



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
25.05.2022 Bulletin 2022/21

(21) Application number: **21201677.8**

(22) Date of filing: **08.10.2021**

(51) International Patent Classification (IPC):
E05B 15/04 (2006.01) **E05B 81/90** (2014.01)
E05B 81/16 (2014.01) **E05B 83/36** (2014.01)
B61D 19/02 (2006.01) **E05B 81/08** (2014.01)
E05B 81/64 (2014.01)

(52) Cooperative Patent Classification (CPC):
E05B 15/04; B61D 19/02; E05B 81/16;
E05B 81/90; E05B 83/363; E05B 81/08;
E05B 81/64

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
KH MA MD TN

(30) Priority: **13.11.2020 JP 2020189855**
04.02.2021 JP 2021016682

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(54) **MANUAL DOOR UNLOCKING DEVICE AND RAILWAY VEHICLE DOOR DEVICE**

(57) A manual door unlocking device (100) according to one aspect of the present invention includes: a locking mechanism (110) for locking a door leaf (10) when the door leaf (10) is at a fully closed position, the door leaf (10) being configured to move by a driving force from a drive source to open and close a doorway (105) of a railway vehicle; an operation portion (120) configured to

receive manual operation; a force accumulating portion (130) for accumulating a predetermined amount of operating force produced by the manual operation; and an unlocking portion (150) configured to transmit the predetermined amount of operating force accumulated in the force accumulating portion (130) to undo the locking mechanism (110).

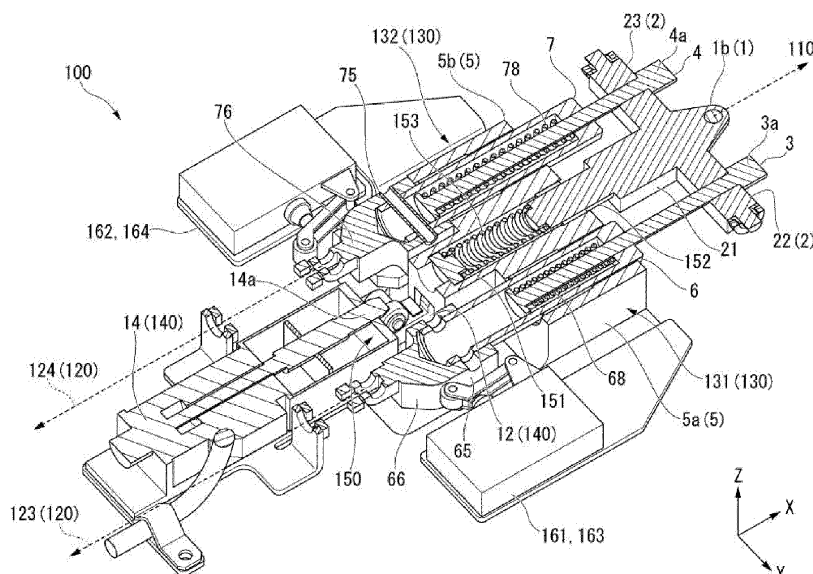


Fig. 3

Description**TECHNICAL FIELD**

5 [0001] The present invention relates to a manual door unlocking device and a railway vehicle door device.

BACKGROUND

10 [0002] A door device for a railway vehicle includes a door body and a locking mechanism for locking the door body in a closed state. While the railway vehicle is traveling, the door device controls the locking mechanism to lock the door body, thereby preventing the door body from unexpectedly being opened, thus ensuring the safety of passengers. On the other hand, the door body may need to be opened in an emergency. Therefore, manual unlocking devices are used for manually undoing the locking mechanism. These manual unlocking devices are sometimes referred to as EVAC (emergency evacuation).

15 [0003] When a passenger pushes a button or the like provided in the vicinity of the door body, a request signal for requesting unlocking of the door body is sent to the door device. If the door device confirms that the speed of the vehicle is lower than a predetermined value, the door device drives an actuator that has been locking the lever provided in the vicinity of the door body to allow operation of the lever. The passenger then uses the lever to manually operate the locking mechanism to undo the locking mechanically. In this way, the EVAC is designed such that a passenger can use
20 the manual unlocking device only when safety is ensured if the door is opened.

RELEVANT REFERENCES**LIST OF RELEVANT PATENT LITERATURE**

25 [0004] Patent Literature 1: Japanese Patent Application Publication No. H07-096834

SUMMARY

30 [0005] In the above technique, if a passenger in an emergency hastily operates the lever with excessive force (operating force), the actuator that locks the lever may be damaged. Furthermore, there is a possibility that the door body could be unlocked while the vehicle is traveling.

[0006] The object of the present invention is to overcome the above drawbacks.

35 [0007] (1) A manual door unlocking device according to one aspect of the present invention comprises: a locking mechanism for locking a door leaf when the door leaf is at a fully closed position, the door leaf being configured to move by a driving force from a drive source to open and close a doorway of a railway vehicle; an operation portion configured to receive manual operation; a force accumulating portion for accumulating a predetermined amount of operating force produced by the manual operation; and an unlocking portion configured to transmit the predetermined amount of operating force accumulated in the force accumulating portion to undo the locking mechanism.

40 [0008] In the manual door unlocking device of the present invention, the operating force can be absorbed by the force accumulating portion. Therefore, even if the operating portion is operated with a large force, the unlocking portion is prevented from being damaged.

[0009] (2) The force accumulating portion may include a restraining portion configured to restrain transmission of the predetermined amount of operating force to the unlocking portion, and when receiving an undoing signal, the force
45 accumulating portion drives the restraining portion to undo restraint and allows the predetermined amount of operating force to be transmitted to the unlocking portion to undo the locking mechanism.

[0010] (3) The operation portion may include: an inside operation portion capable of being operated from inside the vehicle; and an outside operation portion capable of being operated from outside the vehicle. The force accumulating portion may include: an inside force accumulating portion for accumulating an operating force produced by operation of
50 the inside operation portion; and an outside force accumulating portion for accumulating an operating force produced by operation of the outside operation portion.

[0011] (4) The unlocking portion may include a cylinder and a piston. The piston may be connected so as to receive an output of the inside force accumulating portion and an output of the outside force accumulating portion.

55 [0012] (5) The unlocking portion may include a synchronization mechanism for synchronizing movement of the piston caused by the received output of the inside force accumulating portion and movement of the piston caused by the output of the outside force accumulating portion.

[0013] (6) The force accumulating portion may be capable of accumulating the operating force by a biasing force of a spring.

[0014] (7) The unlocking portion may include a cylinder and a piston. The unlocking portion may further include a spring for returning the piston and the spring of the force accumulating portion to positions the piston and the spring of the force accumulating portion were in before accumulation of the operating force.

[0015] (8) The restraining portion may include: at least one latch lever for restraining the transmission of the operating force accumulated in the force accumulating portion to the unlocking portion; and an actuator for driving the at least one latch lever to undo restraint of the transmission to the unlocking portion.

[0016] (9) The unlocking portion may include: a piston configured to receive an output of the force accumulating portion; and a cylinder into which the piston is inserted so as to be able to reciprocate. The piston may have a hooked-on portion formed therein, and the at least one latch lever may have a hooking portion formed at one end thereof, and the hooking portion may be capable of being hooked on the hooked-on portion.

[0017] (10) At least one roller may be provided at the other end of the at least one latch lever. The actuator may rotate the at least one roller while contacting with the at least one roller, so as to undo the restraint of the transmission of the operating force accumulated in the force accumulating portion to the unlocking portion.

[0018] (11) The unlocking portion may include: a piston configured to receive an output of the force accumulating portion; and a cylinder into which the piston is inserted so as to be able to reciprocate. The piston may have a first hooked-on portion and a second hooked-on portion. The at least one latch lever may comprise a pair of latch levers provided on opposite sides of the piston so as to be able to be hooked on the first hooked-on portion and the second hooked-on portion. The at least one roller comprises a plurality of rollers each provided on the other end of associated one of the pair of latch levers, and the plurality of rollers are positioned on opposite sides of the actuator so as to be contactable with the actuator.

[0019] (12) The manual door unlocking device may further comprise a detecting portion for detecting that the operating force has been accumulated in the force accumulating portion by operation of the operation portion.

[0020] (13) A railway vehicle door device according to one aspect of the present invention comprises: a door leaf configured to move by a driving force from a drive source to open and close a doorway of a railway vehicle; a locking mechanism for locking the door leaf when the door leaf is at a fully closed position; an operation portion configured to receive manual operation; a force accumulating portion for accumulating a predetermined amount of operating force produced by the manual operation; and an unlocking portion configured to transmit the predetermined amount of operating force accumulated in the force accumulating portion to undo the locking mechanism.

[0021] In the railway vehicle door device according to one aspect of the present invention, the operating force can be absorbed by the force accumulating portion. Therefore, even if the operating portion is operated with a large force, the unlocking portion is prevented from being damaged.

ADVANTAGEOUS EFFECTS

[0022] According to the present invention, the unlocking portion for undoing the locking mechanism is operated to allow unlocking, by the operating force accumulated in the force accumulating portion through emergency operation. Therefore, even if the operation portion is pulled with a large operating force, the operating force is absorbed in the force accumulating portion, and thus the unlocking portion is prevented from being damaged.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

Fig. 1 is a schematic view of a door in a first embodiment of a manual door unlocking device according to the present invention, as viewed from the vehicle width direction of a railway vehicle.

Fig. 2 is a top view showing the first embodiment of the manual door unlocking device according to the present invention.

Fig. 3 is a top sectional view showing the first embodiment of the manual door unlocking device according to the present invention.

Fig. 4 is a perspective view including a section along the line IV-IV in Fig. 2.

Fig. 5 is a perspective view including a section along the line V-V in Fig. 2.

Fig. 6 is a sectional view in the axial direction showing a second embodiment of the manual door unlocking device according to the present invention.

Fig. 7 shows the manual door unlocking device of Fig. 6 as viewed from the axial direction.

Fig. 8 is a sectional view in the axial direction showing the second embodiment of the manual door unlocking device according to the present invention.

Fig. 9 is a sectional view in the axial direction showing the second embodiment of the manual door unlocking device according to the present invention.

Fig. 10 shows the manual door unlocking device of Fig. 9 as viewed from the axial direction.

DESCRIPTION OF EXAMPLE EMBODIMENTS

First Embodiment

[0024] A first embodiment of a manual door unlocking device according to the invention will be hereinafter described with reference to the accompanying drawings. Fig. 1 is a schematic view around a doorway of a railway vehicle in the present embodiment where a manual door unlocking device is provided, as viewed from the vehicle width direction of the railway vehicle. Fig. 2 is a top view of the manual door unlocking device according to the embodiment. Fig. 3 is a top sectional view of the manual door unlocking device including a section along a plane deeper than in Fig. 2 and parallel to that in Fig. 2. Fig. 4 is a perspective view of the manual door unlocking device including a section along the line IV-IV in Fig. 2. Fig. 5 is a perspective view of the manual door unlocking device including a section along the line V-V in Fig. 2. In these drawings, the reference sign 100 denotes the manual door unlocking device.

[0025] The following description of the embodiment will be based on an example of a railway vehicle door device including a pair of door leaves of a double door for opening and closing a doorway of a railway vehicle (a vehicle). In the following description, such terms as "parallel," "orthogonal," "center" and "coaxial" may appear to describe relative or absolute positions. These terms are not only strictly used to represent such arrangement. For example, these terms also allow some tolerances and relative differences in angle and distance as long as the same effects can be still produced. In the drawings used for the following description, members are shown to different scales into recognizable sizes.

[0026] As shown in Fig. 1, a manual door unlocking device 100 according to the present embodiment is disposed above a doorway 105. As shown in Fig. 1, the manual door unlocking device 100 includes door leaves 10 that move by a driving force from a drive source (not shown) to open and close the doorway 105 of the railway vehicle, a locking mechanism 110 for locking the door leaves 10 when the door leaves 10 are at a fully closed position, and an operation portion 120 that can undo the locking mechanism 110.

[0027] In the following description, an orthogonal coordinate system having X, Y, and Z axes will be used as necessary. The Y direction corresponds to the width direction of the vehicle. The X direction corresponds to the front-rear direction of the vehicle. The Z direction represents the height direction of the vehicle (the direction of gravity) orthogonal to the Y direction and the X direction. In the following description, for each of the Y direction, the X direction, and the Z direction, the side indicated by the arrow is referred to as the positive side, and the side opposite to the side indicated by the arrow is referred to as the negative side. The positive Y side corresponds to the inside in the vehicle width direction (the direction from the outside toward the vehicle), and the negative Y side corresponds to the outside in the vehicle width direction (the direction from the vehicle toward the outside). The positive Z side corresponds to the upper side in the direction of gravity, and the negative Z side corresponds to the lower side in the direction of gravity.

[0028] As shown in Fig. 1, the manual door unlocking device 100 includes an operation portion 120 for manually undoing the locking mechanism 110. The operation portion 120 includes an inside operation portion 121 and an outside operation portion 122. The inside operation portion 121 can be operated from inside the vehicle, and the outside operation portion 122 can be operated from outside the vehicle. The inside operation portion 121 and the outside operation portion 122 are formed of a manually operable operation handle, and transmit an operating force through wires 123, 124, respectively. The positions of the inside operation portion 121 and the outside operation portion 122 are not particularly limited. The inside operation portion 121 and the outside operation portion 122 can be disposed at any positions that allow, for example, easy operation by passengers, crew members, or station staff in an emergency.

[0029] As shown in Figs. 2 to 5, the manual door unlocking device 100 includes a force accumulating portion 130 and an unlocking portion 150. The force accumulating portion 130 includes an inside force accumulating portion 131, an outside force accumulating portion 132, and a restraining portion 140. The inside force accumulating portion 131 accumulates an operating force produced by operation of the inside operation portion 121, and the outside force accumulating portion 132 accumulates an operating force produced by operation of the outside operation portion 122. The inside force accumulating portion 131 accumulates an amount of operating force that can be accumulated by a spring 68 (described later), out of the operating force produced by the manual operation. The outside force accumulating portion 132 accumulates an amount of operating force that can be accumulated by a spring 78 (described later), out of the operating force produced by the manual operation. In Figs. 2 to 5, the door leaves 10 are closed, and the locking mechanism 110 is locking the door leaves 10.

[0030] As shown in Figs. 2 to 5, the manual door unlocking device 100 includes a link 1, a block 2, a rod 3, a rod 4, a base 5, a cylinder 6, a cylinder 7, an actuator 14, latch levers 11, 12, and switches 161 to 164. The link 1 is disposed such that the axial direction thereof corresponds to the X direction. One end of the link 1 is connected to an unlocking lever of the locking mechanism 110. The other end (end portion) 1b of the link 1 is connected to the block 2. The link 1 moves in the negative X direction along with the block 2 to undo the locking mechanism 110.

[0031] The block 2 is positioned in the positive X direction of the base 5. The block 2 includes a middle portion 21, an arm portion 22, and an arm portion 23. The middle portion 21 extends in the X direction, and the arm portion 22 and the arm portion 23 extend in opposite Y directions from the end portion of the middle portion 21 in the positive X direction. The block 2 is T-shaped as viewed from the Z direction.

[0032] The middle portion 21 of the block 2 positioned at the middle in the Y direction can reciprocate in the X direction relative to the base 5. The arm portion 22 of the block 2 positioned at the end in the positive Y direction is in contact with the rod 3 so as to be able to reciprocate in the X direction. The end portion of the arm portion 22 in the positive Y direction is connected to the base 5 via links 62a, 62b. The links 62a, 62b function as a synchronization mechanism for synchronizing the movement of the arm portion 22 in the X direction. The links 62a, 62b are rotatably connected to each other and also rotatably connected to the arm portion 22 and the base 5 via rotating shafts each having a rotational axis along the Y direction.

[0033] The arm portion 23 of the block 2 positioned at the end in the negative Y direction is in contact with the rod 4 so as to be able to reciprocate in the X direction. The end portion of the arm portion 23 in the negative Y direction is connected to the base 5 via links 72a, 72b. The links 72a, 72b function as a synchronization mechanism for synchronizing the movement of the arm portion 23 in the X direction. The links 72a, 72b are rotatably connected to each other and also rotatably connected to the arm portion 23 and the base 5 via rotating shafts each having a rotational axis along the Y direction. The base 5 is provided with detecting portions (switches) 161 to 164 for detecting that the operating force has been accumulated in the force accumulating portion 130 by the operation of the operation portion 120. The switches 161 to 164 are fixed to the base 5 and are configured to be turned ON by cylinder ends 65, 75 and wire fixing portions 66, 76.

[0034] The rod 3 is disposed such that the axial direction thereof corresponds to the X direction, and is capable of reciprocating in the X direction relative to the block 2 and the base 5. The rod 3 is disposed such that the axial direction thereof is parallel with the X direction in which the middle portion 21 of the block 2 extends. The end portion of the rod 3 in the positive X direction penetrates a through-hole formed in the arm portion 22 of the block 2. The end portion of the rod 3 in the positive X direction includes a retainer 3a having a large diameter to prevent the rod 3 from coming off the through-hole in the arm portion 22. The end portion of the rod 3 in the negative X direction is inserted into the cylinder 6. The end portion of the rod 3 in the negative X direction is connected to the spring 68, as will be described later.

[0035] The cylinder 6 is disposed such that the axial direction thereof corresponds to the X direction and is supported on the base 5 so as to be able to reciprocate in the X direction. The cylinder 6 is disposed in a through-hole extending in the X direction formed in a portion 5a of the base 5 positioned in the positive Y direction, so as to be movable in the axial direction (the X direction). The cylinder 6 contains the spring 68 in a coaxial manner. A cylinder end portion 65 is fixed to the end of the cylinder 6 in the negative X direction. Thus, the end of the cylinder 6 in the negative X direction is closed by the cylinder end portion 65. The wire fixing portion 66 is disposed on the portion of the cylinder end portion 65 positioned in the negative X direction.

[0036] The end portion of the cylinder 6 in the positive X direction has a through-hole, and this through-hole is penetrated by the rod 3. The rod 3 is inserted through the through-hole and into the cylinder 6 toward the negative X direction. The cylinder 6 and the rod 3 can reciprocate in the X direction in a coaxial manner. The end portion of the rod 3 in the positive X direction projects outward from the inside of the cylinder 6 along the axial direction and penetrates the block 2. The end portion of the cylinder 6 in the positive X direction is internally connected with the spring 68.

[0037] The arm portion 22 of the block 2, the rod 3, the cylinder 6, the spring 68, the cylinder end portion 65, and the wire fixing portion 66 constitute the inside force accumulating portion 132 that receives the operating force from the inside operation portion 121 and accumulates the operating force. In the force accumulating portion 130, the inside force accumulating portion 131 is capable of accumulating the force by the biasing force of the spring 68.

[0038] The rod 4 is disposed such that the axial direction thereof corresponds to the X direction, and is capable of reciprocating in the X direction relative to the block 2 and the base 5. The rod 4 is disposed such that the axial direction thereof is parallel with the X direction in which the middle portion 21 of the block 2 extends. The end portion of the rod 4 in the positive X direction penetrates a through-hole formed in the arm portion 23 of the block 2. The end portion of the rod 4 in the positive X direction includes a retainer 4a having a large diameter to prevent the rod 4 from coming off the through-hole in the arm portion 23. The end portion of the rod 4 in the negative X direction is inserted into the cylinder 7. The end portion of the rod 4 in the negative X direction is connected to the spring 78, as will be described later.

[0039] The cylinder 7 is disposed such that the axial direction thereof corresponds to the X direction and is supported on the base 5 so as to be able to reciprocate in the X direction. The cylinder 7 is disposed in a through-hole extending in the X direction formed in a portion 5b of the base 5 positioned in the negative Y direction, so as to be movable in the axial direction (the X direction). The cylinder 7 contains the spring 78 in a coaxial manner. A cylinder end portion 75 is fixed to the end of the cylinder 7 in the negative X direction. Thus, the end of the cylinder 7 in the negative X direction is closed by the cylinder end portion 75. The wire fixing portion 76 is disposed on the portion of the cylinder end portion 75 positioned in the negative X direction.

[0040] The end portion of the cylinder 7 in the positive X direction has a through-hole, and this through-hole is penetrated by the rod 4. The rod 4 is inserted through the through-hole and into the cylinder 7 toward the negative X direction. The

cylinder 7 and the rod 4 can reciprocate in the X direction in a coaxial manner. The end portion of the rod 4 in the positive X direction projects outward from the inside of the cylinder 7 along the axial direction and penetrates the block 2. The end portion of the cylinder 7 in the positive X direction is internally connected with the spring 78.

[0041] The arm portion 23 of the block 2, the rod 4, the cylinder 7, the spring 78, the cylinder end portion 75, and the wire fixing portion 76 constitute the outside force accumulating portion 132 that receives the operating force from the outside operation portion 122 and accumulates the operating force. In the force accumulating portion 130, the outside force accumulating portion 132 is capable of accumulating the force by the biasing force of the spring 78.

[0042] When receiving a signal transmitted from a superior device or a conductor or an undoing signal including a power failure state, the force accumulating portion 130 drives the restraining portion 140 to undo the restraint and allows a predetermined amount of operating force to be transmitted to the unlocking portion 150 to undo the locking mechanism 110.

[0043] The restraining portion 140 includes latch levers 11, 12 and an actuator 14. The latch levers 11, 12 restrain transmission of the operating force accumulated in the force accumulating portion 130 to the unlocking portion 150, and the actuator 14 undoes the restraint of transmission to the unlocking portion 150 by driving the latch levers 11, 12.

[0044] The unlocking portion 150 transmits a predetermined amount of operating force accumulated in the force accumulating portion 130 to undo the locking mechanism 110. The unlocking portion 150 includes the rod 3, the rod 4, the block 2, and the link 1. The unlocking portion 150 includes a cylinder 151, a piston 152, and a spring 153. In the unlocking portion 150, the cylinder 151 and the piston 152 are disposed coaxially. The piston 152 can reciprocate in the X direction relative to the cylinder 151. When the piston 152 reciprocates in the X direction relative to the cylinder 151, the block 2 can reciprocate in the X direction relative to the base 5.

[0045] The cylinder 151 is formed in the base 5. The cylinder 151 is formed in the middle of the base 5 in the Y direction. The cylinder 151 contains the spring 153. The piston 152 is inserted into the cylinder 151 in a coaxial manner. The cylinder 151 is disposed parallel with the cylinder 6 and the cylinder 7. The cylinder 6 is disposed proximal to the cylinder 151 in the positive Y direction so as to be parallel with the cylinder 151. The cylinder 7 is disposed proximal to the cylinder 151 in the negative Y direction so as to be parallel with the cylinder 151. Each of the cylinder 6 and the cylinder 7 can move in the X direction independently of the cylinder 151.

[0046] The piston 152 is formed on the block 2. The piston 152 is connected so as to transmit the forces of the inside force accumulating portion 131 and the outside force accumulating portion 132 to the link 1. The piston 152 is disposed such that the axial direction thereof is parallel with the X direction in which the middle portion 21 of the block 2 extends. The end portion of the piston 152 in the negative X direction is contacted by the spring 153. The unlocking portion 150 includes link portions 62, 72 that function as synchronization mechanisms for synchronizing the movement of the piston 152 caused by the output of the inside force accumulating portion 131 and the movement of the piston 152 caused by the output of the outside force accumulating portion 132.

[0047] The piston 152 has grooves 152a, 152b formed in the outer periphery thereof to function as hooked-on portions. The groove 152a functions as a first hooked-on portion. The groove 152b functions as a second hooked-on portion. The grooves 152a, 152b are disposed symmetrically in the outer periphery of the piston 152, one being disposed at an upper position in the Z direction, the other being disposed at a lower position. The grooves 152a, 152b extend in the circumferential direction of the piston 152. In other words, in the outer periphery of the piston 152, the grooves 152a, 152b extending in the circumferential direction form a recessed broken line running in the circumferential direction. As will be described later, the grooves 152a, 152b have a smoothly sloped shape so as to raise the pawls 11b, 12b of the latch levers 11, 12 when the piston 152 moves in the X direction.

[0048] The latch levers 11, 12 are positioned above and below the cylinder 151 in the Z direction. The latch lever 11 is positioned above the cylinder 151 in the Z direction and is disposed along the X direction. The latch lever 12 is positioned below the cylinder 151 in the Z direction and is disposed along the X direction. The latch lever 11 and the latch lever 12 have the same shape and are positioned symmetrically in the Z direction with respect to the axis of the cylinder 151.

[0049] The latch levers 11, 12 are coupled to the base 5 so as to be rotatable by the rotating shafts 11a, 12a. The rotating shafts 11a, 12a are at a position slightly offset toward the negative X direction from the middle of the latch levers 11, 12 in the X direction. The rotating shafts 11a, 12a extend in the Y direction and are parallel with each other. The rotating shafts 11a, 12a are disposed orthogonal to the axis of the cylinder 151, as viewed from the Z direction. The rotating shafts 11a, 12a are disposed to overlap each other, as viewed from the Z direction. The latch lever 11 and the latch lever 12 can rotate symmetrically to each other about the rotating shafts 11a, 12a.

[0050] The pawl (first hooking portion) 11b of the latch lever 11 and the pawl (second hooking portion) 12b of the latch lever 12 are disposed on opposite sides of the piston 152 such that they can be hooked on the groove (first hooked-on portion) 152a and the groove (second hooked-on portion) 152b, respectively. The latch levers 11, 12 have the pawls 11b, 12b at the respective ends in the positive X direction (one end), and the pawls 11b, 12b are configured to be hooked on the grooves 152a, 152b that function as the hooked-on portions.

[0051] The latch levers 11, 12 are provided with rollers 13a, 13b, respectively, at the respective ends in the negative

X direction (the other end). For the latch lever 11, the pawl 11b and the roller 13a are provided at opposite ends with respect to the rotating shaft 11a. For the latch lever 12, the pawl 12b and the roller 13b are provided at opposite ends with respect to the rotating shaft 12a.

[0052] The rollers 13a, 13b are positioned on the opposite sides of an actuator rod 14a in the Z direction and are disposed so as to be contactable with the actuator rod 14a. The roller 13a and the roller 13b have the same shape and are positioned symmetrically in the Z direction with respect to the axis of the cylinder 151. The roller 13a and the roller 13b are opposed to each other in the Z direction. The roller 13a and the roller 13b are separated by such a distance through which the actuator rod 14a of the actuator 14 can be inserted.

[0053] The actuator 14 can reciprocate the actuator rod 14a in the X direction (the axial direction of the actuator rod 14a). The actuator 14 is, for example, an electric solenoid. When moved by the actuator 14 toward the positive X direction, the actuator rod 14a contacts with the roller 13a and the roller 13b. When moved by the actuator 14 toward the negative X direction, the actuator rod 14a is separated from the roller 13a and the roller 13b. Accordingly, when the actuator rod 14a is moved in the X direction, the roller 13a and the roller 13b rotate in opposite directions.

[0054] When the actuator 14 moves the actuator rod 14a toward the positive X direction to stretch, the actuator rod 14a is positioned between the roller 13a and the roller 13b and in contact with the roller 13a and the roller 13b, as described above. At this time, the latch lever 11 and the latch lever 12 rotate about the rotating shafts 11a, 12a such that the roller 13a and the roller 13b are moved away from each other, and the latch levers 11, 12 are set at predetermined angles. Thus, the pawl 11b and the pawl 12b are positioned proximate to each other.

[0055] As a result, the pawl 11b enters and contacts with the groove 152a and is hooked on the groove 152a. Likewise, the pawl 12b enters and contacts with the groove 152b and is hooked on the groove 152b. In this way, the piston 152 is immobilized by the pawl 11b and the pawl 12b on both sides in the Z direction. Accordingly, the pawl 11b and the pawl 12b do not come out of the grooves 152a, 152b. This restrains the movement of the piston 152 in the X direction. The block 2, which is integrated with the piston 152, is also restrained from moving in the X direction.

[0056] When the actuator 14 moves the actuator rod 14a toward the negative X direction to retract, the actuator rod 14a is moved toward the negative X direction from the position between the roller 13a and the roller 13b and comes out of contact with the roller 13a and the roller 13b, as described above. The roller 13a and the roller 13b are thus no longer restrained by the actuator rod 14a. The latch lever 11 and the latch lever 12 rotate about the rotating shafts 11a, 12a so as to be proximate to each other. Thus, the pawl 11b and the pawl 12b are moved away from each other.

[0057] The pawl 11b moves from the groove 152a toward the positive Z direction and comes out of contact. Likewise, the pawl 12b moves from the groove 152b toward the negative Z direction and comes out of contact. In this way, the pawl 11b and the pawl 12b come out of the grooves 152a, 152b. The piston 152 is separated from the pawl 11b and the pawl 12b. Thus, the piston 152 is not restrained from moving in the X direction. The block 2, which is integrated with the piston 152, is also not restrained from moving in the X direction.

[0058] In this way, the actuator 14 moves the actuator rod 14a to cause the rollers 13a, 13b to rotate, thereby undoing the restraint on transmission of the operating force accumulated in the force accumulating portion 130 to the unlocking portion 150.

[0059] In the manual door unlocking device 100 of the present embodiment, the door leaves 10 are unlocked by pulling the link 1 toward the negative X direction, the link 1 being connected at a distal end thereof to an unlocking lever (not shown) of the locking mechanism 110. The movement of the link 1 is associated with the movement of the block 2 of the EVAC connected to the other end 1b of the link 1. The rods 3, 4 penetrating the block 2 receive the spring forces of the springs 68, 78 contained in the cylinders 6, 7 that are guided by the base 5.

[0060] The cylinder end portions 65, 75 are fixed to the cylinders 6, 7. The cylinder end portions 65, 75 are connected with the wire 123 and the wire 124 via the wire fixing portions 66, 76, respectively. The wire (wire cable) 123 is connected to the inside operation portion 121, and the wire (wire cable) 124 is connected to the outside operation portion 122. The cylinders 6, 7 are thus pulled and moved toward the negative X direction.

[0061] In the inside force accumulating portion 131, when the inside operation portion 121 is operated, the cylinder 6 is pulled and moved toward the negative X direction via the wire (wire cable) 123. In the outside force accumulating portion 132, when the outside operation portion 122 is operated, the cylinder 7 is pulled and moved toward the negative X direction via the wire (wire cable) 124. The inside force accumulating portion 131 and the outside force accumulating portion 132 can operate independently of each other.

[0062] In the restraining portion 140, the latch levers 11, 12 positioned in the middle of the base 5 rotate about the rotating shafts 11a, 12a, such that the restraining portion 140 can switch between a restraining state and a non-restraining state based on whether the pawls 11b, 12b are hooked on the grooves 152a, 152b. This switching operation can be accomplished by the actuator rod 14a moved by the actuator 14 being in contact or out of contact with the rollers 13a, 13b.

<Normal State>

[0063] In a normal state such as when the vehicle is traveling, the locking mechanism 110 is locking the door leaves

10. At the same time, the actuator 14 does not permit unlocking. As shown in Fig. 5, the actuator rod 14a is in a stretched position. The pawls 11b, 12b are hooked on the grooves 152a, 152b. Accordingly, the restraining portion 140 is in the restraining state in which the block 2 and the link 1 are not allowed to move relative to the base 5.

5 <Unlocking Operation>

[0064] Suppose that, for example, the inside operation portion 121 formed of a handle or the like is operated in an emergency. As shown in Fig. 3, in the manual door unlocking device 100, the wire fixing portion 66, the cylinder end portion 65, and the cylinder 6 are integrally pulled toward the negative X direction via the wire 123.

10 **[0065]** If the inside operation portion 121 cannot be operated for unlocking (when the vehicle is traveling, or when the associated door is on the opposite side to the platform and thus the passengers are not allowed to get on and off through the door), the actuator rod 14a is in a stretched position and thus in contact with the rollers 13a, 13b. Accordingly, the movement of the latch levers 11, 12 are restrained. Since the pawls 11b, 12b at the distal ends of the latch levers 11, 12 are hooked on the grooves 152a, 152b of the piston 152, the block 2 integrated with the piston 152 is restrained from moving. Therefore, the block 2 remains at the same position relative to the base 5 as it was before the operation portion 120 was operated.

15 **[0066]** Since the rod 3 is retained on the block 2 by the retainer 3a, the rod 3 does not move along with the cylinder 6 and is restrained from performing a stroke. The rod 3 thus retains its position in the X direction. As shown in Fig. 3, the stroke performed by the cylinder 6 causes the spring 68 to contract. The stroke of the cylinder 6 causes the operating force to be accumulated in the spring 68. Accordingly, in an emergency unlocking operation, the handle of the inside operation portion 121 is first retained at a pulled position. Further, the spring 68 of the inside force accumulating portion 131 is retained at a state in which it accumulates the operating force (spring force).

20 **[0067]** At this time, as shown in Fig. 3, the wire fixing portion 66 presses the switches 161, 163. Therefore, the switches 161, 163 transmit a signal for requesting unlocking. The signal is transmitted to a superior entity controlling the vehicle such as a crew member and a transportation command office, for requesting the determination of whether to permit unlocking. The two switches 161, 163 are provided for satisfying reliability of operation by transmitting the signal to separate superior controllers.

25 **[0068]** At this time, the outside operation portion 122 is not operated. As shown in Fig. 3, the outside force accumulating portion 132 is not changed from its normal state. The inside force accumulating portion 131 can accumulate the operating force independently of the outside force accumulating portion 132.

30 **[0069]** When the superior entity (the vehicle, ATC) determines that unlocking should be permitted (the vehicle is stopped, and the doorway 105 is on the platform side), an unlocking signal is transmitted from the superior entity and, for example, the actuator 14 is demagnetized accordingly. This causes the actuator rod 14a to be moved toward the negative X direction into the retracted position. The actuator 14 is also demagnetized when emergency egress is necessary in a state of emergency or when the power supply is cut off.

35 **[0070]** The actuator rod 14a, which has been moved toward the negative X direction into the retracted position, is separated from and out of contact with the rollers 13a, 13b. Accordingly, the movement of the latch levers 11, 12 are no longer restrained. The pawls 11b, 12b at the distal ends of the latch levers 11, 12 are separated from the grooves 152a, 152b of the piston 152. Therefore, the restraining portion 140 is in the non-restraining state in which the block 2 integrated with the piston 152 is not restrained from moving. The piston 152 is allowed to move relative to the base 5 from the position the piston 152 was in before the operation portion 120 was operated. In other words, the block 2 is allowed to move toward the negative X direction relative to the base 5.

40 **[0071]** As a result, the rod 3 is moved toward the negative X direction by the operating force (spring force) accumulated in the spring 68 contracted. The block 2 is moved toward the negative X direction along with the rod 3. The piston 152 in the block 2 is moved toward the negative X direction relative to the base 5. When the block 2 is moved toward the negative X direction by the operating force (spring force) of the spring 68, the pawls 11b, 12b of the latch levers 11, 12 are raised and come out as the piston 152 is moved toward the negative X direction, since the grooves 152a, 152b have the sloped shape.

45 **[0072]** When the block 2 is moving toward the negative X direction, the attitude of the block 2 is controlled by the piston 152. At the same time, the movement of the block 2 in the X direction is synchronized with that of the base 5 via the links 62a, 62b functioning as a synchronization mechanism for the arm portion 22 and the links 72a, 72b functioning as a synchronization mechanism for the arm portion 23.

50 **[0073]** Thus, the link 1 connected to the block 2 is moved toward the negative X direction, and the locking of the door leaves 10 accomplished by the locking mechanism 110 is undone. The unlocking operation causes the spring 153 to contract and accumulate the spring force. At this time, the spring 68 accumulates a spring force balanced with the spring force of the spring 153.

55 **[0074]** Since unlocking is normally performed on one of the inside operation portion 121 and the outside operation portion 122, the block 2 is pulled by one of the cylinders 6, 7 to produce the moment that may cause a malfunction.

However, in the present embodiment, the links 62a, 62b, 72a, 72b mechanically synchronizes the movement of the opposite ends of the block 2 in the Y direction, making it possible to perform the unlocking operation smoothly.

[0075] In the unlocking operation described above, the inside operation portion 121 is operated for unlocking. The same operation applies to the case where the outside operation portion 122 is operated for unlocking. In the description for this case, the inside operation portion 121, the wire 123, the wire fixing portion 66, the cylinder end portion 65, the cylinder 6, the spring 68, the switches 161, 163, the rod 3, the arm portion 22, and the links 62a, 62b are replaced with the outside operation portion 122, the wire 124, the wire fixing portion 76, the cylinder end portion 75, the cylinder 7, the spring 78, the switches 162, 164, the rod 4, the arm portion 23, and the links 72a, 72b.

[0076] Further, even if both the inside operation portion 121 and the outside operation portion 122 are operated before the unlocking signal reaches the actuator 14, the unlocking can be performed smoothly, since the inside force accumulating portion 131 and the outside force accumulating portion 132 can operate independently of each other. Further, when the power supply is cut off, the actuator 14 is demagnetized in the same manner as when the unlocking signal reaches the actuator 14, and therefore, the unlocking can be performed before the unlocking signal reaches the actuator 14.

<Return Operation>

[0077] When the door is closed for starting the traveling of the vehicle for example, a return operation is performed in the manual door unlocking device 100. The unlocking operation causes the spring 153 to contract and accumulate the spring force. At this time, the spring 68 accumulates a spring force balanced with the spring force of the spring 153.

[0078] In the return operation, the latches and other members are first released from the unlocking state caused by the handle of the operation portion 120. The wire 123 then returns to its original position. In accordance with this operation, the block 2 is moved toward the positive X direction by the spring force accumulated in the spring 153 through the unlocking operation. Therefore, the cylinder 6 is likewise moved toward the positive X direction by the spring force of the spring 68 and returns to its original position along with the wire 123.

[0079] Further, when the actuator 14 is excited in response to a command from the superior entity, the actuator rod 14a is stretched toward the positive X direction and contact with the rollers 13a, 13b. The rollers 13a, 13b are rotated to move away from each other in the Z direction. The pawls 11b, 12b of the latch levers 11, 12 are hooked on the grooves 152a, 152b of the block 2, thus returning to the initial state of the EVAC.

[0080] In this way, the return operation can be accomplished only by operating the handle of the operation portion 120 back in place and exciting the actuator 14. Therefore, if the door is unlocked in an emergency, quick return is possible.

[0081] In the manual door unlocking device 100 of the present embodiment, the unlocking portion 150 for undoing the locking mechanism 110 is operated for unlocking, by the operating force accumulated in the force accumulating portion 130 through emergency operation. Accordingly, even if the operation portion 120 is pulled with a large force, the operating force is absorbed in the force accumulating portion 130, and thus the unlocking portion 150 is prevented from being damaged. Also, when the locking of the actuator 14 is undone, the unlocking portion 150 is operated for unlocking by the operating force accumulated in the force accumulating portion 130. Therefore, an operator is not required to perform operation other than operation of the handle (operation of the lever) of the operation portion 120. In addition, after a passenger or other person operates the operation portion 120, the restraining portion 140 at a superior level can determine whether to permit unlocking. Accordingly, it can be determined by crew members, station staff, or the train command office whether to permit unlocking, before opening of the door is selected for unlocking. These features improve safety.

[0082] Actually, it is a passenger who performs the manual unlocking operation of the door leaves 10, and such an unlocking operation is performed in an emergency. Therefore, it is desirable that the unlocking operation of the door leaves 10 be simple and include a small number of steps so as to be intuitively grasped by passengers. The manual door unlocking device 100 of the present embodiment does not require the two-step operation, constituted by signal transmission and unlocking, that was necessary in the conventional technique. The manual door unlocking device 100 of the present embodiment solves the problem of the time required for the door leaves to be opened in conventional configurations. In addition, the manual door unlocking device 100 in the present embodiment can solve the problem that the door cannot be opened without two-step operation.

[0083] In addition, the manual door unlocking device 100 of the present embodiment can solve the problem of the possibility that a signal cannot be output to inform the crew members in the event of an emergency egress, as in conventional configurations. This problem occurs because a lever is locked by an actuator while the vehicle is traveling, such that the lever cannot be operated. In addition, the manual door unlocking device 100 of the present embodiment meets the requirement for unlocking operation from both the inside and outside of the vehicle, and the requirement for reliable operation from both the inside and outside of the vehicle independent of each other. Furthermore, the manual door unlocking device 100 of the present embodiment does not require the two-step operation constituted by signal transmission and unlocking, and can shorten the time required to open the door, thereby improving reliability and safety.

[0084] In the manual door unlocking device 100 of the present embodiment, the force accumulating portion 130 includes

the restraining portion 140 that restrains transmission of a predetermined amount of operating force to the unlocking portion 150, and when receiving an undoing signal, the force accumulating portion 130 drives the restraining portion 140 to undo the restraint. The force accumulating portion 130 then permits transmission of a predetermined amount of operating force to the unlocking portion 150, thereby undoing the locking mechanism 110. This configuration allows the

step of determining whether to permit unlocking. Accordingly, safety can be improved.

[0085] The operation portion 120 includes the inside operation portion 121 and the outside operation portion 122. The inside operation portion 121 can be operated from inside the vehicle, and the outside operation portion 122 can be operated from outside the vehicle. The force accumulating portion 130 includes the inside force accumulating portion 131 and the outside force accumulating portion 132. The inside force accumulating portion 131 accumulates an operating force produced by operation of the inside operation portion 121, and the outside force accumulating portion 132 accumulates an operating force produced by operation of the outside operation portion 122. This configuration makes it possible to independently perform the unlocking of the door leaves 10 from either inside or outside the vehicle.

[0086] The unlocking portion 150 includes the cylinder 151 and the piston 152. The piston 152 is connected so as to transmit the output of the inside force accumulating portion 131 and the output of the outside force accumulating portion 132. This configuration makes it possible to accumulate forces by operations from inside and outside the vehicle independent of each other, and thus unlocking is possible without interference therebetween.

[0087] The unlocking portion 150 includes link portions 62, 72 as synchronization mechanisms for synchronizing the movement of the piston 151 caused by the transmitted output of the inside force accumulating portion 131 and the movement of the piston 151 caused by the output of the outside force accumulating portion 132. This configuration prevents operations inside and outside the vehicle from interfering with each other, and improves the reliability in operation of the manual door unlocking device 100 in an emergency, thus improving the safety.

[0088] The force accumulating portion 130 is capable of accumulating the operating force by the biasing forces of the springs 68, 78. This configuration makes it possible to set the amount of operating force to be accumulated by adjusting the biasing forces of the springs 68, 78, and it is also possible to eliminate the need for a drive power supply.

[0089] The unlocking portion 150 includes the cylinder 151 and the piston 152. The unlocking portion 150 further includes the spring 153 for returning the piston 151 and the springs 68, 78 of the force accumulating portion 130 to positions they were in before the forces were accumulated. This configuration allows quick return operation.

[0090] The restraining portion 140 includes the latch levers 11, 12 and the actuator 14. The latch levers 11, 12 restrain transmission of the operating force accumulated in the force accumulating portion 130 to the unlocking portion 150, and the actuator 14 undoes the restraint of transmission to the unlocking portion 150 by driving the latch levers 11, 12. This configuration facilitates unlocking and locking.

[0091] The unlocking portion 150 includes the cylinder 151 and the piston 152. The piston 152 has the hooked-on portions (grooves) 152a, 152b formed therein. The latch levers 11, 12 have, at one end thereof, the pawls (hooking portions) 11b, 12b that can be hooked on the grooves (hooked-on portions) 152a, 152b. This configuration prevents malfunctions more reliably.

[0092] The latch levers 11, 12 are provided with rollers 13a, 13b at the other end. The actuator rod 14a of the actuator 14 contacting with the rollers 13a, 13b is moved to rotate the rollers 13a, 13b, thereby undoing the restraint on transmission of the operating force accumulated in the force accumulating portion 130 to the unlocking portion 150. This configuration improves the ease of movement in the contact between the actuator rod 14a of the actuator 14 and the rollers 13a, 13b, and allows the actuator 14 to be made smaller.

[0093] The piston 152 has the groove (first hooked-on portion) 152a and the groove (second hooked-on portion) 152b. A pair of latch levers 11, 12 has, at one end thereof, the pawl (first hooking portion) 11b and the pawl (second hooking portion) 12b disposed on opposite sides of the piston 152 such that they can be hooked on the groove 152a and the groove 152b. The pair of latch levers are provided with the rollers 13a, 13b at the other end. The rollers 13a, 13b are positioned on the opposite sides of the actuator rod 14a of the actuator 14 so as to be contactable with the actuator rod 14a. This configuration smoothens the movement of the latch levers 11, 12 and improves the ease of movement in the contact between the actuator rod 14a of the actuator 14 and the rollers 13a, 13b, thereby smoothening the transmission of movement to the unlocking portion 150.

[0094] The detecting portions 161 to 164 are provided for detecting that the operating force has been accumulated in the force accumulating portion 130 by the operation of the operation portion 120. This configuration makes it possible that the restraining portion 140 at a superior level determines whether to permit unlocking based on the detection results of the detecting portions 161 to 164. Accordingly, it can be determined by crew members, station staff, or the train command office whether to permit unlocking.

Second Embodiment

[0095] A second embodiment of a manual door unlocking device according to the invention will be hereinafter described with reference to the accompanying drawings. Fig. 6 is a schematic view showing the manual door unlocking device

according to the present embodiment. Fig. 7 shows the manual door unlocking device of Fig. 6 as viewed from the axial direction. The present embodiment is different from the first embodiment described above in the number of force accumulating portions. Except for this difference, the present embodiment includes the same constituents as in the first embodiment, which are denoted by the same reference numerals and are not described here. In the following description, some constituents are described as "corresponding" to constituents of the first embodiment. Such constituents operate in a corresponding manner but may be different in shape or other properties.

[0096] In the present embodiment, the force accumulating portion 130 includes only one accumulating portion 230 corresponding to the inside force accumulating portion 131, and for example, the outside force accumulating portion 132 is not provided. As shown in Fig. 6, in the manual door unlocking device 200 of the present embodiment, a spring 268 corresponding to the spring 68 of the inside force accumulating portion 131 and a spring 253 corresponding to the spring 153 for the return operation are arranged linearly.

[0097] The manual door unlocking device 200 of the present embodiment also includes a cylinder 202 corresponding to the block 2. The cylinder 202 is coaxially contained in a cylinder 251 that is formed in a base 205 corresponding to the base 5. A rod 203 corresponding to the rod 3 is disposed coaxially in the cylinder 202. The rod 203 further extends toward the negative X direction and is disposed coaxially in the cylinder 251 of the base 205.

[0098] The end portion of the cylinder 202 in the positive X direction is connected to an end portion 201b corresponding to the end portion 1b of the link 1. The end portion 201b has a projection 211b corresponding to the pawl 11b that functions as the hooking portion of the restraining portion 140. The projection 211b is hooked on a latch 252a corresponding to the groove 152a that functions as the hooked-on portion. The latch 252a is driven to come off the projection 211b by an actuator 214 corresponding to the actuator 14 of the restraining portion 140.

[0099] Further, the rod 203 is disposed coaxially in the cylinder 251 formed in the base 205. The portion of the rod 203 extending toward the negative X direction forms a rod 265 corresponding to the cylinder end portion 65. The end portion of the rod 265 in the negative X direction is connected with a wire fixing portion 266 corresponding to the wire fixing portion 66, and the wire fixing portion 266 extends in the negative X direction. The wire fixing portion 266 is connected to the operation portion 120 via the wire (wire cable) 123.

[0100] The cylinder 251 formed in the base 205 receives therein the cylinder 202 in a coaxial manner so as to be movable in the X direction. The end portion of the cylinder 202 in the negative X direction is penetrated by the rod 203. The rod 203 has a large-diameter portion 252 corresponding to the piston 152. The large-diameter portion 252 is formed to contact with the end portion of the cylinder 202 in the negative X direction. The portion of the interior of the cylinder 202 positioned on the positive X direction side relative to the end portion of the cylinder 202 in the negative X direction coaxially contains the spring 268 corresponding to the spring 68.

[0101] The end portion of the rod 203 in the positive X direction is connected with a large-diameter end portion 206 corresponding to the cylinder 6. The large-diameter end portion 206 reciprocates in the X direction within the cylinder 202. The large-diameter end portion 206 is contacted, on the negative X direction side thereof, by the end portion of the spring 268 in the positive X direction. On the negative X direction side of the large-diameter portion 252, the spring 253 is disposed so as to contact with the end portion of the cylinder 251 in the negative X direction. The spring 253 and the spring 268 are in contact with the large-diameter portion 252 such that the pressing forces thereof are opposite to each other. The spring 268 has a higher resilience than the spring 253. Specifically, the spring 268 preferably has a larger winding diameter or wire diameter and has a larger elasticity than the spring 253.

[0102] In the restraining portion 140, the actuator 214 is positioned to move the actuator rod 214a in the Y direction. As shown in Fig. 7, the actuator rod 214a drives the latch 252a via the links 214b, 214c. When the actuator rod 214a is in the retracted position, it is in a locking state. Then it is driven to stretch for unlocking.

<Normal State>

[0103] For the manual door unlocking device 200 of the present embodiment, in a normal state such as when the vehicle is traveling, the locking mechanism 110 is locking the door leaves 10. At the same time, the actuator 214 does not permit unlocking. As shown in Figs. 6 and 7, the actuator rod 214a is in a retracted position. The projection 211b is hooked on the latch 252a. The restraining portion 140 is in a state in which the cylinder 202 and the link 1 are allowed to move relative to the base 205.

<Unlocking Operation>

[0104] Figs. 8 and 9 are schematic views showing the manual door unlocking device 200 according to the present embodiment. Fig. 10 shows the manual door unlocking device of Fig. 9 as viewed from the axial direction. In the manual door unlocking device 200 of the present embodiment, it is supposed that, for example, the operation portion 120 formed of a handle or the like is operated in an emergency. As shown in Fig. 8, in the manual door unlocking device 200, the wire fixing portion 266, the rod 265, the large-diameter portion 252, the rod 203, and the large-diameter end portion 206

are integrally pulled toward the negative X direction via the wire 123.

[0105] If the operation portion 120 cannot be operated for unlocking (when the vehicle is traveling, or when the associated door is on the opposite side to the platform and thus the passengers are not allowed to get on and off through the door), the actuator rod 214a is in the retracted position, and thus the movement of the projection 211b is restrained. The projection 211b is hooked on the latch 252a and thus restrains the movement of the cylinder 202 integrated with the end portion 201b. Therefore, the cylinder 202 remains at the same position relative to the base 205 as it was before the operation portion 120 was operated.

[0106] The end portion of the cylinder 202 in the negative X direction does not move along with the cylinder 202 and thus remains at the same position in the X direction. Therefore, as shown in Fig. 8, the stroke performed by the large-diameter end portion 206 causes the spring 268 to contract. The stroke of the large-diameter end portion 206 causes the operating force to be accumulated in the spring 268. In an emergency unlocking operation, the handle of the operation portion 120 is first retained at a pulled position, and the spring force (operating force) of the spring 268 is accumulated in the force accumulating portion 230 (130). At this time, the wire fixing portion 266 presses a switch (not shown) to transmit a signal for requesting unlocking. The signal is transmitted to a superior entity controlling the vehicle such as a crew member and a transportation command office, for requesting the determination of whether to permit unlocking.

[0107] When the superior entity (the vehicle, ATC) determines that unlocking should be permitted (the vehicle is stopped, and the doorway 105 is on the platform side), an unlocking signal is transmitted from the superior entity, and the actuator 214 of the restraining portion 140 is demagnetized accordingly. This causes the actuator rod 214a to be moved toward the positive Y direction into the stretched position. The actuator 214 is also demagnetized when emergency egress is necessary in a state of emergency or when the power supply is cut off.

[0108] The actuator rod 214a that has been moved toward the positive Y direction into the stretched position drives the latch 252a to cause the projection 211b to come off. Thus, the projection 211b can be moved away from the latch 252a, and the restraining portion 140 is in the non-restraining state in which the cylinder 202 integrated with the end portion 201b is not restrained from moving. The cylinder 202 is allowed to move relative to the base 205 from the position the cylinder 202 was in before the operation portion 120 was operated. In other words, the cylinder 202 is allowed to move in the X direction relative to the base 205.

[0109] As a result, as shown in Figs. 9 and 10, the cylinder 202 is moved toward the negative X direction by the spring force (operating force) accumulated in the spring 268 contracted. At this time, the rod 203 does not move relative to the base 5. When the spring force (operating force) of the spring 268 causes the cylinder 202 to move toward the negative X direction, the link 1 also moves toward the negative X direction. Thus, as the link 1 moves, the locking of the door leaves 10 accomplished by the locking mechanism 110 is undone. The unlocking operation causes the spring 253 to contract and accumulate the spring force. At this time, the spring 268 accumulates a spring force balanced with the spring force of the spring 253.

<Return Operation>

[0110] When the door is closed for starting the traveling of the vehicle for example, a return operation is performed in the manual door unlocking device 200.

[0111] In the return operation, the latches and other members are first released from the unlocking state caused by the handle of the operation portion 120. The wire 123 then returns to its original position. In accordance with this operation, the large-diameter portion 252 is moved toward the positive X direction by the spring force accumulated in the spring 253 through the unlocking operation. At this time, the wire fixing portion 266, the rod 265, the rod 203, and the large-diameter end portion 206 are integrally moved toward the positive X direction. At the same time, the cylinder 202, which is pressed by the large-diameter portion 252 and the large-diameter end portion 206, is also moved toward the positive X direction. The wire fixing portion 266 and the rod 265 are likewise moved toward the positive X direction by the spring force of the spring 253 and return to their original positions along with the wire 123. The projection 211b is moved integrally with the cylinder 202 toward the positive X direction and return to its original position along with the latch 252a.

[0112] At the same time, the actuator 214 is excited in response to a command from the superior entity, and the actuator rod 214a is retracted toward the negative Y direction. As a result, the latch 252a is hooked on the projection 211b, thus returning to the initial state of the EVAC.

[0113] This embodiment produces the same effects as the first embodiment described above.

[0114] In the manual door unlocking device 200 of the present embodiment, the operating force can be absorbed by the force accumulating portion 230. Therefore, even if the operating portion 120 is operated with a large force, the unlocking portion 150 is prevented from being damaged.

[0115] The force accumulating portion 230 includes the restraining portion 140 that restrains transmission of a predetermined amount of operating force to the unlocking portion 150, and when receiving an undoing signal, the force accumulating portion 230 drives the restraining portion 140 to undo the restraint. Further, the force accumulating portion 230 permits transmission of a predetermined amount of operating force to the unlocking portion 150, thereby undoing

the locking mechanism 110. This configuration makes it possible to determine whether to permit unlocking, thus improving the safety.

[0116] The unlocking portion 150 includes the cylinder 251 and the large-diameter portion 252. The large-diameter portion 252 is connected so as to receive the output of the force accumulating portion 230. This configuration makes it possible to accumulate a force by operation in an emergency, and unlocking is possible.

[0117] The force accumulating portion 230 is capable of accumulating the operating force by the biasing force of the spring 268. This configuration makes it possible to set the amount of operating force to be accumulated, and it is also possible to eliminate the need for a drive power supply.

[0118] The unlocking portion 150 includes the cylinder 251 and the large-diameter portion 252. The unlocking portion 150 further includes the spring 253 for returning the large-diameter portion 252 and the spring 268 of the force accumulating portion 230 to positions they were in before the forces were accumulated. This configuration allows quick return operation.

[0119] The restraining portion 140 includes the actuator 214 configured to undo the restraint of transmission of the operating force accumulated in the force accumulating portion 230 to the unlocking portion 150. This configuration facilitates unlocking and locking.

[0120] According to the first and second embodiments described above, the following advantageous effects can be produced. Since the unlocking portion can operate by the operating force accumulated in the force accumulating portion through emergency operation, an operator is not required to perform the two-step operation. At the same time, the restraining portion at a superior level can determine whether to permit unlocking, and therefore, it can be determined by crew members, station staff, or the train command office whether to permit unlocking, before opening of the door is selected. These features improve safety. Even if the operation portion is pulled with a large force, the operating force is absorbed in the force accumulating portion, and thus the unlocking portion is prevented from being damaged.

[0121] The force accumulating portion includes the restraining portion that restrains transmission of a predetermined amount of operating force to the unlocking portion. When receiving an undoing signal, the force accumulating portion drives the restraining portion to undo the restraint and allows a predetermined amount of operating force to be transmitted to the unlocking portion to undo the locking mechanism. This configuration makes it possible to determine whether to permit unlocking, thus improving the safety.

[0122] The operation portion includes an inside operation portion and an outside operation portion. The inside operation portion can be operated from inside the vehicle, and the outside operation portion can be operated from outside the vehicle. The force accumulating portion includes the inside force accumulating portion and the outside force accumulating portion. The inside force accumulating portion accumulates an operating force produced by operation of the inside operation portion, and the outside force accumulating portion accumulates an operating force produced by operation of the outside operation portion. This configuration makes it possible to independently perform the unlocking of the door from either inside or outside the vehicle.

[0123] The unlocking portion includes a cylinder and a piston. The piston is connected so as to receive the output of the inside force accumulating portion and the output of the outside force accumulating portion. This configuration makes it possible to accumulate operating forces by operations from inside and outside the vehicle independent of each other, and thus unlocking is possible without interference therebetween.

[0124] The unlocking portion includes synchronization mechanisms for synchronizing the movement of the piston caused by the received output of the inside force accumulating portion and the movement of the piston caused by the output of the outside force accumulating portion. This configuration prevents operations inside and outside the vehicle from interfering with each other, and improves the reliability of operation in an emergency, thus improving the safety.

[0125] The force accumulating portion is capable of accumulating the operating force by the biasing force of the spring. This configuration makes it possible to set the amount of operating force to be accumulated, and it is also possible to eliminate the need for a drive power supply.

[0126] The unlocking portion includes a cylinder and a piston. The unlocking portion further includes a spring for returning the piston and the spring of the force accumulating portion to positions they were in before the forces were accumulated. This configuration allows quick return operation.

[0127] The restraining portion includes a latch lever and an actuator. The latch lever restrains transmission of the force accumulated in the force accumulating portion to the unlocking portion, and the actuator undoes the restraint of transmission to the unlocking portion by driving the latch lever. This configuration facilitates unlocking and locking.

[0128] The unlocking portion includes a cylinder and a piston. The piston has a hooked-on portion formed therein. The latch lever has a hooking portion formed at one end thereof. The hooking portion can be hooked on the hooked-on portion. This configuration prevents malfunctions more reliably.

[0129] The latch lever is provided with a roller at the other end. The actuator contacting with the roller rotates the roller, thereby undoing the restraint on transmission of the operating force accumulated in the force accumulating portion to the unlocking portion. This configuration improves the ease of movement in the contact between the actuator and the roller, and allows the actuator to be made smaller.

[0130] The piston has a first hooked-on portion and a second hooked-on portion. A pair of latch levers are provided on opposite sides of the piston so as to be able to be hooked on the first hooked-on portion and the second hooked-on portion. The roller is provided on the other end of each of the pair of latch levers. The rollers are positioned on the opposite sides of the actuator so as to be contactable with the actuator. This configuration smoothenes the movement of the latch levers and improves the ease of movement in the contact between the actuator and the rollers, thereby smoothening the transmission of movement to the unlocking portion.

[0131] A detecting portion is provided for detecting that the operating force has been accumulated in the force accumulating portion by the operation of the operation portion. This configuration makes it possible that the restraining portion at a superior level determines whether to permit unlocking, based on the detection result of the detecting portion. Accordingly, it can be determined by crew members, station staff, or the train command office whether to permit unlocking.

[0132] The features of the above embodiments of the manual door unlocking device of the present invention can be selected and combined together as desired for application. Further, each of the features of the above embodiments can be modified as desired. For example, the force accumulating portion 130 may use a resilient member other than the springs 68, 78 for accumulating the force. For example, the air may be used as the resilient member. In this case, the cylinders 6, 7 of the force accumulating portion 130 should have a high air tightness, and the end portions of the rods 3, 4 in the negative X direction act as pistons. Alternatively, the resilient member may be formed of rubber or other material having a high resilience.

[0133] For example, the operation portion 120 may be in a rigid connection with the force accumulating portion 130 without the medium of the wire fixing portions 66, 76 and the wires 123, 124. With use of the wires 123, 124, the operation portion 120 can be positioned relative to the force accumulating portion 130 with a higher degree of freedom.

[0134] Further, it is also possible that when the force accumulating portion 130 has accumulated a predetermined amount or more of operating force, a signal is transmitted to the unlocking portion 150 to perform unlocking. In this case, the restraining portion 140 may be omitted.

[0135] Further, it is also possible that the operation portion 120 does not include both the inside operation portion 121 and the outside operation portion 122. In this case, only one of the inside operation portion 121 and the outside operation portion 122 may be provided.

[0136] It is also possible that the manual door unlocking device 200 of the second embodiment is provided on each of the inside and outside of the vehicle.

[0137] Further, it is also possible that the actuator 14 of the restraining portion 140 stretches and retracts the actuator rod 14a in a direction other than the negative X direction. In this case, the rotational axes of the rollers 13a, 13b should preferably be changed in accordance with the direction in which the actuator rod 14a is stretched and retracted.

[0138] Further, the manual door unlocking device 200 of the second embodiment may be configured as follows. The cylinder 202 is provided with a groove (first hooked-on portion) 152a and a groove (second hooked-on portion) 152b, as in the restraining portion 140 of the first embodiment. A pair of latch levers 11, 12 having a pawl (first hooking portion) 11b and a pawl (second hooking portion) 12b to be hooked on the above grooves are provided on the base 5 so as to be rotatable about rotating shafts 11a, 12a. The latch levers 11, 12 are provided with rollers 13a, 13b, respectively, at the respective ends in the negative X direction (the other end). The rollers 13a, 13b are positioned on the opposite sides of the actuator rod 14a so as to be contactable with the actuator rod 14a. In this configuration, the actuator 214 may reciprocate the actuator rod 14a in the X direction. Further, the manual door unlocking device may be positioned at any rotational angle about the axis of the X direction. The orientation of the manual door unlocking device is not particularly limited as long as the direction of the rod 1 connected to the locking mechanism 110 is the same as the direction in which to drive the locking mechanism 110.

LIST OF REFERENCE NUMBERS

[0139]

100, 200	manual door unlocking device
2	block
3, 4	rod
5	base
6, 7	cylinder
10	door leaf
11, 12	latch lever
11a, 12a	rotating shaft
11b, 12b	pawl (hooking portion)
13a, 13b	roller
14	actuator

	14a	actuator rod
	21	middle portion
	23, 23	arm portion
	62, 72	link portion
5	62a, 62b, 72a, 72b	link
	65, 75	cylinder end portion
	66, 76	wire fixing portion
	68, 78	spring
	105	doorway
10	110	locking mechanism
	120	operation portion
	121	inside operation portion
	122	outside operation portion
	123, 124	wire (wire cable)
15	130	force accumulating portion
	131	inside force accumulating portion
	132	outside force accumulating portion
	140	restraining portion
	150	unlocking portion
20	151	cylinder
	152	piston
	152a, 152b	groove (hooked-on portion)
	153	spring
	161 to 164	detecting portion
25	201b	end portion
	202	cylinder
	203	rod
	205	base
	206	large-diameter end portion
30	211b	projection
	214	actuator
	214a	actuator rod
	214b, 214c	link
	230	force accumulating portion
35	251	cylinder
	252	large-diameter portion
	252a	latch
	253	spring
	265	rod
40	266	wire fixing portion
	268	spring

Claims

- 45
1. A manual door unlocking device (100, 200), comprising:
- 50 a locking mechanism (110) for locking a door leaf (10) when the door leaf (10) is at a fully closed position, the door leaf (10) being configured to move by a driving force from a drive source to open and close a doorway (105) of a railway vehicle;
- an operation portion (120) configured to receive manual operation;
- a force accumulating portion (130, 230) for accumulating a predetermined amount of operating force produced by the manual operation; and
- 55 an unlocking portion (150) configured to transmit the predetermined amount of operating force accumulated in the force accumulating portion (130, 230) to undo the locking mechanism (110).
2. The manual door unlocking device (100, 200) of claim 1,

wherein the force accumulating portion (130, 230) includes a restraining portion (140) configured to restrain transmission of the predetermined amount of operating force to the unlocking portion (150), and wherein when receiving an undoing signal, the force accumulating portion (130, 230) drives the restraining portion (140) to undo restraint and allows the predetermined amount of operating force to be transmitted to the unlocking portion (150) to undo the locking mechanism (110).

3. The manual door unlocking device (100) of claim 1 or 2,

wherein the operation portion (120) includes:

an inside operation portion (121) capable of being operated from inside the vehicle; and
an outside operation portion (122) capable of being operated from outside the vehicle, and

wherein the force accumulating portion (130) includes:

an inside force accumulating portion (131) for accumulating an operating force produced by operation of the inside operation portion (121); and
an outside force accumulating portion (132) for accumulating an operating force produced by operation of the outside operation portion (122).

4. The manual door unlocking device (100) of claim 3,

wherein the unlocking portion (150) includes a cylinder (151) and a piston (152), and wherein the piston (152) is connected so as to receive an output of the inside force accumulating portion (131) and an output of the outside force accumulating portion (132).

5. The manual door unlocking device (100) of claim 4, wherein the unlocking portion (150) includes a synchronization mechanism (62, 72) for synchronizing movement of the piston (152) caused by the received output of the inside force accumulating portion (131) and movement of the piston (152) caused by the output of the outside force accumulating portion (132).

6. The manual door unlocking device (100, 200) of any one of claims 1 to 5, wherein the force accumulating portion (130, 230) is capable of accumulating the operating force by a biasing force of a spring (68, 78, 268).

7. The manual door unlocking device (100, 200) of claim 6,

wherein the unlocking portion (150) includes a cylinder (151, 251) and a piston (152, 252), and wherein the unlocking portion (150) further includes a spring (153, 253) for returning the piston (152, 252) and the spring (68, 78, 268) of the force accumulating portion (130, 230) to positions the piston (152, 252) and the spring (68, 78, 268) of the force accumulating portion (130, 230) were in before accumulation of the operating force.

8. The manual door unlocking device (100) of claim 2, wherein the restraining portion (140) includes:

at least one latch lever (11, 12) for restraining the transmission of the operating force accumulated in the force accumulating portion (130) to the unlocking portion (150); and
an actuator (14) for driving the at least one latch lever (11, 12) to undo restraint of the transmission to the unlocking portion (150).

9. The manual door unlocking device (100) of claim 8,

wherein the unlocking portion (150) includes:

a piston (152) configured to receive an output of the force accumulating portion (130); and
a cylinder (151) into which the piston (152) is inserted so as to be able to reciprocate,

wherein the piston (152) has a hooked-on portion (152a, 152b) formed therein, and

wherein the at least one latch lever (11, 12) has a hooking portion (11b, 12b) formed at one end thereof, and the hooking portion (11b, 12b) is capable of being hooked on the hooked-on portion (152a, 152b).

10. The manual door unlocking device (100) of claim 8,

wherein at least one roller (13a, 13b) is provided at the other end of the at least one latch lever (11, 12), and wherein the actuator (14) rotates the at least one roller (13a, 13b) while contacting with the at least one roller (13a, 13b), so as to undo the restraint of the transmission of the operating force accumulated in the force accumulating portion (130) to the unlocking portion (150).

11. The manual door unlocking device (100) of claim 10,

wherein the unlocking portion (150) includes:

a piston (152) configured to receive an output of the force accumulating portion (130); and
a cylinder (151) into which the piston (152) is inserted so as to be able to reciprocate,

wherein the piston (152) has a first hooked-on portion (152a) and a second hooked-on portion (152b), wherein the at least one latch lever (11, 12) comprises a pair of latch levers (11, 12) provided on opposite sides of the piston (152) so as to be able to be hooked on the first hooked-on portion (152a) and the second hooked-on portion (152b), and

wherein the at least one roller (13a, 13b) comprises a plurality of rollers (13a, 13b) each provided on the other end of associated one of the pair of latch levers (11, 12), and the plurality of rollers (13a, 13b) are positioned on opposite sides of the actuator (14) so as to be contactable with the actuator (14).

12. The manual door unlocking device (100) of any one of claims 1 to 11, further comprising a detecting portion (161-164) for detecting that the operating force has been accumulated in the force accumulating portion (130) by operation of the operation portion (120).

13. A railway vehicle door device, comprising:

a door leaf (10) configured to move by a driving force from a drive source to open and close a doorway (105) of a railway vehicle;

a locking mechanism (110) for locking the door leaf (10) when the door leaf (10) is at a fully closed position;

an operation portion (120) configured to receive manual operation;

a force accumulating portion (130) for accumulating a predetermined amount of operating force produced by the manual operation; and

an unlocking portion (150) configured to transmit the predetermined amount of operating force accumulated in the force accumulating portion (130) to undo the locking mechanism (110).

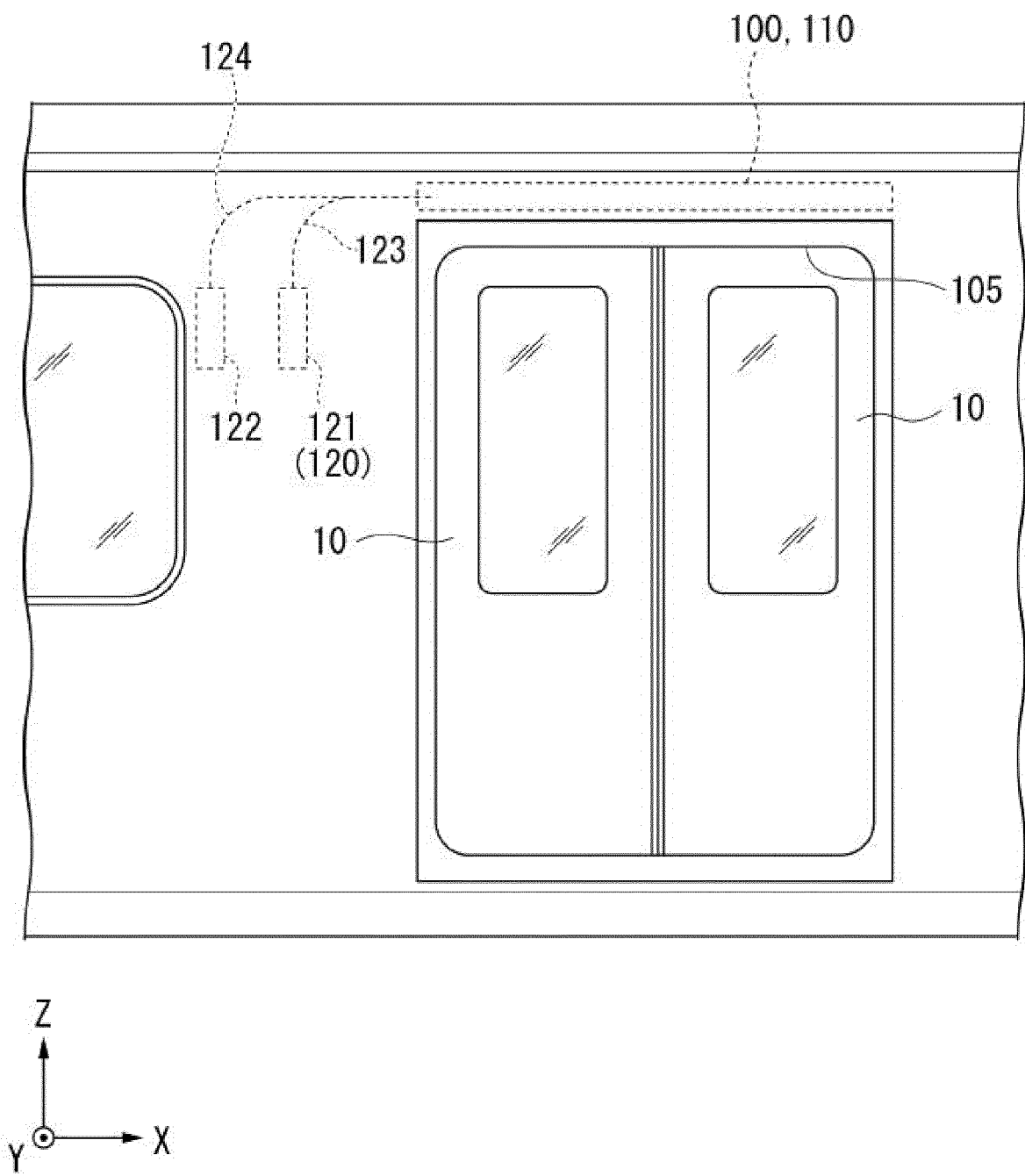


Fig. 1

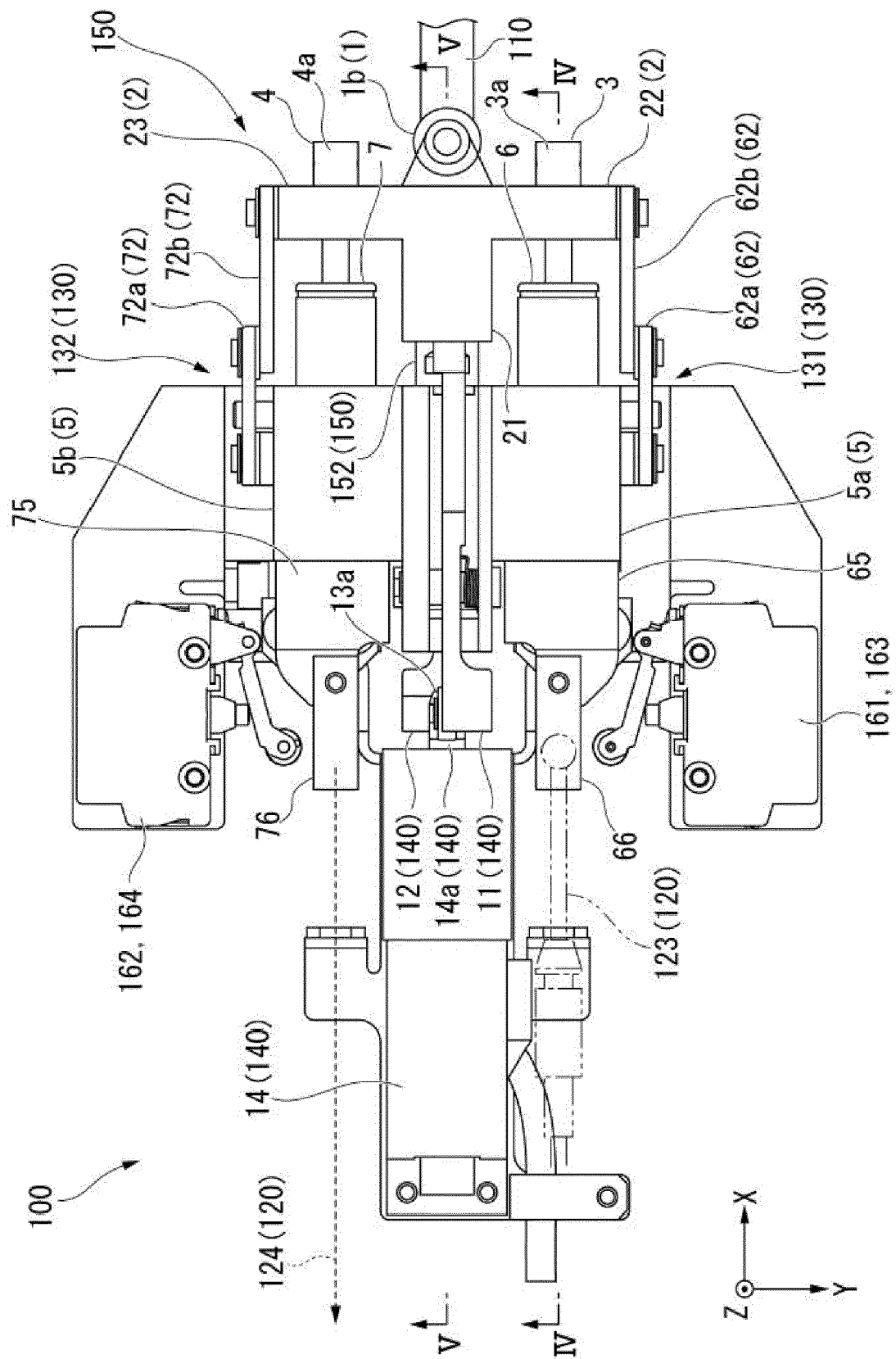


Fig. 2

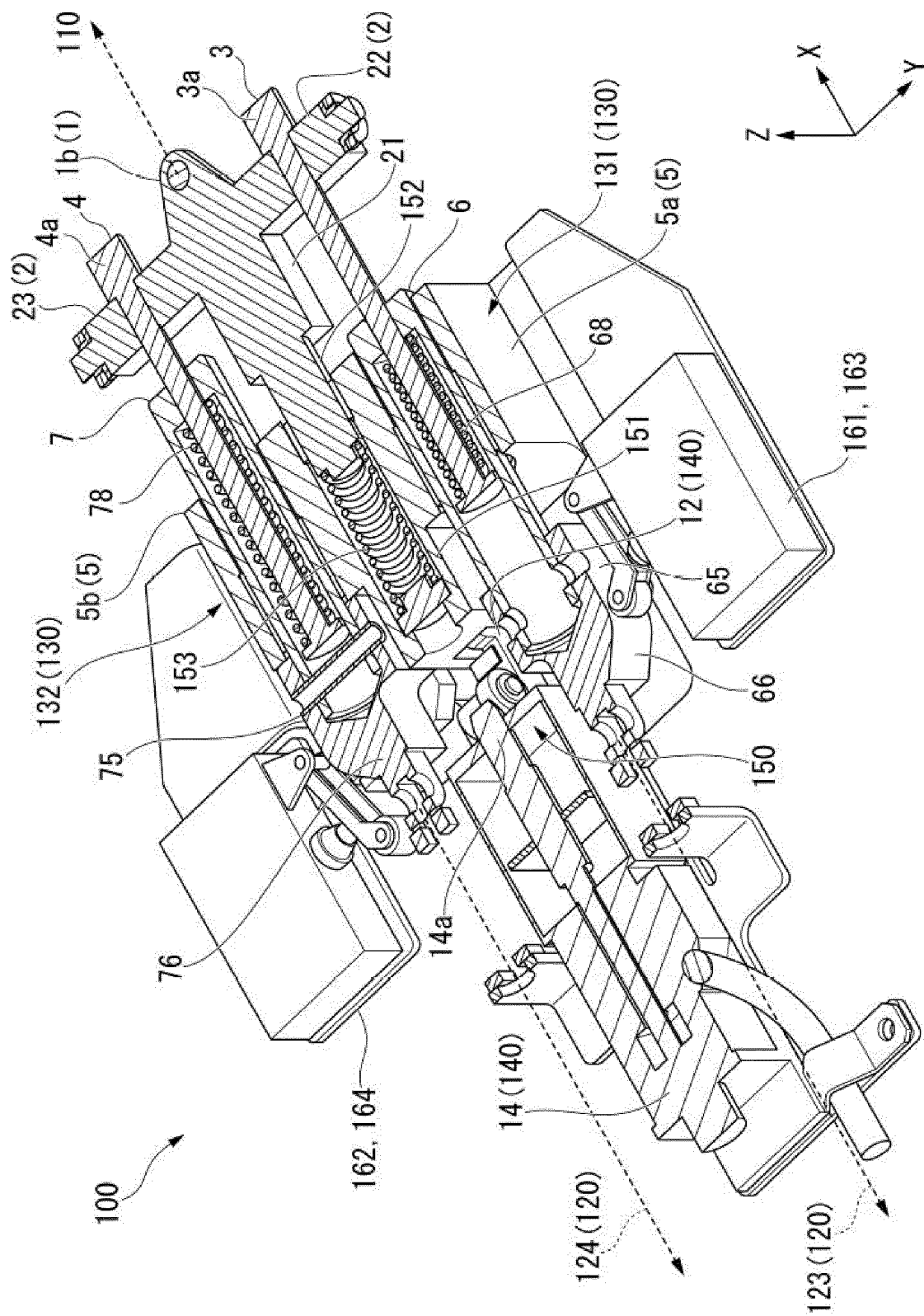


Fig. 3

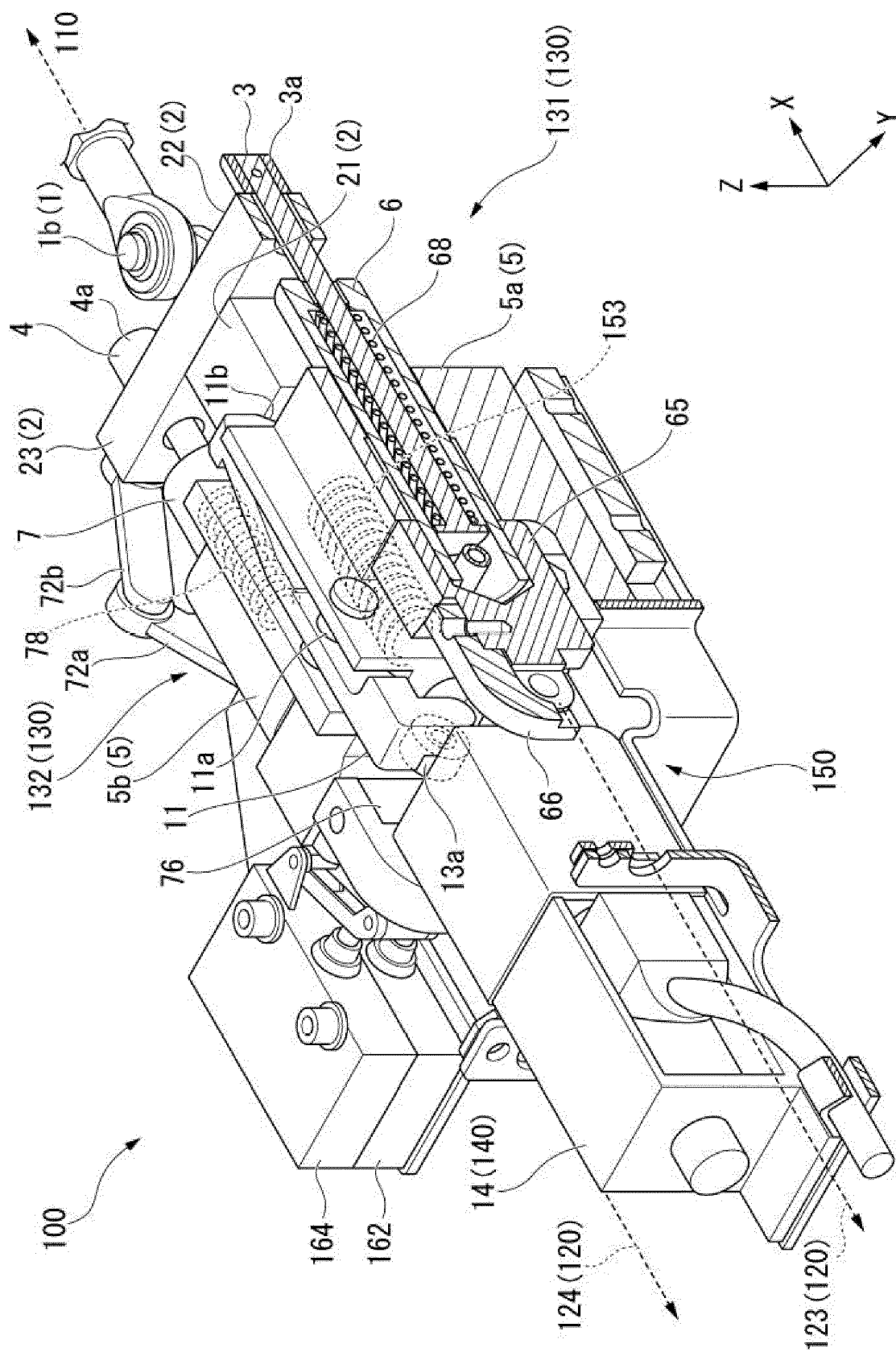


Fig. 4

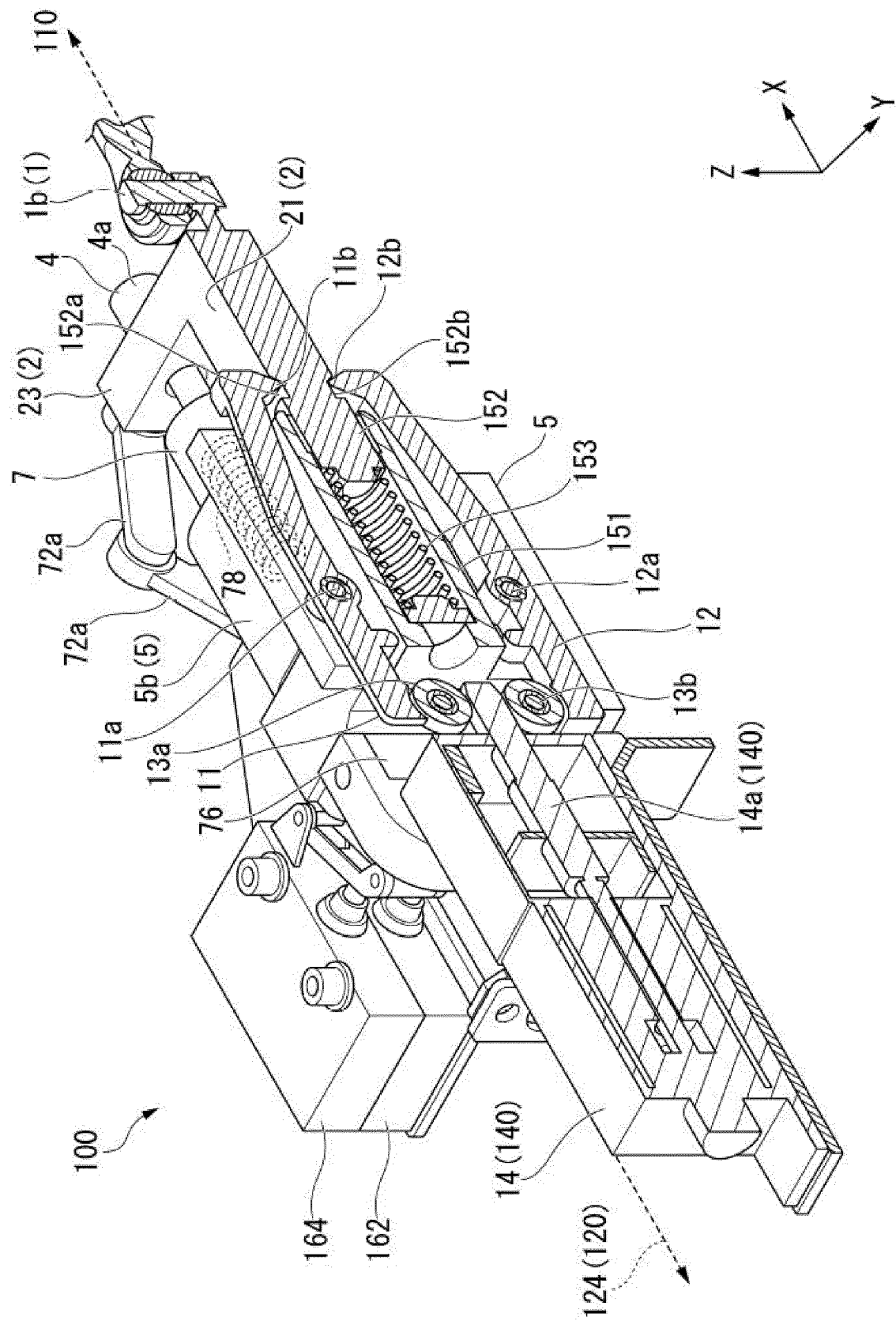


Fig. 5

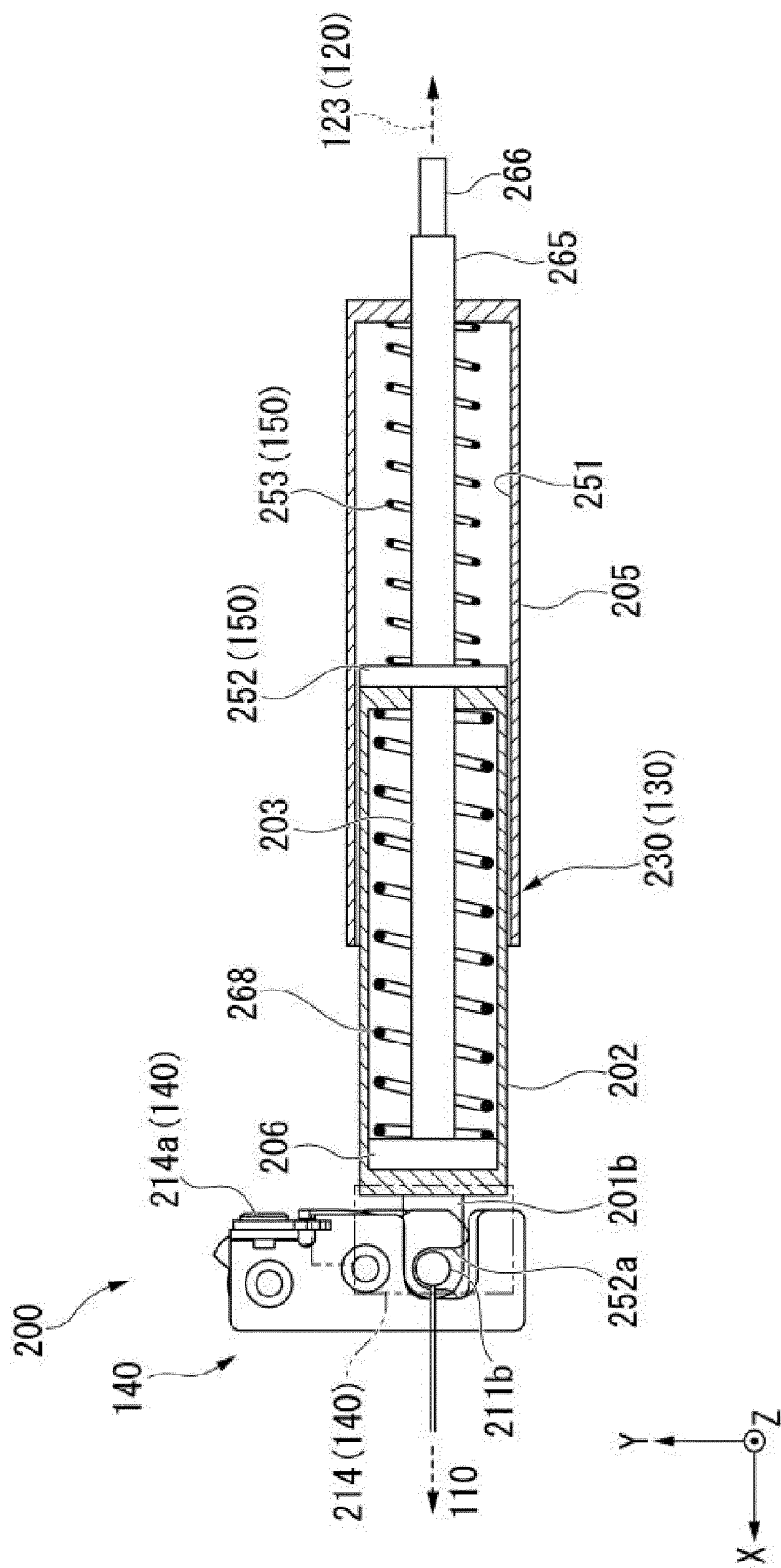


Fig. 6

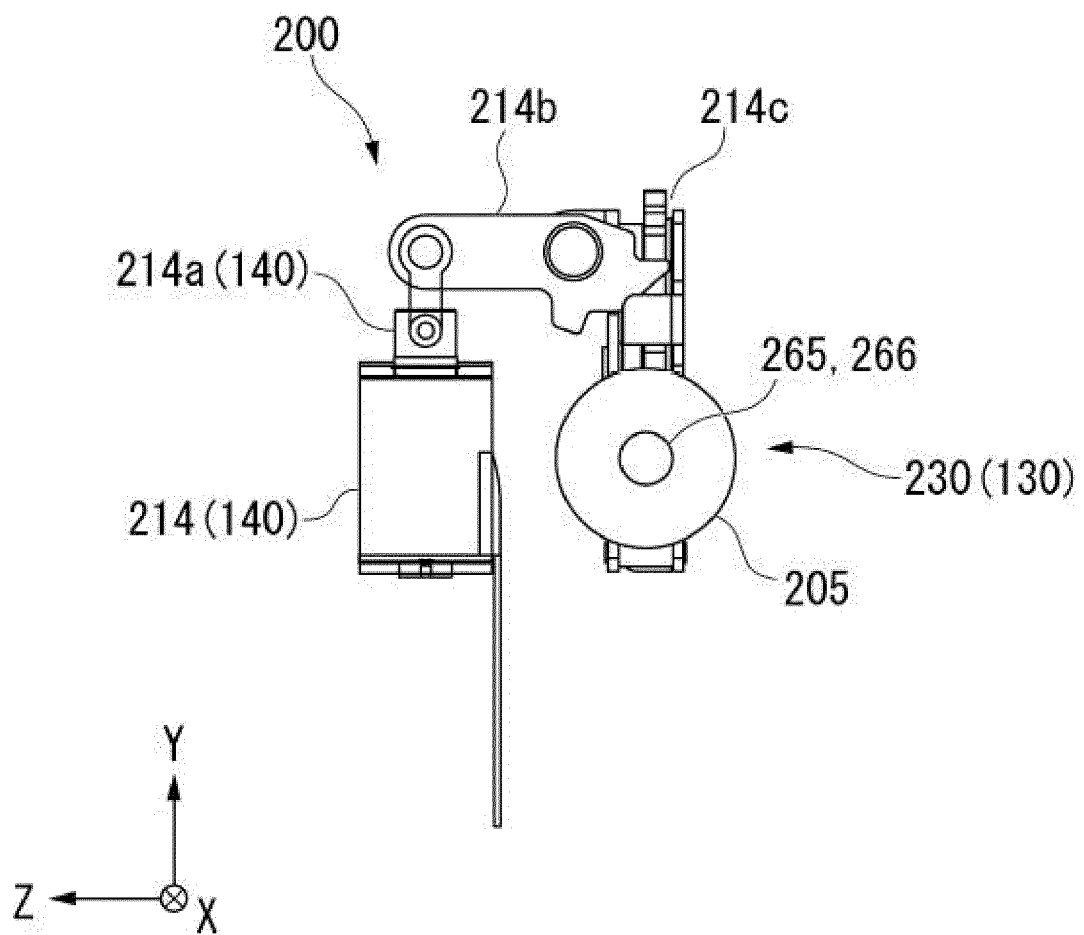


Fig. 7

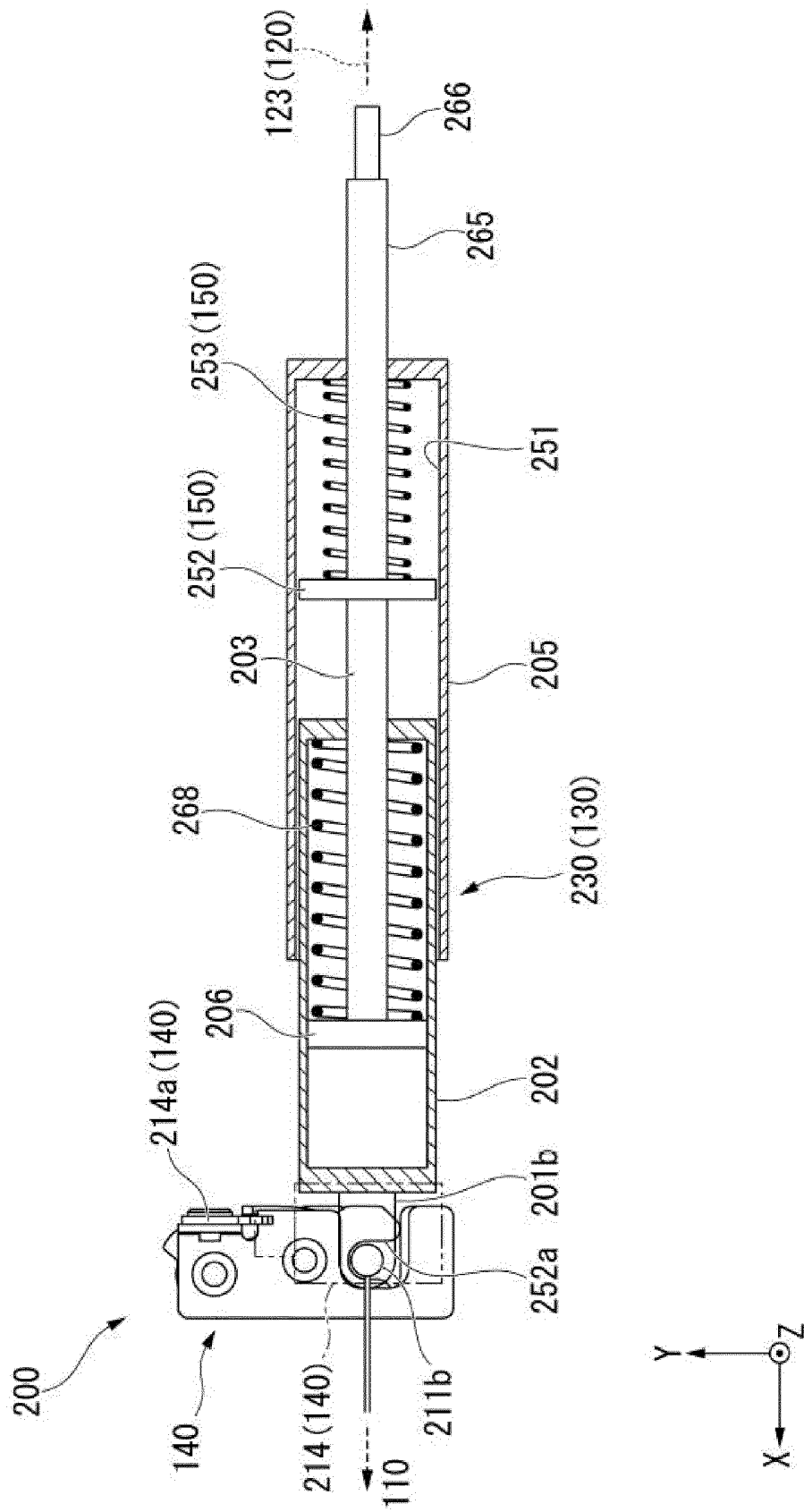


Fig. 8

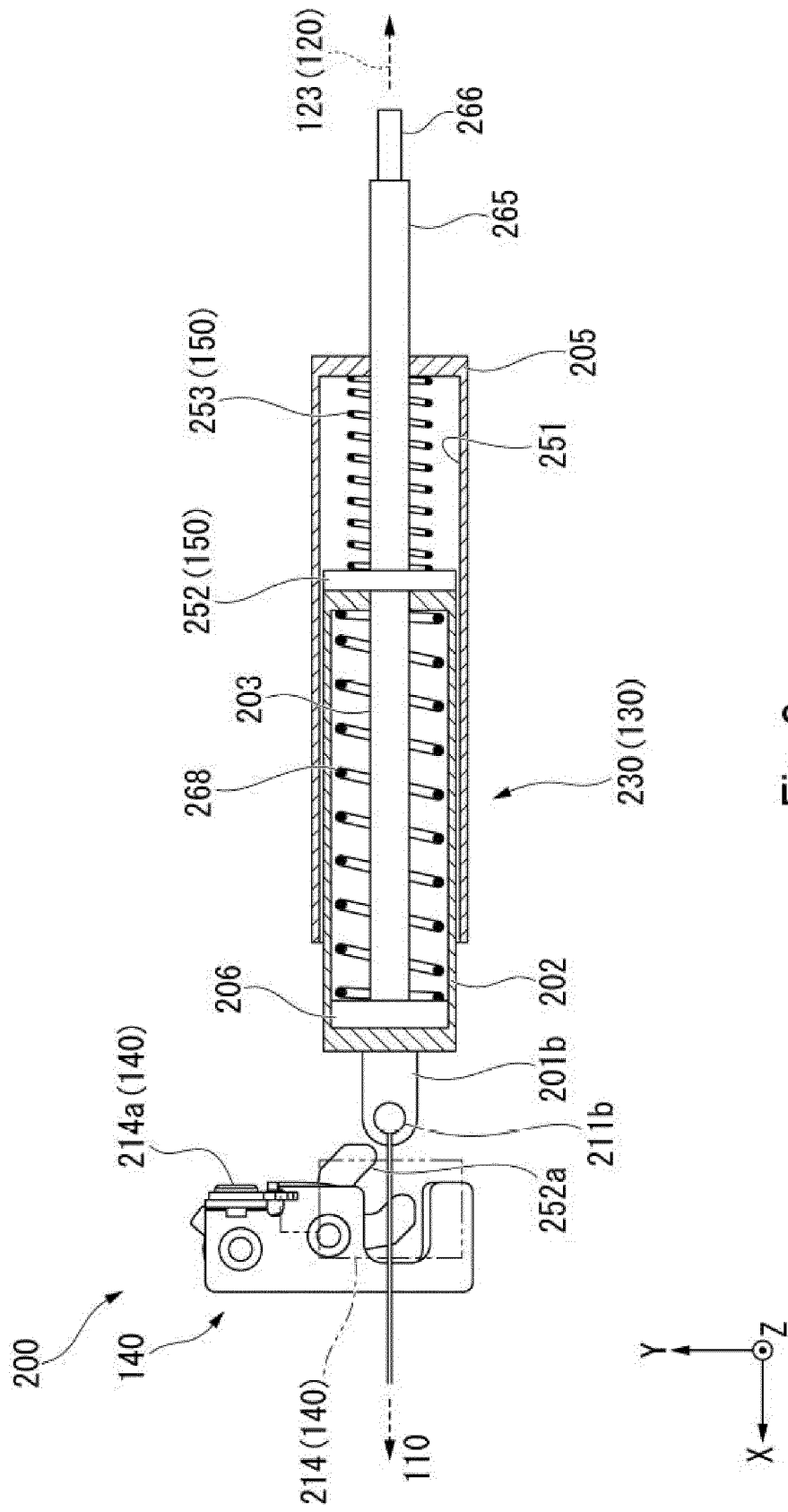


Fig. 9

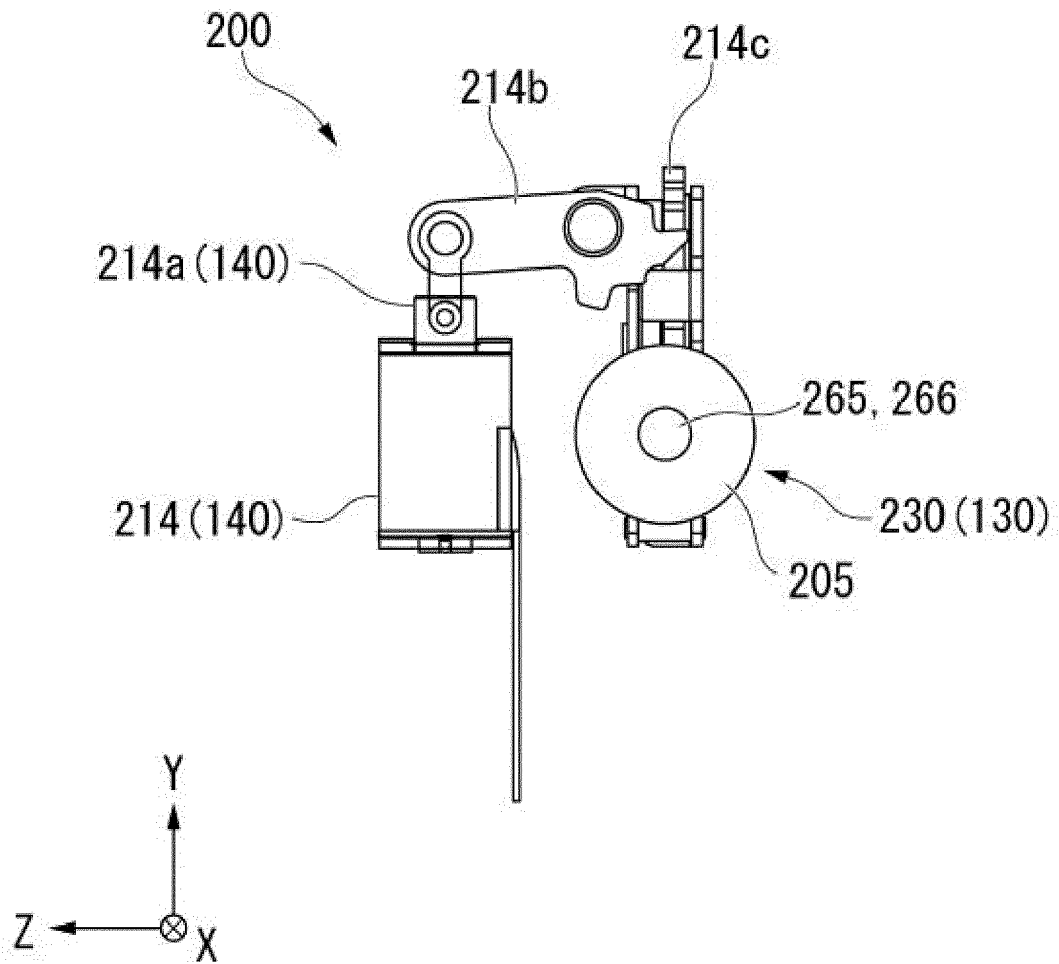


Fig. 10



EUROPEAN SEARCH REPORT

Application Number

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EPO FORM 1503 03.82 (P04C01)

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	WO 2017/079084 A1 (WESTINGHOUSE AIR BRAKE TECH CORP [US]) 11 May 2017 (2017-05-11)	1-4, 6, 8, 12, 13	INV. E05B15/04
A	* the whole document *	5, 7, 9-11	E05B81/90
	-----		E05B81/16
A	WO 2017/091323 A1 (WESTINGHOUSE AIR BRAKE TECH CORP [US]) 1 June 2017 (2017-06-01)	1-13	E05B83/36
	* the whole document *		B61D19/02
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A	CN 108 086 818 A (NANJING QIYUE ELECTROMECHANICAL EQUIPMENT CO LTD) 29 May 2018 (2018-05-29)	1-13	E05B81/08
	* paragraphs [0061], [0066], [0067]; figures 1-5 *		E05B81/64

			TECHNICAL FIELDS SEARCHED (IPC)
			E05B B61D E05F
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
The Hague		26 March 2022	Robelin, Fabrice
CATEGORY OF CITED DOCUMENTS			
X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

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5 This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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26-03-2022

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