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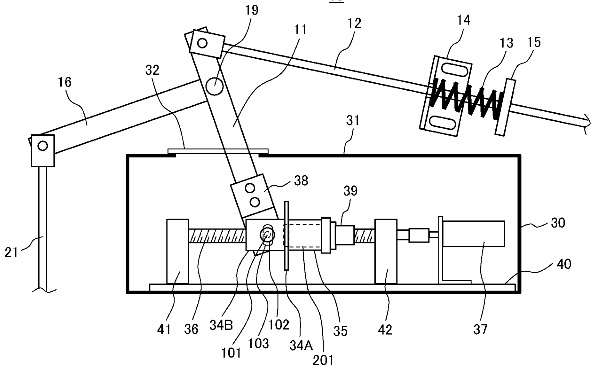
(54) **ELEVATOR APPARATUS**

(57) There is provided an elevator device including an emergency stop device operated by an electric actuator capable of reducing a load applied to a motor. The elevator device includes an elevator car; an emergency stop device; a drive mechanism (12 to 19) that drives the emergency stop device; and an electric actuator (10) that operates the drive mechanism, in which the electric actuator includes an operation lever (11) connected to the drive mechanism, a movable member (34A, 34B) that is rotatably connected to the operation lever, an electromagnet portion (35) that attracts the movable member in a standby state of the electric actuator, a feed screw (36) that is screwed with the electromagnet portion, a motor (37) that drives the feed screw, and a guide portion (201) that, in a return operation of the electric actuator, causes the movable member to follow a movement of the electromagnet portion such that the movable member is aligned with respect to the electromagnet portion when the electromagnet portion comes into contact with the movable member by being moved toward the movable member by driving the feed screw using the motor.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to an elevator device including an emergency stop device operated by an electric actuator.

Background Art

[0002] The elevator device includes a governor and an emergency stop device in order to constantly monitor an elevating speed of an elevator car and to emergently stop the elevator car that has fallen into a predetermined overspeed state. In general, the elevator car and the governor are coupled by a governor rope, and in a case where an overspeed state is detected, the governor restrains the governor rope to operate the emergency stop device on the elevator car side, thereby emergently stopping the elevator car.

[0003] In such an elevator device, since the governor rope which is a long object is laid in a hoistway, space saving and cost reduction are difficult. In addition, in a case where the governor rope swings, a structure and the governor rope in the hoistway easily interfere with each other.

[0004] For this reason, an emergency stop device that does not use a governor rope has been proposed.

[0005] As a technique in the related art regarding an emergency stop device that does not use a governor rope, a technique described in PTL 1 is known.

[0006] In the related art, a drive shaft that drives an emergency stop device and an actuation mechanism that operates the drive shaft are provided on the elevator car. The actuation mechanism includes a movable iron core mechanically connected to the drive shaft via a connection piece, and an electromagnetic core that attracts the movable iron core. Although the drive shaft is biased by a drive spring, the movement of the drive shaft is restrained by the actuation mechanism since an electromagnet portion is energized and the movable iron core is attracted in a normal state.

[0007] In an emergency, the electromagnetic core is demagnetized, the restraint of the drive shaft is released, and the drive shaft is driven by a biasing force of the drive spring. As a result, the emergency stop device is operated to emergently stop the elevator car.

[0008] In a case where the emergency stop device is caused to return to the normal state, the electromagnetic core is moved closer to the movable iron core moved in the emergency. A movement mechanism of the electromagnetic core includes a feed screw, a motor that rotates the feed screw, and a feed nut provided on the electromagnetic core and screwed with the feed screw. In a case where the motor is rotated, the electromagnetic core is moved by the feed screw and the feed nut. In a case where the electromagnetic core abuts on the movable iron core, the electromagnetic core is energized so that the movable iron core is attracted to the electromagnetic core. Further, in a state where the movable iron core is attracted to the electromagnetic core, the electromagnetic core is driven to cause the movable iron core and the electromagnetic core to return to the normal standby positions.

Citation List

Patent Literature

[0009] PTL 1: WO 2020/110437 A

Summary of Invention

Technical Problem

[0010] In the above related art, a mechanical load applied to the motor at the time of recovery of the emergency stop device is increased due to assembly tolerance and dimensional tolerance of the actuation mechanism. Therefore, increasing the output of the motor leads to an increase in the size and power consumption of the motor.

[0011] Therefore, the present invention provides an elevator device including an emergency stop device operated by an electric actuator capable of reducing a load applied to a motor.

Solution to Problem

[0012] In order to solve the problems, an elevator device according to an aspect of the present invention includes an elevator car; an emergency stop device provided to the elevator car; a drive mechanism that is provided to the elevator car and drives the emergency stop device; and an electric actuator that is provided to the elevator car and operates the drive mechanism, in which the electric actuator includes an operation lever connected to the drive mechanism, a movable member that is rotatably connected to the operation lever, an electromagnet portion that attracts the movable member in a standby state of the electric actuator, a feed screw that is screwed with the electromagnet portion, a motor that drives the feed screw, and a guide portion that, in a return operation of the electric actuator, causes the movable member to follow a movement of the electromagnet portion such that the movable member is aligned with respect to the electromagnet portion when the electromagnet portion comes into contact with the movable member by being moved toward the movable member by driving the feed screw using the motor.

Advantageous Effects of Invention

[0013] According to the present invention, it is possible to reduce the load applied to the motor at the time of the return operation of the electric actuator.

[0014] Problems, configurations, and effects other than those described above will be apparent from the description of embodiments below.

Brief Description of Drawings

[0015]

[FIG. 1] FIG. 1 is a schematic configuration diagram of an elevator device according to a first embodiment.
[FIG. 2] FIG. 2 is a front view illustrating a mechanism part of an electric actuator according to the first embodiment (standby state).
[FIG. 3] FIG. 3 is a front view illustrating a mechanism part of an electric actuator according to the first embodiment (operating state).
[FIG. 4] FIG. 4 is a side view illustrating arrangement of a movable member, an electromagnet portion, a guide portion, and a feed screw in FIG. 2.
[FIG. 5] FIG. 5 is a top view illustrating a mechanism part of an electric actuator according to the first embodiment (operating state).
[FIG. 6] FIG. 6 is a top view illustrating a mechanism part of an electric actuator according to the first embodiment (during return operation).
[FIG. 7] FIG. 7 is a top view illustrating a mechanism part of an electric actuator according to the first embodiment (standby state).
[FIG. 8] FIG. 8 is a front view illustrating a mechanism part of an electric actuator according to a second embodiment (standby state).
[FIG. 9] FIG. 9 is a front view illustrating a mechanism part of an electric actuator according to the second embodiment (operating state).
[FIG. 10] FIG. 10 is a side view illustrating arrangement of a movable member, an electromagnet portion, a guide portion, and a feed screw in FIG. 8.
[FIG. 11] FIG. 11 is a top view illustrating a mechanism part of an electric actuator according to the second embodiment (operating state).
[FIG. 12] FIG. 12 is a top view illustrating a mechanism part of an electric actuator according to the second embodiment (during return operation).
[FIG. 13] FIG. 13 is a top view illustrating a mechanism part of an electric actuator according to the second embodiment (standby state).

Description of Embodiments

[0016] Hereinafter, an elevator device according to an embodiment of the present invention will be described according to first and second embodiments with reference to the drawings. In the drawings, the same reference numerals indicate the same components or components having similar functions.

First Embodiment

[0017] FIG. 1 is a schematic configuration diagram of an elevator device according to the first embodiment 1 of the present invention.

[0018] As illustrated in FIG. 1, the elevator device includes an elevator car 1, an electric actuator 10, drive mechanisms (12 to 20), a pull-up rod 21, and an emergency stop device 2.

[0019] The elevator car 1 is suspended by a main rope (not illustrated) in a hoistway provided in a building, and is slidably engaged with a guide rail 4 via a guide device (not illustrated). In a case where the main rope is frictionally driven by a drive device (hoisting machine: not illustrated), the elevator car 1 is moved up and down in the hoistway.

[0020] A speed detection device (not illustrated) is provided in the elevator car 1, and constantly detects the elevating speed of the elevator car 1 in the hoistway. Therefore, it is possible to detect that the elevating speed of the elevator car 1 exceeds a predetermined overspeed using the speed detection device.

[0021] In the first embodiment, the speed detection device includes an image sensor, and detects the speed of the elevator car 1 on the basis of image information of a surface state of the guide rail 4 acquired by the image sensor. For example, the speed detection device calculates the speed from a movement distance of an image feature amount in a predetermined time.

[0022] The speed detection device may calculate the speed of the elevator car on the basis of an output signal of a rotary encoder that is rotated with the movement of the elevator car.

[0023] The electric actuator 10 is an electromagnetic actuator in the first embodiment, and is disposed above the elevator car 1. The electromagnetic actuator includes, for example, a movable piece or a movable rod actuated by a solenoid or an electromagnet portion. The electric actuator 10 is operated in a case where the speed detection device detects a predetermined overspeed state of the elevator car 1. In this case, the pull-up rod 21 is pulled up by the drive mechanisms (12 to 20) connected to an operation lever 11. As a result, the emergency stop device 2 is brought into a braking state.

[0024] The drive mechanisms (12 to 20) will be described later.

[0025] One emergency stop device 2 is disposed on each of the left and right sides of the elevator car 1. A pair of brake shoes (not illustrated) included in each emergency stop device 2 is movable between a braking position and a non-braking position, and in a case where the brake shoes clamp the guide rail 4 at the braking position, and are relatively raised by the lowering of the elevator car 1, a braking force is generated by a frictional force acting between the brake shoes and the guide rail 4. As a result, the emergency stop device 2 is operated in a case where the elevator car 1 falls into the overspeed state, to emergently stops the elevator car 1.

[0026] The elevator device of the first embodiment includes a so-called low-press governor system that does not use a governor rope, and in a case where the elevating speed of the elevator car 1 exceeds the rated speed and reaches a first overspeed (for example, a speed that does not exceed 1.3 times the rated speed), the power supply of the drive device (hoisting machine) and the power supply of a control device that controls the drive device are cut off. In a case where the lowering speed of the elevator car 1 reaches a second overspeed (for example, a speed that does not exceed 1.4 times the rated speed), the electric actuator 10 provided in the elevator car 1 operates the emergency stop device 2, and the elevator car 1 is emergently stopped.

[0027] In the first embodiment, the low-press governor system includes the above-described speed detection device, and a safety control device that determines an overspeed state of the elevator car 1 on the basis of the output signal of the speed detection device. The safety control device measures the speed of the elevator car 1 on the basis of the output signal of the speed detection device, and in a case where it is determined that the measured speed has reached the first overspeed, the safety control device outputs a command signal for cutting off the power supply of the drive device (hoisting machine) and the power supply of the control device that controls the drive device. In a case where it is determined that the measured speed has reached the second overspeed, the safety control device outputs a command signal for operating the electric actuator 10.

[0028] As described above, in a case where the pair of brake shoes included in the emergency stop device 2 is pulled up by the pull-up rod 21, the pair of brake shoes clamps the guide rail 4. The pull-up rod 21 is driven by the drive mechanisms (12 to 20) connected to the electric actuator 10.

[0029] Hereinafter, a configuration of the drive mechanism will be described. The configuration of the electric actuator 10 will be described later (FIGS. 2 to 4).

[0030] The operation lever 11 and a first actuation piece 16 of the electric actuator 10 are connected to form a substantially T-shaped first link member. The operation lever 11 and the first actuation piece 16 constitute a head part and a foot part of the T shape, respectively. The substantially T-shaped first link member is rotatably supported by a crosshead 50 as a support member, via a first actuation shaft 19 at a connection portion between the operation lever 11 and the first actuation piece 16. An end portion of one (left side in the drawing) of the pair of pull-up rods 21 is connected to an end portion of the first actuation piece 16, which is the foot part of the T shape, on a side opposite to the connection portion between the operation lever 11 and the first actuation piece 16.

[0031] A connection piece 17 and a second actuation piece 18 are connected to form a substantially T-shaped second link member. The connection piece 17 and the second actuation piece 18 constitute a head part and a foot part of the T shape, respectively. The substantially T-shaped second link member is rotatably supported by the crosshead 50 via a second actuation shaft 20 at a connection portion between the connection piece 17 and the second actuation piece 18. An end portion of the other (left side in the drawing) of the pair of pull-up rods 21 is connected to an end portion of the second actuation piece 18, which is the foot part of the T shape, on a side opposite to the connection portion between the connection piece 17 and the second actuation piece 18.

[0032] An end portion of the operation lever 11 extending from the inside to the outside of a housing 30 and an end portion that is closer to an upper portion of the elevator car 1 than the second actuation shaft 20 among both end portions of the connection piece 17 are respectively connected to one end (left side in the drawing) and the other end (right side in the drawing) of a drive shaft 12 lying on the elevator car 1.

[0033] The drive shaft 12 slidably passes through a fixing portion 14 (fixing bolt is not illustrated) fixed to the crosshead 50 by bolt fastening. The drive shaft 12 penetrates a pressing member 15, and the pressing member 15 is fixed to the drive shaft 12. The pressing member 15 is positioned on the second link member (connection piece 17, second actuation piece 18) side of the fixing portion 14. A drive spring 13 which is an elastic body is positioned between the fixing portion 14 and the pressing member 15, and the drive shaft 12 is inserted into the drive spring 13.

[0034] In a case where the electric actuator 10 is operated, that is, in a case where the energization to the electromagnet portion is cut off in the first embodiment, an electromagnetic force that restrains the movement of the operation lever 11 against the biasing force of the drive spring 13 disappears, so that the drive shaft 12 is driven along a longitudinal direction by the biasing force of the drive spring 13 applied to the pressing member 15. Therefore, the first link member (operation lever 11, first actuation piece 16) rotates about the first actuation shaft 19, and the second link member (connection piece 17, second actuation piece 18) rotates about the second actuation shaft 20. As a result, one of the pull-up rods 21 connected to the first actuation piece 16 of the first link member is driven and pulled up, and the other of the pull-up rods 21 connected to the second actuation piece 18 of the second link member is driven and pulled up.

[0035] In the first embodiment, a flexible cover member 32 through which the operation lever 11 is inserted is provided in an insertion portion for the operation lever 11, in a housing cover 31 as an upper surface of the housing 30. As a result, entry of dust, foreign matter, and the like into the housing 30 where the mechanism part of the electric actuator 10 is housed is prevented.

[0036] FIG. 2 is a front view illustrating a mechanism part of the electric actuator 10, which is housed in the housing 30, according to the first embodiment in an installed state of FIG. 1. In FIG. 2, the emergency stop device is in a non-operating state, and the electric actuator 10 is in a standby state. That is, the elevator device is in a normal operation state.

[0037] As illustrated in FIG. 2, in the standby state, a movable member (34A, 34B) connected to the operation lever 11 is attracted to an excited electromagnet portion 35. As a result, the movement of the operation lever 11 is restrained against the biasing force of the drive spring 13 (compression spring).

[0038] The movable member includes an attraction portion 34A which is attracted to a magnetic pole surface of the electromagnet portion 35, and a support portion 34B to which the attraction portion 34A is fixed. The operation lever 11 is connected to the support portion 34B via a bracket 38 rotatably connected to the support portion 34B. In the movable member, at least the attraction portion 34A is formed of a magnetic material.

[0039] The support portion 34B is connected to the bracket 38 using an engagement pin 102. A shaft portion 101 of the engagement pin 102 passes through a long hole 103 in the support portion 34B, and an end portion of the shaft portion 101 is fixed to the bracket 38. The longitudinal direction of the long hole 103 is parallel to an attraction surface of the attraction portion 34A. The width of the long hole 103 in a direction perpendicular to the longitudinal direction of the long hole 103 is larger than the diameter of the shaft portion 101 of the engagement pin 102 and is smaller than the diameter of the head of the engagement pin 102.

[0040] Due to such a long hole 103, there is a degree of freedom in the position of the engagement pin 102 in the support portion 34B. Therefore, in a case where the operation lever 11 is rotated to change the height of the engagement pin 102 from a substrate 40 as in the return operation of the electric actuator described later, it is possible to alleviate the stress that the movable member (34A, 34B) receives from the engagement pin 102.

[0041] The electromagnet portion 35 includes a guide portion 201. The guide portion 201 is fitted to the attraction portion 34A of the movable member. As a result, the movable member is aligned with respect to the electromagnet portion 35.

[0042] The movable member may be displaced during an emergency stop operation of the electric actuator 10. Even in a case where displacement occurs, when the guide portion 201 of the electromagnet portion 35 and the attraction portion 34A are fitted to each other in the return operation of the electric actuator 10, the displaced movable member is moved while being guided by the guide portion 201, and thus the movable member is aligned with respect to the electromagnet portion 35.

[0043] Other mechanism parts (36, 37, 40 to 42) in FIG. 2 will be described later (FIG. 3).

[0044] In the first embodiment, the flexible cover member 32 that covers an opening portion is provided in the opening portion through which the operation lever 11 is inserted in the housing cover 31 as the upper surface of the housing 30. For example, the cover member 32 is formed of a thin rubber material. Since the cover member 32 has flexibility, the movement of the operation lever 11 when the emergency stop device is actuated is not hindered.

[0045] The cover member 32 prevents dust, foreign matters, and the like from entering the housing 30 and adhering to or coming into contact with the mechanism part. As a result, the reliability of the operation of the electric actuator 10 in an installation environment (such as in the hoistway) is improved.

[0046] FIG. 3 is a front view illustrating a mechanism part of the electric actuator 10, which is housed in the housing 30, according to the first embodiment in the installed state of FIG. 1. In FIG. 3, the emergency stop device is in the braking state, and the electric actuator 10 is in the operating state. That is, the elevator device is stopped by the emergency stop device.

[0047] In a case where the excitation of the electromagnet portion 35 is stopped due to a command from the safety control device (not illustrated), the attractive force acting on the movable member (34A, 34B) disappears, so that the biasing force of the drive spring 13 is released and the drive shaft 12 is driven. In a case where the drive shaft 12 is driven, the operation lever 11 connected to the drive shaft 12 is rotated about the first actuation shaft 19, and in conjunction with this, the first actuation piece 16 connected to the operation lever 11 is rotated about the first actuation shaft 19. As a result, the pull-up rod 21 connected to the first actuation piece 16 is pulled up.

[0048] In a case where the operation lever 11 is rotated as described above, the movable member connected to the operation lever 11 is moved along a rotation direction of the operation lever 11. In order to cause the electric actuator 10 to return to the standby state as illustrated in FIG. 2, as described below, the movable member returns from a moving position (FIG. 3) to a standby position (FIG. 2) by the mechanism part (36, 37, 40 to 42) of which the description is omitted in FIG. 2.

[0049] As illustrated in FIG. 3, the electric actuator 10 has a feed screw 36 positioned on a planar portion of the substrate 40 in order to drive the movable member. The feed screw 36 is rotatably supported by a first support member 41 and a second support member 42 that are fixed on the plane of the substrate 40. The electromagnet portion 35 includes a feed nut 39, and the feed nut 39 is screwed with the feed screw 36. The feed screw 36 is rotated by a motor 37.

[0050] In order to cause the electric actuator 10 to return to the standby state, first, the motor 37 is driven to rotate the feed screw 36. The rotation of the motor 37 is converted into the linear movement of the electromagnet portion 35 along the axis direction of the feed screw 36 by the rotating feed screw 36 and the feed nut 39 included in the electromagnet portion 35.

[0051] In a case where the electromagnet portion 35 approaches the moving position of the movable member (34A, 34B), the guide portion 201 is fitted to the attraction portion 34A of the movable member. As a result, the attraction portion 34A and the magnetic pole surface of the electromagnet portion 35 are brought into surface contact with each other while the movable member is aligned with respect to the electromagnet portion 35. In a case where such contact between the movable member and the electromagnet portion 35 is detected by a switch (not illustrated) or the load current of the motor 37, the electromagnet portion 35 is excited and the motor 37 is stopped. The electromagnetic force acts on the movable member, and the movable member is attracted to the electromagnet portion 35.

[0052] In a case where the movable member is attracted to the electromagnet portion 35, the rotation direction of the motor 37 is reversed while the excitation of the electromagnet portion 35 is continued, and the feed screw 36 is reversed. As a result, the movable member is moved to the standby position together with the electromagnet portion 35. In this case, since the movable member is aligned with respect to the electromagnet portion 35, the movable member is smoothly moved without increasing the load of the motor 37.

[0053] FIG. 4 is a side view illustrating arrangement of the movable member (34A, 34B), the electromagnet portion 35, the guide portion 201, and the feed screw 36 in FIG. 2. Note that FIG. 4 is a side view of FIG. 2 as viewed from the right in the drawing.

[0054] As illustrated in FIG. 4, the attraction portion 34A of the movable member has a line-symmetric planar shape having a symmetric axis passing through the central axis of the feed screw 36. The electromagnet portion 35 has two circular magnetic pole surfaces. These magnetic pole surfaces are arranged symmetrically with respect to the same symmetric axis.

[0055] The attraction portion 34A has a cutout portion 34C at a central portion. The cutout portion 34C and the guide portion 201 are fitted to each other. The guide portion 201 has a hollow cylindrical shape, and the feed screw 36 passes through the guide portion 201. The opening end portion of the guide portion 201 on the movable member side has a tapered surface of which the diameter is decreased toward the attraction portion 34A of the movable member. In FIG. 4, this tapered surface can be seen.

[0056] Even in a case where the movable member is displaced during the emergency stop operation, when the guide portion 201 and the cutout portion 34C are fitted to each other in the return operation of the electric actuator 10, first, the tapered surface at the opening end portion of the guide portion 201 on the movable member side comes into contact with the edge of the cutout portion 34C to move the movable member. That is, the displaced movable member is moved by being guided by the guide portion 201. Further, in a case where the guide portion 201 and the cutout portion 34C are fitted to each other up to the maximum diameter portion of the tapered surface, that is, the cylindrical portion following the tapered surface, the movable member is aligned at the position set by the guide portion 201 with respect to the electromagnet portion 35.

[0057] The width (w) of the cutout portion 34C in the horizontal direction in FIG. 4, that is, in the axis direction of the engagement pin 102 is set to be larger than the diameter (d) of the cylindrical portion of the guide portion 201 within a range of a desired aligning accuracy (Δx) ($d < w \leq d+\Delta x$). In addition, in the first embodiment, in a case where the guide portion 201 and the cutout portion 34C are fitted to each other, the upper edge of the cutout portion 34C is pushed up by the tapered surface of the guide portion 201, so that it is possible to perform positioning even with respect to the positional displacement of the movable member in the height direction.

[0058] As illustrated in FIG. 4, the support portion 34B of the movable member has two engagement portions with the bracket 38. The two engagement portions are arranged line-symmetrically with respect to the symmetric axis of the attraction portion 34A described above. In each of the two engagement portions, the movable member is connected to the bracket 38 via the engagement pin 102 of which the shaft portion 101 is fixedly connected to the side portion of the bracket 38 through the long hole 103.

[0059] FIG. 4 illustrates a state in which the movable member is aligned. In this state, the dimensions of the bracket 38 and the support portion 34B and the positional relationship between the bracket 38 and the support portion 34B are set such that the side portion of the bracket 38 and the side portion of the support portion 34B facing each other do not come into contact with each other. Therefore, there is a gap (play) between the side portion of the bracket 38 and the side portion of the support portion 34B. As described above, in order to give a degree of freedom to the position of the engagement pin 102 within the range of the long hole 103, the end portion of the shaft portion 101 of the engagement pin 102 on the head side of the engagement pin 102 protrudes from the long hole 103 on a side of the support portion 34B opposite to the bracket 38 side, and is a free end.

[0060] Therefore, the movable member (34A, 34B) is rotatable about the engagement pin 102, and is movable in the axis direction of the engagement pin 102, that is, in the rotation axis direction. As a result, in the axis direction of the engagement pin 102, the movable member (34A, 34B) can be displaced, and the movable member (34A, 34B) can be aligned as described later.

[0061] Next, the return operation of the electric actuator 10 will be described with reference to FIGS. 5 to 7.

[0062] FIGS. 5 to 7 are top views illustrating the mechanism part of the electric actuator according to the first embodiment.

[0063] In FIGS. 5, 6, and 7, the electric actuators are in the operating state (corresponding to FIG. 3), the return operation, and the standby state (corresponding to FIG. 2), respectively.

[0064] In FIG. 5, the movable member (34A, 34B) is displaced in the axis direction of the engagement pin. That is, the center of the cutout portion 34C (the center in the horizontal direction in FIG. 4) is displaced upward in FIG. 5 (rightward in FIG. 4) from the rotation axis of the feed screw 36. Therefore, in a case where the support portion 34B of the movable member approaches the bracket 38 due to the positional displacement, the support portion 34B and the bracket 38 may come into contact with each other due to dimensional tolerance and assembly tolerance of the electric actuator.

[0065] In a case where the support portion 34B and the bracket 38 come into contact with each other, the load on the motor 37 is increased during the return operation. Therefore, in order to ensure the reliability of the return operation, the motor 37 is required to have an output value of a magnitude that allows for an increase in load due to the contact between the support portion 34B and the bracket 38.

[0066] On the other hand, in the first embodiment, as described below, by aligning the movable member with respect to the electromagnet portion 35 at the time of the return operation, it is possible to prevent an increase in the motor load due to the contact between the support portion 34B and the bracket 38.

[0067] As illustrated in FIG. 6, during the return operation of the electric actuator, the electromagnet portion 35 is driven by the feed screw 36 rotated by the motor 37, and the electromagnet portion 35 is moved toward the movable member. In a case where the electromagnet portion 35 approaches the movable member, the tip end portion of the guide portion 201 having the tapered surface is fitted to the cutout portion 34C of the attraction portion 34A. In this case, since the edge of the cutout portion 34C is pressed by the tapered surface, the movable member is moved in the axis direction of the engagement pin 102. In the first embodiment, the movable member is moved downward in FIG. 5 from the position in FIG. 5.

[0068] In a case where the electromagnet portion 35 is further moved so that the guide portion 201 and the cutout portion 34C are fitted to each other up to the maximum diameter portion of the tapered surface, that is, the cylindrical portion following the tapered surface as illustrated in FIG. 6, the movement of the movable member is stopped, and the movable member is aligned at the position set by the guide portion 201 with respect to the electromagnet portion 35.

[0069] That is, in a case where the electromagnet portion 35 approaches the displaced movable member, the movable member is guided by the guide portion 201 included in the electromagnet portion 35, and is moved in a direction opposite to a direction in which the movable member is displaced. As a result, the movable member is aligned at the position set by the guide portion 201 with respect to the electromagnet portion 35.

[0070] With such alignment, it is possible to eliminate a state in which the support portion 34B and the bracket 38 may come into contact with each other, which occurs due to dimensional tolerance or assembly tolerance of the electric actuator when the movable member is displaced.

[0071] In a case where the movable member is aligned with respect to the electromagnet portion 35, the electromagnet portion 35 is energized and attracts the attraction portion 34A using the electromagnetic force. While the electromagnet portion 35 is energized, the motor 37 is rotated in a direction opposite to a direction in which the electromagnet portion 35 is moved toward the movable member. The electromagnet portion 35 is driven by the feed screw 36 rotated by the motor 37 rotating reversely in this manner, and the electromagnet portion 35 and the movable member (34A, 34B) are moved to the position in the standby state as illustrated in FIG. 7. In this case, the electromagnet portion 35 and the movable member (34A, 34B) are moved in a state where the movable member is aligned with respect to the electromagnet portion 35. Therefore, it is possible to prevent an increase in motor load due to the dimensional tolerance or the assembly tolerance of the electric actuator.

[0072] In a case where the electromagnet portion 35 and the movable member (34A, 34B) are moved to the position in the standby state, the motor 37 is stopped, and the energization of the electromagnet portion 35 is maintained. As a result, the electric actuator is in the standby state as illustrated in FIG. 7.

[0073] As described above, according to the first embodiment, at the time of the return operation of the electric actuator, the movable member (34A, 34B), which is displaced at the time of the operation of the electric actuator, is moved while the guide portion 201 guides the direction in which the movable member is moved, in a direction opposite to a direction in which the movable member is displaced, and thereby the movable member is aligned with respect to the electromagnet portion 35. That is, in the return operation, the movable member follows the movement of the electromagnet portion 35 by the guide portion 201 included in the electromagnet portion so that the movable member is aligned with respect to the electromagnet portion 35 in a case where the electromagnet portion 35 is moved toward the movable member and comes into contact with the movable member.

[0074] In addition, the electric actuator according to the first embodiment is similarly operated at the time of power failure recovery even in a case where the energization to the electromagnet portion 35 is stopped due to the power failure.

[0075] As a result, it is possible to prevent an increase in motor load when the electromagnet portion 35 is moved to the position in the standby state, which occurs due to the dimensional tolerance or the assembly tolerance of the electric actuator. Therefore, the output capacity of the motor 37 can be reduced.

Second Embodiment

[0076] Next, an elevator device according to the second embodiment of the present invention will be described with reference to FIGS. 8 to 13.

[0077] Note that a schematic configuration of the elevator device of the second embodiment is similar to that of the first embodiment (FIG. 1).

[0078] Hereinafter, differences from the first embodiment will be mainly described.

[0079] FIG. 8 is a front view illustrating a mechanism part of the electric actuator 10, which is housed in the housing 30, according to the second embodiment in the installed state of FIG. 1 (corresponding to FIG. 2 described above). In FIG. 8, the emergency stop device is in a non-operating state, and the electric actuator 10 is in a standby state. That is, the elevator device is in a normal operation state.

[0080] As illustrated in FIG. 8, in the second embodiment, unlike the first embodiment, the attraction portion 34A of the movable member (34A, 34B) includes a guide portion 301. As will be described later (FIG. 10), the guide portion 301 is re provided on each of both left and right sides of the attraction surface of the attraction portion 34A with the electromagnet portion 35. Between these guide portions 301, the electromagnet portion 35 is fitted to the attraction portion 34A of the movable member. As a result, the movable member is aligned with respect to the electromagnet portion 35.

[0081] As will be described later, in a case where tapered surfaces of the guide portions 301 are pressed by the electromagnet portion 35, the displaced movable member is moved and aligned. Therefore, although the movable member includes the guide portions 301, the alignment mechanism is similar to that of the first embodiment. As described above, also in the second embodiment, the movable member is moved while being guided by the guide portions 301 to be aligned with respect to the electromagnet portion 35.

[0082] FIG. 9 is a front view illustrating a mechanism part of the electric actuator 10, which is housed in the housing 30, according to the second embodiment in the installed state of FIG. 1 (corresponding to FIG. 3 described above). In FIG. 9, the emergency stop device is in the braking state, and the electric actuator 10 is in the operating state. That is, the elevator device is stopped by the emergency stop device.

[0083] In a case where the electromagnet portion 35 approaches the movable member (34A, 34B) from the position illustrated in FIG. 9, the electromagnet portion 35 is fitted to the attraction portion 34A of the movable member between the guide portions 301 provided on both left and right sides of the attraction surface of the attraction portion 34A. As a result, the movable member is aligned with respect to the electromagnet portion 35. Therefore, in a case where the movable member is moved to the standby position together with the electromagnet portion 35 that attracts the movable member, the movable member is smoothly moved without increasing the load of the motor 37.

[0084] FIG. 10 is a side view illustrating arrangement of the movable member (34A, 34B), the electromagnet portion 35, the guide portions 301, and the feed screw 36 in FIG. 8. Note that FIG. 10 is a side view of FIG. 8 as viewed from the right in the drawing.

[0085] As in the first embodiment, the attraction portion 34A has the cutout portion 34C at the central portion of the attraction surface. The feed screw 36 passes through the central portion of the cutout portion 34C. The width of the cutout portion 34C in the horizontal direction in the drawing is set to such a size that the edge of the cutout portion 34C does not come into contact with the feed screw 36 in consideration of the displacement of the movable member.

[0086] As illustrated in FIG. 10, the attraction portion 34A includes the guide portions 301 at both left and right end portions in the horizontal direction in the drawing. As illustrated in FIGS. 11 to 13 described later, each of the two guide portions has a tapered surface that is open toward the electromagnet portion 35. In FIG. 10, these tapered surfaces can be seen.

[0087] Even in a case where the movable member is displaced during the emergency stop operation, when the attraction portion 34A and the electromagnet portion 35 are fitted to each other between the two guide portions 301 in the return operation of the electric actuator 10, first, the end portion of the magnetic pole surface of the electromagnet portion 35 comes into contact with the tapered surfaces of the guide portions 301. Therefore, the tapered surfaces are pressed against the end portion of the magnetic pole surface, and the movable member is moved. That is, the displaced movable member is moved by being guided by the guide portions 301. In a case where the electromagnet portion 35 is further moved and the magnetic pole surface of the electromagnet portion 35 comes into surface contact with the attraction surface between the guide portions 301, the movable member is aligned at the position set by the electromagnet portion 35.

[0088] The width (W) of the attraction surface between the guide portions 301 in the horizontal direction in FIG. 10, that is, in the axis direction of the engagement pin 102 is set to be larger than the distance (D) between two end portions of the magnetic pole surface in contact with the tapered surfaces within a range of a desired aligning accuracy (ΔX) ($D < W \leq D+\Delta X$).

[0089] Next, the return operation of the electric actuator 10 will be described with reference to FIGS. 11 to 13.

[0090] FIGS. 11 to 13 are top views illustrating the mechanism part of the electric actuator according to the first embodiment.

[0091] In FIGS. 11, 12, and 13, the electric actuators are in the operating state (corresponding to FIG. 9), the return operation, and the standby state (corresponding to FIG. 8), respectively.

[0092] As illustrated in FIGS. 11 to 13, the attraction portion 34A of the movable member has the guide portions 301 on both sides of the cutout portion 34C. The guide portions 301 are provided at both end portions of the attraction surface of the attraction portion 34A facing the magnetic pole surface of the electromagnet portion

35 in parallel. The guide portion 301 has the tapered surface. Each of the tapered surfaces is formed of an inclined surface extending outward from the end portion of the attraction surface and approaching the magnetic pole surface of the electromagnet portion 35. Therefore, two tapered surfaces at both end portions of the attraction surface are open toward the electromagnet portion 35. Between such tapered surfaces, the electromagnet portion 35 is fitted to the movable member, and thereby the movable member is aligned as described below.

[0093] In the second embodiment, the guide portions 301 are formed of a member different from the attraction portion 34A. Note that the guide portions 301 may be formed by bending both end portions of a plate material forming the attraction portion 34A in a tapered shape. Further, the guide portion 301 may be formed of a non-magnetic material. In this case, when the electromagnet portion 35 is energized, the magnetic pole surface of the electromagnet and the attraction surface of the attraction portion 34A are attracted with high reliability.

[0094] In FIG. 11, the movable member (34A, 34B) is displaced in the axis direction of the engagement pin 102. That is, the center of the cutout portion 34C (the center in the horizontal direction in FIG. 10) is displaced upward in FIG. 11 (rightward in FIG. 10) from the rotation axis of the feed screw 36. Therefore, in a case where the support portion 34B of the movable member approaches the bracket 38 due to the positional displacement, the support portion 34B and the bracket 38 may come into contact with each other due to dimensional tolerance and assembly tolerance of the electric actuator.

[0095] In a case where the support portion 34B and the bracket 38 come into contact with each other, the load on the motor 37 is increased during the return operation. Therefore, in order to ensure the reliability of the return operation, the motor 37 is required to have an output value of a magnitude that allows for an increase in load due to the contact between the support portion 34B and the bracket 38.

[0096] On the other hand, in the second embodiment, as described below, by aligning the movable member with respect to the electromagnet portion 35 at the time of the return operation, it is possible to prevent an increase in the motor load due to the contact between the support portion 34B and the bracket 38.

[0097] As illustrated in FIG. 12, during the return operation of the electric actuator, the electromagnet portion 35 is driven by the feed screw 36 rotated by the motor 37, and the electromagnet portion 35 is moved toward the movable member. In a case where the electromagnet portion 35 approaches the movable member, the electromagnet portion 35 is fitted between the guide portions 301 of the attraction portion 34A. In this case, since the tapered surfaces of the guide portions 301 are pressed by the end portions of the magnetic pole surface of the electromagnet portion 35, the movable member is moved in the axis direction of the engagement pin 102. In the second embodiment, the movable member is moved downward in FIG. 11 from the position in FIG. 11.

[0098] In a case where the electromagnet portion 35 is further moved and the attraction surface between the guide portions 301 of the attraction portion 34A and the magnetic pole surface of the electromagnet portion 35 come into surface contact with each other as illustrated in FIG. 12, the movement of the movable member is stopped. In this case, the movable member is aligned at the position set by the electromagnet portion 35 with respect to the electromagnet portion 35.

[0099] That is, in a case where the electromagnet portion 35 approaches the displaced movable member, the movable member is guided by the guide portions 301 included in the movable member, and is moved in a direction opposite to a direction in which the movable member is displaced. As a result, the movable member is aligned at the position set by the electromagnet portion 35.

[0100] With such alignment, it is possible to eliminate a state in which the support portion 34B and the bracket 38 may come into contact with each other, which occurs due to dimensional tolerance or assembly tolerance of the electric actuator when the movable member is displaced.

[0101] In a case where the movable member is aligned with respect to the electromagnet portion 35, the electromagnet portion 35 is energized and attracts the attraction portion 34A using the electromagnetic force. While the electromagnet portion 35 is energized, the motor 37 is rotated in a direction opposite to a direction in which the electromagnet portion 35 is moved toward the movable member. The electromagnet portion 35 is driven by the feed screw 36 rotated by the motor 37 rotating reversely in this manner, and the electromagnet portion 35 and the movable member (34A, 34B) are moved to the position in the standby state as illustrated in FIG. 13. In this case, the electromagnet portion 35 and the movable member (34A, 34B) are moved in a state where the movable member is aligned with respect to the electromagnet portion 35. Therefore, it is possible to prevent an increase in motor load due to the dimensional tolerance or the assembly tolerance of the electric actuator.

[0102] In a case where the electromagnet portion 35 and the movable member (34A, 34B) are moved to the position in the standby state, the motor 37 is stopped, and the energization of the electromagnet portion 35 is maintained. As a result, the electric actuator is in the standby state as illustrated in FIG. 13.

[0103] As described above, according to the second embodiment, at the time of the return operation of the electric actuator, the movable member (34A, 34B), which is displaced at the time of the operation of the electric actuator, is moved while the guide portions 301 guide the direction in which the movable member is moved, in a direction opposite to a direction in which the movable member is displaced, and thereby the movable member is aligned with respect to the electromagnet portion 35. That is, in the return operation, the movable member follows the movement of the electromagnet portion 35 by the guide portions 301 included in the movable member so that the movable member is aligned with respect to the electromagnet portion 35 in a case where the electromagnet portion 35 is moved toward the movable member and comes into contact with the movable member.

[0104] In addition, the electric actuator according to the second embodiment is similarly operated at the time of power failure recovery even in a case where the energization to the electromagnet portion 35 is stopped due to the power failure.

[0105] As a result, it is possible to prevent an increase in motor load when the electromagnet portion 35 is moved to the position in the standby state, which occurs due to the dimensional tolerance or the assembly tolerance of the electric actuator. Therefore, the output capacity of the motor 37 can be reduced.

[0106] Note that the present invention is not limited to the above-described embodiments, and includes various modifications. For example, the respective embodiments described above are described in detail in order to describe the present invention for easy understanding, and are not necessarily limited to those having all the described configurations. In addition, it is possible to add, delete, and replace other configurations for a part of the configuration of each embodiment.

[0107] For example, the electric actuator 10 may be provided in a lower portion or a side portion in addition to the upper portion of the elevator car 1.

[0108] Further, the elevator device may include a machine room, or may be a so-called machine-room-less elevator.

Reference Signs List

[0109]

1	elevator car
2	emergency stop device
3	position sensor
4	guide rail
10	electric actuator
11	operation lever
12	drive shaft
13	drive spring
14	fixing portion
15	pressing member
16	actuation piece
17	connection piece
18	actuation piece
19	actuation shaft
20	actuation shaft
21	pull-up rod
30	housing
31	housing cover
32	cover member
33	plate member
34A	attraction portion
34B	support portion
34C	cutout portion
35	electromagnet portion
36	feed screw
37	motor
38	bracket
39	feed nut
40	substrate
41	support member
42	support member
50	crosshead
101	shaft portion
102	engagement pin
103	long hole
201	guide portion
301	guide portion

Claims

1. An elevator device comprising:

an elevator car;
an emergency stop device provided to the elevator car;
a drive mechanism that is provided to the elevator car and drives the emergency stop device; and
an electric actuator that is provided to the elevator car and operates the drive mechanism,
wherein the electric actuator includes an operation lever connected to the drive mechanism,
a movable member that is rotatably connected to the operation lever,
an electromagnet portion that attracts the movable member in a standby state of the electric actuator,
a feed screw that is screwed with the electromagnet portion,
a motor that drives the feed screw, and
a guide portion that, in a return operation of the electric actuator, causes the movable member to follow a movement of the electromagnet portion such that the movable member is aligned with respect to the electromagnet portion when the electromagnet portion comes into contact with the movable member by being moved toward the movable member by driving the feed screw using the motor.

2. The elevator device according to claim 1, wherein there is a gap between the movable member and a connection portion of the operation lever with the movable member.

3. The elevator device according to claim 2, wherein the movable member is movable along a rotation axis.

4. The elevator device according to claim 1, wherein the electromagnet portion includes the guide portion.

5. The elevator device according to claim 4, wherein the guide portion is fitted to the movable member.

6. The elevator device according to claim 5, wherein

the guide portion has a tapered surface, and when the guide portion is fitted to the movable member, the guide portion is pressed by the tapered surface, and the movable member is driven.

7. The elevator device according to claim 1, wherein

the movable member includes the guide portion, and
the guide portion has a first guide portion and a second guide portion that face the electromagnet portion.

8. The elevator device according to claim 7, wherein the electromagnet portion is fitted to the movable member between the first guide portion and the second guide portion.

9. The elevator device according to claim 8, wherein

the guide portion has a tapered surface, and when the electromagnet portion is fitted to the movable member, the tapered surface is pressed by the electromagnet portion, and the movable member is driven.

FIG. 1

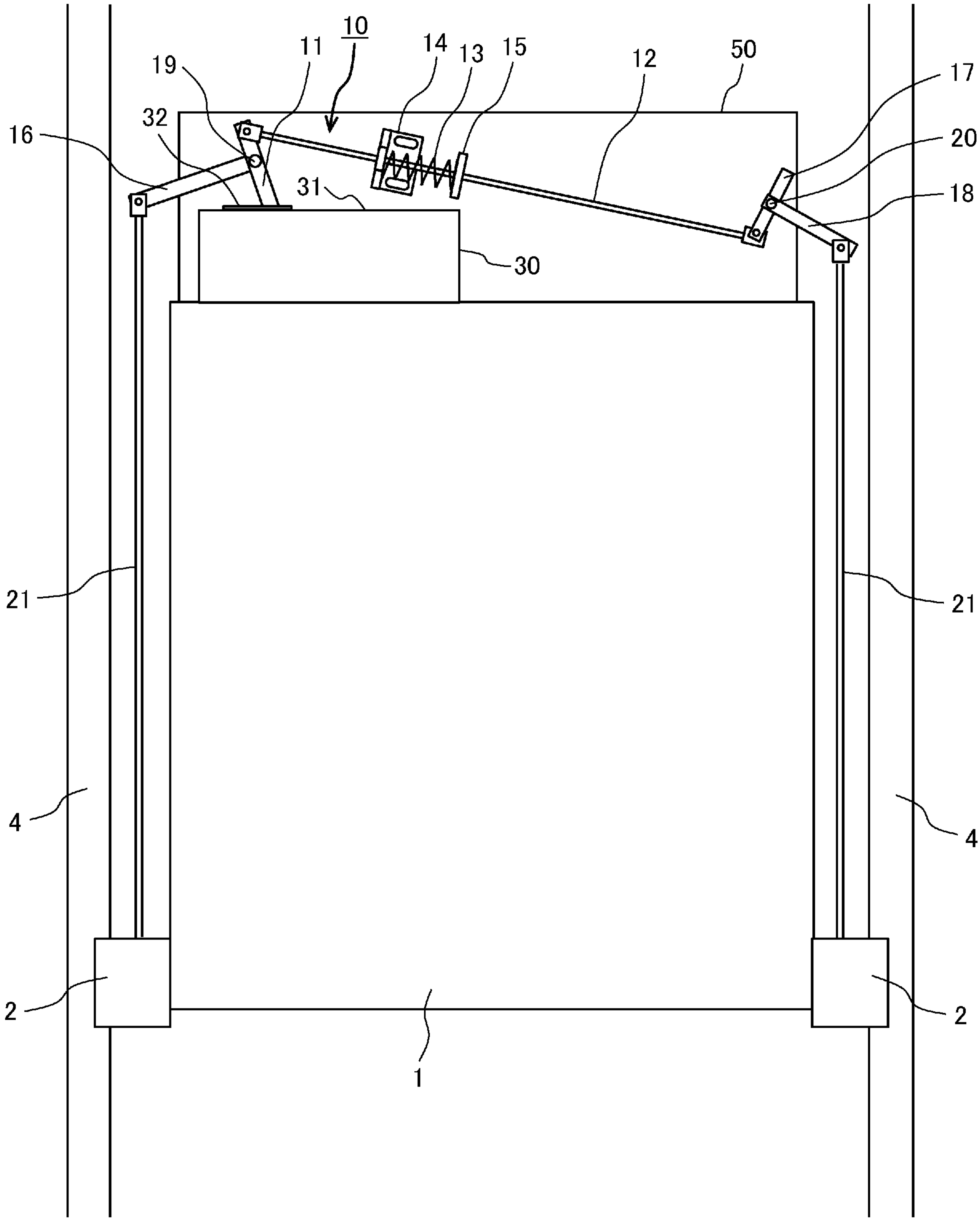

FIG. 2

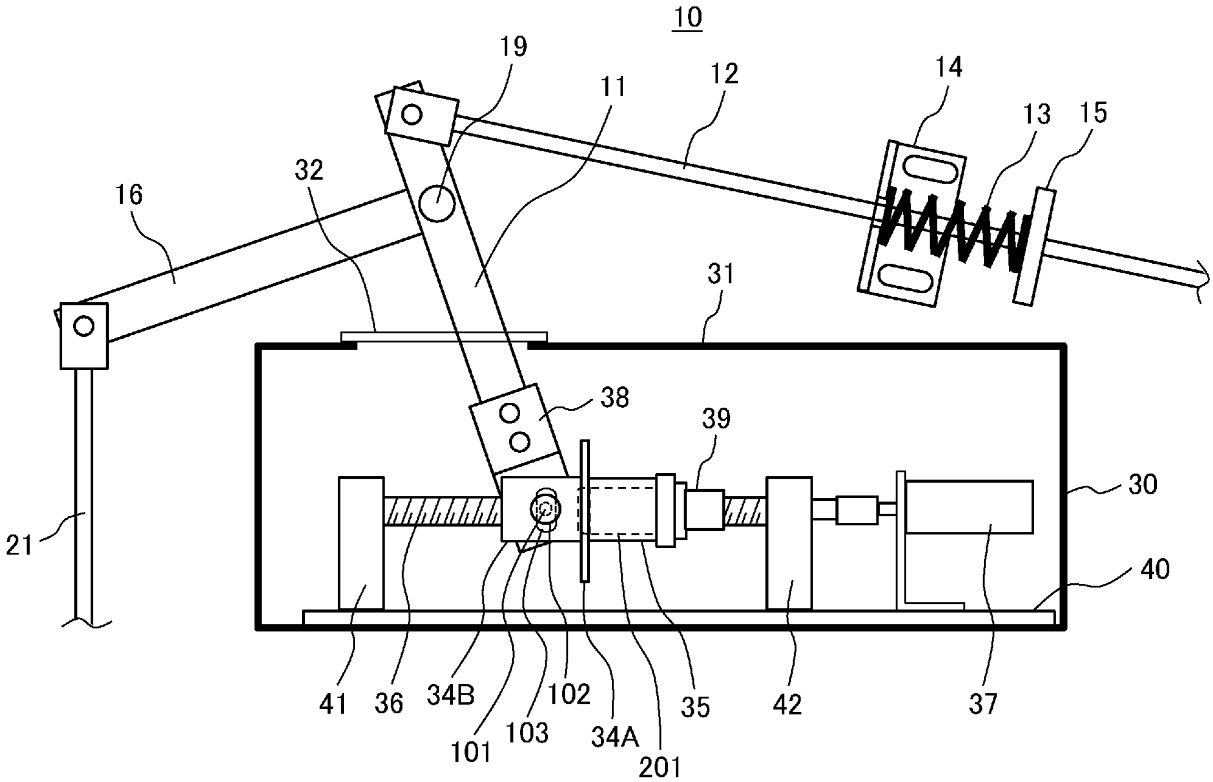
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FIG. 3

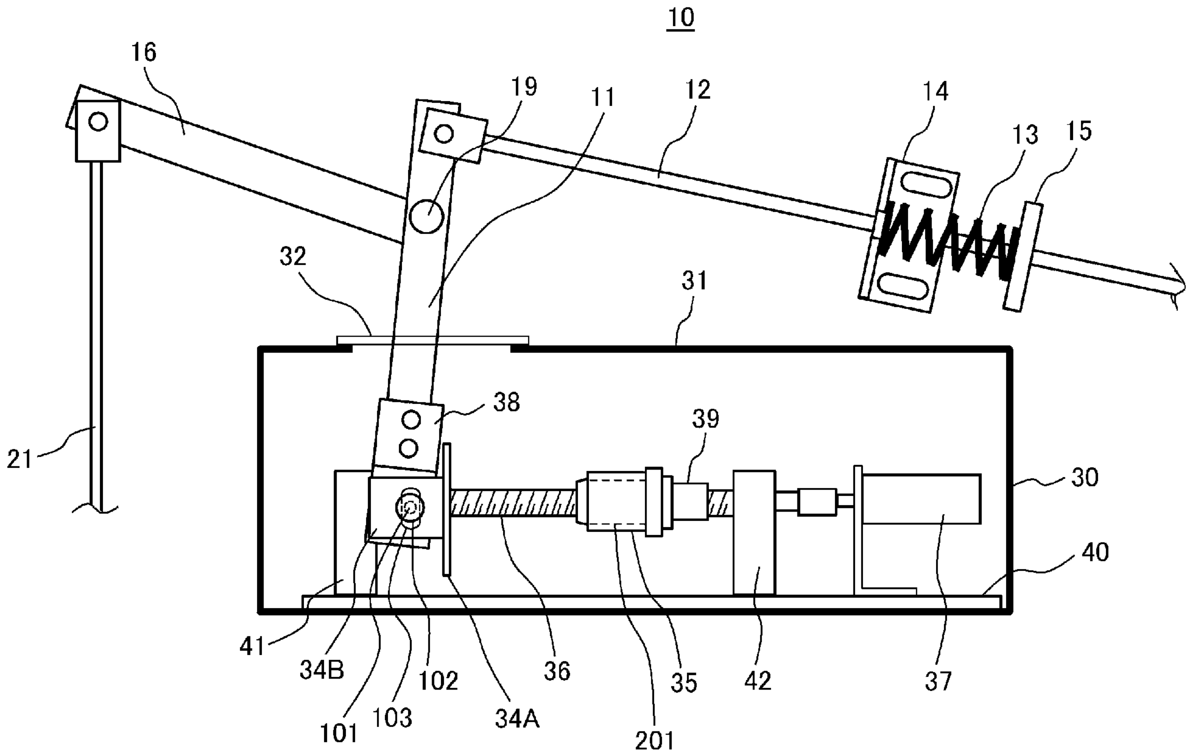
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FIG. 4

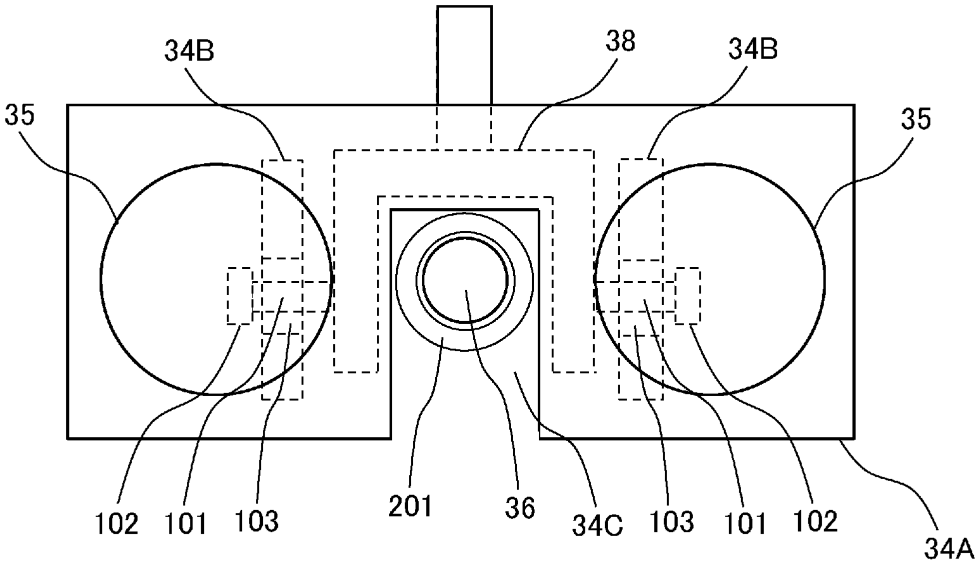
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FIG. 5

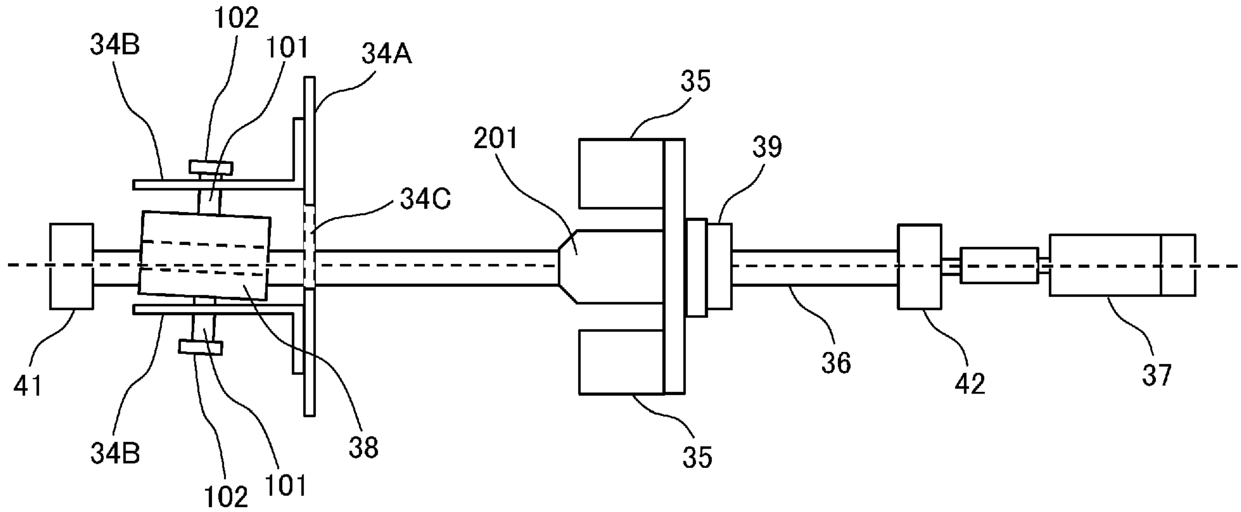
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FIG. 6

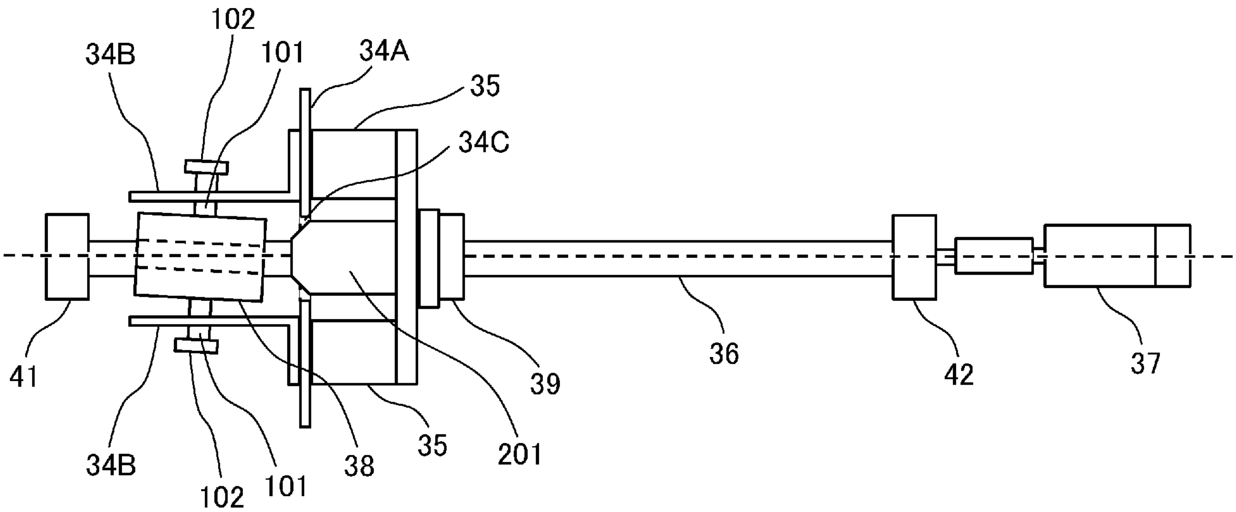

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FIG. 7

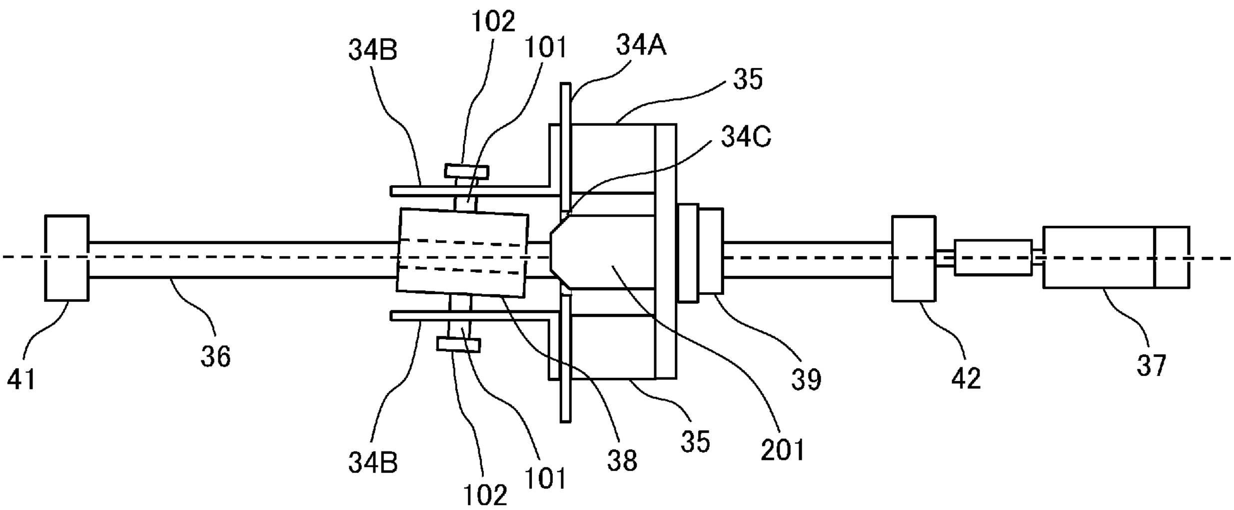

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FIG. 8

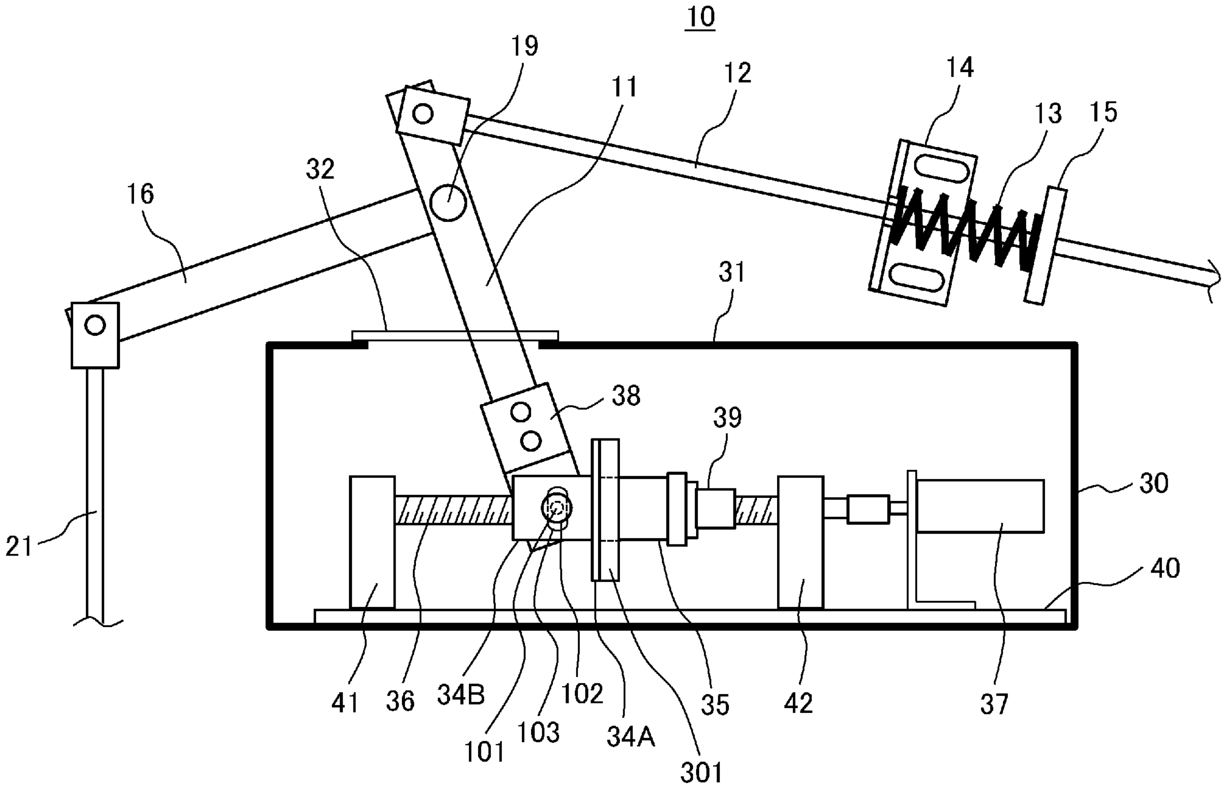
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FIG. 9

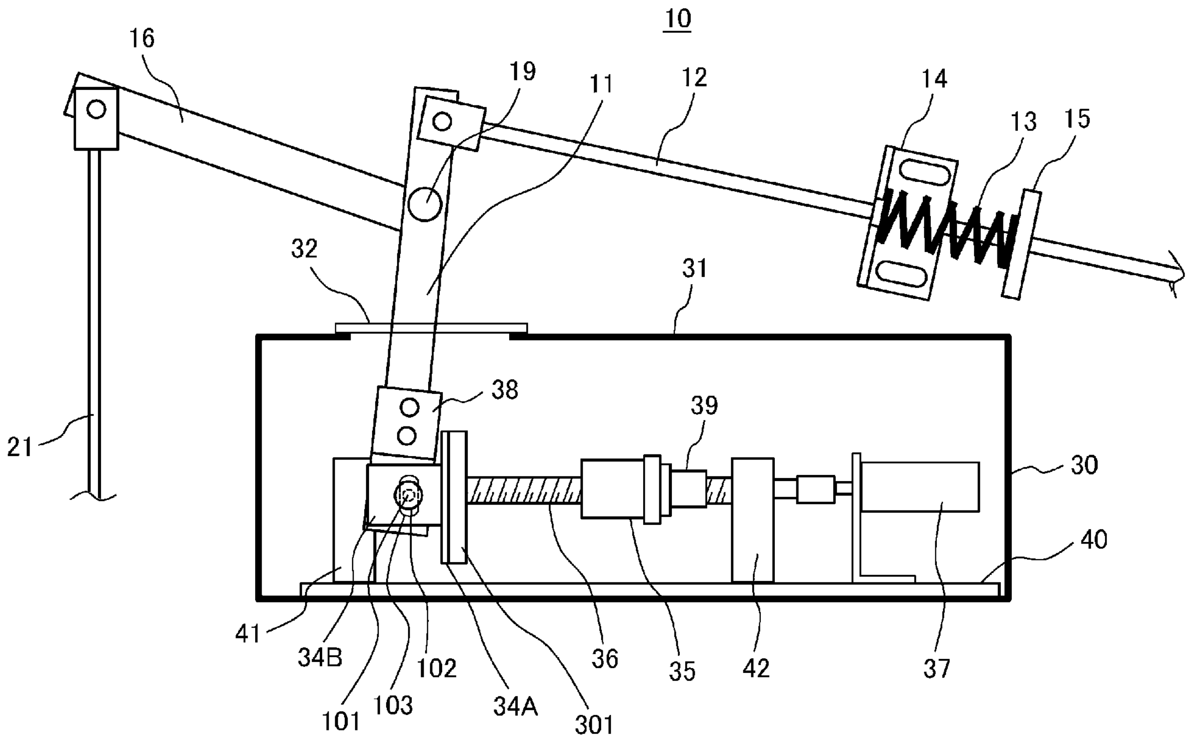
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FIG. 10

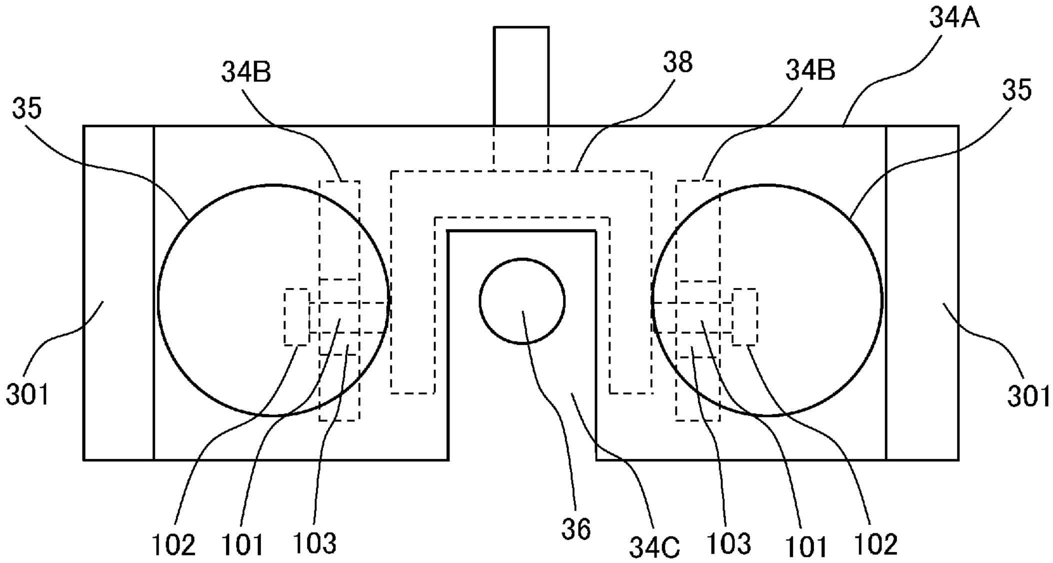
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FIG. 11

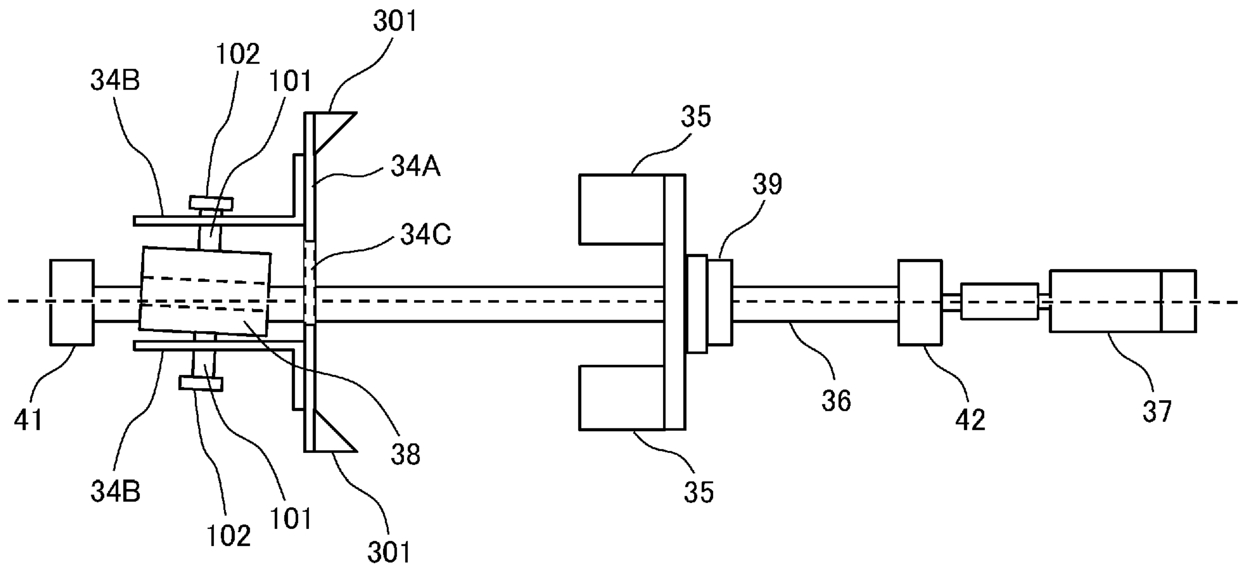
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FIG. 12

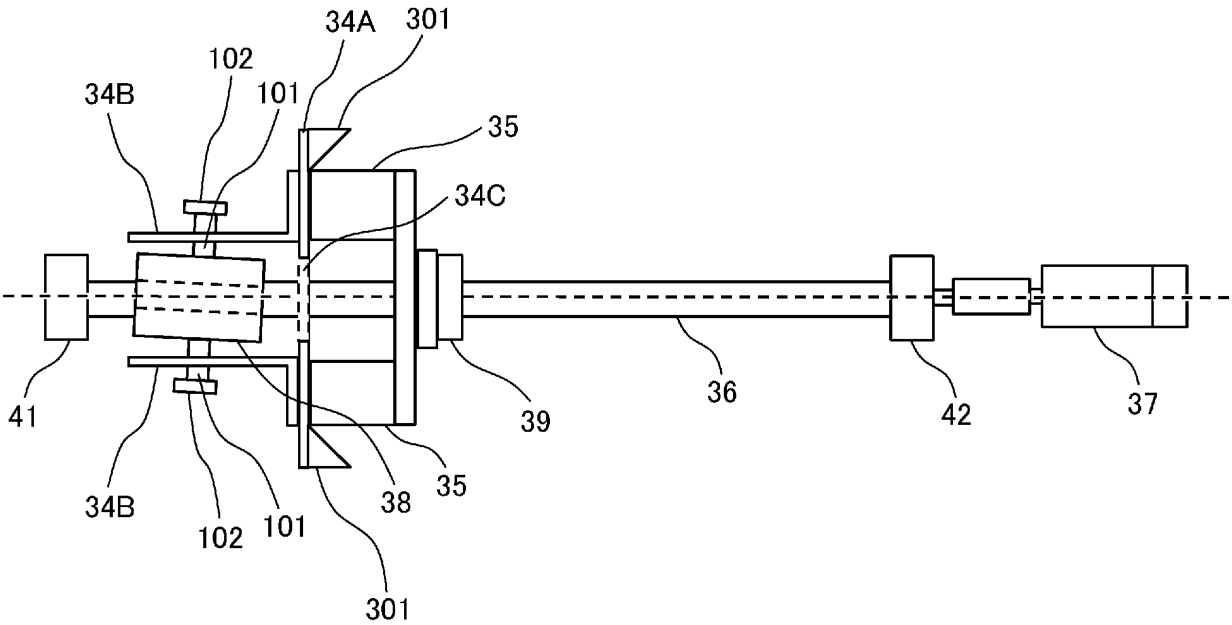
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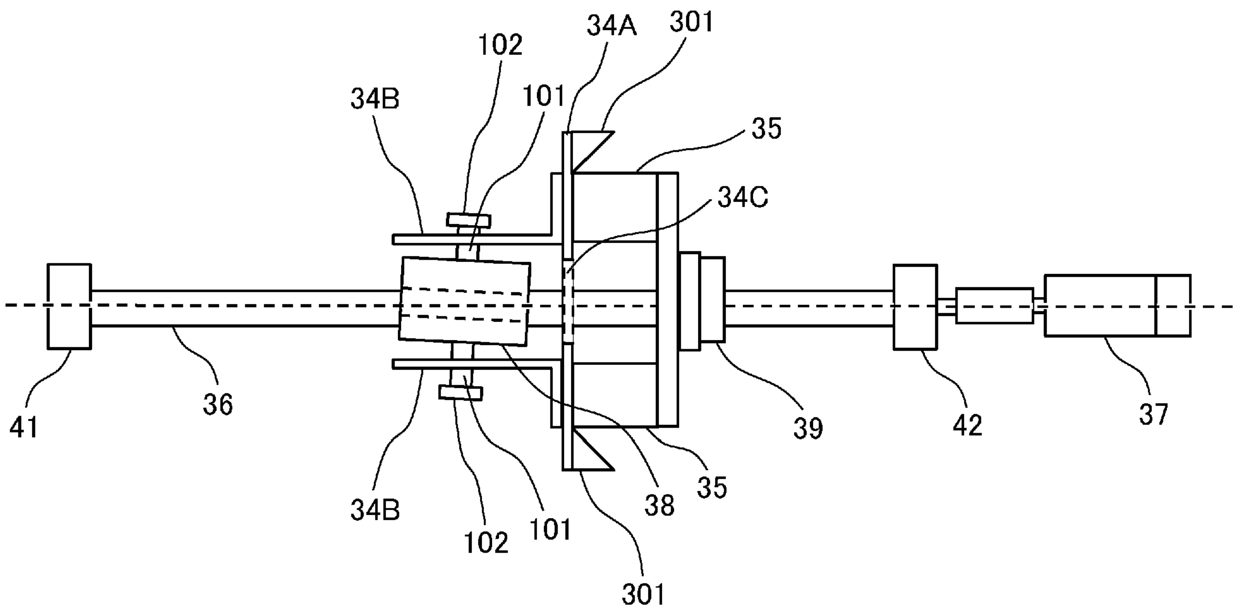
FIG. 13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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2021/016048

A. CLASSIFICATION OF SUBJECT MATTER
B66B 5/18(2006.01)i
FI: B66B5/18 Z
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)
B66B5/00-5/28

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

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2021
Registered utility model specifications of Japan	1996-2021
Published registered utility model applications of Japan	1994-2021

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 2020/110437 A1 (HITACHI LTD) 04 June 2020 (2020-06-04)	1-9
A	JP 2012-520810 A (OTIS ELEVATOR COMPANY) 10 September 2012 (2012-09-10)	1-9
A	WO 2013/092239 A1 (INVENTIO AG) 27 June 2013 (2013-06-27)	1-9
A	JP 2009-227353 A (MITSUBISHI ELECTRIC CORP) 08 October 2009 (2009-10-08)	1-9

☐ Further documents are listed in the continuation of Box C.

☒ See patent family annex.

* Special categories of cited documents:
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"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
11 June 2021 (11.06.2021)	29 June 2021 (29.06.2021)

Name and mailing address of the ISA/	Authorized officer
Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Telephone No.

Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application no.
PCT/JP2021/016048

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WO 2020/110437 A1	04 Jun. 2020	CN 112867687 A	
JP 2012-520810 A	10 Sep. 2012	US 2012/0000732 A1 WO 2010/107408 A1 EP 2408703 B1 CN 102348627 A ES 2614438 T3	
WO 2013/092239 A1	27 Jun. 2013	US 2018/0072536 A1 EP 2794451 A1 CA 2855908 A1 CN 103998363 A BR 112014015079 A2 IN 4578CHN2014 A	
JP 2009-227353 A	08 Oct. 2009	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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