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(54) **OPENING AND CLOSING APPARATUS WITH LOCK**

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Description

Technical Field

[0001] The present invention relates to an opening and closing apparatus with lock, enabling to perform opening and closing movements and locking in a fully closed position of slide-apart type sliding doors, mounted on a housing in a reciprocatingly movable manner.

Background Art

[0002] As a conventional example of an opening and closing apparatus with lock, enabling to perform opening and closing movements and locking in a fully closed position of sliding doors, mounted on a housing in a reciprocatingly movable manner, there is a sliding door opening and closing apparatus described as a second embodiment in Patent Document 1 (Japanese Published Unexamined Patent Application No. 2000-142392). With the arrangement of Patent Document 1, two sliding doors are arranged as slide-apart type opening and closing doors by being coupled via a rack and pinion mechanism, and rail moving members that suspend the sliding doors and an armature of a linear motor for opening/closing drive of the sliding doors are coupled via a cushioning member that includes a cushioning spring. The sliding doors are moved in closing directions by driving the armature of the linear motor, and even when the sliding doors reach a fully closed position, the armature is driven further so as to stretch the spring of the cushioning member. A metal pressing member, disposed at a front end of the armature, then pressingly moves a sliding cam device to slide against a return spring, and since a cam follower that descends in accompaniment also makes a latch lock descend, the latch lock becomes latched in a hole provided in a rack of the rack and pinion mechanism, thereby realizing locking of the sliding doors in the fully closed position.

[0003] With this arrangement, while a driving force of the linear motor is normally allocated to driving the opening and closing of the sliding doors via the cushioning spring of the cushioning member, when the sliding doors reach the fully closed position, the driving force of the linear motor is allocated to the sliding cam device and locking by the latch lock is performed. The driving force of a single linear motor (actuator) is thus used for both the opening/closing drive and the locking operation, providing the advantage that the arrangement can be simplified.

Disclosure of the Invention

[0004] In the arrangement of Patent Document 1, racks are disposed above and below a pinion gear and the pair of left and right sliding doors are coupled respectively to the racks to open and close the slide-apart type sliding doors, and by constraining a rack at one side, the sliding

door at the other side is constrained via the pinion gear. There is thus the problem that when the pinion gear or a rack breaks, the lock of the other door becomes disengaged. Although the pinion gear and the rack may be made robust, this leads to enlargement of installation space, cost increase, and other problems.

[0005] In the arrangement of Patent Document 1, the cushioning member, which is a mechanism that switchingly allocates the driving force of the linear motor to the opening/closing drive of the sliding doors and the pressing movement of the sliding cam device, is arranged to move slidably along with the sliding doors. The overall arrangement is thus made complex, a space for the movement stroke of the cushioning member needs to be secured, and a simple and compact arrangement cannot be realized for the sliding door opening and closing lock apparatus.

[0006] Also because the sliding cam device is pressingly moved so as to stretch the cushioning spring of the cushioning member in the fully closed position of the sliding doors, when, for example, a load (a resistance against the closure of the sliding doors) is applied by wind pressure, etc., to the doors immediately before the fully closed position is reached, the cushioning spring becomes stretched before the sliding doors reach the fully closed position. Consequently, the metal pressing member at the front end of the armature pressingly moves the sliding cam device at a stage that is too early, cause the latch lock to descend without the positions of the latch lock and the hole of the rack being matched, and may thereby cause a breakage of the latch lock or the hole or constraining of the sliding doors before the fully closed position is reached (in the open state).

[0007] Also, when, in the closed, locked state of the sliding doors, the linear motor loses its driving force due to malfunction of the linear motor, power supply failure due to power outage, or other circumstance, because the armature and the metal pressing member are then pulled in the direction of releasing the pressing of the sliding cam device and the sliding cam device is also forced back by the return spring, the latch lock rises along with the cam follower and the lock becomes released. This means that a closed lock becomes released unintendedly upon malfunction or power supply failure. In a case where the sliding doors are used as side doors of a railway vehicle, this means that the doors become open before the vehicle stops and is thus unfavorable in terms of safety as well.

[0008] In a case where the cushioning spring is made strong to prevent the latch lock from descending too early even when some load acts on the sliding doors, because the force, which acts in the direction of releasing the lock when the driving force of the linear motor is lost due to power supply failure, etc., also becomes strong, the probability of unintended unlocking also increases. That is, the two issues described above are in a mutually conflicting relationship and an arrangement that can resolve both issues simultaneously at a satisfactory level has yet

to be proposed.

[0009] The present invention has been made in view of the above circumstances, and an object thereof is to provide an opening and closing apparatus with lock with a simple and compact arrangement that enables secure locking of slide-apart type sliding doors and enables opening/closing and closed locking of the sliding doors to be performed with a single actuator.

[0010] The present invention relates to an opening and closing apparatus with lock, enabling to perform opening and closing movements and locking in a fully closed position of slide-apart type sliding doors, mounted on a housing in a reciprocatingly movable manner. To achieve the above object, an opening and closing apparatus with lock according to the present invention has the aspects described below. That is, the opening and closing apparatus with lock according to the present invention has any of the following aspects in a solitary form or in a suitably combined form.

[0011] To achieve the above object, a first aspect of an opening and closing apparatus with lock according to the present invention is that the opening and closing apparatus with lock includes: a rack and pinion mechanism, having a pair of racks, respectively mounted on a pair of slide-apart type sliding doors that are movable reciprocatingly with respect to a housing, and a pinion engaged with the pair of racks; an actuator, functioning as an opening/closing drive source of the sliding doors; a locking mechanism mounted on the housing and enabling to lock the pair of sliding doors in a fully closed position by constraining respective movements of locking members that are respectively fixed to the respective sliding doors of the pair of sliding doors; a switching mechanism for switching the locking mechanism between a locked state and an unlocked state; and a planetary gear mechanism, having an input portion, into which a driving force of the actuator is input, a first output portion, enabling to output the driving force to the pinion, and a second output portion, enabling to output the driving force to the switching mechanism; and when the sliding doors are in the fully closed position, the driving force is output from the second output portion to the switching mechanism.

[0012] With the above arrangement, because the movements of the locking members, which are respectively fixed to the respective sliding doors of the pair of sliding doors, are respectively constrained by the locking mechanism, each of the pair of sliding doors can be locked independently. Thus even when the rack and pinion mechanism malfunctions, the state, in which the movements of both sliding doors are locked, can be maintained. Oppositely, when the rack and pinion mechanism is functioning normally, even if the lock of one of the sliding doors becomes released due to malfunction, etc., because the one sliding door is coupled to the other sliding door via the rack and pinion mechanism, as long as the lock of the other sliding door is effective, the one sliding door can be maintained in the locked state. The slide-apart type sliding doors can thus be locked more secure-

ly.

[0013] Also with this arrangement, the power of the actuator is allocated via the planetary gear mechanism to drive the pinion of the rack and pinion mechanism on one hand and drive the switching mechanism on the other. Because the arrangement for power transmission (allocation) from the actuator is thus housed in a compact space, the structure can be simplified and a compact opening and closing apparatus with lock can be provided.

[0014] Also, because the driving force from the actuator is allocated using not a cushioning spring as in Patent Document 1 but a planetary gear mechanism, even if the driving force is lost due to actuator malfunction, etc., in the state where the sliding doors are locked at the closed position, a force in a direction of releasing the lock is not applied to the switching mechanism, etc., and unintended unlocking is prevented.

[0015] A second aspect of the opening and closing apparatus with lock according to the present invention is that the switching mechanism has a switching member enabling to switch the locking mechanism between the locked state and the unlocked state by moving according to the drive of the second output portion, and the locking mechanism is arranged so that the movement of the switching member is prevented when the sliding doors are in positions other than the fully closed position and the movement of the switching member is allowed when the sliding doors are in the fully closed position.

[0016] With this arrangement, because the movement of the switching member is prevented when the sliding doors are in positions other than the fully closed position, the locking operation is performed when the sliding doors have reached the fully closed position securely. That is, the locking operation is prevented from being performed at a timing that is too early in the driving of the sliding doors in closing directions, and breakage of the locking mechanism and constraining of the sliding doors before the reaching of the fully closed position are thereby prevented.

[0017] A third aspect of the opening and closing apparatus with lock according to the present invention is that the locking mechanism includes a link mechanism, deformable to a rectilinear state and to an inflected state according to the movement of the switching member, and a link retaining mechanism, retaining the link mechanism in the inflected state when the sliding doors are in positions other than the fully closed position, and when the sliding doors are in the fully closed position, the link mechanism deforms to the rectilinear state and thereby constrains the movement of the locking members fixed to the sliding doors.

[0018] With this arrangement, the movements of the sliding doors can be locked in the fully closed position by putting the link mechanism in the rectilinear state, and because in positions other than the fully closed position, the link mechanism is held in the inflected state by the link retaining mechanism, the locking operation is performed after the sliding doors have reached the fully

closed position. The locking mechanism can thus be formed compactly because it is driven using the link mechanism and stable drive can be realized because the locking mechanism is driven mechanically.

[0019] A fourth aspect of the opening and closing apparatus with lock according to the present invention is that each locking member is constituted of a locking pin, fixed to the sliding door so as to extend in a vertical direction, the link retaining mechanism is constituted of a pair of engaging members, rotatably installed near both ends of the link mechanism and each having a first engaging portion, engaging with the locking pin in the fully closed position, and a second engaging portion, engaging with an end of the link mechanism in the rectilinear state in the fully closed position, and the engaging members prevent the movement of the switching member by preventing the transition of the link mechanism to the rectilinear state when the sliding doors are in positions other than the fully closed position, and allow the movement of the switching member by being urged by the locking pins to rotate to positions enabling engagement of the ends of the link mechanism with the second engaging portions during movement of the sliding doors in the closing directions.

[0020] With this arrangement, in the fully closed position, the engaging members engage with the locking pins. Then by extension of the link mechanism to the rectilinear state, the engaging members engage with the ends of the link mechanism and become constrained in rotational movement. The locking pins are thereby constrained in movement in the state of being engaged with the engaging members. Thus by the engaging members, the transition of the link mechanism to the rectilinear state in positions other than the fully closed position can be prevented and the movement of the locking pins can be constrained in the fully closed position. The number of parts necessary for forming the locking mechanism can thus be made low and a more compact locking mechanism can be arranged.

[0021] A fifth aspect of the opening and closing apparatus with lock according to the present invention is that the switching member is constituted of a locking slider enabling to move slidably in one direction with respect to the locking mechanism and having a slit portion of a curved shape at a bottom surface, the link mechanism operates within a plane parallel to the bottom surface of the locking slider and has a coupling pin, disposed at one coupling point, inserted in the slit portion, and the link mechanism is deformed to the rectilinear state and the inflected state by the coupling pin moving along the slit portion.

[0022] With this arrangement, the link mechanism can be deformed to the rectilinear state and the inflected state by movement of the locking slider in one direction without interposing another member between the locking slider and the link mechanism. The installation space of the locking mechanism can thus be made small.

[0023] A sixth aspect of the opening and closing ap-

paratus with lock according to the present invention is that the link mechanism is deformable to the rectilinear state and the inflected state within a horizontal plane.

[0024] With this arrangement, when the sliding doors reach the fully closed position, the sliding doors can be locked by the switching mechanism being driven and the link mechanism being deformed to the rectilinear state within the horizontal plane. Because the locking mechanism thus puts the sliding doors in the locked state using the link mechanism that operates within the horizontal plane, the installation space of the locking mechanism can be made small in the height direction.

[0025] A seventh aspect of the opening and closing apparatus with lock according to the present invention is that the link mechanism has a link portion, rotatably fixed to the housing, and a movement of an end of the link mechanism is restricted by a rectilinear guide groove provided in the housing.

[0026] With this arrangement, by rotatably fixing the link portion that is a part of the link mechanism to the housing, the position of the link mechanism with respect to the housing can be fixed without obstructing the operation of the link mechanism. The movement of the end of the link mechanism can be restricted to a straight line by the guide groove of the housing, and a link mechanism that can be deformed to the rectilinear state and the inflected state can thus be formed by a simple arrangement.

[0027] An eighth aspect of the opening and closing apparatus with lock according to the present invention is that each locking member is constituted of a locking pin, fixed to the sliding door so as to extend in a vertical direction, and the locking mechanism further includes an engaging member, rotatably installed within a horizontal plane near an end of the link mechanism and having a first engaging portion, engaging with a locking pin in the fully closed position, and a second engaging portion, engaging with the end of the link mechanism in the rectilinear state in the fully closed position.

[0028] With this arrangement, by the locking pin extending in the vertical direction from the sliding door, the locking mechanism that operates within the horizontal plane can be made readily engageable with the locking pin. Because in the fully closed position, the movement of the locking pin can be constrained by constraining the rotation of the engaging member by the end of the link mechanism in the rectilinear state, the direction in which the link mechanism extends to the rectilinear state can be set to any direction that enables the constraining of the rotation of the engaging member. Thus for example, a design can be made readily to prevent a force, which deforms the link mechanism from the rectilinear state to the inflected state in the locked state, from acting from the engaging member, and the locked state can be retained more reliably.

[0029] A ninth aspect of the opening and closing apparatus with lock according to the present invention is that the switching mechanism has a switching member,

movable within a horizontal plane according to the driving of the second output portion, and the link mechanism can be deformed to the rectilinear state and the inflected state by movement of a coupling pin, disposed at a coupling point of the link mechanism, in accordance with the movement of the switching member.

[0030] With this arrangement, because the switching member is movable within a horizontal plane, the installation space can be made small in the height direction. Also, the switching member can switch the state of the link mechanism by use of the coupling pin that constitutes the link mechanism, and a simple arrangement with a low number of parts can thus be realized.

[0031] A tenth aspect of the opening and closing apparatus with lock according to the present invention is that the switching member is a locking slider enabling to move slidably in one direction within a horizontal plane according to the drive of the second output portion and having a slit portion of a curved shape at a bottom surface, a coupling pin, disposed at one coupling point of the link mechanism, is inserted in the slit portion, and the link mechanism can be deformed to the rectilinear state and the inflected state by the coupling pin, disposed at the coupling point of the link mechanism, moving along the slit portion according to the movement of the locking slider.

[0032] With this arrangement, the movement of the link mechanism can be restricted by using the slit portion at the bottom surface of the locking slider enabling to move slidably within the horizontal plane. Because the slit portion has a curved shape, an arrangement that guides the coupling pin in a direction that differs from the movement direction of the locking slider can be realized in a simple manner.

[0033] An eleventh aspect of the opening and closing apparatus with lock according to the present invention is that the opening and closing apparatus with lock further includes: an elastic member; and a collision detection unit, disposed in the housing and stopping the drive of the actuator when a deformation amount of the elastic member reaches a predetermined deformation amount during a closing operation of the sliding doors; and the second output portion is enabled to output the driving force of the actuator to the elastic member.

[0034] With this arrangement, if during the operation of closing the sliding doors (during movement of the sliding doors from a fully open position to the fully closed position), a running resistance of the sliding doors is smaller than a predetermined running resistance, because the rotation of the second output portion is suppressed by an elastic force of the elastic member, the driving force of the actuator is transmitted from the first output unit to the pinion and the operation of closing the sliding doors is performed. While the sliding door closing operation, a passenger becomes caught or a sliding door collides with a passenger, a force no less than the normal running resistance is applied to a sliding door, and if the predetermined running resistance is exceeded, the sec-

ond output portion rotates against the elastic force of the elastic member and the elastic member undergoes elastic deformation. When this elastic deformation amount reaches a predetermined amount, the drive of the actuator is stopped by the collision detection unit. Because the collision detection unit is disposed in the housing as is the actuator, door catching and collision during the sliding door closing operation can be detected without wiring becoming complicated. With this arrangement, collision detection is enabled regardless of whether the sliding doors are accelerating or decelerating and collision detection can be performed across the entire movement range of the sliding doors.

[0035] A twelfth aspect of the opening and closing apparatus with lock according to the present invention is that the elastic member is disposed between the second output portion and the switching member.

[0036] With this arrangement, the output of the second output portion can be used to drive the switching member to switch the locking mechanism and make a force act on the elastic member at the same time. Thus for example, whereas in a case where the elastic member is installed at another position, the driving force from the second output portion in the switching of the locking mechanism is allocated between the elastic member, installed at the other position, and the switching member, when the elastic member is installed between the second output portion and the switching member, the force applied to the elastic member is made to act on the switching member as well, thus enabling the collision detection and the locking operation to be performed efficiently.

[0037] A thirteenth aspect of the opening and closing apparatus with lock according to the present invention is that the collision detection unit is constituted of a limit switch that stops the drive of the actuator upon detecting that a rotation angle of the second output portion has become no less than a predetermined rotation angle.

[0038] With this arrangement, the limit switch detects the rotation angle of the second output portion, which rotates in correspondence to the deformation of the elastic member, to stop the drive of the actuator. The collision detection unit can thus be arranged with a simple arrangement.

[0039] A fourteenth aspect of the opening and closing apparatus with lock according to the present invention is that the elastic member is disposed so as to be balanced with a running resistance when the sliding doors are performing a normal closing operation.

[0040] With this arrangement, "performing a normal closing operation" refers to a state where a force that obstructs the operation of the sliding doors is not acting from the exterior, and because an elastic force that is balanced with the running resistance during this normal closing operation is made to act on the second output portion by the elastic member, the elastic force that is made to act by the elastic member is made smaller. The elastic member can thus be installed in a readily deformable state. Because the elastic member is thereby made

more readily deformable by an increase in the running resistance of the sliding doors, detection of higher sensitivity is enabled. Also in this case, an impact applied from a sliding door to an object of collision in a collision process can be relaxed significantly.

Brief Description of the Drawings

[0041]

FIG. 1 is a front view of a vehicle opening/closing door, in which an opening and closing apparatus with lock according to an embodiment of the present invention is installed.

FIG. 2 is a front view of principal portions of the opening and closing apparatus with lock in an unlocked state.

FIG. 3 is a schematic view of a locking mechanism as viewed from a direction indicated by an arrow X in FIG. 2.

FIG. 4 is a front view of principal portions of the opening and closing apparatus with lock in a locked state.

FIG. 5 is a schematic view of the locking mechanism as viewed from a direction indicated by an arrow X in FIG. 4.

FIG. 6 is a schematic partial sectional view of the locking mechanism and a locking slider as viewed from a direction indicated by an arrow Y in FIG. 4.

FIG. 7 is a schematic partial sectional view of the locking mechanism in the locked state as viewed from a horizontal direction.

FIG. 8 is a schematic view of a state of a carrier during a normal closing operation.

FIG. 9 is a schematic view of a state of the carrier when a running resistance of a sliding door increases during the closing operation.

FIG. 10 is a diagram of a locking mechanism and a locking slider according to a modification example of the embodiment in an unlocked state.

FIG. 11 is a diagram of the locking mechanism and the locking slider according to the modification example of the embodiment in a locked state.

Best Mode for Carrying Out the Invention

[0042] A best mode for carrying out the present invention shall now be described with reference to the drawings.

FIG. 1 is a front view of an embodiment, in which an opening and closing apparatus with lock is installed in a vehicle opening/closing door. FIG. 2 is a front view of principal portions of an arrangement of the opening and closing apparatus with lock in an unlocked state. FIG. 3 is a schematic view of an arrangement of a locking mechanism, shown in FIG. 2, as viewed from a lower side of the locking mechanism (from a direction indicated by an arrow X in FIG. 2). FIG. 4 is a front view of principal portions of the arrangement of the opening and closing ap-

paratus with lock in a locked state. FIG. 5 is a schematic view of the locking mechanism, shown in FIG. 4, as viewed from the lower side of the locking mechanism (from a direction indicated by an arrow X in FIG. 4). FIG. 6 is a schematic partial sectional view of the locking mechanism and a locking slider as viewed in a direction of movement of the locking slider (from a direction indicated by an arrow Y in FIG. 4). In FIG. 6, a planetary gear mechanism is positioned at a C1 side, and sliding doors are positioned at a C2 side.

[0043] The vehicle opening and closing door 1, shown in FIG. 1, is arranged as a door enabling to open and close an opening formed in a side wall of a railway vehicle or other vehicle and has a pair of slide-apart type left and right sliding doors 11A and 11B. The two sliding doors 11A and 11B are disposed in a manner enabling reciprocating movement along a guide rail 2 installed horizontally above the opening. More specifically, hangers 3A and 3B are fixed to respective upper edges of the sliding doors 11A and 11B, and door rollers 4 are axially supported in a rotatable manner in each of the hangers 3A and 3B. Each door roller 4 is enabled to roll along the guide rail 2.

[0044] The vehicle opening and closing door 1 is arranged to be opened and closed and be automatically locked so as not to become open inadvertently in a closed state by the opening and closing apparatus with lock according to the embodiment of the present invention. It is dangerous for a door of a railway vehicle or other vehicle to become open while the vehicle is running and such a door is required to be locked securely so as not to become open inadvertently during running.

[0045] Details shall now be described. A plate-like base 5 is affixed to an upper portion (upper side of the opening) of the side wall (housing) of the vehicle, and two racks 7A and 7B are supported in a rack support 6 fixed to the base 5. The racks 7A and 7B are disposed with longitudinal directions thereof being aligned horizontally (parallel to the guide rail 2), and are supported by slide supports 8 in a manner enabling sliding in the longitudinal directions (horizontal directions).

[0046] The two racks 7A and 7B are disposed parallel to each other with an appropriate interval being formed in an up/down direction and are disposed so that teeth thereof face each other. A pinion 9 is rotatably disposed so as to be engaged simultaneously to the teeth of both of the two racks 7A and 7B. The pinion 9 is disposed at a position, which is a central position in a left/right direction above the opening of the opening and closing door 1 and is a position that is sandwiched from above and below by the two racks 7A and 7B.

[0047] Arm members 13A and 13B are respectively installed at one ends of the two racks 7A and 7B. The arm members 13A and 13B are respectively fixed to the hangers 3A and 3B via coupling members 15a and 15b. The one ends of the racks 7A and 7B are respectively coupled to the corresponding sliding doors 11A and 11B via the arm members 13A and 13B. A rack and pinion

mechanism 10 is constituted of the racks 7A and 7B and the pinion 9, and the two sliding doors 11A and 11B are driven to open and close by the rack and pinion mechanism 10. By coupling the left and right sliding doors 11A and 11B to each other, the rack and pinion mechanism 10 also serves a function of realizing symmetrical opening and closing of the sliding doors 11A and 11B.

[0048] As shown in FIGS. 2 and 4, locking pins 14A and 14B (locking members), extending vertically upward, are respectively fixed to the pair of arm members 13A and 13B. The movement of the pair of sliding doors 11A and 11B is locked by the locking pins 14A and 14B being constrained by a locking mechanism 60 to be described later.

[0049] The planetary gear mechanism 20 is supported in the base 5 (see FIGS. 2 and 4). The planetary gear mechanism 20 has a sun gear 21 (input portion), axially supported in a rotatable manner, planetary gears 24, disposed in plurality at an outer circumference of the sun gear 21 and enabled to undergo rotation and revolution while being engaged with the sun gear 21, an internal gear 22 (first output portion), having internal teeth engaging with the planetary gears 24 at an outer side of the planetary gears 24, and a carrier 23 (second output portion), rotatably supporting the planetary gears 24. The three components of the sun gear 21, the internal gear 22, and the carrier 23 are positioned along the same axial line and are disposed so as to be respectively rotatable relative to each other. The axial line of these three components is also matched with an axial line of the pinion of the rack and pinion mechanism 10.

[0050] An output shaft of a direct drive type electric motor (actuator), omitted from illustration and enabled to rotate forward and in reverse, is coupled to the sun gear 21. The coupling may be achieved via a suitable speed reducing mechanism. A main unit portion of the electric motor is fixed to the side wall of the vehicle. The internal gear 22 is coupled to the pinion 9 of the rack and pinion mechanism 10 via an unillustrated bolt, etc. Furthermore, the carrier 23 is coupled to a pulling member 70 for pulling a locking slider 33 (switching member) for switching the below-described locking mechanism 60 between a locked state and an unlocked state.

[0051] The pulling member 70 and the locking slider 33 are installed in a manner enabling reciprocating movement in one direction along a guide shaft 72, fixed with respect to the base 5 and extending in parallel to the racks 7A and 7B, and constitute a switching mechanism for switching of the locking mechanism. The pulling member 70 is coupled to the carrier 23 so as to be movable in the one direction according to the rotation of the carrier 23. A torque limiting spring 71 (elastic member) of coil spring form is disposed between the pulling member 70 and the locking slider 33. The torque limiting spring 71 makes an elastic force act on the pulling member 70 and the locking slider 33 so as to push the pulling member 70 against the locking slider 33. That is, the torque limiting spring 71 is disposed so as to suppress relative move-

ment of the pulling member 70 with respect to the locking slider 33.

[0052] The locking slider 33 has, at its upper end, a mounting portion 33a and a mounting portion 33b that are spaced apart by a predetermined interval in the movement direction and are formed to be slidable with respect to the guide shaft 72. The locking slider 33 also has a front surface portion 33c, extending downward from the mounting portion 33a and the mounting portion 33b, and a bottom surface portion 33d, formed so as to be inflected by 90 degrees in a direction directed inward from the paper surface in FIG. 2 from a lower end of the front surface portion 33c (see FIGS. 3, 5, and 6). The pulling member 70 is mounted to the guide shaft 72 between the mounting portion 33a and the mounting portion 33b, and the torque limiting spring 71 is mounted on the guide shaft 72 between the pulling member 70 and the mounting portion 33b at a front end side in a locking direction (direction indicated by an arrow A1 in FIGS. 3 and 5; referred to hereinafter as "locking direction A1") of the locking slider 33. Because the torque limit spring 71 is mounted in a state of being compressed in an axial direction (an elastically deformed state), the pulling member 70 receives an urging force directed toward the mounting portion 33a and an end of the pulling member 70 is thereby retained in a state of contacting the mounting portion 33a.

[0053] As shown in FIGS. 3 and 5, the locking slider 33 has, at the bottom surface portion 33d, a slit 33e (slit portion) of curved shape. The slit 33e includes a first hole portion a, extending in parallel to the movement direction, and a second hole portion B, formed so as to be continuous to the first hole portion a and curve smoothly in a direction substantially perpendicular to the movement direction.

[0054] The locking mechanism 60 of the opening/closing door 1 shall now be described in detail. FIG. 7 is a schematic partial sectional view of the locking mechanism 60 in the locked state as viewed from a horizontal direction. In FIG. 7, the planetary gear mechanism is positioned at a C1 side, and the sliding doors are positioned at a C2 side. The locking mechanism 60 is a mechanism that operates within a horizontal plane and is installed so as to be adjacent to an upper side (planetary gear mechanism 20 side) of the bottom surface portion 33d of the locking slider 33 and so as to be fixed in position with respect to the base 5 (see FIGS. 2 and 4).

[0055] As shown in FIGS. 3 and 5, the locking mechanism 60 is constituted of a link mechanism 61 that is deformable to a rectilinear state and an inflected state within a horizontal plane and a link retaining mechanism 65 that operates within the horizontal plane. The link mechanism 61 is formed by coupling three links 62a, 62b, and 62c. At a central portion in its longitudinal direction, the central link 62a is rotatably fixed with respect to the base 5 by a coupling pin 63a. One end of the central link 62a is coupled to one end of the link 62b by a coupling pin 63b. The other end of the central link 62a is coupled

to one end of the link 62c by a guiding coupling pin 63c. The links 62b and the link 62c have pins 63d and 63e at ends at the sides opposite the points of coupling to the link 62a.

[0056] As shown in FIGS. 3, 5, and 7, the pins 63d and 63e, positioned at the ends of the link mechanism 61, have ends thereof respectively inserted in guide grooves 80A and 80B (indicated by alternate long and two short dashes lines in FIGS. 3 and 5), formed rectilinearly and parallel to the movement direction of the locking slider 33, and are installed in a manner enabling movement along the guide grooves 80A and 80B. That is, the movements of the pins 63d and 63e are respectively restricted by the guide grooves 80A and 80B. The ends of the pins 63d and 63e that are inserted into the guide grooves 80A and 80B are formed as rollers (see FIG. 7), enabling friction with respect to the guide grooves 80A and 80B to be reduced and the movements of the ends to be performed smoothly. The ends of the pins 63d and 63e at the locking slider 33 side are also formed as rollers (see FIG. 7), enabling friction during movements along edges of engaging members 66A and 66B, to be described below, to be reduced and the locking operation to be stabilized.

[0057] An end at the locking slider 33 side of the guiding coupling pin 63c of the link mechanism 61 is formed as a roller and is inserted in the slit 33e of the locking slider 33. The position of the guiding coupling pin 63c is thus restricted by the position of the locking slider 33. The link mechanism 61 can thus be switched between the rectilinear state and the inflected state by the movement of the locking slider 33.

[0058] The link retaining mechanism 65 is constituted of a pair of engaging members 66A and 66B, installed symmetrically with respect to the link mechanism 61 (with respect to the coupling pin 63a) at positions near the respective ends of the link mechanism 61 and in a manner enabling rotations within a horizontal plane, and a coupling spring 69, coupling the pair of engaging members to each other. The engaging members 66A and 66B respectively have, at peripheral portions thereof, first engaging portions 67A and 67B and second engaging portions 68A and 68B, and rotation axes 81A and 81B of the engaging members 66A and 66B are fixedly installed on the base 5 (see FIG. 7). A spanning member 82 is fixed to the pair of rotation axes 81A and 81B, and the coupling pin 63a for rotatably fixing the central link 62a of the link mechanism 61 is supported by the spanning member 82 (see FIGS. 2 and 4).

[0059] In a state where an external force is not received by the link retaining mechanism 65, the engaging members 66A and 66B receive a force from the coupling spring 69 and are retained in the state shown in FIG. 3. In this state, the engaging members 66A and 66B constrain, by their peripheral portions (portions indicated by arrows P2 in FIG. 3), an extending movement of the link mechanism 61 to the rectilinear state. When the link mechanism 61 is thus held in the inflected state by the engaging members 66A and 66B, movement of the locking slider 33 in

the locking direction A1 is constrained via the slit 33e and the guiding coupling pin 63c.

[0060] Meanwhile, the engaging members 66A and 66B are formed to be able to rotate, against the urging force of the coupling spring 69, in directions (directions indicated by arrows R1 in FIG. 3) of making the second engaging portions 68A and 68B approach the link mechanism 61 when edges (portions indicated by P1 in FIG. 3) of the first engaging portions 67A and 67B are urged by the movement of the locking pins 14A and 14B, respectively fixed with respect to the sliding doors 11A and 11B, in closing directions (directions indicated by arrows B1 in FIG. 3; referred to hereinafter as "closing directions B1"). In a state in which the sliding doors 11A and 11B are in a fully closed position, the locking pins 14A and 14B and the first engaging portions 67A and 67B are engaged as shown in FIG. 5, and the positions of the second engaging portions 68A and 68B are positions enabling engagement with the pins 63d and 63e disposed at the ends of the link mechanism 61. That is, the engaging members 66A and 66B enter a state of not constraining the deformation of link mechanism 61. If at this point, the locking slider 33 moves in the locking direction A1, the link mechanism 61 is made to transition from the inflected state to the rectilinear state by the guiding connecting pin 63c moving along the slit 33e. The pins 63d and 63e, positioned at the ends of the link mechanism 61 then engage with the second engaging portions 68A and 68B of the engaging members 66A and 66B. Rotations of the engaging members 66A and 66B are thereby constrained. Movements of the locking pins 14A and 14B in opening directions (directions indicated by arrows B2 in FIGS. 3 and 5; hereinafter referred to as "opening directions B2") are thus constrained by the first engaging portions 67A and 67B.

[0061] Opening/closing and locking operations of the sliding doors 11A and 11B shall now be described with reference to FIGS. 2 to 5. FIG. 2 shows a manner in which the sliding doors 11A and 11B move in the closing directions B1 and shows a state in which the locking mechanism 60 is unlocked. In this state, the locking pins 14A and 14B are in positions away from the locking mechanism 60 and the locking mechanism 60 is retained in the state shown in FIG. 3.

[0062] In this unlocked state, the link mechanism 61 is in the inflected state and the rectilinearly extending movement of the link mechanism 61 is constrained by the engaging members 66A and 66B. The movement of the locking slider 33 in the locking direction A1 is thus constrained via the guiding coupling pin 63c of the link mechanism 61 and the slit 33e.

[0063] Thus While the unlocked state of FIGS. 2 and 3, the sun gear 21 of the planetary gear mechanism 20 is driven by the electric motor, a driving force is transmitted to the pinion 9 via the internal gear 22 or is transmitted so as to elastically deform the torque limiting spring 71 via the carrier 23 that rotates according to the revolution of the planetary gears 24.

[0064] Here, the torque limiting spring 71 urges the pulling member 70, coupled to the carrier 23, so as to make a predetermined elastic force, which suppresses the rotation of the carrier 23 according to the revolution of the planetary gears 24, act on the carrier 23 so as to be balanced with a running resistance during a normal closing operation of the sliding doors 11A and 11B. Thus While the normal closing operation, the sun gear 21 of the planetary gear mechanism 20 is driven by the electric motor, the planetary gears 24 only rotate and do not re-

volve, and thus all of the driving force of the sun gear 21 is transmitted to the pinion 9 via the internal gear 22 and the sliding doors 11A and 11B are driven to open/close. **[0065]** Also, even if the sliding doors 11A and 11B move in the closing directions B1, the engaging members 66A and 66B of the locking mechanism 60 that engage with the locking pins 14A and 14B receive the elastic force of the coupling spring 69, are thus retained in the state shown in FIG. 3, and do not rotate to the locked position (position shown in FIG. 5) until the sliding doors 11A and 11B reach the fully closed position. The locking mechanism 61 can thereby be prevented from operating too early before the sliding doors 11A and 11B reach the fully closed position. Malfunction of the locking mechanism 60 thus does not occur due to collision of the locking pins 14A and 14B with the engaging members 66A and 66B that have entered the locked positions.

[0066] When during the closing operation of the sliding doors 11A and 11B, the running resistance of the sliding doors 11A and 11B becomes significantly large due to a passenger becoming caught, etc., the carrier 23 rotates against the urging force due to the torque limiting spring 71, the rotation of the carrier 23 is detected, and the rotation of the electric motor is stopped temporarily or other predetermined safety operation is performed accordingly as shall be described later.

[0067] Next, it shall be deemed that as a result of driving of the sun gear 21 in the direction of closing the sliding doors 11A and 11B, the sliding doors 11A and 11B approach the fully closed position and the locking pins 14A and 14B, which are fixed with respect to the sliding doors 11A and 11B, contact the engaging members 66A and 66B (see FIG. 3). When the sun gear 21 is driven from this state to move the sliding doors 11A and 11B further in the closing directions B1, the locking pins 14A and 14B urge the engaging members 66A and 66B and enter into recesses of the first engaging portions 67A and 67B while making the engaging members 66A and 66B rotate in the directions of arrows R1 in FIG. 3.

[0068] When the sliding doors 11A and 11B reach the fully closed position, the engaging members 66A and 66B engage the locking pins 14A and 14B in the first engaging portions 67A and 67B, and the transition to the locked position, in which the second engaging portions 68A and 68B are made to face the pins 63d and 63e positioned at the ends of the link mechanism 61, is completed. Transition of the link mechanism 61 to the rectilinear state is thereby allowed. Thus when the sliding doors 11A and

11B move to the fully closed position, the locking slider 33, which is coupled via the guiding coupling pin 63c and the slit 33e to the link mechanism 61 that is allowed to transition to the rectilinear state, is enabled to move in the locking direction A1. Consequently, rotation of the carrier 23, coupled to the locking slider 33 via the torque limiting spring 71 and the pulling member 70, is allowed.

[0069] Meanwhile, upon reaching fully closed position, the sliding doors 11A and 11B become unable to move in the closing directions B1. The rotation of the internal gear 22, coupled to the sliding doors 11A and 11B via the rack and pinion mechanism 10, is thus also prevented. Thus the driving force of the sun gear 21 that continues to rotate now becomes transmitted to the carrier 23 so that the carrier 23 rotates in a counterclockwise direction in FIG. 2 and the locking slider 33 is moved in the locking direction A1 via the torque limiting spring 71 and the pulling member 70. In accordance with the movement of the locking slider 33 in the locking direction A1, the link mechanism 61 transitions from the inflected state (the state shown in FIG. 3) to the rectilinear state (the state shown in FIG. 5). In the rectilinear state, the rotations of the engaging members 66A and 66B are constrained by the pins 63d and 63e of the link mechanism 61. Movements of the locking pins 14A and 14B that are engaged with the first engaging portions 67A and 67B of the engaging members 66A and 66B are thus prevented. Movements of the sliding doors 11A and 11B are thus locked via the locking pins 14A and 14B. A locking spring 73 that urges the mounting portion 33a of the locking slider 33 in the locking direction A1 is installed on the guide shaft 72, and this suppresses the locking slider 33 at the locked position from returning to the unlocked position and enables the locked state to be maintained more reliably.

[0070] Thus as illustrated by the deformation from the state shown in FIGS. 2 and 3 to the state shown in FIGS. 4 and 5, the locking mechanism 60 is automatically switched to the locked state after the sliding doors 11A and 11B move into the fully closed position, and the sliding doors 11A and 11B are thereby locked as they are in the closed state. Locking that is coupled to the closing of the sliding doors 11A and 11B can thus be realized by just driving the sun gear 21 of the planetary gear mechanism 20 by a single actuator and the drive arrangement can be made simple.

[0071] Also in the locked state shown in FIGS. 4 and 5, locking can be applied in double, that is, the locking that restricts the rotations of the engaging members 66A and 66B by the link mechanism 61 and the locking that restricts the deformation of the link mechanism 61 from the rectilinear state to the inflected state by the locking slider 33 can be applied. Thus for example, even when a state in which electric power is not supplied to the electric motor due to power outage or malfunction, etc., of a vehicle is entered and the rotation of the output shaft (the sun gear 21) is freed, the opening of the sliding doors 11A and 11B is prevented extremely securely by the dou-

ble locking arrangement. This means that even if a power outage, etc., occurs in the vehicle, inadvertent opening of the sliding doors 11A and 11B due to wind pressure, etc., can be prevented.

[0072] To switch from the above-described locked state to the unlocked state and to open the sliding doors 11A and 11B, it suffices to simply drive the sun gear 21 by the electric motor in the direction opposite that of the closing process. In the locked state (FIGS. 4 and 5), because the sliding doors 11A and 11B are locked by the engaging members 66A and 66B, the rotation of the internal gear 22 is prevented. Meanwhile, movement of the locking slider 33 in an unlocking direction (direction indicated by an arrow A2 in FIGS. 3 and 5; referred to hereinafter as "unlocking direction A2") is suppressed by just the urging force of the locking spring 73. That is, in this state, if a driving force that opposes the urging force of the locking spring 73 is transmitted to locking slider 33, the locking slider 33 can be moved in the unlocking direction A2. Thus when from the locked state, the sun gear 21 is driven in the direction opposite that of the closing process, all of the driving force of the sun gear 21 is transmitted to the carrier 23 and the locking slider 33 is moved, via the pulling member 70, in the unlocking direction A2 against the urging force of the locking spring 73. In accordance with this movement of the locking slider 33 in the unlocking direction A2, the guiding coupling pin 63c of the link mechanism moves along the edge of the slit 33e from the first hole portion a to the second hole portion B and the link mechanism 61 thereby transitions from the rectilinear state to the inflected state. The engagements of the second engaging portions 68A and 68B of the engaging members 66A and 66B with the pins 63d and 63e, positioned at the ends of the link mechanism 61, are thereby released. Then by the pulling elastic force of the coupling spring 69 that couples the pair of engaging members 66A and 66B, the engaging members 66A and 66B receive a force that makes the first engaging portions 67A and 67B face outward (to sides opposite the link mechanism 61). That is, the engaging members 66A and 66B receive a force that rotates the members in the R2 directions in FIG. 5. The lock pins 14A and 14B, which are in engaged states with the second engaging portions 68A and 68B, are thereby allowed to move in the opening directions B2 and the locking of the sliding doors 11A and 11B is released.

[0073] In the position shown in FIG. 2, the movement of the locking slider 33 in the unlocking direction A2 is constrained by the deformation limit of the locking spring 73. The constraining of the movement of the locking slider 33 in the unlocking direction A2 is not restricted to the constraining by the deformation limit of the locking spring 73 and the constraint may instead be applied by contact of the carrier 23 and the base 5 at a predetermined position. Also, the lengths of the guide grooves 80A and 80B, in which the pins 63d and 63e of the link mechanism 61 is inserted, may be set appropriately so that the deformation of the link mechanism 61 is constrained by the

constraining of the movement of the pins 63d and 63e by the guide grooves 80A and 80B and the movement of the locking slider 33 is constrained accordingly.

[0074] As a result of the movement of the locking slider 33 in the unlocking direction A2 being constrained, the driving force of the sun gear 21 in the planetary gear mechanism 20 is now transmitted to the internal gear 22 side. The sliding doors 11A and 11B are thus driven in the opening directions B2 via the rack and pinion mechanism 10. In this process, because the engaging members 66A and 66B receive a force that rotates the members to the unlocked positions (force in the R2 directions in FIG. 5) from the coupling spring 69, the engaging members 66A and 66B do not constrain movements of the locking pins 14A and 14B that are fixed with respect to the sliding doors 11A and 11B.

[0075] An arrangement where the locking slider 33 and an unillustrated lever, disposed at a position accessible from the interior or exterior of the vehicle, are connected via an unillustrated wire or other coupling member, can be provided to enable a person to operate the lever at a time of emergency to move the locking slider in the releasing direction to release the lock and then open the sliding doors 11A and 11B manually. As a more simplified arrangement, the lever may be fixed directly to the locking slider 33.

[0076] A case where the running resistance of at least one of either of the sliding door 11A and 11B becomes significantly large during the closing operation of the sliding doors 11A and 11B (during movements of the sliding doors from the fully opened position to the fully closed position) shall now be described using FIGS. 8 and 9. This corresponds, for example, to a case where a passenger becomes caught by the sliding doors 11A and 11B or a case where a passenger collides with one of the sliding doors. FIG. 8 is a schematic view of a state of the carrier 23 during a normal closing operation. FIG. 9 is a schematic view of a state of the carrier 23 when the running resistance of a sliding door increases during the closing operation.

[0077] When the closing operation of the sliding doors 11A and 11B is being performed normally, that is, when both of the sliding doors 11A and 11B are operating at the normal running resistance without obstruction of movement from the exterior, the driving force of the sun gear 21 is transmitted to the internal gear 22 side and the sliding doors 11A and 11B are driven in the closing directions B1 via the rack and pinion mechanism 10 as described above. This is because, as mentioned above, the movement of the locking slider 33 is constrained when the sliding doors 11A and 11B are in positions other than the fully closed position. That is, the above is due to the pulling member 70, coupled to the carrier 23, being urged by the torque limiting spring 71 at the predetermined elastic force that can suppress the rotation of the carrier 23 in the state in which the movement of the locking slider 33 is constrained. With the present embodiment, the elastic force that suppresses the rotation of the carrier

23 is made to act on the carrier 23 via the pulling member 70 so as to be balanced with the running resistance of the sliding doors 11A and 11B. That is, when during the closing operation, a force no less than the normal running resistance acts on the sliding door 11A or 11B, the carrier 23 can rotate so as to enter the state shown in FIG. 9 while elastically deforming the torque limiting spring 71 with the position of the locking slider 33 being kept fixed.

[0078] A permanent magnet 83 is fixed to an outer peripheral edge of the carrier 23, and a detection switch 84 (collision detection unit, limit switch), mounted on the base 5 side, is arranged to be switched by the movement of the permanent magnet 83 according to the rotation of the carrier 23. Specifically, the detection switch 84 is in the OFF state in the position of the carrier 23 during operation of the sliding doors 11A and 11B at the normal running resistance. On the other hand, when the carrier 23 rotates by a predetermined amount according to an increase of the running resistance of the sliding doors 11A and 11B, the detection switch 84 is put in the ON state (see FIG. 9). When the detection switch 84 is switched to the ON state, a signal that stops driving is transmitted to the electric motor and the driving of the electric motor is stopped.

[0079] By the above arrangement, when, during the closing operation of the sliding doors 11A and 11B, the running resistance in the closing directions B1 of the sliding doors increase due to a passenger becoming caught or one of the sliding doors of the slide-apart type sliding doors colliding with a passenger, etc., the driving of the electric motor can be stopped to relax the impact force applied to the passenger caught by the sliding doors 11A and 11B, etc. The action performed when the detection switch 84 is put in the ON state (when door catching or collision is detected) is not restricted to the stopping of the driving of the electric motor and control may be performed to lower the drive output of the electric motor instead.

[0080] Arrangements are made so that when the sliding doors 11A and 11B are in the fully closed position, the above-described signal for stopping the driving of the electric motor is not transmitted or the driving of the electric motor is not stopped even if the signal is transmitted. The driving of the electric motor during the movement operation of the lock slider 33 in the locking direction A1 is thus not stopped.

[0081] An arrangement is also possible where, for example, a locked state detection sensor that detects that the sliding doors are in a locked state is provided and if after the detection signal is transmitted from the detection switch 84, a detection signal of the locked state detection sensor is not transmitted within a predetermined time, it is judged that door catching or collision, etc., by the sliding doors has occurred and the driving of the electric motor is stopped. Also, for example, a deceleration sensor that detects deceleration of the sliding doors may be used in combination. In this case, when the movement speeds of the sliding doors are high in the closing operation, door

catching or collision, etc., can be judged by detecting the rotation of the carrier by the detection switch 84, and when the sliding doors have become close to the closed position and the movement speeds of the sliding doors have become slow, door catching or collision, etc., can be detected by the deceleration sensor.

[0082] As described above, the opening and closing apparatus with lock according to the present embodiment includes: the rack and pinion mechanism 10, having the pair of racks 7A and 7B, respectively mounted on the pair of slide-apart type sliding doors 11A and 11B that are movable reciprocatingly with respect to the housing (wall surface) of the vehicle, and a pinion 9, engaged with the pair of racks 7A and 7B; the electric motor, functioning as the opening/closing drive source of the sliding doors 11A and 11B; the locking mechanism 60 mounted on the base 5 affixed to the housing and enabling to lock the pair of sliding doors 11A and 11B in the fully closed position by constraining the respective movements of the locking pins 14A and 14B that are respectively fixed to the respective sliding doors of the pair of sliding doors 11A and 11B; the locking slider 33 for switching the locking mechanism 60 between the locked state and the unlocked state; and the planetary gear mechanism 20, having the sun gear 21, into which the driving force of the electric motor is input, the internal gear 22, enabling to output the driving force to the pinion 9, and the carrier 23, enabling to output the driving force to the locking slider 33; and is arranged so that when the sliding doors 11A and 11B are in the fully closed position, the driving force is output from the carrier 23 to the locking slider 33.

[0083] With the above arrangement, because the movements of the locking pins 14A and 14B, which are respectively fixed to the respective sliding doors of the pair of sliding doors 11A and 11B, are respectively constrained by the locking mechanism 60, each of the pair of sliding doors 11A and 11B can be locked independently. Thus even when the rack and pinion mechanism 10 malfunctions, the movements of both sliding doors 11A and 11B can be kept in the locked state. Oppositely, when the rack and pinion mechanism 10 is functioning normally, even if the lock of one sliding door 11A (11B) becomes released due to malfunction, etc., because the one sliding door 11A (11B) is coupled to the other sliding door 11B (11A) via the rack and pinion mechanism 10, as long as the lock of the other sliding door 11B (11A) is effective, the one sliding door 11A (11B) can be maintained in the locked state. The slide-apart type sliding doors 11A and 11B can thus be locked more securely.

[0084] Also with this arrangement, the power of the electric motor is allocated via the planetary gear mechanism 20 to drive the pinion 9 of the rack and pinion mechanism 10 on one hand and drive the locking slider 33 on the other. Because the arrangement for power transmission (allocation) from the electric motor is thus housed in a compact space, the structure can be simplified and a compact opening and closing apparatus with lock can be provided.

[0085] Also, because the driving force from the electric motor is allocated not using a cushioning spring as in Patent Document 1 but using the planetary gear mechanism 20, even if the driving force is lost due to electric motor malfunction, etc., in the state where the sliding doors 11A and 11B are locked at the closed position, a force in a direction of releasing the lock is not applied to the locking slider 33, etc., and unintended unlocking is prevented.

[0086] Also, the opening and closing apparatus with lock according to the present embodiment has the locking slider 33 that is enabled to switch the locking mechanism 60 between the locked state and the unlocked state by moving according to the drive of the carrier 23. The locking mechanism 60 is arranged so that the movement of the locking slider 33 is prevented when the sliding doors 11A and 11B are in positions other than the fully closed position and the movement of the locking slider 33 is allowed when the sliding doors 11A and 11B are in the fully closed position.

[0087] With this arrangement, because the movement of the locking slider 33 is prevented when the sliding doors 11A and 11B are in positions other than the fully closed position, the locking operation is performed when the sliding doors 11A and 11B have reached the fully closed position securely. That is, the locking operation is prevented from being performed at a timing that is too early in the driving of the sliding doors 11A and 11B in the closing directions B1, and breakage of the locking mechanism 60 and constraining of the sliding doors 11A and 11B before the reaching of the fully closed position are thereby prevented.

[0088] Also with the opening and closing apparatus with lock according to the present embodiment, the locking mechanism 60 includes the link mechanism 61, which is deformable to the rectilinear state and the inflected state according to the movement of the locking slider 33, and the link retaining mechanism 65, which retains the link mechanism 61 in the inflected state when the sliding doors are in positions other than the fully closed position. With the locking mechanism 60, when the sliding doors 11A and 11B are in the fully closed position, the link mechanism 61 deforms to the rectilinear state and thereby constrains the movement of the locking pins 14A and 14B respectively fixed to the sliding doors 11A and 11B.

[0089] With this arrangement, the movements of the sliding doors 11A and 11B can be locked in the fully closed position by putting the link mechanism 61 in the rectilinear state, and because in positions other than the fully closed position, the link mechanism 61 is held in the inflected state by the link retaining mechanism 65, the locking operation is performed after the sliding doors 11A and 11B have reached the fully closed position. The locking mechanism 60 can thus be formed compactly because it is driven using the link mechanism 61 and stable drive can be realized because the locking mechanism 60 is driven mechanically.

[0090] Also, the opening and closing apparatus with

lock according to the present embodiment, has locking pins 14A and 14B that are fixed to the sliding doors 11A and 11B so as to extend in vertical directions. The link retaining mechanism 65 is constituted of the pair of engaging members 66A and 66B, having the first engaging portions 67A and 67B, rotatably installed near the respective ends of the link mechanism 61 and engaging with the locking pins 14A and 14B in the fully closed position, and the second engaging portions 68A and 68B, engaging with the ends of the link mechanism 61 in the rectilinear state in the fully closed position. The engaging members 66A and 66B prevent the movement of the locking slider 33 by preventing the transition of the link mechanism 61 to the rectilinear state when the sliding doors 11A and 11B are in positions other than the fully closed position, and allows the movement of the locking slider 33 by being urged by the locking pins 14A and 14B to rotate to positions enabling engagement of the ends of the link mechanism 61 with the second engaging portions 68A and 68B during the movement of the sliding doors 11A and 11B in the closing directions B1.

[0091] With this arrangement, in the fully closed position, the engaging members 66A and 66B engage with the locking pins 14A and 14B. Then by the extension of the link mechanism 61 to the rectilinear state, the engaging members 66A and 66B engage with the ends of the link mechanism 61 and become constrained in rotational movement. The locking pins 14A and 14B are thereby constrained in movement in the state of being engaged with the engaging members 66A and 66B. Thus by the engaging members 66A and 66B, the transition of the link mechanism 61 to the rectilinear state in positions besides the fully closed position can be prevented and the movement of the locking pins 14A and 14B can be constrained in the fully closed position. The number of parts necessary for forming the locking mechanism 60 can thus be made low and a more compact locking mechanism 60 can be arranged.

[0092] Also, the opening and closing apparatus with lock according to the present embodiment includes the locking slider 33, enabling to move slidably in one direction with respect to the locking mechanism 60 and having the slit 33e of a curved shape at the bottom surface, the link mechanism 61 acts within a plane parallel to the bottom surface of the locking slider 33 and has the guiding coupling pin 63c, disposed at one coupling point, inserted in the slit 33e, and the link mechanism 61 is deformed to the rectilinear state and the inflected state by the guiding coupling pin 63c moving along the slit 33e.

[0093] With this arrangement, the link mechanism 61 can be deformed to the rectilinear state and the inflected state by the movement of the locking slider 33 in one direction without interposing another member between the locking slider 33 and the link mechanism 61. The installation space of the locking mechanism 60 can thus be made small.

[0094] The locking mechanism 60 has the link mechanism 61, which is deformable to the rectilinear state and

the inflected state within the horizontal plane, and by the link mechanism 61 deforming to the rectilinear state when the sliding doors 11A and 11B are in the fully closed position, the locking mechanism 60 engages with the locking pins 14A and 14B that are fixed to the sliding doors 11A and 11B and enters the locked state.

[0095] With this arrangement, when the sliding doors 11A and 11B reach the fully closed position, the sliding doors 11A and 11B can be locked by the locking slider 33 being driven and the link mechanism 61 being deformed to the rectilinear state within the horizontal plane. Because the locking mechanism 60 thus puts the sliding doors 11A and 11B in the locked state using the link mechanism 61 that operates within the horizontal plane, the installation space of the locking mechanism 60 can be made small in the height direction. Thus by using the opening and closing apparatus with lock according to the present embodiment, the opening/closing and locking operations can be performed within a smaller installation space.

[0096] With the opening and closing apparatus with lock according to the present embodiment, the link mechanism 61 has the link 62a, rotatably fixed to the base 5, and the movements of the pins 63d and 63e at the ends of the link mechanism 61 are restricted by the rectilinear guide grooves 80A and 80B formed in the base 5.

[0097] With this arrangement, by rotatably fixing the link portion 62a that is a part of the link mechanism 61 to the base 5, the position of the link mechanism 61 with respect to the base 5 can be fixed without obstructing the operation of the link mechanism 61. The movements of the pins 63d and 63e at the ends of the link mechanism 61 can be restricted to straight lines by the guide grooves 80A and 80B of the base 5, and the link mechanism 61 that can be deformed to the rectilinear state and the inflected state can be formed by a simple arrangement.

[0098] The opening and closing apparatus with lock according to the present embodiment has the locking pins 14A and 14B that are fixed to the sliding door so as to extend in vertical directions. The locking mechanism 60 includes the engaging members 66A and 66B, rotatably installed within a horizontal plane near the ends of the link mechanism 61 and having the first engaging portions 67A and 67B, engaging with the locking pins 14A and 14B in the fully closed position, and the second engaging portion 68A and 68B, engaging with the pins 63d and 63e at the ends of the link mechanism 61 in the rectilinear state in the fully closed position.

[0099] With this arrangement, by the locking pins 14A and 14B extending in the vertical directions from the sliding doors 11A and 11B, the locking mechanism 60 that operates within the horizontal plane can be made readily engageable with the locking pins 14A and 14B. Because in the fully closed position, the movements of the locking pins 14A and 14B can be constrained by constraining the rotations of the engaging members 66A and 66B by the pins 63d and 63e at the ends of the link mechanism 61 in the rectilinear state, the direction in which the link

mechanism 61 extends to the rectilinear state can be set to any direction that enables the constraining of the rotation of the engaging members 66A and 66B. As shown in FIG. 5, with the present embodiment, the forces that the pins 63d and 63e at the ends of the link mechanism 61 receive due to the rotations of the engaging members 66A and 66B are perpendicular to the longitudinal directions of the guide grooves 80A and 80B, in which the pins 63d and 63e can move, and the forces applied from the engaging members 66A and 66B are supported by the edges of the guide grooves 80A and 80B. These forces thus do not act to make the link mechanism 61 transition to the inflected state and the locked state can thus be maintained more securely. Furthermore in this case, loads applied to the links 62b and 62c are made small and malfunction, etc., of the link mechanism 61 can be suppressed.

[0100] Also, the opening and closing apparatus with lock according to the present embodiment has the locking slider 33 that is movable within the horizontal plane according to the driving of the carrier 23. The link mechanism 61 can be deformed to the rectilinear state and the inflected state by the movement of the guiding coupling pin 63c, disposed at the coupling point of the link mechanism 61, in accordance with the movement of the locking slider 33.

[0101] With this arrangement, because the locking slider 33 is movable within the horizontal plane, the installation space can be made small in the height direction. Also, the locking slider 33 can switch the state of the link mechanism 61 by using the guiding coupling pin 63c that constitutes the link mechanism 61, and a simple arrangement with a low number of parts can thus be realized.

[0102] Also, the opening and closing apparatus with lock according to the present embodiment has the locking slider 33 that is enabled to move slidably in one direction within the horizontal plane according to the drive of the carrier 23 and has the slit 33e of a curved shape at the bottom surface. The guiding coupling pin 63c, disposed at one coupling point of the link mechanism 61, is inserted in the slit 33e, and the link mechanism 61 can be deformed to the rectilinear state and the inflected state by the guiding coupling pin 63c, disposed at the coupling point of the link mechanism 61, moving along the slit 33e according to the movement of the locking slider 33.

[0103] With this arrangement, the movement of the link mechanism 61 can be restricted by using the slit 33e at the bottom surface of the locking slider 33 that is enabled to move slidably within the horizontal plane. Because the slit 33e has a curved shape, an arrangement that guides the guiding coupling pin 63c in a direction that differs from the movement direction of the locking slider 33 can be realized in a simple manner. With the present embodiment, deformation of the link mechanism 61 to the rectilinear state and the inflected state can be realized by the second hole portion B that extends curvingly in a direction that differs from the movement direction of the locking slider 33.

[0104] Also, the opening and closing apparatus with lock according to the present embodiment includes the torque limiting spring 71 that makes the predetermined elastic force, which suppresses the rotation of the carrier 23 when the running resistance of the sliding doors 11A and 11B is less than the predetermined running resistance, act on the carrier 23 during the closing operation of the sliding doors 11A and 11B, and the detection switch 84 that is disposed in the base 5 and stops the drive of the electric motor when the deformation amount of the torque limiting spring 71 reaches the predetermined deformation amount during the closing operation of the sliding doors 11A and 11B. Here, the carrier 23 is enabled to output the driving force of the electric motor to the torque limiting spring 71.

[0105] With this arrangement, if during the closing operation of the sliding doors 11A and 11B (during movement of the sliding doors 11A and 11B from the fully open position to the fully closed position), the running resistance of the sliding doors 11A and 11B is smaller than the predetermined running resistance, because the rotation of the carrier 23 is suppressed by the elastic force of the torque limiting spring 71, the driving force of the electric motor is transmitted from the internal gear 22 to the pinion 9 and the closing operation of the sliding doors 11A and 11B is performed. While the closing operation of the sliding doors 11A and 11B, a passenger becomes caught or a sliding door 11A or 11B collides with a passenger, a force no less than the normal running resistance is applied to the sliding doors 11A and 11B, and if the predetermined running resistance is exceeded, the carrier 23 rotates against the elastic force of the torque limiting spring 71 and the torque limiting spring 71 undergoes elastic deformation. When the elastic deformation amount reaches the predetermined amount, the drive of the electric motor is stopped by the detection switch 84. Because the detection switch 84 is disposed on the base 5, fixed to the housing side, as is the electric motor, door catching and collision during the sliding door closing operation can be detected without the wiring becoming complicated. With this arrangement, collision detection is enabled regardless of whether the sliding doors 11A and 11B are accelerating or decelerating and collision detection can be performed across the entire movement range of the sliding doors 11A and 11B.

[0106] Also, the opening and closing apparatus with lock according to the present embodiment has the locking slider 33 that can switch the locking mechanism between the locked state and the unlocked state by moving. The torque limiting spring 71 is disposed between the carrier 23 and the locking slider 33.

[0107] With this arrangement, the output of the carrier 23 can be used to drive the locking slider 33 to switch the locking mechanism 60 and make a force act on the torque limiting spring 71 at the same time. Thus for example, in a case where the torque limiting spring 71 is installed at another position, the driving force from the carrier 23 in the switching of the locking mechanism 60

is allocated in parallel among the torque limiting spring 71, which is installed at the other position, and the locking slider 33. The forces that respectively act on the respective components thus become small. However, by installing the torque limiting spring 71 between the carrier 23 and the locking slider 33 as in the present embodiment, the force applied to the torque limiting spring 71 is also made to act on the locking slider 33 in a serial manner, thus enabling the collision detection and the locking operation to be performed efficiently.

[0108] With the opening and closing apparatus with lock according to the present embodiment, the detection switch 84 is constituted of a limit switch that stops the drive of the electric motor upon detecting that the rotation angle of the carrier 23 has become no less than the predetermined rotation angle.

[0109] With this arrangement, the limit switch detects the rotation angle of the carrier 23, which rotates in correspondence to the deformation of the torque limiting spring 71, to stop the drive of the electric motor. The collision detection unit can thus be arranged with a simple arrangement.

[0110] Also with the opening and closing apparatus with lock according to the present embodiment, the torque limiting spring 71 makes the predetermined elastic force, which suppresses the rotation of the carrier 23, act on the carrier 23 so as to be balanced with the running resistance when the sliding doors 11A and 11B are performing the normal closing operation.

[0111] "Performing the normal closing operation" refers to the state where a force that obstructs the operation of the sliding doors 11A and 11B is not acting from the exterior, and the elastic force that is balanced with the running resistance during this normal closing operation is made to act on the carrier 23 by the torque limiting spring 71. The elastic force that is made to act by the torque limiting spring 71 is thus made smaller. The torque limiting spring 71 can thus be installed in a readily deformable state. Because the torque limiting spring 71 is thereby made more readily deformable by an increase in the running resistance of the sliding doors 11A and 11B, detection of higher sensitivity is enabled. Also the arrangement uses the planetary gear mechanism and thus when the sliding door A or B collides, because the force corresponding to the elastic force of the torque limiting spring 71 acts on the object of collision, by making the elastic force that is made to act by the torque limiting spring 71 small, the impact applied to the object of collision from the sliding door A or B can be relaxed significantly.

[0112] Although an embodiment of the present invention has been described above, the present invention is not restricted to the above-described embodiment, and various modifications are possible within the scope of the claims. For example, the following modifications are possible.

(1) Although in the above-described embodiment,

the sun gear 21 is coupled to the output shaft of the electric motor, the internal gear 22 is coupled to the pinion 9, and the carrier 23 is coupled to the pulling member, the present invention is not restricted to this arrangement.

That is various variations, such as coupling the sun gear 21 to the pinion 9 and coupling the internal gear 22 to the electric motor, etc., are possible.

(2) Although in the above-described embodiment, the coupling between the locking slider and the link mechanism is constituted of the slit portion, formed on the bottom surface of the locking slider, and the coupling pin of the link mechanism, the present invention is not restricted thereto. For example, as shown by an unlocked state illustrated in FIG. 10 and a locked state illustrated in FIG. 11, a coupling pin 33f with roller may be fixed to the bottom surface of the locking slider 33 and the central link of the link mechanism 61 may be arranged as a link 62a', with a shape that can be rotated upon being urged by the coupling pin 33f with roller in accordance with the movement of the locking slider 33. The link mechanism 61 can thereby be made to deform to the inflected state and the rectilinear state according to the movement of the locking slider 33 as described with the embodiment.

(3) Although with the above-described embodiment, the carrier and the locking slider are coupled with the pulling member and the torque limiting spring interposed in between, the carrier may instead be coupled directly to the locking slider.

Claims

1. An opening and closing apparatus with lock comprising:

a rack and pinion mechanism (10), in turn comprising a pair of racks (7A, 7B), respectively mounted on a pair of slide-apart type sliding doors (11A, 11B) that are movable reciprocatingly with respect to a housing, and a pinion (9) engaged with the pair of racks (7A, 7B) ;

an actuator with a main unit portion which is fixed to the housing of the actuator, the actuator functioning as an opening/closing drive source of the sliding doors (11A, 11B);

a locking mechanism (60) mounted on the housing and enabling to lock the pair of sliding doors (11A, 11B) in a fully closed position by constraining respective movements of locking members (14A, 14B) that are respectively fixed to the respective sliding doors (11A, 11B) of the pair of sliding doors (11A, 11B);

a switching mechanism (70, 33) for switching the locking mechanism (60) between a locked state and an unlocked state; and

a planetary gear mechanism (20), having an input portion (21) which rotates as a result of inputting thereto a driving force of the actuator, a first output portion (22) which enables to output the driving force to the pinion (9) by rotating with the rotation of the input portion (21), and a second output portion (23), which enables to output the driving force to the switching mechanism (70, 33) by rotating with the rotation of the input portion (21), the planetary gear mechanism (20) being configured so that the second output portion (23) rotates with the rotation of the input portion (21) when the rotation of the first output portion (22) is constrained and the first output portion (22) rotates with the rotation of the input portion (21) when the rotation of the second output portion (23) is constrained, wherein:

the switching mechanism (70, 33) has a switching member (33) enabling to switch the locking mechanism (60) between the locked state and the unlocked state by moving according to the drive of the second output portion (23);

the locking mechanism (60) has a link mechanism (61) which is formed by coupling a plurality of links (62a, 62b, 62c) in series and deformable to a rectilinear state and to an inflected state according to the movement of the switching member (33), and a link retaining mechanism (65) which retains the link mechanism (61) in the inflected state when the sliding doors (11A, 11B) are in positions other than the fully closed position:

the movement of the switching member (33) is prevented by the link mechanism (61) retained in the inflected state when the sliding doors (11A, 11B) are in positions other than the fully closed position; and

when the sliding doors (11A, 11B) are in the fully closed position, the link mechanism (61) thus retained by the link retaining mechanism (65) is released, which allows the movement of the switching member (33), and the link mechanism (61) deforms from the inflected state to the rectilinear state according to the movement of the switching member (33) moved by the driving force from the second output portion (23) and thereby the movements of the locking members (14A, 14B) fixed to the sliding doors (11A, 11B) are constrained.

2. The opening and closing apparatus with lock according to Claim 1, wherein
each locking member comprises a locking pin (14A, 14B), fixed to the sliding door (11A, 11B) so as to extend in a vertical direction,
the link retaining mechanism (65) comprises a pair of engaging members (66A, 66B), rotatably installed near both ends of the link mechanism (61) and each having a first engaging portion (67A, 67B), engaging with a locking pin (14A, 14B) in the fully closed position, and a second engaging portion (68A, 68B), engaging with an end of the link mechanism (61) in the rectilinear state in the fully closed position, and the engaging members (66A, 66B) prevent the movement of the switching member (33) by preventing transition of the link mechanism (61) to the rectilinear state when the sliding doors (11A, 11B) are in positions other than the fully closed position, and allow the movement of the switching member (33) by being urged by the locking pins (14A, 14B) to rotate to positions enabling engagement of the ends of the link mechanism (61) with the second engaging portions (68A, 68B) during movement of the sliding doors (11A, 11B) in closing directions.
3. The opening and closing apparatus with lock according to Claim 2, wherein
the switching member (33) comprises a locking slider (33) enabling to move slidably in one direction with respect to the locking mechanism (60) and having a slit portion of a curved shape at a bottom surface, the link mechanism (61) operates within a plane parallel to the bottom surface of the locking slider (33) and has a coupling pin (63a), disposed at one coupling point, inserted in the slit portion (33e), and the link mechanism (61) is deformed to the rectilinear state and the inflected state by the coupling pin moving (63a) along the slit portion (33e) according to the movement of the lock slider (33).
4. The opening and closing apparatus with lock according to Claim 1, wherein
the link mechanism (61) is deformable to the rectilinear state and the inflected state within a horizontal plane.
5. The opening and closing apparatus with lock according to Claim 4, wherein
the link mechanism (61) has links (62a, 62b, 62c), each rotatably fixed to the housing, and a movement of an end of the link mechanism (61) is restricted by a rectilinear guide groove (80A) provided in the housing.
6. The opening and closing apparatus with lock according to Claim 4 or 5, wherein
each locking member comprises a locking pin (14A, 14B), fixed to the sliding door (11A, 11B) so as to

extend in a vertical direction, and
the locking mechanism (60) further comprises an engaging member (66A, 66B), rotatably installed within a horizontal plane near an end of the link mechanism (61) and having a first engaging portion (67A, 67B), engaging with a locking pin (14A, 14B) in the fully closed position, and a second engaging portion (68A, 68B), engaging with the end of the link mechanism (61) in the rectilinear state in the fully closed position.

7. The opening and closing apparatus with lock according to Claim 4 or 5, wherein
the switching member (33) is movable within a horizontal plane according to the driving of the second output portion (23), and
the link mechanism (61) can be deformed to the rectilinear state and the inflected state by movement of a coupling pin (63c), disposed at a coupling point of the link mechanism (61), in accordance with the movement of the switching member (33).
8. The opening and closing apparatus with lock according to Claim 7, wherein
the switching member (33) is a locking slider (33) enabling to move slidably in one direction within a horizontal plane according to the drive of the second output portion (23) and having a slit portion (33e) of a curved shape at a bottom surface,
a coupling pin (63c), disposed at one coupling point of the link mechanism (61), is inserted in the slit portion (33e), and the link mechanism (61) can be deformed to the rectilinear state and the inflected state by the coupling pin (63c), disposed at the coupling point of the link mechanism (61), moving along the slit portion (33e) according to the movement of the locking slider (33).
9. The opening and closing apparatus with lock according to Claim 1, further comprising:

an elastic member; and a collision detection unit (84), disposed in the housing and stopping the drive of the actuator when a deformation amount of the elastic member reaches a predetermined deformation amount during a closing operation of the sliding doors (11A, 11B); wherein
the second output portion (23) is enabled to output the driving force of the actuator to the elastic member.
10. The opening and closing apparatus with lock according to Claim 9, wherein
the elastic member is disposed between the second output portion (23) and the switching member (33).
11. The opening and closing apparatus with lock according to Claim 9 or 10, wherein

the collision detection unit (84) comprises a limit switch, stopping the drive of the actuator upon detecting that a rotation angle of the second output portion (23) has become no less than a predetermined rotation angle.

12. The opening and closing apparatus with lock according to Claim 9 or 10, wherein the elastic member is disposed so as to be balanced with a running resistance when the sliding doors (11A, 11B) are performing a normal closing operation.

Patentansprüche

1. Öffnungs- und Verschlusvorrichtung mit Sperre, umfassend:

einen Zahnstangenmechanismus (10), der ein Paar Zahnstangen (7A, 7B), die jeweils an einem Paar auseinanderschließbaren Schiebetüren (11A, 11B) angebracht sind, die in bezug auf ein Gehäuse hin und her bewegbar sind, und ein Antriebsrad (9), das mit dem Paar der Zahnstangen (7A, 7B) in Eingriff steht, umfaßt, einen Aktuator mit einer Hauptabschnittseinheit, welche an dem Gehäuse des Aktuators befestigt ist, wobei der Aktuator als Öffnungs-/Schließ-Antriebsquelle der Schiebetüren (11 A, 11 B) dient, einen Sperrmechanismus (60), der an dem Gehäuse angebracht ist und es ermöglicht, das Paar der Schiebetüren (11A, 11 B) in einer vollständig geschlossenen Position zu sperren, in dem entsprechende Bewegungen von Sperr-elementen (14A, 14B), die jeweils an den entsprechenden Schiebetüren (11A, 11B) des Paares der Schiebetüren (11 A, 11 B) befestigt sind, beschränkt werden, einen Umschaltmechanismus (70, 33) zum Umschalten des Sperrmechanismus (60) zwischen einem gesperrten Zustand und einem ungesperrten Zustand und einen Planetengetriebemechanismus (20), der einen Eingabeabschnitt (21), der als Folge des Eingebens einer Antriebskraft des Aktuators rotiert, einen ersten Ausgabeabschnitt (22), der es ermöglicht, die Antriebskraft auf das Antriebsrad (9) durch Rotieren mit der Rotation des Eingabeabschnitts (21) auszugeben, und einen zweiten Ausgabeabschnitt (23), der es ermöglicht die Antriebskraft auf den Umschaltmechanismus (70, 33) durch Rotieren mit der Rotation des Eingabeabschnitts (21) auszugeben, aufweist, wobei der Planetengetriebemechanismus (20) so ausgelegt ist, daß der zweite Ausgabeabschnitt (23) mit der Rotation des Eingabeabschnitts (21) rotiert, wenn die Rotation des ersten Ausgabeabschnitts (22) beschränkt wird, und der erste Ausgabeabschnitt (22) mit der Rotation des Eingabeabschnitts (21) rotiert, wenn die Rotation des zweiten Ausgabeabschnitts (23) beschränkt wird, wobei:

der Umschaltmechanismus (70, 33) ein Umschaltelement (33) aufweist, das es ermöglicht, den Sperrmechanismus (60) zwischen dem gesperrten Zustand und dem ungesperrten Zustand durch Bewegen entsprechend des Antriebs des zweiten Ausgabeabschnitts (23) umzuschalten, der Sperrmechanismus (60) einen Gelenkmechanismus (61) aufweist, der durch Koppeln mehrerer Gelenke (62a, 62b, 62c) in Reihe gebildet und entsprechend der Bewegung des Umschaltelements (33) in einen gradlinigen Zustand und in einen gebeugten Zustand verformbar ist, und ein Gelenkzurückhaltemechanismus (65), der den Gelenkmechanismus (61) in dem gebeugten Zustand zurückhält, wenn die Schiebetüren (11 A, 11 B) sich in anderen Positionen als der vollständig geschlossenen Position befinden:

die Bewegung des Umschaltelements (33) wird durch den in dem gebeugten Zustand zurückgehaltenen Gelenkmechanismus (61) verhindert, wenn die Schiebetüren (11A, 11B) sich in anderen Positionen als der vollständig geschlossenen Position befinden, und wenn sich die Schiebetüren (11 A, 11 B) in der vollständig geschlossenen Position befinden, wird der durch den Gelenkzurückhaltemechanismus (65) zurückgehaltene Gelenkmechanismus (61) freigegeben, was die Bewegung des Umschaltelements (33) erlaubt, und der Gelenkmechanismus (61) verformt sich von dem gebeugten Zustand in den gradlinigen Zustand entsprechend der Bewegung des durch die Antriebskraft von dem zweiten Ausgabeabschnitt (23) bewegten Umschaltelements (33) und dadurch werden die Bewegungen der Sperrelemente (14A, 14B), die an den Schiebetüren (11A, 11B) befestigt sind, beschränkt.

2. Öffnungs- und Verschlusvorrichtung mit Sperre nach Anspruch 1, wobei jedes Sperrelement einen Sperrstift (14A, 14B) umfaßt, der an der Schiebetür (11 A, 11 B) so befestigt ist, daß er sich in einer vertikalen Richtung erstreckt, der Gelenkzurückhaltemechanismus (65) ein Paar eingreifende Elemente (66A, 66B) umfaßt, die in der Nähe der beiden Enden des Gelenkmechanismus

- (61) drehbar angebracht sind und jeweils einen ersten eingreifenden Abschnitt (67A, 67B), der in einen Sperrstift (14A, 14B) in der vollständig geschlossenen Position eingreift, und einen zweiten eingreifenden Abschnitt (68A, 68B), der in ein Ende des Gelenkmechanismus (61) im gradlinigen Zustand in der vollständig geschlossenen Position eingreift, aufweisen, und
- die eingreifenden Elemente (66A, 66B) die Bewegung des Umschaltelements (33) verhindern, in dem sie den Übergang des Gelenkmechanismus (61) in den gradlinigen Zustand verhindern, wenn sich die Schiebetüren (11 A, 11 B) in anderen Positionen als der vollständig geschlossenen Position befinden, und die Bewegung des Umschaltelements (33) erlauben, in dem sie durch die Sperrstifte dazu angetrieben werden, sich in Positionen zu drehen, die das Eingreifen der Enden des Gelenkmechanismus (61) in die zweiten eingreifenden Abschnitte (68A, 68B) während der Bewegung der Schiebetüren (11A, 11B) in Schließrichtung ermöglichen.
3. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 2, wobei
- das Umschaltelement (33) ein Sperrgleitstück (33) umfaßt, das es ermöglicht, sich gleitend in einer Richtung in bezug zum Sperrmechanismus (60) zu bewegen, und das einen Schlitzabschnitt in gebogener Form an der Bodenfläche aufweist, der Gelenkmechanismus (61) innerhalb einer Ebene parallel zur Bodenfläche des Sperrgleitstücks (33) arbeitet und einen an einem Kopplungspunkt angeordneten Kopplungsstift (63a) aufweist, der in den Schlitzabschnitt (33e) eingeführt ist, und der Gelenkmechanismus (61) in den gradlinigen Zustand und den gebeugten Zustand durch den sich entlang des Schlitzabschnitts (33e) entsprechend der Bewegung des Gleitstücks (33) bewegendes Kopplungsstift (63a) verformt wird.
4. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 1, wobei
- der Gelenkmechanismus (61) innerhalb einer horizontalen Ebene in den gradlinigen Zustand und den gebeugten Zustand verformbar ist.
5. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 4, wobei
- der Gelenkmechanismus (61) Gelenke (62a, 62b, 62c) aufweist, die jeweils drehbar am Gehäuse befestigt sind, und eine Bewegung eines Endes des Gelenkmechanismus (61) durch eine am Gehäuse vorgesehene gradlinige Führungsnut (80A) beschränkt wird.
6. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 4 oder 5, wobei jedes Sperrelement einen Sperrstift (14A, 14B) umfaßt, der an der Schiebetür (11 A, 11 B) so befestigt ist, daß er sich in einer vertikalen Richtung erstreckt, und der Sperrmechanismus (60) ferner ein eingreifendes Element (66A, 66B) umfaßt, das innerhalb einer horizontalen Ebene in der Nähe eines Endes des Gelenkmechanismus (61) drehbar angebracht ist, und einen ersten eingreifenden Abschnitt (67A, 67B), der in einen Sperrstift (14A, 14B) in der vollständig geschlossenen Position eingreift, und einen zweiten eingreifenden Abschnitt (68A, 68B), der in das Ende des Gelenkmechanismus (61) im gradlinigen Zustand in der vollständig geschlossenen Position eingreift, aufweist.
7. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 4 oder 5, wobei
- das Umschaltelement (33) innerhalb einer horizontalen Ebene entsprechend des Antriebs des zweiten Ausgabeabschnitts (23) bewegbar ist und der Gelenkmechanismus (61) in den gradlinigen Zustand und den gebeugten Zustand durch Bewegung eines Kopplungsstiftes (63c), der an einem Kopplungspunkt des Gelenkmechanismus (61) angebracht ist, in Übereinstimmung mit der Bewegung des Umschaltelements (33) verformt werden kann.
8. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 7, wobei
- das Umschaltelement (33) ein Sperrgleitstück (33) ist, das es ermöglicht, sich gleitend in einer Richtung innerhalb einer horizontalen Ebene entsprechend des Antriebs des zweiten Ausgabeabschnitts (23) zu bewegen, und der einen Schlitzabschnitt (33e) in gebogener Form an der Bodenfläche aufweist, ein Kopplungsstift (63c), der an einem Kopplungspunkt des Gelenkmechanismus (61) angeordnet ist, in den Schlitzabschnitt (33e) eingeführt wird und der Gelenkmechanismus (61) durch den an dem Kopplungspunkt des Gelenkmechanismus (61) angeordneten Kopplungsstift (63c), der sich entlang des Schlitzabschnitts (33e) entsprechend der Bewegung des Sperrgleitstücks (33) bewegt, in den gradlinigen Zustand und den gebeugten Zustand verformt werden kann.
9. Öffnungs- und Verschlussvorrichtung mit Sperre nach Anspruch 1, ferner umfassend:
- ein elastisches Element und eine Kollisionserkennungseinheit (84), die in dem Gehäuse angeordnet sind und den Antrieb des Aktuators stoppen, wenn ein Verformungsgrad des elastischen Elements einen vorbestimmten Verformungsgrad während eines Schließvorgangs der Schiebetüren (11 A, 11 B) erreicht, wobei der zweite Ausgabeabschnitt (32) es ermöglicht, die Antriebskraft des Aktuators an das elastische Element auszugeben.

10. Öffnungs- und Verschlusvorrichtung mit Sperre nach Anspruch 9, wobei das elastische Element zwischen dem zweiten Ausgabeabschnitt (23) und dem Umschaltetelement (33) angeordnet ist. 5
11. Öffnungs- und Verschlusvorrichtung mit Sperre nach Anspruch 9 oder 10, wobei die Kollisionserkennungseinheit (84) einen Begrenzungsschalter umfaßt, der den Antrieb des Aktuators stoppt, wenn erkannt wird, daß ein Rotationswinkel des zweiten Ausgabeabschnitts (23) nicht kleiner als ein vorbestimmter Rotationswinkel geworden ist. 10
12. Öffnungs- und Verschlusvorrichtung mit Sperre nach Anspruch 9 oder 10, wobei das elastische Element so angeordnet ist, daß es sich im Gleichgewicht mit einem Reibungswiderstand befindet, wenn die Schiebetüren (11A, 11B) einen normalen Schließvorgang durchführen. 20

Revendications

1. Appareil d'ouverture et de fermeture avec verrou comportant : 25
- un mécanisme à pignon et crémaillère (10), comportant à son tour une paire de crémaillères (7A, 7B), montées de manière respective sur une paire de portes coulissantes du type s'écarter par coulissement (11A, 11B) qui sont mobiles en va et vient par rapport à un logement, et un pignon (9) engagé avec la paire de crémaillères (7A, 7B) ; 30
- un dispositif d'actionnement avec une partie d'unité principale qui est fixée sur le logement du dispositif d'actionnement, le dispositif d'actionnement fonctionnant comme une source d'entraînement d'ouverture/fermeture des portes coulissantes (11A, 11B) ; 35
- un mécanisme de blocage (60) monté sur le logement et permettant de bloquer la paire de portes coulissantes (11A, 11B) en position totalement fermée en limitant des mouvements respectifs d'éléments de blocage (14A, 14B) qui sont fixés de manière respective sur les portes coulissantes respectives (11A, 11B) de la paire de portes coulissantes (11A, 11B) ; 40
- un mécanisme de commutation (70, 33) destiné à commuter le mécanisme de blocage (60) entre un état bloqué et un état débloqué ; et 45
- un mécanisme d'engrenage planétaire (20), ayant une partie d'entrée (21) qui tourne en raison de l'entrée d'une force d'entraînement du dispositif d'actionnement, une première partie de sortie (22) qui permet de délivrer la force d'entraînement au pignon (9) par rotation avec la 50

rotation de la partie d'entrée (21), et une deuxième partie de sortie (23), qui permet de délivrer la force d'entraînement au mécanisme de commutation (70, 33) par rotation avec la rotation de la partie d'entrée (21), le mécanisme d'engrenage planétaire (20) étant configuré de telle sorte que la deuxième partie de sortie (23) tourne avec la rotation de la partie d'entrée (21) quand la rotation de la première partie de sortie (22) est retenue et la première partie de sortie (22) tourne avec la rotation de la partie d'entrée (21) quand la rotation de la deuxième partie de sortie (23) est retenue, dans lequel :

le mécanisme de commutation (70, 33) a un élément de commutation (33) permettant de commuter le mécanisme de blocage entre l'état bloqué et l'état débloqué par déplacement en fonction de l'entraînement de la deuxième partie de sortie (23) ; le mécanisme de blocage (60) a un mécanisme de liaison qui est formé en reliant une pluralité de biellettes (62a, 62b, 62c) en série et déformable jusqu'à un état rectiligne et un état fléchi en fonction du mouvement de l'élément de commutation (33), et un mécanisme de retenue de liaison (65) qui maintient le mécanisme de liaison (61) dans l'état fléchi quand les portes coulissantes (11A, 11B) sont dans des positions autres que la position totalement fermée ;

le mouvement de l'élément de commutation (33) est empêché par le mécanisme de liaison (61) maintenu dans l'état fléchi quand les portes coulissantes (11A, 11B) sont dans des positions autres que la position totalement fermée ; et quand les portes coulissantes (11A, 11B) sont dans la position totalement fermée, le mécanisme de liaison (61) ainsi maintenu par le mécanisme de retenue de liaison (65) est libéré, ce qui permet le mouvement de l'élément de commutation (33), et le mécanisme de liaison (61) se déforme de l'état fléchi jusqu'à l'état rectiligne en fonction du mouvement de l'élément de commutation (33) déplacé par la force d'entraînement de la deuxième partie de sortie (23) et ainsi les mouvements des éléments de blocage (14A, 14B) fixés sur les portes coulissantes (11A, 11B) sont retenus.

2. Appareil d'ouverture et de fermeture avec verrou selon la revendication 1, dans lequel

- chaque élément de blocage comporte un axe de blocage (14A, 14B), fixé sur la porte coulissante (11A, 11B) de façon à s'étendre dans une direction verticale,
- le mécanisme de retenue de liaison (65) comporte une paire d'éléments d'engagement (66A, 66B), installés de façon rotative près des deux extrémités du mécanisme de liaison (61) et ayant chacun une première partie d'engagement (67A, 67B), engageant un axe de blocage (14A, 14B) dans la position totalement fermée, et une deuxième partie d'engagement (68A, 68B), engageant une extrémité du mécanisme de liaison (61) dans l'état rectiligne dans la position totalement fermée, et
- les éléments d'engagement (66A, 66B) empêchent le mouvement de l'élément de commutation (33) en empêchant une transition du mécanisme de liaison (61) jusqu'à l'état rectiligne quand les portes coulissantes (11A, 11B) sont dans des positions autres que la position totalement fermée, et permettent le mouvement de l'élément de commutation (33) en étant poussés par les axes de blocage (14A, 14B) afin de tourner jusqu'à des positions permettant un engagement des extrémités du mécanisme de liaison (61) avec les deuxième parties d'engagement (68A, 68B) pendant le mouvement des portes coulissantes (11A, 11B) dans des directions de fermeture.
3. Appareil d'ouverture et de fermeture avec verrou selon la revendication 2, dans lequel
l'élément de commutation (33) comporte un élément coulissant de blocage (33) permettant de se déplacer de façon coulissante dans une direction par rapport au mécanisme de blocage (60) et ayant une partie de fente d'une forme courbe au niveau d'une surface inférieure,
le mécanisme de liaison (61) fonctionne dans un plan parallèle à la surface inférieure de l'élément coulissant de blocage (33) et a un axe de couplage (63a), disposé au niveau d'un point de couplage, inséré dans la partie de fente (33e), et
le mécanisme de liaison (61) est déformé jusqu'à l'état rectiligne et l'état fléchi par l'axe de couplage (63a) se déplaçant le long de la partie de fente (33e) en fonction du mouvement de l'élément coulissant de blocage (33).
 4. Appareil d'ouverture et de fermeture avec verrou selon la revendication 1, dans lequel
le mécanisme de liaison (61) est déformable jusqu'à l'état rectiligne et l'état fléchi dans un plan horizontal.
 5. Appareil d'ouverture et de fermeture avec verrou selon la revendication 4, dans lequel
le mécanisme de liaison (61) a des biellettes (62a, 62b, 62c), chacune fixée de façon rotative sur le logement, et un mouvement d'une extrémité du mécanisme de liaison (61) est limité par une rainure de guidage rectiligne (80A) prévue dans le logement.
 6. Appareil d'ouverture et de fermeture avec verrou selon la revendication 4 ou 5, dans lequel
chaque élément de blocage comporte un axe de blocage (14A, 14B), fixé sur la porte coulissante (11A, 11B) de façon à s'étendre dans une direction verticale, et
le mécanisme de blocage (60) comporte en outre un élément d'engagement (66A, 66B), installé de façon rotative dans un plan horizontal près d'une extrémité du mécanisme de liaison (61) et ayant une première partie d'engagement (67A, 67B), engageant un axe de blocage (14A, 14B) dans la position totalement fermée, et une deuxième partie d'engagement (68A, 68B), engageant l'extrémité du mécanisme de liaison (61) dans l'état rectiligne dans la position totalement fermée.
 7. Appareil d'ouverture et de fermeture avec verrou selon la revendication 4 ou 5, dans lequel
l'élément de commutation (33) est mobile dans un plan horizontal en fonction de l'entraînement de la deuxième partie de sortie (23), et
le mécanisme de liaison (61) peut être déformé jusqu'à l'état rectiligne et l'état fléchi par le mouvement d'un axe de couplage (63c), disposé au niveau d'un point de couplage du mécanisme de liaison (61), en fonction du mouvement de l'élément de commutation (33).
 8. Appareil d'ouverture et de fermeture avec verrou selon la revendication 7, dans lequel
l'élément de commutation (33) est un élément coulissant de blocage (33) permettant de se déplacer de façon coulissante dans une direction dans un plan horizontal en fonction de l'entraînement de la deuxième partie de sortie (23) et ayant une partie de fente (33e) d'une forme courbe sur une surface inférieure, un axe de couplage (63c), disposé au niveau d'un point de couplage du mécanisme de liaison (61), est inséré dans la partie de fente (33e), et le mécanisme de liaison (61) peut être déformé jusqu'à l'état rectiligne et l'état fléchi par l'axe de couplage (63c), disposé au niveau du point de couplage du mécanisme de liaison (61), en se déplaçant le long de la partie de fente (33e) en fonction du mouvement de l'élément coulissant de blocage (33).
 9. Appareil d'ouverture et de fermeture avec verrou selon la revendication 1, comportant en outre :
un élément élastique ; et une unité de détection de collision (84), disposée dans le logement et arrêtant l'entraînement du dispositif d'actionnement quand une quantité de déformation de l'élément élastique atteint une quantité de dé-

formation prédéterminée pendant une opération de fermeture des portes coulissantes (11A, 11B) ; dans lequel la deuxième partie de sortie (23) est activée afin de délivrer la force d'entraînement du dispositif d'actionnement à l'élément élastique. 5

10. Appareil d'ouverture et de fermeture avec verrou selon la revendication 9, dans lequel l'élément élastique est disposé entre la deuxième partie de sortie (23) et l'élément de commutation (33). 10
11. Appareil d'ouverture et de fermeture avec verrou selon la revendication 9 ou 10, dans lequel l'unité de détection de collision (84) comporte un commutateur de limite, arrêtant l'entraînement du dispositif d'actionnement lors de la détection du fait qu'un angle de rotation de la deuxième partie de sortie (23) n'est pas devenu inférieur à un angle de rotation prédéterminé. 15 20
12. Appareil d'ouverture et de fermeture avec verrou selon la revendication 9 ou 10, dans lequel l'élément élastique est disposé de façon à être équilibré avec une résistance au déplacement quand les portes coulissantes (11A, 11B) réalisent une opération de fermeture normale. 25

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Fig.1

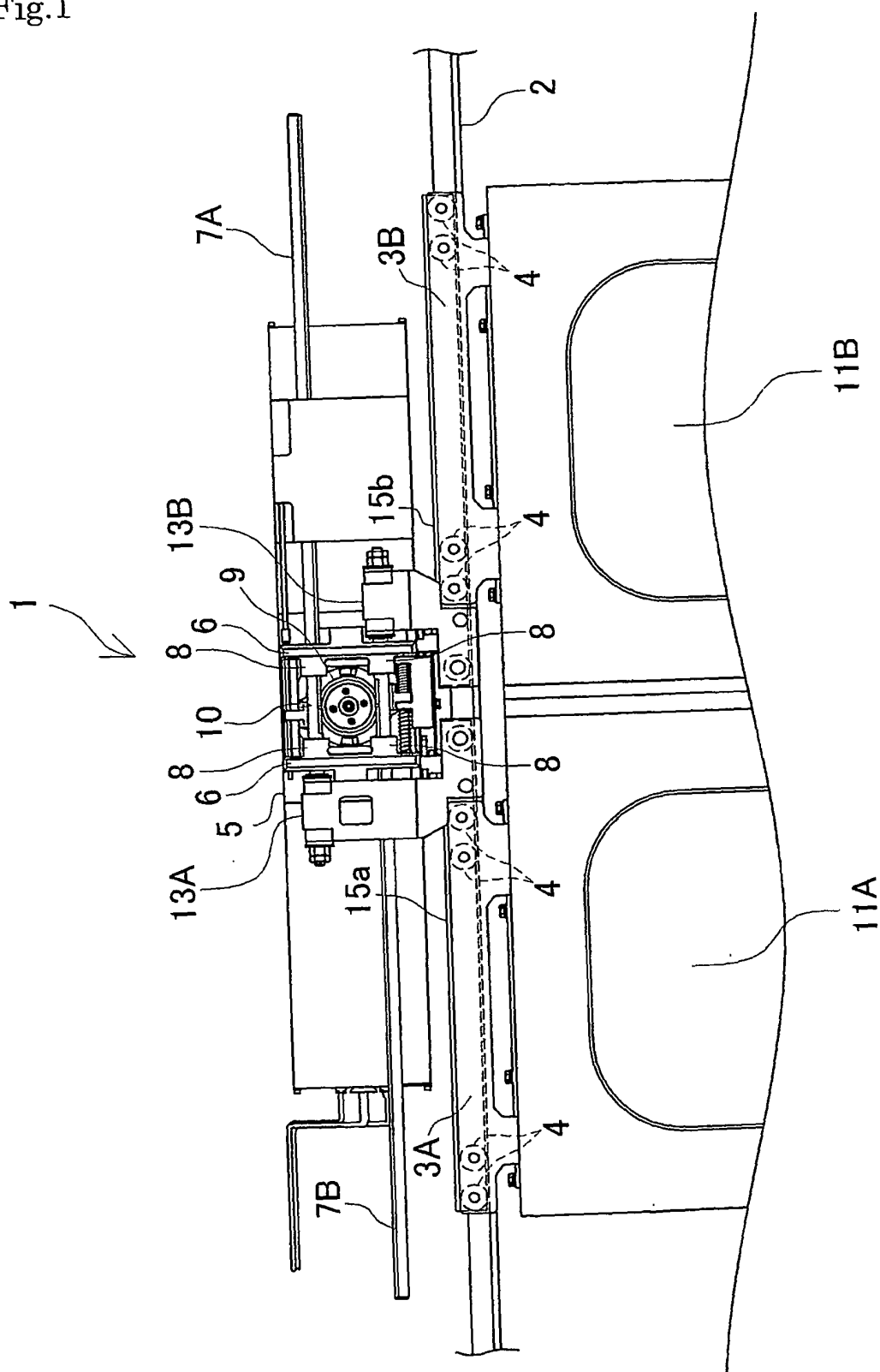


Fig.2

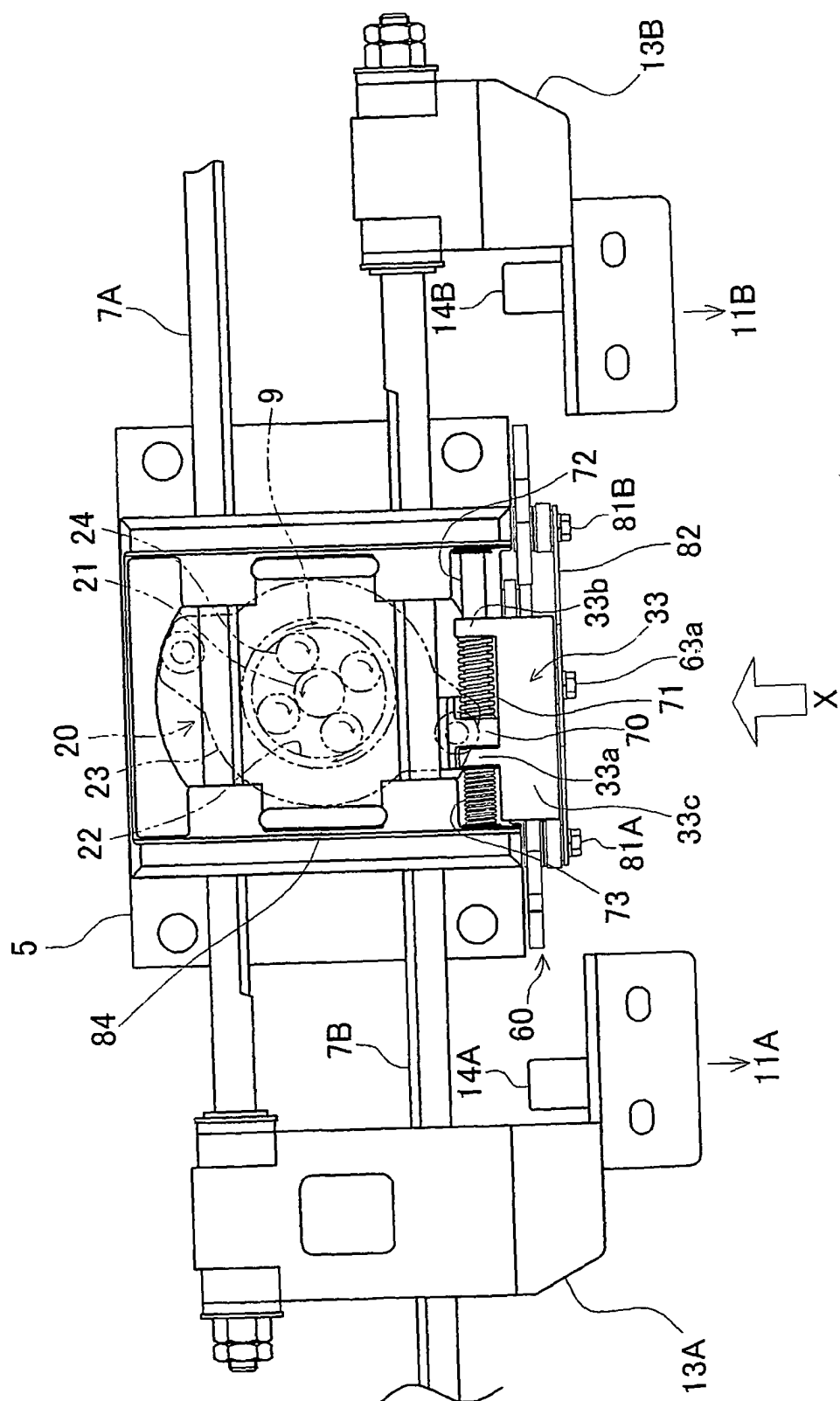


Fig.3

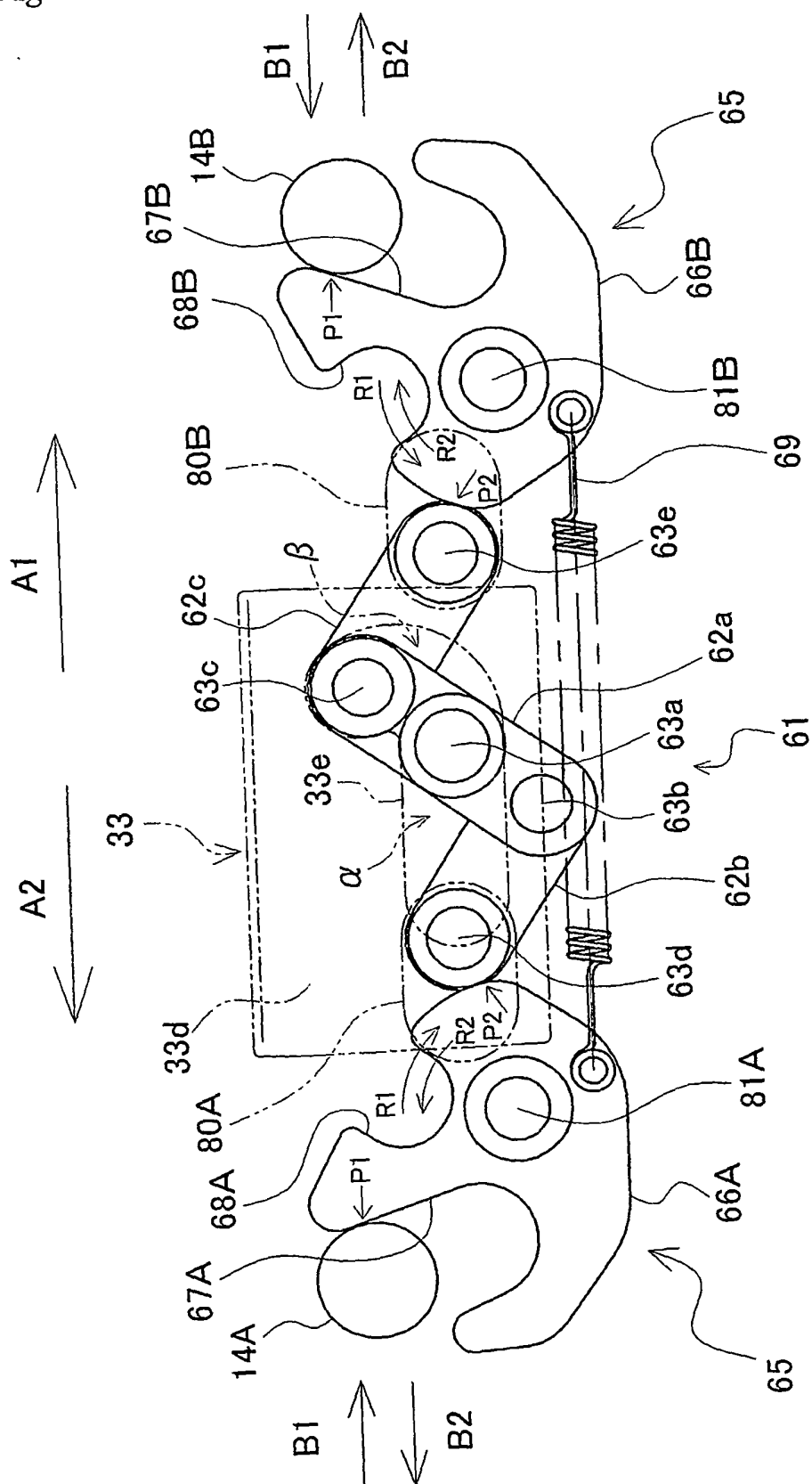


Fig.4

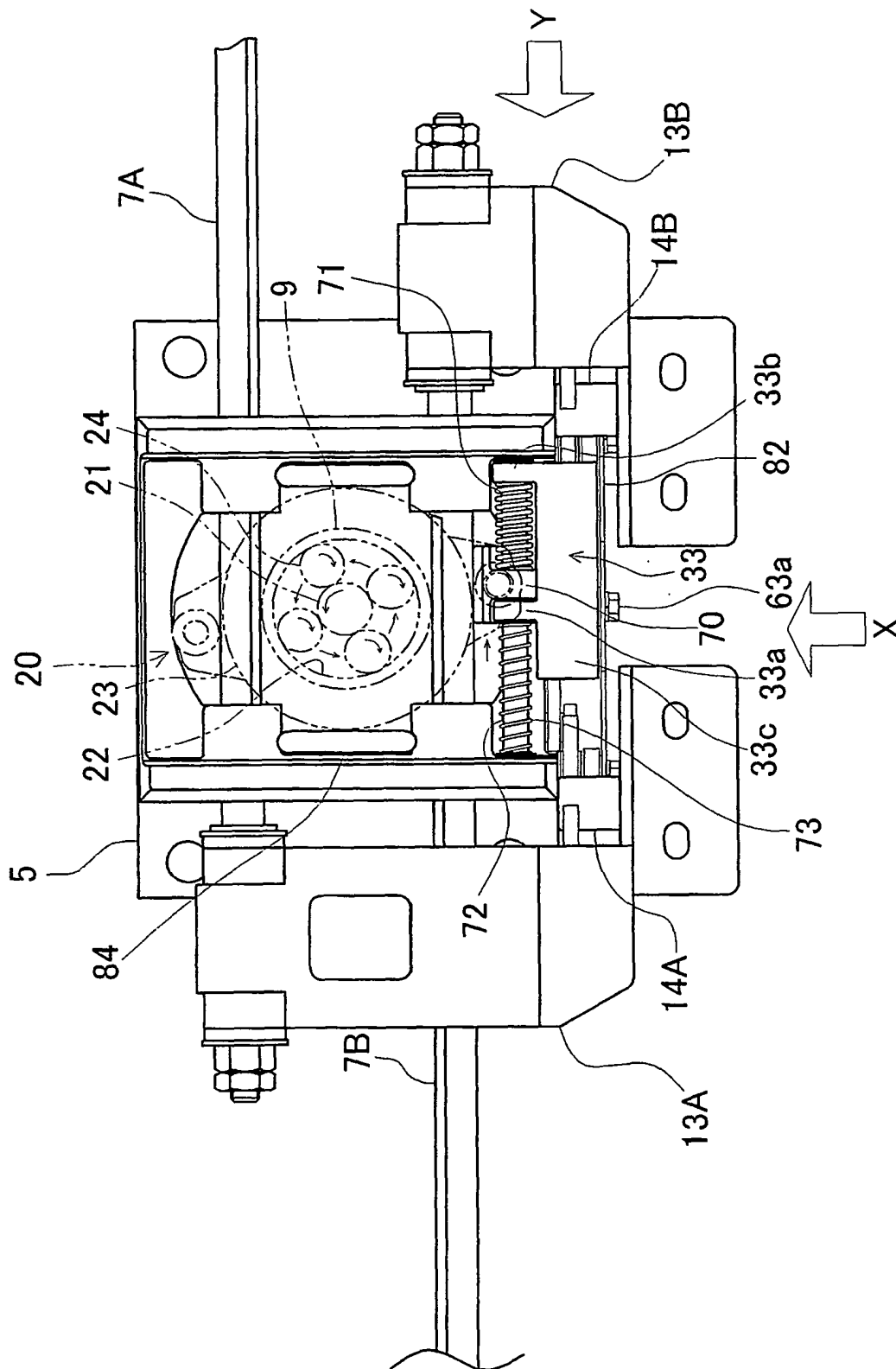


Fig.5

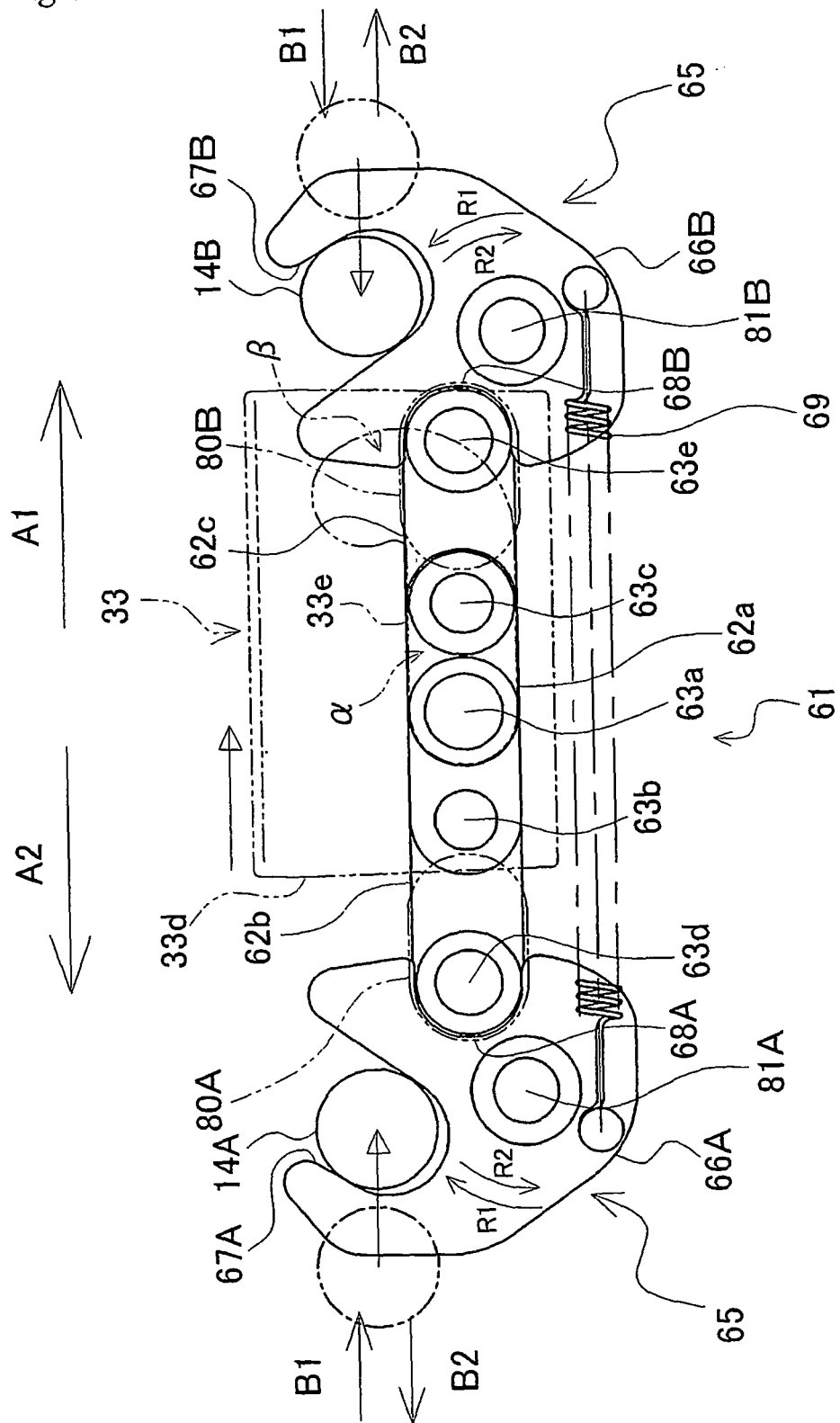


Fig.6

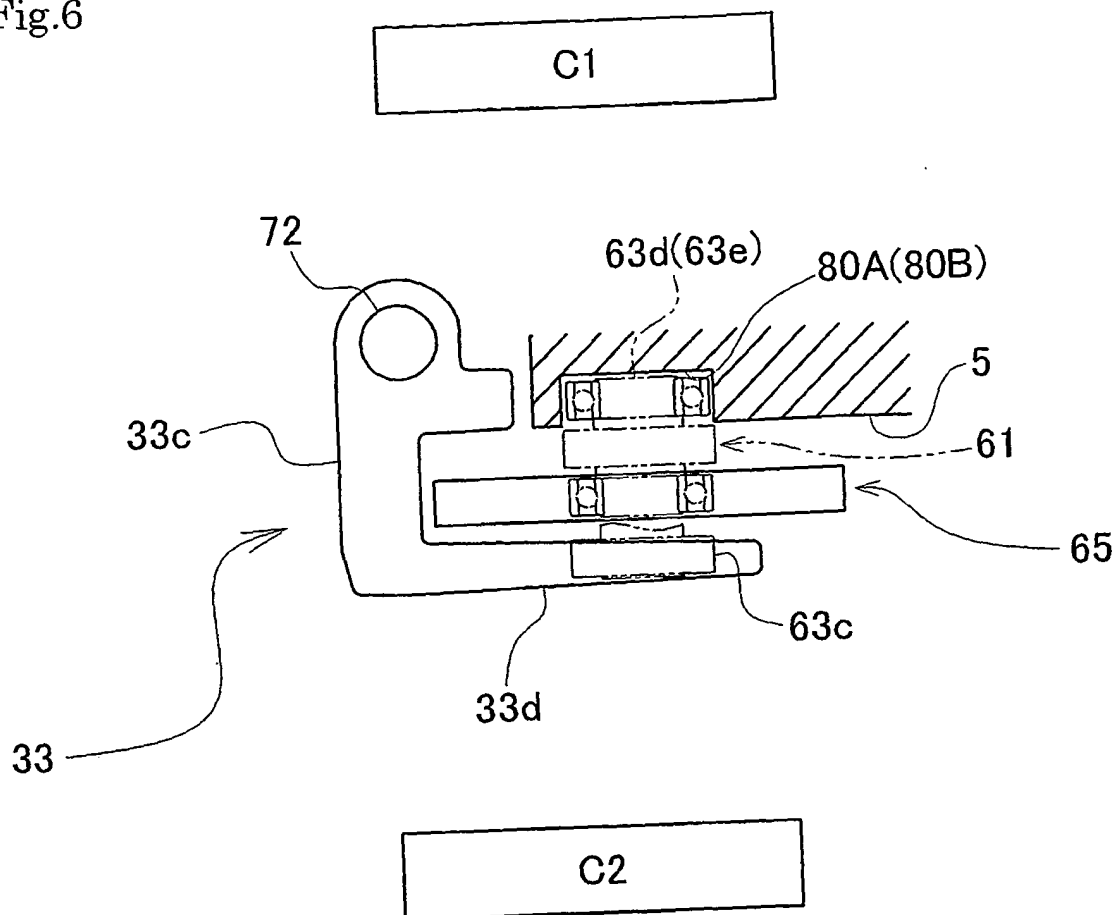


Fig.7

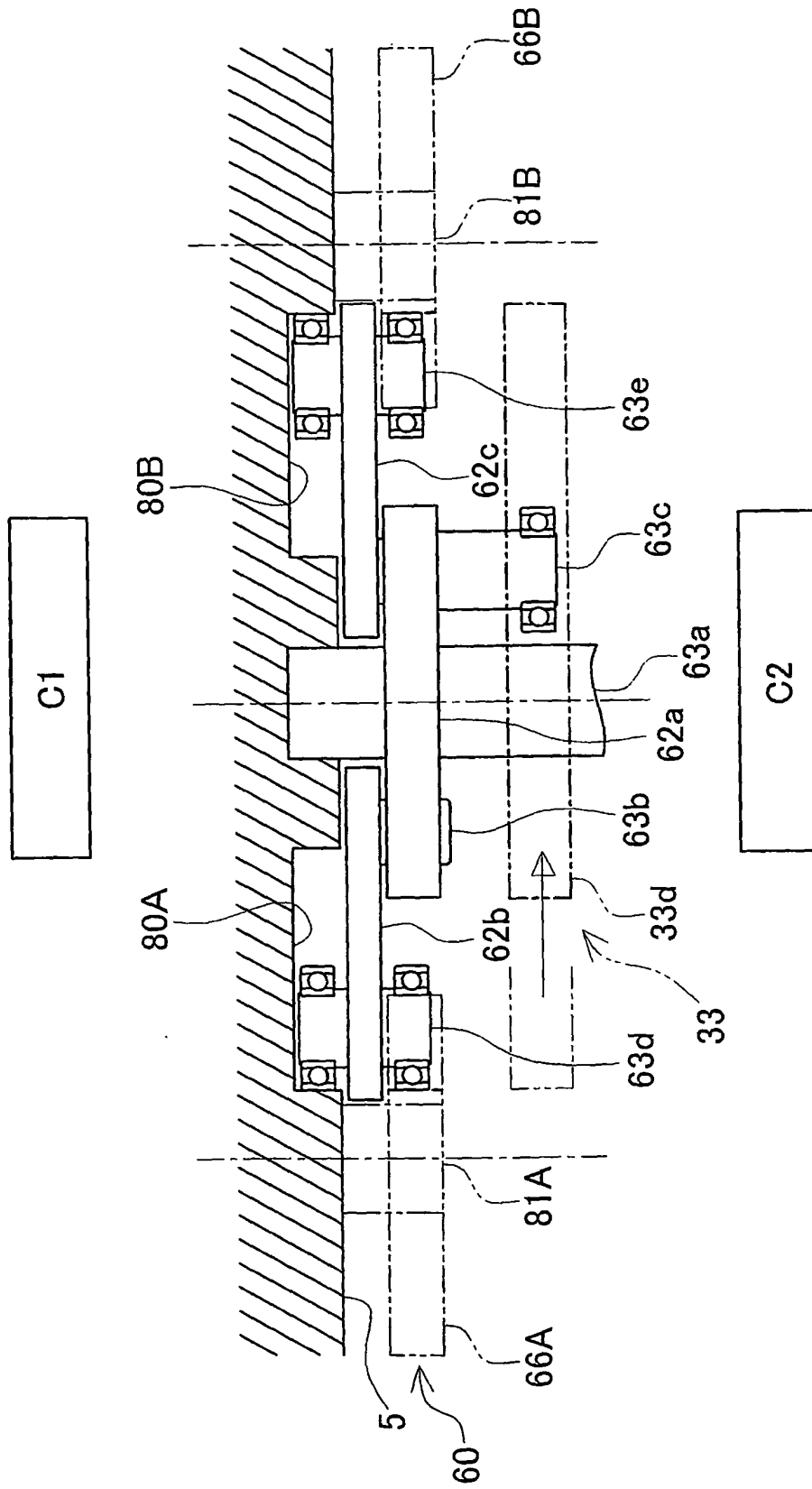


Fig.8

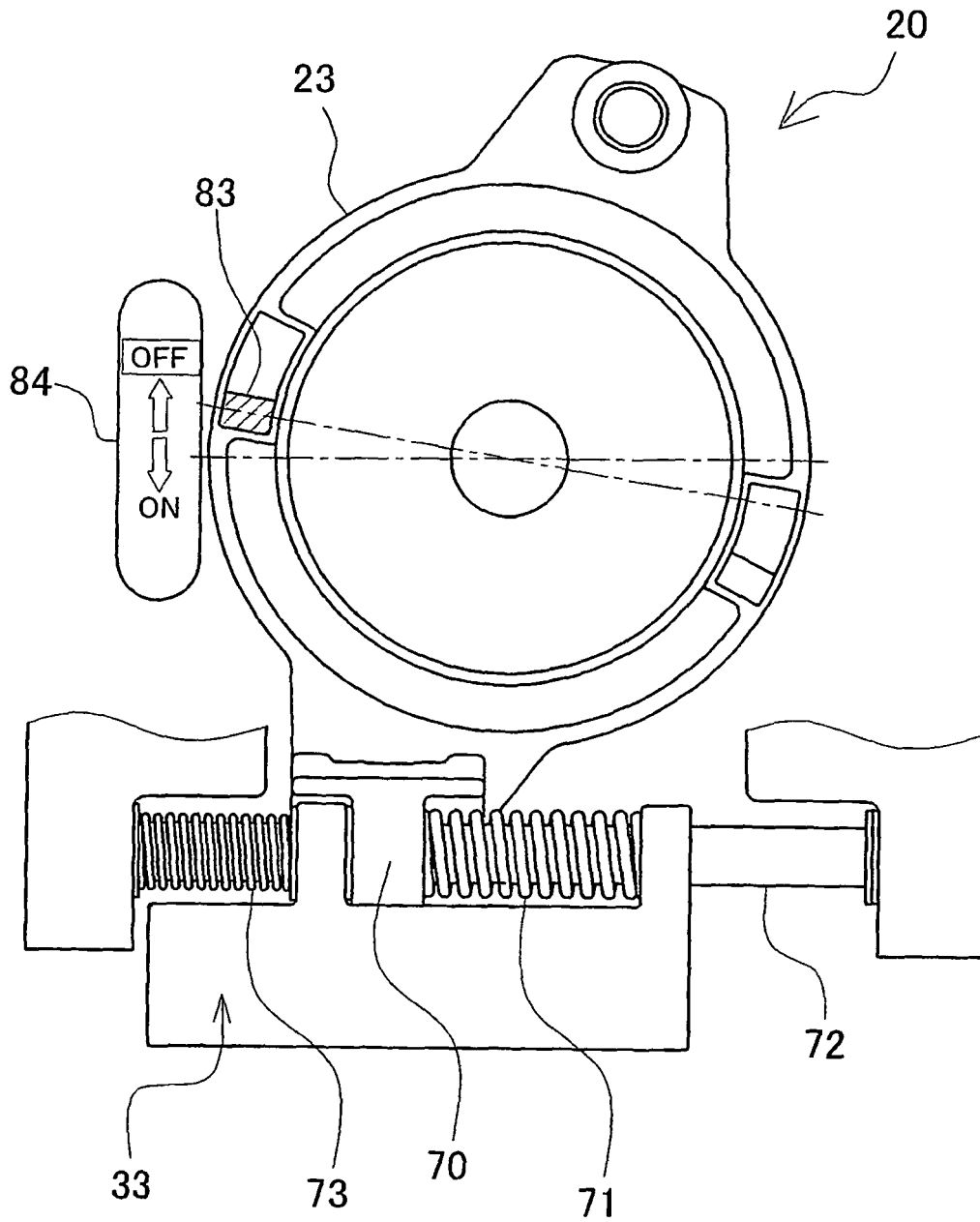


Fig.9

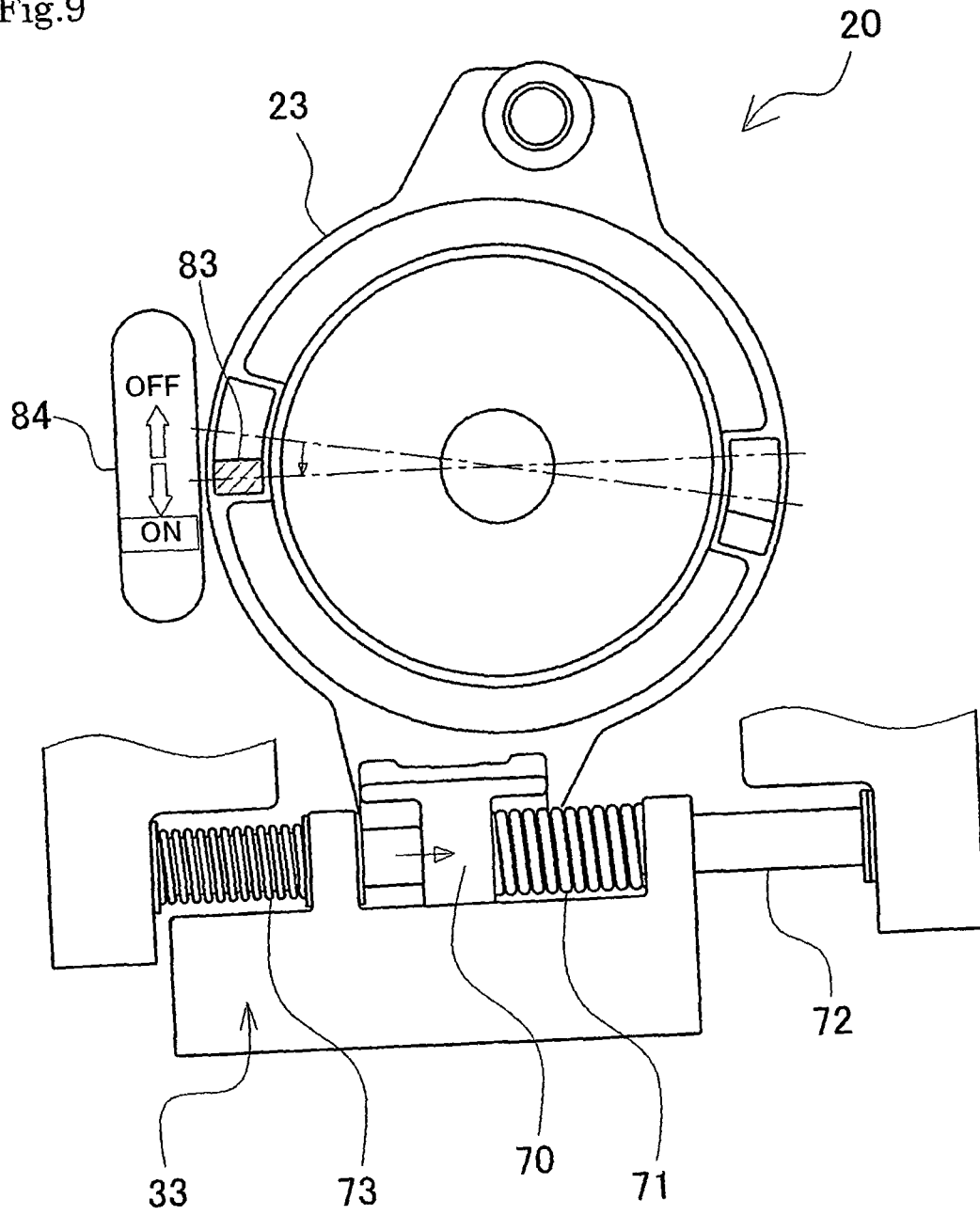


Fig.10

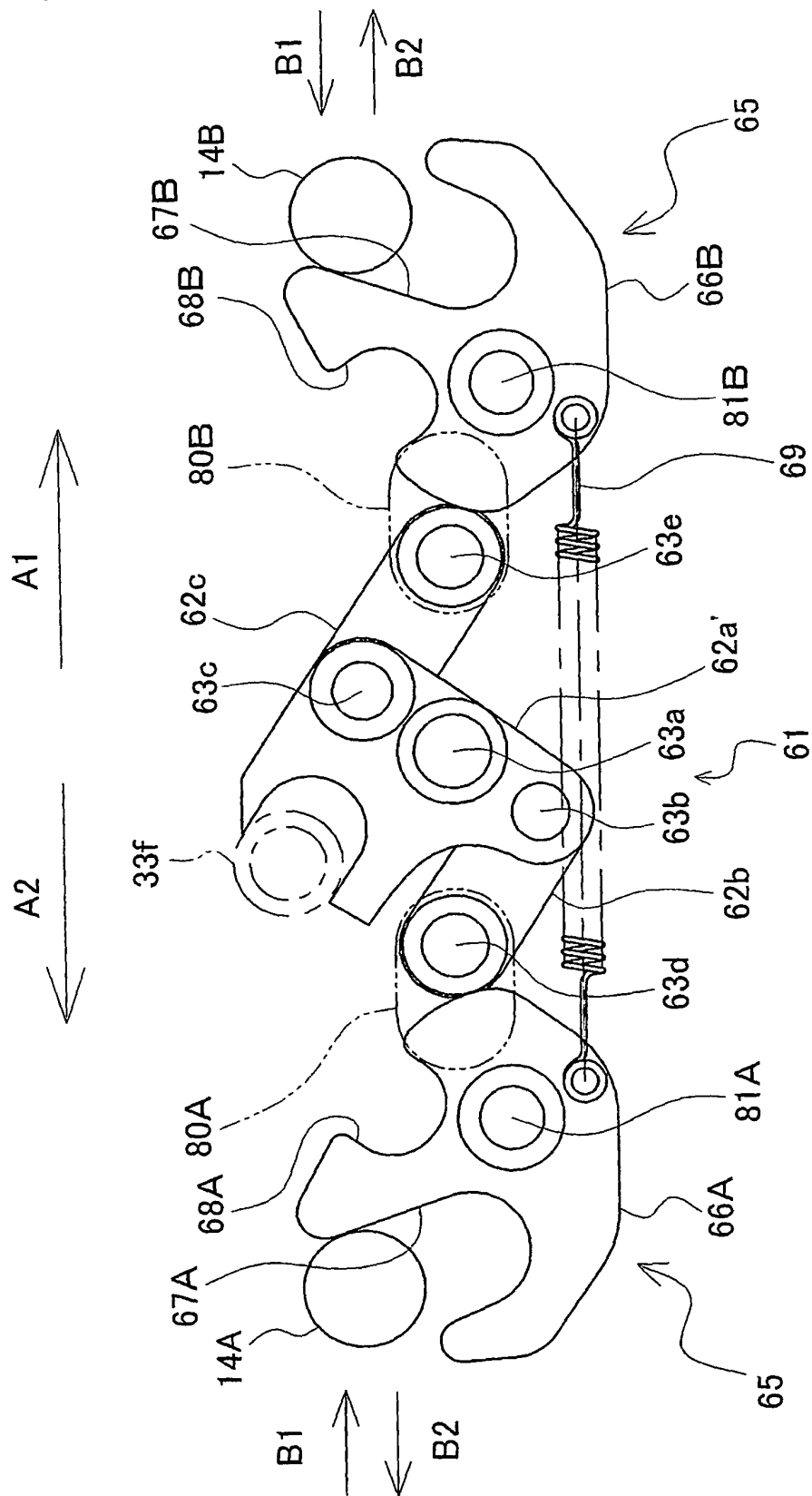
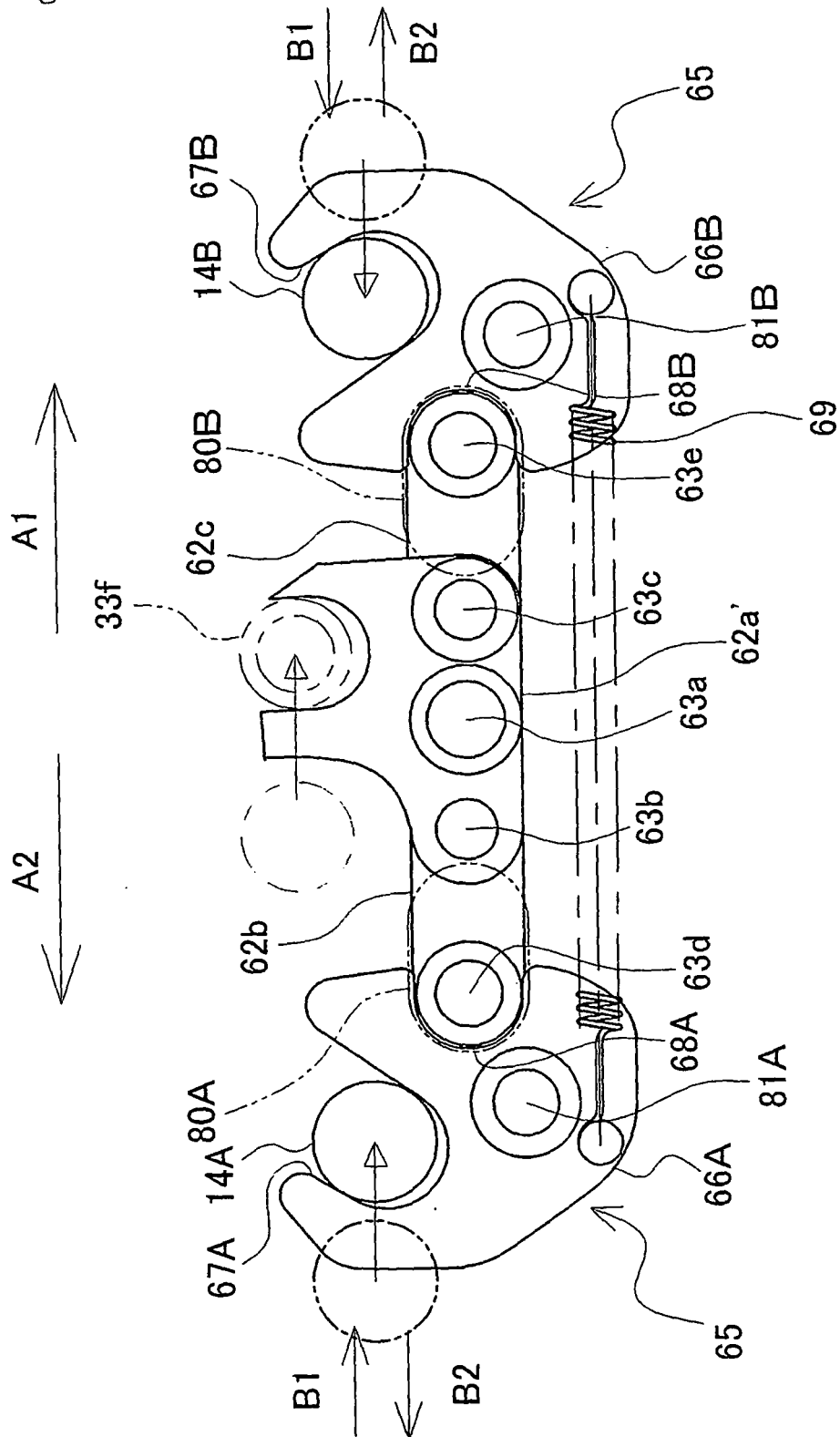


Fig.11



REFERENCES CITED IN THE DESCRIPTION

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