wherein:

the interlocking mechanism includes a main ratchet provided coaxially with the rotary body to be rotated so as to operate the rotary-body stopping mechanism;
 the locking arm is mounted pivotably on a side surface of the main ratchet;
 the actuator includes a movable element displaceable between a normal position and a stop position where the stopper portion is brought into engagement with the engagement disc; and
 the movable element is returned toward the normal position through an intermediation of the link member when the locking arm is displaced by the rotation of the main ratchet.

5. An elevator safety system according to claim 1, wherein the interlocking mechanism includes:

a main ratchet provided coaxially with the rotary body to be rotated so as to operate the rotary-body stopping mechanism;
 a claw provided pivotably on a side surface of the rotary body, for coming into engagement with the main ratchet by the rotation of the rotary body relative to the engagement disc to rotate the main ratchet together with the rotary body; and
 a transmission member provided between the engagement disc and the claw, for pivoting the claw in a direction in which the claw comes into engagement with the main ratchet by the rotation of the rotary body relative to the engagement disc.

6. An elevator safety system according to claim 5, wherein:

a cylindrical guide portion is provided to the engagement disc; and
 the transmission member is a spring wire to be curved along an outer circumferential surface of the guide portion for bringing the claw into engagement with the main ratchet by the rotation of the rotary body with respect to the engagement disc and for disengaging the claw from the main ratchet with a restoring force by the rotation of the rotary body in an opposite direction with respect to the engagement disc.

7. An elevator safety system according to claim 1, wherein the interlocking mechanism includes:

a cam plate integrally provided to the engagement disc;
 a flyweight pivotably provided on a side surface of the rotary body; and
 a roller provided to the flyweight, the roller being held in abutment against the cam plate, and wherein, when the rotation of the engagement disc is stopped by the engagement-disc stopping mechanism, the rotation of the cam plate is also stopped, the roller is displaced along the cam plate by the rotation of the rotary body relative to the engagement disc to pivot the flyweight, and the rotary-body stopping mechanism is operated by the pivoting of the flyweight.

8. An elevator safety system according to claim 7, wherein the rotary-body stopping mechanism includes:

a main ratchet fixed to a fixed shaft; and
 a claw provided pivotably on the side surface of the rotary body, for coming into engagement with the main ratchet by the pivoting of the flyweight to stop the rotation of the rotary body.

FIG. 1

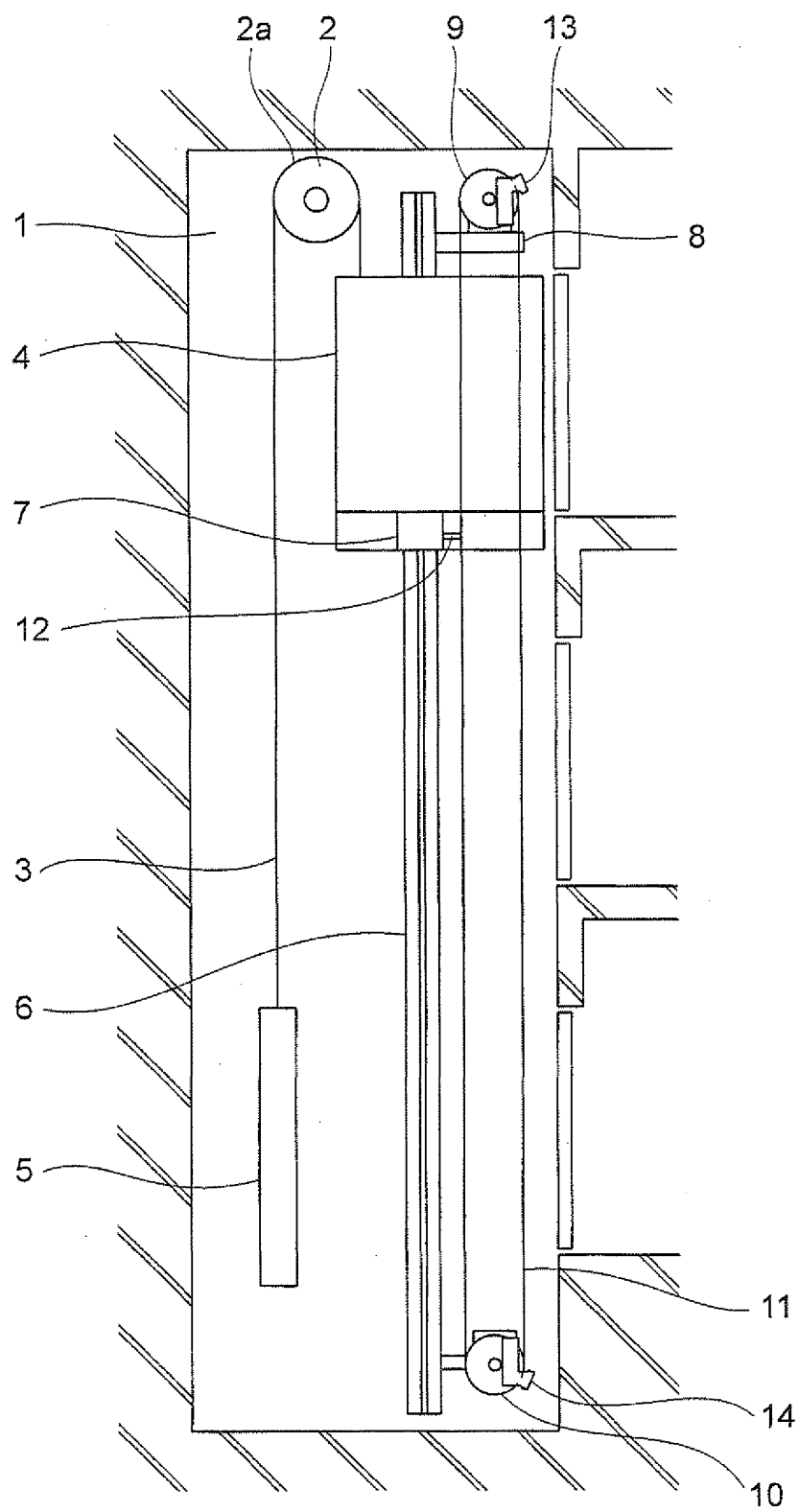


FIG. 2

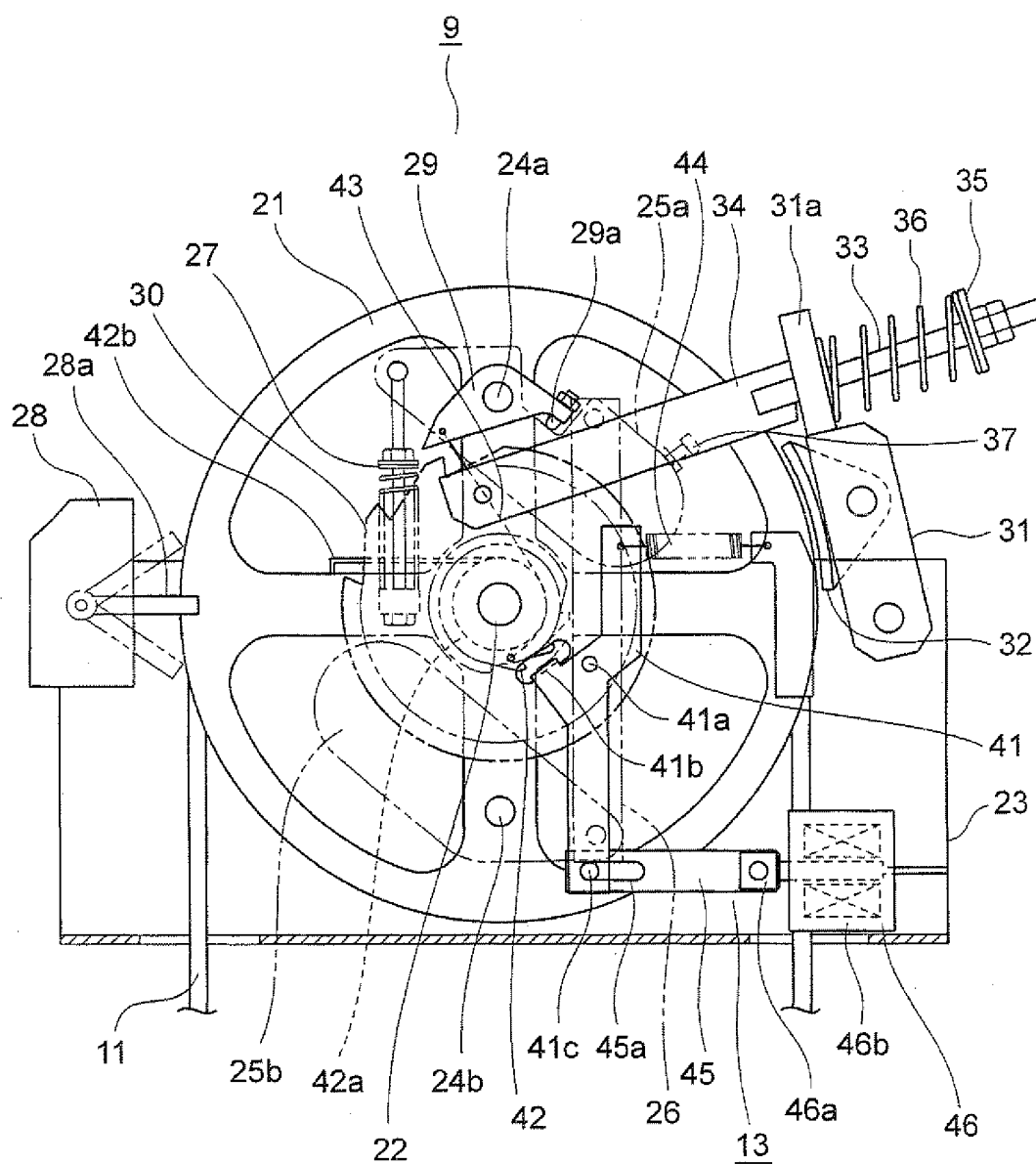


FIG. 3

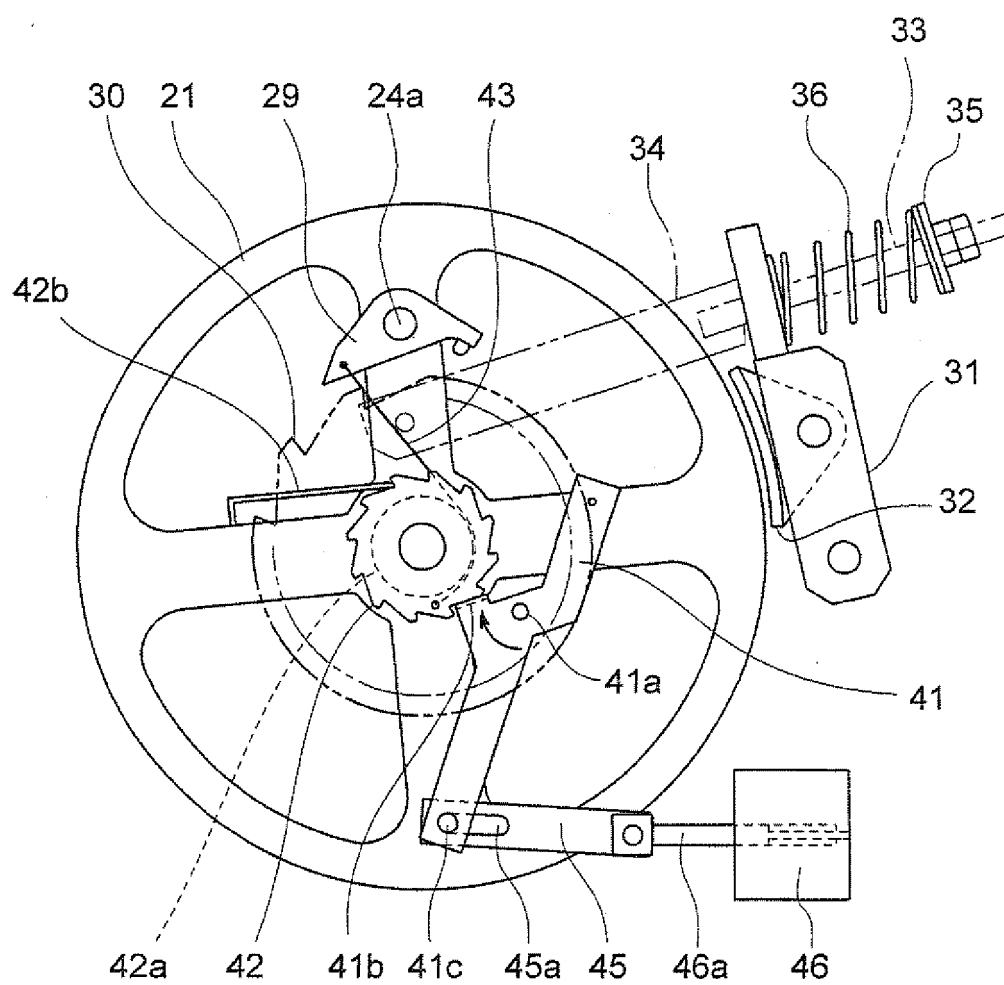


FIG. 4

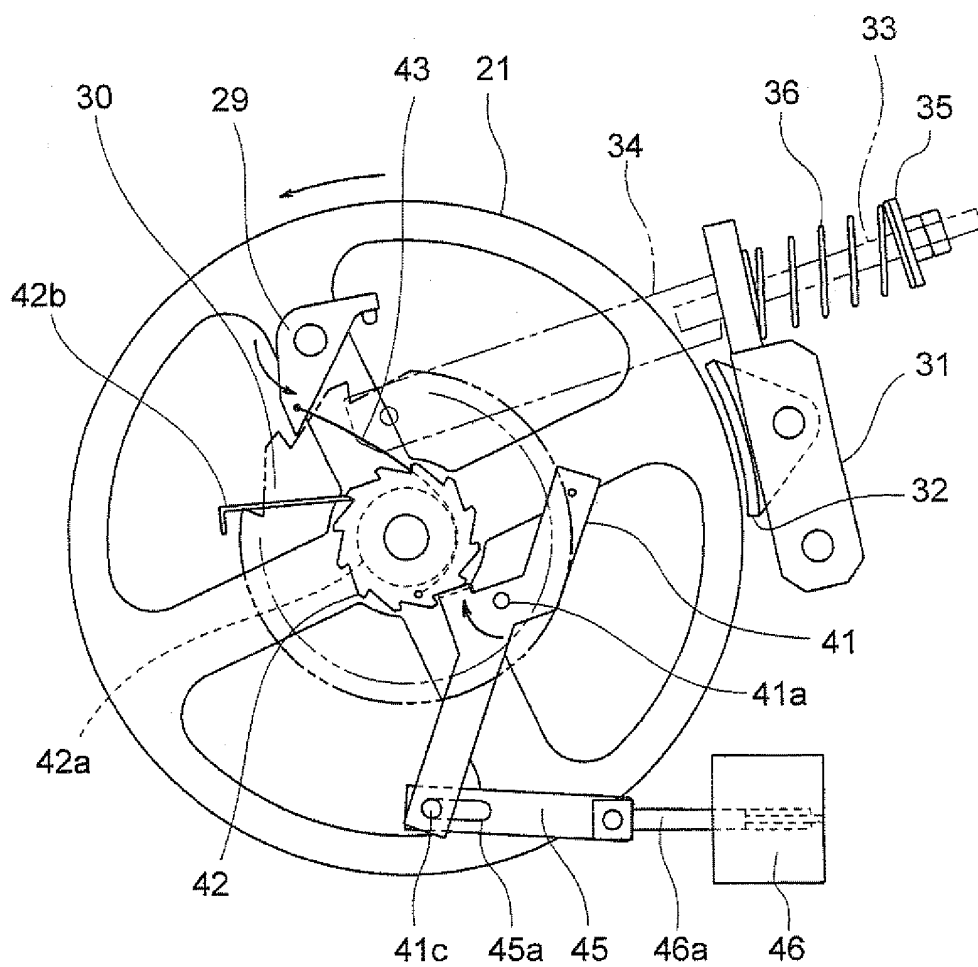


FIG. 5

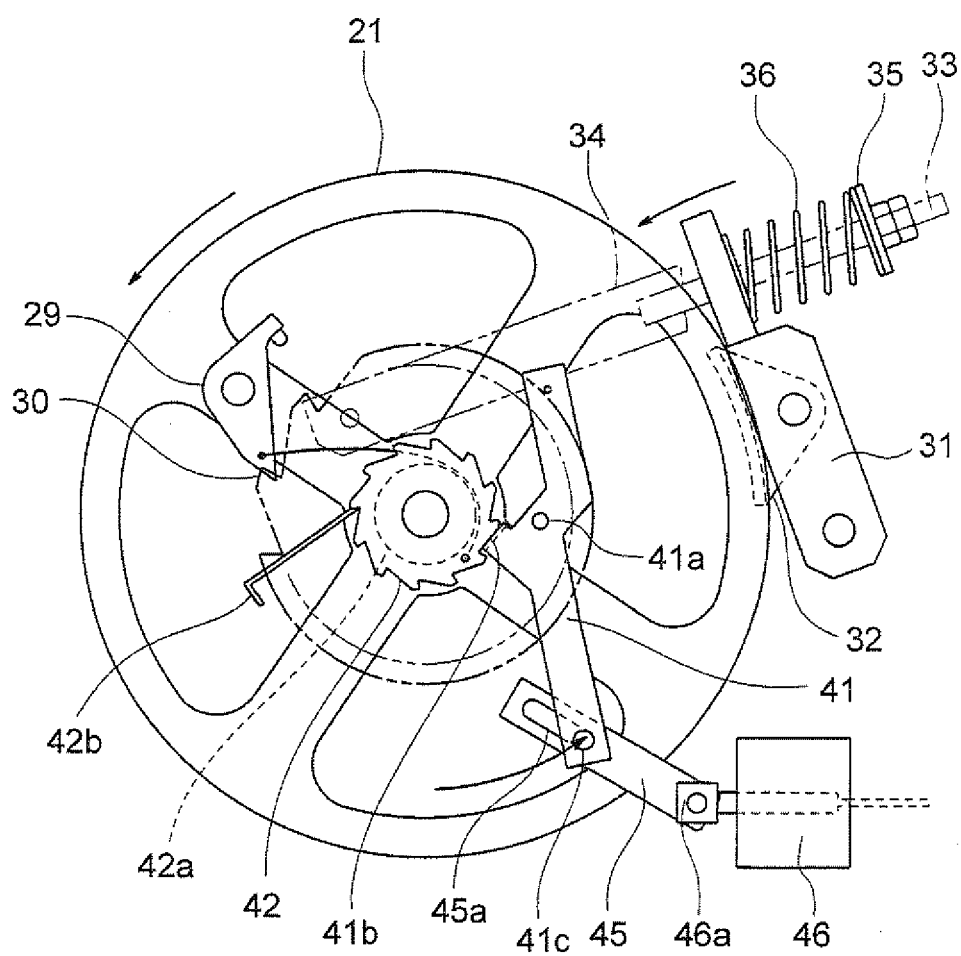


FIG. 6

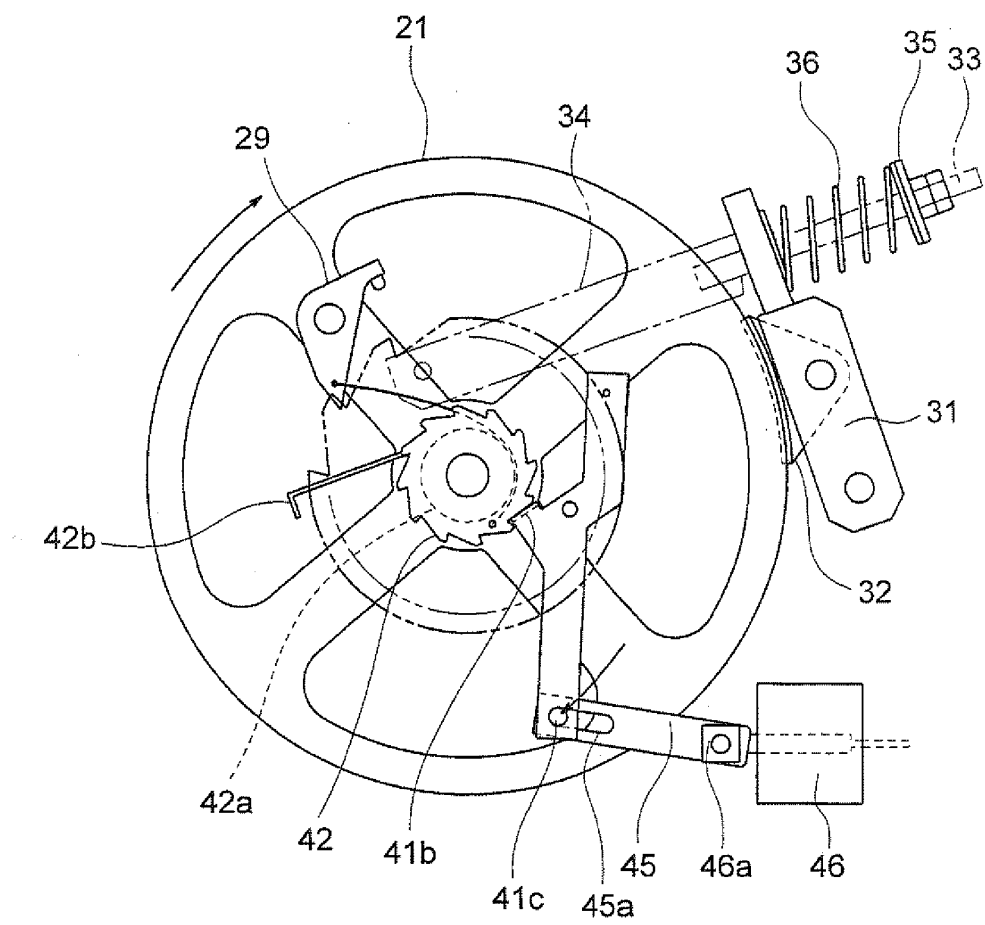


FIG. 7

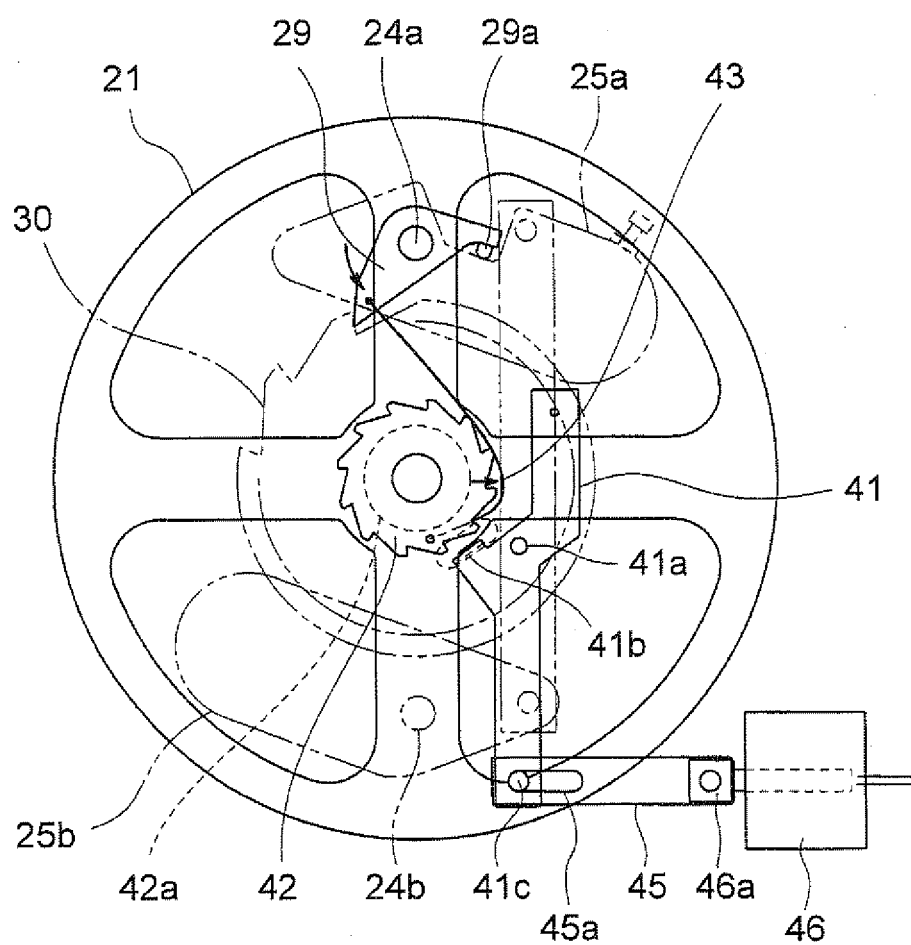


FIG. 8

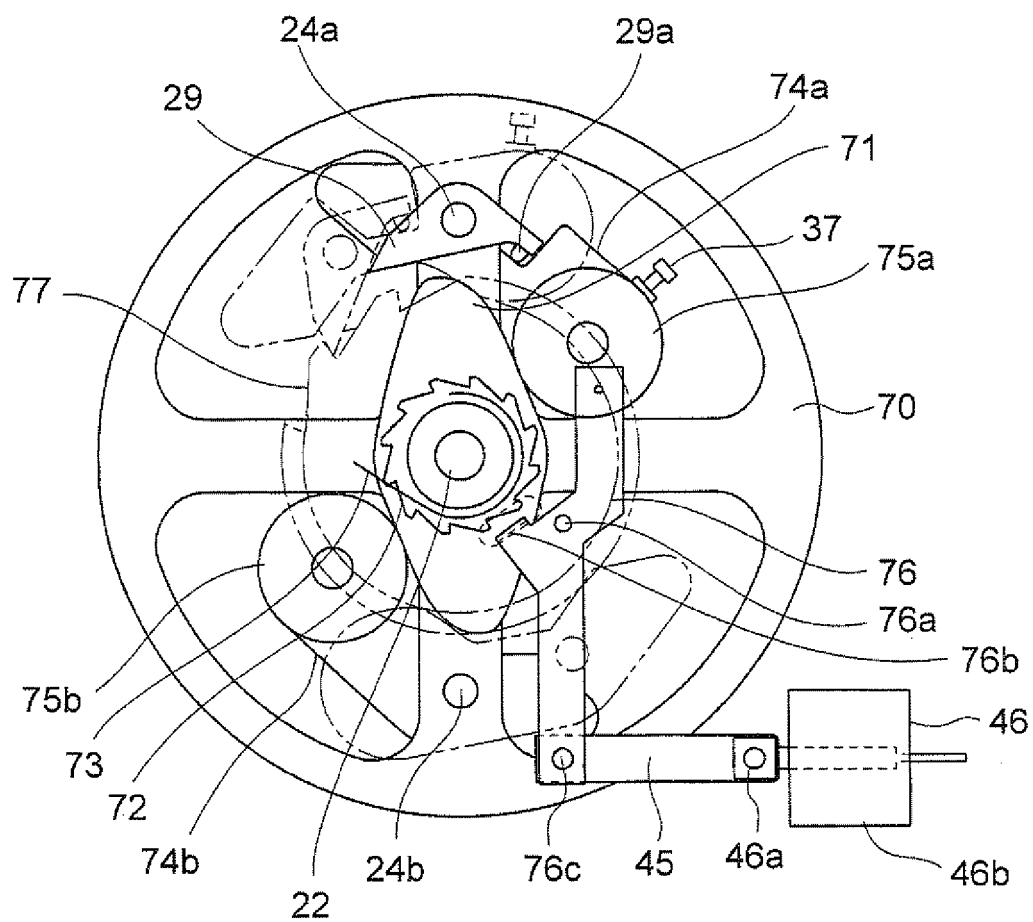


FIG. 9

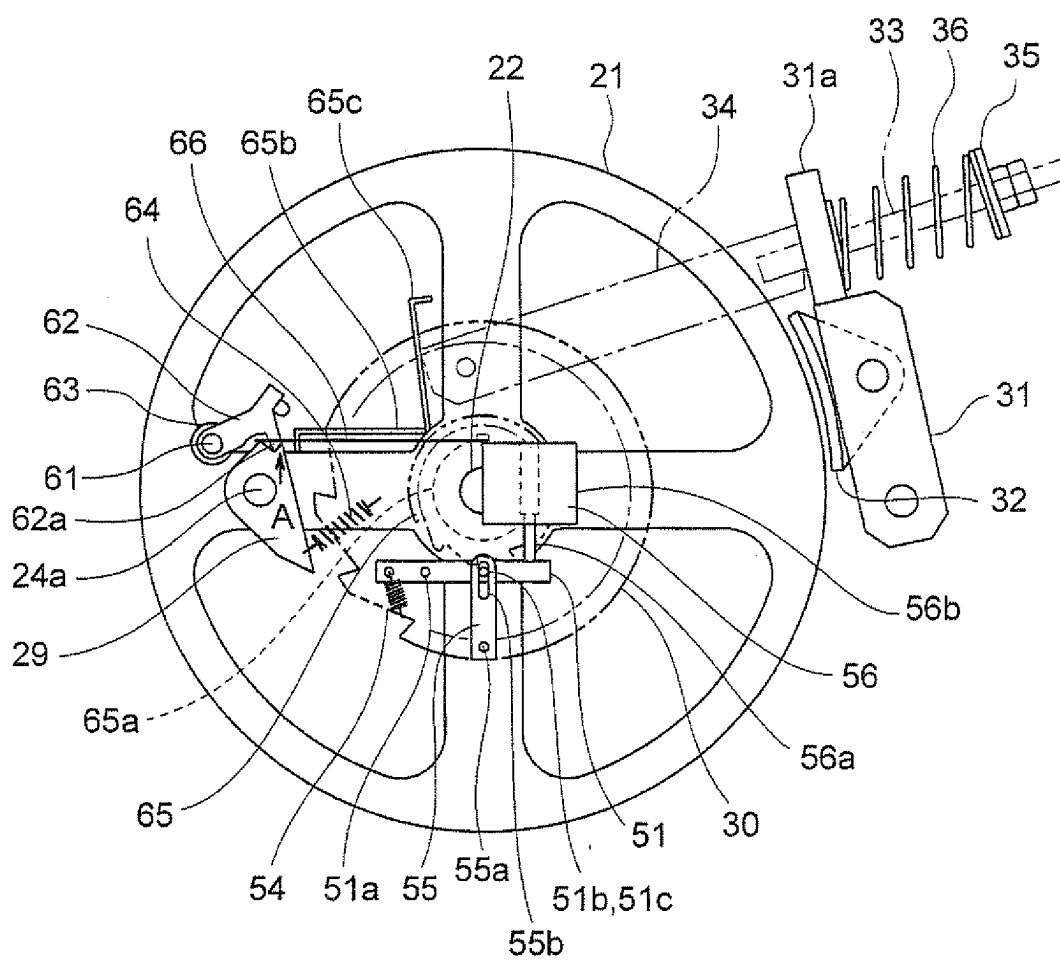


FIG. 10

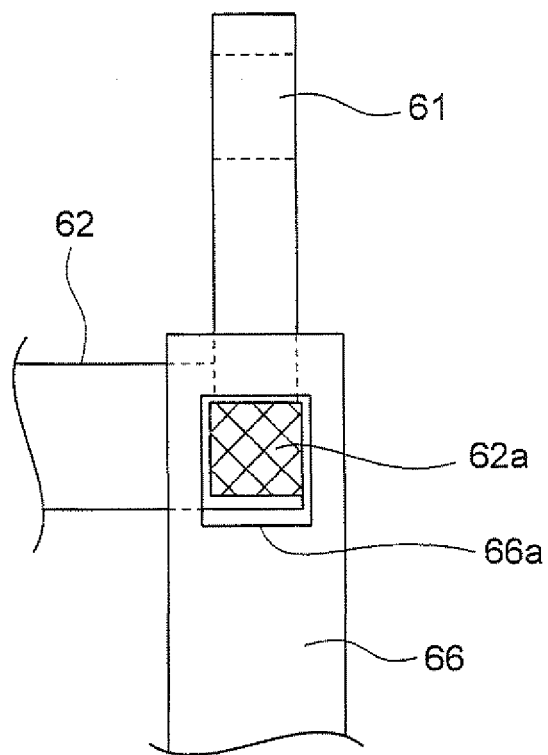


FIG. 11

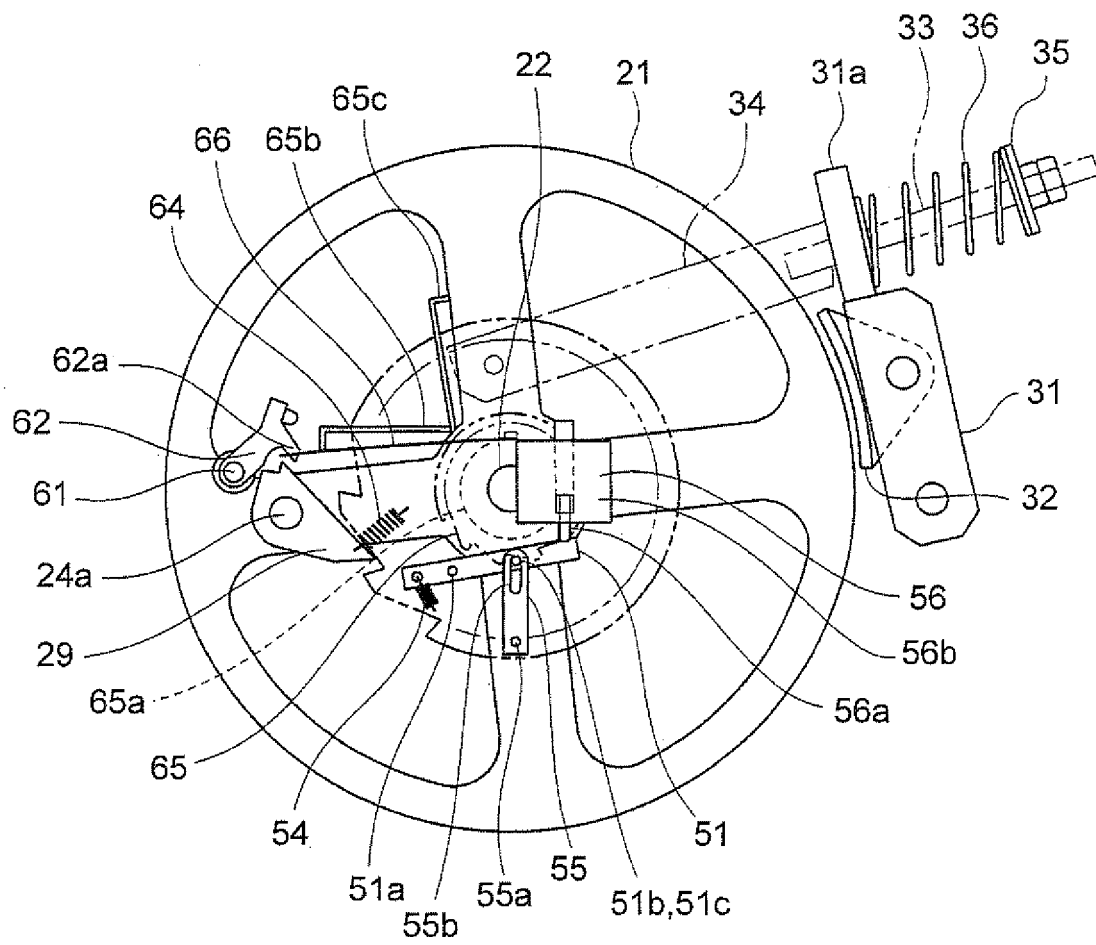


FIG. 12

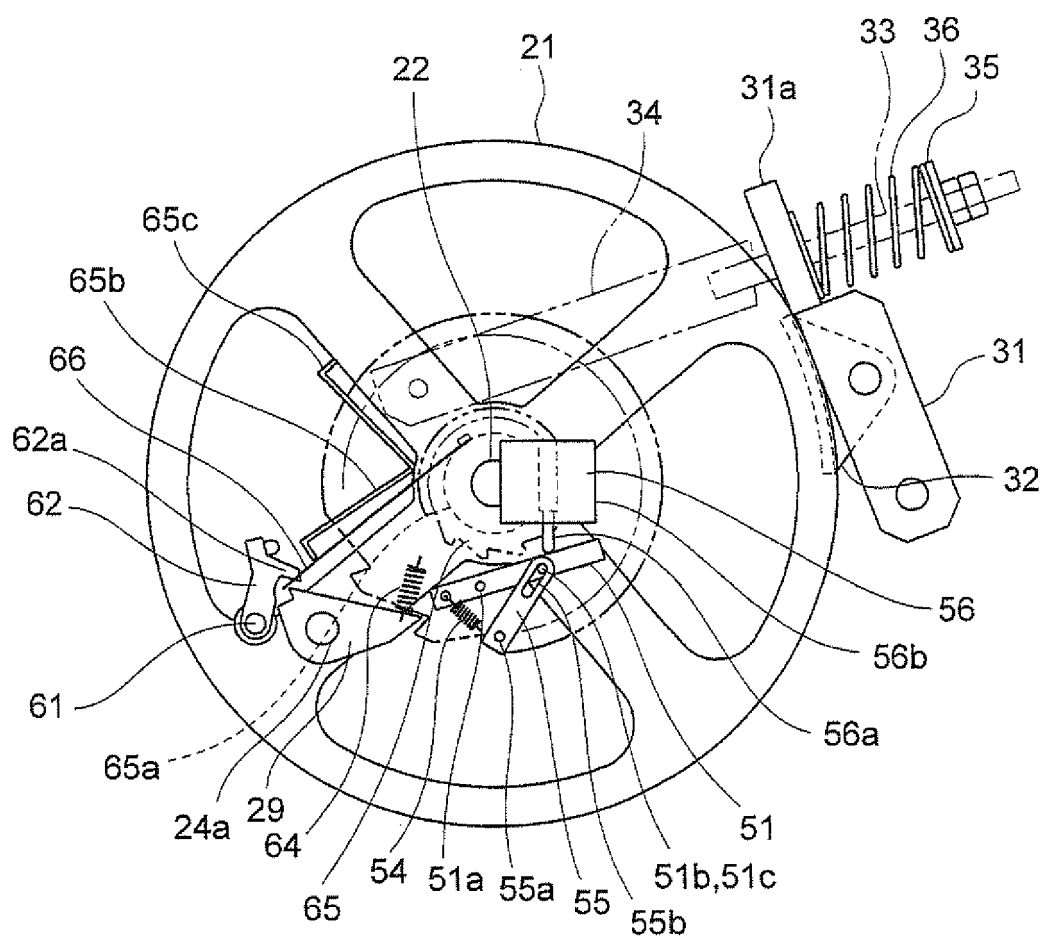
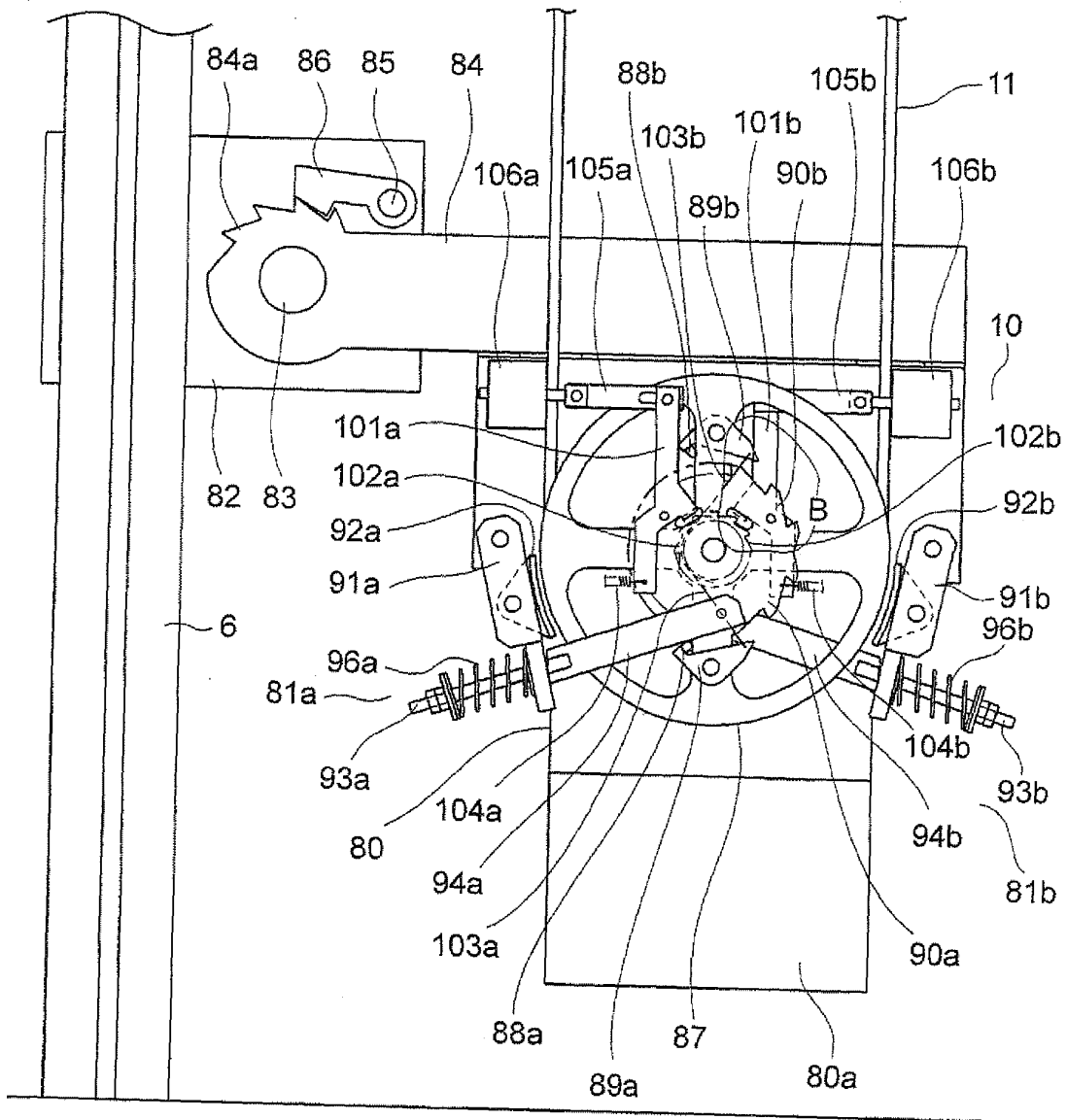


FIG. 13



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/050729

A. CLASSIFICATION OF SUBJECT MATTER
B66B5/04 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
B66B5/04

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	WO 2007/135725 A1 (Mitsubishi Electric Corp.), 29 November 2007 (29.11.2007), entire text; all drawings & EP 2020396 A1	1-8
A	JP 2001-80838 A (Toshiba Corp.), 27 March 2001 (27.03.2001), entire text; all drawings (Family: none)	1-8
A	JP 2002-370879 A (Mitsubishi Electric Corp.), 24 December 2002 (24.12.2002), entire text; all drawings (Family: none)	1-8

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

* Special categories of cited documents:	"I" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"P" document published prior to the international filing date but later than the priority date claimed	

Date of the actual completion of the international search
09 October, 2009 (09.10.09)

Date of mailing of the international search report
20 October, 2009 (20.10.09)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/050729

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 7-10411 A (Kone OY), 13 January 1995 (13.01.1995), entire text; all drawings & US 5492200 A1 & EP 628510 A3 & CN 1108612 A	1-8

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2002370879 A [0096]