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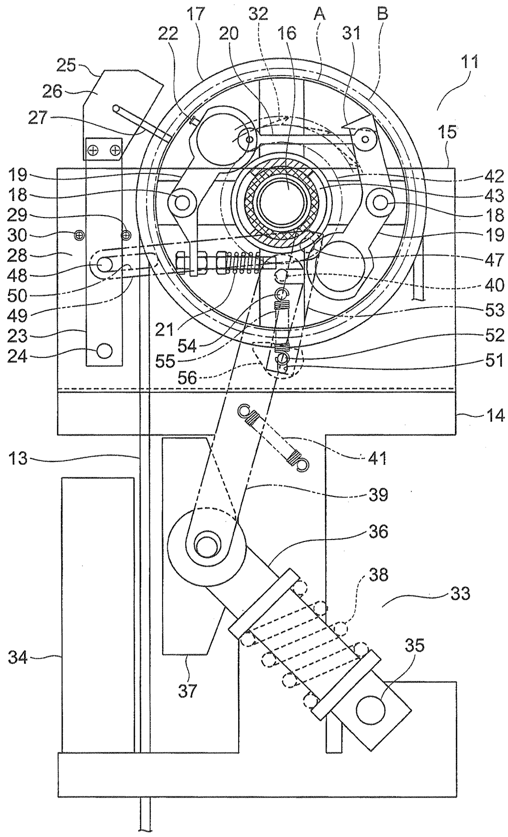
(54) ELEVATOR SPEED GOVERNOR

(57) Torque in a like direction to a speed governor sheave is applied to a rotating body by a torque transmitting apparatus when the speed governor sheave is rotated. An overspeed detecting switch that is displaced together with a switch mounting member is displaceable between a first setting position to be operated by an activating segment when the car speed is at a first overspeed, and a second setting position to be operated by the activating segment when the car speed is at a second overspeed that is higher than the first overspeed. A ratchet is displaceable in an axial direction of a main shaft between an engageable position at which engage with an engaging pawl is possible, and an unengageable position at which engagement with the engaging pawl is avoided. The switch mounting member and the rotating body are operated interdependently by a first interlocking apparatus, and the ratchet and the rotating body are operated interdependently by a second interlocking apparatus. The overspeed detecting switch is thereby displaced between the first setting position and the second setting position in response to the direction of rotation of the rotating body, and the ratchet is displaced between the engageable position and the unengageable position in response to the direction of rotation of the rotating body.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present invention relates to an elevator speed governor that has a speed governor sheave that is rotated together with movement of a car.

BACKGROUND ART

[0002] Conventionally, in order to make a set overspeed during ascent of a car higher than during descent, elevator speed governors have been proposed in which mechanical power transmission between two speed controlling mechanisms is connected and released by a clutching apparatus. The set overspeed of a first speed controlling mechanism is higher than the set overspeed of a second speed controlling mechanism. During ascent of the car, the second speed controlling mechanism is disconnected from the first speed controlling mechanism by the clutching apparatus, and only the first speed controlling mechanism that has the higher set overspeed functions. During descent of the car, the speed controlling mechanisms are connected to each other by means of the clutching apparatus, and both of the speed controlling mechanisms function. Thus, the set overspeed of the speed governing apparatus is lower during descent of the car than during ascent (see Patent Literature 1).

[0003] Progressive safety apparatuses are also conventionally known in which a guiding bolt is moved by a spring force from a compression spring by removing a stopper from the guiding bolt by controlling power supply to an electromagnetic actuator to press a brake shoe against a guide rail to generate a braking force (see Patent Literature 2).

[0004] In addition, elevator speed governors are also conventionally known in which permanent magnets, a direct-current generator that generates electric power that corresponds to a direction of rotation of a sheave, and an electromagnet in which magnetic poles change in response to the electric power from the direct-current generator are disposed on the sheave, and a preset overspeed is made greater during ascent of a car than during descent by attracting the electromagnet to the permanent magnet during reverse rotation of the sheave to restrict pivoting of the flyweight, and repelling the electromagnet from the permanent magnet during forward rotation of the sheave to release the restriction on the pivoting of the flyweight (see Patent Literature 3).

CITATION LIST

PATENT LITERATURE

[0005]

[Patent Literature 1]
Japanese Patent No. 4306014 (Gazette)
[Patent Literature 2]
Japanese Patent Laid-Open No. 2006-347771 (Gazette)
[Patent Literature 3]
Japanese Patent Laid-Open No. 2009-154984 (Gazette)

SUMMARY OF THE INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0006] However, in the elevator speed governing apparatus that is disclosed in Patent Literature 1, because two speed controlling mechanisms are required, the entire apparatus is enlarged.
In the progressive safety apparatus that is disclosed in Patent Literature 2, electricity cannot be supplied to the electromagnetic actuator when there is a power outage, making it impossible to operate the apparatus. Thus, operational reliability of the apparatus is reduced.
In addition, in the elevator speed governor that is disclosed in Patent Literature 3, malfunction of the direct-current generator or the electromagnet due to wire breakage, etc., may arise, reducing the operational reliability of the apparatus. It is also conceivable to dispose a monitoring apparatus that monitors for malfunction due to wire breakage, etc., in order to improve the operational reliability of the apparatus, but in that case the apparatus becomes complicated.

[0007] The present invention aims to solve the above problems and an object of the present invention is to provide an elevator speed governor that can suppress enlargement, and that can operate more reliably.

MEANS FOR SOLVING THE PROBLEM

[0008] In order to achieve the above object, according to one aspect of the present invention, there is provided an elevator speed governor including: a supporting body on which a main shaft is disposed; a speed governor sheave around which is wound a speed governor rope that is moved together with a car, the speed governor sheave being rotated around the main shaft in response to the movement of the car; a flyweight that is disposed on the speed governor sheave, and that is pivoted relative to the speed governor sheave in response to a centrifugal force that arises due to the rotation of the speed governor sheave; an activating segment that is disposed on the flyweight, and that is displaced relative to the speed governor sheave outward in a radial direction of the speed governor sheave by the pivoting of the flyweight in a direction in which a rotational speed of the speed governor sheave increases; an engaging pawl that is disposed on the flyweight, and that is displaced inward in the radial direction of the speed governor sheave by pivoting of the flyweight in the direction in which the rotational speed of the speed governor sheave increases; a rotating body that is rotatable around the main shaft separately from the speed governor sheave; a torque transmitting apparatus that applies torque to the rotating body in a like direction to the speed governor sheave by the speed governor sheave being rotated; a switch mounting member that is disposed displaceably on the supporting body; a first interlocking apparatus that interlocks the rotating body and the switch mounting member to displace the switch mounting member in response to a direction of rotation of the rotating body; an overspeed detecting switch that is displaced together with the switch mounting member, and that is activated by operating the activating segment; a restricting apparatus that restricts a range of displacement of the overspeed detecting switch such that the overspeed detecting switch is displaced between a first setting position at which the overspeed detecting switch is operated by the activating segment when the speed of the car is at a predetermined first overspeed, and a second setting position at which the overspeed detecting switch is operated by the activating segment when the speed of the car is at a second overspeed that is higher than the first overspeed; a ratchet that is displaceable in an axial direction of the main shaft between an engageable position at which the engaging pawl engages when the speed of the car is at an emergency stopping overspeed that is higher than the second overspeed, and an unengageable position that is separated from the speed governor sheave such that engagement with the engaging pawl is avoided, the ratchet being rotated around the main shaft in a like direction to the speed governor sheave by engagement with the engaging pawl; a second interlocking apparatus that interlocks the rotating body and the ratchet so as to displace the ratchet between the engageable position and the unengageable position in response to the direction of rotation of the rotating body; and a gripping apparatus that grips the speed governor rope by the ratchet being rotated.

EFFECTS OF THE INVENTION

[0009] In an elevator speed governor according to the present invention, because torque in a like direction to the speed governor sheave is applied to the rotating body by the torque transmitting apparatus, and the overspeed detecting switch operates interdependently with the rotating body through the first interlocking apparatus, and the ratchet is displaced by the second interlocking apparatus in the axial direction of the main shaft interdependently with the rotating body, it is not necessary to install a plurality of speed governors, enabling overall enlargement of the speed governor to be suppressed. Furthermore, different overspeeds can be detected when the direction of movement of the car is upward from when it is downward without having to use an electrical speed detecting sensor. In addition, the speed governor can be activated without having to supply electric power to the speed governor. Consequently, operation of the speed governor can be prevented from becoming impossible due to the power outages or wire breakages, for example, and the speed governor can thereby be operated more reliably.

BRIEF DESCRIPTION OF THE DRAWINGS

[0010]

Figure 1 is a configuration diagram that shows an elevator apparatus according to Embodiment 1 of the present invention;
Figure 2 is a front elevation that shows a speed governor from Figure 1;
Figure 3 is a lateral cross section that shows the speed governor from Figure 2;
Figure 4 is a front elevation that shows a rotating body and a torque transmitting apparatus from Figure 2;
Figure 5 is a lateral cross section that shows the rotating body and the torque transmitting apparatus from Figure 3;
Figure 6 is a front elevation that shows the speed governor when a car from Figure 1 descends;
Figure 7 is a front elevation that shows part of the speed governor from Figure 6;
Figure 8 is a lateral cross section that shows part of the speed governor from Figure 6;
Figure 9 is a front elevation that shows the speed governor when an operating lever from Figure 6 is operated by an activating segment;
Figure 10 is a front elevation that shows the speed governor when an engaging hook from Figure 6 engages an outer circumferential portion of a ratchet;
Figure 11 is a front elevation that shows the speed governor when a brake shoe from Figure 2 is in an open position;
Figure 12 is a front elevation that shows the speed governor when the brake shoe from Figure 11 is in a gripping position;
Figure 13 is a front elevation that shows the speed governor when the car from Figure 1 ascends;
Figure 14 is a front elevation that shows part of the speed governor from Figure 13;
Figure 15 is a lateral cross section that shows part of the speed governor from Figure 13;
Figure 16 is a top plan that shows a state in which an overspeed detecting switch of an elevator speed governor according to Embodiment 2 of the present invention is set to a low overspeed setting position; and
Figure 17 is a top plan that shows a state in which the overspeed detecting switch of the elevator speed governor from Figure 16 is set to a high overspeed setting position.

DESCRIPTION OF EMBODIMENTS

[0011] Preferred embodiments of the present invention will now be explained with reference to the drawings.

Embodiment 1

[0012] Figure 1 is a configuration diagram that shows an elevator apparatus according to Embodiment 1 of the present invention. In the figure, disposed in an upper portion inside a hoistway 1 are: a hoisting machine (a driving apparatus) 4 that generates a driving force that moves a car 2 and a counterweight 3 vertically; and a deflecting sheave 5. The hoisting machine 4 has: a hoisting machine main body 6 that includes a motor; and a driving sheave 7 that is disposed on the hoisting machine main body 6, and that is rotated by the driving force from the hoisting machine main body 6. The deflecting sheave 5 is disposed so as to be separated from the driving sheave 7.

[0013] A suspending means 8 that suspends the car 2 and the counterweight 3 is wound around the driving sheave 7 and the deflecting sheave 5. Ropes or belts, for example, are used as the suspending means 8. The car 2 and the counterweight 3 are moved vertically inside the hoistway 1 by rotation of the driving sheave 7. When the car 2 and the counterweight 3 are moved inside the hoistway 1, the car 2 is guided by car guide rails (not shown), and the counterweight 3 is guided by counterweight guide rails (not shown).

[0014] A mechanical emergency stopping apparatus 9 that prevents falling of the car 2 is disposed on a lower portion of the car 2. An operating arm 10 is disposed on the emergency stopping apparatus 9. The emergency stopping apparatus 9 grips the car guide rails by operation of the operating arm 10. Falling of the car 2 is stopped by gripping of the car guide rails by the emergency stopping apparatus 9.

[0015] A speed governor 11 is disposed in an upper portion inside the hoistway 1, and a tensioning sheave 12 is disposed in a lower portion inside the hoistway 1. A speed governor rope 13 is wound around the speed governor 11 and the tensioning sheave 12. A first end portion and a second end portion of the speed governor rope 13 are connected to the operating arm 10. The speed governor rope 13 is thereby strung in a loop shape around the speed governor 11 and the tensioning sheave 12. The speed governor rope 13 is moved together with the car 2.

[0016] The speed governor 11 is able to grip the speed governor rope 13. The operating arm 10 is operated by the speed governor rope 13 being gripped by the speed governor 11 when the car 2 is moving, and the car 2 being displaced relative to the speed governor rope 13.

[0017] Figure 2 is a front elevation that shows the speed governor 11 from Figure 1. Figure 3 is a lateral cross section that shows the speed governor 11 from Figure 2. In the figures, a housing (a supporting body) 15 is fixed onto a speed governor base 14 that is fixed inside the hoistway 1. A main shaft 16 is fixed to the housing 15 horizontally. A speed governor sheave 17 around which the speed governor rope 13 is wound is rotatably disposed on the main shaft 16. The speed governor sheave 17 is rotated around the main shaft 16 in response to the movement of the speed governor rope 13 (i.e., the movement of the car 2). Specifically, the speed governor sheave 17 is rotated in a forward direction (clockwise in Figure 2) by upward movement (ascent) of the car 2, and is rotated in a reverse direction (counterclockwise in Figure 2) by downward movement (descent) of the car 2. The rotational speed of the speed governor sheave 17 is a speed that corresponds to the traveling speed of the car 2.

[0018] As shown in Figure 3, the housing 15 has: first and second supporting plates 15a and 15b that face each other in an axial direction of the main shaft 16; and a bottom plate 15c that is mounted to the speed governor base 14 so as to be fixed horizontally between lower end portions of the supporting plates 15a and 15b. A first end portion of the main shaft 16 is fixed to the first supporting plate 15a, and a second end portion of the main shaft 16 is fixed to the second supporting plate 15b.

[0019] A pair of weight shafts 18 that are parallel to a shaft axis of the main shaft 16 are disposed on the speed governor sheave 17, as shown in Figure 2. The weight shafts 18 are disposed at symmetrical positions relative to the shaft axis of the main shaft 16. A flyweight 19 is mounted pivotably to each of the weight shafts 18. Specifically, first and second flyweights 19 that are respectively individually pivotable around the pair of weight shafts 18 are disposed on the speed governor sheave 17.

[0020] The flyweights 19 are pivoted around the weight shafts 18 relative to the speed governor sheave 17 in response to centrifugal force that arises due to the rotation of the speed governor sheave 17. In other words, the flyweights 19 are pivoted relative to the speed governor sheave 17 in response to the rotational speed of the speed governor sheave 17.

[0021] A first end portion of the first flyweight 19 and a second end portion of the second flyweight 19 are linked to each other by means of a link 20, as shown in Figure 2. A balancing spring 21 that opposes the centrifugal force is disposed between the second end portion of the first flyweight 19 and a boss portion of the speed governor sheave 17. As the rotational speed of the speed governor sheave 17 increases, the flyweights 19 are both pivoted relative to the speed governor sheave 17 in opposition to the spring force of the balancing spring 21.

[0022] An activating segment 22 that protrudes outward in a radial direction of the speed governor sheave 17 is disposed on a first end portion of the first flyweight 19. The activating segment 22 is displaced relative to the speed governor sheave 17 outward in the radial direction of the speed governor sheave 17 by the pivoting of the flyweights 19 when the rotational speed of the speed governor sheave 17 increases, and is displaced relative to the speed governor sheave 17 inward in the radial direction of the speed governor sheave 17 by the pivoting of the flyweights 19 when the rotational speed of the speed governor sheave 17 decreases. The orbit of the activating segment 22 when the speed governor sheave 17 is rotated is thereby moved outward in the radial direction of the speed governor sheave 17 as the rotational speed of the speed governor sheave 17 increases (i.e., as the traveling speed of the car 2 increases).

[0023] A first end portion of a flat switch mounting member 23 that has a predetermined length is mounted to the housing 15 by means of a pin 24. The pin 24 is disposed parallel to the shaft axis of the main shaft 16. The switch mounting member 23 is pivotable around the pin 24. In other words, the switch mounting member 23 is disposed displaceably on the housing 15.

[0024] An overspeed detecting switch 25 is mounted to a second end portion of the switch mounting member 23. Consequently, the overspeed detecting switch 25 is displaced relative to the housing 15 together with the switch mounting member 23. Furthermore, the overspeed detecting switch 25 is displaced by the pivoting of the switch mounting member 23 relative to the housing 15 in a direction in which a distance from the main shaft 16 changes.

[0025] The overspeed detecting switch 25 has: a switch main body 26 that is fixed to the second end portion of the switch mounting member 23; and an operating lever 27 that protrudes toward the main shaft 16 from the switch main body 26. The overspeed detecting switch 25 outputs a stopping signal to an elevator controlling apparatus (not shown) when the operating lever 27 is operated. When the controlling apparatus receives the stopping signal from the overspeed detecting switch 25, the power supply to the hoisting machine 4 is stopped under control from the controlling apparatus to activate the braking apparatus (not shown) of the hoisting machine 4.

[0026] A restricting apparatus 28 that restricts a range of displacement of the overspeed detecting switch 25 is disposed on the housing 15. The restricting apparatus 28 has: a first stopper 29 that restricts displacement of the overspeed detecting switch 25 toward the main shaft 16; and a second stopper 30 that restricts displacement of the overspeed detecting switch 25 away from the main shaft 16.

[0027] The first stopper 29 is fixed at a position that is closer to the main shaft 16 than the switch mounting member 23, and the second stopper 30 is fixed at a position that is further away from the main shaft 16 than the switch mounting member 23. The displacement of the overspeed detecting switch 25 toward the main shaft 16 is restricted by the switch mounting member 23 contacting the first stopper 29, and the displacement of the overspeed detecting switch 25 away from the main shaft 16 is restricted by the switch mounting member 23 contacting the second stopper 30.

[0028] The position of the overspeed detecting switch 25 relative to the main shaft 16 is set to a predetermined low overspeed setting position (a first setting position) by the switch mounting member 23 contacting the first stopper 29, and is set to a high overspeed setting position (a second setting position) that is further away from the main shaft 16 than the low overspeed setting position by the switch mounting member 23 contacting the second stopper 30. In other words, the range of displacement of the overspeed detecting switch 25 is limited to a range between the low overspeed setting position and the high overspeed setting position by the restricting apparatus 28.

[0029] When the overspeed detecting switch 25 is set to the low overspeed setting position, a tip end portion of the operating lever 27 is disposed in an orbit A of the activating segment 22 when the speed of the car 2 is at a predetermined first overspeed V1. Consequently, when the overspeed detecting switch 25 is set to the low overspeed setting position, the operating lever 27 is operated by the activating segment 22 by the speed of the car 2 reaching the first overspeed V1.

[0030] When the overspeed detecting switch 25 is set to the high overspeed setting position, the tip end portion of the operating lever 27 is disposed in an orbit B of the activating segment 22 when the speed of the car 2 is at a second overspeed V2 that is higher than the first overspeed V1. Consequently, when the overspeed detecting switch 25 is set to the high overspeed setting position, the operating lever 27 is operated by the activating segment 22 by the speed of the car 2 reaching the second overspeed V2 that is higher than the first overspeed V1.

[0031] An engaging pawl 31 that protrudes radially inward from the speed governor sheave 17 is disposed on a second end portion of the second flyweight 19. Consequently, the engaging pawl 31 is displaced radially relative to the speed governor sheave 17 inward in the radial direction of the speed governor sheave 17 by the pivoting of the flyweights 19 when the rotational speed of the speed governor sheave 17 increases, and is displaced relative to the speed governor sheave 17 outward in the radial direction of the speed governor sheave 17 by the pivoting of the flyweights 19 when the rotational speed of the speed governor sheave 17 decreases. The orbit of the engaging pawl 31 when the speed governor sheave 17 is rotated is thereby moved inward in the radial direction of the speed governor sheave 17 as the rotational speed of the speed governor sheave 17 increases (i.e., as the traveling speed of the car 2 increases).

[0032] A ratchet 32 is disposed on the main shaft 16 separately from the speed governor sheave 17. The ratchet 32 is rotatable around the main shaft 16. As shown in Figure 3, the ratchet 32 is displaceable in an axial direction of the main shaft 16 between a predetermined engageable position; and an unengageable position that is further away from the speed governor sheave 17 than the engageable position.

[0033] As shown in Figure 2, a plurality of teeth that are engageable with the engaging pawl 31 only when the direction of rotation of the speed governor sheave 17 is the reverse direction (i.e., when the car 2 is moving downward) are disposed on an outer circumferential portion of the ratchet 32.

[0034] If the speed of the car 2 reaches an emergency stopping overspeed V3 that is higher than the second overspeed V2 during downward movement of the car 2 when the ratchet 32 is set to the engageable position, the engaging pawl 31 engages with the teeth of the ratchet 32. When the ratchet 32 is set to the unengageable position, the position of the ratchet 32 is outside a range of displacement of the engaging pawl 31, and engagement between the teeth of the ratchet 32 and the engaging pawl 31 is avoided. The ratchet 32 is rotated in a like direction to the speed governor sheave 17 by the engaging pawl 31 engaging with the teeth of the ratchet 32 when the speed governor sheave 17 is being rotated in the reverse direction (i.e., during descent of the car 2).

[0035] A gripping apparatus 33 that grips the speed governor rope 13 when the ratchet 32 is rotated in the reverse direction (counterclockwise in Figure 2) is disposed on the speed governor base 14. The gripping apparatus 33 is disposed below the ratchet 32, as shown in Figure 2.

[0036] The gripping apparatus 33 has: a pressing plate (a bearing portion) 34 that is fixed to the speed governor base 14; a telescopic arm 36 that can be extended and retracted, a first end of which is pivotably mounted onto a pin 35 on the speed governor base 14; a brake shoe (a movable portion) 37 that is mounted pivotably to a second end portion of the telescopic arm 36, and that is displaced in a direction of contact with and separation from the pressing plate 34 by the pivoting of the telescopic arm 36; and a pressing spring 38 that is disposed on the telescopic arm 36, and that generates an elastic repulsive force that opposes force in a direction in which the telescopic arm 36 is retracted.

[0037] The brake shoe 37 is displaceable by the pivoting of the telescopic arm 36 between a gripping position that grips the speed governor rope 13 against the pressing plate 34; and an open position that is separated from the pressing plate 34 to release gripping of the speed governor rope 13. When the brake shoe 37 is in the gripping position, the telescopic arm 36 is compressed, and the brake shoe 37 is pressed against the pressing plate 34 by the elastic repulsive force of the pressing spring 38 with the speed governor rope 13 interposed.

[0038] A supporting lever 39 is linked pivotably to the telescopic arm 36. A holding pin 40 onto which an upper end portion of the supporting lever 39 is hooked is fixed to a side surface of the ratchet 32. The brake shoe 37 is held in the open position by the supporting lever 39 being hooked onto the holding pin 40.

[0039] The supporting lever 39 is configured so as to be disengaged from the holding pin 40 by the ratchet 32 rotating in a like direction to the speed governor sheave 17 while the engaging pawl 31 is engaged in teeth of the ratchet 32. The brake shoe 37 is displaced to the gripping position by deadweight when the supporting lever 39 is disengaged from the holding pin 40. Moreover, a retracting spring 41 is connected between the supporting lever 39 and the speed governor base 14 in order to prevent the supporting lever 39 from disengaging erroneously from the holding pin 40 (malfunctioning) due to vibration, for example.

[0040] A discoid rotating body 42 is disposed on the main shaft 16 separately from the speed governor sheave 17 and the ratchet 32. The rotating body 42 is rotatable around the main shaft 16. The rotating body 42 is disposed on an opposite side of the speed governor sheave 17 from the ratchet 32 in the axial direction of the main shaft 16. A torque transmitting apparatus 43 that applies torque to the rotating body 42 in a like direction to the speed governor sheave 17 due to the speed governor sheave 17 being rotated is disposed between the rotating body 42 and the speed governor sheave 17.

[0041] Now, Figure 4 is a front elevation that shows the rotating body 42 and the torque transmitting apparatus 43 from Figure 2. Figure 5 is a lateral cross section that shows the rotating body 42 and the torque transmitting apparatus 43 from Figure 3. A cylindrical fixed portion 44 that is centered around the shaft axis of the main shaft 16 is fixed to a surface of the speed governor sheave 17 near the rotating body 42. The torque transmitting apparatus 43 has: a plurality of (in this example, two) permanent magnets 45 that are fixed to an inner surface of the fixed portion 44; and a metal body 46 that is fixed to a side surface of the rotating body 42, and that is disposed radially further inside the speed governor sheave 17 than the permanent magnets 45.

[0042] The permanent magnets 45 are disposed on the fixed portion 44 so as to be spaced apart from each other in a circumferential direction. The permanent magnets 45 move in a circular orbit around the metal body 46 by being rotated together with the speed governor sheave 17.

[0043] The metal body 46 is a cylindrical member that is centered around the shaft axis of the main shaft 16. The metal body 46 is a laminated body that is configured by laminating a plurality of metal sheets in the axial direction of the main shaft 16. In addition, the metal body 46 faces the permanent magnets 45 so as to have a predetermined clearance interposed in a radial direction of the speed governor sheave 17. The metal body 46 is rotated together with the rotating body 42 while facing in the permanent magnets 45 inside the fixed portion 44.

[0044] When the speed governor sheave 17 rotates, the permanent magnets 45 move around the metal body 46 together with the speed governor sheave 17. When the permanent magnets 45 move around the metal body 46 in the direction of rotation of the speed governor sheave 17, torque is generated in the metal body 46 in a like direction to the speed governor sheave 17 due to the principle of Arago's disk, because eddy currents are generated on the surface of the metal body 46. Torque is thereby applied to the rotating body 42 in a like direction to the speed governor sheave 17. In other words, the torque transmitting apparatus 43 applies the torque received from the speed governor sheave 17 to the rotating body 42 in the direction of rotation of the speed governor sheave 17 without contact. The rotating body 42 is thereby subjected to torque in the forward direction when the speed governor sheave 17 is rotated in the forward direction, and subjected to torque in the reverse direction when the speed governor sheave 17 is rotated in the reverse direction.

[0045] A linking pin 47 that is parallel to the shaft axis of the main shaft 16 is disposed on a side surface of the rotating body 42. As shown in Figure 2, a linking pin 48 that is parallel to the shaft axis of the main shaft 16 is disposed on an intermediate portion of the switch mounting member 23. A first linking member 49 that functions as a first interlocking device that operates the rotating body 42 and the switch mounting member 23 interdependently is coupled between the linking pins 47 and 48.

[0046] A first end portion of the first linking member 49 is mounted pivotably onto the linking pin 47. A slot 50 that is parallel to a longitudinal direction of the first linking member 49 is disposed on a second end portion of the first linking member 49. The second end portion of the first linking member 49 is mounted onto the linking pin 48 such that the linking pin 48 is inserted slidably into the slot 50. The rotating body 42 and the switch mounting member 23 thereby operate interdependently. The switch mounting member 23 is thereby displaced in response to the direction of rotation of the rotating body 42.

[0047] Movement of the linking pin 47 when the rotating body 42 rotates in the reverse direction (counterclockwise in Figure 2) is restricted by the switch mounting member 23 contacting the first stopper 29. Movement of the liking pin 47 when the rotating body 42 rotates in the forward direction (clockwise in Figure 2) is restricted by the switch mounting member 23 contacting the second stopper 30. The position of the linking pin 47 is set to a predetermined first boundary position that is further away from the switch mounting member 23 than a vertical plane that includes the shaft axis of the main shaft 16 by the switch mounting member 23 contacting the first stopper 29, and is set to a predetermined second boundary position that is closer to the switch mounting member 23 than the vertical plane that includes the shaft axis of the main shaft 16 by the switch mounting member 23 contacting the second stopper 30. Consequently, the range through which the linking pin 47 is moved by the rotation of the rotating body 42 is limited to a range between the first boundary position and the second boundary position.

[0048] Vertically oriented slots 51 are respectively disposed on each of the supporting plates 15a and 15b. Each of the slots 51 is disposed in a vertical plane that includes the shaft axis of the main shaft 16. A common linking shaft 52 is disposed horizontally between each of the supporting plates 15a and 15b so as to be passed through each of the slots 51. The linking shaft 52 is slidable vertically inside each of the slots 51.

[0049] A second linking member 53 is coupled between the linking pin 47 and the linking shaft 52. A first end portion of the second linking member 53 is mounted pivotably onto the linking pin 47. A second end portion of the second linking member 53 is fixed to the linking shaft 52. Consequently the linking shaft 52 is pivoted around the shaft axis of the linking shaft 52 by the linking pin 47 being displaced between the first boundary position and the second boundary position.

[0050] Lugs 54 that are disposed above the slots 51 are respectively fixed to each of the supporting plates 15a and 15b. Retracting springs 55 that force the linking shaft 52 toward the lugs 54 (upward) are respectively connected between the two end portions of the linking shaft 52 and each of the lugs 54. Holding of the linking pin 47 at the respective first and second boundary positions is stabilized by the linking pin 47 being subjected to the forces from the retracting springs 55, preventing the occurrence of malfunction due to vibration, for example.

[0051] A first cam 56 is fixed to the linking shaft 52. The first cam 56 is pivoted around the shaft axis of the linking shaft 52 together with the linking shaft 52.

[0052] As shown in Figure 3, a ratchet forcing spring (a forcing body) 57 that forces the ratchet 32 away from the speed governor sheave 17 parallel to the shaft axis of the main shaft 16 is disposed between the ratchet 32 and the speed governor sheave 17.

[0053] As shown in Figure 3, a second cam 58 that is subjected to the force from the ratchet forcing spring 57 is disposed on an outer circumferential surface of the main shaft 16 in a state of contact with a side surface of the ratchet 32. The second cam 58 is disposed at a position that is further away from the speed governor sheave 17 than the ratchet 32. The second cam 58 is pivotable around a shaft that is oriented in a radial direction of the main shaft 16.

[0054] A shaft 59 that has a first end portion that contacts the first cam 56, and a second end portion that contacts the second cam 58 is disposed between the first cam 56 and the second cam 58. The shaft 59 is displaced vertically in response to the pivoting of the first cam 56. The second cam 58 is pivoted in response to the vertical displacement of the shaft 59. The ratchet 32 is displaced between the engageable position and the unengageable position in response to the pivoting of the second cam 58.

[0055] In other words, the ratchet 32 is configured so as to be operated interdependently with the rotating body 42 by means of the second linking member 53, the linking shaft 52, the first cam 56, the shaft 59, and the second cam 58. When the rotating body 42 is rotated, the second linking member 53, the linking shaft 52, the first cam 56, the shaft 59, and the second cam 58 are activated sequentially depending on the direction of rotation of the rotating body 42, and the ratchet 32 is thereby displaced between the engageable position and the unengageable position depending on the direction of rotation of the rotating body 42. The ratchet 32 is thereby displaced to the unengageable position by the rotating body 42 being rotated in the forward direction, and is displaced to the engageable position by the rotating body 42 being rotated in the reverse direction.

[0056] Moreover, a second interlocking apparatus 60 that operates the rotating body 42 and the ratchet 32 interdependently includes: the second linking member 53, the linking shaft 52, the first cam 56, the shaft 59, the second cam 58, and the ratchet forcing spring 57. The speed governor 11 includes: the housing 15, the speed governor sheave 17, the flyweights 19, the activating segment 22, the switch mounting member 23, the overspeed detecting switch 25, the restricting apparatus 28, the engaging pawl 31, the ratchet 32, the gripping apparatus 33, the rotating body 42, the torque transmitting apparatus 43, the first linking member 49, and the second interlocking apparatus 60.

[0057] Next, operation of the speed governor 11 when the car 2 descends will be explained using Figures 6 through 12. As shown in Figure 6, when the car 2 descends, the speed governor sheave 17 is rotated counterclockwise in Figure 6 (the reverse direction) around the main shaft 16 in response to the movement of the speed governor rope 13. The flyweights 19 are thereby subjected to a centrifugal force that corresponds to the rotational speed of the speed governor sheave 17.

[0058] As the traveling speed of the car 2 increases, the centrifugal force to which the flyweights 19 is subjected increases and the flyweights 19 are pivoted around the weight shafts 18 in opposition to the spring force of the balancing spring 21. The activating segment 22 is thereby gradually displaced outward in a radial direction of the speed governor sheave 17, increasing the orbital radius of rotation of the activating segment 22.

[0059] At the same time, when the speed governor sheave 17 is rotated in the reverse direction, the permanent magnets 45 are also rotated in the reverse direction (counterclockwise in Figure 7) together with the speed governor sheave 17, as shown in Figure 7. At this point, eddy currents are generated on the surface of the metal body 46, and torque is generated in the metal body 46 in a like direction to the speed governor sheave 17 due to the principle of Arago's disk. The rotating body 42 is thereby subjected to torque in the reverse direction.

[0060] When the rotating body 42 is rotated in the reverse direction, as shown in Figure 7, the switch mounting member 23 is pivoted around the pin 24 in a direction in which the overspeed detecting switch 25 is moved closer to the main shaft 16 while being pulled by the first linking member 49, and contacts the first stopper 29. The linking pin 47 thereby reaches the first boundary position, and the rotation of the rotating body 42 in the reverse direction stops. The overspeed detecting switch 25 also reaches the low overspeed setting position.

[0061] When the rotating body 42 is rotated in the reverse direction, as shown in Figure 7, the second linking member 53 is also pivoted around the linking shaft 52 clockwise in Figure 7 together with the linking shaft 52 and the first cam 56. As shown in Figure 8, the shaft 59 is thereby pushed upward by the first cam 56, and the second cam 58 is pivoted in a direction in which the ratchet 32 is moved closer to the speed governor sheave 17. The ratchet 32 is thereby displaced toward the speed governor sheave 17 in opposition to the force from the ratchet forcing spring 57, and reaches the engageable position.

[0062] In other words, when the car 2 descends, the position of the overspeed detecting switch 25 is set to the low overspeed setting position, and the position of the ratchet 32 is set to the engageable position.

[0063] When the position of the overspeed detecting switch 25 is set to the low overspeed setting position, as shown in Figure 9, the operating lever 27 is operated by the activating segment 22 when it is moved in orbit A. The activating segment 22 moves in orbit A when the speed of the car 2 reaches the first overspeed V1. Consequently, when the car 2 descends, the operating lever 27 is operated by the activating segment 22 if the speed of the car 2 reaches the first overspeed V1. When the operating lever 27 is operated by the activating segment 22, the power supply to the hoisting machine 4 is stopped, activating the braking apparatus of the hoisting machine 4.

[0064] If the suspending means 8 breaks, for example, the speed of the car 2 continues increasing even after the hoisting machine 4 is stopped, and when the speed of the car 2 reaches the emergency stopping overspeed V3 that is higher than the first overspeed V1, the engaging pawl 31 engages in the outer circumferential portion of the ratchet 32, as shown in Figure 10. The ratchet 32 is thereby rotated in a like direction to the speed governor sheave 17, disengaging the supporting lever 39 from the holding pin 40. The brake shoe 37 is thereby displaced by deadweight from the open position that is shown in Figure 11 to the gripping position that is shown in Figure 12. The speed governor rope 13 is thereby gripped between the pressing plate 34 and the brake shoe 37, stopping the movement of the speed governor rope 13.

[0065] Next, operation of the speed governor 11 when the car 2 ascends will be explained using Figures 13 through 15. As shown in Figure 13, when the car 2 ascends, the speed governor sheave 17 is rotated clockwise in Figure 13 (the forward direction) around the main shaft 16 in response to the movement of the speed governor rope 13. Here, because the flyweights 19 are thereby also subjected to a centrifugal force that corresponds to the rotational speed of the speed governor sheave 17, the activating segment 22 is gradually displaced outward in a radial direction of the speed governor sheave 17 as the traveling speed of the car 2 increases.

[0066] At the same time, when the speed governor sheave 17 is rotated in the forward direction, the permanent magnets 45 are also rotated in the forward direction (clockwise in Figure 14) together with the speed governor sheave 17, as shown in Figure 14. At this point, eddy currents are generated on the surface of the metal body 46, and torque is generated in the metal body 46 in a like direction to the speed governor sheave 17 due to the principle of Arago's disk. The rotating body 42 is thereby subjected to torque in the forward direction.

[0067] When the rotating body 42 is rotated in the forward direction, as shown in Figure 14, the switch mounting member 23 is pivoted around the pin 24 in a direction in which the overspeed detecting switch 25 is moved away from the main shaft 16 while being pushed by the first linking member 49, and contacts the second stopper 30. The linking pin 47 thereby reaches the second boundary position, and the rotation of the rotating body 42 in the forward direction stops. The overspeed detecting switch 25 also reaches the high overspeed setting position.

[0068] When the rotating body 42 is rotated in the forward direction, as shown in Figure 14, the second linking member 53 is also pivoted around the linking shaft 52 counterclockwise in Figure 14 together with the linking shaft 52 and the first cam 56. As shown in Figure 15, the shaft 59 is thereby displaced downward, and the second cam 58 is pivoted clockwise in Figure 15. The ratchet 32 is thereby displaced away from the speed governor sheave 17 by the force from the ratchet forcing spring 57, and reaches the unengageable position.

[0069] In other words, when the car 2 ascends, the position of the overspeed detecting switch 25 is set to the high overspeed setting position, and the position of the ratchet 32 is set to the unengageable position.

[0070] When the position of the overspeed detecting switch 25 is set to the high overspeed setting position, the operating lever 27 is operated by the activating segment 22 when it is moved in orbit B. The activating segment 22 moves in orbit B when the speed of the car 2 reaches the second overspeed V2 that is higher than the first overspeed V1. Consequently, when the car 2 ascends, the operating lever 27 is operated by the activating segment 22 if the speed of the car 2 reaches the second overspeed V2. When the operating lever 27 is operated by the activating segment 22, the power supply to the hoisting machine 4 is stopped, activating the braking apparatus of the hoisting machine 4.

[0071] As shown in Figure 15, if the position of the ratchet 32 is set to the unengageable position, the position of the ratchet 32 is outside the range in which the engaging pawl 31 is displaced, the engaging pawl 31 cannot engage with the ratchet 32, and does not the gripping apparatus 33 is not activated.

[0072] In an elevator speed governor of this kind, because torque in a like direction to the speed governor sheave 17 is applied to the rotating body 42 by the torque transmitting apparatus 43, and the overspeed detecting switch 25 operates interdependently with the rotating body 42 through the first linking member 49, and the ratchet 32 is displaced by the second interlocking apparatus 60 in the axial direction of the main shaft 16 interdependently with the rotating body 42, it is not necessary to install a plurality of speed governors, enabling overall enlargement of the speed governor to be suppressed. Furthermore, different overspeeds can be detected when the direction of movement of the car 2 is upward from when it is downward without having to use an electrical speed detecting sensor (such as an encoder, for example). In addition, the speed governor 11 can be activated without having to supply electric power to the speed governor 11. Consequently, operation of the speed governor 11 can be prevented from becoming impossible due to the power outages or wire breakages, for example. The speed governor 11 can thereby be operated more reliably.

[0073] Because the torque transmitting apparatus 43 has: permanent magnets 45 that are rotated together with the speed governor sheave 17; and a metal body 46 that faces the permanent magnets 45 so as to have a predetermined clearance interposed, and that is rotated together with the rotating body 42, torque can be applied to the rotating body 42 in a like direction to the speed governor sheave 17 using a simple configuration. Size reductions can be thereby achieved in the speed governor 11.

Embodiment 2

[0074] In Embodiment 1, the overspeed detecting switch 25 is displaced in a direction in which its distance from the main shaft 16 changes, but the overspeed detecting switch 25 may also be displaced in an axial direction of the main shaft 16.

[0075] Specifically, Figure 16 is a top plan that shows a state in which an overspeed detecting switch of an elevator speed governor according to Embodiment 2 of the present invention is set to a low overspeed setting position (a first setting position). Figure 17 is a top plan that shows a state in which the overspeed detecting switch of the elevator speed governor from Figure 16 is set to a high overspeed setting position (a second setting position). In the figures, a switch mounting member (not shown) onto which the overspeed detecting switch 25 is mounted is pivotable around a pin that has a shaft axis that is perpendicular to the shaft axis of the main shaft 16. Consequently, the overspeed detecting switch 25 is displaced in the axial direction of the main shaft 16 by the switch mounting member being pivoted relative to the housing 15.

[0076] The range over which the overspeed detecting switch 25 is displaced is limited to a range between a predetermined low overspeed setting position (Figure 16) and a high overspeed setting position (Figure 17) that is further away from the speed governor sheave 17 in the axial direction of the main shaft 16 than the low overspeed setting position by restricting pivoting of the switch mounting member using a restricting apparatus that is similar or identical to that of Embodiment 1.

[0077] The switch mounting member and the rotating body 42 are configured so as to operate interdependently by means of a first interlocking apparatus that includes a plurality of linking members. The overspeed detecting switch 25 is thereby displaced between the low overspeed setting position and the high overspeed setting position in response to the direction of rotation of the rotating body 42. Specifically, the overspeed detecting switch 25 is displaced to the high overspeed setting position when the direction of rotation of the rotating body

42 is the forward direction (i.e., when the car 2 moves upward), and is displaced to the low overspeed setting position when the direction of rotation of the rotating body 42 is the reverse direction (i.e., when the car 2 moves downward).

[0078] The overspeed detecting switch 25 has: a switch main body 26 that is fixed to the switch mounting member; and an operating lever 27 that protrudes outward from the switch main body 26. The operating lever 27 has: a lever main body 27a that is parallel to a side surface of the speed governor sheave 17; and a first protruding segment 27b and a second protruding segment 27c that each protrude outward from the lever main body 27a toward the speed governor sheave 17.

[0079] The first protruding segment 27b is disposed level with orbit A in the radial direction of the speed governor sheave 17. The second protruding segment 27c is disposed in the radial direction of the speed governor sheave 17 level with orbit B. Consequently, the first protruding segment 27b is disposed in a position that is closer to the main shaft 16 than the second protruding segment 27c. A length of the first protruding segment 27b (specifically, a dimension in the axial direction of the main shaft 16) is shorter than a length of the second protruding segment 27c.

[0080] The activating segment 22 passes through a predetermined plane (an activating segment displacement plane) that is perpendicular to the shaft axis of the main shaft 16 due to the pivoting of the flyweights 19. In other words, the pathway through which the activating segment 22 is displaced relative to the speed governor sheave 17 is contained in the predetermined plane that is perpendicular to the shaft axis of the main shaft 16.

[0081] When the overspeed detecting switch 25 is set to the low overspeed setting position, the first protruding segment 27b and the second protruding segment 27c both intersect the predetermined plane that contains the pathway of the activating segment 22, as shown in Figure 16. Consequently, if the overspeed detecting switch 25 is set to the low overspeed setting position, when the speed of the car 2 is at the first overspeed V1 and the activating segment 22 reaches orbit A, the activating segment 22 contacts the first protruding segment 27b and the operating lever 27 is operated.

[0082] When the overspeed detecting switch 25 is set to the high overspeed setting position, the first protruding segment 27b is outside the predetermined plane that contains the pathway of the activating segment 22, and only the second protruding segment 27c intersects the predetermined plane, as shown in Figure 13. Consequently, if the overspeed detecting switch 25 is set to the high overspeed setting position, even if the speed of the car 2 is at the first overspeed V1 and the activating segment 22 reaches orbit A, the activating segment 22 will not contact the first protruding segment 27b and the operating lever 27 is not operated. If the overspeed detecting switch 25 is set to the high overspeed setting position, when the speed of the car 2 is at the second overspeed V2 that is higher than the first overspeed V1 and the activating segment 22 reaches orbit B, the activating segment 22 contacts the second protruding segment 27c and the operating lever 27 is operated. The rest of the configuration is similar or identical to that of Embodiment 1.

[0083] Thus, even if the overspeed detecting switch 25 is displaced in the axial direction of the main shaft 16, the speed of the car 2 when the overspeed detecting switch 25 is operated by the activating segment 22 can be switched in response to the direction of rotation of the speed governor sheave 17 between the first overspeed V1 and the second overspeed V2.

[0084] Moreover, in each of the above embodiments, the permanent magnets 45 are fixed to a fixed portion 44 of the speed governor sheave 17, and the metal body 46 is fixed to the rotating body 42, but the metal body 46 may also be fixed to the fixed portion 44 of the speed governor sheave 17, the permanent magnets 45 fixed to the rotating body 42, the metal body 46 rotated together with the speed governor sheave 17, and the permanent magnets 45 rotated together with the rotating body 42.

[0085] In each of the above embodiments, the permanent magnets 45 and the metal body 46 face each other in the radial direction of the speed governor sheave 17 so as to have a predetermined clearance interposed, but the permanent magnets 45 and the metal body 46 may also face each other in the axial direction of the main shaft 16 so as to have a predetermined clearance interposed. In that case, because the permanent magnets 45 move relative to the metal body 46 due to the rotation of the speed governor sheave 17, eddy currents can also be generated on the surface of the metal body 46. Consequently, torque in a like direction to the speed governor sheave 17 can be applied to the rotating body 42 due to the principle of Arago's disk.

[0086] In each of the above embodiments, the torque transmitting apparatus 43 has permanent magnets 45 and a metal body 46, and applies torque to the rotating body 42 in a like direction to the speed governor sheave 17 using the principle of Arago's disk, but is not limited thereto provided that it is an apparatus that imparts torque to the rotating body 42 in a like direction to the speed governor sheave 17 while rotating separately from the speed governor sheave 17.

Claims

1. An elevator speed governor **characterized in** comprising:

    a supporting body on which a main shaft is disposed;

    a speed governor sheave around which is wound a speed governor rope that is moved together with a car, the speed governor sheave being rotated around the main shaft in response to the movement of the car;

a flyweight that is disposed on the speed governor sheave, and that is pivoted relative to the speed governor sheave in response to a centrifugal force that arises due to the rotation of the speed governor sheave;

an activating segment that is disposed on the flyweight, and that is displaced relative to the speed governor sheave outward in a radial direction of the speed governor sheave by the pivoting of the flyweight in a direction in which a rotational speed of the speed governor sheave increases;

an engaging pawl that is disposed on the flyweight, and that is displaced inward in the radial direction of the speed governor sheave by pivoting of the flyweight in the direction in which the rotational speed of the speed governor sheave increases;

a rotating body that is rotatable around the main shaft separately from the speed governor sheave;

a torque transmitting apparatus that applies torque to the rotating body in a like direction to the speed governor sheave by the speed governor sheave being rotated;

a switch mounting member that is disposed displaceably on the supporting body;

a first interlocking apparatus that interlocks the rotating body and the switch mounting member to displace the switch mounting member in response to a direction of rotation of the rotating body;

an overspeed detecting switch that is displaced together with the switch mounting member, and that is activated by operating the activating segment;

a restricting apparatus that restricts a range of displacement of the overspeed detecting switch such that the overspeed detecting switch is displaced between a first setting position at which the overspeed detecting switch is operated by the activating segment when the speed of the car is at a predetermined first overspeed, and a second setting position at which the overspeed detecting switch is operated by the activating segment when the speed of the car is at a second overspeed that is higher than the first overspeed;

a ratchet that is displaceable in an axial direction of the main shaft between an engageable position at which the engaging pawl engages when the speed of the car is at an emergency stopping overspeed that is higher than the second overspeed, and an unengageable position that is separated from the speed governor sheave such that engagement with the engaging pawl is avoided, the ratchet being rotated around the main shaft in a like direction to the speed governor sheave by engagement with the engaging pawl;

a second interlocking apparatus that interlocks the rotating body and the ratchet so as to displace the ratchet between the engageable position and the unengageable position in response to the direction of rotation of the rotating body; and

a gripping apparatus that grips the speed governor rope by the ratchet being rotated.

2. An elevator speed governor according to Claim 1, **characterized in that** the torque transmitting apparatus comprises:

a permanent magnet that is rotated together with a first of the speed governor sheave and the rotating body; and

a metal body that faces the permanent magnet so as to have a predetermined clearance interposed, and that is rotated together with a second of the speed governor sheave and the rotating body.

FIG. 1

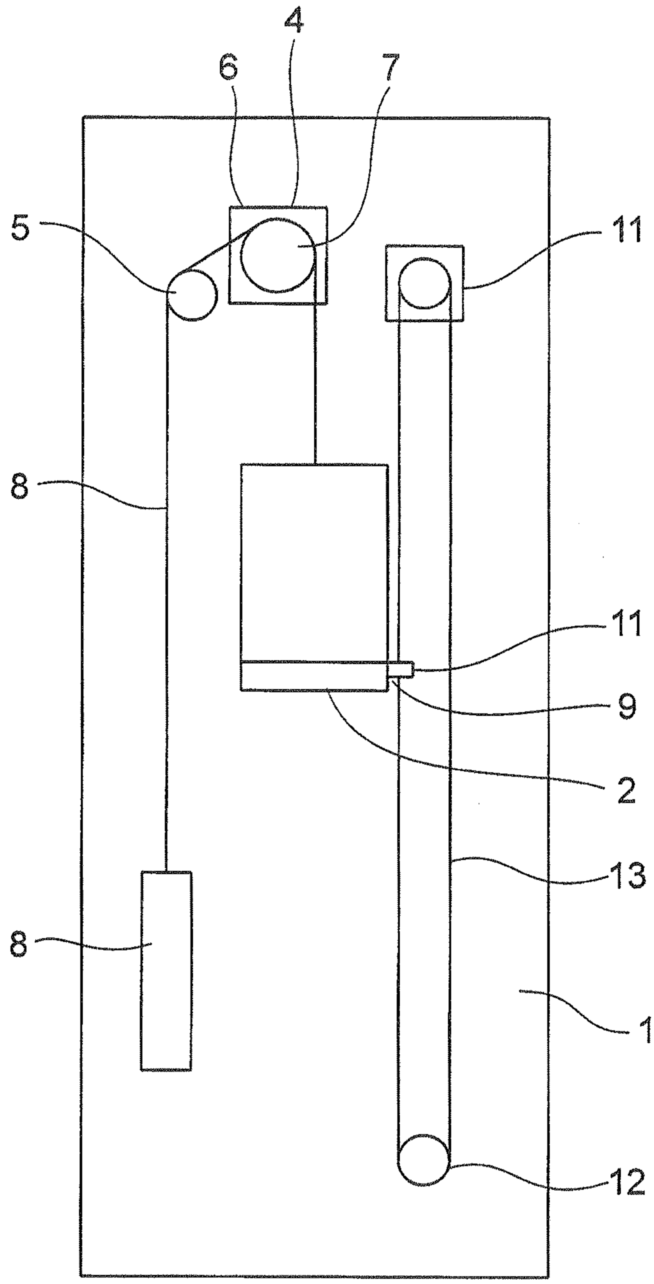

FIG. 2

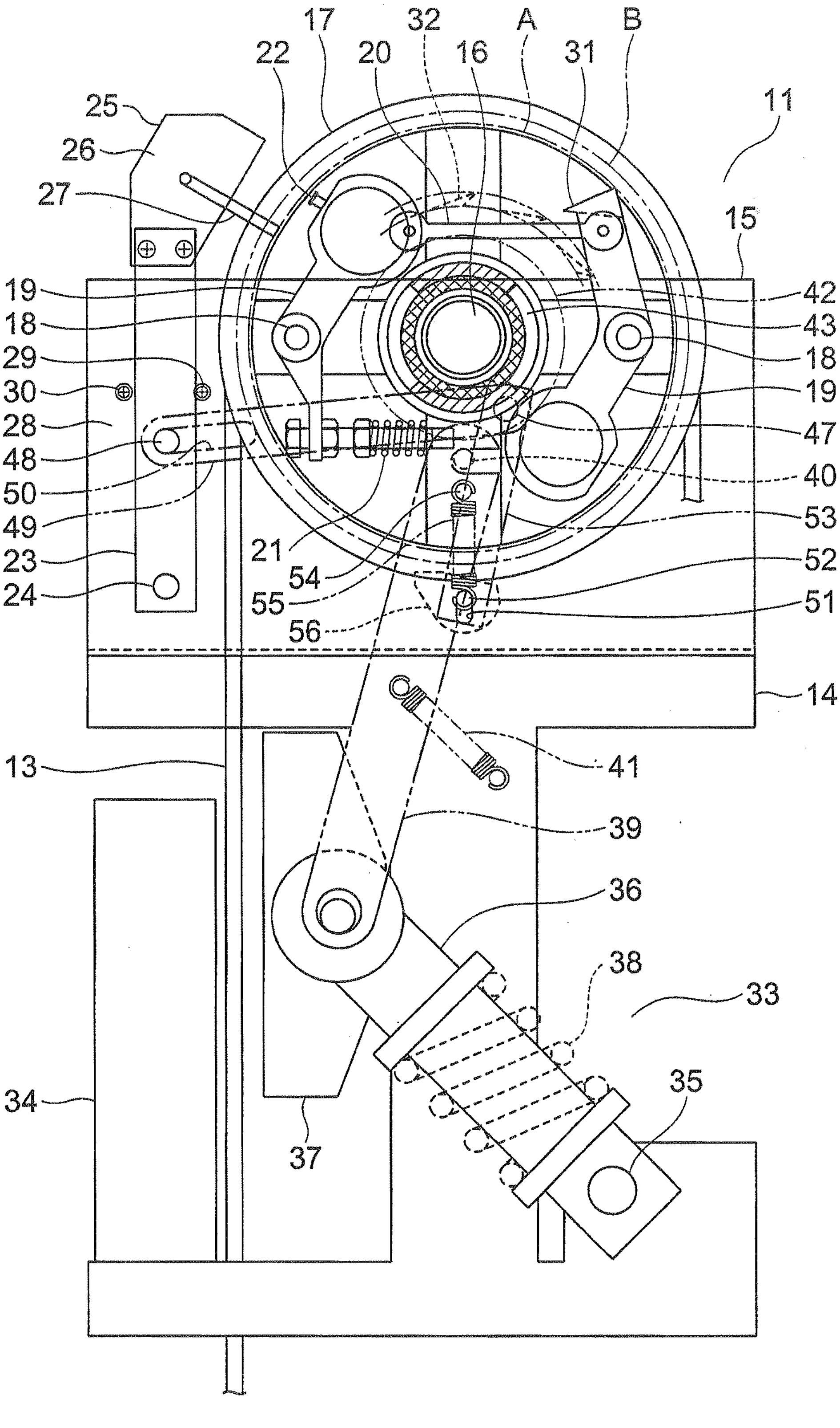
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FIG. 3

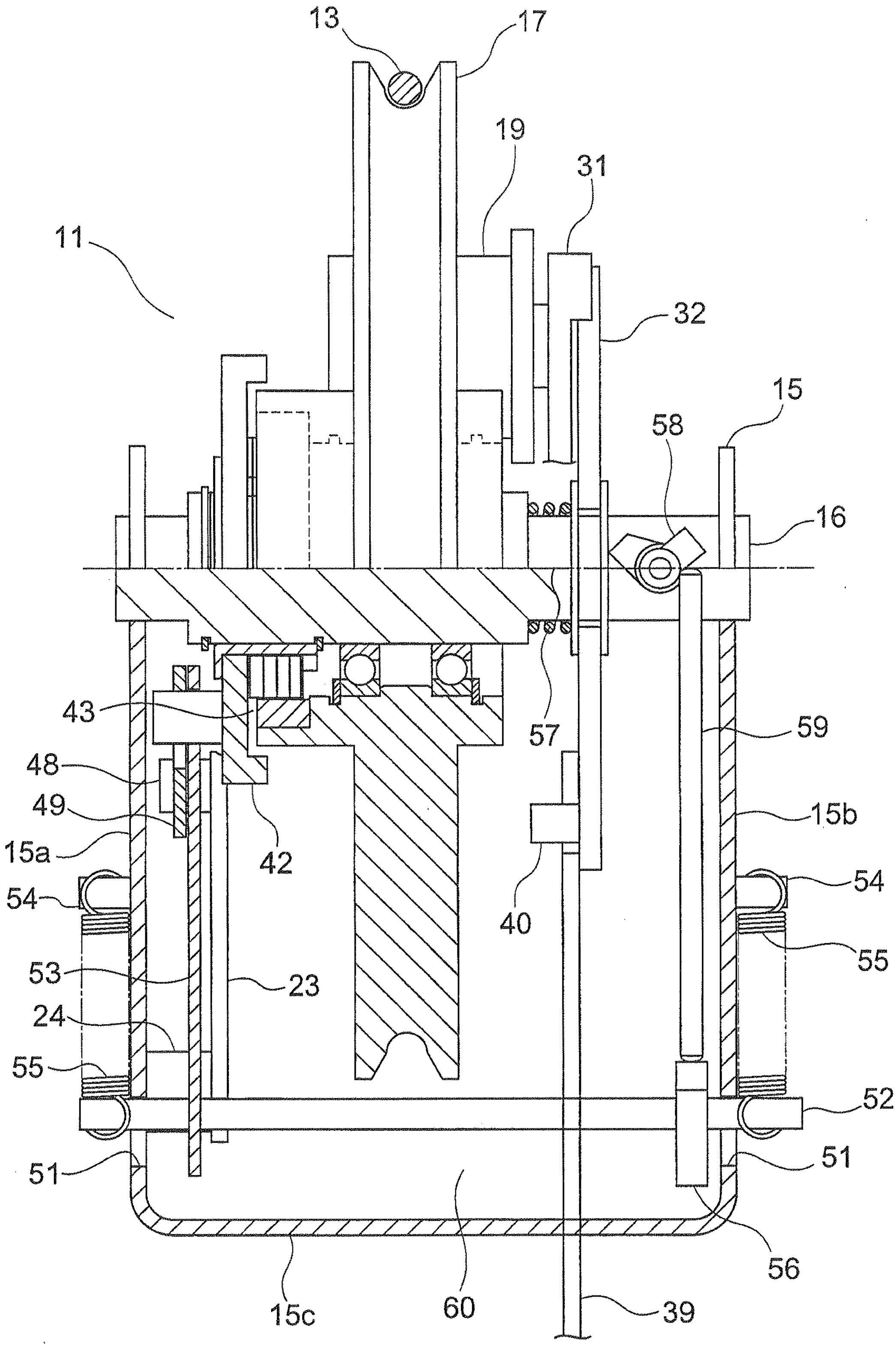
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FIG. 4

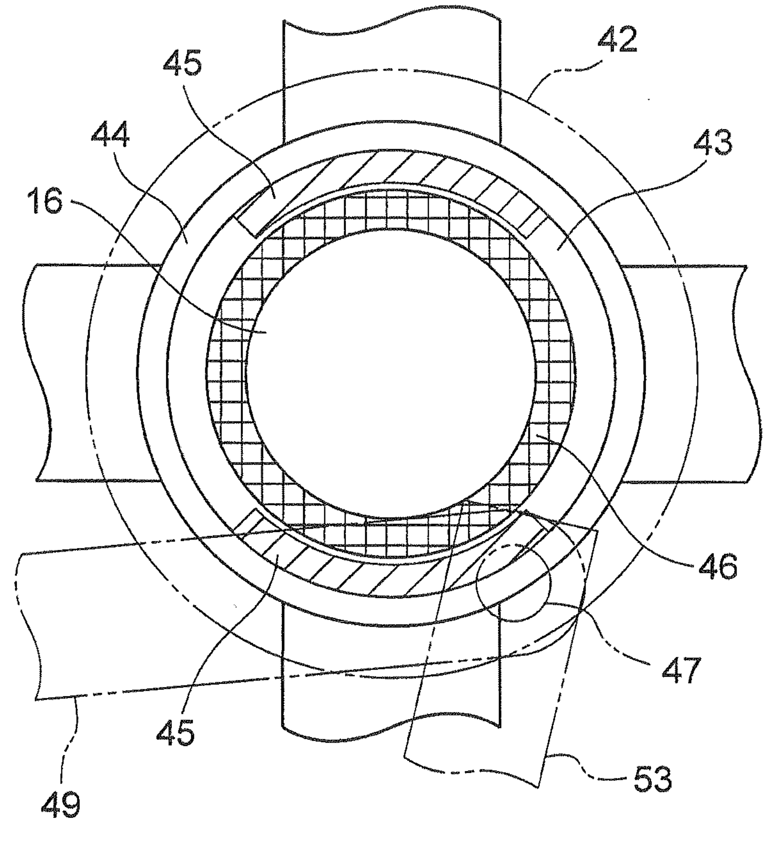

FIG. 5

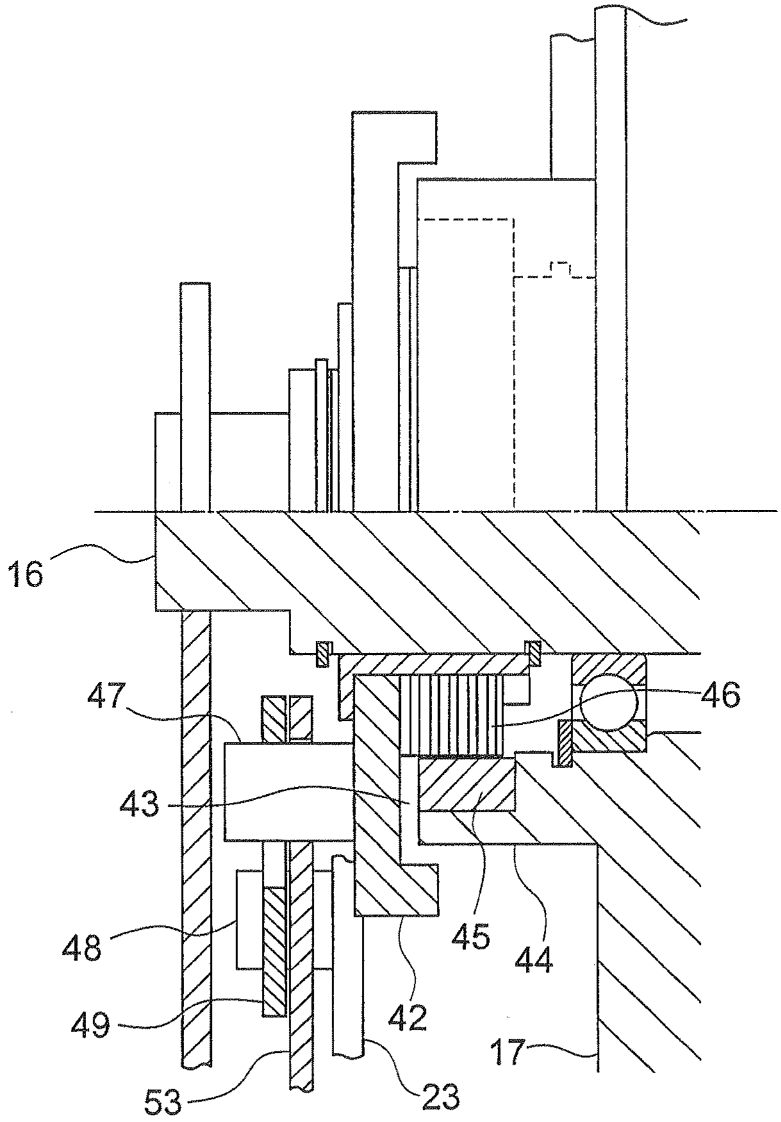

FIG. 6

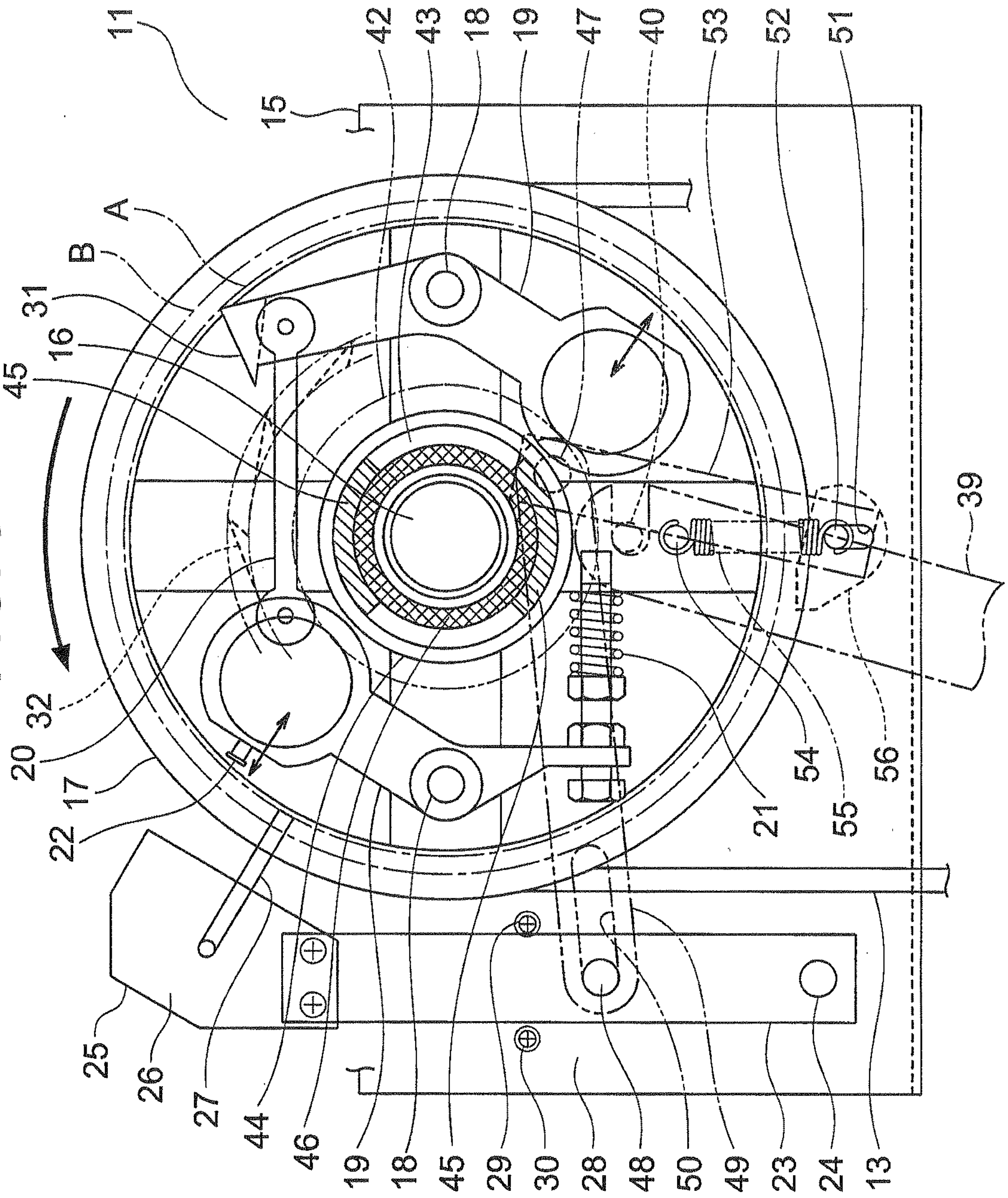
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FIG. 7

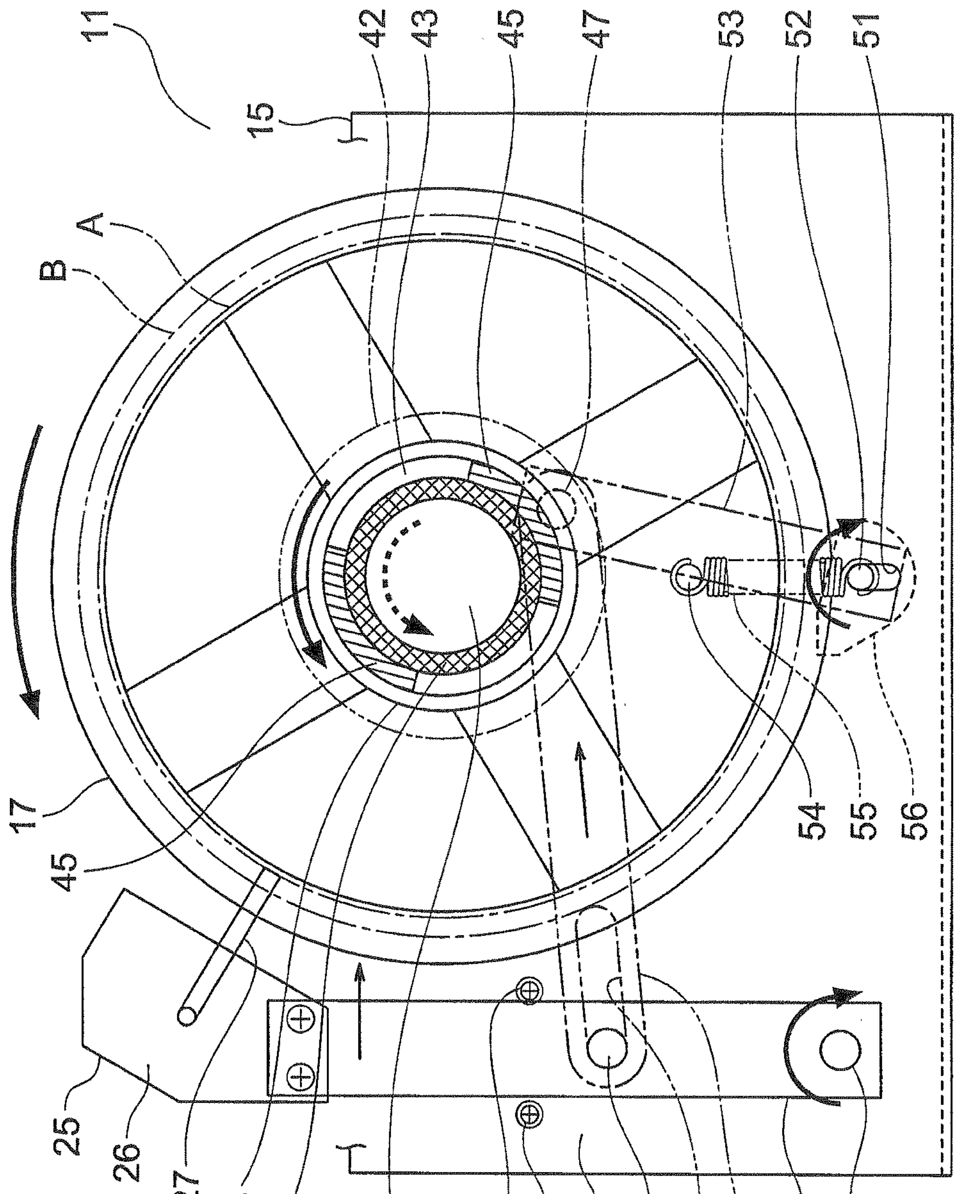
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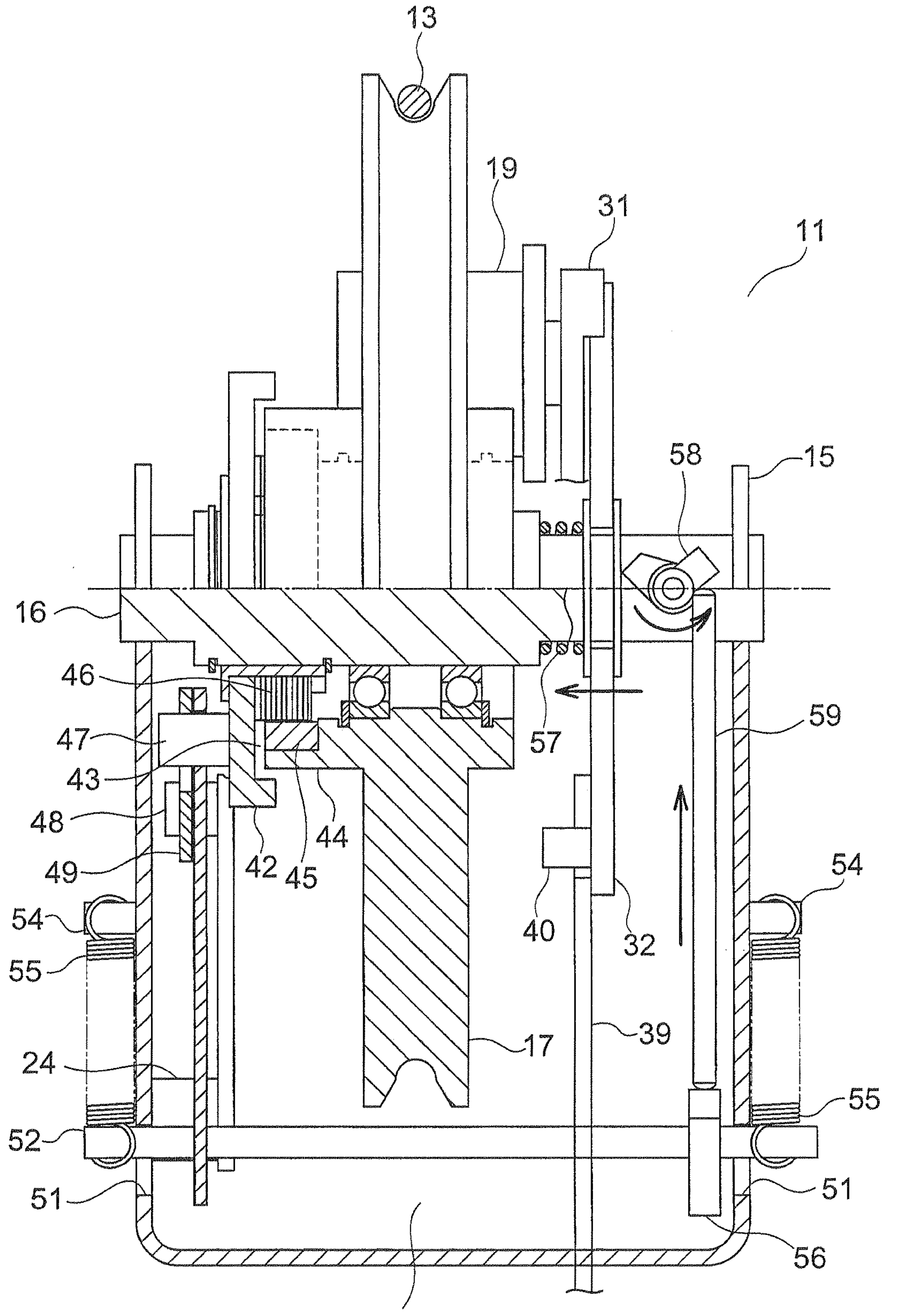
FIG. 8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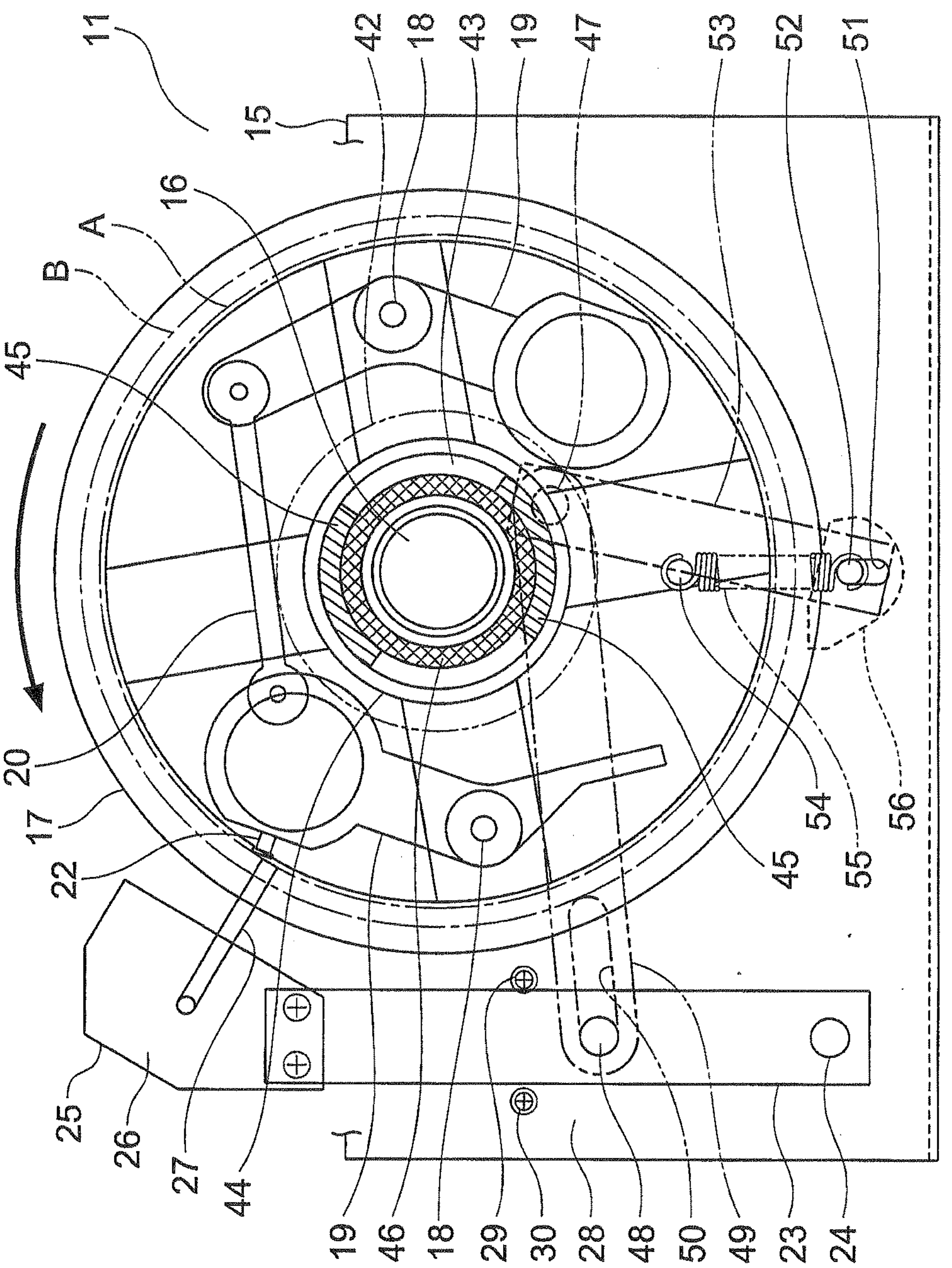
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FIG. 9

FIG. 10

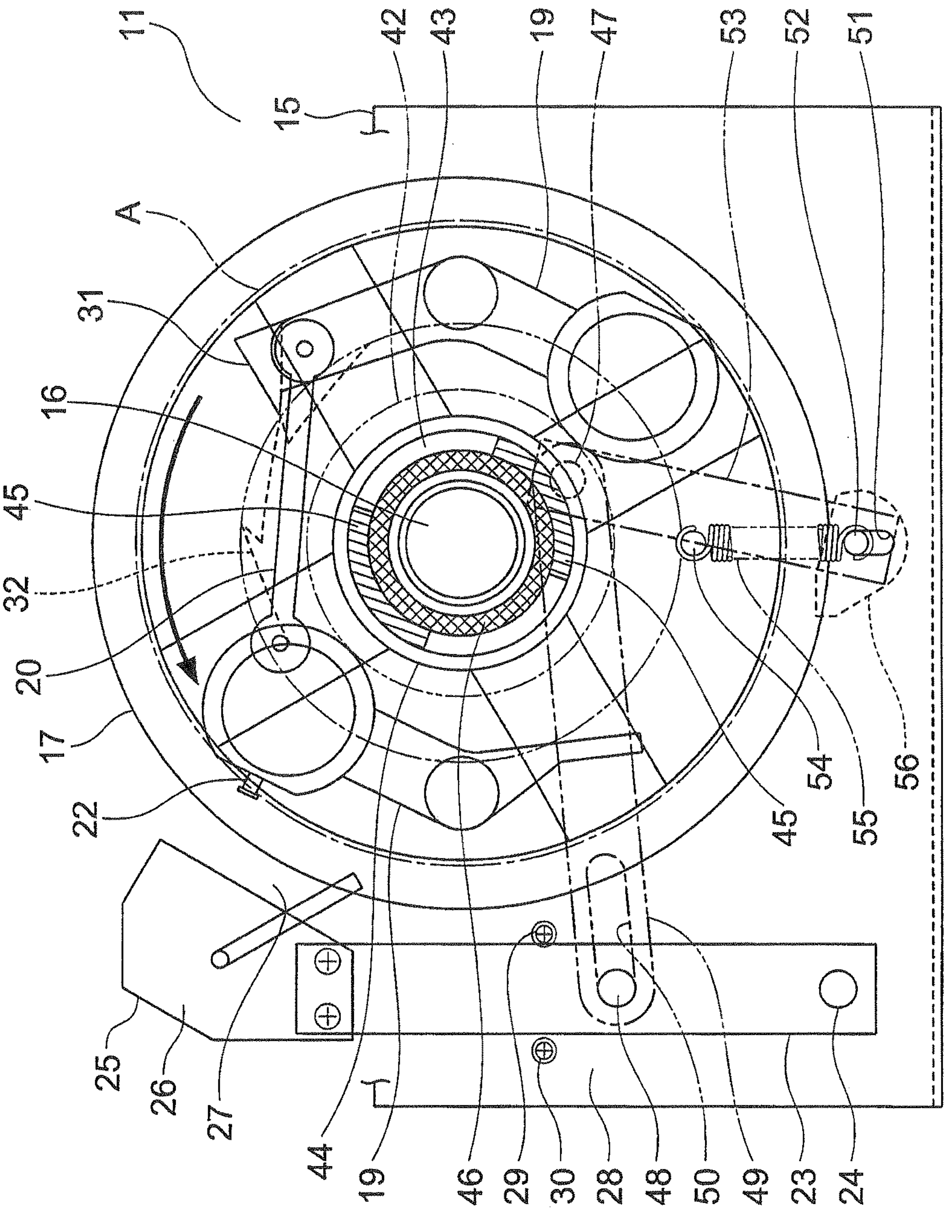
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FIG. 11

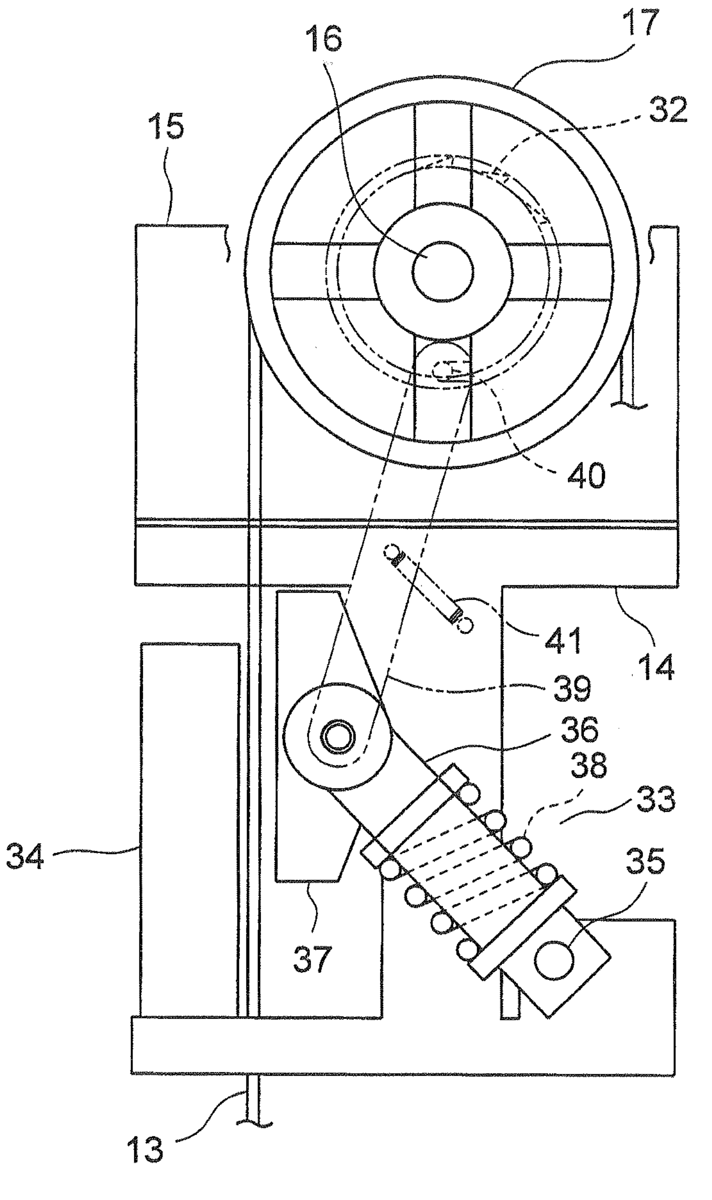

FIG. 12

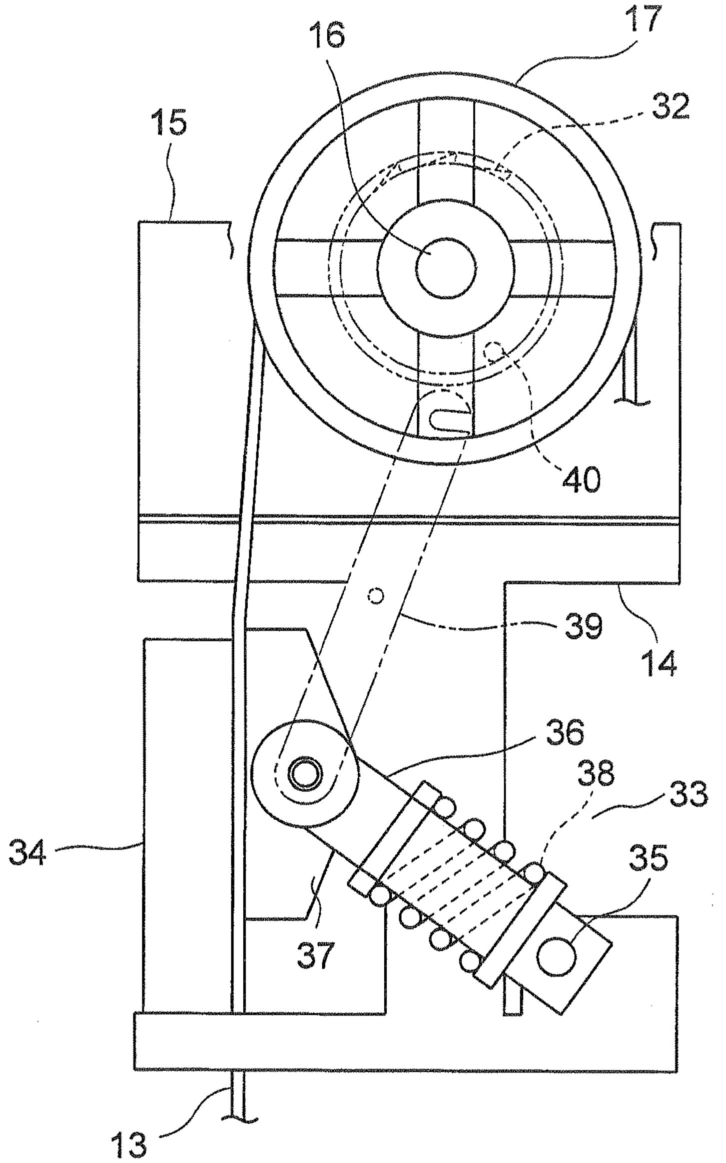

FIG. 13

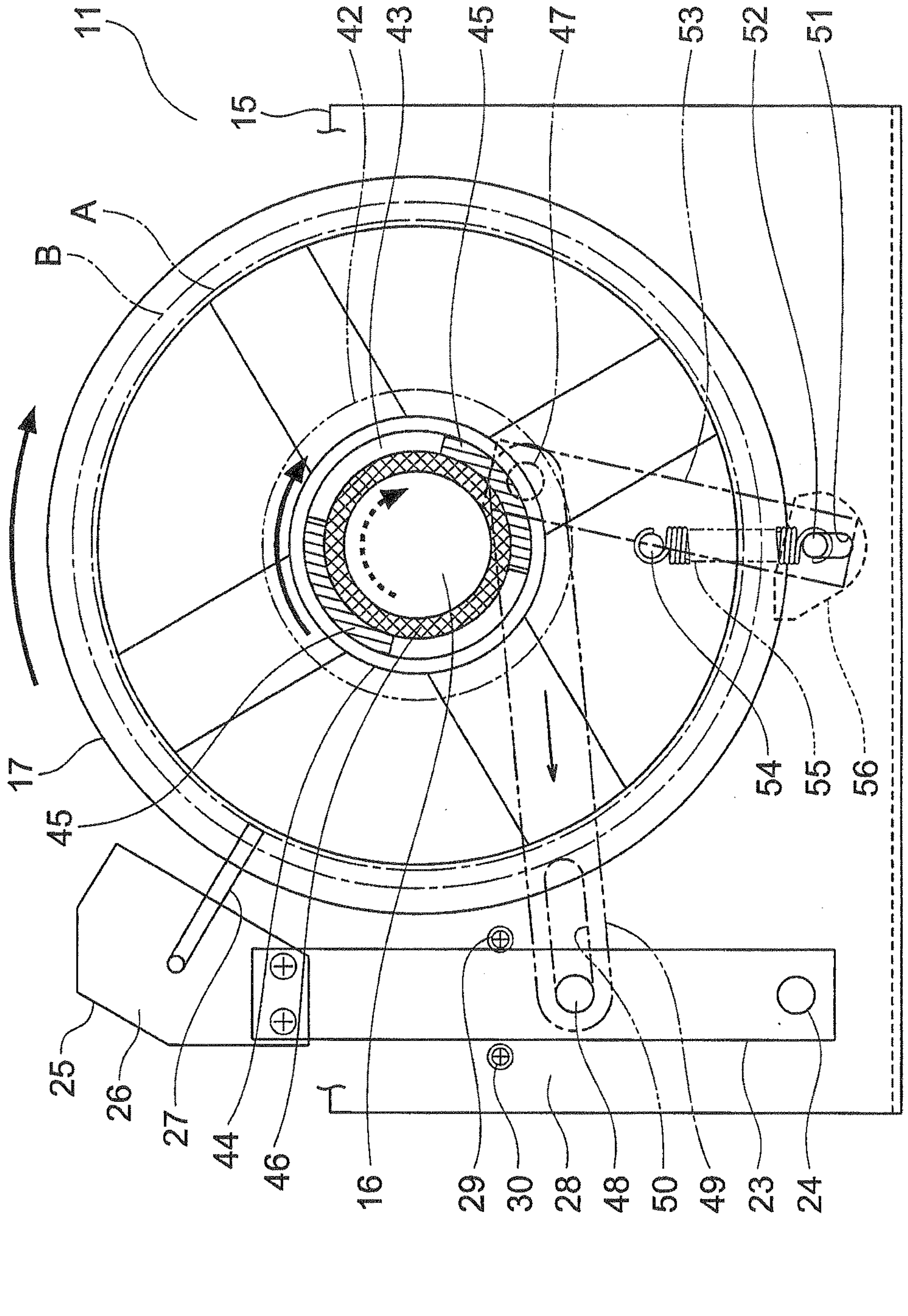
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FIG. 14

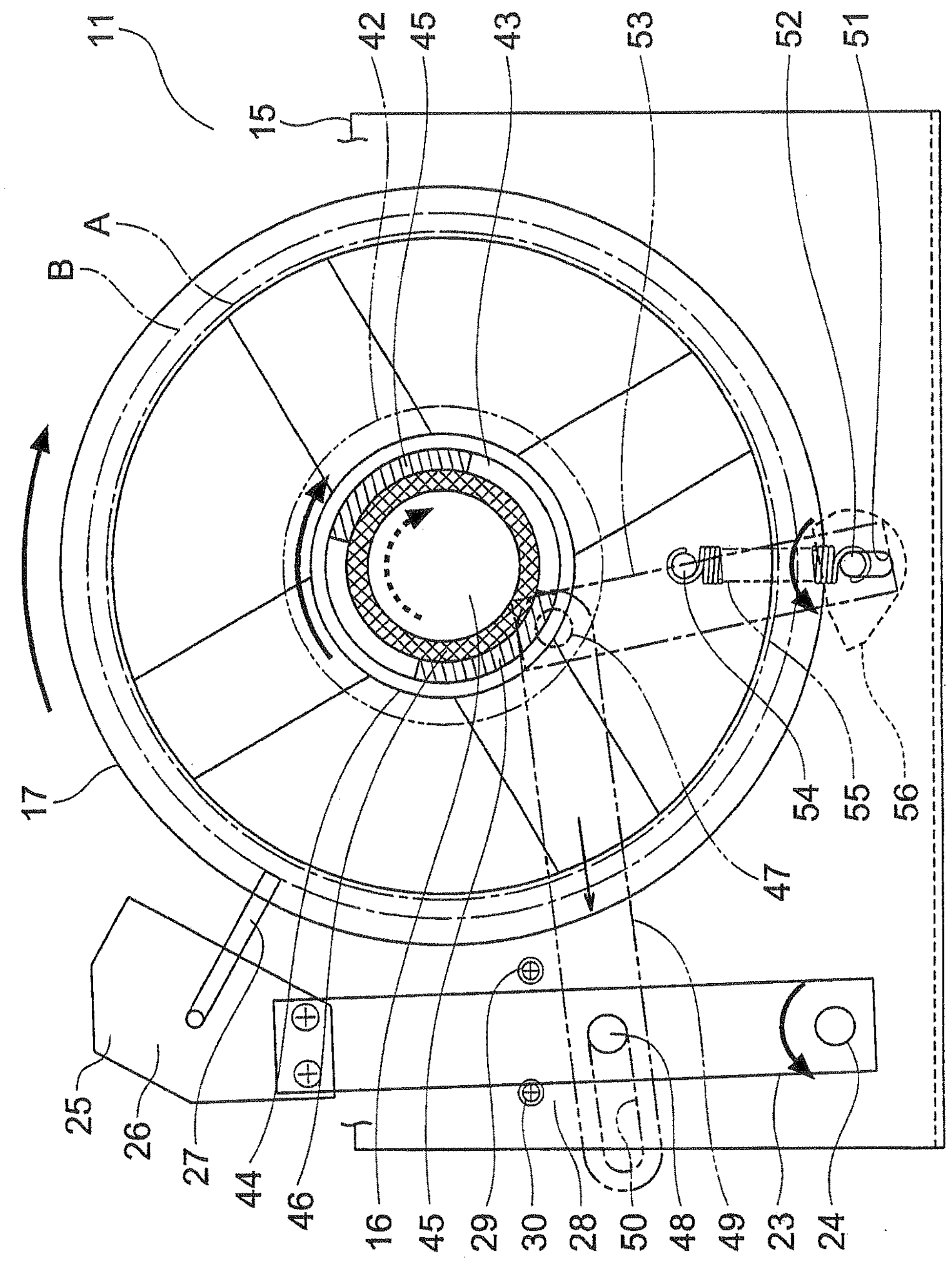
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FIG. 15

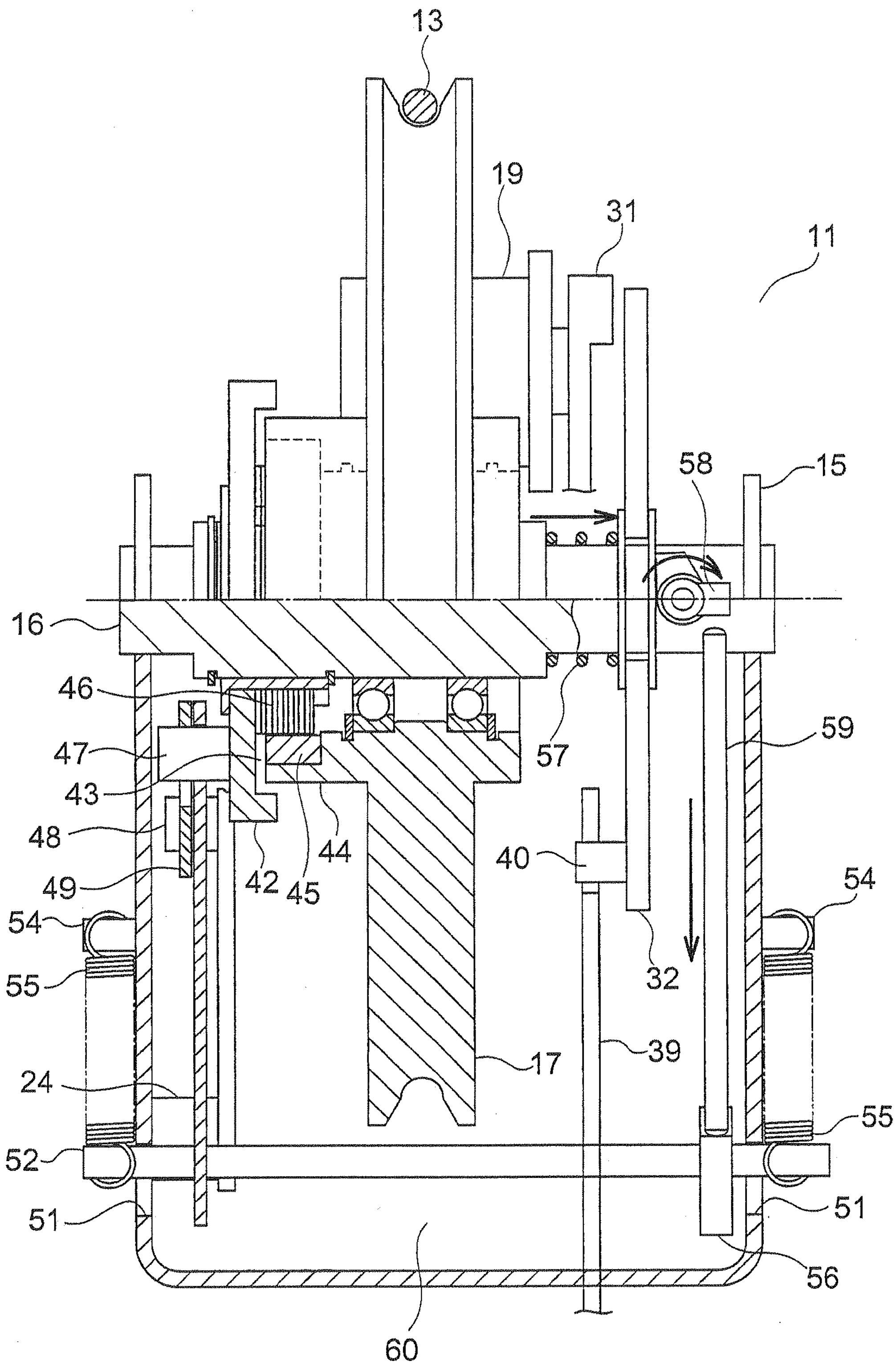
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FIG. 16

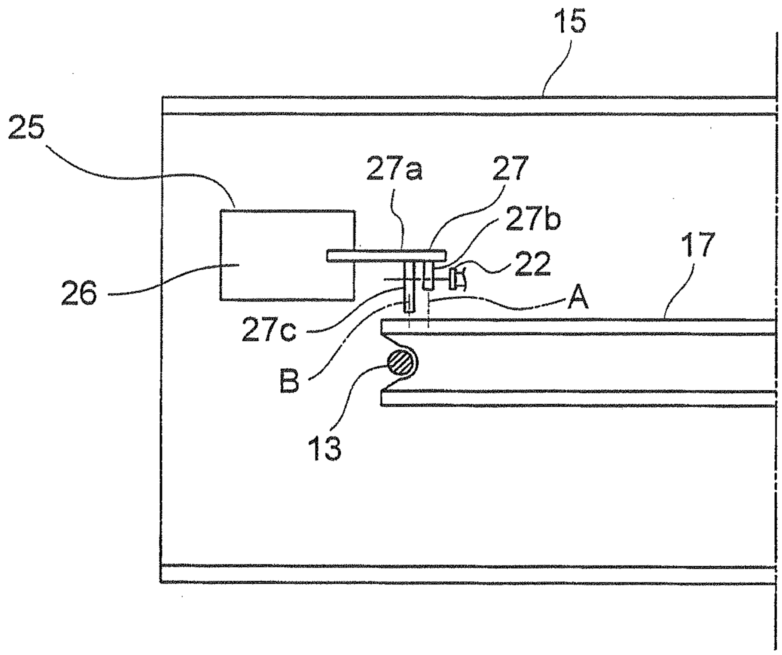
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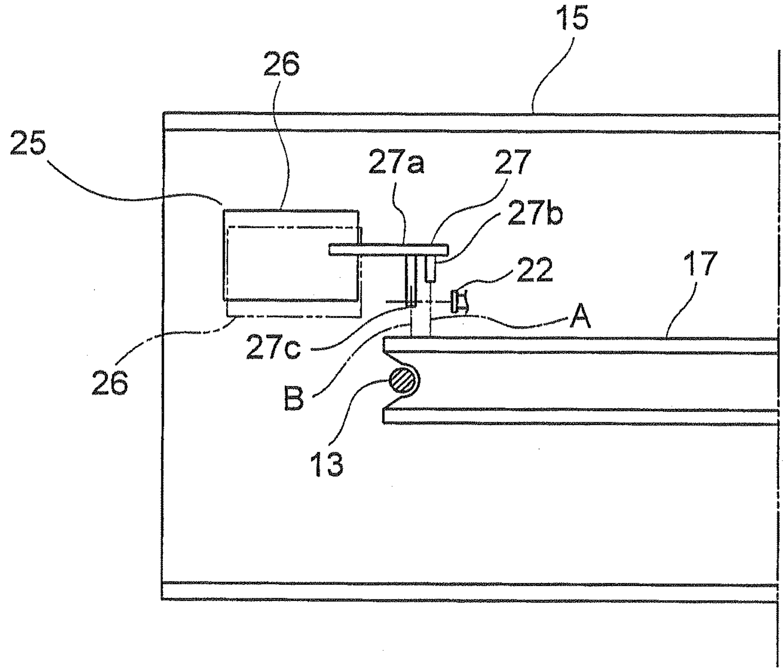
FIG. 17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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/063384

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	1996-2010
Kokai Jitsuyo Shinan Koho	1971-2010	Toroku Jitsuyo Shinan Koho	1994-2010

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-327241 A (Mitsubishi Electric Corp.), 28 November 2000 (28.11.2000), paragraphs [0086] to [0087]; fig. 11 & US 6360847 B1	1-2
A	JP 2000-335846 A (Mitsubishi Electric Corp.), 05 December 2000 (05.12.2000), paragraph [0014] & US 6345696 B1 & TW 550228 B	2

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

* Special categories of cited documents:
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