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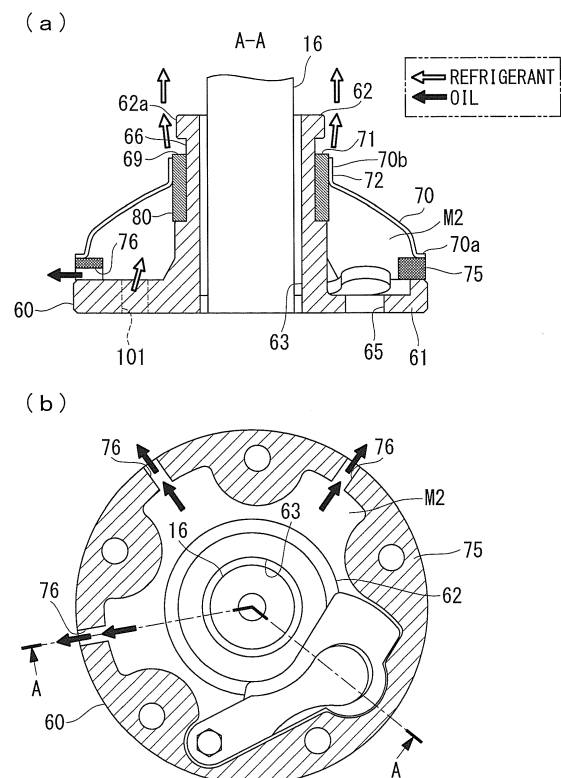
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(54) **Compressor having rotary compression mechanism with a muffler cover**

(57) Provided is a compressor including a rotary compression mechanism having a simple structure, facilitating assembly, and capable of collecting lubricant oil contained in refrigerant with low cost. A mist collecting member is disposed between a cylindrical portion of a muffler cover and a boss, which serves as an outlet for refrigerant from an upper muffler chamber so as to collect the lubricant oil contained in the refrigerant. The mist collecting member is placed in a peripheral groove formed in the boss, and is held between the boss and the cylindrical portion of the muffler cover.

FIG. 3



Description

{Technical Field}

[0001] The present invention relates to a compressor having a rotary compression mechanism.

{Background Art}

[0002] In air conditioners, such as room air conditioners and packaged air conditioners, rotary compressors are used for compressing refrigerant gas in refrigerant circuits, for example.

There have recently been used so-called "scrotary" two-stage compressors each having a rotary compression mechanism at low stage, and a scroll compression mechanism at high stage.

[0003] In these compressors each having a rotary compression mechanism, it is required to reduce sliding resistance at a sliding portion between a cylinder disposed in a casing of the compressor and a piston eccentrically disposed to a crankshaft extending through the cylinder, and also to reduce sliding resistance at a bearing or the like for rotatably supporting the crankshaft. Hence, refrigerant containing lubricant oil is fed into the rotary compression mechanism of the rotary compressor.

[0004] Lubricant oil mixed in the refrigerant should be prevented from flowing into a refrigerating circuit outside the casing. Patent Literature 1 discloses a technique that provides a muffler disposed so as to cover a feed port formed at a head of a bearing of a rotary compression mechanism, and a netted material disposed in the cover of the muffler so as to collect mists of the lubricant oil contained in the refrigerant with this netted material in the muffler. A technique is also disclosed for providing dual covers outside the muffler, and disposing the netted material between these covers.

{Citation List}

{Patent Literature}

[0005]

{PTL 1}

Japanese Unexamined Patent Application, Publication No. 4-134196 (Fig. 1 and Fig. 4)

{Summary of Invention}

{Technical Problem}

[0006] Unfortunately, the configuration of Patent Literature 1 has a disadvantage in necessity of installing the netted material between the covers, which is tedious and time-consuming working for installing this.

In addition, there is another disadvantage in configuration of providing the dual covers outside the muffler, and in-

stalling the netted material between the two covers, which makes the structure complicated, and thus the number of components becomes increased, which causes increase in cost.

[0007] An object of the present invention, which has been made in order to solve the problems according to the conventional art, is to provide a compressor that has a rotary compression mechanism with a simple structure, facilitates assembly of the compressor, and is capable of collecting lubricant oil in refrigerant with lower cost.

{Solution to Problem}

[0008] A compressor having a rotary compression mechanism according to the present invention includes in a housing a rotary compression mechanism for compressing gas, and a driving unit for driving the rotary compression mechanism, wherein the rotary compression mechanism includes: a cylinder having a cylindrical inner surface; a crankshaft extending through the cylinder, being rotationally driven around a central axis of the cylinder by the driving unit, and having an eccentric axial portion eccentric to the central axis of the cylinder in the cylinder; plate members for covering apertures at both end portions of the cylinder; a discharge port formed in at least one of the plate members, and communicating with an inside of the cylinder; a boss in a cylindrical shape integrally disposed with the plate member in which the discharge port is formed, and rotatably supporting the crankshaft that extends through the boss; a muffler cover whose outer periphery abuts against the plate member, and whose inner periphery opposes an outer peripheral surface of the boss so as to form a muffler chamber into which refrigerant is fed from the cylinder through the discharge port; a refrigerant outlet formed between the inner periphery of the muffler cover and the outer peripheral surface of the boss, the refrigerant outlet feeding the refrigerant from the muffler chamber into the housing; and a collecting member disposed at the refrigerant outlet so as to collect lubricant oil contained in the refrigerant, a peripheral groove is formed in the boss such that the peripheral groove continuously extends in a peripheral direction of the boss at a position opposing the inner periphery of the muffler cover, and the collecting member is placed in the peripheral groove, and is disposed between the inner periphery of the muffler cover and the outer peripheral surface of the boss.

Since the collecting member is placed in the peripheral groove in the boss, the collecting member can be securely positioned, and placed at the refrigerant outlet between the inner periphery of the muffler cover and the outer periphery of the boss. At this time, no special components are required for installing the collecting member, which attains a simple structure with less components.

[0009] In the above configuration, communicating passages may be formed between the outer periphery of the muffler cover and the plate member so as to communicate with an inside and an outside of the muffler chamber,

and each communicating passage may have a bent or curved portion between an inner end portion of the muffler chamber and an outer end portion of the muffler chamber. Accordingly, the lubricant oil collected from the refrigerant through the collecting member can be fed from the inside of the muffler through the communicating passages into an inner space of the housing outside the muffler chamber. At this time, each communicating passage has a bent or curved portion at a middle position of the communicating passage, which hinders the lubricant oil from flowing outside the muffler chamber, and thus pressure loss is secured so as to easily maintain a high refrigerant pressure in the muffler chamber.

[0010] In any one of the above configurations, the compressor having a rotary compression mechanism further includes: a scroll compression mechanism including a fixed scroll fixed to the housing; and an orbit scroll eccentrically orbiting relative to the fixed scroll through the crankshaft.

{Advantageous Effects of Invention}

[0011] The compressor including the rotary mechanism of the present invention has a simple structure, facilitates assembly, and is capable of collecting lubricant oil in refrigerant with lower cost.

{Brief Description of Drawings}

[0012]

{Fig. 1} Fig. 1 is an elevational cross section view of a compressor having a rotary compression mechanism of the present invention;

{Fig. 2} Fig. 2 is a partially enlarged cross section view of the compressor having the rotary compression mechanism of the present invention;

{Fig. 3} Figs. 3 are drawings showing an important part of the compressor having the rotary compression mechanism of the present invention, Fig. 3 (a) is a cross section view taken along line a-a of Fig. 3(b), and Fig. 3(b) is a plane cross section view of Fig. 3 (a);

{Fig. 4} Figs. 4 are drawings showing another example of a communicating passage formed in the compressor having the rotary compression mechanism of the present invention, Fig. 4 (a) is a cross section view taken along line a-a of Fig. 4(b), and Fig. 4(b) is a plane cross section view of Fig. 4 (a); {Fig. 5} Fig. 5 is an elevational cross section view showing further another example of the communicating passage formed in the compressor having the rotary compression mechanism of the present invention; and

{Fig. 6} Fig. 6 is a drawing showing another example of the compressor having the rotary compression mechanism of the present invention, and is an elevational cross section view of the compressor having

the rotary compression mechanism of the present invention, in which a rotary compression mechanism is disposed at low stage, and a scroll compression mechanism is disposed at high stage.

{Description of Embodiments}

[0013] Hereinafter, description will be provided on the embodiment of the present invention with reference to drawings.

As shown in Fig. 1, a compressor 1 according to the present embodiment is disposed in a refrigerant circuit of an air conditioner, such as a room air conditioner and a package air conditioner, so as to compress refrigerant gas flowing through this refrigerant circuit.

The compressor 1 includes a housing 2 of a substantially cylindrical sealed vessel whose both ends are closed, and the housing 2 is disposed with its axis line substantially vertical.

This housing 2 stores a rotary compression mechanism 3 for compressing refrigerant gas supplied from the refrigerant circuit, and a driving unit 4 for driving the rotary compression mechanism 3. This rotary compression mechanism 3 is disposed in a lower portion of the housing 2, and the driving unit 4 is disposed above the rotary compression mechanism 3.

[0014] Refrigerant piping P1 of the refrigerant circuit is externally introduced into the housing 2 at its lower side surface, and the refrigerant gas in the refrigerant circuit is supplied to the rotary compression mechanism 3 through the refrigerant piping P1.

An oil reserving chamber (not shown) is disposed at a bottom of the housing 2, and lubricant oil for use in lubrication of the rotary compression mechanism 3 or the like is reserved in this oil reserving chamber.

[0015] The rotary compression mechanism 3 compresses the refrigerant gas supplied from the refrigerant piping P1 into a high-pressure compressed gas, and thereafter feeds this gas into the housing 2.

Refrigerant piping P3 is externally introduced through a ceiling of the housing 2 so as to feed the compressed gas temporarily reserved in the housing 2 downstream of the refrigerant circuit through the refrigerant piping P3.

[0016] The rotary compression mechanism 3 includes a cylinder 11 having a cylindrical inner surface 12. The cylinder 11 is disposed such that the cylindrical inner surface 12 substantially becomes coaxial to the housing 2. A cylindrical rotor 14 having a smaller diameter than that of the cylindrical inner surface 12 is disposed inside the cylinder 11 with its axis line substantially horizontal to the axis line of the cylindrical inner surface 12.

Plural pairs of the cylinders 11 and the rotors 14 may be arranged with intervals in the central axial direction of the housing 2.

[0017] A crankshaft 16 having an axis line coaxial with the cylinder 11 is inserted through the cylinder 11 and the rotor 14. The crankshaft 16 is supported at its upper end portion by the driving unit 4, and is rotationally driven

around its axis line by the driving unit 4. In the present embodiment, the driving unit 4 is constituted by an electric motor having a rotor for holding the upper end portion of the crankshaft 16. The driving unit 4 rotates this rotor so as to rotationally drive the crankshaft 16.

[0018] The driving unit 4 includes a rotor 21 that is fit over the crankshaft 16, and a stator 22 that is disposed on the outer periphery of the rotor 21.

The rotor 21 includes a core (referred to as a "rotor core") 23 formed by laminating plural thin silicon steel plates having a predetermined shape. An axial hole 24 is formed in the core rotor 23 along its central axis line, and the crankshaft 16 is pressed into this axial hole 24. Plural through holes (referred to as "passages", hereinafter) 25 extending in the vertical direction along the axial hole 24 are formed in the rotor core 23. The lower ends of these passages 25 are formed to be open ends.

In addition, a disk-like oil separating plate 28 is attached at an upper end face 23a of the rotor core 23 so as to cover this upper end face 23a.

[0019] The stator 22 includes a core (referred to as a "stator core", hereinafter) 30 formed by laminating plural thin silicon steel plates having a predetermined shape, and a coil end 31 wound around teeth of the stator core 30. The stator core 30 is pressed into (shrinkage-fitted into) the housing 2.

[0020] An eccentric axial portion 17 having a substantially cylindrical shape is disposed in a region of the crankshaft 16 which is inserted in the cylinder 11. The crankshaft 16 is rotationally driven around its axis line so that the rotor 14 is eccentrically rotated along the cylindrical inner surface 12 of the cylinder 11.

[0021] The crankshaft 16 is supported at its lower end by an end bearing 40 so as to be rotatable around the axis line.

As shown in Fig. 1 and Fig. 2, the end bearing 40 includes a lower bearing bracket 41 disposed at the lower portion of the cylinder 11, and an upper bearing bracket 60 disposed at the upper portion of the cylinder 11.

[0022] The lower bearing bracket 41 has a disk-like lower plate (plate member) 43 that abuts against a lower face of the cylinder 11. A shaft hole 44 is formed to extend through the central portion of the lower bearing bracket 41, and the crankshaft 16 is rotatably supported through this shaft hole 44 via a bearing (not shown).

A refrigerant discharge port 45 is formed to extend through the lower plate 43 from the upper face to the lower face of the lower plate 43 at a position facing the cylindrical inner surface 12 of the cylinder 11.

In addition, the lower face of the lower plate 43 is provided with a boss 46 extending downward at the central portion of the lower face of the lower plate 43, and an outer peripheral wall 47 extending downward at the outer periphery of the lower face of the lower plate 43; and a tubular groove 48 is formed to continuously extend in the peripheral direction between the boss 46 and the outer peripheral wall 47. A refrigerant discharge port 45 is formed to face this groove 48.

The lower bearing bracket 41 is clamped to the cylinder 11 with bolts 55 at plural positions in the peripheral direction of the outer periphery of the lower bearing bracket 41.

[0023] An end plate 49 is fixed below the lower plate 43, and this end plate 49 and a plate 51 are so disposed as to cover the groove 48, thereby forming an annular lower muffler chamber M1. The refrigerant discharged from the hole of the port 45 flows through a communicating hole 101 formed in the lower plate 43, the cylinder 11, and the upper bearing bracket 60 to an upper muffler chamber M2 described later. The refrigerant is mixed with refrigerant discharged from a hole of a port 65, and flows from a refrigerant outlet 69 into the compressor. Hence, it is configured that the compressed refrigerant always flows through a netted material 80 in the muffler.

[0024] The end plate 49 shields the shaft hole 44. A lubricant oil flow passage 49a that sucks the lubricant oil from the oil reserving chamber at the bottom of the housing 2, and supplies the lubricant oil to the crankshaft 16 in the shaft hole 44 is formed to extend through this end plate 49.

[0025] As shown in Fig. 2 and Fig. 3, an upper bearing bracket 60 includes a disk-like upper plate (plate member) 61 that abuts against the upper face of the cylinder 11, and a boss 62 extending upward from the upper plate 61. A shaft hole 63 is formed to extend through the central portion of the upper bearing bracket 60, and the crankshaft 16 is rotatably supported through this shaft hole 63 via a bearing (not shown).

[0026] A refrigerant discharge port (discharge port) 65 is formed to extend from the upper face to the lower face of the upper plate 61 at its position facing the cylindrical inner surface 12 of the cylinder 11.

[0027] A peripheral groove 66 having a given height in the vertical direction, and continuously extending in the peripheral direction is formed in an outer peripheral surface 62a of the boss 62.

[0028] A muffler cover 70 in a dome shape is provided on the upper face of the upper plate 61. The muffler cover 70 has a dome shape whose diameter is gradually reduced upward from an outer periphery 70a thereof, and an aperture 71 is formed on a top end (inner periphery) 70b of the muffler cover 70. The outer periphery of the muffler cover 70 abuts against the upper face of the upper plate 61, and in this state, the muffler cover 70 along with the upper plate 61 are clamped to the cylinder 11 with bolts 67 at plural positions of the outer periphery in the peripheral direction of the muffler cover 70.

A muffler chamber (muffler chamber) M2 continuously extending around the boss 62 in the peripheral direction is defined by the muffler cover 70, the upper plate 61, and the boss 62.

[0029] The aperture 71 is formed by a cylindrical portion 72 extending upward. The cylindrical portion 72 is disposed to be opposite to the peripheral groove 66 with a distance from the outer periphery of the peripheral groove 66 in a state that the muffler cover 70 is fixed to

the upper plate 61. In this manner, an annular gap is generated between the top end 70b of the muffler cover 70 and the boss 62, and this gap serves as the refrigerant outlet 69 for the refrigerant flowing from the muffler chamber M2.

[0030] A mist collecting member (collecting member) 80 made of a steel wool, netted, or porous material is placed in the peripheral groove 66, and is installed between the peripheral groove 66 and the cylindrical portion 72 of the muffler cover 70.

The mist collecting member 80 may be previously formed in a cylindrical shape, and is then placed in the peripheral groove 66, or the mist collecting member 80 may be previously formed in a web or tape shape, for example, and is then wound around the peripheral groove 66 in the peripheral direction.

[0031] As shown in Fig. 3, a metallic plate 75 is disposed between the upper plate 61 and the muffler cover 70, for example. This plate 75 is provided at its outer periphery with communicating passages 76 interconnecting the upper muffler chamber M2 and a space outside the outer periphery of the upper bearing bracket 60. Each communicating passage 76 is preferably formed to have a cross sectional area as small as possible so as to generate pressure loss. Hence, in the present embodiment, each communicating passage 76 is formed in a groove shape in a side surface of the plate 75.

[0032] In the above rotary compression mechanism 3, the refrigerant gas supplied from the refrigerant piping P1 into the cylinder 11 is compressed by the rotor 14 eccentrically rotating in the cylinder 11. The compressed refrigerant is fed from the lower refrigerant discharge port 45 into the lower muffler chamber M1, and from the upper refrigerant discharge port 65 into the upper muffler chamber M2, and is then fed from the lower muffler chamber M1 and from the upper muffler M2 into the housing 2. Lubricant oil sucked up from the oil reserving chamber at the bottom of the housing 2 through the lubricant oil flow passage 49a is mixed in the refrigerant that is fed into the lower muffler chamber M1 and the upper muffler chamber M2 in order to lubricate the movable portions of the rotary compression mechanism 3.

The refrigerant fed in the housing 2 flows through the passages 25 formed in the rotor core 23, and is fed through the refrigerant piping P3 at the ceiling portion of the housing 2 downstream of the refrigerant circuit.

[0033] In the upper muffler chamber M2, the refrigerant containing the lubricant oil fed from the refrigerant discharge port 65 into the upper muffler chamber M2 flows through the mist collecting member 80 disposed at the refrigerant outlet 69 between the cylindrical portion 72 of the muffler cover 70 and the boss 62, and is fed into the housing 2. The lubricant oil contained in the refrigerant is collected when it flows through the mist collecting member 80, thereby feeding only the refrigerant into the housing 2.

The collected lubricant oil flows down on the upper plate 61 by the gravity, and is pressed with gas pressure of

the refrigerant in the upper muffler chamber M2, through the communicating passages 76 at the outer periphery of the plate 75 into the housing 2, and then falls down in the oil reserving chamber at the bottom of the housing 2.

[0034] In the above configuration, the mist collecting member 80 disposed at the refrigerant outlet 69 communicating from the upper muffler chamber M2 can collect the lubricant oil contained in the refrigerant. The mist collection member 80 is placed in the peripheral groove 66 formed in the boss 62, and is held between the boss 62 and the cylindrical portion 72 of the muffler cover 70. Hence, at the time of assembling the compressor, it is possible to readily and securely position and install the mist collecting member 80 at the feeding portion between the cylindrical portion 72 of the muffler cover 70 and the boss 62. Accordingly, the compressor 1 can be configured to have a simple structure with less components, to be easily assembled, and to be capable of securely collecting the lubricant oil at low cost.

[0035] The plate 75 having the communicating passages 76 is disposed in the above configuration; and instead of using this plate 75, a gasket 77 made of a softer material than that of the plate 75, such as a rubber material, a cork material, copper, and aluminum, may be used as shown in Fig. 4. In this case, each communicating passage 78 is preferably configured to have a bent portion 78c or a curved portion between an inner end portion 78a of the muffler chamber M2 and an outer end portion 78b of the muffler chamber M2. The communicating passage 78 shown in Fig. 4 is formed to be cranked, for example.

This configuration hinders the lubricant oil from flowing through the communicating passage 78 to the outside of the muffler chamber M2, thereby securing pressure loss at this portion so as to maintain a high refrigerant pressure in the muffler chamber M2.

The gasket 77 made of a softer material than that of the plate 75 facilitates fine machining on each communicating passage 78 having such a bent portion.

The gasket 77 may have a thinner thickness than that of the plate 75. Accordingly, the cross sectional area of each communicating passage 78 can be smaller, and the cranked bent portion thereof can prevent pressure leakage of the refrigerant in the upper muffler chamber M2.

[0036] As shown in Fig. 5, instead of using the communicating passages 76 and 78, through holes 79 may be formed in the upper plate 61 in such a manner that each through hole 79 extends through the upper plate 61, one end of the through hole 79 is open to an upper face 61a of the upper plate 61, and the other end thereof is open to an outer peripheral surface 61b of the upper plate 61.

Instead of these holes, there may be provided at portions opposing the upper plate 61 cut-out portions, grooves, or recessed portions that communicate with the inside and the outside of the muffler chamber M2.

[0037] As shown in Fig. 6, a compressor 100 having the rotary compression mechanism of the present inven-

tion may include a scroll compression mechanism 90 at the upper end portion of the crankshaft 16 in addition to the aforementioned configuration. The scroll compression mechanism 90 includes an orbit scroll 91 disposed at the upper end portion of the crankshaft 16, and a fixed scroll 92 fixed to the housing 2. The orbit scroll 91 and the fixed scroll 92 include a disk-like end plate 93 and a disk-like end plate 95, respectively, and also includes a scroll gear 94 and a scroll gear 96 that are integrally formed with an end plate 93 and an end plate 95, respectively. This scroll compression mechanism 90 compresses the refrigerant between the scroll gears 94 and 96 that are meshed with each other.

This compressor 100 includes the rotary compression mechanism 3 having the same configuration as aforementioned configuration at low stage, and includes the scroll compression mechanism 90 at high stage so as to compress the refrigerant at two stages.

In the compressor 100 having such a configuration, the rotary compression mechanism 3 having the same configuration as aforementioned configuration can also attain the same advantageous effects.

[0038] In addition, the components of the compressor may appropriately be changed to have configurations other than the aforementioned configurations, or other configurations may appropriately be added, or a part of the configurations may appropriately be deleted, without departing from the spirit and scope of the present invention.

{Reference Signs List}

[0039]

1	Compressor
2	Housing
3	Rotary compression mechanism
4	Driving unit
11	Cylinder
12	Cylindrical inner surface
13	Separator
14	Rotor
16	Crankshaft
17	Eccentric axial portion
21	Rotor
22	Stator
23	Rotor core
24	Axial hole
25	Passage
28	Oil separating plate
30	Stator core
40	End bearing
41	Lower bearing bracket
43	Lower plate (plate member)
44	Shaft hole
45	Refrigerant discharge port
46	Boss
47	Outer peripheral wall

48	Groove
49	End plate
49a	Lubricant oil flow passage
51	Plate
5	60 Upper bearing bracket
61	Upper plate (Plate member)
61a	Upper face
61b	Outer peripheral surface
62	Boss
10	62a Outer peripheral surface
63	Shaft hole
65	Refrigerant discharge port (Discharge port)
66	Peripheral groove
67	Bolt
15	69 Refrigerant outlet
70	Muffler cover
70a	Outer periphery
70b	Top end (inner periphery)
71	Aperture
20	72 Cylindrical portion
75	Plate
76	Communicating passage
77	Gasket
78	Communicating passage
25	78a End portion
78b	End portion
78c	Bent portion
79	Through hole
80	Mist collecting member (Collecting member)
30	90 Scroll compression mechanism
91	Orbit scroll
92	Fixed scroll
100	Compressor
101	Communicating hole
35	M1 Lower muffler chamber
M2	Upper muffler chamber (muffler chamber)

Claims

- 40 1. A compressor having a rotary compression mechanism (3) including in a housing (2) the rotary compression mechanism (3) for compressing gas, and a driving unit (4) for driving the rotary compression mechanism,
- 45 wherein
the rotary compression mechanism (3) comprises:
- 50 a cylinder (11) having a cylindrical inner surface (12);
a crankshaft (16) extending through the cylinder, being rotationally driven around a central axis of the cylinder by the driving unit, and having an eccentric axial portion (17) eccentric to the central axis of the cylinder;
- 55 plate members (43, 61) for covering apertures at both end portions of the cylinder;
a discharge port (45, 65) formed in at least one

- of the plate members, and communicating with an inside of the cylinder;
 a boss (46, 62) in a cylindrical shape integrally disposed with the plate member in which the discharge port is formed, and rotatably supporting the crankshaft that extends through the boss;
 a muffler cover (70) whose outer periphery abuts against the plate member, and whose inner periphery (70b) opposes an outer peripheral surface of the boss so as to form a muffler chamber into which refrigerant is fed from the cylinder through the discharge port;
 a refrigerant outlet (69) formed between the inner periphery (70b) of the muffler cover (70) and the outer peripheral surface of the boss, the refrigerant outlet feeding the refrigerant from the muffler chamber into the housing; and
 a collecting member (80) disposed at the refrigerant outlet (69) so as to collect lubricant oil contained in the refrigerant,
 a peripheral groove (66) is formed in the boss (62) such that the peripheral groove continuously extends in a peripheral direction of the boss at a position opposing the inner periphery of the muffler cover, and
 the collecting member (80) is placed in the peripheral groove (66), and is disposed between the inner periphery (70b) of the muffler cover and the outer peripheral surface of the boss (62).
2. The compressor having a rotary compression mechanism according to claim 1, wherein communicating passages (76) are formed between the outer periphery (70a) of the muffler cover (70) and the plate member (61) so as to communicate with an inside and an outside of the muffler chamber.
 3. The compressor having a rotary compression mechanism according to claim 2, wherein each communicating passage (76) has a bent or curved portion (78c) between an inner end portion of the muffler chamber and an outer end portion of the muffler chamber.
 4. The compressor having a rotary compression mechanism according to any one of claim 1 to claim 3, further comprising a scroll compression mechanism (90) including: a fixed scroll (92) fixed to the housing; and an orbit scroll (91) eccentrically orbiting relative to the fixed scroll through the crankshaft (16).

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FIG. 1

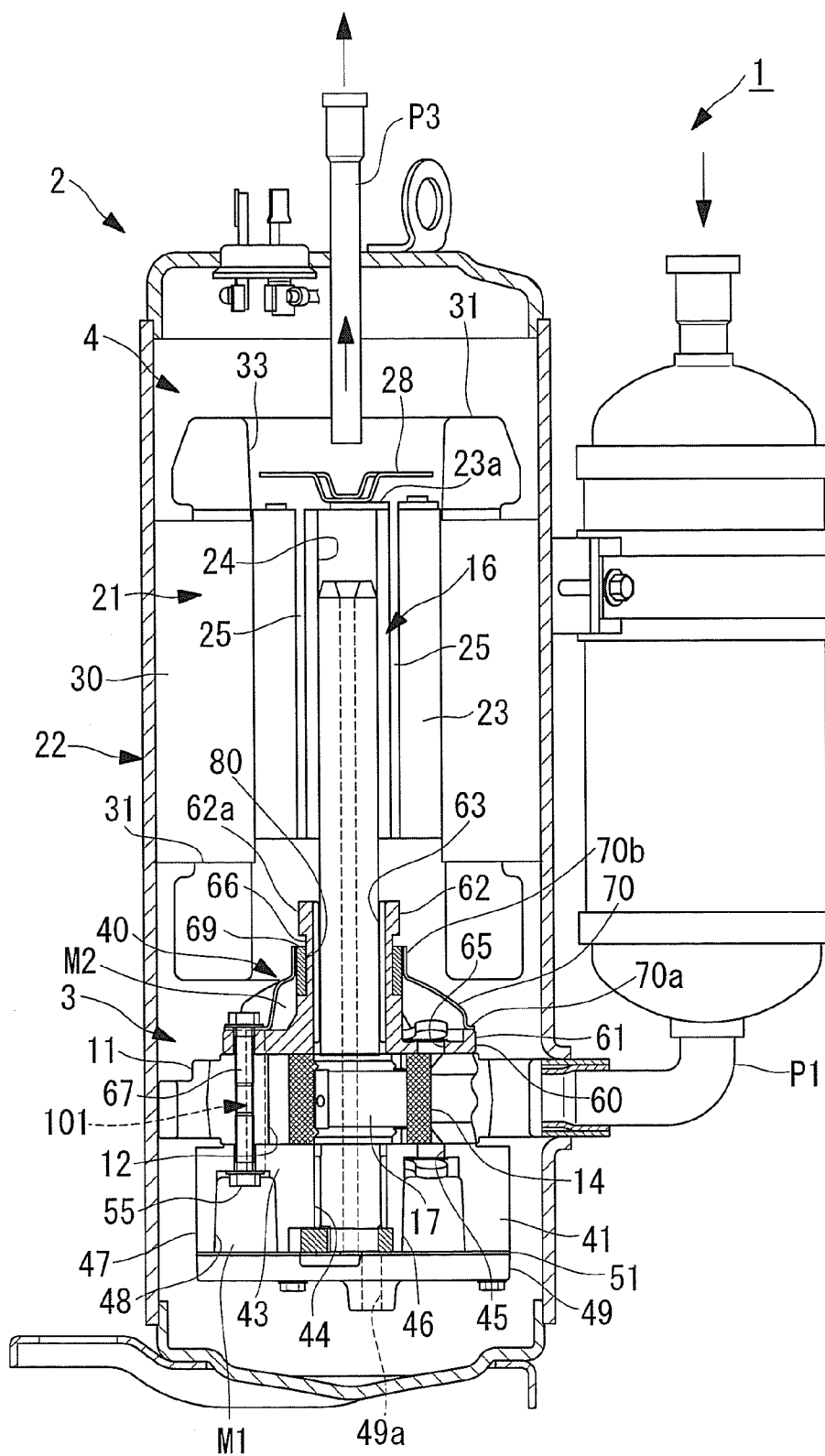


FIG. 2

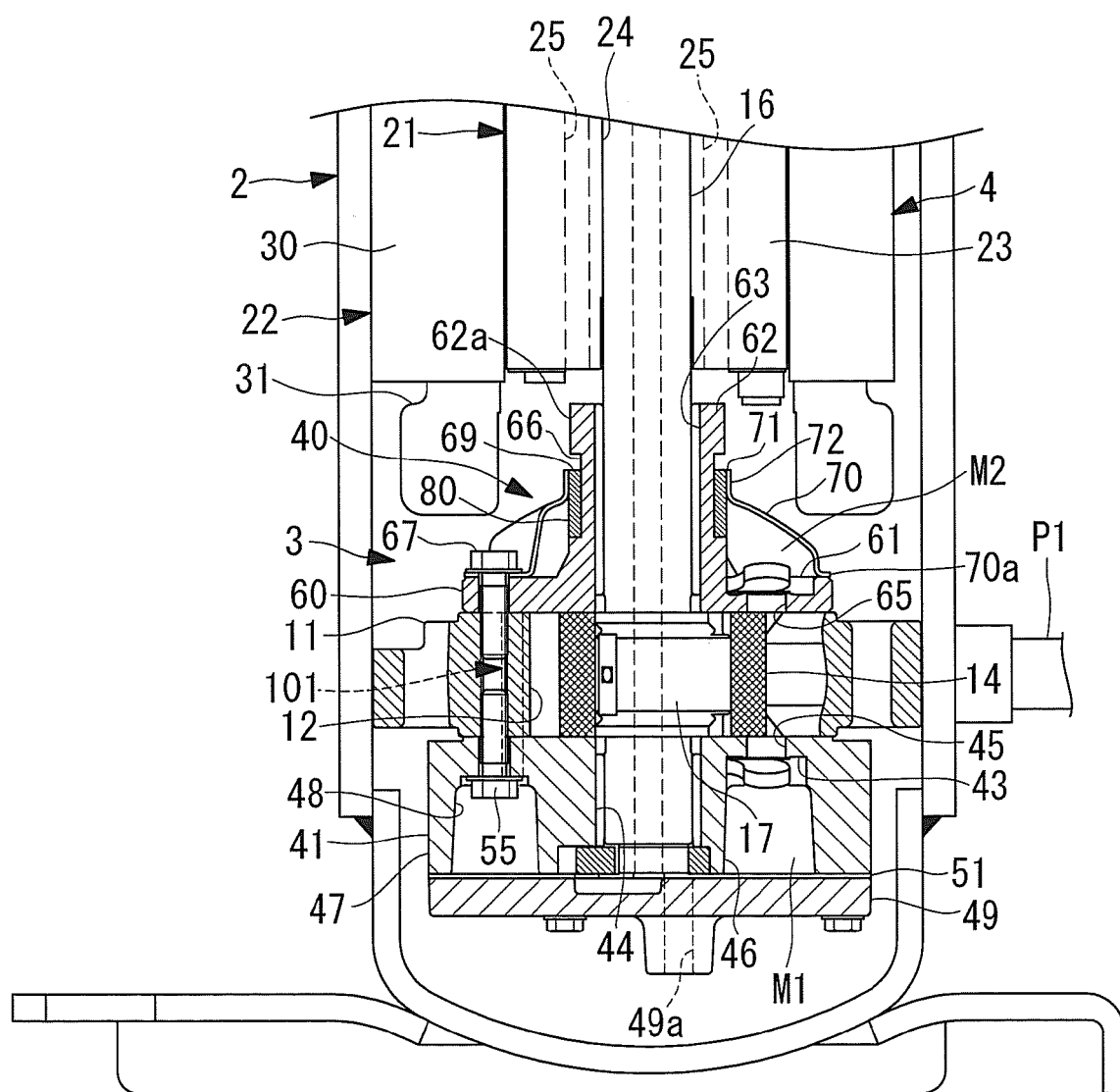


FIG. 3

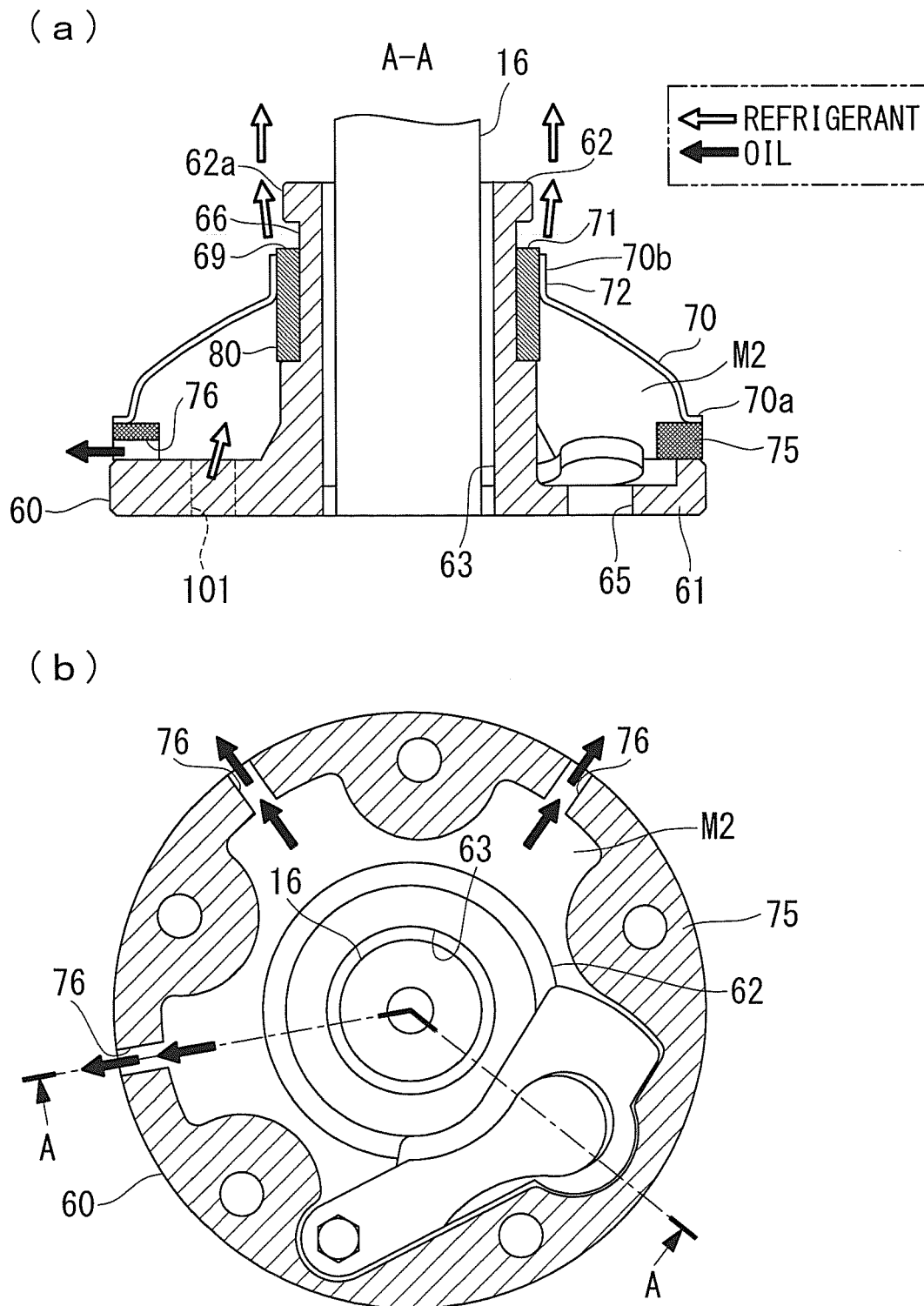


FIG. 4

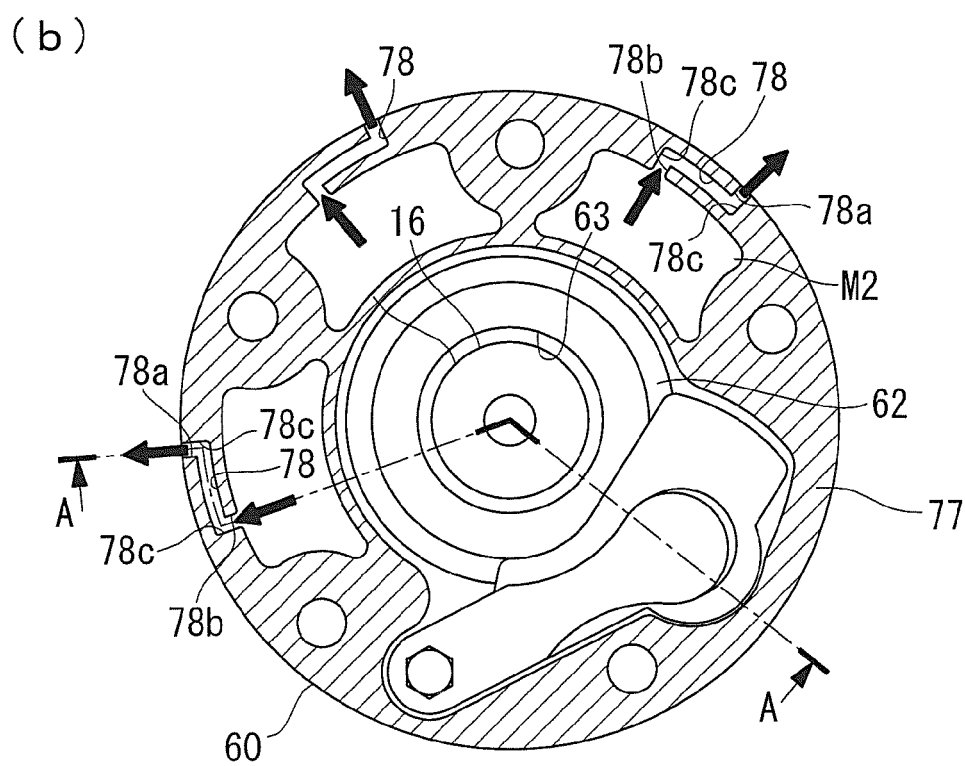
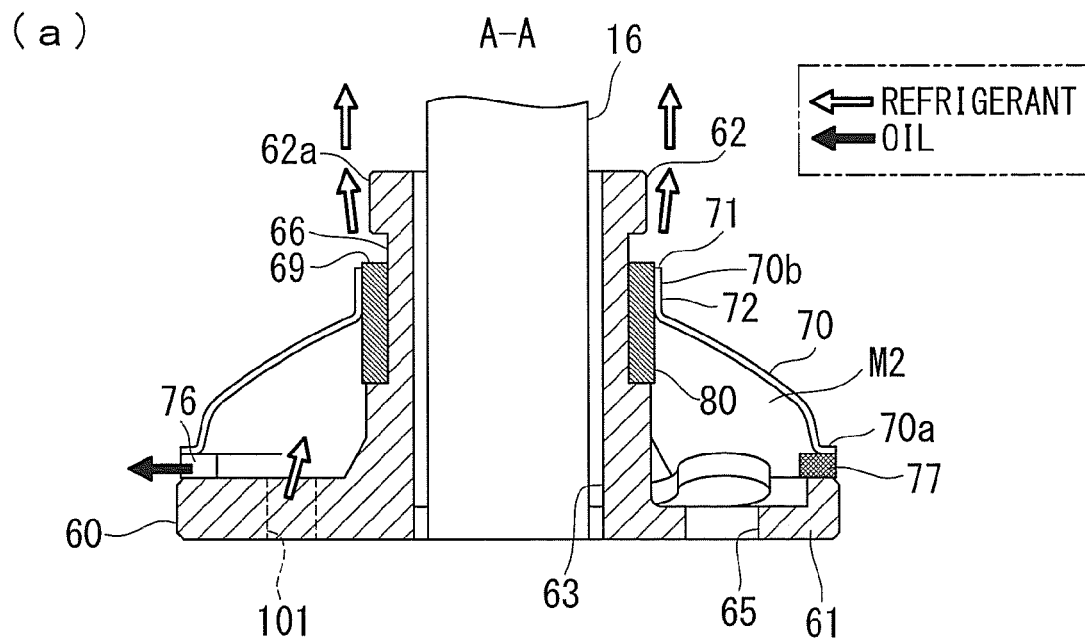


FIG. 5

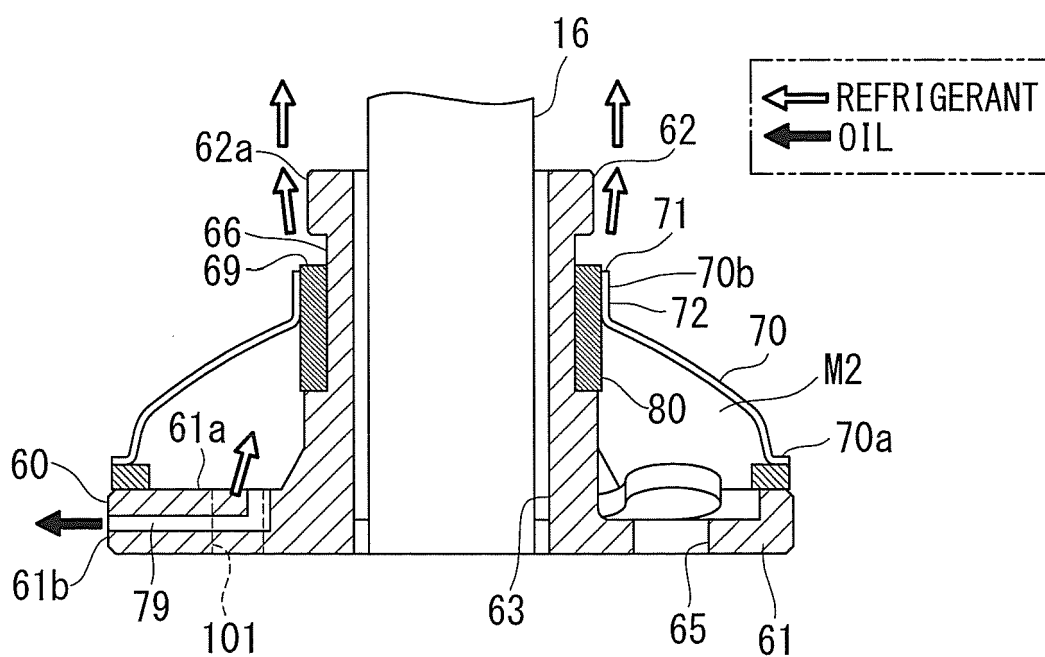
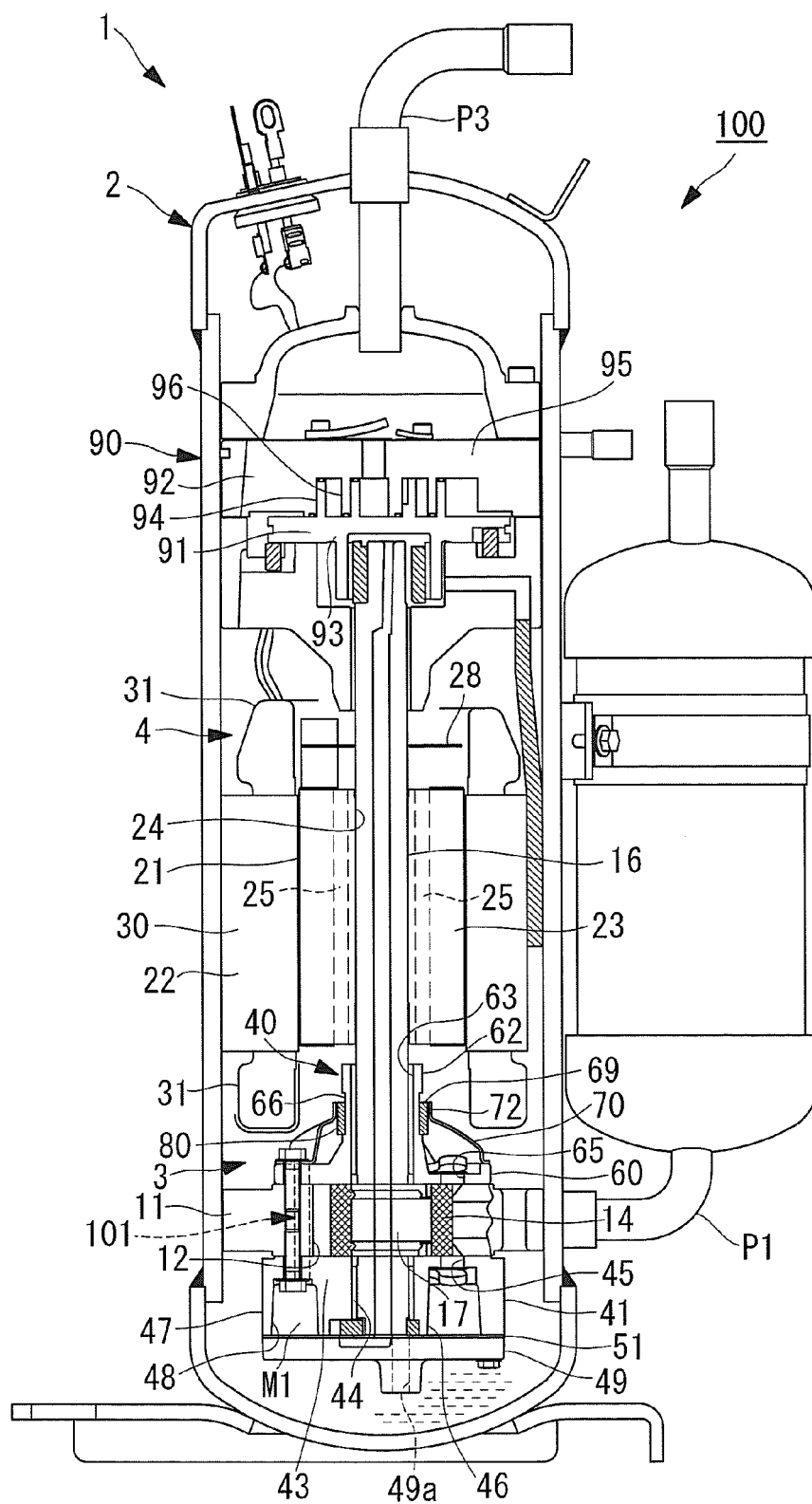


FIG. 6



REFERENCES CITED IN THE DESCRIPTION

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