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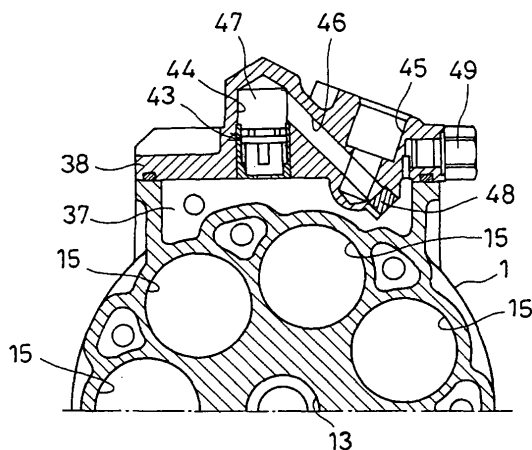
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(54) **VARIABLE DISPLACEMENT-TYPE CLUTCHLESS COMPRESSOR**

(57) A variable displacement-type clutchless compressor in which a housing does not project out over a high-pressure side piping connection area and a sufficient clearance between the cylinder bore outer shell section and a check valve is assured so as to disallow an increase in the passage resistance, is provided. An discharge area via which refrigerant discharged from a compression space exits to the outside of the compressor includes disposed therein, a muffler chamber 37, a check

valve housing portion 44 used to house a check valve 43, which is disposed on the downstream side of the muffler chamber 37, an discharge passage 45 connecting with a high-pressure side piping of a refrigerant circuit and formed substantially parallel to the check valve housing portion 44 and a communicating passage 46 communicating between the check valve housing portion 44 on the check valve discharge side and the discharge passage 46.

Fig. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a variable displacement-type clutchless compressor and more specifically, it relates to a clutchless compressor to which a drive force is applied continuously.

BACKGROUND ART

[0002] At a compressor included in an automotive air-conditioner, to which motive power from the engine is continuously transmitted, the refrigerant gas at a very low flow rate is continuously compressed even when the air-conditioner is turned off. For this reason, in order to prevent the refrigerant gas from being supplied to an outside cycle and freezing the evaporator in the air-conditioner OFF state, a clutchless compressor used in this type of application often includes a check valve with a predetermined valve opening pressure, disposed in an discharge passage in the compressor and forms a circulation path within the compressor (e.g., by opening the pressure control valve disposed on the gas supply passage for intake control) so as to circulate the refrigerant gas within the compressor in the air-conditioner OFF state.

[0003] For instance, patent reference literature 1 discloses a structure that includes a check valve 63 disposed at an exit area of an discharge muffler 44. Via the check valve 63 constituted with a valve element 67, a spring 68 and a spring seat 69, any reverse flow of liquid refrigerant from an external refrigerant circuit 37 to the discharge muffler 44 is prevented and also the compressed refrigerant gas is allowed to flow from the discharge muffler 44 into the external refrigerant circuit 37 (see paragraph 0035).

[0004]

Patent reference literature 1: Japanese Unexamined Patent Publication No. H9-177671

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0005] However, as illustrated in FIGS. 1 and 5 of patent reference literature 1, the check valve 63 located at the exit area of the discharge muffler 44 is accommodated inside the housing constituting the discharge muffler at a projecting portion of the housing that accommodates the check valve. A high-pressure side piping of the external refrigerant circuit is connected to the projected portion in the structure disclosed in the publication. Since this necessitates the piping to be connected in a very limited space, reliable piping connection cannot always be assured. In other words, the structure gives rise to on-vehicle installation-related concerns.

Such concerns may be addressed by disposing the check valve in close proximity to a cylinder bore outer shell section so as to reduce the extent to which the housing portion to connect with the high-pressure side piping projects out. However, the gap between the cylinder bore outer shell section and the check valve in this structure is bound to be very narrow, which, in turn, will increase the passage resistance.

As described above, there are issues, i.e., related to on-vehicle installation expediency and passage resistance, yet to be effectively addressed in the structure in the related art in which the check valve is disposed coaxially with the high-pressure side piping connection area.

[0006] A primary object of the present invention having been completed by addressing the issues discussed above, it is to provide a variable displacement-type clutchless compressor with which the extent to which the housing portion to connect with the high-pressure side piping connects projects out is minimized and an increase in the passage resistance is prevented by assuring a sufficient clearance between the cylinder bore outer shell section and the check valve.

Means for Solving the Problems

[0007] The object described above is achieved in the present invention by providing a variable displacement-type clutchless compressor, which comprises an discharge area through which refrigerant discharged from a compression space flows out of the compressor and a check valve disposed in the discharge area. The discharge area is constituted with a muffler chamber, a check valve housing portion located downstream relative to the muffler chamber, where the check valve is accommodated, an discharge passage connected with a high-pressure side piping of a refrigerant circuit and formed so that an axial line thereof extends substantially parallel to the check valve housing portion with an offset relative to the check valve housing portion, and a communicating passage that communicates between the check valve housing portion on a check valve discharge side and the discharge passage (claim 1).

[0008] At a housing defining the discharge area, the check valve and the discharge passage are disposed with an offset with the axial lines thereof shifted relative to each other and thus, the check valve is not disposed coaxially to the discharge passage connecting with the high-pressure side piping. Since this eliminates the need to dispose a check valve so as to project out at the muffler chamber in the vicinity of the cylinder bore outer shell section, the extent to which the housing portion where the discharge passage connecting with the high-pressure side piping is formed needs to project out can be minimized.

[0009] The check valve housing portion may include a space formed therein, which faces only the downstream-side end of the check valve (claim 2), so as to assure a smooth refrigerant flow by linearly supplying the refrigerant.

erant from the muffler chamber into the refrigerant circuit via the check valve housing portion, the communicating passage and the discharge passage without widening the refrigerant flow.

[0010] In addition, a space may be formed around the check valve in the check valve housing portion (claim 3) so as to ensure that oil adhering to the check valve does not hinder a release operation by collecting the oil returning from the refrigerating cycle around the check valve while the compressor is engaged in operation at the minimum discharge displacement.

[0011] The structure described above may include a safety valve communicating with the muffler chamber, which can be engaged in operation in correspondence to the pressure in the muffler chamber, so as to release the pressure in the discharge area if the pressure rises to an abnormally high level (claim 4), or a safety valve communicating with the discharge passage, which can be engaged in operation in correspondence to the pressure at the check valve downstream side (claim 5). In the latter structure (with the safety valve communicating with the discharge passage) in particular, the safety valve may be disposed on a line extending from the communicating passage (claim 6). In such a case, the communicating passage and a safety valve mounting hole can be formed coaxially with each other, which facilitates machining and also allows the safety valve to close off the open end of the communicating passage, eliminating the need to provide a special blocking member.

[0012] It is to be noted that the variable displacement-type clutchless compressor described above may be a swash plate clutchless compressor, comprising a shaft passing through a crankcase and rotatably supported at the housing, a swash plate that rotates synchronously with the shaft and is disposed tiltably relative to the shaft, a piston held at a circumferential edge of the swash plate and engaged in reciprocal sliding motion inside the cylinder bore formed at the housing as the swash plate rotates and an suction area and an discharge area that selectively communicate with the cylinder bore as the piston slides reciprocally, in which the discharge displacement is controlled by adjusting the angle at which the swash plate is tilted (claim 7). However, the variable displacement-type clutchless compressor may be a compressor other than a swash plate compressor.

Effect of the Invention

[0013] As described above, the discharge area of the variable displacement-type clutchless compressor includes a muffler chamber, a check valve housing portion disposed downstream of the muffler chamber, an discharge passage connecting with the high-pressure side piping of the refrigerant circuit and formed substantially parallel to the check valve housing portion and a communicating passage communicating between the check valve housing portion on the check valve discharge side and the discharge passage. As a result, the extent to

which the housing projects out over the area where it connects with the high-pressure side piping is minimized and piping connection in the limited space is facilitated while improving the installability in the vehicle. In addition, since the check valve does not need to project out at the muffler chamber in close proximity to the cylinder bore outer shell section, a sufficient clearance between the cylinder bore outer shell section and the check valve is assured, which, in turn, prevents an undesirable increase in the passage resistance.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

FIG. 1 is a sectional view of the variable displacement-type clutchless compressor achieved in an embodiment of the present invention;

FIG. 2 is a sectional view presenting examples of structures that may be assumed in the muffler chamber, the check valve housing portion, the communicating passage and the discharge passage in the discharge area of the compressor in FIG. 1;

FIG. 3 is a perspective presenting a structural example for the check valve;

FIG. 4 is a sectional view presenting other examples of structures that may be adopted in the muffler chamber, the check valve housing portion, the communicating passage and the discharge passage;

FIG. 5 is a sectional view presenting other examples of structures that may be adopted in the muffler chamber, the check valve housing portion, the communicating passage and the discharge passage; and

FIG. 6 is a sectional view presenting other examples of structures that may be adopted in the muffler chamber, the check valve housing portion, the communicating passage and the discharge passage. Explanation of reference numerals

[0015]

34	compression space
37	muffler chamber
43	check valve
44	check valve housing portion
45	discharge passage
46	communicating passage
47, 51	space
49	safety valve

BEST MODE FOR CARRYING OUT THE INVENTION

[0016] The best mode for carrying out the invention is now described in reference to the attached drawings.

[0017] FIG. 1 illustrates a swash plate compressor representing an example of a variable displacement-type clutchless compressor. The compressor comprises a cyl-

inder block 1, a rear head 3 attached onto the rear side (the right side in the figure) of the cylinder block 1 via a valve plate 2 and a front head 5 attached so as to close off the front side (the left side in the figure) of the cylinder block 1 and defining a crankcase 4. The front head 5, the cylinder bore 1, the valve plate 2 and the rear head 3 are fastened together along the axial direction with fastening bolts 6.

[0018] The crankcase 4 defined by the front head 5 and the cylinder block 1 houses therein a drive shaft 7, one end of which projects out beyond the front head 5. A drive pulley 10 rotatably fitted onto the outside of a boss portion 5a of the front head 5, is connected to the portion of the drive shaft 7 projecting out beyond the front head 5 via a relay member 9 mounted along the axial direction with a bolt 8, so as to communicate rotational motive power from the engine of the vehicle via a drive belt (not shown). In addition, a space between the one end of the drive shaft 7 and the front head 5 is sealed with a high level of air tightness with a seal member 11 disposed between the drive shaft and the front head 5 and the one end of the drive shaft is rotatably supported at a radial bearing 12. The other end of the drive shaft 7 is rotatably supported at a radial bearing 14 accommodated inside a recessed portion 13 formed at the cylinder block 1.

[0019] As shown in FIG. 2, the recessed portion 13 where the radial bearing 14 is accommodated and a plurality of cylinder bores 15 disposed over equal intervals on the circumference of a circle centered on the recessed portion 13 are formed at the cylinder block 1, with a hollow single-ended piston 16 inserted in each cylinder bore 15 so as to slide reciprocally in the cylinder bore.

[0020] A thrust flange 17, which rotates as one with the drive shaft 7 in the crankcase 4, is fixed onto the drive shaft 7. The thrust flange 17 is rotatably supported via a thrust bearing 18 so as to rotate freely relative to the inner surface of the front head 5, and a swash plate 20 is connected to the thrust flange 17 via a link member 19.

[0021] The swash plate 20 is tiltably disposed so that it tilts around a hinge ball 21 slidably disposed on the drive shaft 7, and rotates as one with the thrust flange 17 in synchronization with the rotation of the thrust flange 17 via the link member 19. Engaging portions 16a of the single-ended pistons 16 are each held at the circumferential edge of the swash plate 20 via a pair of shoes 22.

[0022] Accordingly, as the drive shaft 7 rotates, the swash plate 20 also rotates. The rotating motion of the swash plate 20 is then converted via the shoes 22 to reciprocal linear motion of the single-ended pistons 16 and, as a result, the volumetric capacity of a compression space 23 formed between the single-ended piston 16 inside each cylinder bore 15 and the valve plate 2 is altered.

[0023] An suction hole 31 and an discharge hole 32 are formed at the valve plate 2 in correspondence to each cylinder bore 15, whereas an suction chamber 33, where the working fluid to be supplied into the compression

spaces 23 is stored and an discharge chamber 34, where the working fluid discharged from the compression space 23 is stored, are defined at the rear head 3. The suction chamber 33, formed at a central area of the rear head 3, communicates with an suction passage (not shown) connecting with the discharge side of an evaporator and is also allowed to communicate with the compression spaces 23 via an suction hole 31 opened/closed via an suction valve 35. The discharge chamber 34, formed around the suction chamber 33, is allowed to communicate with the compression space 23 via an discharge hole 32 opened/closed via an discharge valve 36.

[0024] The discharge displacement of the compressor is determined in correspondence to the stroke of the pistons 16, and the stroke of the pistons, in turn, is determined based upon the tilt angle of the swash plate 20 relative to a plane ranging perpendicular to the drive shaft 7. Namely, the swash plate 20 is made to tilt with a specific angle at which the pressure difference between the pressure applied to the front surface of a piston 16, i.e., the pressure in the compression space 23 (the pressure inside the cylinder bore) and the pressure applied to the rear surface of the piston 16, i.e., the pressure in the crankcase 4 (the crankcase pressure P_c) and the level of force applied from a de-stroke spring 28, which applies a force to the hinge ball 21 along the piston stroke-reducing direction, are in balance with each other. The discharge displacement is determined based upon the piston stroke determined in correspondence to the tilt of the swash plate 20.

[0025] It is to be noted that a gas supply passage 40 ranging over the cylinder block 1, the valve plate 2 and the rear head 3 and communicating between the discharge chamber 34 and the crankcase 4 is formed with passage segments 1b, 2b and 3b. A gas bleeding passage 41, communicating between the crankcase 4 and the suction chamber 33 is constituted with passage segments 1c and 2c formed at the cylinder block 1 and the valve plate 2, a passage 7c formed at the shaft 7 and the gap at the radial bearing 14. Via a pressure control valve 42 disposed in the gas supply passage 40, the flow rate of the refrigerant flowing into the crankcase 4 are from the discharge chamber 34 is adjusted so as to control the pressure in the crankcase 4.

[0026] When the discharge displacement needs to be set to the minimum level (when the function of the compressor is turned off), the gas supply passage 40 is opened via the pressure control valve 42 and an internal circulation path is formed inside the compressor with the compression space 23, the discharge hole 32, the discharge chamber 34, the gas supply passage 40, the crankcase 4, the gas bleeding passage 41, the suction chamber 33 and the suction hole 31. When the swash plate 20 assumes the smallest tilt angle or an angle close to the smallest tilt angle, the refrigerant gas is made to circulate inside the compressor through the internal circulation path instead of flowing out to the external circuit via the check valve to be detailed below. As the refriger-

ant gas circulates inside the compressor, the sliding portions inside the compressor.

[0027] The discharge chamber 34 communicates with a muffler chamber 37 formed at the circumferential edge of the cylinder block 1 via passage segments 2a and 1a formed at the valve plate 2 and the cylinder block 1. The muffler chamber 37 is formed between the cylinder block 1 and a cover member 38 mounted at the outer circumference of the cylinder block 1. At the cover member 38, a check valve housing portion 44 communicating with the muffler chamber 37 and housing the check valve 43 on the downstream side of the muffler chamber 37, an discharge passage 45 connecting with a high-pressure side piping of the refrigerant circuit and formed substantially parallel to the axial center of the check valve housing portion 44 with an offset relative to the axial center of the check valve housing portion 44 and a communicating passage 46 communicating between the check valve discharge side of the check valve housing portion 44 and the discharge passage 45 are formed. This means that while the check valve 43 is disposed on the downstream side of the muffler chamber 37 and the check valve housing portion 44, the communicating passage 46 and the discharge passage 45 are formed in series from the muffler chamber side, the check valve housing portion 44 is not disposed coaxially with the discharge passage 45.

[0028] It is to be noted that the discharge chamber 34, the passage segments 1a and 2a, the muffler chamber 37, the check valve housing portion 44, the communicating passage 46 and the discharge passage 45 form an discharge area through which the refrigerant gas discharged from the compression space 23 is output to the outside of the compressor, whereas the suction chamber 33 and an suction passage (not shown) form an suction area through which the refrigerant is taken in from the outside of the compressor. In addition, the front head 5, the cylinder block 1, the rear head 3 and the cover member 38 constitute the housing of the compressor.

[0029] The check valve 43 is accommodated inside the check valve housing portion 44, which does not project into the muffler chamber 37. As shown in FIG. 3, the check valve 43 may be, for instance, a valve disposed in Japanese Unexamined Patent Publication No. 2005-098155, comprising a tubular case 51 with a solid bottom, a valve element 52 accommodated inside the case, a spring 53 that applies a force to the valve element 52 and a stopper 54 that regulates the movement of the valve element, as shown in FIG. 3. A valve hole 56 of the check valve is opened/closed as the valve element 52 moves onto or departs a seat surface 55 of the case 51.

[0030] The check valve housing portion 44 in the embodiment includes a space 47 which faces only the downstream-side end of the check valve 43. While the housing (cover member 38) projects out on the axial line of the check valve 43, the area where the discharge passage 45 connecting with the high-pressure side piping is formed does not project out anymore than the extent to which the check valve housing portion 44 projects out.

The communicating passage 46 is formed so as to extend from the inner wall surface of the cover member 38 through the discharge passage 45 to reach the space 47 located on the downstream side of the check valve 43, with an open end thereof closed off with a blocking member 48. Thus, the refrigerant flowing out from the muffler chamber 37 via the check valve 43 then flows linearly through the space 47 facing opposite the downstream end of the check valve 43, the communicating passage 46 and the discharge passage 45 in sequence without widening the path of its flow, before being discharged into the high-pressure side piping. In addition, since a safety valve 49 communicating with the muffler chamber 37, which opens the muffler chamber to release the pressure therein when the pressure in the muffler chamber becomes equal to or higher than a predetermined level, is disposed at the cover member 38.

[0031] Since the check valve 43 included in the structure described above is accommodated inside the check valve housing portion 44 formed substantially parallel to the discharge passage 45 (the discharge passage 45 is not formed on the axial line of the check valve), the extent to which the portion of the housing where the discharge passage 45 connecting with the high-pressure side piping is present projects out is minimized so as to improve the installability in the vehicle by assuring ample piping connection space. In addition, since the check valve 43 is accommodated inside the check valve housing portion 44 so that it does not project into the muffler chamber 37, a sufficient clearance between the outer shell section of the cylinder bores 15 and the check valve 43 is secured (without reducing the passage section of the muffler chamber 37) whereby preventing an increase in the passage resistance. Moreover, the refrigerant flowing out of the muffler chamber 37 via the check valve 43 flows linearly to reach the discharge passage 45 without widening its path as it exits the check valve 43. It is then discharged into the high-pressure side piping. Thus, a smooth flow of the refrigerant discharged of the muffler chamber is assured.

[0032] FIG. 4 presents a variation of the structure described above. While the structure shown in FIG. 4 is similar to that described in reference to the previous example, in that the check valve 43 is accommodated inside the check valve housing portion 44 formed on the downstream side of the muffler chamber 37 so that the check valve does not project into the muffler chamber 37, that the safety valve 49 is disposed so as to communicate with the muffler chamber 37 and that the discharge passage 45 is disposed substantially parallel to the check valve housing portion 44 with an offset, instead of being disposed coaxially with the check valve housing portion 44, the check valve housing portion 44 in the variation is defined by the cover member 38 and a lid member 60 mounted from the outside of the cover member 38, with a space 61 formed at the check valve housing portion 44 to surround the check valve 43 and the space 61 connected to the discharge passage 45 via the communicating

ing passage 46.

[0033] The communicating passage 46 in this structure is formed as a channel on the outer side of the cover member 38 via the check valve housing portion 44 while the lid member 60 is disengaged. It is to be noted that since other structural features are similar to those in the previous example, the same reference numerals are assigned to identical components so as to preclude the necessity for a repeated explanation thereof.

[0034] In this structure too, the check valve 43 is accommodated inside the check valve housing portion 44 formed substantially parallel to the discharge passage 45 without projecting into the muffler chamber 37 and thus, ample piping connection space is assured by minimizing the extent to which the housing projects out over the area where the discharge passage 45 is formed. In addition, since sufficient clearance between the outer shell section of the cylinder bores 15 and the check valve 43 is assured, the passage resistance does not increase. In this example in particular, the space 61 is formed around the check valve 43, which makes it possible to collect the oil returning from the refrigerant circuit in the space around the check valve 43 when the compressor is engaged in operation at the smallest discharge displacement. As a result, smooth opening operation is enabled without any hindrance by oil adhering to the check valve 43.

[0035] FIG. 5 presents another structural example. While this structure is similar to that shown in FIG. 4 in that the check valve housing portion 44 is formed on the downstream side of the muffler chamber 37 to house the check valve 43 without the check valve projecting out into the muffler chamber 37, that the discharge passage 45 is formed to extend substantially parallel to the check valve housing portion 44 with an offset instead of being disposed coaxially with the check valve housing portion 44 and that the space 61 is formed around the check valve 43, the check valve housing portion 44 in this example is defined entirely by the cover member 38, the safety valve 49, communicating with the discharge passage 45, is engaged in operation in correspondence to the level of pressure on the downstream side of the check valve and the communicating passage 46 is formed so as to reach the space 61 through the discharge passage 45 from the inner wall surface of the cover member 38, with the open end of the communicating passage 46 closed off with a blocking member 48.

[0036] It is to be noted that since other structural features are similar to those in the previous example, the same reference numerals are assigned to identical components so as to preclude the necessity for a repeated explanation thereof. Advantages similar to those of the structural example illustrated in FIG. 4 are achieved by adopting this structure.

[0037] FIG. 6 presents yet another structural example. While the open end of the communicating passage 46 must be closed off with a blocking member 48 during formation of the communicating passage 46 or a lid mem-

ber 60 must be disposed at the cover member 38 after machining the communicating passage 46 in the examples described earlier, the safety valve 49 communicating with the discharge passage 45 is disposed on a line extending from the communicating passage 46 and a mounting hole 62 at which the safety valve 49 is mounted and the communicating passage 46 are formed coaxially in this example.

[0038] It is to be noted that since this structure is similar to that shown in FIG. 5 in that the check valve housing portion 44 is formed on the downstream side of the muffler chamber 37 to house the check valve 43 without the check valve projecting out into the muffler chamber 37, that the discharge passage 45 is formed to extend substantially parallel to the check valve housing portion 44 with an offset instead of being disposed coaxially with the check valve housing portion 44 and that the space 61 is formed around the check valve 43. The same reference numerals are assigned to identical components to preclude the necessity for a repeated explanation thereof.

[0039] Since the communicating passage 46 and the mounting hole 62 of the safety valve 49 are coaxial with each other, they can be formed at the same time, thereby facilitating the machining process. In addition, since the open end of the communicating passage 46 is closed off with the safety valve 49, no special blocking member is required, making it possible to minimize the number of required parts.

Claims

1. A variable displacement-type clutchless compressor, that includes:

an discharge area through which refrigerant discharged from a compression space flows out of said compressor; and

a check valve disposed in said discharge area, wherein:

said discharge area is constituted with;

a muffler chamber (37), a check valve housing portion (44) located downstream relative to said muffler chamber (37), where said check valve (43) is accommodated;

an discharge passage (45) connected with a high-pressure side piping of a refrigerant circuit and formed substantially parallel to said check valve housing portion (44);

and a communicating passage (46) that communicates between said check valve housing portion (44) on a check valve (43) discharge side and said discharge passage (45).

2. A variable displacement-type clutchless compressor according to claim 1, **characterized in:**

that a space that faces only a downstream-side end of said check valve (43) is formed at said check valve housing portion (44).

3. A variable displacement-type clutchless compressor according to claim 1, wherein: 5

a space is formed around said check valve (43) at said check valve housing portion (44).

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4. A variable displacement-type clutchless compressor according to any of claim 1 through 3, further including:

a safety valve communicating with said muffler chamber (37), which can be engaged in operation in correspondence to the level of pressure in said muffler chamber (37). 15

5. A variable displacement-type clutchless compressor according to claim 1 or 3, further including: 20

a safety valve (49) communicating with said discharge passage (45), which can be engaged in operation in correspondence to the level of pressure on the downstream side of said check valve (43). 25

6. A variable displacement-type clutchless compressor according to claim 5, **characterized in:** 30

that said safety valve (49) is disposed on a line extending from said communicating passage (46).

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7. A variable displacement-type clutchless compressor according to any of claims 1 through 6, wherein:

said variable displacement-type clutchless compressor is a swash plate clutchless compressor, comprising: 40

a shaft (7) passing through a crankcase (4) and rotatably supported at a housing;

a swash plate (20) that rotates synchronously with said shaft (7) and is disposed tiltably relative to said shaft (7); 45

a piston (16) held at a circumferential edge of said swash plate (20) and engaged in reciprocal sliding motion inside a cylinder bore (15) formed at said housing as said swash plate (20) rotates; and 50

an suction area and an discharge area that selectively communicate with said cylinder bore (15) as said piston (16) slides reciprocally, with said discharge displacement controlled by adjusting the angle at which said swash plate (20) tilts. 55

Fig. 1

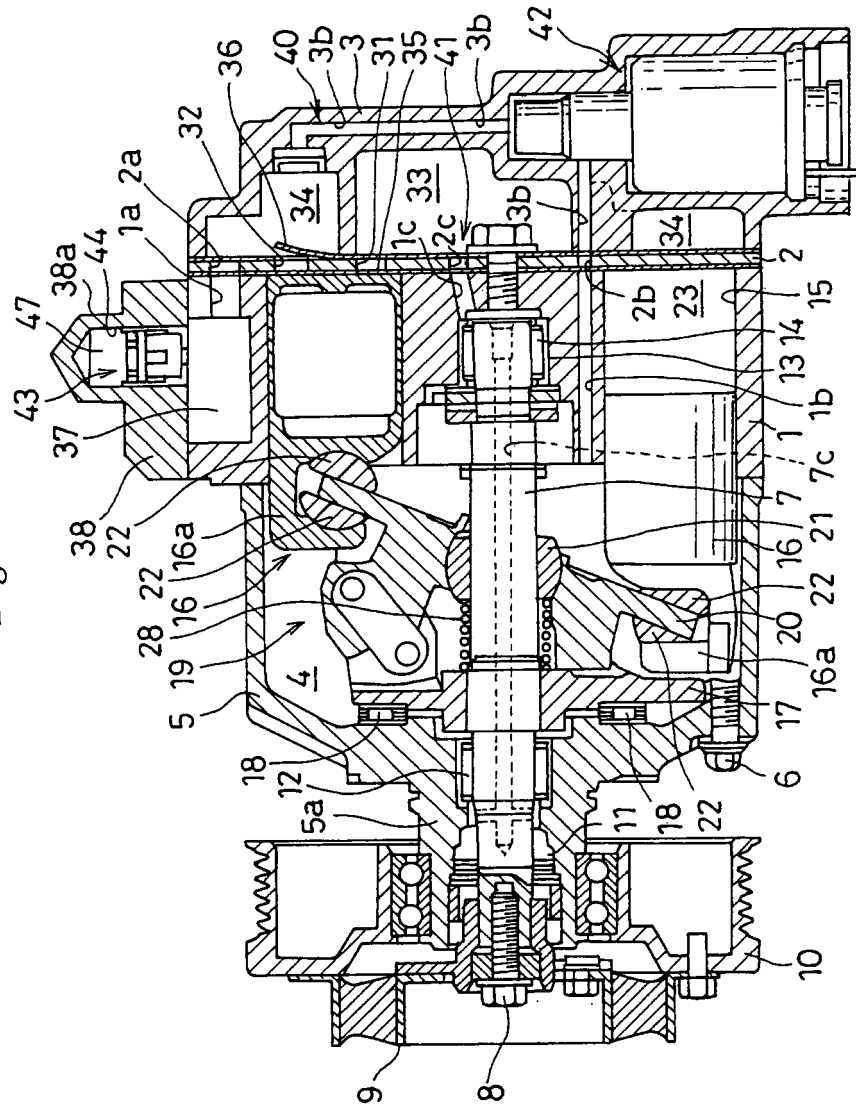


Fig. 2

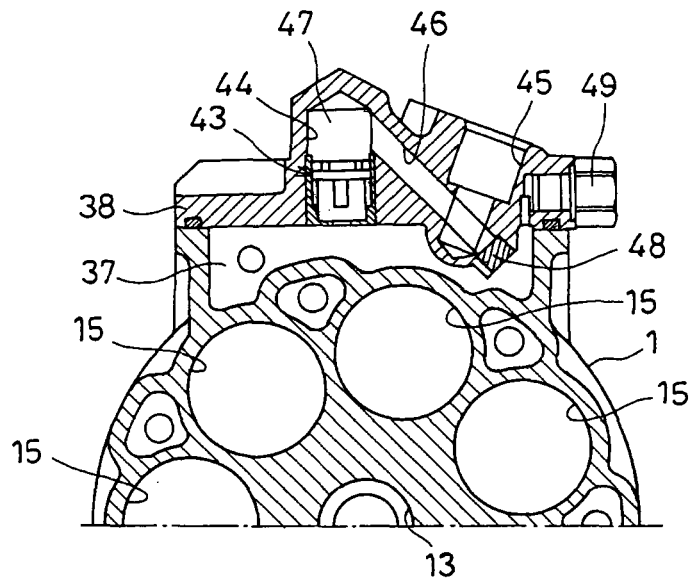


Fig. 3

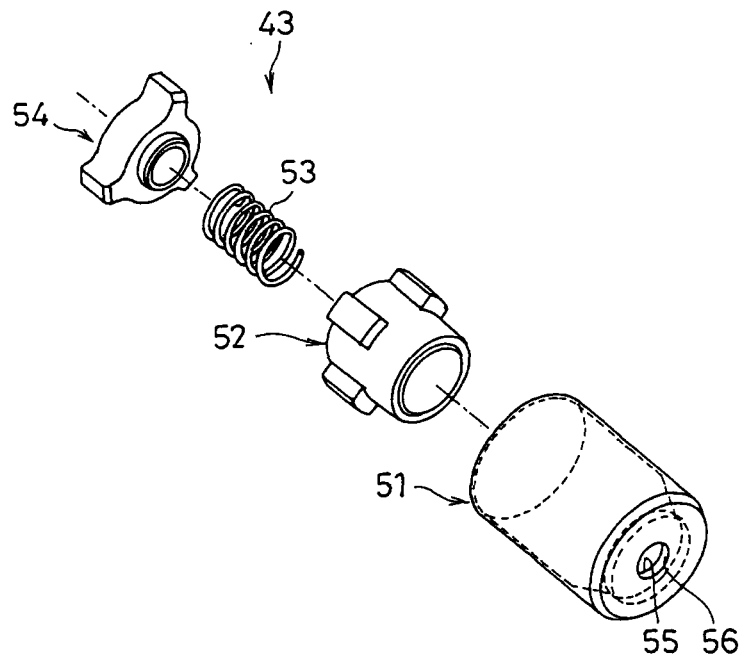


Fig. 4

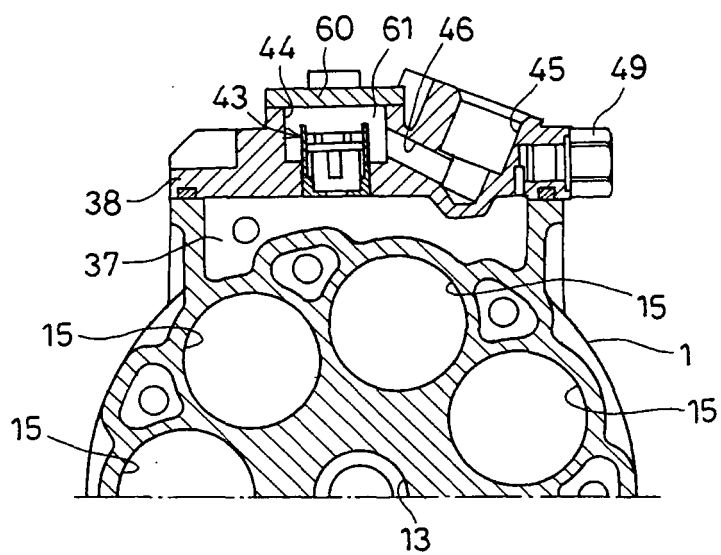


Fig. 5

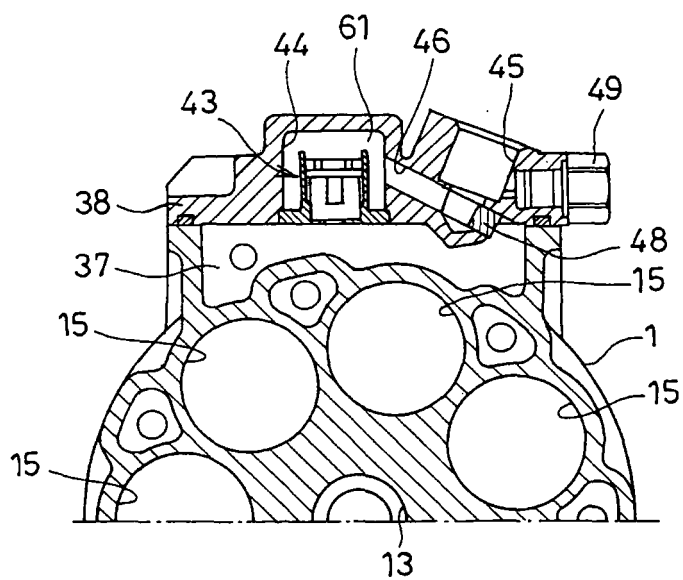
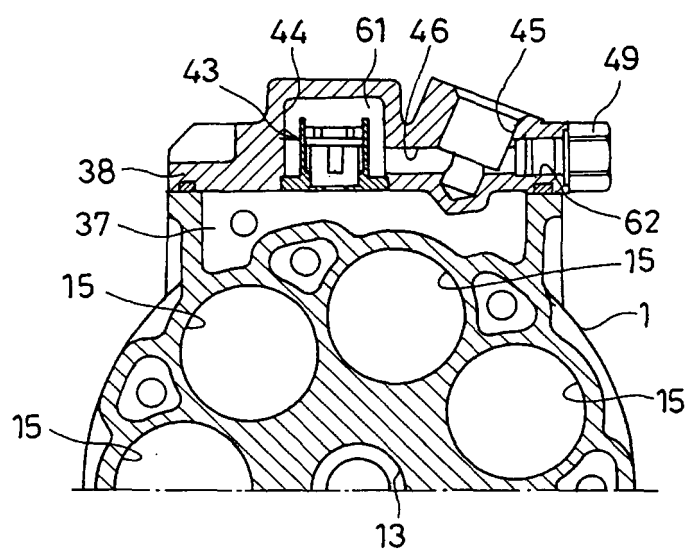


Fig. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/050279

A. CLASSIFICATION OF SUBJECT MATTER

F04B27/08 (2006.01) i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04B27/08, F04B39/00, F04B39/10

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

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2007

Kokai Jitsuyo Shinan Koho 1971-2007 Toroku Jitsuyo Shinan Koho 1994-2007

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
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Y A	JP 10-253174 A (Toyoda Automatic Loom Works, Ltd.), 25 September, 1998 (25.09.98), Par. No. [0047]; Fig. 1 & US 6227812 B1 & DE 19810789 A1	4 1-3, 5-7

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

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Date of the actual completion of the international search
05 April, 2007 (05.04.07)Date of mailing of the international search report
17 April, 2007 (17.04.07)Name and mailing address of the ISA/
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2007/050279

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2000-346241 A (Toyoda Automatic Loom Works, Ltd.), 15 December, 2000 (15.12.00), Full text; all drawings & US 6435848 B1 & EP 1059444 A2 & DE 60024168 D & CN 1276495 A	1-7

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REFERENCES CITED IN THE DESCRIPTION

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