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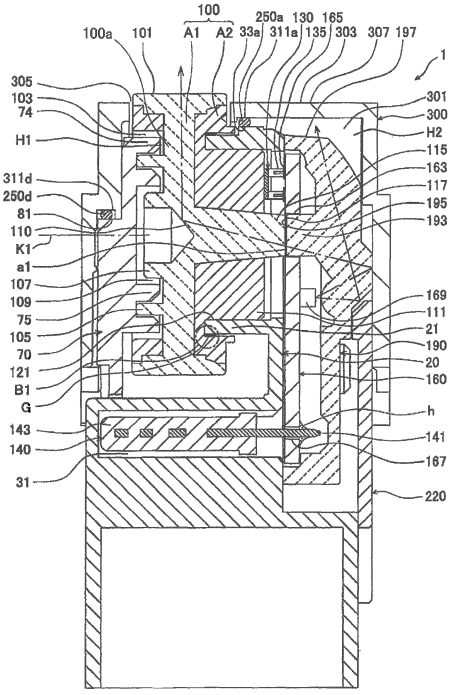
## (54) DRIP-PROOF STRUCTURE OF ELECTRONIC COMPONENT

(57) This drip-proof structure of an electronic component comprises packings 250 (250a - 250d) disposed between a surrounding area of an opening H1 of first and second cases 20, 70 and a surrounding area of an exposure opening 305 of a cover 300. The packings 250 prevent liquid from entering from the exposure opening 305 of the cover 300 and passing between the first and second cases 20, 70 and the cover 300.

FIG.2

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## Description

Cross-Reference to Related Applications

**[0001]** The present application claims priorities of Japanese patent application Nos. 2016/148630 and 2017/130113, the entire contents of which are incorporated herein by reference.

Technical Field

**[0002]** The present invention relates to a drip-proof structure of an electronic component.

Background Art

**[0003]** A rotary electronic component is known in which a portion of an outer periphery of a rotary body of is exposed as an operating portion to the outside through an opening provided on an outer case, and an electrical function portion in a main case is driven by rotationally operating the operating portion with a finger etc. so as to cause a change in an output from the electrical function portion. In the rotary electronic component, a drip-proof structure of an electronic component is known in which a rubbery drip-proof sheet is installed so as to seal a gap between the opening and the rotary body to prevent a liquid from entering through the gap between the opening and the rotary body to contact with the electrical function portion (see, e.g., JP 2011/134573 A).

**[0004]** Another drip-proof structure of an electronic component is known in which an electrical function portion is covered with a waterproof case etc. to prevent liquid from contacting with the electrical function portion (see, e.g., JP 2010/9937 A).

Citation List

Patent Literatures

**[0005]** JP 2011/134573 A
**[0006]** JP 2010/9937 A

Summary of Invention

Technical Problem

**[0007]** The drip-proof structure of an electronic component disclosed in JP 2011/134573 A may be poor in operability of the operating portion since the rubbery drip-proof sheet is in contact with the rotary body.

**[0008]** Also, concerning the drip-proof structure of the electronic component disclosed in JP 2010/9937 A, since it is necessary to separately provide the waterproof case etc., the number of components may increase and the size of the rotary electronic component itself may also increase.

**[0009]** It is an object of the invention to provide a drip-proof structure of an electronic component that is effective in drip-proofness and excellent in operability of the operating portion and allows downsizing of the component.

Solution to Problem

**[0010]** According to an embodiment of the invention, a drip-proof structure of an electronic component defined by [1] to [9] below is provided.

[1] A drip-proof structure of an electronic component, comprising:

a rotary body that comprises a main body comprising a circular outer circumferential surface as an operating portion and a shaft portion provided on one side surface of the main body;
a first case that comprises a bearing rotatably supporting the shaft portion of the rotary body;
a second case that is provided integral with the first case so as to have an opening therebetween, supports the other side surface of the main body of the rotary body, and houses, together with the first case, the rotary body while exposing a portion of the circular outer circumferential surface of the rotary body through the opening;
a sliding piece that is provided on the rotary body located inside the first and second cases and changes its position to follow rotation of the rotary body;
a circuit board that comprises a sliding contact pattern to be in sliding contact with the sliding piece and outputs an output signal corresponding to the rotational position of the rotary body;
a cover that comprises an exposure opening for exposing the portion of the circular outer circumferential surface of the rotary body exposed through the opening and covers the first and second cases and the circuit board; and
first and second drip-proof members arranged between the first case and the cover and between the second case and the cover, respectively.

[2] The drip-proof structure of an electronic component according to [1], wherein the first drip-proof member is arranged between a portion of the first case constituting a surrounding area of the opening and a portion of the cover constituting a surrounding area of the exposure opening, and
wherein the second drip-proof member is arranged between a portion of the second case constituting a surrounding area of the opening and a portion of the cover constituting the surrounding area of the exposure opening.

[3] The drip-proof structure of an electronic compo-

nent according to [1] or [2], wherein the first and second drip-proof members extend in a direction orthogonal to an axial direction of the rotary body.

[4] The drip-proof structure of an electronic component according to [1] or [2], wherein the first and second drip-proof members comprise coupling portions extending in an axial direction of the rotary body.

[5] The drip-proof structure of an electronic component according to [4], wherein the first and second drip-proof members and the coupling portions are ring-shaped.

[6] The drip-proof structure of an electronic component according to any one of [3] to [5], wherein an outer circumferential shape of the bearing of the first case is arc-shaped, and

wherein the first drip-proof member comprises a curved portion that is located on the bearing side and is formed in an arc shape engaging with the outer shape of the bearing of the first case.

[7] The drip-proof structure of an electronic component according to any one of [3] to [5], wherein the second drip-proof member is located on an opposite side of the rotary body to the bearing.

[8] The drip-proof structure of an electronic component according to [1], further comprising a drip-proof processing portion provided between the shaft portion of the rotary body and the bearing,

wherein the drip-proof processing portion comprises an end portion of a cylindrical protruding portion serving as the bearing and receiving the shaft portion of the rotary body inserted therein, and a drip-proof recess formed on the shaft portion of the rotary body so as to be concentrically with the shaft portion and receiving the end portion of the protruding portion inserted therein.

[9] The drip-proof structure of an electronic component according to [1], further comprising a drip-proof portion provided between the other side surface of the main body of the rotary body and the second case, the drip-proof portion comprising a male-female interlocking connection.

## Advantageous Effects of Invention

**[0011]** According to the invention, a drip-proof structure of an electronic component can be provided that is effective in drip-proofness and excellent in operability of the operating portion and allows downsizing of the component.

## Brief Description of Drawings

**[0012]**

**FIG. 1** is a perspective view showing a rotary electronic component in an embodiment.

**FIG. 2** is a cross sectional view showing the rotary electronic component taken along a line A-A in **FIG. 1.**

**FIG. 3** is an exploded perspective view showing a main unit, a cover and drip-proof members.

**FIG. 4** is an exploded perspective view showing the state in which the cover is detached from the rotary electronic component.

**FIG. 5** is an exploded perspective view showing the main unit.

**FIG. 6** is an exploded perspective view showing the main unit when viewed at an angle different from **FIG. 5.**

**FIG. 7** is a perspective view showing the back of the cover.

**FIG. 8** is a cross sectional view showing a liquid ingress path into the rotary electronic component.

## Description of Embodiments

**[0013]** An embodiment of the invention will be described below in reference to the drawings. **FIG. 1** is a perspective view showing an electronic component (hereinafter, referred to as "rotary electronic component") **1** configured using an embodiment of the present invention, **FIG. 2** is a cross sectional view showing the rotary electronic component **1** (a cross section taken along the line A-A in **FIG. 1**), **FIG.** 3 is an exploded perspective view showing a main unit **10,** a cover **300** and drip-proof members (hereinafter, referred to as "packings") **250** that constitute the rotary electronic component **1, FIG. 4** is a perspective view showing a process of attaching the packings **250** and the cover **300** to the main unit **10, FIG. 5** is an exploded perspective view showing the main unit **10,** and **FIG. 6** is an exploded perspective view showing the main unit **10** when viewed at another angle. As shown in these drawings, the rotary electronic component **1** is provided with the main unit **10** housing various parts, and the cover **300** covering a surface of the main unit **10** on the side where an operating knob **100** protrudes. In the following description, "upper/upward" is a direction to view the cover **300** from the main unit **10,** and "lower/downward" is a direction opposite thereto. In addition, "front/forward" is a direction to view the operating knob **100** from a first case **20** (described later), and "rear/rearward" is a direction to view a circuit board **160** (described later) from the first case **20.**

**[0014]** As shown in **FIGS. 1** to **6,** the main unit **10** is configured that the operating knob **100** as a rotary body, with a sliding piece **130** attached thereto, is housed between the first case **20** and a second case **70,** a terminal unit **140** is housed in the first case **20** on the opposite side, and the circuit board **160,** a light guide **190** and a third case **220** are provided thereon. The rotary electronic component **1** is formed by attaching the packings **250** and the cover **300** to the main unit **10.**

**[0015]** The first case **20** is a molded article formed by molding a synthetic resin into a substantially rectangular box shape, and has a substantially cylindrical bearing **21** at the upper center, a first housing portion **23** as a recess

provided on the operating knob **100** side of the bearing **21**, and a second housing portion **25** as a recess provided on the circuit board **160** side. A pair of engagement portions **27,** which are rectangular through-holes to be engaged with claw portions **79** of the second case **70** (described later), are provided on both right and left side surfaces of the first case **20** at positions on the first housing portion **23** side. Meanwhile, a pair of engagement portions **29,** which are rectangular through-holes to be engaged with claw portions **223** of the third case **220** (described later), are formed on both the right and left side surfaces of the first case **20** at positions on the second housing portion **25** side. In addition, a pair of claw-shaped engaging portions **30,** which engage in engagement portions **309** of the cover **300** (described later), are formed both the right and left side surfaces of the first case **20** at positions between the engagement portions **27** and **29.** A terminal unit housing portion **31,** which has a substantially rectangular shape and opens rearward, is formed under the bearing **21.** An arc surface portion of the bearing **21** at the middle of the upper surface and the upper surface portions located on right and left sides of the arc surface portion and protruding toward the first housing portion **23** serve as drip-proof member-mounting surfaces (hereinafter, referred to as "packing mounting surfaces") **33 (33**a to **33**c), where the arc surface portion is defined as a bearing-side drip-proof member-mounting surface **33**a, and linear portions on both sides thereof are defined as right- and left-side packing mounting surfaces **33**b and **33**c. In addition, a pair of right and left stopper engaging portions **35** (only one is shown in **FIG. 5**) are formed, which butt against a stopper **129** of the operating knob **100** (described later) and prevent the stopper **129** from moving upward therebeyond. In addition, although it is not shown in the drawings, a click engaging portion composed of raised and recessed portions along an arc direction (a direction of the arc along which a click ball **127** moves (described later)) is formed in the first housing portion **23** at a lower portion (at a position facing the click ball **127**) of a surface on which the bearing **21** is provided.

**[0016]** The second case **70** is formed in a single piece by molding a synthetic resin and has a case main body **71** having a substantially rectangular plate shape and a circular plate-shaped knob supporting portion **73** which protrudes from the upper center of the case main body **71** toward the operating knob **100.** The knob supporting portion **73** is configured that an outer peripheral portion protruding from a surface on the operating knob **100** side is a cylindrical protruding portion **74** constituting a part of the drip-proof portion, and a protruding portion **75** having a bottomed cylinder shape is provided at the center inside the protruding portion **74.** A pair of engaging claws **77** protrude from both right and left side edges of the case main body **71** toward the operating knob **100.** The engaging claws **77** are flat plate-shaped members on which the claw portions **79** are provided near the end portions on both outer sides (only one claw portion **79** is shown in **FIGS. 5** and **6**). In addition, the upper surface of the case main body **71** serves as a non-bearing-side packing mounting surface **81** to be in contact with the packing **250** (described later).

**[0017]** The operating knob **100** is a molded article of a synthetic resin and is formed by co-molding a transparent material and an opaque material. The operating knob **100** has a substantially circular-plate shape and is configured that the circular outer circumferential surface thereof serves as an operating portion **101.** A circular recessed portion **103** constituting a part of the drip-proof portion is provided on a surface of the operating knob **100** facing the second case **70,** and two cylindrical protruding portions **105** and **107** are concentrically provided and protrude in the recessed portion **103.** A circular recessed portion between the two protruding portions **105** and **107** is an insertion portion (recess) **109** into which the protruding portion **75** of the second case **70** is inserted. The protruding portion **74** of the knob supporting portion **73** of the second case **70** is also inserted into the recessed portion **103.** The drip-proof portion by a male-female interlocking connection between the protruding portion **74** and the recessed portion **103** is thereby formed. Meanwhile, the recessed portion in the middle of the protruding portion **107** has a bottom surface which is recessed in a substantially cone shape and serves as a light-reflecting surface **110.** A shaft portion **111** having a substantially circular-columnar shape protrudes from the center of a side surface (a surface facing the first case **20**) of a main body **100**a of the operating knob **100.** An upper surface of the shaft portion **111** serves as a sliding piece attachment portion **113,** and a truncated cone-shaped light-guiding protrusion **115** is further provided and protrudes from the center of the sliding piece attachment portion **113.** An end face of the light-guiding protrusion **115** serves as a light introducing surface **117.** Sliding piece attaching protrusions **119** formed of small pieces sticking out are formed on the sliding piece attachment portion **113.** A ring-shaped drip-proof recess **121** is formed around the shaft portion **111.** A click mechanism housing portion **123** formed of a bottomed circular hole is formed on the operating knob **100** at an outer peripheral portion of a surface facing the first case **20.** A coil spring **125** and the click ball **127** are housed in the click mechanism housing portion **123.** A portion around the click mechanism housing portion **123** bulges outward from the outer periphery of the operating knob **100** and the bulging portion serves as the stopper **129.** The operating knob **100** is formed by molding two types of resins A**1** and A**2** into a single piece, as shown in **FIG. 2.** The resin A**1** is a transparent resin and the resin A**2** is an opaque resin. The whole transparent resin A**1** constitutes a light guide and is molded so that the circular outer circumferential surface of the operating portion **101** is optically coupled to the light introducing surface **117** of the light-guiding protrusion **115.**

**[0018]** The sliding piece **130** is formed of an elastic metal plate and is provided with a base portion **131** and

arch-shaped arm portions **133** protruding from an outer surface of the base portion **131** and having a shape with U-turn at a root portion. A contact portion **135** which is curved and protrudes toward the circuit board **160** is formed at the center of each arm portion **133.** Attachment holes **137** formed of small holes are also provided on the base portion **131.**

**[0019]** The terminal unit **140** is formed by insert molding in which six metal-plate terminals **141** are molded in a substantially rectangular terminal case **143** consisting of a molding resin and a terminal holding case **145** having a substantially rectangular-prism shape. Each terminal **141** is arranged such that one end protrudes from a rear surface of the terminal case **143** so that the six ends are aligned in a row, and the other end protrudes from a side surface of the terminal case **143,** is bent downward, is fixed by the terminal holding case **145** and then protrudes from a lower surface of the terminal holding case **145** so that the six ends are aligned in a row.

**[0020]** The circuit board **160** is configured that a circular through-hole **163** is provided at an upper portion of an insulating substrate **161** formed of a substantially rectangular hard plate, a sliding contact pattern **165** to be in sliding contact with the contact portions **135** of the sliding piece **130** is formed on a front surface of the insulating substrate **161** around the circular through-hole **163,** six terminal insertion holes **167** formed of small holes for inserting one ends of the terminals **141** are formed horizontally in a row on the insulating substrate **161** in the vicinity of the lower edge, a light-emitting element **169** is attached to the rear surface of the insulating substrate **161** so as to be located below the through-hole **163,** and various other electronic parts **171** are attached to predetermined positions. A circuit pattern (not shown) is formed on the insulating substrate **161** to electrically connect between the sliding contact pattern **165,** the light-emitting element **169,** the various other electronic parts **171** and the terminals **141** inserted into the terminal insertion holes **167.** Various patterns such as switch pattern or resistor pattern can be used as the sliding contact pattern **165.**

**[0021]** The light guide **190** is formed in a single piece by molding a transparent synthetic resin into a substantially rectangular box shape having an opening on the front side. On the front side, the light guide **190** has a substrate housing portion **191** having a recessed shape, and a circular-columnar protruding portion **193** protrudes from an upper portion of the bottom surface of the substrate housing portion **191.** The substrate housing portion **191** is formed in a shape capable of housing and covering the entire circuit board **160.** The protruding portion **193** has a size capable of being inserted into the through-hole **163** of the circuit board **160** and is configured that an end face serves as a light-emitting surface **195.**

**[0022]** The upper surface of the light guide **190** also serves as a light-emitting surface **197.**

**[0023]** The third case **220** is formed in an outer shape which is a substantially rectangular plate shape and substantially covers the rear surface of the first case **20.** A pair of engaging claws **221** protrude from both right and left sides of the third case **220** toward the first case. The engaging claws **221** are flat plate-shaped members on which the claw portions **223** are provided near the end portions on both outer sides.

**[0024]** As shown in **FIG. 3,** the packings **250** are formed of an elastic body such as elastomer into a substantially rectangular ring-shape with a circular cross section and form a shape in which the front side and the right and left sides are linear and the rear side has a curved portion which is curved upward in an arc shape. Here, a portion having the arc-shaped curved portion is defined as a bearing-side packing **250**a, portions on the right and left sides are defined as right- and left-side packings **250**b and **250**c, and a portion on the front side is defined as a non-bearing-side packing **250**d**.** The right- and left-side packings **250**b and **250**c serve as coupling portions for coupling the bearing-side packing **250**a to the non-bearing-side packing **250**d and contribute to improvement in assemblability and wobble prevention, in addition to the sealing effect. The curved portion of the bearing-side packing **250**a matches the outer shape of the bearing **21** of the first case **20.**

**[0025]** **FIG. 7** is a perspective view showing the cover **300** when viewed from the rear lower side. As shown in **FIGS. 7** and also **FIGS. 2** and **3,** the cover **300** is a molded article of a synthetic resin and is formed in a substantially rectangular box shape having an opening on the lower side so that a case main body-housing portion **301** for covering and housing the upper portion of the main unit **10** is formed on the lower side of the cover **300.** On an upper surface (outside surface) **303** of the cover **300,** an exposure opening **305** for exposing a portion of the operating portion **101** of the operating knob **100** is formed at a position facing the operating knob **100** and an illumination portion **307** is formed at a position facing the light-emitting surface **197** of the light guide **190.** The illumination portion **307** is formed by cutting a desired shape, such as letter/character or symbol, out of an opaque coating material applied to a surface of a transparent molded resin constituting the cover **300,** but may be formed by other methods. The engagement portions **309,** which are rectangular through-holes to be engaged with the engaging portions **30** of the first case **20,** are respectively formed on both the right and left side surfaces of the cover **300.** Drip-proof member-mounting surfaces (hereinafter, referred to as "packing mounting surfaces") **311** (**311**a to **311**d) are formed on the back surface of the cover **300** so as to surround the exposure opening **305.** The packing mounting surfaces **311** consist of a bearing-side packing mounting surface **311**a in an arc shape convex toward the exposure opening **305,** linear-shaped right- and left-side packing mounting surfaces **311b** and **311c** on both sides thereof (**311**c is not shown), and a non-bearing-side packing mounting surface **311**d having a linear shape and located on the opposite side to the bearing-side packing mounting surface

**311a,** which together form one substantially rectangular ring-shaped surface (the same shape as that formed by the packings **250**). In other words, the bearing-side packing mounting surface **311a** is formed at a position along the shape of an arc-shaped portion around the rim of the exposure opening **305,** and the non-bearing-side packing mounting surface **311d** is formed at a position away from the arc-shaped portion around the rim of the exposure opening **305.**

**[0026]** Next, assembly of the rotary electronic component **1** will be described. Firstly, the main unit **10** is assembled. In detail, the base portion **131** of the sliding piece **130** is pre-placed on the sliding piece attachment portion **113** of the operating knob **100.** At this time, the sliding piece **130** is attached by heat staking (or only press-fitting) the tips of the sliding piece attaching protrusions **119** of the sliding piece attachment portion **113** which are inserted into the attachment holes **137** of the sliding piece **130.** Also, grease G for drip-proofing is applied to fill the drip-proof recess **121** of the operating knob **100.** Meanwhile, the tip of each terminal **141** protruding from the rear of the terminal unit **140** is inserted into the corresponding terminal insertion hole **167** of the circuit board **160** and is fixed on the opposite side to the circuit pattern (not shown) on the circuit board by solder h (see **FIG. 2**).

**[0027]** Then, the operating knob **100,** with the sliding piece **130** attached thereto and also the coil spring **125** and the click ball **127** housed in the click mechanism housing portion **123,** is arranged to be housed in the first housing portion **23** of the first case **20** in such a manner that the shaft portion **111** of the operating knob **100** inserted into the bearing **21** of the first case **20** is rotatably supported. In this state, the bearing **21** of the first case **20** is inserted in the drip-proof recess **121** of the operating knob **100** which is filled with the grease G, and this provides a drip-proof processing portion B**1**. Next, the second case **70** is attached to cover the front side surface of the operating knob **100.** Once the claw portions **79** of the engaging claws **77** are engaged with the engagement portions **27** of the first case **20,** the second case **70** and the first case **20** are attached to each other with the operating knob **100** sandwiched therebetween. The second case **70** is attached such that the knob supporting portion **73** covers the other side surface (the front side surface) of the operating knob **100,** the protruding portion **75** is inserted into the insertion portion **109** of the operating knob **100,** and the protruding portion **74** is inserted into the recessed portion **103.**

**[0028]** Next, the circuit board **160** with the terminal unit **140** attached thereto and the light guide **190** are arranged to be housed in the second housing portion **25** of the first case **20,** and the third case **220** is placed thereover. Then, the claw portions **223** of the third case **220** are respectively engaged with the engagement portions **29** of the first case **20.** The main unit **10** shown in **FIG. 3** is thereby completed.

**[0029]** In this state, an opening H**1** is formed on the upper surface between the first case **20** and the second case **70,** and an opening H**2** is formed on the upper surface between the first case **20** and the third case **220** (see **FIG. 2**). A portion of the operating portion **101** of the operating knob **100** is exposed (protrudes) in the opening H**1**. Meanwhile, the light-emitting surface **197** of the light guide **190** is exposed in the opening H**2** so as to protrude externally (upward). Then, the contact portions **135** of the sliding piece **130** are in contact with the sliding contact pattern **165** of the circuit board **160,** as shown in **FIG. 2.** In addition, in this state, the terminal unit **140** is housed in the terminal unit housing portion **31.** Furthermore, the outer peripheral portion of the light guide **190** is in contact with a surface of the first case **20** facing the light guide **190** and encircles the circuit board **160.** Furthermore, the protruding portion **193** of the light guide **190** is inserted into the through-hole **163** of the circuit board **160** so that the tip of the light-emitting surface **195** located at the end thereof closely faces the light introducing surface **117** of the operating knob **100.**

**[0030]** Next, the packings **250** shown in **FIG. 3** are inserted into the case main body-housing portion **301** of the cover **300** and are placed in contact with the packing mounting surfaces **311** (**311**a to **311**d) of the cover **300.** Then, the cover **300** with the packings **250** installed thereon is attached to the main unit **10** from above. In other words, the upper portion of the main unit **10** is housed in the case main body-housing portion **301** of the cover **300.** Then, the engaging portions **30** of the main unit **10** are respectively engaged with engagement portions **309** of the cover **300.** Assembly of the rotary electronic component **1** is thereby completed. Note that, the above-mentioned assembly process is only an example and it is obvious that various other assembly processes may be use for assembly. For example, instead of attaching the packings **250** to the cover **300,** the packings **250** may be attached to the main unit **10** which is then covered with the cover **300.** In this case, ribs, etc., for preventing the packings **250** from coming out of alignment are preferably formed on at least some of the packing mounting surfaces **33** (**33**a to **33**c) and the non-bearing-side packing mounting surface **81** of the main unit **10.**

**[0031]** **FIG. 4** is an exploded perspective view showing the state in which only the cover **300** is detached from the assembled rotary electronic component **1.** As understood from **FIG. 4,** the packings **250** in the rotary electronic component **1** are in contact with the main unit **10** in the surrounding area of the hole the opening H**1** which is formed by combining the first and second cases **20** and **70.** In detail, among the packings **250,** the bearing-side packing **250**a is in contact with the bearing-side drip-proof member-mounting surface **33**a of the first case **20,** the right- and left-side packings **250**b and **250**c are in contact with the right- and left-side packing mounting surfaces **33**b and **33**c of the first case **20,** and the non-bearing-side packing **250**d is in contact with the non-bearing-side packing mounting surface **81** of the second case **70.**

**[0032]** Meanwhile, a portion of the operating portion

**101** of the operating knob **100** is exposed through the exposure opening **305,** as shown in **FIGS. 1** and **2.** The light-emitting surface **197** of the light guide **190** is arranged at a position facing the lower surface (the back surface) of the illumination portion **307** of the cover **300.** Then, in the assembled state, the bearing-side packing **250**a is in contact with the bearing-side packing mounting surface **311**a**,** the right- and left-side packings **250**b and **250**c are in contact with the right- and left-side packing mounting surfaces **311**b and **311**c**,** and the non-bearing-side packing **250**d is in contact with the non-bearing-side packing mounting surface **311**d**,** hence, the packings **250** are sandwiched between the packing mounting surfaces **33** (**33**a to **33**c)/the non-bearing-side packing mounting surface **81** of the main unit **10** and the cover **300** and seals between the main unit **10** and the cover **300.**

**[0033]** In the rotary electronic component **1** assembled as described above, when the operating knob **100** is rotated, the contact portions **135** of the sliding piece **130** slide on the sliding contact pattern **165** of the circuit board **160** and this produces a difference in the detection output between the terminals **131.** When rotating the operating knob **100,** the grease G causes some resistance but a large torque is not required to rotate the operating knob **100** since the packings **250** are not in contact therewith at all, hence, operability is not impaired. The operating knob **100**, when rotated, does not rotate more than about half of a turn since the stopper **129** thereof (see **FIG. 6**) butts against the pair of right and left stopper engaging portions **35** (only one is shown in **FIG. 5**) provided in the first housing portion **23** of the first case **20.** In other words, the operating knob **100** is moves in an arc motion.

**[0034]** When the light-emitting element **169** is turned on, light therefrom is introduced into and reflected by the light guide **190,** is then emitted from the light-emitting surface **197,** and illuminates the illumination portion **307** of the cover **300** from the back side thereof, as indicated by a dot-and-dash line. On the other hand, the light reflected inside the light guide **190** and emitted from the light-emitting surface **195** is introduced into the resin A**1** from the light introducing surface **117** of the operating knob **100,** is reflected therein and guided to the circular outer circumferential surface of the operating portion **101,** and illuminates the operating portion **101.**

**[0035]** In the meantime, the rotary electronic component 1 is installed on an operation panel C of an electronic device, as shown in **FIG. 8.** When installed, the upper surface **303** of the cover **300** is exposed, as the outside surface, to the outside of the operation panel C. Liquid may spill on the upper surface **303** exposed to the outside of the operation panel C. The spilled liquid enters inside the cover **300** through the exposure opening **305.** The entered liquid tries to advance from the surrounding area of the operating portion **101** of the operating knob **100** toward the circuit board **160** by passing through a gap between the cover **300** and the first case **20** as indicated by an arrow **L1,** by passing through a gap between the cover **300** and the second case **70,** moving down along the outer surface of the second case **70** and going under its lower edge and around to the opposite side of the operating knob **100** as indicated by an arrow **L2,** or by passing through the opening **HI** of the main unit **10** as indicated by an arrow **L3.**

**[0036]** In the rotary electronic component **1,** however, ingress of the liquid advancing toward the circuit board **160** by passing through a gap between the cover **300** and the first case **20** as indicated by the arrow L**1** is prevented by the bearing-side packing **250**a**.** Then, ingress of the liquid advancing toward the circuit board **160** by passing through a gap between the cover **300** and the second case **70,** moving down along the outer surface of the second case **70** and going under its lower edge of and around to the opposite side of the operating knob **100** as indicated by the arrow **L2** is prevented by the non-bearing-side packing **250**d. Meanwhile, the liquid entered through the opening H**1** of the main unit **10** as indicated by the arrow L**3** passes in the surrounding area of the operating knob **100** and is directly drained downward, but the liquid advancing toward the sliding piece **130** is blocked by the drip-proof processing portion B**1** and the ingress thereof is prevented. As such, drip-proof against the liquid entering through the exposure opening **305** of the cover **300** is effectively provided at each of these points.

**[0037]** As described above, the rotary electronic component **1** is configured that the operating knob **100** moving in a circular motion (including an arc motion and an oscillatory motion) about an axis K (see **FIG. 2**) is arranged on one side of the circuit board **160,** a detection means composed of the sliding piece **130** and the sliding contact pattern **165** and changing its output according to the motion of the operating knob **100** is provided between the operating knob **100** and the circuit board **160,** at least the operating knob **100** is housed in the first and second cases **20** and **70,** a portion of the operating portion **101** on the outer surface of the operating knob **100** is exposed through the opening H**1** provided on the first and second cases **20** and **70,** the cover **300** having the exposure opening **305** for exposing the portion of the operating portion **101** of the operating knob **100** is attached to cover the outer surface of the first and second cases **20** and **70** on which the opening H**1** is provided, and the packings **250** are sandwiched and held between a surrounding area of the opening H**1** of the first and second cases **20** and **70** and a surrounding area of the exposure opening **305** of the cover **300** and prevent ingress of liquid from the exposure opening **305** of the cover **300** through a gap between the first and second cases **20** and **70** and the cover **300.**

**[0038]** In addition, since the shaft portion **111** provided on the operating knob **100** so as to protrude from a side surface on the circuit board **160** side is rotatably inserted into the bearing **21** protruding from the first case **20** at a position near the detection means and the drip-proof processing portion B**1** is provided at the end portion of the bearing **21** into which the shaft portion **111** is inserted,

liquid which is not blocked by the packings **250** and enters the first and second cases **20** and **70** from the opening H**1** of the first and second cases **20** and **70** is prevented from entering by a portion of the bearing **21** inside the first and second cases **20** and **70.** Thus, it is possible to prevent ingress of liquid into the detection means and the circuit board **160** more effectively.

**[0039]** The bearing-side packing **250**a, which is the packing **250** arranged on the side where the surface of the operating knob **100** with the shaft portion **111** attached (the one side surface) is located, is arranged at a position along the operating portion **101** of the operating knob **100.** Thus, the bearing-side packing **250**a, which is arranged on the side where the circuit board **160** is located, prevents ingress of liquid at a position in the vicinity of the operating portion **101** of the operating knob **100** (immediately after the position of liquid ingress). On the other hand, the non-bearing-side packing **250**d, which is the packing **250** arranged on the side where the surface (the other side surface) of the operating knob **100** opposite to the surface with the shaft portion **111** attached is located, is arranged in the vicinity of the axis K of the operating knob **100.** Thus, the non-bearing-side packing **250**d, which is arranged on the side where the circuit board **160** is not located, provides drip-proof protection near the center of the side surface of the operating knob **100** which is distant from the operating portion **101** of the operating knob **100.** That is, the drip-proof effect at the portion near the circuit board **160** side is enhanced by providing drip-proof protection at a position in the vicinity of the exposure opening **305** of the cover **300.** On the other hand, in a region on the opposite side of the operating knob **100** which is distant from the circuit board **160,** the non-bearing-side packing **250**d is arranged at a position rearward (downward) of the operating portion **101** of the operating knob **100,** which allows a width dimension S**1** of a portion of the cover **300** in the vicinity of the exposure opening **305** (see **FIG. 8**) to be reduced. The portion of the cover **300** in the vicinity of the exposure opening **305** is a portion exposed on the operation panel C of the electronic device when the rotary electronic component **1** is mounted thereon. Since the width dimension S**1** of such portion can be reduce, it is possible to reduce the size or thickness, etc., of the operation panel C as well as of the electronic device provided with the operation panel C.

**[0040]** It is also configured such that the circular recessed portion **103** is provided on the operating knob **100** on a surface opposite to the surface with the shaft portion **111** attached, the cylindrical protruding portion **74** to be inserted into the recessed portion **103** is provided on a surface of the second case **70** facing the surface with recessed portion **103,** and the recessed portion **103** engages with the protruding portion **74.** Thus, even when liquid enters through the opening H**1** of the first and second cases **20** and **70,** the liquid is prevented from further advancing through a gap between the second case **70** and the surface of the operating knob **100** on the opposite side to the shaft portion **111.**

**[0041]** The following configurations and effects can be included in and achieved by the invention.

(**1**) A drip-proof structure is used for an electronic component in which an operating knob moving in a circular motion, an arc motion or an oscillatory motion about an axis is arranged on one side of a circuit board, a detection means changing its output according to the motion of the operating knob is provided between the operating knob and the circuit board, at least the operating knob is housed in a case, a portion of an operating portion on the outer surface of the operating knob is exposed through an opening provided on the case, and a cover having an exposure opening for exposing the portion of the operating portion of the operating knob is attached to cover the outer surface of the case on which the opening is provided, and the drip-proof structure of the electronic component is configured that drip-proof members are sandwiched and held between a surrounding area of the opening of the case and a surrounding area of the exposure opening of the cover and prevent ingress of liquid from the exposure opening of the cover through a gap between the case and the cover.

This configuration effectively provides drip-proof against the liquid entering from the exposure opening of the cover through a gap between the case and the cover. In addition, since the drip-proof members are not in contact with the operating knob at all, operability when rotating the operating knob is not impaired.

The drip-proof members are preferably formed of an elastic material, etc., and form a ring shape, but may be formed of a different material and have a different shape and structure. In addition, the drip-proof members do not necessarily need to completely surround the exposure opening of the cover (or the opening of the case) and may surround partially.

(2) The drip-proof structure of the electronic component described in the above (1) is configured that a shaft portion is provided on the operating knob so as to protrude from a side surface on the circuit board side, the shaft portion is rotatably inserted into a bearing protruding from the case at a position near the detection means, and a drip-proof processing portion is provided at an end portion of the bearing into which the shaft portion inserted.

In this configuration, liquid which is not blocked by the drip-proof members and enters the case from the opening of the case is prevented from advancing by the end portion of the bearing inside the case and it is thus possible to prevent ingress of liquid into the detection portion and the circuit board more effectively.

Various drip-proof structures such as applying grease or providing a packing can be used to form

the drip-proof processing portion. The position to provide grease or packing, etc., may be any of the inner circumferential surface side, the end face side and the outer circumferential surface side of the bearing.

(**3**) The drip-proof structure of the electronic component described in the above (**1**) or (**2**) is configured that the drip-proof member, which is arranged on the side where the surface of the operating knob with the shaft portion attached is located, is arranged at a position along the operating portion of the operating knob, and the drip-proof member, which is arranged on the side where the surface of the operating knob opposite to the surface with the shaft portion attached is located, is arranged in the vicinity of the axis of the operating knob.

In this configuration, the drip-proof member, which is arranged on the side where the circuit board is located, prevents ingress of liquid at a position in the vicinity of the operating portion on the outer periphery of the operating knob (immediately after the position of liquid ingress). On the other hand, the drip-proof member, which is arranged on the side where the circuit board is not located, provides drip-proof protection near the center of the side surface of the operating knob which is distant from the operating portion on the outer periphery of the operating knob. That is, the drip-proof effect on the circuit board side is enhanced by providing drip-proof protection at a position in the vicinity of the exposure opening of the cover. On the other hand, in a region on the opposite side of the operating knob which is distant from the circuit board, the drip-proof member is arranged at a position rearward (downward) of the operating portion of the operating knob, which allows a width dimension of a portion of the cover in the vicinity of the exposure opening to be reduced. The portion of the cover in the vicinity of the exposure opening is a portion exposed on an operation panel of an electronic device when the electronic component is mounted thereon. Since the width dimension of such portion can be reduce, it is possible to reduce the size or thickness of the operation panel of the electronic device.

(**4**) The drip-proof structure of the electronic component described in any one of the above (**1**) to (**3**) is characterized in that a circular recessed portion is provided on the operating knob on a surface opposite to the surface with the shaft portion attached, a cylindrical protruding portion to be inserted into the recessed portion is provided on a surface of the case facing the surface with recessed portion, and the recessed portion engages with the protruding portion.

**[0042]** This configuration prevents ingress of liquid from the exposure opening of the cover through a gap between the case and the operating knob and it is thereby possible to prevent ingress of liquid into the circuit board more effectively.

**[0043]** Although the embodiment of the invention has been described above, the invention is not intended to be limited to the embodiment, and the various kinds of modifications can be implemented without departing from the scope of the technical idea described in the claims, the specification and the drawings. Any shapes, structures and materials which are not directly described in the specification and the drawings can be within the scope of the technical idea of the present invention as long as the functions and effects of the invention are obtained. For example, although the packings formed of an elastic body and arranged in a ring shape are used as the drip-proof members in the embodiment, drip-proof members formed of another material and having another shape and structure may be used. In addition, the shape formed by the drip-proof members does not necessarily need to completely surround the exposure opening of the cover (or the opening of the case) and may surround partially. In detail, for example, to prevent ingress of liquid on the circuit board side, the packings may be arranged in contact with only the bearing-side packing mounting surface and the non-bearing-side packing mounting surface of the cover without contacting with the right- and left-side packing mounting surfaces. In this regard, however, the packings in a ring shape are easier to assemble and also eliminate an unnecessary gap, allowing the cover to be attached to the main unit without wobble. In addition, although the drip-proof processing portion is configured by applying grease in the embodiment, various other drip-proof means such as providing packing may be used to form the drip-proof processing portion. In addition, although the rotational angle of the operating knob is limited by the stopper mechanism (an arc motion) in the embodiment, it may be configured to be **360**° rotatable (a rotary motion) or to be able to move in an oscillatory motion other than the rotary motion. In addition, the exposure opening of the cover is arranged to face straight up in the embodiment, but may be arranged to face in another direction (e.g., obliquely upward, horizontal, or obliquely downward, etc.).

**[0044]** The contents of the embodiment described above and shown in the drawings can be combined as long as the purpose and configuration, etc., do not contradict. In addition, the contents described above and shown in the drawings, even a part of them, can be respectively independent embodiments, and the embodiment of the invention is not limited to one embodiment as a combination of the above description and the drawings.

Reference Signs List

**[0045]**

1 ROTARY ELECTRONIC COMPONENT (ELECTRONIC COMPONENT)
20 FIRST CASE (CASE)

21 BEARING
70 SECOND CASE (CASE)
100 OPERATING KNOB
101 OPERATING PORTION
111 SHAFT PORTION
130 SLIDING PIECE (DETECTION MEANS)
160 CIRCUIT BOARD
165 SLIDING CONTACT PATTERN (DETECTION MEANS)
250 PACKING (DRIP-PROOF MEMBER)
250a BEARING-SIDE PACKING (DRIP-PROOF MEMBER)
250d NON-BEARING-SIDE PACKING (DRIP-PROOF MEMBER)
300 COVER
305 EXPOSURE OPENING
K1 AXIS
HI OPENING
B1 DRIP-PROOF PROCESSING PORTION

## Claims

**1.** A drip-proof structure of an electronic component, comprising:

a rotary body that comprises a main body comprising a circular outer circumferential surface as an operating portion and a shaft portion provided on one side surface of the main body;
a first case that comprises a bearing rotatably supporting the shaft portion of the rotary body;
a second case that is provided integral with the first case so as to have an opening therebetween, supports the other side surface of the main body of the rotary body, and houses, together with the first case, the rotary body while exposing a portion of the circular outer circumferential surface of the rotary body through the opening;
a sliding piece that is provided on the rotary body located inside the first and second cases and changes its position to follow rotation of the rotary body;
a circuit board that comprises a sliding contact pattern to be in sliding contact with the sliding piece and outputs an output signal corresponding to the rotational position of the rotary body;
a cover that comprises an exposure opening for exposing the portion of the circular outer circumferential surface of the rotary body exposed through the opening and covers the first and second cases and the circuit board; and
first and second drip-proof members arranged between the first case and the cover and between the second case and the cover, respectively.

**2.** The drip-proof structure of an electronic component according to claim 1, wherein the first drip-proof member is arranged between a portion of the first case constituting a surrounding area of the opening and a portion of the cover constituting a surrounding area of the exposure opening, and
wherein the second drip-proof member is arranged between a portion of the second case constituting a surrounding area of the opening and a portion of the cover constituting the surrounding area of the exposure opening.

**3.** The drip-proof structure of an electronic component according to claim 1 or 2, wherein the first and second drip-proof members extend in a direction orthogonal to an axial direction of the rotary body.

**4.** The drip-proof structure of an electronic component according to claim 1 or 2, wherein the first and second drip-proof members comprise coupling portions extending in an axial direction of the rotary body.

**5.** The drip-proof structure of an electronic component according to claim 4, wherein the first and second drip-proof members and the coupling portions are ring-shaped.

**6.** The drip-proof structure of an electronic component according to any one of claims 3 to 5, wherein an outer circumferential shape of the bearing of the first case is arc-shaped, and
wherein the first drip-proof member comprises a curved portion that is located on the bearing side and is formed in an arc shape engaging with the outer shape of the bearing of the first case.

**7.** The drip-proof structure of an electronic component according to any one of claims 3 to 5, wherein the second drip-proof member is located on an opposite side of the rotary body to the bearing.

**8.** The drip-proof structure of an electronic component according to claim 1, further comprising a drip-proof processing portion provided between the shaft portion of the rotary body and the bearing,
wherein the drip-proof processing portion comprises an end portion of a cylindrical protruding portion serving as the bearing and receiving the shaft portion of the rotary body inserted therein, and a drip-proof recess formed on the shaft portion of the rotary body so as to be concentrically with the shaft portion and receiving the end portion of the protruding portion inserted therein.

**9.** The drip-proof structure of an electronic component according to claim 1, further comprising a drip-proof portion provided between the other side surface of the main body of the rotary body and the second

case, the drip-proof portion comprising a male-female interlocking connection.

FIG.1

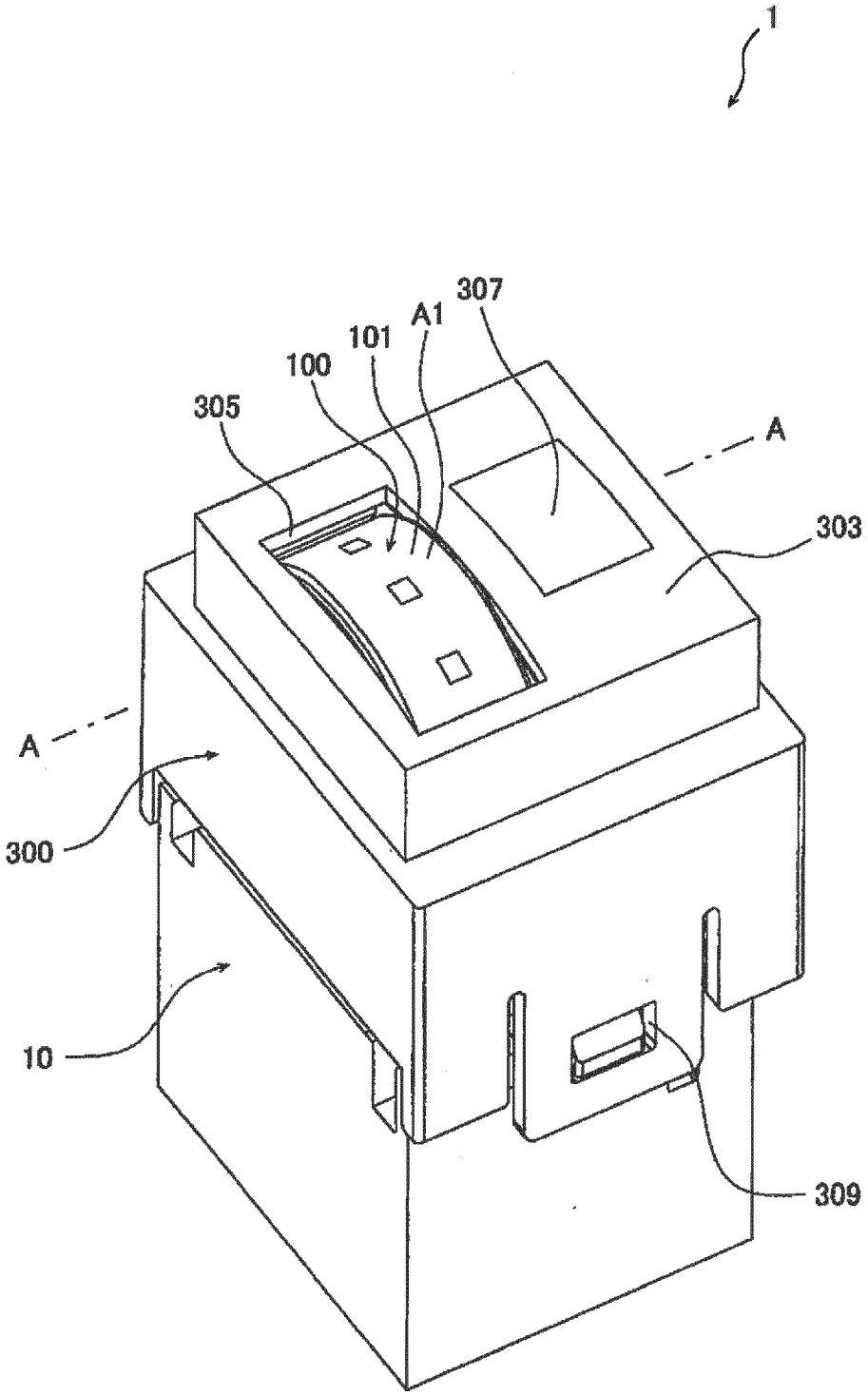
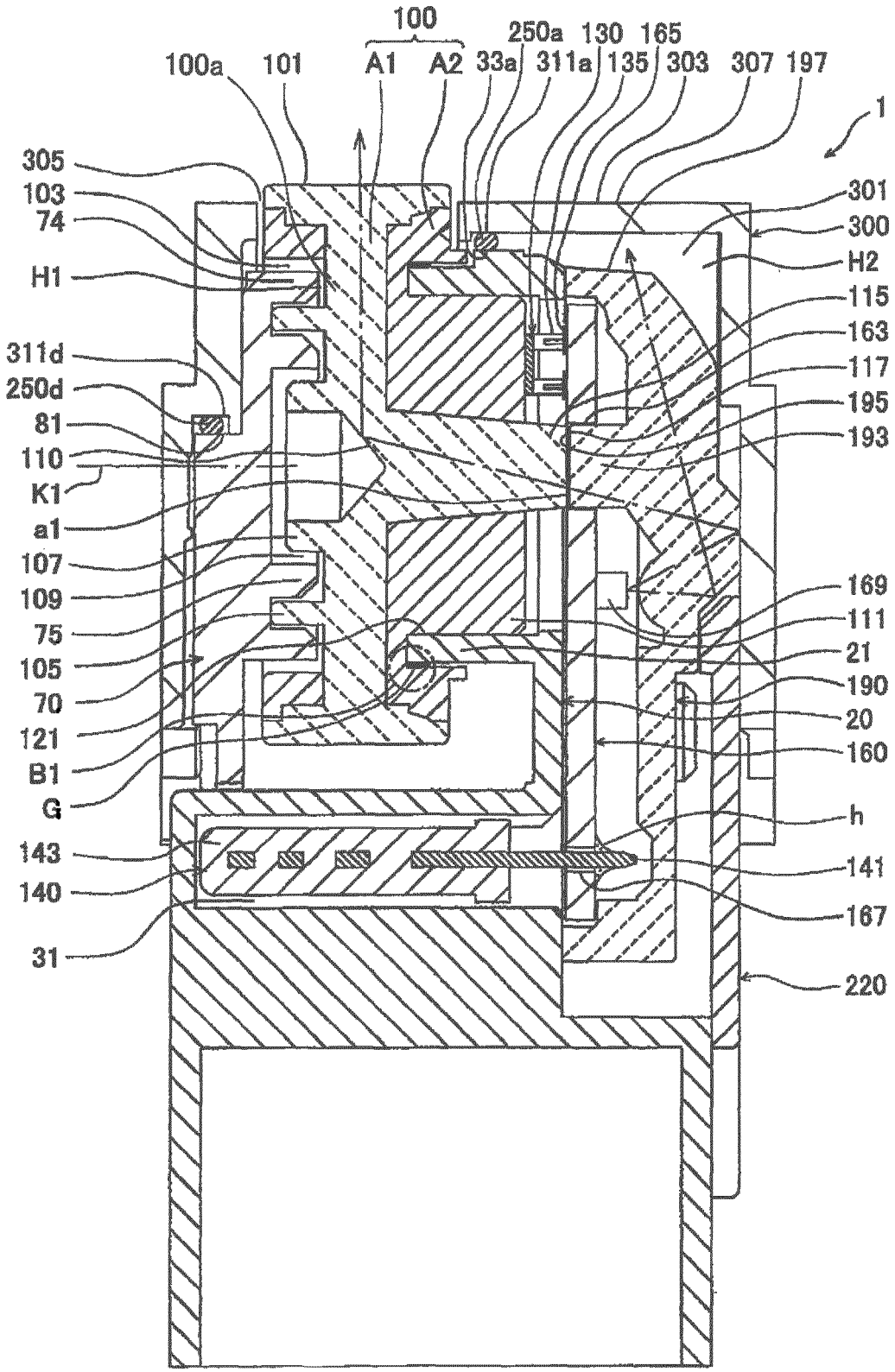


FIG.2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B1
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FIG.3

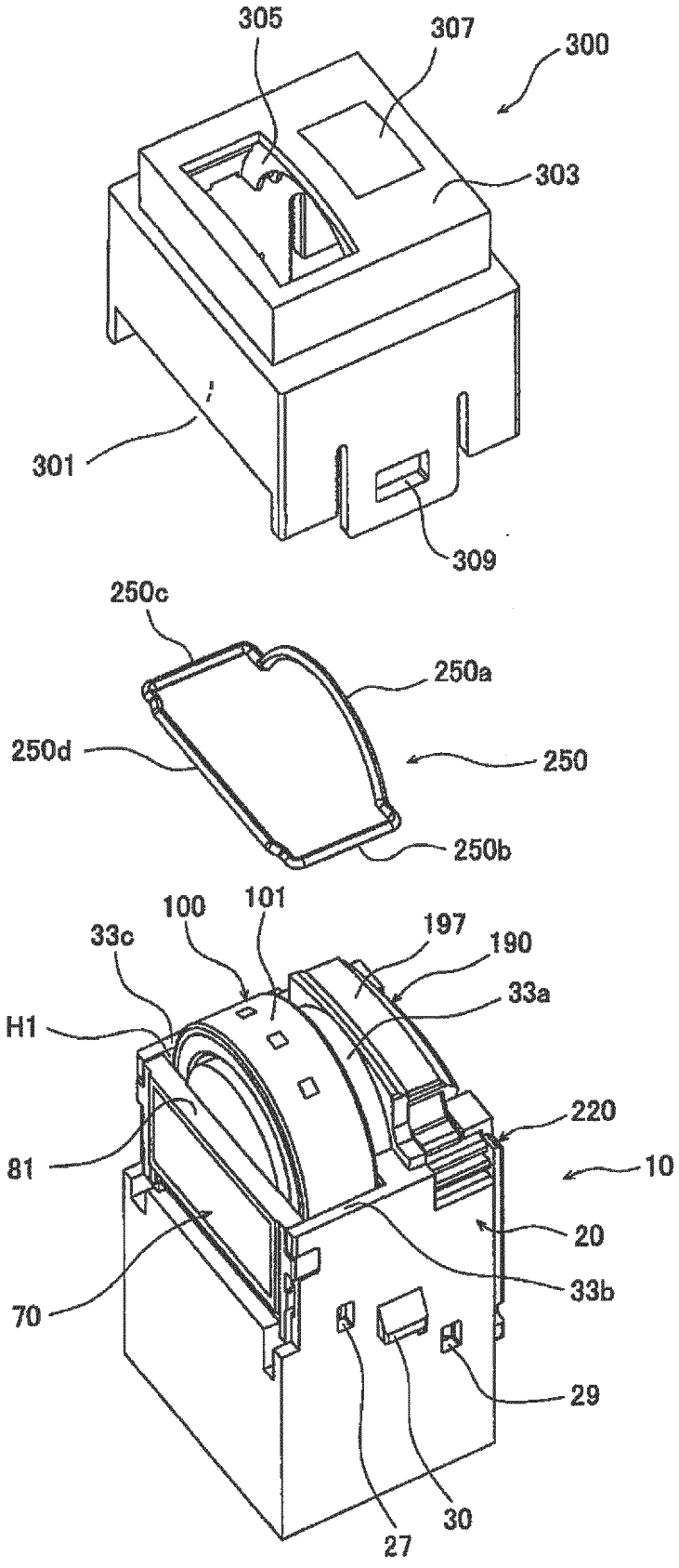
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FIG.4

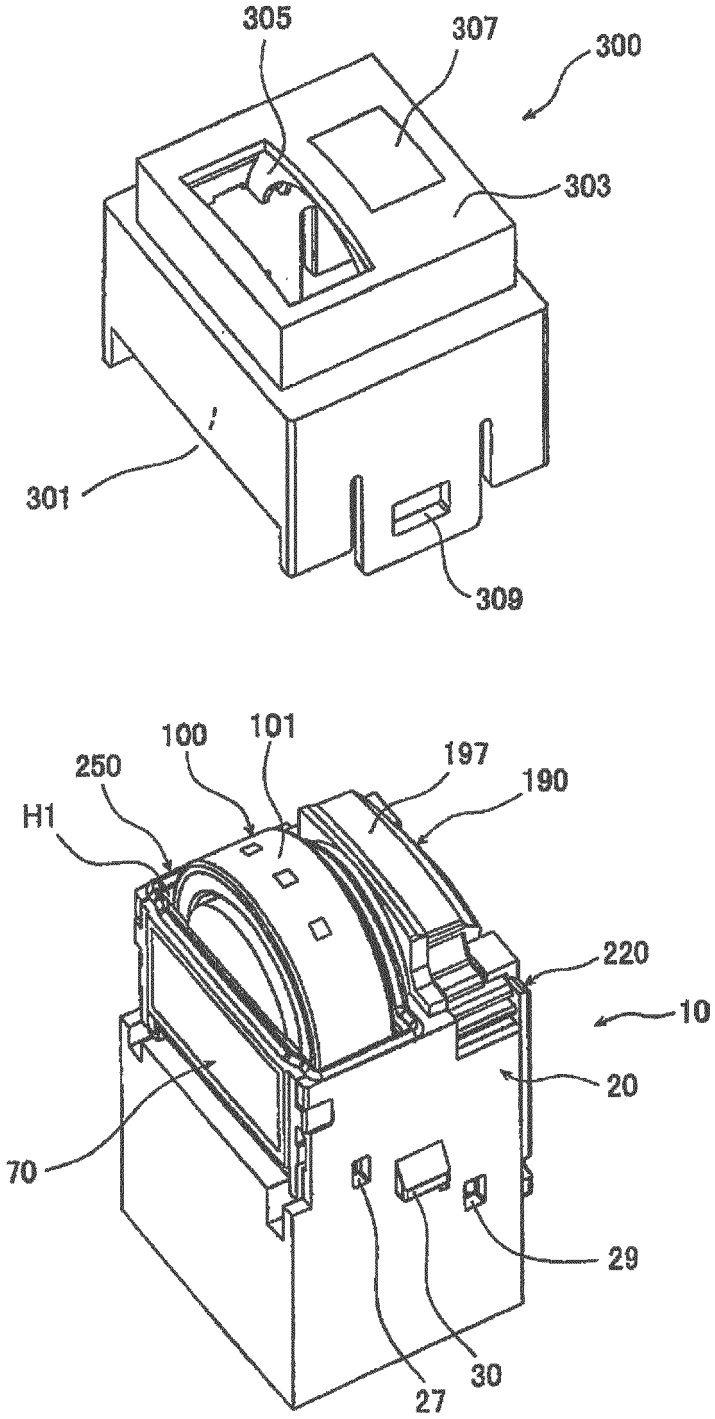
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FIG.5

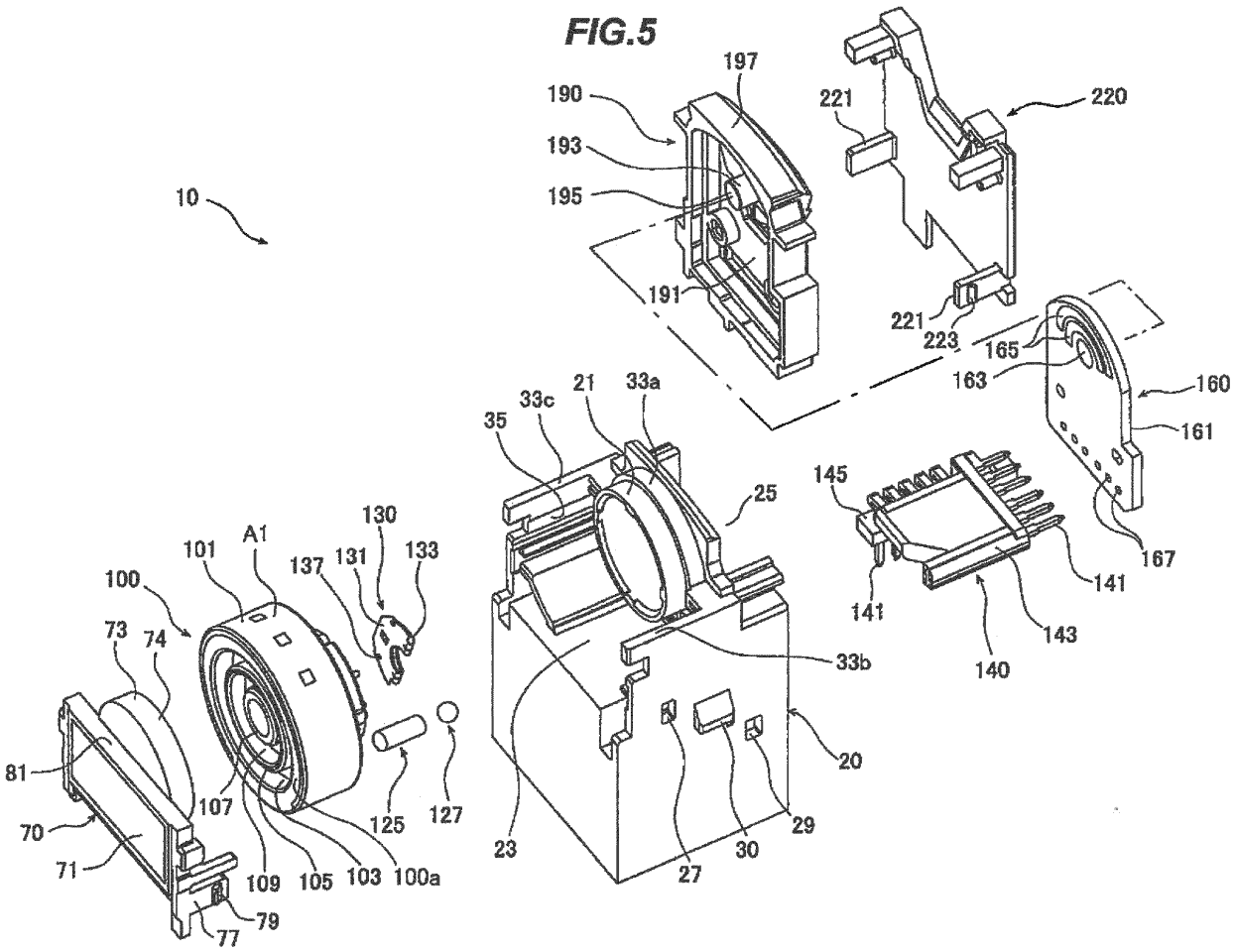
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FIG.6

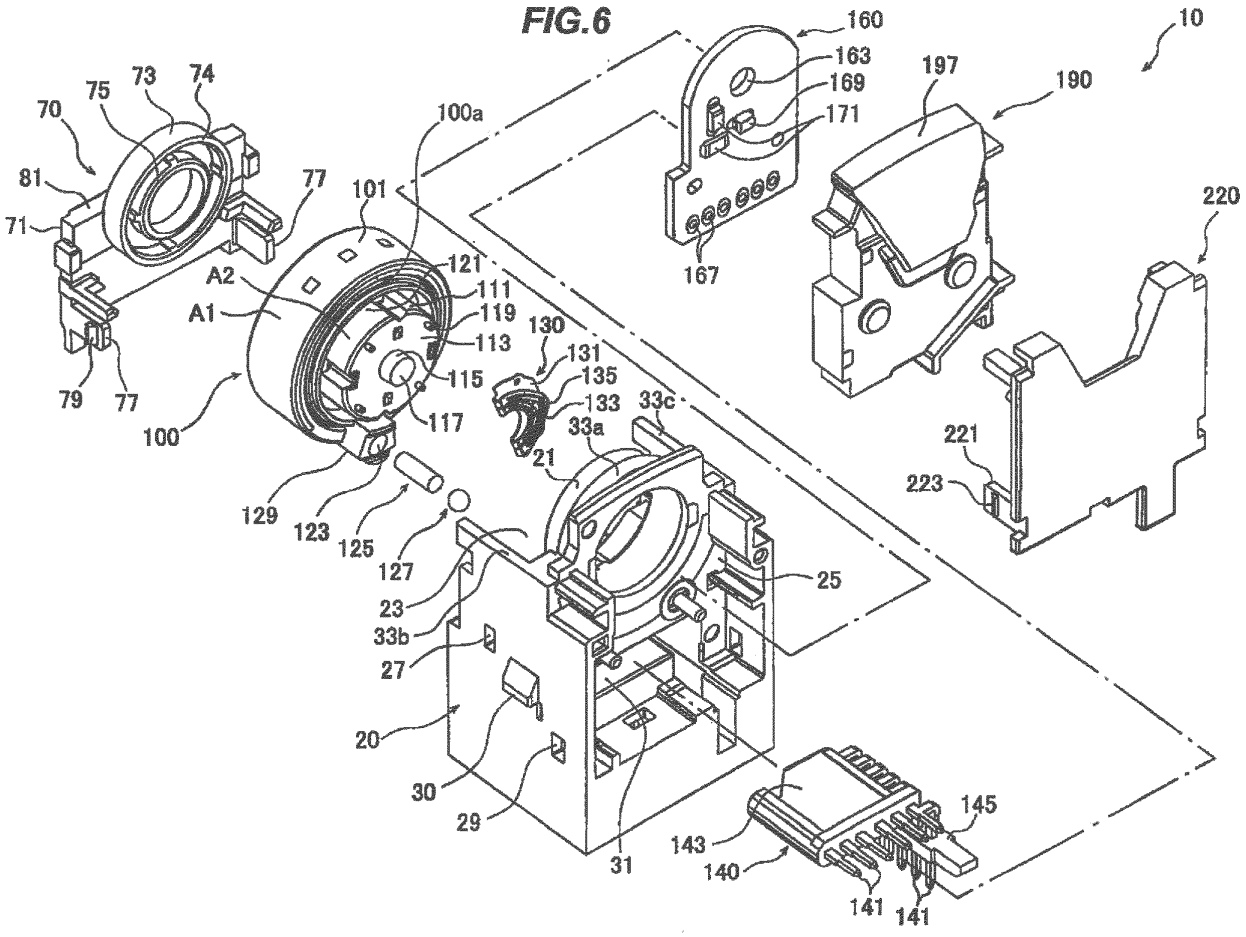
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*FIG.7*

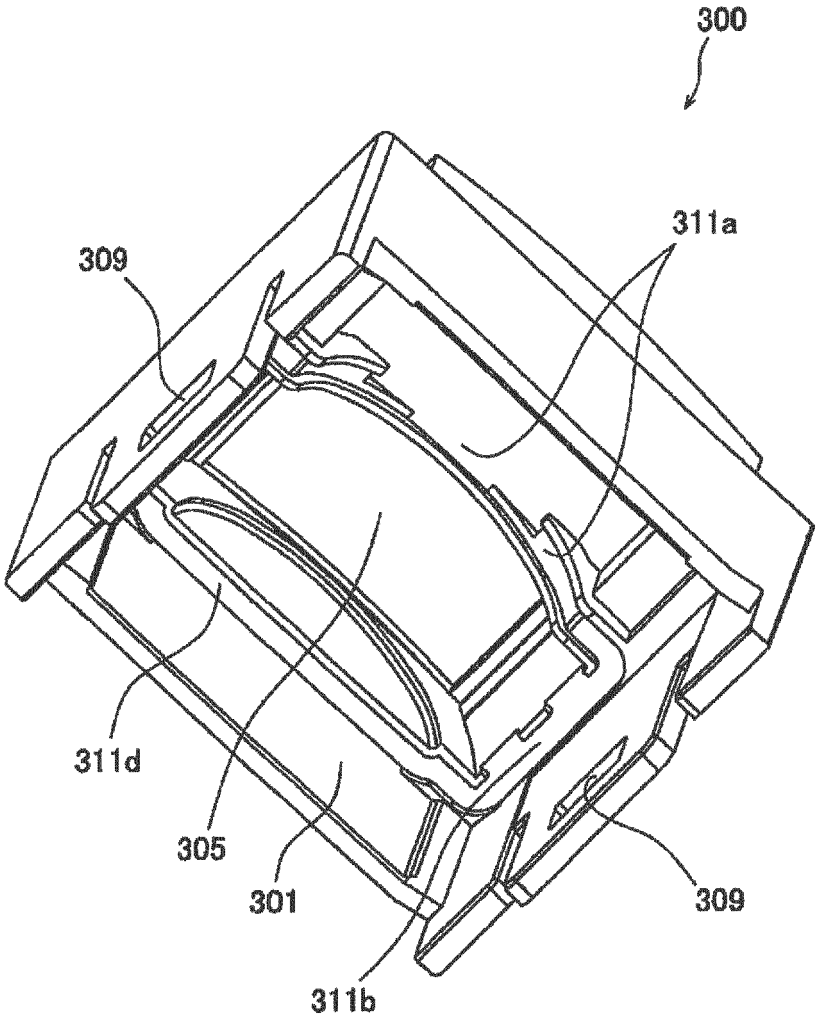
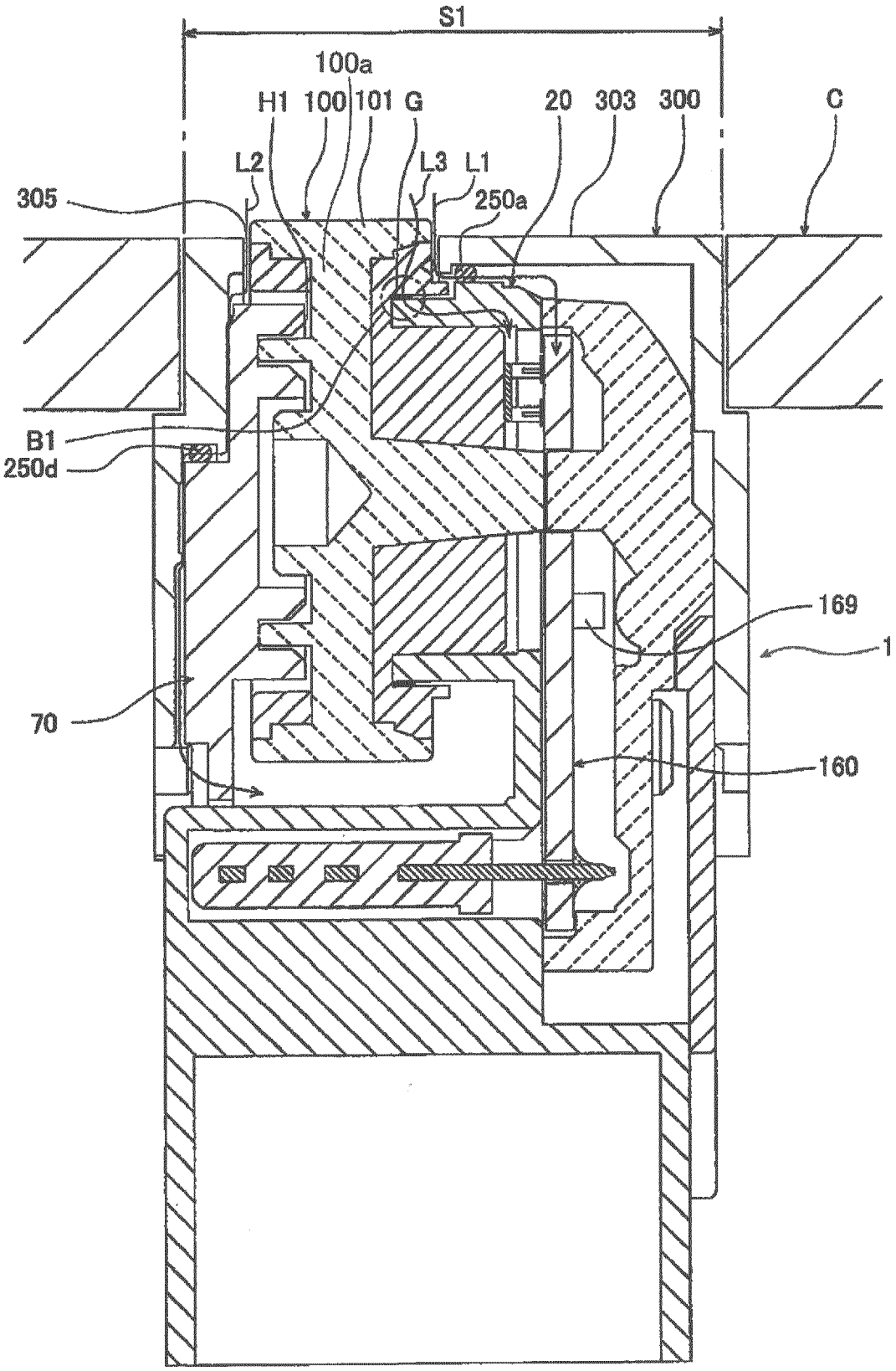


*FIG.8*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**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2017/026361

A. CLASSIFICATION OF SUBJECT MATTER
*H01H9/04*(2006.01)i, *H01H19/06*(2006.01)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)
H01H9/04, H01H19/06

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 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

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. |
|---|---|---|
| X<br>A | WO 2015/087366 A1 (Tokyo Cosmos Electric Co., Ltd.),<br>18 June 2015 (18.06.2015),<br>paragraphs [0019] to [0091]; fig. 1 to 9<br>& US 2016/0358727 A1<br>paragraphs [0032] to [0105]; fig. 1 to 9 | 1-7<br>8,9 |
| A | JP 2011-134573 A (Teikoku Tsushin Kogyo Co., Ltd.),<br>07 July 2011 (07.07.2011),<br>paragraphs [0017] to [0038]; fig. 1 to 8<br>(Family: none) | 1-7 |

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

* Special categories of cited documents:
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"O" document referring to an oral disclosure, use, exhibition or other means
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
"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 |
|---|---|
| 04 September 2017 (04.09.17) | 19 September 2017 (19.09.17) |
| Name and mailing address of the ISA/<br>Japan Patent Office<br>3-4-3,Kasumigaseki,Chiyoda-ku,<br>Tokyo 100-8915,Japan | Authorized officer<br><br>Telephone No. |

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

**INTERNATIONAL SEARCH REPORT**

International application No.
PCT/JP2017/026361

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages | Relevant to claim No. |
|---|---|---|
| A | JP 2016-091806 A (Teikoku Tsushin Kogyo Co., Ltd.), 23 May 2016 (23.05.2016), paragraphs [0015] to [0022]; fig. 1 to 4 (Family: none) | 1 |

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

## REFERENCES CITED IN THE DESCRIPTION

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### Patent documents cited in the description


- JP 2016148630 A **[0001]**
- JP 2017130113 A **[0001]**
- JP 2011134573 A **[0003] [0005] [0007]**
- JP 2010009937 A **[0004] [0006] [0008]**