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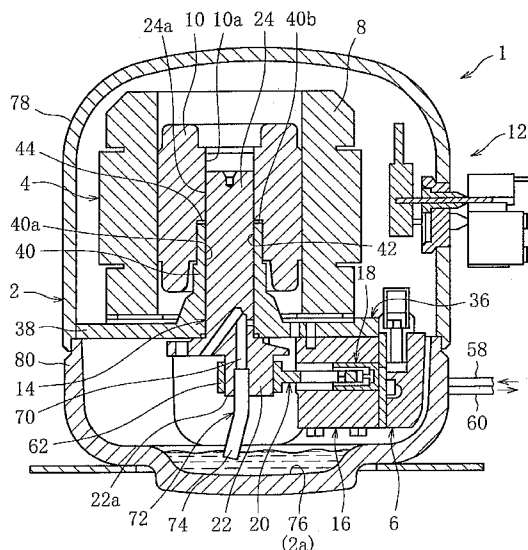
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(54) **FLUID MACHINE**

(57) Provided is a fluid machine which can be produced with a reduced weight and size at a reduced production cost. The fluid machine (1) comprises a drive unit (4) and a driven unit (6) arranged in a hermetic container (2) such that drive power is transmitted from the drive

unit to the driven unit, the hermetic container (2) including a first shell (78) covering the drive unit (4) and a second shell (80) covering the driven unit (6) and joined to the first shell (78), wherein the first and second shells (78, 80) are members formed by different working processes.

FIG. 1



Description

Technical Field

[0001] This invention relates to a fluid machine, specifically a fluid machine suited to form a hermetic reciprocating compressor compressing carbon-dioxide refrigerant.

Background Art

[0002] There is known a hermetic compressor which belongs to this class of fluid machine and which comprises an electric motor and a compressing mechanism arranged in a hermetic container such that drive power is transmitted from the electric motor to the compressing mechanism to compress a refrigerant.

Patent document 1 discloses a hermetic container composed of three members: a center, a top and a bottom shells, the center shell being a steel tube open at each end, and the top and bottom shells being cup-shaped cast members welded to each open end of the center shell.

[0003] Patent document 2 discloses a hermetic container composed of two press-formed members: top and bottom shells, and patent document 3 discloses a hermetic container composed of two forged members: top and bottom shells.

Prior-art Document

Patent Document

[0004]

Patent document 1: Japanese Patent Application Laid-open No. 2006-177285

Patent document 2: Japanese Patent Publication No. Sho 58-19869

Patent document 3: Japanese Patent Application Laid-open No. 2004-285927

Summary of the Invention

Problem to be Solved by the Invention

[0005] The aforementioned hermetic containers are each constructed by welding the shells together. In the hermetic container disclosed in patent document 1, however, the top and bottom shells are cast products, and thus, difficult to weld together and likely to produce poor welds, since cast products have generally a high carbon content.

Further, the center shell in the form of a steel tube incurs high material costs. Furthermore, the hermetic container composed of three members requires welding at two locations or more, resulting in correspondingly-increased assembly manhours, and thus, increased cost of produc-

ing the hermetic container, and thus, the compressor.

[0006] The hermetic container composed of two shells, as seen in patent documents 2 and 3, requires welding at fewer locations, and thus, less assembly manhours, leading to a reduced cost of producing the hermetic container. Further, the press-formed or forged shells are expected to alleviate the aforementioned problem of poor welds.

However, press-forming only allows the shells to have a simple shape such as a dome shape, and portions for the electric motor, the compressing mechanism and others to be fixed to need to be created in the shells by additional working, leading to an increase in cost of producing the hermetic container.

[0007] Forging allows the shells to have a complicated shape as needed. The shells forged, however, tend to have a great wall thickness, and thus, a great weight compared with the shells press-formed, preventing the hermetic container, and thus, the fluid machine from having a reduced weight and size.

The present invention has been made in view of the above problems. An object of the present invention is to provide a fluid machine which can be produced with a reduced weight and size at a reduced production cost.

Means for Solving the Invention

[0008] In order to achieve the above object, a fluid machine according to the present invention comprises a drive unit and a driven unit arranged in a hermetic container such that drive power is transmitted from the drive unit to the driven unit, the hermetic container including a first shell covering the drive unit and a second shell covering the driven unit and joined to the first shell, wherein the first and second shells are members formed by different working processes (claim 1).

[0009] Specifically, the first and second shells may be a forged and a press-formed members, respectively (claim 2), or vice versa (claim 3).

The fluid machine may be configured such that the drive unit is arranged in the first shell with its length aligned with a depth of the first shell, while the driven unit is arranged in the second shell with its length aligned with a diameter of the second shell (claim 4).

The second shell may have a holding portion by which to hold the second shell during forging of the second shell, the holding portion forming a crest of the second shell projecting outward in a central region radially away from a side wall of the second shell (claim 5).

[0010] The second shell may have a lubricating system configured to supply a lubricant collecting in an inner bottom portion of the second shell to sliding parts of the drive unit and of the driven unit, wherein said inner bottom portion is a recess defined by an inner side of said holding portion and having a shape approximately similar to an outer shape of said holding portion and serving as an oil reservoir (claim 6).

The second shell may have a support portion for the drive

unit and the driven unit to be fixed to (claim 7).

[0011] The holding portion, the oil reservoir and the support portion may be parts formed all at once when the second shell is forged (claim 8).

The hermetic container may undergo pressure exerted by a working fluid sucked in and discharged from the driven unit, the working fluid being carbon-dioxide refrigerant (claim 9).

Effect of the Invention

[0012] The fluid machine according to the present invention recited in claim 1 comprises a hermetic container composed of two shells, namely first and second shells, wherein at least either the first or the second shell has a reduced wall thickness since it is formed by press-forming. As a result, the hermetic container, and thus, the fluid machine have a reduced weight and size.

Specifically, in the fluid machine recited in claim 2, at least the second shell, which is press-formed, has a reduced wall thickness, and in the fluid machine recited in claim 3, at least the first shell, which is press-formed, has a reduced wall thickness. In either type of the fluid machine, the shell formed not by forging is unlikely to produce a poor weld when welded to the other shell. The hermetic container has thus an increased weld strength.

[0013] In the fluid machine recited in claim 4, the first shell is formed by press-forming to have a depth corresponding to the length of the drive unit, and the second shell is formed by forging to have a diameter corresponding to the length of the driven unit. Specifically, the first shell, requiring a great depth compared with the second shell, can be easily formed by press-forming into a shape corresponding to the outer shape of the drive unit, with a reduced wall thickness.

[0014] The second shell, not requiring a great depth compared with the first shell, can be easily formed by forging into a shape corresponding to the outer shape of the driven unit, with a reduced wall thickness. This ensures that the hermetic container, and thus, the fluid machine have a reduced weight and size. Further, this allows a reduction of dead space within the hermetic container, leading to a further reduced size of the fluid machine.

In the fluid machine recited in claim 5, the holding portion provided to form the crest of the second shell saves the second shell from having an unprofitably-great wall thickness at the side and/or the crest, which would be inevitable when the holding portion is provided at the side of the bottom shell. This leads to a further reduced weight and size of the hermetic container, and thus of the compressor.

[0015] In the fluid machine recited in claim 6, the provision of the holding portion not only allows a reduction in wall thickness of the second shell but also facilitates provision of an inner bottom portion serving as an oil reservoir, without requiring a separate member such as an oil pan. The inner bottom portion serving as an oil reservoir can hold the lubricant to have an oil surface at a

specified level. This ensures that the lubricant is smoothly supplied to the sliding parts through the lubricating system and efficiently circulates within the hermetic container, even though the amount of the lubricant collecting in the inner bottom portion is small.

[0016] In the fluid machine recited in claim 7, the drive and driven units are easily fixed without requiring another member such as a frame.

In the fluid machine recited in claim 8, the holding portion, the oil reservoir and the support portion are easily formed without requiring another member or another working process, which means that the fluid machine can be produced with an increased productivity.

When the working fluid is carbon-dioxide refrigerant, the working fluid is discharged from the driven unit at very high pressure. The inner side of the hermetic container can therefore be subjected to very high pressure, and thus, normally, the hermetic container cannot avoid having a great thickness and weight for safety's sake. The hermetic container and fluid machine structured as described above, which allow effective reduction of weight and size, are therefore favorable.

Brief Description of the Drawings

[0017]

FIG. 1 is a vertical cross-sectional view of a compressor, a first embodiment of the present invention. FIG. 2 is an enlarged view showing a relevant part of a compressing mechanism shown in FIG. 1, FIG. 3 is a diagram showing the outer shape of a hermetic container of the compressor shown in FIG. 1, and FIG. 4 is a perspective view showing a bottom shell shown in FIG. 3, viewed from above.

Best Mode of Carrying out the Invention

[0018] FIGS. 1 to 4 show a compressor 1, a first embodiment of fluid machine.

The compressor 1 is a hermetic reciprocating compressor, which belongs to the class of positive-displacement compressors called reciprocating compressors or piston compressors and which is incorporated into, for example an automatic vending machine to constitute a refrigeration cycle circuit, not shown.

The refrigeration cycle circuit has a circulation path along which a refrigerant, or working fluid of the compressor 1 circulates. The refrigerant is for example carbon dioxide, which is a non-combustible natural refrigerant.

[0019] As seen in FIG. 1, the compressor 1 comprises a hermetic container 2 enclosing an electric motor (drive unit) 4 and a compressing mechanism (driven unit) 6, the latter being supplied with drive power from the former.

The electric motor 4 comprises a stator 8 supplied with current to generate a magnetic field, and a rotor 10 rotating in the magnetic field generated by the stator 8. The

rotor 10 is arranged within the stator 8, coaxially, and fixed on a main shaft portion 24 of a crankshaft 14, described later, by heat-fitting. Current is supplied to the stator 8 from outside the compressor 1 via electric components 12 fixed to the hermetic container 2 and leads, not shown.

[0020] The compressing mechanism 6 is composed of a crankshaft 14, a cylinder block 16, a piston 18, a connecting rod 20 and others. The crankshaft 14 includes an eccentric shaft portion 22 and a main shaft portion 24. As seen in FIG. 2, the cylinder block 16 has a cylinder bore 26. A cylinder gasket 28, a suction valve 50, described later, a valve plate 30, a head gasket 32 and a cylinder head 34, arranged in this order, are fastened to the cylinder block 16 with bolts to close an entrance to the cylinder bore 26.

[0021] As seen in FIG. 1, the stator 8 is bolted to the cylinder block 16 with a frame 36 between, the frame 36 being joined to the hermetic container 2.

Specifically, the frame 36 includes a lower base portion 38 joined to the hermetic container 2 and supporting the electric motor 4 and the compressing mechanism 6, and an upper cylindrical portion 40 with a bearing 42 arranged on an inner circumferential face 40a and a bearing 44 on a top face 40b. The bearing 42 supports the main shaft portion 24, and the bearing 44 in the form of a thrust race (bearing), a thrust washer or the like supports a thrust load generated by the rotor 10.

[0022] As seen in FIG. 2, the valve plate 30 has a refrigerant suction hole 46 and a refrigerant discharge hole 48 opened and closed by a suction valve 50 and a discharge valve 52, respectively. The suction and discharge valves are reed valves.

The cylinder head 34 has a refrigerant suction chamber 54 and a refrigerant discharge chamber 56. In the compression stroke of a piston 18, the discharge valve 52 opens to allow a flow from the cylinder bore 26 to the discharge chamber 56 through the discharge hole 48. In the suction stroke of the piston 18, the suction valve 50 opens to allow a flow from the suction chamber 54 to the cylinder bore 26 through the suction hole 46.

[0023] A suction pipe 58 and a discharge pipe 60 are fitted to the hermetic container 2. The suction and discharge pipes 58, 60 connect to the suction and discharge chambers 54, 56 in the cylinder head 34, at an end, respectively, and to the refrigeration cycle circuit at the other end. Suction and discharge mufflers, not shown, are incorporated in the suction and discharge pipes to reduce pulsation and noise of the refrigerant flowing therein.

[0024] The connecting rod 20 has a large end portion 62 connected to the eccentric shaft portion 22 of the crankshaft 14 in a manner allowing rotating motion of the crankshaft, and an opposite small end portion connected to the piston 18 in a manner allowing reciprocating motion of the piston. The small end portion 64 is connected to the piston 18 by a piston pin 66, which is prevented from coming off the piston 18 by a fixing pin 68.

[0025] As the crankshaft 14 rotates, eccentric rotation

of the eccentric shaft portion 22 makes the connecting rod 20 swing on the piston pin 66, which in turn makes the piston 18 reciprocate within the cylinder bore 26.

The inside of the hermetic container 2 is mostly subjected to refrigerant discharge pressure. A lubricant lubricating sliding parts of the electric motor 4 and of the compressing mechanism 6, such as the bearings 42, 44, collects in an inner bottom portion 2a of the hermetic container 2 in a small amount.

[0026] The crankshaft 14 has an oil passage (lubricating system) 70 extending approximately from the shaft center at the bottom 22a of the eccentric shaft portion 22 to the middle of the main shaft portion 24. The oil passage 70 has an upper end open at the outer circumferential face 24a of the main shaft portion 24 and a lower end connected to an oil pipe (lubricating system) 72. The oil pipe 72 includes a lower slant portion 74 slanting in a manner approaching the shaft center of the main shaft portion 24 approximately from the shaft center of the eccentric shaft portion 22. The slant portion 74 of the oil pipe 72 extends downward into an inner bottom portion 2a of the hermetic container 2 in the shape of a recess, the inner bottom portion 2a thus serving as an oil reservoir 76.

[0027] The oil reservoir 76 has an area and a depth ensuring that a small amount of the lubricant, more or less 200 cc, for example, has an oil surface at the level of the lower end of the oil pipe 74 or above. As the crankshaft 14 rotates, the oil pipe 72 eccentrically rotates with the eccentric shaft portion 22, resulting in the lubricant moving up the oil passage 74 from the oil reservoir 76 by centrifugal force acting on the lubricant in the slant portion 74 of the oil pipe 72 in the obliquely in- and upward direction.

[0028] The operation and action of the compressor 1 will be described below.

The compressor 1 is designed such that as the stator 8 is supplied with current, the rotor 10 fixed on the main shaft portion 24 rotates, and thus, the crankshaft 14 rotates, which in turn makes the piston 18 reciprocate within the cylinder bore 18 by means of the connecting rod 20. As the piston 18 reciprocates, the refrigerant is sucked into the cylinder bore 26 from the refrigeration cycle circuit, compressed in the cylinder bore 26 and discharged from the cylinder bore to the refrigeration cycle circuit.

[0029] Specifically, the piston 18 moves in the direction decreasing the volume of the cylinder bore 26, so that the refrigerant is compressed within the cylinder bore 26. When the pressure in the cylinder bore 26 exceeds refrigerant discharge pressure, the discharge valve 52 opens because of pressure difference between the cylinder bore 26 and the discharge chamber 56. The refrigerant compressed thus flows from the cylinder bore into the discharge chamber 56 through the discharge hole 48, and then to the refrigeration cycle circuit through the discharge pipe 60.

[0030] After reaching the top dead center, the piston 18 moves in the direction increasing the volume of the

cylinder bore 26, and thus, the pressure in the cylinder bore 26 decreases and the discharge valve 50 closes because of pressure difference between the cylinder bore 26 and the discharge chamber 56.

When the pressure in the cylinder bore 26 decreases to refrigerant suction pressure or below, the suction valve opens 50 because of pressure difference between the cylinder bore 26 and the suction chamber 54. The refrigerant thus flows into the suction chamber 54 through the suction pipe 58, and then into the cylinder bore 56 through the suction hole 46.

[0031] After reaching the bottom dead center, the piston 18 moves in the direction decreasing the volume of the cylinder bore 26, and thus, the refrigerant is again compressed within the cylinder bore 26. The process of sucking the refrigerant from the refrigeration cycle circuit into the cylinder bore 26, compressing it within the cylinder bore 26 and discharging it from the cylinder bore to the refrigeration cycle circuit is repeated this way.

[0032] The above-described operation of the compressor 1 makes the lubricant move from the oil reservoir 76 up into the oil passage 70, then flow out of the oil passage 70 down toward the eccentric shaft portion 22, thus lubricating parts including the large end portion 62, and splash over the piston by centrifugal force, thus lubricating parts including a skirt portion 18 of the piston 18.

[0033] Part of the lubricant flows out of the oil passage 70 and moves upward along a groove in the circumferential face of the crankshaft 14, not shown, by centrifugal force, thereby forming an oil film between the crankshaft 14 and the frame 36, thus lubricating the bearing 42, and moves further up toward the top of the crankshaft 14. After reaching the top face 40b of the cylindrical portion 40 and lubricating the bearing 44, the lubricant flows down into the oil reservoir 76 by gravity. The part of the lubricant not passing over the bearing 44 moves further up the inner wall surface 10a of the rotor 10 to reach the top of the rotor 10, and splashes accompanying the rotation of the rotor 10, by centrifugal force, thus cooling the stator 8, and falls into the oil reservoir 76 by gravity.

[0034] While lubricating the parts including the skirt portion 18a of the piston 18, part of the lubricant is sucked into the cylinder bore 26 in the form of oil mist, which flows into a space between the piston 18 and the cylinder block 18 together with a refrigerant gas leaking from the cylinder bore 26, thus sealing and lubricating the piston 18 and the cylinder block. The lubricant adhering to the wall surface 54a of the suction chamber 54 falls into the oil reservoir 76 by gravity. The lubricant falling into the oil reservoir 76 again moves up through the oil pipe 72. The lubricant thus circulates within the hermetic container 2, lubricating and sealing the sliding parts of the electric motor 4 and of the compressing mechanism 6.

[0035] In the present embodiment, as seen also from FIG. 3, the hermetic container 2 is a shell structure composed of two shells: a top shell (first shell) 78 covering the electric motor 4 and a bottom shell (second shell) 80 covering the compressing mechanism 6. Within the her-

metic container 2, the crankshaft 14 and the connecting rod 20 need to be arranged at right angles to each other, and thus, the electric motor 4 is arranged in the top shell 78 with its length aligned with the depth of the top shell, while the compressing mechanism 6 is arranged in the bottom shell 80 with its length aligned with a diameter of the bottom shell 80. The top shell 78 has therefore a great depth compared with the bottom shell 80.

[0036] The shells 78, 80 each have a root edge at their rims 78a, 80a so that the root edges mated form a groove 82. The shells 78, 80 are joined together by forming a weld 84 in the form a continuous series of beads in the groove 82 over its entire length, by a single step of welding. In other words, the shells are joined together by a single butt weld joint formed by a single step of welding.

[0037] The top shell 78 is formed by press-forming, more specifically deep-drawing a soft steel, such as SPCC or SPHE, into a simple shape like a dome. The top shell 78 is formed as thin as possible, specifically into a thickness of more or less 6.8mm at the thinnest portion and more or less 7mm even at thick portions. Work hardening during deep drawing provides a sufficient resistance to high pressure exerted by the refrigerant.

The bottom shell 80, on the other hand, is formed by forging a soft steel, such as S20C or S25C. The bottom shell 80 is formed as thin as possible, specifically into a thickness of more or less 8.5mm. Like the top shell 78, the bottom shell has a sufficient resistance to high pressure exerted by the refrigerant on the hermetic container 2.

[0038] The bottom shell 80 includes a holding portion 86 by which to hold the bottom shell 80 during forging of the bottom shell 80. The holding portion 86 forms a crest 80c of the bottom shell 80 projecting outward in a central region radially away from a side 80b of the bottom shell 80. The inner bottom portion 2a serving as the oil reservoir 76 is a recess defined by the inner side of the holding portion 86 and having a shape similar to the outer shape of the holding portion 86. The bottom shell 80 has thus an approximately uniform wall thickness throughout the side 80b and the crest 80a.

[0039] A base plate 88 is fitted around the crest 80a, or holding portion 86 to allow the compressor 1 to be installed stably. Attaching a rubber vibration insulator or the like, not shown, to the underside of the base plate 88 ensures that the compressor 1 is fixed with vibration being reduced during operation.

The bottom shell 80 has four support portions 90 bulging radially-inward from the rim 80a and describing an undulating outline. The frame 36 supporting the stator 8 and the cylinder block 16, as seen in FIG. 1, is fixed to these support portions 4. Although not shown, the hermetic container 2 may have another support structure allowing the stator 8 and the cylinder block 16 to be fixed directly to the support portions without a frame 36.

[0040] The holding portion 86, the oil reservoir 76 and the support portions 90 of the bottom shell 80 are formed all at once when the bottom shell 80 is forged.

The above-described compressor 1 presented as a first embodiment of the present invention has a hermetic container 2 composed of two shells 78, 80, wherein at least the press-formed top shell 78 has a reduced wall thickness, resulting in a reduced weight and size of the hermetic container 2, and thus, of the compressor 1.

The top shell 78 formed not by forging is unlikely to produce a poor weld when welded to the bottom shell 80, resulting in an increased weld strength of the hermetic container.

[0041] The top shell 78 is press-formed to have a depth corresponding to the length of the electric motor 4, while the bottom shell 80 is forged to have a diameter corresponding to the length of the compressing mechanism 8. Specifically, the top shell 78, requiring a great depth compared with the bottom shell 80, can be easily formed by press-forming into a shape corresponding to the outer shape of the electric motor 4, with a reduced wall thickness.

[0042] The bottom shell 80, not requiring a great depth compared with the top shell 78, can be easily formed by forging into a shape corresponding to the outer shape of the compressing mechanism 6, with a reduced wall thickness. This ensures that the hermetic container 2, and thus, the compressor 1 have a reduced weight and size. Further, this allows a reduction of dead space within the hermetic container 2, leading to a further reduced size of the compressor 1.

[0043] The holding portion 86 provided to form the crest of the bottom shell 80 saves the bottom shell 80 from having an unprofitably-great wall thickness at the side 80b and/or the crest 80c, which would be inevitable when the holding portion 83 is provided at the side 80b of the bottom shell 80. This leads to a further reduced weight and size of the hermetic container 2, and thus of the compressor 1.

The provision of the holding portion 86 not only allows a reduction in wall thickness of the bottom shell 80 but also facilitates provision of an inner bottom portion 2a serving as an oil reservoir 76, without requiring a separate member such as an oil pan. The inner bottom portion 2a serving as an oil reservoir 78 can hold the lubricant to have an oil surface at a specified level. This ensures that the lubricant is smoothly supplied to the sliding parts of the electric motor 4 and of the compressing mechanism through the lubricating system including the oil pipe 72 and the oil passage 70 and efficiently circulates within the hermetic container 2, even though the amount of the lubricant collecting in the inner bottom portion 2a is small.

[0044] If the hermetic container 2 has a support structure allowing the stator 8 and the cylinder block 16 to be fixed directly to the support portions 90 without requiring a frame 36, the electric motor 4 and the compressing mechanism 6 are easily fixed without requiring a separate member such as a frame 36.

The holding portion 86, the oil reservoir 76 and the support portions 90 are formed all at once when the bottom shell 80 is forged. In other words, these parts can be

easily formed without requiring another member or another working process, which means that the compressor 1 can be produced with an increased productivity.

[0045] The present invention is not restricted to the above-described embodiment, which can be modified in various ways.

Specifically, although in the described embodiment, the top shell 78 is press-formed and the bottom shell 80 is forged, the shells 78, 80 may be formed in another way. What is essential is that the shells 78, 80 be formed by different working processes allowing them to have a reduced wall thickness, and thus, allowing the hermetic container 2, and thus, the compressor 1 to have a reduced weight and size. The described embodiment may be modified such that the top shell 78 is forged and the bottom shell 80 is press-formed, for example.

[0046] In the present embodiment of compressor 1, the working fluid is carbon-dioxide refrigerant. The working fluid is however not restricted to carbon-dioxide refrigerant. When the working fluid is carbon-dioxide refrigerant, the working fluid is discharged from the compressing mechanism 8 in a supercritical state, and thus, at very high pressure. The inner side of the hermetic container 2 can therefore be subjected to very high pressure, and thus, normally, the hermetic container 2 cannot avoid having a great thickness and weight for safety's sake. The hermetic container 2 and compressor 1 structured as described above, which allow effective reduction of weight and size, are therefore favorable.

[0047] Although the present embodiment is a positive-displacement compressor 1, the present invention is applicable to hermetic fluid machines in general, including scroll compressors and expanders. Needless to say, fluid machines to which the present invention is applied can be used to constitute a refrigeration cycle circuit incorporated in apparatuses other than vending machines.

Explanation of the Reference Characters

[0048]

1	Compressor (fluid machine)
2	Hermetic container
2a	Inner bottom portion
4	Electric motor (drive unit)
6	Compressing mechanism (driven unit)
70	Oil passage (lubricating system)
72	Oil pipe (lubricating system)
76	Oil reservoir
78	Top shell (first shell)
80	Bottom shell (second shell)
80a	Side
80c	Crest
86	Holding portion
90	Support portion

Claims

1. A fluid machine comprising a drive unit and a driven unit arranged in a hermetic container such that drive power is transmitted from the drive unit to the driven unit, the hermetic container including a first shell covering the drive unit and a second shell covering the driven unit and joined to the first shell, wherein the first and second shells are members formed by different working processes. 5
10
2. The fluid machine according to claim 1, wherein the first shell is a forged member and the second shell is a press-formed member. 15
3. The fluid machine according to claim 1, wherein the first shell is a press-formed member and the second shell is a forged member.
4. The fluid machine according to claim 3, wherein the drive unit is arranged in the first shell with its length aligned with a depth of the first shell, and the driven unit is arranged in the second shell with its length aligned with a diameter of the second shell. 20
25
5. The fluid machine according to claim 4, wherein the second shell has a holding portion by which to hold the second shell during forging of the second shell, the holding portion forming a crest of the second shell projecting outward in a central region radially away from a side wall of the second shell. 30
6. The fluid machine according to claim 5, wherein the second shell has a lubricating system configured to supply a lubricant collecting in an inner bottom portion of the second shell to sliding parts of the drive unit and of the driven unit, wherein said inner bottom portion is a recess defined by an inner side of said holding portion and having a shape approximately similar to an outer shape of said holding portion and serving as an oil reservoir. 35
40
7. The fluid machine according to claim 6, wherein the second shell has a support portion for the drive unit and the driven unit to be fixed to. 45
8. The fluid machine according to claim 7, wherein the holding portion, the oil reservoir and the support portion are parts formed all at once when the second shell is forged. 50
9. The fluid machine according to any of claims 1 to 8, wherein the hermetic container undergoes pressure exerted by a working fluid sucked in and discharged from the driven unit, the working fluid being carbon-dioxide refrigerant. 55

FIG. 1

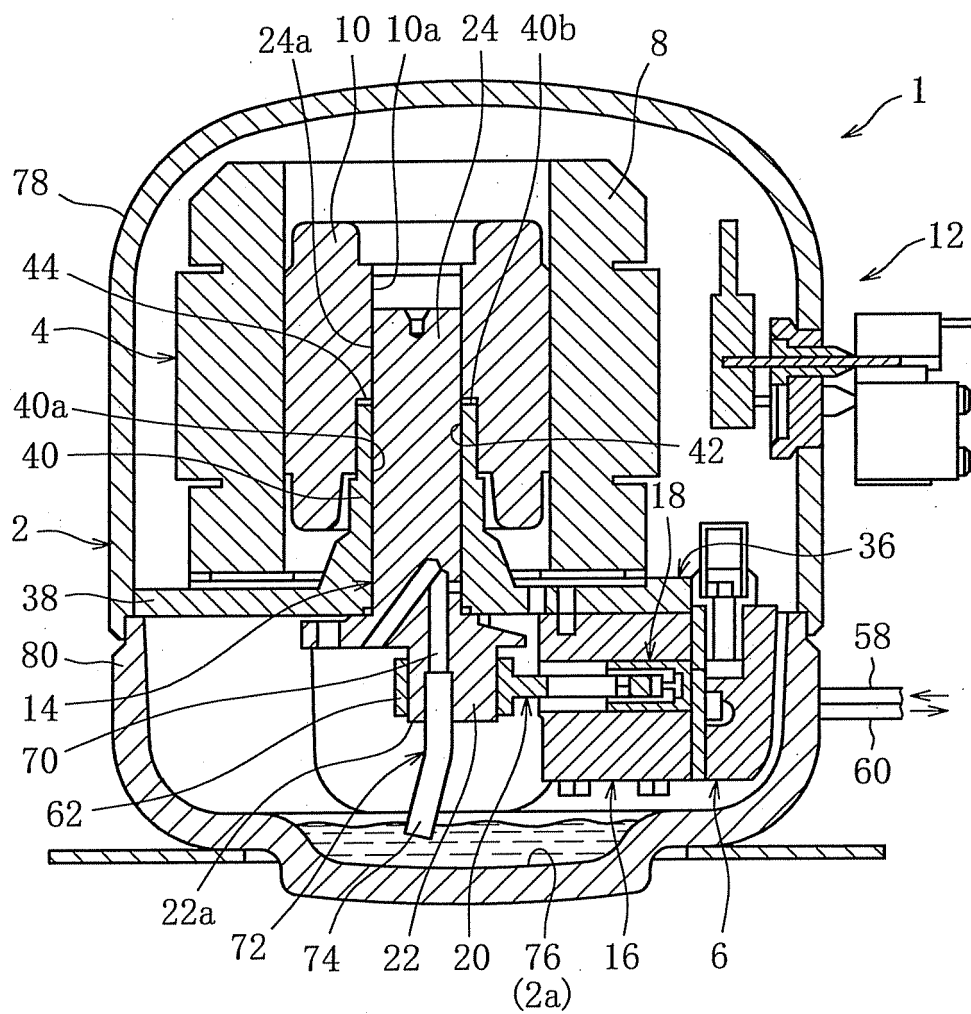


FIG. 2

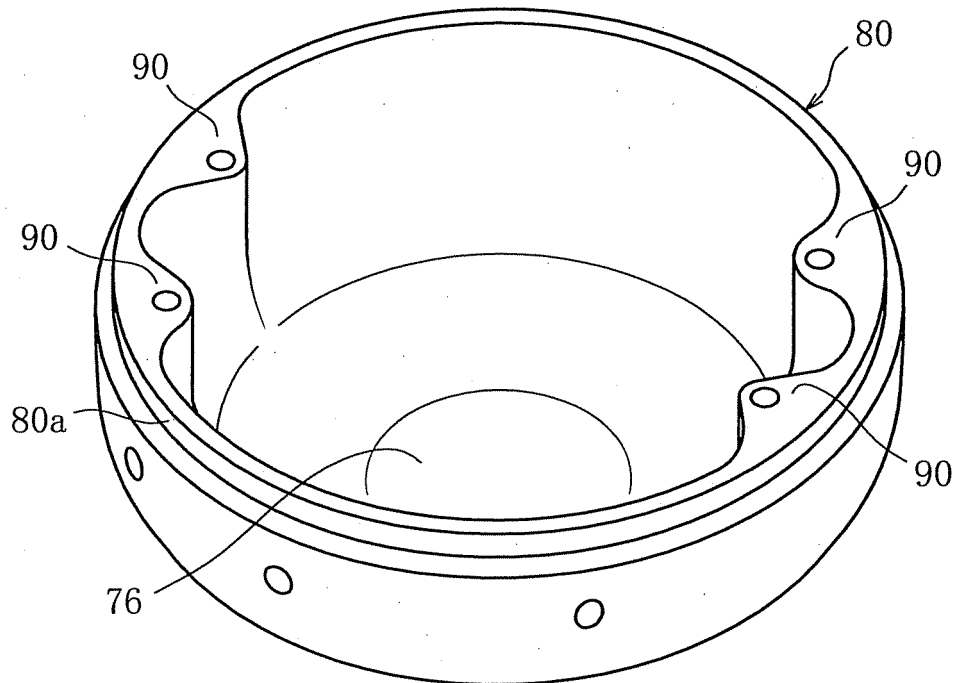


FIG. 3

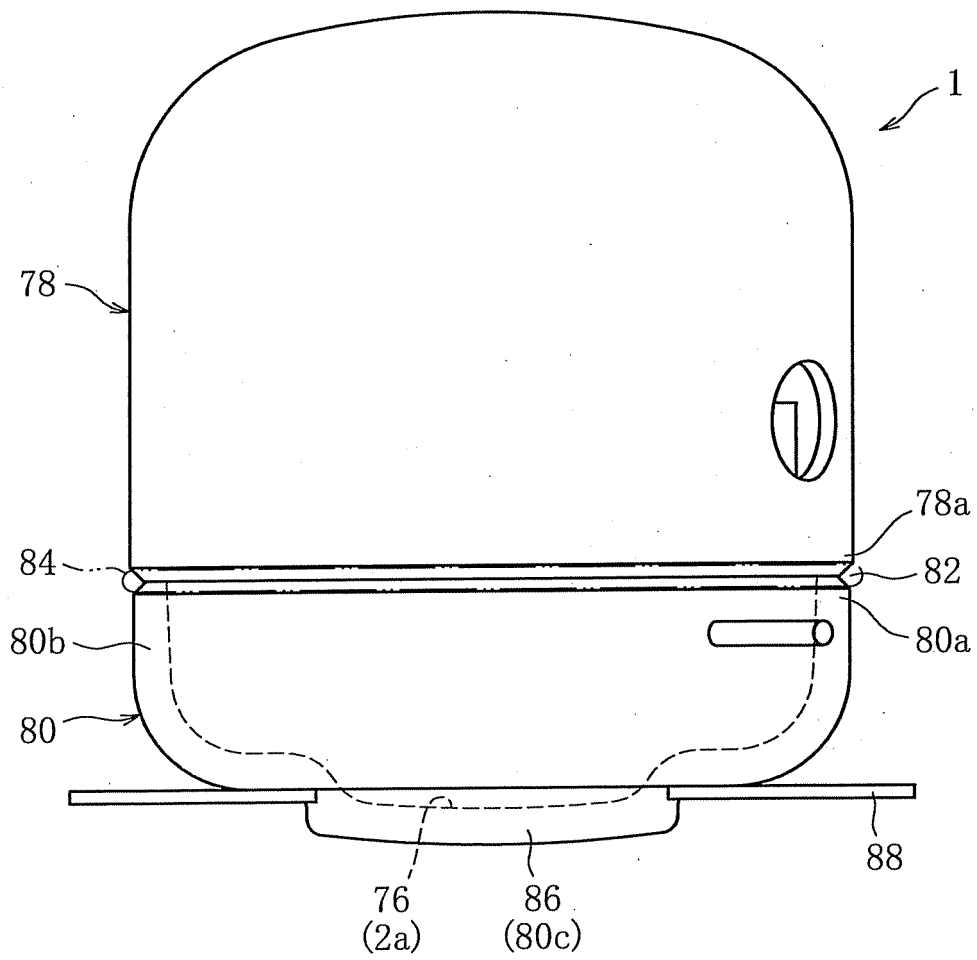
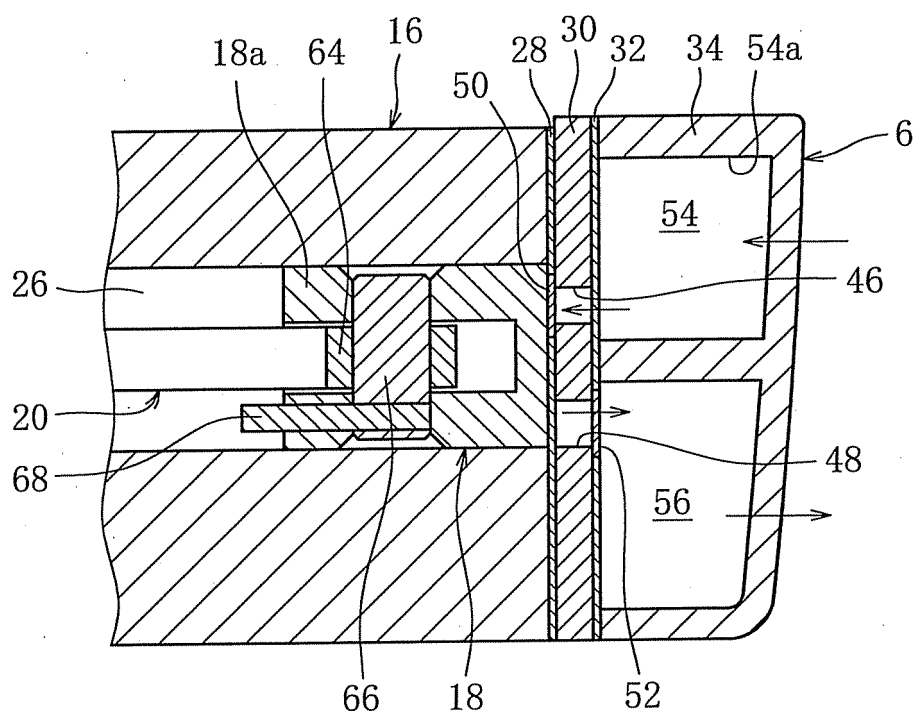


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000366

A. CLASSIFICATION OF SUBJECT MATTER

F04B39/12 (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)

F04B39/12

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 1996-2011

Kokai Jitsuyo Shinan Koho 1971-2011 Toroku Jitsuyo Shinan Koho 1994-2011

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 2003-56463 A (Toyota Industries Corp.), 26 February 2003 (26.02.2003), paragraphs [0031], [0075], [0080], [0082]; fig. 1, 5 (Family: none)	1-4, 9 5-8
Y	JP 10-318140 A (Matsushita Refrigeration Co.), 02 December 1998 (02.12.1998), fig. 1 & US 6276906 B1 & WO 1998/053205 A1	1-4, 9
Y	JP 2004-285927 A (Sanyo Electric Co., Ltd.), 14 October 2004 (14.10.2004), paragraph [0027] (Family: none)	2-4, 9

☒ 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
07 March, 2011 (07.03.11)Date of mailing of the international search report
15 March, 2011 (15.03.11)Name and mailing address of the ISA/
Japanese Patent Office

Authorized officer

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000366

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

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REFERENCES CITED IN THE DESCRIPTION

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