US 20250262385A1

(19) **United States**

(12) **Patent Application Publication** (10) **Pub. No.: US 2025/0262385 A1**

GOTO et al. (43) **Pub. Date: Aug. 21, 2025**

(54) **GASKET RETAINER, GASKET RETAINER SET, AND GASKET CONTAINER**

(71) Applicant: **TERUMO KABUSHIKI KAISHA**, Tokyo (JP)

(72) Inventors: **Kazunori GOTO**, Fujinomiya-shi (JP); **Yusuke SAKAGUCHI**, Fujinomiya-shi (JP); **Masahiko SHINJO**, Fujinomiya-shi (JP); **Yusuke KAKU**, Fujinomiya-shi (JP)

(73) Assignee: **TERUMO KABUSHIKI KAISHA**, Tokyo (JP)

(21) Appl. No.: **19/202,249**

(22) Filed: **May 8, 2025**

Related U.S. Application Data

(63) Continuation of application No. PCT/JP2023/022587, filed on Jun. 19, 2023.

(30) **Foreign Application Priority Data**

Nov. 14, 2022 (JP) 2022-181790

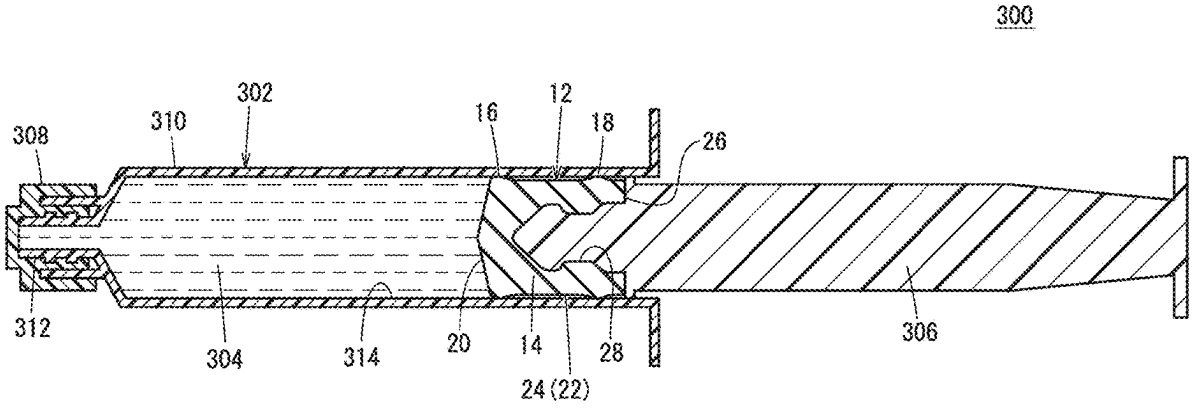
Publication Classification

(51) **Int. Cl.**
A61M 5/315 (2006.01)
A61M 5/00 (2006.01)

(52) **U.S. Cl.**
CPC ***A61M 5/31513*** (2013.01); ***A61M 5/001*** (2013.01)

(57) **ABSTRACT**

A gasket holding tool for holding a gasket to be inserted into an outer tube of a syringe, the gasket including: a gasket body; and an annular distal-end-side protruding portion that protrudes radially outward from a portion of an outer peripheral surface of the gasket body distal of a center in an axial direction of the gasket body and is in liquid-tight or gas-tight contact with an inner peripheral surface of the outer tube, the gasket holding tool including: a base plate; and a holding structure located on the base plate and configured to hold the gasket, wherein the holding structure includes: a cylindrical portion that protrudes from the base plate in a thickness direction of the base plate and into which the gasket is insertable, and a bulging portion that bulges radially inward from an inner peripheral surface of the cylindrical portion.



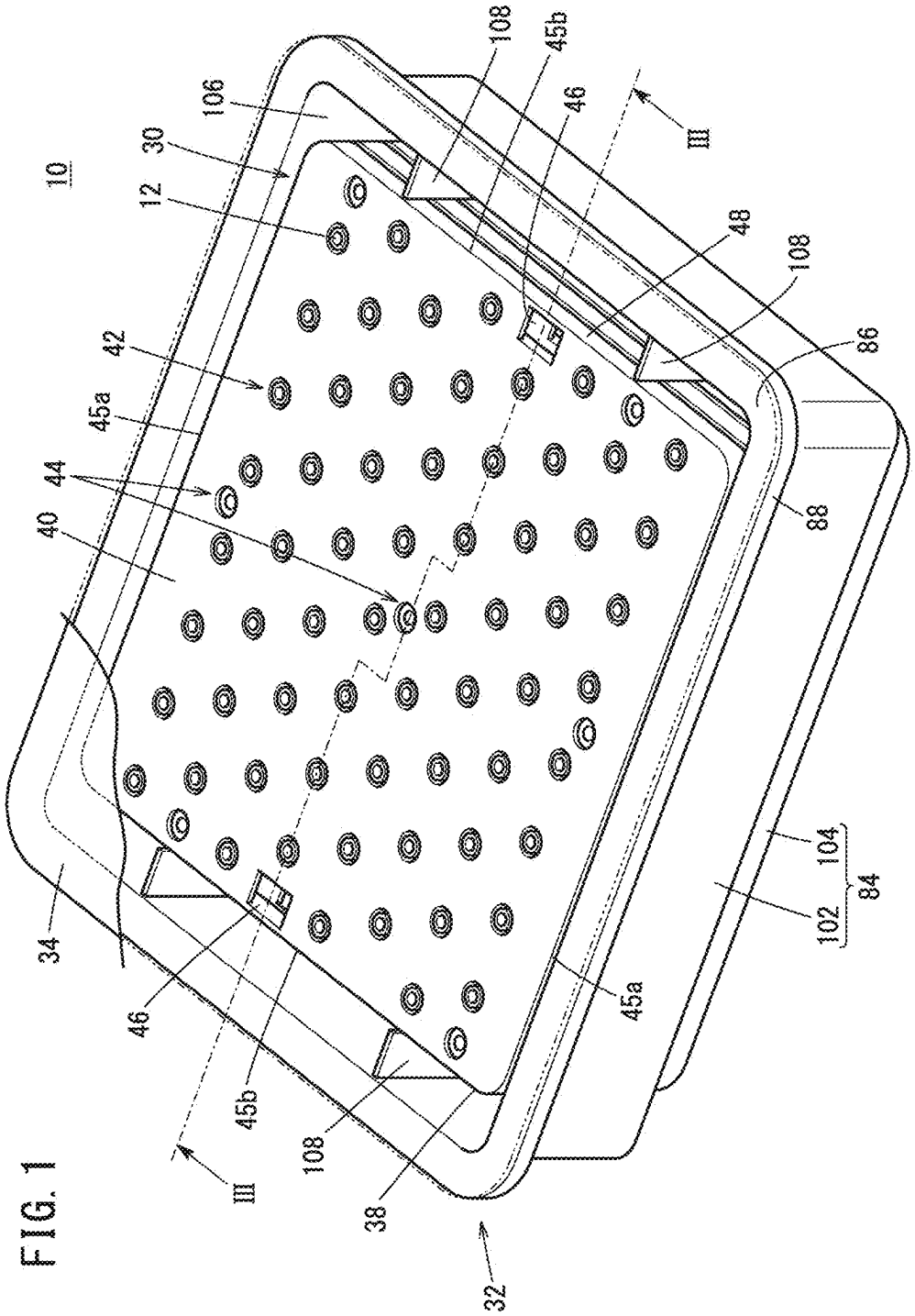
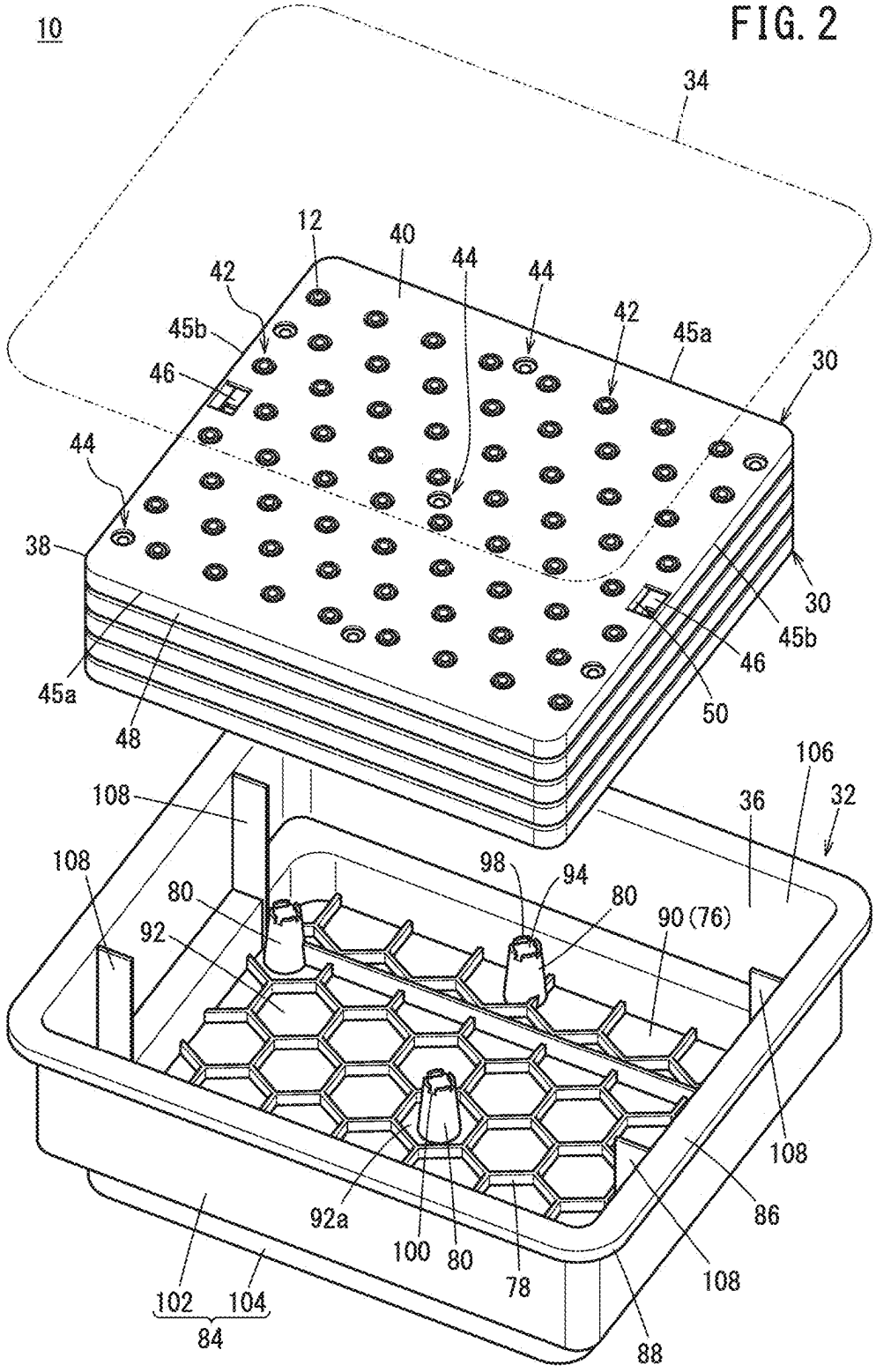

10
12
30
106
108
45b
46
III
48
108
86
42
45a
44
40
88
104
84
102
34
46
45a
45b
108
III
38
32

FIG. 1

FIG. 2


10
34
12
40
44
44
42
42
45b
45a
46
30
44
38
30
45b
46
45a
50
48
106
108
36
32
108
98
94
80
80
90 (76)
92
108
92a
100
80
78
108
86
108
102
104
84
88

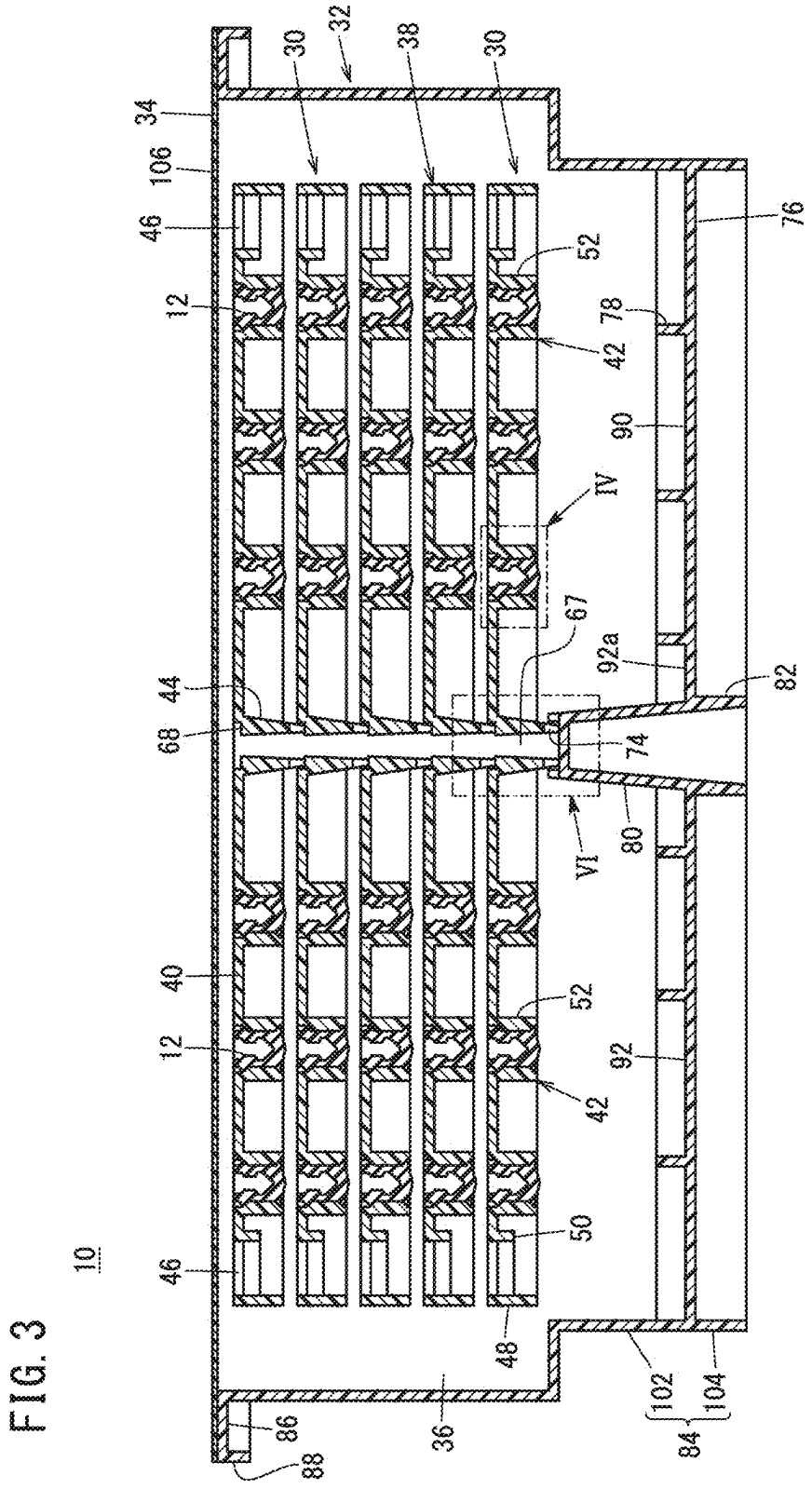

10
30
32
38
30
34
106
46
52
76
12
78
42
90
IV
67
92a
82
44
68
74
80
VI
40
52
12
92
42
50
46
48
102
104
84
36
86
88

FIG. 3

FIG. 4

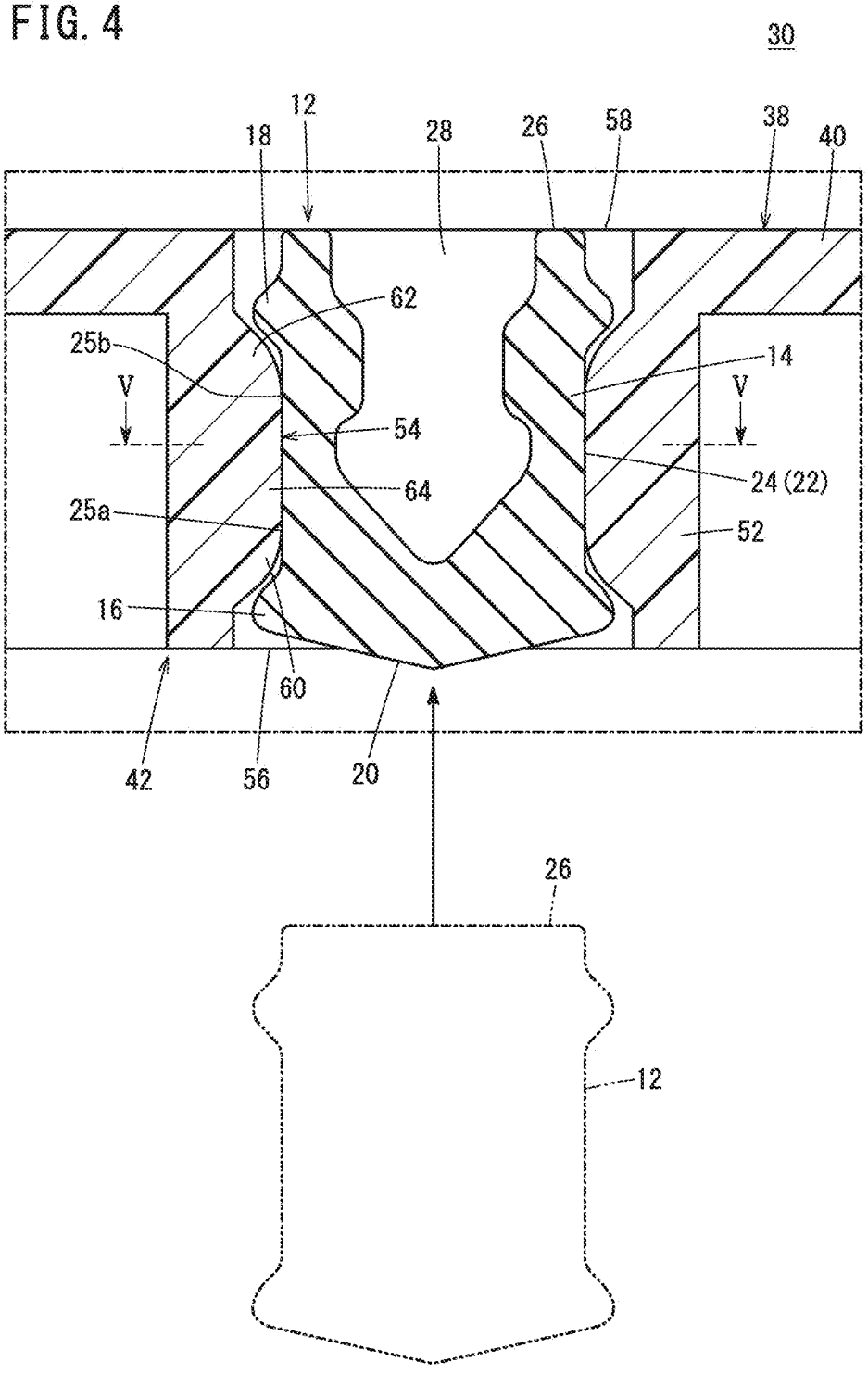

30
12
18
28
26
58
38
40
62
25b
V
14
V
54
24 (22)
64
25a
52
16
60
42
56
20
26
12

FIG. 5

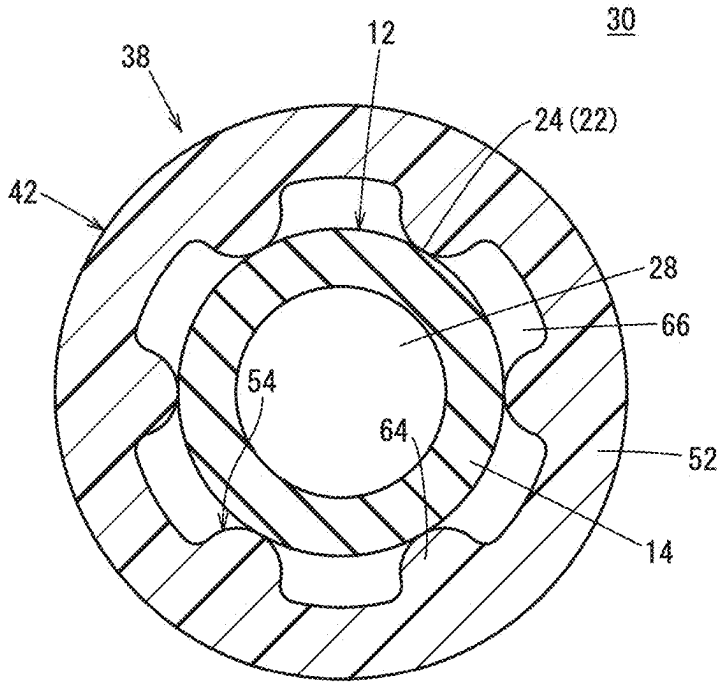
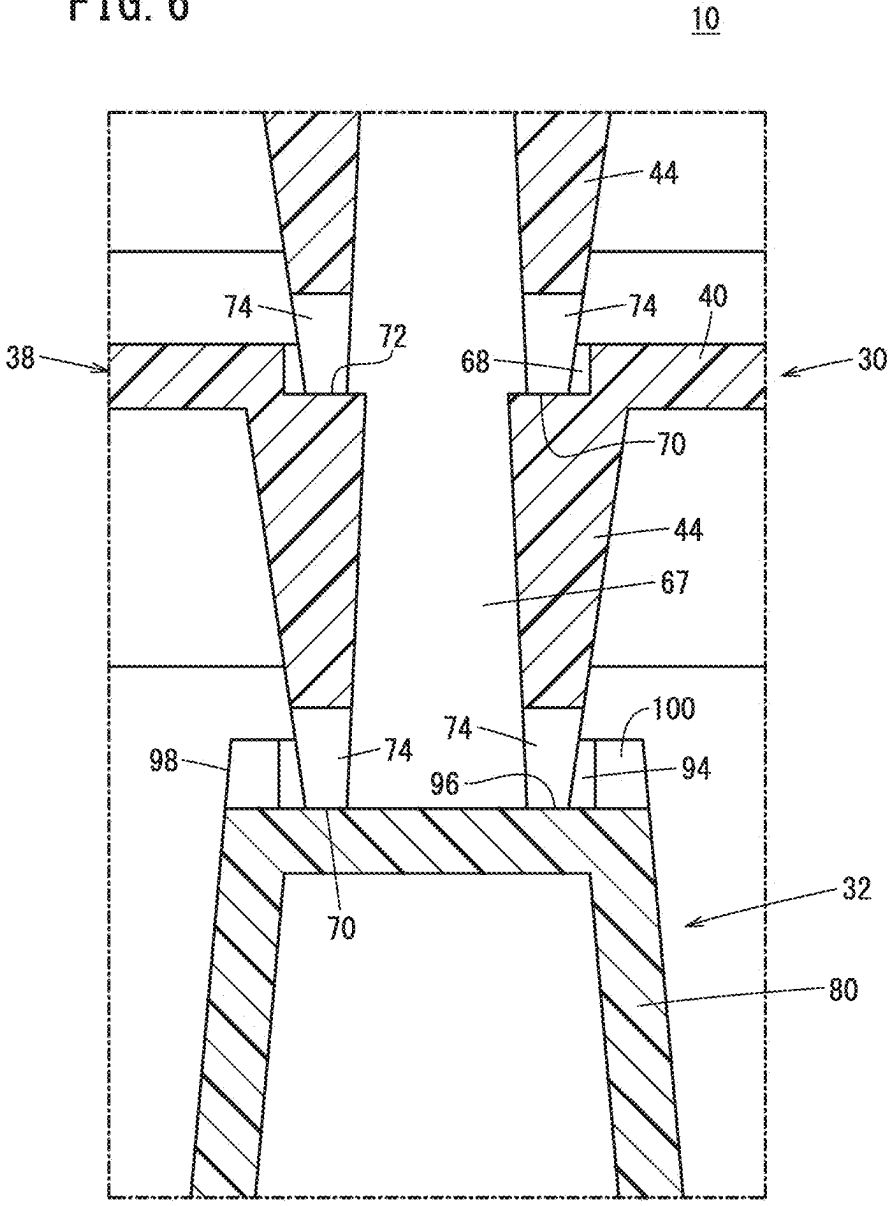


FIG. 6



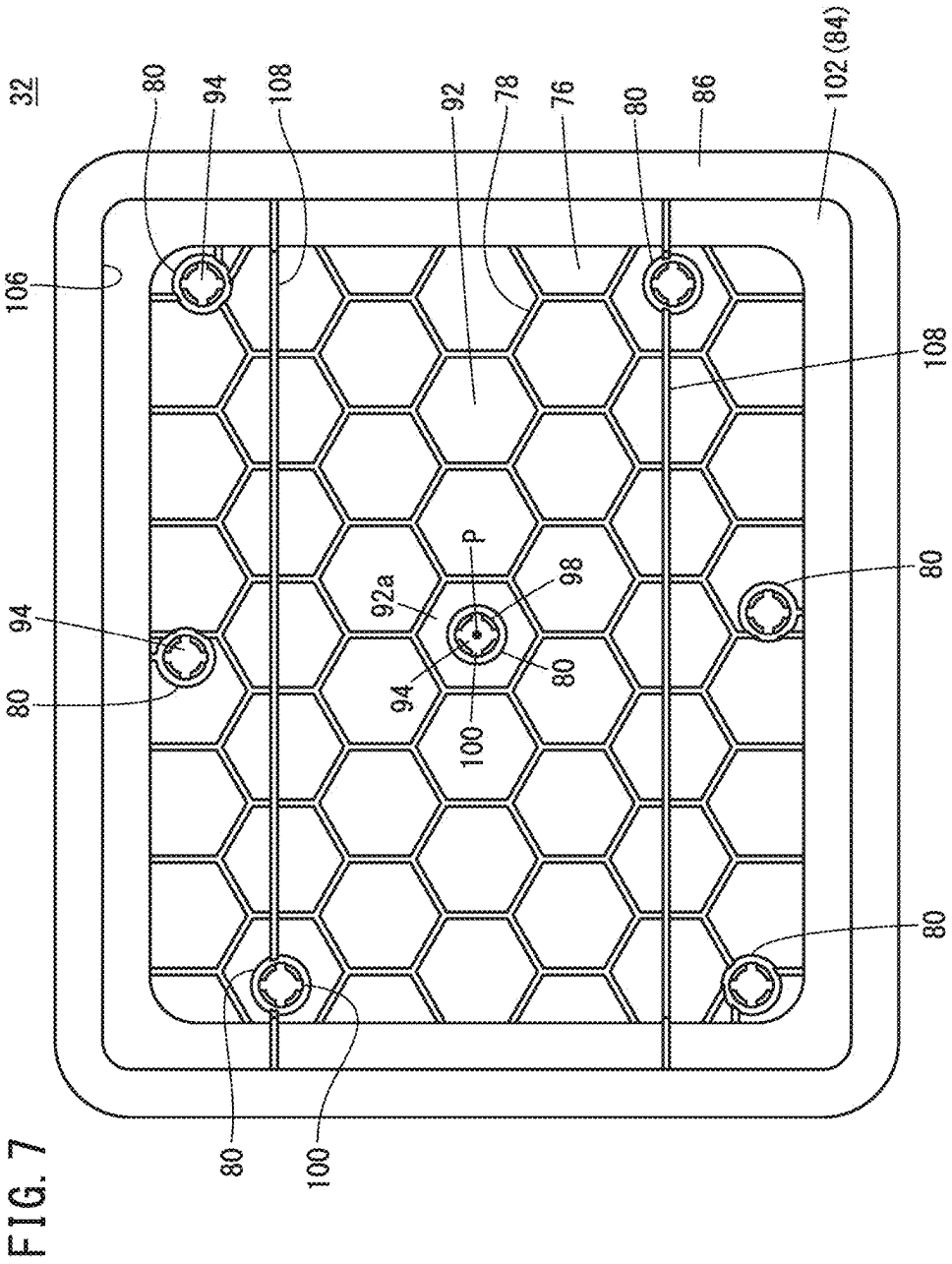

32
80
94
108
92
78
76
80
86
102 (84)
106
108
80
94
80
92a
P
98
94
80
100
80
80
100

FIG. 7

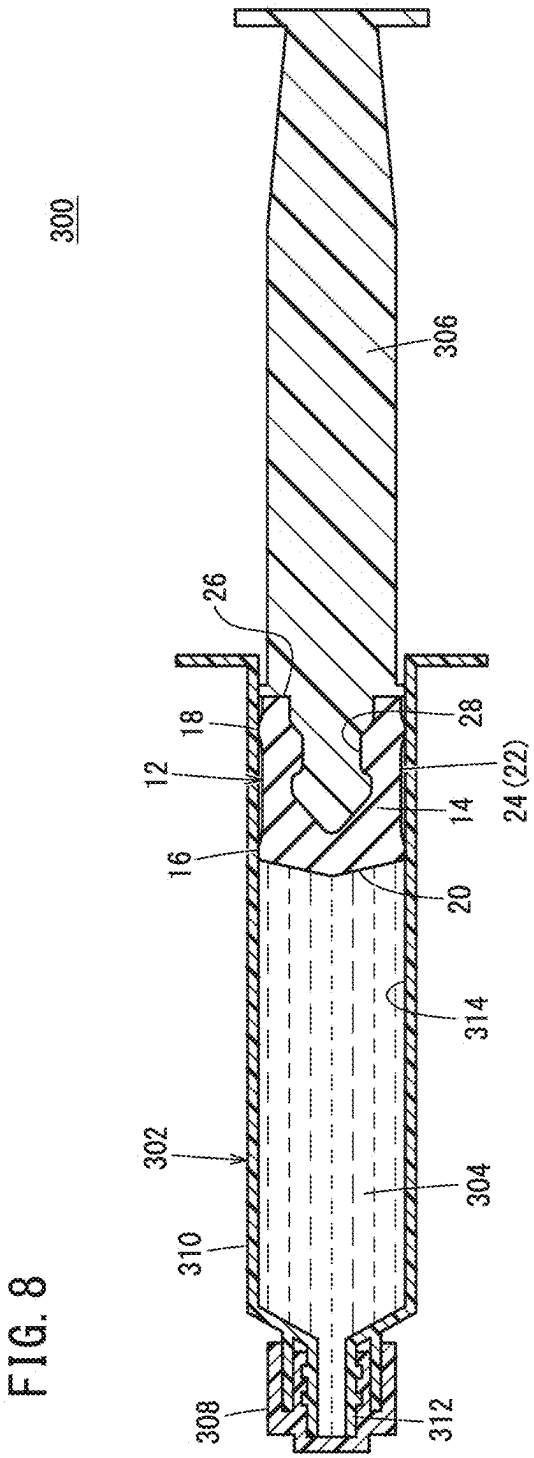
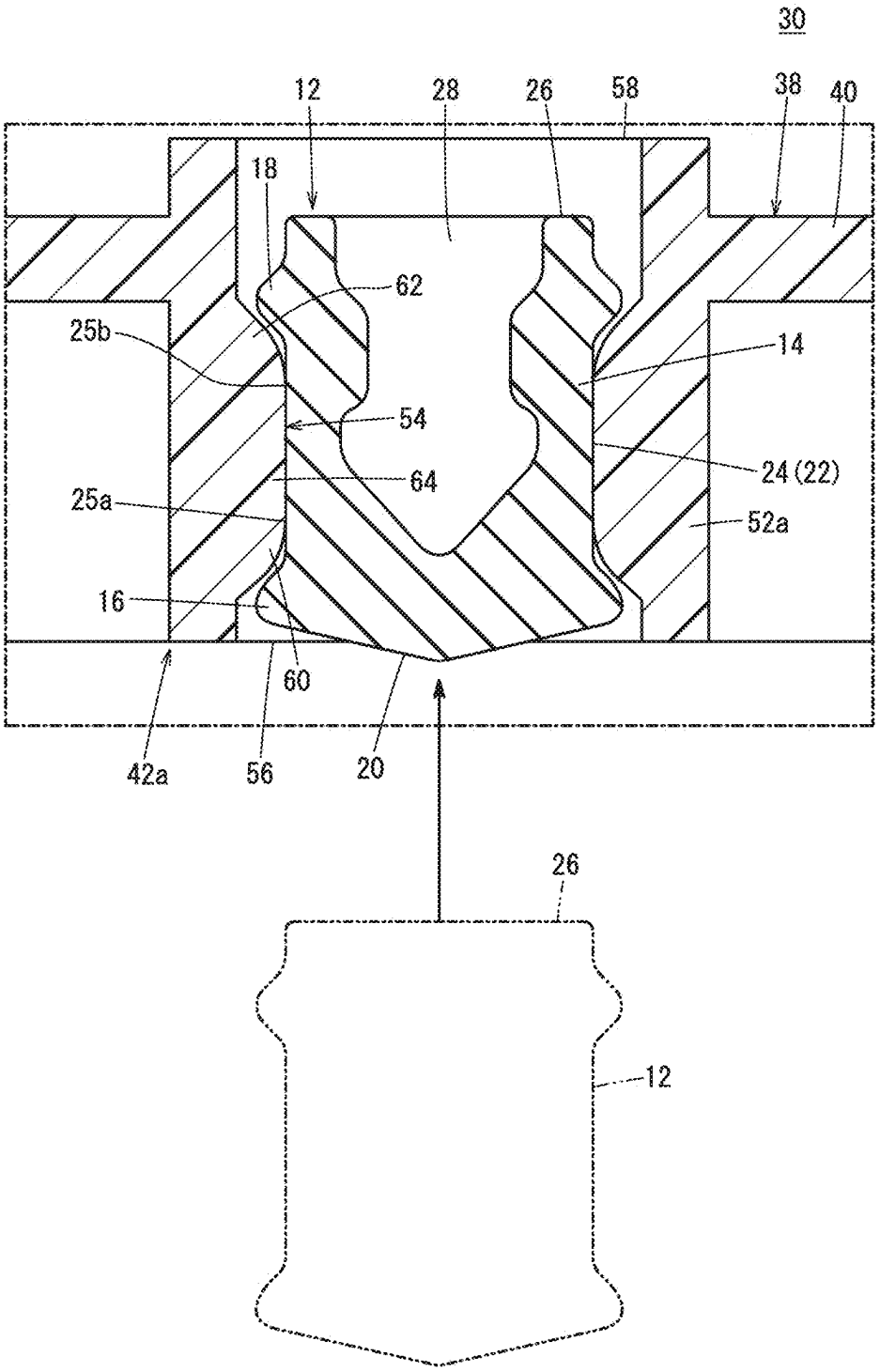


FIG. 8

FIG. 9


30
12
28
26
58
38
40
18
62
25b
14
54
24 (22)
64
25a
52a
16
60
42a
56
20
26
12

GASKET RETAINER, GASKET RETAINER SET, AND GASKET CONTAINER

CROSS-REFERENCE TO RELATED APPLICATIONS

[0001] The present application is a bypass continuation of PCT Application No. PCT/JP2023/022587, filed on Jun. 19, 2023,which claims priority to Japanese Patent Application No. 2022-181790, filed on Nov. 14, 2022. The entire contents of these application are incorporated herein by reference.

BACKGROUND

[0002] The present disclosure relates to a gasket holding tool, a gasket holding tool set, and a gasket housing body.

Background Art

[0003] For example, WO 2015/012206 discloses a gasket to be inserted into an outer tube of a syringe. The gasket includes a gasket body and an annular distal-end-side protruding portion that protrudes radially outward from an outer peripheral surface of the gasket body and is in liquid-tight contact with an inner peripheral surface of the outer tube.

SUMMARY

[0004] In a case where the gasket as described above is inserted into the cylindrical portion of the gasket holding tool and held before the gasket is plugged into the outer tube, there is a possibility that the distal-end-side protruding portion as the sealing portion comes into contact with the inner peripheral surface of the cylindrical portion and is damaged.

[0005] An object of certain embodiments of the present disclosure is to solve the problem described above.

[0006] (1) A first aspect of the present disclosure is a gasket holding tool for holding a gasket to be inserted into an outer tube of a syringe, the gasket including: a gasket body; and an annular distal-end-side protruding portion that protrudes radially outward from a portion of an outer peripheral surface of the gasket body in distal of a center in an axial direction of the gasket body and is in liquid-tight or gas-tight contact with an inner peripheral surface of the outer tube, the gasket holding tool including: a base plate; and a holding structure that is provided on the base plate to hold the gasket, in which the holding structure includes: a cylindrical portion that protrudes from the base plate in a thickness direction of the base plate and into which the gasket is insertable; and a bulging portion that bulges radially inward from an inner peripheral surface of the cylindrical portion and comes into contact with the outer peripheral surface of the gasket body to hold the gasket, the bulging portion is in contact with a portion of the outer peripheral surface of the gasket body in a proximal direction with respect to the distal-end-side protruding portion, and the holding structure is not in contact with the distal-end-side protruding portion in a holding state in which the gasket is held by the bulging portion.

[0007] According to such a configuration, by inserting the gasket into the cylindrical portion from the proximal direction of the gasket body, the gasket can be held by the bulging portion without the distal-end-side protruding portion touching the holding structure. In addition, the holding structure is not in contact with the distal-end-side protruding portion in the holding state of the gasket. As a result, the gasket can be held by the gasket holding tool while suppressing the distal-end-side protruding portion from being damaged by contact with the holding structure.

[0008] (2) In the gasket holding tool according to item (1), the bulging portion may be in contact with an adjacent portion of the outer peripheral surface of the gasket body adjacent to the distal-end-side protruding portion in a proximal direction.

[0009] According to such a configuration, the distal end portion of the gasket can be stably held by the bulging portion.

[0010] (3) In the gasket holding tool according to item (2), the adjacent portion may be located in a range of a length of ⅓ or less of an entire length of the gasket body along the axial direction from a distal end of the gasket toward a proximal direction.

[0011] According to such a configuration, the distal end portion of the gasket can be more stably held by the bulging portion.

[0012] (4) In the gasket holding tool according to any one of items (1) to (3), the cylindrical portion includes: a first opening located at one end of the cylindrical portion; and a second opening located at another end of the cylindrical portion, and in the holding state, a distal end of the gasket protrudes from the first opening to an outside of the cylindrical portion.

[0013] (5) In the gasket holding tool according to any one of items (1) to (4), the bulging portion may extend along an axial direction of the cylindrical portion by a length of ½ or more of an entire length along the axial direction of the cylindrical portion.

[0014] According to such a configuration, the gasket can be stably held in the axial direction by the bulging portion.

[0015] (6) In the gasket holding tool according to any one of items (1) to (5), the gasket may have a proximal-end-side protruding portion that protrudes radially outward from the outer peripheral surface of the gasket body and be located in a proximal direction with respect to the center of the gasket body, and the bulging portion may be in contact with an intermediate outer peripheral surface between the distal-end-side protruding portion and the proximal-end-side protruding portion of the outer peripheral surface of the gasket body.

[0016] According to such a configuration, the gasket can be more stably held by the bulging portion.

[0017] (7) In the gasket holding tool according to any one of items (1) to (6), a plurality of the bulging portions may be arranged at intervals in a circumferential direction of the cylindrical portion, and a gap through which steam or gas can flow when high-pressure steam sterilization or gas sterilization is performed on the gasket in the holding state may be formed between the bulging portions adjacent to each other in a circumferential direction of the cylindrical portion.

[0018] According to such a configuration, the gasket held by the gasket holding tool can be efficiently sterilized with high-pressure steam or gas. In addition, the gasket can be stably held in the circumferential direction by the plurality of bulging portions.

[0019] (8) The gasket holding tool according to any one of items (1) to (7) includes a leg portion protruding downward

from the base plate, in which a lower end of the leg portion may be located below a lower end of the gasket in the holding state.

[0020] According to such a configuration, in a case where the plurality of gasket holding tools are disposed in an overlapping manner, it is possible to prevent the adjacent gasket holding tools from coming into contact with the gasket.

[0021] (9) In the gasket holding tool according to item (8), a leg insertion recess into which a lower end of the leg portion is insertable may be provided at an upper end of the leg portion.

[0022] According to such a configuration, in a case where the plurality of gasket holding tools are disposed in an overlapping manner, the lower end portion of the leg portion can be easily located by being inserted into the leg insertion recess.

[0023] (10) In the gasket holding tool according to item (8) or (9), the leg portion may be formed in a tubular shape, and a notch for discharging water inside the leg portion may be formed at a lower end of the leg portion.

[0024] According to such a configuration, in a case where the gasket is sterilized with high-pressure steam, the water (liquid water) in the leg portion can be discharged to the outside from the notch.

[0025] (11) In the gasket holding tool according to any one of items (1) to (10), an outer peripheral rib protruding in a thickness direction of the base plate may be provided on an outer peripheral portion of the base plate.

[0026] According to such a configuration, the rigidity of the outer peripheral portion of the base plate can be improved by the outer peripheral rib.

[0027] (12) In the gasket holding tool according to item (11), a through-hole for transportation may be formed in a portion of the base plate adjacent to the outer peripheral rib.

[0028] According to such a configuration, it is possible to easily transport the gasket holding tool by inserting a human finger, a claw of a robot arm, or the like into the through-hole. Further, the periphery of the portion of the base plate where the through-hole is formed can be reinforced by the outer peripheral rib.

[0029] (13) In the gasket holding tool according to any one of items (1) to (12), the cylindrical portion may protrude only to one side of the base plate.

[0030] (14) In the gasket holding tool according to any one of items (1) to (13), the cylindrical portion may protrude to both sides of the base plate.

[0031] According to such a configuration, compared to a case where the cylindrical portion protrudes only to one side of the base plate, rigidity of a portion of the base plate where the cylindrical portion is provided can be improved.

[0032] (15) A second aspect of the present disclosure is a gasket holding tool set including: a gasket holding tool according to any one of items (1) to (14); and the gasket.

[0033] (16) A third aspect of the present disclosure is a gasket housing body including: a gasket holding tool set according to item (15); a container that has an opening opened upward and houses the gasket holding tool set; and a sealing member that seals the opening of the container, in which the sealing member is formed such that steam or gas for performing high-pressure steam sterilization or gas sterilization of the gasket can pass therethrough.

[0034] According to such a configuration, the gasket held by the gasket holding tool can be sterilized with high-pressure steam or gas.

[0035] (17) In the gasket housing body according to item (16), the container may include: a bottom wall having a bottom surface forming a housing chamber of the container; a peripheral wall provided on an outer peripheral portion of the bottom wall; and a bottom surface rib protruding upward from the bottom surface, and the bottom surface rib may be provided so as to partition the bottom surface into a plurality of regions.

[0036] According to such a configuration, the rigidity of the bottom wall can be improved by the bottom surface rib. Therefore, thermal deformation of the bottom wall (warpage of the bottom wall) during high-pressure steam sterilization can be suppressed. In addition, water (liquid water) generated at the time of high-pressure steam sterilization of the gasket can be dispersed and stored in the plurality of regions. That is, it is possible to suppress biased accumulation of water (liquid water) in the bottom surface.

[0037] (18) In the gasket housing body according to item (17), the bottom surface rib may be formed such that each of the plurality of regions has a polygonal shape in top view.

[0038] According to such a configuration, the rigidity of the bottom wall can be effectively improved by the bottom surface rib.

[0039] (19) In the gasket housing body according to item (18), the bottom surface rib may be formed such that each of the plurality of regions has a hexagonal shape in top view.

[0040] According to such a configuration, the rigidity of the bottom wall can be more effectively improved by the bottom surface rib. In addition, the plurality of regions can be arranged on the bottom surface in a well-balanced manner.

[0041] (20) In the gasket housing body according to item (19), the bottom surface rib may be formed such that one of the plurality of regions is located at a center of the bottom wall, and a center of the bottom wall may be located in the one region.

[0042] According to such a configuration, because the bottom surface rib can be arranged on the bottom surface in a more balanced manner, it is possible to suppress the variation in the magnitude of the rigidity of the bottom wall. This makes it possible to further suppress thermal deformation of the bottom wall (warpage of the bottom wall) at the time of high-pressure steam sterilization.

[0043] (21) In the gasket housing body according to any one of items (17) to (20), the bottom wall may be located at an intermediate portion of the peripheral wall in a vertical direction.

[0044] According to such a configuration, the rigidity of the peripheral wall can be effectively improved by the bottom wall as compared with the case where the bottom wall is located at the lower end of the peripheral wall.

[0045] (22) In the gasket housing body according to any one of items (17) to (21), the container may include: a flange portion extending outward from an upper end portion of the peripheral wall; and a flange rib protruding in a vertical direction from the flange portion.

[0046] According to such a configuration, the rigidity of the upper end portion of the peripheral wall can be improved by the flange portion and the flange rib.

[0047] (23) A fourth aspect of the present disclosure is a gasket housing body including: a gasket holding tool set

including a gasket holding tool according to item (8) and the gasket; a container that has an opening opened upward and houses the gasket holding tool set; and a sealing member that seals the opening of the container, in which the sealing member is formed such that steam or gas for performing high-pressure steam sterilization or gas sterilization of the gasket can pass therethrough, the container includes: a bottom wall having a bottom surface forming a housing chamber of the container; a peripheral wall provided on an outer peripheral portion of the bottom wall; and a support portion protruding upward from the bottom wall, and a support recess into which a lower end portion of the leg portion is insertable is provided at an upper end portion of the support portion.

[0048] According to such a configuration, the weight of the gasket holding tool set can be supported by the support portion protruding from the bottom wall. By inserting the lower end portion of the leg portion of the gasket holding tool into the support recess, the gasket holding tool can be easily located with respect to the container.

[0049] (24) In the gasket housing body according to item (23), the leg portion may be formed in a tubular shape, a notch for discharging water inside the leg portion may be formed at a lower end portion of the leg portion, a lower end surface of the leg portion may abut on a bottom surface of the support recess, and a drain hole for guiding the water discharged from the notch to the outside of the support portion may be formed in a side wall forming the support recess.

[0050] According to such a configuration, the water (liquid water) in the leg portion can be discharged through the notch and the drain hole at the time of high-pressure steam sterilization of the gasket.

[0051] (25) In the gasket housing body according to item (23) or (24), the container may include a container leg portion that extends downward from the support portion below the bottom wall and receives a load acting on the support portion.

[0052] According to such a configuration, because the load acting on the support portion can be received by the container leg portion, it is possible to suppress the support portion and the bottom wall from being deformed by the weight of the gasket holding tool set.

[0053] According to certain embodiments of the present disclosure, the gasket can be held by the gasket holding tool while suppressing the distal-end-side protruding portion from being damaged by contact with the holding structure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0054] FIG. **1** is a perspective view of a gasket housing body according to an embodiment of the present disclosure.

[0055] FIG. **2** is an exploded perspective view of the gasket housing body of FIG. **1**.

[0056] FIG. **3** is a longitudinal cross-sectional view taken along line III-III of the gasket housing body of FIG. **1**.

[0057] FIG. **4** is an enlarged view of the holding structure and the gasket of FIG. **3**.

[0058] FIG. **5** is a transverse cross-sectional view taken along line V-V in FIG. **4**.

[0059] FIG. **6** is an enlarged view of the leg portion and the support portion of FIG. **3**.

[0060] FIG. **7** is a plan view of the container of FIG. **2**.

[0061] FIG. **8** is a longitudinal cross-sectional view of a syringe including the gasket of FIG. **3**.

[0062] FIG. **9** is a cross-sectional view illustrating a holding structure according to a modification.

DETAILED DESCRIPTION

[0063] As illustrated in FIGS. **1** to **3**, a gasket housing body **10** according to an embodiment of the present disclosure is a medical device for simultaneously performing high-pressure steam sterilization (autoclave treatment) on a large number of gaskets **12**. First, a syringe **300**, which is a final product including the gasket **12**, will be described.

[0064] As illustrated in FIG. **8**, the syringe **300** is configured as, for example, a prefilled syringe. However, as long as the syringe **300** includes the gasket **12**, the structure and use thereof are not limited. That is, the syringe **300** may be a blood sampling syringe or the like.

[0065] The syringe **300** includes a syringe body **302**, a drug **304**, a gasket **12**, a plunger **306**, and a cap **308**. The syringe body **302** includes a cylindrical outer tube **310** (barrel) and a nozzle **312** forming a distal end portion of the outer tube **310**. The gasket **12** is disposed inside the outer tube **310** so as to be slidable in the axial direction of the syringe body **302**. A syringe chamber **314** filled with the drug **304** is formed in the distal direction of the gasket **12** in the outer tube **310**.

[0066] In FIGS. **4** and **8**, the gasket **12** includes a gasket body **14**, a distal-end-side protruding portion **16** (sealing portion), and a proximal-end-side protruding portion **18**. The gasket body **14** extends along the axial direction of the syringe body **302**. The distal end surface **20** of the gasket body **14** seals the syringe chamber **314** from the proximal direction (see FIG. **8**). The distal end surface **20** of the gasket body **14** is tapered in diameter in the distal direction.

[0067] Each of the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18** protrudes radially outward from an outer peripheral surface **22** of the gasket body **14** and extends annularly. The distal-end-side protruding portion **16** is provided at a distal end portion of the outer peripheral surface **22** of the gasket body **14**. In other words, the distal-end-side protruding portion **16** is located distal of the center in the axial direction of the gasket body **14** and is not located proximal of the center in the axial direction of the gasket body **14**. The distal-end-side protruding portion **16** is located in a range of ¼ of the entire length in the axial direction of the gasket body **14** proximal of the distal end of the gasket body **14**.

[0068] The distal-end-side protruding portion **16** is formed to be narrowed radially outward (so that the width in the axial direction of the gasket body **14** is narrowed). The protruding end surface of the distal-end-side protruding portion **16** is formed in an arc shape when viewed from a direction orthogonal to the axial direction of the gasket body **14** (see FIG. **4**). The outer surface of the distal-end-side protruding portion **16** is connected to the distal end surface **20** of the gasket body **14** without a step.

[0069] As illustrated in FIG. **8**, the distal-end-side protruding portion **16** is in liquid-tight or gas-tight contact with the inner surface of the outer tube **310**. That is, the syringe chamber **314** is kept liquid-tight or gas-tight by the distal-end-side protruding portion **16** of the gasket **12**. A lubricant is applied to an outer surface of the gasket **12** including the distal-end-side protruding portion **16**. Accordingly, the gasket **12** can smoothly slide on the inner surface of the outer tube **310** in the axial direction of the gasket body **14**.

[0070] In FIGS. **4** and **8**, the proximal-end-side protruding portion **18** is located proximal of the center in the axial direction of the gasket body **14** and is not located distal of the center in the axial direction of the gasket body **14**. The proximal-end-side protruding portion **18** is located in the distal direction with respect to the proximal end of the gasket body **14**. The proximal-end-side protruding portion **18** is formed to be narrowed radially outward (so that the width in the axial direction of the gasket body **14** is narrowed).

[0071] The protruding end surface of the proximal-end-side protruding portion **18** is formed in an arc shape when viewed from a direction orthogonal to the axial direction of the gasket body **14** (see FIG. **4**). In FIG. **8**, the proximal-end-side protruding portion **18** is in contact with the inner surface of the outer tube **310**. The proximal-end-side protruding portion **18** suppresses inclination of the axis of the gasket body **14** with respect to the axis of the syringe body **302**.

[0072] As illustrated in FIGS. **4** and **8**, an intermediate outer peripheral surface **24** between the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18** in the outer peripheral surface **22** of the gasket body **14** is located radially inward of the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18**. That is, the gasket **12** has a shape in which the intermediate portion in the axial direction of the gasket body **14** is recessed radially inward. The length of the intermediate outer peripheral surface **24** along the axial direction of the gasket body **14** (the interval between the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18**) is ⅓ or more of the entire length of the gasket body **14** in the axial direction.

[0073] In FIG. **8**, the plunger **306** presses the gasket **12** in the distal direction. A distal end portion of the plunger **306** is connected to a connection hole **28** formed in the proximal end surface **26** of the gasket **12**. The cap **308** seals the distal end opening of the nozzle **312**.

[0074] In FIGS. **1** to **3**, the gasket housing body **10** includes a plurality of gasket holding tool sets **30**, a container **32**, and a sealing member **34**.

[0075] As illustrated in FIGS. **2** and **3**, the plurality of gasket holding tool sets **30** are housed in the housing chamber **36** of the container **32** in a state of being stacked on each other in the vertical direction. The gasket holding tool set **30** includes a large number of gaskets **12** and a gasket holding tool **38**. The gasket holding tool **38** holds a large number of gaskets **12** of the syringe **300**. Before being held by the gasket holding tool **38**, the outer surface of the gasket **12** including the distal-end-side protruding portion **16** is coated with a lubricant.

[0076] The gasket holding tool **38** is integrally molded with a resin material. The gasket holding tool **38** includes a base plate **40**, a large number of holding structures **42**, and a plurality of leg portions **44**. In FIG. **2**, the base plate **40** is formed in a quadrangular shape. The base plate **40** has a pair of first sides **45***a* extending in parallel with each other and a pair of second sides **45***b* extending in parallel with each other.

[0077] Two through-holes **46** for transportation are formed in the base plate **40**. The through-hole **46** is a quadrangular hole. The two through-holes **46** are provided so as to be adjacent to the pair of second sides **45***b* of the base plate **40**. The through-hole **46** is formed in a size that allows a finger of a human, a nail of a robot hand, or the like to pass through.

[0078] The position, size, and shape of the through-hole **46** may be designed appropriately.

[0079] As illustrated in FIGS. **2** and **3**, a reinforcing outer peripheral rib **48** protruding downward (in the thickness direction of the base plate **40**) is provided on the outer peripheral portion of the base plate **40**. The outer peripheral rib **48** extends annularly along the outer peripheral portion of the base plate **40**. However, the outer peripheral rib **48** may not be integrally connected in an annular shape. The outer peripheral rib **48** may be intermittently provided along the outer peripheral portion of the base plate **40**.

[0080] The outer peripheral rib **48** extends so as to cover the through-hole **46** from the outside. That is, the through-hole **46** is located adjacent to the inner side of the outer peripheral rib **48**. The through-hole **46** is surrounded by the outer peripheral rib **48** and a U-shaped reinforcing rib **50**. The reinforcing rib **50** protrudes downward from the base plate **40** and is connected to the outer peripheral rib **48**.

[0081] In FIG. **2**, the large number of holding structures **42** are arranged at intervals (at equal intervals) on the base plate **40**. The large number of holding structures **42** are arranged in a line along the extending direction of the first side **45***a* of the base plate **40**. The large number of holding structures **42** are arranged in a staggered manner (staggered) along the extending direction of the second side **45***b*. The holding structure **42** holds the gasket **12**.

[0082] As illustrated in FIGS. **4** and **5**, the holding structure **42** includes a cylindrical portion **52** and a bulging portion **54**. The cylindrical portion **52** protrudes downward from the base plate **40** and surrounds the gasket **12**. The cylindrical portion **52** is formed in a cylindrical shape. The gasket **12** is inserted into the cylindrical portion **52**. The inner diameter of the cylindrical portion **52** is larger than the maximum outer diameter of the gasket **12** (the outer diameter of the distal-end-side protruding portion **16**).

[0083] In FIG. **4**, the cylindrical portion **52** includes a first opening **56** located at the lower end of the cylindrical portion **52** and a second opening **58** located at the upper end of the cylindrical portion **52**. The second opening **58** is located at the same height position as the upper surface of the base plate **40**. That is, the cylindrical portion **52** does not protrude upward from the upper surface of the base plate **40**. The entire length of the cylindrical portion **52** is shorter than the entire length of the gasket **12**.

[0084] The bulging portion **54** bulges radially inward from the inner peripheral surface of the cylindrical portion **52** and comes into contact with the outer peripheral surface **22** of the gasket body **14** to hold the gasket **12**. In FIG. **5**, a plurality of bulging portions **54** are provided at intervals in the circumferential direction of the cylindrical portion **52**. In the present embodiment, six bulging portions **54** are provided at equal intervals in the circumferential direction of the cylindrical portion **52**. As illustrated in FIG. **4**, the bulging portion **54** is located at an intermediate portion of the inner peripheral surface of the cylindrical portion **52** in the axial direction of the cylindrical portion **52**. The lower end of the bulging portion **54** is located above the lower end of the cylindrical portion **52**. The upper end of the bulging portion **54** is located below the upper end of the cylindrical portion **52**.

[0085] The bulging portion **54** extends along the axial direction of the cylindrical portion **52** by a length of ½ or more of the entire length along the axial direction of the cylindrical portion **52**. When viewed from the direction orthogonal to the axial direction of the cylindrical portion **52** (in the cross-sectional view of FIG. **4**), the outer surface of the lower end portion **60** of the bulging portion **54** protrudes in an arc shape toward the radially inner side of the cylindrical portion **52**. The height of the lower end portion **60** of the bulging portion **54** (bulging length from the inner peripheral surface of the cylindrical portion **52**) gradually decreases downward (first opening **56**).

[0086] When viewed from the direction orthogonal to the axial direction of the cylindrical portion **52** (in the cross-sectional view of FIG. **4**), the outer surface of the upper end portion **62** of the bulging portion **54** protrudes in an arc shape toward the radially inner side of the cylindrical portion **52**. The height of the upper end portion **62** of the bulging portion **54** (bulging length from the inner peripheral surface of the cylindrical portion **52**) gradually decreases upward (second opening **58**).

[0087] An intermediate portion **64** connecting the lower end portion **60** and the upper end portion **62** of the bulging portion **54** extends at a constant height along the axial direction of the cylindrical portion **52**. As illustrated in FIG. **5**, the bulging portion **54** protrudes radially inward in an arc shape as viewed in the axial direction of the cylindrical portion **52** (in the cross-sectional view of FIG. **5**).

[0088] In a case where the gasket **12** is attached to the holding structure **42**, as illustrated in FIG. **4**, the gasket **12** is inserted into the cylindrical portion **52** from the first opening **56** in a state where the proximal end surface **26** of the gasket body **14** faces the first opening **56** of the cylindrical portion **52**. Then, the proximal-end-side protruding portion **18** gets over the bulging portion **54**, so that the bulging portion **54** is located between the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18** of the gasket **12**. That is, the bulging portion **54** abuts on the intermediate outer peripheral surface **24** of the gasket body **14**. In other words, the bulging portion **54** presses the intermediate outer peripheral surface **24** of the gasket body **14** radially inward.

[0089] Specifically, the bulging portion **54** abuts on the intermediate outer peripheral surface **24** from a first adjacent portion **25***a* (adjacent portion) adjacent in the proximal direction to the distal-end-side protruding portion **16** in the intermediate outer peripheral surface **24** to a second adjacent portion **25***b* adjacent in the distal direction to the proximal-end-side protruding portion **18** in the intermediate outer peripheral surface **24**. The first adjacent portion **25***a* extends over ⅓ or less of the entire length along the axial direction of the gasket body **14** from the distal end of the gasket **12** toward the proximal direction. Further, the first adjacent portion **25***a* is preferably located in a range of ¼ of the entire length along the axial direction of the gasket body **14** from the distal end of the gasket **12** toward the proximal direction.

[0090] Accordingly, the gasket **12** is held in a predetermined posture by the bulging portion **54**. In a case where the gasket **12** is attached to the holding structure **42** in this manner, the distal-end-side protruding portion **16** of the gasket **12** does not touch the bulging portion **54**. Therefore, the distal-end-side protruding portion **16** is prevented from coming into contact with the holding structure **42** and being damaged (for example, peeling off the coating of the lubricant).

[0091] In the holding state (hereinafter, it may be simply referred to as a "holding state of the gasket **12**") in which the gasket **12** is held by the bulging portion **54**, the distal-end-side protruding portion **16** is away from (not in contact with) the holding structure **42** (the cylindrical portion **52** and the bulging portion **54**). In the example of FIG. **4**, in the holding state of the gasket **12**, the proximal-end-side protruding portion **18** is away from (not in contact with) the holding structure **42** (the cylindrical portion **52** and the bulging portion **54**), but may be in contact with the cylindrical portion **52** or the bulging portion **54**. In the holding state of the gasket **12**, the distal end (lower end) of the gasket **12** protrudes downward from the first opening **56** of the cylindrical portion **52**. As illustrated in FIG. **5**, a gap **66** for allowing steam to flow at the time of high-pressure steam sterilization is formed between the bulging portions **54** adjacent to each other in the holding state of the gasket **12**.

[0092] The number, position, shape, and size of the bulging portions **54** can be appropriately set. In particular, the number of bulging portions **54** may be one or more (other than **6**). In a case where the number of bulging portions **54** is one, the bulging portion **54** may extend in a range of 180° or more and less than 360° in the circumferential direction of the cylindrical portion **52** so as to form a gap **66** for steam flow (for example, it may extend in a C shape or a U shape). In a case where only one bulging portion **54** is provided, the bulging portion **54** may extend spirally on the inner peripheral surface of the cylindrical portion **52** so as to form the gap **66** for steam flow. As the numbers of bulging portions **54** increase, the gasket **12** can be stably held, but the gap **66** for the steam flow narrows, and it becomes difficult to remove the gasket **12** from the gasket holding tool **38**.

[0093] In FIG. **2**, the leg portions **44** are provided at a central portion and an outer peripheral portion of the base plate **40**. In the example of FIG. **2**, one leg portion **44** is provided in the central portion of the base plate **40** and six leg portions are provided in the outer peripheral portion of the base plate **40**. The number and positions of the leg portions **44** can be set as appropriate.

[0094] As illustrated in FIG. **6**, the leg portion **44** protrudes downward from the base plate **40**. The leg portion **44** is formed in a cylindrical shape. That is, the leg portion **44** has an inner hole **67** penetrating in the vertical direction. The outer peripheral surface of the leg portion **44** is tapered in diameter toward the lower side (protruding direction). As illustrated in FIG. **3**, the lower end of the leg portion **44** is located below the lower end of the cylindrical portion **52**. In other words, the lower end of the leg portion **44** is located below the lower end (distal end) of the gasket **12** in the holding state of the gasket **12**.

[0095] In FIG. **6**, a leg insertion recess **68** into which the lower end of the leg portion **44** is insertable is provided at the upper end of the leg portion **44**. The leg insertion recess **68** is a circular recess. The inner hole **67** of the leg portion **44** is opened in a bottom surface **72** of the leg insertion recess **68**. That is, the bottom surface **72** of the leg insertion recess **68** extends in an annular shape. With the gasket holding tool **38** stacked in the vertical direction, a lower end surface **70** of the leg portion **44** abuts on the bottom surface **72** of the leg insertion recess **68**. The plurality of gasket

holding tools **38** are located in the horizontal direction by inserting the leg portion **44** into the leg insertion recess **68**.

[0096] Two notches **74** for discharging water (liquid water) in the inner hole **67** of the leg portion **44** are formed at the lower end of the leg portion **44**. The two notches **74** are located at positions offset by 180° in the circumferential direction of the leg portion **44**. The number, position, size, and shape of the notches **74** may be designed appropriately.

[0097] As illustrated in FIGS. **2** and **3**, the container **32** is integrally molded with a resin material. The container **32** has a housing chamber **36** that houses the plurality of gasket holding tool sets **30**.

[0098] The container **32** includes a bottom wall **76**, a bottom surface rib **78**, a support portion **80**, a container leg portion **82** (see FIG. **3**), a peripheral wall **84**, a flange portion **86**, and a flange rib **88**. In FIG. **3**, the bottom wall **76** is formed in a plate shape and is connected to an intermediate portion in the height direction of the peripheral wall **84**. The bottom wall **76** is located between the center of the peripheral wall **84** in the vertical direction (height direction) and the lower end of the peripheral wall **84**. The bottom wall **76** has a bottom surface **90** forming the housing chamber **36**.

[0099] The bottom surface rib **78** protrudes upward from the bottom surface **90** of the bottom wall **76**. In FIGS. **2**, **3**, and **7**, the bottom surface rib **78** is provided so as to partition the bottom surface **90** into a plurality of regions **92**. Each region **92** can store water generated during high-pressure steam sterilization.

[0100] As illustrated in FIGS. **2** and **7**, the bottom surface rib **78** is formed such that each region **92** has a polygonal shape in top view. Specifically, the bottom surface rib **78** is formed such that each region **92** has a hexagonal shape in top view. In other words, the bottom surface rib **78** has a honeycomb structure in top view.

[0101] The size and shape of each region **92**, and the number of regions **92** formed by the bottom surface rib **78** can be appropriately set. The bottom surface rib **78** may be formed such that each region **92** has a triangular shape, a quadrangular shape, or a pentagonal shape.

[0102] As illustrated in FIG. **7**, the bottom surface rib **78** is formed such that one region **92** (central region **92***a*) of the plurality of regions **92** is located at the center of the bottom wall **76**. A center P of the bottom wall **76** is located in the central region **92***a*. Specifically, the center P of the bottom wall **76** is located at the central portion of the hexagonal region **92**. In other words, the center P of the bottom wall **76** is located at the center of the central region **92***a* or in the vicinity of the center.

[0103] As illustrated in FIGS. **2** and **3**, the support portion **80** protrudes upward from the bottom wall **76** to support portion the leg portion **44** of the gasket holding tool **38**. As many support portions **80** as the leg portions **44** of the gasket holding tool **38** are provided (see FIG. **2**).

[0104] In FIGS. **2**, **6**, and **7**, a support recess **94** into which the lower end of the leg portion **44** is insertable is provided at the upper end of the support portion **80**. The lower end surface **70** of the leg portion **44** abuts on a bottom surface **96** of the support recess **94** (see FIG. **6**). In a side wall **98** forming the support recess **94**, four drain holes **100** (drain grooves) for guiding water (liquid water) discharged from the notch **74** to the outside of the support portion **80** are formed. The four drain holes **100** are provided at equal intervals (90° intervals) in the circumferential direction of the support portion **80**.

[0105] As illustrated in FIG. **3**, the container leg portion **82** extends downward from the lower end of the support portion **80**. The container leg portions **82** are provided in the same number as the support portions **80**. The lower surface of the container leg portion **82** is at the same height position as the lower end of the peripheral wall **84**. The lower surface of the container leg portion **82** comes into contact with an arrangement surface of a chamber (surface on which the gasket housing body **10** is arranged) of a high-pressure steam sterilization device (not illustrated). The support portion **80** and the container leg portion **82** receive the weight of the plurality of gasket holding tool sets **30**.

[0106] In FIGS. **2** and **3**, the peripheral wall **84** includes an upper peripheral wall **102** extending upward from the outer peripheral portion of the bottom wall **76** and a lower peripheral wall **104** extending downward from the outer peripheral portion of the bottom wall **76**. The upper peripheral wall **102** extends in a quadrangular shape so as to surround the plurality of gasket holding tool sets **30** from the horizontal direction. The upper peripheral wall **102** forms the housing chamber **36**. The upper peripheral wall **102** is bent so as to expand outward at a middle portion extending upward from the bottom wall **76**. Accordingly, the rigidity of the upper peripheral wall **102** can be enhanced. An opening **106** is formed at an upper end of the upper peripheral wall **102**. A plate-shaped rib **108** is provided on the inner surface of the peripheral wall **84** and the bottom surface **90** of the bottom wall **76** (see FIG. **2**).

[0107] The flange portion **86** extends outward from the upper end of the upper peripheral wall **102**. The flange portion **86** extends annularly and is formed in a plate shape. The sealing member **34** is fixed to the upper surface of the flange portion **86**. The flange rib **88** protrudes downward from the extending end of the flange portion **86**. The flange rib **88** reinforces the flange portion **86**. The flange rib **88** extends annularly so as to surround the flange portion **86**. The flange rib **88** only needs to protrude in at least one of the vertical directions from the flange portion **86**.

[0108] The sealing member **34** seals the opening **106** of the container **32**. The sealing member **34** is formed to allow vapor to pass therethrough.

[0109] In the present embodiment, as illustrated in FIG. **3**, the plurality of gasket holding tool sets **30** are arranged on the support portion **80** in a state of being overlapped with each other. At this time, the lower end of the leg portion **44** of the gasket holding tool **38** located at the lowermost position is inserted into the support recess **94** of the support portion **80** (see FIG. **6**). Therefore, the gasket holding tool **38** can be easily located with respect to the container **32**.

[0110] Further, the lower end portion of the leg portion **44** of the gasket holding tool **38** placed on the lowermost gasket holding tool **38** is inserted into the leg insertion recess **68** of the gasket holding tool **38** adjacent below (see FIG. **6**). Thus, the plurality of gasket holding tool sets **30** can be easily located. After the plurality of gasket holding tool sets **30** are arranged in the housing chamber **36** of the container **32**, the opening **106** of the container **32** is sealed by the sealing member **34**.

[0111] The gasket housing body **10** is subjected to high-pressure steam sterilization in a chamber of a high-pressure steam sterilization device (not illustrated). The steam in the chamber passes through the sealing member **34**, flows into the housing chamber **36** of the container **32**, and comes into contact with the gasket **12**. At this time, because the steam

flows through the gap **66** (see FIG. **5**) between the bulging portions **54** adjacent to each other, the steam smoothly flows around the gasket **12**. The water (liquid water) generated in the housing chamber **36** is dispersed and stored in the plurality of regions **92** of the bottom surface **90**. That is, the water is not unevenly stored in one place of the bottom surface **90**. Part of the water stored in each region **92** evaporates and returns to steam.

[0112] Water (liquid water) generated in the inner hole **67** of the leg portion **44** is guided to the inner hole **67** of the leg portion **44** of the gasket holding tool **38** located at the lowermost position. The water in the inner hole **67** of the leg portion **44** is discharged to the outside of the support portion **80** via the notch **74** and the drain hole **100** and stored in the region **92** of the bottom surface **90**.

[0113] After the high-pressure steam sterilization is performed, the sealing member **34** is opened. Then, a human finger or a claw of a robot arm is inserted into the through-hole **46** of the gasket holding tool **38**, and the gasket holding tool set **30** is transported to a plugging device (not illustrated).

[0114] Thereafter, for example, the outer tube **310** (barrel) of the syringe **300** is disposed below the gasket **12** of the gasket holding tool set **30** in a state where the proximal end opening of the outer tube **310** faces upward. Then, the gasket **12** is plugged (for example, a vacuum plug) into the outer tube **310** by pressing the proximal end surface **26** of the gasket **12** from above toward the proximal end opening of the outer tube **310**. As a result, the syringe **300** in which the gasket **12** is inserted into the outer tube **310** is manufactured.

[0115] The present embodiment has the following effects.

[0116] According to the present embodiment, by inserting the gasket **12** into the cylindrical portion **52** from the proximal direction of the gasket body **14**, the gasket **12** can be held by the bulging portion **54** without the distal-end-side protruding portion **16** touching the holding structure **42**. In addition, the holding structure **42** is not in contact with the distal-end-side protruding portion **16** in the holding state of the gasket **12**. As a result, the gasket **12** can be held by the gasket holding tool **38** while suppressing the distal-end-side protruding portion **16** from being damaged by being in contact with the holding structure **42**.

[0117] The bulging portion **54** is in contact with the first adjacent portion **25***a* of the outer peripheral surface **22** of the gasket body **14** adjacent in the proximal direction to the distal-end-side protruding portion **16**.

[0118] According to such a configuration, the distal end portion of the gasket **12** can be stably held by the bulging portion **54**.

[0119] The first adjacent portion **25***a* extends over ⅓ or less of the entire length along the axial direction of the gasket body **14** from the distal end of the gasket **12** toward the proximal direction.

[0120] According to such a configuration, the distal end portion of the gasket **12** can be more stably held by the bulging portion **54**.

[0121] The bulging portion **54** extends along the axial direction of the cylindrical portion **52** by a length of ½ or more of the entire length along the axial direction of the corresponding cylindrical portion **52**.

[0122] According to such a configuration, the gasket **12** can be stably held in the axial direction by the bulging portion **54**.

[0123] The gasket **12** has a proximal-end-side protruding portion **18** which protrudes radially outward from the outer peripheral surface **22** of the gasket body **14** and is located in the proximal direction with respect to the center of the gasket body **14**. The bulging portion **54** is in contact with an intermediate outer peripheral surface **24** between the distal-end-side protruding portion **16** and the proximal-end-side protruding portion **18** of the outer peripheral surface **22** of the gasket body **14**.

[0124] According to such a configuration, the gasket **12** can be more stably held by the bulging portion **54**.

[0125] The plurality of bulging portions **54** are arranged at intervals in the circumferential direction of the cylindrical portion **52**. Between the bulging portions **54** adjacent to each other in the circumferential direction of the cylindrical portion **52**, the gap **66** through which steam can flow in a holding state of the gasket **12** is formed.

[0126] According to such a configuration, the gasket **12** held by the gasket holding tool **38** can be efficiently sterilized with high-pressure steam. In addition, the gasket **12** can be stably held in the circumferential direction by the plurality of bulging portions **54**.

[0127] The gasket holding tool **38** includes a leg portion **44** protruding downward from the base plate **40**. The lower end of the leg portion **44** is located below the lower end of the gasket **12** in the holding state.

[0128] According to such a configuration, in a case where the plurality of gasket holding tools **38** are disposed in an overlapping manner, it is possible to prevent the adjacent gasket holding tools **38** from coming into contact with the gasket **12**.

[0129] A leg insertion recess **68** into which a lower end of the leg portion **44** is insertable is provided at an upper end of the leg portion **44**.

[0130] According to such a configuration, in a case where the plurality of gasket holding tools **38** are disposed in an overlapping manner, the lower end portion of the leg portion **44** can be easily located by being inserted into the leg insertion recess **68**.

[0131] The leg portion **44** is formed in a tubular shape, and a notch **74** for discharging water inside the leg portion **44** is formed at a lower end portion of the leg portion **44**.

[0132] According to such a configuration, in a case where the gasket **12** is sterilized with high-pressure steam, the water (liquid water) in the leg portion **44** can be discharged to the outside from the notch **74**.

[0133] An outer peripheral rib **48** protruding in a thickness direction of the base plate **40** is provided on an outer peripheral portion of the base plate **40**.

[0134] According to such a configuration, the rigidity of the outer peripheral portion of the base plate **40** can be improved by the outer peripheral rib **48**.

[0135] A through-hole **46** for transportation is formed in a portion of the base plate **40** adjacent to the outer peripheral rib **48**.

[0136] According to such a configuration, it is possible to easily transport the gasket holding tool **38** by inserting a human finger, a claw of a robot arm, or the like into the through-hole **46**. Further, the periphery of the portion of the base plate **40** where the through-hole **46** is formed can be reinforced by the outer peripheral rib **48**.

[0137] In the gasket housing body **10**, the container **32** includes a bottom wall **76** having a bottom surface **90** forming the housing chamber **36** of the container **32**, a

peripheral wall **84** provided on an outer peripheral portion of the bottom wall **76**, and a bottom surface rib **78** protruding upward from the bottom surface **90**. The bottom surface rib **78** is provided so as to partition the bottom surface **90** into a plurality of regions **92**.

[0138] According to such a configuration, the rigidity of the bottom wall **76** can be improved by the bottom surface rib **78**. Therefore, thermal deformation of the bottom wall **76** (warpage of the bottom wall **76**) during high-pressure steam sterilization can be suppressed. In addition, water (liquid water) generated at the time of high-pressure steam sterilization of the gasket **12** can be dispersed and stored in the plurality of regions **92**. That is, it is possible to suppress biased accumulation of water (liquid water) in the bottom surface **90**.

[0139] The bottom surface rib **78** is formed such that each of the plurality of regions **92** has a polygonal shape in top view.

[0140] According to such a configuration, the rigidity of the bottom wall **76** can be effectively improved by the bottom surface rib **78**.

[0141] The bottom surface rib **78** is formed such that each of the plurality of regions **92** has a hexagonal shape in top view.

[0142] According to such a configuration, the rigidity of the bottom wall **76** can be more effectively improved by the bottom surface rib **78**. In addition, the plurality of regions **92** can be arranged on the bottom surface **90** in a well-balanced manner.

[0143] The bottom surface rib **78** is formed such that one region **92** (central region **92***a*) of the plurality of regions **92** is located at the center of the bottom wall **76**. The center P of the bottom wall **76** is located in the central region **92***a*.

[0144] According to such a configuration, because the bottom surface rib **78** can be arranged on the bottom surface **90** in a more balanced manner, it is possible to suppress the variation in the magnitude of the rigidity of the bottom wall **76**. This makes it possible to further suppress thermal deformation of the bottom wall **76** (warpage of the bottom wall **76**) at the time of high-pressure steam sterilization.

[0145] The bottom wall **76** is located at a vertically intermediate portion of the peripheral wall **84**.

[0146] According to such a configuration, the rigidity of the peripheral wall **84** can be effectively improved by the bottom wall **76** as compared with the case where the bottom wall **76** is located at the lower end of the peripheral wall **84**.

[0147] The container **32** has a flange portion **86** extending outward from an upper end portion of the peripheral wall **84** and a flange rib **88** protruding in the vertical direction from the flange portion **86**.

[0148] According to such a configuration, the rigidity of the upper end portion of the peripheral wall **84** can be improved by the flange portion **86** and the flange rib **88**.

[0149] The container **32** has a support portion **80** protruding upward from the bottom wall **76**. A support recess **94** into which the lower end of the leg portion **44** is insertable is provided at the upper end of the support portion **80**.

[0150] According to such a configuration, the weight of the gasket holding tool set **30** can be supported by the support portion **80** protruding from the bottom wall **76**. By inserting the lower end portion of the leg portion **44** of the gasket holding tool **38** into the support recess **94**, the gasket holding tool **38** can be easily located with respect to the container **32**.

[0151] The lower end surface **70** of the leg portion **44** abuts on the bottom surface **96** of the support recess **94**. In the side wall **98** forming the support recess **94**, a drain hole **100** for guiding the water discharged from the notch **74** to the outside of the support portion **80** is formed.

[0152] According to such a configuration, the water (liquid water) in the leg portion **44** can be discharged through the notch **74** and the drain hole **100** at the time of high-pressure steam sterilization of the gasket **12**.

[0153] The container **32** has a container leg portion **82** that extends downward from the support portion **80** below the bottom wall **76** and receives a load acting on the support portion **80**.

[0154] According to such a configuration, because the load acting on the support portion **80** can be received by the container leg portion **82**, it is possible to suppress the support portion **80** and the bottom wall **76** from being deformed by the weight of the gasket holding tool set **30**.

[0155] In the present embodiment, the gasket holding tool **38** may have a holding structure **42***a* as in a modification illustrated in FIG. **9** instead of the holding structure **42**. Further, in the present modification, the same components as those of the above-described holding structure **42** are denoted by the same reference numerals, and the detailed description thereof will be omitted. As illustrated in FIG. **9**, in the gasket holding tool **38**, the holding structure **42***a* according to the modification includes a cylindrical portion **52***a* and a bulging portion **54**. The cylindrical portion **52***a* protrudes to both sides of the base plate **40**. That is, the cylindrical portion **52***a* includes a portion protruding downward from the base plate **40** and a portion protruding upward from the base plate **40**.

[0156] According to such a configuration, compared to a case where the cylindrical portion **52***a* protrudes only to one side of the base plate **40**, rigidity of a portion of the base plate **40** where the cylindrical portion **52***a* is provided can be improved.

[0157] As described above, in certain embodiments of the present disclosure, the cylindrical portion may protrude from only one side of the base plate as in the present embodiment, or may protrude from both sides of the base plate as in the modification.

[0158] In the present embodiment, an example has been described in which the gasket holding tool **38** is used in both the step of sterilizing the gasket **12** with high-pressure steam (high-pressure steam sterilization step) and the step of inserting the gasket **12** into the outer tube **310** of the syringe **300** (plugging step). However, the gasket holding tool **38** may not be used in the high-pressure steam sterilization step, and may be used only in the plugging step.

[0159] In the present embodiment, the high-pressure steam sterilization has been described as an example of the sterilization treatment, but gas sterilization may be performed instead of the high-pressure steam sterilization. Examples of the gas used for gas sterilization include ethylene oxide and hydrogen peroxide.

[0160] Note that the present invention is not limited to the above disclosure, and various configurations can be adopted without departing from the gist of the present invention.

REFERENCE CHARACTER LIST

[0161] **10** gasket housing body

[0162] **12** gasket

[0163] **14** gasket body

[0164] **16** distal-end-side protruding portion
[0165] **18** proximal-end-side protruding portion
[0166] **22** outer peripheral surface
[0167] **24** intermediate outer peripheral surface
[0168] **25***a* first adjacent portion (adjacent portion)
[0169] **30** gasket holding tool set
[0170] **32** container
[0171] **34** sealing member
[0172] **36** housing chamber
[0173] **38** gasket holding tool
[0174] **40** base plate
[0175] **42**, **42***a* holding structure
[0176] **44** leg portion
[0177] **46** through-hole
[0178] **48** outer peripheral rib
[0179] **52**, **52***a* cylindrical portion
[0180] **54** bulging portion
[0181] **56** first opening
[0182] **58** second opening
[0183] **60** lower end
[0184] **62** upper end
[0185] **64** intermediate portion
[0186] **66** gap
[0187] **68** leg insertion recess
[0188] **70** lower end surface
[0189] **72** bottom surface
[0190] **74** notch
[0191] **76** bottom wall
[0192] **78** bottom surface rib
[0193] **80** support portion
[0194] **82** container leg portion
[0195] **84** peripheral wall
[0196] **86** flange portion
[0197] **88** flange rib
[0198] **90** bottom surface of bottom wall
[0199] **92** region
[0200] **92***a* central region
[0201] **94** support recess
[0202] **96** bottom surface of support recess
[0203] **98** side wall
[0204] **100** drain hole
[0205] **106** opening
[0206] **300** syringe
[0207] **310** outer tube
[0208] P center

1. A gasket holding tool for holding a gasket to be inserted into an outer tube of a syringe, the gasket comprising: a gasket body; and an annular distal-end-side protruding portion that protrudes radially outward from a portion of an outer peripheral surface of the gasket body distal of a center in an axial direction of the gasket body and is in liquid-tight or gas-tight contact with an inner peripheral surface of the outer tube, the gasket holding tool comprising:

a base plate; and

a holding structure located on the base plate and configured to hold the gasket, wherein the holding structure comprises:

a cylindrical portion that protrudes from the base plate in a thickness direction of the base plate and into which the gasket is insertable, and

a bulging portion that bulges radially inward from an inner peripheral surface of the cylindrical portion and is configured to come into contact with the outer peripheral surface of the gasket body to hold the gasket;

the bulging portion is configured to contact a portion of the outer peripheral surface of the gasket body proximal of the distal-end-side protruding portion; and

the holding structure is configured not to contact the distal-end-side protruding portion in a holding state in which the gasket is held by the bulging portion.

2. The gasket holding tool according to claim **1**, wherein the bulging portion is configured to contact an adjacent portion of the outer peripheral surface of the gasket body adjacent to and proximal of the distal-end-side protruding portion.

3. The gasket holding tool according to claim **1**, wherein:

the cylindrical portion comprises:

a first opening located at a first end of the cylindrical portion, and

a second opening located at a second end of the cylindrical portion; and

the cylindrical portion is configured such that, in the holding state, a distal end of the gasket protrudes from the first opening to an outside of the cylindrical portion.

4. The gasket holding tool according to claim **1**, wherein the bulging portion extends along an axial direction of the cylindrical portion by a length of ½ or more of an entire length along the axial direction of the cylindrical portion.

5. The gasket holding tool according to claim **1**, wherein:

the gasket has a proximal-end-side protruding portion that protrudes radially outward from the outer peripheral surface of the gasket body and is located in a proximal direction with respect to the center of the gasket body, and

the bulging portion is configured to contact an intermediate outer peripheral surface between the distal-end-side protruding portion and the proximal-end-side protruding portion of the outer peripheral surface of the gasket body.

6. The gasket holding tool according to claim **1**, wherein:

a plurality of the bulging portions are arranged at intervals in a circumferential direction of the cylindrical portion; and

a gap through which steam or gas can flow when high-pressure steam sterilization or gas sterilization is performed on the gasket in the holding state is formed between the bulging portions adjacent to each other in a circumferential direction of the cylindrical portion.

7. The gasket holding tool according to claim **1**, comprising:

a leg portion protruding downward from the base plate;

wherein a lower end of the leg portion is located below a lower end of the gasket in the holding state.

8. The gasket holding tool according to claim **7**, wherein a leg insertion recess into which a lower end of the leg portion is insertable is located at an upper end of the leg portion.

9. The gasket holding tool according to claim **7**, wherein:

the leg portion is formed in a tubular shape; and

a notch for discharging water inside the leg portion is located at a lower end of the leg portion.

10. The gasket holding tool according to claim **1**, wherein an outer peripheral rib protruding in a thickness direction of the base plate is located on an outer peripheral portion of the base plate.

11. The gasket holding tool according to claim **10**, wherein a through-hole for transportation is located in a portion of the base plate adjacent to the outer peripheral rib.

12. The gasket holding tool according to claim **1**, wherein the cylindrical portion protrudes only to one side of the base plate.

13. The gasket holding tool according to claim **1**, wherein the cylindrical portion protrudes to both sides of the base plate.

14. A gasket holding tool set comprising:

a gasket holding tool according to claim **1**; and

the gasket.

15. A gasket housing body comprising:

a gasket holding tool set according to claim **14**;

a container that has an opening opened upward and houses the gasket holding tool set; and

a sealing member that seals the opening of the container;

wherein the sealing member is formed such that steam or gas for performing high-pressure steam sterilization or gas sterilization of the gasket can pass therethrough.

16. The gasket housing body according to claim **15**, wherein:

the container comprises:

a bottom wall having a bottom surface forming a housing chamber of the container,

a peripheral wall located on an outer peripheral portion of the bottom wall, and

a bottom surface rib protruding upward from the bottom surface; and

the bottom surface rib partitions the bottom surface into a plurality of regions.

17. The gasket housing body according to claim **16**, wherein the bottom surface rib is formed such that each of the plurality of regions has a polygonal shape in top view.

18. The gasket housing body according to claim **17**, wherein the bottom surface rib is formed such that each of the plurality of regions has a hexagonal shape in top view.

19. The gasket housing body according to claim **18**, wherein:

the bottom surface rib is formed such that one of the plurality of regions is located at a center of the bottom wall; and

a center of the bottom wall is located in the one region.

20. The gasket housing body according to claim **16**, wherein the bottom wall is located at an intermediate portion of the peripheral wall in a vertical direction.

21. The gasket housing body according to claim **16**, wherein:

the container comprises:

a flange portion extending outward from an upper end portion of the peripheral wall, and

a flange rib protruding in a vertical direction from the flange portion.

22. A gasket housing body comprising:

a gasket holding tool set comprising a gasket holding tool according to claim **8**, and the gasket;

a container that has an opening opened upward and houses the gasket holding tool set; and

a sealing member that seals the opening of the container;

wherein:

the sealing member is formed such that steam or gas for performing high-pressure steam sterilization or gas sterilization of the gasket can pass therethrough;

the container comprises:

a bottom wall having a bottom surface forming a housing chamber of the container,

a peripheral wall located on an outer peripheral portion of the bottom wall, and

a support portion protruding upward from the bottom wall; and

a support recess into which a lower end portion of the leg portion is insertable is located at an upper end portion of the support portion.

23. The gasket housing body according to claim **22**, wherein:

the leg portion has a tubular shape;

a notch for discharging water inside the leg portion is formed at a lower end portion of the leg portion;

a lower end surface of the leg portion abuts on a bottom surface of the support recess; and

a drain hole for guiding the water discharged from the notch to the outside of the support portion is located in a side wall forming the support recess.

24. The gasket housing body according to claim **22**, wherein the container comprises a container leg portion that extends downward from the support portion below the bottom wall and receives a load acting on the support portion.

* * * * *