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(54) **FLUID COUPLING**

FLÜSSIGKUPPLUNG

COUPLAGE DE FLUIDE

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(56) References cited:
EP-A1- 0 391 489 US-A- 4 412 792
US-A1- 2003 072 661 US-B1- 6 231 323

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Description

BACKGROUND

1. Field of the Invention

[0001] The present invention relates to a piston pump.

2. Description of the Related Art

[0002] Conventionally, there is known, for example, a pump disclosed in Japanese Unexamined Patent Application Publication No. 2006-509171 (FIG. 2) as a non-return valve (check valve) used in an ultrahigh-pressure generating apparatus for very high pressure fluid. A non-return valve element 14 of the check valve includes, in its center portion, a flange portion whose diameter expands rapidly. The non-return valve element 14 is combined with a pump housing 35 by being sandwiched, and has a poppet 19 approximately in a cylindrical shape.

[0003] The non-return valve element constituting the conventional check valve is secured to the pump housing while its flange portion is sandwiched. Accordingly, the stress concentrates on the rapidly expanded portion of the cross-sectional surface. This stress becomes a tensile stress. Accordingly, a problem has arisen in that the conventional valve seat causes cracking starting from the stress concentration part and is likely to be damaged.

[0004] A similar problem has occurred in a fluid coupling, which couples a pipe to the pressure container, as a common problem. In particular, a high pressure container at high pressure or a high pressure container at high pressure amplitude and frequency has caused a problem where the main body of the coupling is likely to be damaged.

[0005] A suction valve or a discharge valve has caused a problem where the valve element repeats to open and close the valve and thus the valve seat surface is likely to be damaged. When the valve seat surface is once damaged so as to cause leakage of fluid from the damaged part, the leaked fluid causes wear of the valve seat surface or the valve element due to the fast flow rate of the leaked fluid. Additionally, a problem has arisen in that the leakage of the fluid causes cavitation in the upper stream of the valve so as to damage the flow passage inside the non-return valve element.

[0006] The present invention has been made in view of the above-described circumstances, and it is an object of the present invention to provide a fluid coupling that reduces the load on the main body of the fluid coupling so as to improve the durability.

[0007] EP391489 discloses a high pressure fluid pump having a reciprocating piston which pumps fluid through a central passageway in a valve body of a valve assembly. The valve body forms with an end section of the housing a high pressure fluid chamber axially aligned with the piston. The effective pressure area in the valve chamber acting on the valve body is greater than the effective pres-

sure area acting on the valve body from the cylinder chamber in which the piston reciprocates, so that a net rearward force is exerted on the valve body. There are forward and rear seal members around the valve body which are caused to come into sealing engagement due to fluid pressure in the valve chamber.

SUMMARY

[0008] To solve the above-described problem, a piston pump according to claim 1 is provided.

[0009] The pressure inside the cylinder acts on the main body from one direction side, and the receiving member receives the force multiplied by the cross-sectional area of the portion inserted into the cylinder of the main body. The conical surface of the main body and the tapered surface of the receiving portion have the identical groove angles. Accordingly, the force by the pressure inside the cylinder is received by the entire tapered surface of the receiving member. As its reaction, the receiving member applies the force, which is perpendicular to the conical surface of the main body and uniform, to the main body from the peripheral area toward the center portion. On the other hand, the through-passage is affected by the pressure identical to that inside the pressure container. The pressure applied to the inside of the through-passage pushes out the main body from the center to the radially outer peripheral direction. The force acting from the outer peripheral portion and the force acting from the inside cause an approximately uniform compressive stress acting on the entire main body. The piston pump has no portion where the cross-sectional surface of the main body expands rapidly. This reduces the occurrence of the stress concentration.

[0010] With the main body having an enlarged diameter portion between the engaging portion and the conical surface, the enlarged diameter portion is radially enlarged relative to the engaging portion.

[0011] As a result, no contact is caused between the enlarged diameter portion and the inner surface of the cylinder. The main body receives the force obtained by a product of the pressure inside the cylinder and the cross-sectional area of the cylinder. This force acts from the tapered portion of the main body via the tapered surface of the receiving member in the direction for removing the receiving member from the cylinder, that is, to the other side. The receiving member is combined with the cylinder using a combining force larger than this force. In the case where the fluid pressure inside the cylinder is significantly high, this combining force can be a force to the extent that can deform the main body. The enlarged diameter portion is not in contact with the inner surface of the cylinder. Accordingly, the combining force between the receiving member and the cylinder does not act on the main body. Accordingly, only the internal stress generated by the fluid pressure acts on the main body. This improves the durability of the main body.

[0012] With the engaging portion including: a first cyl-

inder portion internally fitted to an inner surface of the pressure container; a packing installation portion having a diameter smaller than a diameter of the first cylinder portion; and a packing disposed in the packing installation portion, the main body can be assembled by internally fitting the first cylinder portion, which is formed on the suction port side, to the inner surface of the cylinder, so as to cause the state where the main body and the inner surface of the cylinder are coaxially disposed. In the main body, the packing installation portion, which has a diameter smaller than that of the first cylinder portion and inserted into the inner surface of the cylinder, is formed on the suction port side, so as to allow disposing the packing in the packing installation portion. Accordingly, in the center portion of the main body on the discharge side of the portion where the packing installation portion of the main body is formed, the pressure by the ultrahigh-pressure fluid internally accumulated in the cylinder is stopped by the packing so as not to act. The ultrahigh-pressure fluid inside the cylinder is blocked by the packing. The cross-sectional area in contact with the ultrahigh-pressure fluid corresponds to the outer diameter of the packing, that is, the inner diameter of the cylinder. The ultrahigh-pressure fluid does not act on the enlarged diameter portion of the main body having a cross-sectional area larger than the inner diameter of the cylinder. This allows reducing the forward force by the pressure received by the main body. This force acts on the receiving member so as to allow reducing the force for combining the receiving member.

[0013] With the receiving member having a housing portion to which the discharge-side middle diameter portion is fitted by insertion, and using the housing portion to restrict the discharge-side middle diameter portion so as to support the main body, the discharge-side middle diameter portion of the main body is fitted to the housing portion of the receiving member so as to allow disposing the main body and the receiving member in accurate positions. The main body and the receiving member are accurately disposed such that the point of action of the resultant force of the forces that the main body receives from the receiving member coincides with the point of action of the force that the main body receives from the pressured fluid. The accurate coincidence of the point of action causes the action that more uniformly distributes the compressive stress acting on the inside of the main body so as to improve the durability of the main body.

[0014] The following configuration is preferred. The main body includes: a valve seat of the suction valve formed on the one side of the main body; and a valve seat of the discharge valve formed on the other side of the main body.

[0015] With this configuration, the main body includes the valve seat. This allows forming a fluid coupling as a check valve that has a simple structure and high durability.

[0016] The following configuration is preferred. The discharge valve includes: a discharge valve element hav-

ing a flat valve portion; and a discharge-valve-body guiding portion slidably supporting the discharge valve element. The suction valve includes a suction valve element having a flat valve portion; and a suction-valve-body guiding portion slidably supporting the suction valve element. The discharge valve and the suction valve have respective planar valve seat surfaces.

[0017] With this configuration, the discharge valve element is supported by the discharge-valve-body guiding portion, and the suction valve element is supported by the suction-valve-body guiding portion. Accordingly, the discharge valve element and the suction valve element stably slide to open and close the valves. The valve element is formed such that the flat valve portion has a thinned thickness to be likely to warp. This allows improving the close contact property to have close contact with the valve seat surface formed by the planar surface.

[0018] The following configuration is preferred. The flat valve portions of the suction valve element and the discharge valve element are formed having respective thicknesses equal to or more than 15% and equal to or less than 45% of outer diameters of the flat valve portions.

[0019] With this configuration, the flat valve portions of the suction valve and the discharge valve are formed by flat valves formed in thin flat plate shapes having respective thicknesses equal to or more than 15% and equal to or less than 45% of the outer diameters of the flat valve portions, and abut on the valve seat surfaces formed by planar surfaces in the main body. The flat valve portion has a valve thickness thinner than that of a conventional valve element, and thus the valve element is likely to deform along the shape of the valve seat. This allows increasing the close contact property of the valve element to the valve seat. As a result, the flat valve portion of the valve element is in close contact with the valve seat surface. This allows preventing the leakage from the valve element also in the case where the valve seat starts to wear. Additionally, the valve seat surface becomes less likely to be damaged, so as to prolong the life of the main body.

[0020] The piston pump according to the present invention allows improving the durability and can be appropriately used with, in particular, a cylinder pressure in a region of high pressure (350 to 700 MPa).

BRIEF DESCRIPTION OF THE DRAWINGS

[0021] Non-limiting and non-exhaustive embodiments of the present embodiments are described with reference to the following FIGURES, wherein like reference signs refer to like parts throughout the various views unless otherwise specified.

Fig. 1 is a schematic cross-sectional view illustrating one example of a check valve forming part of an embodiment of the present invention.

Fig. 2 is an enlarged cross-sectional view of the main part of the check valve illustrated in Fig. 1.

Fig. 3A is an enlarged cross-sectional view of the main part illustrating a closed state of the suction valve.

Fig. 3B is an enlarged cross-sectional view of the main part illustrating an open state of the suction valve.

Fig. 4A is an enlarged cross-sectional view of the main part illustrating a closed state of a discharge valve.

Fig. 4B is an enlarged cross-sectional view of the main part illustrating an open state of the discharge valve.

Fig. 5A is an enlarged cross-sectional view illustrating a suction valve element.

Fig. 5B is an enlarged cross-sectional view illustrating a discharge valve element.

DETAILED DESCRIPTION

[0022] The following describes a piston pump according to an embodiment of the present invention with reference to the accompanying drawings. For convenience of explanation, in a check valve 1, one side (a suction side) where a suction valve 3 is disposed is referred to as a rear side as necessary, and another side (a discharge side) where a discharge valve 4 is disposed is referred to as a front side as necessary.

[0023] The check valve 1, which is disposed in a cylinder 5 of a piston pump as a pressure container, includes: a valve seat 2, which is a main body having a discharge flow passage 22 (a through-passage) that is communicated with the cylinder 5 and allows flow of fluid; and a flange member 6, which is a receiving member disposed on the cylinder 5 to support the valve seat 2. The valve seat 2 has: an engaging portion 2o that is formed on the rear side of the discharge flow passage 22, which is the through-passage, and is disposed to be engaged inside the cylinder 5; and a tapered portion 2j, which is a conical surface formed on the front side. The flange member 6 has: a tapered surface 6c, which is a receiving portion having an inclination as a groove angle, identical to that of the tapered portion 2j; and a discharge-valve installation portion 6d (a housing portion), which is a circulation passage communicated with the front side of the discharge flow passage 22; and a female thread portion 6e. In the flange member 6, the tapered portion 2j of the valve seat 2 abuts on the tapered surface 6c of the flange member 6 such that the flange member 6 supports the valve seat 2.

[0024] The valve seat 2 includes a large-diameter portion 2a, which is an enlarged diameter portion between the engaging portion 2o and the tapered portion 2j (the conical surface). The enlarged diameter portion is radially enlarged relative to the engaging portion 2o.

[0025] The engaging portion 2o includes: a suction-side middle-diameter portion 2b (a first cylinder portion) internally fitted to the inner surface of the cylinder 5; a packing installation portion 2g having a diameter smaller

than that of the first cylinder portion; and a packing P disposed in this packing installation portion 2g.

[0026] The valve seat 2 has a discharge-side middle-diameter portion 2d, which is a second cylinder portion, in a forward end portion on its front side. The flange member 6 has the discharge-valve installation portion 6d to which the discharge-side middle-diameter portion 2d is fitted by insertion, and uses the discharge-valve installation portion 6d to restrict the discharge-side middle-diameter portion 2d so as to support the valve seat 2.

[0027] The valve seat 2 has a supply port 21a for supplying the fluid; and a suction port 21b on the rear side for, discharging the fluid supplied from the supply port 21a into the cylinder 5.

[0028] The discharge flow passage 22 (the through-passage) has: an inflow port 22a on the rear side (one side) for causing inflow of the fluid pressured inside the cylinder 5; and a discharge port 22b on the front side (the other side) for discharging the fluid. The suction valve 3 is disposed in the suction port 21b. The discharge valve 4 is disposed in the discharge port 22b.

[0029] The valve seat 2 includes: a suction valve seat 2h formed on its rear side; and a discharge valve seat 2n formed on its front side.

[0030] The discharge valve 4 includes: a discharge valve element 41 having a flat valve portion 41a; and a discharge-valve-body guiding portion 43a slidably supporting the discharge valve element 41. The suction valve 3 includes: a suction valve element 31 having a flat valve portion 31a; and a suction-side small-diameter portion 2c, which is a suction-valve-body guiding portion slidably supporting the suction valve element 31. The discharge valve seat 2n and the suction valve seat 2h have respective planar seating surfaces.

[0031] The flat valve portions of the suction valve element 31 and the discharge valve element 41 are formed to have respective thicknesses t equal to or more than 15% and equal to or less than 45% of the outer diameters of the flat valve portions 31a and 41a.

[0032] An inlet 1a is disposed on the outer peripheral side of the flange member 6, and couples to a fluid supply unit, which supplies fluid to the check valve 1 via a control valve (not illustrated), via a pipe. An outlet 1b is communicated with a supply destination to which a high-pressure fluid is supplied.

<Main Body (Valve Seat)>

[0033] As illustrated in Fig. 2, the valve seat 2 is a member that has: a supply flow passage 21, which causes flow of the fluid from the outer peripheral portion toward the suction port 21b formed on the one side (suction side); and the discharge flow passage 22 (the through-passage), which causes flow of the fluid from the inflow port 22a toward the discharge port 22b formed on the other side (the discharge side). The valve seat 2 includes the suction valve 3, which opens and closes the suction port 21b, disposed on the rear side; and the discharge valve

4, which opens and closes the discharge port 22b, disposed on the front side.

[0034] The valve seat 2 has: the large-diameter portion 2a (the enlarged diameter portion), which is formed in the center outer peripheral portion; a cross-section enlarged portion 2f, the engaging portion 2o, and the suction-side small-diameter portion 2c, which are formed on the rear side of the large-diameter portion 2a; and the tapered portion 2j, the discharge-side middle-diameter portion 2d (the second cylinder portion) and a discharge-side small-diameter portion 2e, which are formed on the front side of the large-diameter portion 2a. The entire valve seat 2 is formed in an approximately shogi-piece shape (an approximately pear shape).

[0035] On the suction side of the valve seat 2, the cross-section enlarged portion 2f, which is formed between the large-diameter portion 2a and the suction-side middle-diameter portion 2b, the engaging portion 2o, which is formed continuously with the rear side of the cross-section enlarged portion 2f, the suction valve seat 2h, which is formed continuously with the rear side of the engaging portion 2o, and a spring receiving portion 2i, which is formed in the rear end portion of the suction-side small-diameter portion 2c, are formed.

[0036] On the discharge side of the valve seat 2, the tapered portion 2j, which is formed between the large-diameter portion 2a and the discharge-side middle-diameter portion 2d, a stepped surface 2k, which is formed continuously with the front side of the discharge-side middle-diameter portion 2d, a reduced diameter portion 2m, which is formed in the shaft-center-side base end portion of the stepped surface 2k, and the discharge valve seat 2n, which is formed on the front end surface of the discharge-side small-diameter portion 2e, are formed.

[0037] The valve seat 2 intervenes between the cylinder 5 (the pressure container) and the flange member 6 in the state where the suction-side middle-diameter portion 2b (the first cylinder portion) on the suction side is internally fitted to the inner wall of a cylinder chamber 5a while the large-diameter portion 2a, the tapered portion 2j, and the discharge-side middle-diameter portion 2d on the discharge side are internally fitted to a through-hole 6a.

[0038] The supply flow passage 21 is a flow passage for feeding the fluid supplied to the inlet 1a of the check valve 1 to the suction port 21b through the inside of the valve seat 2. The supply flow passage 21 extends from the supply port 21a, which is formed on the outer peripheral surface of the large-diameter portion 2a of the valve seat 2, toward the shaft center direction, then is folded or bent in an L-shape on the rear side in the vicinity of the discharge flow passage 22, and formed along the discharge flow passage 22 toward the suction port 21b of the suction valve seat 2h.

[0039] The supply port 21a is disposed in communication with the inlet 1a of the flange member 6, and is coupled to a fluid supply source (not illustrated) by a tube and similar member via the flange member 6 and the

inlet 1a.

[0040] As illustrated in Figs. 3A and 3B, the suction port 21b is disposed in an opened state in the cylinder chamber 5a inside the cylinder 5. Movement in the front-rear direction (the arrow i and j directions) of a plunger 7 (see Fig. 1) causes the suction valve element 31 to move backward and forward (in the arrow h and g directions) against the spring force of a valve spring 32 so as to open and close the valve.

[0041] As illustrated in Fig. 2, the discharge flow passage 22 (the through-passage) is a flow passage for feeding the fluid inside the cylinder chamber 5a to the discharge port 22b. The discharge flow passage 22 is formed in a straight line from the inflow port 22a in the center of the rear end portion of the valve seat 2, along the axis center line, toward the discharge port 22b in the center of the forward end portion of the valve seat 2.

[0042] The inflow port 22a is an opening portion into which the fluid pressured by the plunger 7 (see Fig. 1) inside the cylinder chamber 5a is fed, and is formed in the rear end of the suction-side small-diameter portion 2c in a cylindrical shape to be opened toward the cylinder chamber 5a inside the cylinder 5.

[0043] The discharge port 22b is an opening portion from which the fluid fed into the discharge flow passage 22 from the inflow port 22a by the plunger 7 (see Fig. 1) is discharged. The discharge port 22b is disposed in the state opened toward the space inside a valve-body housing portion 44a of a valve-body housing member 44, and is opened and closed by the discharge valve element 41. In the peripheral edge portion of the discharge port 22b, the discharge valve seat 2n of the discharge valve 4 is formed.

[0044] The large-diameter portion 2a (the enlarged diameter portion) is a cylinder portion having the largest outer diameter in the valve seat 2, and is formed in the center portion of the valve seat 2 in the axial direction. The large-diameter portion 2a is formed between the engaging portion 2o (the small-diameter portion) and the tapered portion 2j (the conical surface) to be radially enlarged relative to the engaging portion 2o. In the front-rear direction of the supply port 21a formed in the large-diameter portion 2a, a sealing member O disposed in the flange member 6 is installed in the abutting state.

[0045] The cross-section enlarged portion 2f is a portion formed in a taper shape whose cross-sectional surface is gradually radially enlarged toward the discharge-side direction from the front end of the suction-side middle-diameter portion 2b to the rear end of the large-diameter portion 2a, and is formed on the rear side of the valve seat 2. In a cross-sectional view, the cross-section enlarged portion 2f is formed such that its outer diameter does not expand or is not reduced rapidly, so as to reduce the stress concentration. Between the cross-section enlarged portion 2f and the end surface of the cylinder 5 adjacent to the rear side of the cross-section enlarged portion 2f, a clearance S is formed by disposing a cutout part 5c of the cylinder 5.

[0046] In the cross-section enlarged portion 2f, the presence of the clearance S eliminates the fastening force of fastening bolts B to the valve seat 2 from a front end surface 5b of the cylinder 5 when the flange member 6 is fastened with the fastening bolts B to a housing (not illustrated) via the valve seat 2 and the cylinder 5.

[0047] The engaging portion 2o is the portion where a part of the suction side of the valve seat 2 is inserted into the cylinder 5, and includes the suction-side middle-diameter portion 2b (the first cylinder portion), the packing installation portion 2g, and the packing P. The length of the engaging portion 2o is formed longer than the depth of the insertion of the engaging portion 2o into the cylinder 5.

[0048] The suction-side middle-diameter portion 2b is a cylindrically-shaped portion internally fitted to the inner surface of the cylinder chamber 5a, and is formed continuously with the rear side of the cross-section enlarged portion 2f.

[0049] The packing installation portion 2g is a portion on which the packing P externally fitted to the valve seat 2, and is formed continuously with a stepped shape slightly smaller than the thickness of the packing P on the rear side of the suction-side middle-diameter portion 2b. In other words, the packing installation portion 2g is formed on the front side (the suction port side) of the cylinder 5.

[0050] The valve seat 2 (the main body) can be assembled by internally fitting the suction-side middle-diameter portion 2b, which is formed on the suction port side, to the inner surface of the cylinder 5, so as to cause the state where the valve seat 2 and the inner surface of the cylinder 5 (the pressure container) are coaxially disposed. In the valve seat 2, the packing installation portion 2g, which has a diameter smaller than that of the suction-side middle-diameter portion 2b and inserted into the inner surface of the cylinder 5, is formed on the suction port side, so as to allow disposing the packing P in the packing installation portion 2g. Accordingly, in the center portion of the valve seat 2 on the discharge side of the portion where the packing installation portion 2g of the valve seat 2 is formed, the pressure by the ultrahigh-pressure fluid internally accumulated in the cylinder 5 is stopped by the packing P so as not to act.

[0051] The discharge-side middle-diameter portion 2d (the second cylinder portion) is a cylindrical portion where the discharge valve 4 is disposed from the base end portion of the tapered portion 2j on the reduced diameter side and that is formed toward the front side. The discharge-side middle-diameter portion 2d is internally fitted to the discharge-valve installation portion 6d formed inside the through-hole 6a of the flange member 6.

[0052] In the check valve 1, the discharge-side middle-diameter portion 2d (the cylinder portion) of the valve seat 2 (the main body) is fitted to the discharge-valve installation portion 6d (the housing portion) of the flange member 6 (the receiving member) so as to allow disposing the valve seat 2 and the flange member 6 in accurate positions. The valve seat 2 and the flange member 6 are

accurately disposed such that the point of action of the resultant force of the forces that the valve seat 2 receives from the flange member 6 coincides with the point of action of the force that the valve seat 2 receives from the pressured fluid. In the check valve 1, the accurate coincidence of the points of action causes the action that more uniformly distributes the compressive stress acting on the inside of the valve seat 2 so as to improve the durability of the valve seat 2.

[0053] The stepped surface 2k is a portion formed flat from the front end of the discharge-side middle-diameter portion 2d toward the shaft center direction. The rear end surface of the valve-body housing member 44 in a cylindrical shape is disposed to face this stepped surface 2k.

[0054] The reduced diameter portion 2m is a portion formed in a taper shape from the shaft-center-side base end portion of the stepped surface 2k to the rear end of the discharge-side small-diameter portion 2e. On the reduced diameter portion 2m, the rear end of the valve-body housing member 44 is installed in the abutting state.

[0055] The discharge-side small-diameter portion 2e is a portion in a cylindrical shape to which the rear end portion of the valve-body housing member 44 is externally fitted, and is formed from the front end of the reduced diameter portion 2m to the peripheral edge of the discharge valve seat 2n.

<Flange Member>

[0056] As illustrated in Fig. 1, the flange member 6 (a valve-seat receiving member, the receiving member) is a supporting member that holds the valve seat 2, where the suction-side middle-diameter portion 2b is internally fitted to the forward end portion inside the cylinder chamber 5a, from the inner surface side on the front side. In the flange member 6, the through-hole 6a is formed. The through-hole 6a includes the receiving portion, which houses the large-diameter portion 2a and the tapered portion 2j of the valve seat 2 on the axis center line, and the circulation passage. Additionally, bolt insertion holes 6g, which allow insertion of the fastening bolts B for fastening the flange member 6 to the housing (not illustrated), are formed. Here, the "circulation passage" in the appended claims means the flow passage in communication with the front side of the discharge flow passage 22 (the through-passage).

[0057] As illustrated in Fig. 2, the valve seat 2, the valve-body housing member 44, and a coupling member 8 are coaxially inserted into the circulation passage. In the through-hole 6a, a stepped surface 6f, a valve-seat internally disposing portion 6b (the receiving portion), the tapered surface 6c (the receiving portion), the discharge-valve installation portion 6d, and the female thread portion 6e are formed. The stepped surface 6f is disposed abutting on the inserted front end surface 5b of the cylinder 5. To the valve-seat internally disposing portion 6b, the large-diameter portion 2a of the valve seat 2 is internally fitted. The tapered surface 6c is disposed to face

and fit the tapered portion 2j. To the discharge-valve installation portion 6d, the valve-body housing member 44 forming the outer peripheral portion of the discharge valve 4 is inserted. To the female thread portion 6e, the coupling member 8 is secured.

[0058] Here, the "receiving portion" described in the appended claims includes the valve-seat internally disposing portion 6b and the tapered surface 6c.

[0059] The coupling member 8 is a supporting member that has a male thread portion 8a screwed to the female thread portion 6e so as to obstruct the forward end portion side of the valve-body housing member 44. In the coupling member 8, the male thread portion 8a, which is formed in the outer peripheral portion, a coupling hole 8b, which forms the outlet 1b of the flow passage formed on the axis line, and a female thread portion 8c, which is formed on the opening end side inside the coupling hole 8b, are formed. To the female thread portion 8c, a coupling tool is screwed.

<Housing>

[0060] The housing (not illustrated) is a member that houses the cylinder 5 and to which the flange member 6 is fastened, and is, for example, formed by a pump housing such as a high pressure pump.

<Cylinder>

[0061] As illustrated in Fig. 1, the cylinder 5 (the pressure container) is a cylindrically-shaped member that forms the cylinder chamber 5a to which the plunger 7 is inserted movably forward and backward, and is internally disposed in the housing (not illustrated). The cylinder 5 has the cylinder chamber 5a on the shaft center portion side, and has the cutout part 5c on the shaft center portion side of the front end surface 5b. In the forward end portion of the cylinder 5, the front end surface 5b abuts on the stepped surface 6f of the flange member 6.

<Plunger>

[0062] As illustrated in Fig. 1, the plunger 7 is a member that reciprocates using an oil pressure or similar pressure. The plunger 7 achieves the function of a plunger pump, which moves backward to suction the suction valve element 31 against the valve spring 32 and to suction the fluid inside the supply flow passage 21 into the cylinder chamber 5a and which moves forward to press the fluid inside the cylinder chamber 5a so as to feed the fluid from the inflow port 22a into the discharge flow passage 22.

<Suction Valve>

[0063] As illustrated in Figs. 3A and 3B, the suction valve 3 is a valve that opens and closes the suction port 21b. The suction valve 3 is formed by a normally closed

valve that includes: the suction port 21b; the suction valve seat 2h, which is formed on the peripheral edge of the suction port 21b; the suction valve element 31, which obstructs the suction port 21b; the valve spring 32, which biases the suction valve element 31 to the valve closing side; the suction-side small-diameter portion 2c (the valve-body guiding portion), which supports the suction valve element 31 and the valve spring 32; and the spring receiving portion 2i of the valve spring 32.

[0064] The suction valve element 31 is formed of an annular plate material that is disposed to be biased by the valve spring 32 and obstruct the suction port 21b, and closes and opens the suction port 21b. The suction valve 3 opens when the fluid supplied to the supply flow passage 21 presses the suction valve element 31 to the rear-side direction using the force equal to or more than the spring force of the valve spring 32, and closes when the fluid supplied to the supply flow passage 21 presses the suction valve element 31 to the front-side direction using a force less than the spring force of the valve spring 32. The suction valve element 31 has the flat valve portion 31a abutting on the valve seat surface, and is disposed slidably along the suction-side small-diameter portion 2c (a valve-body guiding portion) supporting this suction valve element 31. As illustrated in Figs. 5A and 5B, the flat valve portions 31a and 41a of the suction valve element 31 and the discharge valve element 41 described later are formed to have respective thicknesses t equal to or more than 15% and equal to or less than 45% of the outer diameters of the flat valve portions 31a and 41a, and are formed of, for example, stainless steel formed thinner than the conventional valve element.

[0065] As illustrated in Fig. 3A, the valve spring 32 is a spring member that constantly presses the suction valve element 31 in the valve-closing direction (the arrow g direction) using a preliminarily set spring force, and is formed of a helical compression spring.

[0066] The suction valve seat 2h is a portion where a valve seat is formed. The valve seat includes the suction port 21b and the suction valve element 31, which opens and closes the suction port 21b. The suction valve seat 2h is formed by the planar surface formed in a radial fashion around this suction-side small-diameter portion 2c from the front-end-side base end portion of the suction-side small-diameter portion 2c toward the outer periphery.

[0067] The suction-side small-diameter portion 2c (the suction-valve-body guiding portion) is a portion that telescopically supports and guides the valve spring 32 of the suction valve 3, and is formed having a diameter smaller than the outer diameter of the suction-side middle-diameter portion 2b and the inner diameter of the valve spring 32. The suction-side small-diameter portion 2c is formed of a cylindrical-shaped protrusion disposed to protrude from the suction valve seat 2h toward the rear side, and includes the discharge flow passage 22 formed inside and the spring receiving portion 2i formed in the outer rear end portion.

[0068] The spring receiving portion 2i is a portion that receives the rear end of the valve spring 32 formed of a helical compression spring, and is formed, for example, in an annular shape (a flange shape) formed integrally with the rear end portion of the suction-side small-diameter portion 2c. Here, the spring receiving portion 2i only needs to achieve a function that receives the valve spring 32, and may be a member that is mountable on the suction-side small-diameter portion 2c, for example, a retaining ring separate to the valve seat 2.

<Discharge Valve>

[0069] As illustrated in Fig. 2, the discharge valve 4 is a valve that opens and closes the discharge port 22b of the valve seat 2. The discharge valve 4 includes: the discharge valve seat 2n, which is formed in the peripheral edge portion of the discharge port 22b; the discharge valve element 41, which opens and closes the discharge port 22b; a valve spring 42, which causes the discharge valve element 41 to abut on the discharge valve seat 2n so as to close the discharge port 22b; a valve-body supporting member 43, which supports the discharge valve element 41; and the valve-body housing member 44, which houses the discharge valve element 41, the valve spring 42, and the valve-body supporting member 43.

[0070] As illustrated in Figs. 4A and 4B, the discharge valve element 41 is formed of a bar-attached flat valve that includes the flat valve portion 41a in a flat circular plate shape and a rod-shaped portion 41b disposed to protrude in the flat valve portion 41a, and is formed of, for example, stainless steel.

[0071] The flat valve portion 41a is formed in a circular flat plate shape having a thin plate thickness, and is the portion that abuts on the valve seat surface to close the discharge port 22b. The discharge valve seat 2n is formed by the planar surface formed on the front end surface of the valve seat 2.

[0072] The rod-shaped portion 41b is slidably inserted into the valve-body supporting member 43 having the discharge-valve-body guiding portion 43a, which is formed in a pipe shape to support the discharge valve element 41.

[0073] The valve spring 42 is a spring member for pressing the flat valve portion 41a against the discharge valve seat 2n, and is formed of a helical compression spring. The valve spring 42 is telescopically and freely fitted to the discharge-valve-body guiding portion 43a, and has the rear end supported by the discharge valve element 41 while having the front end supported by a spring receiving portion 43b formed on the discharge side (the front side) of the discharge-valve-body guiding portion 43a.

[0074] The valve-body supporting member 43 is a member that achieves: a function that supports the discharge valve element 41; a function that supports the valve spring 42; and the function of a flow passage to discharge the fluid inside the valve-body housing portion

44a from the outlet 1b. In the valve-body supporting member 43, the discharge-valve-body guiding portion 43a, the spring receiving portion 43b, a shaft center hole 43c, which is formed by penetration in the axial direction, and a lateral hole 43d penetrated perpendicularly to this shaft center hole 43c, are formed.

[0075] The valve spring 42 is externally fitted to the outer side of the discharge-valve-body guiding portion 43a, and the rod-shaped portion 41b of the discharge valve element 41 is inserted into the shaft center hole 43c to be housed in the valve-body housing portion 44a of the valve-body housing member 44.

[0076] As illustrated in Figs. 4A and 4B, the discharge-valve-body guiding portion 43a is a cylindrical portion extending from the center of the rear end portion of the spring receiving portion 43b toward the rear-side direction. The discharge-valve-body guiding portion 43a supports the rod-shaped portion 41b movably forward and backward inside this the discharge-valve-body guiding portion 43a (in the shaft center hole 43c), and telescopically supports the valve spring 42 in the front-rear direction outside the discharge-valve-body guiding portion 43a.

[0077] The spring receiving portion 43b is a portion that is integrally formed with the front end side of the discharge-valve-body guiding portion 43a while having an outer diameter larger than the outer diameter of the discharge-valve-body guiding portion 43a and that supports the valve spring 42. In the spring receiving portion 43b, the shaft center hole 43c and the lateral hole 43d forming the flow passage of the fluid are formed. The spring receiving portion 43b is biased by the valve spring 42 and disposed in the state pressed to the rear end surface of a housing-member flow passage portion 44b of the valve-body housing member 44.

[0078] Here, the spring receiving portion 43b can be formed on the rear end surface of the housing-member flow passage portion 44b.

[0079] The shaft center hole 43c is formed from the rear end surface to the front end surface of the valve-body supporting member 43 along the shaft center. The shaft center hole 43c has a rear side forming a supporting portion inserted into the rod-shaped portion 41b and has a front side forming a flow passage that causes flow of the fluid inside the lateral hole 43d to the housing-member flow passage portion 44b.

[0080] The lateral hole 43d is a flow passage formed from the outer peripheral portion on one side of the spring receiving portion 43b through the shaft center hole 43c to the outer peripheral portion on the other side, and is formed to feed a flow of the fluid inside the valve-body housing portion 44a to the shaft center hole 43c.

[0081] As illustrated in Fig. 2, the valve-body housing member 44 is a pipe-shaped member that includes: the valve-body housing portion 44a having the space formed to house the discharge valve 4 inside; and the housing-member flow passage portion 44b where a flow passage is formed. The valve-body housing member 44 may be

formed by a member where the valve-body housing portion 44a and the housing-member flow passage portion 44b are integrated, but the valve-body housing portion 44a and the housing-member flow passage portion 44b are preferred to be formed as mutually independent members.

[0082] The valve-body housing member 44 is internally disposed in the discharge-valve installation portion 6d (the housing portion) of the flange member 6, has the rear end into which the discharge-side small-diameter portion 2e of the outer periphery of the discharge valve seat 2n is internally fitted in the state where the rear end abuts on the reduced diameter portion 2m, and has the front side in the state abutting on the coupling member 8.

[0083] The housing-member flow passage portion 44b has a cylindrical shape where a flow passage 44e is formed. Through the flow passage 44e, the fluid inside the valve-body housing portion 44a passes toward the outlet 1b. A flow-passage inlet 44c is communicated with the shaft center hole 43c. A flow-passage outlet 44d may be formed in a taper shape expanded to the front side. The front-side end surface of the housing-member flow passage portion 44b abuts on the rear-side end surface of the coupling member 8.

<Action>

[0084] The following describes the action of the check valve according to the embodiment of the present invention with reference to the accompanying drawings.

[0085] When the reciprocating plunger 7 moves in the rear-side direction (the arrow i direction in Fig. 1), as illustrated in Fig. 3B, the plunger 7 opens the suction valve element 31 of the suction valve 3 and suctions the fluid inside the supply flow passage 21 to the cylinder chamber 5a side. At this time, the pressures of the fluids inside the supply flow passage 21, inside the cylinder chamber 5a, and inside the discharge flow passage 22 are, for example, 0.4 MPa.

[0086] The fluid inside the supply flow passage 21 is suctioned by the plunger 7 so as to flow to the direction (the arrow b direction) of the cylinder chamber 5a, and presses the suction valve element 31 closing the suction port 21b against the valve spring 32 rearward (in the arrow h direction) so as to open the suction valve element 31. The annular suction valve element 31 is freely fitted to the suction-side small-diameter portion 2c (the valve-body guiding portion) together with the valve spring 32 to be guided, and thus stably slides along the suction-side small-diameter portion 2c so as to open and close the valve. That is, the movement of the flat valve portion 31a becomes stable.

[0087] The suction valve element 31 decreases in rigidity due to thinning of the thickness of the flat valve portion 31a, but increases in close contact property to the suction valve seat 2h formed by the planar surface due to occurrence of warping in the flat valve portion 31a by the pressure difference. The suction valve seat 2h

gradually wears due to opening and closing of the suction valve element 31. However, despite the wear of the suction valve seat 2h, the high close contact property of the flat valve portion 31a to the suction valve seat 2h allows preventing leakage from the suction valve 3.

[0088] When the plunger 7 (see Fig. 1) moves rearward, as illustrated in Fig. 4A, the discharge valve 4 is closed in the state where the flat valve portion 41a of the discharge valve element 41 is pressed against the discharge valve seat 2n by the spring force of the valve spring 42. At this time, the pressure of the fluid inside the discharge flow passage 22 is, for example, 0.4 MPa. The pressure of the fluid inside the valve-body housing portion 44a is, for example, 500 MPa.

[0089] When the plunger 7 moves in the front-side direction (the arrow j direction in Fig. 1), the plunger 7 presses the fluid inside the cylinder chamber 5a in the front-side direction to close the suction port 21b and causes, as illustrated in Fig. 3A, flow of the fluid inside the cylinder chamber 5a in the direction (the arrow c direction) inside the discharge flow passage 22. At this time, the pressure of the fluid inside the supply flow passage 21 is, for example, 0.4 MPa. The pressure of the fluid inside the discharge flow passage 22 is, for example, 500 MPa.

[0090] The fluid inside the cylinder chamber 5a flows from the inflow port 22a into the discharge flow passage 22, as illustrated in Fig. 4B, presses the flat valve portion 41a of the discharge valve element 41 against the valve spring 42 forward (in the arrow m direction) so as to open the discharge valve element 41, and flows into the valve-body housing portion 44a. Then, the fluid passes from the inside of the valve-body housing portion 44a through the lateral hole 43d and the shaft center hole 43c of the valve-body supporting member 43, a flow passage 44e of a housing-member flow passage portion 44b, and the coupling hole 8b of the coupling member 8 illustrated in Fig. 2, and comes out from the outlet 1b.

[0091] As illustrated in Fig. 4B, when the discharge valve 4 opens, the discharge valve element 41 where the rod-shaped portion 41b is inserted into the discharge-valve-body guiding portion 43a of the valve-body supporting member 43 slides and the valve spring 42 is also compressed while being supported by the discharge-valve-body guiding portion 43a. At this time, the pressures of the fluids inside the discharge flow passage 22 and inside the valve-body housing portion 44a are, for example, 500 MPa.

[0092] The discharge valve element 41 stably slides along the discharge-valve-body guiding portion 43a to open and close the valve.

[0093] The discharge valve element 41 decreases in rigidity due to thinning of the thickness of the flat valve portion 41a, but increases in close contact property to the discharge valve seat 2n formed by the planar surface due to occurrence of warping in the flat valve portion 41a by the pressure difference. The discharge valve seat 2n gradually wears due to opening and closing of the discharge valve element 41. However, despite the wear of

the discharge valve seat 2n, the high close contact property of the flat valve portion 41a to the discharge valve seat 2n allows preventing leakage from the discharge valve 4.

[0094] In the suction valve element 31 and the discharge valve element 41 of the check valve 1 according to the embodiment, the thicknesses of the flat valve portions 31a and 41a are thinned. As a result of experiment, the valve element having a conventional thickness became unable to provide the sealing property at a repeat count of 1.5×10^5 and became unusable. In contrast, the flat valve portions 31a and 41a according to the present invention prolonged the sealing property up to a repeat count of 1×10^6 .

[0095] As illustrated in Fig. 4B, when the plunger 7 moves in the front-side direction (the arrow j direction in Fig. 1), the pressure inside the cylinder chamber 5a of the cylinder 5 (the pressure container) acts on the valve seat 2 (the main body). The tapered portion 2j (the conical surface) of the valve seat 2 and the tapered surface 6c of the receiving portion of the flange member 6 have identical groove angles. Accordingly, a force F1 by the pressure inside the cylinder chamber 5a is received by the entire surface of the tapered surface 6c of the flange member 6. As its reaction, the flange member 6 applies a force F2, which is perpendicular to the tapered portion 2j of the valve seat 2 and uniform, to the valve seat 2 from the peripheral area toward the center portion.

[0096] On the other hand, the discharge flow passage 22 is affected by the pressure identical to that of the cylinder chamber 5a. The pressure applied to the discharge flow passage 22 pushes out the valve seat 2 from the center to the radially outer peripheral direction. The force acting from the outer peripheral portion and the force acting from the inside cause an approximately uniform compressive stress acting on the entire valve seat 2.

[0097] In the valve seat 2, the reduced diameter portion 2m is formed to be inclined between the stepped surface 2k and the discharge-side small-diameter portion 2e. Accordingly, there is no portion where the cross-sectional surface of the valve seat 2 expands rapidly. This reduces the occurrence of the stress concentration so as to allow reducing the occurrence of cracking and breakage.

[0098] The valve seat 2 resolves the occurrence of the tensile stress on the root of the flanged portion, thus prolonging the product lifetime.

[0099] In the check valve 1, the thicknesses t of the flat valve portions 31a and 41a of the suction valve element 31 and the discharge valve element 41 are formed to be equal to or more than 15% and equal to or less than 45% of the outer diameters of the flat valve portions 31a and 41a. Accordingly, the suction valve element 31 and the discharge valve element 41 decrease in the thicknesses to the extent that allows the deformation while keeping the strength so as to reduce the rigidity, thus abutting on the suction valve seat 2h and the discharge valve seat 2n while warping. This allows providing a valve element in an appropriate shape having improved close contact

property.

[First Modification]

[0100] The present invention is not limited to the foregoing embodiment, and can be changed and modified in various forms within the scope of the appended claims.

[0101] The check valve 1 described in the above-described embodiment is a valve appropriate for an ultra-high-pressure generating apparatus such as a high pressure pump.

Claims

1. A piston pump comprising:

a cylinder (5);
a main body (2) having a through-passage (22) that is communicated with the cylinder and allows flow of fluid; and
a receiving member (6) disposed on the cylinder to support the main body,
wherein the main body (2) has:

an engaging portion (2o) that is formed on one side of the through-passage and disposed to be engaged inside the cylinder;
a conical surface (2j) formed on another side;
an enlarged diameter portion (2a) between the engaging portion (2o) and the conical surface (2j), the enlarged diameter portion being radially enlarged relative to the engaging portion;
a discharge-side middle diameter portion (2d) in a forward end portion on the other side of the main body;
a supply port (21a) for supplying the fluid; and
a suction port (21b) on one side, for discharging the fluid supplied from the supply port into the cylinder,

the through-passage (22) has:

an inflow port (22a) on the one side, for causing inflow of the fluid pressured inside the cylinder;
a discharge port (22b) on the other side, for discharging the fluid,
a suction valve (3) disposed in the suction port (21b); and
a discharge valve (4) disposed in the discharge port (22b);

the receiving member (6) has:

a receiving portion having a valve-seat internally disposing portion (6b) and a tapered surface (6c) with a groove angle identical to a groove angle of the conical surface;
 a circulation passage communicated with the other side of the through-passage; and
 a housing portion (6d) to which the discharge-side middle diameter portion (2d) is fitted by insertion, and uses the housing portion (6d) to restrict the discharge-side middle diameter portion so as to support the main body (2);

the engaging portion (2o) includes:

a first cylinder portion (2b) internally fitted to an inner surface of the cylinder (5);
 a packing installation portion (2g) having a diameter smaller than a diameter of the first cylinder portion; and
 a packing (P) disposed in the packing installation portion;

wherein the conical surface (2j) of the main body (2) abuts on the tapered surface (6c) of the receiving member (6) such that the receiving member supports the main body (2) and the enlarged diameter portion (2a) of the main body (2) is internally fitted to the valve seat internally disposing portion (6b) of the receiving member (6).

2. The piston pump according to claim 1, wherein the main body (2) includes:

a valve seat (2h) of the suction valve formed on the one side of the main body; and
 a valve seat (2h) of the discharge valve formed on the other side of the main body.

3. The piston pump according to claim 1, wherein

the discharge valve (4) includes: a discharge valve element (41) having a flat valve portion (41a); and a discharge-valve-body guiding portion (43a) slidably supporting the discharge valve element (41),
 the suction valve (3) includes: a suction valve element (31) having a flat valve portion (31a); and a suction-valve-body guiding portion slidably supporting the suction valve element (31), and
 the discharge valve (3) and the suction valve (4) have respective planar valve seat surfaces.

4. The piston pump according to claims 2 or 3, wherein the flat valve portions of the suction valve element (31) and the discharge valve element (41) are formed

having respective thicknesses equal to or more than 15% and equal to or less than 45% of outer diameters of the flat valve portions (31a, 41a).

Patentansprüche

1. Kolbenpumpe, umfassend:

einen Zylinder (5);
 einen Hauptkörper (2), der einen Durchgangskanal (22) hat, der mit dem Zylinder kommuniziert und eine Strömung eines Fluids zulässt; und
 ein Aufnahmeelement (6), das auf dem Zylinder angeordnet ist, um den Hauptkörper abzustützen, wobei der Hauptkörper (2) aufweist:

einen Eingriffsabschnitt (2o), der auf einer Seite des Durchgangskanals ausgebildet und dazu angeordnet ist, im Inneren des Zylinders in Eingriff zu sein;
 eine konische Fläche (2j), die auf einer anderen Seite ausgebildet ist;
 einen Abschnitt mit vergrößertem Durchmesser (2a) zwischen dem Eingriffsabschnitt (2o) und der konischen Fläche (2j), wobei der Abschnitt mit vergrößertem Durchmesser relativ zu dem Eingriffsabschnitt radial vergrößert ist;
 einen auf der Ausstoßseite gelegenen Mitteldurchmesserabschnitt (2d) in einem vorderen Endabschnitt auf der anderen Seite des Hauptkörpers;
 einen Zufuhranschluss (21a) zum Zuführen des Fluids; und
 einen Sauganschluss (21b) auf einer Seite zum Auslassen des von dem Zufuhranschluss zugeführten Fluids in den Zylinder, der Durchgangskanal (22) aufweist:

einen Einlassanschluss (22a) auf der einen Seite, um ein Einströmen des in dem Zylinder unter Druck gesetzten Fluids zu veranlassen;
 einen Auslassanschluss (22b) auf der anderen Seite zum Auslassen des Fluids,
 ein Saugventil (3), das in dem Sauganschluss (21b) angeordnet ist; und
 ein Auslassventil (4), das in dem Auslassanschluss (22b) angeordnet ist;

das Aufnahmeelement (6) aufweist:

einen Aufnahmeabschnitt, der einen den Ventilsitz im Inneren anordnenden Ab-

schnitt (6b) und eine verjüngte Fläche (6c) mit einem Öffnungswinkel hat, der zu dem Öffnungswinkel der konischen Fläche identisch ist;

einen Zirkulationskanal, der mit der anderen Seite des Durchgangskanals kommuniziert; und

einen Gehäuseabschnitt (6d), in den der auf der Ausstoßseite gelegene Mitteldurchmesserabschnitt (2d) durch Einführen eingesteckt ist, und den Gehäuseabschnitt (6d) dazu verwendet, den auf der Ausstoßseite gelegenen Mitteldurchmesserabschnitt zu umgeben, um so den Hauptkörper (2) zu unterstützen;

der Eingriffsabschnitt (2o) aufweist:

einen ersten Zylinderabschnitt (2b), der innen an einer Innenoberfläche des Zylinders (5) angebracht ist;

einen Packungs-Einbauabschnitt (2g), der einen Durchmesser hat, der kleiner als ein Durchmesser des ersten Zylinderabschnitts ist; und

eine Packung (P), die in dem Packungs-Einbauabschnitt angeordnet ist;

wobei die konische Fläche (2j) des Hauptkörpers (2) an die verjüngte Fläche (6c) des Aufnahmeelements (6) anstößt, sodass das Aufnahmeelement den Hauptkörper (2) abstützt und der Abschnitt mit vergrößertem Durchmesser (2a) des Hauptkörpers (2) von innen an dem den Ventilsitz innerlich anordnenden Abschnitt (6b) des Aufnahmeelements (6) angebracht ist.

2. Kolbenpumpe gemäß Anspruch 1, wobei der Hauptkörper (2) aufweist:

einen Ventilsitz (2h) des Saugventils, der auf der einen Seite des Hauptkörpers ausgebildet ist; und

einen Ventilsitz (2h) des Auslassventils, der auf der anderen Seite des Hauptkörpers ausgebildet ist.

3. Kolbenpumpe gemäß Anspruch 1, wobei

das Auslassventil (4) aufweist: ein Auslassventilelement (41), das einen flachen Ventilabschnitt (41a) hat; und einen Auslassventilkörperführungsabschnitt (43a), der das Auslassventilelement (41) gleitend lagert,

das Saugventil (3) aufweist: ein Saugventilelement (31), das einen flachen Ventilabschnitt (31a) hat; und einen Saugventilkörperführungsabschnitt, der das Saugventilelement (31) glei-

tend lagert, und das Auslassventil (3) und das Saugventil (4) jeweils eine ebene Ventilsitzoberfläche haben.

4. Kolbenpumpe gemäß Anspruch 2 oder 3, wobei die flachen Ventilabschnitte des Saugventilelements (31) und des Auslassventilelements (41) so ausgebildet sind, dass sie jeweils eine Dicke haben, die größer oder gleich 15% und kleiner oder gleich 45% der Außendurchmesser der flachen Ventilabschnitte (31a, 41a) ist.

Revendications

1. Pompe à piston comprenant :

un cylindre (5) ;
un corps principal (2) ayant un passage traversant (22) qui est en communication avec le cylindre et qui permet un écoulement de fluide ; et
un organe de réception (6) disposé sur le cylindre pour supporter le corps principal,
dans laquelle le corps principal (2) a :

une portion d'engagement (2o) qui est formée sur un côté du passage traversant et disposée pour être engagée à l'intérieur du cylindre ;

une portion conique (2j) formée sur un autre côté ;

une portion de diamètre élargie (2a) entre la portion d'engagement (2o) et la surface conique (2j), la portion de diamètre élargie étant élargie radialement par rapport à la portion d'engagement ;

une portion de diamètre intermédiaire côté refoulement (2d) dans une portion d'extrémité avant sur l'autre côté du corps principal ;

un orifice d'alimentation (21a) pour alimenter le fluide ; et

un orifice d'aspiration (21b) sur un côté, pour refouler le fluide alimenté depuis l'orifice d'alimentation dans le cylindre,

le passage traversant (22) a :

un orifice d'entrée (22a) sur l'un côté, pour provoquer une entrée du fluide pressurisé à l'intérieur du cylindre ;

un orifice de refoulement (22b) sur l'autre côté, pour refouler le fluide,

une soupape d'aspiration (3) disposée dans l'orifice d'aspiration (21b) ; et

une soupape de refoulement (4) disposée dans l'orifice de refoulement (22b) ;

l'organe de réception (6) a :

une portion de réception ayant une portion de disposition à l'intérieur de siège de soupape (6b) et une surface effilée (6c) avec un angle de rainure identique à un angle de rainure de la surface conique ;
un passage de circulation en communication avec l'autre côté du passage traversant ; et
une portion de logement (6d) sur laquelle la portion de diamètre intermédiaire côté refoulement (2d) est ajustée par insertion, et utilise la portion de logement (6d) pour restreindre la portion de diamètre intermédiaire côté refoulement de manière à supporter le corps principal (2) ;

la portion d'engagement (2o) inclut :

une première portion de cylindre (2b) ajustée à l'intérieur sur une surface interne du cylindre (5) ;
une portion d'installation de garniture (2g) ayant un diamètre plus petit qu'un diamètre de la première portion de cylindre ; et
une garniture (P) disposée dans la portion d'installation de garniture ;

dans laquelle la surface conique (2j) du corps principal (2) vient en butée sur la surface effilée (6c) de l'organe de réception (6) de sorte que l'organe de réception supporte le corps principal (2), et
la portion de diamètre élargie (2a) du corps principal (2) est ajustée à l'intérieur sur la portion de disposition à l'intérieur de siège de soupape (6b) de l'organe de réception (6).

2. Pompe à piston selon la revendication 1, dans laquelle le corps principal (2) inclut :

un siège de soupape (2h) de la soupape d'aspiration formé sur l'un côté du corps principal ; et
un siège de soupape (2h) de la soupape de refoulement formé sur l'autre côté du corps principal.

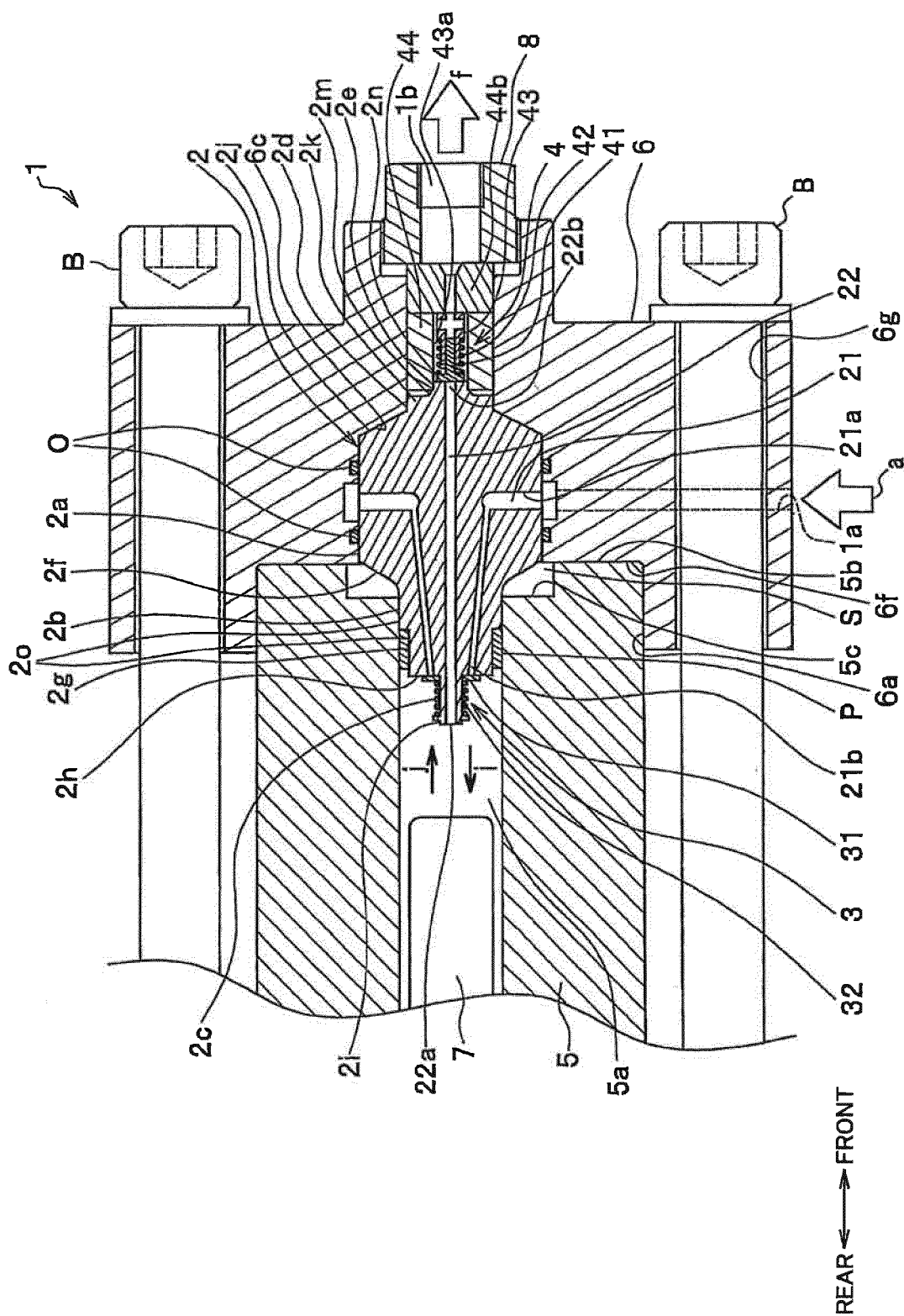
3. Pompe à piston selon la revendication 1, dans laquelle

la soupape de refoulement (4) inclut : un élément de soupape de refoulement (41) ayant une portion de soupape plate (41a) ; et une portion de guidage de corps de soupape de refoulement (43a) supportant en coulissant l'élément de soupape de refoulement (41),

la soupape d'aspiration (3) inclut : un élément de soupape d'aspiration (31) ayant une portion de soupape plate (31a) ; et une portion de guidage de corps de soupape d'aspiration supportant en coulissant l'élément de soupape d'aspiration (31), et
la soupape de refoulement (3) et la soupape d'aspiration (4) ont des surfaces de siège de soupape planes respectives.

4. Pompe à piston selon la revendication 2 ou 3, dans laquelle les portions de soupape plates de l'élément de soupape d'aspiration (31) et de l'élément de soupape de refoulement (41) sont formées en ayant des épaisseurs respectives supérieures ou égales à 15 % et inférieures ou égales à 45 % des diamètres extérieurs des portions de soupape plates (31a, 41a).

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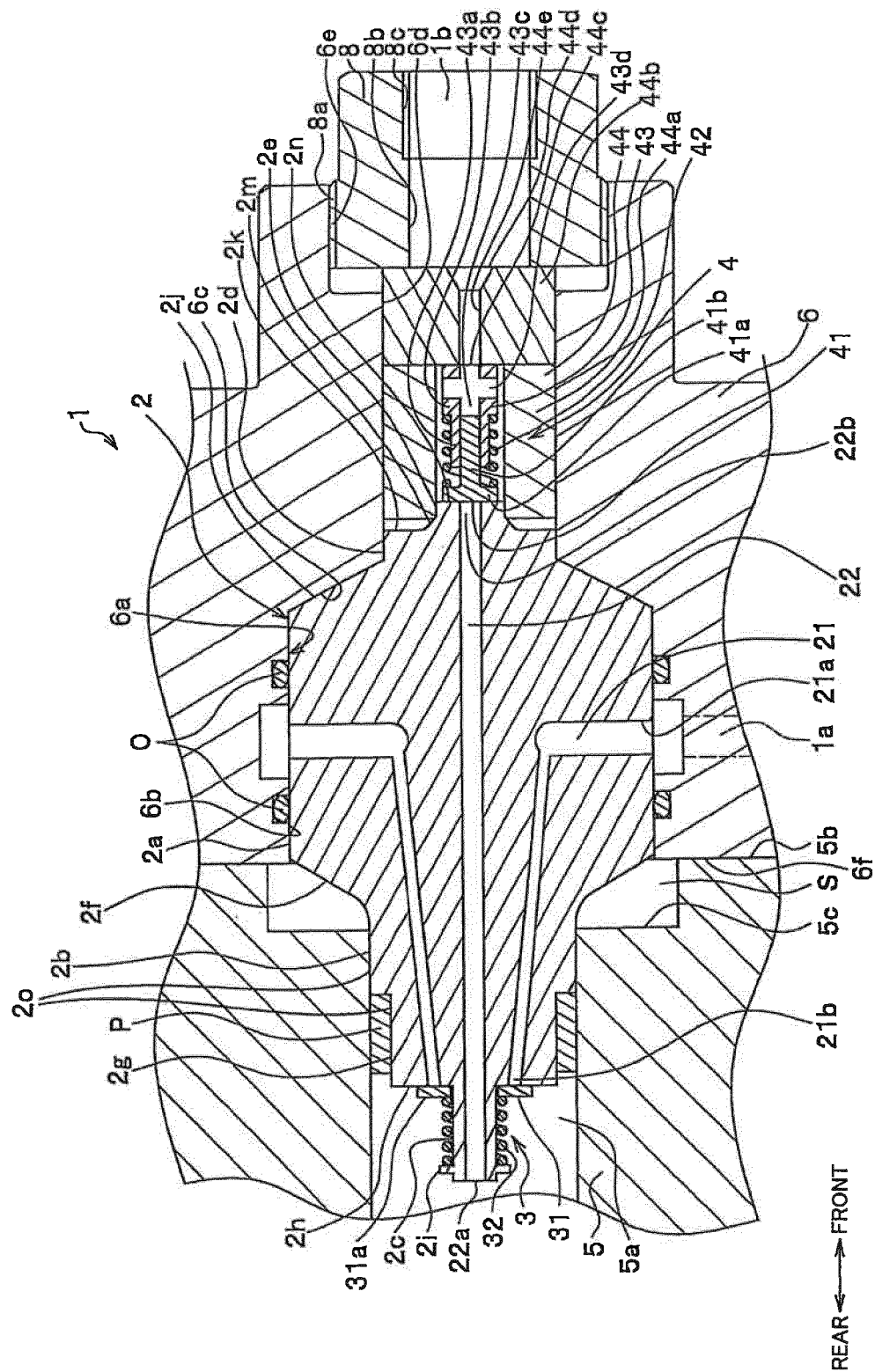


Fig. 3A

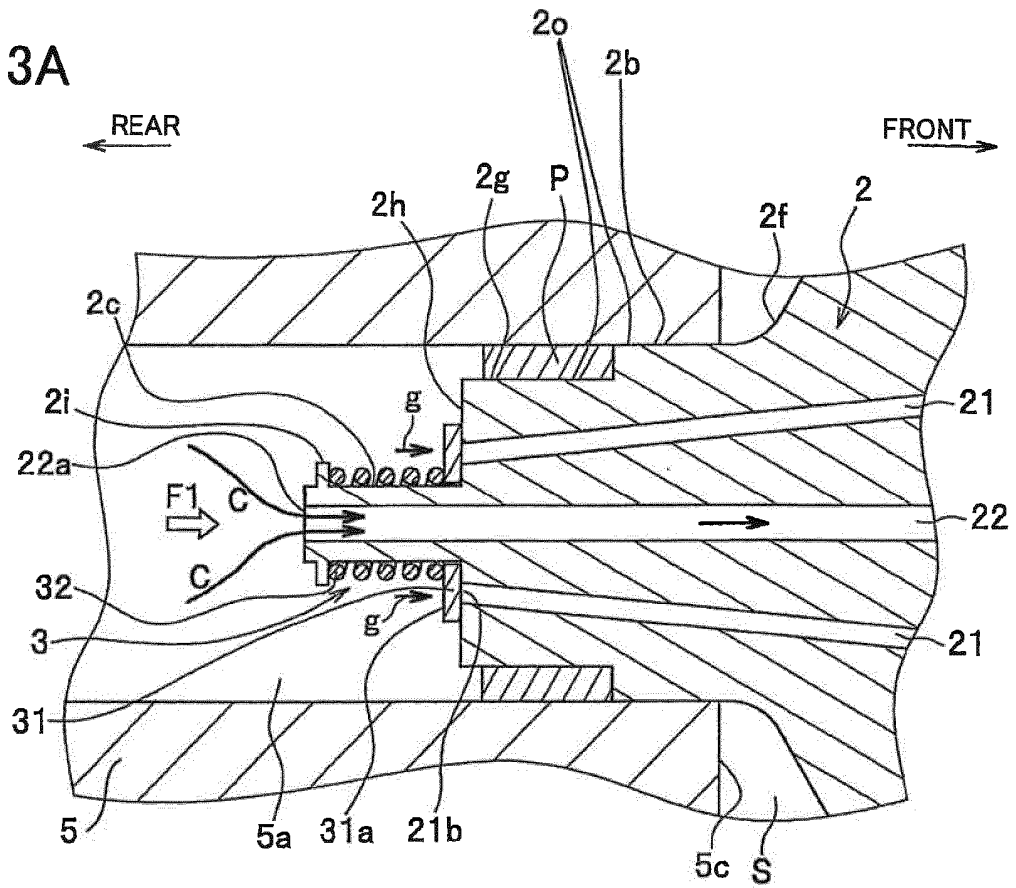


Fig. 3B

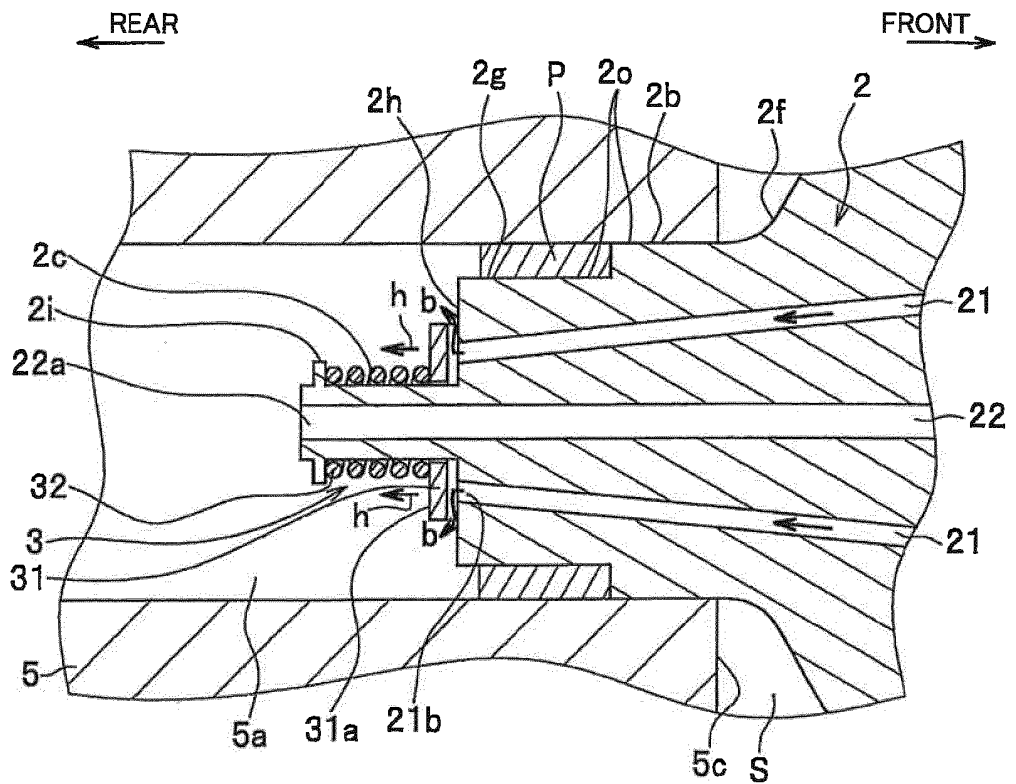


Fig. 4A

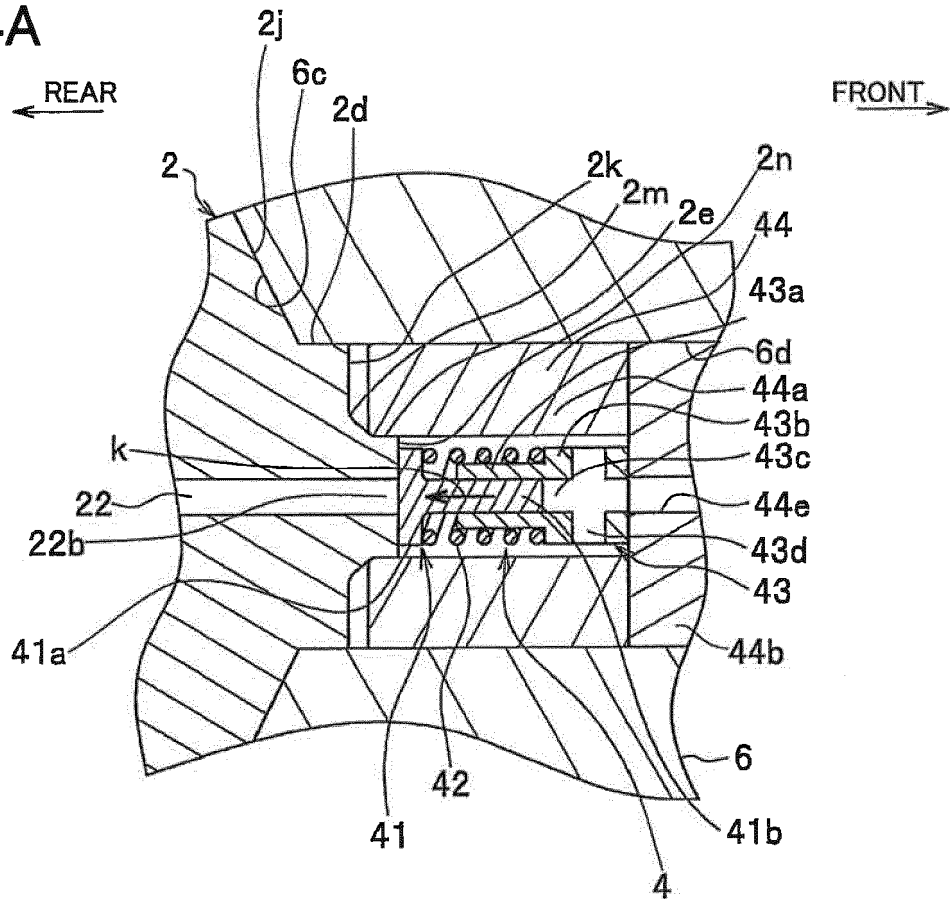


Fig. 4B

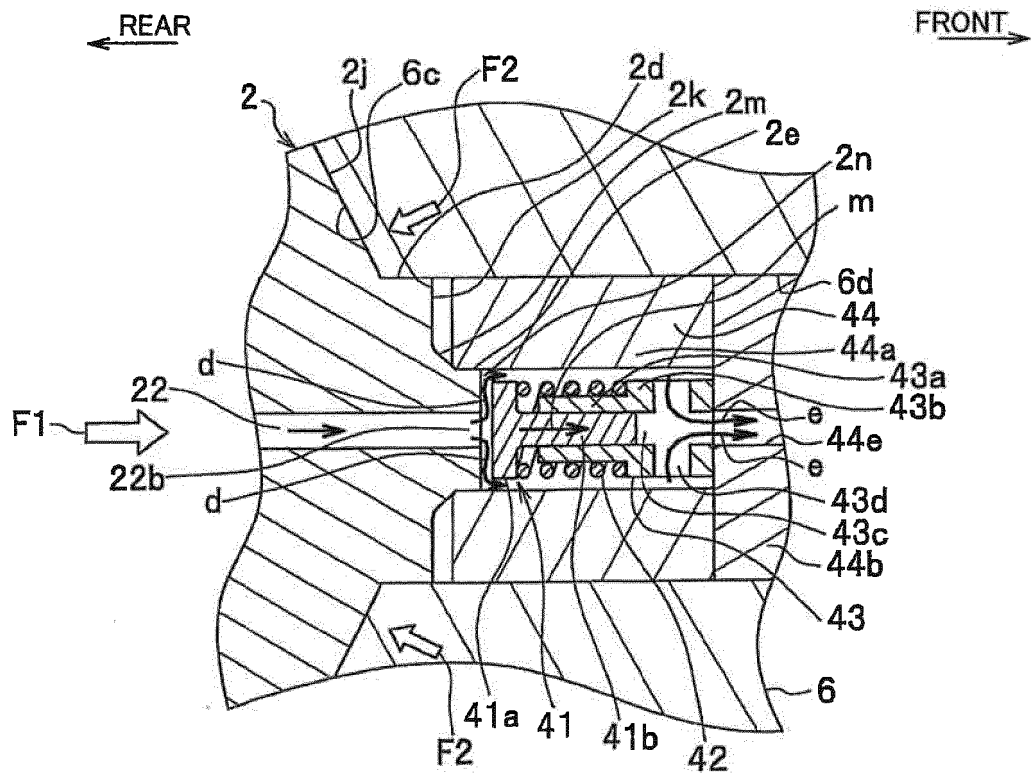


Fig. 5A

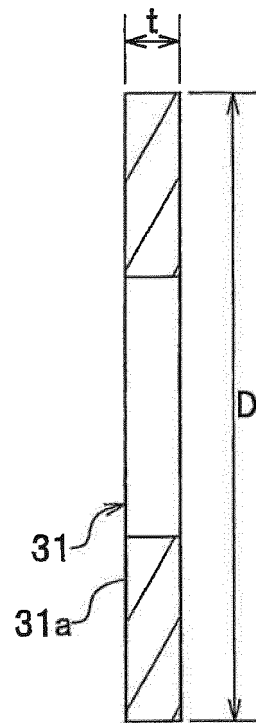
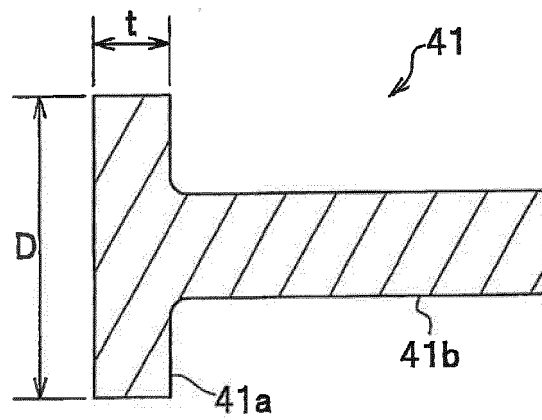


Fig. 5B



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2006509171 A [0002]
- EP 391489 A [0007]