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(71) Applicant: **Valeo Thermal Systems Japan Corporation**
Konan-machi, Osato-gun
Saitama 3600193 (JP)

(72) Inventors:
• **KANESUGI, Keiichi**
Valeo Thermal Systems Japan Corp
Ohsato-gun Saitama 360-0193 (JP)

• **TAKAHASHI, Tomoyasu**
Valeo Thermal Sys. Japan Corp.
Ohsato-gun Saitama 360-0193 (JP)
• **ADACHI, Yoshihiro**
Valeo Thermal Sys. Japan Corp.
Ohsato-gun Saitama 360-0193 (JP)

(74) Representative: **Degwert, Hartmut**
Prinz & Partner GbR
Rundfunkplatz 2
80335 München (DE)

(54) **COMPRESSOR**

(57) A compressor capable of avoiding the instability of the control of a pressure in a crankcase by feeding a working fluid with a low oil mixing ratio to a pressure control valve to reduce the adhesion of oil to the valve body of the pressure control valve. When an supply passage (44) supplying the working fluid to the pressure control valve (34) is formed in a rear housing (5), the introducing port (45) of the supply passage (44) is opened to the downstream side of the oil separating tube (39) of an oil separator (36). Since the working fluid from which the oil is separated and removed from the oil separator (36) is returned to the crankcase (8) through an supply passage (46) after being fed from the introducing port (45) to the pressure control valve (34) through the supply passage (44), the possibility of the adhesion of the oil mixed in the working fluid to the pressure control valve (34) can be reduced.

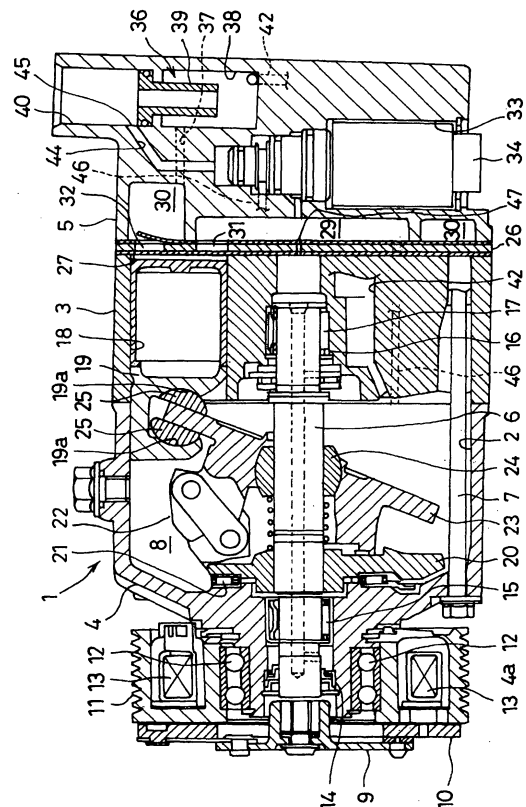


Fig. 1

Description

TECHNICAL FIELD

[0001] The present invention relates to the structure of a compressor having a pressure control valve for controlling the pressure in the crankcase and an oil separation mechanism for separating oil mixed in the compressed working fluid.

BACKGROUND TECHNOLOGY

[0002] When the amount of oil (lubricant) coming to an external cycle from a compressor is relatively increased, some inconveniences occur, such as an oil shortage of the compressor and reduced heat exchange efficiency of the heat exchanger provided on the cycle. This can be prevented by an oil separator for separating oil mixed in the compressed working fluid coming from the discharge chamber to the discharge side of the compressor (for example see Patent Document 1).

[0003] In a known structure for attenuating the intake pulsation or discharge pulsation of a compressor, one of the intake chamber and discharge chamber that is formed to the center of the rear housing communicates with the corresponding discharge outlet via a tunnel-like communicating passage, in which a muffler chamber is provided between the tunnel-like communicating passage and the pipe connection to which the discharge outlet is connected (for example see Patent Document 2).

[0004] On the other hand, the pressure control valve is provided on the supply passage that communicates with the discharge chamber via the introducing port at one end and with the crankcase at the other so that the opening rate of the supply passage is adjusted to control the pressure in the crankcase (for example see Patent Document 3).

Patent Document 1: Japanese Laid-Open Patent Application No. 2005-23847;

Patent Document 2: Japanese Laid-Open Patent Application No. 2002-202054; and

Patent Document 3: Japanese Laid-Open Patent Application No. 2004-183623.

DISCLOSURE OF THE INVENTION

PROBLEMS OVERCOME BY THE INVENTION

[0005] When the introducing port of the supply passage is directly open to the discharge chamber as described above, the working fluid containing a relatively large amount of oil is sent to the supply passage, which causes the oil to adhere to the valve body of the pressure control valve, slowing down the opening/closing motion of the valve and substantially changing the passage area because of the oil adhering to the valve body, and the desired working fluid rate supplied to the crankcase may

not be ensured, destabilizing the crankcase pressure control.

[0006] The purpose of the present invention is to prevent the instability of the pressure control in a crankcase by sending a working fluid having a relatively low oil mixing ratio to the pressure control valve so as to reduce the adhesion of oil to the valve body of the pressure control valve.

10 PROBLEM RESOLUTION MEANS

[0007] The compressor of the present invention is provided with a housing, a crankcase formed in the housing, a driving shaft rotatably supported by the housing and rotated by an external driving force, a compression mechanism converting the rotation of the driving shaft to the compression of a working fluid, a pressure control valve supplying the working fluid that is compressed by the compression mechanism and relatively highly pressurized to the crankcase so as to control the pressure in the crankcase, and an oil separation mechanism separating oil from the working fluid compressed by the compression mechanism, characterized by the fact that the introducing port of an supply passage for supplying the working fluid to the pressure control valve is open to the passage where the working fluid from which oil is separated and removed by the oil separation mechanism can be introduced (Claim 1). The working fluid can be, for example, a refrigerant for chlorofluorocarbon compressors or a refrigerant for CO₂ compressors. "The pressure control valve for supplying a working fluid compressed by the compression mechanism and relatively highly pressurized to the crankcase so as to control the pressure in the crankcase" can be one for adjusting the opening rate of the supply passage to control the working fluid rate entering the crankcase (entry control) or the one for adjusting the opening rates of both the supply passage and the bleeding passage to control the pressure in the crankcase. Furthermore, the compressor can particularly be of a reciprocating piston-operated variable capacity type including single swash plate, wobbling, and other similar types. The separated oil is led to low pressure chambers such as the crankcase and intake chamber.

[0008] More specifically, the oil separation mechanism consists of an oil separation chamber in communication with an discharge chamber where the working fluid compressed by the compression mechanism is temporarily stored, and an oil separating tube protruding in the oil separation chamber for swirling the working fluid introduced from the discharge chamber and connecting the discharge outlet for discharging the working fluid outside the compressor and the oil separation chamber, and the introducing port is opened to the downstream side of said oil separating tube (Claim 2). The oil separator is provided with a separate passage from the supply passage for supplying the oil separated in the oil separation chamber to low pressure chambers such as the crankcase and intake chamber.

[0009] The oil separation mechanism can be constituted of a muffler chamber formed in the housing, the muffler chamber and the discharge chamber into which the working fluid compressed by the compression mechanism is discharged are connected via a first communicating passage, and the muffler chamber and the discharge outlet for discharging the working fluid outside the compressor are connected via a second communicating passage, wherein the introducing port is opened to the downstream side of the muffler chamber (Claim 3). The muffler chamber is capable of preventing the separated oil from being discharged through the second communicating passage and is in communication with a separate passage from the first and second communicating passages for supplying the separated oil from the muffler chamber to low pressure chambers such as the crankcase and intake chamber.

EFFICACY OF THE INVENTION

[0010] According to the present invention, working fluid having a relatively low oil mixing ratio after oil is separated and removed therefrom by the oil separation mechanism, and is sent to the pressure control valve, thereby reducing the adhesion of oil to the valve body of the pressure control valve. Consequently, the valve opening/closing operation of the pressure control valve can be controlled in a desired manner, improving the controllability of the compressor.

[0011] Particularly in the invention according to Claim 3, the muffler chamber serves to attenuate the intake pulsation or discharge pulsation of the compressor and separate oil from the working fluid while the working fluid passes through there. The separated oil is supplied to low pressure chambers such as the crankcase through a separate passage. Therefore, the muffler chamber also serves as the oil separation mechanism. According to the invention described in Claim 3, the muffler chamber serving as the oil separation mechanism eliminates the provision of a separate oil separation mechanism for separating oil from the working fluid sent to the pressure control valve as described in Claim 2 and gives the compressor a relatively simple structure.

BRIEF EXPLANATION OF THE DRAWINGS

[0012]

[Fig.1] Fig.1 is a cross-sectional view showing an entire structure of a compressor to which the present invention is applied.

[Fig.2] Fig.2 is a cross-sectional view showing another entire structure of a compressor to which the present invention is applied.

[Fig.3] Fig.3 is a schematic view showing the structure of the muffler chamber of the same compressor as the above.

LEGEND

[0013]

- | | |
|----|---------------------------------|
| 5 | 1 compressor |
| | 2 housing |
| | 6 driving shaft |
| | 8 crankcase |
| | 19 single-ended piston |
| 10 | 20 thrust flange |
| | 23 swash plate |
| | 29 intake chamber |
| | 30 discharge chamber |
| | 34 pressure control valve |
| 15 | 36 oil separator |
| | 38 oil separation chamber |
| | 39 oil separating tube |
| | 40 discharge outlet |
| | 49 muffler chamber |
| 20 | 50 first communicating passage |
| | 51 second communicating passage |

BEST MODE FOR IMPLEMENTING THE INVENTION

[0014] Embodiments of the present invention are described hereafter with reference to the drawings.

[0015] Fig.1 shows a reciprocating piston-operated variable capacity compressor 1 as an embodiment of a compressor 1 to which the present invention is applied. The compressor 1 comprises a cylinder block 3, a front housing 4 secured to the front of the cylinder block 3, a rear housing 5 secured to the back (to the right in Fig.1) of the cylinder block 3 via a valve plate 26, and a driving shaft 6. The cylinder block 3, front housing 4, valve plate 26, and rear housing 5 are joined and secured to each other by a fastening bolt 7 inserted in the axial direction of cylinder bores 18 described later, thereby constituting a nearly cylindrical metal housing 2.

[0016] The front housing 4 and cylinder block 3 forms a crankcase 8. The driving shaft 6 is encased in the crankcase 8 with one end protruding from the front housing 4. A clutch plate 10 is fixed to the portion of the driving shaft 6 that protrudes from the front housing 4 via an axial relay member 9. A drive pulley 11 is rotatably fitted on a boss 4a of the front housing 4, facing the clutch plate 10. The drive pulley 11 is rotatably fitted on the boss 4a via a bearing 12. When an exciting coil 13 embedded in the drive pulley 11 is excited, the clutch plate 10 is attracted to the drive pulley 11 and transmits the rotation of the drive pulley 11 to the driving shaft 6.

[0017] One end of the driving shaft 6 is air-tightly sealed by a shaft sealing device 14 provided between the front housing 4 and the driving shaft 6 and rotatably supported by the front housing 4 via a radial bearing 15 fitted on the outer periphery of the driving shaft 6. The other end of the driving shaft 6 is rotatably supported by the cylinder block 3 via a radial bearing 17 housed in a supporting recess 16 of the cylinder block 3.

[0018] The cylinder block 3 has a supporting recess 16 for supporting the driving shaft 6 and multiple cylinder bores 18 around the supporting recess 16 at equal intervals in the circumferential direction. The cylinder bores 18 each house a single-ended piston 19 in a reciprocable manner.

[0019] A thrust flange 20 is fixed to and rotates with the driving shaft 6 within the crankcase 8. The thrust flange 20 is rotatably supported by the inner wall of the front housing 4 that is nearly perpendicular to the driving shaft 6 via a thrust bearing 21. A swash plate 23 is coupled to the thrust flange 20 via a linking member 22.

[0020] The swash plate 23 is held via a hinge ball 24 provided on the driving shaft 6 and allowed to tilt. The swash plate 23 rotates in sync with and together with the thrust flange 20. The rim of the swash plate 23 is engaged with an engaging part 19a of the single-ended piston 19 via a pair of shoes 25 provided on the front and back.

[0021] The above described thrust flange 20, swash plate 23, and single-ended piston 19 constitute a compressor mechanism converting the rotation of the driving shaft 6 to compression of the working fluid. When the driving shaft 6 rotates, the swash plate 23 rotates in sync with and together with the driving shaft 6. The rotation is converted to the linear reciprocating motion of the single-ended piston 19 via the shoes 25. The reciprocating motion of the single-ended piston 19 changes the capacity of the compression chamber 27 formed between the single-ended piston 19 and the valve plate 26 in the cylinder bore 18.

[0022] The rear housing 5 is joined to the cylinder block 3 via the valve plate 26 to form an intake chamber 29 and an discharge chamber 30 continuously formed around the intake chamber 29. The valve plate 26 has an intake hole 31 connecting the intake chamber 29 and compression chamber 27 via a not-shown intake valve and an discharge hole 32 connecting the discharge chamber 30 and compression chamber 27 via a not-shown intake valve.

[0023] The rear housing 5 has on the side wall an installation bore 33 in which a pressure control valve 34 for controlling the pressure in the crankcase 8 in this embodiment is installed. The pressure control valve 34 is described in detail later.

[0024] An oil separator 36 for separating oil mixed in the compressed working fluid discharged into the discharge chamber 30 is also provided in the rear housing 5. The oil separator 36 consists of an oil separation chamber 38 in communication with the discharge chamber 30 via a discharge passage 37 and an oil separating tube 39 for swirling the working fluid discharged from the discharge chamber 30 into the oil separation chamber 38 via the discharge passage 37 and connecting an external cycle and the separation chamber 38. In other words, the oil separation chamber 38 is a space in communication with an discharge outlet 40 for the connection to an external cycle and extended in the axial direction of the discharge outlet 40. The oil separating tube 39 is inserted

in a small-diameter part at the boundary between the discharge outlet 40 and the oil separation chamber 38 from the opening end of the discharge outlet 40.

[0025] With the above structure, the compressed working fluid is introduced into the oil separation chamber 38 from the discharge chamber 30 via the discharge passage 37. The introduced working fluid is led to the center of the rear housing 5 while swirling around the separating tube 39, during which oil mixed in the working fluid is separated. The working fluid from which the oil is separated is discharged to an external cycle from the discharge outlet 40 through the separating tube 39. The separated oil is supplied to low pressure chambers such as the crankcase 8 and intake chamber 29 via a lubricating oil passage 42.

[0026] The supply passage 44 for sending the working fluid to the pressure control valve 34 has an introducing port 45 that is opened to the downstream side of the downstream end of the separating tube 39 at the discharge outlet 40. An supply passage 46 extends from the pressure control valve 34 to the crankcase 8 for sending the working fluid to the crankcase 8. The valve plate 26 further has a bleeding passage 47 for releasing the working fluid in the crankcase 8 to the intake chamber 29. The present embodiment shows a so-called entry control system in which the pressure control valve 34 is provided on the way of the supply passages 44 and 46 to control only the working fluid rate to be supplied to the crankcase 8. A so-called entry and exit control system in which the opening rates of the supply passage and bleeding passage are controlled by the pressure control valve can also be used.

[0027] With the above structure, the working fluid from which oil is separated and removed while passing through the oil separator 36 is sent to the pressure control valve 34 from the introducing port 45 via the supply passage 44 and returned to the crankcase 8 via the supply passage 46, thus reducing the possible adhesion of oil mixed in the working fluid to the pressure control valve 34. Therefore, the opening/closing operation of the pressure control valve 34 can be controlled in a desired manner, improving the controllability of the compressor 1.

[0028] In another embodiment of the present invention shown in Figs. 2 and 3, the compressor 1 does not have the oil separator 36. This compressor 1 is described hereafter with reference to these figures. The same components as in the above embodiment are given the same reference numbers and their explanation is omitted.

[0029] The compressor 1 shown in Fig. 2 has in the outer wall of the cylinder block 3 a muffler chamber 49 for attenuating the discharge pulsation of the compressor 1. The muffler chamber 49 extends in the axial and radial directions of the cylinder block 3.

[0030] The muffler chamber 49 is in communication with the discharge chamber 30 via a first communicating passage 50 and with the discharge outlet 40 via a second communicating passage 51. The muffler chamber side ends of the first and second communicating passages

50 and 51 are placed closely to each other nearly at the center in the circumferential direction on the discharge outlet side of the muffler chamber 49 and connected to the muffler chamber 49. The valve plate 26 also has a through-hole 53 for connecting the first communicating passage 50 and muffler chamber 49 and a through-hole 54 for connecting the second communicating passage 51 and muffler chamber 49.

[0031] An supply passage 44 for sending the working fluid to the pressure control valve is provided. The supply passage 44 has an introducing port 45 that is opened in the middle of the second communicating passage 51 located on the downstream side of the muffler chamber 49. An supply passage 46 extends from the installation bore 33 to the crankcase 8 for sending the working fluid to the crankcase 8. The introducing port 45 of the supply passage 45 can be open in the discharge outlet 40 located on the downstream side of the muffler chamber 49. The valve plate 26 has a bleeding passage 47 for releasing the working fluid in the crankcase 8. This embodiment shows a so-called entry control system in which the pressure control valve 34 is provided on the way of the supply passages 44 and 46 to control only the working fluid rate to be supplied to the crankcase 8. A so-called entry and exit control system in which the opening rates of the supply passage and bleeding passage are controlled by the pressure control valve can also be used.

[0032] With the muffler chamber 49, for example, the radially inner wall of the compressor is closer to the center than the opening of the second communicating passage 51 so that the oil separated in the muffler chamber 39 does not flow out through the second communicating passage 51 and the end of the lubricating oil passage 42 is open in the radially inner wall of the compressor so that the separated oil is supplied to the shaft sealing device 14 and radial bearings 15 and 17. The muffler chamber 49 also serves as an oil separation mechanism separating and removing oil from the working fluid.

[0033] With the above structure, the working fluid from which oil is separated and removed while passing through the muffler chamber 49 is sent to the pressure control valve 34 from the introducing port 45 via the supply passage 44 and returned to the crankcase 8 via the supply passage 46, thus reducing the possible adhesion of oil mixed in the working fluid to the pressure control valve 34. Therefore, opening/closing of the pressure control valve 34 can be controlled in a desired manner, improving the controllability of the compressor 1.

Claims

1. A compressor having a housing, a crankcase formed in said housing, a driving shaft rotatably supported by said housing and rotated by an external driving force, a compression mechanism converting the rotation of said driving shaft to the compression of a working fluid, a pressure control valve supplying the

working fluid that is compressed by said compression mechanism and relatively highly pressurized to said crankcase so as to control the pressure in the crankcase, and an oil separation mechanism separating oil from said working fluid compressed by said compression mechanism, **characterized in:**

that the introducing port of an supply passage for supplying said working fluid to said pressure control valve is open to the passage where the working fluid from which oil is separated and removed by said oil separation mechanism can be introduced.

2. The compressor according to Claim 1 **characterized in:**

that said oil separation mechanism consists of an oil separation chamber in communication with an discharge chamber where the working fluid compressed by said compression mechanism is temporarily stored, and an oil separating tube protruding in said oil separation chamber for swirling said working fluid introduced from said discharge chamber and connecting the discharge outlet for discharging said working fluid outside the compressor and said oil separation chamber, and said introducing port is opened to the downstream side of said oil separating tube.

3. The compressor according to Claim 1 **characterized in:**

that a muffler chamber is formed in said housing, said muffler chamber and the discharge chamber into which the working fluid compressed by said compression mechanism is discharged are connected via a first communicating passage, and said muffler chamber and the discharge outlet for discharging the working fluid outside the compressor are connected via a second communicating passage, and said introducing port is opened to the downstream side of the muffler chamber.

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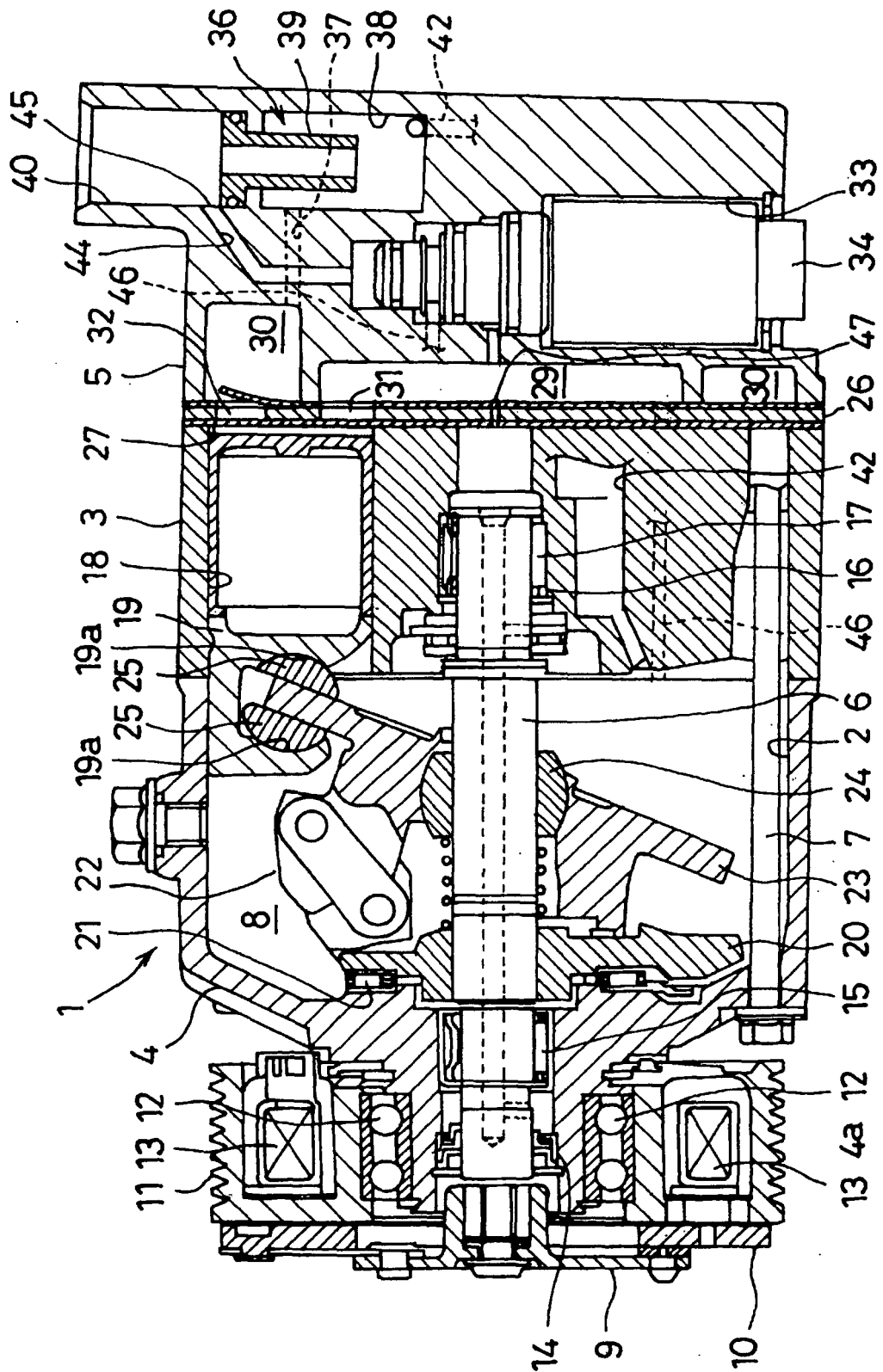


Fig. 1

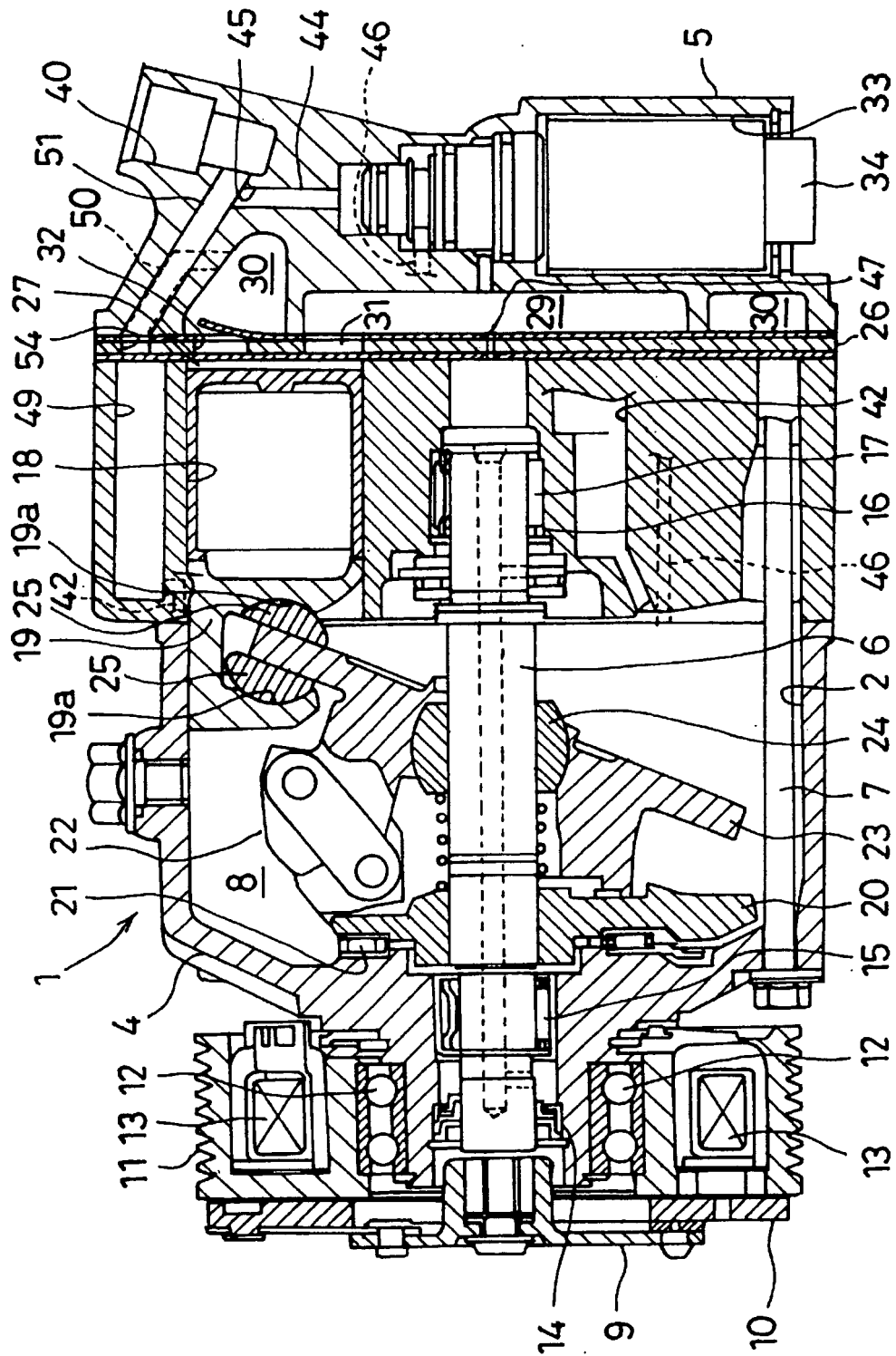


Fig. 2

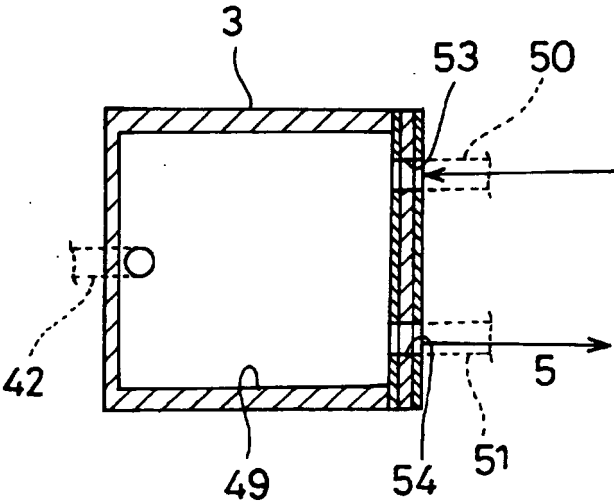


Fig. 3

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/309780

A. CLASSIFICATION OF SUBJECT MATTER

F04B27/14(2006.01) i, F04B39/04(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)

F04B27/14, F04B39/04

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 1996-2006

Kokai Jitsuyo Shinan Koho 1971-2006 Toroku Jitsuyo Shinan Koho 1994-2006

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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P, X	JP 2006-97587 A (Sanden Corp.), 13 April, 2006 (13.04.06), Par. Nos. [0022], [0029] to [0030]; Figs. 1 to 3 (Family: none)	1
Y	JP 2005-23847 A (Zexel Valeo Climate Control Corp.), 27 January, 2005 (27.01.05), Par. Nos. [0019], [0021] to [0025]; Figs. 1 to 3 (Family: none)	1-2

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

* Special categories of cited documents:

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Date of the actual completion of the international search

19 July, 2006 (19.07.06)

Date of mailing of the international search report

01 August, 2006 (01.08.06)

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2006/309780

C (Continuation). 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	JP 10-176659 A (Toyoda Automatic Loom Works, Ltd.), 30 June, 1998 (30.06.98), Par. Nos. [0004] to [0008]; Fig. 3 & US 6062823 A & EP 848164 B1	1-3

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REFERENCES CITED IN THE DESCRIPTION

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