

[DESCRIPTION]

[Title of Invention]

JOINT STRUCTURE AND MEHTOD FOR ASSEMBLING VALVE DEVICE

[Technical Field]

[0001] The present disclosure relates to a valve device and a method for assembling a valve device.

[Background Art]

[0002] In the valve device disclosed in Patent Literature 1, an orifice plate is disposed on a body, and a valve seat member, an inner disk, a diaphragm, and the like are placed on the orifice plate. By threadedly engaging a bonnet with the body, constituent elements including the orifice plate are fixed to the body.

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] Japanese Patent No. 4137267

[Summary of Invention]

[Technical Problem]

[0004] In the valve device disclosed in Patent Document 1, when the threaded engagement between the bonnet and the body is loosened, all of the constituent elements become loosened. In order to prevent this, a valve device may be configured such that an inner member having a flow passage formed therein is disposed within a housing recess of the body in which the orifice plate is disposed, a thrust ring is disposed on the inner member, and a fixing ring is threadedly engaged with a threaded portion formed on an inner peripheral surface of the housing recess so as to press the inner member toward a bottom surface of the housing recess via the thrust ring. The thrust ring suppresses co-rotation of the inner member caused by rotation of the fixing ring. A diaphragm is disposed on the inner member and is fixed to the inner member via a retainer adapter by threadedly engaging the bonnet with the body.

[0005] In assembling the valve device having the above-described configuration, when the thrust ring is disposed on the inner member, the inner member is not provided with a positioning structure or a fixing structure for the thrust ring. Accordingly, positional displacement may occur due to vibration or the like, and the displacement may need to

be corrected each time, thereby increasing assembly effort.

[0006] Accordingly, one object of the present disclosure is to provide a valve device and a method for assembling a valve device capable of suppressing positional displacement of a thrust ring during assembly.

[Solution to Problem]

[0007] In order to solve the above-described problems, a valve device according to one aspect of the present disclosure includes: a body in which a first flow passage is formed, the body having a housing recess that opens at an upper surface thereof and in which the first flow passage opens at a bottom surface thereof; an inner member disposed within the housing recess and having a second flow passage communicating with the first flow passage; a fixing ring positioned above the inner member and threadedly engaged with a threaded portion formed on an inner peripheral surface of the housing recess to press the inner member toward the bottom surface; and a thrust ring interposed between the inner member and the fixing ring and configured to suppress co-rotation of the inner member caused by rotation of the fixing ring. The second flow passage opens at an upper surface of the inner member, and an annular upper end surface is formed around the second flow passage. The thrust ring is disposed on the annular upper end surface. The fixing ring has an annular shape, and a ring recess that is recessed upward and in which the thrust ring is inserted is formed in a lower surface thereof. The ring recess has: an annular recess upper surface extending in a direction perpendicular to an axial direction of the fixing ring and contacting an upper surface of the thrust ring; and a recess inner peripheral surface extending along a circumferential direction of the fixing ring and covering an outer peripheral surface of the thrust ring. A ring protrusion is provided on the recess inner peripheral surface. An outer peripheral edge portion of the thrust ring is positioned above the ring protrusion in the axial direction.

[0008] In the axial direction, a length from a lowermost surface of the thrust ring to the lower surface of the fixing ring may be configured to fall within a predetermined length range.

[0009] According to one aspect of the present disclosure, a method for assembling a valve device is disclosed, the valve device including: a body in which a first flow passage is formed, the body having a housing recess that opens at an upper surface

thereof and in which the first flow passage opens at a bottom surface thereof; an inner member disposed within the housing recess and having a second flow passage communicating with the first flow passage; a fixing ring positioned above the inner member and threadedly engaged with a threaded portion formed on an inner peripheral surface of the housing recess to press the inner member toward the bottom surface; and a thrust ring interposed between the inner member and the fixing ring and configured to suppress co-rotation of the inner member caused by rotation of the fixing ring. The second flow passage opens at an upper surface of the inner member, and an annular upper end surface is formed around the second flow passage. The thrust ring is disposed on the annular upper end surface. The fixing ring has an annular shape, and a ring recess that is recessed upward and in which the thrust ring is inserted is formed in a lower surface thereof. The ring recess has: an annular recess upper surface extending in a direction perpendicular to an axial direction of the fixing ring and contacting an upper surface of the thrust ring; and a recess inner peripheral surface extending along a circumferential direction of the fixing ring and covering an outer peripheral surface of the thrust ring. A ring protrusion is provided on the recess inner peripheral surface. An outer peripheral edge portion of the thrust ring is positioned above the ring protrusion in the axial direction. The method includes: disposing the inner member within the housing recess of the body; inserting the thrust ring between the ring protrusion and the recess upper surface of the ring recess of the fixing ring; and with the lower surface of the fixing ring facing downward, threadedly engaging the fixing ring with the threaded portion formed on the inner peripheral surface of the housing recess to cover the inner member from above, thereby pressing the inner member toward the bottom surface via the thrust ring and fixing the inner member to the body.

[0010] The method may further include measuring whether a length from a lowermost surface of the thrust ring to the lower surface of the fixing ring falls within a predetermined length range in a state in which the thrust ring is disposed so as to contact the recess upper surface of the ring recess.

[Effects of Invention]

[0011] According to the present invention, it is possible to provide a valve device and a method for assembling a valve device capable of suppressing positional displacement of a thrust ring during assembly.

[Brief Description of Drawings]

[0012] FIG. 1 is a cross-sectional view of a valve device according to an embodiment of the present disclosure.

FIG. 2 is an enlarged cross-sectional view showing a principal portion of the valve device 1 shown in FIG. 1.

FIG. 3 is a perspective view of an orifice plate.

FIG. 4(a) is a perspective view of an inner member, and FIG. 4(b) is a cross-sectional view of the inner member.

FIG. 5(a) is a perspective view of a fixing ring, and FIG. 5(b) is a cross-sectional view of the fixing ring.

FIG. 6 is a plan view of a thrust ring.

FIG. 7 is an explanatory view of a process of inserting thrust rings into a ring recess of the fixing ring.

FIG. 8 is an explanatory view of a process of fixing the fixing ring to a body.

FIG. 9 is a cross-sectional view of a fixing ring according to a modified example.

[Description of Embodiments]

[0013] A valve device and a method for assembling a valve device according to an embodiment of the present disclosure will now be described with reference to the drawings.

[0014] FIG. 1 is a cross-sectional view of the valve device 1 according to the present embodiment in a closed state, and FIG. 2 is an enlarged cross-sectional view showing a principal portion of the valve device 1 shown in FIG. 1. The valve device 1 according to the present embodiment is a diaphragm valve device having a built-in orifice.

[0015] The valve device 1 is, for example, a diaphragm valve device, and includes a body portion 2 and an actuator 3. In the following description, the actuator 3 side of the valve device 1 will be referred to as the upper side, and the body portion 2 side thereof will be referred to as the lower side.

[0016] The body portion 2 includes a body 10, a gasket 15, an orifice plate 20, an inner member 30, a valve seat 40, a fixing ring 50, thrust rings 60, a diaphragm 70, and a retainer adapter 80.

[0017] The body 10 is formed in a block shape from a metallic material such as

stainless steel. A first inflow passage 11 and a first outflow passage 12 are formed in the body 10, and the body 10 includes a housing recess 13 having a circular cross-sectional opening and opening at an upper surface of the body 10. The first inflow passage 11 and the first outflow passage 12 correspond to a first flow passage. In the present embodiment, the gasket 15, the orifice plate 20, the inner member 30, the valve seat 40, the fixing ring 50, the thrust rings 60, the diaphragm 70, and the retainer adapter 80 constitute valve elements.

[0018] At a center portion of the bottom surface of the housing recess 13, the first outflow passage 12 opens. Around the first outflow passage 12, an annular plate support surface 13a, a cylindrical portion 13b, an annular recess 13c, and a contact surface 13d are concentrically formed in this order. The plate support surface 13a is planar. The cylindrical portion 13b is provided so as to protrude upward. The first inflow passage 11 opens at a bottom surface 13f of the annular recess 13c, and an annular first protrusion 13g is provided thereon. The first protrusion 13g is positioned outward of the opening. The contact surface 13d is planar and serves as a surface against which an abutment surface 30c of the inner member 30, described later, comes into contact. A female threaded portion 13h is formed on an inner peripheral surface of an upper portion of the housing recess 13. The surfaces constituting the plate support surface 13a, the cylindrical portion 13b, the annular recess 13c, and the contact surface 13d correspond to the bottom surface of the housing recess 13.

[0019] The gasket 15 is an annular member formed of a soft material, and in the present embodiment is formed of a metal such as annealed stainless steel. In other words, the gasket 15 is formed of a metal softer than the body 10 and the inner member 30. The gasket 15 is disposed in the annular recess 13c and has a through-hole 15a communicating with the first inflow passage 11. Since the gasket 15 is formed of a soft material, when the valve elements are fixed to the body 10, the first protrusion 13g bites into a lower surface 15b of the gasket 15 to seal a connection portion between the first inflow passage 11 and the through-hole 15a.

[0020] FIG. 3 is a perspective view of the orifice plate 20. As shown in FIGS. 2 and 3, the orifice plate 20 is disposed on the body 10 and has an orifice 20a communicating with the first outflow passage 12. The orifice plate 20 is a thin metal disk made of stainless steel or the like, and the orifice 20a is formed at a center portion thereof. The

orifice plate 20 is disposed on the plate support surface 13a of the housing recess 13 and is clamped and fixed between the plate support surface 13a and the pressing surface 30a of the inner member 30. The orifice plate 20 is configured to restrict an opening of the second outflow passage 32 of the inner member 30. Although only one orifice 20a is formed in the orifice plate 20, a plurality of orifices may alternatively be formed.

[0021] FIGS. 4(a) and 4(b) are a perspective view and a cross-sectional view, respectively, of the inner member 30. As shown in FIGS. 2 and 4, the inner member 30 is disposed within the housing recess 13 and positioned on the gasket 15 and the orifice plate 20. The inner member 30 is provided with four second inflow passages 31 and one second outflow passage 32. Each second inflow passage 31 communicates with the first inflow passage 11 via the through-hole 15a. The second outflow passage 32 communicates with the first outflow passage 12 via the orifice 20a. The second inflow passages 31 and the second outflow passage 32 correspond to a second flow passage. The inner member 30 is formed of a metal such as stainless steel having the same hardness as the body 10, and has a substantially stepped cylindrical shape including a large-diameter portion 33 and a small-diameter portion 34 positioned inward of the large-diameter portion 33 and having an upper end protruding upward. An outer peripheral surface of the large-diameter portion 33 fits with an inner peripheral surface of a lower portion of the housing recess 13 of the body 10, thereby positioning the inner member 30 itself relative to the body 10.

[0022] The second outflow passage 32 extends through a central portion of the inner member 30. At a center portion of a lower surface of the inner member 30, the second outflow passage 32 opens. Around the second outflow passage 32, an annular pressing surface 30a, an annular recess 30b, and an abutment surface 30c are concentrically formed in this order. The pressing surface 30a is planar, and an annular pressing protrusion 30d is provided on an outer peripheral side thereof. The four second inflow passages 31 open at a bottom surface 30e of the annular recess 30b, and annular second protrusion 30f is provided so as to surround the openings. The second protrusion 30f opposes the first protrusion 13g in the vertical direction over the entire circumference thereof. Due to the annular recess 30b, a central portion of a bottom portion of the inner member 30 defines a protruding portion 30g that protrudes downward. The pressing surface 30a and the pressing protrusion 30d are formed on the protruding portion 30g.

When the valve elements are fixed to the body 10, the protruding portion 30g is inserted into the cylindrical portion 13b. The surfaces constituting the pressing surface 30a, the annular recess 30b, and the abutment surface 30c correspond to the lower surface of the inner member 30.

[0023] The abutment surface 30c is planar and comes into contact with the contact surface 13d of the body 10 when the valve elements are fixed to the body 10. The pressing protrusion 30d is configured to press an upper surface 20b of the orifice plate 20 to seal a connection portion between the second outflow passage 32 and the first outflow passage 12. The second protrusion 30f is configured to bite into an upper surface 15c of the gasket 15 to seal connection portions between the second inflow passages 31 and the through-hole 15a. Before pressing the orifice plate 20, the pressing protrusion 30d has an arcuate outer edge in cross section. The pressing protrusion 30d deforms when pressing the orifice plate 20 and bending an outer peripheral edge portion 20c thereof.

[0024] On an upper surface side of the inner member 30, the second outflow passage 32 opens at a center portion thereof. Around the second outflow passage 32, an annular seat placement groove 30h, an annular outflow groove 30i, a diaphragm support portion 30j, and an annular upper end surface 30k are concentrically formed in this order. The four second inflow passages 31 are formed at equal intervals in a circumferential direction. Each second inflow passage 31 opens at a lower end thereof into the annular recess 30b and opens at an upper end thereof into the annular outflow groove 30i. The number of the second inflow passages 31 may be one or more. Each second inflow passage 31 is inclined inward as it extends upward. The lower end of each second inflow passage 31 communicates with the first inflow passage 11 of the body 10 through the through-hole 15a of the gasket 15.

[0025] The valve seat 40 is an annular member provided around the opening of the second outflow passage 32 on the upper surface of the inner member 30. The valve seat 40 is made of, for example, a fluororesin (PTFE). The valve seat 40 is fitted into the seat placement groove 30h of the inner member 30.

[0026] FIGS. 5(a) and 5(b) are a perspective view and a cross-sectional view, respectively, of the fixing ring 50. As shown in FIGS. 2 and 5, the fixing ring 50 is formed of a metal such as stainless steel and has a substantially annular shape. A male

threaded portion 50a is formed on an outer peripheral surface of the fixing ring 50, and a double-hex structure configured to engage with a rotary tool is formed on an inner peripheral surface 50b thereof. A ring recess 50d recessed upward is formed in a lower surface 50c of the fixing ring 50. Two thrust rings 60 are accommodated in the ring recess 50d (see FIG. 7).

[0027] The ring recess 50d has an annular recess upper surface 50e extending in a direction perpendicular to an axial direction of the fixing ring 50, and a recess inner peripheral surface 50f extending along a circumferential direction of the fixing ring 50 and extending parallel to the axial direction of the fixing ring 50. The recess upper surface 50e comes into contact with an upper surface 60a of the upper thrust ring 60 (see FIG. 2). The recess inner peripheral surface 50f covers outer peripheral surfaces of the thrust rings 60 (see FIGS. 2 and 8). A ring protrusion 50g projecting inward is provided on the recess inner peripheral surface 50f. The ring protrusion 50g includes, from a lower side thereof, an inclined surface 50g1 extending obliquely upward toward a center of the fixing ring 50, an upper-and-lower surface 50g2 extending in a vertical direction, and a flat surface 50g3 extending in a direction perpendicular to the vertical direction.

[0028] FIG. 6 is a plan view of the thrust ring 60. Each thrust ring 60 is a member formed by coating a substantially washer-shaped stainless-steel plate with a sliding material. The thrust rings 60 reduce friction generated during rotational tightening by the fixing ring 50 when fixing the valve elements to the body 10, thereby preventing co-rotation of the inner member 30. The thrust rings 60 are not limited to members formed by coating stainless-steel plates with a sliding material, and may be any members capable of reducing friction during rotation of the fixing ring 50. For example, the thrust rings 60 may be formed of a synthetic resin material having excellent sliding properties, or may alternatively be thrust bearings. As shown in FIG. 2, the two thrust rings 60 are disposed on the annular upper end surface 30k of the inner member 30 in a state of being inserted into the ring recess 50d of the fixing ring 50.

[0029] FIG. 7 is an explanatory view of a process of inserting the two thrust rings 60 into the ring recess 50d of the fixing ring 50. As shown in FIG. 7(a), with the fixing ring 50 turned upside down, the two thrust rings 60 are inserted into the ring recess 50d so as to be fitted therein. The outer diameter of each thrust ring 60 is larger than an

inner diameter of the portion of the recess inner peripheral surface 50f at which the ring protrusion 50g is formed. However, due to elastic deformation of the thrust ring 60, the thrust ring 60 is inserted between the flat surface 50g3 of the ring protrusion 50g and the recess upper surface 50e. The thrust ring 60 can be easily inserted into the ring recess 50d by being guided along the inclined surface 50g1 of the ring protrusion 50g. As shown in FIG. 7(b), the two thrust rings 60 are disposed on the recess upper surface 50e. In this state, in the axial direction of the fixing ring 50, a length L from a lower surface 60b of the lower thrust ring 60 to the lower surface 50c of the fixing ring 50 is configured to fall within a predetermined length range.

[0030] As shown in FIG. 2, the diaphragm 70 is disposed on the inner member 30 and is configured to communicate or block communication between the second inflow passages 31 and the second outflow passage 32 by separating from or coming into contact with the valve seat 40. The diaphragm 70 is formed by laminating a thin metal plate made of a special stainless steel or the like and a thin nickel-cobalt alloy plate, and bulging a central portion thereof upward. The diaphragm 70 is supported by the diaphragm support portion 30j of the inner member 30 and is fixed by being pressed by a lower portion 4a of a bonnet 4 of the actuator 3 via a ring-shaped retainer adapter 80. The diaphragm 70 defines a part of a flow path and is elastically deformed by being pressed by a diaphragm presser 6. When the diaphragm 70 comes into contact with the valve seat 40, the flow path is closed, and when the diaphragm 70 separates from the valve seat 40, the flow path is opened.

[0031] As shown in FIG. 1, the actuator 3 includes the bonnet 4, an actuator cap 5, the diaphragm presser 6, a stem 7, a piston 8, and a compression coil spring 9.

[0032] The bonnet 4 has a substantially cylindrical shape and includes a lower portion 4a, an intermediate portion 4b, and an upper portion 4c. The lower portion 4a is inserted into the body 10, and the bonnet 4 is fixed to the body 10 by threaded engagement between an outer peripheral portion of an upper end portion of the lower portion 4a and the body 10. The lower portion 4a passes through the inner peripheral surface 50b of the fixing ring 50, and a lower end surface thereof presses the retainer adapter 80. The intermediate portion 4b is positioned above the lower portion 4a and has a hexagonal prism outer shape. The upper portion 4c is provided so as to extend upward from an outer edge portion of the intermediate portion 4b.

[0033] The actuator cap 5 has a substantially capped cylindrical shape and includes an outer cylindrical portion 5a, an upper cover portion 5b, and an inner cylindrical portion 5c. The actuator cap 5 is fixed to the bonnet 4 by threaded engagement between a lower end portion of the outer cylindrical portion 5a and the upper portion 4c of the bonnet 4. The upper cover portion 5b is provided so as to cover an upper end of the outer cylindrical portion 5a. The inner cylindrical portion 5c is connected to an inner end portion of the upper cover portion 5b. The bonnet 4 and the actuator cap 5 define an accommodation space 5d for accommodating the piston 8 and the compression coil spring 9.

[0034] The diaphragm presser 6 is provided above the diaphragm 70 and is supported by the lower portion 4a of the bonnet 4 to be movable in a vertical direction. The stem 7 is supported by the intermediate portion 4b of the bonnet 4 to be movable in the vertical direction, and is configured to open and close the flow path by moving toward and away from the diaphragm 70.

[0035] The piston 8 is integrally formed with the stem 7, is provided above the stem 7, and is supported by the bonnet 4 and the actuator cap 5 to be movable in the vertical direction. The piston 8 includes a base portion 8a and an upper protruding portion 8b. The base portion 8a has a substantially disk shape, and the stem 7 is integrally provided on a lower surface thereof. The upper protruding portion 8b has a substantially cylindrical shape and extends upward from an upper surface of the base portion 8a. A pressure chamber 8c is defined between the lower surface of the base portion 8a of the piston 8 and an upper surface of the intermediate portion 4b of the bonnet 4. A drive fluid introduction passage 8d extending from an upper end of the piston 8 to the pressure chamber 8c is formed in the piston 8. The compression coil spring 9 is disposed between a lower surface of the upper cover portion 5b of the actuator cap 5 and the upper surface of the base portion 8a of the piston 8, and constantly biases the piston 8 downward.

[0036] When a drive fluid is supplied to the valve device 1, the drive fluid passes through the drive fluid introduction passage 8d and flows into the pressure chamber 8c. When the drive fluid flows into the pressure chamber 8c, the piston 8 rises against the biasing force of the compression coil spring 9. As a result, the piston 8 provided at the tip of the stem 7 moves to a top dead center position, and the diaphragm presser 6

moves upward due to the elastic force of the diaphragm 70 and the pressure of the fluid (gas), whereby the second inflow passages 31 and the second outflow passage 32 communicate with each other, and the valve device 1 is brought into an open state.

[0037] Next, a method for assembling the valve device 1 will be described with reference to FIGS. 1, 2, 7, and 8. FIG. 8 is an explanatory view showing a process of fixing the fixing ring 50 to the body 10.

[0038] In assembling the valve device 1, the valve elements and the actuator 3 are sequentially assembled to the body 10. First, the orifice plate 20 is disposed on the plate support surface 13a of the housing recess 13 of the body 10. The gasket 15 is disposed in the annular recess 13c of the housing recess 13. The valve seat 40 is fitted into the seat placement groove 30h of the inner member 30. The inner member 30 is placed in the housing recess 13 of the body 10. At this time, the protruding portion 30g of the inner member 30 is inserted into the cylindrical portion 13b. As shown in FIG. 7, the two thrust rings 60 are inserted between the flat surface 50g3 of the ring protrusion 50g and the recess upper surface 50e of the ring recess 50d. In the axial direction of the fixing ring 50, a length L from the lower surface 60b of the lower thrust ring 60 (the upper thrust ring 60 in FIG. 7) (i.e., the lowermost surface of the two thrust rings 60) to the lower surface 50c of the fixing ring 50 is measured, and it is determined whether the measured length L falls within a predetermined length range. If the measured length L does not fall within the predetermined length range, it indicates that one of the thrust rings 60 has been omitted or that the number of the thrust rings 60 is incorrect. Accordingly, the thrust rings 60 are checked, and insertion of the omitted thrust ring 60 or the like is performed such that the length L falls within the predetermined length range. The predetermined length range is appropriately set based on a depth of the ring recess 50d (a distance between the lower surface 50c and the recess upper surface 50e), a thickness of the thrust rings 60, and the number of the thrust rings 60 to be inserted.

[0039] When the measured length L falls within the predetermined length range, as shown in FIG. 8, the fixing ring 50 and the thrust rings 60 are turned upside down from the state shown in FIG. 7(b) such that the lower surface 50c of the fixing ring 50 faces downward. Since the outer peripheral edge portions 60c of the thrust rings 60 are positioned above the ring protrusion 50g in the axial direction of the fixing ring 50, the outer peripheral edge portions 60c rest on the flat surface 50g3 of the ring protrusion

50g, thereby preventing the thrust rings 60 from falling out from the ring recess 50d of the fixing ring 50. Then, the male threaded portion 50a of the fixing ring 50 is threadedly engaged with the female threaded portion 13h of the housing recess 13 such that the fixing ring 50 covers the inner member 30 from above, thereby pressing the inner member 30 toward the bottom surface via the thrust rings 60. The fixing ring 50 is tightened until the abutment surface 30c of the inner member 30 comes into contact with the contact surface 13d of the body 10, whereby the gasket 15, the orifice plate 20, and the inner member 30 are fixed to the body 10.

[0040] The diaphragm 70 is disposed on the diaphragm support portion 30j of the inner member 30, the retainer adapter 80 is disposed on the diaphragm 70, and the bonnet 4 of the actuator 3 is screwed into the female threaded portion 13h of the housing recess 13. In this manner, the valve device 1 according to the present embodiment is assembled.

[0041] As described above, in the valve device 1 according to the present embodiment, the two thrust rings 60 can be inserted between the flat surface 50g3 of the ring protrusion 50g of the ring recess 50d and the recess upper surface 50e, and the outer peripheral edge portions 60c of the thrust rings 60 are configured to be positioned above the ring protrusion 50g in the axial direction of the fixing ring 50. Accordingly, during assembly of the valve device 1, the fixing ring 50 can be pressed against the inner member 30 while the thrust rings 60 are mounted at predetermined positions of the fixing ring 50, thereby suppressing positional displacement of the thrust rings 60 and facilitating assembly of the valve device 1.

[0042] In the axial direction of the fixing ring 50, the length L from the lower surface 60b of the lower thrust ring 60 to the lower surface 50c of the fixing ring 50 is configured to fall within the predetermined length range. Accordingly, by determining whether the length L falls within the predetermined length range, omission of one of the thrust rings 60 and an incorrect number of the thrust rings 60 can be prevented.

[0043] The present disclosure is not limited to the embodiments described above. A person skilled in the art may make various additions, modifications, and the like within the scope of the present disclosure.

[0044] For example, the valve device to which the present disclosure is applicable is not limited to the valve device 1 described above, and the present disclosure is

applicable to any valve device including the body 10, the inner member 30, the fixing ring 50, and the thrust rings 60 similar to those of the valve device 1. Although two thrust rings 60 are provided in the above-described embodiment, one or more thrust rings 60 may be provided. Although the ring protrusion 50g is provided over an entirety of the recess inner peripheral surface 50f, the ring protrusion 50g may be provided on only a part of the recess inner peripheral surface 50f as long as the thrust rings 60 can be prevented from falling out. Although the gasket 15 is formed of a metal such as annealed stainless steel, when heat resistance is not highly required, the gasket 15 may be formed of a resin material such as a fluororesin (PCTFE).

[0045] In the above-described embodiment, the ring protrusion 50g of the fixing ring 50 is integrally formed on the recess inner peripheral surface 50f. However, the ring protrusion may alternatively be provided separately from the recess inner peripheral surface 50f. As shown in FIG. 9, an annular groove 50h extending in a circumferential direction is formed in the recess inner peripheral surface 50f of the fixing ring 50, and an O-ring 51 is fitted into the groove 50h. A part of the O-ring 51 is provided so as to protrude inward from the recess inner peripheral surface 50f. The O-ring 51 corresponds to the ring protrusion. The thrust rings 60 are inserted between the O-ring 51 and the recess upper surface 50e by elastically deforming the O-ring 51. Even with this configuration, positional displacement of the thrust rings 60 can be suppressed, thereby facilitating assembly of the valve device 1. Furthermore, since the thrust rings 60 can be inserted by elastically deforming the O-ring 51, the thrust rings 60 can be installed in the fixing ring 50 even when the thrust rings 60 themselves are not elastically deformable. Instead of the O-ring, an elastic ring such as a snap ring may be used. Alternatively, instead of the O-ring, an annular member having an external thread formed on an outer side thereof may be used, and an internal thread may be formed on the recess inner peripheral surface 50f of the fixing ring 50 such that the annular member is threadedly engaged with the recess inner peripheral surface 50f of the fixing ring 50, thereby providing a configuration corresponding to the ring protrusion.

[Reference Signs List]

[0046]

1: valve device

10: body

11: first inflow passage
12: first outflow passage
13: housing recess
13a: plate support surface, 13b: cylindrical portion, 13c: annular recess
13d: contact surface, 13h: female threaded portion
30: inner member
30k: annular upper end surface, 31: second inflow passage, 32: second outflow passage
50: fixing ring
50a: male threaded portion, 50c: lower surface, 50d: ring recess
50e: recess upper surface, 50f: recess inner peripheral surface
50g: ring protrusion
51: O-ring
60: thrust ring
60a: upper surface, 60b: lower surface, 60c: outer peripheral edge portion
L: length

[CLAIMS]

[Claim 1]

A valve device comprising:

a body in which a first flow passage is formed, the body having a housing recess that opens at an upper surface thereof and in which the first flow passage opens at a bottom surface thereof;

an inner member disposed within the housing recess and having a second flow passage communicating with the first flow passage;

a fixing ring positioned above the inner member and threadedly engaged with a threaded portion formed on an inner peripheral surface of the housing recess to press the inner member toward the bottom surface; and

a thrust ring interposed between the inner member and the fixing ring and configured to suppress co-rotation of the inner member caused by rotation of the fixing ring,

wherein:

the second flow passage opens at an upper surface of the inner member, and an annular upper end surface is formed around the second flow passage;

the thrust ring is disposed on the annular upper end surface;

the fixing ring has an annular shape, and a ring recess that is recessed upward and in which the thrust ring is inserted is formed in a lower surface thereof;

the ring recess has:

an annular recess upper surface extending in a direction perpendicular to an axial direction of the fixing ring and contacting an upper surface of the thrust ring; and

a recess inner peripheral surface extending along a circumferential direction of the fixing ring and covering an outer peripheral surface of the thrust ring;

a ring protrusion is provided on the recess inner peripheral surface; and

an outer peripheral edge portion of the thrust ring is positioned above the ring protrusion in the axial direction.

[Claim 2]

The valve device according to claim 1,

wherein, in the axial direction, a length from a lowermost surface of the thrust

ring to the lower surface of the fixing ring falls within a predetermined length range.

[Claim 3]

A method for assembling a valve device, the valve device including:

a body in which a first flow passage is formed, the body having a housing recess that opens at an upper surface thereof and in which the first flow passage opens at a bottom surface thereof;

an inner member disposed within the housing recess and having a second flow passage communicating with the first flow passage;

a fixing ring positioned above the inner member and threadedly engaged with a threaded portion formed on an inner peripheral surface of the housing recess so as to press the inner member toward the bottom surface; and

a thrust ring interposed between the inner member and the fixing ring and configured to suppress co-rotation of the inner member caused by rotation of the fixing ring,

wherein:

the second flow passage opens at an upper surface of the inner member, and an annular upper end surface is formed around the second flow passage;

the thrust ring is disposed on the annular upper end surface;

the fixing ring has an annular shape, and a ring recess that is recessed upward and in which the thrust ring is inserted is formed in a lower surface thereof;

the ring recess has:

an annular recess upper surface extending in a direction perpendicular to an axial direction of the fixing ring and contacting an upper surface of the thrust ring; and

a recess inner peripheral surface extending along a circumferential direction of the fixing ring and covering an outer peripheral surface of the thrust ring;

a ring protrusion is provided on the recess inner peripheral surface; and

an outer peripheral edge portion of the thrust ring is positioned above the ring protrusion in the axial direction,

the method comprising:

disposing the inner member within the housing recess of the body;

inserting the thrust ring between the ring protrusion and the recess upper

surface of the ring recess of the fixing ring; and

with the lower surface of the fixing ring facing downward, threadedly engaging the fixing ring with the threaded portion formed on the inner peripheral surface of the housing recess to cover the inner member from above, thereby pressing the inner member toward the bottom surface via the thrust ring and fixing the inner member to the body.

[Claim 4]

The method for assembling a valve device according to claim 3, the method further comprising:

measuring whether a length from a lowermost surface of the thrust ring to the lower surface of the fixing ring falls within a predetermined length range in a state in which the thrust ring is disposed to contact the recess upper surface of the ring recess.