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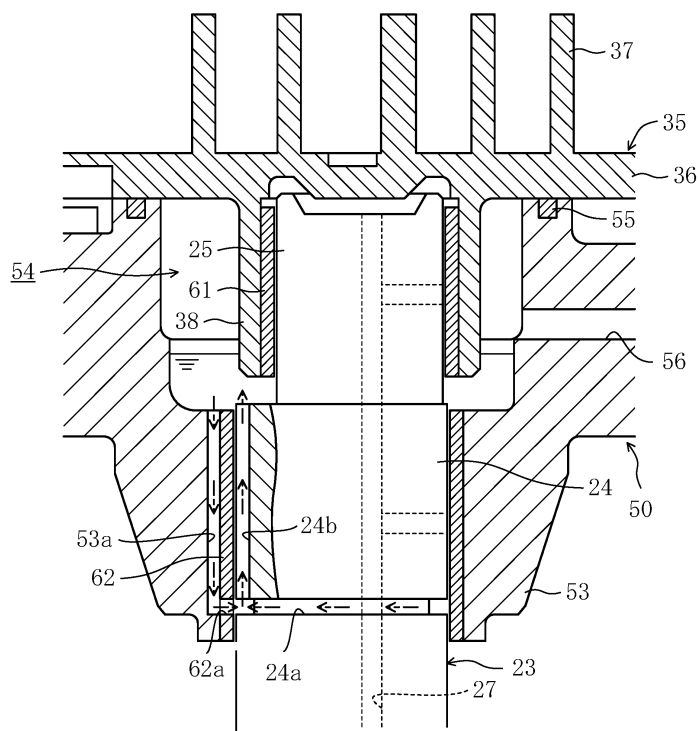
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(54) **SCROLL COMPRESSOR**

(57) If oil shortage occurs and oil feed to an upper bearing (62) through an oil feed path (27) is stopped, oil accumulated in a crank chamber (54) is fed to the upper

bearing (62) from the crank chamber (54) through a bearing back-face passage (53a) and an annular groove (24a) due to a pump effect of a spiral groove (24b).

FIG.4



Description

TECHNICAL FIELD

[0001] The present invention relates to a scroll compressor.

BACKGROUND ART

[0002] Rotary compressors in which lubricating oil is continuously supplied to a gap between a crank shaft and a bearing to achieve smooth rotation of the crank shaft with respect to the bearing have been known (see, e.g., Patent Document 1). Specifically, this crank shaft includes an oil feed path through which the lubricating oil accumulated in the bottom of the casing is sucked up. The lubricating oil which has passed through the oil feed path is fed to the bearing gap.

[0003] However, the lubricating oil may sometimes be discharged to the outside of the casing with a refrigerant gas compressed by a compression mechanism. Thus, if an excessive oil discharge occurs since a large amount of lubricating oil has been discharged to the outside of the casing, the lubricating oil at the bottom of the casing is depleted and oil shortage occurs. As a result, no lubricating oil is fed to the bearing gap.

[0004] To avoid this, the rotary compressor disclosed in Patent Document 1 is configured such that the lubricating oil flowing down through a bearing gap is collected in an annular groove formed in a crank shaft, and the lubricating oil collected in the annular groove is transferred to a crank chamber through a bearing back-face passage formed in a housing closer to the back face of the bearing such that the lubricating oil is accumulated in the crank chamber.

[0005] Thus, if the lubricating oil at the bottom of the casing is depleted and supply of the lubricating oil to the bearing gap through the oil feed path is stopped, the lubricating oil accumulated in the crank chamber flows into the bearing gap due to its own weight to achieve continuous lubrication of the sliding portion between the crank shaft and the bearing.

CITATION LIST

PATENT DOCUMENT

[0006] Patent Document 1: Japanese Unexamined Patent Publication No. 2012-097576

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0007] However, in the known rotary compressors, the gap between the crank shaft and the bearing is set to be very narrow. Thus, the problem is that only a small amount of oil can flow, due to its own weight, into the

bearing gap from the crank chamber. This may lead to unsatisfactory lubrication at the sliding portion between the crank shaft and the bearing even in the event of the depletion of the lubricating oil, since the lubricating oil accumulated in the crank chamber cannot be effectively used.

[0008] In view of the foregoing, it is therefore an object of the present invention to achieve continuous lubrication of a sliding portion between a crank shaft and a bearing even in a situation in which no oil is fed to a sliding surface of the crank shaft through an oil feed path during rotation of the crank shaft.

SOLUTION TO THE PROBLEM

[0009] Aspects of the present disclosure are directed to a scroll compressor which includes: a casing (11) provided with an oil reservoir (17) at a bottom; a fixed scroll (40) and a movable scroll (35) which are housed in the casing (11); a crank shaft (23) having an upper end portion slidably connected to a boss (38) on a back face of the movable scroll (35); and a housing (50) arranged under the movable scroll (35) and having an upper bearing (62) which rotatably supports the crank shaft (23). The present disclosure provides the following solutions.

[0010] Specifically, a first aspect of the present disclosure is characterized in that: the crank shaft (23) is provided with an oil feed path (27) which feeds oil in the oil reservoir (17) to a sliding surface between the boss (38) and the upper bearing (62); the housing (50) is provided with a crank chamber (54) which is a recessed portion of the housing (50) closer to a top surface thereof to house the boss (38) of the movable scroll (35), and the crank chamber (54) being configured to accumulate oil fed to a sliding surface of the crank shaft (23) through the oil feed path (27); the crank shaft (23) is provided, on an outer peripheral surface thereof, with an annular groove (24a) formed at a lower position of a sliding surface with the upper bearing (62) and extending in a circumferential direction of the crank shaft (23) to collect oil fed to the upper bearing (62), and a spiral groove (24b) connecting the crank chamber (54) and the annular groove (24a) to transfer oil collected in the annular groove (24a) to the crank chamber (54); the housing (50) is provided with a bearing back-face passage (53a) formed at a position closer to a back face of the upper bearing (62), the bearing back-face passage (53a) connecting the crank chamber (54) and the annular groove (24a); and in an event in which no oil is fed from the oil reservoir (17) to the sliding surface of the crank shaft (23) through the oil feed path (27) during rotation of the crank shaft (23), the oil accumulated in the crank chamber (54) is fed to the upper bearing (62) from the crank chamber (54) through the bearing back-face passage (53a) and the annular groove (24a) due to a pump effect of the spiral groove (24b).

[0011] According to the first aspect of the present disclosure, the outer peripheral surface of the crank shaft (23) is provided with an annular groove (24a) and a spiral

groove (24b). The annular groove (24a) collects the oil which has been fed to the upper bearing (62). The oil collected in the annular groove (24a) passes through the spiral groove (24b) to be transferred to the crank chamber (54). The housing (50) is provided with a bearing back-face passage (53a) at a position closer to the back face of the upper bearing (62). The bearing back-face passage (53a) connects the crank chamber (54) and the annular groove (24a).

[0012] This configuration allows continuous lubrication of the sliding portion between the crank shaft (23) and the upper bearing (62) even if oil shortage occurs and no oil is fed to the sliding surface of the crank shaft (23) from the oil reservoir (17) through the oil feed path (27) during rotation of the crank shaft (23).

[0013] Specifically, oil is not fed to the upper bearing (62) through the oil feed path (27) if the remaining amount of oil accumulated in the oil reservoir (17) is small. If the crank shaft (23) continues to rotate in this oil shortage state, seizing between the crank shaft (23) and the upper bearing (62) may occur.

[0014] To avoid this, an aspect of the present disclosure is that if oil shortage occurs and oil feed to the upper bearing (62) through the oil feed path (27) is stopped, the oil accumulated in the crank chamber (54) is fed to the upper bearing (62) from the crank chamber (54) through the bearing back-face passage (53a) and the annular groove (24a) due to a pump effect of the spiral groove (24b). This allows continuous lubrication of the sliding portion between the crank shaft (23) and the upper bearing (62) even after the oil shortage, as long as oil is accumulated in the crank chamber (54). As a result, seizing between the crank shaft (23) and the upper bearing (62) may be reduced.

[0015] A second aspect of the present disclosure is an embodiment of the first aspect of the present disclosure. In the second aspect, in a normal operation in which the oil is fed from the oil reservoir (17) to the sliding surface of the crank shaft (23) through the oil feed path (27), the oil collected in the annular groove (24a) passes through the spiral groove (24b) and the bearing back-face passage (53a) to be transferred to the crank chamber (54).

[0016] According to the second aspect of the present disclosure, the oil collected in the annular groove (24a) is transferred to the crank chamber (54) not only through the spiral groove (24b), but also through the bearing back-face passage (53a) in a normal operation. The amount of oil that is transferred from the annular groove (24a) to the crank chamber (54) may be increased accordingly.

[0017] A third aspect of the present disclosure is an embodiment of the first or second aspect of the present disclosure. In the third aspect, an inner wall surface of the crank chamber (54) is provided with an auxiliary oil reservoir (57) which is recessed in a radial direction and is capable of accumulating oil together with the crank chamber (54).

[0018] According to the third aspect of the present dis-

closure, the oil which has been fed to the sliding surface of the crank shaft (23) can be accumulated not only in the crank chamber (54), but also in the auxiliary oil reservoir (57). This allows continuous lubrication of the sliding portion between the crank shaft (23) and the upper bearing (62) for a longer period of time even after the oil shortage, compared to the case in which oil is accumulated in only the crank chamber (54).

[0019] A fourth aspect of the present disclosure is an embodiment of the third aspect of the present disclosure. In the fourth aspect, the housing (50) is provided with an oil discharge passage (56) whose upstream end is open to the inner wall surface of the crank chamber (54) at a position away from a bottom surface of the crank chamber (54) by a predetermined distance, and whose downstream end is open to an outside of the housing (50), and the auxiliary oil reservoir (57) is open to the inner wall surface of the crank chamber (54) at a position lower in height than the oil discharge passage (56).

[0020] According to the fourth aspect of the present disclosure, the auxiliary oil reservoir (57) is open at a position lower in height than the oil discharge passage (56). This prevents the oil from being discharged from the crank chamber (54) and the auxiliary oil reservoir (57) to the oil discharge passage (56) until the level of the oil accumulated in the crank chamber (54) and the auxiliary oil reservoir (57) reaches the opening position of the upstream end of the oil discharge passage (56). It is therefore possible to accumulate a predetermined amount of oil in the crank chamber (54) and the auxiliary oil reservoir (57).

ADVANTAGES OF THE INVENTION

[0021] According to the aspects of the present disclosure, if oil shortage occurs and oil feed to the upper bearing (62) through the oil feed path (27) is stopped, the oil accumulated in the crank chamber (54) is fed to the upper bearing (62) from the crank chamber (54) through the bearing back-face passage (53a) and the annular groove (24a) due to a pump effect of the spiral groove (24b). This allows continuous lubrication of the sliding portion between the crank shaft (23) and the upper bearing (62) even after the oil shortage, as long as the oil is accumulated in the crank chamber (54). As a result, seizing between the crank shaft (23) and the upper bearing (62) may be reduced.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

[FIG. 1] FIG. 1 is a longitudinal cross-sectional view illustrating a configuration of a scroll compressor according to a first embodiment.

[FIG. 2] FIG. 2 is a longitudinal cross-sectional view illustrating an oil flow in a normal operation.

[FIG. 3] FIG. 3 is a front view illustrating a shape of

a transfer groove formed in a crank shaft.

[FIG. 4] FIG. 4 corresponds to FIG. 2 and illustrates an oil flow when oil in an oil reservoir is depleted.

[FIG. 5] FIG. 5 is a perspective view, part of which is a cross-sectional view, illustrating a configuration of a housing of a scroll compressor according to a second embodiment.

[FIG. 6] FIG. 6 is a perspective view illustrating the configuration of the housing.

[FIG. 7] FIG. 7 is a horizontal cross-sectional view illustrating the configuration of the housing.

[FIG. 8] FIG. 8 is a perspective cross-sectional view illustrating an oil flow in a normal operation.

[FIG. 9] FIG. 9 corresponds to FIG. 8 and illustrates an oil flow when oil in an oil reservoir is depleted.

DESCRIPTION OF EMBODIMENTS

[0023] Embodiments of the present invention will be described below, based on the drawings. The following embodiments are merely preferred examples in nature, and are not intended to limit the scope, applications, and use of the invention.

«First Embodiment»

[0024] FIG. 1 is a longitudinal cross-sectional view illustrating a configuration of a scroll compressor according to a first embodiment of the present invention. A scroll compressor (10) is connected, for example, to a refrigeration circuit which performs a vapor compression refrigeration cycle in an air conditioner. The scroll compressor (10) includes a casing (11), a rotary compression mechanism (30), and a drive mechanism (20) which drives and rotates the compression mechanism (30).

[0025] The casing (11) is comprised of a vertically-elongated cylindrical sealed container with its both ends closed. The interior of the casing (11) is divided into upper and lower spaces by a housing (50) connected to an inner circumferential surface of the casing (11). The space above the housing (50) constitutes an upper space (15), and the space under the housing (50) constitutes a lower space (16). The configuration of this housing (50) will be described in detail later.

[0026] An oil reservoir (17) is provided at the bottom of the lower space (16) of the casing (11). The oil reservoir (17) accumulates oil for lubricating sliding portions of the scroll compressor (10).

[0027] A suction pipe (18) and a discharge pipe (19) are attached to the casing (11). One end of the suction pipe (18) is connected to a suction pipe coupling (47). The discharge pipe (19) passes through a body (12). One end of the discharge pipe (19) is open to the lower space (16) of the casing (11).

[0028] The drive mechanism (20) includes a motor (21) and a crank shaft (23). The motor (21) is housed in the lower space (16) of the casing (11). The motor (21) has cylindrical stator (21a) and rotor (21b). The stator (21a)

is fixed to the inner circumferential surface of the casing (11).

[0029] The rotor (21b) is arranged in a hollow of the stator (21a). The crank shaft (23) is fixed to a hollow of the rotor (21b) so as to pass through the rotor (21b), and the rotor (21b) and the crank shaft (23) rotate integrally. The configuration of the crank shaft (23) will be described in detail later.

[0030] The compression mechanism (30) is a so-called scroll compression mechanism having a movable scroll (35), a fixed scroll (40) and the housing (50). The housing (50) and the fixed scroll (40) are coupled to each other with a bolt, with the movable scroll (35) housed therebetween.

[0031] The movable scroll (35) has an approximately disc-shaped movable end plate (36). A movable wrap (37) stands on the top surface of the movable end plate (36). The movable wrap (37) is a spiral-shaped wall extending radially outward from a portion near the center of the movable end plate (36). Further, a boss (38) projects from the lower surface of the movable end plate (36).

[0032] The fixed scroll (40) has an approximately disc-shaped fixed end plate (41). A fixed wrap (42) stands on the lower surface of the fixed end plate (41). The fixed wrap (42) is a spiral-shaped wall extending radially outward from a portion near the center of the fixed end plate (41), and is configured to engage with the movable wrap (37) of the movable scroll (35). A compression chamber (31) is formed between the fixed wrap (42) and the movable wrap (37).

[0033] The fixed scroll (40) has an outer edge portion (43) which is continuous to the fixed wrap (42) and extends radially outward from the outermost wall of the fixed wrap (42). The lower end surface of the outer edge portion (43) is fixed to the upper end surface of the housing (50). Further, the outer edge portion (43) has an opening (44) that is open upward. A suction port (34) which connects the interior of the opening (44) and the outermost end of the compression chamber (31) is formed in the outer edge portion (43). The suction port (34) is open at a suction position of the compression chamber (31). The suction pipe coupling (47) mentioned above is connected to the opening (44) formed in the outer edge portion (43).

[0034] A discharge port (32) is formed in the fixed end plate (41) of the fixed scroll (40) at a position near the center of the fixed wrap (42). The discharge port (32) vertically passes through the fixed end plate (41). The lower end of the discharge port (32) is open at a discharge position of the compression chamber (31). The upper end of the discharge port (32) is open to a discharge chamber (46) defined in an upper portion of the fixed scroll (40). Although not shown, the discharge chamber (46) communicates with the lower space (16) of the casing (11).

[0035] The housing (50) has an approximately cylindrical shape. The outer peripheral surface of the housing (50) has a gradually decreasing diameter from the top to

the bottom of the housing (50). An upper portion of this outer peripheral surface is fixed to the inner circumferential surface of the casing (11).

[0036] The crank shaft (23) is inserted in a hollow of the housing (50). Further, this hollow of the housing (50) has a larger diameter at its upper portion, compared to its lower portion, since the housing (50) closer to its top surface is recessed. An upper bearing portion (53) is provided at the lower portion of the hollow. An upper bearing (62) is inserted in the upper bearing portion (53). A bearing back-face passage (53a), which will be described later, is formed in the housing (50) closer to the back face of the upper bearing (62).

[0037] A sealing member (55) is fitted between the top surface of the housing (50) and the back face of the movable scroll (35). The upper hollow of the housing (50) is defined by the sealing member (55) and constitutes a crank chamber (54).

[0038] The crank chamber (54) faces the back face of the movable scroll (35). The boss (38) of the movable scroll (35) is located in the crank chamber (54). A pin bearing (61) is inserted in the boss (38).

[0039] A lower bearing portion (28) is fixed to the casing (11) near the lower end of the body (12). A lower bearing (63) is inserted in the lower bearing portion (28).

[0040] The crank shaft (23) includes a vertically-extending main shaft portion (24) and an eccentric portion (25) provided at the upper end of the main shaft portion (24). The main shaft portion (24) and the eccentric portion (25) are integrally formed. The eccentric portion (25) has a smaller diameter than the largest diameter of the main shaft portion (24). The center of the eccentric portion (25) is eccentric by a predetermined distance with respect to the center of the main shaft portion (24). The eccentric portion (25) engages with the pin bearing (61) of the boss (38). The movable scroll (35) therefore revolves around when the crank shaft (23) rotates.

[0041] An upper end portion of the main shaft portion (24) of the crank shaft (23) is rotatably supported by the upper bearing (62) of the upper bearing portion (53) of the housing (50). A lower end portion of the main shaft portion (24) is rotatably supported by the lower bearing (63) of the lower bearing portion (28).

[0042] An oil feed path (27) is formed in the crank shaft (23) so as to extend along the axial direction of the crank shaft (23). The oil feed path (27) branches to the pin bearing (61), the upper bearing (62) and the lower bearing (63) from the axis along which the oil feed path (27) extends.

[0043] An oil feed nozzle (26) is provided at a lower end portion of the crank shaft (23). The oil feed nozzle (26) has a suction port that is open to the oil reservoir (17) of the casing (11). The oil feed nozzle (26) has a discharge port that is connected to the oil feed path (27) formed in the crank shaft (23). Oil suctioned by the oil feed nozzle (26) from the oil reservoir (17) of the casing (11) is fed to the sliding portions, such as the pin bearing (61), the upper bearing (62) and the lower bearing (63),

of the scroll compressor (10).

[0044] Oil fed from the oil feed path (27) to the sliding surface between the pin bearing (61) and the eccentric portion (25) flows down due to its own weight into the crank chamber (54). This means that the crank chamber (54) has the same pressure as the lower space (16) of the casing (11). This pressure of the crank chamber (54) acts on the back face of the movable scroll (35), and pushes the movable scroll (35) toward the fixed scroll (40).

[0045] The main shaft portion (24) of the crank shaft (23) has, on its outer peripheral surface, an annular groove (24a) and a spiral groove (24b). The annular groove (24a) is formed at a lower position of the sliding surface with the upper bearing (62), and extends in the circumferential direction of the main shaft portion (24). The annular groove (24a) connects the crank chamber (54) and the annular groove (24a).

[0046] Part of oil fed from the oil feed path (27) to the sliding surface between the upper bearing (62) and the main shaft portion (24) flows up into the crank chamber (54). The rest of the oil flows down and is collected in the annular groove (24a).

[0047] The spiral groove (24b) is configured to transfer the oil collected in the annular groove (24a) to the crank chamber (54). Specifically, as illustrated in FIG. 3, the spiral groove (24b) is tilted with respect to the axial direction of the crank shaft (23) such that an upper end portion of the spiral groove (24b) is located rearward of a lower end portion of the spiral groove (24b) in a rotational direction (indicated by arrow in FIG. 3) of the crank shaft (23). If the spiral groove (24b) is tilted in this manner that is opposite to the rotational direction of the crank shaft (23), the oil in the annular groove (24a) goes up along the spiral groove (24b) due to viscosity pump effects, allowing the oil to be transferred into the crank chamber (54).

[0048] The housing (50) is provided with the bearing back-face passage (53a), which connects the crank chamber (54) and the annular groove (24a), at a position closer to the back face of the upper bearing (62). Specifically, the upper bearing (62) is provided with a through hole (62a) which connects a lower end portion of the bearing back-face passage (53a) and the annular groove (24a). The bearing back-face passage (53a) communicates with the annular groove (24a) via the through hole (62a). This configuration allows the oil collected in the annular groove (24a) to be transferred to the crank chamber (54) not only through the spiral groove (24b), but also through the bearing back-face passage (53a).

[0049] The housing (50) is provided with an oil discharge passage (56) for discharging the oil which has flowed into the crank chamber (54) to the outside of the housing (50). Specifically, the upstream end of the oil discharge passage (56) is open to the inner wall surface of the crank chamber (54) at a position away from the bottom surface of the crank chamber (54) by a predetermined distance. The downstream end of the oil discharge

passage (56) is open downward at a position closer to the outer periphery of the housing (50) so as to communicate with the lower space (16).

[0050] This prevents the oil from being discharged from the crank chamber (54) to the oil discharge passage (56) until the level of the oil accumulated in the crank chamber (54) reaches the opening position of the upstream end of the oil discharge passage (56). It is thus possible to accumulate a predetermined amount of oil in the crank chamber (54).

-Operation-

[0051] Operation of the above-described scroll compressor (10) will now be described. As illustrated in FIG. 1, when the motor (21) of the scroll compressor (10) is activated, the rotor (21b) and the crank shaft (23) are rotated, and the movable scroll (35) revolves around. This revolution of the movable scroll (35) periodically increases and decreases the volume of the compression chamber (31).

[0052] Specifically, when the crank shaft (23) rotates, a refrigerant is sucked into the compression chamber (31) from the suction port (34). As the crank shaft (23) continues to rotate, the compression chamber (31) is completely closed. With further rotation of the crank shaft (23), the volume of the compression chamber (31) starts decreasing, and compression of the refrigerant in the compression chamber (31) starts.

[0053] After that, the volume of the compression chamber (31) further decreases, and the discharge port (32) opens when the volume of the compression chamber (31) decreases to a predetermined volume. Through this discharge port (32), the refrigerant compressed in the compression chamber (31) is discharged to the discharge chamber (46) of the fixed scroll (40). The refrigerant in the discharge chamber (46) is discharged from the discharge pipe (19) via the lower space (16) of the casing (11). As mentioned above, the lower space (16) communicates with the crank chamber (54). The movable scroll (35) is pushed toward the fixed scroll (40) by the pressure of the refrigerant in the crank chamber (54).

-Oil feed in normal operation-

[0054] Oil feed in the scroll compressor (10) will now be described. As illustrated in FIG. 2, when the compression mechanism (30) starts operating, the oil in the oil reservoir (17) is sucked up through the oil feed nozzle (26) due to centrifugal pump effects. Then, the oil sucked up through the oil feed nozzle (26) flows through the oil feed path (27) in the crank shaft (23) and is fed to sliding portions, such as a thrust sliding surface between the movable scroll (35) and the fixed scroll (40), a sliding surface between the pin bearing (61) of the boss (38) and the eccentric portion (25), a sliding surface between the upper bearing (62) of the housing (50) and the main shaft portion (24), and a sliding surface between the lower

bearing (63) of the lower bearing portion (28) and the main shaft portion (24). The oil which has been fed to the respective sliding portions is collected in the oil reservoir (17).

[0055] The oil which has been fed to the sliding surface between the pin bearing (61) of the boss (38) and the eccentric portion (25) flows in the crank chamber (54). Part of the oil which has been fed to the sliding surface between the upper bearing (62) and the main shaft portion (24) flows up into the crank chamber (54).

[0056] The rest of the oil fed to the sliding surface between the upper bearing (62) and the main shaft portion (24) flows down to be collected in the annular groove (24a). The oil collected in the annular groove (24a) passes through the spiral groove (24b) and the bearing back-face passage (53a), and flows into the crank chamber (54). The oil starts to be accumulated in the crank chamber (54). When the oil level reaches the opening position of the oil discharge passage (56), the oil in the crank chamber (54) passes through the oil discharge passage (56) and is discharged to the outside of the housing (50) to be collected in the oil reservoir (17).

-Oil feed in the event of oil shortage-

[0057] Now, oil feed in the scroll compressor (10) in the following situation will be described in which an excessive oil discharge occurs since a large amount of oil has been discharged to the outside of the casing (11), and the oil accumulated in the oil reservoir (17) is depleted, thus causing oil shortage.

[0058] As illustrated in FIG. 4, if oil shortage occurs and oil feed to the upper bearing (62) through the oil feed path (27) is stopped, the oil accumulated in the crank chamber (54) is fed from the crank chamber (54) to the upper bearing (62) through the bearing back-face passage (53a) and the annular groove (24a) due to pump effects of the spiral groove (24b).

[0059] Thus, the oil circulates at the sliding portion between the crank shaft (23) and the upper bearing (62) even after the oil shortage, as long as the oil is accumulated in the crank chamber (54). This allows continuous lubrication of the sliding portion, and may reduce seizing between the crank shaft (23) and the upper bearing (62).

«Second Embodiment»

[0060] In the following description, like reference characters are used to designate the same elements as those in the first embodiment, and only differences will be described.

[0061] As illustrated in FIGS. 5-7, the housing (50) includes the crank chamber (54) which is a recessed portion of the housing (50) closer to its top surface. The bottom of the crank chamber (54) is provided with an annular elastic groove (29). The oil fed to the sliding surface of the eccentric portion (25) through the oil feed path (27) of the crank shaft (23) flows down, due to its own

weight, into the crank chamber (54).

[0062] The housing (50) is provided with the oil discharge passage (56) for discharging the oil which has flowed into the crank chamber (54) to the outside of the housing (50). Specifically, the upstream end of the oil discharge passage (56) is open to the inner wall surface of the crank chamber (54) at a position away from the bottom surface of the crank chamber (54) by a predetermined distance. The downstream end of the oil discharge passage (56) is open downward at a position closer to the outer periphery of the housing (50) so as to communicate with the lower space (16).

[0063] The inner wall surface of the crank chamber (54) is provided with auxiliary oil reservoirs (57) recessed in a radial direction. Specifically, the auxiliary oil reservoirs (57) are comprised of holes each passing through the housing (50) in the radial direction from the inner wall surface of the crank chamber (54), and this housing (50) is fitted and fixed to the body (12) of the casing (11) to allow the hole to accumulate oil.

[0064] The auxiliary oil reservoirs (57) are for accumulating part of the oil which has flowed into the crank chamber (54), and arranged at six positions of the housing (50) which are spaced apart from each other in the circumferential direction of the housing (50) (see FIG. 7).

[0065] Thus, oil can be accumulated not only in the crank chamber (54), but also in the auxiliary oil reservoirs (57). This allows continuous lubrication of the sliding portion between the crank shaft (23) and the upper bearing (62) for a longer period of time even after the oil shortage, compared to the case in which oil is accumulated in only the crank chamber (54).

[0066] Further, the auxiliary oil reservoirs (57) are open to the inner wall surface of the crank chamber (54) at positions lower in height than the oil discharge passage (56). This prevents the oil from being discharged from the crank chamber (54) and the auxiliary oil reservoirs (57) to the oil discharge passage (56) until the level of the oil accumulated in the crank chamber (54) and the auxiliary oil reservoirs (57) reaches the opening position of the upstream end of the oil discharge passage (56). It is thus possible to accumulate a predetermined amount of oil in the crank chamber (54) and the auxiliary oil reservoirs (57).

[0067] Note that the number and positions of the auxiliary oil reservoirs (57) are merely examples, and are not limited thereto.

-Oil feed in normal operation-

[0068] Oil feed in normal operation will now be described. As illustrated in FIG. 8, the oil which has flowed through the oil feed path (27) of the crank shaft (23) and has been fed to the sliding surface of the eccentric portion (25) flows into the crank chamber (54) and the auxiliary oil reservoirs (57). Further, part of the oil which has been fed to the sliding surface between the upper bearing (62) and the main shaft portion (24) flows up into the crank

chamber (54) and the auxiliary oil reservoirs (57).

[0069] The rest of the oil fed to the sliding surface between the upper bearing (62) and the main shaft portion (24) flows down to be collected in the annular groove (24a). The oil collected in the annular groove (24a) passes through the spiral groove (24b) and the bearing back-face passage (53a), and flows into the crank chamber (54) and the auxiliary oil reservoirs (57). The oil starts to be accumulated in the crank chamber (54) and the auxiliary oil reservoirs (57). When the oil level reaches the opening position of the oil discharge passage (56), the oil in the crank chamber (54) and the auxiliary oil reservoirs (57) passes through the oil discharge passage (56) and is discharged to the outside of the housing (50) (see FIG. 5).

-Oil feed in the event of oil shortage-

[0070] Oil feed in the event of oil shortage will now be described. As illustrated in FIG. 9, if oil shortage occurs and oil feed to the upper bearing (62) through the oil feed path (27) is stopped, the oil accumulated in the crank chamber (54) and the auxiliary oil reservoirs (57) is fed to the upper bearing (62) through the bearing back-face passage (53a) and the annular groove (24a) from the crank chamber (54) and the auxiliary oil reservoirs (57) due to pump effects of the spiral groove (24b).

[0071] Thus, the oil circulates at the sliding portion between the crank shaft (23) and the upper bearing (62) even after the oil shortage, as long as the oil is accumulated in the crank chamber (54) and the auxiliary oil reservoirs (57). This allows continuous lubrication of the sliding portion, and may reduce seizing between the crank shaft (23) and the upper bearing (62).

INDUSTRIAL APPLICABILITY

[0072] As can be seen from the foregoing description, the present invention produces practical effects, that is, allowing continuous lubrication of a sliding portion between a crank shaft and a bearing even in a situation in which no oil is fed to a sliding surface of the crank shaft through an oil feed path during rotation of the crank shaft. The present invention is therefore very useful with high industrial applicability.

DESCRIPTION OF REFERENCE CHARACTERS

[0073]

10	scroll compressor
11	casing
17	oil reservoir
23	crank shaft
24a	annular groove
24b	transfer groove
27	oil feed path
35	movable scroll

38 boss
 40 fixed scroll
 50 housing
 53a bearing back-face passage
 54 crank chamber
 57 auxiliary oil reservoir
 62 upper bearing

Claims

1. A scroll compressor comprising:

a casing (11) provided with an oil reservoir (17) at a bottom;
 a fixed scroll (40) and a movable scroll (35) which are housed in the casing (11);
 a crank shaft (23) having an upper end portion slidably connected to a boss (38) on a back face of the movable scroll (35); and
 a housing (50) arranged under the movable scroll (35) and having an upper bearing (62) which rotatably supports the crank shaft (23), wherein

the crank shaft (23) is provided with an oil feed path (27) which feeds oil in the oil reservoir (17) to a sliding surface between the boss (38) and the upper bearing (62),

the housing (50) is provided with a crank chamber (54) which is a recessed portion of the housing (50) closer to a top surface thereof to house the boss (38) of the movable scroll (35), the crank chamber (54) being configured to accumulate oil fed to a sliding surface of the crank shaft (23) through the oil feed path (27),

the crank shaft (23) is provided, on an outer peripheral surface thereof, with an annular groove (24a) formed at a lower position of a sliding surface with the upper bearing (62) and extending in a circumferential direction of the crank shaft (23) to collect oil fed to the upper bearing (62), and a spiral groove (24b) connecting the crank chamber (54) and the annular groove (24a) to transfer oil collected in the annular groove (24a) to the crank chamber (54),
 the housing (50) is provided with a bearing back-face passage (53a) formed at a position closer to a back face of the upper bearing (62), the bearing back-face passage (53a) connecting the crank chamber (54) and the annular groove (24a), and

in an event in which no oil is fed from the oil reservoir (17) to the sliding surface of the crank shaft (23) through the oil feed path (27) during rotation of the crank shaft (23), the oil accumulated in the crank chamber (54) is fed to the upper bearing (62) from the crank chamber (54) through the bearing back-face passage (53a) and the annular groove (24a) due to a pump effect of the spiral groove (24b).

2. The scroll compressor of claim 1, wherein in a normal operation in which the oil is fed from the oil reservoir (17) to the sliding surface of the crank shaft (23) through the oil feed path (27), the oil collected in the annular groove (24a) passes through the spiral groove (24b) and the bearing back-face passage (53a) to be transferred to the crank chamber (54).

3. The scroll compressor of claim 1 or 2, wherein an inner wall surface of the crank chamber (54) is provided with an auxiliary oil reservoir (57) which is recessed in a radial direction and capable of accumulating oil together with the crank chamber (54).

4. The scroll compressor of claim 3, wherein the housing (50) is provided with an oil discharge passage (56) whose upstream end is open to the inner wall surface of the crank chamber (54) at a position away from a bottom surface of the crank chamber (54) by a predetermined distance, and whose downstream end is open to an outside of the housing (50), and the auxiliary oil reservoir (57) is open to the inner wall surface of the crank chamber (54) at a position lower in height than the oil discharge passage (56).

FIG.1

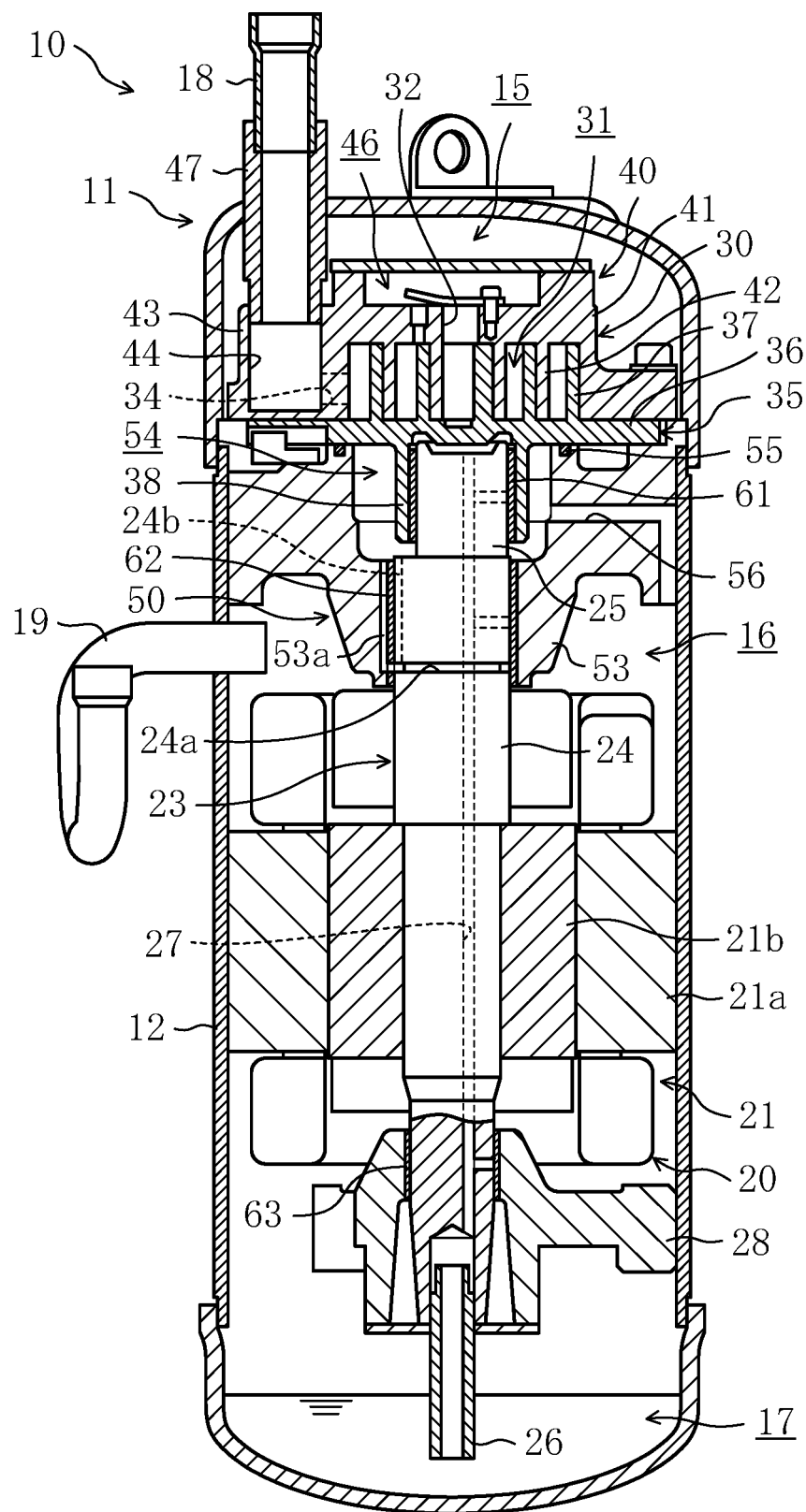


FIG.2

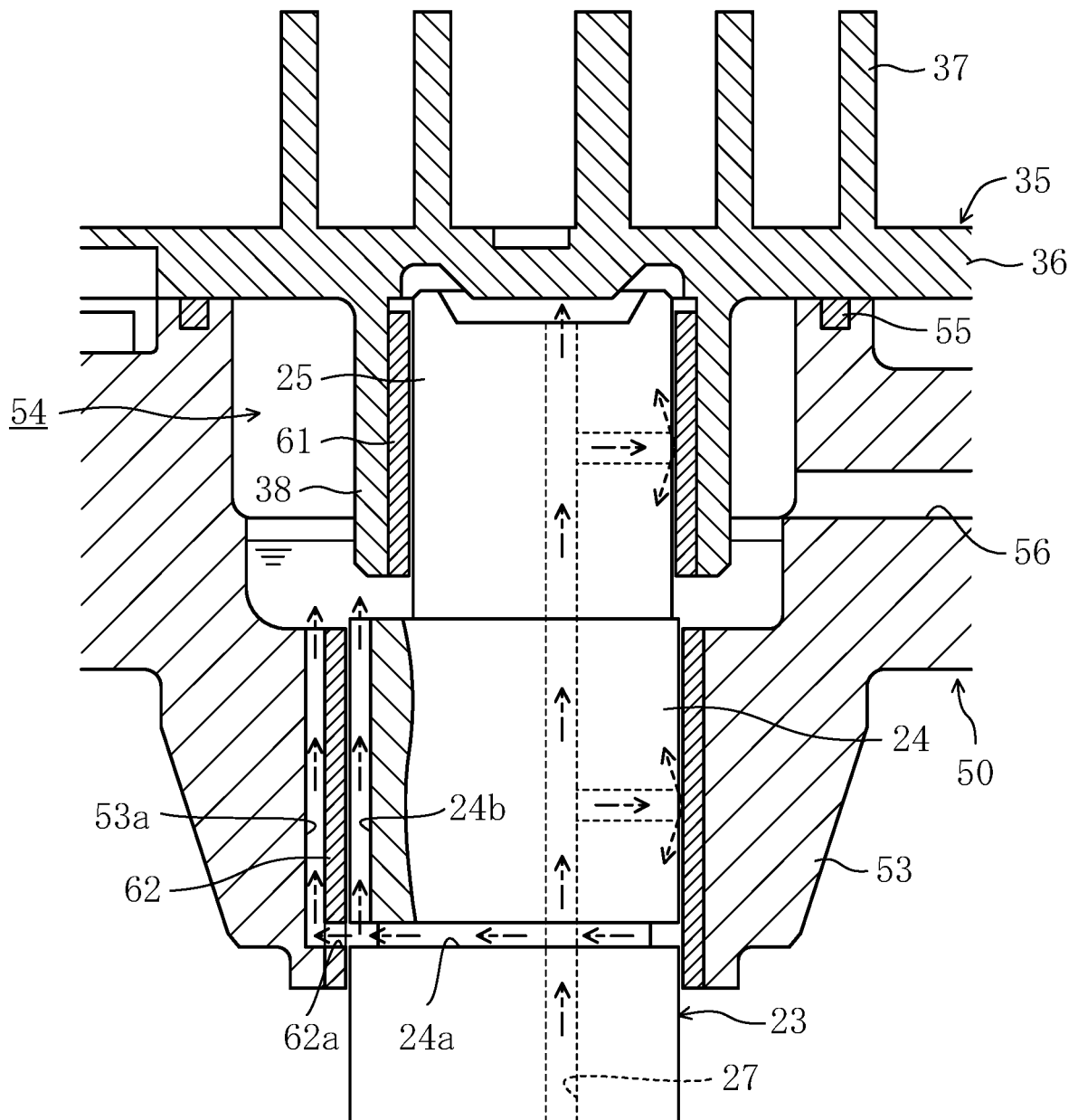


FIG.3

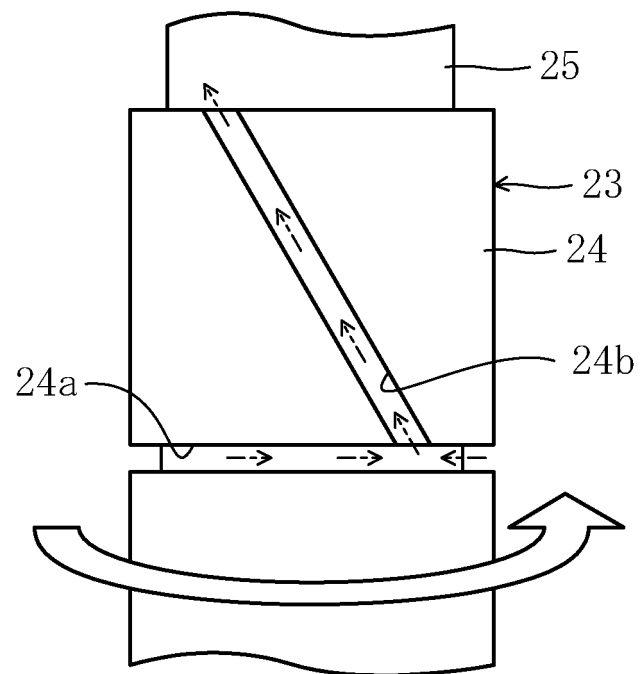


FIG.4

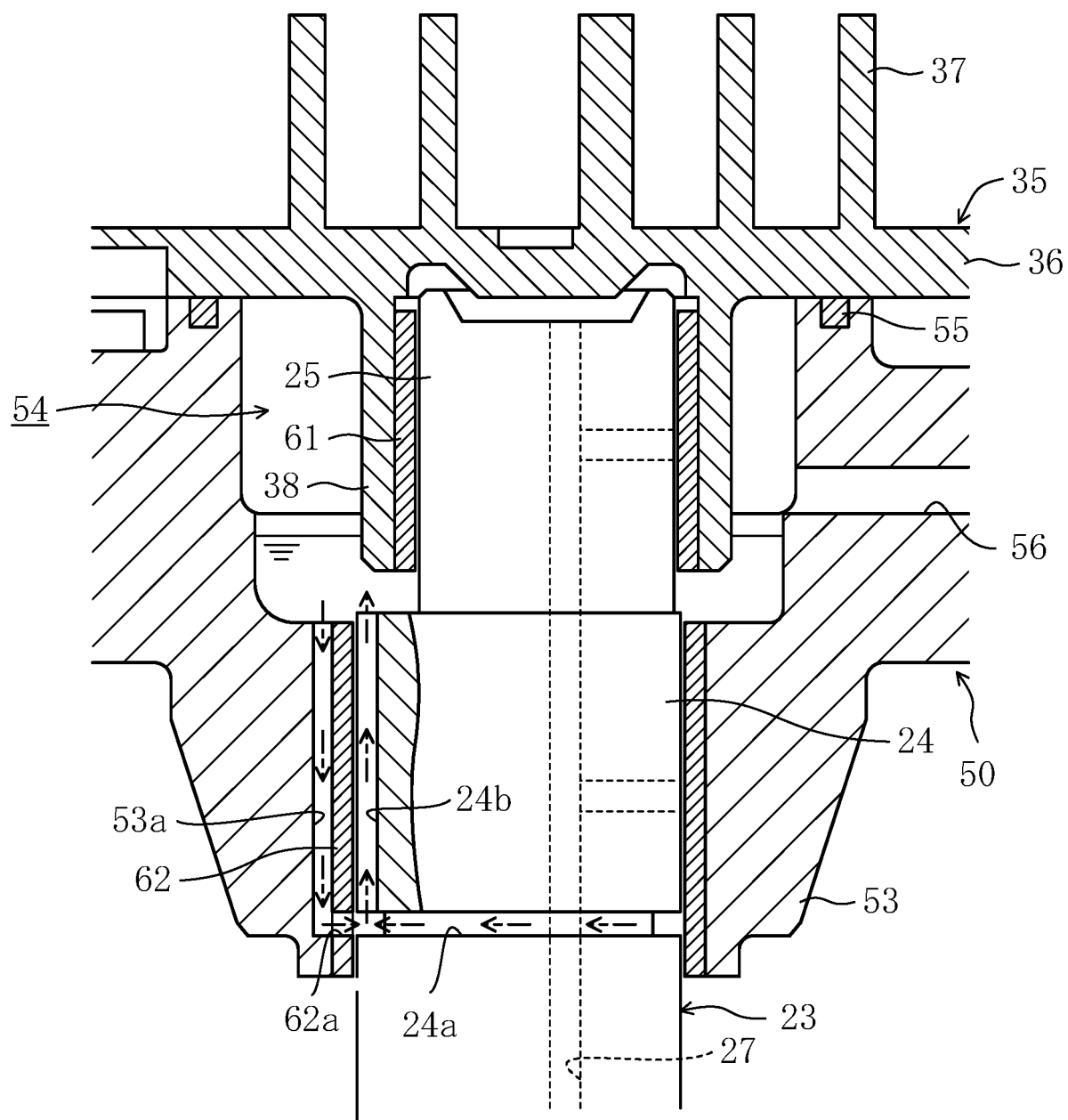


FIG.5

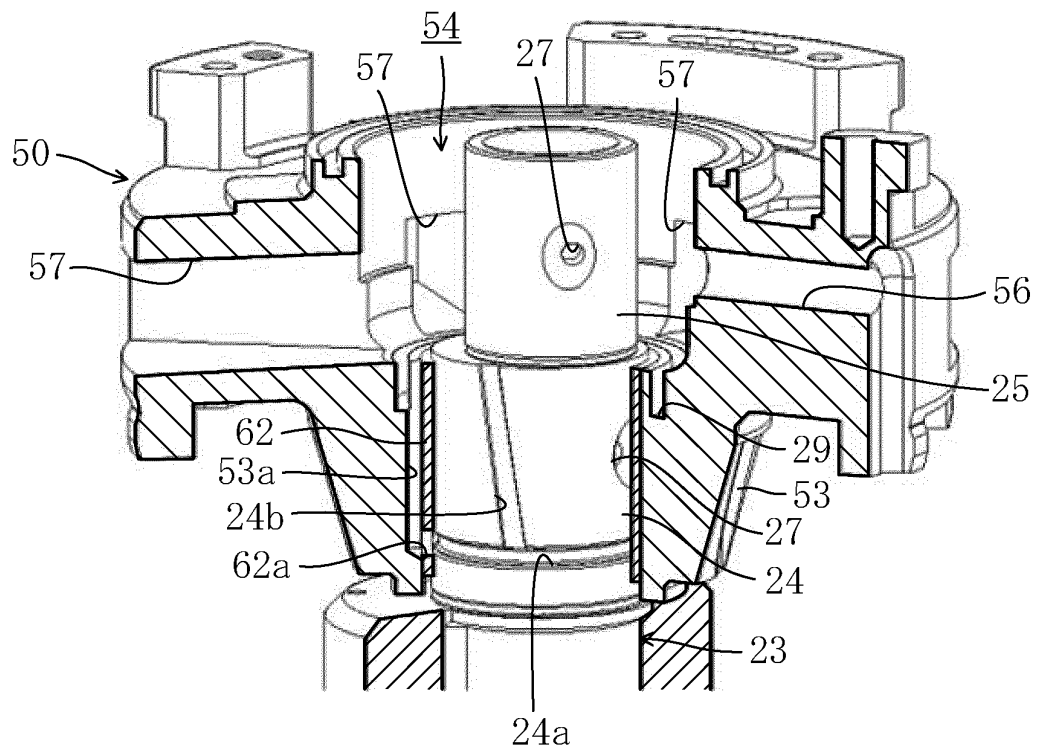


FIG.6

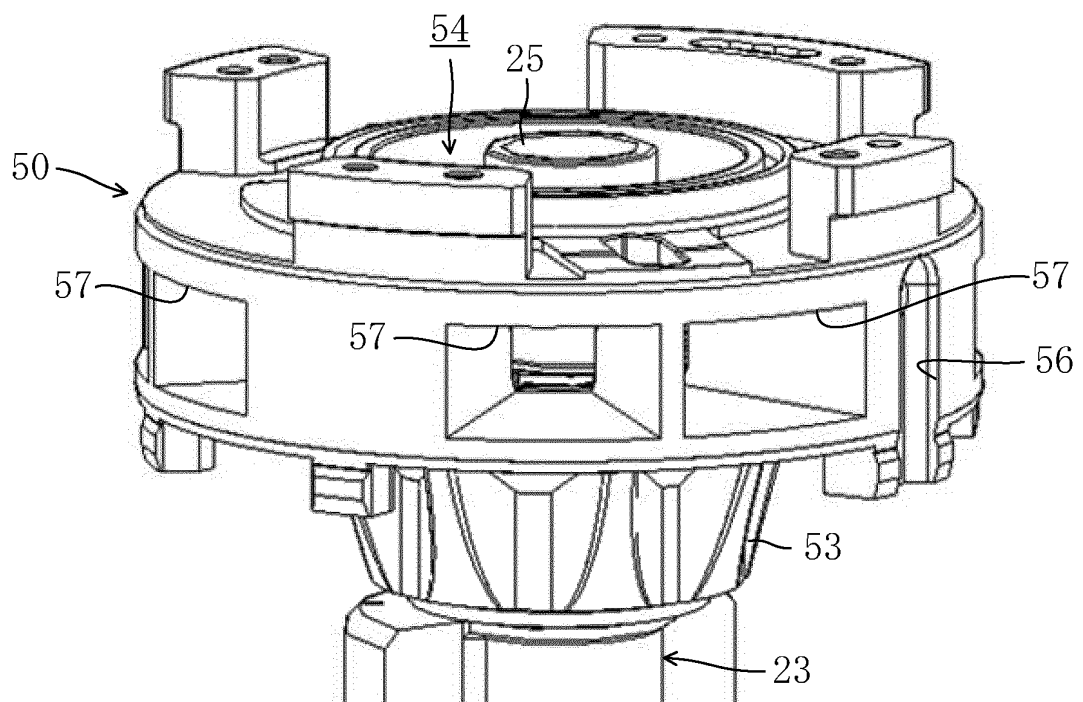


FIG.7

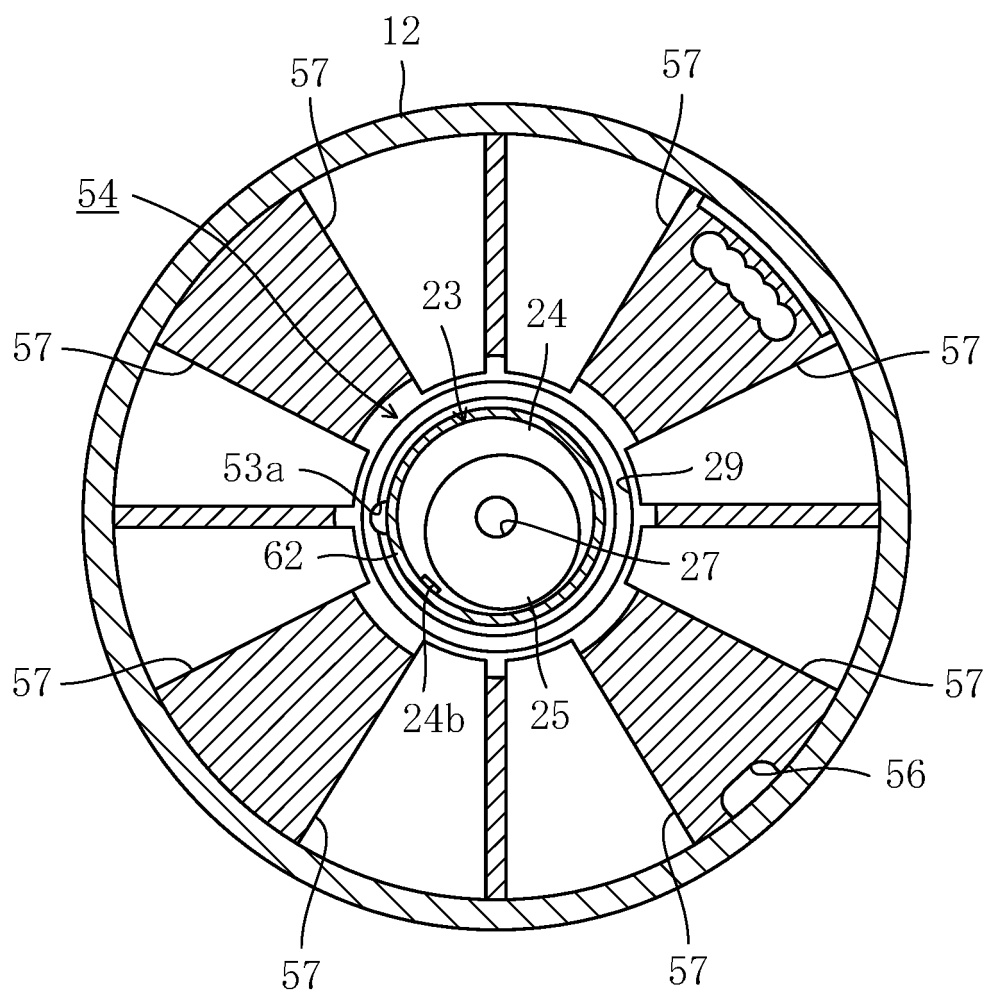


FIG.8

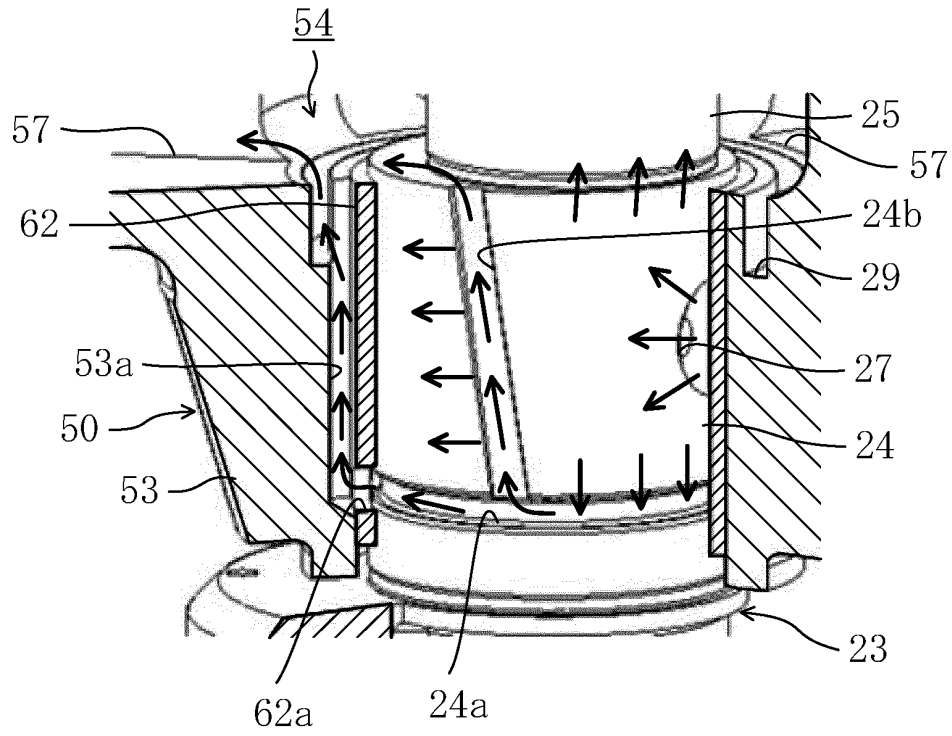
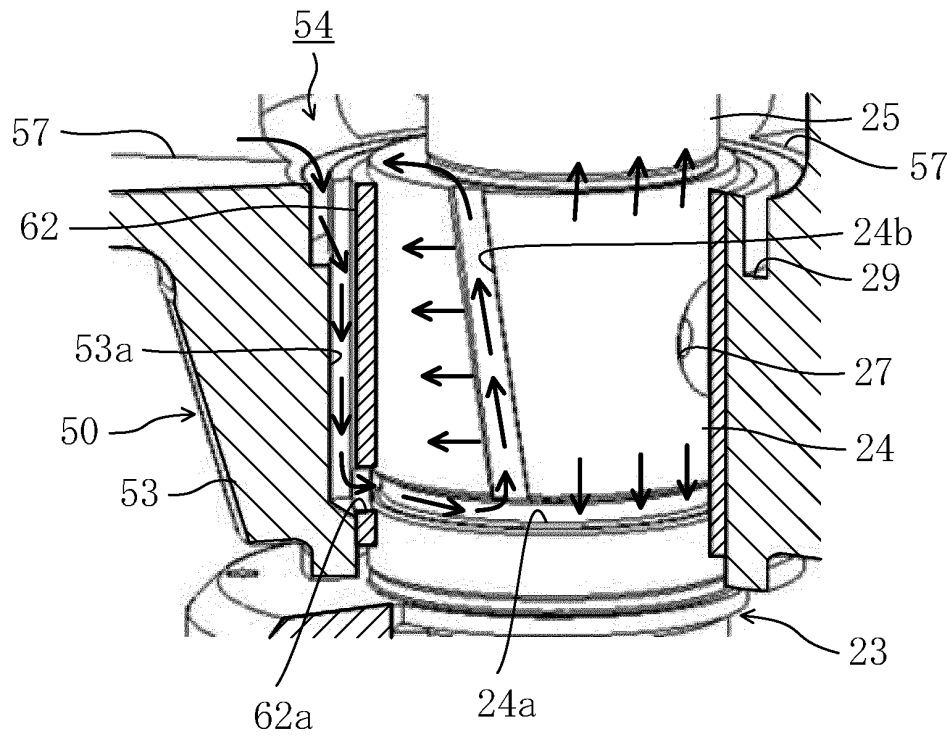


FIG.9



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/005993

A. CLASSIFICATION OF SUBJECT MATTER

F04C18/02(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)

F04C18/02, 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	1996-2015
Kokai Jitsuyo Shinan Koho	1971-2015	Toroku Jitsuyo Shinan Koho	1994-2015

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.
A	JP 2555766 B2 (Daikin Industries, Ltd.), 20 November 1996 (20.11.1996), entire text; all drawings (Family: none)	1-4
A	JP 4064325 B2 (Hitachi Appliances, Inc.), 19 March 2008 (19.03.2008), entire text; all drawings (Family: none)	1-4
A	JP 2009-228676 A (Daikin Industries, Ltd.), 08 October 2009 (08.10.2009), entire text; all drawings & US 2010/0329914 A1 & EP 2267310 A1 & WO 2009/107797 A1	1-4

☒ 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
13 February 2015 (13.02.15)Date of mailing of the international search report
24 February 2015 (24.02.15)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/005993

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 58-160582 A (Hitachi, Ltd.), 24 September 1983 (24.09.1983), entire text; all drawings (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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