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

(11) **EP 4 741 703 A1**

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
13.05.2026 Bulletin 2026/20

(21) Application number: **24835821.0**

(22) Date of filing: **04.06.2024**

(51) International Patent Classification (IPC):
F17C 13/00 *(2006.01)* ***F17C 9/00*** *(2006.01)*

(52) Cooperative Patent Classification (CPC):
F17C 9/00; F17C 13/00

(86) International application number:
PCT/JP2024/020278

(87) International publication number:
WO 2025/009301 (09.01.2025 Gazette 2025/02)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **06.07.2023 JP 2023111354**

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(54) CONTAINER AND PUMP SYSTEM

(57) A hollow container (3, 4) is disposed above a hollow column (2) disposed around a pump (P), with a cable (8) being passed through a central portion of the container (3, 4) from bottom to top. The container (3, 4) includes a lower plate member (5, 6) having, in a central portion of the lower plate member, a cable passage hole (9, 10) through which the cable (8) can be passed, and a stuffing box member (12) disposed in the central portion of lower plate member (5, 6) around the cable passage hole (9, 10) and having, in a central portion of the stuffing box member, a cable insertion hole (13) into which the cable (8) is inserted. The stuffing box member (12) includes an opening diameter adjustment mechanism (14, 20) for adjusting a size of an opening diameter of the cable insertion hole (13).

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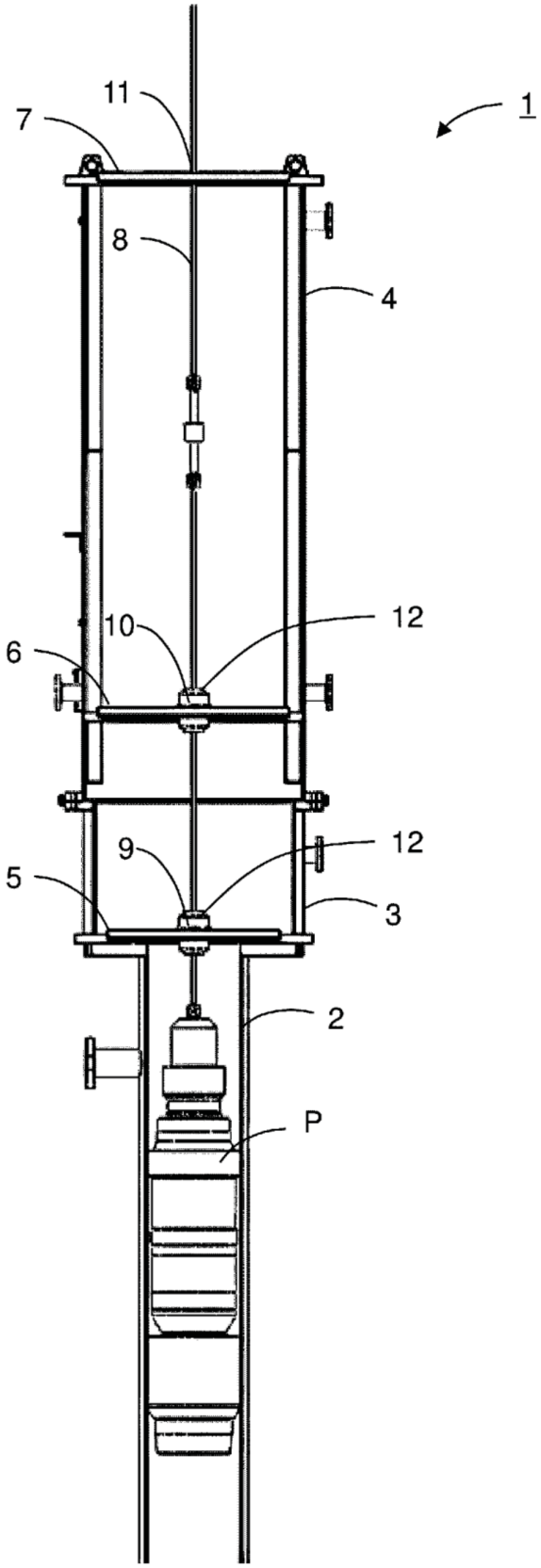
FIG. 1



Description

Technical Field

[0001] The present invention relates to a container and a pump system.

Background Art

[0002] Among liquefied gas pumps, conventional liquefied natural gas (LNG: Liquefied Natural Gas) pumps address leakage of LNG to the outside by placing a temporary plate on a flange of a column top (see Patent Literature 1, for example). Since LNG is heavier than air in lower temperature ranges, it is not emitted into the atmosphere. By contrast, in the case of cryogenic fluid such as liquefied hydrogen and liquefied ammonia, the specific gravity of their gasified gas is lighter than air. Hence, there is a risk of emission of liquefied hydrogen or liquefied ammonia.

[0003] In maintenance of a liquefied hydrogen pump, the boiling point of liquefied hydrogen is -253°C, whereas air (primarily oxygen and nitrogen) liquefies and solidifies in the region of -253°C. Liquefaction of air produces liquid oxygen, which poses a risk of explosion, while solidification of air poses a risk of damage to the pump by both nitrogen and oxygen. In maintenance of a liquefied ammonia pump, leakage of ammonia to the outside can lead to human health hazard because of its toxicity.

[0004] When performing maintenance of a liquefied gas pump, in order to avoid entry of air or emission of the liquid in question (such as liquefied hydrogen and liquefied ammonia) to the outside in pulling out of a cryogenic pump or installing of a cryogenic pump, it is necessary to provide a barrier chamber, like a buffer container which is disposed on a column around the liquefied gas pump to form a barrier zone, or a purge container disposed on the buffer container.

[0005] While such a barrier chamber is equipped with a door for partitioning its interior from the atmosphere side or the tank side, a cable (wire) for installation and extraction of the liquefied gas pump passes through the interior of the barrier chamber. Thus, there is a problem of gas leak through a hole for cable passage.

[0006] For a liquid hydrogen pump, entry of nitrogen and oxygen into the column cannot be sufficiently prevented, and for an ammonia pump, ammonia gas leaks to the upper side and the outside as well. Furthermore, as a cable is not constant in diameter and accessories such as shackles and links are attached to it, the hole bored in the door needs to be large relative to the cable diameter. It has thus been very difficult to prevent leakage of gas from a hole for cable passage.

Citation List

Patent Literature

[0007] Patent Literature 1: Japanese Patent Laid-Open No. 2018-80801

Summary of Invention

Technical Problem

[0008] The present invention has been made against the background outlined above. An object of the present invention is to provide a container and a pump system that can prevent leakage of gas through a hole for cable passage.

Solution to Problem

[0009] One aspect of the present invention is a container. The container is a hollow container that is disposed above a hollow column disposed around a liquefied gas pump, with a cable for installation and extraction of the liquefied gas pump being passed through a central portion of the container from a lower side of the container toward an upper side,
the container including:

a lower plate member disposed in a lower portion of the container and having, in a central portion of the lower plate member, a cable passage hole through which the cable can be passed; and
a stuffing box member disposed in the central portion of the lower plate member around the cable passage hole and having, in a central portion of the stuffing box member, a cable insertion hole into which the cable is inserted,
wherein the stuffing box member includes an opening diameter adjustment mechanism for adjusting a size of an opening diameter of the cable insertion hole.

[0010] Another aspect of the present invention is a pump system. The pump system includes a liquefied gas pump and

the container set forth above.

[0011] As will be described below, the present invention has other aspects. Hence, the disclosure of this invention is intended to provide some of the aspects of the present invention and is not intended to limit the scope of the invention as described and claimed herein.

Brief Description of the Drawings

[0012]

[Figure 1] Figure 1 is a schematic diagram (a side view) showing a pump system in an embodiment of the present invention.

[Figure 2] Figure 2 is a schematic diagram (a perspective view) showing the pump system in the embodiment of the present invention.

[Figure 3] Figure 3 is a schematic diagram (a side view) showing a stuffing box in an embodiment of the present invention.

[Figure 4] Figure 4 is a schematic diagram (a side view) showing the stuffing box in the embodiment of the present invention.

[Figure 5] Figure 5 is a schematic diagram (a plan view) showing the stuffing box in the embodiment of the present invention.

[Figure 6] Figure 6 is a schematic diagram (a plan view) showing the stuffing box in the embodiment of the present invention.

[Figure 7] Figure 7 is a schematic diagram (a side view) showing how purging gas flows in according to an embodiment of the present invention.

[Figure 8] Figure 8 is a schematic diagram (side view) showing the stuffing box in another embodiment.

[Figure 9] Figure 9 is a schematic diagram (a side view) showing the stuffing box in the other embodiment.

[Figure 10] Figure 10 is a schematic diagram (a plan view) showing the stuffing box in the other embodiment.

[Figure 11] Figure 11 is a schematic diagram (a plan view) showing the stuffing box in the other embodiment.

[Figure 12] Figure 12 is a schematic diagram (a side view) showing the pump system in another embodiment.

[Figure 13] Figure 13 is a schematic diagram (a perspective view) showing the pump system in the other embodiment.

Description of Embodiments

[0013] The present invention will be described in detail below. However, the following detailed description and the attached drawings are not intended to limit the invention.

[0014] The container according to the present invention is a hollow container that is disposed above a hollow column disposed around a liquefied gas pump, with a cable for installation and extraction of the liquefied gas pump being passed through a central portion of the container from a lower side of the container toward an upper side. The container includes: a lower plate member disposed in a lower portion of the container and having, in a central portion of the lower plate member, a cable passage hole through which the cable can be passed; and a stuffing box member disposed in the central portion of the lower plate member around the cable passage hole and having, in a central portion of the stuffing box member, a cable insertion hole into which the cable is inserted. The stuffing box member includes an opening diameter adjustment mechanism for adjusting a size of an opening diameter of the cable insertion hole.

[0015] With this arrangement, a stuffing box member is disposed around the cable passage hole and the stuffing box member is equipped with an opening diameter adjustment mechanism for adjusting the size of the opening diameter of the cable insertion hole. Accordingly, by adjusting the size of the opening diameter of the cable insertion hole with the opening diameter adjustment mechanism of the stuffing box, gas that leaks from the hole for cable passage can be decreased.

[0016] In the container of the present invention, the opening diameter adjustment mechanism may include: a rotary ring member capable of rotating around a central axis of the cable insertion hole; a pair of upper and lower linear-moving ring members disposed on an upper side and a lower side of the rotary ring member, respectively, and capable of sliding along the central axis of the cable insertion hole; and a pair of upper and lower cloth members each being fixed at opposite edges to a corresponding one of the pair of upper and lower linear-moving ring members and to the rotary ring member, and being disposed so as to cover peripheries of the linear-moving ring member and the rotary ring member. A pair of upper and lower cable insertion holes may be formed by the pair of upper and lower cloth members, and the sizes of the opening diameters of the pair of upper and lower cable insertion holes may be adjusted simultaneously by rotating the rotary ring member.

[0017] With this arrangement, the opening diameter adjustment mechanism is constructed of the rotary ring member, the pair of upper and lower linear-moving ring members and the cloth members, and the pair of upper and lower cable insertion holes is formed by the pair of upper and lower cloth members. By rotating the rotary ring member, the sizes of the opening diameters of the pair of upper and lower cable insertion holes can be adjusted simultaneously.

[0018] In the container of the present invention, the rotary ring member may be provided with a gas inlet port for allowing purging gas to flow to the inside of the rotary ring member.

[0019] With this arrangement, purging gas can flow to the inside of the rotary ring member through the gas inlet port provided in the rotary ring member. After flowing to the inside of the rotary ring member, the purging gas will flow inside the rotary ring member toward the upper side and the lower side. Thus, any gas that is about to flow in from above the linear-moving ring member on the upper side of the rotary ring member downward can be prevented from entering by the purging gas flowing toward the upper side. Likewise, any gas that is about to flow in from below the linear-moving ring member on the lower side of the rotary ring member upward can be prevented from entering by the purging gas flowing toward the lower side.

[0020] In the container of the present invention, the rotary ring member, the linear-moving ring members and the cloth members may be each divisible into two parts, from a ring-closed state to a ring-open state.

[0021] With this arrangement, as the rotary ring member and the linear-moving ring members are divisible into two parts, the opening diameter adjustment mechanism can be attached to the cable from a middle portion of the cable by changing them from a ring-open state to a ring-closed state within the container. By changing them from a ring-closed state to a ring-open state, the opening diameter adjustment mechanism can also be removed from the cable from a middle portion of the cable.

[0022] In the container of the present invention, the opening diameter adjustment mechanism may include: a ring-shaped body member having the cable insertion hole in a central portion; a pair of right and left, plate-shaped seal members being disposed on an upper side and a lower side of the body member, respectively, and being openable and closeable; and spring members for biasing the pair of right and left seal members, respectively, in a direction of closing toward the central portion. The cable insertion hole may be formed in a central portion of the pair of right and left seal members, and the size of the opening diameter of the cable insertion hole may be adjustable by movement of the pair of right and left seal members in a direction of opening against the elastic force of the spring members.

[0023] With this arrangement, the opening diameter adjustment mechanism is constructed of the body member, the seal members and the spring members, and a cable insertion hole is formed in the central portion of the pair of right and left seal members. The sizes of the opening diameters of the pair of upper and lower cable insertion holes can be adjusted simultaneously by movement of the pair of right and left seal members in the direction of opening against the elastic force of the spring members.

[0024] In the container of the present invention, the body member may be provided with a gas inlet port for allowing purging gas to flow to the inside of the body member.

[0025] With this arrangement, purging gas can flow to the inside of the body member through the gas inlet port provided in the body member. After flowing to the inside of the body member, the purging gas will flow inside the body member toward the upper side and the lower side. Thus, any gas that is about to flow in from the upper side of the body member (from top to bottom) can be prevented from entering by the purging gas flowing toward the upper side. Likewise, any gas that is about to flow in from the lower side of the body member (from bottom to top) can be prevented from entering by the purging gas flowing toward the lower side.

[0026] In the container of the present invention, the body member may be divisible into two parts in a direction in which the pair of right and left seal members open.

[0027] With this arrangement, as the body member is divisible into two parts, the opening diameter adjustment mechanism can be attached to the cable from a middle portion of the cable within the container, or the opening diameter adjustment mechanism can be removed from the cable from a middle portion of the cable.

[0028] The container of the present invention may also include a glove box provided inside the container and configured to allow a user to insert his hands thereinto from outside of the container for operating the stuffing box member; and an observation window positioned near the glove box and the stuffing box member such that the glove box and the stuffing box member can be seen from outside of the container.

[0029] With this arrangement, when a user performs maintenance of the liquefied gas pump, the user can insert his hands into the glove box inside the container (the purge container) from outside of the container and adjust the size of the opening diameter of the cable insertion hole via the opening diameter adjustment mechanism of the stuffing box member, thereby decreasing the gas that leaks out of the hole for cable passage.

[0030] A pump system of the present invention includes a liquefied gas pump and the container set forth in any of the foregoing paragraphs.

[0031] As with the foregoing container, this pump system also includes a stuffing box member around the cable passage hole, and the stuffing box member is equipped with an opening diameter adjustment mechanism for adjusting the size of the opening diameter of the cable insertion hole. Accordingly, by adjusting the size of the opening diameter of the cable insertion hole with the opening diameter adjustment mechanism of the stuffing box member, leakage of gas through the hole for cable passage can be prevented.

[0032] The present invention can prevent leakage of gas through a hole for cable passage.

(Embodiments)

[0033] A container in an embodiment of the present invention is now described with reference to the drawings. This embodiment describes a container for use with a pump system that includes a liquefied gas pump for pumping liquefied gas at cryogenic temperatures, such as liquefied hydrogen and liquefied ammonia, by way of illustration.

[0034] An arrangement of the container in the embodiment of the present invention will be described with reference to the drawings. Figures 1 and 2 are schematic diagrams showing a pump system in this embodiment. As shown in Figures 1 and 2, a pump system 1 includes a liquefied gas pump P. The liquefied gas pump P according to an aspect is a pump for cryogenic liquefied gas, e.g., a liquid hydrogen pump and a liquefied ammonia pump. The pump system 1 further includes a hollow column 2 disposed around the liquefied gas pump P, a hollow buffer container 3 disposed on top of the column 2, and a hollow purge container 4 disposed above the column 2 and on top of the buffer container 3. The buffer container 3 and the purge container 4 are also collectively called a "container". This container is hollow and disposed above the hollow column 2 disposed around the liquefied gas pump P.

[0035] The buffer container 3 includes a buffer lower plate 5, which is disposed on the lower surface side of the buffer container 3 and can be opened upward and closed. The purge container 4 includes a container lower plate 6, which is disposed on the lower surface side of the purge container 4 and can be opened upward and closed, and a container upper plate 7, which is disposed on the upper surface side of the purge container 4 and can be opened upward and closed.

[0036] Through a central portion of the container, a cable 8 for installation and extraction of the liquefied gas pump P is passed from the lower side of the container toward the upper side. A cable passage hole 9 through which the cable 8 can be passed is provided in a central portion of the buffer lower plate 5, a cable passage hole 10 through which the cable 8 can be passed is provided in a central portion of the container lower plate 6, and a cable passage hole 11 through which the cable 8 can be passed is provided in a central portion of the container upper plate 7. A stuffing box 12 is disposed in the central portion of the buffer lower plate 5 around the cable passage hole 9. A stuffing box 12 is also disposed in the central portion of the container lower plate 6 around the cable passage hole 10. A stuffing box 12 is also disposed in the central portion of the container upper plate 7 around the cable passage hole 11.

[0037] As shown in Figures 12 and 13, the container 3 may also include a glove box 30 configured to allow a user to insert his hands thereinto from outside of the buffer container 12 for operating the stuffing box 12, and an observation window 31 positioned near the glove box 30. The stuffing box 12 and the glove box 30 inside the buffer container 3 can be seen from the outside of the buffer container 3 through the observation window 31.

[0038] In the pump system 1, the purge container 4 includes a glove box 32 configured to allow a user to insert his hands thereinto from the outside of the purge container 4 for operating the stuffing box 12, and an observation window 33 positioned near the glove box 32. The stuffing box 12 and glove box 32 in the purge container 4 can be seen from the outside of the purge container 4 through the observation window 33.

[0039] In this case, when a person operates the opening diameter adjustment mechanism of the stuffing box 12 for maintaining the liquefied gas pump, he does not have to open the container in order to place his hands into the container. Accordingly, it is possible to prevent entry of air into a barrier zone or leakage of the liquid in question from a barrier chamber (container) to the outside which results from a person placing his hands into the barrier chamber (container), as is done in conventional practices.

[0040] In the container of the present invention, the buffer container 4 may also be provided with a second glove box 34 configured to allow a user to insert his hands thereinto from outside of the container for manual operations within the container, and a second observation window 35 positioned near the second glove box 34 so that the inside of the buffer container 4 can be seen from outside of the buffer container.

[0041] With this arrangement, when a user performs maintenance of the liquefied gas pump, the user can insert his hands into the second glove box 32 within the container from outside of the container and perform operations inside the container. In this case, it is not necessary for the user to open the container in order to place his hands into the container when performing manual operations inside the container for the maintenance of the liquefied gas pump. Accordingly, it is possible to prevent entry of air into a barrier zone or leakage of the liquid in question from the container to the outside which results from a person placing his hands into the container, as is done in conventional practices.

[0042] A method of maintaining a liquefied gas pump according to the present invention includes the steps of a user inserting his hands into the glove boxes 30, 32, 34 provided inside the containers from outside of the containers, operating the opening diameter adjustment mechanism of the stuffing boxes 12 provided inside the containers, and hanging a liquefied gas pump.

[0043] This method of maintaining also does not require a person to open the container in order to place his hands in the container when operating the opening diameter adjustment mechanism of the stuffing box 12 for the maintenance of the liquefied gas pump, as with the container described above. Accordingly, it is possible to prevent entry of air into a barrier zone or leakage of the liquid in question from the container to the outside which results from a person placing his hands into the container, as is done in conventional practices.

[0044] Figures 3 through 7 are schematic diagrams showing the stuffing box 12 in this embodiment. A cable insertion

hole 13 into which the cable 8 is inserted is provided in the central portion of the stuffing box 12. The stuffing box 12 in turn includes an opening diameter adjustment mechanism 14 for adjusting the size of the opening diameter of the cable insertion hole 13.

[0045] As shown in Figures 3 and 4, the opening diameter adjustment mechanism 14 includes a rotary ring 15 capable of rotating around the central axis of the cable insertion hole 13, and a pair of upper and lower linear-moving rings 16 disposed on the upper and lower sides of the rotary ring 15, respectively, and capable of sliding along the central axis of the cable insertion hole 13. The pair of upper and lower linear-moving rings 16 are provided with a pair of upper and lower cloths 17, respectively, which is in the form of a cylinder such that each cloth is fixed at its opposite edges to the linear-moving ring 16 and the rotary ring 15 and the cloth covers the peripheries of the linear-moving ring 16 and the rotary ring 15. A pair of upper and lower cable insertion holes 13 are formed by this pair of upper and lower cloths 17.

[0046] The material for the pair of upper and lower cloths 17 is preferably flexible and airtight, and is less likely to get frayed or cause loss of surface at cryogenic temperatures. Table 1 below shows the results of an experiment that examines four kinds of material (Materials A to D) for flexibility, airtightness, and any fray or loss of surface at cryogenic temperatures.

[Table 1]

Material	Flexibility at cryogenic temperatures	Airtightness	Frays/Loss of surface
Material A	High	Low/None	frays observed
Material B	High	Medium	unchanged
Material C	High	Medium	unchanged
Material D	Low/None	High	unchanged

[0047] For Material A, Kevlar (a registered trademark), para-aramid fiber manufactured by DuPont-Toray Co., Ltd, was used. For Material B, silicone-coated heat-resistant sheet flame-proofing KW-031 manufactured by Kikuchi Sheet Kogyo Co., Ltd was used. For Material C, double side silicone-coated synthetic fiber heat-resistant sheet manufactured by Kikuchi Sheet Kogyo Co., Ltd was used. For Material D, cold-resistant partitioning sheet, Achilles Frigo Soft, manufactured by Achilles Corporation was used.

[0048] Specimens of these materials A to D were immersed in liquid nitrogen and sufficiently cooled. After taking them out of the liquid nitrogen, they were subjected to twisting. The specimens were then examined by visual observation for retention of their flexibility or any damage to their surfaces such as loss and frays. The airtightness of the specimens was also examined in a simple gas test (e.g., an experiment where a test device is divided into two chambers with each material, and one of the chambers is filled with a particular kind of gas and the other with air. After the chambers are left stand for a certain period of time, an increase in gas concentration in the other chamber is measured). The results in Table 1 revealed that Material B or Material C is preferable for use as the material of the pair of upper and lower cloths 17.

[0049] The rotary ring 15 is provided with a rotating lever 18, such that by inserting one's hands via the glove box and operating the rotating lever 18 to rotate the rotary ring 15, the sizes of the opening diameters of the pair of upper and lower cable insertion holes 13 can be adjusted simultaneously. In this case, applying a rotary motion to edges of the cloths 17 disposed in the form of a cylinder via the rotating lever 18 causes twisting of the cloths 17 and reduces the diameter of the cylinder, as a result of which the cloths 17 can make close contact with the periphery of the cable 8. Thus, the cloths 17 wrap the cable 8 for installation and extraction to narrow a gas flow path, enabling suppression of gas leakage. When moving the cable 8 vertically, such as when housing the liquefied gas pump P down in the column 2 or when pulling up and removing the liquefied gas pump P from the bottom of the column 2, applying a rotary motion in the opposite direction to the twisting direction via the rotating lever 18 can untwist the cloths 17 and increase the diameter of the cylinder, resulting in a space between the periphery of the cable 8 and the cloths 17. Accordingly, the cable 8 can be moved vertically without interference of the cloths 17 with the cable 8 for installation and extraction. In this manner, the opening diameter adjustment mechanism 14 can not only adjust the degree of torsion in accordance with the diameter of the cable 8 but also allows for change of the opening diameter as appropriate for an operation and enables repeated opening and closing.

[0050] Moreover, as shown in Figures 5 and 6, the rotary ring 15, the linear-moving rings 16 and the cloths 17 are each divisible into two parts, from a ring-closed state to a ring-open state. This allows attachment and detachment of the stuffing box 12 with the cable 8 passed through the container. In addition, by adjusting the degree of torsion in accordance with the diameter of the cable 8, leakage can be also suppressed for a cable 8 with a locally varying diameter.

[0051] As shown in Figures 3, 4 and 7, the rotary ring 15 is also provided with a gas inlet port 19 for allowing purging gas to flow to the inside of the rotary ring 15. For the purging gas, nitrogen gas or helium gas can be used, for example. As shown in Figure 7, purge gas will flow out from the inside of the stuffing box 12 upward and from the inside of the stuffing box 12 downward, providing the effect of hindering a gas flow falling from the upper side of the container to the lower side and the effect of hindering a gas flow that is about to leak out from the lower side of the container to the upper side. It is thus possible

to suppress leakage of hazardous gas such as ammonia and hydrogen to the outside or fall of air and/or nitrogen into the column 2.

[0052] Here again, the space between the periphery of the cable 8 and the cloths 17 can be closed and opened to a suitable gap by operating the rotating lever 18 depending on when there is no movement of the cable 8 or when the cable 8 is moved vertically. Hence, a flow rate through the space can be made proper, and use and emission of unnecessarily large amount of purge gas can be suppressed.

[0053] In such a container of this embodiment, the stuffing boxes 12 are provided around the cable passage holes 9, 10, 11, and each stuffing box 12 is equipped with the opening diameter adjustment mechanism 14 for adjusting the size of the opening diameter of the cable insertion hole 13. Accordingly, by adjusting the size of the opening diameter of the cable insertion hole 13 with the opening diameter adjustment mechanism 14 of the stuffing box 12, gas that leaks from the hole for cable passage can be decreased.

[0054] In this embodiment, the opening diameter adjustment mechanism 14 is constructed of the rotary ring 15, the pair of upper and lower linear-moving rings 16 and the cloths 17, and the pair of upper and lower cable insertion holes 13 is formed by the pair of upper and lower cloths 17. By rotating the rotary ring 15, the sizes of the opening diameters of the pair of upper and lower cable insertion holes 13 can be adjusted simultaneously.

[0055] In this embodiment, purging gas can flow to the inside of the rotary ring 15 through the gas inlet port 19 provided in the rotary ring 15. After flowing to the inside of the rotary ring 15, the purging gas will flow inside the rotary ring 15 toward the upper side and the lower side. Thus, any gas that is about to flow in from above the linear-moving ring 16 on the upper side of the rotary ring 15 downward can be prevented from entering by the purging gas flowing toward the upper side. Likewise, any gas that is about to flow in from below the linear-moving ring 16 on the lower side of the rotary ring 15 upward can be prevented from entering by the purging gas flowing toward the lower side.

[0056] In this embodiment, as the rotary ring 15, the linear-moving rings 16 and the cloths 17 are divisible into two parts, the opening diameter adjustment mechanism 14 can be attached to the cable 8 in a middle portion of the cable 8 by changing them from a ring-open state to a ring-closed state within the container. By changing them from a ring-closed state to a ring-open state, the opening diameter adjustment mechanism 14 can also be removed from the cable 8 in a middle portion of the cable 8.

[0057] The container (the buffer container 3 and the purge container 4) in this embodiment may include a glove box 30 provided inside the container and configured to allow a user to insert his hands thereinto from outside of the container for operating the stuffing box 12, and an observation window 31 positioned near the glove box and the stuffing box 12 such that the glove box 30 and the stuffing box 12 can be seen from outside of the container.

[0058] With this arrangement, when a user performs maintenance of the liquefied gas pump, the user can insert his hands into the glove box 30 inside the container (purge container 3) from outside of the container and adjust the size of the opening diameter of the cable insertion hole 13 via the opening diameter adjustment mechanism 14 of the stuffing box 12, thereby decreasing the gas that leaks from the hole for cable passage.

[0059] While an embodiment of the present invention has been described above by way of illustration, the scope of the present invention is not limited to it and modifications and variations can be made as needed for a purpose within the scope defined by the claims.

(Other embodiments)

[0060] For example, Figures 8 to 11 depict another example of an opening diameter adjustment mechanism 20. As shown in Figures 8 to 11, the opening diameter adjustment mechanism 20 may include a ring-shaped body 21 having the cable insertion hole 13 in a central portion, and a pair of right and left, plate-shaped seal components 22 which are disposed on the upper side and the lower side of the body 21, respectively, and are openable and closeable. In this case, the cable insertion hole 13 is formed in the central portion of the pair of right and left seal components 22, and the pair of right and left seal components 22 are biased in a direction of closing toward the central portion by elastic forces of pressing springs 23. The size of the opening diameter of the cable insertion hole 13 is adjustable by movement of the pair of right and left seal components 22 in a direction of opening against the elastic forces of the pressing springs 23.

[0061] In this case, as shown in Figures 8 and 9, by providing tapered portions 25, 26 on a link 24 attached to the cable 8 and on the seal components 22, respectively, the size of the opening diameter of the cable insertion hole 13 can be changed just by pulling up and hanging of the cable 8, improving workability. The body 21 of the opening diameter adjustment mechanism 20 is provided with a gas inlet port 19 for allowing purging gas to flow to the inside of the body 21. Furthermore, the body 21 of the opening diameter adjustment mechanism 20 is divisible into two parts in a direction in which the pair of right and left seal components 22 open.

[0062] According to such a different embodiment, the opening diameter adjustment mechanism 20 is also constructed of the body 21, the seal components 22 and the pressing springs 23, and the cable insertion hole 13 is formed in the central portion of the pair of right and left seal components 22. The sizes of the opening diameters of the pair of upper and lower cable insertion holes 13 can be adjusted simultaneously by movement of the pair of right and left seal components 22 in the

direction of opening against the elastic forces of the pressing springs 23.

[0063] In this case, purging gas can flow to the inside of the body 21 through the gas inlet port 19 provided in the body 21. After flowing to the inside of the body 21, the purging gas will flow inside the body 21 toward the upper side and the lower side. Thus, any gas that is about to flow in from the upper side of the body 21 (from top to bottom) can be prevented from entering by the purging gas flowing toward the upper side. Likewise, any gas that is about to flow in from the lower side of the body 21 (from bottom to top) can be prevented from entering by the purging gas flowing toward the lower side.

[0064] Since the body 21 of the opening diameter adjustment mechanism 20 is also divisible into two parts in this case, the opening diameter adjustment mechanism 20 can be attached to the cable 8 in a middle portion of the cable 8 within the container, or the opening diameter adjustment mechanism 20 can be removed from the cable 8 in a middle portion of the cable 8.

Industrial Applicability

[0065] As has been described above, the container according to the present invention has the effect of being able to prevent leakage of gas through a hole for cable passage, and can be advantageously used with a pump system that includes a liquefied gas pump for pumping liquefied gas at cryogenic temperatures, such as liquefied hydrogen and liquefied ammonia, for example.

Reference Sign List

[0066]

1	pump system
2	column
3	buffer container (container)
4	purge container (container)
5	buffer lower plate (lower plate member)
6	container lower plate (lower plate member)
7	container upper plate
8	cable
9	cable passage hole
10	cable passage hole
11	cable passage hole
12	stuffing box (stuffing box member)
13	cable insertion hole
14	opening diameter adjustment mechanism
15	rotary ring
16	linear-moving ring
17	cloth
18	rotating lever
19	gas inlet port
20	opening diameter adjustment mechanism
21	body
22	seal component
23	pressing spring
24	link
25	tapered portion
26	tapered portion
30	glove box
31	observation window
32	glove box
33	observation window
34	glove box
35	observation window
P	liquefied gas pump

Claims

1. A hollow container that is disposed above a hollow column disposed around a liquefied gas pump, with a cable for installation and extraction of the liquefied gas pump being passed through a central portion of the container from a lower side of the container toward an upper side,
the container comprising:

a lower plate member disposed in a lower portion of the container and having, in a central portion of the lower plate member, a cable passage hole through which the cable can be passed; and
a stuffing box member disposed in the central portion of the lower plate member around the cable passage hole and having, in a central portion of the stuffing box member, a cable insertion hole into which the cable is inserted, wherein the stuffing box member includes an opening diameter adjustment mechanism for adjusting a size of an opening diameter of the cable insertion hole.

2. The container according to claim 1, wherein the opening diameter adjustment mechanism includes:

a rotary ring member capable of rotating around a central axis of the cable insertion hole;
a pair of upper and lower linear-moving ring members disposed on an upper side and a lower side of the rotary ring member, respectively, and capable of sliding along the central axis of the cable insertion hole; and
a pair of upper and lower cloth members each being fixed at opposite edges to a corresponding one of the pair of upper and lower linear-moving ring members and to the rotary ring member, and being disposed so as to cover peripheries of the linear-moving ring member and the rotary ring member,
wherein a pair of upper and lower cable insertion holes are formed by the pair of upper and lower cloth members, and
wherein the sizes of the opening diameters of the pair of upper and lower cable insertion holes can be adjusted simultaneously by rotating the rotary ring member.

3. The container according to claim 2, wherein the rotary ring member is provided with a gas inlet port for allowing purging gas to flow to the inside of the rotary ring member.

4. The container according to claim 2 or 3, wherein the rotary ring member, the linear-moving ring members and the cloth members are each divisible into two parts, from a ring-closed state to a ring-open state.

5. The container according to claim 1, wherein the opening diameter adjustment mechanism includes:

a ring-shaped body member having the cable insertion hole in a central portion;
a pair of right and left, plate-shaped seal members being disposed on an upper side and a lower side of the body member, respectively, and being openable and closeable; and
spring members for biasing the pair of right and left seal members, respectively, in a direction of closing toward the central portion,
wherein the cable insertion hole is formed in a central portion of the pair of right and left seal members, and
wherein the size of the opening diameter of the cable insertion hole is adjustable by movement of the pair of right and left seal members in a direction of opening against elastic forces of the spring members.

6. The container according to claim 5, wherein the body member is provided with a gas inlet port for allowing purging gas to flow to the inside of the body member.

7. The container according to claim 5 or 6, wherein the body member is divisible into two parts in a direction in which the pair of right and left seal members open.

8. The container according to claim 1, comprising:

a glove box provided inside the container and configured to allow a user to insert his hands thereinto from outside of the container for operating the stuffing box member; and
an observation window positioned near the glove box and the stuffing box member such that the glove box and the stuffing box member can be seen from outside of the container.

9. A pump system comprising:

a liquefied gas pump; and
the container according to any of claims 1 to 8.

FIG. 1

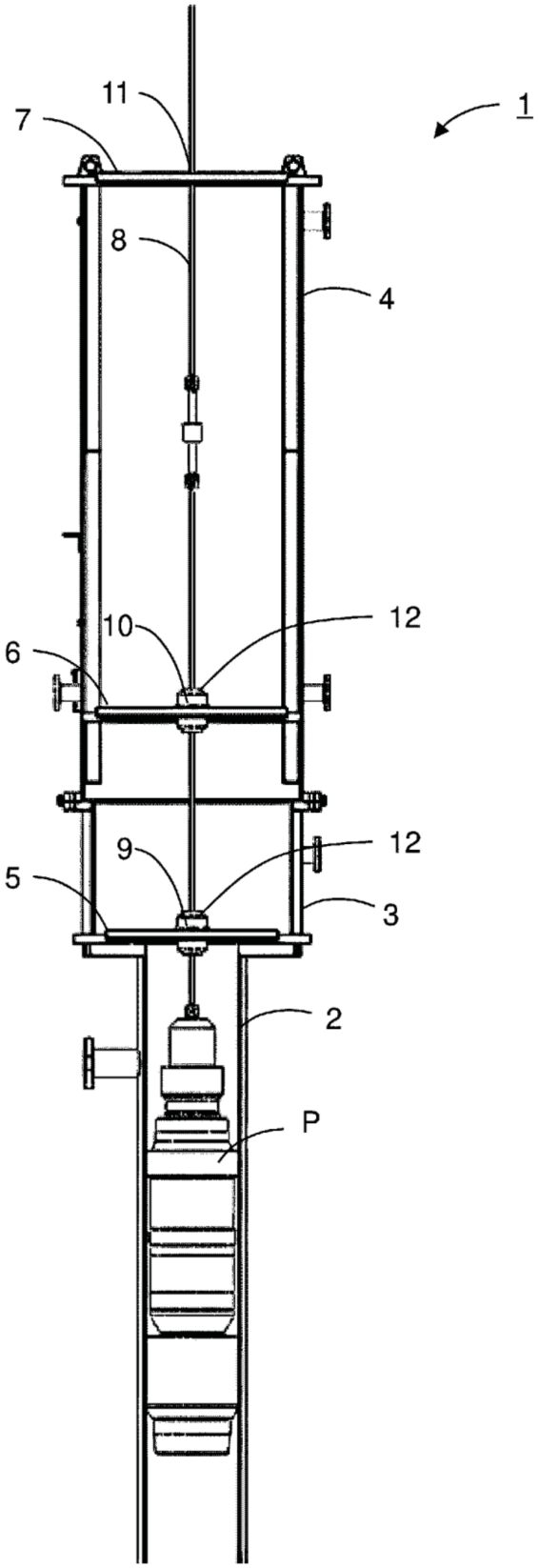


FIG. 2

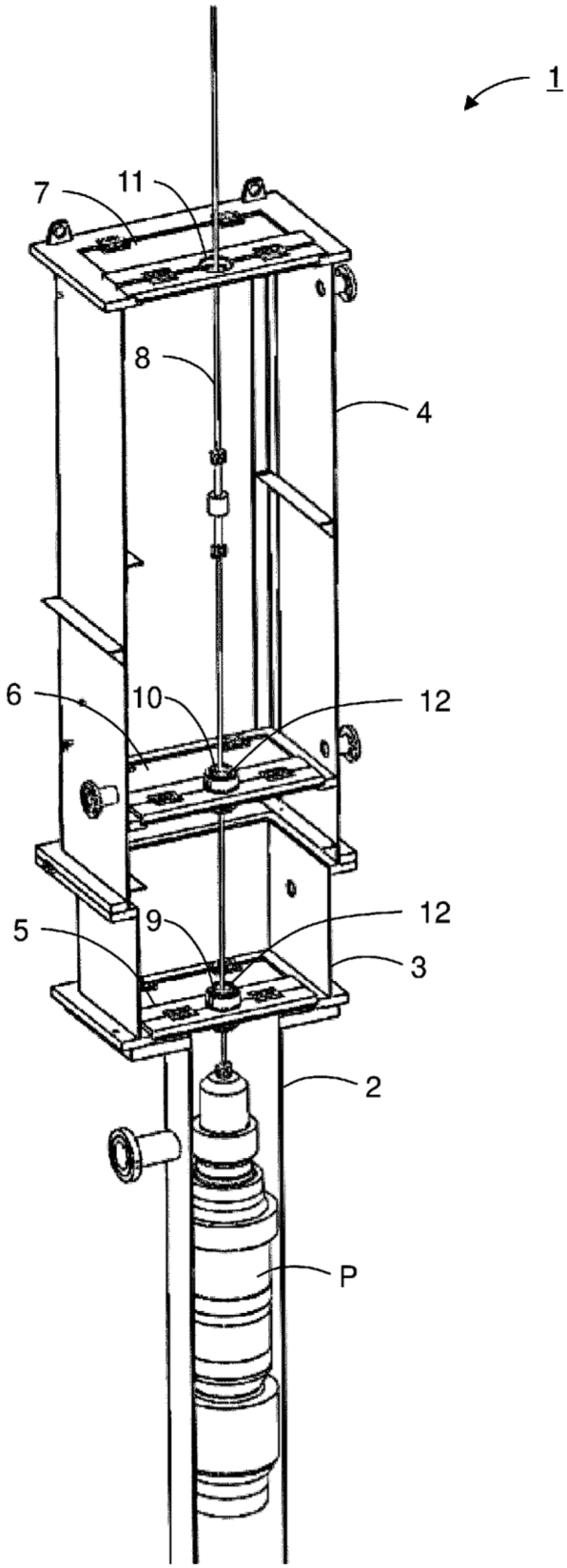


FIG. 3

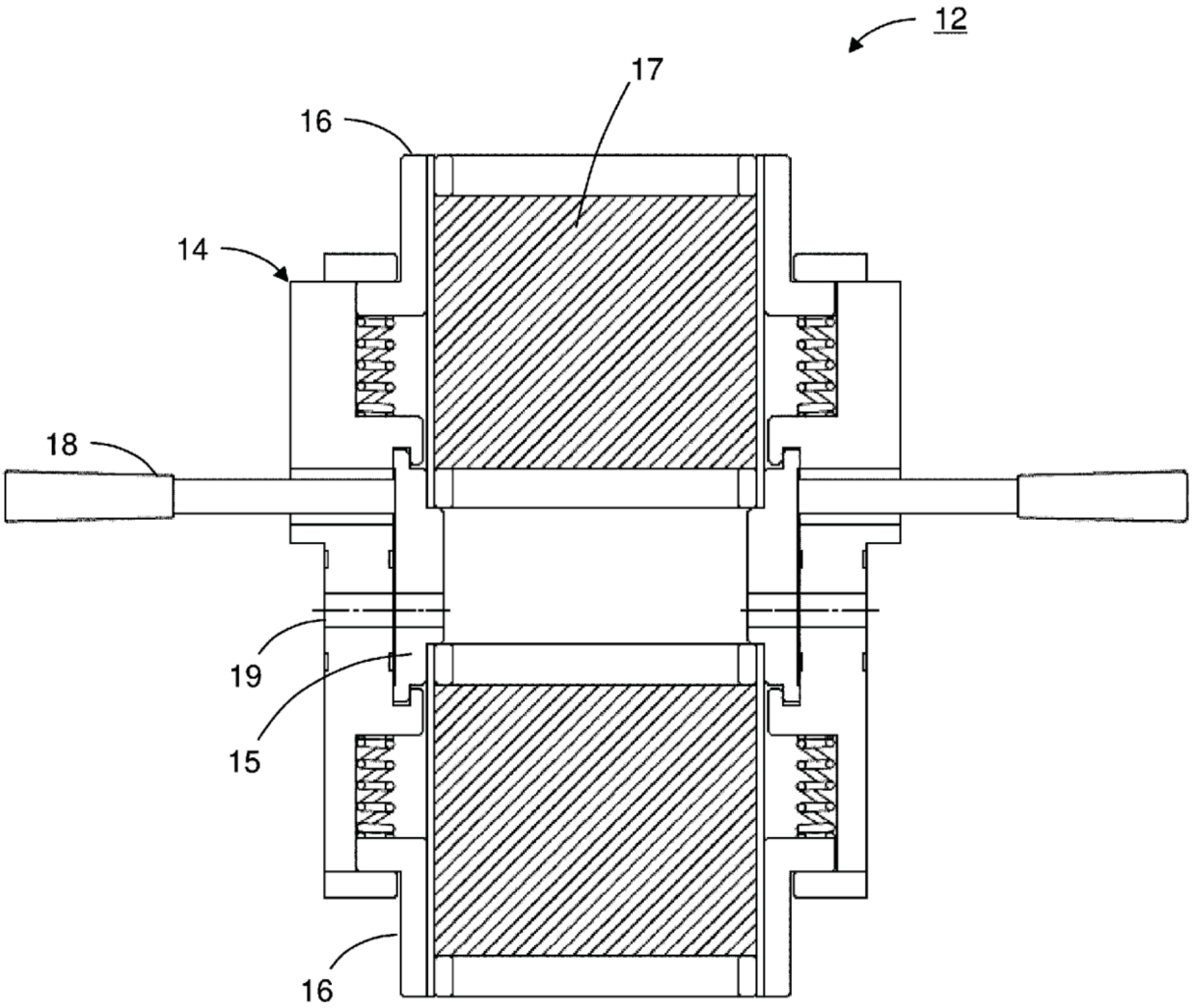


FIG. 4

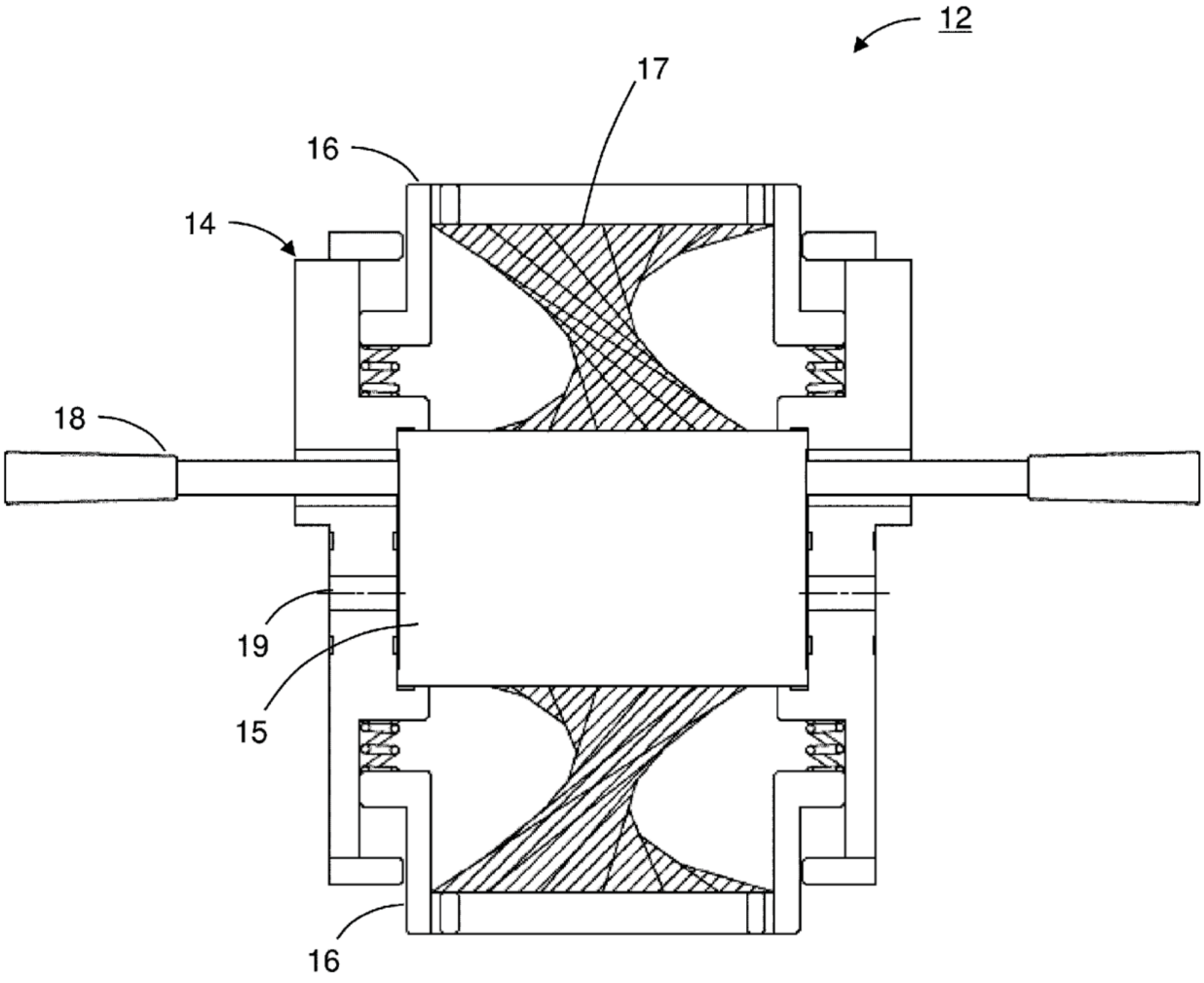


FIG. 5

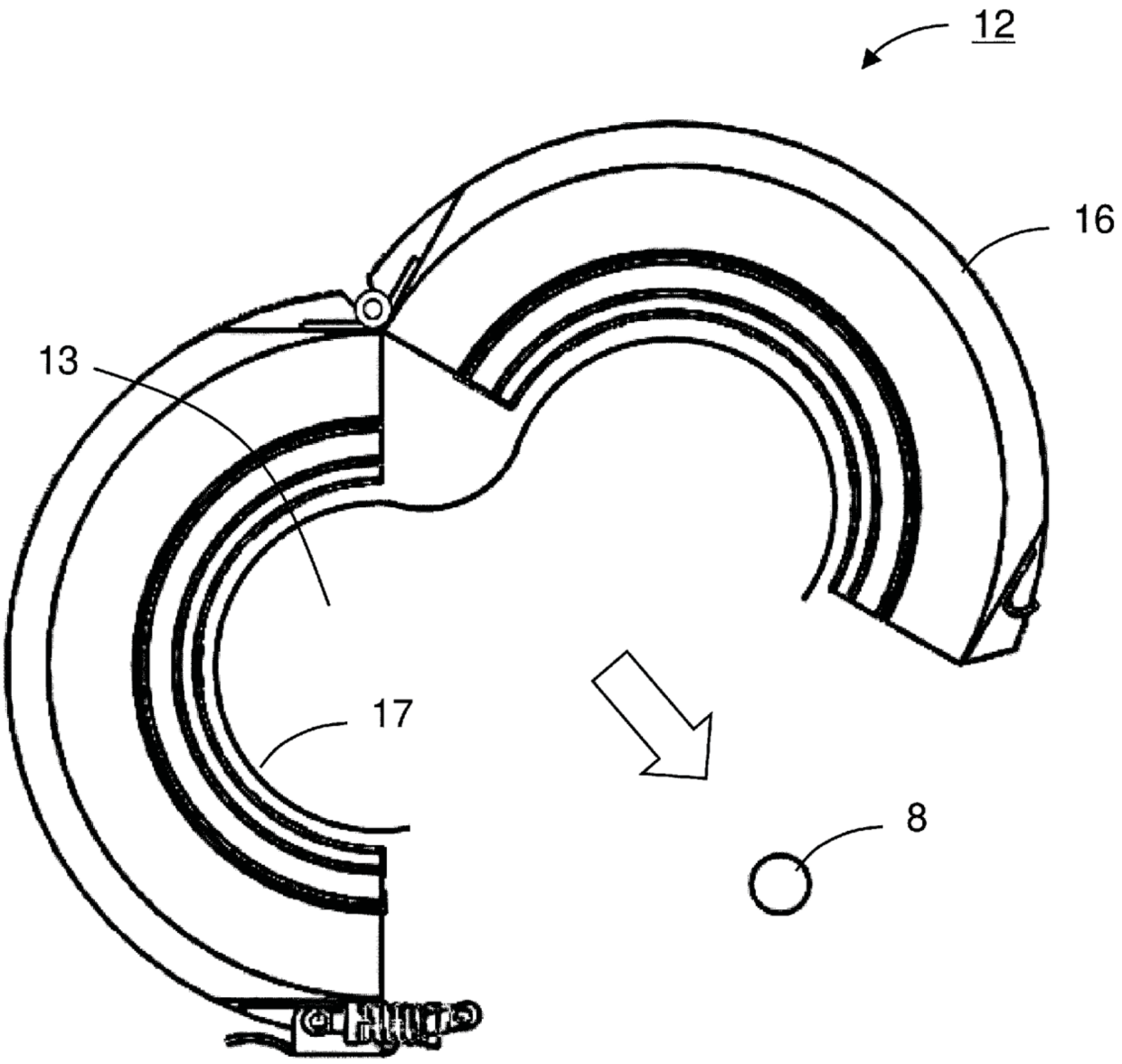


FIG. 6

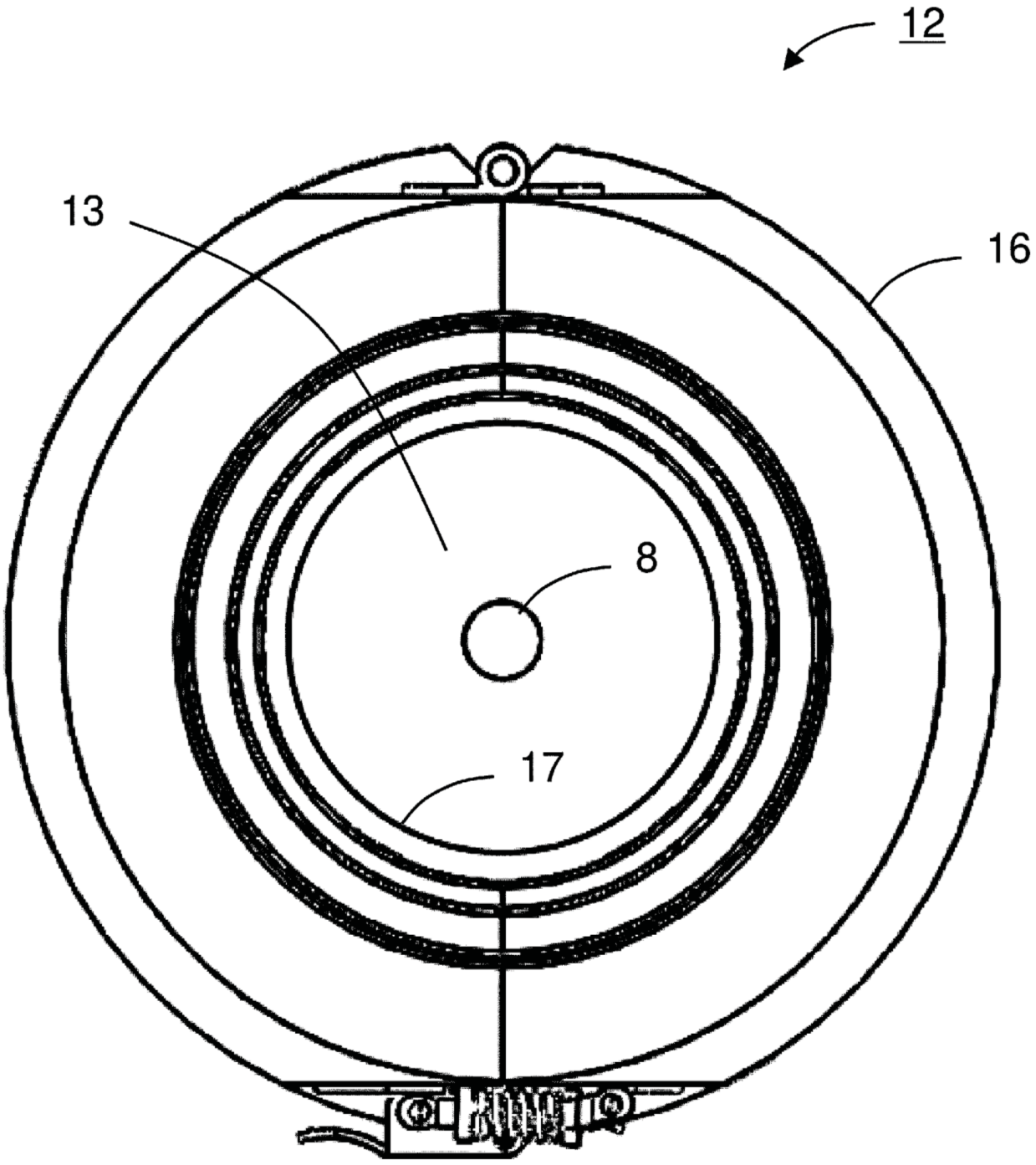


FIG. 7

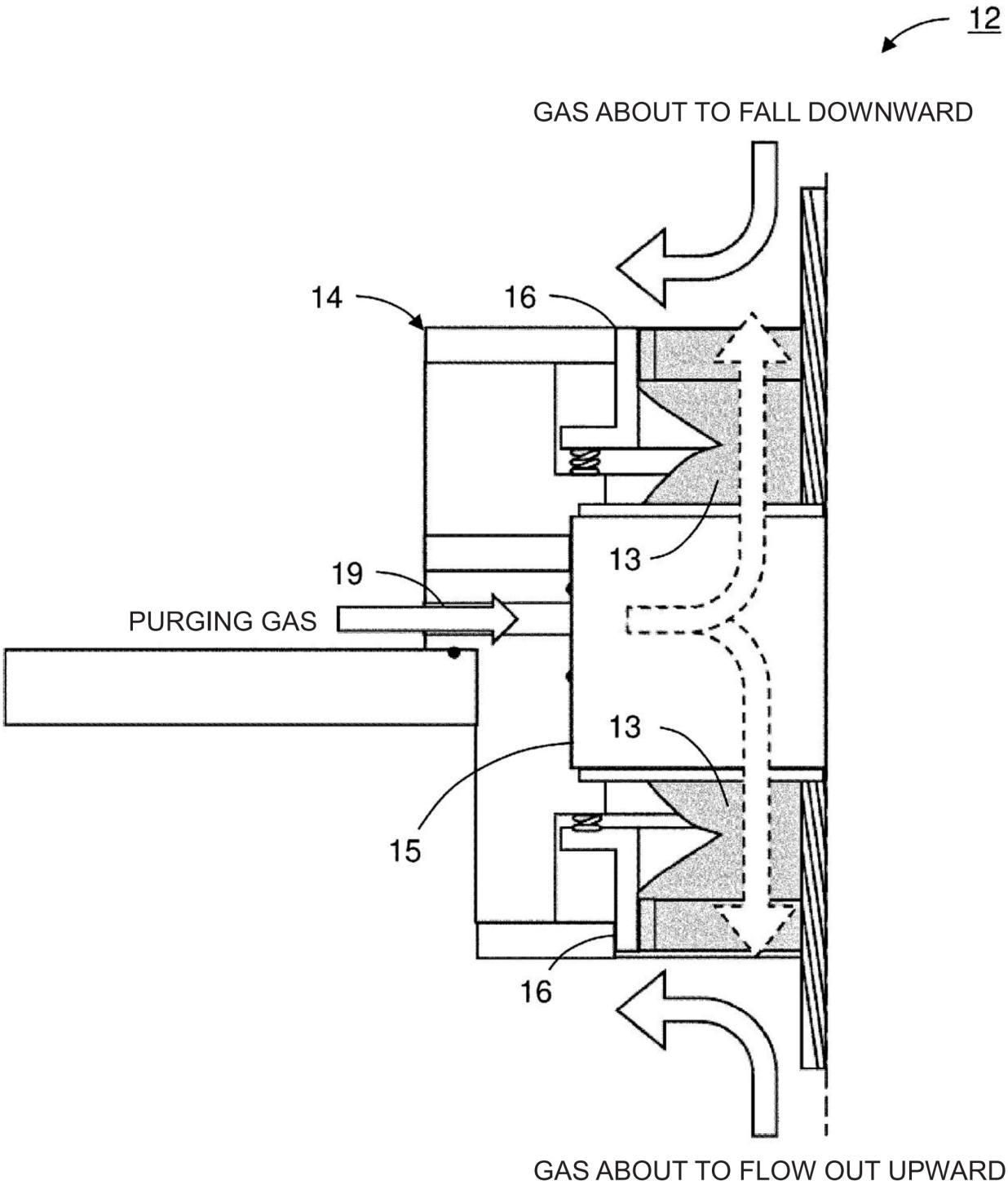

12
GAS ABOUT TO FALL DOWNWARD
14
16
13
19
PURGING GAS
13
15
16
GAS ABOUT TO FLOW OUT UPWARD

FIG. 8

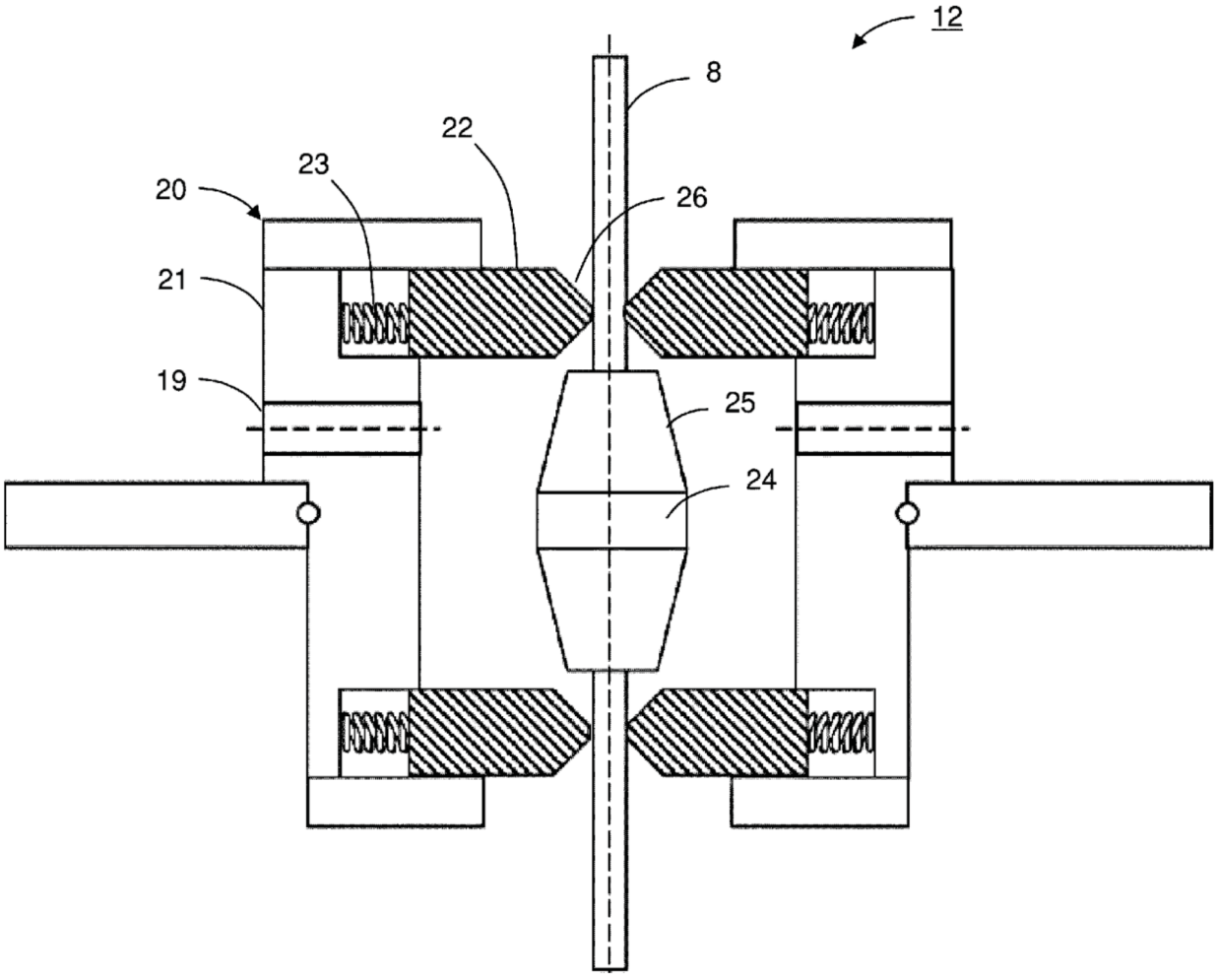


FIG. 9

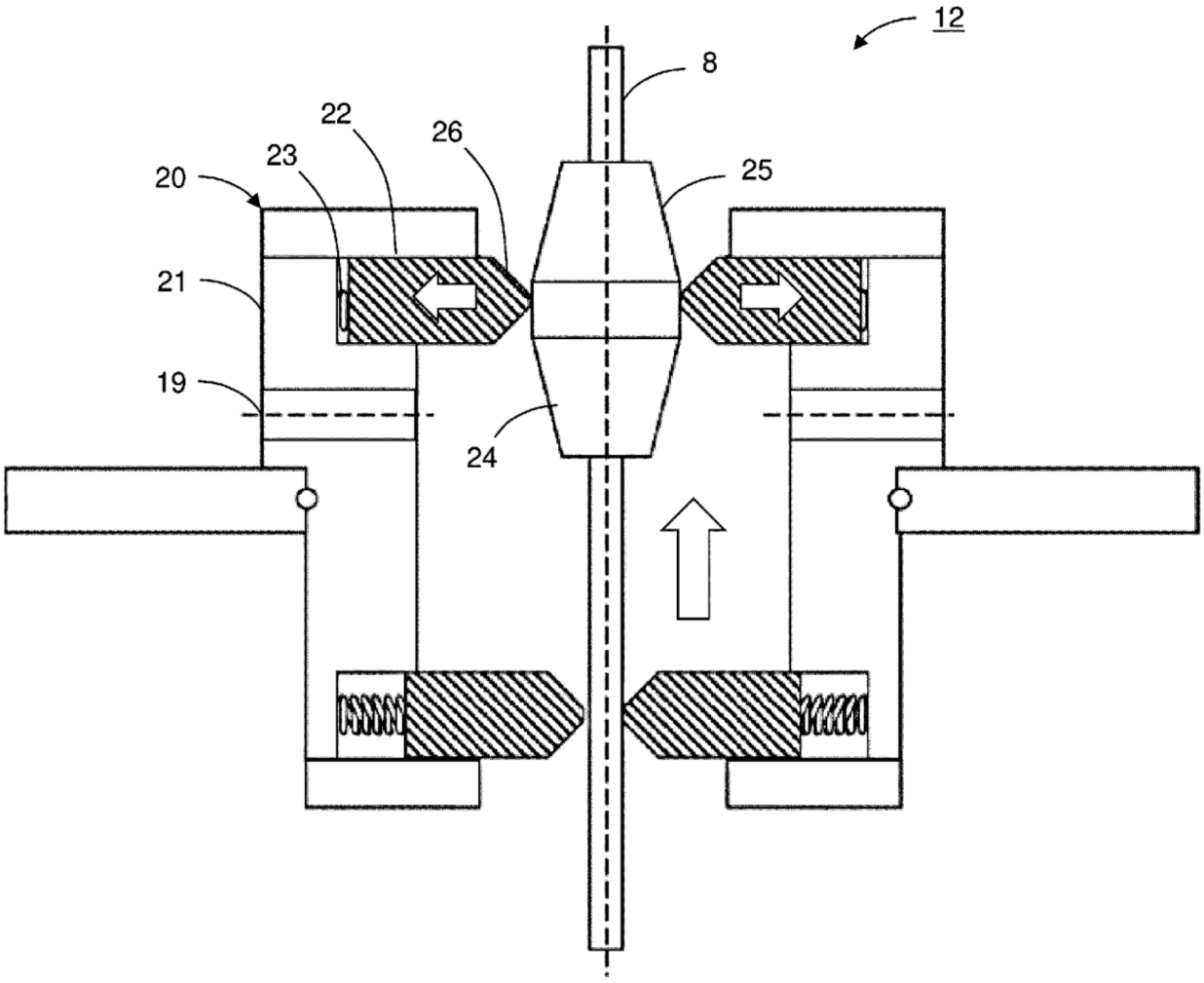


FIG. 10

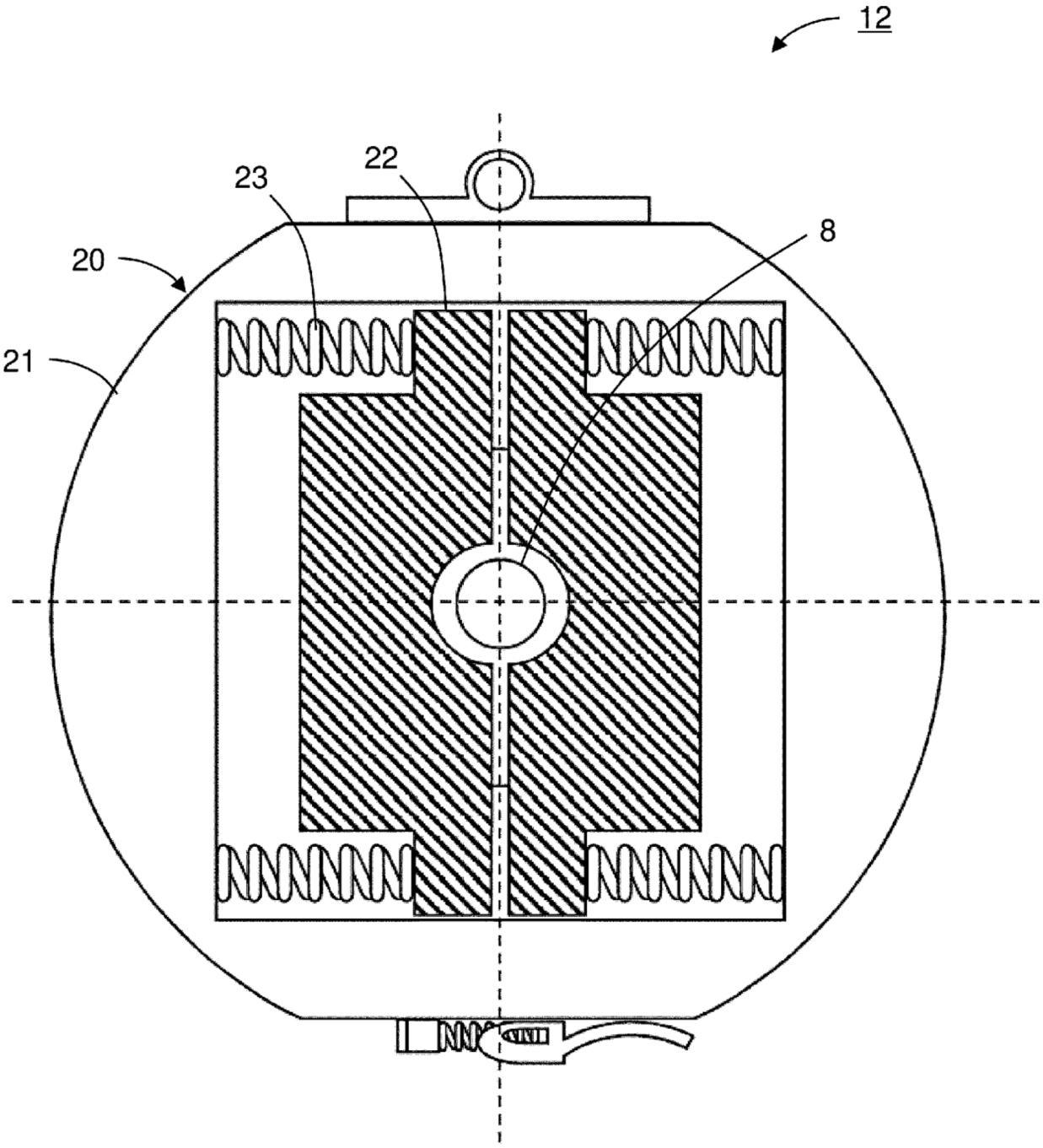


FIG. 11

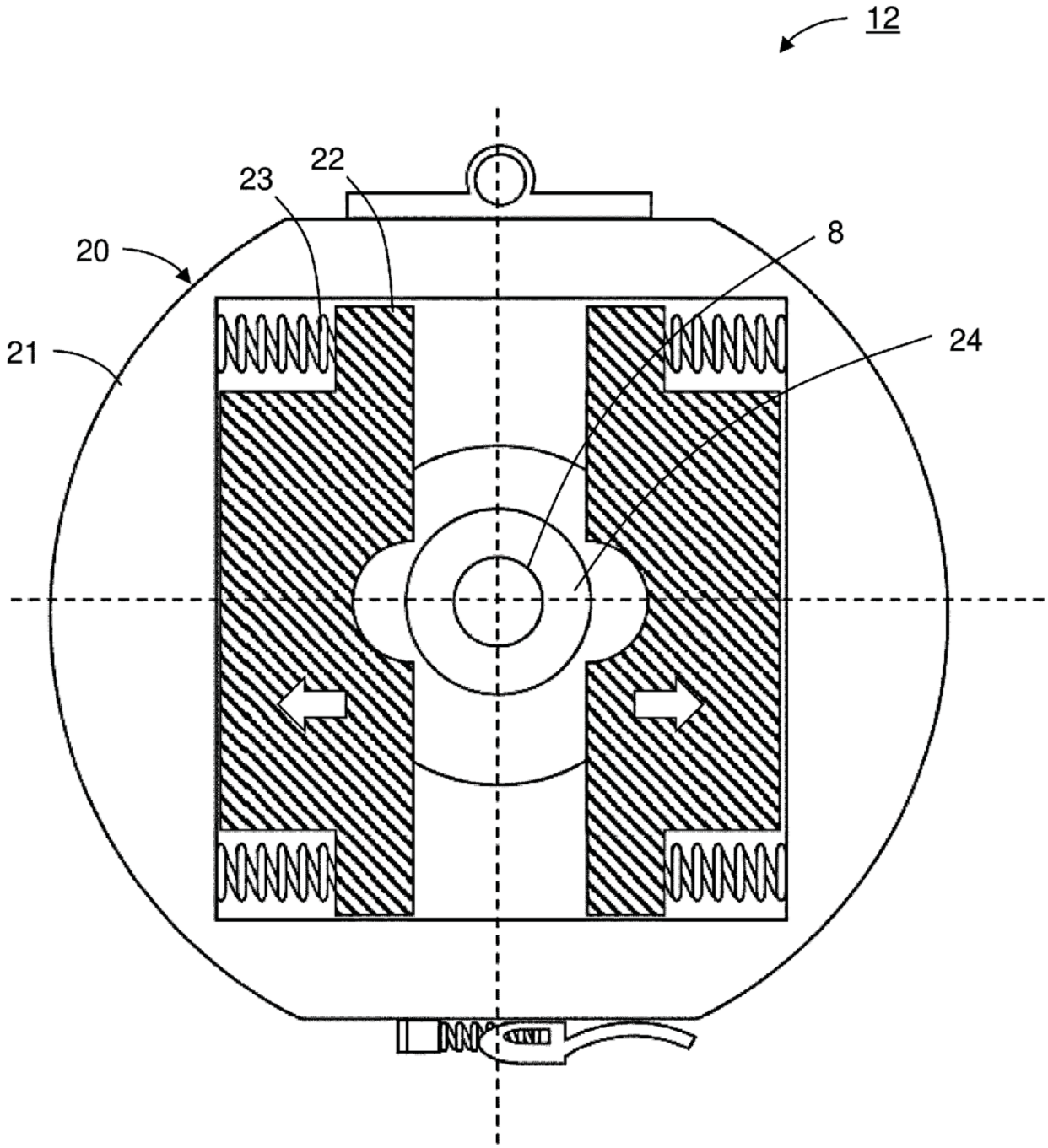


FIG. 12

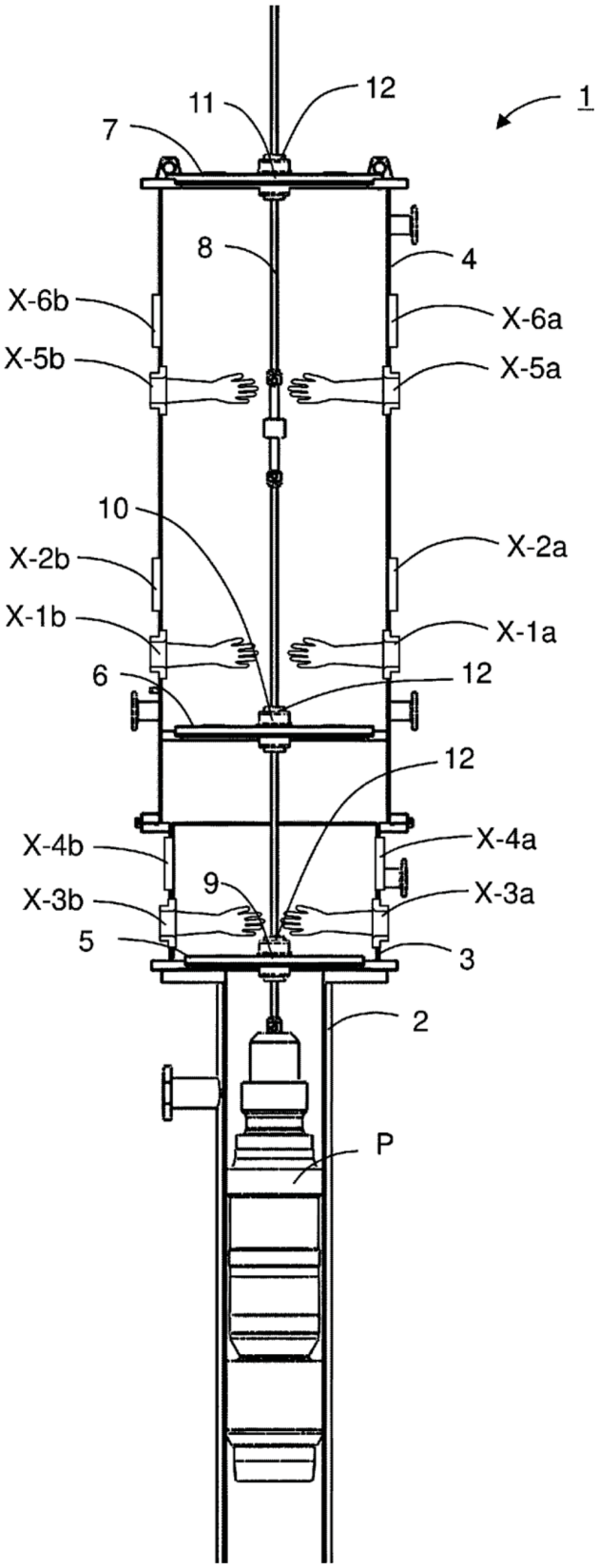
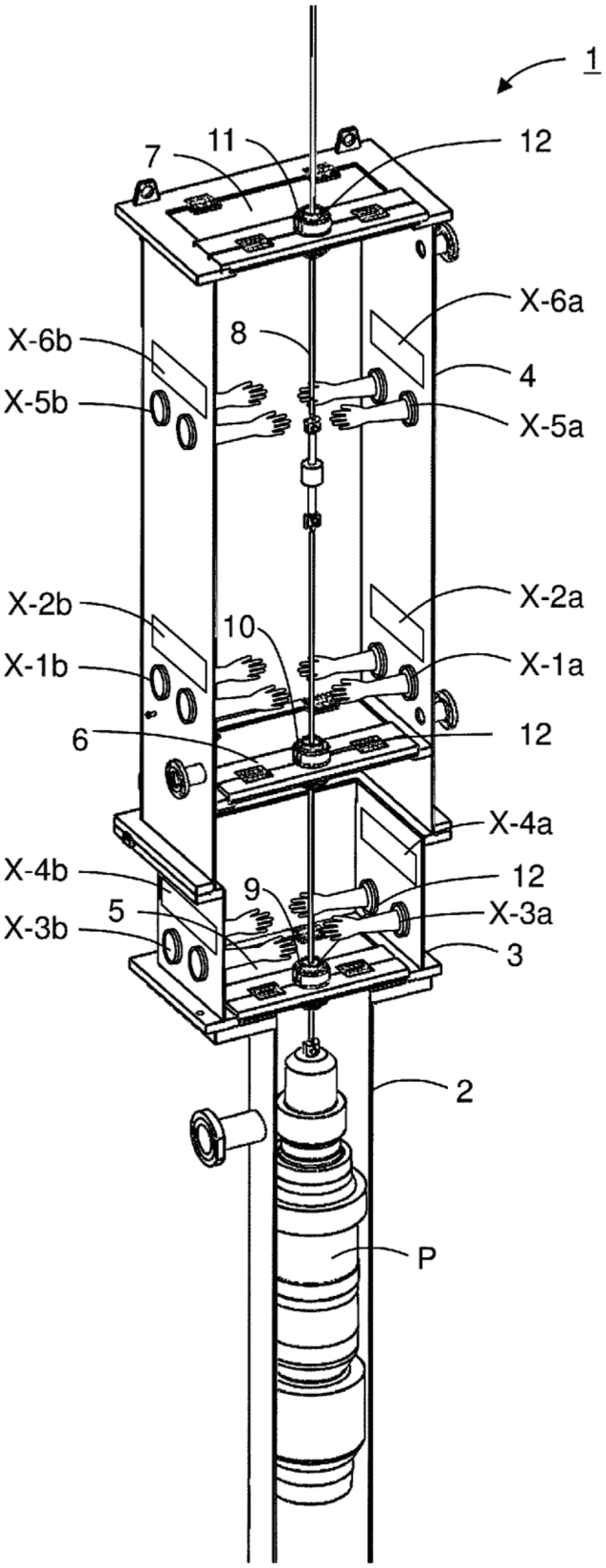

1
11
12
7
8
4
X-6b
X-6a
X-5b
X-5a
10
X-2b
X-2a
X-1b
X-1a
6
12
12
X-4b
X-4a
9
X-3b
X-3a
5
3
2
P

FIG. 13


1
7
11
12
X-6a
X-6b
8
4
X-5b
X-5a
X-2b
X-2a
10
X-1b
X-1a
6
12
X-4a
X-4b
12
9
5
X-3a
X-3b
3
2
P

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/020278

A. CLASSIFICATION OF SUBJECT MATTER

F17C 13/00(2006.01)i; ***F17C 9/00***(2006.01)i
FI: F17C13/00 302E; F17C9/00 B

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F17C13/00; F17C9/00

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 59-58194 A (SHINKO KINZOKU INDUSTRIES CO., LTD.) 03 April 1984 (1984-04-03) page 2, lower left column, line 11 to page 3, upper right column, line 16, fig. 1	1, 8-9
A	entire text, all drawings	2-7
Y	JP 9-324792 A (KUBOTA CORPORATION) 16 December 1997 (1997-12-16) paragraphs [0008], [0009], fig. 1	1, 8-9
A	entire text, all drawings	2-7
Y	JP 2018-25130 A (EBARA CORPORATION) 15 February 2018 (2018-02-15) paragraph [0003], fig. 6, 7	1, 8-9
A	entire text, all drawings	2-7
Y	JP 2011-11274 A (MITSUI ENGINEERING & SHIPBUILDING CO., LTD.) 20 January 2011 (2011-01-20) paragraphs [0016], [0017], fig. 1	8-9
A	entire text, all drawings	1-7

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 July 2024	**23 July 2024**
Name and mailing address of the ISA/JP **Japan Patent Office (ISA/JP)** **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Authorized officer Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/020278

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2003-200148 A (TOSHIBA CORPORATION) 15 July 2003 (2003-07-15) paragraphs [0029]-[0031], fig. 1	8-9
A	entire text, all drawings	1-7
P, X	WO 2023/136246 A1 (EBARA CORPORATION) 20 July 2023 (2023-07-20) entire text, all drawings	1-9

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/020278

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 59-58194 A	03 April 1984	(Family: none)	
JP 9-324792 A	16 December 1997	(Family: none)	
JP 2018-25130 A	15 February 2018	(Family: none)	
JP 2011-11274 A	20 January 2011	(Family: none)	
JP 2003-200148 A	15 July 2003	(Family: none)	
WO 2023/136246 A1	20 July 2023	(Family: none)	

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2018080801 A **[0007]**