(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 182 148 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
05.05.2010 Bulletin 2010/18

(51) Int Cl.:
E05B 47/02 *(2006.01)* ***E05B 65/12*** *(2006.01)*

(21) Application number: **09174384.9**

(22) Date of filing: **28.10.2009**

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

(30) Priority: **28.10.2008 JP 2008276489**
28.10.2008 JP 2008276493

(71) Applicant: **Aisin Seiki Kabushiki Kaisha**
Aichi-ken 448-8650 (JP)

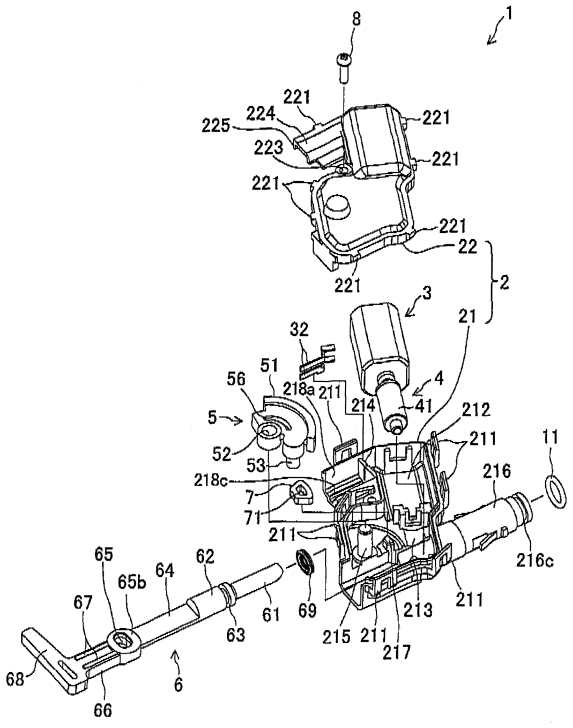
(72) Inventors:
- **Sono, Yasuhiko**
  Aichi-ken (JP)
- **Imatomi, Yasuo**
  Kariya-shi, Aichi-ken 448-8650 (JP)
- **Kubo, Eiji**
  Kariya-shi, Aichi-ken 448-8650 (JP)

(74) Representative: **Albutt, Anthony John**
D Young & Co LLP
120 Holborn
London EC1N 2DY (GB)

(54) Lid lock apparatus for vehicle

(57) A lid lock apparatus for a vehicle includes a housing (2), a drive motor (3), an output gear (5) having an engagement piece (53), and a shaft member (6) of which one end is engageable with a lid member (91). The shaft member (6) includes a support portion (62), a relief portion (64), and a recess portion (65). The shaft member (6) further includes a contact portion (65a) obtained by a portion of the engagement piece (53) closest to an axial center (P) of the shaft member (6) to extend radially outwardly in a case where the contact portion (65a) is formed at the engagement piece (53), the contact portion being obtained by a portion of the recess portion (65) closest to the axial center (P) to extend radially inwardly in a case where the contact portion (65a) is formed at the recess portion (65).

FIG. 1



EP 2 182 148 A2

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a lid lock apparatus for a vehicle.

BACKGROUND

[0002] A known lid lock apparatus for a vehicle is disclosed in JP3079611B. According to the lid lock apparatus disclosed, a shaft member is configured to project from a housing by means of a spring force to engage with a lid member provided at a vehicle body, thereby locking the lid member in a closed state. Then, an electric motor provided within the housing is operated to rotate a worm wheel so that the shaft member moves against the spring force and disengages from the lid member. As a result, the lid member is brought to open.

[0003] According to the aforementioned lid lock apparatus disclosed in JP307961 1 B, a drive unit including a worm for transmitting a drive force of the electric motor to the shaft member is arranged so as to overlap the shaft member in a thickness direction of the housing. Then, a reduction of dimensions of the lid lock apparatus in a thickness direction thereof is attempted. In order to define a space where the drive unit is arranged in an overlapping manner on the shaft member, a relief portion is formed at the shaft member so that dimensions in the thickness direction of the shaft member is partially reduced.

[0004] However, in a case where the relief portion is formed, a point on the shaft member where a load is applied from a worm wheel (i.e., a point of application) and an axial center of a guide portion of the shaft member where the shaft member is guided by the housing do not match each other. Thus, when the shaft member pressed by the worm wheel via the relief portion axially moves, a rotational momentum is likely to be generated on the shaft member in the thickness direction thereof. As a result, the shaft member inclines in the thickness direction relative to the housing so that the shaft member may hit or hollow the housing. The failure in locking the lid member in a closed state may occur.

[0005] Further, a sliding resistance caused by a seal member for waterproofing provided at a front portion of the shaft member in a moving direction thereof accelerates the inclination of the shaft member.

[0006] In addition, according to the aforementioned lid lock apparatus disclosed in JP3079611B, a holding portion, to which a stopper made of an elastic member is fixed, projects from the housing. Two projections formed at the worm wheel make contact with the stopper, respectively, depending on a rotation direction of the worm wheel, thereby stopping the rotation of the worm wheel.

[0007] The stopper having a snapping performance used in the aforementioned lid lock apparatus is simply mounted on the holding portion that has a pile shape and that extends from an inner surface of the housing in a manner that the holding portion is inserted into an inner bore formed at a center of the stopper. Thus, in a case where a deflection of the stopper is repeated each time the worm wheel makes contact with the stopper, the stopper may be lifted up relative to the holding portion and eventually may fall off from the holding portion.

[0008] In order to prevent the falling-off of the stopper from the holding portion, it is considered to integrally form a retainer having a larger diameter than that of the stopper at an upper end of the holding portion. However, this method leads to a deterioration of performance for mounting the stopper on the holding portion. In addition, it may be possible to mount the stopper on the holding portion and then to attach a separate retainer to the holding portion. However, the number of components of the lid lock apparatus increases and an assembly man-hour increases. Further, it may be possible to adhere or bond the stopper to the holding portion by adhesive, and the like when the stopper is mounted on the holding portion. However, a repetition of deflection may cause the stopper to fall off via the adhesion portion from the holding portion.

[0009] A need thus exists for a lid lock apparatus for a vehicle which is smoothly operated and in which a stopper for an output gear such as a worm wheel is prevented from falling off.

SUMMARY OF THE INVENTION

[0010] According to an aspect of the present invention, a lid lock apparatus for a vehicle includes a housing, a drive motor accommodated within the housing, an output gear supported within the housing to be rotatable by means of an operation of the drive motor, and a shaft member axially movably supported within the housing, one end of the shaft member being engageable with a lid member provided at a vehicle body by projecting from the housing, the shaft member axially moving by engaging with the output gear. The output gear includes an engagement piece extending in a thickness direction of the housing and engaging with the shaft member. The shaft member includes a support portion movably supported by the housing, a relief portion cut out in the thickness direction and on which the output gear is placed in an overlapping manner in the thickness direction, and a recess portion into which the engagement piece of the output gear is inserted in the thickness direction. The shaft member further includes a contact portion formed at least at one of the engagement piece and the recess portion. The contact portion is obtained by a portion of the engagement piece closest to an axial center of the shaft member in the thickness direction to extend radially outwardly relative to the other portion of the engagement piece in a case where the contact portion is formed at the engagement piece. The contact portion is obtained by a portion of the recess portion closest to the axial center of the shaft member in the thickness direction to extend radially inwardly relative to the other portion of the recess portion in a case where the contact portion is

formed at the recess portion so that the engagement piece and the recess portion engage with each other at the axial center of the shaft member passing through a center of the support portion in the thickness direction in a case where the shaft member axially moves.

[0011] Accordingly, in a case where the shaft member moves in the axial direction thereof, a portion of the engagement piece positioned closest to the axial center in the thickness direction and a portion of the recess portion positioned closest to the axial center in the thickness direction engage with each other at the axial center of the support portion of the shaft member. Thus, the shaft member is prevented from inclining relative to the housing and is smoothly operated to engage with or disengage from the lid member.

[0012] The recess portion includes an interlock bore penetrating through the shaft member.

[0013] Accordingly, even when the recess portion extends radially inwardly, a die for the shaft member is parted in the axial direction of the recess portion at the radially inwardly extending portion of the recess portion. A die cutting for molding the shaft member is easily performed and thus the shaft member is easily molded.

[0014] The housing includes a first body and a second body fitted to each other, and the lid lock apparatus further includes a stopper held by the first body and restricting a rotation of the output gear by making contact with the output gear in a rotational direction thereof, a stopper holding portion formed at the first body and holding the stopper at the first body by engaging with the stopper, and a stopper holder formed at the second body and making contact with the stopper in a direction where the stopper engages with the stopper holding portion.

[0015] Accordingly, when the stopper is lifted up relative to the stopper holding portion, the stopper makes contact with the stopper holder formed to extend from the second body, thereby preventing the stopper from falling off from the stopper holding portion.

[0016] The stopper makes contact with the output gear at an outer peripheral surface, engages with the stopper holding portion at an inner peripheral portion, and makes contact with the stopper holder at an end surface.

[0017] Accordingly, the single stopper stops the rotations of the output gear in both directions.

[0018] The output gear includes an opening into which the stopper holder penetrates, and the stopper holder penetrates through the output gear to make contact with the end surface of the stopper.

[0019] Accordingly, the output gear and the stopper are arranged in an overlapping manner.

[0020] The opening includes an arc-shaped slit relative to a rotational shaft of the output gear.

[0021] Accordingly, the output gear appropriately rotates.

[0022] An end portion of the stopper holder faces the end surface of the stopper positioned closer to a rotational shaft of the output gear compared to other end portions of the stopper.

[0023] Accordingly, the slit is arranged in the vicinity of the rotational shaft (center) of the output gear, thereby causing the slit that penetrates through the output gear to have a small diameter. The strength of the output gear is enhanced accordingly.

BRIEF DESCRIPTION OF THE DRAWINGS

[0024] The foregoing and additional features and characteristics of the present invention will become more apparent from the following detailed description considered with the reference to the accompanying drawings, wherein:

[0025] Fig. 1 is an exploded perspective view of a lid lock apparatus for a vehicle according to an embodiment;

[0026] Fig. 2 is a front view of the lid lock apparatus shown in Fig. 1 in a locked position when viewed in a direction where a cover is provided;

[0027] Fig. 3 is a front view of the lid lock apparatus shown in Fig. 2 when viewed in a direction where a body is provided;

[0028] Fig. 4 is a cross-sectional view taken along line IV-IV shown in Fig. 2;

[0029] Fig. 5 is a cross-sectional view taken along line V-V shown in Fig. 2;

[0030] Fig. 6 is a cross-sectional view taken along line VI-VI shown in Fig. 2;

[0031] Fig. 7 is a bottom view of a worm wheel according to the embodiment;

[0032] Fig. 8 is a left lateral view of the lid lock apparatus shown in Fig. 2;

[0033] Fig. 9 is a perspective view of the lid lock apparatus shown in Fig. 2; and

[0034] Fig. 10 is a front view of the lid lock apparatus shown in Fig. 2 in an unlocked state when viewed in a direction where the body is provided.

DETAILED DESCRIPTION

[0035] A lid lock apparatus 1 according to an embodiment will be explained with reference to Figs. 1 to 10. In Fig. 4, a vertical direction corresponds to a thickness direction of a housing. As illustrated in Fig. 1, the lid lock apparatus 1 includes an actuator housing 2 serving as a housing constituted by a body 21 serving as a first body and a cover 22 serving as a second body. The housing 2 accommodates therein an electric motor 3 serving as a drive motor, a worm 4 serving as a drive force transmitting mechanism, a worm wheel 5 serving as the drive force transmitting mechanism and an output gear, a lock shaft 6 serving as a shaft member, and a wheel stopper 7. The body 21 and the cover 22 are both made of synthetic resin material. The body 21 and the cover 22 engage with each other after accommodating therein the electric motor 3, the worm 4, the worm wheel 5, the lock shaft 6 and the wheel stopper 7 so as to be united by means of an engagement between engagement pieces 211 of the body 21 and respective engagement projec-

tions 221 of the cover 22.

[0036] An output shaft 31 (see Fig. 2) of the electric motor 3 is press-fitted to the worm 4 so that the worm 4 is rotatable by the electric motor 3. The worm 4 is made of a metallic material or a synthetic resin material. Teeth are formed at an outer peripheral surface 41 of the worm 4. After the output shaft 31 of the electric motor 3 is press-fitted to the worm 4 (i.e., the electric motor 3 and the worm 4 are integrally connected to each other), the electric motor 3 and the worm 4 are accommodated within a motor receiving portion 212 and a worm receiving portion 213 of the body 21, respectively. A pair of motor terminals 32, 32 is fixed to a terminal holding portion 214 of the body 21 for supplying an electric power so that the motor terminals 32 are electrically connected to the electric motor 3.

[0037] The worm wheel 5 is made of a synthetic resin material of which an outer peripheral surface 51 is formed into a substantially fan shape forming an arc shape. A pivot bore 52 is formed, penetrating through the worm wheel 5 in a thickness direction thereof. The worm wheel 5 includes an engagement pole 53 serving as an engagement piece and projecting downward as illustrated in Fig. 1. The worm wheel 5 further includes a first stopper wall 54 and a second stopper wall 65 as illustrated in Fig. 7. Specifically, the flat-shaped first stopper wall 54 is provided in the vicinity of the engagement pole 53 so as to extend downward. The second stopper wall 55 is provided in the vicinity of the pivot bore 52 so as to extend in the direction same as the first stopper wall 54. Further, a slit 56 serving as an opening and having an arc shape is formed between the first stopper wall 54 and the second stopper wall 65 so as to penetrate through the worm wheel 5 in the thickness direction thereof concentrically with the pivot bore 52.

[0038] The worm wheel 5 is rotatably mounted on the body 21 about a wheel shaft 215 that engages with the pivot bore 52 of the worm wheel 5. The wheel shaft 215 projects from an inner surface of the body 21. Teeth are formed at the outer peripheral surface 51 of the worm wheel 5 so as to engage with the teeth of the worm 4.

[0039] The lock shaft 6 is integrally formed into an elongated shape by a synthetic resin material. The lock shaft 6 includes a lock portion 61 and a support portion 62. The lock portion 61, which is formed at an end of the lock shaft 6, engages with a lid 91 serving as a lid member for covering a fuel opening provided at a vehicle body 9. The lock portion 61 is formed into a column shape and of which an end is formed by a tapered portion 61a (see Figs. 2 to 4). The support portion 62 arranged adjacent to the lock portion 61 is also formed into a column shape having a larger diameter than that of the lock portion 61. The support portion 62 includes a ring groove 63 where a seal ring 69 made of a synthetic rubber material is attached.

[0040] As illustrated in Fig. 4, the lock portion 61 and the support portion 62 of the lock shaft 6 are inserted into a shaft holding portion 216 of the body 21 so as to be axially movable. The shaft holding portion 216 is formed into a substantially cylindrical shape having a stepped portion. The shaft holding portion 216 includes a small diameter portion 216a and a large diameter portion 216b at an inner periphery. The lock portion 61 penetrates through the small diameter portion 216a of the shaft holding portion 216 while the support portion 62 is guided by the large diameter portion 216b via the seal ring 69, thereby preventing the lock shaft 6 from inclining and thereby enhancing a sealing performance of the lock shaft 6 relative to the housing 2.

[0041] A relief portion 64 is formed at a substantially center of the lock shaft 6 across a predetermined distance. In order to arrange the worm wheel 5 on top of the relief portion 64, the relief portion 64 is formed into such a shape that an upper half of the support portion 62 in a thickness direction in Fig. 4 is cut out, i.e., the relief portion 64 is formed into a half-moon shape in a cross section as illustrated in Fig. 5. The relief portion 64 is substantially half the size of the support portion 62 in a vertical direction in Fig. 4 (a vertical dimension of the relief portion 64 in Fig, 4 is smaller than an outer diameter of the seal ring 69 or the lock portion 61). The center of gravity (i.e., center axis) of the relief portion 64 is prevented from matching a guide center P serving as an axial center of the support portion 62. According to the aforementioned structure, a height of the lid lock apparatus 1 (which corresponds to the vertical direction in Fig. 4 and the thickness direction) is reduced to thereby achieve the downsizing of the lid lock apparatus 1.

[0042] An interlock bore 65 serving as a recess portion is formed in the rear of the relief portion 64 (i.e., a side of the relief portion 64 opposite from the support portion 62), penetrating through the lock shaft 6 in the thickness direction. The engagement pole 53 formed at the worm wheel 5 is inserted into the interlock bore 65 so as to be in parallel with the wheel shaft 215 serving as a rotational shaft of the worm wheel 5. As illustrated in Fig. 2, the interlock bore 65 is elongated so as to be engageable with the engagement pole 53 in response to a rotation of the worm wheel 5.

[0043] As illustrated in Fig. 4, a small diameter portion 65a serving as a contact portion is formed at an inner peripheral surface of the interlock bore 65 in the vicinity of the guide center P that passes through a radial center of the support portion 62. The small diameter portion 65a extends radially inwardly so that the interlock bore 65 and the engagement pole 63 engage with each other. The small diameter portion 65a is formed at least at a straight portion L (see Fig, 2), where the engagement pole 53 makes contact, in the inner peripheral surface of the interlock bore 65 having an oval shape. According to the present embodiment, because a height of the relief portion 64 is lower than the guide center P, a padding 65b is formed around an upper opening portion of the interlock bore 65 and then the small diameter portion 65a is formed.

[0044] A flat portion 66 is formed in the rear (i.e., left

side in Fig. 2) of the interlock bore 65 of the lock shaft 6. A pair of ribs 67 (see Fig. 1) is formed at each side surface (front and rear surfaces) of the flat portion 66. The ribs 67 formed at the front and rear surfaces of the flat portion 66 are sandwiched by the body 21 and the cover 22. Thus, the lock shaft 6 is also guided by the housing 2 via the flat portion 66. A handle 68 for a manual operation in case of a malfunction of the motor 3, and the like is formed at a rear side (i.e., left side in Fig. 2) of the lock shaft 6. According to the aforementioned structure, the lock shaft 6 is accommodated within the housing 2 so as to be movable in the axial direction (left and right direction in Fig. 2) while engaging with the worm wheel 5.

[0045] A stopper holding portion 217 that extends towards the worm wheel 5 is formed at a portion of the body 21 facing the worm wheel 5. The wheel stopper 7 is assembled on the stopper holding portion 217. The wheel stopper 7 is made of synthetic rubber material such as ethylene propylene (EP) and ethylene propylene diene methylene terpolymer (EPDM) serving as an elastic member having excellent heat resistance and weathering resistance. As illustrated in Fig. 1, the wheel stopper 7 is formed into a ring shape having a fan-shaped outline. The stopper holding portion 217 is inserted into an inner peripheral portion 71 of the wheel stopper 7. The wheel stopper 7 is mounted on the stopper holding portion 217 in a snapping manner by surrounding an outer peripheral surface of the stopper holding portion 217.

[0046] As illustrated in Fig. 6, when the worm wheel 5 rotates in a state to be mounted on the body 21, the slit 56 of the worm wheel 5 is positioned to face the wheel stopper 7. A stopper holder 222 is formed in a projecting manner at a portion of the cover 22 where the stopper holder 222 is inserted into the slit 56. Specifically, the stopper holder 222 projects in the thickness direction of the housing 2 that corresponds to a direction where the wheel stopper 7 engages with the stopper holding portion 217 (a vertical direction in Fig. 6). The worm wheel 5 rotates, makes contact with an outer periphery of the wheel stopper 7, and then stops. The stopper holder 222 inserted into the slit 56 extends from an inner surface of the cover 22 to an upper end surface of the wheel stopper 7 in Fig. 6 (i.e., an end surface of the wheel stopper 7 away from the body 21). In a case where the wheel stopper 7 is lifted up relative to the stopper holding portion 217 because of a contact of the worm wheel 5 with the wheel stopper 7 at a time the worm wheel 5 rotates, the stopper holder 222 makes contact with the upper end surface of the wheel stopper 7 to thereby prevent the wheel stopper 7 from disengaging from the stopper holding portion 217.

[0047] According to the present embodiment, a small gap is formed between the stopper holder 222 and the wheel stopper 7. Alternatively, the stopper holder 222 may constantly press the upper end surface of the wheel stopper 7. In addition, as illustrated in Fig. 6, the stopper holder 222 faces a portion of the wheel stopper 7 close to the rotational center of the worm wheel 5 (i.e., the wheel shaft 215) relative to the stopper holding portion 217.

[0048] After component parts constituting the lid look apparatus 1 are accommodated in the boy 21, the engagement pieces 211 of the body 21 engage with the engagement projections 221 of the cover 22 to thereby fit the cover 22 onto the body 21 as a unit Next, a tapping screw 8 serving as a tightening device and a screw is inserted into the wheel shaft 215 serving as the rotational center of the worm wheel 5 and a screw bore 223 (see Fig. 10) formed at the cover 22 between the wheel shaft 215 and a female connector portion 12 which will be explained later.

[0049] Afterwards, the tapping screw 8 is tightened to the body 21 through a thread cutting for tightening the body 21 and the cover 22, thereby completing the lid lock apparatus 1. The electric motor 3, the worm 4, the worm wheel 5, and the lock shaft 6 are held by the body 21 and the cover 22 without looseness accordingly. A waterprooring ring 11 made of a synthetic rubber material is attached to a seal groove 216c formed at the shaft holding portion 216 of the body 21 and thereafter the lid lock apparatus 1 is mounted on the vehicle body 9.

[0050] As illustrated in Fig. 8, the female connector portion 12 serving as a connector holding portion is provided at a side surface of the housing 2 of the completed lid lock apparatus 1. The female connector portion 12 is connected to an external connector M (i.e., a male connector, see Fig. 9) for supplying electric power to the electric motor 3. The female connector portion 12 includes first and second connector lateral walls 218a and 218b serving as first and second lateral wall portions, integrally formed at the body 21 and facing each other. The female connector portion 12 further includes first and second connector longitudinal walls 218c and 224 serving as a bottom wall portion and a cover portion, respectively. The first and second connector longitudinal walls 218c and 224, facing each other, are integrally formed at the body 21 and the cover 22, respectively. According to such structure, the female connector portion 12 is formed to surround the motor terminals 32. In Fig. 8, the walls of the female connector portion 12 formed by the body 21 are indicated by a shaded area.

[0051] As illustrated in Fig. 9, the first and second connector lateral walls 218a and 218b are formed at both ends of the connector longitudinal wall 218c. The first and second connector lateral walls 218a, 218b, and the first connector longitudinal wall 218c form an engagement portion according to the embodiment. The second connector longitudinal wall 224 is configured to cover the external connector M that is fitted to the first and second connector lateral walls 218a, 218b, and the first connector longitudinal wall 218c.

[0052] That is, a position of a fitting portion where the body 21 and the cover 22 that constitute the housing 2 is fitted to each other is adjusted and determined so that the first and second connector lateral walls 218a, 218b, and the first connector longitudinal wall 218c are formed

only at the body 21 while the second longitudinal wall 224 is formed at the cover 22 in the female connector portion 12. Thus, horizontal and vertical dimensions of the female connector portion 12 to which the external connector M is fitted are determined only by lengths of the walls 218a, 218b, and 218c formed at the body 21. In Fig. 8, an engagement piece 225 of the cover 22 that engages with the first connector lateral wall 218a has a guide function for the first connector lateral wall 218a and does not influence dimensions of the female connector portion 12.

[0053] As illustrated in Fig. 9, an engagement opening 219 where an engagement hook of the external connector M engages in a case where the external connector M is fitted to the female connector portion 12 is formed at the second connector lateral wall 218b of the female connector portion 12. The engagement opening 219 is a rectangular-shaped opening that penetrates through the second connector lateral wall 218b, The engagement opening 219 is formed only at the body 21 (i.e., the engagement opening 219 is defined, being surrounded only by the body 21).

[0054] As illustrated in Fig. 10, in a state where the lock portion 61 disengages from the lid 91 (i.e., the lock portion 61 is in an unlocked state relative to the lid 91), the electric motor 3 is operated for a predetermined time period so as to rotate the worm wheel 5 via the worm 4 in a clockwise direction about the wheel shaft 215 in Fig, 10. Then, the lock shaft 6 that engages with the worm wheel 5 via the engagement between the engagement pole 53 and the interlock bore 65 moves in the axial direction relative to the housing 2, specifically, in the left direction in Fig. 10, so that the lock portion 61 projects from the housing 2 (see Figs. 2 and 3). The lock portion 61 that projects from the housing 2 engages with the lid 91 provided at the vehicle body 9 to thereby retain the lid 91 in the closed state (see Fig. 4). The worm wheel 5 driven to rotate by the worm 4 is stopped by means of the contact of the first stopper wall 54 with the wheel stopper 7.

[0055] As illustrated in Figs. 2 and 3, in a state where the lock portion 61 engages with the lid 91 (i.e., the lock portion 61 is in a locked state relative to the lid 91), the electric motor 3 is operated for a predetermined time period so as to rotate the worm wheel 5 in an opposite direction from the aforementioned direction (i.e., in a counterclockwise direction in Fig. 2). Then, the lock shaft 6 moves in the axial direction relative to the housing 2, specifically, in the left direction in Fig. 2, so that the lock portion 61 moves closer to the housing 2 (see Fig. 10). The lock portion 61 disengages from the lid 91 so as to open the lid 91, The worm wheel 5 driven to rotate in the clockwise direction in Fig. 2 by the worm 4 is stopped by means of the contact of the second stopper wall 55 with the wheel stopper 7.

[0056] According to the aforementioned embodiment, the small diameter portion 65a is formed at the inner peripheral surface of the interlock bore 66 that extends radially inwardly at the guide center P. In a case where the lock shaft 6 axially projects, the engagement column 53 and the interlock bore 65 engage with each other in the vicinity of the guide center P of the lock shaft 6. Therefore, the lock shaft 6 is prevented from inclining relative to the housing 2 and the lock shaft 6 is smoothly operated to engage with the lid 91.

[0057] Specifically, when the lock shaft 6 projects from the housing 2, a large rotational momentum is generated at the lock shaft 6 in the thickness direction compared to a case where the lock shaft 6 moves towards the housing 2 (i.e., the lock shaft 6 moves in a direction stored within the housing 2). That is, a distance from the small diameter portion 65a of the interlock bore 65 of the lock shaft 6 where the lock shaft 6 engages with the worm wheel 5 (i.e., a point of force) to the tapered portion 61a formed at the end of the lock shaft 6 (i.e., a point of application) is long. On the other hand, when the lock shaft 6 moves towards the housing 2, a point where the engagement column 53 and the interlock bore 65 make contact with each other serve as both the point of force and the point of application. The rotational momentum is likely to be generated at the lock shaft 6 when the lock shaft 6 projects from the housing 2 by means of the worm wheel 5.

[0058] The interlock bore 65 that extends radially inwardly at the guide center P penetrates through the lock shaft 6. Thus, even when the inner peripheral surface of the interlock bore 65 extends inwardly, a die for the lock shaft 6 is parted in the axial direction at a portion where the inner diameter portion 65a is formed. A die cutting for molding the lock shaft 6 is easily performed and thus the lock shaft 6 is easily molded.

[0059] Further, according to the aforementioned embodiment, the stopper holder 222 that extends from the cover 22 is configured to make contact with the wheel stopper 7 in a direction where the wheel stopper 7 engages with the stopper holding portion 217. Therefore, when the wheel stopper 7 is lifted up relative to the stopper holding portion 217, the wheel stopper 7 makes contact with the stopper holder 222, thereby preventing the wheel stopper 7 from falling off or disengaging from the stopper holding portion 217.

[0060] In addition, because the stopper holder 222 is formed at the cover 22 in an extending manner, the number of components of the lid lock apparatus 1 is prevented from increasing and the assembly performance thereof is prevented from deteriorating. Further, the wheel stopper 7 is formed into an annular shape so as to make contact with the worm wheel 5 at an outer peripheral surface, to engage with the stopper holding portion 217 at the inner peripheral portion 71, and to make contact with the stopper holder 222 at the end surface facing the cover 22. As a result, the single wheel stopper 7 is able to stop the rotations of the worm wheel 5 in both directions.

[0061] Further, the worm wheel 5 includes the slit 56 into which the stopper holder 222 penetrates. The stop-

per holder 222 penetrates through the worm wheel 5 via the slit 56 and makes contact with the end surface of the wheel stopper 7 facing the cover 22. As a result, the worm wheel 5 and the wheel stopper 7 are arranged in an overlapping manner in the thickness direction of the housing 2. The slit 56 is formed into an arc shape about the rotational shaft of the worm wheel 5, which leads to an excellent rotation of the worm wheel 5.

[0062] Furthermore, the end portion of the stopper holder 222 faces the end surface of the wheel stopper 7 facing the cover 22 close to the rotational center of the worm wheel 5. Thus, the slit 56 is formed in the vicinity of the rotational center of the worm wheel 5, which leads to the slit 56 that penetrates through the worm wheel 5 having a small diameter. The strength of the worm wheel 5 is enhanced accordingly. Because the slit 56 is formed at a portion away from a wheel gear of the worm wheel 5, the strength of the wheel gear is also enhanced.

[0063] The present embodiment is not limited to have the aforementioned structure and is modified as below. That is, according to the aforementioned embodiment, in order to prevent the lock portion 61 from inclining when the lock portion 61 projects from the housing 2, the guide center P is provided at a center of the support portion 62 in the thickness direction. Alternatively, in order to prevent the lock portion 61 from inclining when the lock shaft 6 is stored within the housing 2, the guide center P may be provided at a center of the flat portion 66 supported by the housing 2. Then, the inner peripheral surface of the interlock bore 65 may extend radially inwardly in the vicinity of the guide center P provided at the center of the flat portion 66 in the thickness direction.

[0064] Further alternatively, the guide center P may be provided at an appropriate position in the thickness direction of the lock shaft 6 in view of guide portions of the lock portion 61, the seal ring 69, and the flat portion 66, respectively, guided by the housing 2. Then, the inner peripheral surface of the interlock bore 65 may extend radially inwardly in the vicinity of the guide center P specified in the aforementioned manner. In order to engage the engagement column 53 and the interlock bore 65 to each other in the vicinity of the guide center P, an outer peripheral surface of the engagement column 53 may extend radially outwardly in the vicinity of the guide center P instead of the inner peripheral surface of the interlock bore 65 of the lock shaft 6 to extend radially inwardly. Alternatively, the inner peripheral surface of the interlock bore 65 may extend radially inwardly while the outer peripheral surface of the engagement column 53 may extend radially outwardly.

[0065] A portion of the interlock bore 65 that extends radially inwardly or a portion of the engagement column 53 that extends radially outwardly is not necessarily and strictly provided on the guide center P. As long as each of the portions has an effect for preventing the lock shaft 6 from inclining when the lock shaft 6 moves, the position of the extending portion may be slightly deviated from the guide center P. In addition, the interlock bore 65 may be formed into a cylindrical shape having a bottom. Further, the interlock bore 65 may not be formed into a bore surrounded by a continuous side surface and may have a slit that opens at a portion not engaging with the engagement column 53.

[0066] Further, the stopper holding portion 217 may extend from the cover 22. Then, the stopper holder 222 may be formed at the body 21. Regardless of portions where the stopper holding portion 217 and the stopper holder 222 are formed, the wheel rotation shaft 215 that rotatably supports the worm wheel 5 may be formed at the cover 22.

[0067] The slit 56 formed at the worm wheel 5 may be formed into any shape as long as the insertion of the stopper holder 222 into the slit 56 is not interfered. The stopper holder 222 may contact with the wheel stopper 7 at multiple portions to thereby prevent the wheel stopper 7 from falling off from the stopper holding portion 217.

[0068] The lid lock apparatus according to the embodiment is not limited to cover a fuel opening and may be applicable to lock a trunk lid for a vehicle in a closed state.

[0069] According to the aforementioned embodiment, a lid lock apparatus for a vehicle includes a housing 2 including a first body 21 and a second body 22 fitted to each other, a drive motor 3 accommodated within the housing 2, an output gear 5 supported within the housing 2 to be rotatable by means of an operation of the drive motor 3, a shaft member 6 axially movably supported within the housing 2, one end of the shaft member 6 being engageable with a lid member 91 provided at a vehicle body 9 by projecting from the housing 2, the other end of the shaft member 6 receiving a rotational force of the output gear 5, the shaft member 6 axially moving by engaging with the output gear 5, a stopper 7 held by the first body 21and restricting a rotation of the output gear 5 by making contact with the output gear 5 in a rotational direction thereof, a stopper holding portion 217 formed at the first body 21 and holding the stopper 7 at the first body 21 by engaging with the stopper 7, and a stopper holder 222 formed at the second body 22 and making contact with the stopper 7 in a direction where the stopper 7 engages with the stopper holding portion 217.

[0070] Accordingly, when the stopper 7 is lifted up relative to the stopper holding portion 217, the stopper 7 makes contact with the stopper holder 222 formed to extend from the cover 22, thereby preventing the stopper 7 from falling off from the stopper holding portion 217.

[0071] The stopper 7 makes contact with the output gear 5 at an outer peripheral surface, engages with the stopper holding portion 217 at an inner peripheral portion 71, and makes contact with the stopper holder 222 at an end surface.

[0072] Accordingly, the single stopper 7 stops the rotations of the worm gear 5 in both directions.

[0073] The output gear 5 includes an opening 56 into which the stopper holder 222 penetrates, and the stopper holder 222 penetrates through the output gear 5 to make contact with the end surface of the stopper 7.

[0074] Accordingly, the worm gear 5 and the stopper 7 are arranged in an overlapping manner.

[0075] The opening 56 includes an arc-shaped slit relative to a rotational shaft 215 of the output gear.

[0076] Accordingly, the worm gear 5 appropriately rotates.

[0077] An end portion of the stopper holder 222 faces the end surface of the stopper 7 positioned closer to a rotational shaft 215 of the output gear 5 compared to other end portions of the stopper 7.

[0078] Accordingly, the slit 56 is arranged in the vicinity of the rotational center of the worm gear 5, thereby causing the slit 56 that penetrates through the slit 56 to have a small diameter. The strength of the worm gear 5 is enhanced accordingly.

Claims

1. A lid lock apparatus for a vehicle (1), comprising:

a housing (2);
a drive motor (3) accommodated within the housing (2);
an output gear (5) supported within the housing (2) to be rotatable by means of an operation of the drive motor (3); and
a shaft member (6) axially movably supported within the housing (2), one end of the shaft member (6) being engageable with a lid member (91) provided at a vehicle body (9) by projecting from the housing (2), the shaft member (6) axially moving by engaging with the output gear (5); wherein
the output gear (5) includes an engagement piece (53) extending in a thickness direction of the housing (2) and engaging with the shaft member (6),
the shaft member (6) includes a support portion (62) movably supported by the housing (2), a relief portion (64) cut out in the thickness direction and on which the output gear (5) is placed in an overlapping manner in the thickness direction, and a recess portion (65) into which the engagement piece (53) of the output gear (5) is inserted in the thickness direction, and
the shaft member (6) further includes a contact portion (65a) formed at least at one of the engagement piece (53) and the recess portion (65), the contact portion (65a) being obtained by a portion of the engagement piece (53) closest to an axial center (P) of the shaft member (6) in the thickness direction to extend radially outwardly relative to the other portion of the engagement piece (53) in a case where the contact portion (65a) is formed at the engagement piece (53), the contact portion (65a) being obtained by a portion of the recess portion (65) closest to the axial center (P) of the shaft member (6) in the thickness direction to extend radially inwardly relative to the other portion of the recess portion (65) in a case where the contact portion (65a) is formed at the recess portion (65) so that the engagement piece (53) and the recess portion (65) engage with each other at the axial center (P) of the shaft member (6) passing through a center of the support portion (62) in the thickness direction in a case where the shaft member (6) axially moves.

2. The lid lock apparatus (1) according to claim 1, wherein the recess portion (65) includes an interlock bore penetrating through the shaft member (6).

3. The lid lock apparatus (1) according to one of claims 1 and 2, wherein the housing (2) includes a first body (21) and a second body (22) fitted to each other, and the lid lock apparatus (1) further comprises a stopper (7) held by the first body (21) and restricting a rotation of the output gear (5) by making contact with the output gear (5) in a rotational direction thereof, a stopper holding portion (217) formed at the first body (21) and holding the stopper (7) at the first body (21) by engaging with the stopper (7), and a stopper holder (222) formed at the second body (22) and making contact with the stopper (7) in a direction where the stopper (7) engages with the stopper holding portion (217).

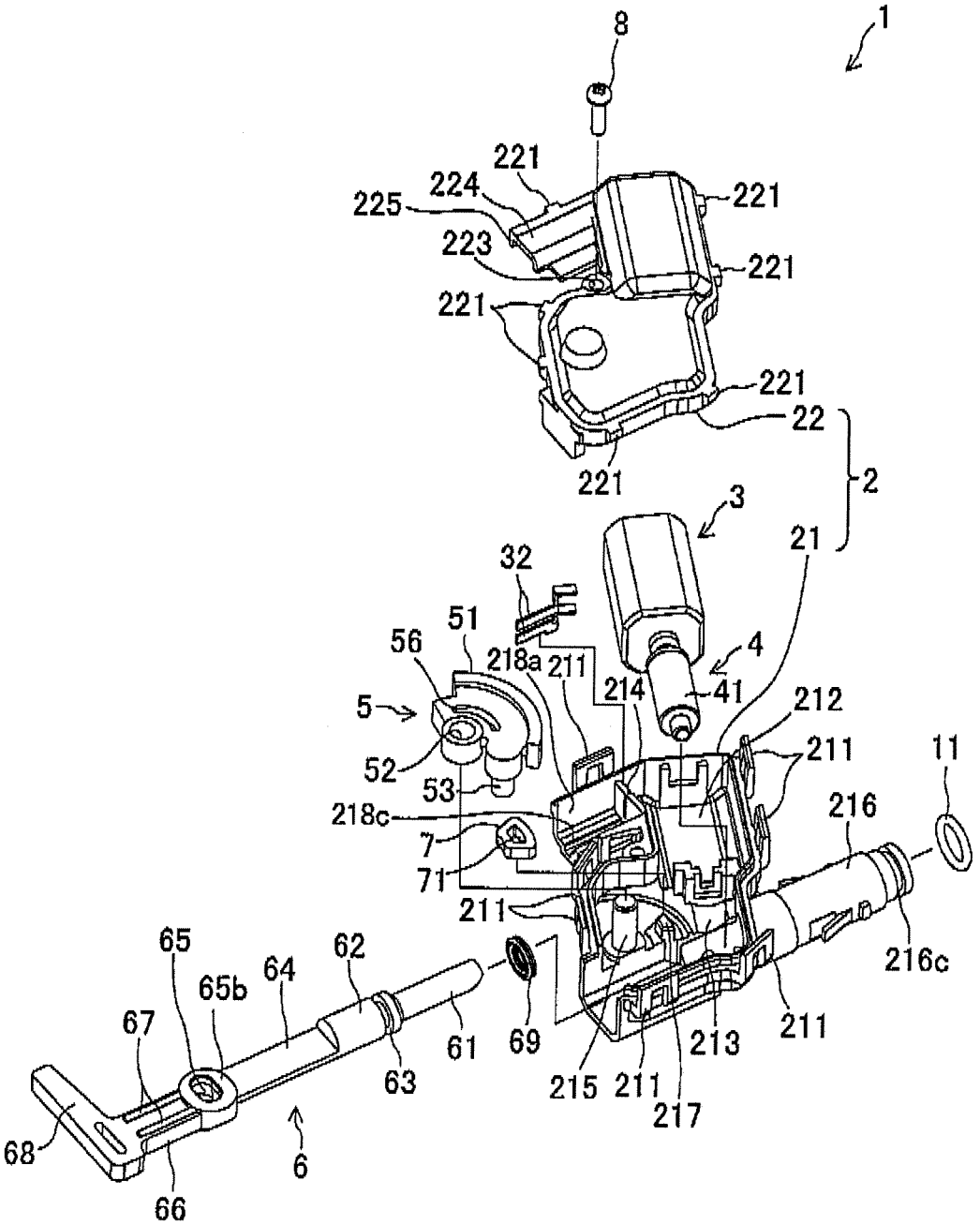
4. The lid lock apparatus (1) according to claim 3, wherein the stopper (7) makes contact with the output gear (5) at an outer peripheral surface, engages with the stopper holding portion (217) at an inner peripheral portion (71), and makes contact with the stopper holder (222) at an end surface.

5. The lid lock apparatus (1) according to claim 4, wherein the output gear (5) includes an opening (56) into which the stopper holder (222) penetrates, and the stopper holder (222) penetrates through the output gear (5) to make contact with the end surface of the stopper (7).

6. The lid lock apparatus (1) according to claim 5, wherein the opening (56) includes an arc-shaped slit relative to a rotational shaft (215) of the output gear.

7. The lid lock apparatus (1) according to one of claims 5 and 6, wherein an end portion of the stopper holder (222) faces the end surface of the stopper (7) positioned closer to a rotational shaft (215) of the output gear (5) compared to other end portions of the stopper (7).

FIG. 1


1
8
221
224
225
223
221
221
221
221
22
2
221
3
21
32
51
56
218a
211
214
4
41
212
5
52
53
211
11
218c
7
71
216
211
65
62
64
65b
67
61
69
213
211
216c
63
215
211
217
68
6
66

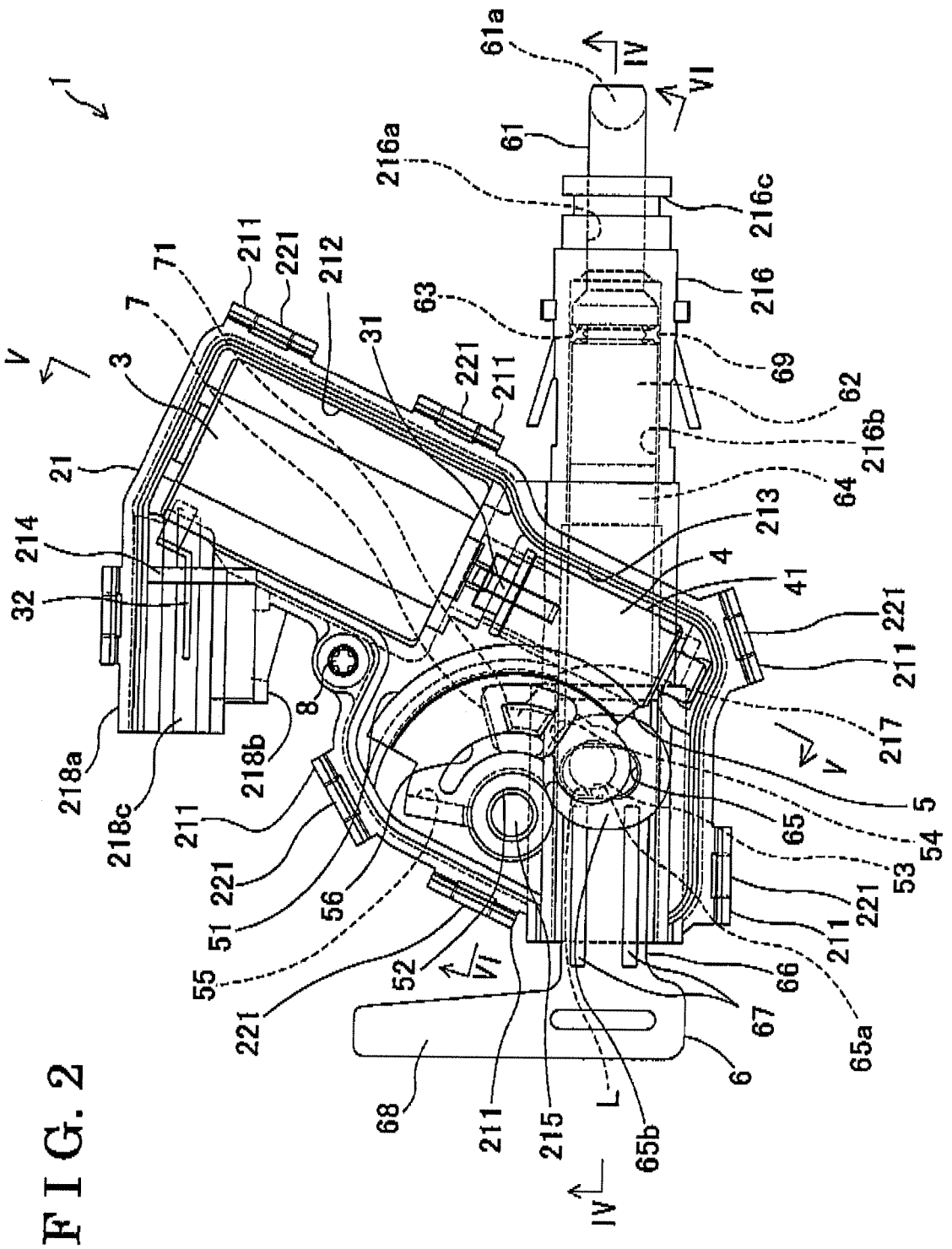

1
61a
IV
VI
61
216a
216c
216
63
69
62
216b
64
213
4
41
221
211
217
V
5
65
54
53
66
67
65a
6
68
211
215
L
65b
IV
52
VI
55
221
51
56
8
218a
218c
211
221
218b
32
214
21
3
7
71
211
221
212
31
63
221
211

FIG. 2

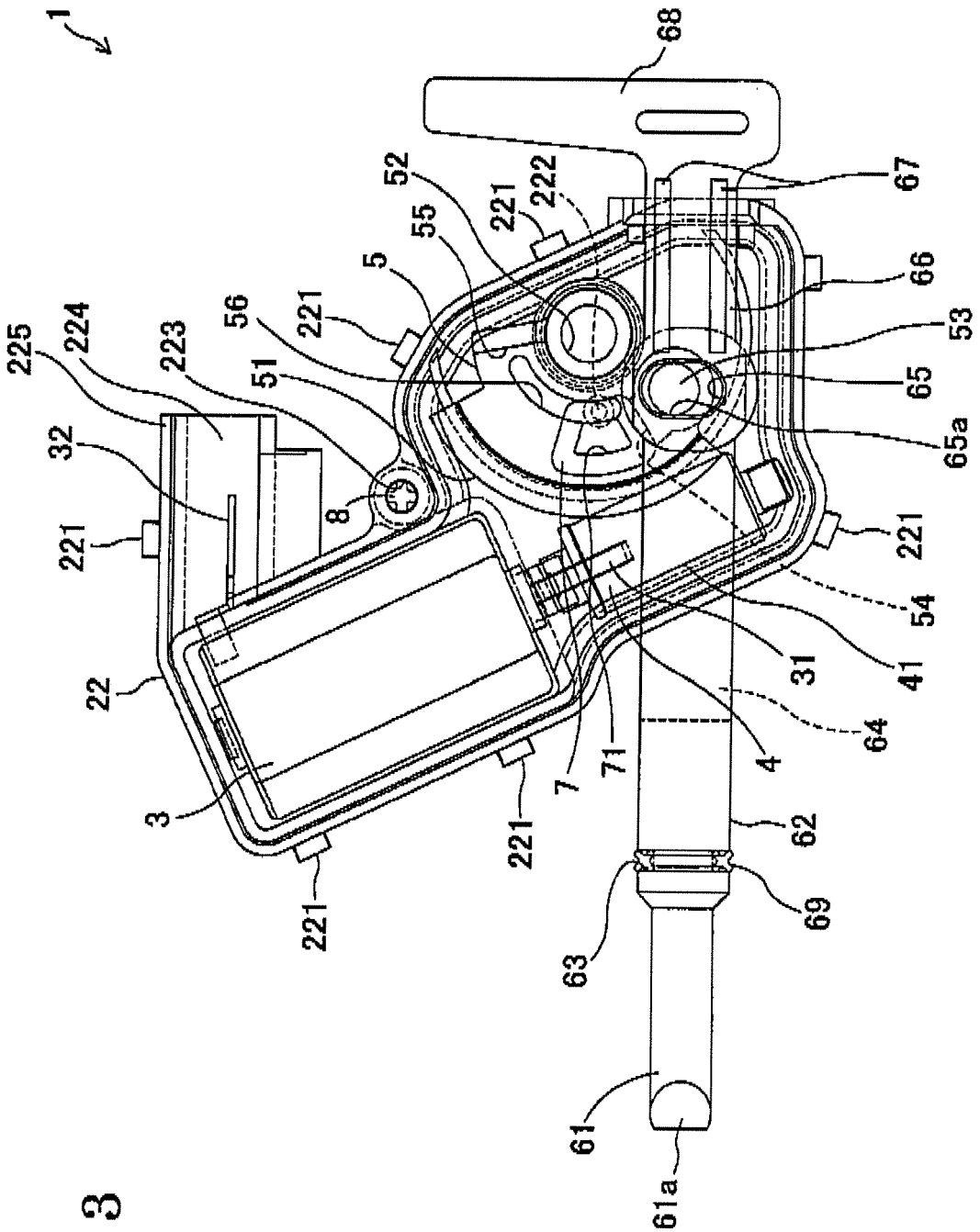

1
68
67
52
55
221
222
5
66
56
221
53
225
224
223
51
65
65a
32
8
221
221
54
22
31
41
64
4
71
7
3
221
62
221
69
63
61
61a

FIG. 3

FIG. 4

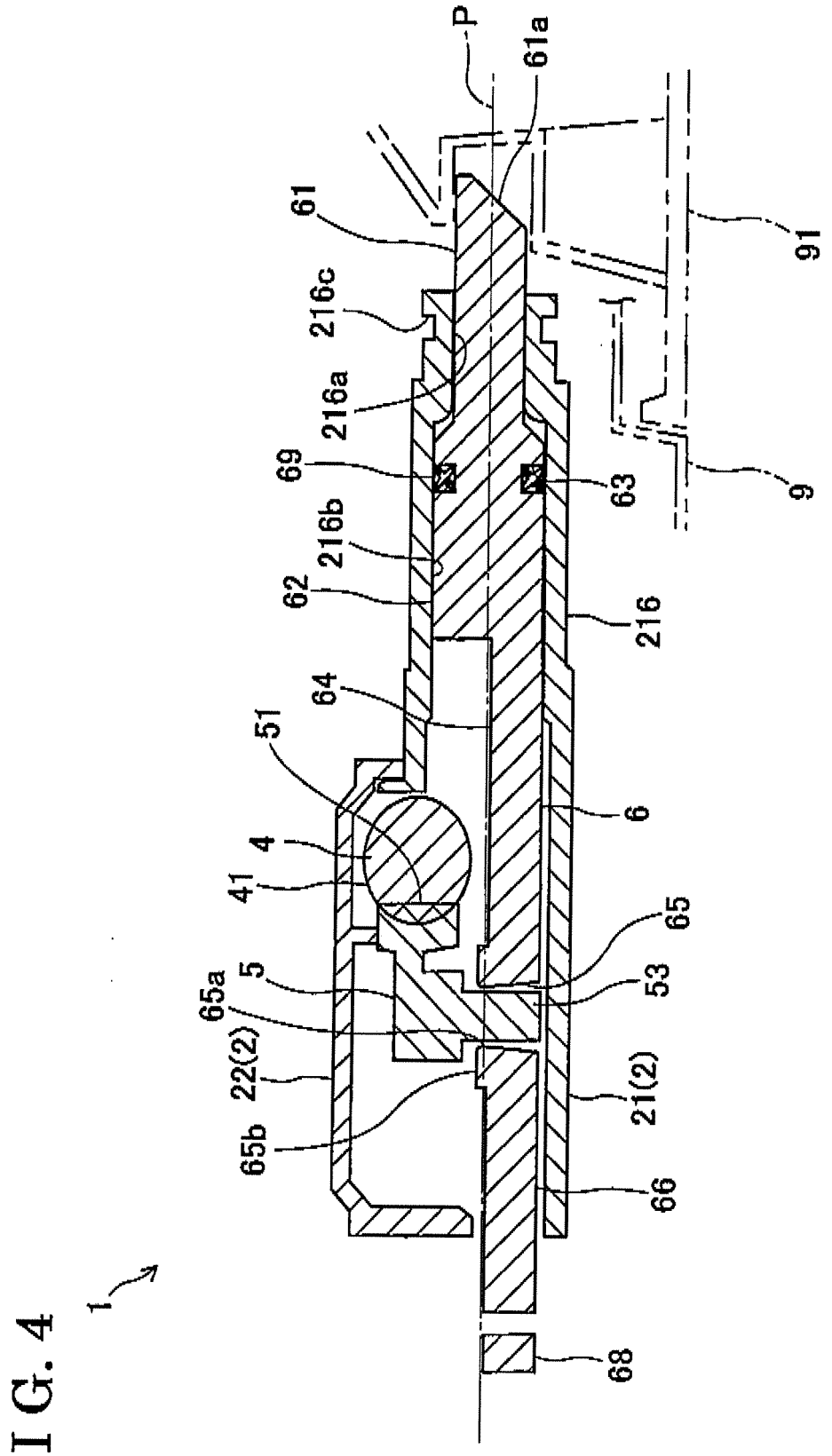

1
P
61a
61
91
216c
216a
69
63
9
216b
62
216
64
51
6
4
41
65
65a
5
53
22(2)
21(2)
65b
66
68

FIG. 5

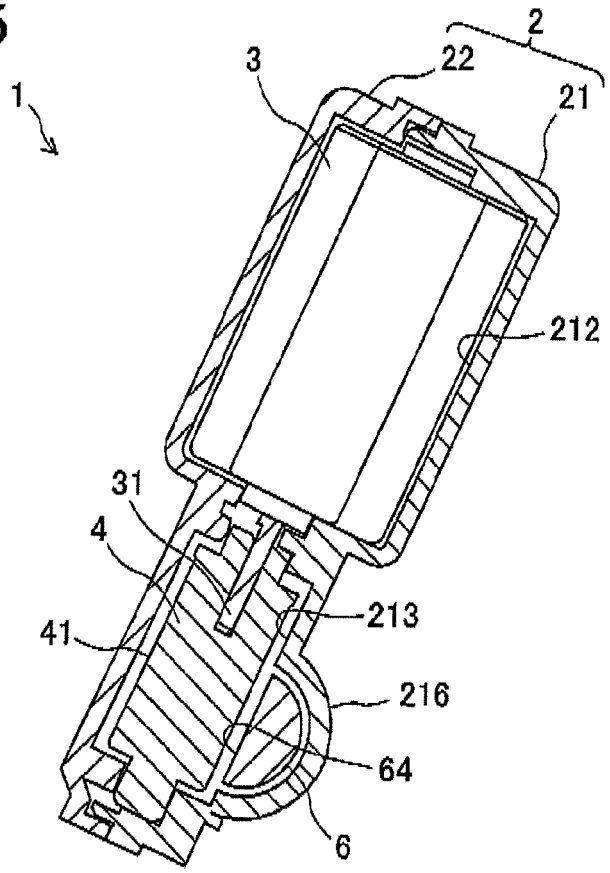

1
2
3
22
21
212
31
4
213
41
216
64
6

FIG. 6

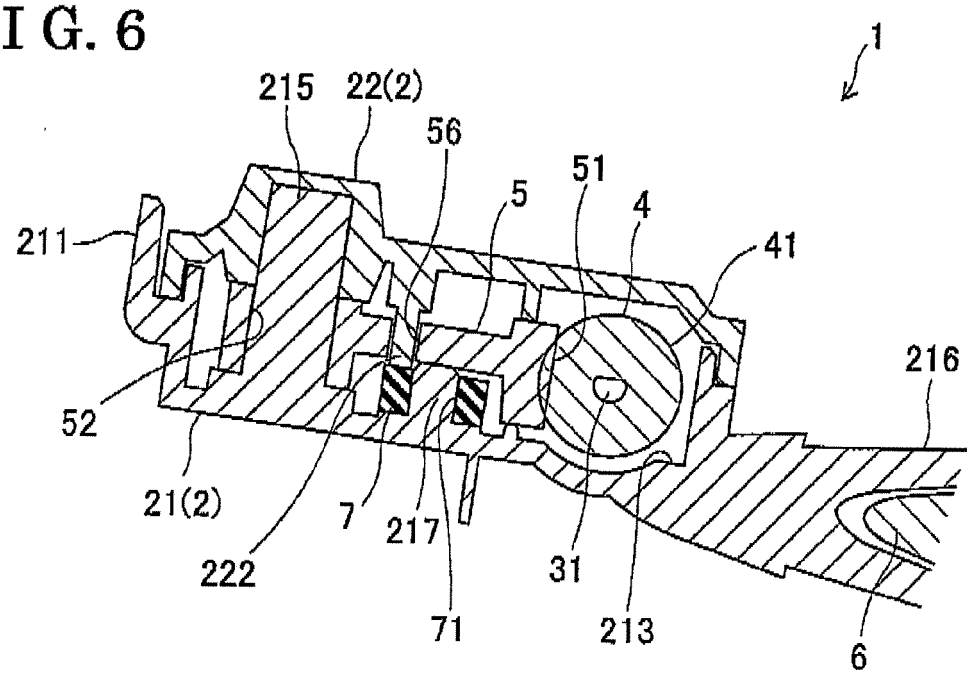

1
215
22(2)
56
5
51
4
41
211
216
52
21(2)
7
217
222
31
71
213
6

FIG. 7

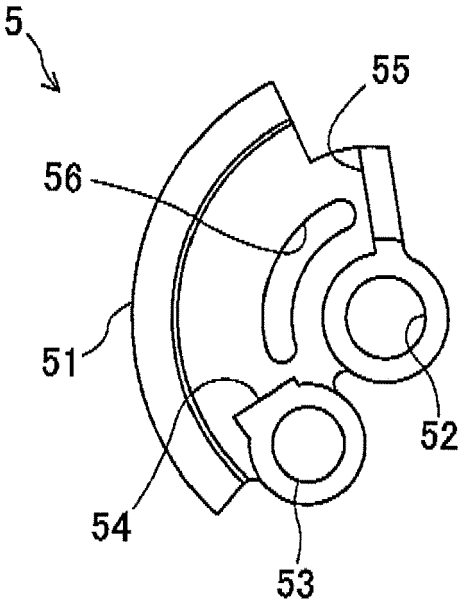


FIG. 8

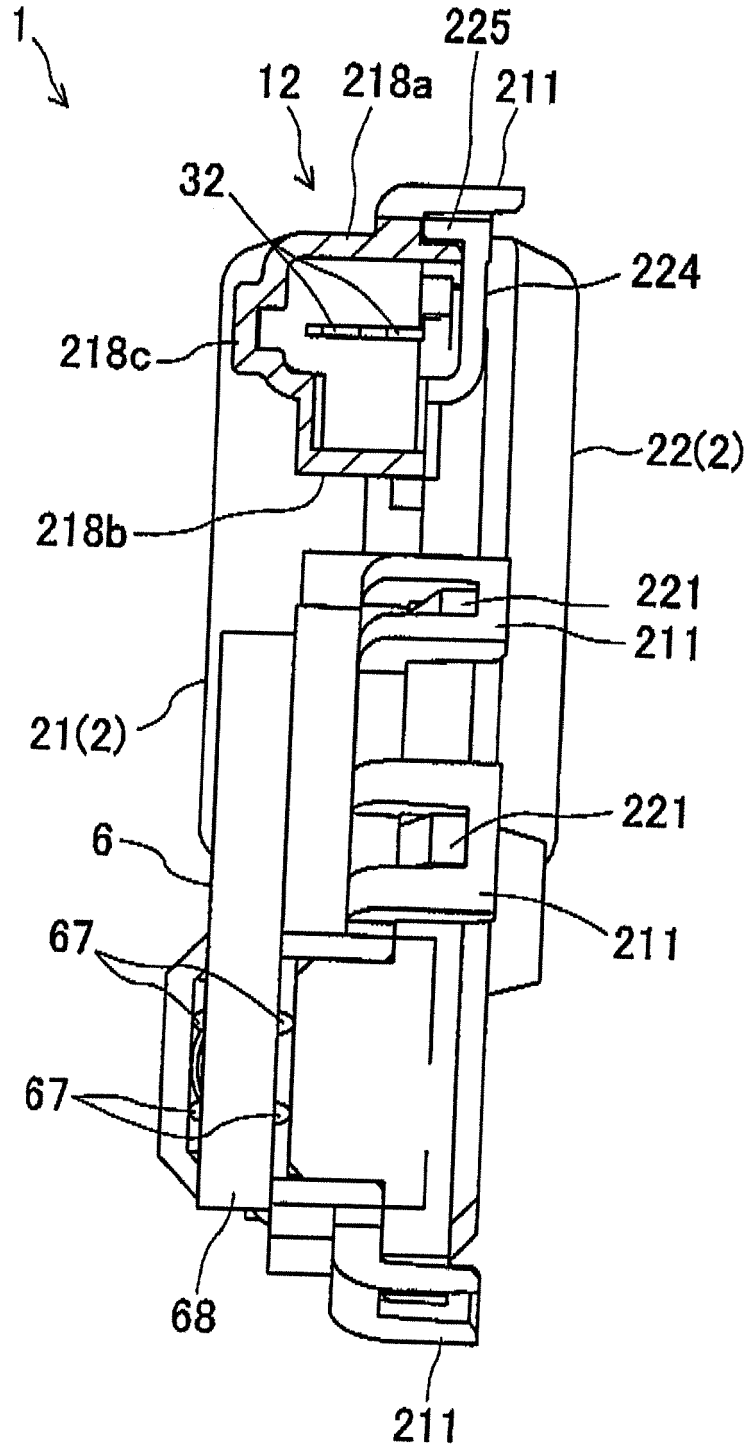

1
225
12
218a
211
32
224
218c
22(2)
218b
221
211
21(2)
221
6
211
67
67
68
211

FIG. 9

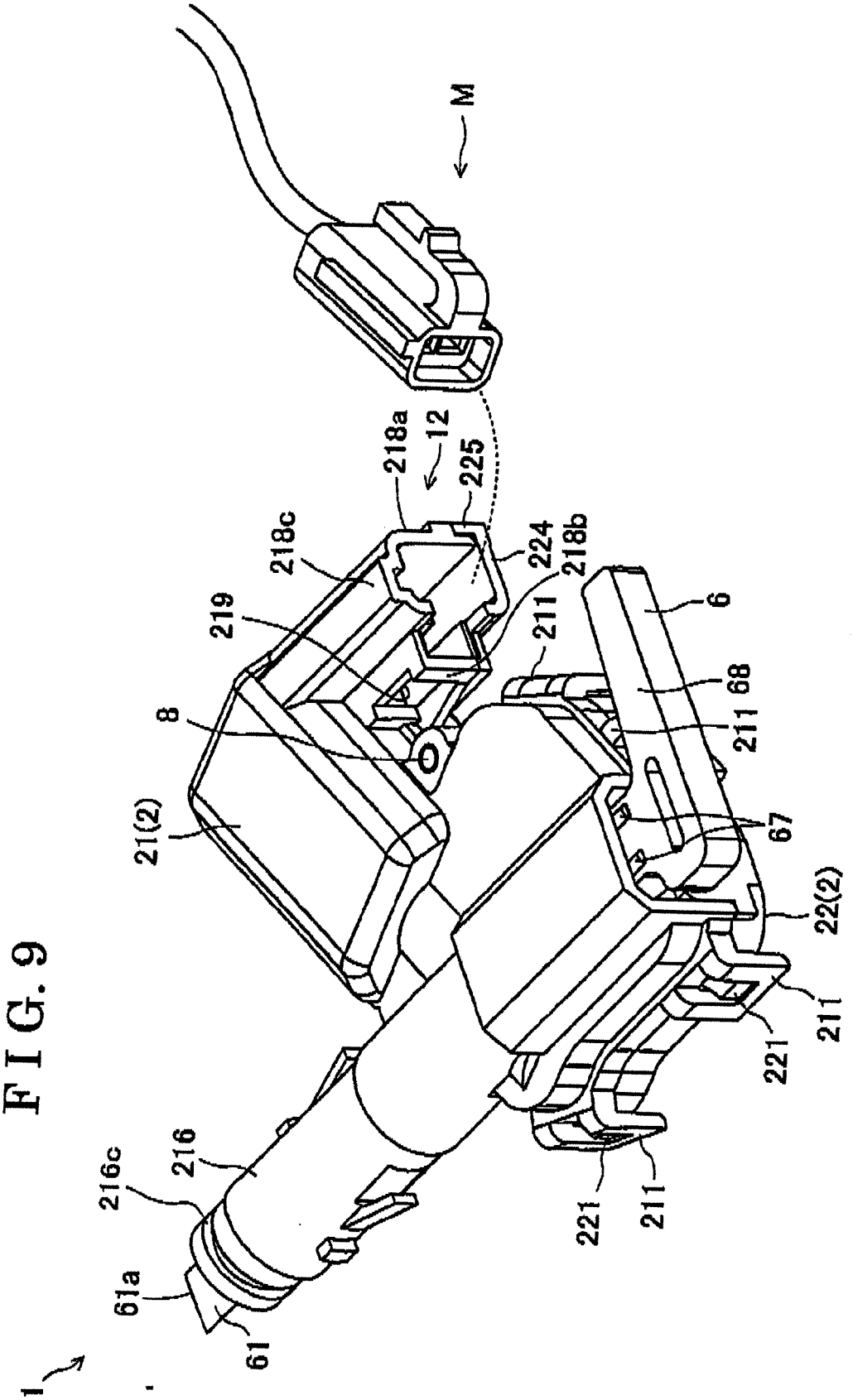
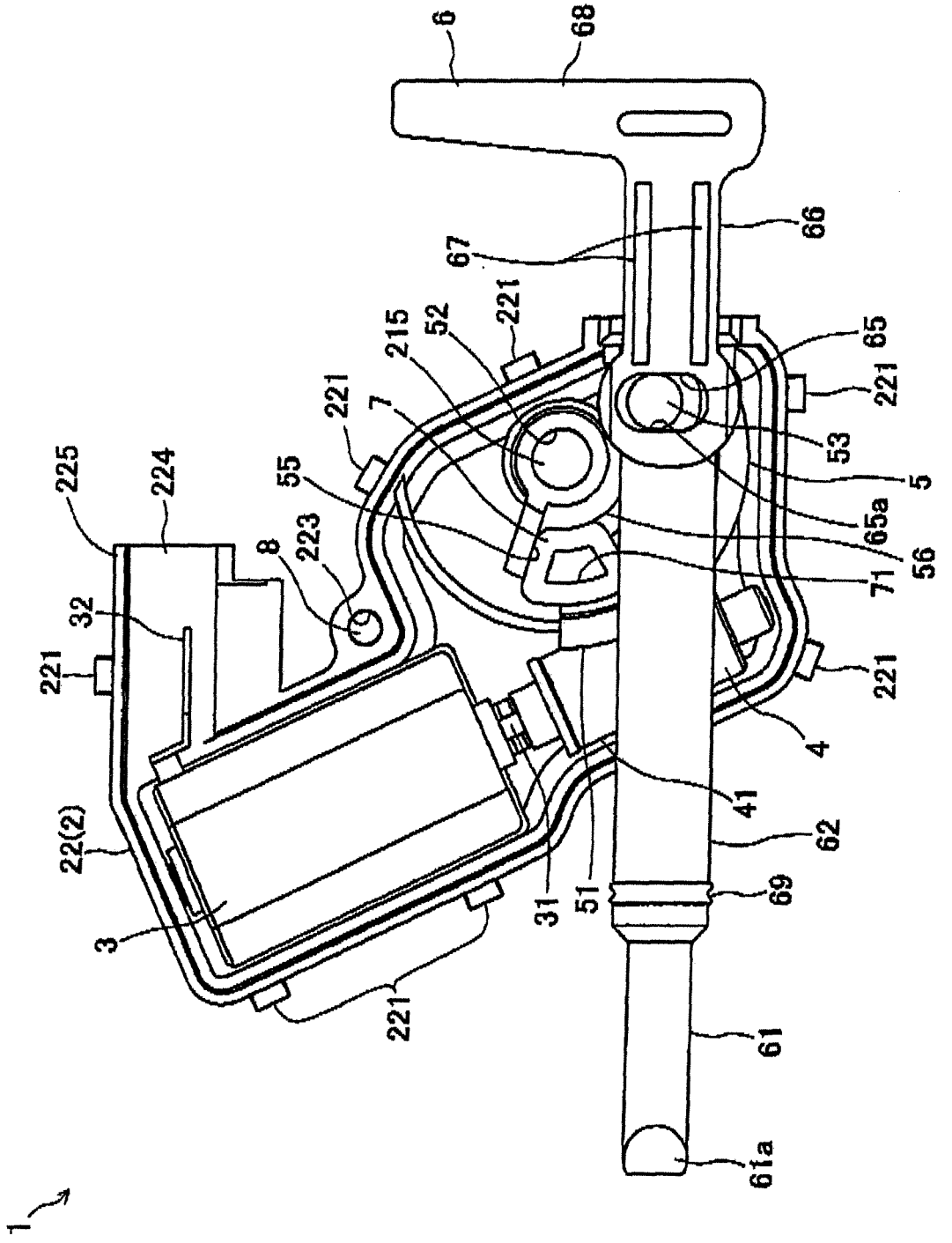

M
218a
12
225
218c
224
218b
219
211
6
8
68
211
21(2)
67
22(2)
211
221
216c
216
61a
61
221
211
1

FIG. 10


6
68
66
67
221
52
215
65
221
7
53
5
225
224
55
65a
56
8
223
71
32
221
221
4
22(2)
41
62
3
31
51
69
221
61
61a
1

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 3079611 B **[0002] [0003] [0006]**