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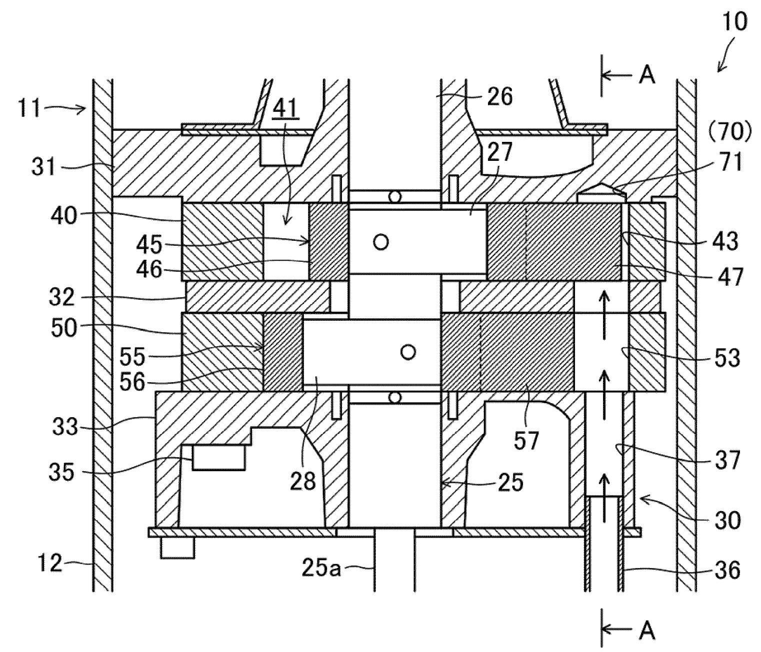
(54) ROTARY COMPRESSOR AND REFRIGERATION APPARATUS

(57) A cylinder (40) includes a blade chamber (43) that houses a tip portion of the blade (47). An oil supply passage (37) supplies oil to the blade chamber (43). A loss reducer (70) reduces an oil stirring loss in the blade chamber (43) due to the swing of the blade (47).

FIG.6



EP 4 459 128 A1

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a rotary compressor and a refrigeration apparatus.

BACKGROUND ART

[0002] Patent Document 1 discloses a compressor including a front head, a first cylinder having a first cylinder chamber, a partition plate, a second cylinder having a second cylinder chamber, and a rear head.

[0003] A piston having a blade is disposed in each of the first cylinder chamber and the second cylinder chamber. The blade is housed in a blade chamber. An oil supply siphon pipe communicates with the blade chamber. The oil supply siphon pipe sucks up oil in an oil reservoir and supplies the oil to the blade chamber.

CITATION LIST

PATENT DOCUMENT

[0004] Patent Document 1: Japanese Unexamined Patent Publication No. 2022-072807

SUMMARY OF THE INVENTION

TECHNICAL PROBLEM

[0005] The blade chamber is divided into two spaces by the blade interposed therebetween. When the blade swings with the eccentric rotation of the piston, the volumes of the two spaces in the blade chamber vary to cause the oil to flow from one of the spaces to the other.

[0006] At this time, the oil in the blade chamber flows through a clearance between an inner peripheral wall of the blade chamber and the tip portion of the blade. Thus, if the clearance is narrow, an oil stirring loss may increase.

[0007] An object of the present disclosure is to achieve smooth flow of oil in a blade chamber when a blade swings.

SOLUTION TO THE PROBLEM

[0008] A first aspect of the present disclosure is a rotary compressor including: a rotary compressor, comprising: a cylinder (40) having a cylinder chamber (41) therein; a piston (45) housed in the cylinder chamber (41); and a blade (47) extending radially outward from the piston (45), the piston (45) eccentrically rotating in the cylinder chamber (41) while the blade (47) swings, wherein the cylinder (40) includes a blade chamber (43) that houses a tip portion of the blade (47), and the rotary compressor further includes: an oil supply passage (37) that supplies oil to the blade chamber (43); and a loss reducer (70) that reduces an oil stirring loss in the blade chamber (43) due to swing of the blade (47).

[0009] According to the first aspect, the loss reducer (70) achieves smooth flow of the oil in the blade chamber (43), and can reduce the oil stirring loss, when the blade (47) swings. This allows smooth eccentric rotation of the piston (45).

[0010] A second aspect of the present disclosure is an embodiment of the first aspect. The rotary compressor of the second aspect further includes a head member (31) stacked on the cylinder (40), wherein the oil supply passage (37) supplies the oil to the blade chamber (43) from a surface of the cylinder (40) opposite to a surface on which the head member (31) is stacked, the head member (31) is provided with a recess (71) at a position facing the blade chamber (43), and the recess (71) functions as the loss reducer (70).

[0011] According to the second aspect, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the recess (71) of the head member (31). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0012] A third aspect of the present disclosure is an embodiment of the first aspect. In the rotary compressor of the third aspect, the blade (47) is provided with a penetrating portion (75) passing through the blade (47) in a thickness direction of the blade (47), and the penetrating portion (75) functions as the loss reducer (70).

[0013] According to the third aspect, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the penetrating portion (75) of the blade (47). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0014] A fourth aspect of the present disclosure is an embodiment of the second aspect. In the rotary compressor of the fourth aspect, $D3 \geq (D1 - D2) / 2$ is satisfied, where D1 is a cross-sectional area of the blade chamber (43) when viewed in an axial direction of the cylinder (40), D2 is a cross-sectional area of the blade (47) in the blade chamber (43) when the blade (47) reaches a deepest point of the blade chamber (43), and D3 is a cross-sectional area of the recess (71) when viewed in a lateral direction of the head member (31).

[0015] According to the fourth aspect, appropriately setting the cross-sectional area of the recess (71) allows smooth flow of the oil in the blade chamber (43).

[0016] A fifth aspect of the present disclosure is an embodiment of the third aspect. In the rotary compressor of the fifth aspect, $D4 \geq (D1 - D2) / 2$ is satisfied, where D1 is a cross-sectional area of the blade chamber (43) when viewed in an axial direction of the cylinder (40), D2 is a cross-sectional area of the blade (47) in the blade chamber (43) when the blade (47) reaches a deepest point of the blade chamber (43), and D4 is a cross-sectional area of the penetrating portion (75) when viewed in a thickness direction of the blade (47).

[0017] According to the fifth aspect, appropriately setting the cross-sectional area of the penetrating portion (75) allows smooth flow of the oil in the blade chamber (43).

[0018] A sixth aspect of the present disclosure is an embodiment of any one of the first to fifth aspects. In the rotary compressor of the sixth aspect, the number of rotations of the piston (45) is 118 rps or more.

[0019] According to the sixth aspect, increasing the number of rotations of the piston (45) improves the performance of the compressor and can reduce the oil stirring loss even in the high-speed rotation range.

[0020] A seventh aspect of the present disclosure is directed to a refrigeration apparatus including: the rotary compressor (10) of any one of the first to sixth aspects; and a refrigerant circuit (1a) through which a refrigerant compressed by the rotary compressor (10) flows.

[0021] According to the seventh aspect, a refrigeration apparatus including the rotary compressor (10) can be provided.

BRIEF DESCRIPTION OF THE DRAWINGS

[0022]

FIG. 1 is a refrigerant circuit diagram illustrating a configuration of a refrigeration apparatus according to a first embodiment.

FIG. 2 is a longitudinal sectional view illustrating a configuration of a rotary compressor.

FIG. 3 is a transverse sectional view illustrating a configuration of a first cylinder and a first piston.

FIG. 4 is a transverse sectional view illustrating a configuration of a second cylinder and a second piston.

FIG. 5 is a transverse sectional view illustrating a direction of flow of oil in a first blade chamber associated with the swing of a first blade.

FIG. 6 is a side sectional view illustrating a configuration of a compression mechanism.

FIG. 7 is a sectional view in the direction of arrows on line A-A in FIG. 6.

FIG. 8 is a sectional view in the direction of arrows on line B-B in FIG. 7.

FIG. 9 is a sectional view in the direction of arrows on line C-C in FIG. 7.

FIG. 10 is a side sectional view illustrating a configuration of a compression mechanism according to a second embodiment.

FIG. 11 is a perspective view illustrating a configuration of a first piston.

FIG. 12 is a view illustrating the shape of a penetrating portion that functions as a loss reducer.

FIG. 13 is a side sectional view illustrating a configuration of a compression mechanism according to a third embodiment.

FIG. 14 is a perspective view illustrating a configuration of a first piston.

FIG. 15 is a view illustrating the shape of a penetrating portion as a loss reducer.

FIG. 16 is a side sectional view illustrating a configuration of a compression mechanism according to a fourth embodiment.

FIG. 17 is a perspective view illustrating a configuration of a first piston.

FIG. 18 is a view illustrating the shape of a penetrating portion as a loss reducer.

DESCRIPTION OF EMBODIMENTS

«First Embodiment»

[0023] As illustrated in FIG. 1, a rotary compressor (10) is provided in a refrigeration apparatus (1). The refrigeration apparatus (1) includes a refrigerant circuit (1a) filled with a refrigerant. The refrigerant circuit (1a) includes a rotary compressor (10), a radiator (3), a decompression mechanism (4), and an evaporator (5). The decompression mechanism (4) is, for example, an expansion valve. The refrigerant circuit (1a) performs a vapor compression refrigeration cycle.

[0024] The refrigeration apparatus (1) is an air conditioner. The air conditioner may be any of a cooling-only apparatus, a heating-only apparatus, or an air conditioner switchable between cooling and heating. In this case, the air conditioner has a switching mechanism (e.g., a four-way switching valve) that switches the direction of circulation of the refrigerant. The refrigeration apparatus (1) may be a water heater, a chiller unit, or a cooling apparatus that cools the air in a storage. The cooling apparatus cools the air in a refrigerator, a freezer, or a container, for example.

[0025] As illustrated in FIG. 2, the rotary compressor (10) includes a casing (11), a drive mechanism (20), and a compression mechanism (30). The drive mechanism (20) and the compression mechanism (30) are housed in the casing (11).

[0026] The casing (11) is configured as a vertically long cylindrical closed container. The casing (11) includes a barrel (12), a bottom end plate (13), and a top end plate (14). The barrel (12) is in the shape of a cylinder extending in the vertical direction, with both axial ends open. The bottom end plate (13) is fixed to the lower end of the barrel (12). The top end plate (14) is fixed to the upper end of the barrel (12).

[0027] A suction pipe (15) passes through, and is fixed to, the barrel (12). A discharge pipe (16) passes through, and is fixed to, the top end plate (14).

[0028] The casing (11) has an oil reservoir (18) at its bottom. The oil reservoir (18) is formed by the bottom end plate (13) and an inner wall of a lower portion of the barrel (12). The oil reservoir (18) stores oil for lubricating sliding portions of the compression mechanism (30) and a drive shaft (25).

<Drive Mechanism>

[0029] The drive mechanism (20) includes a motor (21) and a drive shaft (25). The motor (21) is disposed above the compression mechanism (30). The motor (21) includes a stator (22) and a rotor (23).

[0030] The stator (22) is fixed to the inner peripheral surface of the barrel (12) of the casing (11). The rotor (23) extends to penetrate the stator (22) in the vertical direction. The drive shaft (25) passes through the axis of the rotor (23) and is fixed to the rotor (23). The drive shaft (25) is driven to rotate together with the rotor (23) when the motor (21) is energized.

[0031] The drive shaft (25) is arranged on the axis of the barrel (12) of the casing (11). An oil supply pump (25a) is provided at the lower end of the drive shaft (25). The oil supply pump (25a) conveys the oil collected in the oil reservoir (18). The conveyed oil is supplied to the sliding portions of the compression mechanism (30) and the drive shaft (25) through an oil passage (25b) in the drive shaft (25).

[0032] The drive shaft (25) includes a main shaft portion (26), a first eccentric portion (27), and a second eccentric portion (28). An upper portion of the main shaft portion (26) is fixed to the rotor (23) of the motor (21). The first eccentric portion (27) is disposed above the second eccentric portion (28). The axes of the first eccentric portion (27) and the second eccentric portion (28) are eccentric from the axis of the main shaft portion (26) by a predetermined amount.

[0033] Part of the main shaft portion (26) above the first eccentric portion (27) is rotatably supported by a front head (31) described later. Part of the main shaft portion (26) below the second eccentric portion (28) is rotatably supported by a rear head (33) described later.

<Compression Mechanism>

[0034] In the example shown in FIG. 2, the compression mechanism (30) is a two-cylinder rotary fluid machine. The compression mechanism (30) is disposed below the motor (21). The compression mechanism (30) includes a front head (31) as a head member, a first cylinder (40), a middle plate (32), a second cylinder (50), and a rear head (33).

[0035] The front head (31), the first cylinder (40), the middle plate (32), the second cylinder (50), and the rear head (33) are stacked in this order from top to bottom and fixed with a fastening bolt (35).

[0036] The front head (31) is fixed to the barrel (12) of the casing (11). The front head (31) is stacked on top of the first cylinder (40). The front head (31) is arranged to cover a first cylinder chamber (41) of the first cylinder (40) from above. The main shaft portion (26) of the drive shaft (25) is inserted in the front head (31) to pass through the center of the front head (31). The front head (31) rotatably supports the drive shaft (25). The front head (31) has a first discharge passage (49) penetrating the front head (31) in the axial direction (see FIG. 3).

[0037] The first cylinder (40) is configured as a flat, substantially annular member. As illustrated in FIG. 3, the first cylinder (40) includes a first cylinder chamber (41), a first suction passage (42), and a first blade chamber (43).

[0038] The first cylinder chamber (41) is provided in the center of the first cylinder (40). The first suction passage (42) extends from the inner wall surface of the first cylinder chamber (41) toward the outside in the radial direction of the first cylinder (40). The first suction passage (42) opens on the outer surface of the first cylinder (40). The suction pipe (15) is connected to an inlet end of the first suction passage (42). An outlet end of the first suction passage (42) communicates with the first cylinder chamber (41).

[0039] The first cylinder chamber (41) houses a first piston (45). The first piston (45) includes a first piston body (46) and a first blade (47). The first piston body (46) is formed in an annular shape. The first eccentric portion (27) of the drive shaft (25) fits into the first piston body (46). The first blade (47) extends radially outward from the first piston body (46). The first blade (47) is supported by a pair of first bushes (48). The first blade (47) divides the inside of the first cylinder chamber (41) into a low-pressure chamber and a high-pressure chamber.

[0040] The first piston (45) rotates eccentrically in the first cylinder chamber (41) when the drive shaft (25) is driven to rotate. When the volume of the low-pressure chamber gradually increases with the eccentric rotation of the first piston (45), the refrigerant flowing through the suction pipe (15) is sucked through the first suction passage (42) into the low-pressure chamber.

[0041] When the low-pressure chamber is isolated from the first suction passage (42), the isolated space constitutes a high-pressure chamber. The internal pressure of the high-pressure chamber increases as the volume of the high-pressure chamber gradually decreases. When the internal pressure of the high-pressure chamber exceeds a predetermined pressure, the refrigerant in the high-pressure chamber flows out of the compression mechanism (30) through the first discharge passage (49). The high-pressure refrigerant flows upward through the internal space of the casing (11) and passes through a core cut (not shown) of the motor (21) or any other passage. The high-pressure refrigerant that has flowed upward of the motor (21) is transferred to the refrigerant circuit through the discharge pipe (16).

[0042] The first blade chamber (43) is located radially outward of the first cylinder chamber (41) and away from the first cylinder chamber (41). The first blade chamber (43) penetrates into the first cylinder (40) in the thickness direction of the first cylinder (40). A tip portion of the first blade (47) is housed in the first blade chamber (43). The first blade (47) swings in the first blade chamber (43) with the eccentric rotation of the first piston body (46). The first blade chamber (43) communicates with an oil supply passage (37) described later.

[0043] As illustrated in FIG. 2, the middle plate (32) is sandwiched between the first cylinder (40) and the second cylinder (50). The middle plate (32) is disposed to cover the first cylinder chamber (41) of the first cylinder (40) from below. The middle plate (32) is disposed to cover a second cylinder chamber (51) of the second cylinder (50) from above.

[0044] As also illustrated in FIG. 4, the second cylinder (50) is configured as a flat, substantially annular member. The second cylinder (50) includes the second cylinder chamber (51), a second suction passage (52), and a second blade chamber (53).

[0045] The second cylinder chamber (51) is provided in the center of the second cylinder (50). The second suction passage (52) extends from the inner wall surface of the second cylinder chamber (51) toward the outside in the radial direction of the second cylinder (50). The second suction passage (52) opens on the outer surface of the second cylinder (50). A suction pipe (15) is connected to an inlet end of the second suction passage (52). An outlet end of the second suction passage (52) communicates with the second cylinder chamber (51).

[0046] The second cylinder chamber (51) houses a second piston (55). The second piston (55) includes a second piston body (56) and a second blade (57). The second piston body (56) is formed in an annular shape. The second eccentric portion (28) of the drive shaft (25) fits into the second piston body (56). The second blade (57) extends radially outward from the second piston body (56). The second blade (57) is supported by a pair of second bushes (58). The second blade (57) divides the inside of the second cylinder chamber (51) into a low-pressure chamber and a high-pressure chamber.

[0047] The action of the second piston (55) is substantially the same as the action of the first piston (45), and will not be described below.

[0048] The second blade chamber (53) is located radially outward of the second cylinder chamber (51) and away from the second cylinder chamber (51). The second blade chamber (53) penetrates into the second cylinder (50) in the thickness direction of the second cylinder (50). A tip portion of the second blade (57) is housed in the second blade chamber (53). The second blade (57) swings in the second blade chamber (53) with the eccentric rotation of the second piston body (56). The second blade chamber (53) communicates with the oil supply passage (37) described later.

[0049] As illustrated in FIG. 2, the rear head (33) is stacked on the bottom of the second cylinder (50). The rear head (33) is disposed to cover the second cylinder chamber (51) of the second cylinder (50) from below. The main shaft portion (26) of the drive shaft (25) is inserted in the rear head (33) to pass through the center of the rear head (33). The rear head (33) rotatably supports the drive shaft (25). The rear head (33) has a second discharge passage (59) penetrating the rear head (33) in the axial direction (see FIG. 4). When the internal pressure of the high-pressure chamber in the second cylinder chamber (51) exceeds a predetermined pressure, the refrigerant in the high-pressure chamber flows out of the compression mechanism (30) through the second discharge passage (59).

[0050] An oil supply siphon pipe (36) is connected to the rear head (33). An upper end of the oil supply siphon pipe (36) is connected to the oil supply passage (37). The oil supply passage (37) continuously penetrates the rear head (33), the second cylinder (50), the middle plate (32), and the first cylinder (40). The oil supply passage (37) includes the first blade chamber (43) of the first cylinder (40) and the second blade chamber (53) of the second cylinder (50).

[0051] A lower end of the oil supply siphon pipe (36) opens toward the oil reservoir (18). The oil supply siphon pipe (36) sucks up the oil in the oil reservoir (18) and supplies the oil to the first blade chamber (43) and the second blade chamber (53) through the oil supply passage (37).

<Configuration of Accumulator>

[0052] An accumulator (60) is connected to the upstream side of the rotary compressor (10). The accumulator (60) temporarily stores the refrigerant that is to be sucked into the rotary compressor (10) and performs gas-liquid separation for a liquid refrigerant and oil contained in a gas refrigerant.

[0053] The accumulator (60) includes a closed container (61), an inlet pipe (62), and outlet pipes (63). The inlet pipe (62) allows the refrigerant to flow into the closed container (61). The outlet pipes (63) allow the refrigerant to flow out of the closed container (61).

[0054] The closed container (61) is constituted of a vertically long cylindrical member. The inlet pipe (62) is connected to the top of the closed container (61). A lower end of the inlet pipe (62) opens in the internal space of the closed container (61) near the top of the closed container (61).

[0055] Two outlet pipes (63) are connected to the bottom of the closed container (61). Each of the outlet pipes (63) has an upper end portion extending upward in the internal space of the closed container (61) and opens near the top of the closed container (61).

[0056] Each of the outlet pipes (63) has a lower end portion that extends downward from the lower end of the closed container (61), bends toward the suction pipe (15) of the rotary compressor (10), and is connected to the suction pipe (15).

<Oil Stirring Loss>

[0057] The first blade chamber (43) is divided into two spaces (left and right spaces in FIG. 3) by the first blade (47) interposed therebetween. When the first blade (47) swings with the eccentric rotation of the first piston (45), the volumes of the two spaces in the first blade chamber (43) vary to cause the oil to flow from one of the spaces (the left space in FIG. 5) to the other (the right space in FIG. 5). In FIG. 5, a dashed arrow indicates the flow of the oil in the first blade chamber (43).

[0058] At this time, the oil in the first blade chamber (43) flows through a clearance between the inner peripheral wall of the first blade chamber (43) and the tip portion of the first blade (47). Thus, if the clearance is narrow, an oil stirring loss may increase.

[0059] In this embodiment, the oil is allowed to flow smoothly in the first blade chamber (43) when the first blade (47) swings.

[0060] Specifically, as illustrated in FIG. 6, the rotary compressor (10) includes a loss reducer (70). The loss reducer (70) reduces the oil stirring loss in the first blade chamber (43) due to the swing of the first blade (47). In the example shown in FIG. 6, the loss reducer (70) is a recess (71) formed in the front head (31).

[0061] The recess (71) is provided in the front head (31) at a position facing the first blade chamber (43). The oil supply passage (37) supplies the oil to the first blade chamber (43) from a surface of the first cylinder (40) (a lower surface in FIG. 6) opposite to a surface on which the front head (31) is stacked.

[0062] The oil in the first blade chamber (43) flows through a clearance between the inner peripheral wall of the first blade chamber (43) and the tip portion of the first blade (47) and through the recess (71) of the front head (31) (see FIG. 7).

[0063] This configuration achieves smooth flow of the oil in the first blade chamber (43), and can reduce the oil stirring loss, even in a high-speed rotation range of the first piston (45). For example, the number of rotations of the first piston (45) is preferably 118 rps or more.

[0064] Further, the recess (71) provided in the front head (31) can reduce the contact area between the first blade (47) and the front head (31). This reduces a viscous sliding loss of the first blade (47), allowing smooth rotation of the first piston (45).

[0065] Suppose that D1 is the cross-sectional area of the first blade chamber (43) when viewed in the axial direction of the first cylinder (40), and D2 is the cross-sectional area of the first blade (47) in the first blade chamber (43) when the first blade (47) reaches the deepest point of the first blade chamber (43) as illustrated in FIG. 8.

[0066] At this time, as illustrated in FIG. 9, the cross-sectional area D3 of the recess (71) as viewed in a lateral direction of the front head (31) preferably satisfies $D3 \geq (D1 - D2) / 2$.

-Advantages of First Embodiment-

[0067] According to the features of this embodiment, the loss reducer (70) achieves smooth flow of the oil in the blade chamber (43), and can reduce the oil stirring loss, when the blade (47) swings. This allows smooth eccentric rotation of the piston (45).

[0068] According to the features of this embodiment, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the recess (71) of the head member (31). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0069] According to the features of this embodiment, appropriately setting the cross-sectional area of the recess (71) allows smooth flow of the oil in the blade chamber (43).

[0070] According to the features of this embodiment, increasing the number of rotations of the piston (45) improves the performance of the compressor and can reduce the oil stirring loss even in the high-speed rotation range.

[0071] According to the features of this embodiment, the refrigeration apparatus includes the rotary compressor (10) and the refrigerant circuit (1a) through which the refrigerant compressed by the rotary compressor (10) flows. A refrigeration apparatus including the rotary compressor (10) can thus be provided.

«Second Embodiment»

[0072] In the following description, the same reference characters designate the same components as those of the first embodiment, and the description will be focused only on the differences.

[0073] As illustrated in FIG. 10, a rotary compressor (10) includes a loss reducer (70). The loss reducer (70) reduces the oil stirring loss in the first blade chamber (43) due to the swing of the first blade (47).

[0074] As also illustrated in FIG. 11, the loss reducer (70) is configured as a penetrating portion (75) passing through the first blade (47) in the thickness direction of the first blade (47). The penetrating portion (75) is a circular hole passing through the tip portion of the first blade (47) in the thickness direction of the first blade (47).

[0075] As illustrated in FIG. 10, the oil in the first blade chamber (43) flows through the clearance between the inner peripheral wall of the first blade chamber (43) and the tip portion of the first blade (47) and through the penetrating portion (75) of the first blade (47) in the thickness direction.

[0076] Suppose that D1 is the cross-sectional area of the first blade chamber (43) when viewed in the axial direction of the first cylinder (40), and D2 is the cross-sectional area of the first blade (47) in the first blade chamber (43) when the first blade (47) reaches the deepest point of the first blade chamber (43) (see FIG. 8).

[0077] In this case, as illustrated in FIG. 12, the cross-sectional area D4 of the penetrating portion (75) as viewed in the thickness direction of the first blade (47) preferably satisfies $D4 \geq (D1 - D2) / 2$.

-Advantages of Second Embodiment-

[0078] According to the features of this embodiment, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the penetrating portion (75) of the blade (47). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0079] According to the features of this embodiment, appropriately setting the cross-sectional area of the penetrating portion (75) allows smooth flow of the oil in the blade chamber (43).

«Third Embodiment»

[0080] As illustrated in FIG. 13, a rotary compressor (10) includes a loss reducer (70). The loss reducer (70) reduces the oil stirring loss in the first blade chamber (43) due to the swing of the first blade (47).

[0081] As also illustrated in FIG. 14, the loss reducer (70) is configured as penetrating portions (75) passing through the first blade (47) in the thickness direction of the first blade (47). The penetrating portions (75) are formed by cutting out corners of the first blade (47). The penetrating portions (75) are provided by cutting the upper right corner of the first blade (47) in FIG. 13 and the lower right corner of the first blade (47) in FIG. 13.

[0082] As illustrated in FIG. 13, the oil in the first blade chamber (43) flows through the clearance between the inner peripheral wall of the first blade chamber (43) and the tip portion of the first blade (47) and through the penetrating portions (75) of the first blade (47) in the thickness direction.

[0083] Suppose that D1 is the cross-sectional area of the first blade chamber (43) when viewed in the axial direction of the first cylinder (40), and D2 is the cross-sectional area of the first blade (47) in the first blade chamber (43) when the first blade (47) reaches the deepest point of the first blade chamber (43) (see FIG. 8).

[0084] In this case, as illustrated in FIG. 15, the cross-sectional area D4 of the penetrating portions (75) as viewed in the thickness direction of the first blade (47) preferably satisfies $D4 \geq (D1 - D2) / 2$. The cross-sectional area D4 is the sum of the cross-sectional areas of the two penetrating portions (75).

-Advantages of Third Embodiment-

[0085] According to the features of this embodiment, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the penetrating portions (75) of the blade (47). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0086] According to the features of this embodiment, appropriately setting the cross-sectional area of the penetrating portions (75) allows smooth flow of the oil in the blade chamber (43).

«Fourth Embodiment»

[0087] As illustrated in FIG. 16, a rotary compressor (10) includes a loss reducer (70). The loss reducer (70) reduces the oil stirring loss in the first blade chamber (43) due to the swing of the first blade (47).

[0088] As also illustrated in FIG. 17, the loss reducer (70) is configured as a penetrating portion (75) passing through the first blade (47) in the thickness direction of the first blade (47). The penetrating portion (75) is formed by cutting a rectangular shape out of an axial center part of the tip portion of the first blade (47).

[0089] As illustrated in FIG. 16, the oil in the first blade chamber (43) flows through the clearance between the inner peripheral wall of the first blade chamber (43) and the tip portion of the first blade (47) and through the penetrating portion (75) of the first blade (47) in the thickness direction.

[0090] Suppose that D 1 is the cross-sectional area of the first blade chamber (43) when viewed in the axial direction of the first cylinder (40), and D2 is the cross-sectional area of the first blade (47) in the first blade chamber (43) when the first blade (47) reaches the deepest point of the first blade chamber (43) (see FIG. 8).

[0091] In this case, as illustrated in FIG. 18, the cross-sectional area D4 of the penetrating portion (75) as viewed in the thickness direction of the first blade (47) preferably satisfies $D4 \geq (D1 - D2) / 2$.

-Advantages of Fourth Embodiment-

[0092] According to the features of this embodiment, when the blade (47) swings, the oil in the blade chamber (43) flows through the clearance between the inner peripheral wall of the blade chamber (43) and the tip portion of the blade (47) and through the penetrating portion (75) of the blade (47). This configuration achieves smooth flow of the oil in the blade chamber (43) and can reduce the oil stirring loss.

[0093] According to the features of this embodiment, appropriately setting the cross-sectional area of the penetrating portion (75) allows smooth flow of the oil in the blade chamber (43).

«Other Embodiments»

[0094] While the embodiments and variations have been described above, it will be understood that various changes in form and details can be made without departing from the spirit and scope of the claims. The elements according to the embodiments, the variations thereof, and the other embodiments may be combined and replaced with each other. In addition, the expressions of "first," "second," "third," ... , in the specification and claims are used to distinguish the terms to which these expressions are given, and do not limit the number and order of the terms.

INDUSTRIAL APPLICABILITY

[0095] As can be seen from the foregoing description, the present disclosure is useful for a rotary compressor and a refrigeration apparatus.

DESCRIPTION OF REFERENCE CHARACTERS

[0096]

1	Refrigeration Apparatus
1a	Refrigerant Circuit
10	Rotary Compressor
31	Front Head (Head Member)
37	Oil Supply Passage
40	First Cylinder
41	First Cylinder Chamber
43	First Blade Chamber
45	First Piston
47	First Blade
70	Loss Reducer
71	Recess
75	Penetrating Portion

Claims

1. A rotary compressor, comprising: a cylinder (40) having a cylinder chamber (41) therein; a piston (45) housed in the cylinder chamber (41); and a blade (47) extending radially outward from the piston (45), the piston (45) eccentrically rotating in the cylinder chamber (41) while the blade (47) swings, wherein

    the cylinder (40) includes a blade chamber (43) that houses a tip portion of the blade (47), and
    the rotary compressor further includes: an oil supply passage (37) that supplies oil to the blade chamber (43); and
    a loss reducer (70) that reduces an oil stirring loss in the blade chamber (43) due to swing of the blade (47).

2. The rotary compressor of claim 1, further comprising:

    a head member (31) stacked on the cylinder (40), wherein
    the oil supply passage (37) supplies the oil to the blade chamber (43) from a surface of the cylinder (40) opposite to a surface on which the head member (31) is stacked,
    the head member (31) is provided with a recess (71) at a position facing the blade chamber (43), and
    the recess (71) functions as the loss reducer (70).

3. The rotary compressor of claim 1, wherein

    the blade (47) is provided with a penetrating portion (75) passing through the blade (47) in a thickness direction of the blade (47), and
    the penetrating portion (75) functions as the loss reducer (70).

4. The rotary compressor of claim 2, wherein
D3 ≥ (D1 - D2) / 2 is satisfied, where D1 is a cross-sectional area of the blade chamber (43) when viewed in an axial direction of the cylinder (40), D2 is a cross-sectional area of the blade (47) in the blade chamber (43) when the blade (47) reaches a deepest point of the blade chamber (43), and D3 is a cross-sectional area of the recess (71) when viewed in a lateral direction of the head member (31).

5. The rotary compressor of claim 3, wherein
D4 ≥ (D1 - D2) / 2 is satisfied, where D1 is a cross-sectional area of the blade chamber (43) when viewed in an axial direction of the cylinder (40), D2 is a cross-sectional area of the blade (47) in the blade chamber (43) when the blade (47) reaches a deepest point of the blade chamber (43), and D4 is a cross-sectional area of the penetrating portion (75) when viewed in a thickness direction of the blade (47).

6. The rotary compressor of any one of claims 1 to 5, wherein
the number of rotations of the piston (45) is 118 rps or more.

7. A refrigeration apparatus, comprising: the rotary compressor (10) of any one of claims 1 to 6; and
a refrigerant circuit (1a) through which a refrigerant compressed by the rotary compressor (10) flows.

FIG.1

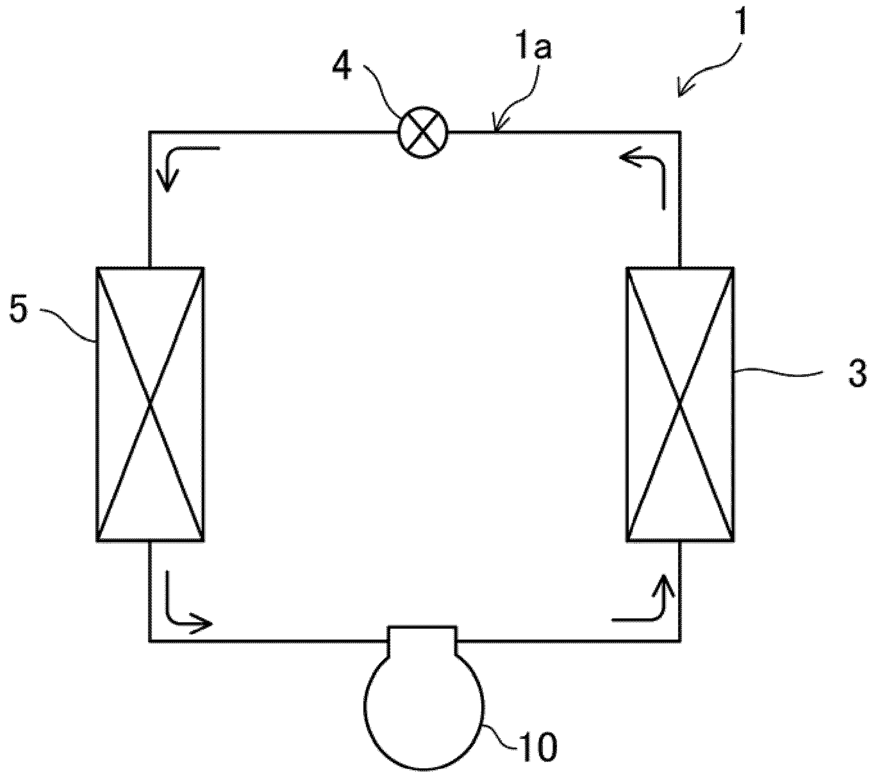


FIG.2

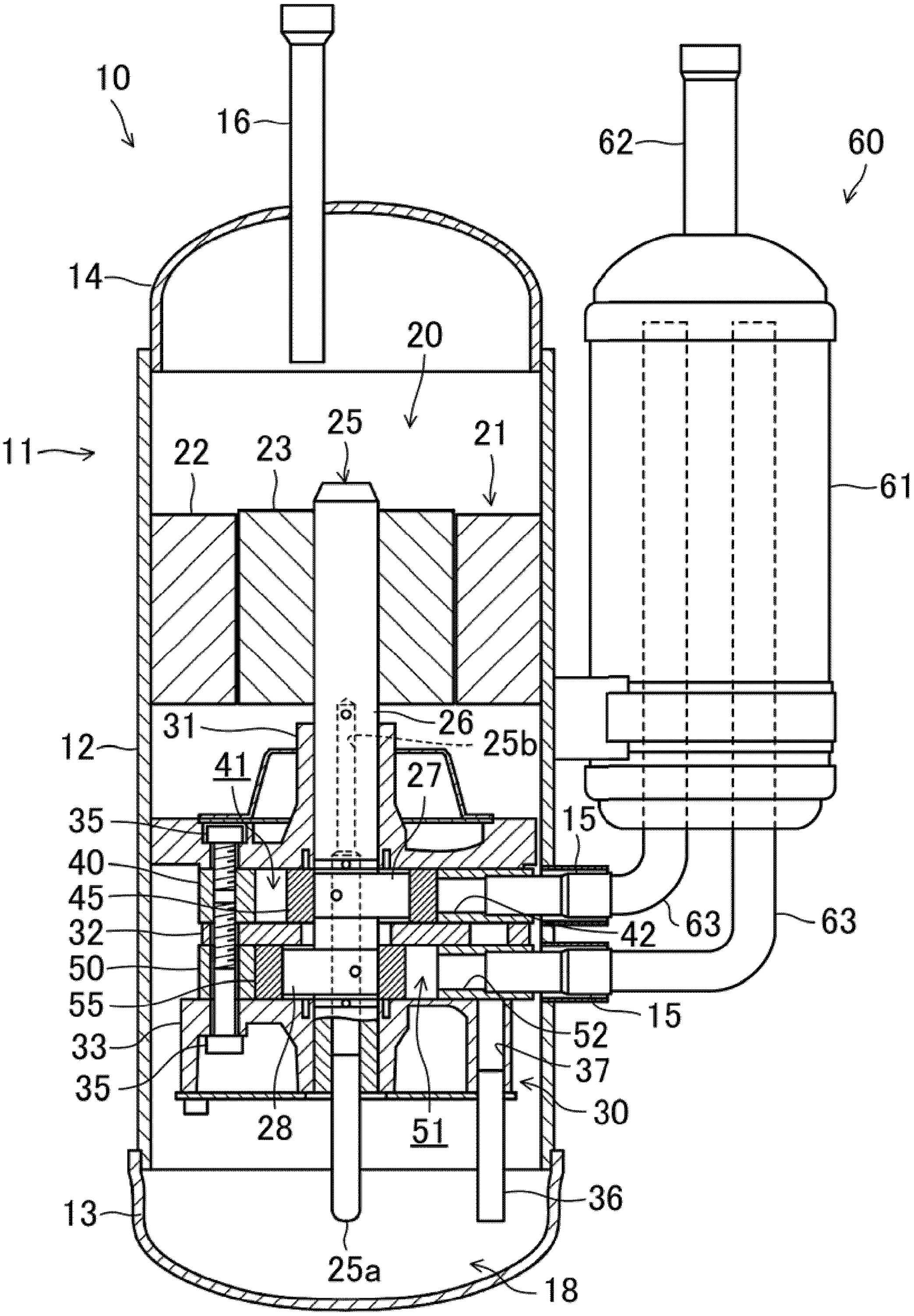

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FIG.3

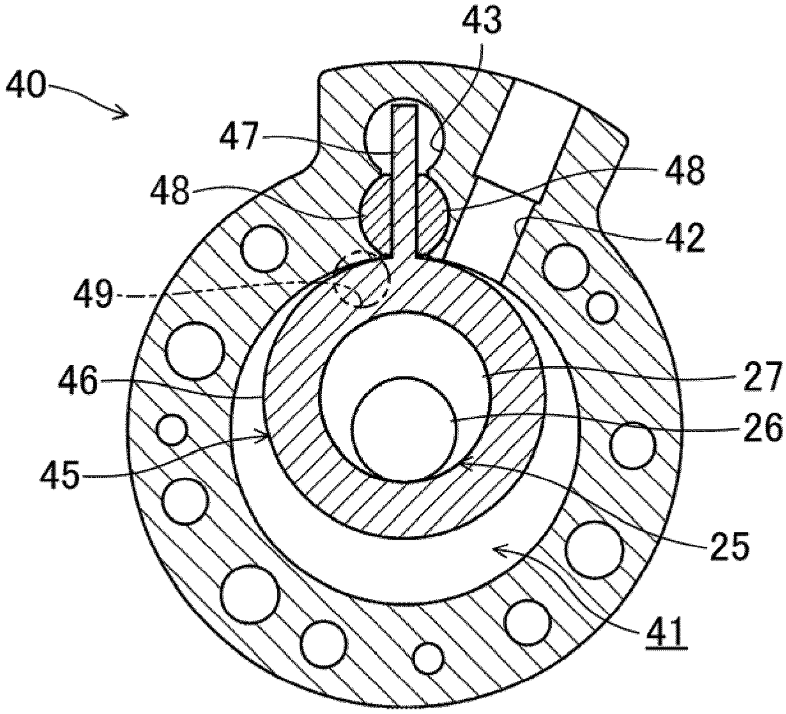
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FIG.4

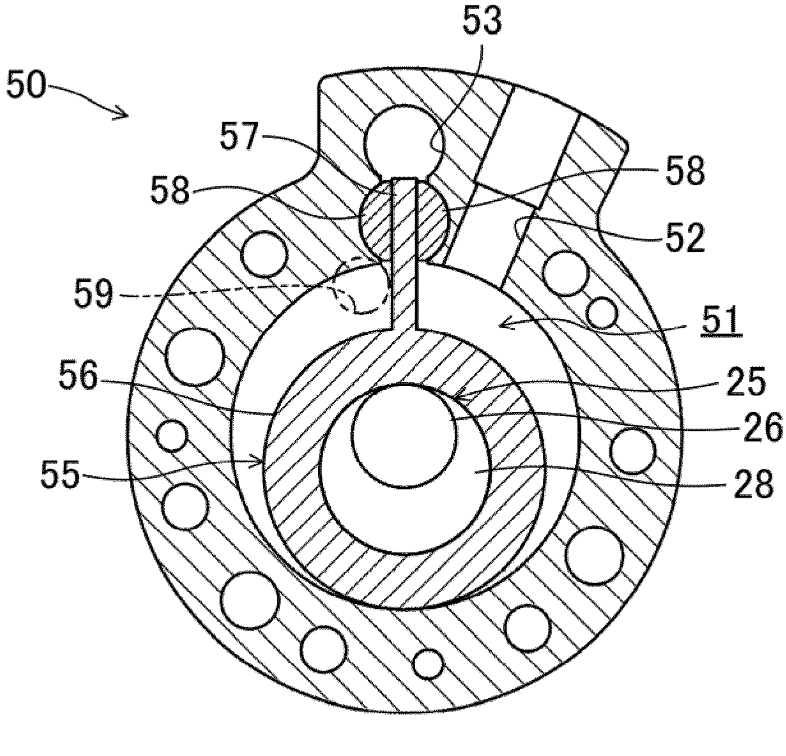
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FIG.5

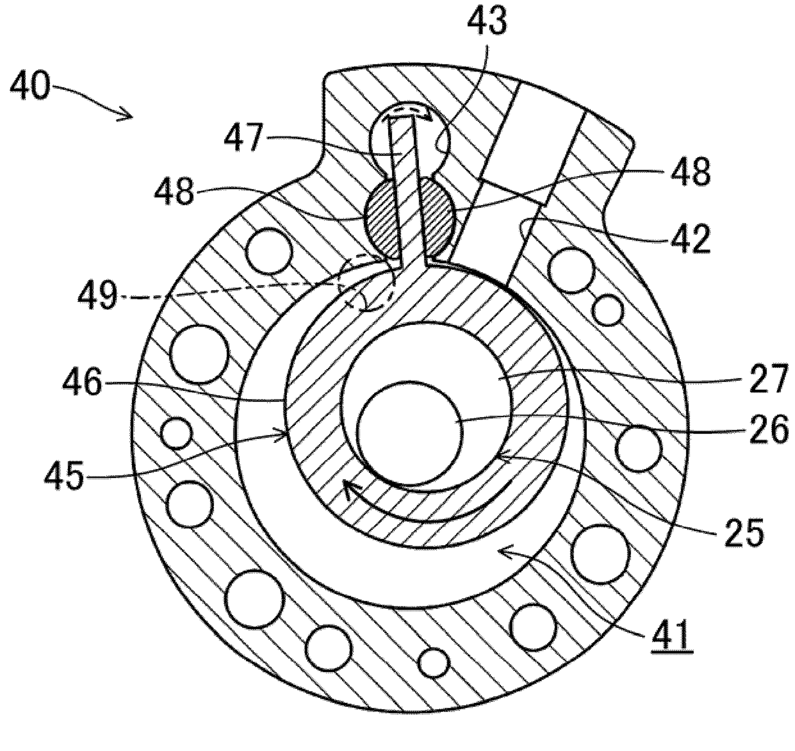

FIG.6

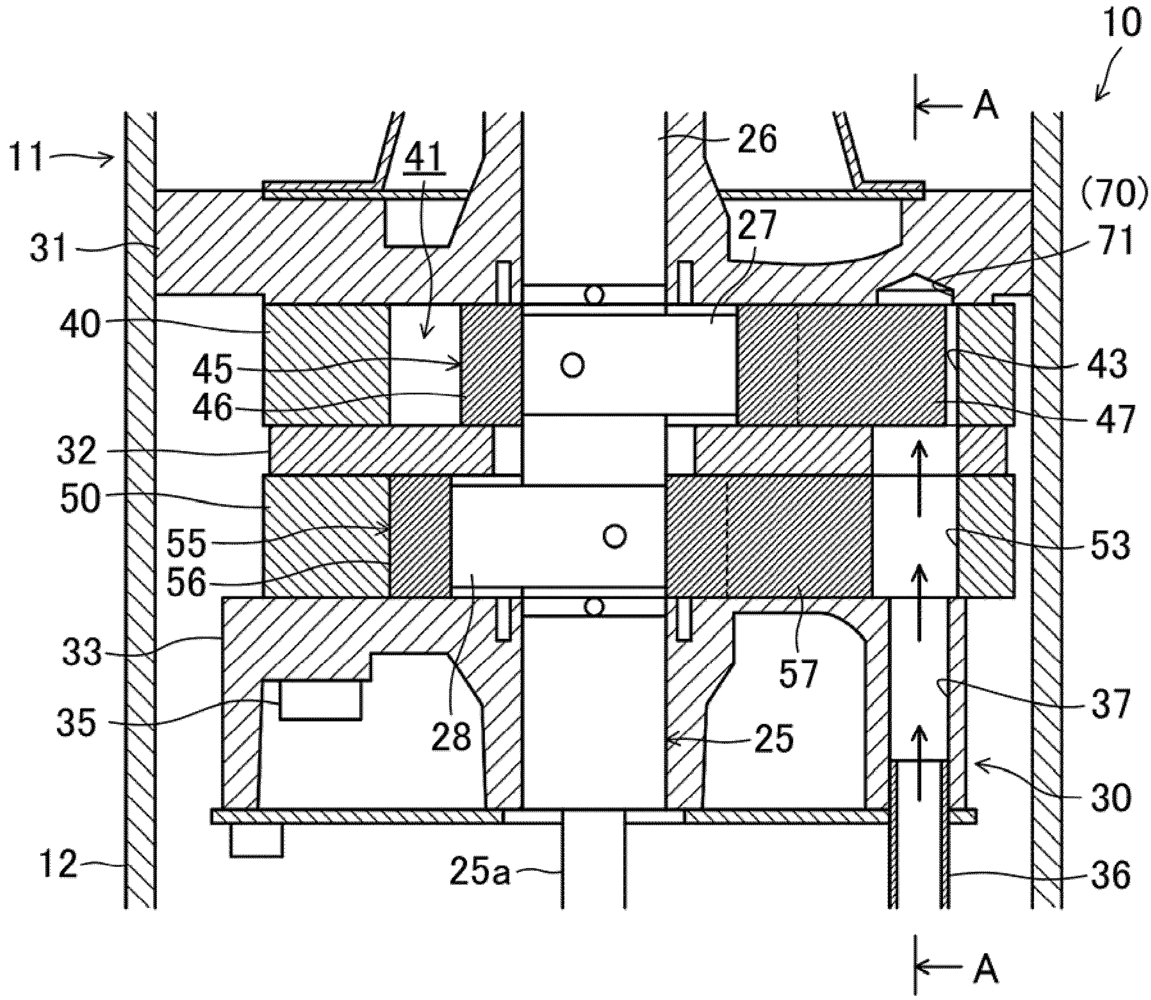
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FIG.7

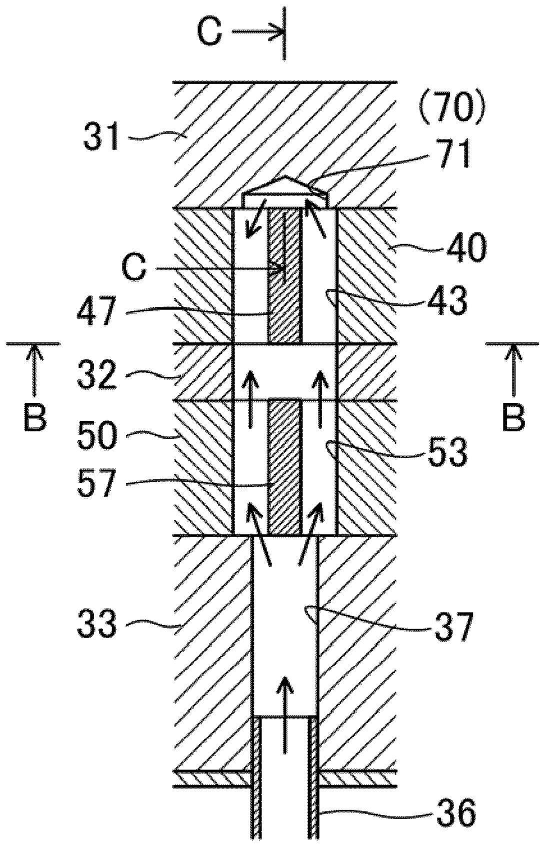

FIG.8

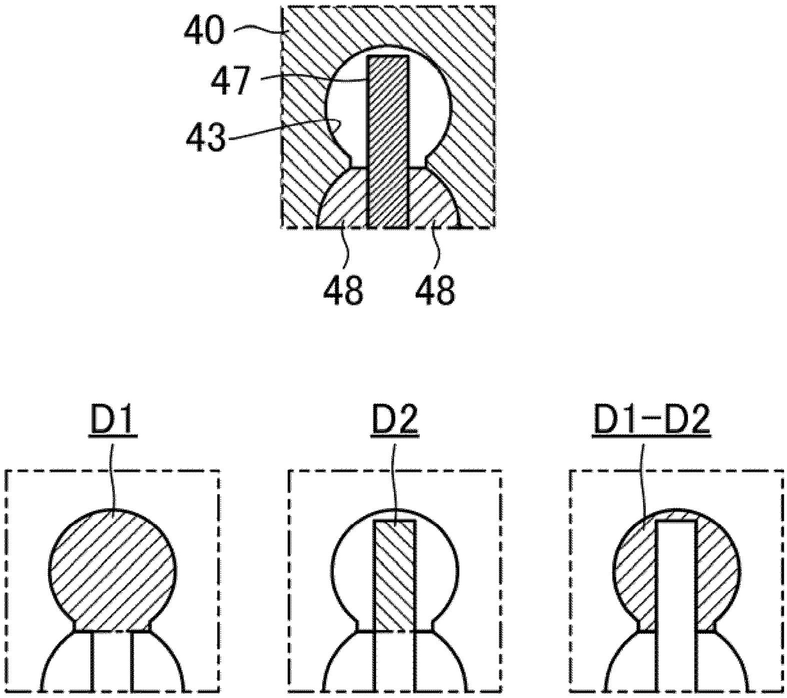

FIG.9

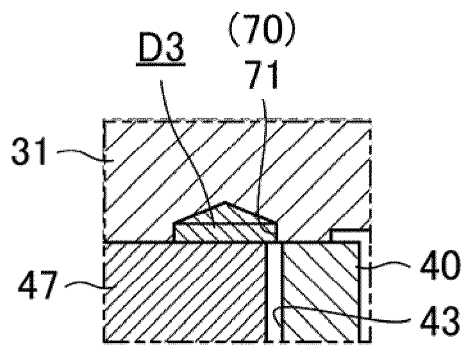

FIG.10

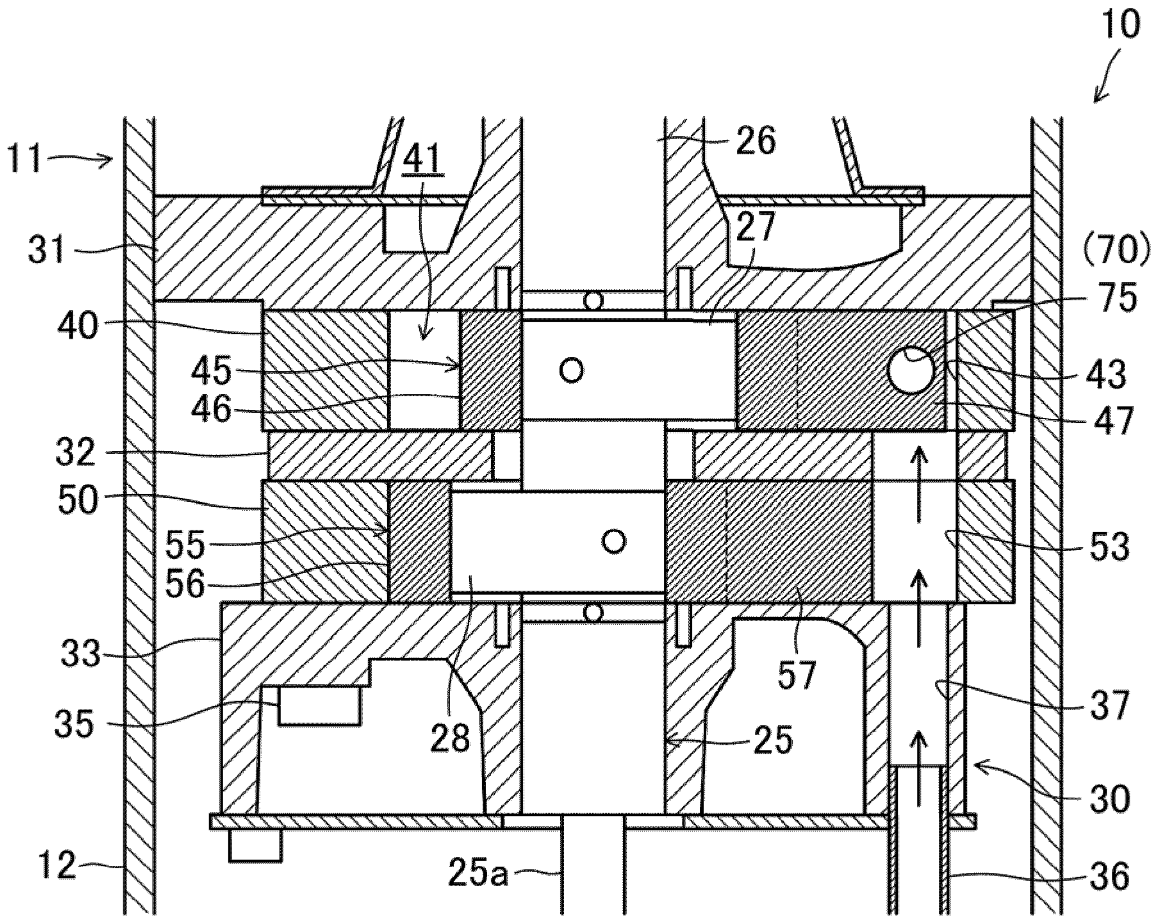
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FIG.11

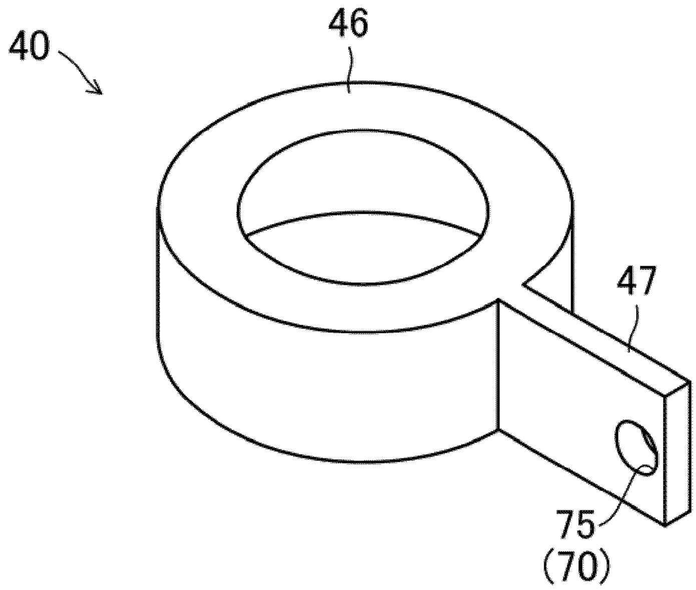

FIG.12

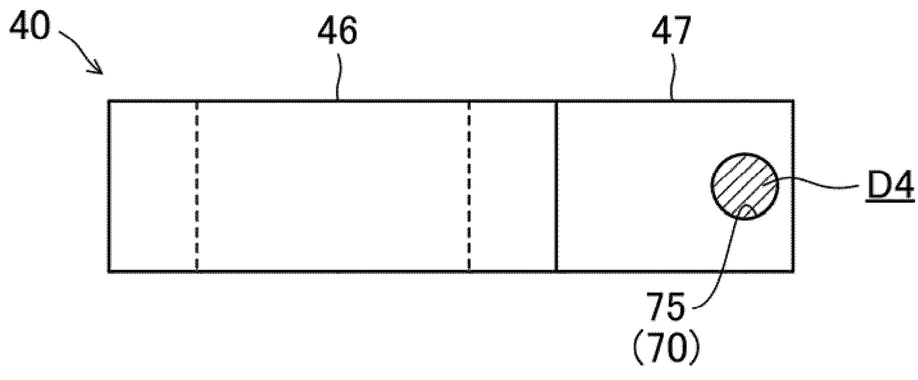

FIG.13

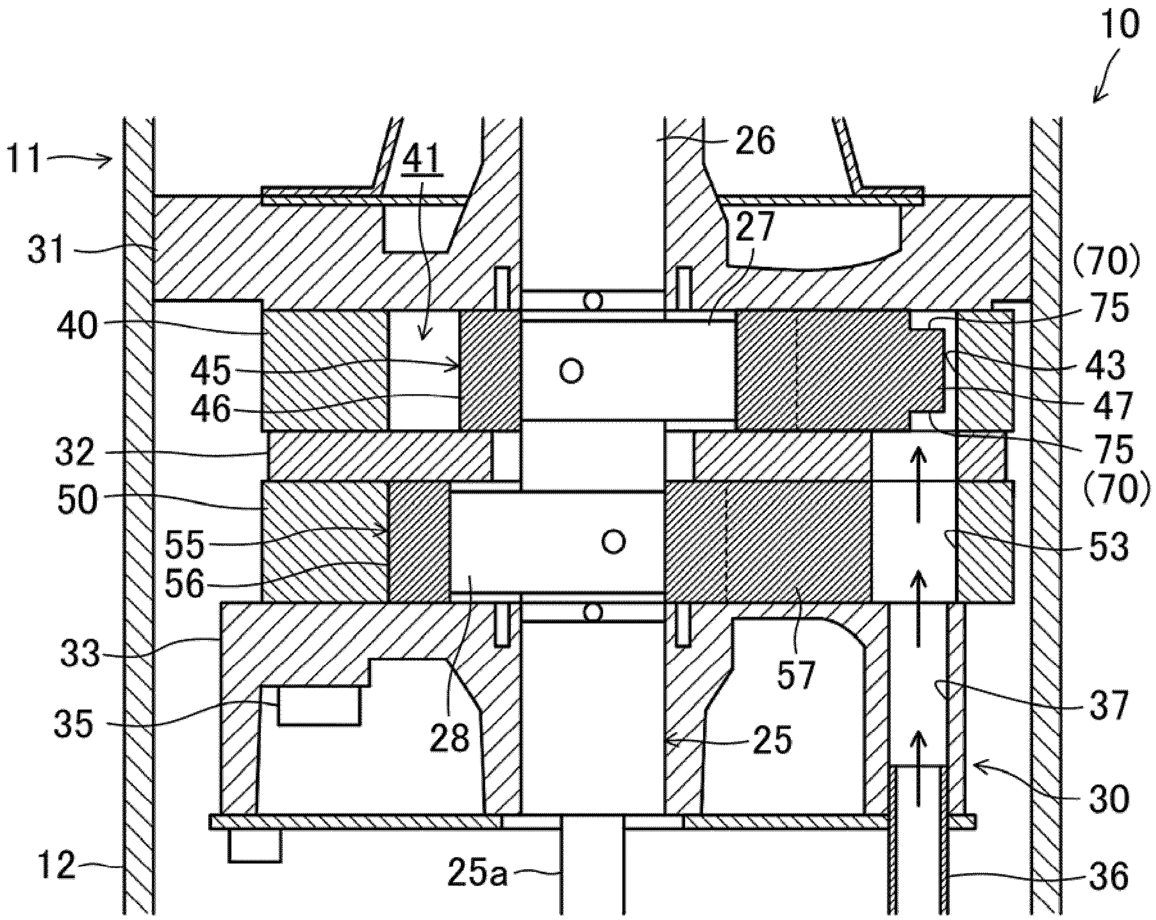
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FIG.14

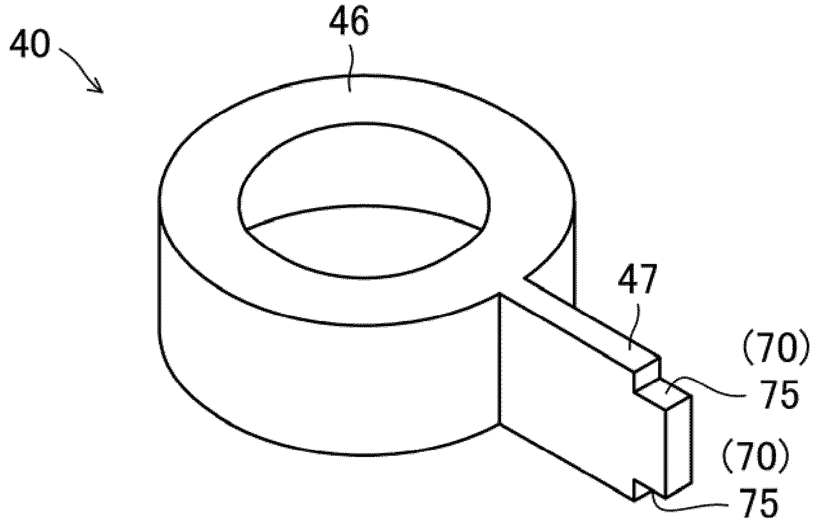

FIG.15

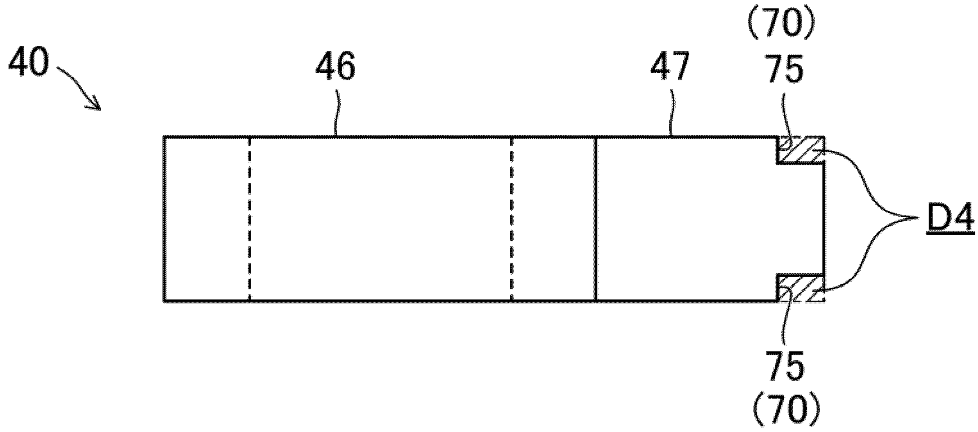

FIG.16

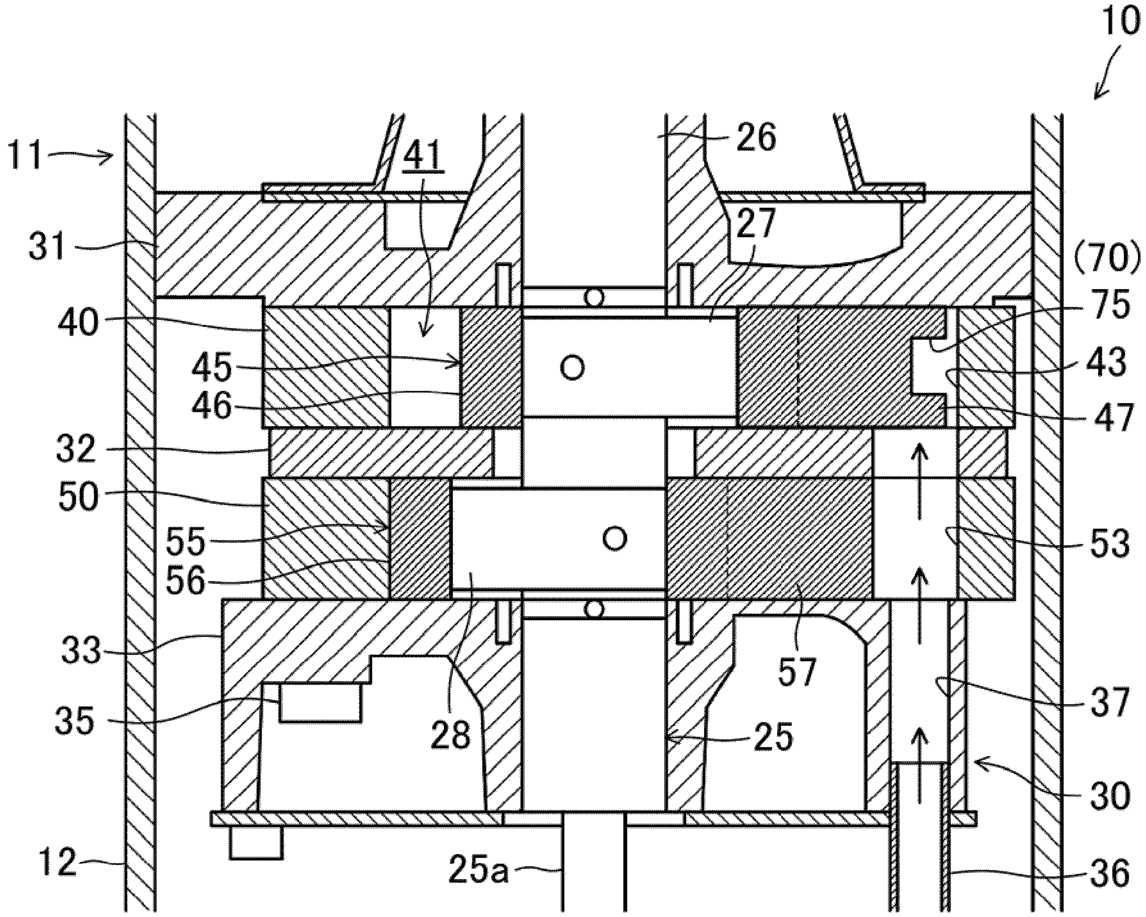
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FIG.17

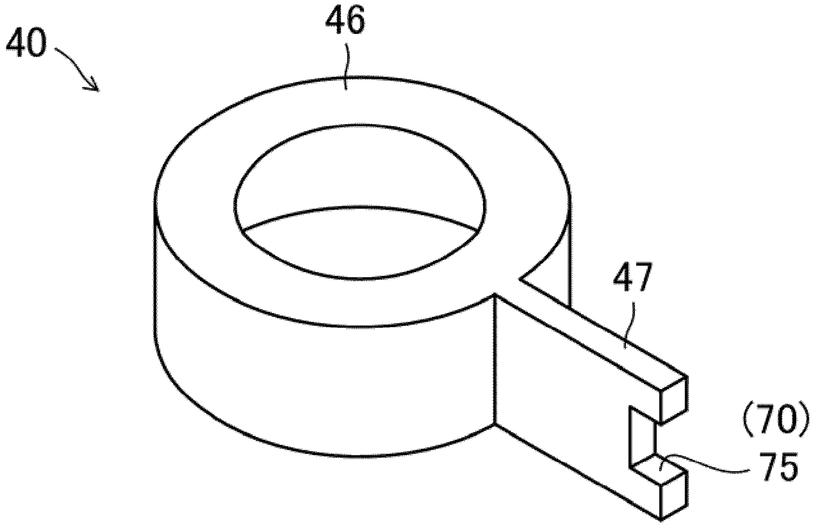
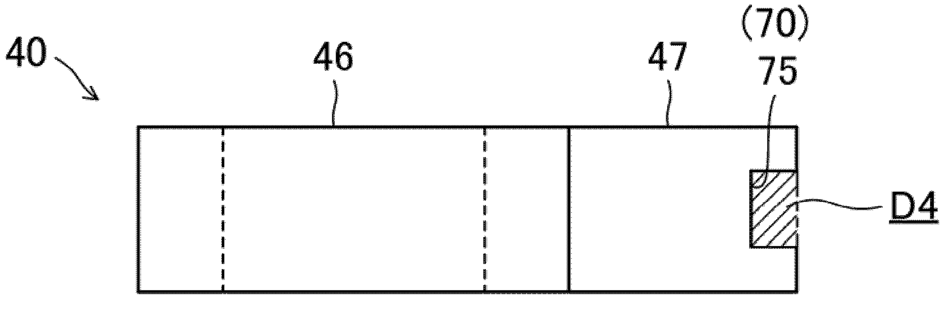


FIG.18



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/008355

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/00(2006.01)i; ***F04C 18/32***(2006.01)i; ***F04C 29/02***(2006.01)i
FI: F04C29/00 C; F04C29/02 311A; F04C18/32

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04C29/00; F04C18/32; F04C29/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan 1922-1996
Published unexamined utility model applications of Japan 1971-2024
Registered utility model specifications of Japan 1996-2024
Published registered utility model applications of Japan 1994-2024

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 A	JP 2007-177634 A (DAIKIN INDUSTRIES, LTD.) 12 July 2007 (2007-07-12) paragraphs [0015]-[0060], fig. 1-2	1, 6-7 2-5
X A	JP 2003-206876 A (HITACHI, LTD.) 25 July 2003 (2003-07-25) paragraphs [0008]-[0036], fig. 1-7	1, 3, 5-7 2, 4

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

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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
25 April 2024	**14 May 2024**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/008355

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2007-177634 A	12 July 2007	(Family: none)	
JP 2003-206876 A	25 July 2003	CN 1431403 A p. 6, line 13 to p. 11, line 13, fig. 1-7	

Form PCT/ISA/210 (patent family annex) (July 2022)

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2022072807 A **[0004]**