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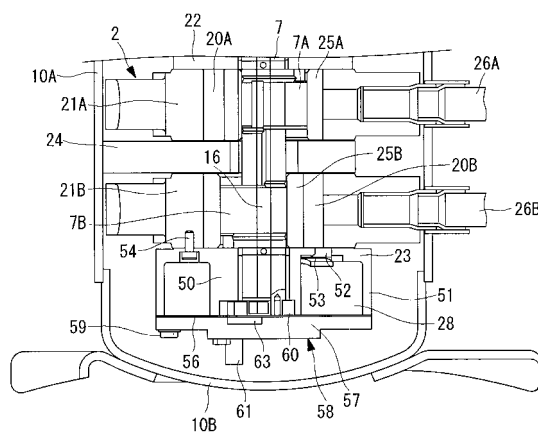
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(54) **HERMETIC COMPRESSOR**

(57) Provided is a hermetic compressor, in which first and second compressors are disposed at a lower portion and an upper portion, the first compressor at the lower portion being a rotary compressor, wherein the number of parts constituting an oil supply pump and a lower muffler chamber is reduced and manufacture of the parts is made easy, thereby achieving a simpler configuration and cost reduction. In a hermetic compressor (1), in which first and second compressors (2 and 3) are disposed at a lower portion and an upper portion in a sealed housing (10), the first compressor (2) at the lower portion being a rotary compressor, a lower bearing (23) of the rotary compressor (2) supports, at a center thereof, a bottom end of the rotating shaft (7); is provided with a bearing boss portion (50) having a cylinder chamber (55) of the oil supply pump (14) at a bottom end surface thereof; and the lower bearing is in a double cylinder form provided with an outer cylinder (51) that surrounds the bearing boss portion (50) on the outer circumferential side; and forms the cylinder chamber (55) and a lower muffler chamber (28) of the rotary compressor (2) as compartments by mounting a cover member (58) at the bottom end surface of the lower bearing (23).

FIG. 2



Description

plication, Publication No. 2007-177624.

Technical Field

Disclosure of Invention

[0001] The present invention relates to a hermetic compressor wherein a first compressor and a second compressor, which are driven by an electric motor, are respectively disposed at an upper portion and a lower portion in a sealed housing.

Background Art

[0002] As a hermetic compressor configured with an electric motor installed in a central location in a sealed housing and first and second compressors disposed at an upper portion and a lower portion thereof, which are rotationally driven via a crank shaft connected to the electric motor, one disclosed in Patent Citation 1 has been proposed. The hermetic compressor disclosed in Patent Citation 1 is a hermetic multi-stage compressor, wherein a lower-stage rotary compressor constituting the first compressor is disposed below an electric motor and, thereabove, a higher-stage scroll compressor constituting a second compressor is disposed, that is configured such that refrigerant gas of intermediate pressure compressed by the lower-stage rotary compressor is discharged into a sealed housing, and this refrigerant gas is taken in by the higher-stage scroll compressor to be compressed to high pressure, after which it is sent outside of the compressor. In a hermetic compressor in which a second compressor is disposed at an upper portion of a sealed housing in this way, an oil supply pump is provided at a bottom end of a crank shaft in order to lubricate sliding parts of the second compressor, and it is essential to supply the second compressor with lubrication oil charged in a lower portion of the sealed housing with this oil supply pump.

[0003] On the other hand, regarding the hermetic compressor configured with a rotary compressor disposed at a lower portion of a sealed housing, many have been proposed having a lower muffler chamber on a lower bearing side. Many hermetic compressors having a lower muffler chamber on a lower bearing side are, as disclosed in Patent Citations 2 and 3, two-cylinder rotary compressors (also called twin rotary compressors). However, they are not limited thereto, and in a known configuration with a single-cylinder rotary compressor, in order to reduce pressure loss at the time of discharge, muffler chambers are provided at upper and lower bearings so as to discharge compressed gas from the two locations at the upper and lower portions.

[0004]

Patent Citation 1: Japanese Unexamined Patent Application, Publication No. Hei 5-87074.

Patent Citation 2: Japanese Unexamined Patent Application, Publication No. 2006-83842.

Patent Citation 3: Japanese Unexamined Patent Ap-

[0005] However, in a hermetic compressor in which a first compressor and a second compressor are disposed at an upper portion and a lower portion in a sealed housing, respectively, wherein the first compressor provided at the lower portion is a rotary compressor, if a discharge valve, a lower muffler chamber, and a pump for supplying oil to the second compressor were provided around a lower bearing, the structure around the lower bearing would become complicated, which also inevitably increases costs as well as the number of manufacturing processes and assembly processes. Furthermore, there is a problem in that, because it is necessary to secure a mounting space for mounting constituent members of the lower muffler chamber to the lower bearing, the volume of the lower muffler chamber becomes correspondingly smaller, causing deterioration of discharge muffler function.

[0006] The present invention has been conceived in light of such circumstances, and an object thereof is to provide a hermetic compressor that is capable of achieving a simpler configuration and cost reduction by reducing the number of parts constituting an oil supply pump and a lower muffler chamber and by making manufacture of the parts easy in a hermetic compressor, wherein first and second compressors respectively are disposed at an upper portion and a lower portion in a sealed housing, the first compressor at the lower portion being a rotary compressor.

[0007] In order to solve the problems described above, a hermetic compressor of the present invention employs the following solutions.

Specifically, a hermetic compressor according to an aspect of the present invention is a hermetic compressor provided with first and second compressors that are disposed at a lower portion and an upper portion in a sealed housing; an electric motor that is disposed between the first and second compressors; a rotating shaft that is driven by the electric motor and that is connected at both ends to the first and second compressors, respectively; and an oil supply pump that is provided at a bottom end of the rotating shaft and that supplies the second compressor with lubrication oil charged in the sealed housing, the first compressor being constituted of a rotary compressor; wherein a lower bearing of the rotary compressor supports, at a center thereof, a bottom end of the rotating shaft, is provided with a bearing boss portion having a cylinder chamber of the oil supply pump at a bottom end surface thereof, and the lower bearing is in a double cylinder form provided with an outer cylinder that surrounds the bearing boss portion on the outer circumferential side, and forms the cylinder chamber and a lower muffler chamber of the rotary compressor as compartments by mounting a cover member at the bottom end surface of the lower bearing.

[0008] With the aspect described above, the lower bearing supports the bottom end of the rotating shaft; has a double cylinder form having the bearing boss portion provided with the cylinder chamber of the oil supply pump at the bottom end surface thereof and the outer circumference thereof is surrounded by the outer cylinder; and forms the cylinder chamber and the lower muffler chamber as compartments by mounting the cover member on the bottom end surface of this lower bearing. Therefore, by using the lower bearing having the double cylinder form, the cylinder chamber of the oil supply pump and the lower muffler chamber of the rotary compressor can both be formed as compartments. Accordingly, the number of parts is reduced and manufacture of the parts is made easy, thereby making it possible to achieve a simpler configuration and cost reduction. Because the lower muffler chamber can be of a simple configuration with the outer cylinder of the lower bearing having the double cylinder form, the effective volume thereof can be maximized by eliminating a mounting space for the lower muffler chamber.

[0009] In the hermetic compressor according to an aspect of the present invention, with the above-described hermetic compressor, the bottom end surface of the bearing boss portion and the bottom end surface of the outer cylinder are formed in the same plane; and the cylinder chamber and the lower muffler chamber are formed as compartments by covering the bottom end surfaces with the cover member, having a plate-like form.

[0010] With the above-described aspect, the bottom end surface of the bearing boss portion and the bottom end surface of the outer cylinder are formed in the same plane, and these bottom end surfaces are covered with the cover member, thereby forming the cylinder chamber and the lower muffler chamber as compartments. Therefore, a single-step processing is possible for the processing of the bottom end surfaces of the bearing boss portion and the outer cylinder, and flattening of the plate-like cover member to be mounted to the bottom end surfaces. Accordingly, the number of manufacturing processes for the lower bearing and the cover member is reduced, and thereby, it is possible to improve productivity and to reduce the cost.

[0011] In the hermetic compressor according to an aspect of the present invention, with any of the above-described hermetic compressors, the oil supply pump is constituted of a positive-displacement pump that is mounted at the bottom end of the rotating shaft; that is provided with a rotor that rotationally moves in the cylinder chamber and an inlet and an outlet that communicate with the cylinder chamber; and that pumps the lubrication oil to an oil supply hole penetrating the rotating shaft.

[0012] In the above-described aspect, the oil supply pump is constituted of the rotor that is mounted at the bottom end of the rotating shaft and that rotationally moves in the cylinder chamber, and the positive-displacement pump, which is provided with the inlet and the outlet that communicate with the cylinder chamber, for

pumping the lubrication oil into the oil supply hole penetrating the rotating shaft. Accordingly, by using the lower bearing and the bottom end of the rotating shaft, a positive-displacement oil supply pump for supplying the lubrication oil to the second compressor can be provided with minimum constituent parts. Therefore, the lower muffler chamber and the positive-displacement oil supply pump can both be formed simply and at a low cost, with the minimum number of parts.

[0013] In the hermetic compressor according to an aspect of the present invention, with the above-described hermetic compressor, a discharge port and a discharge valve that discharge compressed gas into the lower muffler chamber are disposed at the opposite side of the inlet and the outlet of the oil supply pump, with a shaft core of the rotating shaft therebetween.

[0014] In the above-described aspect, the discharge port and the discharge valve that discharge the compressed gas to the lower muffler chamber are disposed at the opposite side of the inlet and the outlet of the oil supply pump having the shaft core of the rotating shaft therebetween. Therefore, the space in the lower muffler chamber on the side where the discharge port and the discharge valve are disposed can be made wider than the space on the side where the inlet and the outlet of the oil supply pump are disposed. Accordingly, a discharge valve with a commonly used long, narrow reed valve can be easily installed, and the oil supply pump and the discharge valve can be installed by accommodating them without increasing the size of the lower bearing, keeping it compact.

[0015] With the present invention, by employing the lower bearing having the double cylinder form, the cylinder chamber of the oil supply pump and the lower muffler chamber of the rotary compressor can both be formed as compartments. Accordingly, it is possible to reduce the number of parts and to make manufacture of the parts easy, thereby achieving a simpler configuration and cost reduction. Because the lower muffler chamber can be simply configured with the outer cylinder of the lower bearing in the double cylinder form, the installation space for the lower muffler chamber can be eliminated and the effective volume thereof can be maximized.

Brief Description of Drawings

[0016]

[Fig. 1] Fig. 1 is a longitudinal sectional view of a hermetic compressor according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is an enlarged longitudinal sectional view of relevant parts of the hermetic compressor shown in Fig. 1.

[Fig. 3] Fig. 3 is a plan view of a lower bearing of the hermetic compressor shown in Fig. 2, viewed from below.

[Fig. 4] Fig. 4 is a sectional view of the lower bearing,

taken along a-a in Fig. 3.

[Fig. 5] Fig. 5 is a cross-sectional view of an oil supply pump unit of the hermetic compressor shown in Fig.

2. Explanation of References:

[0017]

1. hermetic compressor
2. first compressor (two-cylinder rotary compressor)
3. second compressor (scroll compressor)
4. electric motor
7. rotating shaft (crank shaft)
10. sealed housing
14. oil supply pump
16. oil supply hole
23. lower bearing
28. lower muffler chamber
50. bearing boss portion
51. outer cylinder
52. discharge port
53. discharge valve
55. cylinder chamber
58. cover member
60. rotor
62. inlet
64. outlet

Best Mode for Carrying Out the Invention

[0018] An embodiment according to the present invention will be described below, referring to Figs. 1 to 5.

Fig. 1 shows a longitudinal sectional view of a hermetic compressor 1 according to an embodiment of the present invention. In this embodiment, for the sake of convenience, the hermetic compressor 1 of the present invention will be illustrated in terms of an example hermetic multi-stage compressor wherein a lower-stage two-cylinder rotary compressor, which constitutes a first compressor 2, is disposed at a lower portion of a sealed housing 10, and disposed at an upper portion thereof is a higher-stage scroll compressor which constitutes a second compressor 3; however, the present invention is not limited thereto, and the first compressor 2 may be a single-cylinder rotary compressor, and furthermore, the second compressor 3 need not be a scroll compressor but may be another type of compressor.

[0019] The hermetic compressor (hermetic multi-stage compressor) 1 is provided with a sealed housing 10. The sealed housing 10 is constituted of a cylindrical center housing 10A; an annular bearing bracket 11 provided at a top portion of the center housing 10A by circumferentially welding thereto; a lower housing 10B which seals off a lower portion of the center housing 10A; and an upper housing 10C which is provided at a top portion of the bearing bracket 11 by circumferentially welding thereto to seal off the top portion of the center housing 10A.

[0020] At a substantially center portion in the center

housing 10A, an electric motor 4 constituted of a stator 5 and a rotor 6 is fixedly installed. The rotor 6 is integrally joined to a rotating shaft (crank shaft) 7. The lower-stage two-cylinder rotary compressor 2, which constitutes the first compressor 2, is installed below the electric motor 4. The two-cylinder rotary compressor 2 is provided with cylinder chambers 20A and 20B and is configured having cylinder main bodies 21A and 21B, which are fixedly installed in the center housing 10A; an upper portion bearing 22 and a lower bearing 23 which are fixedly installed at an upper portion of the cylinder main body 21A and a lower portion of the cylinder main body 21B sealing the top portion of the cylinder chamber 20A and the bottom portion of the cylinder chamber 20B; an intermediate partition plate 24 which is interposed between the cylinder main body 21A and the cylinder main body 21B; rotors 25A and 25B which engage with crank portions 7A and 7B of the rotating shaft 7 to rotationally move on inner circumferential surfaces of the cylinder chambers 20A and 20B; and a blade, blade pressing spring, etc. (not shown) for separating the cylinder chambers 20A and 20B into an intake side and a discharge side.

[0021] The above-described two-cylinder rotary compressor 2 is configured such that low-pressure refrigerant gas (working gas) is taken into the cylinder chambers 20A and 20B via intake pipes 26A and 26B; this refrigerant gas is compressed to an intermediate pressure by rotation of the rotors 25A and 25B; after which the compressed gas is discharged into an upper muffler chamber 27 and a lower muffler chamber 28 formed at the top and bottom, using the upper bearing 22 and the lower bearing 23; and the compressed gas is discharged into the center housing 10A after being combined in the upper muffler chamber 27. This intermediate-pressure refrigerant gas is guided to a space in the upper portion of the electric motor 4 upon passing through a gas passage hole (not shown), etc. provided in the rotor 6 of the electric motor 4, and is further taken into the higher-stage scroll compressor 3, which constitutes the second compressor 3, so as to be compressed in two stages.

[0022] The higher-stage scroll compressor 3 that constitutes the second compressor 3 is provided in the upper housing 10C. The scroll compressor 3 includes a bearing case 31 (also known as a frame member or a support member) in which a bearing 30 that supports the rotating shaft (crank shaft) 7 is provided and which is fixedly installed on the upper surface of the bearing bracket 11 via a bolt 12, and a fixed scroll member 32 and a gyrating scroll member 33 having convolute wraps 32B and 33B that are erected on end pieces 32A and 33A, respectively, and which constitute a pair of compression chambers 34 by engaging the convolute wraps 32B and 33B with each other and mounting them.

[0023] The scroll compressor 3 is configured further having a gyrating boss portion 33C that connects the gyrating scroll member 33 and an eccentric pin 7C of the rotating shaft 7 via a drivebush 13 and that drives the gyrating scroll member 33 in a revolving gyration; a ro-

tation preventing mechanism 35, provided between the gyrating scroll member 33 and the bearing case 31, that prevents the gyrating scroll member 33 from rotating, thereby making it undergo revolving gyration; a discharge reed valve 36 provided on the backside of the fixed scroll member 32 for opening/closing of a discharge port 32C; a discharge cover 38 fixedly installed on the back side of the fixed scroll member 32 so as to surround the discharge reed valve 36, forming an oil separating chamber 37; a discharge pipe 39 connected to the center portion of the discharge cover 38 to discharge compressed high-pressure gas to the outside; and an oil separating mechanism 40 which is installed in the oil separating chamber 37 and which centrifugally separates oil from the compressed gas.

[0024] The above-described scroll compressor 3 is configured so as to take the intermediate-pressure refrigerant gas, which has been compressed by the two-cylinder rotary compressor 2 and discharged into the sealed housing 10, into the compression chamber 34 to compress this intermediate-pressure refrigerant gas into an even higher pressure state by a compressing action of the gyrating scroll member 33 being driven in a revolving gyration, and then to discharge the compressed gas into the oil separating chamber 37 in the discharge cover 38 via the discharge reed valve 36. After oil contained in the gas is separated in the oil separating chamber 37 by the oil separating mechanism 40, this high-temperature high-pressure refrigerant gas is sent out via the discharge pipe 39 to the outside of the hermetic compressor 1, that is, to the refrigerating cycle side.

[0025] A positive-displacement oil supply pump 14 is mounted between the bottommost end portion of the rotating shaft (crank shaft) 7 and the lower bearing 23 of the lower-stage rotary compressor 2. This oil supply pump 14 is configured so as to pump lubrication oil 15 charged in the bottom portion of the sealed housing 10 and to forcibly supply the lubrication oil 15 to locations requiring lubrication, such as the two-cylinder rotary compressor 2, the bearing portion of the scroll compressor 3, etc., via an oil supply hole 16 provided in the rotating shaft 7.

[0026] The oil that has been supplied by the oil supply pump 14 and that has lubricated the scroll compressor 3, and the oil that has been separated by the oil separating mechanism 40 described above passes through oil drop holes 41, 42 and 43, provided in the fixed scroll member 32 and the bearing case 31, respectively, to flow down to the bottom portion of the sealed housing 10 from the oil ejection pipe 44 connected to the bearing bracket 11. Note that it is assumed that a decompression mechanism (not shown) is interposed in the oil drop hole 41 from the oil separating mechanism 40.

[0027] In this embodiment, the lower bearing 23, the lower muffler chamber 28, and the oil supply pump 14 described above are configured as follows.

As shown in Figs. 2 to 4, the lower bearing 23 has a double cylinder form wherein a bearing boss portion 50

that supports an end of the rotating shaft (crank shaft) 7 is provided at a center part, and an outer cylinder 51 that opens downward is provided so as to surround the bearing boss portion 50 at the outer circumference thereof. The configuration thereof is such that an annular space formed between the bearing boss portion 50 and the outer cylinder 51 of the lower bearing 23 becomes the lower muffler chamber 28.

[0028] A discharge port 25, which communicates between the cylinder chamber 20B and the lower muffler chamber 28, penetrates the lower bearing 23, and a discharge valve 53 constituted of a spring plate reed valve is provided on the lower muffler chamber 28 side of the discharge port 52. The lower bearing 23 is fixedly installed in the cylinder main body 21B with a plurality of bolts 54. In a bottom end surface of the bearing boss portion 50, a cylinder chamber 55 having a predetermined size in the axial direction and that constitutes the oil supply pump 14 is formed concentrically with the rotating shaft 7. The cylinder chamber 55 is provided with a blade groove 55A that extends in a radial direction.

[0029] In the lower bearing 23, a bottom end surface of the bearing boss portion 50 and a bottom end surface of the outer cylinder 51 are formed in the same plane, and, to these bottom end surfaces, a plate-like cover member 58, which consists of a thin plate member 56 and a plate pressing member 57 with large plate thickness, is fixedly installed via a bolt 59. Accordingly, the lower muffler chamber 28 and the cylinder chamber 55 have a configuration in which they are sealed by being covered by the shared plate-like cover member 58.

[0030] As shown in Fig. 5, a rotor 60, which is mounted to an eccentric portion 7D provided at the shaft end of the rotating shaft 7 and is rotationally moved on the inner circumferential surface of the cylinder chamber 55 as the rotating shaft 7 rotates, is accommodated in the cylinder chamber 55 which is formed as a compartment by the cover member 58. A blade 60A, which slidably fits into the blade groove 55A of the cylinder chamber 55, is integrally provided on the outer circumference of the rotor 60 to partition the cylinder chamber 55 into a lubrication oil intake side and discharge side. An inlet 62, which communicates with an intake pipe 61 that hangs down into the lubrication oil 15 charged in the bottom portion of the sealed housing 10, opens on the lubrication oil intake side of the cylinder chamber 55, and an outlet 64, which communicates with the oil supply hole 16 provided in the rotating shaft 7 via an oil channel 63 provided in the cover member 58, is formed at the lubrication oil discharge side.

[0031] The oil supply pump 14, which forcibly supplies the lubrication oil 15 to the two-cylinder rotary compressor 2 and the scroll compressor 3, is thus configured. Note that the oil channel 63 is provided at the joining surface of the plate member 56 and the plate pressing member 57 that constitute the cover member 58, so as to communicate between the discharge port 64 and the oil supply hole 16. The discharge port 52 provided in the lower bearing 23 and the inlet 62, the outlet 64, and the

blade groove 55A, which constitute the oil supply pump 14 provided in the bearing boss portion 50, are disposed facing each other with a shaft core of the rotating shaft 7 therebetween (see Fig. 3). That is, a space in a radial direction toward the outer cylinder 51 is narrow because the outside diameter of the bearing boss portion 50 becomes large to provide the inlet 62, outlet 64, and the blade groove 55A, whereas a space between the bearing boss portion 50 and the outer cylinder 51 can be made wide on the other side of the center core of the rotating shaft 7, that is, the side where the discharge port 52 is provided. Accordingly, an adequate space can be secured for installing the discharge valve 53 which is constituted of the reed valve.

[0032] With the configuration described above, the following advantages and effects can be afforded by this embodiment.

Low-temperature low-pressure refrigerant gas is taken into the cylinder chambers 20A and 20B of the two-cylinder rotary compressor 2 that constitutes the first compressor 2 via the intake pipes 26A and 26B; is compressed to intermediate pressure by rotation of the rotors 25A and 25B; and is then discharged into the upper muffler chamber 27 and the lower muffler chamber 28; thus, attenuating pulsation. After being combined in the upper muffler chamber 27, the intermediate-pressure refrigerant gas is discharged into the space below the electric motor 4 and migrates therefrom to the space above the electric motor 4, by flowing through the gas channel hole (not shown), etc. provided in the rotor 6 of the electric motor 4.

[0033] The intermediate-pressure refrigerant gas migrated to the space above the electric motor 4 is taken into the compression chamber 34, which is formed between the fixed scroll member 32 and the gyrating scroll member 33, via a gas intake channel (not shown) formed between an outer surface of the bearing case 31 and the upper surface of the bearing bracket 11 from a center region of the center housing 10A. This intermediate-pressure refrigerant gas is compressed into a high-temperature high-pressure state in two stages by a compressing action of the gyrating scroll member 33 being driven in a revolving gyration, and is then discharged from the discharge port 32C into the discharge cover 38 via the discharge reed valve 36.

[0034] In the above-described two-stage compression process, part of the lubrication oil 15 which has been supplied by the oil supply pump 14 and has lubricated the two-cylinder rotary compressor 2 dissolves into refrigerant gas and is discharged into the center housing 10A together with the intermediate-pressure refrigerant gas. Furthermore, part of lubrication oil 15, which is supplied to the scroll compressor 3 via the oil supply hole 16, and which, after lubricating the scroll compressor, flows down to the bottom portion of the sealed housing 10 via the oil drop holes 43 and 42 and the oil ejection pipe 44, dissolves into this intermediate-pressure refrigerant gas. The intermediate-pressure refrigerant gas, in

which the lubrication oil 15 is thus dissolved, is taken into the scroll compressor 3 to be compressed while the oil is dissolved therein, and is discharged from the discharge port 32C as high-temperature high-pressure gas along with the oil.

[0035] Oil is centrifugally removed from this oil-containing high-temperature high-pressure gas by the centrifugal oil separating mechanism 40 provided in the oil separating chamber 37 in the discharge cover 38, after which the high-temperature high-pressure refrigerant gas is discharged to the refrigerating cycle side from the discharge pipe 39 connected to the center portion of the discharge cover 38. By doing so, the oil circulation rate (OCR) of the lubrication oil 15 that circulates to the refrigerating cycle side is lowered, thereby improving the system efficiency and preventing a lubrication oil shortage in the hermetic compressor 1. The oil separated in the oil separating chamber 37 is decompressed to low pressure in the oil drop hole 41 by the decompression mechanism, after which the decompressed oil flows down to the bottom portion of the sealed housing 10 via the oil drop hole 42 and the oil ejection pipe 44.

[0036] In the hermetic compressor 1 described above, the lower muffler chamber 28, into which the intermediate-pressure refrigerant gas compressed in the lower cylinder chamber 20B of the two-cylinder rotary compressor 2 is discharged, and the lower bearing 23, in which the cylinder chamber 55 of the oil supply pump 14 that supplies the lubrication oil 15 to the two-cylinder rotary compressor 2 and the scroll compressor 3 is provided, are assumed to take a double cylinder form, and thus, the cylinder chamber 55 is provided at the bottom end surface of the bearing boss portion 50 formed in the center portion thereof, and the annular lower muffler chamber 28 is provided between the bearing boss portion 50 and the outer cylinder 51 formed so as to surround the outer circumference thereof. Additionally, the bottom end surfaces of the bearing boss portion 50 and the outer cylinder 51 are coplanar and are covered by the shared plate-like cover member 58, thereby forming the lower muffler chamber 28 and the cylinder chamber 55 as compartments.

[0037] Therefore, the lower muffler chamber 28 and the cylinder chamber 55 both can be formed as compartments by the plate-like cover member 58 and the lower bearing 23 made in the double cylinder form. Accordingly, the number of constituent parts of the lower muffler chamber 28 and the oil supply pump 14 is reduced, and it is possible to achieve simplification of the configuration and cost reduction.

Because processing of the bottom end surfaces of the bearing boss portion 50 and the outer cylinder 51 and the flattening of the plate-like cover member 58 to be mounted onto the bottom end surfaces can be processed in a single step, the number of processes is reduced for the manufacture of the lower bearing 23 and the cover member 58 (the plate member 56 and the plate pressing member 57); therefore, productivity can be improved and

the cost can be reduced.

[0038] Because the lower muffler chamber 28 can be simply configured with the outer cylinder 51 of the lower bearing 23 in the double cylinder form, it is possible to eliminate the installation space for installing the lower muffler parts made as separate parts. Accordingly, the effective volume of the lower muffler chamber 28 can be maximized and reduction of the discharge pulsation can be enhanced.

[0039] Because the positive-displacement oil supply pump 14, which pumps the lubrication oil 15 to the oil supply hole 16 penetrating the rotating shaft 7, is formed by providing the inlet 62 and the outlet 64, which communicate with the cylinder chamber 55, and the rotor 60, which is mounted to the eccentric portion 7D provided in the bottom end of the rotating shaft 7 and rotationally moves in the cylinder chamber 55, the oil supply pump 14 for the second compressor (scroll compressor) 3 disposed at the upper portion in the sealed housing 10 can be configured with minimum constituent parts using the lower bearing 23 and the bottom end of the rotating shaft 7. Accordingly, the lower muffler chamber 28 and the positive-displacement oil supply pump 14 can both be configured with the minimum number of parts simply and at low cost.

[0040] In the lower muffler chamber 28, the discharge port 52 and the discharge valve 53 for discharging the intermediate-pressure compressed gas compressed in the lower cylinder chamber 20B are disposed opposite from the inlet 62 and the outlet 64 of the oil supply pump 14 with the shaft core of the rotating shaft 7 therebetween. Accordingly, the space in the lower muffler chamber 28 on the side where the discharge port 42 and the discharge valve 53 are disposed can be made wider than the space on the side where the inlet 62 and the outlet 63 of the oil supply pump 14 are disposed. Consequently, a discharge valve 53 with a commonly used long, narrow reed valve can be easily installed, and the oil supply pump 14 and the discharge valve 53 can be accommodated without increasing the size of the lower bearing 23, keeping it compact.

[0041] Note that, the present invention is not limited to the above-described embodiment, and appropriate modifications are possible without departing from the gist thereof. For example, the hermetic compressor 1 of the present invention is not limited to those that employ HFC refrigerant such as R410A as the working gas and can be similarly applied to those using CO₂ refrigerant or other types of refrigerant. Specifically, when a high-density CO₂ refrigerant is used, the first compressor 2 disposed at the lower portion of the sealed housing 10 may be a single-cylinder rotary compressor. Even in this case, it is still effective to provide the lower muffler chamber 28 in the lower bearing 23 in order to reduce pressure loss at the time of discharge.

In addition, the oil supply pump 14 is not limited to the one in the above-described embodiment, and other types of positive-displacement pump may be employed as a

matter of course.

Claims

1. A hermetic compressor provided with first and second compressors that are disposed at a lower portion and an upper portion in a sealed housing; an electric motor that is disposed between the first and second compressors; a rotating shaft that is driven by the electric motor and that is connected at both ends to the first and second compressors, respectively; and an oil supply pump that is provided at a bottom end of the rotating shaft and that supplies the second compressor with lubrication oil charged in the sealed housing, the first compressor being constituted of a rotary compressor; wherein a lower bearing of the rotary compressor supports, at a center thereof, a bottom end of the rotating shaft, is provided with a bearing boss portion having a cylinder chamber of the oil supply pump at a bottom end surface thereof, and the lower bearing is in a double cylinder form provided with an outer cylinder that surrounds the bearing boss portion on the outer circumferential side, and forms the cylinder chamber and a lower muffler chamber of the rotary compressor as compartments by mounting a cover member at the bottom end surface of the lower bearing.
2. The hermetic compressor according to Claim 1, wherein the bottom end surface of the bearing boss portion and the bottom end surface of the outer cylinder are formed in the same plane, and the cylinder chamber and the lower muffler chamber are formed as compartments by covering the bottom end surfaces with the cover member, having a plate-like form.
3. The hermetic compressor according to Claim 1 or 2, wherein the oil supply pump is constituted of a positive-displacement pump that is mounted at the bottom end of the rotating shaft, that is provided with a rotor that rotationally moves in the cylinder chamber and an inlet and an outlet that communicate with the cylinder chamber, and that pumps the lubrication oil to an oil supply hole penetrating the rotating shaft.
4. The hermetic compressor according to Claim 3, wherein a discharge port and a discharge valve that discharge compressed gas into the lower muffler chamber are disposed at the opposite side of the inlet and the outlet of the oil supply pump, with a shaft core of the rotating shaft therebetween.

FIG. 1

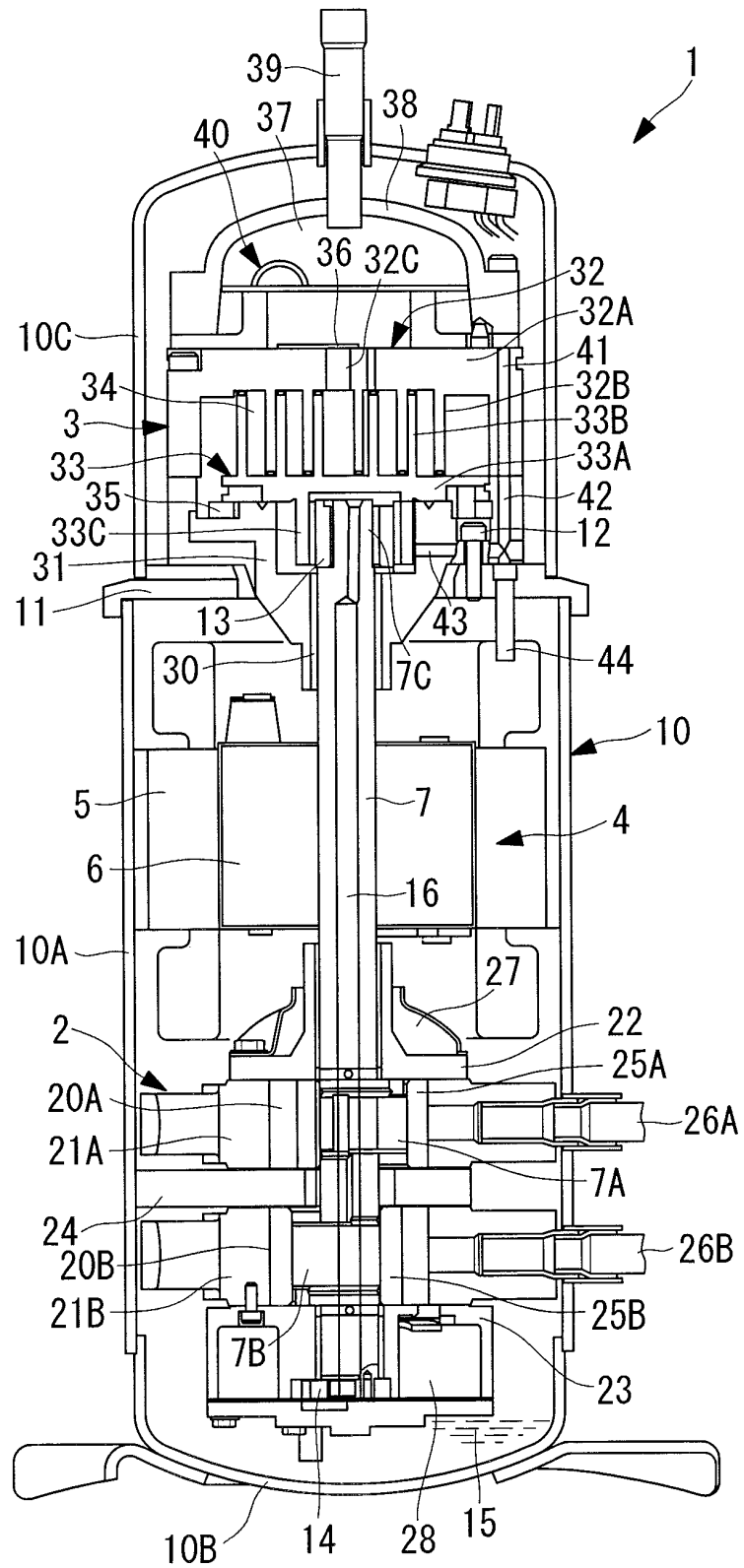


FIG. 2

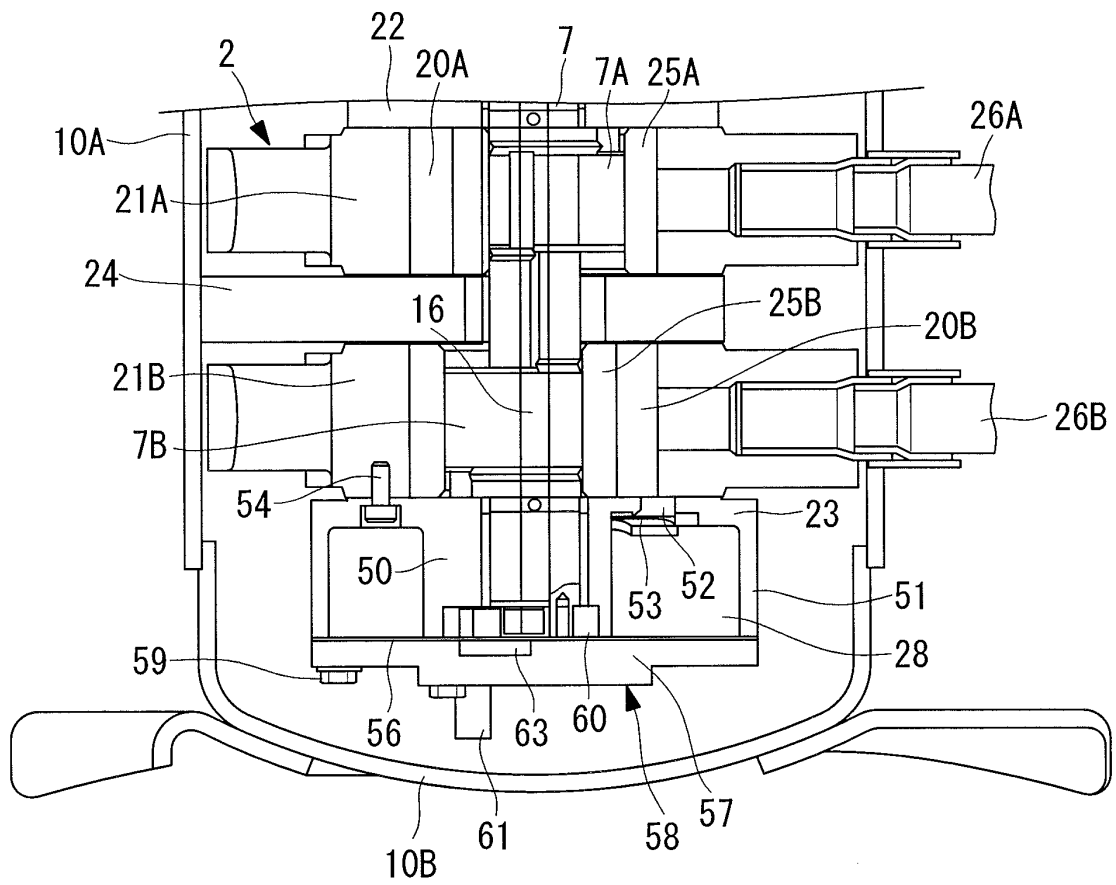


FIG. 3

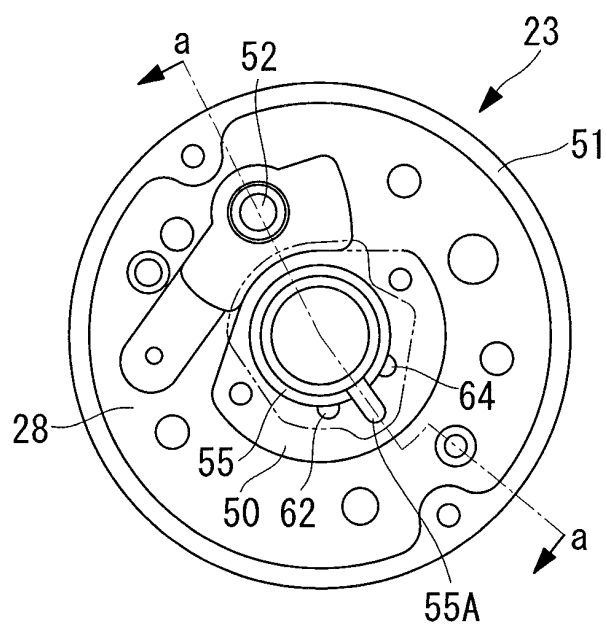


FIG. 4

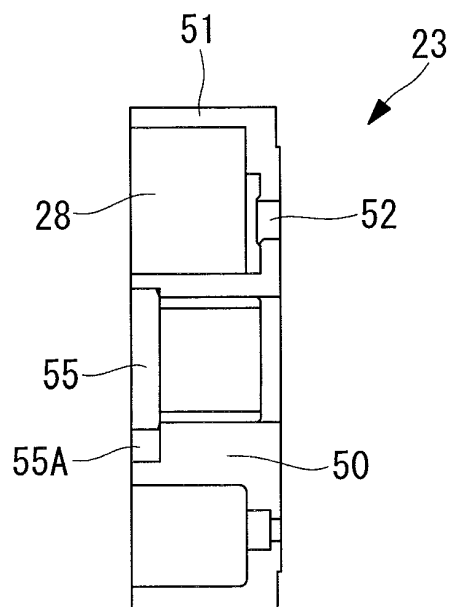
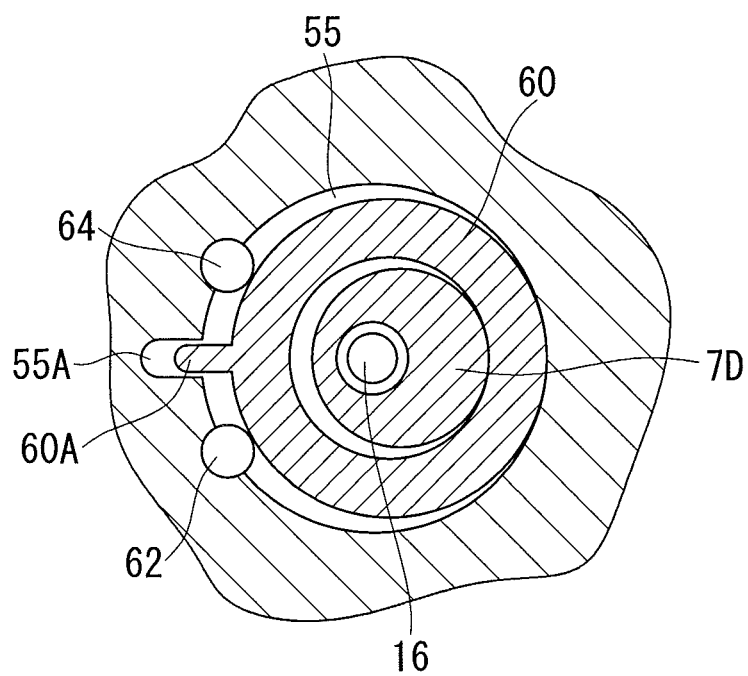


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/050322

A. CLASSIFICATION OF SUBJECT MATTER

F04C29/02 (2006.01) i, F04C23/00 (2006.01) i, F04C29/06 (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)

F04C29/02, F04C23/00, F04C29/06

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	1996-2009
Kokai Jitsuyo Shinan Koho	1971-2009	Toroku Jitsuyo Shinan Koho	1994-2009

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.
Y A	JP 2002-250292 A (Hitachi, Ltd.), 06 September, 2002 (06.09.02), Full text; Figs. 8 to 10 (Family: none)	1-3 4
Y A	JP 10-9175 A (Mitsubishi Heavy Industries, Ltd.), 13 January, 1998 (13.01.98), Figs. 1 to 5 (Family: none)	1-3 4
Y A	JP 9-151866 A (Sanyo Electric Co., Ltd.), 10 June, 1997 (10.06.97), Figs. 1 to 12 & US 5810573 A	1-3 4

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

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"&" document member of the same patent family

Date of the actual completion of the international search
01 April, 2009 (01.04.09)

Date of mailing of the international search report
14 April, 2009 (14.04.09)

Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2009/050322

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 7-103167 A (Mitsubishi Heavy Industries, Ltd.), 18 April, 1995 (18.04.95), Fig. 3 (Family: none)	1-3 4
Y A	JP 2000-87892 A (Daikin Industries, Ltd.), 28 March, 2000 (28.03.00), Fig. 8 (Family: none)	1-3 4
A	JP 8-200223 A (Daikin Industries, Ltd.), 06 August, 1996 (06.08.96), Fig. 1 (Family: none)	1-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 151092/1988 (Laid-open No. 72383/1990) (Shimadzu Corp.), 01 June, 1990 (01.06.90), Figs. 1 to 2 (Family: none)	1-4
A	JP 3-67094 A (Mitsubishi Electric Corp.), 22 March, 1991 (22.03.91), Figs. 1 to 2 (Family: none)	1-4

Form PCT/ISA/210 (continuation of second sheet) (April 2007)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP HEI587074 B [0004]
- JP 2006083842 A [0004]
- JP 2007177624 A [0004]