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(54) **Variable-displacement swash plate compressor**

(57) In a variable-displacement swash plate compressor, a secure seal is provided between a discharge chamber (16) and a suction chamber (15) in a cylinder head (14) to improve compression performance and controllability. Compressed fluid is introduced into a crank chamber (2) through a communication path (9) formed between a silencer chamber (43) and cylinder bores (31) in a cylinder block (3), which path makes the discharge chamber in the cylinder head and the crank chamber in the cylinder block communicate with each other, and through a pipe-shaped orifice (45) inserted which allows a predetermined amount of compressed fluid to flow toward the crank chamber side of the communication path. The orifice can also be directly formed in the cylinder block. The flow rate is adjusted by choosing one among a plurality of orifices with different hole diameters or lengths.

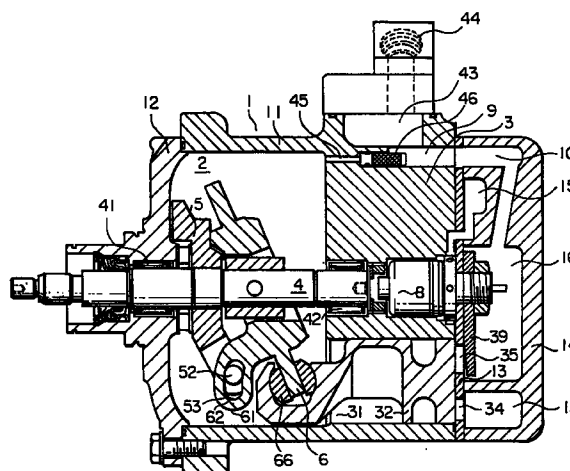


FIG. 3

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Description

BACKGROUND OF THE INVENTION:

The present invention relates to an arrangement that introduces compressed fluid from a discharge chamber to a crank chamber in a variable-displacement swash plate compressor designed to change the inclination angle of the swash plate by controlling the pressure in the crank chamber.

Japanese Patent Publication (JP-B) No. 32479/1990 discloses an arrangement that introduces compressed fluid from a discharge chamber to a crank chamber in a conventional variable-displacement swash plate compressor.

The variable-displacement swash plate compressor disclosed is outlined below.

As shown in Figs. 1 and 2, a compressor housing 1 with a cylindrical casing 11, one end of which is closed by a front end plate 12, defines a crank chamber 2 and has a cylinder block 3 inside. A cylinder head 14 is installed through a valve plate 13 on the cylinder block 3 to define a suction chamber 15 and a discharge chamber 16 between the cylinder head 14 and the valve plate 13.

A main rotating shaft 4, passing through the center of the crank chamber 2, mentioned above, is rotatably borne through needle bearings 41 and 42 by the front end plate 12 and the cylinder block 13, respectively.

A pin 51 secures a rotor 5 to the main rotating shaft 4, extending through the crank chamber 2. A bracket 53 with a pin 52 is formed on the rotor 5, and the pin 52 is slidably fit into a slot 62, formed in an arm 61 extending from a swash plate 6.

A wobble plate 7, fit over a bearing unit 63 formed in the swash plate 6, is disposed over the swash plate 6, with a bearing 65 between the wobble and swash plates, so that a rotation prevention mechanism 64 prevents the wobble plate from rotating.

Pivots 71 of piston rods 33, described later, and a pin 72, fitting into the rotation prevention mechanism 64, are provided at the external edge of the wobble plate 7. A plurality of cylinder bores 31 and a communication path 9, all of which are substantially parallel with the main rotating shaft 4, and a displacement control mechanism 8 are formed in the cylinder block 3. Pistons 32 are disposed in the cylinder bores 31, each of the pistons being connected through a piston rod 33 to the wobble plate 7. Thus when an external drive source rotates the main rotating shaft 4 via a pulley 100 and a clutch 101, the rotor 5 and swash plate 6 also rotate together with the main rotating shaft 4. However, the wobble plate 7 only wobbles because the rotation prevention mechanism 64 prevents the wobble plate's rotation. Wobbling motion of the wobble plate 7 causes the pistons 32 to slide back and forth in the cylinder bores 31 by the aid of the piston rods 33.

Using reciprocation of the pistons 32, fluid is taken

into the cylinder bores 31 through suction holes 34, communicating with the suction chamber 15, and check valves (not shown) are operated to discharge compressed fluid through discharge holes 35 into the discharge chamber 16.

The displacement control mechanism 8 has a valve 81 and a bellows 82, both of which are disposed inside a casing 83 in a chamber 36, provided next to the bearing unit for the main rotating shaft 4 in the cylinder block 3. The casing 83 is provided with communication holes 84 and 85. The communication hole 84 communicates with the crank chamber 2, and the communication hole 85 communicates via a path 86 with the suction chamber 15.

If the pressure in the crank chamber 2 is above a predetermined value, the crank chamber 2 and suction chamber 15 are made communicate with each other using the displacement control mechanism 8 to reduce the pressure in the crank chamber so that the compressor operates at its maximum compression displacement. If the pressure in the crank chamber is below the predetermined value, the communication of the crank chamber 2 with the suction chamber 15 is shut off, thus causing the inclination angle of the swash plate 6 to vary with the pressure in the crank chamber 2, so that the compression displacement changes.

The communication path 9 is formed in the cylinder block 3, the valve plate 13, and a valve retainer 39, which path connects the crank chamber 2 with the discharge chamber 16 so that the two chambers communicate with each other, and a capillary tube 91 is inserted into the communication path 9. A filter 92 is attached to the discharge chamber 16 side end of the capillary tube 91.

Thus after being reduced in pressure by the capillary tube 91, compressed fluid in the discharge chamber 16 flows into the crank chamber 2 and changes the pressure in the crank chamber 2 using the displacement control mechanism 8, thereby varying the inclination angle of the swash plate 6 to control displacement.

The inner diameter and length of the capillary tube 91 can be adjusted to set the pressure and rate of flow from the discharge chamber 16 into the crank chamber 2 for appropriate values.

Although the crank chamber and the discharge chamber of the conventional variable-displacement swash plate compressor, described above, are arranged to communicate with each other, the communication path is formed between one of the cylinder bores and the other cylinder bores in the cylinder block.

If the communication path is formed in such a manner, the thickness of a wall around the communication path is insufficient to provide a seal between a high pressure side (the discharge chamber) and a low pressure side (the suction chamber), causing a deterioration in compression performance or controllability. Insufficient wall thickness also causes a cylinder bore to deform.

SUMMARY OF THE INVENTION:

It is an object of the present invention to provide a variable-displacement swash plate compressor that enables compression performance and controllability to be improved by providing a secure seal between a discharge chamber and a suction chamber in a cylinder head.

It is another object of the present invention to provide a variable-displacement swash plate compressor that enables durability to be enhanced by preventing cylinder bore deformation.

The present invention provides a variable-displacement swash plate compressor that is arranged to introduce compressed fluid into a crank chamber through a communication path formed between a silencer chamber or a discharge hole and cylinder bores in a cylinder block. The communication path makes a discharge chamber in a cylinder head and the crank chamber in the cylinder block communicate with each other, and through an orifice allowing a predetermined amount of compressed fluid to flow toward the crank chamber side of the communication path.

BRIEF DESCRIPTION OF THE DRAWINGS:

Fig. 1 is a cross-sectional view of a conventional variable-displacement swash plate compressor.

Fig. 2 is a front view of part of a cylinder block of a conventional variable-displacement swash plate compressor.

Fig. 3 is a cross-sectional view of an embodiment of the present invention.

Fig. 4 is a front view of main part of a cylinder block of an embodiment of the present invention.

DESCRIPTION OF THE PREFERRED EMBODIMENT:

Referring now to Figs. 3 and 4, an embodiment of the present invention is described below.

As shown in Figs. 3 and 4, a compressor housing 1 with a cylindrical casing 11, one end of which is closed by a front end plate 12, defines a crank chamber 2 and has a cylinder block 3 inside. A cylinder head 14 is installed on the cylinder block 3 through a valve plate 13 to define a suction chamber 15 and a discharge chamber 16 between the cylinder head 14 and the valve plate 13.

A main rotating shaft 4, passing through the center of the crank chamber 2, mentioned above, is rotatably borne through needle bearings 41 and 42 by the front end plate 12 and the cylinder block 3, respectively.

A rotor 5 is secured to the main rotating shaft 4, extending through the crank chamber 2. A bracket 53 with a pin 52 is formed on the rotor 5, and the pin 52 is slidably fit into a slot 62, formed in an arm 61 extending from a swash plate 6.

A plurality of cylinder bores 31 and a communica-

tion path 9, all of which are substantially parallel with the main rotating shaft 4, and a displacement control mechanism 8 are formed in the cylinder block 3. Pistons 32 are disposed in the cylinder bores 31. Thus when an external drive source rotates the main rotating shaft 4, the rotor 5 and the swash plate 6 also rotate together with the main rotating shaft 4. Rotation of the swash plate 6 causes the pistons 32 to slide back and forth in the cylinder bores 31 by the aid of shoes 66.

Using reciprocation of the pistons 32, fluid is taken into the cylinder bores 31 through suction holes 34, communicating with the suction chamber 15, and check valves (not shown) are operated to discharge compressed fluid through discharge holes 35 into the discharge chamber 16.

The displacement control mechanism 8 of the embodiment is the case with a conventional variable-displacement swash plate compressor.

A silencer chamber 43, which is of expansion form and has muffler function, is installed on the cylinder block 3. The silencer chamber 43 attenuates pulsation of compressed fluid discharged which flows from the discharge chamber 16 to the silencer chamber 43 through a communication path 10 and the communication path 9. The silencer chamber 43 is provided with a discharge hole 44 to allow compressed fluid to flow into a refrigerating circuit.

The communication path 9 and the communication path 10, making the crank chamber 2 communicate with the discharge chamber 16 of the cylinder head 14, are installed in the cylinder block 3, the valve plate 13, and the cylinder head 14. The communication path 9 is installed between the silencer chamber 43 and the cylinder bores 31. A pipe-shaped orifice 45 is inserted into the communication path 9 on the crank chamber 2 side. The orifice 45 can also be directly formed in the cylinder block 45. A filter 46 is installed on the discharge chamber 16 side of the orifice 45 to remove dirt from compressed fluid.

The orifice 45 allows a predetermined amount of compressed fluid to flow from the discharge chamber 16 to the crank chamber 2. The flow rate is adjusted by choosing one among a plurality of orifices having different hole diameters or lengths.

The embodiment of the present invention, described above, is a variable-displacement swash plate compressor having no wobble plate, but the present invention can of course apply to a variable-displacement swash plate compressor with a wobble plate.

Claims

1. A variable-displacement swash plate compressor that is adapted to introduce compressed fluid into a crank chamber through a communication path formed between a silencer chamber and cylinder bores in a cylinder block, said communication path making a discharge chamber in a cylinder head and

said crank chamber in said cylinder block communicate with each other, and through an orifice installed which allows a predetermined amount of compressed fluid to flow toward said crank chamber side of said communication path.

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2. A variable-displacement swash plate compressor as claimed in claim 1, wherein said orifice is arranged by inserting a pipe into said communication path.

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3. A variable-displacement swash plate compressor as claimed in claim 1 or 2, wherein a filter is installed in front of said orifice.

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4. A variable-displacement swash plate compressor that is adapted to introduce compressed fluid into a crank chamber through a communication path formed between a discharge hole and cylinder bores in a cylinder block, said communication path making a discharge chamber in a cylinder head and said crank chamber in said cylinder block communicate with each other, and through an orifice installed which allows a predetermined amount of compressed fluid to flow toward said crank chamber side of said communication path.

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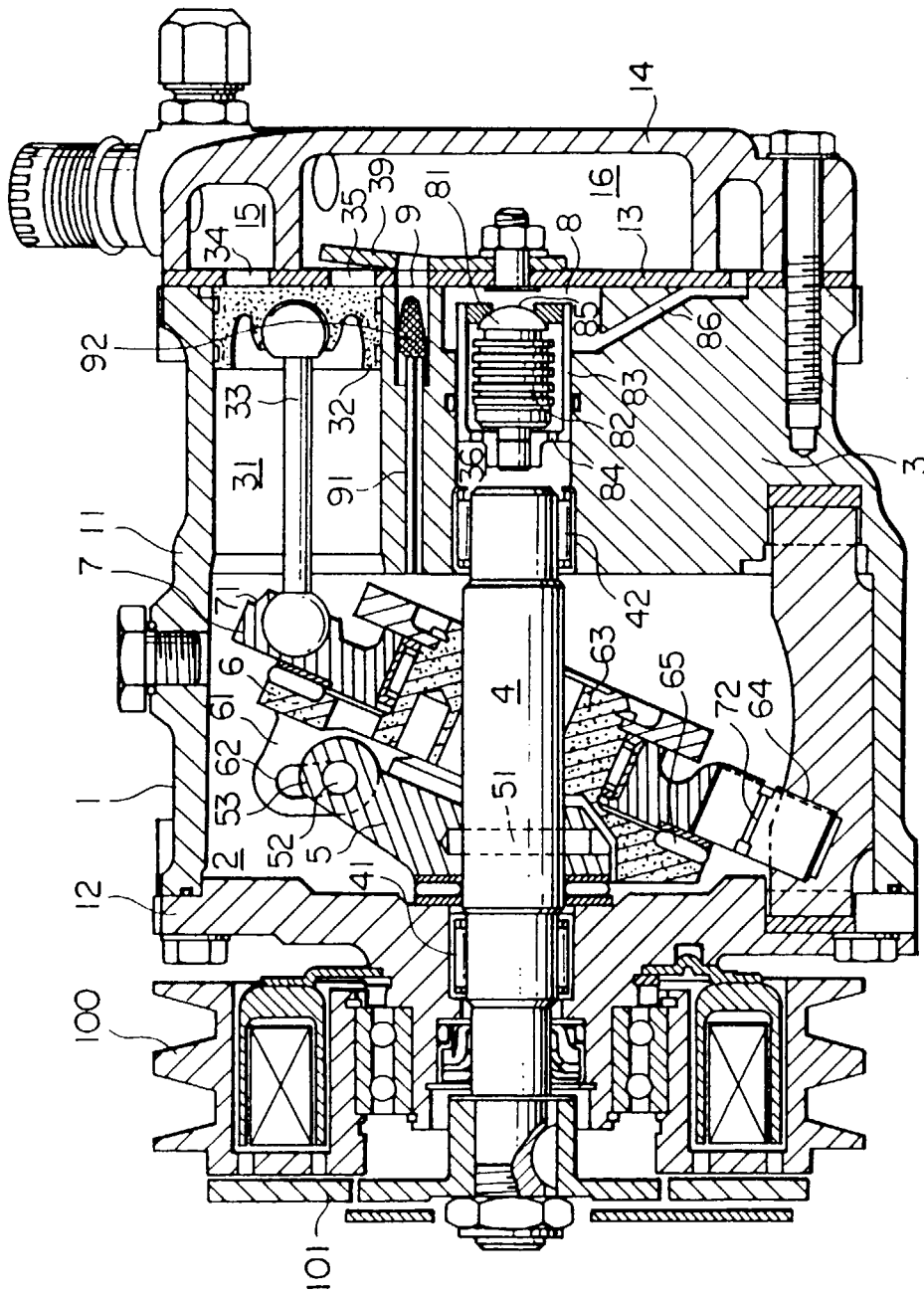


FIG. 1
PRIOR ART

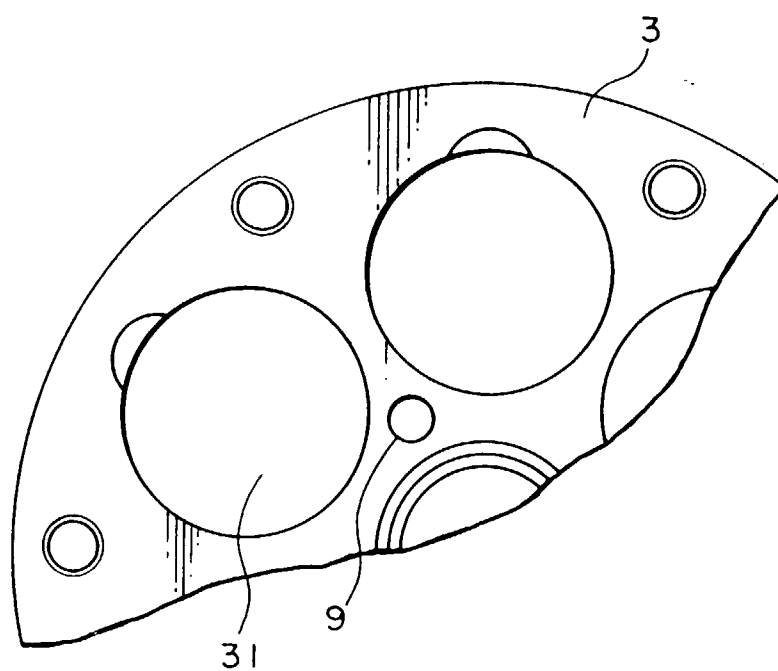


FIG. 2
PRIOR ART

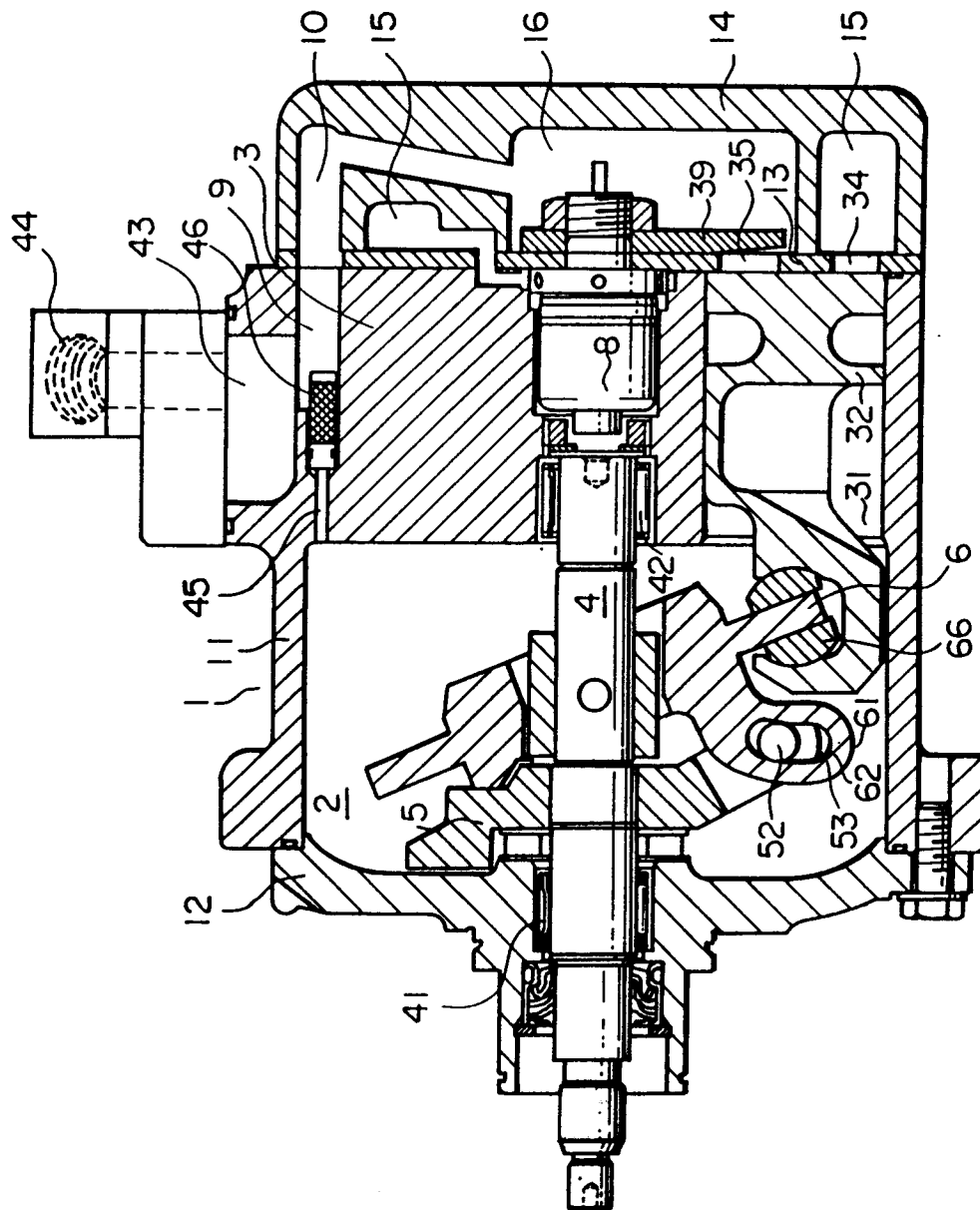


FIG. 3

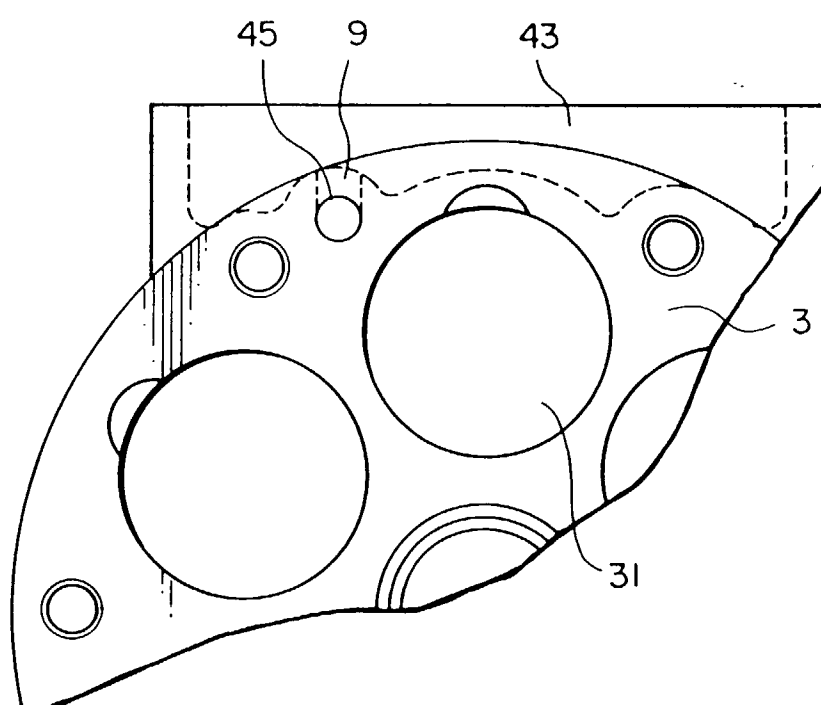


FIG. 4



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EUROPEAN SEARCH REPORT

Application Number
EP 97 12 0476

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int.C1.6)
A	EP 0 318 976 A (SANDEN CORP) * column 5, line 34 - line 48; figure 1 * ---	1-4	F04B27/18
A	US 4 752 189 A (BEARINT DAVID E ET AL) * column 6, line 9 - line 61; figures 2,5 * ---	1,2,4	
A	US 5 518 374 A (OTA MASAKI ET AL) * column 5, line 51 - column 6, line 26; figures 1,2 * ---	1,4	
A	DE 36 33 489 A (TOYODA AUTOMATIC LOOM WORKS) * column 7, line 15 - line 26; figure 1 * -----	1,4	
The present search report has been drawn up for all claims			TECHNICAL FIELDS SEARCHED (Int.C1.6) F04B
Place of search THE HAGUE		Date of completion of the search 2 February 1998	Examiner Bertrand, G
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