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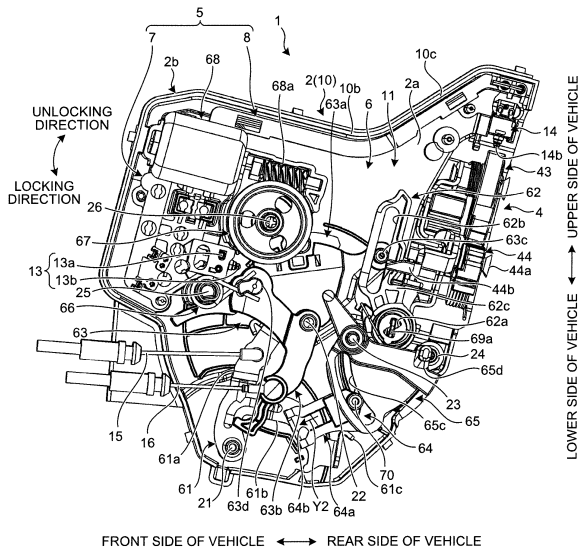
(54) DOOR LOCK DEVICE FOR VEHICLE

(57) A vehicle door locking device (1) provided as one aspect of the present invention includes: a casing; a connection part to which a connector for connection to an external device is connected; a latch mechanism (4) including a latch (43) and a ratchet (44); a locking-unlocking mechanism (6) including a lever lock (63) and a motor (68); a first switch (13) that detects the rotational position of the lever lock (63); a second switch (14) that switches a room lamp of a vehicle on and off in accordance with the rotational position of the latch (43); a switch plate (7) that electrically connects the connection part to the motor (68) and the first switch (13) that are arranged in a front portion of the inside of the casing in a front-to-rear direction of the vehicle; and a harness plate that electrically connects the second switch (14) and the connection part to each other through a plurality of harnesses and the switch plate (7).

FIG.5



EP 3 231 969 A1

Description

Field

[0001] The present invention relates to a vehicle door locking device.

Background

[0002] Conventionally, there have been publicly known vehicle door locking devices capable of switching a door between a state (locked state) being closed and locked and a state (unlocked state) being released from the locked state to be openable. For example, Patent Literature 1 discloses a technique of a vehicle door locking device including a latch mechanism and a locking-unlocking mechanism (a lock mechanism). The latch mechanism is engaged with and released from a striker in the vehicle body side when a vehicle door is opened and closed. The locking-unlocking mechanism (a lock mechanism) is capable of switching between a locked state in which state having the latch mechanism and the striker engaged with each other (a state having the door closed) is being locked and an unlocked state in which the locked state has been canceled.

[0003] Inside a casing of the vehicle door locking device disclosed in Patent Literature 1, an active lever, a motor, and a detection switch are provided. The active lever is rotatable between a locking position corresponding to the locked state and an unlocking position corresponding to the unlocked state in response to operation of a door locking knob, key cylinder, a wireless key, or the like. The motor is a driving source for the rotation of the active lever. The detection switch is provided for detecting the rotational position (the locking position or the unlocking position) of the active lever. In the vehicle door locking device having this configuration, wiring is needed that electrically connects the motor and the detection switch to external devices such as a power supply and an electronic control unit installed in the vehicle. In general, this wiring is assembled in such a manner that a conducting plate formed by being punched out from sheet metal is insert-molded into resin, and is installed inside the casing of the vehicle door locking device.

Citation List

Patent Literature

[0004] Patent Literature 1: Japanese Patent Application Laid-open No. 2013-83086

Summary

Technical Problem

[0005] In recent years, there has risen the need to arrange, inside a casing of a vehicle door locking device, not only the motor and the detection switch but also a plurality of electronic components such as a room lamp switch that switches on and off a room lamp of the vehicle. As a result, the shape of wiring provided (embedded) in a casing of a vehicle door locking device tends to be more complex than in the past, and this complexity results in reduced yields of wiring components. Consequently, the size and cost of the vehicle door locking device increase.

[0006] The present invention has been made in view of the above-described circumstances, and is aimed at providing a vehicle door locking device that can improve the yields of wiring components to be embedded therein.

Solution to Problem

[0007] To solve the above-described problem and achieve the object, a vehicle door locking device according to the present invention includes: a casing; a connection part to which a connector for connection to an external device is connected, the connection part being arranged in a front portion of an outer surface of the casing in a front-to-rear direction of a vehicle; a latch mechanism arranged in a rear-end portion of the casing in the front-to-rear direction of the vehicle and including a latch and a ratchet; a locking-unlocking mechanism arranged inside the casing, the locking-unlocking mechanism including a lever lock that, in accordance with a rotational position thereof, switches between enabling and disabling transmission of a door-opening operation to the latch mechanism, and a motor that drives the lever lock; a first switch that detects the rotational position of the lever lock; a second switch that switches a room lamp of the vehicle on and off in accordance with a rotational position of the latch; a switch plate including a conducting plate and a resin base member on which the conducting plate is mounted, the switch plate being arranged inside the casing and electrically connecting the connection part to the motor and the first switch arranged in a front portion of the inside of the casing in the front-to-rear direction of the vehicle; and a harness plate including a plurality of harnesses and a harness holding section that collectively holds the harnesses, the harness plate being arranged inside the casing and electrically connecting the second switch and the connection part to each other through the harnesses and the switch plate.

[0008] Moreover, in the vehicle door locking device according to the present invention, the casing includes an upper-end side wall part in an upper-end portion thereof in a top-to-bottom direction of the vehicle, the upper-end side wall part including an inclined part inclined upward in the top-to-bottom direction of the vehicle in a manner corresponding to the latch mechanism while extending in a direction from the front side of the vehicle toward the rear side of the vehicle, the harness holding section is arranged along the upper-end side wall part and includes a groove section into which the harnesses are collectively fitted, and the groove section holds the harnesses alongside one another in an inside-to-outside direction of the vehicle thoroughly from a bottom portion to a top portion of the inclined part in the upper-end side wall part.

[0009] Moreover, in the vehicle door locking device according to the present invention, the harness holding section includes, in a rear-end portion in the front-to-rear direction of the vehicle, an insertion holding section that holds vicinities of end portions of the respective harnesses by having the harnesses individually inserted therethrough in the inside-to-outside direction of the vehicle, the end portions electrically connecting to the second switch.

[0010] Moreover, in the vehicle door locking device according to the present invention, the harness holding section includes, in a rear-end portion in the front-to-rear direction of the vehicle, a switch holding section that holds the second switch, and the switch holding section places the second switch near an outer circumference of the latch by inserting the held second switch through an insertion hole formed in a body of the latch mechanism.

[0011] Moreover, in the vehicle door locking device according to the present invention, the second switch is placed between an upper end portion of the casing and an upper end portion of the latch in a top-to-bottom direction of the vehicle.

Advantageous Effects of Invention

[0012] The present invention has the effect of making it possible to improve the yields of wiring components to be embedded in a vehicle door locking device.

Brief Description of Drawings

[0013]

FIG. 1 is a side view illustrating an exemplary configuration of a vehicle door locking device according to an embodiment of the present invention as viewed from the inside of a vehicle.

FIG. 2 is a rear view illustrating the exemplary configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the rear of the vehicle.

FIG. 3 is a perspective view illustrating an exemplary configuration of a first casing of the vehicle door locking device according to the embodiment of the present invention.

FIG. 4 is a rear view illustrating exemplary configurations of a latch mechanism and a locking-unlocking mechanism of the vehicle door locking device according to the embodiment of the present invention as viewed from the rear of the vehicle.

FIG. 5 is a side view illustrating an exemplary internal configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the inside of the vehicle.

FIG. 6 is a side view illustrating an exemplary internal configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle.

FIG. 7 is a side view illustrating an exemplary configuration of a conduction wiring section embedded in the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle.

FIG. 8 is a side view illustrating an exemplary configuration of a switch plate of the conduction wiring section according to the embodiment of the present invention as viewed from the outside of the vehicle.

FIG. 9 is a perspective view illustrating the exemplary configuration of the switch plate of the conduction wiring section according to the embodiment of the present invention.

FIG. 10 is a side view illustrating an exemplary configuration of a harness plate of the conduction wiring section according to the embodiment of the present invention as viewed from the outside of the vehicle.

FIG. 11 is a perspective view illustrating the exemplary configuration of the harness plate of the conduction wiring section according to the embodiment of the present invention.

FIG. 12 is a perspective view illustrating exemplary configurations of an insertion holding section and a switch holding section of the harness plate according to the embodiment of the present invention.

FIG. 13 is another perspective view illustrating the exemplary configurations of the insertion holding section and the switch holding section of the harness plate according to the embodiment of the present invention as viewed from a different view point.

FIG. 14 is a perspective view illustrating how a second switch held by the switch holding section of the harness plate and a latch mechanism are arranged according to the embodiment of the present invention.

FIG. 15 is a side view illustrating an exemplary arrangement of the second switch inside a casing of the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle.

Description of Embodiments

[0014] The following describes a preferred embodiment of a vehicle door locking device according to the present invention in detail with reference to the accompanying drawings. This embodiment is not intended to limit the present invention. In addition, it is to be noted that each of the drawings is schematic and does not necessarily represent actual size relations among elements or actual propositions of elements to others. Regarding elements from the different drawings, the size relation between the elements or the proposition of one element to another may be different from the actual one. In addition, the same reference signs are assigned to the same constituent parts throughout the drawings.

Structure of Vehicle Door Locking Device

[0015] First, with reference to FIGS. 1 to 6, the vehicle door locking device according to the embodiment of the present invention is described. FIG. 1 is a side view illustrating an exemplary configuration of a vehicle door locking device according to an embodiment of the present invention as viewed from the inside of a vehicle. FIG. 2 is a rear view illustrating the exemplary configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the rear of the vehicle. FIG. 2 illustrates the rear face of the vehicle door locking device 1 as viewed from the II direction in FIG. 1. FIG. 3 is a perspective view illustrating an exemplary configuration of a first casing of the vehicle door locking device according to the embodiment of the present invention. FIG. 4 is a rear view illustrating exemplary configurations of a latch mechanism and a locking-unlocking mechanism of the vehicle door locking device according to the embodiment of the present invention as viewed from the rear of the vehicle. FIG. 5 is a side view illustrating an exemplary internal configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the inside of the vehicle. FIG. 6 is a side view illustrating an exemplary internal configuration of the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle.

[0016] The vehicle door locking device 1 according to the embodiment of the present invention is installed in the inside of a door (for example, a rear side door) of a vehicle, and includes a casing 10 and a latch mechanism 4 as illustrated in FIG. 1. The vehicle door locking device 1 also includes a locking-unlocking mechanism 6, a first switch 13, a second switch 14, and a conduction wiring section 5 composed of a switch plate 7 and a harness plate 8 as illustrated in FIG. 5 and other drawings.

[0017] In this embodiment, a vehicle front-to-rear direction, a vehicle top-to-bottom direction, and a vehicle inside-to-outside direction are defined to denote a direction from the front to the rear, a direction from the upper side to the lower side, and a direction from the right to the left (lateral direction), respectively, of the vehicle door locking device 1 and individual components included therein. The vehicle front-to-rear direction is a direction from the front to the rear of the vehicle after the installation of the vehicle door locking device 1 in the door of the vehicle. Likewise, the vehicle top-to-bottom direction is a direction from the upper side to the lower side of the vehicle after the installation of the vehicle door locking device 1 in the door of the vehicle. The vehicle inside-to-outside direction is a direction from the inside to the outside of the vehicle after the installation of the vehicle door locking device 1 in the door of the vehicle, which is a direction perpendicular to the vehicle front-to-rear direction and the vehicle top-to-bottom direction.

[0018] As illustrated in FIG. 2, the casing 10 includes a first casing 2 and a second casing 3. As illustrated in FIG. 3, the first casing 2 includes a first storage section 11 and a second storage section 12. The first storage section 11 is a space section in which to store the locking-unlocking mechanism 6. The second storage section 12 is a space section in which to store the latch mechanism 4. As illustrated in FIG. 3, the first storage section 11 is positioned nearer to the front side of the vehicle than the second storage section 12 is.

[0019] As illustrated in FIG. 3, the first casing 2 including a first outer wall part 2a and a first side wall part 2b that form the first storage section 11. The first outer wall part 2a is a wall part intersecting with the vehicle inside-to-outside direction, and, for example, is substantially perpendicular to the vehicle inside-to-outside direction. The first side wall part 2b is a wall part surrounding the first outer wall part 2a, and projects from the first outer wall part 2a toward the inside of the vehicle. The first side wall part 2b is continuously provided along the edge of the upper end of the first outer wall part 2a, the edge of the front end thereof, and the edge of the lower end thereof.

[0020] As illustrated in FIG. 3, the first casing 2 includes a second outer wall part 2c and a second side wall part 2d that form the second storage section 12. The second outer wall part 2c is a wall section intersecting with the vehicle front-to-rear direction. The second outer wall part 2c projects from the rear end of the first outer wall part 2a toward the outside of the vehicle. The second side wall part 2d is a wall surrounding the second outer wall part 2c and is projected from the second outer wall part 2c toward the rear side of the vehicle. The second side wall part 2d is continuously provided along an edge portion of the upper end of the second outer wall part 2c and an edge portion of the outer end thereof. The second storage section 12 is a space section located in a rear end portion of the casing 10 in the vehicle front-to-rear direction.

[0021] The second casing 3 is a cover member that blocks up an opening of the first casing 2 that opens toward the inside of the vehicle. Together with the first casing 2, the second casing 3 forms a storage space in which to store the locking-unlocking mechanism 6 and the latch mechanism 4.

[0022] The latch mechanism 4 is a mechanism to be engaged with and released from a striker in the vehicle body when the door of the vehicle is opened and closed, and is arranged in the rear end portion of the casing 10 in the vehicle front-to-rear direction as illustrated in FIG. 1. As illustrated in FIG. 2, the latch mechanism 4 includes a body 41 and a cover plate 42. The cover plate 42 includes an entrance groove 42a to be entered by the striker provided in the vehicle body. As illustrated in FIG. 4, the latch mechanism 4 includes a latch 43 and a ratchet 44. The latch 43 and the ratchet 44 are rotatably supported by a shaft 43a and a shaft 44a, respectively. The latch 43 is biased by a spring in the clockwise direction (release direction) in FIG. 4. The ratchet 44 is biased by a spring in the counterclockwise direction in FIG. 4.

[0023] When the latch mechanism 4 is in an unlatching state, an engagement groove 43c of the latch 43 is in a state having its opening facing the entrance groove 42a (refer to FIG. 2) in the cover plate 42 and a groove section of the body 41 that corresponds to this entrance groove 42a. That is, the rotational position of the latch 43 is at an unlatching position. In the unlatching state as described above, when the vehicle door is closed, the striker S in the vehicle body enters the inside of the latch mechanism 4 along the entrance groove 42a and the like as indicated by the arrow Y1. The striker S then comes into abutment with an abutment part 43b of the latch 43, thereby causing the latch 43 to rotate in the counterclockwise direction (engaging direction). At the same time, the latch 43 receives the striker S into the engagement groove 43c. The ratchet 44 comes into abutment with the latch 43 with the striker S having been received into the engagement groove 43c, thereby regulating rotation of the latch 43 in the release direction. That is, the ratchet 44 stops the latch 43 at a half latching position by coming into abutment with the abutment part 43b of the latch 43, and stops the latch 43 at a fully latching position by coming into abutment with a protruding part 43d. When the rotational position of the latch 43 is at the half latching position, the latch mechanism 4 is a half latching state; and when the rotational position of the latch 43 is at the fully latching position, the latch mechanism 4 is a fully latching state. When in the half latching state and in the fully latching state, the latch 43 holds the striker S by having the engagement groove 43c and the striker S engaged with each other, as illustrated in FIG. 4. FIG. 4 illustrates the latch mechanism 4 in the fully latching state.

[0024] The locking-unlocking mechanism 6 is a mechanism capable of switching the door between a locked state and an unlocked state, and is arranged inside the casing 10. As illustrated in FIG. 5, the locking-unlocking mechanism 6 includes an inside lever 61, an open link 62, a lever lock 63, an intermediate lever 64, a coupling member 70, a childproof lever 65, a worm wheel 67, and a motor 68. The locking-unlocking mechanism 6 further includes an outside lever 69 illustrated in FIG. 4.

[0025] With reference back to FIG. 5, the inside lever 61 is arranged in the lower end of the first storage section 11. The inside lever 61 is rotatably supported by a first shaft 21 of the first casing 2. The inside lever 61 includes a first arm 61a, a second arm 61b, and a pressing part 61c. The first arm 61a extends from the first shaft 21 toward the upper side of the vehicle. The first arm 61a is coupled to an inner handle of the door via a cable 15. The second arm 61b extends from the first shaft 21 toward the rear side of the vehicle. The pressing part 61c is provided in the tip end portion of the second arm 61b.

[0026] The lever lock 63 switches, in accordance with the rotational position thereof, between enabling and disabling transmission of a door-opening operation in the vehicle to the latch mechanism 4. As illustrated in FIG. 5, the lever lock 63 is arranged in central portions of the first storage section 11 in the vehicle front-to-rear direction and in the vehicle top-to-bottom direction. The lever lock 63 is rotatably supported by a second shaft 22 of the first casing 2. The lever lock 63 includes a silencer 63a positioned near to the upper side of the vehicle than the second shaft 22 is, and an arm 63b extending from the second shaft 22 toward the lower side of the vehicle. The silencer 63a has a substantially sectorial shape in a plan view, and becomes wider as it goes outward in the radial direction of the second shaft 22.

[0027] As illustrated in FIG. 5, the silencer 63a is provided with a coupling protrusion 63c and an engagement protrusion 63d that project toward the inside of the vehicle. The coupling protrusion 63c is a circular cylindrical protrusion arranged in an end portion of the silencer 63a that faces the rear side of the vehicle. The engagement protrusion 63d is a circular columnar protrusion arranged in an end portion of the silencer 63a that faces the front side of the vehicle. The arm 63b is coupled to a door locking knob via a cable 16.

[0028] An over-the-center spring 66 is a spring imparting biasing force in a rotational direction to the lever lock 63. The over-the-center spring 66 is a coil spring, in which opposite ends of a wire member forming a coil part project outward from the coil part and intersect with each other. This intersection engages with the engagement protrusion 63d of the lever lock 63 as illustrated in FIG. 5. The over-the-center spring 66 is supported by a spring shaft 25 of the first casing 2 and presses the silencer 63a toward the rear side of the vehicle. The biasing force of the over-the-center spring 66 is force to rotate the lever lock 63 in an unlocking direction thereof. The unlocking direction of the lever lock 63 is the clockwise direction in FIG. 5.

[0029] The childproof lever 65 and the intermediate lever 64 are arranged in the lower part in the first storage section 11 in a portion thereof facing the rear side of the vehicle, as illustrated in FIG. 5. The childproof lever 65 is rotatably supported by a third shaft 23 of the first casing 2. The intermediate lever 64 is rotatably supported by a fourth shaft 24 of the first casing 2. The intermediate lever 64 includes an arm 64a and a coupling hole 64b provided in the arm 64a. The arm 64a extends from the fourth shaft 24 toward the front side of the vehicle. The coupling hole 64b is a slit-like through-hole formed in a certain length along the longitudinal direction of the arm 64a. The coupling member 70 is arranged at the coupling hole 64b. The coupling member 70 is a member coupling together the childproof lever 65 and the intermediate lever 64, and is supported by the coupling hole 64b. The coupling member 70 is movable along the coupling hole 64b in the longitudinal direction of the arm 64a.

[0030] The childproof lever 65 moves the coupling member 70 in accordance with an operation performed by a user, thereby switching between enabling and disabling a door-opening operation performed on the inner handle. As illustrated in FIG. 5, the childproof lever 65 includes a coupling hole 65c and a tab 65d. The coupling hole 65c is a slit-like through-hole formed in a certain

length in a direction intersecting with the coupling hole 64b of the intermediate lever 64. The tab 65d is provided in a rear end portion of the childproof lever 65 in the vehicle front-to-rear direction. As illustrated in FIG. 1, the tab 65d projects into the outside from an opening 31 provided in the second casing 3. The user can pinch the tab 65d with the door being open, and then rotate the childproof lever 65 to either a child-safety locking position or a child-safety unlocking position.

[0031] FIG. 5 illustrates the childproof lever 65 at the child-safety unlocking position. When the childproof lever 65 is at the child-safety unlocking position, the pressing part 61c of the inside lever 61 can come into abutment with the coupling member 70. A door-opening operation on the inner handle causes the inside lever 61 to rotate in the counterclockwise direction in FIG. 5. Consequently, the pressing part 61c comes into abutment with the coupling member 70 and presses the coupling member 70 and the arm 64a toward the upper side of the vehicle. As illustrated in FIG. 4, the intermediate lever 64 includes a pressing part 64c. The pressing part 64c is provided on the arm 64a illustrated in FIG. 5, and is in abutment with an abutment part 69c of the outside lever 69 as illustrated in FIG. 4. The outside lever 69 is supported by the first casing 2 so as to be rotatable about a rotational axis line XX illustrated in FIG. 4. The pressing part 64c presses the abutment part 69c toward the upper side of the vehicle, thereby causing the outside lever 69 to rotate in the clockwise direction in FIG. 4. A coupling part 69b of the outside lever 69 is coupled to an outer handle of the door. When a door-opening operation is performed on the outer handle, the coupling part 69b is pressed toward the lower side of the vehicle. Consequently, the outside lever 69 rotates in the clockwise direction in FIG. 4 in the same manner as it does when the abutment part 69c is pressed by the pressing part 64c.

[0032] With reference back to FIG. 5, the open link 62 can be switched between an unlocking position and a locking position. The open link 62 is a plate-like member, and includes a first coupling hole 62a and a second coupling hole 62b. The first coupling hole 62a is provided in an end portion of the open link 62 that faces the lower side of the vehicle. A coupling protrusion 69a of the outside lever 69 (refer to FIG. 4) is inserted through the first coupling hole 62a. The coupling protrusion 69a is a plate-like projecting part and is provided in an end portion of the outside lever 69 that faces the inside of the vehicle. The first coupling hole 62a of the open link 62 permits the open link 62 to rotate relative to and about the coupling protrusion 69a. More specifically, the first coupling hole 62a permits the open link 62 to rotate about the coupling protrusion 69a in the counterclockwise direction in a certain angular range from the unlocking position illustrated in FIG. 5 to the locking position.

[0033] The second coupling hole 62b of the open link 62 is a slit-like through-hole extending in the vehicle top-to-bottom direction. The coupling protrusion 63c of the lever lock 63 is inserted into the second coupling hole 62b as illustrated in FIG. 5. That is, the open link 62 is coupled to the lever lock 63 via the coupling protrusion 63c, and rotates about the coupling protrusion 69a of the outside lever 69 in conjunction with rotation of the lever lock 63. The second coupling hole 62b permits to the open link 62 to move relative to the coupling protrusion 63c in the vehicle top-to-bottom direction.

[0034] The open link 62 further includes a pressing part 62c. The pressing part 62c is a surface facing the upper side of the vehicle, and is provided nearer to the upper side of the vehicle than the first coupling hole 62a is. As illustrated in FIG. 5, when the open link 62 is at the unlocking position, the pressing part 62c faces a release lever 44b in the vehicle top-to-bottom direction. The release lever 44b is rotatably supported and connected to the ratchet 44 by a shaft 44a of the ratchet 44. When the pressing part 62c comes into abutment with the release lever 44b and presses up the release lever 44b with the open link 62 having moved toward the upper side of the vehicle, the ratchet 44 rotates in the clockwise direction in FIG. 4. Consequently, the latch 43 and the ratchet 44 are released from interlocking with each other, so that the latch mechanism 4 is switched to the unlatching state.

[0035] Thus, when a door-opening operation is performed on the inner handle with the childproof lever 65 being at the child-safety unlocking position, the inside lever 61 presses the coupling member 70 and the arm 64a of the intermediate lever 64 toward the upper side of the vehicle. Consequently, the pressing part 64c (refer to FIG. 4) of the intermediate lever 64 causes the outside lever 69 to rotate, thereby causing the open link 62 to move toward the upper side of the vehicle. When being at the unlocking position, the open link 62 switches the latch mechanism 4 to the unlatching state by causing the release lever 44b to rotate.

[0036] In contrast, with the childproof lever 65 rotating toward the child-safety locking position, the coupling hole 65c of the childproof lever 65 causes the coupling member 70 to move toward the front side of the vehicle as indicated by the arrow Y2 in FIG. 5. As a result, the position of the coupling member 70 is switched from the child-safety unlocking position to the child-safety locking position. When the coupling member 70 is positioned at the child-safety locking position, the pressing part 61c of the inside lever 61 cannot come into abutment with the coupling member 70. Thus, a door-opening operation on the inner handle is not transmitted from the inside lever 61 to the open link 62, and this door-opening operation is thereby disabled.

[0037] The lever lock 63 switches, in accordance with the rotational position thereof, between enabling and disabling transmission of a door-opening operation in the vehicle to the latch mechanism 4. When the user performs an unlocking operation on the locking knob, the cable 16 pulls the arm 63b toward the front side of the vehicle in response to that unlocking operation. Consequently, the lever lock 63 rotates in the unlocking direction. In contrast, when the user performs a locking oper-

ation on the locking knob, the cable 16 pulls the arm 63b toward the rear side of the vehicle in response to that locking operation. Consequently, the lever lock 63 rotates in a locking direction.

[0038] The worm wheel 67 transmits rotation of the motor 68 to the lever lock 63, thereby causing the lever lock 63 to rotate in either the locking direction or the unlocking direction. As illustrated in FIG. 5, the worm wheel 67 is rotatably supported by a wheel shaft 26 of the first casing 2. The worm wheel 67 includes helical screw grooves formed on the outer circumferential surface thereof, and these screw grooves are engaged with a worm 68a of the motor 68. As illustrated in FIG. 6, the worm wheel 67 includes protrusions 67a. Each of the protrusion 67a has a substantially triangular shape in a plan view, and becomes narrower as it goes outward in the radial direction of the worm wheel 37. In this embodiment, as illustrated in FIG. 6, the worm wheel 67 includes the three protrusions 67a arranged at uniform intervals in the circumferential direction thereof.

[0039] As illustrated in FIG. 6, the silencer 63a of the lever lock 63 includes an interlocking groove 63e. The interlocking groove 63e is a concave portion formed in the outer circumferential surface of the silencer 63a, that is, a surface thereof that faces the wheel shaft 26 (refer to FIG. 5). Each of the protrusions 67a of the worm wheel 67 interlocks with the interlocking groove 63e, and presses the silencer 63a in a locking direction and an unlocking direction. That is, the motor 68 drives the lever lock 63 into either the locking direction or the unlocking direction via the worm wheel 67.

[0040] As illustrated in FIG. 4 or FIG. 5, the second switch 14 is inserted into an insertion hole 41a formed through the body 41 of the latch mechanism 4 and is arranged near the outer circumference of the latch 43 so as to neighbor the latch 43 in the direction from the upper side to the lower side of the vehicle. In this embodiment, the second switch 14 is an ajar switch and detects the rotational position of the latch 43. Specifically, the second switch 14 detects whether the rotational position of the latch 43 is located at a position other than the fully latching position. In this detection, the second switch 14 detects whether the rotational position of the latch 43 is nearer to the unlatching position than when it is at a position between the fully latching position and the half latching position. When the second switch 14 detects that the rotational position of the latch 43 is located at a position other than the fully latching position (that the door is half-shut or open), a room lamp of the vehicle is turned on. In contrast, when the rotational position of the latch 43 is located at the fully latching position (the door is completely shut), the second switch 14 turns off the room lamp of the vehicle. That is, the second switch 14 has the function of a room lamp switch that switches on and off the room lamp of the vehicle in accordance with the rotational position of the latch 43.

[0041] The second switch 14 includes a main body 14a and a mover 14b. The main body 14a is fixed to the first casing 2 with a harness holding section 83 of the harness plate 8 to be described later therebetween. The mover 14b is a circular columnar member having the tip end portion thereof curved like a spherical surface. The mover 14b is supported by the main body 14a so as to be relatively movable in the axial direction of the mover 14b. The tip end portion of the mover 14b projects from the lower surface of the main body 14a toward the outer circumferential surface of the latch 43. The mover 14b is biased toward the latch 43 by a spring (not illustrated).

[0042] When the latch 43 is located at the unlatching position, the tip end of the mover 14b comes into abutment with a first outer circumferential surface 43f of the latch 43. The first outer circumferential surface 43f pushes the mover 14b into the main body 14a against the biasing force of the spring. When the mover 14b has been pressed into the main body 14a, the second switch 14 outputs an open signal (for example, an ON signal) indicating that the rotational position of the latch 43 is nearer to the unlatching position than when it is at a position between the fully latching position and the half latching position. In contrast, when the latch 43 is at the fully latching position as illustrated in FIG. 4, a second outer circumferential surface 43g of the latch 43 faces the mover 14b. In the latch 43, the distance from the shaft 43a to the second outer circumferential surface 43g is shorter than the distance from the shaft 43a to the first outer circumferential surface 43f. When the latch 43 is at the fully latching position, the biasing force of the spring leaves the mover 14b projecting toward the second outer circumferential surface 43g. When the mover 14b is left projecting, the second switch 14 outputs an engagement signal (for example, an OFF signal) indicating that the rotational position of the latch 43 is at the fully latching position.

[0043] As illustrated in FIG. 5 and FIG. 6, the first switch 13 is arranged beside the lever lock 63 and detects the rotational position of the lever lock 63. In this embodiment, the first switch 13 detects whether the rotational position of the lever lock 63 is the locking position. The first switch 13 is arranged nearer to the front side of the vehicle than the silencer 63a of the lever lock 63 is. The first switch 13 includes a main body 13a and a mover 13b. The main body 13a is fixed to the first casing 2 with a resin base member 73 of the switch plate 7 to be described later therebetween. The mover 13b is a circular columnar member having the tip end portion thereof curved like a spherical surface. The mover 13b is supported by the main body 13a so as to be relatively movable in the axial direction of the mover 13b. The tip end portion of the mover 13b projects toward a side surface of the silencer 63a from a side surface of the main body 13a that faces the rear side of the vehicle. The mover 13b is biased toward the side surface of the silencer 63a by a spring (not illustrated).

[0044] When the lever lock 63 is located at the unlocking position as illustrated in FIG. 5, the side surface of the silencer 63a is separated from the mover 13b of the

first switch 13. Consequently, the biasing force of the spring leaves the mover 13b of the first switch 13 projecting from the main body 13a toward the side surface of the silencer 63a. When the mover 13b is left projecting from the main body 13a, the first switch 13 outputs an unlocking signal (for example, an OFF signal) indicating that the rotational position of the lever lock 63 is at the unlocking position. In contrast, when the lever lock 63 is at the locking position, the side surface of the silencer 63a is in abutment with the mover 13b, so that the silencer 63a pushes the mover 13b into the main body 13a against the biasing force of the spring. When the mover 13b has been pushed into the main body 13a, the first switch 13 outputs a locking signal indicating that the rotational position of the lever lock 63 is at the locking position (for example, an ON signal).

[0045] The motor 68 is an electrically driven component that functions as a driving source for the above-described rotation of the lever lock 63. As illustrated in FIG. 5, the motor 68 and the first switch 13 are arranged in a front part of the inside of the casing 10 (more specifically the inside of the first casing 2) in the vehicle front-to-rear direction. More specifically, the motor 68 and the first switch 13 are arranged nearer to the front side of the vehicle than the lever lock 63 is. Consequently, wiring for the motor 68 and the first switch 13 can be collectively provided in a portion of the inside of the casing 10 that faces the front side of the vehicle.

[0046] As illustrated in FIG. 1, the second casing 3 includes a connection part 3a, to which a connector for connection to an external device installed in the vehicle side is connected, exposed to the outside of the second casing 3. To the connection part 3a, a connector of external wiring such as a wire harness is connected. The vehicle door locking device 1 is electrically connected, through external wiring connected to the connection part 3a, to external devices mounted on the vehicle, specifically, a control device and a control circuit such as an electronic control unit (ECU) that controls the vehicle door locking device 1. As illustrated in FIG. 1, the connection part 3a is arranged on a front part of the outer surface of the casing 10 (more specifically the second casing 3) in the vehicle front-to-rear direction. A tip end portion of the connector of the external wiring is plugged into a mating portion of the connection part 3a. After being plugged into the mating portion of the connection part 3a, the connector of the external wiring is fixed to the connection part 3a by engaging with a claw-like engagement protrusion provided on the connection part 3a. Consequently, the connector of the external wiring is prevented from slipping out of the connection part 3a.

[0047] As illustrated in FIG. 5, the vehicle door locking device 1 includes a conduction wiring section 5 as internal wiring that electrically connects the above-described connection part 3a to the motor 68, the first switch 13, and the second switch 14. The conduction wiring section 5 includes the switch plate 7 and the harness plate 8. The switch plate 7 is arranged in a front portion of the inside of the casing 10 in the vehicle front-to-rear direction, and electrically connects the connection part 3a (refer to FIG. 1) to the motor 68 and the first switch 13. The harness plate 8 is arranged in the upper part of the inside of the casing 10 in the vehicle top-to-bottom direction, and electrically connects the second switch 14 and the connection part 3a to each other through the switch plate 7.

[0048] Here, as illustrated in FIG. 1, the vehicle door locking device 1 includes a waterproof cover 17 covering the casing 10. The waterproof cover 17 is a non-pervious covering member continuously covering the first casing 2 and the second casing 3 constituting the casing 10. As illustrated in FIG. 1, the waterproof cover 17 continuously covers the upper edge of the casing 10 and the edge thereof facing the front side of the vehicle. The waterproof cover 17 thus configured prevents water seepage into the inside of the casing 10, thereby protecting internal components, such as the conduction wiring section 5, of the vehicle door locking device 1.

Configuration of Conduction Wiring Section

[0049] Next described is a configuration of the conduction wiring section 5 embedded in the vehicle door locking device 1 according to the embodiment of the present invention. FIG. 7 is a side view illustrating an exemplary configuration of the conduction wiring section embedded in the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle. FIG. 8 is a side view illustrating an exemplary configuration of the switch plate of the conduction wiring section according to the embodiment of the present invention as viewed from the outside of the vehicle. FIG. 9 is a perspective view illustrating the exemplary configuration of the switch plate of the conduction wiring section according to the embodiment of the present invention. FIG. 10 is a side view illustrating an exemplary configuration of the harness plate of the conduction wiring section according to the embodiment of the present invention as viewed from the outside of the vehicle. FIG. 11 is a perspective view illustrating the exemplary configuration of the harness plate of the conduction wiring section according to the embodiment of the present invention.

[0050] The conduction wiring section 5 is arranged inside the casing 10 of the vehicle door locking device 1, and is internal wiring that electrically connects the above-described connection part 3a to the motor 68, the first switch 13, and the second switch 14. In this embodiment, as illustrated in FIG. 7, the conduction wiring section 5 is constructed of the plate-like switch plate 7 and the harness plate 8 including a flexible electric wire.

[0051] The switch plate 7 is plate-like internal wiring including a conducting plate and a resin base member and arranged inside the casing 10 with the resin base member including the conducting plate mounted thereon, and electrically connects the connection part 3a to the

motor 68 and the first switch 13, which are described above. Specifically, as illustrated in FIG. 8 and FIG. 9, the switch plate 7 includes a motor-connecting conducting plate 71, a switch-connecting conducting plate 72, and the resin base member 73.

[0052] The motor-connecting conducting plate 71 is a conducting plate that electrically connects the connection part 3a and the motor 68 to each other. As illustrated in FIG. 8, the motor-connecting conducting plate 71 includes a first conducting plate 71a and a second conducting plate 71b. The first conducting plate 71a is connected to one input terminal of the motor 68. The second conducting plate 71b is connected to the other input terminal of the motor 68. Electric current the direction of which corresponds to the rotational direction of the motor 68 is supplied to the motor 68 through the first conducting plate 71a and the second conducting plate 71b. The motor-connecting conducting plate 71 extends in the vehicle top-to-bottom direction in a region from the connection part 3a to the motor 68. The first conducting plate 71a and the second conducting plate 71b are each a conductive plate-like member made of material such as copper. The first conducting plate 71a and the second conducting plate 71b are formed by, for example, being pressed and punched out.

[0053] An end portion (terminal) 711a of the first conducting plate 71a that faces the upper side of the vehicle is bent toward the inside of the vehicle, as illustrated in FIG. 9. Likewise, an end portion (terminal) 711b of the second conducting plate 71b that faces the upper side of the vehicle is bent toward the inside of the vehicle, as illustrated in FIG. 9. The respective terminals 711a and 711b are connected to different terminals of the motor 68. An end portion (terminal) 712a of the first conducting plate 71a that faces the lower side of the vehicle is bent toward the inside of the vehicle, as illustrated in FIG. 9. Likewise, an end portion (terminal) 712b of the second conducting plate 71b that faces the lower side of the vehicle is bent toward the inside of the vehicle, as illustrated in FIG. 9. Tip end portions of the terminals 712a and 712b are arranged in the connection part 3a illustrated in FIG. 1.

[0054] The switch-connecting conducting plate 72 is a conducting plate that electrically connects the connection part 3a and the first switch 13 and also electrically connects the connection part 3a and the harness plate 8. As illustrated in FIG. 8, the switch-connecting conducting plate 72 includes an input plate 74, a first output plate 75a, and a second output plate 75b. The input plate 74, the first output plate 75a, and the second output plate 75b are each a conductive plate-like member made of material such as copper, and are formed by, for example, being pressed and punched out. A certain voltage is applied to the input plate 74 from an external device. As illustrated in FIG. 8, the input plate 74 branches into a first input plate 74a and a second input plate 74b.

[0055] An end portion (terminal) 741a of the first input plate 74a is connected to an input terminal 13c of the first switch 13 by, for example, resistance welding. An end portion (terminal) 741b of the second input plate 74b is arranged inside a connector section 734 provided in the resin base member 73. The second input plate 74b is connected to the harness plate 8 through this terminal 741b. An end portion (terminal) 751a of the first output plate 75a is connected by, for example, resistance welding to an output terminal 13d of the first switch 13. An end portion (terminal) 751b of the second output plate 75b is arranged inside the connector section 734. The second output plate 75b is connected to the harness plate 8 through this terminal 751b.

[0056] As illustrated in FIG. 9, an end portion (terminal) 742 of the input plate 74 that faces the lower side of the vehicle is bent toward the inside of the vehicle. An end portion (terminal) 752a of the first output plate 75a that faces the lower side of the vehicle is bent toward the inside of the vehicle. An end portion (terminal) 752b of the second output plate 75b that faces the lower side of the vehicle is bent toward the inside of the vehicle. Tip end portions of the terminals 742, 752a, and 752b are arranged in the connection part 3a illustrated in FIG. 1.

[0057] The motor-connecting conducting plate 71 and the switch-connecting conducting plate 72, which have the above-described configurations, are individually held by the resin base member 73 as illustrated in FIG. 8 and FIG. 9. In this embodiment, the resin base member 73 is integrally molded with resin. As illustrated in FIG. 8, the resin base member 73 includes a groove 731 corresponding to the motor-connecting conducting plate 71, and a groove 732 corresponding to the switch-connecting conducting plate 72. The motor-connecting conducting plate 71 and the switch-connecting conducting plate 72 are fitted into the respective grooves 731 and 732 by, for example, a method such as press fitting or thermal caulking to be consequently mounted on the resin base member 73.

[0058] As illustrated in FIG. 8 and FIG. 9, the resin base member 73 further includes a switch holding section 733 that holds the first switch 13. The switch holding section 733 positions the main body 13a relative to the lever lock 63 (refer to FIG. 5) by immovably holding the main body 13a of the first switch 13.

[0059] In addition, as illustrated in FIG. 8 and FIG. 9, the resin base member 73 includes a connector section 734. The connector section 734 is provided to couple together the switch plate 7 and the harness plate 8, as illustrated in FIG. 7. The connector section 734 is provided in the resin base member 73 in such a manner as to be located nearer to the lower side of the vehicle than the motor 68 is. The connector section 734 is a hollow rectangular body that can be fitted into a connector section 834 of the harness plate 8, which is illustrated in FIG. 10. Inside the connector section 734, the terminals 741b and 751b of the switch-connecting conducting plate 72 are arranged side by side in the vehicle front-to-rear direction as illustrated in FIG. 8. The connector section 734, by being fitted into the connector section 834 of the

harness plate 8, not only couples together the switch plate 7 and the harness plate 8 but also brings the terminals 741b and 751b close to end portions (terminals 81b and 82b of harnesses 81 and 82 to be described later) of electric wires in the harness plate 8. In this state, the respective terminals 741b and 751b inside the connector section 734 are connected by, for example, resistance welding to the end portions of the corresponding wires in the harness plate 8. Consequently, the switch-connecting conducting plate 72 of the switch plate 7 is electrically connected to the harness plate 8.

[0060] The resin base member 73 has fixation sections 735 and 736 as illustrated in FIG. 8 and FIG. 9. The fixation section 735 is provided in the lower end of the resin base member 73. The fixation section 735 includes a through-hole 735a. The fixation section 736 is provided in the front end of the resin base member 73. The fixation section 736 includes a through-hole 736a. When the resin base member 73 is mounted on the first casing 2, a shaft 27 (refer to FIG. 3) of the first casing 2 is inserted into the through-hole 735a of the fixation section 735, and a shaft 28 (refer to FIG. 3) thereof is inserted into the through-hole 736a of the fixation section 736. Consequently, the resin base member 73 is positioned relative to and fixed to (and therefore the switch plate 7 is positioned relative to and fixed to) the first casing 2.

[0061] The harness plate 8 is internal wiring that electrically connects the second switch 14 and the switch plate 7 to each other, and, while being arranged inside the casing 10, electrically connects the second switch 14 and the connection part 3a (refer to FIG. 1) to each other through the switch plate 7. Specifically, as illustrated in FIG. 10 and FIG. 11, the harness plate 8 includes a plurality of (two in this embodiment) harnesses 81 and 82 and a harness holding section 83 that collectively holds these two harnesses 81 and 82.

[0062] The harnesses 81 and 82 are flexible conducting members, and are each constructed of a conductive linear member of copper or the like and an insulative member of resin or the like coating the conductive linear member. One of these harnesses, the harness 81, is an input line that applies, to the second switch 14, a certain voltage input from an external device through the switch plate 7. Opposite end portions (terminals) 81a and 81b of this harness 81 in the longitudinal direction thereof are not coated and are exposed. The other harness 82 is an output line that transmits an output signal from the second switch 14 to the switch plate 7. Opposite end portions (terminals) 82a and 82b of this harness 82 in the longitudinal direction thereof are not coated and are exposed.

[0063] As illustrated in FIG. 10 and FIG. 11, the harness holding section 83 includes a groove section 831 into which the harnesses 81 and 82 are collectively fitted. The harness holding section 83 includes an insertion holding section 832 and a switch holding section 833 in the rear end portion in the vehicle front-to-rear direction. The insertion holding section 832 holds portions of the harnesses 81 and 82 by having these portions inserted therethrough, the portions being near the respective terminals 81a and 82a that electrically connect to the second switch 14. The switch holding section 833 holds the second switch 14. The harness holding section 83 includes, in a lower end portion in the vehicle top-to-bottom direction, the connector section 834 that couples together the switch plate 7 and the harness plate 8 and electrically connects them to each other.

[0064] The groove section 831 is a concave member having a space in which the harnesses 81 and 82 electrically connecting the second switch 14 and the switch plate 7 can be held with these harnesses adjoined to each other. As illustrated in FIG. 10 and FIG. 11, the groove section 831 integrally has a part extending from the connector section 834 toward the upper side of the vehicle, and a part extending along the upper end of the casing 10.

[0065] Here, as illustrated in FIG. 5 and FIG. 6, the casing 10 includes, in an upper end portion thereof in the vehicle top-to-bottom direction, an upper-end side wall part 10b continuing from the front to the rear end of the vehicle door locking device 1 in the vehicle front-to-rear direction. The upper-end side wall part 10b is a side wall part included in and located at the upper end of the first side wall part 2b of the first casing 2, and includes an inclined part 10c inclined upward in the vehicle top-to-bottom direction while extending from the front side of the vehicle toward the rear side of the vehicle in a manner corresponding to the latch mechanism 4.

[0066] As illustrated in FIG. 10 and FIG. 11, the groove section 831 integrally includes a connector-side groove part 831a, a switch-side groove part 831b, and an intermediate groove part 831c. The connector-side groove part 831a continues into the connector section 834, and extends toward the upper side of the vehicle from the connector section 834. While being a part of the groove section 831 that faces the second switch 14, the switch-side groove part 831b extends with inclining along the inclined part 10c in the upper-end side wall part 10b of the casing 10. While being an intermediate part bringing the connector-side groove part 831a and the switch-side groove part 831b into continuity with each other, the intermediate groove part 831c extends in the vehicle front-to-rear direction along a part of the upper-end side wall part 10b other than the inclined part 10c. The groove section 831 is arranged along the upper-end side wall part 10b so that the switch-side groove part 831b can extend along the inclined part 10c and that the intermediate groove part 831c can extend along a part of the upper-end side wall part 10b other than the inclined part 10c.

[0067] The groove section 831 has an opening toward the outside of the vehicle, and the harnesses 81 and 82 are collectively fitted into and mounted on the groove section 831 through the opening. The harnesses 81 and 82 fitted into the groove section 831 are prevented from slipping out thereof by a plurality of protruding parts provided at intervals on an end portion of the opening of the

groove section 831. The groove section 831 forms a routing path from the connector section 834 to the second switch 14 along the upper-end side wall part 10b of the casing 10, and holds these two harnesses 81 and 82 along this routing path with these harnesses adjoined alongside each other.

[0068] Specifically, as illustrated in FIG. 10 and FIG. 11, the connector-side groove part 831a holds the harnesses 81 and 82 alongside each other in the vehicle front-to-rear direction, along a routing path that runs from the connector section 834 toward the upper side of the vehicle, then passes over the motor 68 (refer to FIG. 7), and then runs into the intermediate groove part 831c. The intermediate groove part 831c holds the harnesses 81 and 82 alongside each other in the vehicle top-to-bottom direction, along a routing path that runs from the upper end of the connector-side groove part 831a toward the rear side of the vehicle and then runs into the lower end of the switch-side groove part 831b (that is, along a part of the upper-end side wall part 10b other than the inclined part 10c). The switch-side groove part 831b holds the harnesses 81 and 82 alongside each other in the vehicle inside-to-outside direction, along a routing path that incliness toward the upper side of the vehicle from the intermediate groove part 831c in agreement with the inclined part 10c and runs into the neighborhood of the second switch 14. That is, the groove section 831 holds the two harnesses 81 and 82 alongside each other in the vehicle inside-to-outside direction thoroughly from a bottom portion to a top portion of the inclined part 10c in the upper-end side wall part 10b.

[0069] The insertion holding section 832, by having a plurality of harnesses inserted therethrough in the vehicle inside-to-outside direction, holds the vicinities of end portions of these respective harnesses, that is, the vicinities of the respective harness end portions that electrically connect to the second switch 14. The switch holding section 833 holds the second switch 14. FIG. 12 is a perspective view illustrating exemplary configurations of the insertion holding section and the switch holding section of the harness plate according to the embodiment of the present invention. FIG. 13 is another perspective view illustrating the exemplary configurations of the insertion holding section and the switch holding section of the harness plate according to the embodiment of the present invention as viewed from a different view point.

[0070] In this embodiment, the insertion holding section 832 holds the vicinities of the respective terminals 81a and 82a of the two harnesses 81 and 82 that electrically connect to the second switch 14, and includes a pair of insertion holes 832a and 832b and a pair of fitting grooves 832c and 832d as illustrated in FIG. 12 and FIG. 13.

[0071] The pair of insertion holes 832a and 832b are each a through-hole penetrating in the vehicle inside-to-outside direction, and are formed in the vicinity of an exit portion of the groove section 831 in the upper side thereof (an exit portion of the switch-side groove part 831b) and alongside each other in the vehicle front-to-rear direction. Through the insertion hole 832a, the terminal 81a and the vicinity thereof of the harness 81 are inserted from the inside to the outside in the vehicle inside-to-outside direction. Through the insertion hole 832b, the terminal 82a and the vicinity thereof of the harness 82 are inserted from the inside to the outside in the vehicle inside-to-outside direction.

[0072] The pair of fitting grooves 832c and 832d are concave portions that continue into the pair of the insertion holes 832a and 832b, and are formed between the pair of insertion holes 832a and 832b and the switch holding section 833 as illustrated in FIG. 12. The vicinity (a coated electric wire portion) of the terminal 81a of the harness 81 that has been fitted into one of the insertion holes, the insertion hole 832a, is fitted into the fitting groove 832c. Consequently, as illustrated in FIG. 12, the fitting groove 832c keeps the terminal 81a of the harness 81 in a position that allows the terminal 81a to come into abutment with an input terminal 14c of the second switch 14 while the second switch 14 is held by the switch holding section 833. The vicinity (a coated electric wire portion) of the terminal 82a of the harness 82 that has been fitted into the other insertion hole 832b is fitted into the fitting groove 832d. Consequently, as illustrated in FIG. 12, the fitting groove 832d keeps the terminal 82a of the harness 82 in a position that allows the terminal 82a to come into abutment with an output terminal 14d of the second switch 14 while the second switch 14 is held by the switch holding section 833.

[0073] The terminal 81a of the harness 81 inserted and held by the action of one of the insertion holes, the insertion hole 832a, and the fitting groove 832c of the above-described insertion holding section 832 is connected by, for example, resistance welding to the input terminal 14c of the second switch 14 while the second switch 14 is held by the switch holding section 833. The terminal 82a of the harness 82 inserted and held by the action of the other insertion hole 832b, and the fitting groove 832d is connected by, for example, resistance welding to the output terminal 14d of the second switch 14 while the second switch 14 is held by the switch holding section 833.

[0074] As illustrated in FIG. 12 and FIG. 13, the switch holding section 833 positions the main body 14a relative to the latch 43 in the latch mechanism 4 (refer to FIG. 4) by immovably holding the main body 14a of the second switch 14. FIG. 14 is a perspective view illustrating how the second switch held by the switch holding section of the harness plate and the latch mechanism are arranged according to the embodiment of the present invention. FIG. 15 is a side view illustrating an exemplary arrangement of the second switch inside the casing of the vehicle door locking device according to the embodiment of the present invention as viewed from the outside of the vehicle.

[0075] As illustrated in FIG. 14, the switch holding section 833 inserts the second switch 14 held thereby into the insertion hole 41a formed in the body 41 of the latch

mechanism 4, thereby positioning the second switch 14 in the vicinity of the outer circumference of the latch 43. Consequently, the harness plate 8 causes the mover 14b of the second switch 14 held by the switch holding section 833 to face the outer circumferential surface (the first outer circumferential surface 43f and the second outer circumferential surface 43g illustrated in FIG. 4) through the insertion hole 41a of the body 41 from the upper end side of the latch mechanism 4. This structure enables the second switch 14, while being held by the switch holding section 833, to detect the rotational position of the latch 43 through the insertion hole 41a of the body 41.

[0076] In addition, as described above, while being held by the switch holding section 833, the second switch 14 is placed between an upper end portion of the casing 10 and an upper end portion of the latch 43 in the vehicle top-to-bottom direction. Specifically, as illustrated in FIG. 15, the harness holding section 83 places the second switch 14 held by the switch holding section 833 in a position Pc between a position Pa, that is, the uppermost position of the upper-end side wall part 10b of the casing 10, and a position Pb, that is, the uppermost position of the outer circumferential surface of the latch 43 in the latch mechanism 4. Consequently, placement of the second switch 14 relative to the latch 43 is immovably set to the position Pc illustrated in FIG. 15.

[0077] The connector section 834 illustrated in FIG. 10 and FIG. 11 is provided to couple together the switch plate 7 and the harness plate 8, as illustrated in FIG. 7. In this embodiment, the connector section 834 is provided in the lower end of the harness holding section 83 so as to be positioned nearer to the lower side of the vehicle than the motor 68 (refer to FIG. 7) is. The connector section 834 is a hollow rectangular body into which the connector section 734 of the switch plate 7, which is illustrated in FIG. 8, can be fitted. As illustrated in FIG. 10 and FIG. 11, a pair of fitting grooves 834a and 834b continuing into the connector-side groove part 831a are provided in an edge portion of the connector section 834 that faces the upper side of the vehicle. The vicinity (a coated electric wire portion) of the terminal 81b of one of the harnesses mounted on the groove section 831, the harness 81, is fitted into the fitting groove 834a. Consequently, the fitting groove 834a holds the terminal 81b of this harness 81 inside the connector section 834. The vicinity (a coated electric wire portion) of the terminal 82b of the other harness 82 mounted on the groove section 831 is fitted into the fitting groove 834b. Consequently, the fitting groove 834b holds the terminal 82b of this harness 82 inside the connector section 834.

[0078] The connector section 834, by having the connector section 734 of the switch plate 7 fitted thereinto, not only couples together the switch plate 7 and the harness plate 8 but also brings the respective terminals 81b and 82b of the harnesses 81 and 82 close to the terminals 741b and 751b (refer to FIG. 8) of the switch plate 7, respectively. In this state, the respective terminals 81b and 82b inside the connector section 834 are connected by, for example, resistance welding to the terminals 741b and 751b in the switch plate 7. Consequently, the harness plate 8 is electrically connected to the switch-connecting conducting plate 72 of the switch plate 7. That is, the second switch 14 is electrically connected to the switch-connecting conducting plate 72 of the switch plate 7 through the harnesses 81 and 82 in the harness plate 8.

[0079] Furthermore, the harness holding section 83 includes a fixation section 835 as illustrated in FIG. 10 and FIG. 11. The fixation section 835 is provided in the upper part of the harness holding section 83, specifically, in a part between the switch-side groove part 831b and the switch holding section 833. The fixation section 835 includes a through-hole 835a. When the harness plate 8 is mounted on the first casing 2, a shaft 29 (refer to FIG. 3) of the first casing 2 is inserted into the through-hole 835a of the fixation section 835. Consequently, the harness plate 8 is positioned relative to and fixed to the first casing 2.

[0080] The harness holding section 83 integrally includes the groove section 831, the insertion holding section 832, the switch holding section 833, the connector section 834, and the fixation section 835, which are described above. That is, the groove section 831, the insertion holding section 832, the switch holding section 833, the connector section 834, and the fixation section 835 is integrally formed by resin molding into the structure of the harness holding section 83 as illustrated in FIG. 10 and FIG. 11.

[0081] As described above, in the embodiment of the present invention, the switch plate 7 having a conducting plate mounted on the resin base member 73, and the harness plate 8 having the two harnesses 81 and 82 collectively mounted on the groove section 831 of the harness holding section 83 are formed as separate bodies. In addition, the switch plate 7 that electrically connects, in one part inside the casing 10, the motor 68 and the first switch 13 to the connection part 3a on the outer surface of the casing 10 is electrically connected through a connector to the harness plate 8 that electrically connects the harnesses 81 and 82 to the second switch 14 arranged away from the switch plate 7 inside the casing 10. Furthermore, the second switch 14 and the switch plate 7 are electrically connected to each other via the harnesses 81 and 82, while the motor 68, the first switch 13, and the second switch 14 are electrically connected to the connection part 3a through the switch plate 7 and the harness plate 8.

[0082] Thus, the switch plate 7 for which manufacturing processes that need high precision, such as punching out and resin insert molding of conducting plates, are required can be smaller than conventional internal wiring formed by connecting a plurality of switch plates through connectors. In addition, the shape of the switch plate 7 can be formed in a linear and simple shape with a smaller number of bent structures. Furthermore, second internal wiring that electrically connects to the second switch 14 is changed to the harness plate 8 from a conventional

switch plate (a second switch plate). Consequently, the second internal wiring can be extremely smaller than conventional wiring, and the shape of the wiring can be simplified. As a result, the yield of the switch plate 7 is improved as compared with the conventional one, so that size reduction and cost reduction for a switch plate embedded in the vehicle door locking device 1 are made possible. Not only that, size reduction and cost reduction for the vehicle door locking device 1 can be facilitated.

[0083] In the embodiment of the present invention, the harnesses 81 and 82 in the harness plate 8 are mounted on the groove section 831 of the harness holding section 83 so as to be held alongside each other in the vehicle inside-to-outside direction thoroughly from the top portion to the bottom portion of the inclined part 10c in the upper-end side wall part 10b of the casing 10. Consequently, the height positions of the harnesses 81 and 82 can be set as low as possible without imposing excessive torsional loads on the harnesses 81 and 82. As a result, the height position of the upper-end side wall part 10b of the casing 10 extending along the harness plate 8 can be set as low as possible. Thus, size reduction of the casing 10 and consequent size reduction of the vehicle door locking device 1 can be further facilitated.

[0084] In the embodiment of the present invention, the terminals 81a and 82a and the vicinities thereof of the respective harnesses 81 and 82 are inserted through the insertion holes 832a and 832b of the insertion holding section 832, respectively, in the inside-to-outside direction of the vehicle so that the terminals 81a and 82a are held so as to be able to come into abutment with the respective terminals of the second switch 14. This makes it possible to eliminate the step (harness press-fitting step) of mounting the vicinities of the terminals 81a and 82a of the respective harnesses 81 and 82 onto a part near the second switch 14 in the harness holding section 83 by press-fitting the above-described vicinities into the part from the upper side in the top-to-bottom direction of the vehicle. Consequently, the labor and time for the harness press-fitting step can be saved, and, as a result, while the time for assembling the harness plate 8 can be reduced, the labor for assembling the harness plate 8 can be reduced.

[0085] In the embodiment of the present invention, the second switch 14 held by the switch holding section 833 of the harness plate 8 is inserted through the insertion hole 41a formed in the body 41 of the latch mechanism 4 to be placed near the outer circumference of the latch 43. This makes it possible to cause the mover 14b of the second switch 14 mounted on the switch holding section 833 to face the outer circumferential surface of the latch 43 through the insertion hole 41a in the body 41 from the upper-end side of the latch mechanism 4. As a result, the second switch 14 mounted on the switch holding section 833 is enabled to detect the rotational position of the latch 43 without complication of the structure of the harness plate 8, for example, a structure thereof in which the second switch 14 bypasses the body 41 of the latch mechanism 4 to be placed near the outer circumference of the latch 43.

[0086] Furthermore, internal wiring of the vehicle door locking device 1 that includes the switch plate 7 and the harness plate 8 connected to each other through a connector is placed, in the inside of the casing 10, largely in a region relatively close to the upper side of the vehicle. This makes it possible to make the switch plate 7 and the harness plate 8 less likely to, when water seepage into the casing 10 has occurred, be affected by the water seepage.

[0087] Although the two harnesses 81 and 82 are collectively mounted on the harness plate 8 in the above-described embodiment, the present invention is not limited to this. In the present invention, the number of harnesses that are collectively mounted on the harness plate 8 may be multiple (two or more). In this case, the number of conducting plates of the switch plate 7 may be multiple (two or more) so as to agree with the number of harnesses in the harness plate 8. The two or more harnesses that are collectively mounted on the harness plate 8 may include a harness that connects to an electronic component other than the second switch 14.

[0088] Although the harnesses 81 and 82 in the harness plate 8 are arranged alongside each other in the vehicle inside-to-outside direction from the bottom portion to the top portion of the inclined part 10c in the upper-end side wall part 10b of the casing 10 in the above-described embodiment, the present invention is not limited to this. In the present invention, the two or more harnesses that are collectively mounted on the harness plate 8 may be arranged alongside one another in the vehicle inside-to-outside direction all along the upper-end side wall part 10b of the casing 10. That is, the harness holding section 83 may hold the two or more harnesses alongside one another in the vehicle inside-to-outside direction all the way through the switch-side groove part 831b and the intermediate groove part 831c.

[0089] The above-described embodiment is not intended to limit the present invention, and embodiments configured by appropriately combining any of the above-described constituent elements also fall within the present invention. All the other embodiments, examples, and operational techniques and the like to be made by those skilled in the art on the basis of the above-described embodiment fall within the scope of the present invention.

Industrial Applicability

[0090] As described above, the vehicle door locking device according to the present invention is advantageous to size reduction and cost reduction for a vehicle door locking device that includes a plurality of electronic components, and is particularly suitable for a vehicle door locking device that can improve the yields of wiring components embedded therein.

Reference Signs List

[0091]

1 VEHICLE DOOR LOCKING DEVICE
2 FIRST CASING
2a FIRST OUTER WALL PART
2b FIRST SIDE WALL PART
2c SECOND OUTER WALL PART
2d SECOND SIDE WALL PART
3 SECOND CASING
3a CONNECTION PART
4 LATCH MECHANISM
5 CONDUCTION WIRING SECTION
6 LOCKING-UNLOCKING MECHANISM
7 SWITCH PLATE
8 HARNESS PLATE
10 CASING
10b UPPER-END SIDE WALL PART
10c INCLINED PART
11 FIRST STORAGE SECTION
12 SECOND STORAGE SECTION
13 FIRST SWITCH
13a MAIN BODY
13b MOVER
13c INPUT TERMINAL
13d OUTPUT TERMINAL
14 SECOND SWITCH
14a MAIN BODY
14b MOVER
14c INPUT TERMINAL
14d OUTPUT TERMINAL
15, 16 CABLE
17 WATERPROOF COVER
21 FIRST SHAFT
22 SECOND SHAFT
23 THIRD SHAFT
24 FOURTH SHAFT
25 SPRING SHAFT
26 WHEEL SHAFT
27, 28, 29 SHAFT
31 OPENING
41 BODY
41a INSERTION HOLE
42 COVER PLATE
42a ENTRANCE GROOVE
43 LATCH
43b ABUTMENT PART
43c ENGAGEMENT GROOVE
43d PROTRUDING PART
43f FIRST OUTER CIRCUMFERENTIAL SURFACE
43g SECOND OUTER CIRCUMFERENTIAL SURFACE
44 RATCHET
44b RELEASE LEVER
61 INSIDE LEVER
61a FIRST ARM
61b SECOND ARM
61c PRESSING PART
62 OPEN LINK
62a FIRST COUPLING HOLE
62b SECOND COUPLING HOLE
62c PRESSING PART
63 LEVER LOCK
63a SILENCER
63b ARM
63c COUPLING PROTRUSION
63d ENGAGEMENT PROTRUSION
63e INTERLOCKING GROOVE
64 INTERMEDIATE LEVER
64a ARM
64b COUPLING HOLE
64c PRESSING PART
65 CHILDPROOF LEVER
65c COUPLING HOLE
65d TAB
66 OVER-THE-CENTER SPRING
67 WORM WHEEL
68 MOTOR
69 OUTSIDE LEVER
69a COUPLING PROTRUSION
69b COUPLING PART
69c ABUTMENT PART
70 COUPLING MEMBER
71 MOTOR-CONNECTING CONDUCTING PLATE
71a FIRST CONDUCTING PLATE
71b SECOND CONDUCTING PLATE
711a, 711b, 712a, 712b TERMINAL
72 SWITCH-CONNECTING CONDUCTING PLATE
73 RESIN BASE MEMBER
731, 732 GROOVE
733 SWITCH HOLDING SECTION
734 CONNECTOR SECTION
74 INPUT PLATE
74a FIRST INPUT PLATE
74b SECOND INPUT PLATE
741a, 741b, 742 TERMINAL
75a FIRST OUTPUT PLATE
75b SECOND OUTPUT PLATE
751a, 751b, 752a, 752b TERMINAL
81, 82 HARNESS
81a, 81b, 82a, 82b TERMINAL
83 HARNESS HOLDING SECTION
831 GROOVE SECTION
831a CONNECTOR-SIDE GROOVE PART
831b SWITCH-SIDE GROOVE PART
831c INTERMEDIATE GROOVE PART
832 INSERTION HOLDING SECTION
832a, 832b INSERTION HOLE
832c, 832d FITTING GROOVE
833 SWITCH HOLDING SECTION
834 CONNECTOR SECTION
834a, 834b FITTING GROOVE

Claims

1. A vehicle door locking device comprising:

   a casing;
   a connection part to which a connector for connection to an external device is connected, the connection part being arranged in a front portion of an outer surface of the casing in a front-to-rear direction of a vehicle;
   a latch mechanism arranged in a rear-end portion of the casing in the front-to-rear direction of the vehicle and including a latch and a ratchet;
   a locking-unlocking mechanism arranged inside the casing, the locking-unlocking mechanism including

      a lever lock that, in accordance with a rotational position thereof, switches between enabling and disabling transmission of a door-opening operation to the latch mechanism, and
      a motor that drives the lever lock;

   a first switch that detects the rotational position of the lever lock;
   a second switch that switches a room lamp of the vehicle on and off in accordance with a rotational position of the latch;
   a switch plate including a conducting plate and a resin base member on which the conducting plate is mounted, the switch plate being arranged inside the casing and electrically connecting the connection part to the motor and the first switch arranged in a front portion of the inside of the casing in the front-to-rear direction of the vehicle; and
   a harness plate including a plurality of harnesses and a harness holding section that collectively holds the harnesses, the harness plate being arranged inside the casing and electrically connecting the second switch and the connection part to each other through the harnesses and the switch plate.

2. The vehicle door locking device according to claim 1, wherein
   the casing includes an upper-end side wall part in an upper-end portion thereof in a top-to-bottom direction of the vehicle, the upper-end side wall part including an inclined part inclined upward in the top-to-bottom direction of the vehicle in a manner corresponding to the latch mechanism while extending in a direction from the front side of the vehicle toward the rear side of the vehicle,
   the harness holding section is arranged along the upper-end side wall part and includes a groove section into which the harnesses are collectively fitted, and
   the groove section holds the harnesses alongside one another in an inside-to-outside direction of the vehicle thoroughly from a bottom portion to a top portion of the inclined part in the upper-end side wall part.

3. The vehicle door locking device according to claim 1 or 2, wherein the harness holding section includes, in a rear-end portion in the front-to-rear direction of the vehicle, an insertion holding section that holds vicinities of end portions of the respective harnesses by having the harnesses individually inserted therethrough in the inside-to-outside direction of the vehicle, the end portions electrically connecting to the second switch.

4. The vehicle door locking device according to any one of claims 1 to 3, wherein
   the harness holding section includes, in a rear-end portion in the front-to-rear direction of the vehicle, a switch holding section that holds the second switch, and
   the switch holding section places the second switch near an outer circumference of the latch by inserting the held second switch through an insertion hole formed in a body of the latch mechanism.

5. The vehicle door locking device according to any one of claims 1 to 4, wherein the second switch is placed between an upper end portion of the casing and an upper end portion of the latch in a top-to-bottom direction of the vehicle.

FIG.1

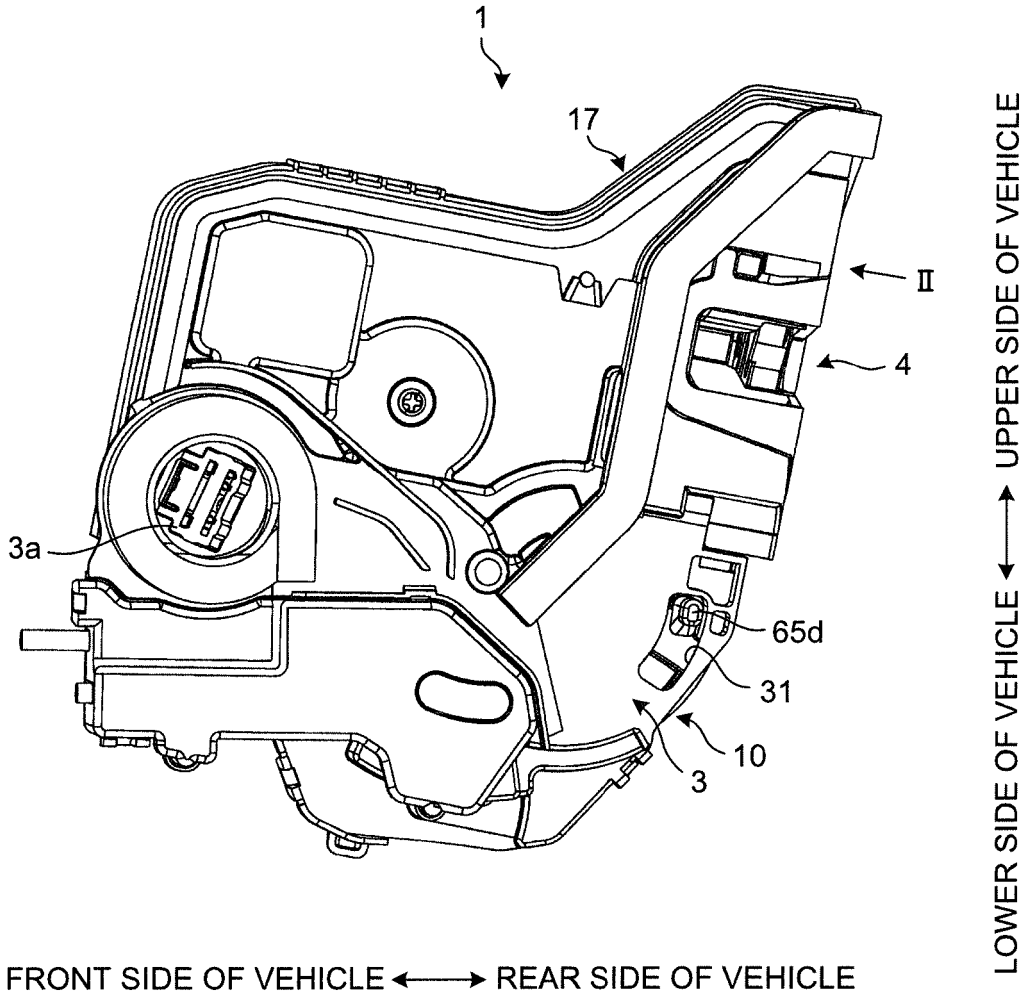

1
17
II
4
3a
65d
31
10
3
FRONT SIDE OF VEHICLE ⟷ REAR SIDE OF VEHICLE
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE

FIG.2

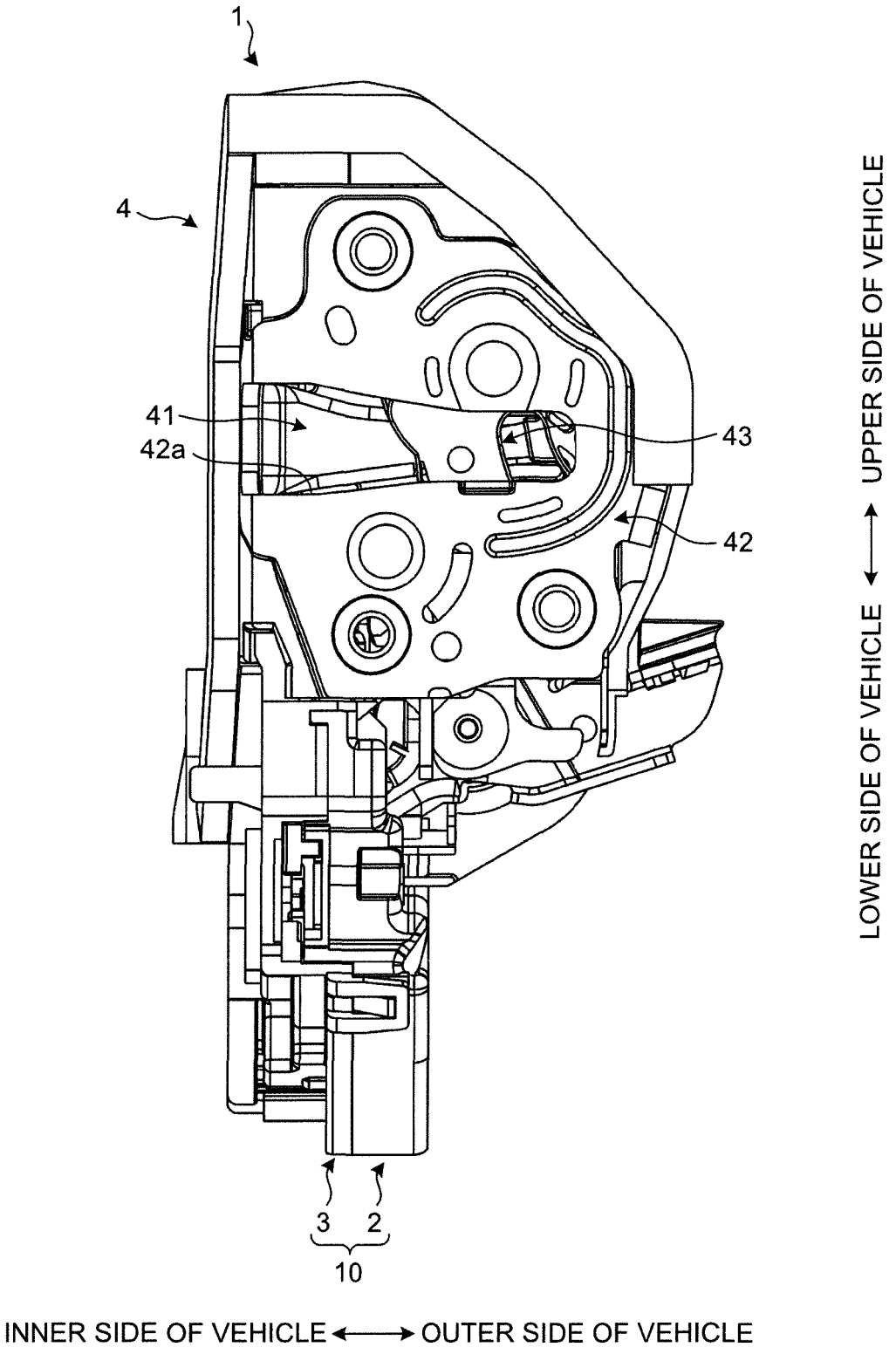

1
4
41
42a
43
42
3
2
10
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE
INNER SIDE OF VEHICLE ⟷ OUTER SIDE OF VEHICLE

FIG.3

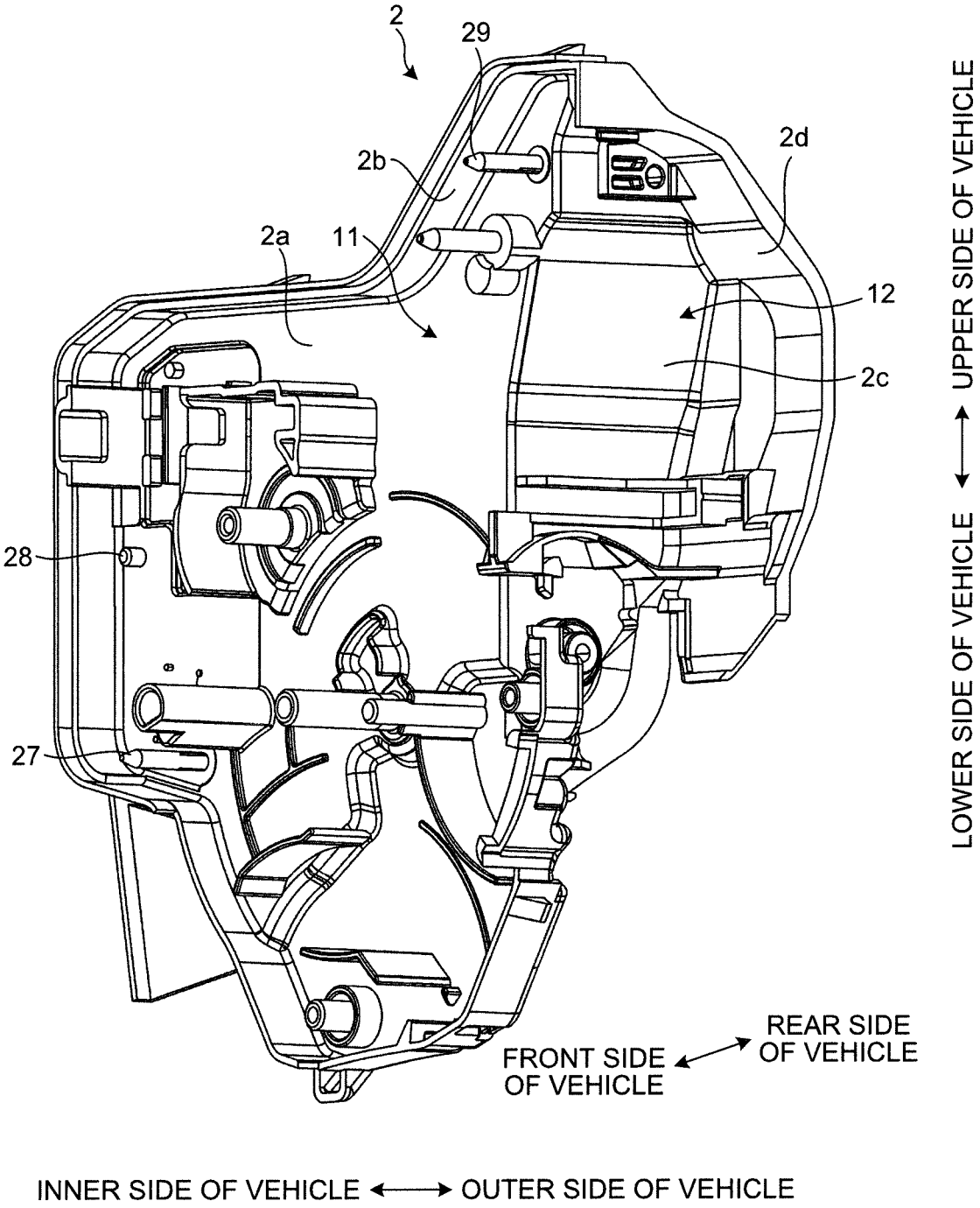

2
29
2b
2d
2a
11
12
2c
28
27
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
REAR SIDE OF VEHICLE
FRONT SIDE OF VEHICLE
INNER SIDE OF VEHICLE
OUTER SIDE OF VEHICLE

FIG.4

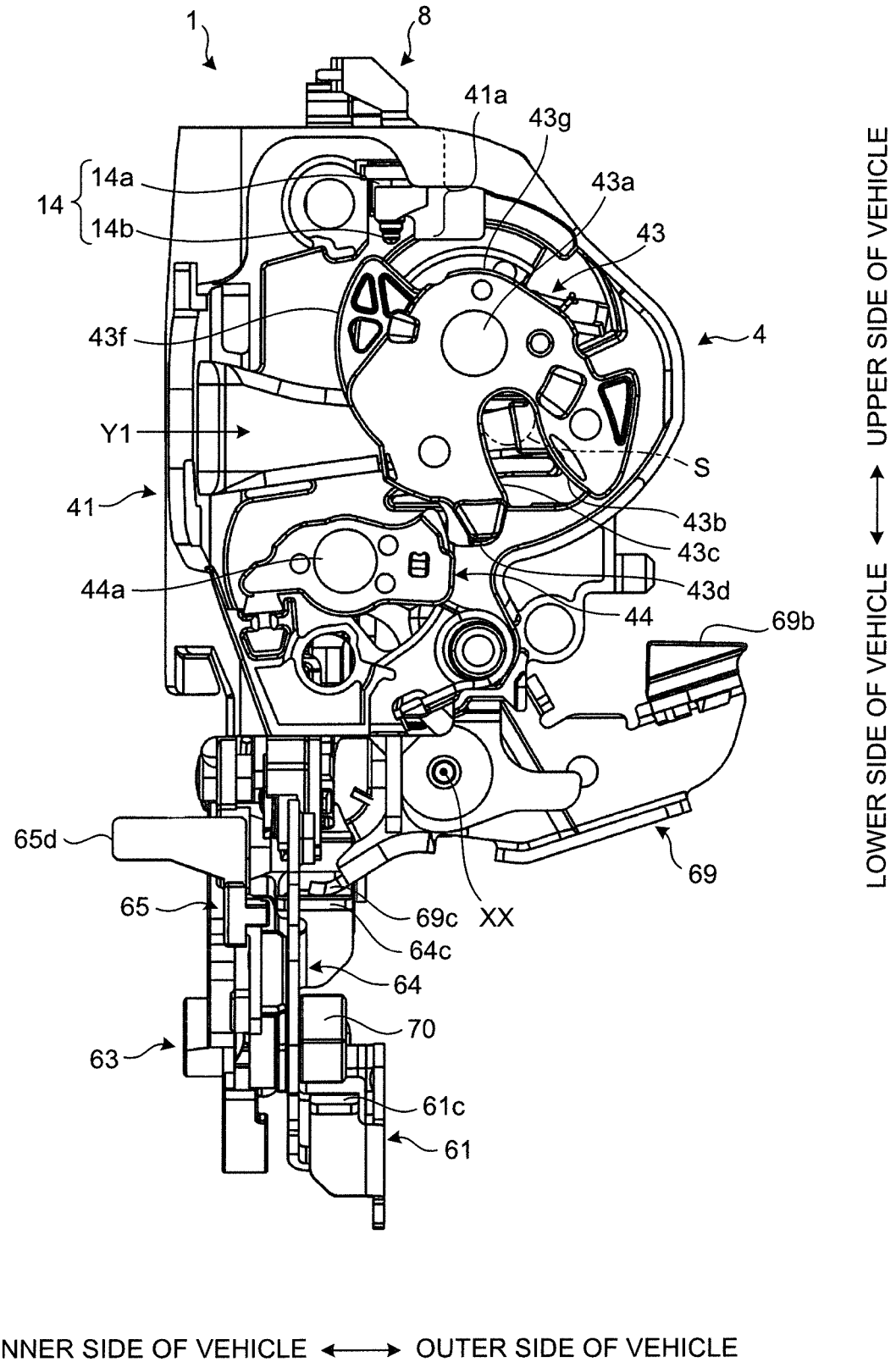

1
8
41a
43g
14
14a
14b
43a
43
43f
4
Y1
S
41
43b
43c
44a
43d
44
69b
65d
69
65
69c
XX
64c
64
70
63
61c
61
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE
INNER SIDE OF VEHICLE ⟷ OUTER SIDE OF VEHICLE

FIG.5

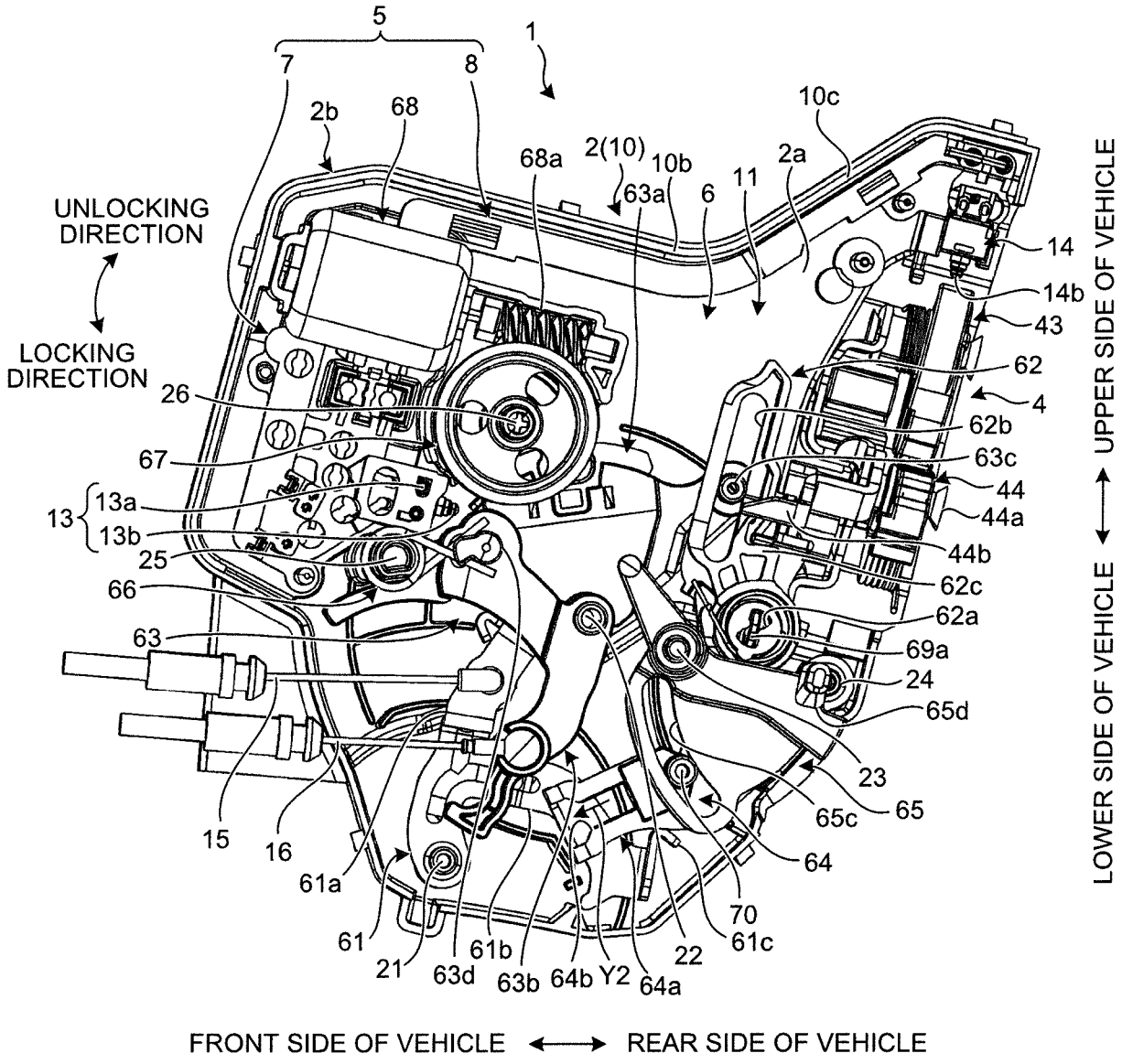

5
7
8
1
2b
68
68a
2(10)
10b
10c
2a
11
6
63a
UNLOCKING DIRECTION
LOCKING DIRECTION
14
14b
43
62
4
62b
63c
44
44a
44b
62c
62a
69a
24
65d
23
65
65c
64
70
61c
22
64a
Y2
64b
63b
61b
63d
21
61
61a
16
15
26
67
13
13a
13b
25
66
63
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
FRONT SIDE OF VEHICLE
REAR SIDE OF VEHICLE

FIG.6

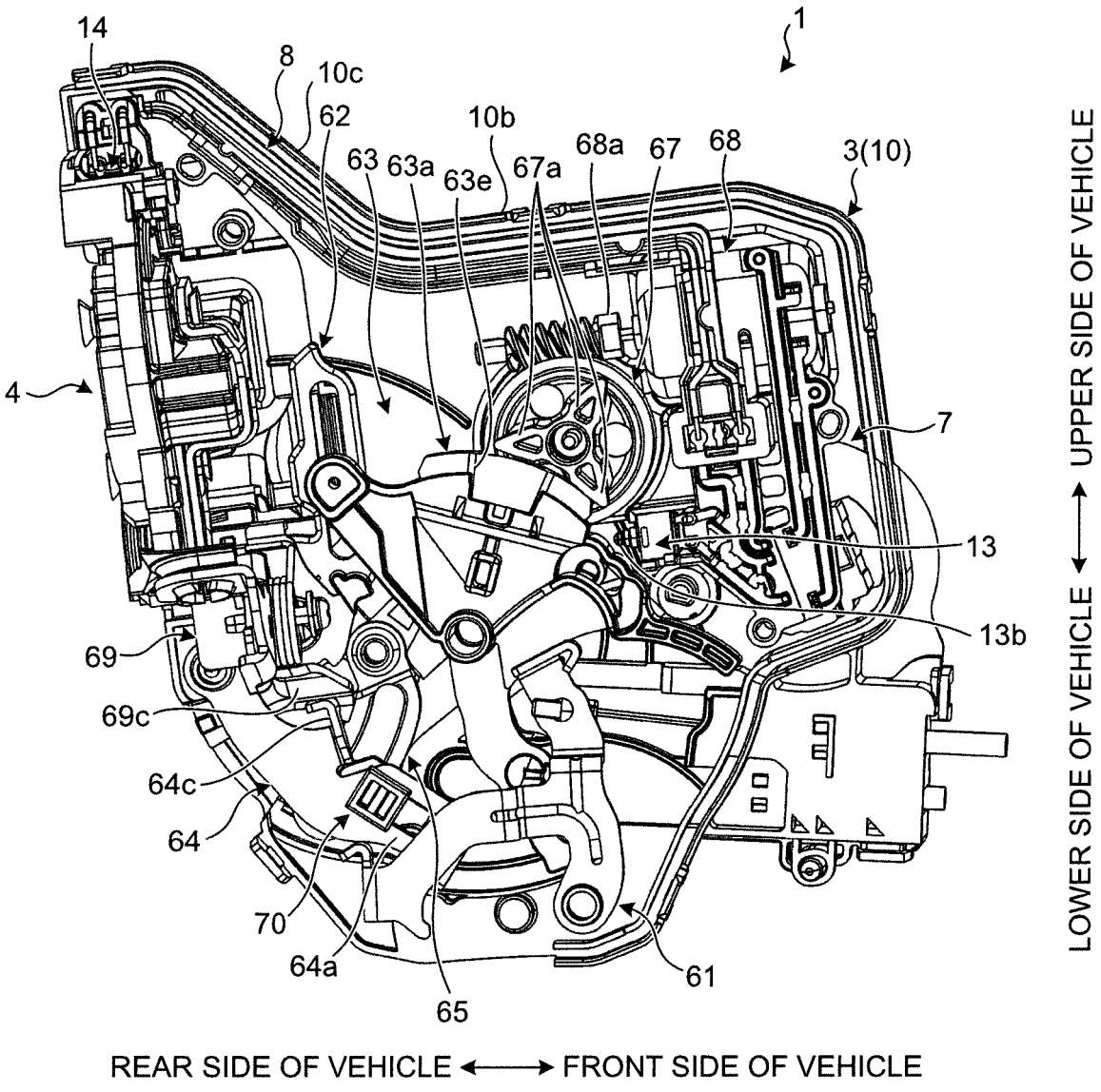

14
8
10c
62
10b
63
63a
63e
67a
68a
67
68
3(10)
1
4
7
13
13b
69
69c
64c
64
70
64a
65
61
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE
REAR SIDE OF VEHICLE ⟷ FRONT SIDE OF VEHICLE

FIG.7

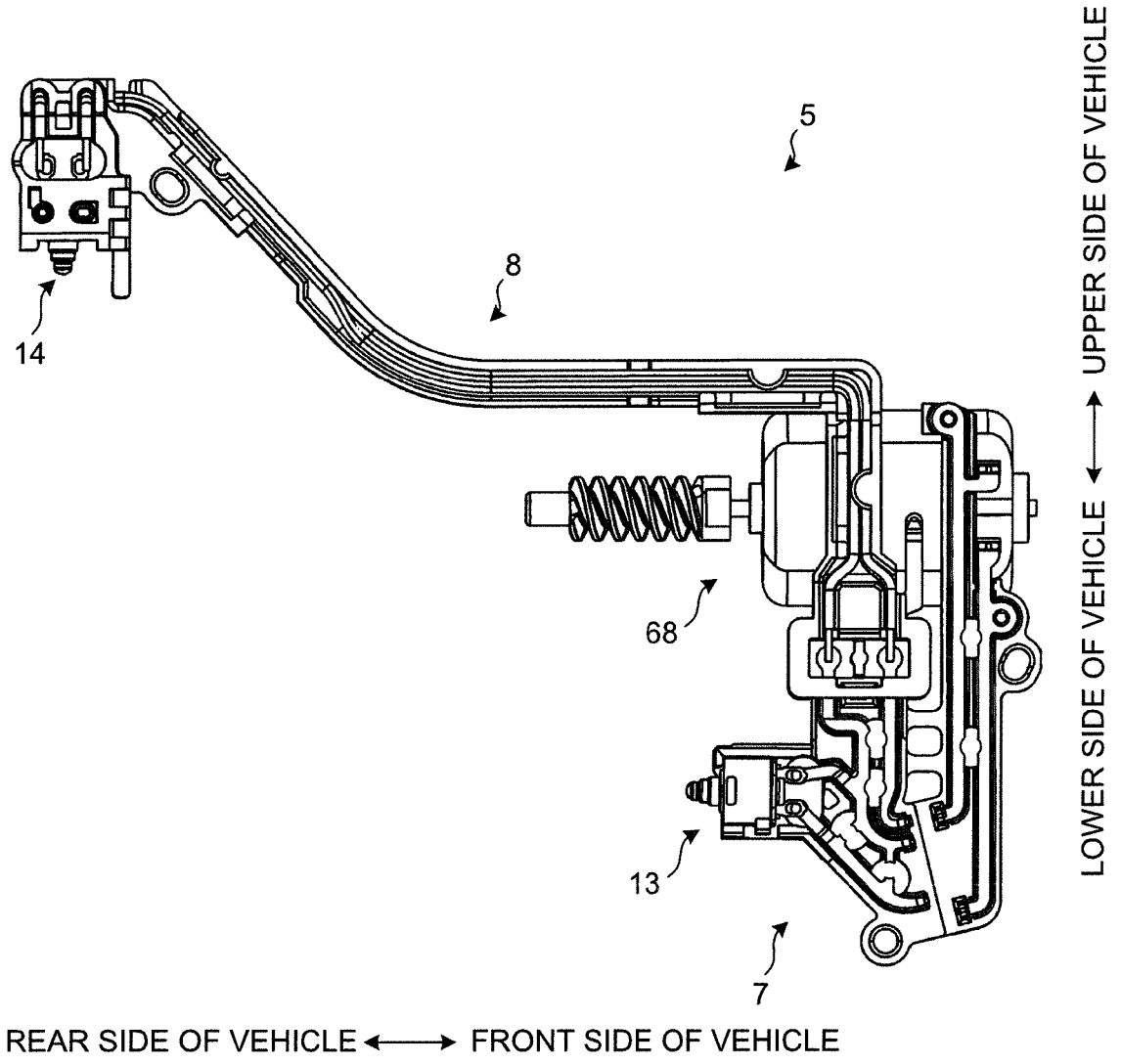

5
8
14
68
13
7
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE
REAR SIDE OF VEHICLE ⟷ FRONT SIDE OF VEHICLE

FIG.8

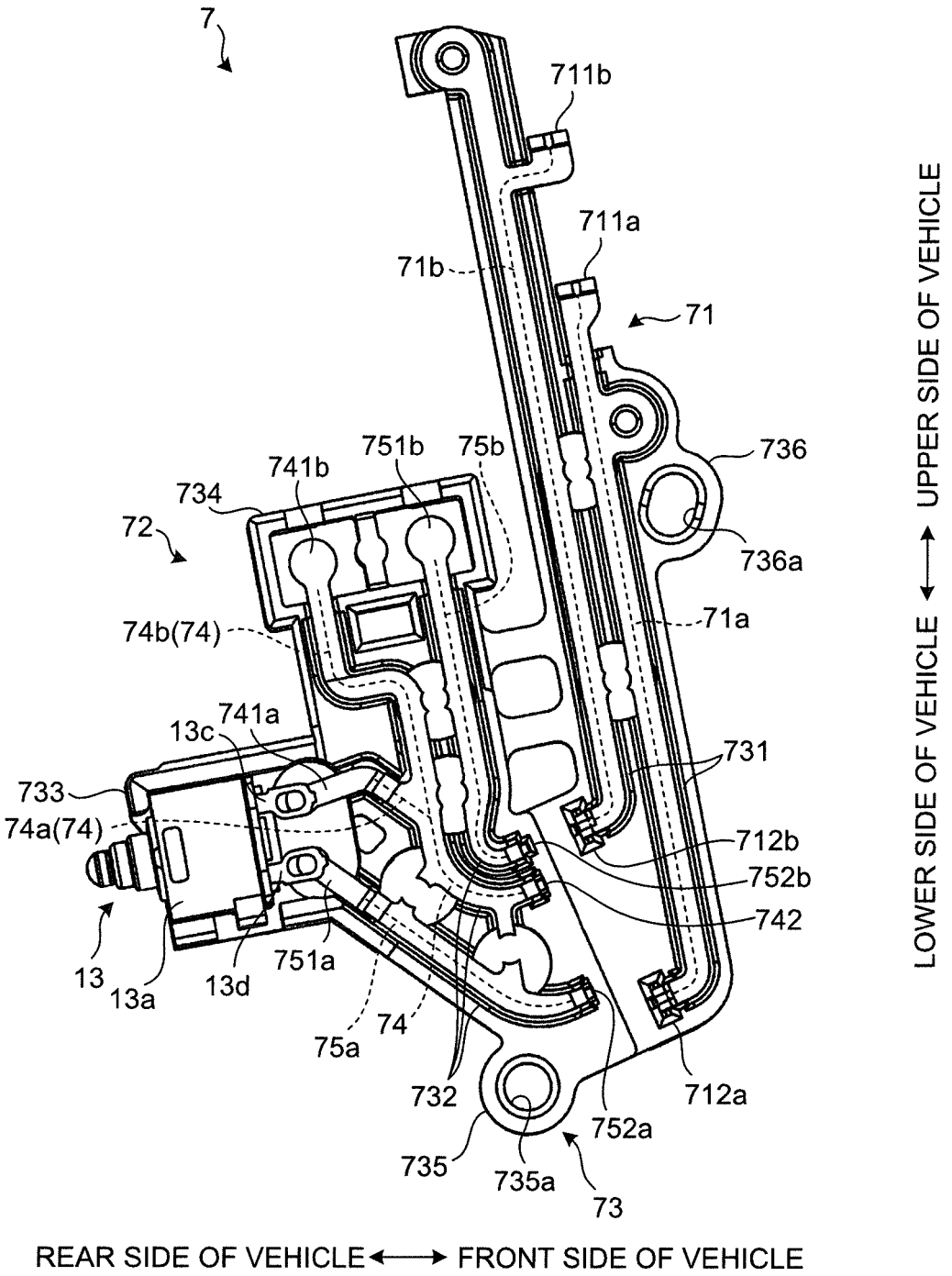

7
711b
711a
71b
71
736
751b
75b
741b
734
72
736a
74b(74)
71a
741a
13c
731
733
74a(74)
712b
752b
742
13
13a
13d
751a
74
75a
732
712a
752a
735
735a
73
REAR SIDE OF VEHICLE ⟷ FRONT SIDE OF VEHICLE
LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE

FIG.9

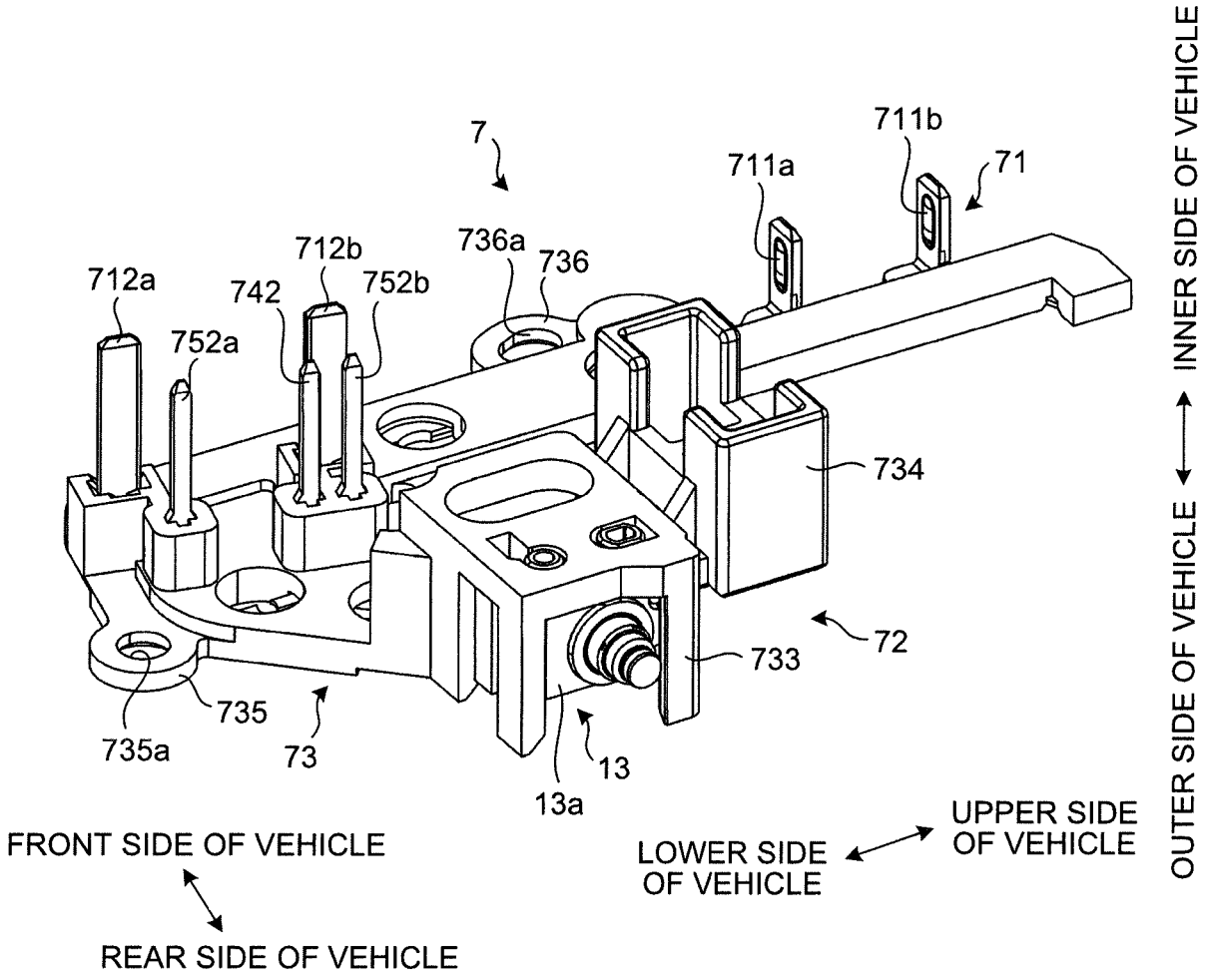

7
711b
711a
71
712b
736a
736
712a
742
752b
752a
734
72
733
735
735a
73
13
13a
FRONT SIDE OF VEHICLE
REAR SIDE OF VEHICLE
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
OUTER SIDE OF VEHICLE
INNER SIDE OF VEHICLE

FIG.10

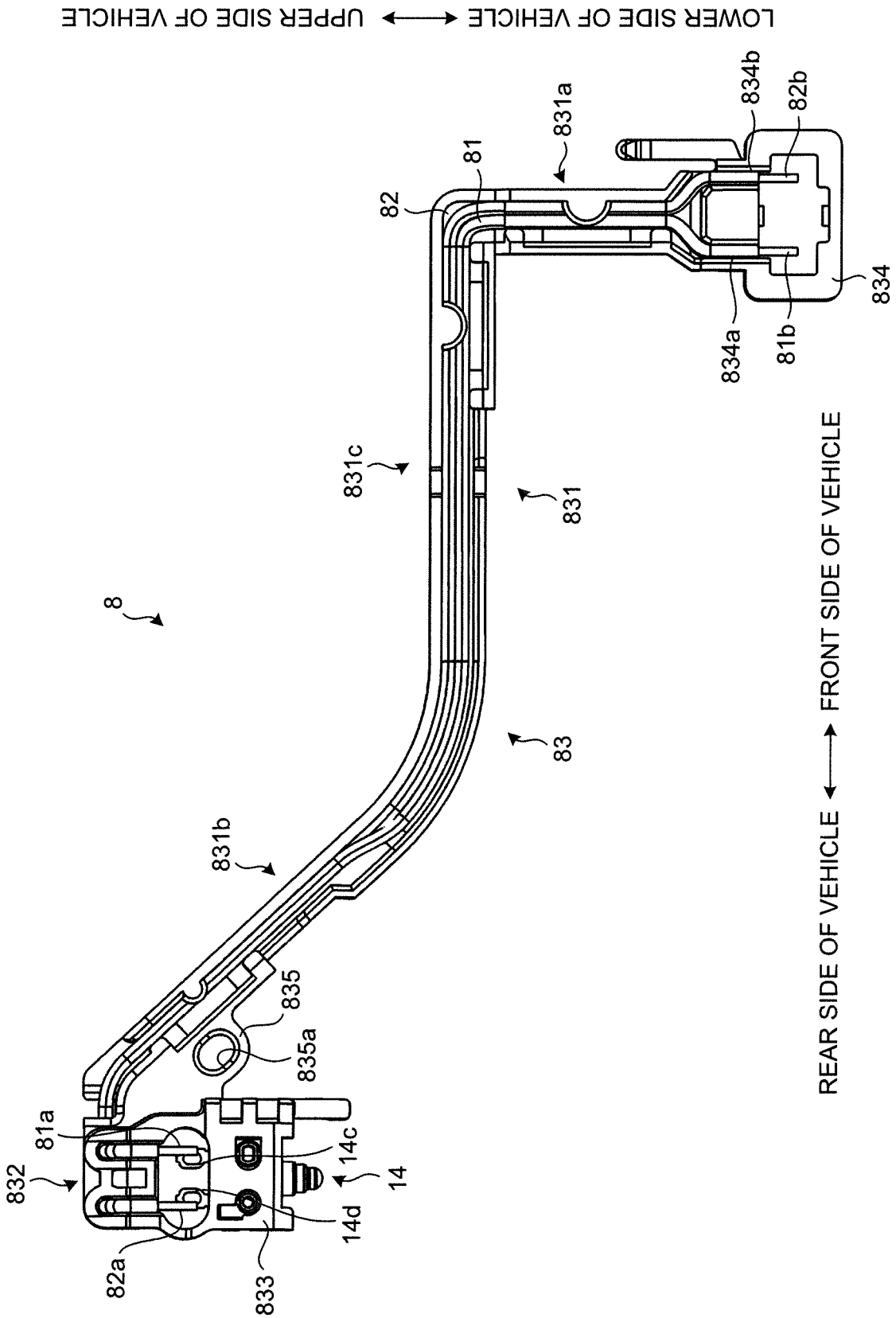

LOWER SIDE OF VEHICLE ⟷ UPPER SIDE OF VEHICLE
REAR SIDE OF VEHICLE ⟷ FRONT SIDE OF VEHICLE
8
831a
834b
82b
81
82
834
834a
81b
831c
831
83
831b
835
835a
81a
832
14c
14
14d
82a
833

FIG.11

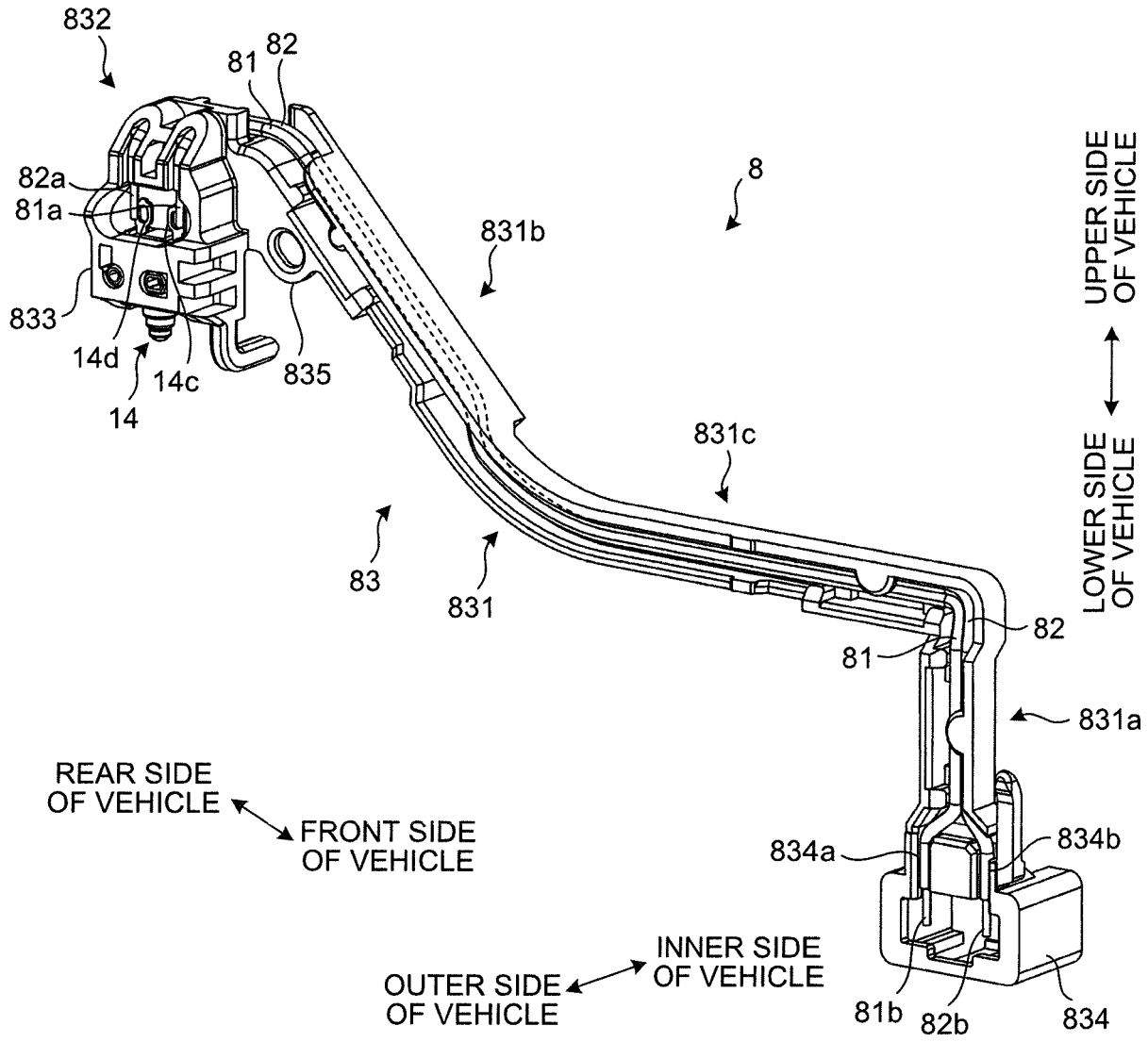

832
81
82
82a
81a
833
14d
14c
14
835
8
831b
831c
83
831
UPPER SIDE OF VEHICLE
LOWER SIDE OF VEHICLE
82
81
831a
834a
834b
REAR SIDE OF VEHICLE
FRONT SIDE OF VEHICLE
INNER SIDE OF VEHICLE
OUTER SIDE OF VEHICLE
81b
82b
834

FIG.12

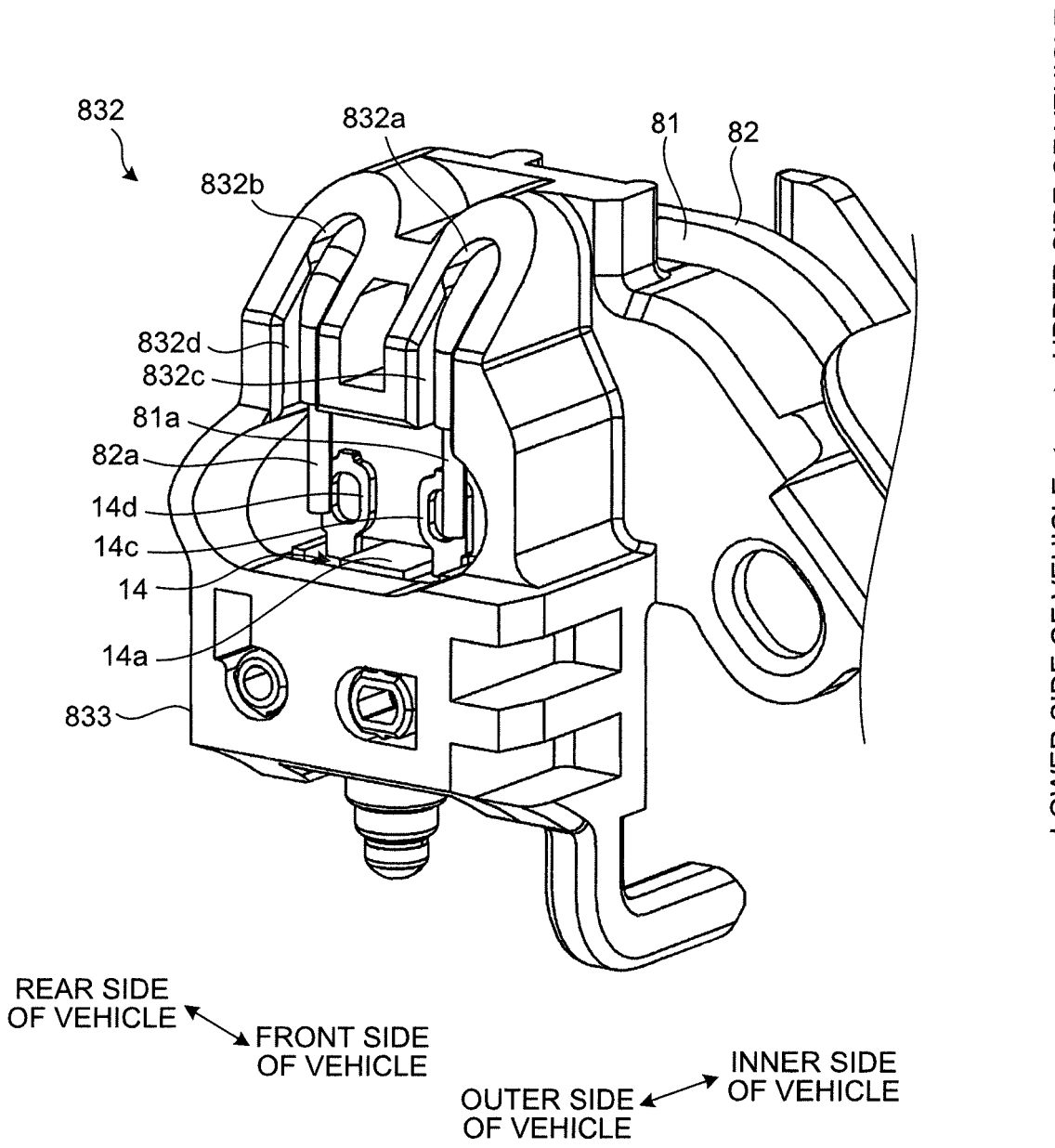

832
832a
81
82
832b
832d
832c
81a
82a
14d
14c
14
14a
833
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
REAR SIDE OF VEHICLE
FRONT SIDE OF VEHICLE
OUTER SIDE OF VEHICLE
INNER SIDE OF VEHICLE

FIG.13

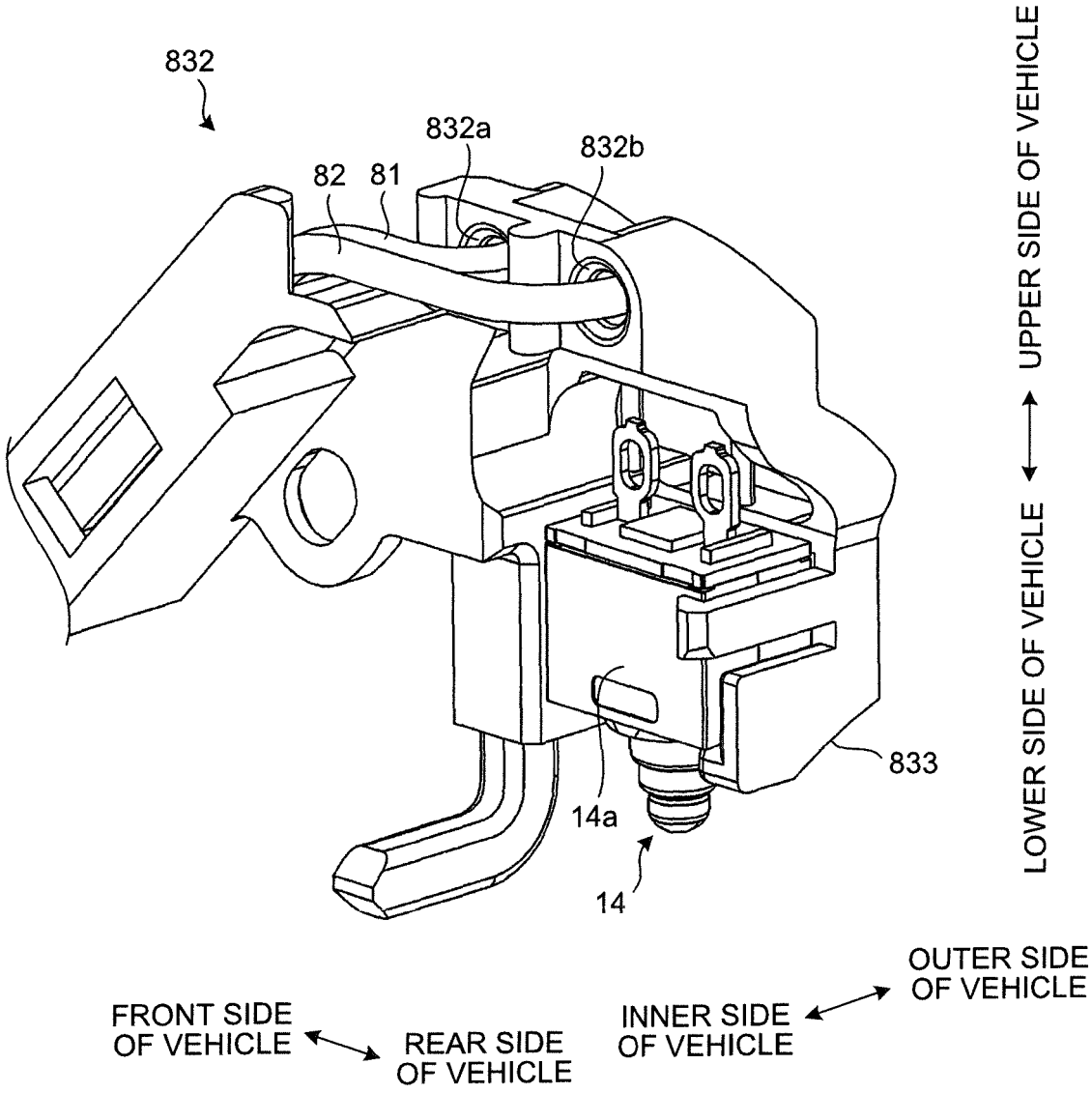

832
832a
832b
82
81
833
14a
14
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
FRONT SIDE OF VEHICLE
REAR SIDE OF VEHICLE
INNER SIDE OF VEHICLE
OUTER SIDE OF VEHICLE

FIG.14

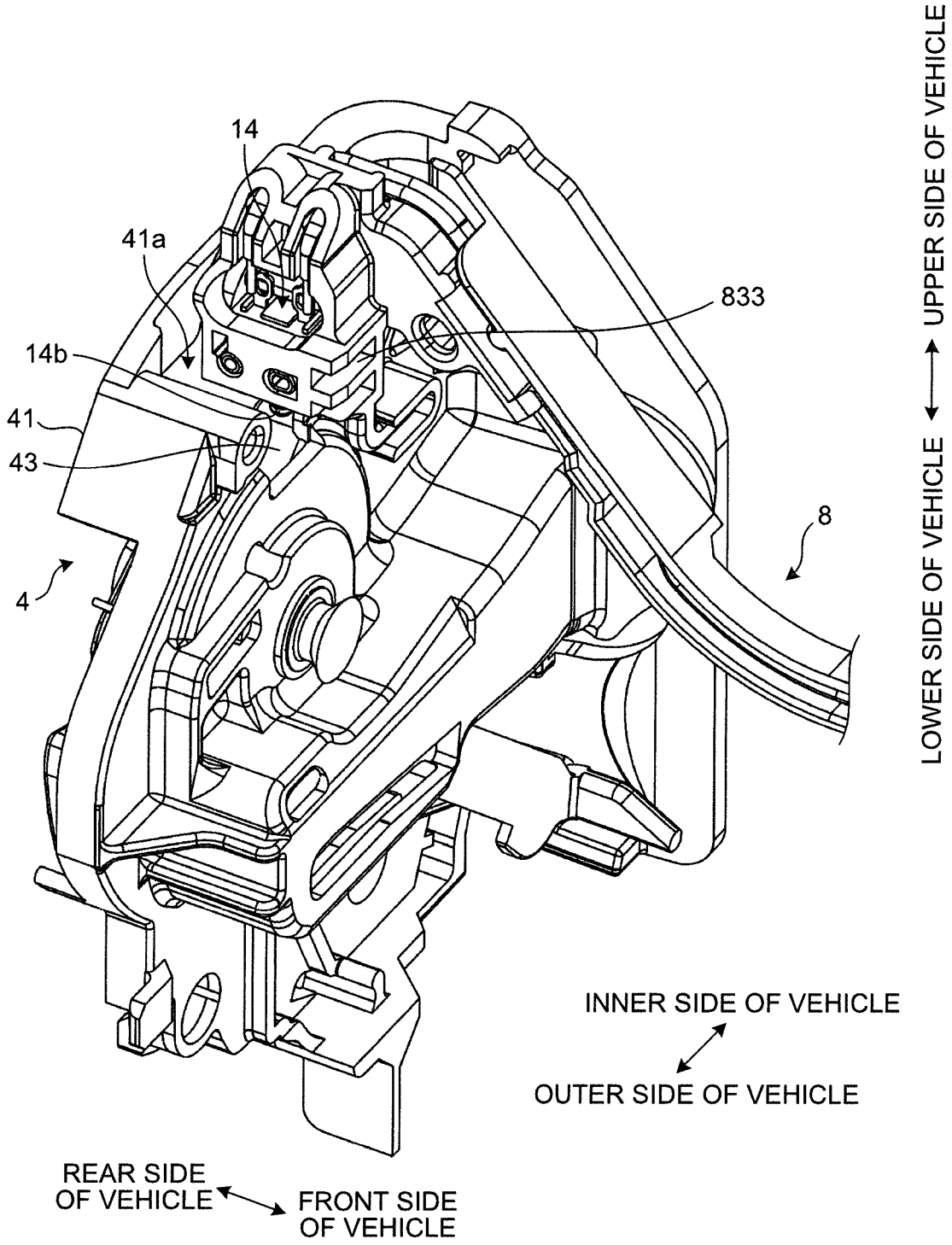
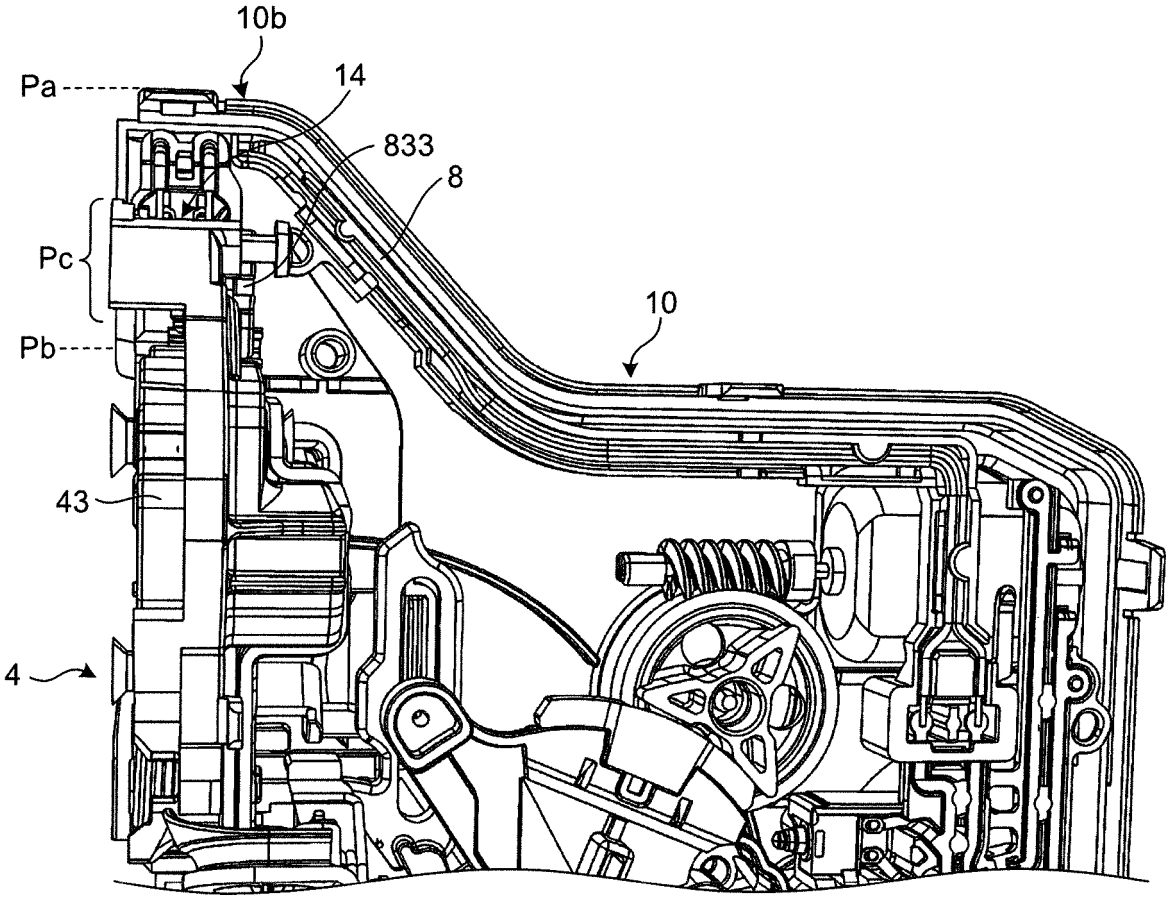

14
41a
833
14b
41
43
8
4
LOWER SIDE OF VEHICLE
UPPER SIDE OF VEHICLE
INNER SIDE OF VEHICLE
OUTER SIDE OF VEHICLE
REAR SIDE OF VEHICLE
FRONT SIDE OF VEHICLE

FIG.15



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/061249

A. CLASSIFICATION OF SUBJECT MATTER
E05B81/54(2014.01)i, *B60J5/00*(2006.01)i, *E05B81/16*(2014.01)i, *E05B81/66*(2014.01)i, *E05B81/72*(2014.01)i, *E05B85/02*(2014.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
E05B81/54, B60J5/00, E05B81/16, E05B81/66, E05B81/72, E05B85/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2016
Kokai Jitsuyo Shinan Koho 1971-2016 Toroku Jitsuyo Shinan Koho 1994-2016

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2012-41764 A (Mitsui Kinzoku Act Corp.), 01 March 2012 (01.03.2012), entire text; all drawings & CN 202347957 U	1-5
A	JP 2012-12810 A (Mitsui Kinzoku Act Corp.), 19 January 2012 (19.01.2012), entire text; all drawings (Family: none)	1-5
A	JP 2014-214501 A (Honda Lock Mfg. Co., Ltd.), 17 November 2014 (17.11.2014), entire text; all drawings & US 2016/0076277 A1 & EP 2990572 A1 & CN 105209703 A	1-5

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

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

Date of the actual completion of the international search	Date of mailing of the international search report
01 June 2016 (01.06.16)	21 June 2016 (21.06.16)
Name and mailing address of the ISA/ Japan Patent Office 3-4-3,Kasumigaseki,Chiyoda-ku, Tokyo 100-8915,Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2016/061249

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E,A	JP 2016-89350 A (Mitsui Kinzoku Act Corp.), 23 May 2016 (23.05.2016), entire text; all drawings (Family: none)	1-5
P,A	JP 2016-23461 A (Mitsui Kinzoku Act Corp.), 08 February 2016 (08.02.2016), entire text; all drawings & WO 2016/009657 A1	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2013083086 A **[0004]**