



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
18.03.2009 Bulletin 2009/12

(51) Int Cl.:
F04B 27/10 ^(2006.01)

(21) Application number: **08162733.3**

(22) Date of filing: **21.08.2008**

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

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(30) Priority: **11.09.2007 JP 2007234881**

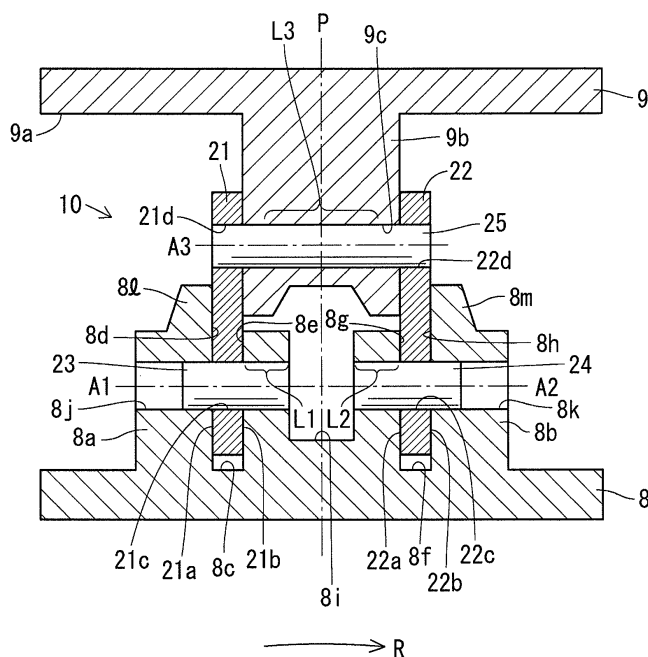
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(54) **Capacity-variable type swash plate compressor**

(57) A capacity-variable type swash plate compressor in which a link mechanism is hardly worn and superior durability is demonstrated. According to the compressor in the invention, a link mechanism 10 comprises a swash plate arm 9b and first and second intermediate arms 21, 22. The first and second intermediate arms 21, 22 include pairs of first guided surfaces 21a, 21b, 22a, 22b extending in parallel to a virtual plane P and having back sides

thereof facing each other in front and back in the direction of rotation R of a drive shaft 6, and each are formed into a plate shape extending from the side of a lug plate 8 to the side of a swash plate 9. First and second lug arms 8a, 8b of the lug plate 8 are formed with first and second lug-side storage recesses 8c, 8f having first guiding surfaces 8d, 8e, 8g, 8h. The first and second intermediate arms 21, 22 are stored in the first and second lug-side storage recesses 8c, 8f.

Fig. 3



Description

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a capacity-variable type swash plate compressor.

BACKGROUND ART

[0002] In the related art, a capacity-variable type swash plate compressor disclosed in JP-A-10-176658 is known. In this compressor, a housing includes a cylinder block, a front housing and a rear housing, and the cylinder block includes a plurality of cylinder bores. The rear housing includes an suction chamber and a discharge chamber, which communicate with the respective cylinder bores via valve units. The front housing and the cylinder block define a crank chamber, and the front housing and the cylinder block includes a rotatably supported drive shaft. In the crank chamber, a lug plate is fixed to the drive shaft, and a thrust bearing is provided between the lug plate and the front housing.

[0003] In the crank chamber, a swash plate is supported by the drive shaft so as to be capable of varying in inclination angle, and a link mechanism is provided between the lug plate and the swash plate. As shown in Fig. 12, the link mechanism comprises a first and second lug arm 91a, 91b integrated with a lug plate 91 and projecting toward a swash plate 92, a single swash plate arm 92a projecting toward the lug plate 91, a first intermediate arm 93 provided between the first lug arm 91a and the swash plate arm 92a, and a second intermediate arm 94 provided between the second lug arm 91b and the swash arm 92a.

[0004] The first and second intermediate arms 93, 94 are rotatably supported by the first and second lug arm 91a, 91b via a bolt 95, and are rotatably supported by the swash plate arm 92a via a pin 96. The bolt 95 extends in the direction of lug side axis A1 which is orthogonal to a virtual plane P defined by a center axis of the drive shaft and a top dead center position of the swash plate 92. The pin 96 extends in the direction of a swash plate side axis A2 extending in parallel with the lug side axis A1.

[0005] Each cylinder bore accommodates a piston capable of reciprocating, and the each piston defines a compression chamber in the cylinder bore. A movement transferring mechanism is provided between the swash plate 92 and the each piston. More specifically, the movement transferring mechanism includes a rocking plate provided on the side of the each piston with respect to the swash plate 92, a bearing provided between the swash plate 92 and the rocking plate for causing the rocking plate to make a rocking movement according to the inclination angle of the swash plate 92, and a piston rod for connecting the rocking plate and the each piston.

[0006] In this compressor, when the swash plate 92 rotates in association with a rotational movement of the drive shaft in the direction of rotation R, the respective

pistons are reciprocated in the cylinder bores via the rocking plate and the respective piston rods, whereby refrigerant gas is sucked from the suction chamber into the compression chamber. The refrigerant gas, after having compressed, is discharged into the discharge chamber. Meanwhile, the movement transferring mechanism transfers the rocking movement of the swash plate 92 into the reciprocal movement of the pistons. A link mechanism allowing the swash plate 92 to change in the inclination angle with respect to the lug plate 91 while disabling the swash plate 92 to rotate relatively with respect to the drive shaft.

STATEMENT OF INVENTION

PROBLEM TO BE SOLVED BY THE INVENTION

[0007] However, in the compressor in the related art as described above, the first and second intermediate arm 93, 94 includes guided surfaces 93a, 93b, 94a, 94b respectively in the front and back in the direction of rotation R of the drive shaft, and guides the both guided surfaces 93a, 93b of the first intermediate arm 93 by an inner surface of the first lug arm 91a and one side surface of the swash arm 92a, and guides the both guided surfaces 94a, 94b of the second intermediate arm 94 by the inner surface of the second lug arm 91b and other side surfaces of the swash arm 92a. Since the lug plate 91 and the swash plate 92 are different members, the relative positions between the inner surface of the first lug arm 91a and the one side surface of the swash arm 92a, and between the inner surface of the second lug arm 91b and the other side surface of the swash arm 92a are easily changed, so that the first and second intermediate arms 93, 94, and hence the swash plate 92 are easily deviated from their normal positions and hence may be skewed. In this case, the link mechanism is worn and hence a risk of deterioration in durability of the compressor arises. In this compressor, in order to restrain the complication of the first and second intermediate arms 93, 94 as such, the first and second lug arms 91a, 91b are adapted to project significantly toward the swash plate 92 with the sacrifice of the manufacturing of the lug plate 91. However, it cannot be sufficient.

[0008] In view of such problems, it is an object of the invention to provide a capacity-variable type swash plate compressor in which the link mechanism is hardly worn and superior durability is demonstrated.

MEANS FOR SOLVING PROBLEM

[0009] A capacity-variable type swash plate compressor in the invention comprises a housing having a cylinder bore, a drive shaft rotatably supported by the housing, a lug member fixed to the drive shaft in the housing, a swash plate supported by the drive shaft so as to be capable of changing inclination angle in the housing, a link mechanism provided between the lug member and

the swash plate in the housing allowing the swash plate to change the inclination angle with respect to the lug member while disabling the swash plate to rotate with respect to the drive shaft, a piston accommodated in the cylinder bore so as to be capable of reciprocating therein, and a movement transferring mechanism provided between the swash plate and the piston for transferring the rocking movement of the swash plate into the reciprocal movement of the piston,

[0010] the link mechanism is comprising a swash plate arm integrated with the swash plate and projecting toward the lug member side, and an intermediate arm provided between the lug member and the swash plate arm, being rotatably supported by the lug member about a lug-side axis which is orthogonal to a virtual plane defined by a center axis of the drive shaft and a top dead center position of the swash plate, and being rotatably supported by the swash plate arm about a swash-plate-side axis which extends in parallel with the lug-side axis,

[0011] the intermediate arm is comprising a first intermediate arm being plate-shaped, existing on one side of the virtual plane, and extending from the lug member side to the swash-plate-side, and a second intermediate arm being plate-shaped, existing on the other side of the virtual plane, and extending from the lug member side to the swash-plate-side,

[0012] the first intermediate arm includes a pair of first guided surfaces extending in parallel with the virtual plane and having back sides thereof facing each other in the front and back in the direction of rotation of the drive shaft,

[0013] the second intermediate arm includes a pair of second guided surfaces extending in parallel with the virtual plane and having the back sides thereof facing each other in the front and back in the direction of rotation of the drive shaft,

[0014] at least one of the lug member and the swash plate arm includes a first storage recess existing on one side of the virtual plane and a second storage recess existing on the other side of the virtual plane,

[0015] the first storage recess includes a pair of first guiding surfaces extending in parallel with the virtual plane and facing each other in the front and back in the direction of rotation of the drive shaft,

[0016] the second storage recess includes a pair of second guiding surfaces extending in parallel with the virtual plane and facing each other in the front and back in the direction of rotation of the drive shaft, and

[0017] the first intermediate arm is stored in the first storage recess in such a manner that the both first guided surfaces are guided by the both first guiding surfaces, and the second intermediate arm is stored in the second storage recess in such a manner that the both second guided surfaces are guided by the both second guided surfaces.

[0018] The compressor in the invention includes the first and second storage recesses on at least one of the lug member and the swash plate arm. The both first guid-

ed surfaces of the first intermediate arm is guided by the both first guiding surfaces of the first storage recess and the both second guided surfaces of the second intermediate arm are guided by the both second guided surfaces of the second storage recesses. Since the both first guiding surfaces of the first storage recess and the both second guiding surfaces of the second storage recess are formed on the same member, the relative position does not change. Therefore, the first and second intermediate arms and the swash plate are easily maintained at the normal positions and hence are hardly be skewed.

[0019] In the compressor in the invention, since the lug member does not need to be projected significantly toward the swash-plate-side, the manufacture of the lug member and the manufacture of the entire compressor are also simplified.

[0020] Therefore, according to the capacity-variable type swash plate compressor in the invention, the link mechanism is hardly worn and superior durability is demonstrated.

[0021] In JP-A-2003-172333, another link mechanism is disclosed as shown in Fig. 13. This link mechanism comprises a first and second lug arms 81a, 81b integrated with a lug plate 81 and being projected toward a swash plate 82 side, a single swash plate arm 82a integrated with the swash plate 82 and being projected toward the lug plate 81 side, and an intermediate arm 83 formed into an angular C-shape.

[0022] The intermediate arm 83 is rotatably supported by the first and second lug arms 81a, 81b via a lug-side pin 84, and is rotatably supported by the swash plate arm 82a via a swash-plate-side pin 85. The lug-side pin 84 extends in the direction of a lug side axis A1 orthogonal to a virtual plane P. The swash-plate-side pin 85 extends in the direction of the swash plate side axis A2 which is in parallel with the lug side axis A1. When the lug plate 81 and the intermediate arm 83 are formed of an aluminum-based material, an iron washer is provided between the first and second lug arms 81a, 81b and the intermediate arm 83.

[0023] In this link mechanism, the intermediate arm 83 includes guided surfaces 83a, 83b on the side of the lug plate 81 in the front and back in the direction of rotation R of the drive shaft and guided surfaces 83c, 83d on the side of the swash plate 82. The guided surfaces 83a, 83b of the intermediate arm 83 is guided by the both inner surface of the first and second lug arms 81a, 81b, and the guided surfaces 83c, 83d thereof are guided by the both side surfaces of the swash plate arm 82a. Therefore, in this link mechanism, it is considered that skew hardly occurs in the intermediate arm 83 and hence the swash plate 82.

[0024] However, in this link mechanism, the shape of the intermediate arm 83 is complicated, and it is necessary to slidably stores the intermediate arm 83 between the both inner surfaces of the first and second lug arms 81a, 81b and slidably stores the both side surfaces of the swash plate arm 82a between the both inner surfaces

83c, 83d of the intermediate arm 83, so that control of tolerance is troublesome. When the washer is provided between the first and second lug arms 81a, 81b and the intermediate arm 83, insertion of the washer is also troublesome. Therefore, in this compressor, increase in manufacturing cost is resulted in order to demonstrate the superior durability.

[0025] In contrast, according to the compressor in the invention, the first and second intermediate arms of the link mechanism are formed into a plate shape, and the control of tolerance may be simplified in comparison with the link mechanism disclosed in JP-A-2003-172333. By forming the lug plate of an aluminum-based material and the intermediate arm of an iron-based material, it is not necessary to provide the iron washer between the lug member and the first and second intermediate arms. Therefore, according to the compressor in the invention, a superior durability is demonstrated and increase in manufacturing cost may be prevented.

[0026] Preferably, the compressor in the invention is configured in such a manner that the first storage recess and the second storage recess are formed on the lug member, and the swash plate arm comes into contact with the first intermediate arm and the second intermediate arm on the both side surfaces thereof. In this case, manufacture of the swash plate arm, and hence of the swash plate is simplified and the weight of the swash plate is reduced to reduce the force of inertia of the swash plate, so that the quicker responsibility for the change in capacity is achieved.

[0027] Preferably, the compressor in the invention is configured in such a manner that the first storage recess and the second storage recess are formed on the swash plate arm, the lug member includes a lug arm projecting toward the swash plate side, and the lug arm comes into contact by the sides face thereof with the first intermediate arm and the second intermediate arm on the both side surfaces thereof. In this case, manufacture of the lug arm, and hence of the lug member is simplified. In addition, the weight of the lug member may be reduced, so that the force of inertia of the lug member is reduced.

[0028] The compressor in the invention may be configured in such a manner that the first storage recess and the second storage recess are formed on the lug member and the swash plate arm. In this case, the both first guided surface of the first intermediate arm are guided by the both first guiding surface of the first storage recess of the lug member and the both first guiding surfaces of the first storage recess of the swash plate arm, and the both second guided surfaces of the second intermediate arm are guided by the both second guiding surfaces of the second storage recess of the lug member and the both second guiding surfaces of the second storage recess of the swash plate arm, so that the first and second intermediate arms, and hence the swash plate is maintained further easily at the normal position, and is more hardly be skewed.

[0029] Preferably, the first intermediate arm and the

second intermediate arm are rotatably supported by the lug member via a lug-side pin having a center axis corresponding to the lug side axis. In this case, the first and second intermediate arms do not move away from the lug member, so that abnormal noise is hardly generated.

[0030] Preferably, the first intermediate arm and the second intermediate arm are rotatably supported by the swash plate arm via the swash-plate-side pin having a center axis corresponding to the swash plate side axis. In this case, the first and second intermediate arms do not move away from the swash plate arm and hence abnormal noise is hardly generated.

[0031] Preferably, the lug member comprises a first lug arm projecting toward the swash-plate-side and formed with the first storage recess, a second lug arm projecting to the swash-plate-side and formed with the second storage recess, and a removed portion is formed between the first lug arm and the second lug arm. In this case, the weight of the lug member may be reduced by the removed portion, so that the force of inertia of the lug member may be reduced. The removed portion may also be used for assembly.

[0032] When the weight of the lug member is reduced, a rotational inertia moment of the compressor may be reduced with respect to a high-output diesel engine. When the compressor is of a type having no clutch, erroneous operation due to an excessive stress to the torque limiter may be prevented against excessive variations in rotation transmitted from the engine to the pulley via a belt. In contrast, when the compressor has a clutch, abrasion of an engaged portion between the drive shaft and the hub such as spline may be prevented against excessive variations in rotation transmitted to the pulley.

[0033] Preferably, the first intermediate arm is rotatably supported by the first lug arm via a first lug-side pin having a center axis corresponding to the lug side axis, and the second intermediate arm is rotatably supported by the second lug arm via a second lug-side pin having a center axis corresponding to the lug side axis. In this case, the first and second intermediate arms do not move away from the first and second lug arms, and hence abnormal noise can hardly be generated. Since the total length of the first lug-side pin and the second lug-side pin may be shorter than the single lug-side pin, the weight of the lug-side pin may be reduced, so that the force of inertia may be reduced. In addition, center alignment of the first lug-side pin and the second lug-side pin may be simplified in comparison with the case of assembling a long lug-side pin so as not to be inclined, so that assembly workability is improved.

[0034] Preferably, the first lug-side pin is press-fitted into the first lug arm on the virtual plane side with respect to the first storage recess, and the second lug-side pin is press-fitted into the second lug arm on the virtual plane side with respect to the second storage recess. In this case, the first and second storage recesses are not deformed, so that the first and second intermediate arms may be guided preferably under a high productivity. Fur-

thermore, the first and second lug-side pins do not need a detent structure.

[0035] Preferably, the lug member comprises a first lug arm projecting toward the swash-plate-side and formed with the first storage recess, and a second lug arm projecting toward the swash-plate-side and formed with the second storage recess, and the first lug arm and the second lug arm are overlapped with the swash plate arm in the direction of projection. In this case, the first and second intermediate arms are prevented from falling down further reliably. Since the thickness of the first and second intermediate arms may be reduced, the desirable balance of rotation is achieved to reduce vibrations.

[0036] Preferably, a swash-plate-side pin is press-fitted at the center of the swash plate arm. In this case, the first and second intermediate arm may be guided preferably under a high-productivity. The swash-plate-side pin does not need the detent structure.

[0037] The movement transferring mechanism may comprises shoe sliding surfaces formed on the front and back outer peripheral surfaces of the swash plate, shoe receiving surfaces formed on the piston, and semi-spherical shoes provided between the shoe sliding surfaces and the shoe receiving surfaces. In this case, the swash plate arm is preferably formed at a position avoiding a position on the vertical of the shoe sliding surface. Accordingly, the swash plate allow easy machining of the shoe-sliding surfaces, so that the productivity is improved.

[0038] Preferably, the lug member is formed of an aluminum-based material, and the intermediate arm is formed of an iron-based material. In this case, machining of the aluminum-based material is relatively easy. In addition, the force of inertia of the lug member is reduced. When the intermediate arm is formed of the iron-based material, sliding movement between the lug member and the intermediate arm is desirably maintained.

DESCRIPTION OF DRAWINGS

[0039] Fig. 1 is a cross-sectional view of a compressor in Embodiment 1.

[0040] Fig. 2 relates to a compressor in Embodiment 1, and is a perspective view of a link mechanism.

[0041] Fig. 3 relates to the compressor in Embodiment 1, and is a pattern cross-sectional view of the link mechanism.

[0042] Fig. 4 relates to the compressor in Embodiment 1, and is an explanatory drawing illustrating a reaction force applied to the link mechanism.

[0043] Fig. 5 relates to the compressor in Embodiment 1, and is an explanatory drawing illustrating a reaction force applied to the link mechanism.

[0044] Figs. 6 (A) to (F) relate to the compressor in Embodiment 1, and are explanatory drawings showing a method of assembling the link mechanism.

[0045] Figs. 7 (G) to (K) relate to the compressor in Embodiment 1, and are explanatory drawings showing

a method of assembling the link mechanism.

[0046] Fig. 8 is relates to a compressor in Embodiment 2, and is a pattern cross-sectional view of the link mechanism.

[0047] Fig. 9 relates to a compressor in Embodiment 3, and is a pattern cross-sectional view of the link mechanism.

[0048] Fig. 10 relates to a compressor in Embodiment 4, and is a pattern cross-sectional view of the link mechanism.

[0049] Fig. 11 relates to a compressor in Embodiment 5, and is a pattern cross-sectional view of the link mechanism.

[0050] Fig. 12 relates to a compressor in the related art, and is a pattern cross-sectional view of the link mechanism.

[0051] Fig. 13 relates to a compressor in another related art, and is a pattern cross-sectional view of the link mechanism.

DESCRIPTION OF SPECIFIC EMBODIMENT

[0052] Referring now to the drawings, Embodiments 1 to 5 in which the invention is embodied will be described.

EMBODIMENT 1

[0053] As shown in Fig. 1, a capacity-variable type swash plate compressor in Embodiment 1 comprises a front housing 2 joined to a front end of a cylinder block 1 and a rear housing 4 joint to a rear end of the cylinder block 1 via a valve unit 3. The cylinder block 1 and the front housing 2 are formed with shaft holes 1a, 2a extending in the axial direction, and a drive shaft 6 is rotatably supported in the shaft holes 1a, 2a respectively via radial bearings 5a, 5b and a shaft seal device 5c, respectively. The left side in Fig. 1 corresponds to the front side and the right side corresponds to the rear side.

[0054] The front housing 2 and the cylinder block 1 define a crank chamber 7. In the crank chamber 7, a lug plate 8 as a lug member is press-fitted to the drive shaft 6 with the intermediary of a thrust bearing 5d with respect to the front housing 2. The lug plate 8 is formed of an aluminum-based material (for example, A4000-system T6).

[0055] In the crank chamber 7, a swash plate 9 is provided on the back side of the lug plate 8. A flat shoe sliding surface 9a is formed on the front and rear outer peripheral surfaces on the outer peripheral side of the swash plate 9. The swash plate 9 is formed by machining the shoe sliding surface 9a on an integral component of an iron-based material (for example, FCD700). The swash plate 9 receives the drive shaft 6 inserted there-through and, in this state, is adapted to be changed in the inclination angle by a link mechanism 10 provided with respect to the lug plate 8.

[0056] The cylinder block 1 is formed with a plurality of cylinder bores 1b extending therethrough in the axial

direction concentrically. A single head piston 11 is reciprocally accommodated in the each cylinder bore 1b. Shoe receiving surfaces 11a formed into a spherical recess are provided at a neck portion of the each piston 11 so as to oppose to each other. A pair of front and rear shoes 12 are provided between the swash plate 9 and the piston 11. The each shoe 12 is formed into a substantially semi-spherical shape. Front and rear shoe sliding surfaces 9a, front and rear shoe receiving surfaces 11a and front and rear shoes 12 constitutes a movement transferring mechanism.

[0057] The rear housing 4 is formed with an suction chamber 4a and a discharge chamber 4b. The cylinder bores 1b are able to communicate with the suction chamber 4a via an intake valve mechanism of the valve unit 3, and are able to communicate with the discharge chamber 4b via a discharge valve mechanism of the valve unit 3.

[0058] A capacity control valve 13 is accommodated in the rear housing 4. The capacity control valve 13 communicates with the suction chamber 4a via a detection path 4c, and communicates the discharge chamber 4b and the crank chamber 7 via a gas-supply path 4d which is partly shown in the drawing. The capacity control valve 13 changes the opening of the gas-supply path 4d and changes the discharge capacity of the compressor by detecting the pressure in the suction chamber 4a. The crank chamber 7 and the suction chamber 4a communicate with each other by an gas-bleeding path, not shown. A condenser 15, an expansion valve 16 and an evaporator 17 are connected to the discharge chamber 4b via a piping 14, and the evaporator 17 is connected to the suction chamber 4a via the piping 14.

[0059] As shown in Fig. 2 and Fig. 3, the link mechanism 10 comprises first and second lug arms 8a, 8b integrated with the lug plate 8 and projecting toward the swash plate 9, a swash plate arm 9b integrated with the swash plate 9 and projecting toward the lug plate 8, an first intermediate arm 21 provided between the first lug arm 8a and the swash plate arm 9b, and a second intermediate arm 22 provided between the second lug arm 8b and the swash plate arm 9b.

[0060] The first and second intermediate arms 21, 22 each are formed respectively of an iron-based material (for example, a quenched carbon steel product), and is a plate-shaped member extending from the lug plate 8 side to the swash plate 9 side. As shown in Fig. 3, the first intermediate arm 21 includes a pair of first guided surfaces 21a, 21b extending in parallel with a virtual plane P defined by the center axis of the drive shaft 6 and the top dead center position of the swash plate 9 and having the back sides thereof facing each other on the front and back in the direction of rotation R of the drive shaft 6. The second intermediate arm 22 includes second guided surfaces 22a, 22b extending in parallel with the virtual plane P and having the back sides thereof facing each other in the front and back in the direction of rotation R of the drive shaft 6.

[0061] The lug plate 8 is formed with a first lug-side storage recess 8c existing on one side of the virtual plane P, and a second lug-side storage recess 8f existing on the other side of the virtual plane P. The first lug arm 8a is formed with the first lug-side storage recess 8c. The first lug-side storage recess 8c extends in parallel with the virtual plane P, and has a pair of first guiding surfaces 8d, 8e extending in parallel with the virtual plane P and facing each other in the front and back in the direction of rotation R of the drive shaft 6. The second lug arm 8b is formed with the second lug-side storage recess 8f. The second lug-side storage recess 8f includes a pair of second guiding surfaces 8g, 8h extending in parallel with the virtual plane P and facing each other in the front and back sides in the direction of rotation R of the drive shaft 6. The distance between the first and second lug-side storage recesses 8c, 8f is larger than the outer diameter of the drive shaft 6. A removed portion 8i is formed between the first lug arm 8a and the second lug arm 8b.

[0062] The first intermediate arm 21 is stored in the first lug-side storage recess 8c so that the both first guided surfaces 21a, 21b are guided by the both first guiding surfaces 8d, 8e. The second intermediate arm 22 is stored in the second lug-side storage recess 8f so that the both second guided surfaces 22a, 22b are guided by the both second guiding surfaces 8g, 8h.

[0063] The first lug arm 8a is formed with a pin hole 8j having a center axis corresponding to the lug side axis A1 which is orthogonal to the virtual plane P, and the second lug arm 8b is formed of a pin hole 8k having a center axis corresponding to the swash-plate-side axis A2 which is orthogonal to the virtual plane P. The first intermediate arm 21 is formed with a pin hole 21c at a right angle with respect to the first guided surfaces 21a, 21b and the second intermediate arm 22 is formed of a pin hole 22c at a right angle with respect to the second guided surfaces 22a, 22b.

[0064] A first lug-side pin 23 is shorter than the depth of the pin hole 8j of the first lug arm 8a. The first lug-side pin 23 is press-fitted into the pin hole 8j within a range L1 on the side of the virtual plane P with respect to the first lug-side storage recess 8c, and is loosely fitted to the pin hole 8j in other ranges. The first lug-side pin 23 is loosely fitted to the pin hole 21c of the first intermediate arm 21.

[0065] In the same manner, a second lug-side pin 24 is shorter than the depth of the pin hole 8k of the second lug arm 8b. The second lug-side pin 24 is press-fitted to the pin hole 8k in the range L2 on the side of the virtual plane P with respect to the second lug-side storage recess 8f, and is loosely fitted to the pin hole 8k in other ranges. The second lug-side pin 24 is loosely fitted to the pin hole 22c of the second intermediate arm 22.

[0066] In this manner, the first intermediate arm 21 is rotatably supported by the first lug arm 8a via the first lug-side pin 23, and the second intermediate arm 22 is rotatably supported by the second lug arm 8b by the second lug-side pin 24.

[0067] The swash plate arm 9b is formed at a position avoiding a position on the vertical of the shoe sliding surface 9a. The swash plate arm 9b is formed of a pin hole 9c having a center axis corresponding to the swash plate side axis A3 which is parallel to the lug side axis A1 and A2. The first intermediate arm 21 is formed of a pin hole 21d at a right angle with respect to the first guided surfaces 21a, 21b, and the second intermediate arm 22 is formed of a pin hole 22d at a right angle with respect to the second guided surfaces 22a, 22b.

[0068] A swash-plate-side pin 25 is press-fitted to the pin hole 9c of the swash plate arm 9b in the range L3 at the center and is loosely fitted to the pin hole 9c in other ranges. The swash-plate-side pin 25 is loosely fitted to the pin hole 21d of the first intermediate arm 21 and the pin hole 22d of the second intermediate arm 22. The first and second lug-side pins 23, 24 and the swash-plate-side pin 25 are formed of an iron-based material (for example, a quenched material of SUJ2).

[0069] In this manner, the first and second intermediate arms 21, 22 are rotatably supported by the swash plate arm 9b via the swash-plate-side pin 25.

[0070] The outside portion of the first lug arm 8a with respect to the first lug-side storage recess 8c is formed with a projecting portion 8i which projects toward the swash plate 9 side and the outer diameter side with respect to the inside with respect to the first lug-side storage recess 8c of the first lug arm 8a. The outside portion of the second lug arm 8b with respect to the second lug-side storage recess 8f is formed with a projecting portion 8m which projects toward the swash plate 9 side and the outer diameter side with respect to the inside with respect to the second lug-side storage recess 8f of the second lug arm 8b. In this manner, these projections 8i, 8m overlap with the swash plate arm 9b in the projecting direction in the range of rocking movement of the first and second intermediate arms 21, 22. The projections 8i, 8m exposes both ends of the swash-plate-side pin 25.

[0071] As shown in Fig. 2, the lug plate 8 has a weight 8n at the position plane symmetry with respect to the first and second lug arm 8a, 8b, and a weight 9d at the position plane symmetry with respect to the swash plate arm 9b. The distal end and the inner surface of the weight 9d are adapted to come into abutment with the lug plate 8 at a maximum capacity where the inclination angle of the swash plate 9 is maximized with respect to a plane orthogonal to the center axis of the drive shaft 6.

[0072] The link mechanism 10 is assembled in a manner shown below. Firstly, the lug plate 8, the swash plate 9, the first and second intermediate arms 21, 22, the first and second lug-side pins 23, 24, and the swash-plate-side pin 25 are prepared. The drive shaft 6 may be press-fitted into the lug plate 8.

[0073] As shown in Fig. 6(A), the first and second intermediate arms 21, 22 are inserted into the first and second lug-side storage recesses 8c, 8f of the lug plate 8. In this case, a jig 26 is prepared. The jig 26 includes a main body 26a, an inserting portion 26b projecting from

the main body 26a and insertable into the removed portion 8i of the lug plate 8, and a resilient member 26c such as leaf springs provided on both side surfaces of the main body 26a. Then, the inserting portion 26b is inserted into the removed portion 8i and positioned therein and the first and second intermediate arms 21, 22 are held by the resilient member 26c.

[0074] Subsequently, as shown in Fig. 6(B), the first and second intermediate arms 21, 22 held by the jig 26 are moved to align the pin holes 8j, 8k of the first and second lug arms 8a, 8b and the pin holes 21c, 22c of the first and second intermediate arms 21, 22, and then the first lug-side pin 23 is loosely fitted into the pin holes 8j, 21c from the outside of the first lug arm 8a.

[0075] When the first lug-side pin 23 is moved to the range L1, as shown in Fig. 6(C), the first lug-side pin 23 is press-fitted into the pin hole 8j. In this case, the inserting portion 26b of the jig 26 restrains excessive press-fitting into the first lug-side pin 23. Therefore, the lug plate 8 is not used for the positioning of the outer surface of the first lug arm 8a, so that the machining of the outer surface of the first lug arm 8a on the inner side of the first lug-side storage recess 8c is restrained from being deformed by the inserting portion 26b of the jig 26.

[0076] As shown in Figs. 6(D) to (F), the second lug-side pin 24 is loosely fitted into the pin holes 8k, 22c from the outside of the second lug arm 8b, and in the range L2, the second lug-side pin 24 is press-fitted into the pin hole 8k.

[0077] Subsequently, as shown in Figs. 7(G), (H), the swash plate arm 9b of the swash plate 9 is inserted between the first and second intermediate arms 21, 22 while bringing the jig 26 down toward the near side or the far side of the paper plane of the drawings in a state in which the inserting portion 26b is inserted into the removed portion 8i. Then, the jig 26 is detached as shown in Fig. 7(I).

[0078] Subsequently, as shown in Fig. 7(J), a jig 27 is prepared. The jig 27 includes a main body 27a formed with a pin storage hole 27b, a positioning pin 27c which is storable in the pin storage hole 27b, and a spring 27d having an urging force in the direction to cause the positioning pin 27c to project from the pin storage hole 27b. Then, the positioning pin 27c is positioned by inserting the same into the pin holes 22d, 9c and 21d, while aligning the pin hole 9c of the swash plate arm 9b and the pin holes 21d, 22d of the first and second intermediate arms 21, 22. Then, the swash-plate-side pin 25 is fitted to the swash plate arm 9b by being loosely fitted into the pin holes 21d, 9c from the direction opposite from the jig 27 so that the positioning pin 27c is compressed.

[0079] When the swash-plate-side pin 25 is moved to the range L3, as shown in Fig. 7(K), the swash-plate-side pin 25 is press-fitted into the pin hole 9c. When the swash-plate-side pin 25 exceeds the range L3, the swash-plate-side pin 25 is loosely fitted to the pin hole 22d. In this manner, the link mechanism 10 in Embodiment 1 is obtained. The compressor is assembled with this link mech-

anism 10.

[0080] In the compressor configured as described above, the lug plate 8 and the swash plate 9 are synchronously rotated by the drive shaft 6 being driven in the direction of rotation R, and the pistons 11 are reciprocated via the shoes 12 in the cylinder bores 1b. Accordingly, the capacities of the compressing chambers formed on the head sides of the pistons 11 are changed. Therefore, the refrigerant gas in the suction chamber 4a is sucked into the compression chamber and is compressed, and then is discharged into the discharge chamber 4b. In this manner, the air conditioning operation is carried out by the refrigeration cycle including the compressor, the condenser 15, the expansion valve 16 and the evaporator 17. Meanwhile, the movement transferring mechanism transfers the rocking movement of the swash plate 9 into the reciprocal movement of the piston 11. The link mechanism 10 allows the lug plate 8 to change the inclination angle of the swash plate 9 and disables the relative rotation of the swash plate 9 with respect to the drive shaft 6.

[0081] In this case, in this compressor, the lug plate 8 is formed with the first and second lug arms 8a, 8b and the first and second lug arms 8a, 8b are formed with the first and second lug-side storage recesses 8c, 8f. Then, the both first guided surfaces 21a, 21b of the first intermediate arm 21 are guided by the both first guiding surfaces 8d, 8e of the first lug-side storage recess 8c, and the both second guided surfaces 22a, 22b of the second intermediate arm 22 are guided by the both second guiding surfaces 8g, 8h of the second lug-side storage recess 8f. The both first guiding surfaces 8d, 8e of the first lug-side storage recess 8c and the both second guiding surfaces 8g, 8h of the second lug-side storage recess 8f are formed on the same lug plate 8, the relative position is not changed. Therefore, the first and second intermediate arms 21, 22 and hence the swash plate 9 are easily held at the normal positions.

[0082] Reaction forces of the respective components generated when a thrust load F1 is applied to the swash plate 9 in the link mechanism 10 of this compressor will be shown in Fig. 4. Fig. 4 shows a case in which clearances between the first and second lug-side storage recesses 8c, 8f and the first and second intermediate arms 21, 22 are relatively large. It is understood from Fig. 4 that the thrust load F1 is desirably dispersed by the respective components in this link mechanism 10.

[0083] In the link mechanism 10 in this compressor, reaction forces of the respective components generated when a radial load F2 is applied to the swash plate 9 are shown in Fig. 5. Fig. 5 also shows a case in which the clearances between the first and second lug-side storage recesses 8c, 8f and the first and second intermediate arms 21, 22 are relatively large. It is understood from Fig. 5 that the radial load F2 is desirably dispersed by the respective components in the link mechanism 10.

[0084] Therefore, according to the link mechanism 10, it is understood that when the thrust load F1 and the radial load F2 are applied to the swash plate 9, the reaction

forces of the respective components may be composed of the thrust forces and a relatively small radial force, so that the skew is hardly occurred.

[0085] In this compressor, it is not necessary to cause the first and second lug arms 8a, 8b to project significantly toward the swash plate 9 side. Therefore, the lug plate 8 is easily cast or forged. Since the distance between the first and second lug-side storage recesses 8c, 8f is set to be larger than the outer diameter of the drive shaft 6, it is possible to carry out slotter machining on the first and second lug-side storage recesses 8c, 8f after having press-fitted the lug plate 8 onto the drive shaft 6. Therefore, the influence of deformation caused by the press-fitting of the drive shaft 6 is not applied to the first and second lug-side storage recesses 8c, 8f. Since the lug plate 8 is formed of aluminum-based material, it may be machined easier than the cast lug plate. Therefore, the manufacture of the entire compressor is easy. Furthermore, according to this compressor, the first and second intermediate arms 21, 22 of the link mechanism 10 are formed into a plate shape, and the control of tolerance may be simplified in comparison with the link mechanism in the related art.

[0086] Therefore, according to the compressor, abrasion of the link mechanism 10 hardly occurs and a superior durability may be demonstrated and, simultaneously, elevation of the manufacture cost is also prevented.

[0087] According to this compressor, the first and second lug-side storage recesses 8c, 8f are formed on the lug plate 8, and the swash plate arm 9b is in abutment with the first and second intermediate arms 21, 22. Therefore, manufacture of the swash plate arm 9b and hence of the swash plate 9 is simplified and the weight of the swash plate 9 is reduced to reduce the force of inertia of the swash plate 9, so that the quicker responsibility for the change in capacity is achieved.

[0088] In addition, according to this compressor, the first and second intermediate arms 21, 22 are rotatably supported by the lug plate 8 via the first and second lug-side pins 23, 24. Also, the first and second intermediate arms 21, 22 are rotatably supported by the swash plate arm 9b via the swash-plate-side pin 25. Therefore, the first and second intermediate arms 21, 22 do not move away from the lug plate 8 and the swash plate arm 9b, so that the abnormal sound is hardly generated.

[0089] According to the compressor, since the removed portion 8i is formed between the first lug arm 8a and the second lug arm 8b, the weight of the lug plate 8 is reduced by the removed portion 8i, so that the force of inertia of the lug plate 8 is reduced. According to this compressor, the first and second lug-side pins 23, 24 are shorter than the depth of the pin holes 8j, 8k of the first and second lug arms 8a, 8b and, in addition, the total length of the first lug-side pin 23 and the second lug-side pin 24 is shorter by a length corresponding to the removed portion 8i. Therefore, the force of inertia is reduced by the reduction of the weight of the first and second lug-side pins 23, 24. In particular, according to this

compressor, since the lug plate 8 is formed of an aluminum-based material, the reduction of the force of inertia of the lug plate 8 is ensured. Therefore, the durability of a torque limiter provide as needed may be improved, and abrasion of the engaged portion of the clutch may be prevented.

[0090] On the other hand, according to this compressor, the first and second intermediate arms 21, 22 each are formed of a thin plate shaped member, the first and second lug-side pins 23, 24 are employed, and the removed portion 8i is employed. Therefore, the problem that the balancing effect of the weight 8n is low because the lug plate 8 is formed of an aluminum-based material is solved, and the vibration noise generated with high-velocity revolutions is also restrained.

[0091] Furthermore, according to this compressor, the total length of the first lug-side pin 23 and the second lug-side pin 24 is shorter by a length corresponding to the removed portion 8i. Therefore, the center alignment of the first lug-side pin 23 and the second lug-side pin 24, that is, the lug side axis A1, A2 may be aligned coaxially with easiness in comparison with assembly of a long lug-side pin so as not to incline, so that the assembly workability is also improved.

[0092] According to this compressor, the first lug-side pin 23 is press-fitted into the first lug arm 8a on the side of the virtual plane P with respect to the first lug-side storage recess 8c, and the second lug-side pin 24 is press-fitted into the second lug arm 8b on the side of the virtual plane P with respect to the second lug-side storage recess 8f. The swash-plate-side pin 25 is press-fitted at the center of the swash plate arm 9b. Therefore, the first and second lug-side storage recesses 8c, 8f are not deformed, so that the first and second intermediate arms 21, 22 are desirably guided under a high productivity. The detent structure is not necessary for the first and second lug-side pins 23, 24 and the swash-plate-side pin 25.

[0093] According to this compressor, since the first and second lug arms 8a, 8b are overlapped with the swash plate arm 9b by the projections 8l, 8m, the first and second intermediate arms 21, 22 are prevented from falling down further reliably. Therefore, the first and second intermediate arms 21, 22 may be reduced in thickness, and the rotational balance may be improved, so that the vibrations may be reduced. The projections 8l, 8m are also functioned as the detent structure of the swash-plate-side pin 25.

[0094] According to this compressor, there is one swash plate arm 9b, and the swash plate arm 9b is formed at a position avoiding the position on the vertical of the shoe sliding surface 9a. Therefore, the swash plate 9 may be formed into an integral product and the shoe sliding surface 9a may easily be machined. This point is effective, for example, for the compressor disclosed in JP-2005-299516.

EMBODIMENT 2

[0095] A compressor in Embodiment 2 employs a link mechanism 30 shown in Fig. 8. The link mechanism 30 includes a single lug arm 28a being integrated with a lug plate 28 and projecting toward the swash plate 9 side, the single swash plate arm 9b being integrated with the swash plate 9 and projecting toward the lug plate 28 side, and the first and second intermediate arms 21, 22 provided between the lug arm 28a and the swash plate arm 9b.

[0096] The lug arm 28a is formed with the first and second lug-side storage recesses 8c, 8f. The lug arm 28a is not formed with the removed portion 8i as in the link mechanism 10 in Embodiment 1. The lug arm 28a is formed with a pin hole 28b having a center axis corresponding to the lug side axis A4 which is orthogonal to the virtual plane P. A lug-side pin 29 is shorter than the depth of the pin hole 28b of the lug arm 28a. The lug-side pin 29 is press-fitted into the pin hole 28b in the range L4 outside the second lug-side storage recess 8f, and is loosely fitted into the pin hole 28b in other ranges. The lug-side pin 29 is loosely fitted into the pin holes 21c, 22c of the first and second intermediate arms 21, 22.

[0097] In this manner, the first and second intermediate arms 21, 22 are rotatably supported by the lug arm 28a via the lug-side pin 29. Other components are the same as those in the link mechanism 10 in Embodiment 1, so that the same components are designated by the same reference numerals and detail description will be omitted.

[0098] According to this compressor, although the lug plate 28 and the lug-side pin 29 are rather heavy, other effects and advantages may be achieved in the same manner as the compressor in Embodiment 1.

EMBODIMENT 3

[0099] The compressor in Example 3 employs a link mechanism 40 shown in Fig. 9. The link mechanism 40 includes a single lug arm 31a being integrated with a lug plate 31 and projecting toward a swash plate 32 side, first and second swash arms 32a, 32b being integrated with the swash plate 32 and projecting toward the lug plate 31, and the first and second intermediate arms 21, 22 provided between the lug arm 31a and the first and second swash plate arms 32a, 32b.

[0100] The swash plate 32 includes a first swash-plate-side storage recess 32c existing on one side of the virtual plane P and a second swash-plate-side storage recess 32f existing on the other side of the virtual plane P. The first swash plate arm 32a is formed with the first swash-plate-side storage recess 32c. The first swash-plate-side storage recess 32c includes first guiding surfaces 32d, 32e extending in parallel to the virtual plane P and facing to each other in pair on the front and back in the direction of rotation R of the drive shaft 6. Also, the second swash plate arm 32b is formed with the second swash-plate-

side storage recess 32f. The second swash-plate-side storage recess 32f includes second guiding surfaces 32g, 32h extending in parallel to the virtual plane P and facing to each other in pair on the front and back in the direction of rotation R of the drive shaft 6. The distance between the first and second swash-plate-side storage recesses 32c, 32f are set to be larger than the outer diameter of the drive shaft 6. A removed portion 32i is formed between the first swash plate arm 32a and the second swash plate arm 32b.

[0101] The lug arm 31a is formed with a pin hole 31b having a center axis corresponding to a lug side axis A5 which is orthogonal to the virtual plane p. A lug-side pin 33 is press-fitted into the pin hole 31b of the lug arm 31a in a central range L5, and is loosely fitted into a pin hole 31b in other ranges. The lug-side pin 33 is loosely fitted to the pin hole 21c of the first intermediate arm 21 and the pin hole 22c of the second intermediate arm 22.

[0102] The first and second swash plate arms 32a, 32b are formed at a position avoiding a position on the vertical of the shoe sliding surface 9a. The first swash plate arm 32a is formed with a pin hole 32j having a center axis corresponding to a swash plate side axis A6 which is parallel to the lug side axis A5, and the second swash plate arm 32b is formed with a pin hole 32k having a center axis corresponding to a swash plate side axis A7 which is parallel to the lug side axis A5.

[0103] A first swash-plate-side pin 34 is press-fitted into the pin hole 32j in a range L6 on the side of the virtual plane P with respect to the first swash-plate-side storage recess 32c, and is loosely fitted to the pin hole 32j in other ranges. The first swash-plate-side pin 34 is loosely fitted to the pin hole 21d of the first intermediate arm 21.

[0104] In the same manner, the second swash-plate-side pin 35 is press-fitted into the pin hole 32k in a range L7 on the side of the virtual plane P with respect to the second swash-plate-side storage recess 32f, and is loosely fitted into a pin hole 32k in other ranges. The second swash-plate-side pin 35 is loosely fitted to the pin hole 22d of the second intermediate arm 22.

[0105] In this manner, the first and second intermediate arms 21, 22 are rotatably supported via the lug arm 31a by the lug-side pin 33. The first and second intermediate arms 21, 22 are rotatably supported by the first and second swash plate arms 32a, 32b via the first and second swash-plate-side pins 34, 35. The outside portion of the first swash plate arm 32a with respect to the first swash-plate-side storage recess 32c and the outside portion of the second swash plate arm 32b with respect to the second swash-plate-side storage recess 32f may be provided with the projection overlapped with the lug arm 31a in the direction of projection as in the Embodiment 1. Other components are the same as the link mechanism 10 of Embodiment 1, and the same components are designated with the same reference signs and detailed description is omitted.

[0106] According to this compressor, since the first and second swash-plate-side storage recesses 32c, 32f are

formed on the swash plate 32 and the lug arm 31a is in abutment with the first and second intermediate arms 21, 22 on the both sides thereof, manufacture of the lug arm 31a, and hence of the lug plate 31 is simplified. The weight of the lug plate 31 may be reduced to reduce the force of inertial of the lug plate 31. Other effects and advantages may also be achieved as in the compressor in Embodiment 1.

10 EMBODIMENT 4

[0107] A compressor according to Embodiment 4 employs a link mechanism 50 shown in Fig. 10. The link mechanism 50 includes a first and second lug arms 41a, 41b being integrated with a lug plate 41 and projecting toward the swash plate 32 side, the first and second swash plate arms 32a, 32b being integrated with the swash plate 32 and projecting toward the lug plate 41 side, and the first and second intermediate arms 21, 22 provided between the first and second lug arms 41a, 41b and the first and second swash plate arms 32a, 32b.

[0108] The lug plate 41 is formed with a first lug-side storage recess 41c existing on one side of the virtual plane P and a second lug-side storage recess 41f existing on the other side of the virtual plane P. The first lug arm 41a is formed with the first lug-side storage recess 41c. The first lug-side storage recess 41c includes first guiding surfaces 41d, 41e extending in parallel with the virtual plane P and facing to each other in pair on the front and back in the direction of rotation R of the drive shaft 6. The second lug arm 41b is formed with the second lug-side storage recess 41f. The second lug-side storage recess 41f includes second guide surfaces 41g, 41h extending in parallel to the virtual plane P and facing to each other in pair on the front and back in the direction of rotation R of the drive shaft 6. The distance between the first and second lug-side storage recesses 41c, 41f is set to be larger than the outer diameter of the drive shaft 6. A removed portion 41i is formed between the first lug arm 41a and the second lug arm 41b.

[0109] The first lug arm 41a is formed with a pin hole 41j having a center axis corresponding to a lug side axis A8 which is orthogonal to the virtual plane P, and the second lug arm 41b is formed with a pin hole 41k having a center axis corresponding to the lug side axis A9 which is orthogonal to the virtual plane P.

[0110] A first lug-side pin 42 is press-fitted to a pin hole 41j in a range L8 on the side of the virtual plane P with respect to the first lug-side storage recess 41c, and is loosely fitted to the pin hole 41j in other ranges. The first lug-side pin 42 is loosely fitted to the pin hole 21d of the first intermediate arm 21.

[0111] In the same manner, a second lug-side pin 43 is press-fitted in the pin hole 41k in a range L9 on the side of the virtual plane P with respect to the second lug-side storage recess 41f and is loosely fitted to the pin hole 41k in other ranges. The second lug-side pin 43 is loosely fitted to the pin hole 22d of the second interme-

diate arm 22.

[0112] In this manner, the first and second intermediate arms 21, 22 are rotatably supported by the first and second lug arms 41a, 41b via the first and second lug-side pins 42, 43, and the first and second intermediate arms 21, 22 are rotatably supported by the first and second swash plate arms 32a, 32b via the first and second swash-plate-side pins 34, 35. Other components are the same as those in the link mechanism 10 in Embodiment 1 and 3, so that the same components are designated by the same reference numerals and detail description will be omitted.

[0113] According to this compressor, the lug plate 41 is formed with the first and second lug-side storage recesses 41c, 41f, and the swash plate 32 is formed with the first and second swash-plate-side storage recesses 32c, 32f. Therefore, the both first and second guided surfaces 21a, 21b of the first intermediate arm 21 are guided by the both first guiding surfaces 41d, 41e of the first lug-side storage recess 41c and the both first guiding surfaces 32d, 32e of the first swash-plate-side storage recess 32c, and the both second guided surfaces 22a, 22b of the second intermediate arm 22 are guided by the both second guide surfaces 41g, 41h of the second lug-side storage recess 41f and the both second guiding surfaces 32g, 32h of the second swash-plate-side storage recess 32f. Therefore, the first and second intermediate arms 21, 22 and hence the swash plate 32 is maintained at the normal position further easily, and are hardly be skewed. Other effects and advantages are achieved in the same manner as the compressor in Embodiment 1.

EMBODIMENT 5

[0114] The compressor in Embodiment 5 employs a link mechanism 60 shown in Fig. 11. The link mechanism 60 is formed with screw holes 51c, 51d on first and second lug arms 51a, 51b of a lug plate 51. The screw holes 51c, 51d are formed only on the outsides of the first and second lug-side storage recesses 8c, 8f. Bolts 52, 53 are screwed into the screw holes 51c, 51d, as the first and second lug-side pins. The bolts 52, 53 are formed at distal ends thereof with pin portions 52a, 53b having the same length as the thickness of the first and second intermediate arms 21, 22. A pair of bolts having pin portions between the head portions and the screw portions may be used instead of the pin 25 provided on the swash plate arm 9b. Other components are the same as those in the link mechanism 10 in Embodiment 1, so that the same components are designated by the same reference numerals and detail description will be omitted.

[0115] In this compressor as well, the same effects and advantages as the compressor in Embodiment 1 is achieved.

[0116] Although the invention has been described on the basis of Embodiments 1 to 5 above, the invention is not limited to Embodiment 1 to 5, and modifications may be made without departing the scope of the invention.

[0117] For example, in Embodiments 1 to 5, the lug plate to be press-fitted onto the drive shaft for receiving the thrust load with respect to the front housing has been employed as the lug member. However, a configuration in which the thrust plate is loosely fitted on the drive shaft for receiving the thrust load by the thrust plate and the lug member is fixed to the drive shaft may also be employed. In this case, a configuration in which the lug arm is not formed on the lug member, the swash plate arm is formed on the swash plate, the first and second swash-plate-side storage recesses are formed on the swash plate arm, so that the first and second intermediate arms may be stored in the first and second swash-plate-side storage recess while nipping the lug members with the first and second intermediate arms.

[0118] In addition, the rotatable support of the lug side axis and rotatable support of the swash plate side axis may be achieved by pins such as the bolts or, alternatively, so as to allow the lug member and the first and second intermediate arms pivots with respect to each other about the lug side axis as a center axis and the first and second intermediate arms and the swash plate arm pivots with respect to each other about the swash plate side axis as a center axis.

EXPLANATION OF INDUSTRIAL APPLICATION OF INVENTION

[0119] The invention is applicable to an air-conditioning apparatus for vehicles.

A capacity-variable type swash plate compressor in which a link mechanism is hardly worn and superior durability is demonstrated. According to the compressor in the invention, a link mechanism 10 comprises a swash plate arm 9b and first and second intermediate arms 21, 22. The first and second intermediate arms 21, 22 include pairs of first guided surfaces 21a, 21b, 22a, 22b extending in parallel to a virtual plane P and having back sides thereof facing each other in front and back in the direction of rotation R of a drive shaft 6, and each are formed into a plate shape extending from the side of a lug plate 8 to the side of a swash plate 9. First and second lug arms 8a, 8b of the lug plate 8 are formed with first and second lug-side storage recesses 8c, 8f having first guiding surfaces 8d, 8e, 8g, 8h. The first and second intermediate arms 21, 22 are stored in the first and second lug-side storage recesses 8c, 8f.

Claims

1. A capacity-variable type swash plate compressor comprising:
 - a housing having a cylinder bore;
 - a drive shaft rotatably supported by the housing;
 - a lug member fixed to the drive shaft in the housing;

a swash plate supported by the drive shaft so as to be capable of changing inclination angle in the housing;

a link mechanism provided between the lug member and the swash plate in the housing allowing the swash plate to change in the inclination angle with respect to the lug member while disabling the swash plate to rotate with respect to the drive shaft;

a piston accommodated in the cylinder bore so as to be capable of reciprocating therein; and

a movement transferring mechanism provided between the swash plate and the piston for transferring the rocking movement of the swash plate into the reciprocal movement of the piston, wherein the link mechanism is comprising a swash plate arm integrated with the swash plate and projecting toward the lug member side, and an intermediate arm provided between the lug member and the swash plate arm, being rotatably supported by the lug member about a lug side axis which is orthogonal to a virtual plane defined by the center axis of the drive shaft and a top dead center position of the swash plate, and being rotatably supported by the swash plate arm about a swash-plate-side axis which extends in parallel with the lug-side axis,

wherein the intermediate arm is comprising a first intermediate arm being plate-shaped, existing on one side of the virtual plane, and extending from the lug member side to the swash-plate-side, and a second intermediate arm being plate-shaped, existing on the other side of the virtual plane, and extending from the lug member side to the swash-plate-side,

wherein the first intermediate arm includes a pair of first guided surfaces extending in parallel with the virtual plane and having back sides thereof facing each other in the front and back in the direction of rotation of the drive shaft,

wherein the second intermediate arm includes a pair of second guided surfaces extending in parallel with the virtual plane and having the back sides thereof facing each other in the front and back in the direction of rotation of the drive shaft,

wherein at least one of the lug member and the swash plate arm includes a first storage recess existing on one side of the virtual plane and a second storage recess existing on the other side of the virtual plane,

wherein the first storage recess includes a pair of first guiding surfaces extending in parallel with the virtual plane and facing each other in the front and back in the direction of rotation of the drive shaft,

wherein the second storage recess includes a pair of second guiding surfaces extending in par-

allel with the virtual plane and facing each other in the front and back in the direction of rotation of the drive shaft, and

wherein the first intermediate arm is stored in the first storage recess in such a manner that the both first guided surfaces are guided by the both first guiding surfaces, and the second intermediate arm is stored in the second storage recess in such a manner that the both second guided surfaces are guided by the both second guiding surfaces.

2. The capacity-variable type swash plate compressor according to Claim 1, wherein the first storage recess and the second storage recess are formed on the lug member, and the swash plate arm comes into contact with the first intermediate arm and the second intermediate arm on the both side surfaces thereof.

3. The capacity-variable type swash plate compressor according to Claim 1, wherein the first storage recess and the second storage recess are formed on the swash plate arm, the lug member includes a lug arm projecting toward the swash plate side, and the lug arm comes into contact by the sides face thereof with the first intermediate arm and the second intermediate arm on the both side surfaces thereof.

4. The capacity-variable type swash plate compressor according to Claim 1, wherein the first storage recess and the second storage recess are formed on the lug member and the swash plate arm.

5. The capacity-variable type swash plate compressor according to Claim 1, 2 or 4, wherein the first intermediate arm and the second intermediate arm are rotatably supported by the lug member via a lug-side pin having a center axis corresponding to the lug side axis.

6. The capacity-variable type swash plate compressor according to Claim 1, 3 or 4, wherein the first intermediate arm and the second intermediate arm are rotatably supported by the swash plate arm via the swash-plate-side pin having a center axis corresponding to the swash plate side axis.

7. The capacity-variable type swash plate compressor according to Claim 2, wherein the lug member comprises:

a first lug arm projecting toward the swash-plate-side and formed with the first storage recess;

a second lug arm projecting toward the swash-plate-side and formed with the second storage recess; and

a removed portion is formed between the first

lug arm and the second lug arm.

8. The capacity-variable type swash plate compressor according to Claim 7, wherein the first intermediate arm is rotatably supported by the first lug arm via a first lug-side pin having a center axis corresponding to the lug side axis, and the second intermediate arm is rotatably supported by the second lug arm via a second lug-side pin having a center axis corresponding to the lug side axis. 5
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9. The capacity-variable type swash plate compressor according to Claim 8, wherein the first lug-side pin is press-fitted into the first lug arm on the virtual plane side with respect to the first storage recess, and the second lug-side pin is press-fitted into the second lug arm on the virtual plane side with respect to the second storage recess. 15
10. The capacity-variable type swash plate compressor according to Claim 2, wherein the lug member comprises: 20
 - a first lug arm projecting toward the swash-plate-side and formed with the first storage recess; 25
 - and
 - a second lug arm projecting toward the swash-plate-side and formed with the second storage recess,
 - and the first lug arm and the second lug arm are overlapped with the swash plate arm in the direction of projection. 30
11. The capacity-variable type swash plate compressor according to Claim 10, wherein the swash-plate-side pin is press-fitted at the center of the swash plate arm. 35
12. The capacity-variable type swash plate compressor according to Claim 1, wherein the movement transferring mechanism comprising: 40
 - shoe sliding surfaces formed on the front and back outer peripheral surfaces of the swash plate; 45
 - shoe receiving surfaces formed on the piston;
 - and
 - semi-spherical shoe provided between the shoe sliding surfaces and the shoe receiving surfaces, 50
 - and wherein the swash plate arm is formed at a position avoiding a position on the vertical of the shoe sliding surface.
13. The capacity-variable type swash plate compressor according to Claim 1, wherein the lug member is formed of an aluminum-based material, and the intermediate arm is formed of an iron-based material. 55

Fig. 1

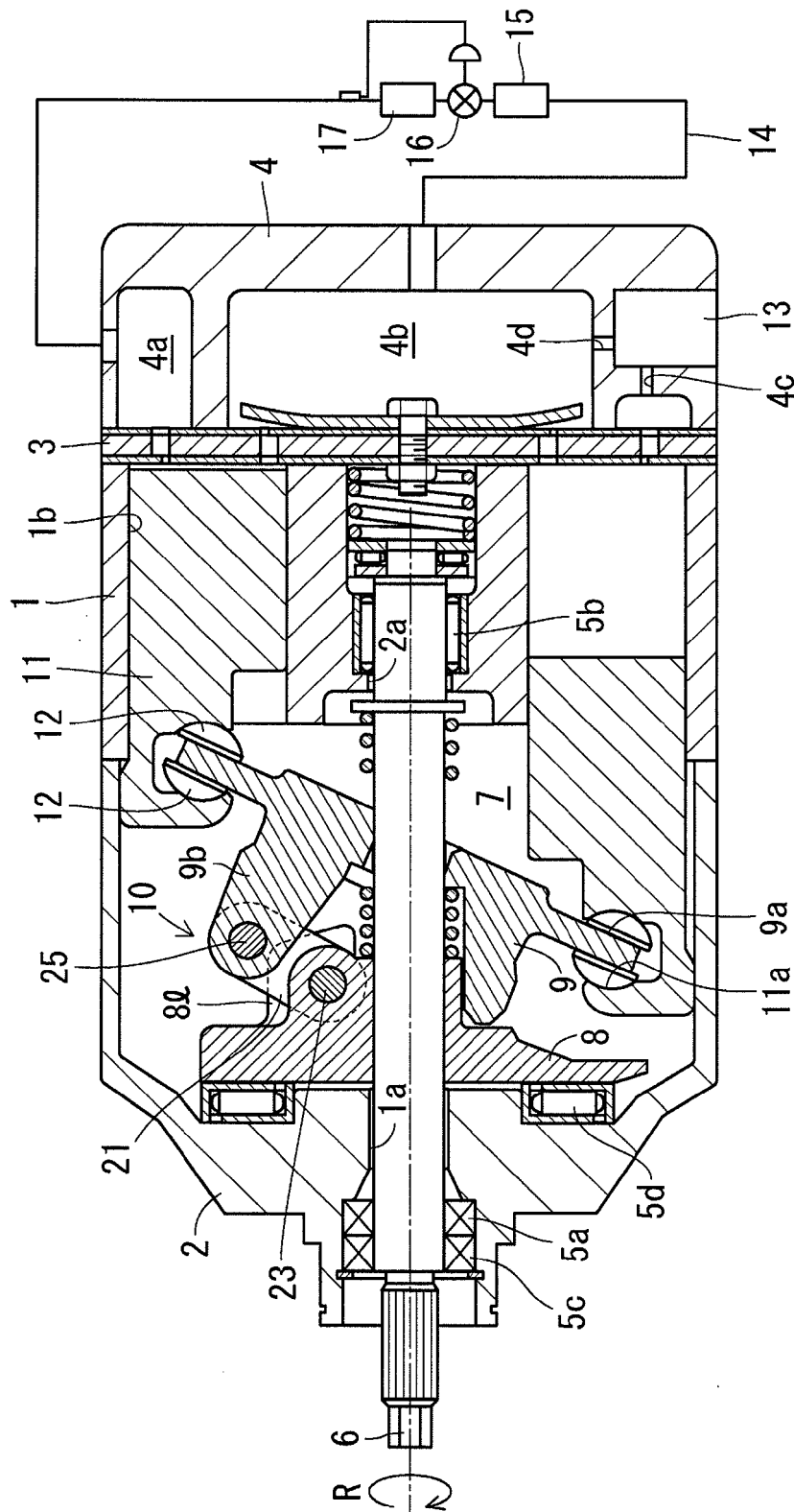


Fig. 2

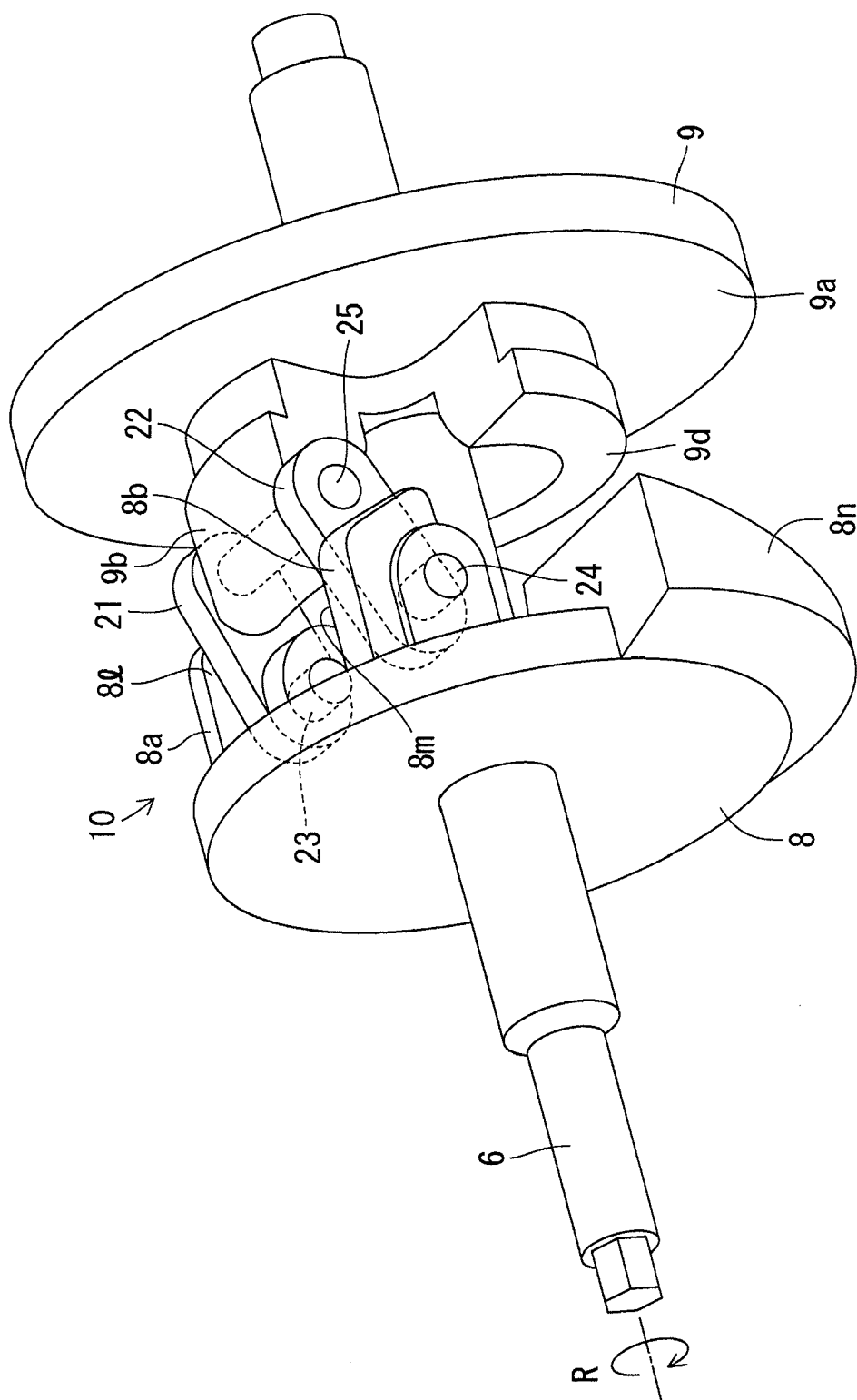


Fig. 3

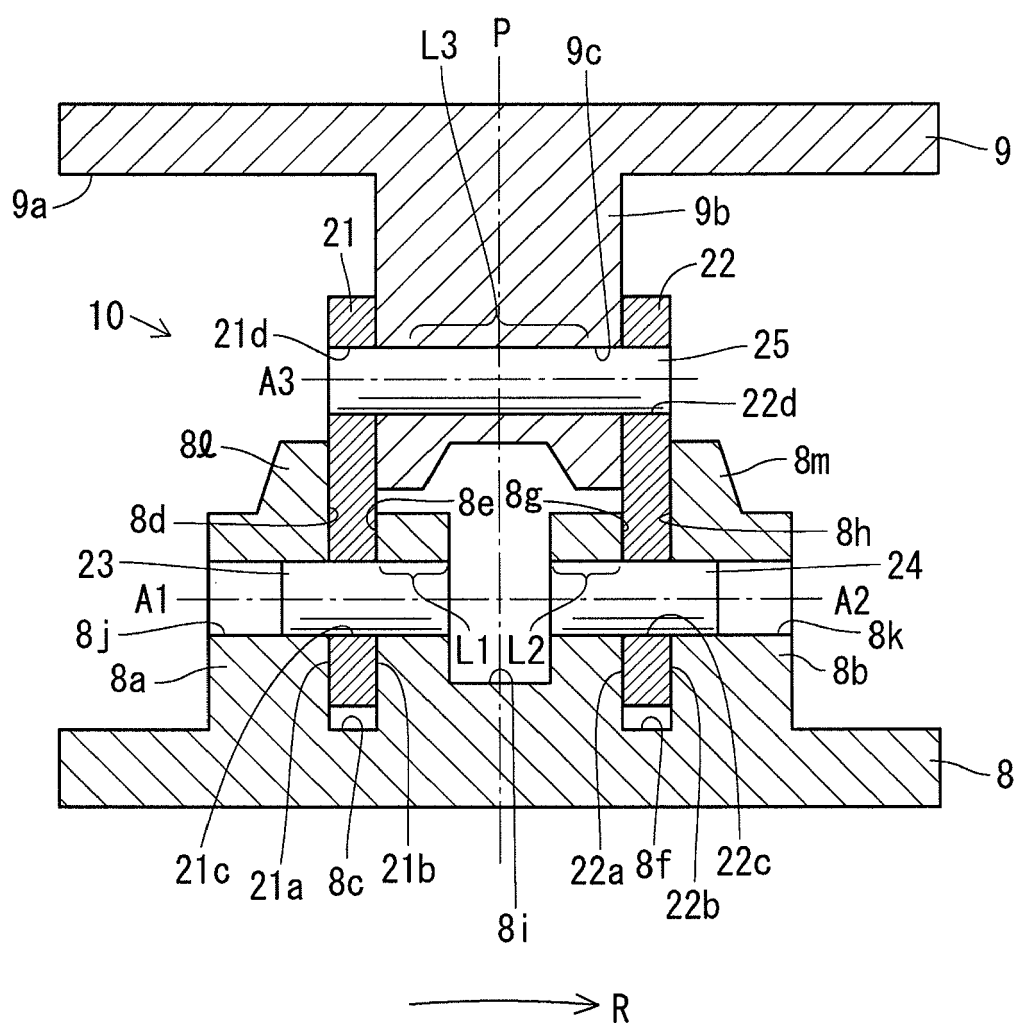


Fig. 4

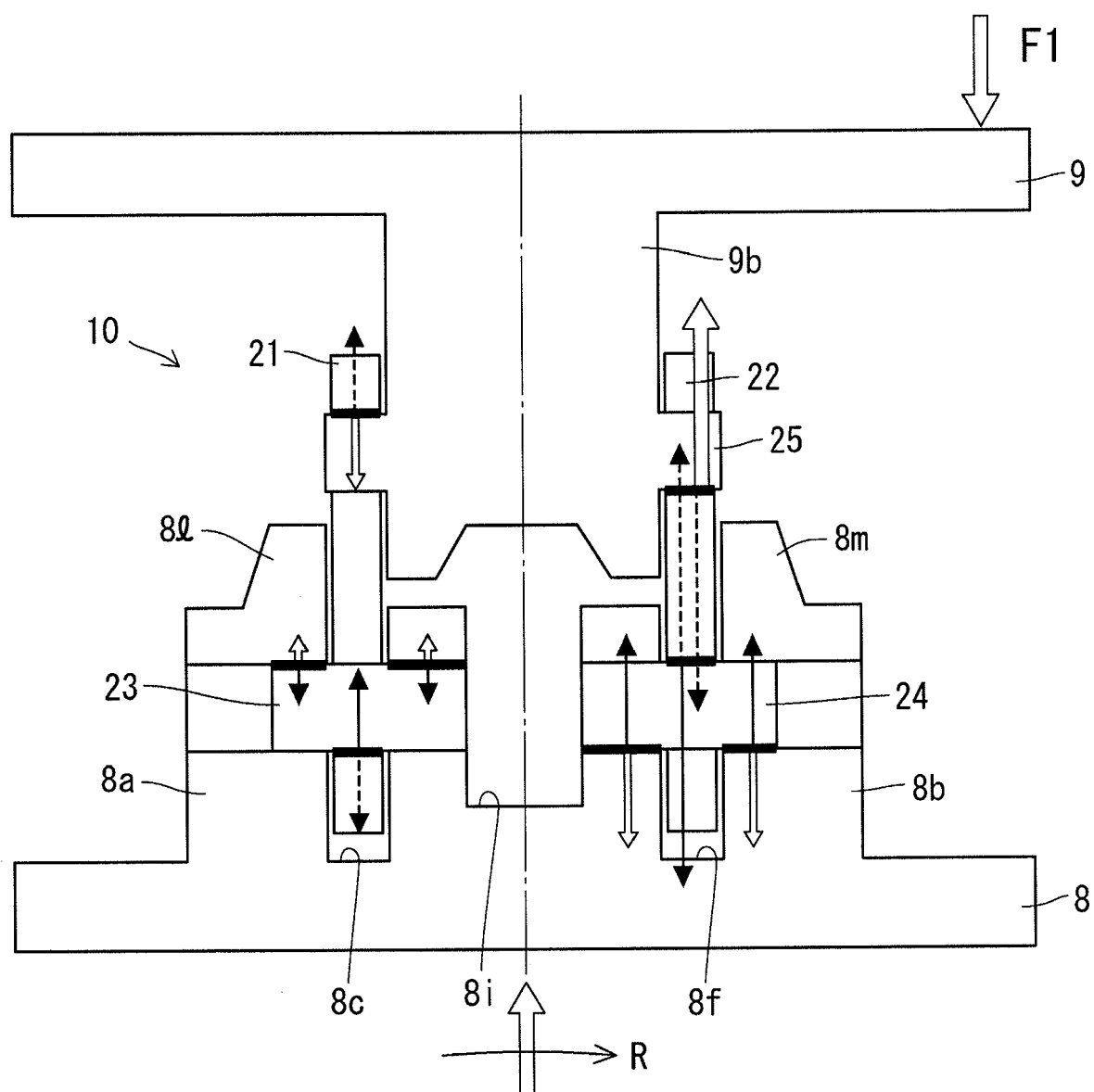


Fig. 5

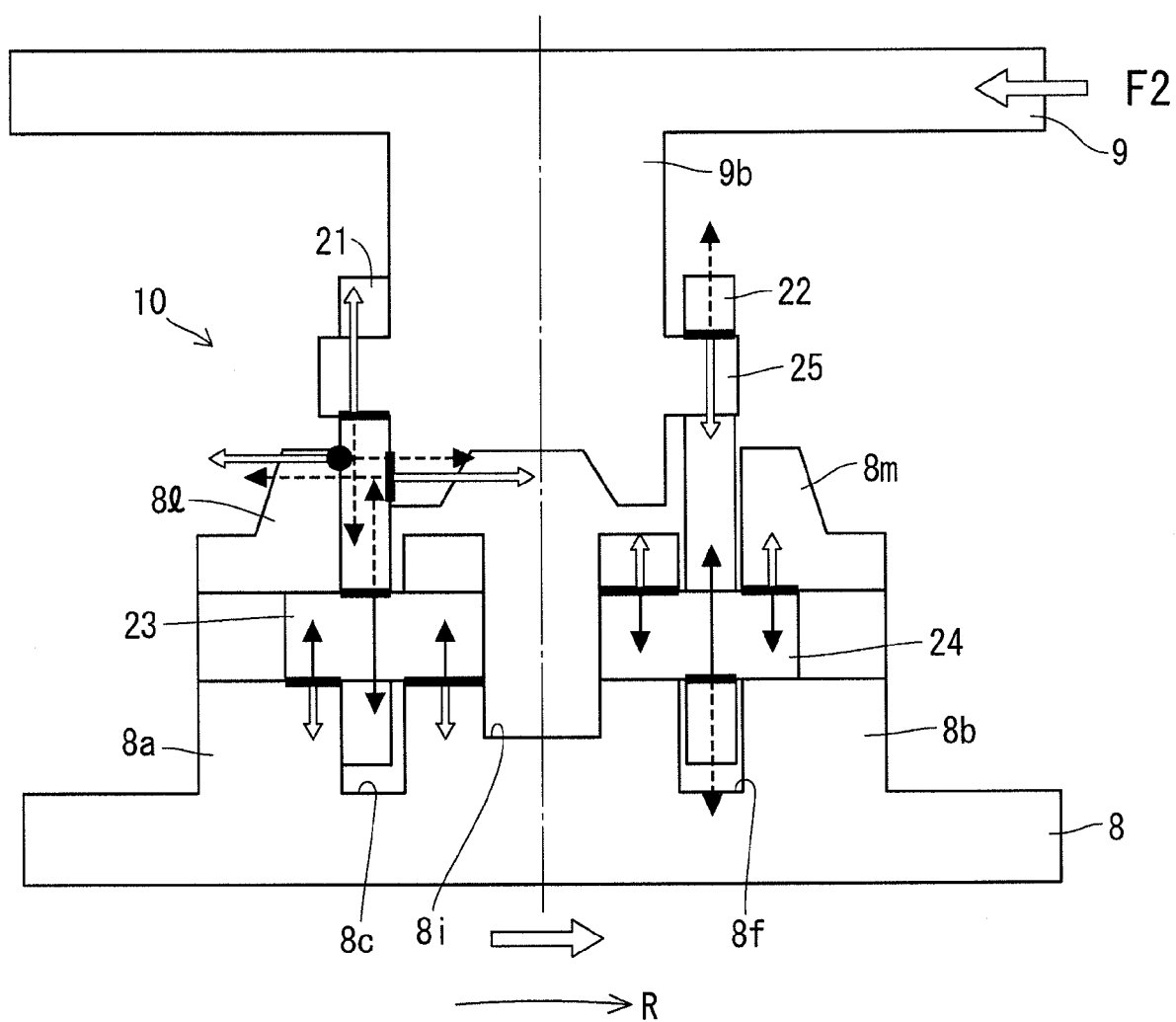


Fig. 6A

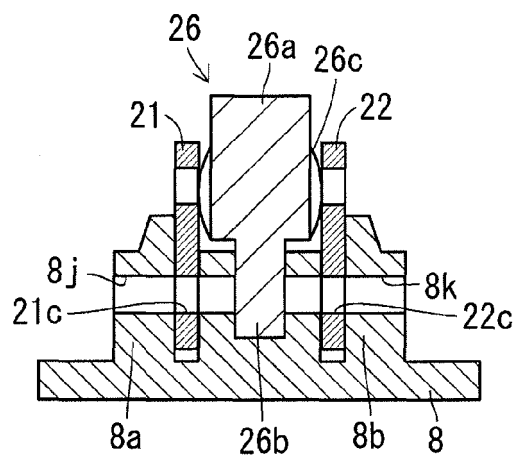


Fig. 6B

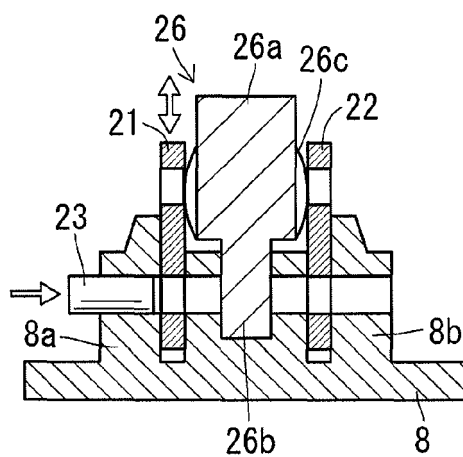


Fig. 6C

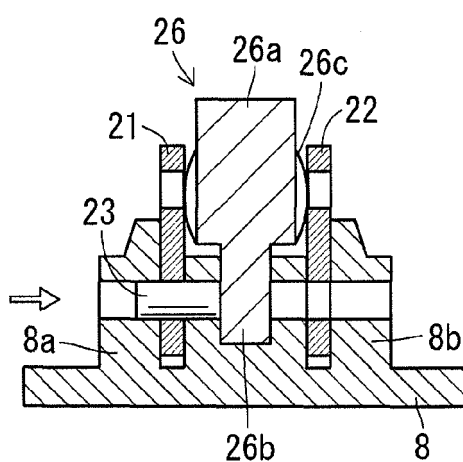


Fig. 6D

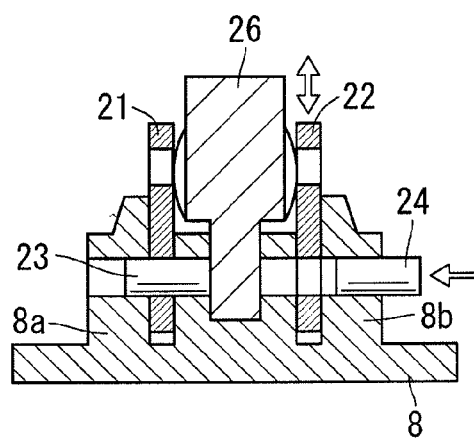


Fig. 6E

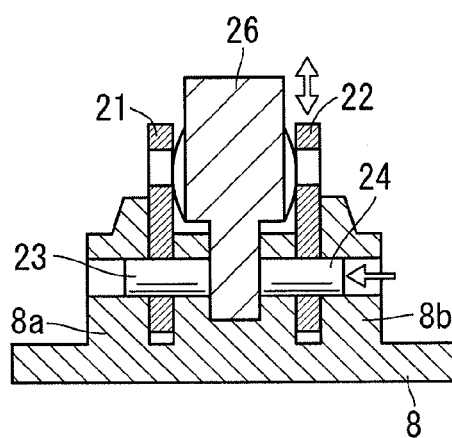


Fig. 6F

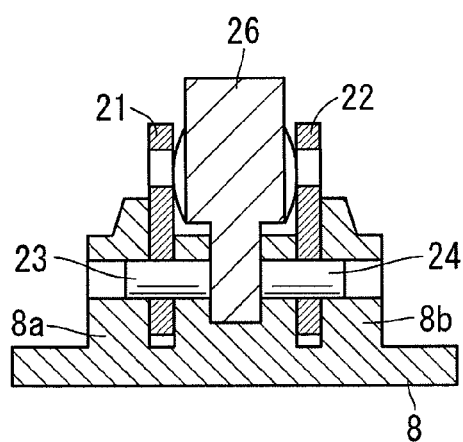


Fig. 7G

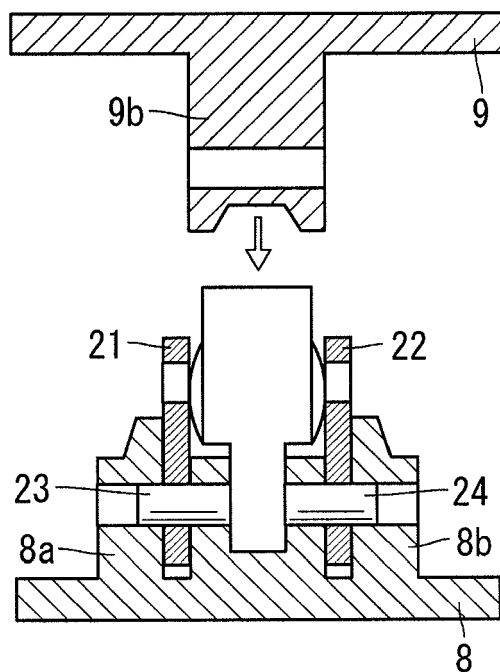


Fig. 7H

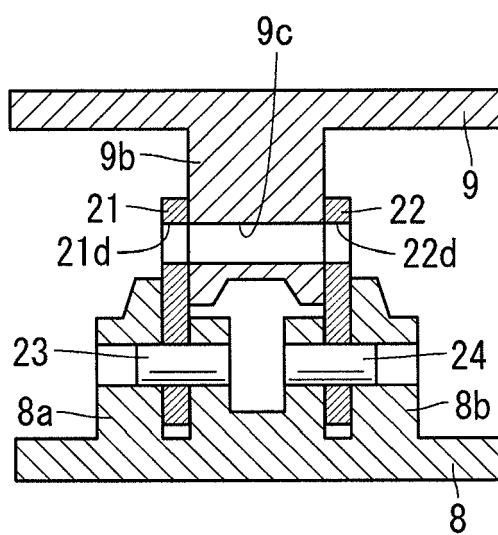


Fig. 7I

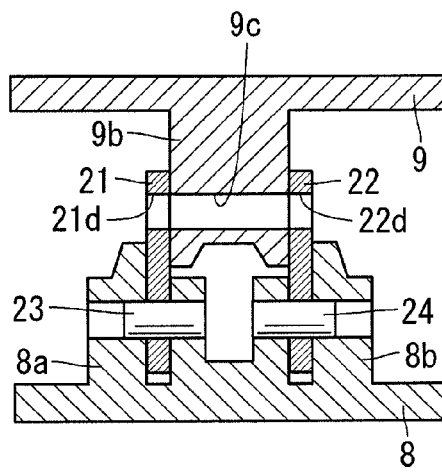


Fig. 7J

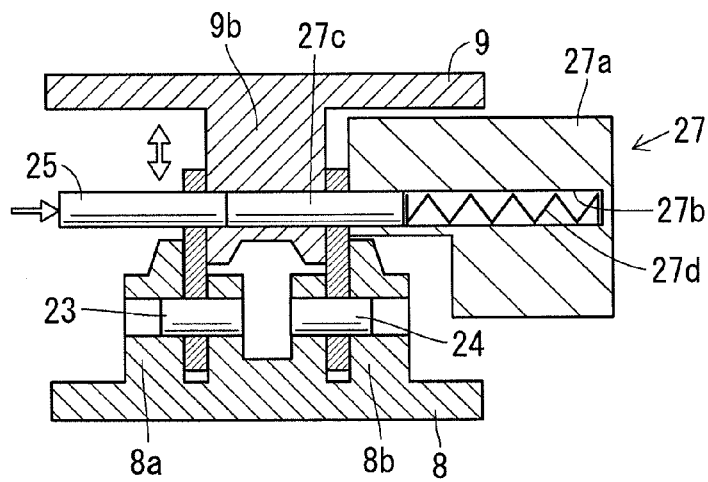


Fig. 7K

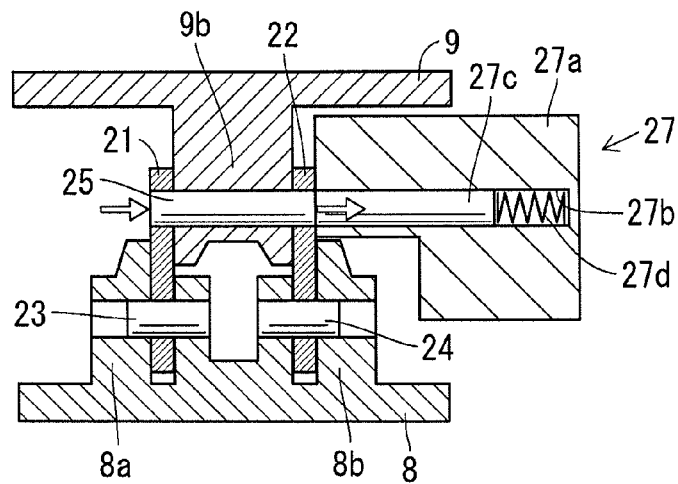


Fig. 8

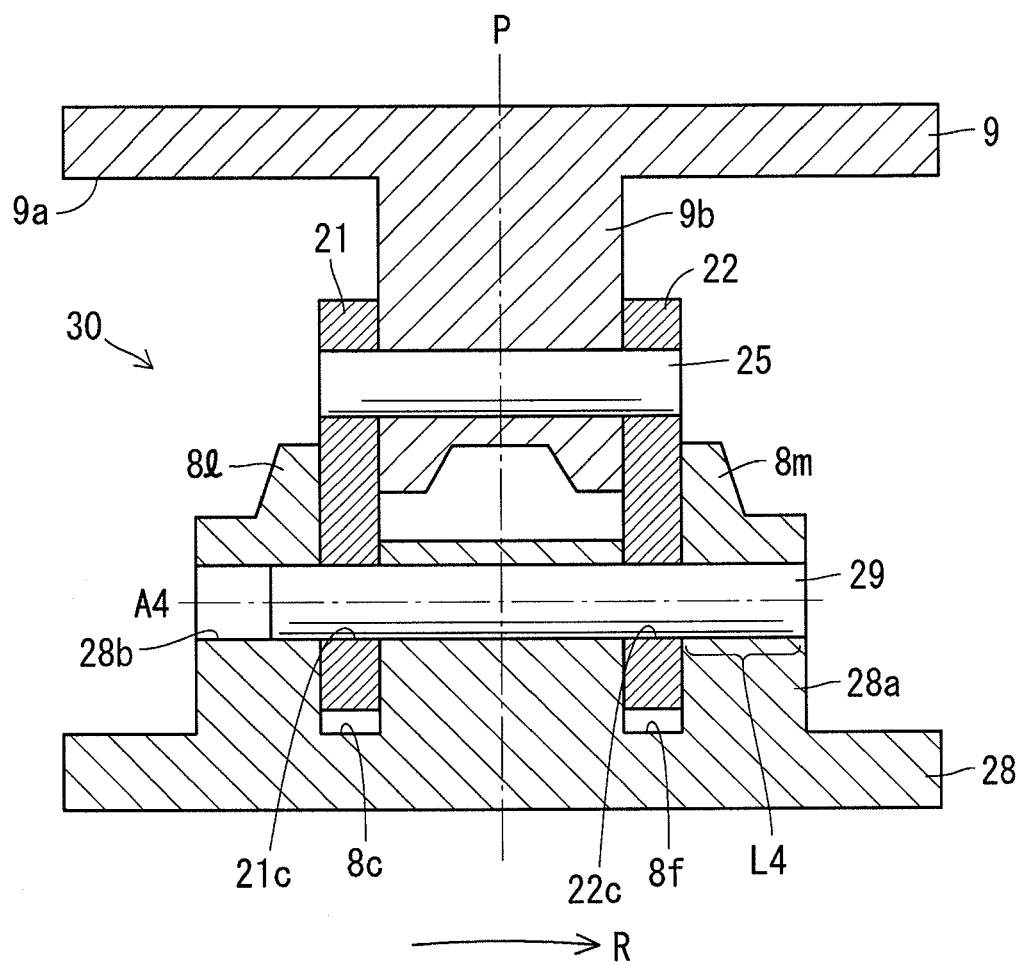


Fig. 9

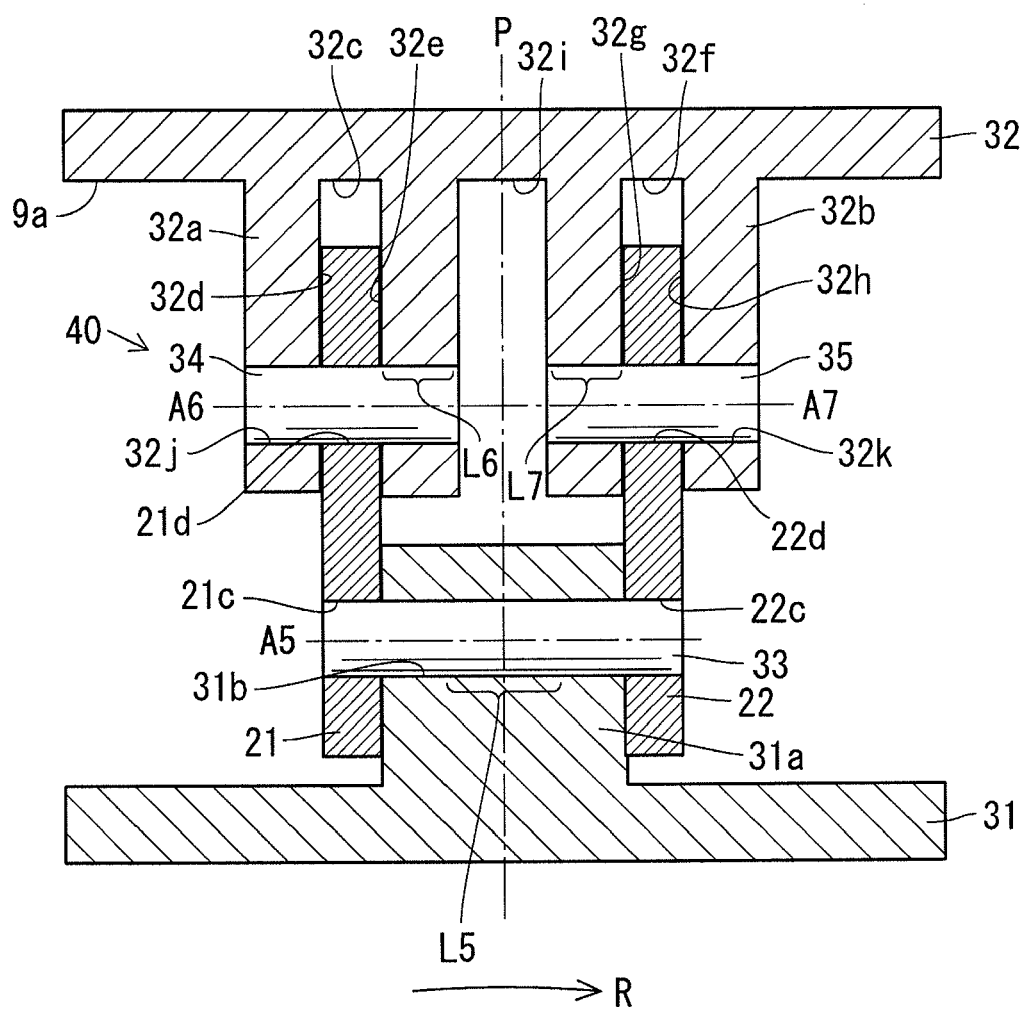


Fig. 10

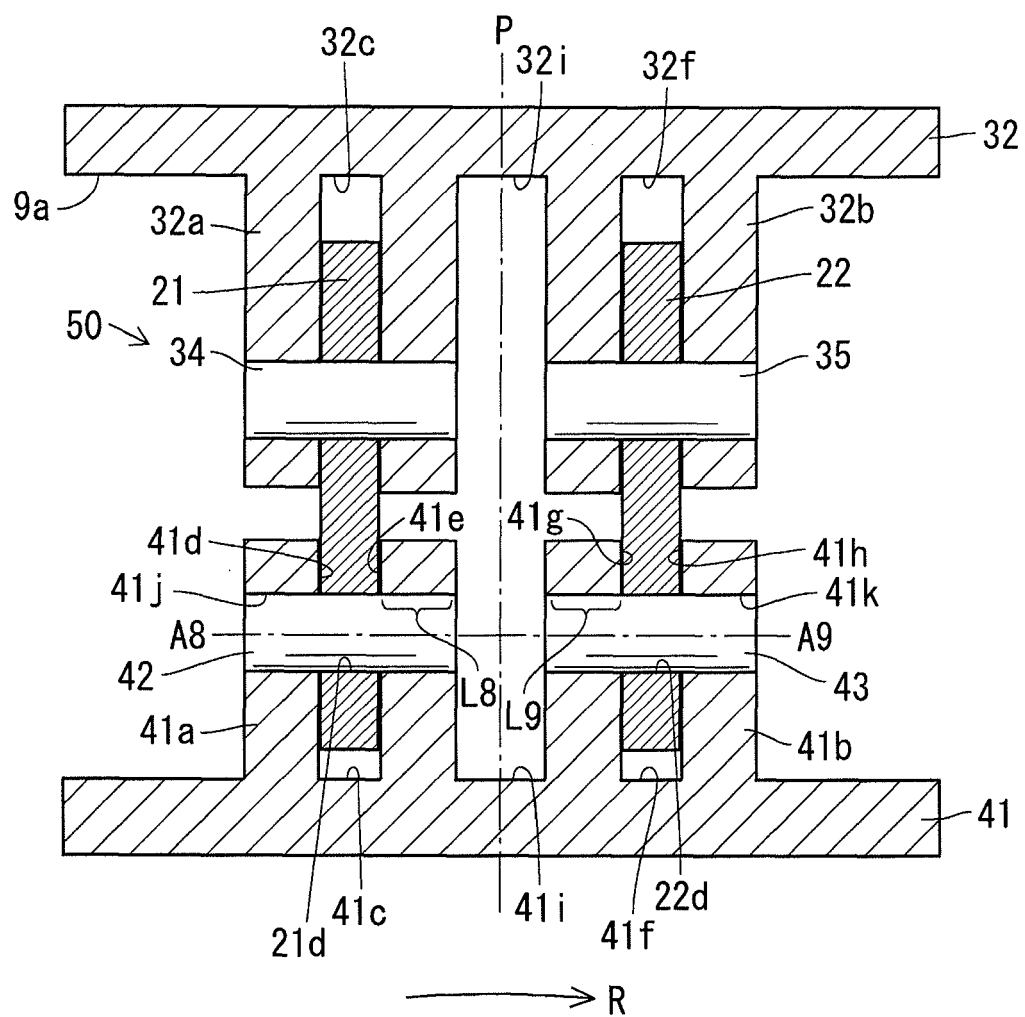


Fig. 11

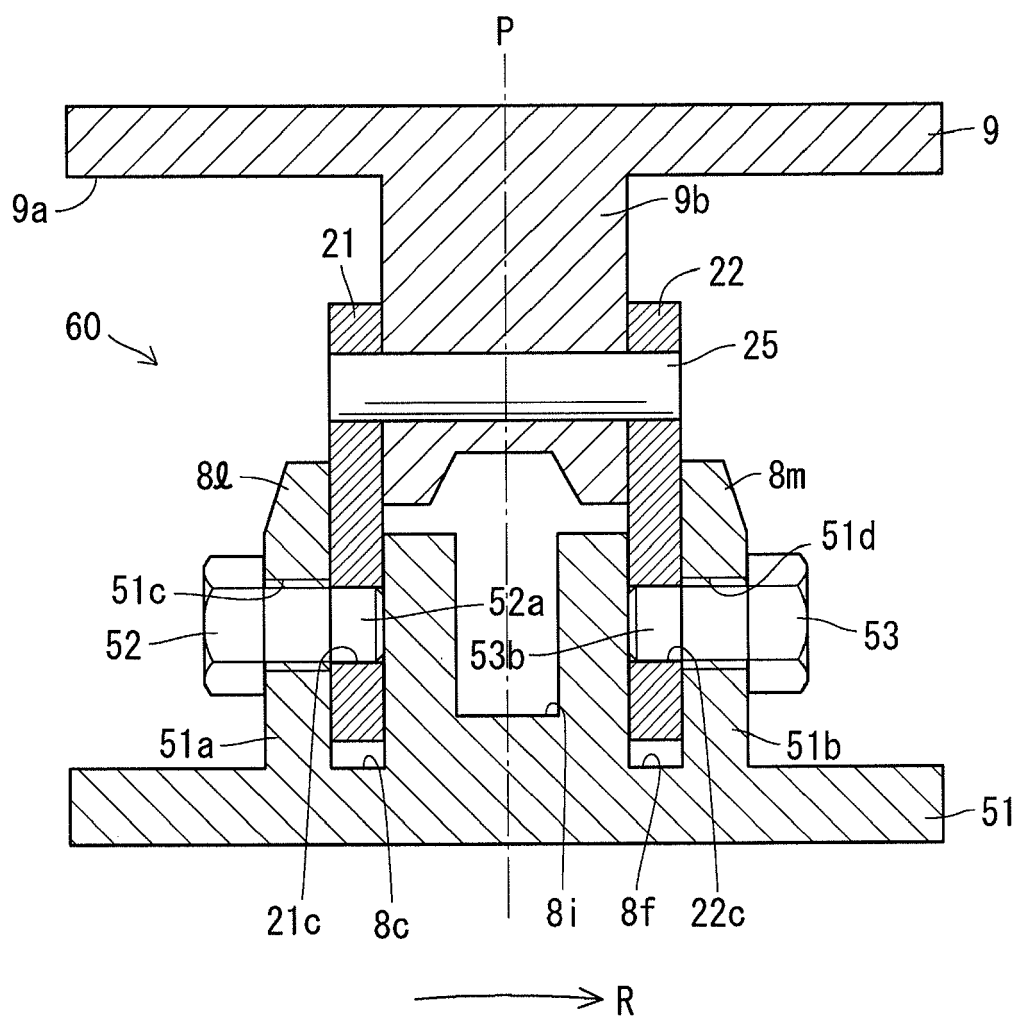


Fig. 12

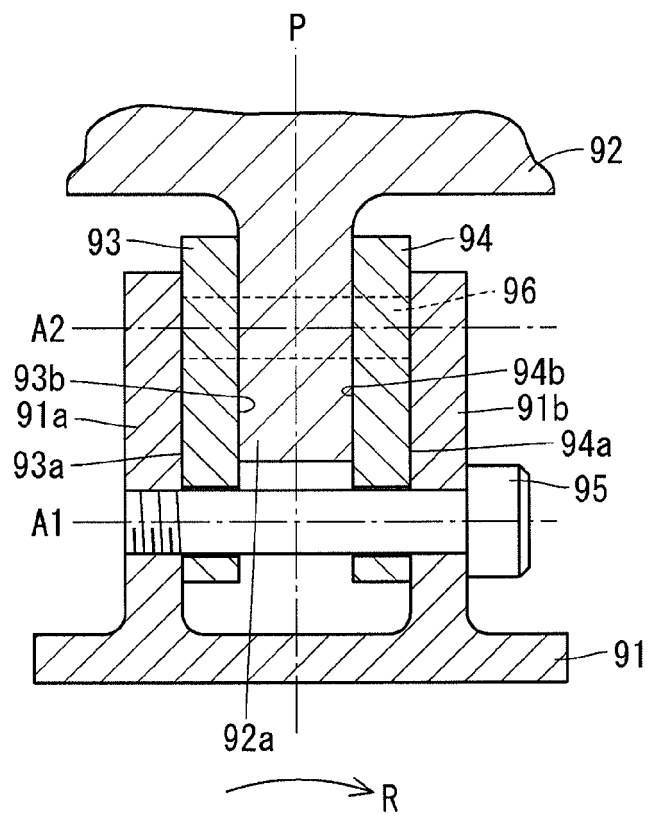
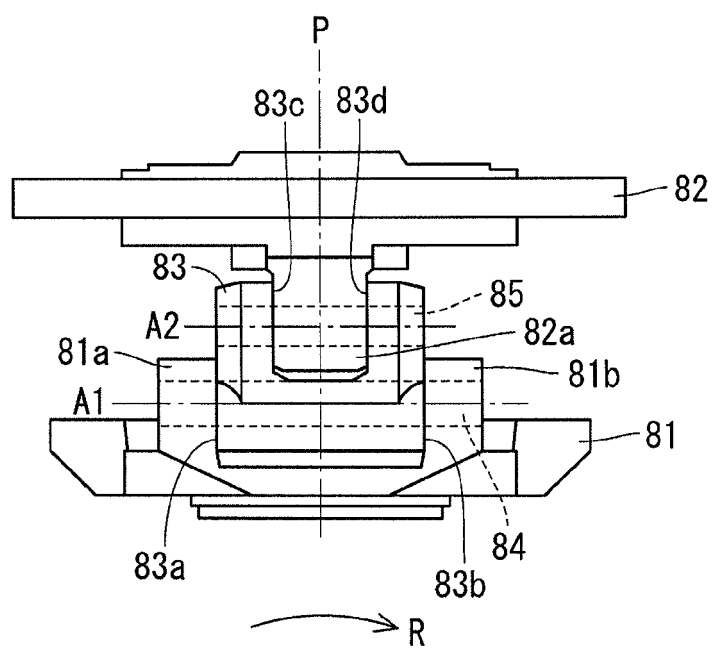


Fig. 13



REFERENCES CITED IN THE DESCRIPTION

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