



(12) **EUROPEAN PATENT APPLICATION**

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

(21) Application number: **21201455.9**

(22) Date of filing: **07.10.2021**

(51) International Patent Classification (IPC):
E05F 11/00 ^(2006.01) **E05F 11/08** ^(2006.01)
E05F 11/10 ^(2006.01) **E05F 15/632** ^(2015.01)
E05F 15/643 ^(2015.01)

(52) Cooperative Patent Classification (CPC):
E05F 15/632; E05F 11/00; E05F 11/08;
E05F 11/10; E05F 15/643; E05Y 2201/218;
E05Y 2201/22; E05Y 2201/244; E05Y 2201/624;
E05Y 2201/626; E05Y 2201/638; E05Y 2201/646;
E05Y 2201/652; E05Y 2201/676; E05Y 2201/68;
(Cont.)

(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 2020189854**

(71) Applicant: **Nabtesco Corporation**
Tokyo 102-0093 (JP)

(72) Inventor: **Sakaki, Genta**
Chiyoda-ku, Tokyo (JP)

(74) Representative: **Grünecker Patent- und**
Rechtsanwälte
PartG mbB
Leopoldstraße 4
80802 München (DE)

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

(57) A manual locking device (101) according to one aspect of the present invention includes: a transmission mechanism (4) for transmitting a driving force from a drive source (3) to a door leaf 10 to cause the door leaf (10) to move between a fully open position and a fully closed position; at least one moving portion (5) provided on the transmission mechanism (4) and configured to move in synchronization with opening and closing of the door leaf (10); a restraining portion (6) configured to restrain movement of the at least one moving portion (5) in an opening-closing direction of the door leaf (10); an operation portion (7) configured to be manually operated to produce an operating force; and a locking portion (8) configured to accomplish locking when the door leaf (10) is at the fully closed position, by moving the restraining portion (6) by the operating force of the operation portion (7) from an unlocking position in which the movement of the at least one moving portion (5) is not restrained to a locking position in which the movement of the at least one moving portion (5) is restrained.

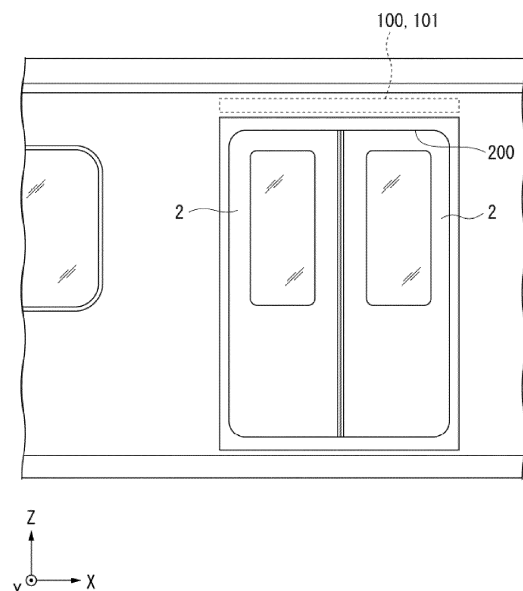


Fig. 1

(52) Cooperative Patent Classification (CPC): (Cont.)
E05Y 2201/686; E05Y 2400/324; E05Y 2400/354;
E05Y 2900/51

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a manual locking device and a railway vehicle door device. Specifically, the present disclosure relates to a technique suitable for use in manually locking a door in a closed state such that the door cannot be used. This technique is supposed to be used by a train crew when a door of a railway vehicle is broken down.

BACKGROUND

[0002] In order to allow running of a railway vehicle even when a fault occurs in a door of the railway vehicle for example, it is necessary to put the door out of service. For such a case, a mechanism called OoSL (Out of Service Lock) is provided as a device for a train crew to manually lock the door of the railway vehicle in the closed state.

[0003] For example, in a double sliding door, it is known to lock each door leaf independently. By way of an example, Patent Literature 1 discloses that a latch rod 7 moves into a latch hole 10 to lock a sliding door 1.

RELEVANT REFERENCES

LIST OF RELEVANT PATENT LITERATURE

[0004] Patent Literature 1: Japanese Patent Application Publication No. 2004-324159

SUMMARY

[0005] However, in the conventional technique, the door is locked by restraining its movement through contact with door leaves. Therefore, the door leaves are restrained after a driving force is transmitted from the motor to the door leaves, and thus it is required to restrain the movement of the door leaves having some degree of weight. A large restraining force is necessary to prohibit the door from moving. Thus, the restraining member is required to have a large rigidity and strength, leading to an increase of the strength and the size of the device. However, it has been demanded that the door can be locked with a smaller restraining force. Further, it has also been demanded that when one door leaf of a double sliding door is locked, the other door leaf can remain unlocked.

[0006] One object of the present invention is to provide an OoSL technique in which a door leaf can be restrained with a smaller restraining force before a driving force is transmitted to the door leaf, as compared to the case where the door leaf having some degree of weight is restrained directly.

[0007] (1) A manual locking device according to one aspect of the present invention comprises: a transmis-

sion mechanism for transmitting a driving force from a drive source to a door leaf to cause the door leaf to move between a fully open position and a fully closed position; at least one moving portion provided on the transmission mechanism and configured to move in synchronization with opening and closing of the door leaf; a restraining portion configured to contact with the at least one moving portion to restrain movement of the at least one moving portion in an opening-closing direction of the door leaf; an operation portion configured to be manually operated to produce an operating force; and a locking portion configured to accomplish locking when the door leaf is at the fully closed position, by moving the restraining portion by the operating force of the operation portion from an unlocking position in which the movement of the at least one moving portion is not restrained to a locking position in which the movement of the at least one moving portion is restrained.

[0008] In the manual locking device according to one aspect of the present invention, the moving portion, which moves integrally with the door leaf but is positioned halfway within the transmission mechanism, is locked by the restraining portion to prevent opening and closing of the door leaf. Therefore, locking can be accomplished with a smaller restraining force than in the case where the door leaf is locked directly.

[0009] (2) The manual locking device may comprise a lock restraining portion configured to allow locking by the locking portion only when the door leaf is at the fully closed position.

[0010] (3) The restraining portion may include an engaged portion. The lock restraining portion may include: an engaging portion configured to contact with the engaged portion to prevent movement of the restraining portion; and a pressed portion configured to be pressed by the at least one moving portion in a closing direction when the door leaf reaches the fully closed position, such that the engaging portion comes out of contact with the engaged portion.

[0011] (4) The lock restraining portion may be formed of a cam including the pressed portion and the engaging portion; and the cam may rotate when the pressed portion is pressed, such that the engaging portion comes out of contact with the engaged portion.

[0012] (5) The manual locking device may comprise a full closing switch for detecting that the door leaf has reached the fully closed position. The cam may further include a switch pressing portion configured to rotate when the pressed portion is pressed, to press the full closing switch.

[0013] (6) The manual locking device may be installed on each of a plurality of doors for opening and closing a plurality of doorways of a railway vehicle. The full closing switch may be connected to an interlock circuit that transmits a full closing signal when all of the plurality of doors are fully closed, and the full closing switch may be connected so as to be constantly able to transmit the full closing signal bypassing the interlock circuit when locking

by the locking portion is accomplished by manual operation of the operation portion.

[0014] (7) The locking portion may include: a first link configured to rotate by the operating force of the operation portion; and a second link connected at one end thereof to an end portion of the first link and connected at the other end thereof to the restraining portion. The first link may rotate from the unlocking position toward the locking position, such that the first link and the second link enter the locking position beyond a dead center.

[0015] (8) In the locking position, the second link may extend along a moving direction of the at least one moving portion.

[0016] (9) When the door leaf is at the fully closed position, the restraining portion connected to the second link may be in contact with a portion of the at least one moving portion facing toward the fully open position.

[0017] (10) The at least one moving portion may comprise a plurality of moving portions each connected to associated one of the door leaves of a double sliding door, and the locking portion may lock the plurality of moving portions simultaneously by the operating force of the operation portion.

[0018] (11) The operation portion may be disposed in a middle of the door leaves of the double door in a moving direction of the at least one moving portion.

[0019] (12) The transmission mechanism may include a coupled moving portion configured to move integrally with the at least one moving portion.

[0020] (13) The operation portion may include an input portion configured to receive operational input applied vertically upward.

[0021] (14) The operation portion may include a conversion portion for converting an operating force input vertically upward through the input portion into a force in a lateral direction intersecting a moving direction of the at least one moving portion.

[0022] (15) A railway vehicle door device according to another aspect of the present invention comprises: a door leaf for opening and closing a doorway of a railway vehicle; a drive source for driving the door leaf; a transmission mechanism for transmitting a driving force from the drive source to the door leaf to cause the door leaf to move between a fully open position and a fully closed position; a moving portion provided on the transmission mechanism and configured to move in synchronization with opening and closing of the door leaf; a restraining portion configured to restrain movement of the moving portion in an opening-closing direction of the door leaf; an operation portion configured to be manually operated to produce an operating force; and a locking portion configured to accomplish locking when the door leaf is at the fully closed position, by moving the restraining portion by the operating force of the operation portion from an unlocking position in which the movement of the moving portion is not restrained to a locking position in which the movement of the moving portion is restrained.

[0023] In the railway vehicle door device according to

the other aspect of the present invention, the moving portion, which moves integrally with the door leaf but is positioned halfway within the transmission mechanism, is locked by the restraining portion to prevent opening and closing of the door leaf. Therefore, locking can be accomplished with a smaller restraining force than in the case where the door leaf is locked directly.

ADVANTAGEOUS EFFECTS

[0024] In the present invention, the driving force is restrained from being transmitted to the door leaf, by contact with the moving portion provided on the transmission mechanism for transmitting the driving force to the door leaf. This makes it possible to restrain the movement of the door leaf with a smaller force as compared to the case where the movement of the door leaf is restrained by contact with it.

BRIEF DESCRIPTION OF THE DRAWINGS

[0025]

Fig. 1 is a schematic view of a doorway in an embodiment of a manual locking device and a railway vehicle door device according to the present invention.

Fig. 2 is a front view from the vehicle width direction showing a fully closed state in the embodiment of the manual locking device and the railway vehicle door device according to the present invention.

Fig. 3 is a perspective view around a locking portion in the embodiment of the manual locking device according to the present invention.

Fig. 4 is a perspective view around the locking portion in the embodiment of the manual locking device according to the present invention.

Fig. 5 is a front view from the vehicle width direction showing an open state in the embodiment of the manual locking device and the railway vehicle door device according to the present invention.

Fig. 6 illustrates operation in progress of manual locking in the embodiment of the manual locking device according to the present invention.

Fig. 7 illustrates a locked state in the embodiment of the manual locking device according to the present invention.

DESCRIPTION OF EXAMPLE EMBODIMENTS

[0026] Embodiments of the manual locking device and the railway vehicle door device according to the present invention will be hereinafter described with reference to the drawings. Fig. 1 is a schematic view around a doorway of a railway vehicle in the present embodiment as viewed from the vehicle width direction. Fig. 2 is a front view showing an open state in the railway vehicle door device and the manual locking device according to the

present invention. Fig. 3 is a perspective view around a locking portion of the manual locking device in the present embodiment. Fig. 4 is a perspective view around a locking portion of the manual locking device in the present embodiment. In these drawings, the reference sign 100 denotes a railway vehicle door device.

[0027] The following description of the embodiment will be based on an example of a railway vehicle door device including a pair of double door leaves 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.

[0028] As shown in Fig. 1, a railway vehicle door device 100 according to the present embodiment is disposed above a doorway 200. The railway vehicle door device 100 includes a manual locking device 101. As shown in Figs. 2 to 4, the railway vehicle door device 100 includes a double door 2, a drive source 3, a transmission mechanism 4, a moving portion 5, a restraining portion 6, an operation portion 7, a locking portion 8, and a lock restraining portion 9. The transmission mechanism 4, the moving portion 5, the restraining portion 6, the operation portion 7, the locking portion 8, and the lock restraining portion 9 constitute the manual locking device 101.

[0029] In the following description, an orthogonal coordinate system having Y, X, 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, the side indicated by the arrow in each of the Y direction, the X direction, and the Z direction 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.

[0030] As shown in Fig. 1, the railway vehicle door device 100 includes a double door 2 for sliding in the X direction to open and close the doorway 200. As shown in Fig. 2, the door 2 includes door leaves 10 and door hangers (coupled moving portions) 11 coupled to the door leaves 10. The door 2 move along guide rails (not shown) in an opening-closing path for opening and closing the doorway 200 of the vehicle. The door leaves 10

reciprocates in the X direction between the fully closed position and the fully open position. The door 2 is opened and closed by a driving force from the drive source 3.

[0031] The drive source 3 outputs the driving force for moving the door 2. For example, the drive source 3 is a motor. The output shaft of the motor rotates about an axis along the X direction. For example, the output shaft of the motor can rotate about an axis along the X direction (in the forward and reverse directions). The forward and reverse rotation of the motor causes the door leaves 10 to reciprocate in the X direction between the fully closed position and the fully open position.

[0032] The transmission mechanism 4 transmits the driving force from the drive source 3 to the door leaves 10 to cause the door leaves 10 to move between the fully open position and the fully closed position. The transmission mechanism 4 includes, for example, a power converting mechanism 41 and an endless belt 42. The power converting mechanism 41 converts the direction of the driving force from the drive source 3, and the belt 42 extends in the front-rear direction of the vehicle (the X direction). The power transmission mechanism 41 converts the rotation of the output shaft of the motor about the axis along the X direction into rotation about the axis along the width direction of the vehicle (the Y direction). The power transmission mechanism 41 includes a gear 43 that rotates about the axis along the width direction of the vehicle (the Y direction). At a position distant from the gear 43 in the X direction, a pulley 44 is provided. The pulley 44 can rotate about the axis parallel to the rotation axis of the gear 43 (the axis along the Y direction).

[0033] The belt 42 is stretched between the gear 43 and the pulley 44. The belt 42 runs (rotates) around the gear 43 and the pulley 44 in association with the rotation of the gear 43. The moving portion 5, which moves along with the belt 42, is attached to the belt 42. The moving portion 5 reciprocates in the front-rear direction of the vehicle (the X direction). The moving portion 5 is connected with the door hangers 11. The door hangers 11 move along guide rails (not shown) in an opening-closing path.

[0034] The moving portion 5 reciprocates in the front-rear direction of the vehicle (the X direction) between a full closing associated position and a full opening associated position in association with the movement of the door leaves 10 between the fully closed position and the fully open position. The moving portion 5 is attached to the outer side of the belt 42 stretched between the gear 43 and the pulley 44. As viewed in the Y direction, the positions enclosed by the belt 42 and located proximate to the gear 43 and the pulley 44 are referred to as the inside of the belt. On the other hand, the positions opposite to the gear 43 and the pulley 44 with respect to the belt 42 are referred to as the outside of the belt. The full closing associated position and the full opening associated position of the moving portion 5 are located between the gear 43 and the pulley 44 in the front-rear direction of the vehicle (the X direction). As shown in Fig. 2, the

moving portion 5 includes an upper moving portion 51 attached to the upper side of the belt 42 and a lower moving portion 52 attached to the lower side of the belt 42.

[0035] In Fig. 2, the full closing associated position of the upper moving portion 51 is a right side position proximate to the pulley 44 in the front-rear direction of the vehicle (the X direction). The full opening associated position of the upper moving portion 51 is a left side position proximate to the gear 43. Likewise, in Fig. 2, the full opening associated position of the lower moving portion 52 is a right side position proximate to the pulley 44 in the front-rear direction of the vehicle (the X direction). The full closing associated position of the lower moving portion 52 is a left side position proximate to the gear 43. The door leaf 10 shown in the left side of Fig. 2 is connected to the upper moving portion 51 via the door hanger 11. The door leaf 10 shown in the right side of Fig. 2 is connected to the lower moving portion 52 via the door hanger 11.

[0036] The upper moving portion 51 and the lower moving portion 52 move in opposite directions for the same distance in accordance with the running of the belt 42 in the front-rear direction of the vehicle (the X direction). Accordingly, the full closing associated position of the upper moving portion 51 and the full closing associated position of the lower moving portion 52 are at the same distance in the front-rear direction of the vehicle (the X direction) from the center of the doorway 200. Likewise, the full opening associated position of the upper moving portion 51 and the full opening associated position of the lower moving portion 52 are at the same distance in the front-rear direction of the vehicle (the X direction) from the center of the doorway 200. Both the upper moving portion 51 and the lower moving portion 52 have a rectangular outer shape as viewed from the width direction of the vehicle (the Y direction).

[0037] As shown in Figs. 2 to 4, the restraining portion 6 includes a right restraining portion 61 and a left restraining portion 62 that are associated with the upper moving portion 51 and the lower moving portion 52. The terms "right" and "left" are defined based on Fig. 2 and used for convenience. The right restraining portion 61 is rotatably supported by a rotating shaft 61a having a rotational axis extending in the Y direction. The right restraining portion 61 rotates about the rotating shaft 61a to move between a locking position and an unlocking position. In the locking position, the right restraining portion 61 contacts with the upper moving portion 51, and in the unlocking position, the right restraining portion 61 does not contact with the upper moving portion 51 and does not prevent the movement of the upper moving portion 51. The rotating shaft 61a is positioned proximate to the upper moving portion 51 located at its full closing associated position. As viewed from the Y direction, the rotating shaft 61a is positioned proximate in the negative Z direction and the negative X direction to the upper moving portion 51 located at its full closing associated position.

[0038] The right restraining portion 61 includes a first arm 61b and a second arm 61c that extend in opposite

directions from the rotating shaft 61a. The right restraining portion 61 rotates between the unlocking position in which the first arm 61b and the second arm 61c extend in the X direction and the locking position in which the first arm 61b and the second arm 61c extend in the Z direction. The right restraining portion 61 rotates clockwise by about 90° about the rotating shaft 61a from the unlocking position shown in Fig. 2 to the locking position.

[0039] In the unlocking position, the first arm 61b is positioned to extend in the negative X direction from the rotating shaft 61a. In the locking position, the first arm 61b is positioned to extend in the positive Z direction from the rotating shaft 61a. When in the unlocking position, the first arm 61b is positioned inside the belt 42, as viewed from the Y direction. When moving from the unlocking position to the locking position, the first arm 61b rotates to a position outside the belt 42, as viewed from the Y direction.

[0040] The first arm 61b includes a movement restraining portion 61d that, in the locking position, contacts with the upper moving portion 51 to prevent the movement of the upper moving portion 51 in the negative X direction. When the upper moving portion 51 is at the full closing associated position, the movement restraining portion 61d contacts with a front surface 51a of the upper moving portion 51 facing the negative X direction (see Fig. 7 described later). In the locking position, the movement restraining portion 61d is positioned outside the belt 42 and at such a distance from the rotating shaft 61a as to contact with the front surface 51a of the upper moving portion 51.

[0041] In the unlocking position, the movement restraining portion 61d is positioned at the upper surface of first arm 61b facing the positive Z direction. The movement restraining portion 61d has a surface shaped to be parallel with the front surface 51a of the upper moving portion 51 at the locking position, so as to maximize the area of contact with the front surface 51a of the upper moving portion 51. Specifically, the movement restraining portion 61d has a surface that extends along the YZ direction at the locking position. As viewed from the Y direction, the rotating shaft 61a is positioned proximate in the negative X direction to the front surface 51a of the upper moving portion 51 located at its full closing associated position.

[0042] The first arm 61b is connected with the locking portion 8 (described later) via a rotating shaft 61f provided at a distance from the rotating shaft 61a. The rotating shaft 61f has a rotational axis extending in parallel with the rotating shaft 61a, or in the Y direction. When the first arm 61b is at the unlocking position, the movement restraining portion 61d is positioned in the positive Z direction relative to the rotating shaft 61f. When the right restraining portion 61 is at the locking position, the rotating shaft 61f is positioned in the positive Z direction relative to the rotating shaft 61a.

[0043] Likewise, in the unlocking position, the second arm 61c is positioned to extend in the positive X direction from the rotating shaft 61a. In the locking position, the

second arm 61c is positioned to extend in the negative Z direction from the rotating shaft 61a. When in the unlocking position, the second arm 61c is positioned inside the belt 42, as viewed from the Y direction. When moving from the unlocking position to the locking position, the second arm 61c rotates to a position at which it does not contact or interfere with the belt 42, as viewed from the Y direction.

[0044] The second arm 61c includes an engaged portion 61e that, in the unlocking position, contacts with the lock restraining portion 9 (described later) to prevent the clockwise rotational movement of the right restraining portion 61 relative to the rotating shaft 61a. When the engaged portion 61e is in contact with the lock restraining portion 9, the right restraining portion 61 is restrained by the lock restraining portion 9 and prevented from rotating.

[0045] The left restraining portion 62 is point-symmetric to the right restraining portion 61. Specifically, as viewed from the Y direction, the left restraining portion 62 and the right restraining portion 61 are point-symmetric to each other with respect to the middle point between the rotational axis of the gear 43 and the rotational axis of the pulley 44. The left restraining portion 62 is rotatably supported by a rotating shaft 62a having a rotational axis extending in the Y direction. The left restraining portion 62 rotates about the rotating shaft 62a to move between a locking position and an unlocking position. In the locking position, the left restraining portion 62 contacts with the lower moving portion 52, and in the unlocking position, the left restraining portion 62 does not contact with the lower moving portion 52 and does not prevent the movement of the lower moving portion 52. The rotating shaft 62a is positioned proximate to the lower moving portion 52 located at its full closing associated position. As viewed from the Y direction, the rotating shaft 62a is positioned proximate in the positive Z direction and the positive X direction to the lower moving portion 52 located at its full closing associated position.

[0046] The left restraining portion 62 includes a first arm 62b and a second arm 62c that extend in opposite directions from the rotating shaft 62a. The left restraining portion 62 rotates between the unlocking position in which the first arm 62b and the second arm 62c extend in the X direction and the locking position in which the first arm 62b and the second arm 62c extend in the Z direction. The left restraining portion 62 rotates clockwise by about 90° about the rotating shaft 62a from the unlocking position shown in Fig. 2 to the locking position.

[0047] In the unlocking position, the first arm 62b is positioned to extend in the positive X direction from the rotating shaft 62a. In the locking position, the first arm 62b is positioned to extend in the negative Z direction from the rotating shaft 62a. When in the unlocking position, the first arm 62b is positioned inside the belt 42, as viewed from the Y direction. When moving from the unlocking position to the locking position, the first arm 62b rotates to a position outside the belt 42.

[0048] The first arm 62b includes a movement restrain-

ing portion 62d that, in the locking position, contacts with the lower moving portion 52 to prevent the movement of the lower moving portion 52 in the positive X direction. When the lower moving portion 52 is at the full closing associated position, the movement restraining portion 62d contacts with a front surface 52a of the lower moving portion 52 facing the positive X direction (see Fig. 7 described later). In the locking position, the movement restraining portion 62d is positioned outside the belt 42 and at such a distance from the rotating shaft 62a as to contact with the front surface 52a of the lower moving portion 52.

[0049] In the unlocking position, the movement restraining portion 62d is positioned at the lower surface of first arm 62b facing the negative Z direction. The movement restraining portion 62d has a surface shaped to be parallel with the front surface 52a of the lower moving portion 52 at the locking position, so as to maximize the area of contact with the front surface 52a of the lower moving portion 52. Specifically, the movement restraining portion 62d has a surface that extends along the YZ direction at the locking position. As viewed from the Y direction, the rotating shaft 62a is positioned proximate in the positive X direction to the front surface 52a of the lower moving portion 52 located at its full closing associated position.

[0050] The first arm 62b is connected with the locking portion 8 (described later) via a rotating shaft 62f provided at a distance from the rotating shaft 62a. The rotating shaft 62f has a rotational axis extending in parallel with the rotating shaft 62a, or in the Y direction. When the first arm 62b is at the unlocking position, the movement restraining portion 62d is positioned in the negative Z direction relative to the rotating shaft 62f. When the left restraining portion 62 is at the locking position, the rotating shaft 62f is positioned in the negative Z direction relative to the rotating shaft 62a.

[0051] Likewise, in the unlocking position, the second arm 62c is positioned to extend in the negative X direction from the rotating shaft 62a. In the locking position, the second arm 62c is positioned to extend in the positive Z direction from the rotating shaft 62a. When in the unlocking position, the second arm 62c is positioned inside the belt 42, as viewed from the Y direction. When moving from the unlocking position to the locking position, the second arm 62c rotates to a position at which it does not contact or interfere with the belt 42.

[0052] The second arm 62c includes an engaged portion 62e that, in the unlocking position, contacts with the lock restraining portion 9 (described later) to prevent the clockwise rotational movement of the left restraining portion 62 relative to the rotating shaft 62a. When the engaged portion 62e is in contact with the lock restraining portion 9, the left restraining portion 62 is restrained by the lock restraining portion 9 and prevented from rotating.

[0053] The operation portion 7 is manually operated to produce an operating force for operating the locking portion 8. As shown in Figs. 3 and 4, the operation portion 7 includes an input portion 71 and a conversion portion

72. The input portion 71 receives an operating force input manually, and the conversion portion 72 converts the direction of the operating force input through the input portion 71 and transmits the operating force to the locking portion 8.

[0054] The input portion 71 is disposed at the middle of the doorway 200 in the X direction (see Fig. 1). The input portion 71 is positioned above the door leaves 10. The input portion 71 includes an input shaft 71a that is rotated in mesh with a locking key (not shown). The input shaft 71a has a rotational axis extending along the Z direction, and receives the operating force input at its lower end vertically upward. The input shaft 71a is positioned at an equal distance from the rotational axis of the gear 43 and the rotational axis of the pulley 44 in the X direction. The input shaft 71a is disposed at the middle of the doorway 200 in the X direction.

[0055] The conversion portion 72 includes bevel gears 71b, 72b that transmit rotation between the input shaft 71a and a rotating shaft 81a of the locking portion 8 (described later), while changing the direction of transmission. The bevel gear 71b is disposed around the upper end of the input shaft 71a. The bevel gear 72b is disposed on the rotating shaft 81a of the locking portion 8 (described later). The rotating shaft 81a has a rotational axis extending along the Y direction. The bevel gear 71b and the bevel gear 72b mesh with each other and transmit rotation from the input shaft 71a to the rotating shaft 81a.

[0056] As shown in Figs. 2 to 4, the locking portion 8 includes a first link 81 that rotates about the rotating shaft 81a, a right second link (second link) 82 connected at one end thereof to an end portion of the first link 81, and a left second link (second link) 83. The rotating shaft 81a has a rotational axis extending along the Y direction. The rotating shaft 81a is disposed at the middle of the doorway 200 in the X direction. The rotating shaft 81a is positioned at an equal distance from the rotational axis of the gear 43 and the rotational axis of the pulley 44 in the X direction. The rotating shaft 81a is positioned inside the belt 42 as viewed from the Y direction.

[0057] The first link 81 includes an arm 81b and an arm 81c. In the unlocking position, the arm 81b extends toward the positive X direction, and the arm 81c extends toward the negative X direction, and the center of these arms is at the rotating shaft 81a. The first link 81 can rotate by 180° between the unlocking position and the locking position thereof with its rotational center positioned at the rotating shaft 81a. In the unlocking position, the arms 81b, 81c extend along the X direction toward the directions opposite to each other so as to be centered at the rotating shaft 81a, while in the locking position, the arms 81b, 81c extend along the X direction toward the opposite directions than in the unlocking position.

[0058] The distal end of the arm 81b is connected with one end of the left second link (second link) 83 via a rotating shaft 81d. The distal end of the arm 81c is connected with one end of the right second link (second link) 82 via a rotating shaft 81e. In the distal end of the arm

81c, a stopping portion 81g is formed at a position more distant from the rotating shaft 81a than is the rotating shaft 81e. In the locking position, the stopping portion 81g stops the first link 81 and immobilize the rotational position thereof. In the locking position, the stopping portion 81g abuts against a stop restraint portion 84 to be immobilized.

[0059] The arm 81c includes at the distal end thereof a switch pressing portion that contacts with a locking switch 103. The switch pressing portion may be provided by the stopping portion 81g. The locking switch 103, which is turned ON by contact with the switch pressing portion, detects that the first link 81 is in the locking position. In other words, the locking switch 103 detects that the moving portion 5 is in the full closing associated position, and the restraining portion 6 is in the locking position. Thus, the locking switch 103 can be used as a switch for detecting full closing of the door in normal vehicle operation.

[0060] In the unlocking position, the rotating shaft 81d is positioned at a distance from the rotating shaft 81a in the positive X direction. In the unlocking position, the rotating shaft 81e is positioned at a distance from the rotating shaft 81a in the negative X direction. As viewed from the Y direction, the distance between the rotating shaft 81d and the rotating shaft 81a is equal to the distance between the rotating shaft 81e and the rotating shaft 81a.

[0061] The left second link (second link) 83 is connected at the other end thereof with the left restraining portion 62 via the rotating shaft 62f such that the left restraining portion 62 is rotatable. In the unlocking position, the left second link (second link) 83 extends in the negative X direction from the rotating shaft 81d. The right second link (second link) 82 is connected at the other end thereof with the right restraining portion 61 via the rotating shaft 61f such that the right restraining portion 61 is rotatable. In the unlocking position, the right second link (second link) 82 extends in the positive X direction from the rotating shaft 81e.

[0062] In the unlocking position, the arm 81b extends in the positive X direction from the rotating shaft 81a, and the left second link (second link) 83 extends in the negative X direction from the rotating shaft 81d. Also, in the unlocking position, the arm 81b and the left second link (second link) 83 are parallel and overlap each other as viewed from the Y direction. Therefore, the left second link (second link) 83 includes a curved portion 83a at a position proximate to the rotating shaft 81d. The curved portion 83a is curved from the rotating shaft 81d in the negative Z direction to extend round the rotating shaft 81e.

[0063] In the unlocking position, the arm 81c extends in the negative X direction from the rotating shaft 81a, and the right second link (second link) 82 extends in the positive X direction from the rotating shaft 81e. Also, in the unlocking position, the arm 81c and the right second link (second link) 82 are parallel and overlap each other

as viewed from the Y direction. Therefore, the right second link (second link) 82 includes a curved portion 82a at a position proximate to the rotating shaft 81e. The curved portion 82a is curved from the rotating shaft 81e in the positive Z direction to extend round the rotating shaft 81d.

[0064] The rotating shaft 81a, the rotating shaft 81d, the rotating shaft 81e, the rotating shaft 61f, and the rotating shaft 62f extend along the Y direction and are parallel to one another. The arm 81b, the left second link (second link) 83, and the left restraining portion 62 form a lock link for restraining the movement of the lower moving portion 52 at the full closing associated position. The arm 81c, the right second link (second link) 82, and the right restraining portion 61 form a lock link for restraining the movement of the upper moving portion 51 at the full closing associated position.

[0065] The operating force input through the operation portion 7 causes the first link 81 to rotate clockwise as viewed in Fig. 2 to abut against the stop restraint portion 84, such that the locking portion 8 is put into the locking position. In this locking position, the first link 81 is in a horizontal position, in which the arm 81b extends along the negative X direction, and the arm 81c rotates about the rotating shaft 81a to such a position as to extend toward the positive X direction. At this time, as shown in Fig. 7 (described later), in the right second link 82, the rotating shaft 61f is positioned above the rotating shaft 81e in the Z direction. Likewise, in the left second link 83, the rotating shaft 62f is positioned below the rotating shaft 81d in the Z direction. In other words, when rotating from the locking position to the unlocking position, the first link 81 and the second links 82, 83 rotate beyond the dead center at which they are in a linear arrangement. Accordingly, when returning from the locking position to the unlocking position, the first link 81 and the second links 82, 83 need to rotate beyond the dead center again. When the operating force input through the operation portion 7 causes the first link 81 to rotate counterclockwise to enter the horizontal position shown in Fig. 2, the locking portion 8 is in the unlocking position.

[0066] Only when the door leaves 10 are at the fully closed position, the lock restraining portion 9 allows locking by the locking portion 8. As shown in Figs. 2 to 4, the lock restraining portion 9 includes a right lock restraining portion 91 and a left lock restraining portion 92.

[0067] The right lock restraining portion 91 can restrain locking accomplished by the right restraining portion 61. The right lock restraining portion 91 is rotatably supported by a rotating shaft 91a having a rotational axis extending in the Y direction. The right lock restraining portion 91 rotates about the rotating shaft 91a to move between a lock-enabled position at which the right lock restraining portion 91 is contacted and pressed by the upper moving portion 51 and a lock-disabled position at which the right lock restraining portion 91 is not contacted or pressed by the upper moving portion 51. The rotating shaft 91a is positioned inside the belt 42 as viewed from the Y direc-

tion. The rotating shaft 91a is positioned proximate to the upper moving portion 51 located at its full closing associated position. As viewed from the Y direction, the rotating shaft 91a is positioned proximate in the negative Z direction to the upper moving portion 51 located at its full closing associated position, and the rotating shaft 91a is aligned in the X direction with the upper moving portion 51 located at its full closing associated position. A torsion spring (not shown) is attached to the rotating shaft 91a so as to encircle it. The torsion spring biases the right lock restraining portion 91 counterclockwise around the rotating shaft 91a as viewed in Fig. 2.

[0068] The right lock restraining portion 91 is formed of a cam including a first arm 91b and an engaging portion 91h. The first arm 91b extends from the rotating shaft 91a in the positive Z direction, and the engaging portion 91h projects in the negative X direction at the proximal end side of the first arm 91b. The first arm 91b includes at the distal end thereof a pressed portion 91d to be contacted by the upper moving portion 51 and thereby pressed by the upper moving portion 51. The pressed portion 91d projects in the negative X direction from the distal end of the first arm 91b extending in the positive Z direction from the rotating shaft 91a. When the pressed portion 91d is pressed in the positive X direction, the first arm 91b rotates about the rotating shaft 91a from the lock-disabled position to the lock-enabled position. When the upper moving portion 51 moves in the positive X direction, the pressed portion 91d is contacted and pressed by the front surface 51b of the upper moving portion 51 that is facing forward. When the pressed portion 91d is no longer pressed by the upper moving portion 51 and is no longer contacted by the front surface 51b, the torsion spring around the rotating shaft 91a causes the first arm 91b to return from the lock-enabled position to the lock-disabled position.

[0069] The right lock restraining portion 91 can rotate about the rotating shaft 91a between the lock-disabled position at which the distal end of the first arm 91b extends in the positive Z direction and the lock-enabled position at which the distal end of the first arm 91b is tilted toward the positive X direction as compared to the lock-disabled position. The right lock restraining portion 91 moves from the lock-disabled position shown in Fig. 2 to the lock-enabled position by rotating clockwise about the rotating shaft 91a (see Figs. 5 to 7 described later). When the right lock restraining portion 91 is at the lock-disabled position, the engaging portion 91h contacts with the engaged portion 61e to prevent the rotational movement of the right restraining portion 61. When the right lock restraining portion 91 is at the lock-enabled position, the engaging portion 91h is separated from the engaged portion 61e and does not prevent the movement of the right restraining portion 61.

[0070] In the right lock restraining portion 91, the upper moving portion 51 pressing the pressed portion 91d causes the first arm 91b to rotate to the lock-enabled position, and thus the engaging portion 91h comes out of contact

with the engaged portion 61e, and locking by the right restraining portion 61 is enabled.

[0071] The left lock restraining portion 92 is point-symmetric to the right lock restraining portion 91. Specifically, as viewed from the Y direction, the left lock restraining portion 92 and the right lock restraining portion 91 are point-symmetric to each other with respect to the middle point between the rotational axis of the gear 43 and the rotational axis of the pulley 44. The left lock restraining portion 92 can restrain locking accomplished by the left restraining portion 62. The left lock restraining portion 92 is rotatably supported by a rotating shaft 92a having a rotational axis extending in the Y direction. The left lock restraining portion 92 rotates about the rotating shaft 92a to move between a lock-enabled position at which the left lock restraining portion 92 is contacted and pressed by the lower moving portion 52 and a lock-disabled position at which the left lock restraining portion 92 is not contacted or pressed by the lower moving portion 52.

[0072] The rotating shaft 92a is positioned inside the belt 42 as viewed from the Y direction. The rotating shaft 92a is positioned proximate to the lower moving portion 52 located at its full closing associated position. As viewed from the Y direction, the rotating shaft 92a is positioned proximate in the positive Z direction to the lower moving portion 52 located at its full closing associated position, and the rotating shaft 92a is aligned in the X direction with the lower moving portion 52 located at its full closing associated position. A torsion spring (not shown) is attached to the rotating shaft 92a so as to encircle it. The torsion spring biases the left lock restraining portion 92 counterclockwise around the rotating shaft 92a as viewed in Fig. 2.

[0073] The left lock restraining portion 92 is formed of a cam including a first arm 92b, a second arm 92c, and an engaging portion 92h. The first arm 92b extends from the rotating shaft 92a in the negative Z direction, the second arm 92c extends from the rotating shaft 92a in the positive Z direction, and the engaging portion 92h projects in the positive X direction at the proximal end side of the first arm 92b. The first arm 92b includes at the distal end thereof a pressed portion 92d to be contacted by the lower moving portion 52 and thereby pressed by the lower moving portion 52. The pressed portion 92d projects in the positive X direction from the distal end of the first arm 92b extending in the negative Z direction from the rotating shaft 92a.

[0074] When the pressed portion 92d is pressed in the negative X direction, the first arm 92b rotates about the rotating shaft 92a from the lock-disabled position to the lock-enabled position. When the lower moving portion 52 moves in the negative X direction, the pressed portion 92d is contacted and pressed by the front surface 52b of the lower moving portion 52 that is facing forward. When the pressed portion 92d is no longer pressed by the lower moving portion 52 and is no longer contacted by the front surface 52b, the torsion spring around the rotating shaft 92a causes the first arm 92b to return from the lock-en-

abled position to the lock-disabled position.

[0075] The second arm 92c includes at the distal end thereof a switch pressing portion 92e that contacts with a full closing switch 102. The full closing switch 103, which is turned ON by contact with the switch pressing portion 92e, detects that the lower moving portion 52 is in the full closing associated position, and the left lock restraining portion 92 is in the lock-enabled position. In other words, the full closing switch 102 detects that the moving portion 5 is in the full closing associated position, and the lock restraining portion 9 is in the lock-enabled position.

[0076] The left lock restraining portion 92 can rotate about the rotating shaft 92a between the lock-disabled position at which the distal end of the first arm 92b extends in the negative Z direction and the lock-enabled position at which the distal end of the first arm 92b is tilted toward the negative X direction as compared to the lock-disabled position. The left lock restraining portion 92 moves from the lock-disabled position shown in Fig. 2 to the lock-enabled position by rotating clockwise about the rotating shaft 92a (see Figs. 5 to 7 described later). When the left lock restraining portion 92 is at the lock-disabled position, the engaging portion 92h contacts with the engaged portion 62e to prevent the rotational movement of the left restraining portion 62. When the left lock restraining portion 92 is at the lock-enabled position, the engaging portion 92h is separated from the engaged portion 62e and does not prevent the movement of the left restraining portion 62.

[0077] In the left lock restraining portion 92, the lower moving portion 52 pressing the pressed portion 92d causes the first arm 92b to rotate to the lock-enabled position, and thus the engaging portion 92h comes out of contact with the engaged portion 62e, and locking by the left restraining portion 62 is enabled. Simultaneously, the second arm 92c rotates integrally with the first arm 92b, and thus the switch pressing portion 92e contacts with the full closing switch 102. As a result, the full closing switch 102 detects that the lower moving portion 52 is in the full closing associated position, and outputs an indication of this. The full closing switch 102 is connected to an interlock circuit that transmits a full closing signal when all the doors 2 are fully closed. Also, the full closing switch 102 is connected so as to be constantly able to transmit a full closing signal bypassing the interlock circuit when locking by the locking portion 8 is accomplished.

[0078] In the railway vehicle door device 100 of the embodiment, the moving portion 5 is not in contact with the lock restraining portion 9 when the door 2 is open as shown in Fig. 2 or at least when the door 2 is not fully closed. Therefore, the lock restraining portion 9 remains in the lock-disabled position, and the lock restraining portion 9 keeps restraining the operation of the restraining portion 6. Accordingly, the restraining portion 6 remains in the unlocking position, and thus manual locking is restrained.

[0079] Further, as shown in Fig. 5, when the door 2 is

closed, or when the door leaves 10 have reached the fully closed position, the moving portion 5 is in contact with the lock restraining portion 9, and thus the lock restraining portion 9 is in the lock-enabled position. Thus, the lock restraining portion 9 ceases restraining the operation of the restraining portion 6. Simultaneously, the full closing switch 102 detects that the door leaves 10 have reached the fully closed position.

[0080] It is necessary that manual locking of the door 2 is enabled only when the door leaves 10 have reached the fully closed position. In this state, a key (not shown) is used to rotate the input shaft 71a for locking operation through the operation portion 7. The operating force is transmitted to the bevel gear 71b, the bevel gear 72b, and the rotating shaft 81a to rotate the first link 81 of the locking portion 8.

[0081] When the door leaves 10 are in the fully closed position and the locking operation is made through the operation portion 7, the first link 81 of the locking portion 8 rotates from the unlocking position shown in Figs. 2 to 5 via the halfway position shown in Fig. 6 to the locking position shown in Fig. 7. The stopping portion 81g abuts against the stop restraint portion 84 and stops the rotation at the locking position. The second links 82, 83, the right restraining portion 61, and the left restraining portion 62 also rotate in association with the rotation of the first link 81. In the locking position shown in Fig. 7, in contrast to the first link 81 oriented in the horizontal direction (the X direction), the second links 82, 83 are oriented such that the rotating shafts 61f, 62f at the end portions on the restraining portion 6 side are at a larger distance in the Z direction from the first link 81 than the rotating shafts 81d, 81e at the end portions on the first link 81 side.

[0082] In other words, as shown in Fig. 7, the right second link 82 in the locking position has rotated by an angle θ_2 beyond 180° about the rotating shaft 81e, relative to the first link 81. Also, the left second link 83 in the locking position has rotated by an angle θ_3 beyond 180° about the rotating shaft 81d, relative to the first link 81.

[0083] The right second link 82 is tilted upward about the rotating shaft 81e by the angle θ_2 beyond the horizontal direction, relative to the first link 81. This is because the right restraining portion 61 has rotated to the locking position in which the rotating shaft 61f of the right restraining portion 61 is positioned outside the belt 42 and the rotating shaft 61f is positioned in the positive Z direction relative to the rotating shaft 61a.

[0084] The left second link 83 is tilted downward about the rotating shaft 81d by the angle θ_3 beyond the horizontal direction, relative to the first link 81. This is because the left restraining portion 62 has rotated to the locking position in which the rotating shaft 62f of the left restraining portion 62 is positioned outside the belt 42 and the rotating shaft 62f is positioned in the negative Z direction relative to the rotating shaft 62a. In the locking position, if the door 2 tries to open, the moving portion 5 will try to move from the full closing associated position. In this case, the moving portion 5 tries to move toward

the full opening associated position.

[0085] In the right restraining portion 61, the movement restraining portion 61d is pressed in the negative X direction by the front surface 51a of the upper moving portion 51. The right restraining portion 61 then receives a force for rotating counterclockwise about the rotating shaft 61a, as viewed from the positive Y direction. This force is transmitted to the second link 82 of the locking portion 8. At this time, the above force acts along the axis of the second link 82 and is transmitted through the rotating shaft 81e to the first link 81.

[0086] As described above, in the locking position, the right second link 82 is at an angular position beyond the dead center relative to the first link 81. Therefore, the line of action of the force for opening the door 2 that is transmitted through the right second link 82 to the first link 81 runs toward the rotational direction for locking, and the rotation of the first link 81 is restrained by the stop restraint portion 84.

[0087] Likewise, in the left restraining portion 62, the movement restraining portion 62d is pressed in the positive X direction by the front surface 52a of the lower moving portion 52. The left restraining portion 62 then receives a force for rotating counterclockwise about the rotating shaft 62a, as viewed from the positive Y direction. This force is transmitted to the second link 83 of the locking portion 8. At this time, the above force acts along the axis of the second link 83 and is transmitted through the rotating shaft 81d to the first link 81.

[0088] As described above, in the locking position, the left second link 83 is at an angular position beyond the dead center relative to the first link 81. Therefore, the line of action of the force for opening the door 2 that is transmitted through the left second link 83 to the first link 81 runs toward the rotational direction for locking, and the rotation of the first link 81 is restrained by the stop restraint portion 84. The second links 82, 83 need to be rotated beyond the dead center in order to be rotated in the direction for unlocking. Accordingly, the manual locking can be maintained without need of additional components.

[0089] In addition, this locking arrangement across the dead center is maintained with the first link 81 and the second links 82, 83 arranged point-symmetric with respect to the rotating shaft 81a as viewed from the Y direction. Therefore, even when the pressing force of the moving portion 5 or the pressing force of the restraining portion 6 in the direction for unlocking is large, the locking can be readily maintained.

[0090] In the manual locking device 101 of the railway vehicle door device 100 of the embodiment, the upper moving portion 51 and the lower moving portion 52 of the moving portion 5 attached to the belt 42 of the transmission mechanism 4 that moves integrally with the door leaves 10 are locked simultaneously by the right restraining portion 61 and the left restraining portion 62 of the restraining portion 6, respectively, to prevent the door leaves 10 from opening and closing. This makes it pos-

sible to accomplish locking with a smaller restraining force than in the case where the door leaves are locked directly.

[0091] In the manual locking device 101 of the railway vehicle door device 100 of the embodiment, the lock restraining portion 9 abuts against the restraining portion 6 to prevent manual locking operation. The lock restraining portion 9 is not separated from the restraining portion 6 until the manual locking device 101 is in the fully closed state in which the door leaves 10 are in the fully closed position. Therefore, when the door leaves 10 are not in the fully closed position, the manual locking can be prevented. In addition, the door leaves 10 of the double door can be locked simultaneously by the key operation on the operation portion 7, and the locking can be maintained.

[0092] This makes it possible to secure the manual locking operation of the door leaves in the fully closed state in the event that the door cannot be driven for closing, for example, in the case where the vehicle needs to run in an emergency such as the failure of the door 2. In particular, even when the door leaves 10 are damaged, the locking can be secured and thus the security can be improved, as compared to the mechanism in which the door leaves 10 are locked directly.

[0093] Further, since the locking is prevented when the door leaves 10 are not in the fully closed position, it is possible to prevent malfunctions and improve the security. The locking can be secured with smaller components and with a smaller restraining force, as compared to the mechanism in which the door leaves 10 are locked directly.

[0094] In the above configuration, the lock restraining portion 9 contacted by the moving portion 5 moves from the lock restraining position to the lock permitting position, allowing the locking operation of the restraining portion 6 and the locking portion 8. Therefore, the manual locking is allowed only at the fully closed position, without having to install a lock restraining portion (blank panel) over the entire region in the opening-closing direction.

[0095] The manual locking device of the present invention may include a lock restraining portion that allows locking by the locking portion only when the door leaves are at the fully closed position. Since locking is not allowed when the door leaves are not in the fully closed position, the security can be improved.

[0096] In the manual locking device of the present invention, the restraining portion may include an engaged portion. Further, the lock restraining portion may include an engaging portion and a pressed portion. The engaging portion is configured to contact with the engaged portion to prevent movement of the restraining portion, and the pressed portion is pressed by the moving portion in the closing direction when the door leaves reach the fully closed position, such that the engaging portion comes out of contact with the engaged portion. This makes it possible to switch between unlocking and locking according only to whether or not the moving portion is pressing

the pressed portion, resulting in a reduced number of components and an improved operation reliability.

[0097] In the manual locking device of the present invention, the lock restraining portion is formed of a cam including the pressed portion and the engaging portion. The cam rotates when the pressed portion is pressed, such that the engaging portion comes out of contact with the engaged portion. This makes it possible to secure the switching between the state in which the engaging portion is in contact with the engaged portion and the state in which the engaging portion is out of contact with the engaged portion.

[0098] The manual locking device of the present invention may include a full closing switch for detecting that the door leaves have reached the fully closed position. The cam may further include a switch pressing portion that rotates when the pressed portion is pressed, to press the full closing switch. This makes it possible to detect that the door leaves are in the fully closed state without having to detect the position of the door leaves directly.

[0099] The manual locking device of the present invention may be installed on a plurality of doors for opening and closing a plurality of doorways of a railway vehicle. The full closing switch may be connected to an interlock circuit that transmits a full closing signal when all the doors 2 are fully closed. Also, the full closing switch may be connected so as to be constantly able to transmit a full closing signal bypassing the interlock circuit when locking by the locking portion is accomplished by manual operation of the operation portion. This makes it possible to detect the locking in an emergency in which the locking is accomplished by manual operation. In addition, the full closing switch can be used for detecting the fully closed state in normal opening and closing operation of the door.

[0100] In the manual locking device of the present invention, the locking device may include a first link and a second link. The first link may rotate by an operating force of the operation portion, and the second link may be connected at one end thereof to an end portion of the first link and is connected at the other end thereof to the restraining portion. The first link may rotate from the unlocking position toward the locking position, such that the first link and the second link enter the locking position beyond the dead center. Since the locking is accomplished at the position at which the angle between the first link and the second link is beyond the dead center, there is no need of providing a component for fixing the first link and the second link at the locking position, and it is possible to secure the locking.

[0101] In the manual locking device of the present invention, the second link in the locking position may extend along the moving direction of the moving portion. With this arrangement in the locking position, when the moving portion tries unlocking, it presses the second link in the direction in which the second link extends. Thus, the locking can be readily maintained even if a large force is imparted.

[0102] In the manual locking device of the present in-

vention, when the door leaves are in the fully closed position, the restraining portion connected with the second link may be in contact with a portion of the moving portion facing toward the full opening associated position. With this arrangement, the restraining portion restrains the moving portion by directly contacting with a portion of the moving portion facing forward in the moving direction from the fully closed position at the end of the range of movement of the moving portion, and thus it is possible to restrain the movement effectively.

[0103] In the manual locking device of the present invention, the moving portion may include a plurality of moving portions each connected to associated one of the door leaves of a double sliding door, and the locking portion may lock the plurality of moving portions simultaneously by an operating force of the operation portion. This makes it possible to simultaneously lock the door leaves of the double door, preventing that one of the door leaves is not locked.

[0104] In the manual locking device of the present invention, the operation portion may be disposed in the middle of the door leaves of a double door in the moving direction of the moving portion. This makes it possible to simultaneously lock the door leaves of the double door, improving the ease of operation.

[0105] In the manual locking device of the present invention, the transmission mechanism may include a coupled moving portion that moves integrally with the moving portion. This makes it possible to secure the locking when the transmission mechanism for transmitting the driving force is of the wound belt type, the rack-and-pinion type, the screw type, the linear motor type, or the electric cylinder type, whether the moving portion moves integrally with the above mechanism or with the door hanger.

[0106] In the manual locking device of the present invention, the operation portion may include an input portion that receives operational input applied vertically upward. This improves the ease of locking operation.

[0107] In the manual locking device of the present invention, the operation portion may include a conversion portion for converting an operating force input vertically upward through the input portion into a force in a lateral direction intersecting the moving direction of the moving portion. This makes it possible to build in the operation portion to the position above the door of the doorway, which requires smaller space. Also, since the key hole in the operation portion is invisible from the middle of the vehicle in the vehicle width direction, the design can be improved.

[0108] The features of the above embodiment of the manual locking device of the present invention can be selected and combined together as desired for application. Further, each of the features of the above embodiment can be modified as desired. For example, the OoSL mechanism may be configured for a single leaf door. It is also possible that the moving portion 5 (the upper moving portion 51, the lower moving portion 52) is not connected to the door hanger 11. In this case, the moving

portion 5 (the upper moving portion 51, the lower moving portion 52) may be disposed on the belt 42 at a different position than it was connected to the door hanger 11. It is also possible that the locking portion 8 is not a link mechanism. In this case, the locking portion 8 may be configured such that the second arm 61c of the right restraining portion 61 and the second arm 62c of the left restraining portion 62 are simultaneously rotated to approach the rotating shaft 81a and enter the locking position. Further, in this case, the locking portion 8 may also be configured to allow rotation for return that is in the opposite direction than for locking.

LIST OF REFERENCE NUMBERS

[0109]

100	railway vehicle door device
101	manual locking device
200	doorway
2	door
3	drive source
4	transmission mechanism
5	moving portion
6	restraining portion
7	operation portion
8	locking portion
9	lock restraining portion
10	door leaf
11	door hanger (coupled moving portion)
42	belt
61e, 62e	engaged portion
71	input portion
81g	switch pressing portion
82a, 83a	curved portion
84	stop restraint portion
91d	pressed portion
91h, 92h	engaging portion
92e	switch pressing portion

Claims

1. A manual locking device (101), comprising:

a transmission mechanism (4) for transmitting a driving force from a drive source (3) to a door leaf (10) to cause the door leaf (10) to move between a fully open position and a fully closed position;

at least one moving portion (5) provided on the transmission mechanism (4) and configured to move in synchronization with opening and closing of the door leaf (10);

a restraining portion (6) configured to contact with the at least one moving portion (5) to restrain movement of the at least one moving portion (5) in an opening-closing direction of the

- door leaf (10);
 an operation portion (7) configured to be manually operated to produce an operating force; and
 a locking portion (8) configured to accomplish locking when the door leaf (10) is at the fully closed position, by moving the restraining portion (6) by the operating force of the operation portion (7) from an unlocking position in which the movement of the at least one moving portion (5) is not restrained to a locking position in which the movement of the at least one moving portion (5) is restrained.
2. The manual locking device (101) of claim 1, comprising a lock restraining portion (9) configured to allow locking by the locking portion (8) only when the door leaf (10) is at the fully closed position.
3. The manual locking device (101) of claim 2, wherein the restraining portion (6) includes an engaged portion (61e, 62e); and wherein the lock restraining portion (9) includes:
 an engaging portion (91h, 92h) configured to contact with the engaged portion (61e, 62e) to prevent movement of the restraining portion (6); and
 a pressed portion (91d, 92d) configured to be pressed by the at least one moving portion (5) in a closing direction when the door leaf (10) reaches the fully closed position, such that the engaging portion (91h, 92h) comes out of contact with the engaged portion (61e, 62e).
4. The manual locking device (101) of claim 3, wherein the lock restraining portion (9) is formed of a cam including the pressed portion (91d, 92d) and the engaging portion (91h, 92h); and wherein the cam rotates when the pressed portion (91d, 92d) is pressed, such that the engaging portion (91h, 92h) comes out of contact with the engaged portion (61e).
5. The manual locking device (101) of claim 4, comprising:
 a full closing switch (102) for detecting that the door leaf (10) has reached the fully closed position, wherein the cam further includes a switch pressing portion (92e) configured to rotate when the pressed portion (92d) is pressed, to press the full closing switch (102).
6. The manual locking device (101) of claim 5, wherein the manual locking device (101) is installed on each of a plurality of doors (2) for opening and closing a plurality of doorways (200) of a railway vehicle, and wherein the full closing switch (102) is connected to an interlock circuit that transmits a full closing signal when all of the plurality of doors (2) are fully closed, and the full closing switch (102) is connected so as to be constantly able to transmit the full closing signal bypassing the interlock circuit when locking by the locking portion (8) is accomplished by manual operation of the operation portion (7).
7. The manual locking device (101) of any one of claims 1 to 6, wherein the locking portion (8) includes:
 a first link (81) configured to rotate by the operating force of the operation portion (7); and
 a second link (82, 83) connected at one end thereof to an end portion of the first link (81) and connected at the other end thereof to the restraining portion (6), and wherein the first link (81) rotates from the unlocking position toward the locking position, such that the first link (81) and the second link (82, 83) enter the locking position beyond a dead center.
8. The manual locking device (101) of claim 7, wherein in the locking position, the second link (82, 83) extends along a moving direction of the at least one moving portion (5).
9. The manual locking device (101) of claim 7 or 8, wherein when the door leaf (10) is at the fully closed position, the restraining portion (6) connected to the second link (82, 83) is in contact with a portion of the at least one moving portion (5) facing toward the fully open position.
10. The manual locking device (101) of any one of claims 1 to 9, wherein the at least one moving portion (5) comprises a plurality of moving portions (51, 52) each connected to associated one of the door leaves (10) of a double sliding door, and the locking portion (8) locks the plurality of moving portions (51, 52) simultaneously by the operating force of the operation portion (7).
11. The manual locking device (101) of claim 10, wherein the operation portion (7) is disposed in a middle of

the door leaves (10) of the double door in a moving direction of the at least one moving portion (5).

12. The manual locking device (101) of any one of claims 1 to 11, wherein the transmission mechanism (4) includes a coupled moving portion (11) configured to move integrally with the at least one moving portion (5). 5
13. The manual locking device (101) of any one of claims 1 to 12, wherein the operation portion (7) includes an input portion (71) configured to receive operational input applied vertically upward. 10
14. The manual locking device (101) of claim 13, wherein the operation portion (7) includes a conversion portion (72) for converting an operating force input vertically upward through the input portion (71) into a force in a lateral direction intersecting a moving direction of the at least one moving portion (5). 15
20
15. A railway vehicle door device (100) comprising:
 - a door leaf (10) for opening and closing a doorway (200) of a railway vehicle; 25
 - a drive source (3) for driving the door leaf (10);
 - a transmission mechanism (4) for transmitting a driving force from the drive source (3) to the door leaf (10) to cause the door leaf (10) to move between a fully open position and a fully closed position; 30
 - a moving portion (5) provided on the transmission mechanism (4) and configured to move in synchronization with opening and closing of the door leaf (10); 35
 - a restraining portion (6) configured to restrain movement of the moving portion (5) in an opening-closing direction of the door leaf (10);
 - an operation portion (7) configured to be manually operated to produce an operating force; 40
 - and
 - a locking portion (8) configured to accomplish locking when the door leaf (10) is at the fully closed position, by moving the restraining portion (6) by the operating force of the operation portion (7) from an unlocking position in which the movement of the moving portion (5) is not restrained to a locking position in which the movement of the moving portion (5) is restrained. 45
50

55

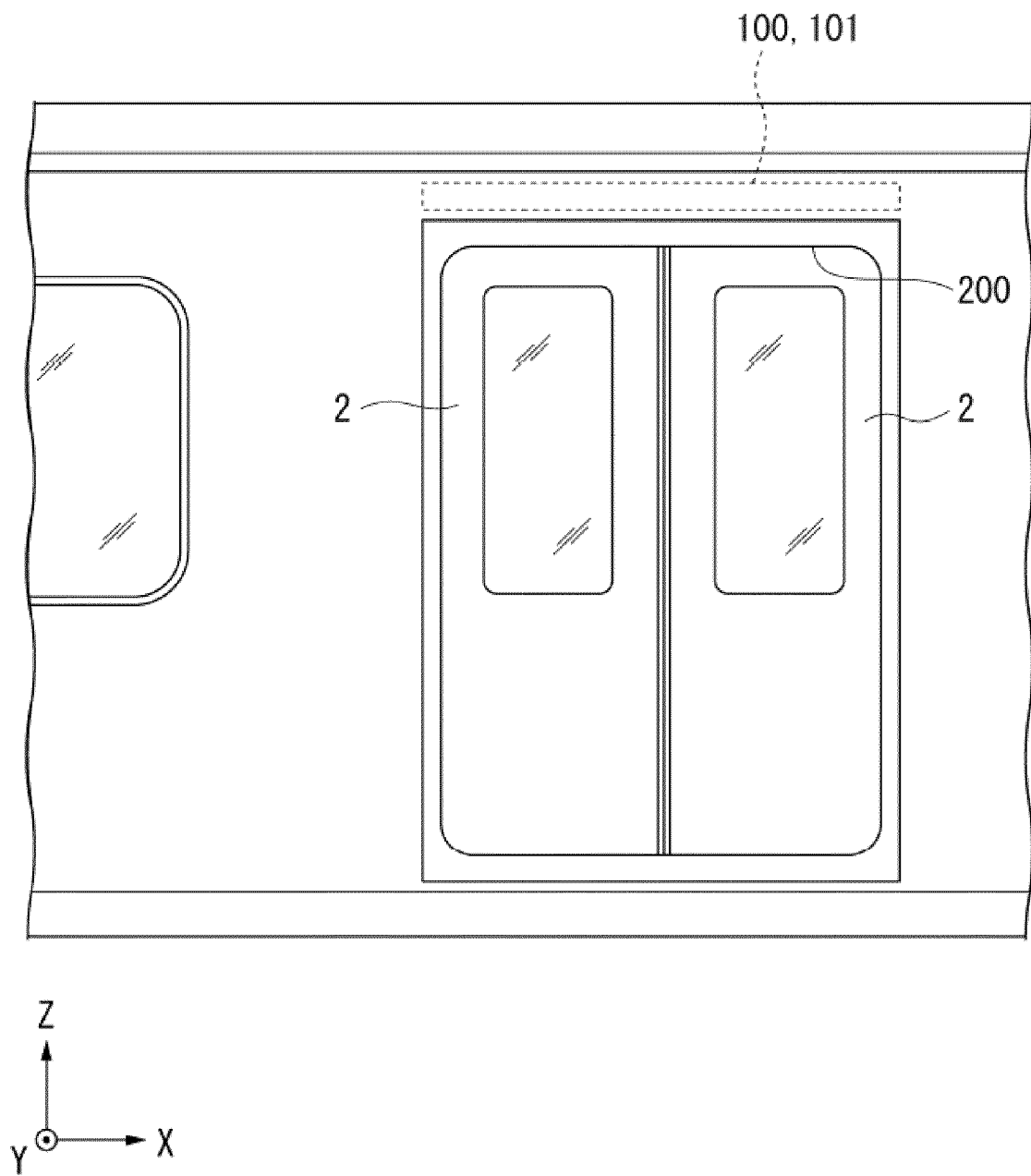


Fig. 1

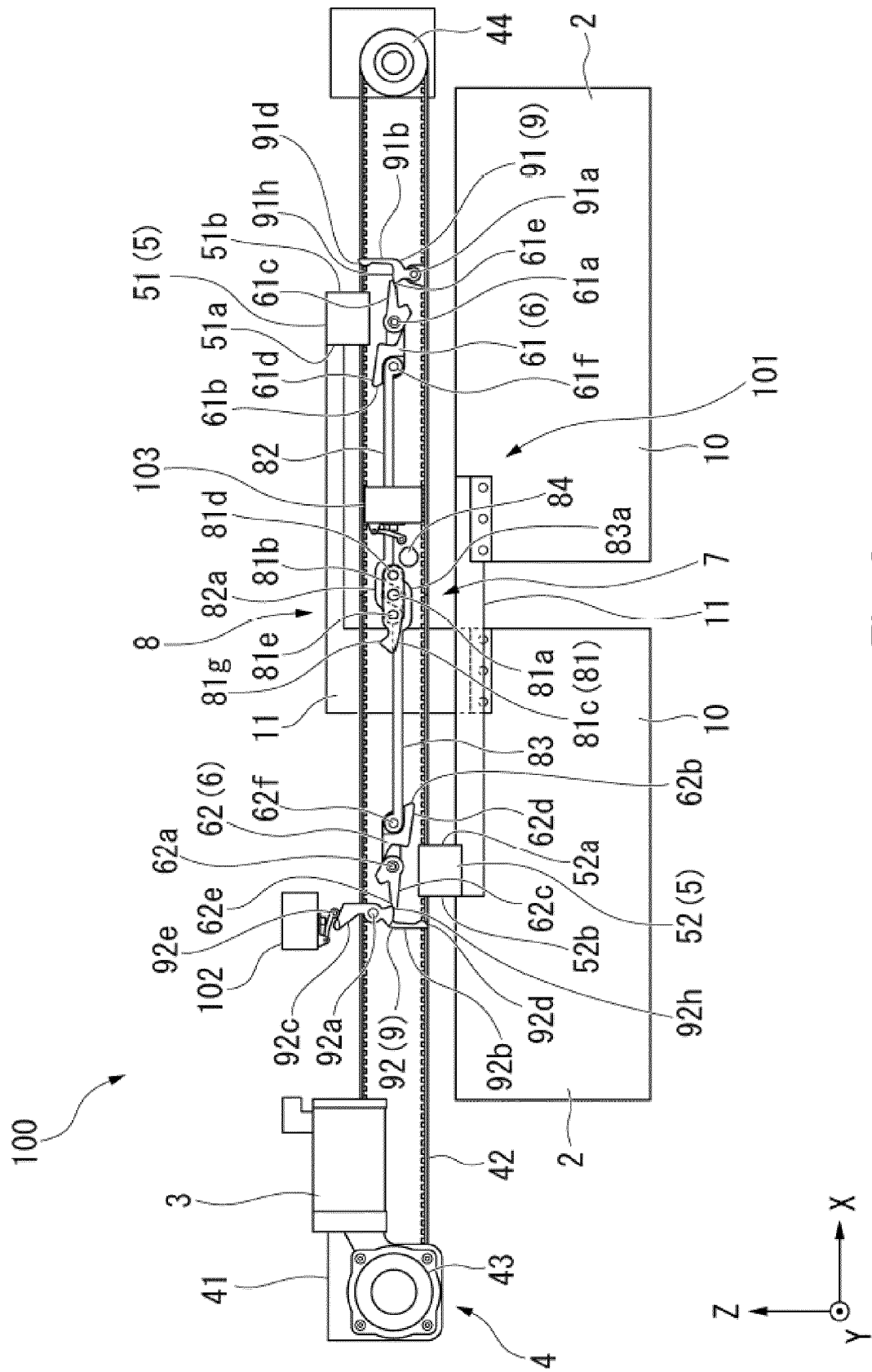


Fig. 2

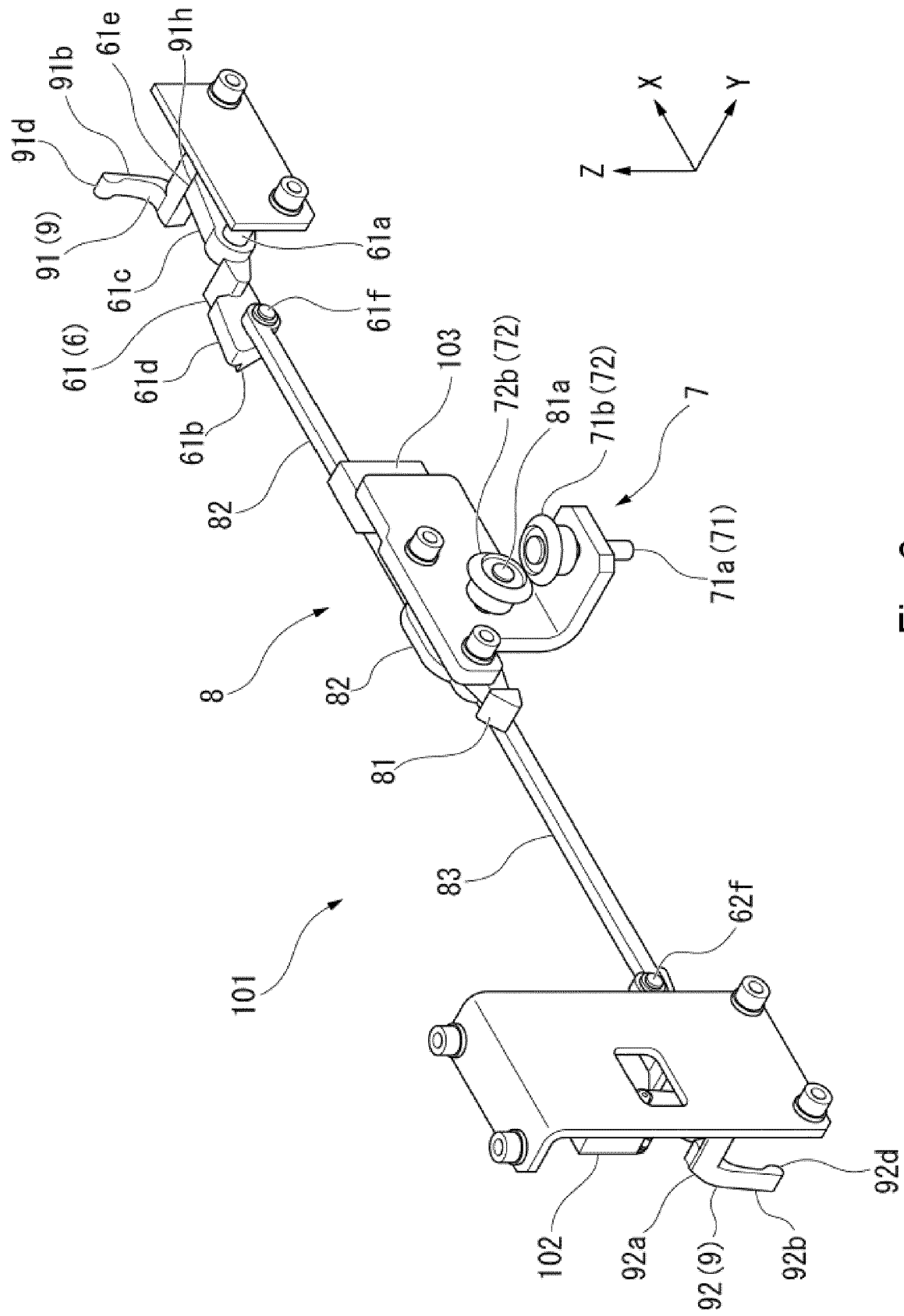


Fig. 3

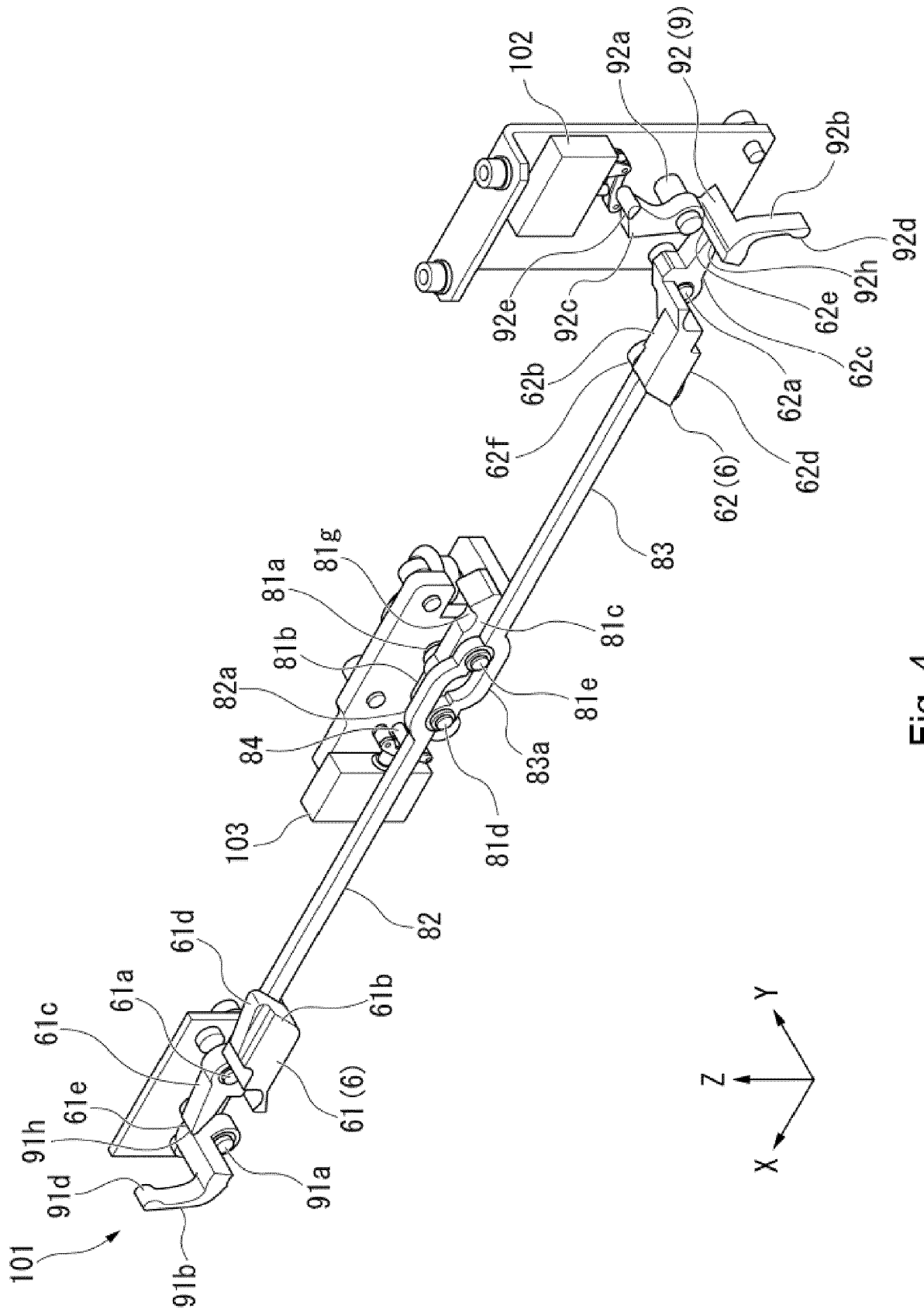
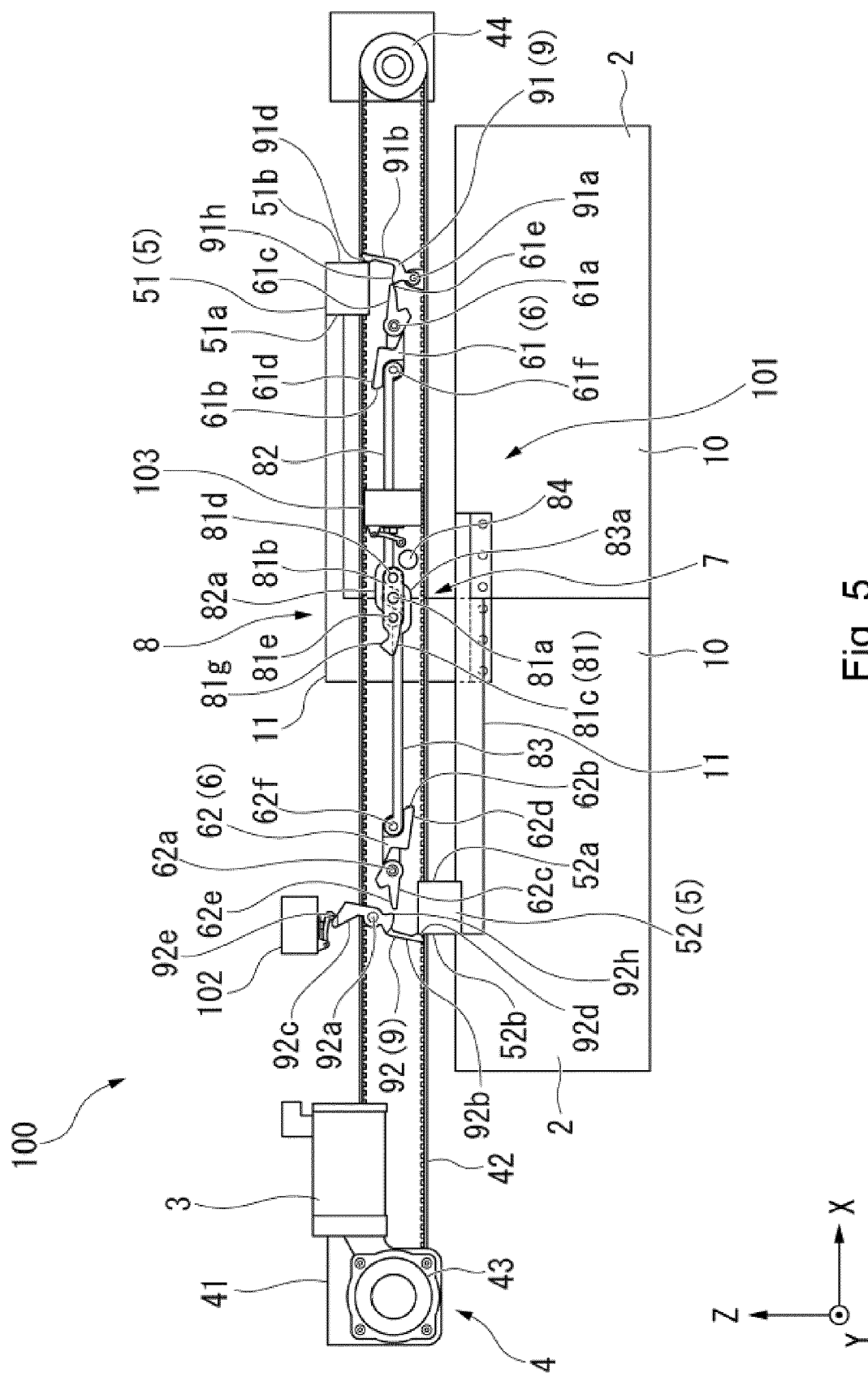


Fig. 4



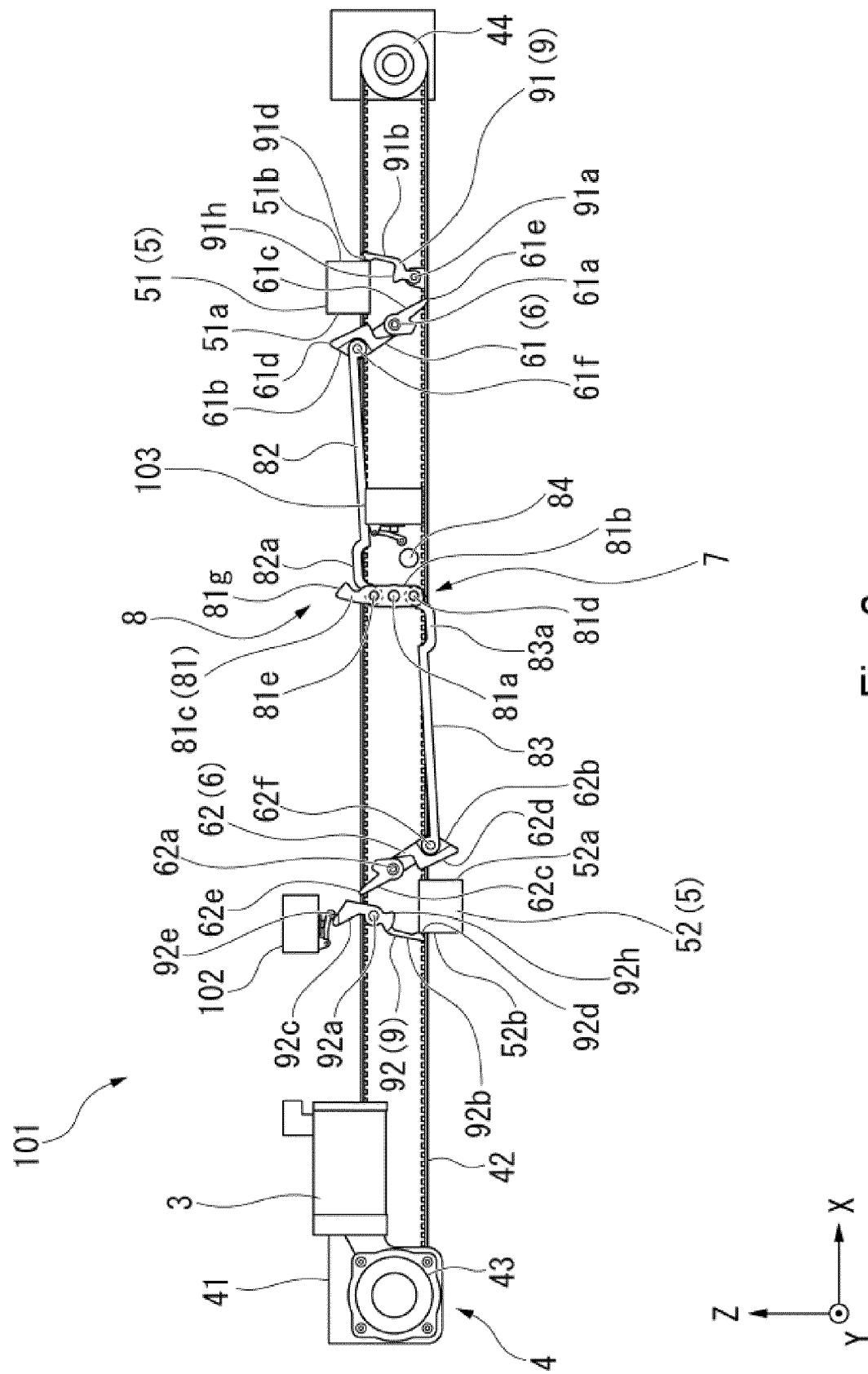
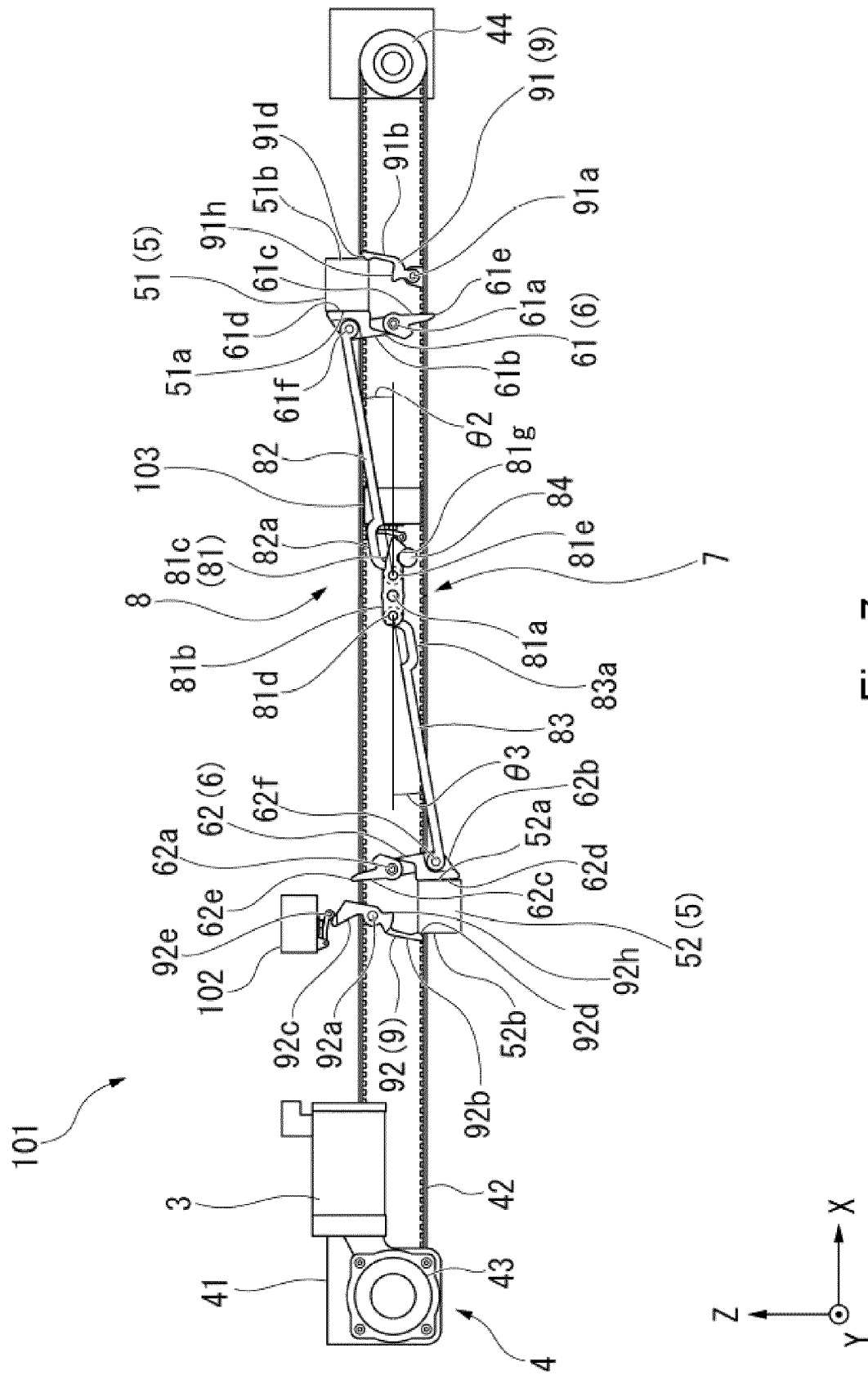


Fig. 6





EUROPEAN SEARCH REPORT

Application Number

EP 21 20 1455

5

10

15

20

25

30

35

40

45

50

55

1

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	GB 2 046 828 A (WESTINGHOUSE BRAKE & SIGNAL) 19 November 1980 (1980-11-19)	1, 2, 10-15	INV. E05F11/00
A	* page 1, line 1 - page 3, line 45; figures 1-3 *	3-9	E05F11/08 E05F11/10 E05F15/632 E05F15/643
A	US 2014/366449 A1 (MASUDA TAKESHI [JP] ET AL) 18 December 2014 (2014-12-18) * paragraphs [0028] - [0110]; figures 1-6 *	1-15	
A	US 5 755 060 A (ZWEILI MARC [CA]) 26 May 1998 (1998-05-26) * column 1, line 59 - column 5, line 31; figures 1-7 *	1-15	
A	EP 2 079 894 B1 (NABTESCO CORP [JP]) 15 August 2012 (2012-08-15) * paragraphs [0042] - [0112]; figures 1-11 *	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			E05F
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 14 March 2022	Examiner Rémondot, Xavier
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			

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 21 20 1455

5

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

14-03-2022

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
GB 2046828 A	19-11-1980	NONE	
US 2014366449 A1	18-12-2014	JP 6180806 B2	16-08-2017
		JP 2015001054 A	05-01-2015
		US 2014366449 A1	18-12-2014
US 5755060 A	26-05-1998	NONE	
EP 2079894 B1	15-08-2012	CN 102864990 A	09-01-2013
		DK 2079894 T3	03-12-2012
		EP 2079894 A1	22-07-2009
		ES 2393008 T3	17-12-2012
		HK 1177777 A1	30-08-2013
		KR 20090069190 A	29-06-2009
		PL 2079894 T3	31-01-2013
		TW 200833931 A	16-08-2008
		WO 2008056620 A1	15-05-2008

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2004 A [0004]
- JP 324159 A [0004]