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(54) **FLUID MACHINERY**

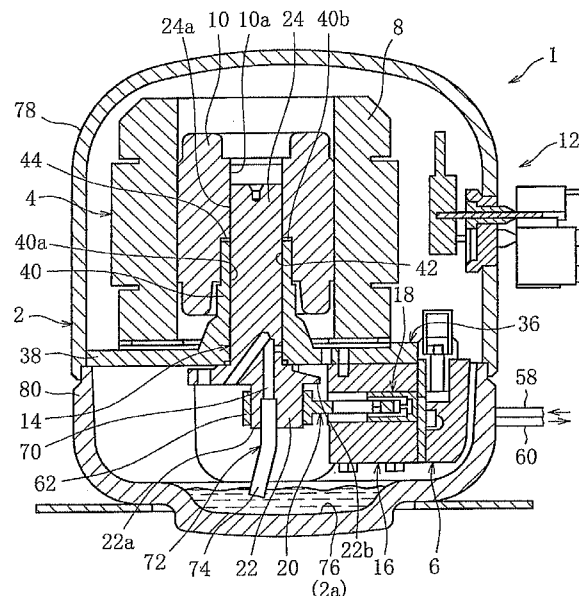
(57) [Summary]

[Purpose] To provide a fluid machine improved in lubrication performance and reliability.

[Means for Attaining the Purpose] A fluid machine (1), in which a driving unit (4) and a driven unit (6) to which driving force of the driving unit is transmitted through a rotary shaft (14) are housed in a hermetic container (2), includes an oil reservoir (76) located at an in-

side bottom (2a) of the hermetic container and storing lubricating oil, and an oil feed mechanism (70, 72) configured to rotate together with the rotary shaft to supply the lubricating oil in the oil reservoir to individual sliding parts of the driving and driven units, wherein the hermetic container has a baffle section (90) provided on an inner wall (80d) thereof and configured to disturb a circumferential flow of the lubricating oil along the inner wall.

FIG. 5



## Description

### Technical Field

[0001] The present invention relates to fluid machines, and more particularly, to a fluid machine suitable for use as a hermetic type reciprocating compressor for compressing carbon dioxide refrigerant.

### Background Art

[0002] As a fluid machine of this type, a hermetic type compressor has been known which comprises a hermetic container, an electrically driven compression element housed in the hermetic container and constituted by a compression element (driven unit) and an electrically driving element (driving unit), an oil reservoir provided on the compression element, and a suction pipe having one end connected to the compression element and the other end opening in the vicinity of the lubricating oil reservoir (see Patent Document 1, for example).

### Prior Art Literature

#### Patent Document

[0003] Patent Document 1: Japanese Laid-open Patent Publication No. 06-294380

### Summary of the Invention

#### Problems to be Solved by the Invention

[0004] In the above conventional technique, a crankshaft (rotary shaft), which constitutes the compression element, has one end immersed in the lubricating oil stored in the inside bottom of the hermetic container. When driven by the electrically driving element, the crankshaft draws up the lubricating oil by means of an oil feed mechanism provided therein, to feed the lubricating oil to sliding parts of the compression element. The oil feed mechanism is rotated by the electrically driving element, and accordingly, when drawn up from the oil reservoir, the lubricating oil scatters parabolically within the hermetic container due to rotation of the oil feed mechanism. Also, the lubricating oil is released from the rotating crankshaft to the interior of the hermetic container, and the thus-released lubricating oil scatters parabolically within the hermetic container.

[0005] The lubricating oil thus scattered in the interior of the hermetic container adheres to the inner wall of the hermetic container and then flows along the inner wall in a circumferential direction of the hermetic container. The time required from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir lengthens with increase in initial velocity of the scattered lubricating oil and also with increase in viscous force of the lubricating oil.

Specifically, the crankshaft and thus its oil pipe are sometimes rotated at 3000 rpm or thereabout depending on the specification of the compressor 1. In such a case, therefore, the initial velocity of the scattered lubricating oil is high.

[0006] Also, in the case of a hermetic type compressor, in particular, a hermetic type compressor using carbon dioxide refrigerant as its working fluid, a refrigerant oil larger in viscous force than conventional ones is often used, so that the aforementioned required time tends to become longer. Further, where the compressor is small in size and a maximum oil storage amount of the oil reservoir is as small as, for example, 200 cc or thereabout, the amount of the lubricating oil stored in the oil reservoir may temporarily decrease by a large margin if the required time is long. In the worst case, the oil storage amount temporarily becomes zero.

[0007] If such a situation arises, the oil feed mechanism malfunctions and fails to appropriately supply the lubricating oil to the individual sliding parts of the driving and driven units, giving rise to a problem that the lubrication performance of the compressor significantly lowers.

The present invention was created in view of the above circumstances, and an object thereof is to provide a fluid machine improved in lubrication performance and reliability.

#### Means for Solving the Problems

[0008] To achieve the object, the present invention provides a fluid machine in which a driving unit and a driven unit to which driving force of the driving unit is transmitted through a rotary shaft are housed in a hermetic container, the fluid machine comprising: an oil reservoir located at an inside bottom of the hermetic container and storing lubricating oil; and an oil feed mechanism configured to rotate together with the rotary shaft to supply the lubricating oil in the oil reservoir to individual sliding parts of the driving and driven units, wherein the hermetic container has a baffle section provided on an inner wall thereof and configured to disturb a circumferential flow of the lubricating oil along the inner wall (claim 1).

[0009] Specifically, the baffle section protrudes from the inner wall of the hermetic container toward the oil reservoir (claim 2).

The fluid machine may further comprise a frame supporting the driving unit and the driven unit, and the frame may be fixed to the baffle section of the hermetic container (claim 3).

Further, the hermetic container may include a bottom shell formed by forging and molding, and the baffle section may be formed simultaneously with the formation of the bottom shell by forging and molding (claim 4). The oil reservoir may also be formed simultaneously with the formation of the bottom shell by forging and molding (claim 5).

[0010] Also, the baffle section may have a profile of

successive waves bulging toward the oil reservoir (claim 6) and may include a plurality of baffle sections (claim 7). Further, pressure of a working fluid drawn into and discharged from the driven unit prevails in an interior of the hermetic container, and the working fluid may be carbon dioxide refrigerant (claim 8).

### Advantageous Effects of the Invention

[0011] The fluid machine according to claims 1 and 2 has the baffle section. Accordingly, the lubricating oil scattered within the hermetic container directly collides with the baffle section, or if it does not collide directly with the baffle section, the lubricating oil adheres to the inner wall of the hermetic container, then moves circumferentially along the inner wall and ascends the baffle section, whereupon the velocity of the lubricating oil substantially lowers. The lubricating oil thus decelerated no longer keeps moving circumferentially along the inner wall but immediately flows down to the oil reservoir. Consequently, the time required from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir can be substantially shortened. Thus, even in the case where the fluid machine is operated at high rotational speeds while using lubricating oil with large viscous force and the maximum oil storage amount of the oil reservoir is small, the circulation efficiency of the lubricating oil can be enhanced, making it possible to improve the lubrication performance of the fluid machine.

[0012] According to the invention of claim 3, the frame is fixed to the baffle section, so that the baffle section can be used as a seating section for fixing the frame to the hermetic container. Thus, the frame can be fixed to the hermetic container without the need to use a different portion or a separate member, whereby the productivity of the fluid machine can be improved.

According to the invention of claim 4, the baffle section is formed at the same time that the bottom shell is formed by forging and molding. The baffle section can therefore be formed easily without the need for a separate member or additional machining, so that the productivity of the fluid machine improves.

[0013] According to the invention of claim 5, the oil reservoir is formed at the same time that the bottom shell is formed by forging and molding. The oil reservoir can therefore be formed easily without the need for a separate member or additional machining, whereby the productivity of the fluid machine can be improved.

According to the invention of claim 6, the baffle section has a profile of successive waves bulging toward the oil reservoir. Thus, compared with the case where the baffle section includes a single bulge, the scattered lubricating oil collides directly against the baffle section with a higher probability, and even if the lubricating oil does not collide directly with the baffle section, the lubricating oil adhering to the inner wall of the hermetic container and moving circumferentially along the inner wall encounters the baffle section more frequently. Accordingly, the lubricating

oil can be decelerated more effectively, making it possible to further shorten the required time from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir. Thus, even in the case where the fluid machine is operated at high rotational speeds while using lubricating oil with large viscous force and the maximum oil storage amount of the oil reservoir is small, the circulation efficiency of the lubricating oil can be further enhanced, making it possible to further improve the lubrication performance of the fluid machine.

[0014] According to the invention of claim 7, the baffle section includes a plurality of baffle sections. Thus, compared with the case where only one baffle section is provided, the scattered lubricating oil collides directly against the baffle section with a higher probability, and even if the lubricating oil does not collide directly with the baffle section, the lubricating oil adhering to the inner wall of the hermetic container and moving circumferentially along the inner wall encounters the baffle section more frequently. Accordingly, the lubricating oil can be decelerated more effectively, making it possible to further shorten the required time from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir. Thus, even in the case where the fluid machine is operated at high rotational speeds while using lubricating oil with large viscous force and the maximum oil storage amount of the oil reservoir is small, the circulation efficiency of the lubricating oil can be further enhanced, making it possible to further improve the lubrication performance of the fluid machine.

[0015] According to the invention of claim 8, carbon dioxide refrigerant is used as the working fluid. Where carbon dioxide refrigerant is used as the working fluid, the working fluid discharged from the driven unit is in a supercritical state and thus the pressure thereof is very high. Since the temperature of the interior of the fluid machine becomes high, lubricating oil with relatively high viscosity is used in order to prevent an oil film from failing to form because of lowering of the viscosity at high temperatures. However, when the temperature of the interior of the fluid machine is low, on the other hand, the scattered lubricating oil tends to return slowly because the viscosity of the lubricating oil is high. With the aforementioned configuration, however, the circulation efficiency of the lubricating oil can be enhanced even if the viscosity of the lubricating oil is high and thus the scattered lubricating oil tends to return slowly, so that the lubrication performance of the fluid machine can advantageously be improved.

### Brief Description of the Drawings

[0016]

FIG. 1 is a longitudinal sectional view of a compressor according to a first embodiment.

FIG. 2 is an enlarged view of a principal part of a compression mechanism shown in FIG. 1.

FIG. 3 is an external view of a hermetic container of the compressor of FIG. 1.

FIG. 4 is a perspective view illustrating a bottom shell shown in FIG. 3 as viewed from above.

FIG. 5 is a plan view of the bottom shell of FIG. 4, exemplifying lubricating oil flow routes.

### Mode of Carrying out the Invention

[0017] FIGS. 1 through 5 illustrate a compressor 1 as a fluid machine according to a first embodiment.

The compressor 1 is a hermetic type reciprocating compressor, which is more particularly classified as displacement type compressor referred to as reciprocating compressor or piston compressor, and is used as a device constituting a refrigeration cycle, not shown, incorporated in an automatic vending machine, for example.

The refrigeration cycle has a path through which a refrigerant as a working fluid for the compressor 1 is circulated. For the refrigerant, carbon dioxide, which is a non-flammable natural refrigerant, is used, for example.

[0018] As illustrated in FIG. 1, the compressor 1 is provided with a hermetic container 2. The hermetic container 2 contains an electric motor (driving unit) 4 and a compression mechanism (driven unit) 6 to which driving force of the electric motor 4 is transmitted.

The electric motor 4 includes a stator 8 configured to generate a magnetic field when supplied with electric power, and a rotor 10 configured to rotate by the magnetic field generated by the stator 8. The rotor 10 is arranged inside the stator 8 coaxially therewith and is secured by shrink fitting to a main shaft section 24 of a crankshaft 14, described later. The stator 8 is supplied with electric power from outside of the compressor 1 through electric equipment 12 fixed to the hermetic container 2, and leads, not shown.

[0019] The compression mechanism 6 includes the crankshaft 14, a cylinder block 16, a piston 18, and a connecting rod 20. The crankshaft 14 has an eccentric shaft section 22 and the main shaft section 24.

As illustrated in FIG. 2, a cylinder bore 26 is formed through the cylinder block 16. A cylinder gasket 28, a suction valve 50, described later, a valve plate 30, a head gasket 32 and a cylinder head 34 are urgingly fixed, in the mentioned order from the cylinder block side, to the cylinder block 16 by bolts, so as to close an outer open end of the cylinder bore 26.

[0020] The stator 8 shown in FIG. 1 is fixed by bolts to the cylinder block 16 with a frame 36 therebetween, and the frame 36 is secured to the hermetic container 2.

Specifically, the electric motor 4 and the compression mechanism 6 are supported by a seating section 38 forming a lower part of the frame 36, and the frame 36 is secured at the seating section 38 to the hermetic container 2. At a cylindrical section 40 forming an upper part of the frame 36, on the other hand, a bearing 42 for the main shaft section 24 is arranged on an inner peripheral surface 40a of the cylindrical section 40, and a bearing

44 for receiving thrust load of the rotor 10, such as a thrust race (bearing) or thrust washer, is arranged on an upper end face 40b of the cylindrical section 40.

[0021] As illustrated in FIG. 2, the valve plate 30 has a suction hole 46 and a discharge hole 48 for letting the refrigerant in and out, respectively. The suction and discharge holes 46 and 48 are respectively opened and closed by the suction and discharge valves 50 and 52, each constituted by a reed valve.

The cylinder head 34 has a suction chamber 54 and a discharge chamber 56, both for the refrigerant. When the discharge valve 52 is open during compression stroke of the piston 18, the discharge chamber 56 communicates with the cylinder bore 26 through the discharge hole 48.

On the other hand, when the suction valve 50 is open during suction stroke of the piston 18, the suction chamber 54 communicates with the cylinder bore 26 through the suction hole 46.

[0022] A suction pipe 58 and a discharge pipe 60 are fixed to the hermetic container 2 and have one ends connected to the suction and discharge chambers 54 and 56, respectively, of the cylinder head 34. The suction and discharge pipes 58 and 60 have respective other ends connected to the refrigeration cycle via a suction muffler and a discharge muffler, respectively, neither of which is shown. The mufflers serve to reduce pulsation and noise of the refrigerant flowing between the compressor 1 and the refrigeration cycle.

[0023] The connecting rod 20 has one end formed as a large end portion 62 to which the eccentric shaft section 22 of the crankshaft 14 is rotatably coupled, and has the other end formed as a small end portion 64 to which the piston 18 is coupled so as to be capable of reciprocating motion. The small end portion 64 is coupled to the piston 18 by a piston pin 66, and a fixing pin 68 prevents the piston pin 66 from coming off the piston 18.

[0024] With the individual parts configured in this manner, as the crankshaft 14 rotates, the connecting rod 20 makes a rocking motion on the piston pin 66 as a fulcrum, in conjunction with eccentric rotation of the eccentric shaft section 22, and the piston 18 makes a reciprocating motion within the cylinder bore 26 in conjunction with the rocking motion of the connecting rod 20.

Suction pressure of the refrigerant mainly prevails in the interior of the hermetic container 2. A small amount of lubricating oil for lubricating individual sliding parts of the electric motor 4 and compression mechanism 6, such as the bearings 42 and 44, is stored in an inside bottom 2a of the hermetic container 2.

[0025] An oil passage (oil feed mechanism) 70 is formed in the crankshaft 14 so as to extend from a nearly axial center of a lower end face 22a of the eccentric shaft section 22 up to an intermediate portion of the main shaft section 24. The oil passage 70 opens, at an upper section thereof, in an outer peripheral surface 24a of the main shaft section 24, and is connected, at a lower section thereof, with an oil pipe (oil feed mechanism) 72. The oil pipe 72 has an inclined portion 74 at a distal end portion

thereof, and the inclined portion 74 is so inclined as to extend from nearly the axial center of the eccentric shaft section 22 toward the axis of the main shaft section 24. A distal end of the inclined portion 74 of the oil pipe 72 extends to an oil reservoir 76 formed in the inside bottom 2a of the hermetic container 2 and having a concave shape as viewed in section.

**[0026]** The oil reservoir 76 has a size and a depth such that a small amount, for example, about 200 cc, of lubricating oil can be stored with its oil level located above the distal end of the oil pipe 72. As the oil pipe 72 eccentrically rotates together with the eccentric shaft section 22 due to rotation of the crankshaft 14, centrifugal force acts upon the lubricating oil in the inclined portion 74 of the oil pipe 72 in an obliquely upward and outward direction, so that the lubricating oil is drawn from the oil reservoir 76 upward into the oil passage 74 by the centrifugal force. Also, as the oil pipe 72 rotates eccentrically, part of the lubricating oil in the oil reservoir 76 is scattered parabolically within the hermetic container 2.

**[0027]** Operation and function of the compressor 1 will be now described.

In the compressor 1, when electric power is supplied to the stator 8, the rotor 10, which is fixed to the main shaft section 24, and thus the crankshaft 14 rotate, with the result that the piston 18 is actuated by the connecting rod 20 to make a reciprocating motion inside the cylinder bore 26. As the piston 18 reciprocates, the refrigerant is drawn from the refrigeration cycle into the cylinder bore 26, then compressed in the cylinder bore 26, and discharged to the refrigeration cycle.

**[0028]** Specifically, as the piston 18 moves in a direction of decreasing the volumetric capacity of the cylinder bore 26, the refrigerant in the cylinder bore 26 is compressed, and when the pressure in the cylinder bore 26 exceeds a refrigerant discharge pressure, the discharge valve 52 opens because of the difference between the pressure in the cylinder bore 26 and the pressure in the discharge chamber 56. The compressed refrigerant is guided through the discharge hole 48 into the discharge chamber 56 and then is discharged to the refrigeration cycle through the discharge pipe 60.

**[0029]** Subsequently, as the piston 18 moves from its top dead center in a direction of increasing the volumetric capacity of the cylinder bore 26, the pressure in the cylinder bore 26 lowers. Since the pressure in the cylinder bore 26 lowers, the discharge valve 52 closes due to the difference between the pressure in the cylinder bore 26 and the pressure in the discharge chamber 56.

When the pressure in the cylinder bore 26 drops below a refrigerant suction pressure, the suction valve 50 opens because of the difference between the pressure in the cylinder bore 26 and the pressure in the suction chamber 54. The refrigerant in the refrigeration cycle is guided through the suction pipe 58 into the suction chamber 54 and then drawn into the cylinder bore 26 via the suction hole 46.

**[0030]** Then, as the piston 18 moves from its bottom

dead center in a direction of decreasing the volumetric capacity of the cylinder bore 26, the refrigerant in the cylinder bore 26 is compressed. In this manner, a series of processes, namely, suction of the refrigerant from the refrigeration cycle into the cylinder bore 26, compression of the refrigerant in the cylinder bore 26 and discharge of the refrigerant to the refrigeration cycle, repeatedly takes place.

**[0031]** As the compressor 1 operates in the aforementioned manner, the lubricating oil drawn upward from the oil reservoir 76 into the oil passage 70 flows out of the oil passage 70 and then scatters parabolically inside the hermetic container 2. The lubricating oil thus scattered flows down toward the eccentric shaft section 22 and lubricates the large end portion 62 and its vicinities. Further, the lubricating oil is scattered toward the piston 18 by a flange 22b formed on the eccentric shaft section 22 and lubricates a skirt 18a of the piston 18 and its vicinities.

**[0032]** On the other hand, part of the lubricating oil flowing out of the oil passage 70 moves upward due to centrifugal force along outer peripheral grooves, not shown, formed in the crankshaft 14, thus forming an oil film in the gap between the crankshaft 14 and the frame 36 to lubricate the bearing 42, and is guided toward the upper end of the crankshaft 14. On reaching the upper end face 40b of the cylindrical section 40, the lubricating oil lubricates the bearing 44 and then flows down by gravity to the oil reservoir 76. The lubricating oil that failed to pass through the bearing 44 moves further upward along an inner wall surface 10a of the rotor 10 up to the upper end of the rotor 10, is scattered outward due to the centrifugal force produced by the rotation of the rotor 10 to cool the stator 8, and flows down by gravity to the oil reservoir 76.

**[0033]** Oil mist drawn into the cylinder bore 26 to lubricate the skirt 18a of the piston 18 and its vicinities enters, together with the refrigerant gas leaking from the cylinder bore 26, the gap between the piston 18 and the cylinder block 16 for sealing and lubrication of the piston 18. The lubricating oil that adheres to a wall surface 54a of the suction chamber 54 at this time flows down by gravity to the oil reservoir 76. The lubricating oil thus reaching the oil reservoir 76 is again drawn up through the oil pipe 72 and circulates in the hermetic container 2 while contributing to lubrication and sealing of the individual sliding parts of the electric motor 4 and compression mechanism 6.

**[0034]** In this embodiment, as illustrated in FIG. 3, the hermetic container 2 has a shell structure constituted by two shells, namely, a top shell 78 covering the electric motor 4 and a bottom shell 80 surrounding the compression mechanism 6. The crankshaft 14 and the connecting rod 20 are arranged inside the hermetic container 2 such that the former is positioned substantially perpendicularly to the latter, and thus, the electric motor 4 is housed with its longitudinal axis directed in a depth direction of the top shell 78. The top shell 78 has a depth greater than that of the bottom shell 80. The compression mechanism 6, on the other hand, is housed with its longitudinal axis

directed in a radial direction of the bottom shell 80, and the bottom shell 80 has a smaller depth than the top shell 78.

**[0035]** The shells 78 and 80 have protruding edges defining respective open ends 78a and 80a and having root faces, and the root faces are butted against each other to form a groove 82. The shells 78 and 80 are joined together by welding operation performed once to form a weld bead 84 continuously extending over the whole circumference of the groove 82. That is, the shells 78 and 80 are joined together by butt welding executed once along a single butt joint thereof.

**[0036]** The bottom shell 80 is formed by forging and molding and has a grip 86 which is clamped during the forging and molding. The grip 86 is formed as an outward protruding portion 80c of the bottom shell 80, the outward protruding portion 80c being located radially inward with respect to a side 80b of the bottom shell 80. The oil reservoir 76 is formed in the inside bottom 2a opposite to and corresponding in position to the grip 86, as a recess with a shape similar to the external form of the grip 86. That is, the bottom shell 80 has a nearly uniform wall thickness from its side 80b through to its outward protruding portion 80c.

**[0037]** A base plate 88 is fitted around the outward protruding portion 80c serving as the grip 86, to permit the compressor 1 to be stably placed. By attaching a rubber vibration insulator or the like, not shown, to the lower surface of the base plate 88, it is possible to fix the compressor 1 in position while suppressing vibrations during operation of the compressor 1.

As illustrated in FIG. 4, according to this embodiment, the bottom shell 80 has two lubricating oil baffle sections 90 formed on an inner wall 80d thereof close to the open end 80a such that the baffle sections 90 bulge radially toward the center of the bottom shell 80, that is, toward the oil reservoir 76. Each baffle section 90 has a profile of two successive waves bulging toward the oil reservoir 76, and the two baffle sections 90 are located opposite each other with the oil reservoir 76 therebetween, as viewed from above the bottom shell 80.

**[0038]** The frame 36 supporting the stator 8 and the cylinder block 16, shown in FIG. 1, is fixed on upper surfaces 90a of the baffle sections 90, and thus, the baffle sections 90 also function as a seating section for fixing the frame 36 to the hermetic container 2.

The grip 86, the oil reservoir 76 and the baffle sections 90 are formed collectively at the same time that the bottom shell 80 is formed by forging and molding.

**[0039]** In the aforementioned compressor 1 of the first embodiment, the lubricating oil scattered in the hermetic container 2, especially in the bottom shell 80, by the oil pipe 72 rotating in a clockwise direction, for example, as viewed from above the bottom shell 80, the lubricating oil released from the oil passage 70, and the lubricating oil scattered due to collision with the flange 22b adhere to the inner wall 80d of the bottom shell 80. The lubricating oil thus adhering to the inner wall 80d tends to move in

a circumferential direction of the bottom shell 80 along the inner wall 80d.

**[0040]** As indicated by arrows in FIG. 5, however, the scattered lubricating oil, indicated by (a), directly collides with the baffle section 90, as indicated by (b), or if it does not collide directly with the baffle section 90, the lubricating oil adheres to the inner wall 80d, as indicated by (c), then moves circumferentially along the inner wall 80d and ascends the baffle section 90, whereupon the moving velocity of the lubricating oil substantially lowers because of the baffle section 90. The lubricating oil thus decelerated no longer keeps moving circumferentially along the inner wall 80d but immediately flows down to the oil reservoir 76, as indicated by (d). Consequently, a time T required from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir 76 can be substantially shortened.

**[0041]** The required time T lengthens with increase in initial velocity v of the scattered lubricating oil and also with increase in viscous force of the lubricating oil. Also, where the compressor 1 is small in size and the maximum oil storage amount of the oil reservoir 76 is as small as, for example, 200 cc or thereabout as mentioned above, the amount of the lubricating oil stored in the oil reservoir 76 may temporarily decrease by a large margin if the required time T is long. In the worst case, the oil storage amount becomes zero, with the result that the oil feed mechanism malfunctions and fails to appropriately supply the lubricating oil to the individual sliding parts of the electric motor 4 and compression mechanism 6, giving rise to a problem that the lubrication performance of the compressor 1 significantly lowers.

**[0042]** According to the embodiment, by contrast, even in the case where the compressor 1 is operated at high rotational speeds while using lubricating oil with large viscous force and the maximum oil storage amount of the oil reservoir 76 is small, the circulation efficiency of the lubricating oil can be enhanced, making it possible to improve the lubrication performance of the compressor 1.

Also, the frame 36 is fixed to the baffle sections 90, so that the baffle sections 90 can be used as the seating section for fixing the frame 36 to the hermetic container 2. Thus, the frame 36 can be fixed to the hermetic container 2 without the need to use a different portion or a separate member, whereby the productivity of the compressor 1 can be improved.

**[0043]** Further, the baffle sections 90 and the oil reservoir 76 are formed collectively at the same time that the bottom shell 80 is formed by forging and molding. The baffle sections 90 and the oil reservoir 76 can therefore be formed easily without the need for separate members or additional machining, so that the productivity of the compressor 1 improves.

Furthermore, two baffle sections 90 are provided, each having a profile of two successive waves bulging toward the oil reservoir 76. Thus, compared with the case where a single bulge is provided per baffle section 90, or the

case where only one baffle section 90 is provided, the scattered lubricating oil collides directly against the baffle section 90 with a higher probability, and even if the lubricating oil does not collide directly with the baffle section 90, the lubricating oil adhering to the inner wall 80d and moving circumferentially along the inner wall 80d encounters the baffle section 90 more frequently. Accordingly, the lubricating oil can be decelerated more effectively, making it possible to further shorten the required time T from the scattering of the lubricating oil until the lubricating oil flows down to the oil reservoir 76. Thus, even in the case where the compressor 1 is operated at high rotational speeds while using lubricating oil with large viscous force and the maximum oil storage amount of the oil reservoir 76 is small, the circulation efficiency of the lubricating oil can be further enhanced, making it possible to further improve the lubrication performance of the compressor 1.

**[0044]** The present invention is not limited to the foregoing embodiment and may be modified in various ways. For example, the baffle sections 90 to be formed are not limited in shape to the ones of the above embodiment in which the baffle sections 90 protrude from the inner wall 80d toward the oil reservoir 76. The baffle sections 90 may have various other shapes and also a desired number of baffle sections may be formed insofar as the baffle sections 90 are capable of disturbing the circumferential flow of the lubricating oil along the inner wall 80d to decelerate the lubricating oil and thereby guiding the lubricating oil to the oil reservoir 76. Specifically, the baffle sections 90 may be in the form of plates provided on the inner wall 80d, or wavy recesses formed in part of the inner wall 80d, or circumferential jagged irregularities formed on the inner wall 80d, or circumferential step-like irregularities formed on the inner wall 80d.

**[0045]** Also, in the above embodiment, carbon dioxide refrigerant is exemplified as the working fluid for the compressor 1, but the working fluid to be used is not limited to the carbon dioxide refrigerant. Where carbon dioxide refrigerant is used as the working fluid, however, the working fluid discharged from the compression mechanism 6 is in a supercritical state and thus the pressure thereof is very high. Since the temperature of the interior of the compressor 1 becomes high, lubricating oil with relatively high viscosity is used in order to prevent the oil film from failing to form because of lowering of the viscosity at high temperatures. When the temperature of the interior of the compressor 1 is low, on the other hand, the scattered lubricating oil tends to return slowly because the viscosity of the lubricating oil is high. With the aforementioned configuration, the circulation efficiency of the lubricating oil can be enhanced even if the viscosity of the lubricating oil is high and thus the scattered lubricating oil tends to return slowly, so that the lubrication performance of the compressor 1 can advantageously be improved.

**[0046]** Further, in the foregoing embodiment, the displacement type compressor 1 is explained by way of ex-

ample. The present invention is applicable to hermetic type fluid machines in general, such as scroll compressor and expander, and fluid machines to which the invention is applied can of course be used as devices constituting refrigeration cycles incorporated in apparatuses other than automatic vending machines.

#### Explanation of Reference Signs

#### 10 [0047]

|     |                                     |
|-----|-------------------------------------|
| 1   | compressor (fluid machine)          |
| 2   | hermetic container                  |
| 2a  | inside bottom                       |
| 4   | electric motor (driving unit)       |
| 6   | compression mechanism (driven unit) |
| 14  | crankshaft (rotary shaft)           |
| 36  | frame                               |
| 70  | oil passage (oil feed mechanism)    |
| 72  | oil pipe (oil feed mechanism)       |
| 76  | oil reservoir                       |
| 80  | bottom shell                        |
| 80d | inner wall                          |
| 90  | baffle section                      |

#### Claims

1. A fluid machine in which a driving unit and a driven unit to which driving force of the driving unit is transmitted through a rotary shaft are housed in a hermetic container, comprising:

an oil reservoir located at an inside bottom of the hermetic container and storing lubricating oil; and

an oil feed mechanism configured to rotate together with the rotary shaft to supply the lubricating oil in the oil reservoir to individual sliding parts of the driving and driven units, wherein the hermetic container has a baffle section provided on an inner wall thereof and configured to disturb a circumferential flow of the lubricating oil along the inner wall.

2. The fluid machine according to claim 1, wherein the baffle section protrudes from the inner wall of the hermetic container toward the oil reservoir.

3. The fluid machine according to claim 2, further comprising a frame supporting the driving unit and the driven unit, wherein the frame is fixed to the baffle section of the hermetic container.

4. The fluid machine according to claim 3, wherein:

the hermetic container includes a bottom shell

formed by forging and molding, and  
the baffle section is formed simultaneously with  
the formation of the bottom shell by forging and  
molding.

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5. The fluid machine according claim 4, wherein the oil reservoir is formed simultaneously with the formation of the bottom shell by forging and molding.

6. The fluid machine according to claim 5, wherein the baffle section has a profile of successive waves bulging toward the oil reservoir.

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7. The fluid machine according to any one of claims 1 to 6, wherein the baffle section includes a plurality of baffle sections.

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8. The fluid machine according to any one of claims 1 to 7, wherein pressure of a working fluid drawn into and discharged from the driven unit prevails in an interior of the hermetic container, and the working fluid is carbon dioxide refrigerant.

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FIG. 1

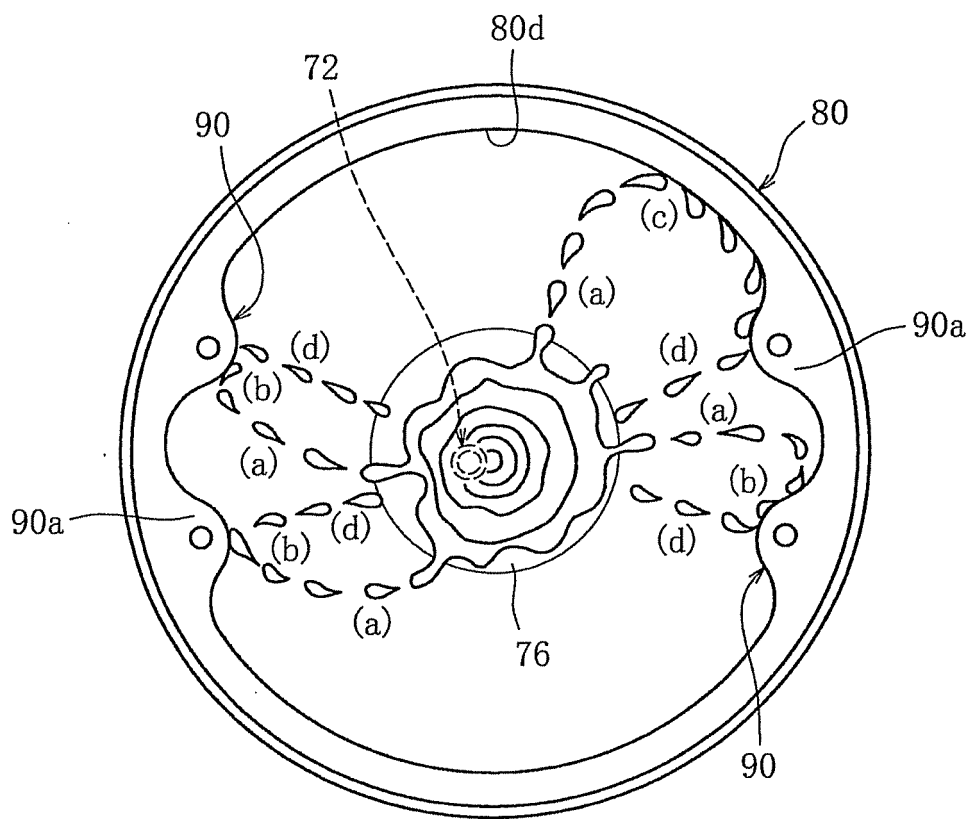


FIG. 2

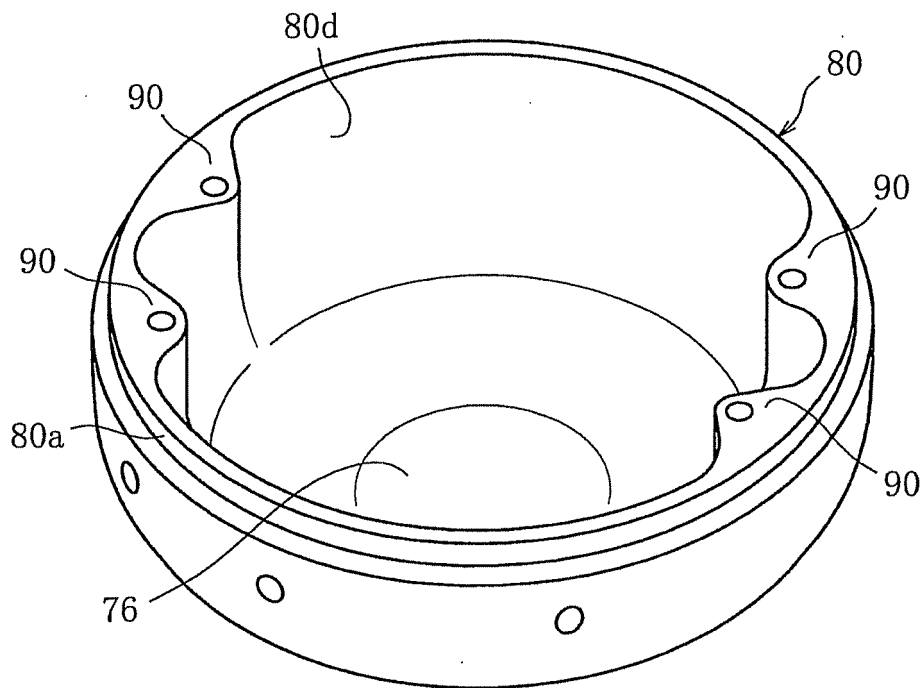


FIG. 3

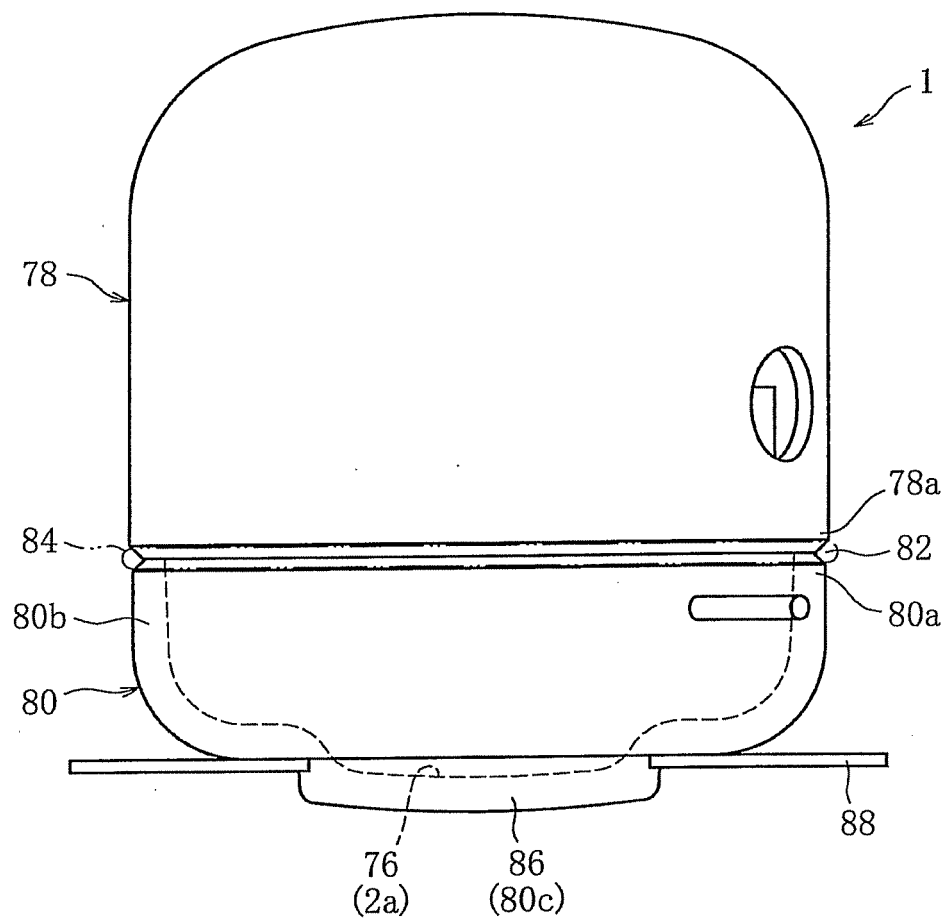


FIG. 4

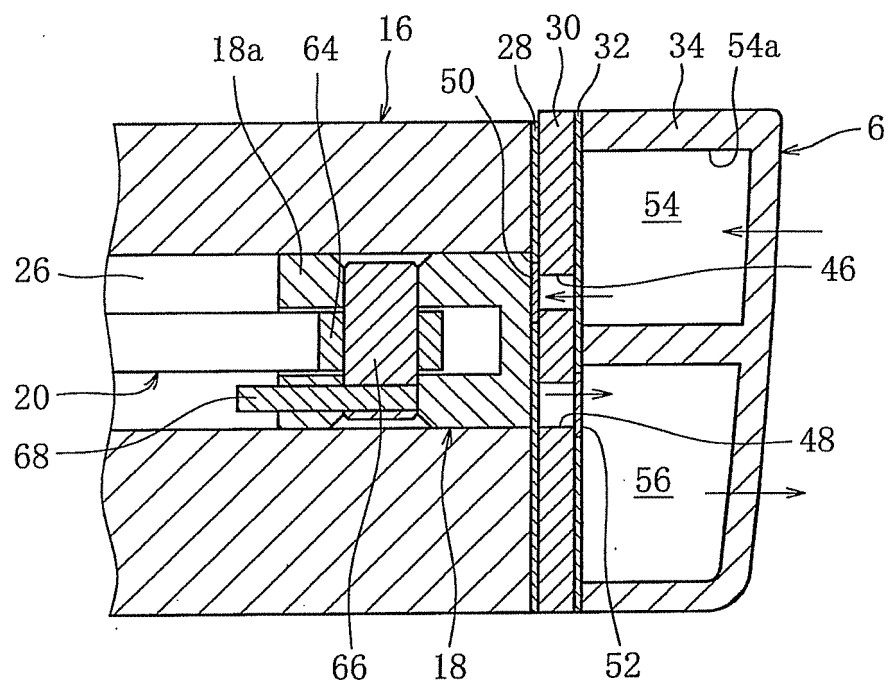
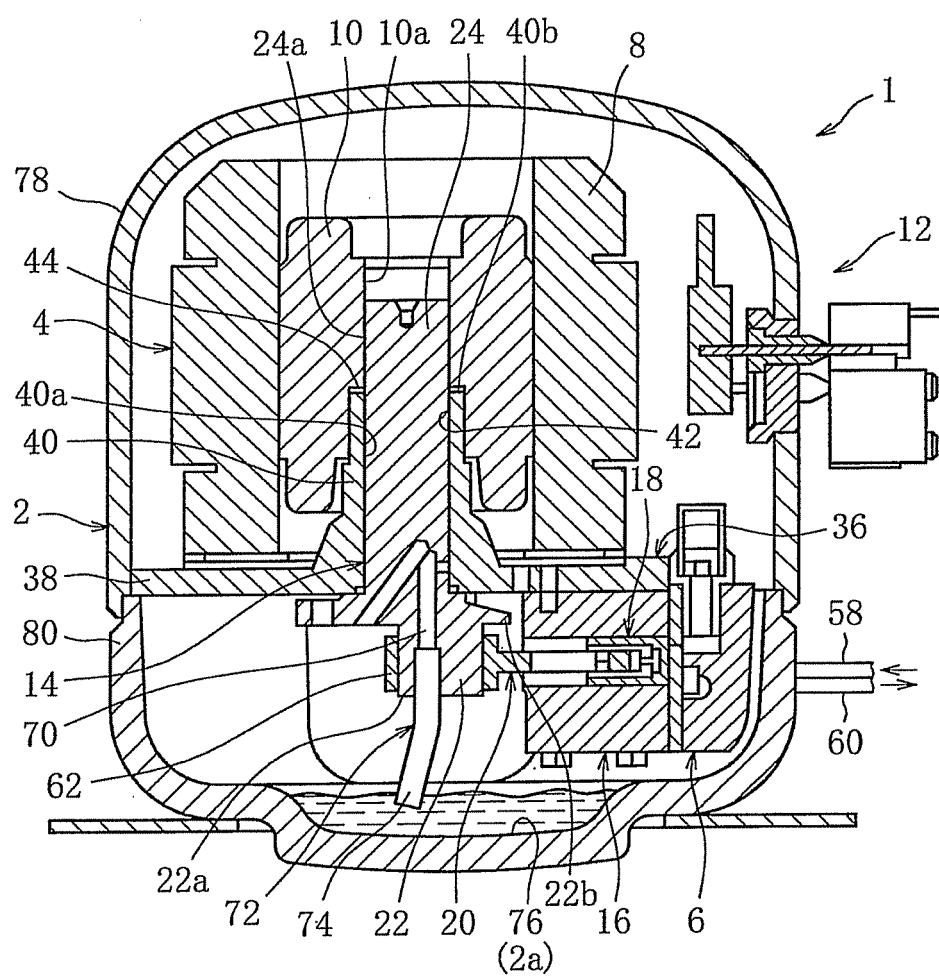


FIG. 5



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000459

## A. CLASSIFICATION OF SUBJECT MATTER

F04B39/02(2006.01)i, F04B39/12(2006.01)i, F04C29/02(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)

F04B39/02, F04B39/12, F04C29/02

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. |
|-------------|----------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| X<br>Y<br>A | JP 62-258182 A (Hitachi, Ltd.),<br>10 November 1987 (10.11.1987),<br>page 2, upper right column, line 19 to page 3,<br>upper right column, line 9; fig. 1 to 3<br>(Family: none) | 1, 2, 7<br>8<br>3-6   |
| X<br>Y      | JP 62-129595 A (Hitachi, Ltd.),<br>11 June 1987 (11.06.1987),<br>page 2, upper right column, line 9 to page 3,<br>lower left column, line 8; fig. 1 to 5<br>(Family: none)       | 1, 2, 7<br>8          |
| Y           | JP 2000-73951 A (Mitsubishi Electric Corp.),<br>07 March 2000 (07.03.2000),<br>paragraphs [0049] to [0054]; fig. 1<br>& US 6189322 B1 & CN 1234429 A                             | 8                     |



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search  
09 May, 2011 (09.05.11)Date of mailing of the international search report  
24 May, 2011 (24.05.11)Name and mailing address of the ISA/  
Japanese Patent Office

Authorized officer

Facsimile No.

Telephone No.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/000459

## C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

| Category* | Citation of document, with indication, where appropriate, of the relevant passages                                                                                                                    | Relevant to claim No. |
|-----------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|-----------------------|
| A         | JP 2-11888 A (Matsushita Electric Industrial Co., Ltd.),<br>16 January 1990 (16.01.1990),<br>page 2, lower right column, line 8 to page 3,<br>upper right column, line 2; fig. 1, 3<br>(Family: none) | 1-8                   |
| A         | JP 62-197675 A (Matsushita Refrigeration Co.),<br>01 September 1987 (01.09.1987),<br>page 2, upper right column, line 8 to lower<br>left column, line 10; fig. 1 to 3<br>(Family: none)               | 1-8                   |
| A         | JP 2004-308623 A (Matsushita Electric Industrial Co., Ltd.),<br>04 November 2004 (04.11.2004),<br>fig. 1, 2<br>& WO 2004/090333 A1                                                                    | 1-8                   |

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**REFERENCES CITED IN THE DESCRIPTION**

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**Patent documents cited in the description**

- JP 6294380 A [0003]