



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

(43) Date of publication:
06.11.2013 Bulletin 2013/45

(51) Int Cl.:
F04C 2/107 (2006.01)

(21) Application number: **11853739.8**

(86) International application number:
PCT/JP2011/080135

(22) Date of filing: **26.12.2011**

(87) International publication number:
WO 2012/090968 (05.07.2012 Gazette 2012/27)

(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 MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **27.12.2010 JP 2010290366**

(71) Applicant: **Heishin Ltd.**
Hyogo 652-0852 (JP)

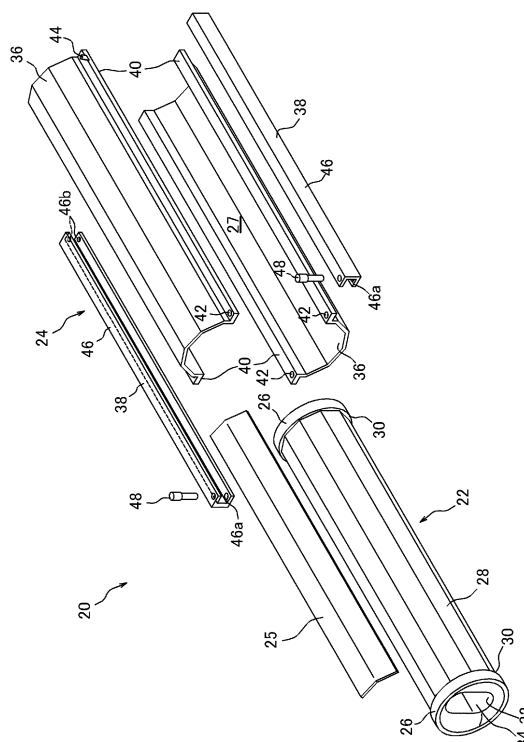
(72) Inventors:
• **HASHIMA, Takashi**
Kobe-shi
Hyogo 652-0852 (JP)
• **OGAWA, Masaki**
Nagahama-shi
Shiga 529-0261 (JP)

(74) Representative: **Plougmann & Vingtoft A/S**
Rued Langgaards Vej 8
2300 Copenhagen S (DK)

(54) **UNIAXIAL ECCENTRIC SCREW PUMP**

(57) The purpose of the invention is to provide a uniaxial eccentric screw pump in which a stator is easily separatable to an outer cylinder and a lining member, and a tightening margin is easily adjustable. The stator 20 has a cylindrical liner part 22 of which an inner circumferential face is integrally formed to be a female thread, and a cylindrical outer cylinder part 24. Flange parts 26 and 26 projecting outwardly in the radial direction are formed in both ends of the liner part 22, and an outer cylinder mounting part 28 is provided therebetween. The outer cylinder mounting part 28 is mounted to the outer cylinder part 24 in a non-adhesion manner, and both ends thereof contact the flange parts 26 and 26. The tightening margin can be adjusted by inserting or removing a shim 25 between the liner part 22 and the outer cylinder part 24.

Fig. 3



Description

[Technical Field]

[0001] The present invention relates to a uniaxial eccentric screw pump provided with a stator which can be divided into an outer cylinder part and a lining part.

[Background Art]

[0002] Conventionally, as disclosed in the following Patent Literature 1, a pump called a uniaxial eccentric screw pump having a structure in which a rotor formed into a male thread shape is inserted into a stator of which an inner circumferential face is formed into a female thread shape is provided. Many of the stators adopted to this pump are constructed so that a lining member formed of, for example, rubber or resin is inserted into a metal outer cylinder. The stator adopted to the conventional technology prevents, by fixing the outer cylinder and the lining member by adhesive or the like, a misalignment of both and a misalignment of the lining member.

[Citation List]

[Patent Literature]

[0003]

[Patent Literature 1] JP2005-344587A

[Summary of the Invention]

[Technical Problem]

[0004] In the uniaxial eccentric screw pump of the conventional technology, if it becomes impossible to demonstrate sufficient performance of the stator due to a deterioration over time by reductions in a contacting pressure between an outer surface of a rotor and an inner surface of the stator, and a tightening margin (an overlap between the outer surface of the rotor and the inner surface of the stator), a measure by replacing the stator or a measure by replacing the rotor with one having a greater diameter is taken. If the approach in which the rotor is replaced with one having a greater diameter for the adjustments of, for example, the tightening margin, is adopted, a disassembly of the uniaxial eccentric screw pump is required and, thus, this will cause a problem that a working efficiency drops.

[0005] Alternatively, if the measure is taken by replacing the stator, since the stator of the conventional technology is structured so that the outer cylinder and the lining member are integrated by adhesion, it is necessary to replace not only the worn-out lining member but the outer cylinder as well. Thus, in terms of considerations to environmental problems, running cost and the like, it

is desirable to have a structure in which, for example, the outer cylinder and the lining member which constitute the stator can easily be collected separately and the worn-out lining member is replaced to recover the contacting pressure and the tightening margin between the rotor and the stator.

[0006] If the measure is taken by replacing, for example, the lining member, a disassembly and assembly of the uniaxial eccentric screw pump must be performed. In addition, in the uniaxial eccentric screw pump of the conventional technology, a work to accurately align the center axes of the lining member and the stator at the time of assembling is required. Thus, in order to further suppress the replacing frequency of the lining member, the running cost associated with the replacement of the lining member, and the like, it is desirable to have a configuration in which the tightening margin and the like is easily recoverable with sufficient accuracy without replacing the lining member except for a case where the lining member is excessively worn out, and the center axes of the lining member and the stator are not necessary to be aligned when performing the work of recovering the tightening margin and the like.

[0007] Further, in the uniaxial eccentric screw pump, it is desired that the tightening margin is suitably adjustable according to a temperature change, an application of transferring fluid, etc. Specifically, in the uniaxial eccentric screw pump, there is a need to wash members, such as the rotor and the stator, by transferring hot water or the like after fluid such as foodstuffs is transferred. However, in the conventional technology, since the tightening margin and the like cannot be adjusted unless the rotor or the stator is replaced, the outer diameter of the rotor and the inner diameter of the stator are set so that the tightening margin will not be excessive when transferring hot water or the like. Thus, in the uniaxial eccentric screw pump of the conventional technology, it is very difficult to have the tightening margin and the like in the suitable state when transferring low-temperature fluid.

[0008] Thus, the purpose of the present invention is to provide a uniaxial eccentric screw pump in which a stator is easily separable into an outer cylinder and a lining member, and a contacting pressure and a tightening margin between an outer surface of the rotor and an inner surface of the stator are easily adjustable with sufficient accuracy.

[Solution to Problem]

[0009] In order to resolve the problem described above, a uniaxial eccentric screw pump of the present invention includes a male threaded rotor and a stator through which the rotor is insertable. The stator includes a cylindrical liner part having a female threaded inner circumferential face, an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner, and an adjusting means capable of offsetting the outer cylinder

part in a radial direction of the liner part, at least in an area corresponding to a part of the outer cylinder part in a circumferential direction of the liner part.

[0010] When configured as above, by offsetting in the radial direction at least the area corresponding to the part of the outer cylinder part in the circumferential direction by the adjusting means, it is possible to adjust a contacting pressure and a tightening margin between the outer surface of the rotor and the inner surface of the stator. Thus, it is possible to suitably adjust the tightening margin according to wear of the lining member, a temperature change of transferring fluid, application, and the like, without, for example, replacing the stator or the rotor. In addition, by this, it is possible to further suppress a replacing frequency and running cost of the lining member.

[0011] Further, it was found that, after the present inventors' diligent considerations, even if only the area corresponding to the part of the outer cylinder part in the circumferential direction is offset as described above, the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the liner part are substantially uniform regardless of locations, and the lining member does not suffer uneven wear, but it is worn substantially uniform. Thus, in the uniaxial eccentric screw pump of the present invention, it is possible to suppress the replacing frequency and the running cost of the liner part to the minimum. Further, in the uniaxial eccentric screw pump of the present invention, when a work of adjusting the contacting pressure and the tightening margin by using the adjusting member is performed, it is possible to easily adjust the tightening margin and the like with sufficient accuracy, without a need to perform a work in which the center axes of the lining member and the rotor are aligned.

[0012] In the uniaxial eccentric screw pump of the present invention, it is possible by adjusting the tightening margin and the like using the adjusting means to operate in a suitable state according to the temperature of transferring fluid, the application and the like. Thus, according to the uniaxial eccentric screw pump of the present invention, it is possible to prevent breakage of the stator due to the tightening margin becoming excessive, and degradation of fluid transfer performance due to the tightening margin becoming too small.

[0013] A uniaxial eccentric screw pump of the present invention provided based on a similar knowledge includes a male threaded rotor and a stator through which the rotor is insertable. The stator includes a cylindrical liner part having a female threaded inner circumferential face, an outer cylinder part forming a liner part mounting area where the liner part is accommodated in a non-adhesion manner, and an adjusting means capable of expanding and/or contracting the liner part mounting area in a radial direction of the liner part, at least in a part of the liner part in a circumferential direction of the liner part.

[0014] In the uniaxial eccentric screw pump of the present invention, by the adjusting means expanding and/or contracting in the radial direction the liner part

mounting area formed inside the outer cylinder part, in the part of the liner part in the circumferential direction, it is possible to adjust the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator. Thus, it is possible to suitably adjust the tightening margin, without, for example, replacing the stator or the rotor.

[0015] In the uniaxial eccentric screw pump of the present invention, it is not necessary to replace the lining member except for a case where the lining member is excessively worn-out, and it is not necessary to replace the lining member and the rotor, even if the temperature of transferring fluid, the application and the like change. Thus, it is possible to suppress the replacing frequency of the lining member to the minimum, and to suppress the time and effort required for maintenance, the running cost and the like to the minimum.

[0016] Further, after the present inventors' diligent considerations, it was found that, even if only an area corresponding to a part of the inner circumferential face of the outer cylinder in the circumferential direction is expanded and contracted, the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the liner part become substantially uniform regardless of locations. For this reason, in the uniaxial eccentric screw pump of the present invention, even if it is operated in a state where the liner part mounting area is expanded and contracted by the adjusting means, uneven wear of the lining member does not occur. Thus, according to the present invention, it is possible to suppress the replacing frequency and the running cost of the liner part to the minimum.

[0017] Since the uneven wear of the lining member does not occur, when the work of adjusting the contacting pressure and the tightening margin using the adjusting member is performed, it is not necessary to perform the work to align the center axes of the lining member and the rotor. Thus, in the uniaxial eccentric screw pump of the present invention, the adjusting work of the tightening margin and the like can be performed very easily.

[0018] In the uniaxial eccentric screw pump of the present invention, it is possible by adjusting the tightening margin and the like using the adjusting means to operate in a suitable state according to the temperature of transferring fluid, application and the like. Thus, according to the uniaxial eccentric screw pump of the present invention, it is possible to prevent the breakage of the stator due to the tightening margin becoming excessive and the transfer performance degradation of fluid due to the tightening margin becoming too small.

[0019] A uniaxial eccentric screw pump of the present invention provided based on a similar knowledge includes a male threaded rotor and a stator through which the rotor is insertable. The stator includes a cylindrical liner part having a female threaded inner circumferential face, an outer cylinder part forming a liner part mounting area where the liner part is accommodated in a non-adhesion manner, and an adjusting means capable of ex-

panding and/or contracting the liner part mounting area in a radial direction of the liner part, at least in a part of the liner part mounting area in a circumferential direction of the liner part, by adjusting a pressing force acting in the radial direction from the outer cylinder part side at least on a partial area in the circumferential direction of the liner part.

[0020] In the uniaxial eccentric screw pump of the present invention, by using the adjusting means, it is possible by adjusting the pressing force which acts from the outer cylinder part side at least on the partial area of the liner part in the circumferential direction to expand and/or contract the liner part mounting area in the radial direction, and to adjust the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator. Thus, it is possible to suitably adjust the tightening margin, without, for example, replacing the stator or the rotor.

[0021] In the uniaxial eccentric screw pump of the present invention, except for a case where the lining member is excessively worn-out, even if the tightening margin is reduced due to wear of the lining member, even if a temperature of transferring fluid is changed, even if application is changed, and the like, it is possible to suitably adjust the tightening margin only by adjusting using the adjusting means. Thus, according to the uniaxial eccentric screw pump of the present invention, it is possible to suppress the replacing frequency of the lining member to the minimum, and to suppress time and effort required for maintenance, running cost and the like to the minimum.

[0022] Further, after the present inventors' diligent considerations, even if the pressing force which acts in the radial direction from the outer cylinder part side on the partial area of the liner part in the circumferential direction is adjusted using the adjusting means, it was found that the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the liner part are substantially uniform regardless of locations. For this reason, in the uniaxial eccentric screw pump of the present invention, even if the tightening margin and the like are adjusted using the adjusting means, the uneven wear of the lining member does not occur. Thus, according to the present invention, it is possible to suppress the replacing frequency and the running cost of the liner part to the minimum.

[0023] Since the uneven wear of the lining member does not occur, when the work to adjust the contacting pressure and the tightening margin is performed using the adjusting member, it is not necessary to perform the work to align the center axes of the lining member and the rotor. Thus, in the uniaxial eccentric screw pump of the present invention, the adjusting work of the tightening margin and the like can be performed very easily.

[0024] In the uniaxial eccentric screw pump of the present invention, it is possible by adjusting the pressing force which acts at least on the partial area of the liner part in the circumferential direction using the adjusting

means to easily adjust the tightening margin and the like to an appropriate value according to the temperature of transferring fluid, the application and the like. Thus, according to the uniaxial eccentric screw pump of the present invention, it is possible to prevent the breakage of the stator due to the tightening margin becoming excessive and the transfer performance degradation of fluid due to the tightening margin becoming too small.

[0025] In the uniaxial eccentric screw pump of the present invention, it is preferable that the adjusting means is comprised of a shim insertable into and/or removable from between the liner part and the outer cylinder part.

[0026] According to this configuration, it is possible to adjust the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator to an optimum state by the removal and insertion of the shim, an adjustment of the thickness of the shim, an adjustment of the number of the shims, etc.

[0027] In the uniaxial eccentric screw pump of the present invention, it is desirable that the outer cylinder part is dividable into a plurality of outer cylinder constituting members in the circumferential direction, the outer cylinder constituting member each having a flange part extending in an axial direction thereof at both ends in the circumferential direction, respectively, the adjusting means is comprised of a coupling body for coupling the flange parts of the outer cylinder constituting members adjacent to each other in the circumferential direction, and the adjusting means is adjustable of an interval between the flange parts.

[0028] According to this configuration, it is possible by adjusting the interval between the flange parts by the adjusting means to adjust the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator to an optimum state.

[0029] Further, in the uniaxial eccentric screw pump of the present invention, the coupling body may be comprised of a pinching member for pinching the flange parts.

[0030] According to this configuration, it is possible by adjusting the pinching force which acts on the flange parts by the pinching member to easily adjust the interval between the flange parts and to adjust the tightening margin and the like with sufficient accuracy.

[0031] A uniaxial eccentric screw pump of the present invention provided based on a similar knowledge includes a male threaded rotor and a stator through which the rotor is insertable. The stator includes a cylindrical liner part having a female threaded inner circumferential face, and an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner. A shim is insertable into and/or removable from between the liner part and the outer cylinder part, in an area that is at least a part of the liner part in a circumferential direction of the liner part and extends in an axial direction of the liner part.

[0032] When configured as above, it is possible by in-

serting and/or removing the shim between the liner part and the outer cylinder part to offset in the radial direction of the liner part the area corresponding at least to a circumferential part of the inner circumferential face of the outer cylinder part. In other words, it is possible to expand and/or contract in the radial direction of the liner part the area formed inside the outer cylinder part, where the liner part is to be mounted (the liner part mounting area), in the part of the liner part to the circumferential direction. Thus, in the uniaxial eccentric screw pump of the present invention, it is possible by inserting and/or removing the shim between the liner part and the outer cylinder part to adjust the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator. Therefore, in the uniaxial eccentric screw pump of the present invention, the tightening margin can suitably be adjusted according to wear of the lining member, a temperature change of transferring fluid, application and the like, without, for example, replacing the stator or the rotor. In addition, by this, it is possible to further suppress the replacing frequency and the running cost of the lining member.

[0033] Further, as described above, as a result of the present inventors' diligent considerations, it was found that, even if only the area corresponding to the circumferential part of the inner circumferential face of the outer cylinder part is offset, or even if the liner part mounting area, in the part of the liner part in the circumferential direction, is expanded and/or contracted in the radial direction of the liner part, the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the liner part are substantially uniform regardless of locations. Thus, in the uniaxial eccentric screw pump of the present invention, even if the fluid transferred in a state where the shim is inserted and/or removed between the outer cylinder and the lining member, the lining member is worn substantially uniform, without being unevenly worn. Thus, in the uniaxial eccentric screw pump of the present invention, it is possible to suppress the replacing frequency and the running cost of the liner part due to the uneven wear to the minimum. In addition, since the uneven wear of the liner part does not occur, when inserting and/or removing the shim between the liner part and the outer cylinder part, it is not necessary to perform the work to align the center axes of the lining member and the rotor. Thus, in the uniaxial eccentric screw pump of the present invention, the adjusting work such as of the tightening margin can be performed very simply.

[0034] In the uniaxial eccentric screw pump of the present invention, it is possible by adjusting the tightening margin and the like using the shim to operate in a suitable state according to the temperature of transferring fluid, the application and the like. Thus, according to the uniaxial eccentric screw pump of the present invention, it is possible to prevent a breakage of the stator due to the tightening margin becoming excessive and a transfer performance degradation of fluid due to the tightening

margin becoming too small.

[0035] A uniaxial eccentric screw pump of the present invention provided based on a similar knowledge includes a male threaded rotor and a stator through which the rotor is insertable. The stator includes a cylindrical liner part having a female threaded inner circumferential face, and an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner. The outer cylinder part is dividable into a plurality of outer cylinder constituting members in a circumferential direction. The outer cylinder constituting members has a flange part extending in an axial direction of the outer cylinder constituting members at both ends in the circumferential direction. The outer cylinder part is able to be formed by coupling the flange parts of the outer cylinder constituting members adjacent to each other in the circumferential direction with a coupling body. The coupling body is adjustable of an interval between the flange parts.

[0036] When configured as above, it is possible by adjusting the interval between the flange parts of the outer cylinder constituting members, which constitute the outer cylinder part, using the coupling body to offset in the radial direction of the liner part the area corresponding to at least the circumferential area of the inner circumferential face of the outer cylinder part. In other words, it is possible to expand and/or contract in the radial direction of the liner part the area formed inside the outer cylinder part, where the liner part is mounted (liner part mounting area), in the part of the liner part in the circumferential direction. In addition, it is possible to change the pressing force which acts on the liner part, at least in the circumferential area of the liner part. Thus, in the uniaxial eccentric screw pump of the present invention, by adjusting the interval between the flange parts of the outer cylinder constituting members using the coupling body, the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator can be adjusted, and it is not necessary to perform the replacement or the like of the stator or the rotor. In addition, by this, it is possible to further suppress the replacing frequency and the running cost of the lining member.

[0037] As described above, according to the results of the present inventors' diligent considerations, in any of the cases where only the area corresponding to the circumferential part of the inner circumferential face of the outer cylinder part is offset, where the liner part mounting area is expanded and/or contracted in the radial direction of the liner part, in the circumferential part of the liner part, and where the pressing force which acts on the liner part is changed at least in the circumferential area of the liner part, the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the liner part become substantially uniform regardless of locations. Thus, in the uniaxial eccentric screw pump of the present invention, even if the fluid is transferred in a state where the interval between the flange parts of the outer cylinder constituting members

is adjusted using the coupling body, the lining member is not unevenly worn, but it is worn substantially uniform. Thus, in the uniaxial eccentric screw pump of the present invention, it is possible to suppress the replacing frequency and the running cost of the liner part due to the uneven wear to the minimum. In addition, since the uneven wear of the liner part does not occur, when inserting and/or removing the shim between the liner part and the outer cylinder part, it is not necessary to perform the work to align the center axes of the lining member and the rotor. Thus, in the uniaxial eccentric screw pump of the present invention, the adjusting work of the tightening margin and the like can be performed very easily.

[0038] In the uniaxial eccentric screw pump of the present invention, it is preferable that the coupling body is comprised of a pinching member for pinching the flange parts.

[0039] According to this configuration, it is possible to easily adjust by the pinching member the coupling force which acts on the flange parts. Thus, it is possible to adjust the tightening margin and the like with sufficient accuracy.

[0040] In the uniaxial eccentric screw pump of the present invention, it is preferable that a flange-shaped part projecting outwardly in the radial direction is provided to both end parts of the liner part, respectively, the outer cylinder part is arranged between the flange-shaped parts, and end parts of the outer cylinder part contact the flange-shaped parts.

[0041] In the uniaxial eccentric screw pump of the present invention, it is constructed so that the outer cylinder part is arranged between the flange-shaped parts provided to both end parts of the liner part, and, further, the end part of the outer cylinder part contacts the flange-shaped part. Thus, the outer cylinder part plays a role as a support for preventing the contraction of the liner part in the axial direction, and it can maintain the inner diameter of the liner part substantially uniform. Thus, it is possible to avoid the uneven wear of the liner part, and to stabilize the discharging amount.

[0042] In the uniaxial eccentric screw pump of the present invention, it is desirable to include an end stud with which one end side of the stator is connected, a pump casing with which the other end side of the stator is connected, and a stay bolt for coupling the end stud and the pump casing. It is desirable that a nut part threadably engageable with the stay bolt is provided to the end stud and/or the pump casing, and an interval between the end stud and the pump casing is changeable by relatively rotating the stay bolt and the nut part.

[0043] In the uniaxial eccentric screw pump of the present invention, since it is possible by relatively rotating the stay bolt and the nut part to change the interval between the end stud and the pump casing, it is possible to easily perform the tightening margin adjustment by the adjusting means as described above.

[0044] In the uniaxial eccentric screw pump of the present invention, the contour of the liner part may have

a polygonal shape.

[0045] By having this configuration, it is possible to prevent the misalignment of the liner part in the circumferential direction, and to further stabilize the operating conditions of the uniaxial eccentric screw pump.

[0046] Further, in the uniaxial eccentric screw pump of the present invention, it is preferable that the outer cylinder part is bent in a shape conforming to the contour of the liner part.

[0047] By having this configuration, it is possible to more securely prevent the misalignment of the liner part in the circumferential direction, and to further stabilize the operating conditions of the uniaxial eccentric screw pump.

[Advantageous Effects of the Invention]

[0048] According to the present invention, it is possible to provide the uniaxial eccentric screw pump in which the stator can easily be separated into the outer cylinder and the lining member, and the contacting pressure and the tightening margin between the outer surface of the rotor and the inner surface of the stator can easily be adjusted with sufficient accuracy.

[Brief Description of Drawings]

[0049]

Fig. 1 is a cross-sectional view showing a uniaxial eccentric screw pump according to one embodiment of the present invention.

Fig. 2(a) is an enlarged view of an α -portion in Fig. 1, and Fig. 2(b) is an enlarged view of a β -portion in Fig. 1.

Fig. 3 is an exploded perspective view of a stator.

Fig. 4 is views showing the stator adopted to the uniaxial eccentric screw pump of Fig. 1, where Fig. 4(a) is a front view, Fig. 4(b) is a side view. Fig. 4(c) is a B-B cross-sectional view of Fig. 4(d), and Fig. 4(d) is an A-A cross-sectional views of Fig. 4(a).

Fig. 5 is views showing a liner part adopted to the stator of Fig. 3, where Fig. 5(a) is a front view. Fig 5 (b) is a side view, Fig 5(c) is a D-D cross-sectional view of Fig. 5(b), and Fig. 5(d) is a C-C cross-sectional view of Fig. 5(a).

Fig. 6 is a diagram illustrating a method of mounting a pinching piece to a gripping part when clamp coupling an outer cylinder constituting body.

Fig. 7(a) is a cross-sectional view of the stator in a state where a shim is attached, and Fig. 7(b) is a cross-sectional view of the stator in a state where the shim is removed.

Figs. 8(a) and (b) are side views of the pinching piece, and Fig. 8(c) is a cross-sectional view of the stator in a state where the pinching piece shown in Fig. 8(a) is mounted.

[Description of Embodiments]

[0050] Hereinafter, a uniaxial eccentric screw pump 10 according to one embodiment of the invention is described in detail with reference to the drawings. The uniaxial eccentric screw pump 10 is so-called a rotary displacement pump, and, as shown in Fig. 1, it is configured to include a stator 20, a rotor 50, a power transmission mechanism 70. The uniaxial eccentric screw pump 10 also includes a cylindrical pump casing 12 made of metal and an end stud 13, and is structured so that both are connected with each other to be integrated. Specifically, in the uniaxial eccentric screw pump 10, swivel nuts 12x and 13x are provided to each of the pump casing 12 and the end stud 13. The pump casing 12 and the end stud 13 are connected with each other via stay bolts 18 connected with the swivel nuts 12x and 13x to be integrated. Thus, the uniaxial eccentric screw pump 10 is possible to increase and decrease an interval between the end stud 13 and the pump casing 12 by rotating the swivel nuts 12x and 13x.

[0051] The uniaxial eccentric screw pump 10 has a first opening 14a in the end stud 13, and has a second opening 14b in an outer circumferential portion of the pump casing 12. The first opening 14a is a penetrating hole, which penetrates in an axial direction of the uniaxial eccentric screw pump 10. The second opening 14b communicates with an interior space of the pump casing 12 in an intermediate part 12a located in an intermediate portion of the pump casing 12 in a longitudinal direction thereof.

[0052] The first and second openings 14a and 14b are parts which function as a suction port and a discharge port of the uniaxial eccentric screw pump 10, respectively. Describing in more detail, the uniaxial eccentric screw pump 10 of this embodiment can pump fluid by rotating the rotor 50 in a positive direction so that the first opening 14a functions as the discharge port and the second opening 14b functions as the suction port. Contrary to this, the uniaxial eccentric screw pump 10 is possible to pump the fluid by rotating the rotor 50 in the opposite direction so that the first opening 14a functions as the suction port and the second opening 14b functions as the discharge port.

[0053] As shown in Figs. 1 and 2, the pump casing 12 has a fit-in part 12c formed in a portion (an end part 12b) which faces to the end stud 13 side in an assembled state of the uniaxial eccentric screw pump 10 so that a cross-sectional shape thereof has a step. Moreover, the end stud 13 also has a fit-in part 13b formed in a portion (an end part 13a) which faces to the pump casing 12 side in the assembled state of the uniaxial eccentric screw pump 10 so that the cross-sectional shape thereof has a step. The fit-in parts 12c and 13b are parts formed to be inserted with the flange part 26 of the stator 20 described later in detail. A width h1 of the fit-in parts 12c and 13b (a length in the axial direction) is substantially the same as the thickness of the flange part 26 (a length in the axial

direction), and an opening diameter h2 in the portions where the fit-in parts 12c and 13b are formed is substantially the same as the outer diameter of the flange part 26.

[0054] The uniaxial eccentric screw pump 10 has a stator attaching part 15 where the stator 20 is attached between the pump casing 12 and the end stud 13. The uniaxial eccentric screw pump 10 becomes in a state where a series of flow paths which connect the first and second opening 14a and 14b described above is formed, by mounting the stay bolts 18 in a state where the stator 20 is arranged in the stator attaching part 15, and connecting the pump casing 12 and the end stud 13 via the stator 20.

[0055] The stator 20 is the most characteristic portion in the uniaxial eccentric screw pump 10, and as shown in Figs. 1, 3 and 4, it is roughly divided into a liner part 22, an outer cylinder part 24, and a shim 25. The liner part 22 is integrally formed of, for example, an elastic body which is represented by rubber, or resin. Although the material of the liner part 22 can suitably be selected in accordance with the kind, properties or the like of fluid to be transferred using the uniaxial eccentric screw pump 10, it is possible to suitably use fluororubber, fluorosilicone rubber, or silicone rubber. Further, the liner part 22 is preferred to be formed of a rubber material having characteristics of a permanent compression set being 20% or less when, using a measuring method described in JIS K6262, a small test piece is compressed under a condition where a compression rate is set to 25% while exposing the test piece to an atmosphere at 100°C temperature for 72 hours. Further, the hardness of the liner part 22 is preferred to be within a range from 60 to 80 by a measurement under an atmosphere at 23±1°C temperature by a type-A durometer described in JIS K6253.

[0056] The liner part 22 is a cylindrical body provided with an outer cylinder mounting part 28 for having, at both ends in the axial direction, flange parts 26 and 26 (flange-shaped parts) outwardly projecting in the radial direction, and for mounting the outer cylinder part 24 between the flange parts 26 and 26. The liner part 22 is constructed by integrally forming the flange parts 26 and 26 and the outer cylinder mounting part 28, and has a step 30 in a boundary portion between the flange parts 26 and 26 and the outer cylinder mounting part 28. The contour (cross-sectional shape) of the flange parts 26 and 26 is substantially circular, and the contour (cross-sectional shape) of the outer cylinder mounting part 28 is polygonal (in this embodiment, a substantially regular decagon). Further, as described above, the thickness of the flange parts 26 and 26 is the same as or greater than the width h1 of the fit-in parts 12c and 13b which are provided to the end parts 12b and 13a of the pump casing 12 and the end stud 13. The thickness of the flange parts 26 and 26 is desirable to be 5% to 15% thicker than the width h1. By this, the flange parts 26 and 26 are firmly pressure-joined and fixed between the end stud 13 and the pump casing 12 to be in a sealed state. Further, the outer diameters of the flange parts 26 and 26 are substantially

the same as the opening diameter h2 of the fit-in parts 12c and 13b provided to the end parts 12b and 13a of the pump casing 12 and the end stud 13, respectively.

[0057] An inner circumferential face 32 of the liner part 22 is formed in a single-twist or multiple-twist female thread shape with n-grooves. In this embodiment, the inner circumferential face 32 of the liner part 22 is formed in a multiple-twist female thread shape. More specifically, a penetrating bore 34 having a female thread shape, which extends along the longitudinal direction of the liner part 22 and is twisted at a predetermined pitch, is formed inside the liner part 22. The penetrating bore 34 is formed so that its cross-sectional shape (aperture shape) becomes substantially an oval even if it is seen as a cross section at any position of the liner part 22 in the longitudinal direction.

[0058] As shown in Figs. 3 and 4, the outer cylinder part 24 is mounted on the outer cylinder mounting part 28 of the liner part 22 described above to cover the periphery of the liner part 22 in a non-adhesion manner. Specifically, the outer cylinder part 24 is mounted on the periphery of the liner part 22 with pressure and, thus, it is integrated with the liner part 22 without using adhesives, and it is aligned both in the circumferential direction and the axial direction.

[0059] As shown in Fig. 3, the outer cylinder part 24 is comprised of a plurality of (in this embodiment, two) outer cylinder constituting bodies 36 and 36, and clamps 38 and 38, and can be formed with a liner part mounting area 27 therein. The outer cylinder constituting bodies 36 and 36 are metal members, each covering a substantially half area of the outer cylinder mounting part 28 of the liner part 22 in the circumferential direction, and they are curved (bent) to be in a shape conforming to the outer cylinder mounting part 28. Thus, by mounting the outer cylinder constituting bodies 36 to the liner part 22 so that the outer cylinder mounting part 28 is accommodated in the liner part mounting area 27, the outer cylinder constituting bodies 36 become in a state where their rotations are prohibited in the circumferential direction. Further, as shown in Fig. 4(d), the thickness of the outer cylinder constituting body 36 is greater than the steps 30 which are formed between the flange parts 26 and the outer cylinder mounting part 28 in the liner part 22. Thus, when the outer cylinder constituting bodies 36 are mounted to the outer cylinder mounting part 28, as shown in Figs. 1 and 4, the outer cylinder constituting bodies 36 become in a state where they outwardly protrude in the radial direction of the liner part 22, more than the flange parts 26.

[0060] The length of the outer cylinder constituting body 36 is substantially the same as the length of the outer cylinder mounting part 28. Thus, when the outer cylinder constituting bodies 36 are mounted to the outer cylinder mounting part 28, they become in a state where both the ends of the outer cylinder constituting bodies 36 contact the flange parts 26 and 26, in the portions where the steps 30 of the liner part 22 are formed as shown in

Figs. 1, 2 and 4. Thus, when a compression stress acts in the axial direction (longitudinal direction) in a state where the outer cylinder constituting bodies 36 are mounted to the liner part 22, the outer cylinder part 24 receives the stress by the outer cylinder constituting bodies 36, and it is possible to prevent a compressive deformation of the liner part 22 and a deformation of the penetrating bore 34 formed in the liner part 22.

[0061] Gripping parts 40 and 40 (flange parts) are formed in both ends of the outer cylinder mounting part 28 in the circumferential direction so that they extend in the longitudinal direction. Pin insertion holes 42 and 42 are formed on one end side of the gripping parts 40 and 40, and the engagement grooves 44 and 44 are formed on the other end side. The pin insertion holes 42 and 42 and the engagement grooves 44 and 44 are used in order to mount clamps 38 and 38, which are described later in detail, respectively. The engagement grooves 44 are formed so as to extend obliquely rearward (on the other end side) from the edge of the gripping part 40.

[0062] The clamp 38 is provided with a pinching piece 46 of a substantially channel shape in cross section, and a pin 48. When mounting the outer cylinder constituting body 36 to the outer cylinder mounting part 28, the pinching piece 46 is mounted so that it pinches the gripping parts 40 and 40. The pinching piece 46 has substantially the same length as the gripping parts 40, pin insertion holes 46a are formed therein on one end side in its longitudinal direction, and protrusions 46b are formed on the other end side. In a state of the pinching piece 46 where the protrusions 46b are slid along the engagement groove 44 formed so as to extend obliquely in the gripping part 40 as shown by an arrow X in Fig. 6, and the protrusion 46b then collides against an end of the engagement groove 44, it is possible to change into a state where the pin insertion holes 46a communicate with the pin insertion holes 42 and 42 on the gripping part 40 and 40 side, by rotating the pinching piece 46 about the protrusions 46b as the center as shown by an arrow Y. In this state, by inserting the inserting pin 48 through the pin insertion holes 46a, 42 and 42, it is possible to change into a state where the gripping parts 40 and 40 are pinched and fixed by the clamp 38 (a clamp coupled state).

[0063] As shown in Fig. 3, a shim 25 (adjusting means, pressing force adjusting means) is comprised of a thin plate made of metal or resin, and is a member inserted between the liner part 22 and the outer cylinder part 24 which are described above. The thickness of the shim 25 is preferred to be about 1/30 to 1/100 of the diameter of the rotor 50. In this embodiment, the thickness of the shim 25 is about 0.1 mm to 0.4 mm. Further, a lateral width of the shim 25 is set to the axial length of the outer cylinder mounting part 28 in the liner part 22 described above, in other words, a length equivalent to the length of the liner part mounting area 27 of the outer cylinder part 24. Further, a longitudinal width of the shim 25 is set to be a length equivalent to a part of the length of the

outer periphery of the outer cylinder mounting part 28 in the liner part 22. Specifically, the longitudinal width of the shim 25 is set to be about 1/12 to 1/8 of the length of the outer periphery of the outer cylinder mounting part 28. In other words, the longitudinal width of the shim 25 is set to be a length equivalent to a length from 30° to 45° in the circumferential direction of the outer cylinder mounting part 28.

[0064] As shown in Fig. 3, the shim 25 is mounted over substantially the entire width of the outer cylinder mounting part 28 in the liner part 22. Further, as shown in Figs. 3, 4 and 7(a), the shim 25 is mounted to a partial area of the outer cylinder mounting part 28 in the circumferential direction (in this embodiment, about 1/12 to 1/8 area of the outer periphery). Alternatively, only a single piece of the shim 25 may be mounted, or two or more shims 25 may be mounted in a piled-up manner as needed. Further, if the shims 25 have already mounted in the piled-up manner, some of the shims are possible to be removed as needed. Although the shim(s) 25 can be arranged so as to be on the outer cylinder mounting part 28, it is also possible to be mounted to the outer cylinder mounting part 28 using adhesive material or the like, in consideration of preventing a falling-off of the shim(s) 25 from outer cylinder mounting part 28, preventing a misalignment of the shim(s) 25 due to the effects, such as vibration, associated with operation of the uniaxial eccentric screw pump 10, and the like.

[0065] As for the stator 20, it is possible by inserting or removing the shim(s) 25 between the liner part 22 and the outer cylinder part 24 to offset a part corresponding to the circumferential part of the outer cylinder part 24 (i.e., the outer cylinder constituting body 36) in the radial direction of the liner part 22.

[0066] Specifically, in a situation where the shim (s) 25 are not inserted, it is in a state where the entire inner circumferential face of the outer cylinder part 24 substantially close contacts the outer cylinder mounting part 28 of the liner part 22 as shown in Fig. 7 (b). In this situation, when the shim 25 are inserted between the liner part 22 and the outer cylinder part 24, it becomes in a state where the outer cylinder constituting body 36 on the side where the shim 25 is inserted as shown in Fig. 7 is outwardly offset in the radial direction of the liner part 22. Further, when the shim 25 is removed from between the liner part 22 and the outer cylinder part 24, it becomes in a state where the entire inner circumferential face of the outer cylinder part 24 closely contacts the outer cylinder mounting part 28 of the liner part 22. By this, it becomes in a state where the outer cylinder constituting body 36 is inwardly offset in the radial direction of the liner part 22 by an amount of the thickness of the shim 25 removed. Thus, by inserting or removing the shim 25 between the liner part 22 and the outer cylinder part 24, the part of the outer cylinder part 24 can be offset in the radial direction of the liner part 22.

[0067] In addition, as for the stator 20, by inserting or removing the shim 25 between the liner part 22 and the

outer cylinder part 24, at least a part of the liner part mounting area 27 in the circumferential direction of the liner part 22 can be expanded and/or contracted in the radial direction of the liner part 22. Further, it is possible by inserting or removing the shim 25 to adjust the pressing force which acts in the radial direction from the outer cylinder part 24 side to the partial area of the liner part 22 in the circumferential direction. Specifically, when the shim 25 is inserted into between the liner part 22 and the outer cylinder part 24 or removed from between the liner part 22 and the outer cylinder part 24, the liner part mounting area 27 is expanded or contracted in the radial direction by the amount of the thickness of the shim 25 in the area where the shim 25 is inserted or removed. Further, since the outer cylinder part 24 is mounted in the pressing state against the liner part 22, when the shim 25 is inserted between the liner part 22 and the outer cylinder part 24, the pressing force which acts on the liner part 22 in the area where the shim 25 is inserted increases locally. Contrary to this, when the shim 25 is removed, the pressing force which acts on the liner part decreases locally by the amount.

[0068] Further, the number of the shims 25 inserted between the liner part 22 and the outer cylinder part 24 does not necessarily need to be single, but a plurality of shims may be inserted in a stacked manner. When the plurality of shims 25 are inserted in the stacked state, it is possible by adjusting the number of the shims 25 to stack to further finely adjust the offset amount of the outer cylinder constituting body 36, the amount of expansion and contraction of the liner part mounting area 27, and the balance of the pressing force which acts on the liner part 22.

[0069] The stator 20 is used in a state where the liner part 22 is covered by the outer cylinder constituting bodies 36 and 36, and the gripping parts 40 and 40 are coupled by the clamps 38 and 38. The stator 20 is incorporated into the stator attaching part 12b at a position of the pump casing 12 adjacent to the first opening 14a. Specifically, the stator 20 is fixed by inserting the flange parts 26 and 26 provided at both ends of the liner part 22 into the fit-in parts 12c and 13b formed in the pump casing 12 and the end stud 13, respectively, pinching it between the end stud 13 and the intermediate part 12a (the stator attaching part 12b), and attaching and fastening the stay bolts 18 over the end stud 13 and the body part of the pump casing 12.

[0070] As described above, when the stator 20 is attached, as shown in Fig. 2(a), one of the flange parts 26 becomes in a state where it is pinched between the end stud 13 and the outer cylinder part 24 on one end side of the liner part 22. Further, as shown in Fig. 2(b), on the other end side, it becomes in a state where the other flange part 26 is pinched between the intermediate part 12a and the outer cylinder part 24. Further, as for the outer cylinder part 24, it contacts the end parts of the flange part 26 and the end stud 13 on one end side thereof, and contacts the end parts of the flange part 26 and

the pump casing 12 on the other end side. For this reason, as for the stator 20, both the liner part 22 and the outer cylinder part 24 will not be caused misalignments and the like inside the stator attaching part 12b of the pump casing 12.

[0071] As shown in Fig. 1, the rotor 50 is a metal shaft body and is formed in a single-twist or multiple-twist female thread shape with n-1 grooves. In this embodiment, the rotor 50 is formed in a multiple-twist eccentric male thread shape with one groove. The rotor 50 is formed so that, even if it is seen as a cross section at any position in the longitudinal direction, the cross-sectional shape becomes a substantially true circle. The rotor 50 is inserted into the penetrating bore 34 formed in the stator 20 described above, and it is eccentrically rotatable inside the penetrating bore 34.

[0072] When the rotor 50 is inserted into the penetrating bore 34 formed in the liner part 22 of the stator 20, it becomes in a state where the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the stator 20 contact with each other over both tangent lines. Further, in this state, a fluid carrying path 60 is formed between the inner circumferential face 32 of the stator 20 and the outer circumferential face of the rotor 50.

[0073] The fluid carrying path 60 spirally extends in the longitudinal direction of the stator 20 and the rotor 50. Further, when the rotor 50 is rotated inside the penetrating bore 34 of the stator 20, the fluid carrying path 60 advances in the longitudinal direction of the stator 20 while revolving inside the stator 20. Thus, when the rotor 50 is rotated, it is possible to suck fluid into the fluid carrying path 60 from one end side of the stator 20, transfer this fluid toward the other end side of the stator 20 in a state where the fluid is sealed inside the fluid carrying path 60, and discharge the fluid to the other end side of the stator 20. That is, when the rotor 50 is rotated in a positive direction, it is possible to pump the fluid sucked from the second opening 14b and to discharge it from the first opening 14a. Alternatively, when the rotor 50 is rotated in the opposite direction, it is possible to discharge from the second opening 14b the fluid sucked from the first opening 14a.

[0074] The power transmission mechanism 70 is provided in order to transmit power to the rotor 50 described above from a power source (not illustrated) such as a motor provided outside the pump casing 12. The power transmission mechanism 70 has a power connecting part 72 and an eccentric rotating part 74. The power connecting part 72 is provided inside the shaft accommodating part 12c provided on one end side of the pump casing 12 in the longitudinal direction, more specifically, on the opposite side (hereinafter, simply referred to as "the base end side") from the side where the end stud 13 and the stator attaching part 12b are provided as described above. Further, the eccentric rotating part 74 is provided to the intermediate part 12a formed between the shaft accommodating part 12c and the stator attaching part 12b.

[0075] The power connecting part 72 has a drive shaft 76, and this is rotatably supported by two bearings 78a and 78b. The drive shaft 76 is taken out from an occluded portion on the base end side of the pump casing 12, and is connected with the power source. Thus, it is possible by operating the power source to rotate the drive shaft 76. Between the shaft accommodating part 12c where the power connecting part 72 is provided and the intermediate part 12a, a shaft seal device 80 comprised of, for example, a mechanical seal or a gland packing, and, thus, it is structured so that the fluid does not leak from the intermediate part 12a side to the shaft accommodating part 12c side.

[0076] The eccentric rotating part 74 is a part which connects the drive shaft 76 and the rotor 50 which are described above so that they are possible to transmit power therebetween. The eccentric rotating part 74 has a coupling shaft 82 and two coupling bodies 84 and 86. The coupling shaft 82 is comprised of a conventionally known coupling rod, screw rod, etc. The coupling body 84 is to connect the coupling shaft 82 and the rotor 50, and the coupling body 86 is to connect the coupling shaft 82 and the drive shaft 76. The coupling bodies 84 and 86 are each comprised of a conventionally known universal joint or the like, and they are possible to transmit the rotational power transmitted via the drive shaft 76 to the rotor 50, to eccentrically rotate the rotor 50.

[0077] The uniaxial eccentric screw pump 10 is possible to adjust the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22, by inserting or removing the shim(s) 25 between the liner part 22 and the outer cylinder part 24 in the stator 20 and adjusting the offset amount of the outer cylinder part 24 (the outer cylinder constituting bodies 36), the expansion and contraction of the liner part mounting area 27, and the balance of the pressing force which acts on the liner part 22.

[0078] Specifically, when it is necessary to increase the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 due to wear of the liner part 22 or the like, some or all of the outer cylinder constituting bodies 36 which constitutes the outer cylinder part 24 are removed from the liner part 22, and the shim (s) 25 are then arranged on the outer circumferential face of the liner part 22. If the shim 25 has already been arranged, shim (s) 25 are further arranged in the stacked manner. It becomes in a state where the shim (s) 25 are mounted over the entire width (the entire part in the axial direction) in the partial area of the outer cylinder mounting part 28 of the liner part 22 in the circumferential direction. In this state, by mounting the removed outer cylinder constituting bodies 36, the outer cylinder constituting body or bodies 36 become in a state where they are outwardly offset in the radial direction in the area where the shim (s) 25 are mounted. In addition, in the area where the shim (s) 25 are mounted,

the liner part mounting area 27 contracts in the radial direction, and the pressing force which acts on the liner part 22 increases locally. Thus, the contacting pressure and the tightening margin between an outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 increases.

[0079] On the other hand, if it is necessary to reduce the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 due to the reason of the fluid being high in temperature or the like, some or all of the outer cylinder constituting bodies 36 which constitute the outer cylinder part 24 are removed from the liner part 22, and the shim 25 arranged on the outer circumferential face of the liner part 22 is removed. If two or more shims 25 are arranged in the stacked manner, all the shims 25 are removed, or some of the shims 25 may be removed. Thus, by mounting the outer cylinder constituting bodies 36 after the shim(s) 25 are removed, the outer cylinder constituting bodies 36 become in a state where they are inwardly offset in the radial direction by the number of the removed shims 25. Further, in the area where the shim(s) 25 are removed, the liner part mounting area 27 expands in the radial direction and, thus, the pressing force which acts on the liner part 22 decreases. Therefore, the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 are reduced.

[0080] As described above, in the uniaxial eccentric screw pump 10 of this embodiment, the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 can be adjusted by mounting and removing the shim(s) 25. In addition, it is possible to mount and remove the shim(s) 25 by mounting and removing some or all of the outer cylinder constituting bodies 36 which constitute the outer cylinder part 24, and it is not necessary to disassemble after removing all the stator 20 and the rotor 50. Moreover, in the uniaxial eccentric screw pump 10, by rotating the swivel nuts 12x and 13x, the interval between the pump casing 12 and the end stud 13, i.e., the stator attaching part 15 can be extended and reduced, and it does not take time and effort for the mounting and removing work of the outer cylinder constituting bodies 36. Thus, in the uniaxial eccentric screw pump 10, the adjustment of the tightening margin and the like can easily be performed by the shim(s) 25, and the uniaxial eccentric screw pump 10 is excellent in maintainability.

[0081] In the uniaxial eccentric screw pump 10, even if it is operated in the state where the shim(s) 25 are mounted and the state where the shim(s) 25 are removed as described above, the contacting pressure and the tightening margin between the rotor 50 and the liner part 22 become substantially uniform without depending locations thereof. Thus, in the uniaxial eccentric screw pump 10, the liner part 22 can be worn substantially uni-

form, without being worn unevenly. In addition, even if the shim(s) 25 are inserted between the liner part 22 and the outer cylinder part, it is not necessary to do any work for aligning the center axes of the liner part 22 and the rotor 50. Thus, the uniaxial eccentric screw pump 10 can suppress the replacing frequency of the liner part 22 and the work required for maintenance to the minimum.

[0082] By mounting or removing the shim(s) 25 according to operating conditions, such as temperature and application of the transferring fluid, the uniaxial eccentric screw pump 10 can be operated after the tightening margin and the like are made in a suitable state for the operating conditions. Thus, according to the uniaxial eccentric screw pump 10, it is possible to prevent breakage of the stator 20 by the tightening margin becoming excessive and to prevent the fluid transfer performance degradation by the tightening margin becoming too small.

[0083] The thickness, the longitudinal width, and the lateral width of the shim 25 described above are not necessarily limited to what is described above, and they may be suitably adjusted. Note that, in order to make the lateral width of the shim 25 shorter than the axial length of the outer cylinder mounting part 28, by an approach of, for example, arraying the two or more shims 25 in the axial direction of the outer cylinder mounting part 28, it becomes in a state where the shims 25 are mounted to substantially the entire part of the outer cylinder mounting part 28 in the axial direction and, thus, similar operations and effects to the case where the shims 25 of this embodiment described above are used can be obtained.

[0084] In this embodiment, although the example where, by inserting or removing the shim(s) 25 between the liner part 22 and the outer cylinder part 24, the shim(s) 25 are used as an adjusting member for adjusting the offset amount of the outer cylinder part 24 (the outer cylinder constituting bodies 36), the expansion and contraction of the liner part mounting area 27, and the balance of the pressing force which acts on the liner part 22, is shown, the present invention is not necessarily limited to this. Specifically, it may be a configuration in which the clamp 38 provided in order to catch the gripping parts 40 and 40 provided to both ends of the outer cylinder constituting body 36 in the circumferential direction can be used as the adjusting member described above. Specifically, as shown in Fig. 8, holding pieces 46x and 46y having different intervals of two opposing pinching surfaces 46p and 46q, respectively, may be provided, and the holding pieces 46x and 46y may be selectively used according to the tightening margin or the like.

[0085] Specifically, when the outer cylinder constituting bodies 36 and 36 are connected using the holding piece 46x of which the interval shown in Fig. 8 (a) is d1, the liner part mounting area 27 is expanded as shown in Fig. 8 (c), and the pressing force which acts on the liner part 22 becomes loose. In addition, the part of the outer cylinder part 24 which surrounds the liner part 22 (i.e., the outer cylinder constituting bodies 36) becomes in a state where it is outwardly offset in the radial direction of

the liner part 22. This reduces the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22.

[0086] On the contrary, when the outer cylinder mounting part 28 is connected using the holding piece 46y having the interval d2 which is smaller than d1 shown in Fig. 8(b), the entire inner circumferential face of the outer cylinder part 24 becomes in a state where it substantially close contacts the outer cylinder mounting part 28 of the liner part 22, as shown in Fig. 7(b). In this state, compared with the case where the holding piece 46x is used, the liner part mounting area 27 contracts and the pressing force which acts on the liner part 22 increases. In addition, it becomes in a state where the part of the outer cylinder part 24 which surrounds the liner part 22, i.e., the outer cylinder constituting body 36 is inwardly offset in the radial direction of the liner part 22, more than the case where the holding piece 46x is used. Thus, the contacting pressure and the tightening margin between the outer circumferential face 52 of the rotor 50 and the inner circumferential face 32 of the liner part 22 increases.

[0087] As described above, it is also possible to use the shim(s) 25 even in the case where the holding pieces 46x and 46y having different intervals are selectively used according to the tightening margin and the like. By using the holding pieces 46x and 46y and the shim(s) 25 together, it is possible to more finely perform the adjustments of the offset amount of the outer cylinder constituting body 36 which is a part of the outer cylinder part 24, the expansion and contraction of the liner part mounting area 27, and the balance of the pressing force which acts on the liner part 22.

[0088] Further, instead of using the clamps 38 having different intervals of the pinching surfaces 46p and 46q as shown in Fig. 8, the uniaxial eccentric screw pump 10 may be configured to fix using a fixture which is adjustable of the pinching force, comprised of bolts or the like at a plurality of locations of the outer cylinder constituting bodies 36 in the longitudinal direction of the gripping parts 40. If configured as above, it is possible by adjusting the pinching force which acts by the fixture 47 on the gripping parts 40 to adjust the offset amount of the outer cylinder constituting bodies 36, the expansion and contraction of the liner part mounting area 27, and the pressing force which acts on the liner part 22 and, thus, the tightening margin and the like can be properly adjusted. Note that, also in the case where the fixture 47 is used, it is possible to more finely adjust the tightening margin and the like by using the shim (s) 25 described above together.

[0089] As described above, in the stator 20 of the uniaxial eccentric screw pump 10 of this embodiment, the outer cylinder part 24 is mounted to the integrally-formed liner part 22 in the non-adhesion manner. Specifically, the pressing force in the radially inward direction of the liner part 22 acts on the outer cylinder part 24 under the effects of the pinching forces which are generated by

mounting the clamps 38 to the gripping parts 40 and 40 of the outer cylinder constituting bodies 36. The outer cylinder part 24 is mounted by this pressing force to the outer periphery of the liner part 22 in the pressed state, and the outer cylinder part 24 is in a state where it is aligned in the axial direction and the circumferential direction of the liner part 22. Thus, by removing the outer cylinder constituting bodies 36 and 36 and the clamps 38 and 38, the uniaxial eccentric screw pump 10 can easily be separated into the liner part 22 and the outer cylinder part 24 to be collected and, thus, it is possible to take sufficient considerations to environmental problems.

[0090] Further, the uniaxial eccentric screw pump 10 has a structure in which the outer cylinder part 24 covers the outer cylinder mounting part 28 which exists between the flange parts 26 provided to both ends of the liner part 22, and the end parts of the outer cylinder part 24 contact the flange parts 26 and, thus, it can prevent the liner part 22 from contracting in the axial direction. That is, the outer cylinder part 24 plays a supportive role for preventing the contraction of the liner part 22 in the axial direction. By this, even if the compressive force acts on the stator 20 in the axial direction under the effects of a discharge pressure or the like, it is possible to maintain the inner diameter of the liner part 22 substantially uniform regardless of locations thereof, and it is possible to avoid the uneven wear of the liner part 22 and attain stabilization of the discharging amount. Note that, although the configuration in which the flange parts 26 are provided to both ends of the liner part 22 in terms of the contraction prevention of the liner part 22 in the axial direction and the like is illustrated in this embodiment, the present invention is not limited to this, and the flange part 26 may be configured to be provided either end or no flange part is provided to both the ends.

[0091] As for the uniaxial eccentric screw pump 10, since the outer cylinder part 24 can be divided in the circumferential direction into the plurality of outer cylinder constituting bodies 36, the mounting and removing works of the outer cylinder part 24 to the liner part 22 can easily be performed. In addition, the outer cylinder part 24 described above is integrated by coupling the outer cylinder constituting bodies 36 to each other using the clamps 38 (clamp coupling), and the outer cylinder part 24 can be attached and detached only by attaching and detaching the pinching pieces 46 and the pins 48 to the gripping parts 40 and 40.

[0092] Note that, although the example in which the outer cylinder part 24 is constituted with the two outer cylinder constituting bodies 36 is illustrated in this embodiment, the present invention is not limited to this, and the outer cylinder part 24 may be constituted with more number of outer cylinder constituting bodies 36. Further, although the example in which the outer cylinder constituting bodies 36 and 36 are coupled by the clamps 38 at two locations in the circumferential direction is illustrated in this embodiment, the present invention is not limited

to this, and it may have a structure in which, for example, one end side of the outer cylinder constituting bodies 36 and 36 in the circumferential direction are coupled with a hinge or the like, and the other end side is coupled with the clamp 38 or by other approaches. Further, although the example in which the clamp 38 comprised of the pinching piece 46 and the pin 48 is used in order to couple the outer cylinder constituting bodies 36 and 36 is illustrated in this embodiment, the present invention is not limited to this, and the outer cylinder constituting bodies 36 and 36 may be coupled using any other approaches which can fix the outer cylinder constituting bodies 36 and 36 so that they are not misaligned.

[0093] In the uniaxial eccentric screw pump 10 of this embodiment, the end stud 13 is arranged on one end side of the stator 20, and the stator 20 is integrally coupled to the pump casing 12 along with the end stud 13 using the fastening force generated by the stay bolts 18. Further, the stator 20 is in a state where the outer cylinder part 24 contacts the end parts 12b and 13a of the end stud 13 and the pump casing 12, respectively. Thus, in the state where the stator 20 is assembled, the fastening force by the stay bolts 18 acts on the outer cylinder part 24 prior to the liner part 22 and, thus, it can prevent that a large compressive force acts on the liner part 22 in the axial direction, and that the liner part 22 is deformed the compression. In addition, by this, the uneven wear of the liner part 22 can be prevented to stabilize the discharging amount.

[0094] In the uniaxial eccentric screw pump 10 of this embodiment, the fit-in parts 12c and 13b into which the flange part 26 can be fitted is provided to the end part 12b of the pump casing 12 and the end part 13a of the end stud 13, respectively, and the flange parts 26 of the liner part 22 which are fitted therein are pinched between the outer cylinder part 24, and the end stud 13 and the pump casing 12. Thus, it is possible to securely prevent the misalignment of the liner part 22 in the axial direction, and it is possible to further stabilize the operating conditions of the uniaxial eccentric screw pump 10.

[0095] As described above, the contour of the outer cylinder mounting part 28 of the liner part 22 is formed into a polygonal shape (in this embodiment, a substantially decagon). Further, both the outer cylinder constituting bodies 36 and 36 are bent in the shape conforming to the outer cylinder mounting part 28, and, by holding and coupling the gripping parts 40 by the clamps 38, the cylindrical outer cylinder part 24 is formed to have the substantially same shape as that of the outer cylinder mounting part 28 (in this embodiment, a substantially regular decagon). By this, even if a load acts on the liner part 22 in the circumferential direction, it can prevent that only the liner part 22 is misaligned in the circumferential direction, and it is possible to stabilize the operating conditions of the uniaxial eccentric screw pump 10.

[0096] Further, since the liner part 22 is formed in the polygonal shape, the shim (s) 25 are easily arrangeable at desired location (s) and desired area (s). Further, since

the outer cylinder constituting body 36 is formed in the shape conforming to the contour of the liner part 22, even if the shim 25 is arranged across two or more faces beyond the apex formed on the outer periphery of the liner part 22, it is possible to bend the shim 25 into the shape to securely conform to the surface of the liner part 22, and to pinch the shim 25 without the misalignment and the like.

[0097] Note that, although the example in which the outer cylinder mounting part 28 and the outer cylinder part 24 are respectively formed in the polygonal shape for the purpose of the misalignment prevention of the liner part 22 with respect to the outer cylinder part 24, easiness of the arrangement of the shim 25 and the like is illustrated in this embodiment, it may have a different configuration from what described above, if other configurations which can prevent the misalignment in the circumferential direction and the like are adopted, or when it is not necessary to consider the misalignment in the circumferential direction and the like. Specifically, although the outer cylinder mounting part 28 and the outer cylinder part 24 have substantially the same cross-sectional shape, both the cross-sectional shapes may be different, within the scope where the shape functions as a stop of the rotation of the liner part 22, such that the outer cylinder mounting part 28 is formed into a substantially regular decagon and the outer cylinder part 24 is formed into a substantially regular dodecagon, for example.

[0098] Further, it may be configured so that a protrusion is provided on the inner circumferential side of the outer cylinder part 24, and it may be configured so that, by mounting the outer cylinder part 24 to the outer cylinder mounting part 28, the protrusion described above contacts in a pressed state against the outer circumferential face of the liner part 22. According to this configuration, since the protrusion is caught to the outer circumferential face of the liner part 22 and the shim 25, it is possible to prevent the misalignment of the liner part 22 in the circumferential direction and the axial direction, the falling-off of the shim 25, and the like. Thus, the configuration in which the protrusion is provided is effective not only when the outer cylinder mounting part 28 and the outer cylinder part 24 are formed into the polygonal shapes like this embodiment, but also when the misalignment of the liner part 22, the falling-off of the shim 25, and the like are anticipated like in the case where the contour of the liner part 22 is the circular cylinder.

[Reference Signs List]

[0099]

10	Uniaxial Eccentric Screw Pump
12	Pump Casing
12b	End Part
12c	Fit-in Part
13	End Stud

13b	Fit-in Part			a cylindrical liner part having a female threaded inner circumferential face;
15	Stator Attaching Part			an outer cylinder part forming a liner part mounting area where the liner part is accommodated in a non-adhesion manner; and
20	Stator			an adjusting means capable of expanding and/or contracting the liner part mounting area in a radial direction of the liner part, at least in a part of the liner part mounting area in a circumferential direction of the liner part, by adjusting a pressing force acting in the radial direction from the outer cylinder part side at least on a partial area in the circumferential direction of the liner part.
22	Liner Part			
24	Outer Cylinder Part	5		
25	Shim (Adjusting Means)			
26	Flange Part (Flange-Shaped Part)			
27	Liner Part Mounting Area			
28	Outer Cylinder Mounting Part			
36	Outer Cylinder Constituting Body	10		
46	Pinching Piece			
50	Rotor			
Claims		15		
1.	A uniaxial eccentric screw pump, comprising:		4.	The uniaxial eccentric screw pump of any one of claims 1 to 3, wherein the adjusting means is comprised of one or more shim insertable into and/or removable from between the liner part and the outer cylinder part.
	a male threaded rotor; and			
	a stator through which the rotor is insertable, the stator including:	20		
	a cylindrical liner part having a female threaded inner circumferential face;		5.	The uniaxial eccentric screw pump of any one of claims 1 to 4, wherein the outer cylinder part is dividable into a plurality of outer cylinder constituting members in the circumferential direction, the outer cylinder constituting members each having a flange part extending in an axial direction thereof at both ends in the circumferential direction, respectively, and
	an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner; and	25		wherein the adjusting means is comprised of a coupling body for coupling the flange parts of the outer cylinder constituting members adjacent to each other in the circumferential direction, and the adjusting means is adjustable of an interval between the flange parts.
	an adjusting means capable of offsetting the outer cylinder part in a radial direction of the liner part, at least in an area corresponding to a part of the outer cylinder part in a circumferential direction of the liner part.	30		
2.	A uniaxial eccentric screw pump, comprising:	35	6.	The uniaxial eccentric screw pump of claim 5, wherein the coupling body is comprised of a pinching member for pinching the flange parts.
	a male threaded rotor; and			
	a stator through which the rotor is insertable, the stator including:	40	7.	A uniaxial eccentric screw pump, comprising:
	a cylindrical liner part having a female threaded inner circumferential face;			a male threaded rotor; and
	an outer cylinder part forming a liner part mounting area where the liner part is accommodated in a non-adhesion manner; and	45		a stator through which the rotor is insertable, the stator including:
	an adjusting means capable of expanding and/or contracting the liner part mounting area in a radial direction of the liner part, at least in a part of the liner part mounting area in a circumferential direction of the liner part.	50		a cylindrical liner part having a female threaded inner circumferential face; and
3.	A uniaxial eccentric screw pump, comprising:			an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner,
	a male threaded rotor; and	55		wherein a shim is insertable into and/or removable from between the liner part and the outer cylinder part, in an area that is at least a part of the liner part in a circumferential direction of the
	a stator through which the rotor is insertable, the stator including:			

liner part and extends in an axial direction of the liner part.

8. A uniaxial eccentric screw pump, comprising:

a male threaded rotor; and
a stator through which the rotor is insertable, the stator including:

a cylindrical liner part having a female threaded inner circumferential face; and
an outer cylinder part arranged to surround the outer periphery of the liner part, and mounted to the liner part in a non-adhesion manner,

wherein the outer cylinder part is dividable into a plurality of outer cylinder constituting members in a circumferential direction thereof,
wherein the outer cylinder constituting member has a flange part extending in an axial direction of the outer cylinder constituting member at both ends in the circumferential direction, and the outer cylinder part is able to be formed by coupling the flange parts of the outer cylinder constituting members adjacent to each other in the circumferential direction with a coupling body, and
wherein the coupling body is adjustable of an interval between the flange parts.

9. The uniaxial eccentric screw pump of claim 8, wherein the coupling body is comprised of a pinching member for pinching the flange parts.

10. The uniaxial eccentric screw pump of any one of claims 1 to 9, wherein a flange-shaped part projecting outwardly in the radial direction is provided to both end parts of the liner part, respectively, and wherein the outer cylinder part is arranged between the flange-shaped parts, and end parts of the outer cylinder part contact the flange-shaped parts.

11. The uniaxial eccentric screw pump of any one of claims 1 to 10, comprising:

an end stud with which one end side of the stator is connected;
a pump casing with which the other end side of the stator is connected;
and
a stay bolt for coupling the end stud and the pump casing,
wherein a nut part threadedly engageable with the stay bolt is provided to the end stud and/or the pump casing, and
wherein an interval between the end stud and the pump casing is changeable by relatively rotating the stay bolt and the nut part.

12. The uniaxial eccentric screw pump of any one of claims 1 to 11, wherein the contour of the liner part has a polygonal shape.

13. The uniaxial eccentric screw pump of claim 12, wherein the outer cylinder part is bent in a shape conforming to the contour of the liner part.

FIG. 1

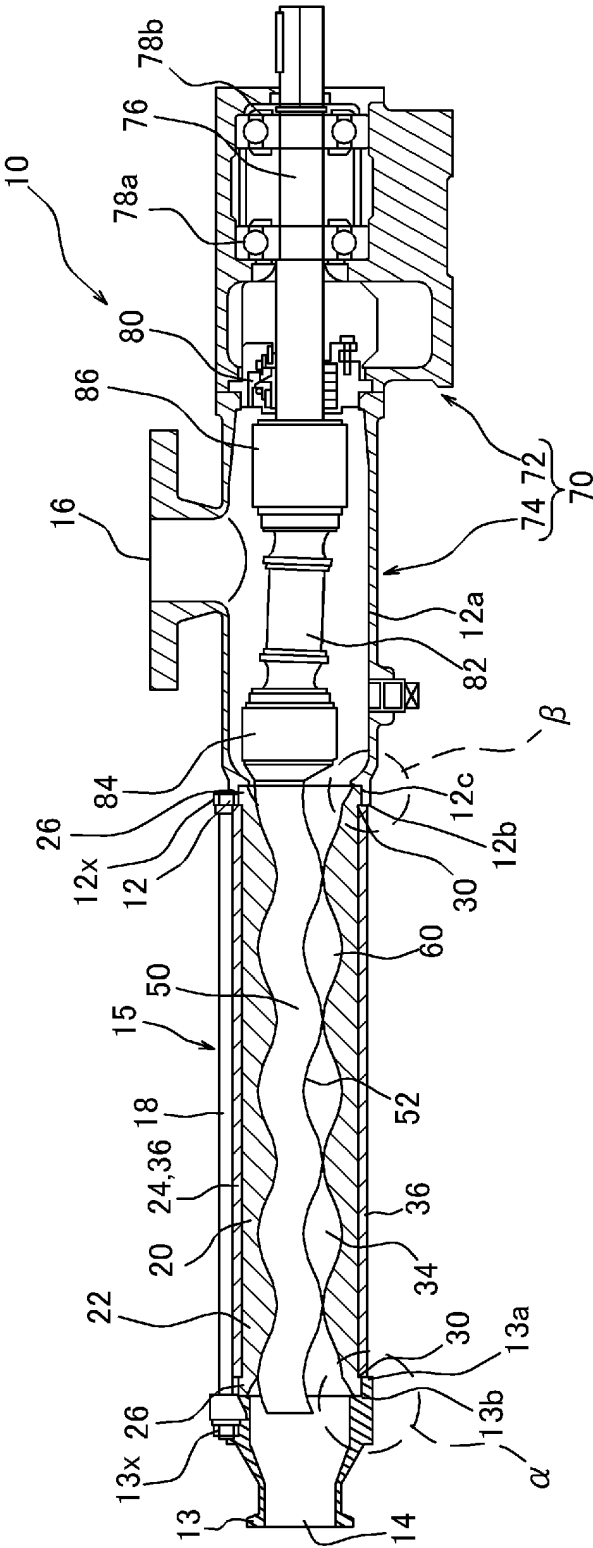
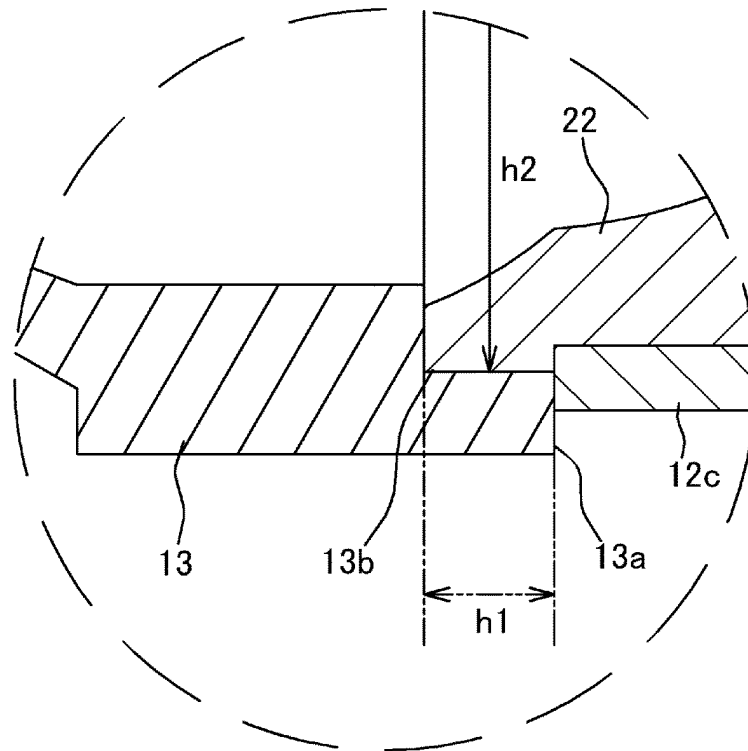


Fig. 2

(a)



(b)

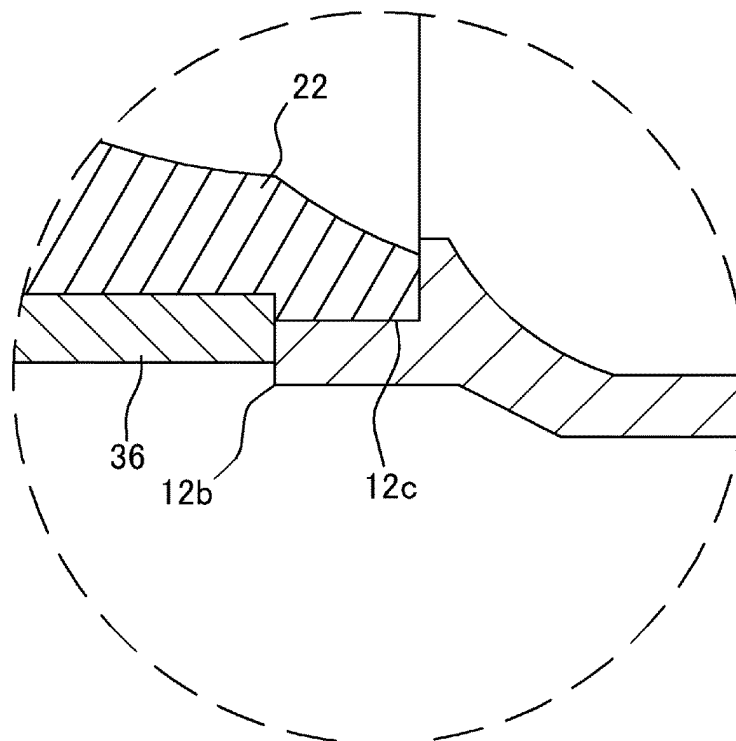


Fig. 3

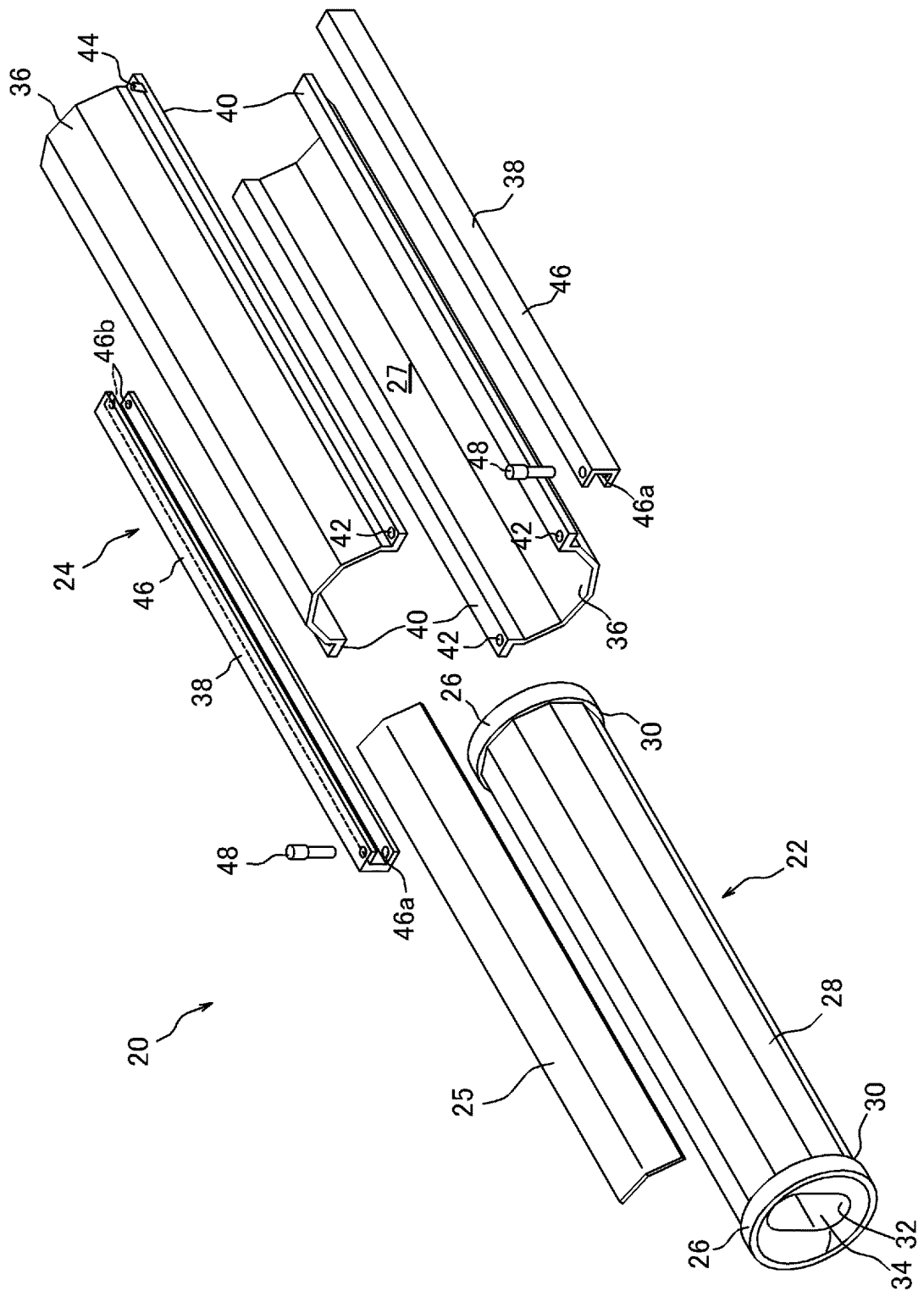


Fig. 4

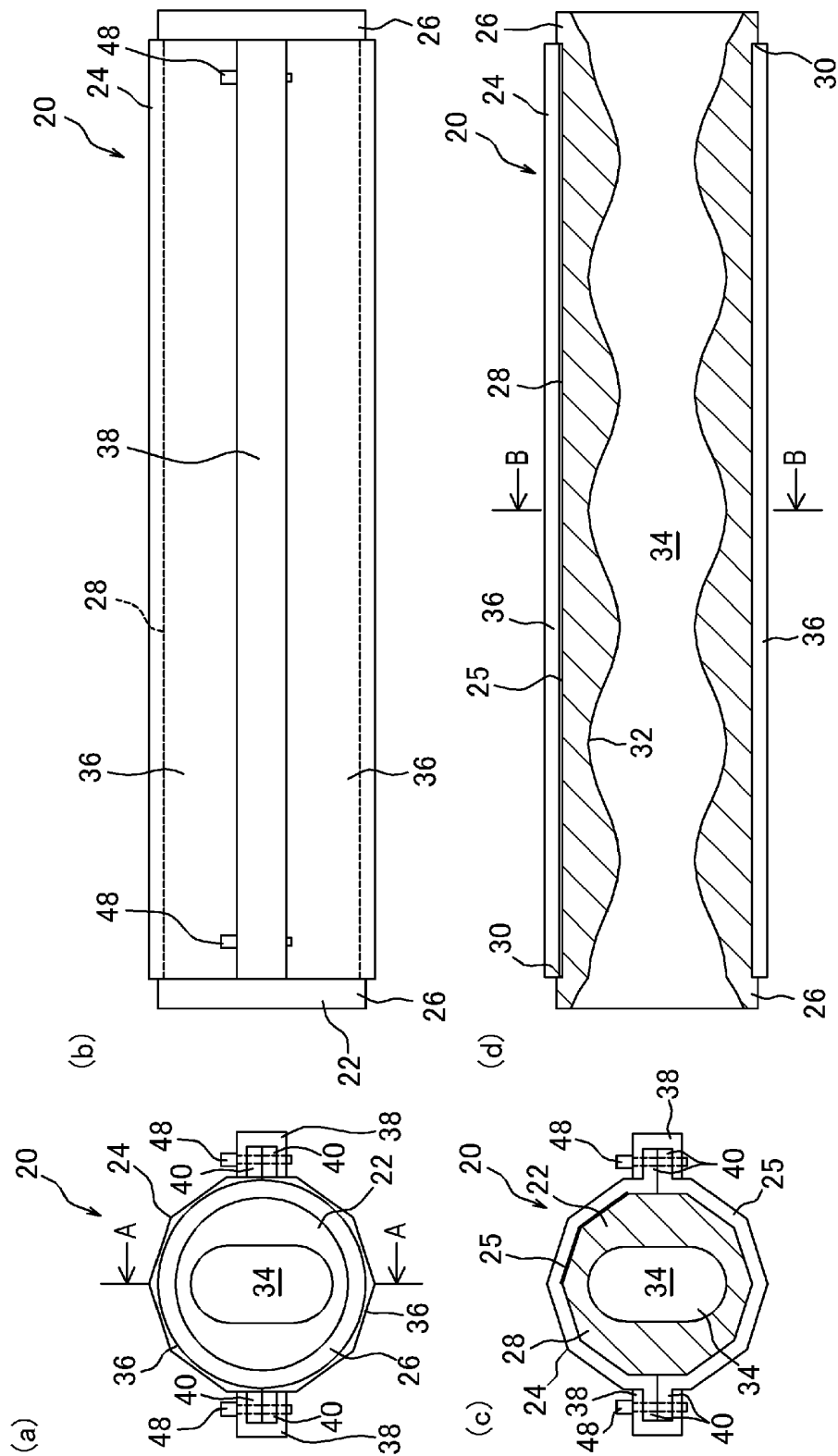


Fig. 5

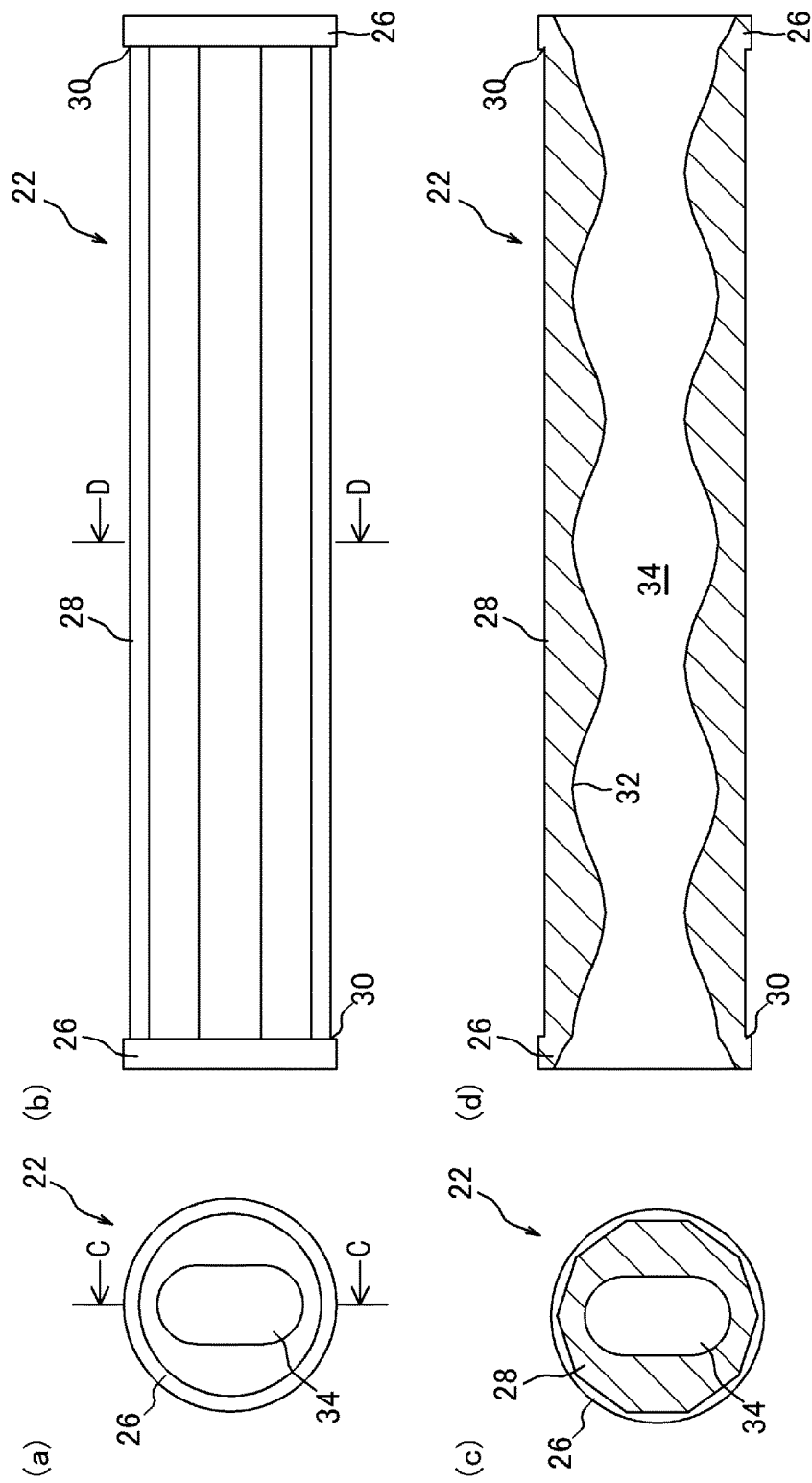


Fig. 6

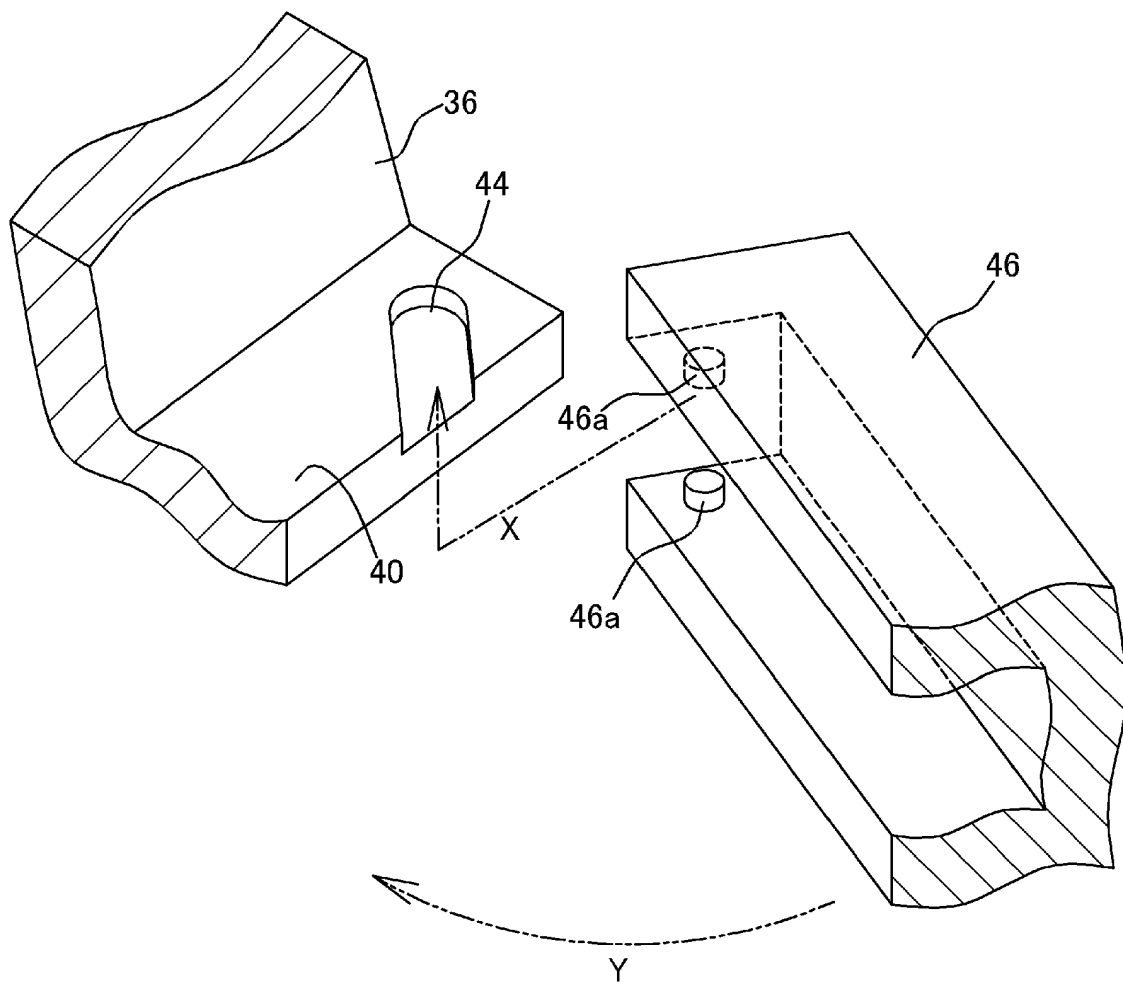


Fig. 7

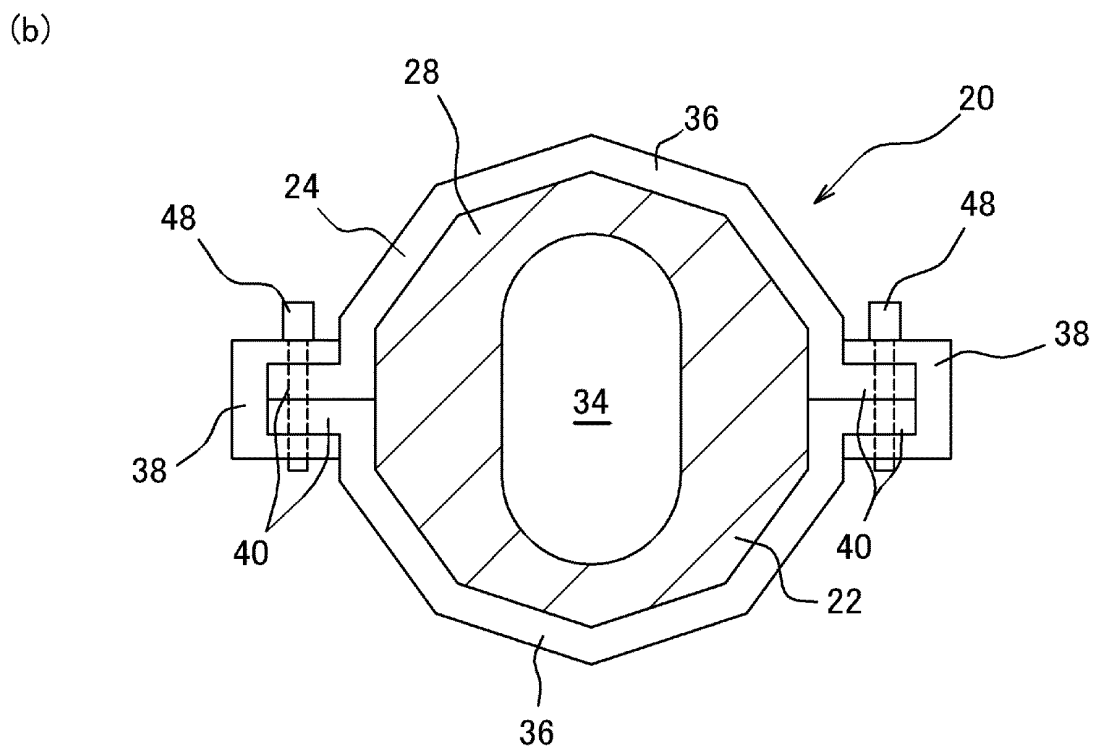
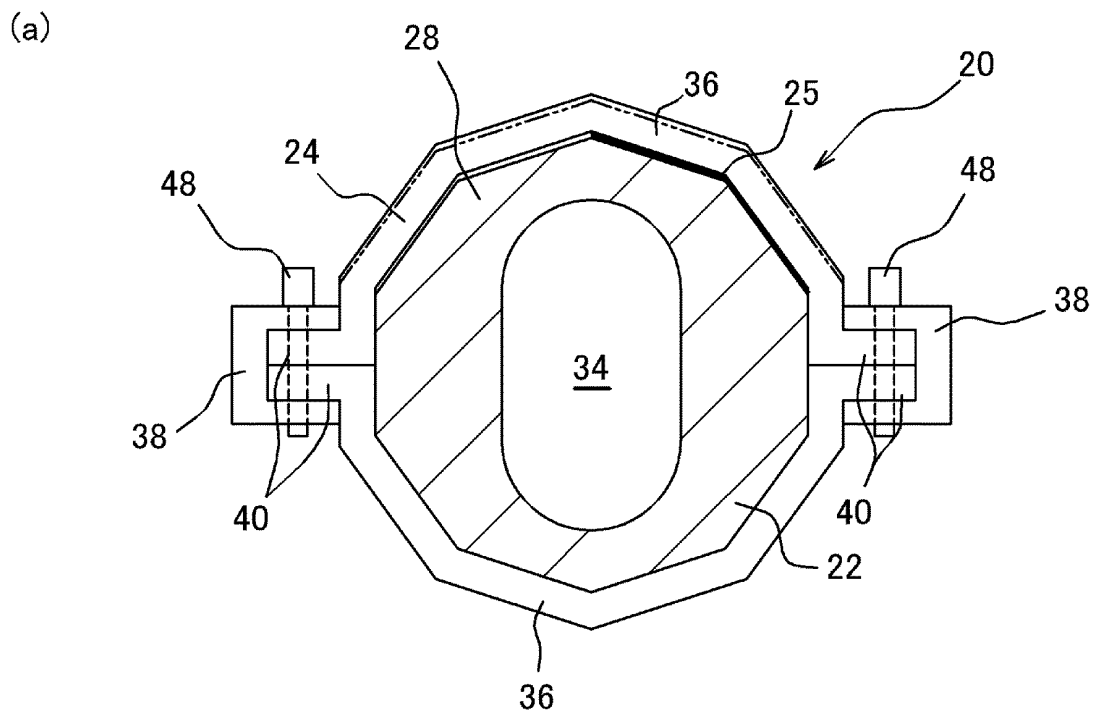
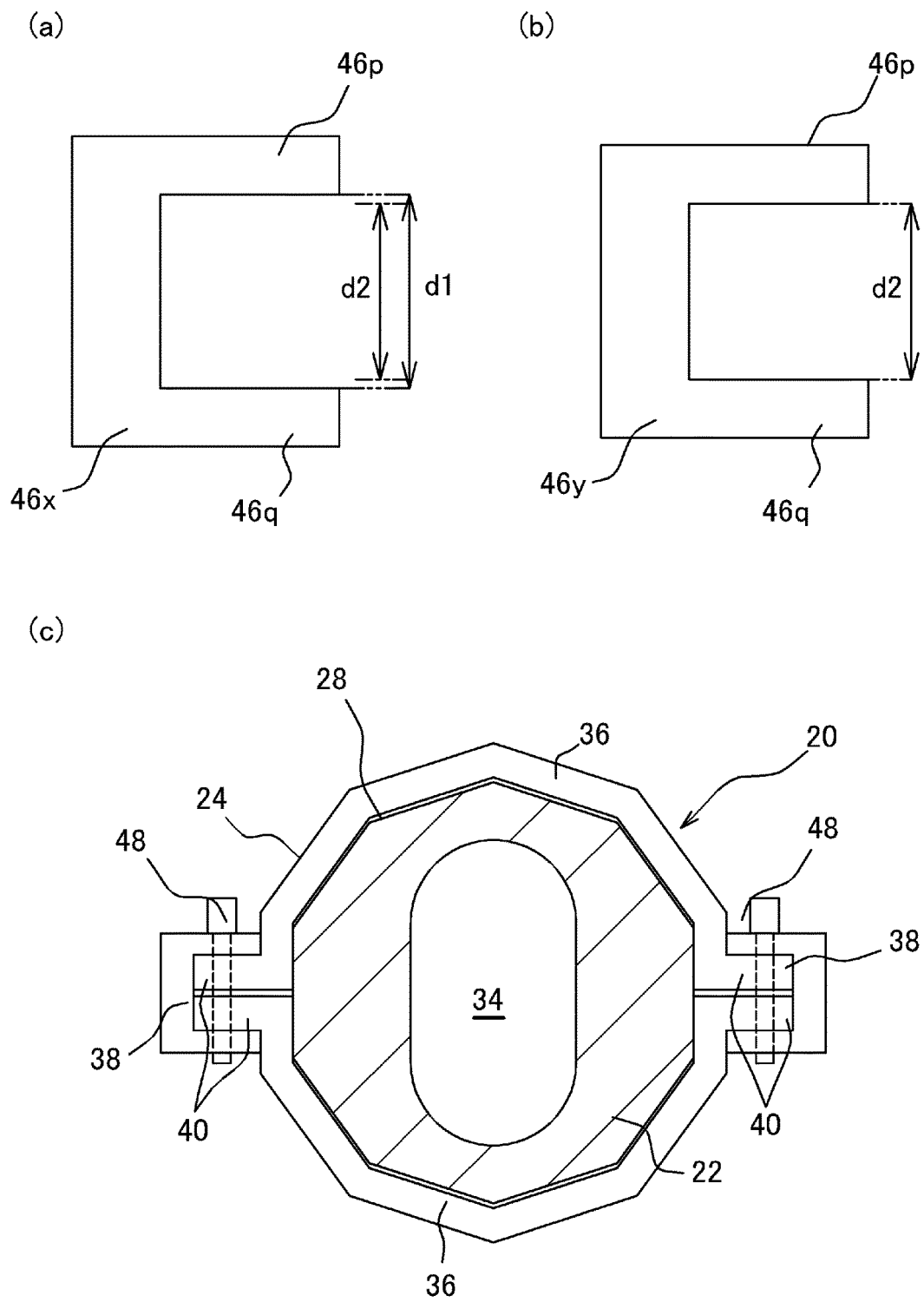


Fig. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/080135

A. CLASSIFICATION OF SUBJECT MATTER F04C2/107(2006.01)i		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) F04C2/107		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2012 Kokai Jitsuyo Shinan Koho 1971-2012 Toroku Jitsuyo Shinan Koho 1994-2012		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 168525/1988 (Laid-open No. 87988/1990) (Sanyo Electric Works, Ltd.), 12 July 1990 (12.07.1990), entire text; all drawings (Family: none)	1-4, 7, 10 12-13
X Y	JP 50-22310 A (Netzsch Mohnopumpen GmbH), 10 March 1975 (10.03.1975), entire text; all drawings & DE 2331173 A1	1-4, 7 12-13
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 05 March, 2012 (05.03.12)		Date of mailing of the international search report 13 March, 2012 (13.03.12)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/080135

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 12195/1991 (Laid-open No. 104185/1992) (Iwaki Co., Ltd.), 08 September 1992 (08.09.1992), entire text; all drawings (Family: none)	1-3, 11 12-13
Y	JP 58-122384 A (Yujin F Kopetsuki), 21 July 1983 (21.07.1983), entire text; all drawings (Family: none)	2-3, 5-6, 8-9, 12-13
Y	JP 44-18032 B1 (Karu Shiyurehito), 07 August 1969 (07.08.1969), entire text; all drawings (Family: none)	2-3, 5-6, 8-9, 12-13
Y	JP 2009-536703 A (Netzsch Mohnopumpen GmbH), 15 October 2009 (15.10.2009), entire text; all drawings & US 2009/0074599 A1 & EP 2018478 A1 & WO 2007/131476 A1	12-13

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

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

Patent documents cited in the description

- JP 2005344587 A [0003]