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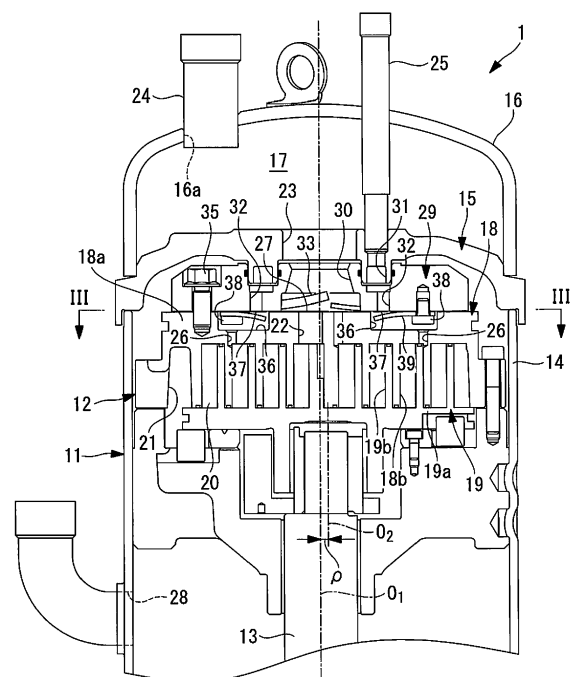
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(54) **COMPRESSOR WITH AN INJECTION PORT AND CHECK VALVE.**

(57) A scroll compressor (1) includes: a discharge cover (15) accommodated in a housing (11), and installed on a side of a scroll type mechanical compression unit (12) on which a refrigerant is discharged; and an injection pipe (25) having one end connected to the discharge cover (15). An injection port (26) that introduces the refrigerant passing through the injection pipe (25) into a compression chamber (20) of the mechanical compression unit (12) is formed in a fixed scroll (18). A lead valve (37) that is capable of opening and closing the outlet of the injection pipe (25) on a tip end side of the lead valve (37) and prevents backflow of the refrigerant supplied from the injection pipe (25) is installed. The injection port (26) of the fixed scroll (18) is formed closer to a fixing point of the lead valve (37) than to the tip end of the lead valve (37).

FIG. 2



Description

[Technical Field]

[0001] The present invention relates to a compressor.

[Background Art]

[0002] As a refrigeration cycle, a two-stage compression refrigeration cycle in which a refrigerant is compressed in two stages is sometimes used to improve performance of a heat pump and improve the coefficient of performance (COP). In the two-stage compression refrigeration cycle, an economizer (gas-liquid separator) is provided between two expansion valves to introduce an intermediate-pressure refrigerant from the economizer in the middle of a compression process. Such a refrigeration cycle is also referred to as a gas injection cycle or an economizer cycle.

[0003] Japanese Unexamined Patent Application, Publication No. Hei11-107949 (hereinafter referred to as "JP 11-107949 A") discloses that an injection port penetrating an end plate of a fixed scroll is provided, and a check-valve chamber is provided in a connection portion connecting the injection port and an injection pipe. A check valve that opens and closes the outlet of the injection pipe is provided in the check-valve chamber.

[Citation List]

[Patent Literature]

[0004] [PTL 1]

Japanese Unexamined Patent Application, Publication No. Hei11-107949

[Summary of Invention]

[Technical Problem]

[0005] Aforementioned JP 11-107949 A describes that in the check-valve chamber, the injection port formed in the fixed scroll is shifted by ΔH to the tip end edge side of the check valve (lead valve) from the outlet (introduction port) of the injection pipe. Hence, the injection gas that pushes open the tip end of the lead valve and flows into the check-valve chamber from the introduction port flows toward the injection port while escaping to the tip end edge side of the lead valve.

[0006] However, with the layout of the outlet of the injection pipe and the injection port on the fixed scroll side disclosed in JP 11-107949 A, the gap between the injection port and the check valve becomes narrow when the check valve is opened. For this reason, there is still a large amount of pressure loss in the flow of refrigerant inside the check-valve chamber. To reduce pressure loss with this layout, the inner wall of the check-valve chamber needs to be spaced apart from the check valve, and the

space inside the check-valve chamber needs to be increased.

[0007] Moreover, JP 11-107949 A describes that in a horizontal compressor, the injection port is formed in a lowermost part of the check-valve chamber in consideration of the flow of the lubricating oil, and merely discloses that the injection port is formed on the tip end edge side of the check valve.

[0008] The present invention has been made in view of the foregoing, and aims to provide a compressor that can reduce pressure loss near a check valve by focusing on the layout of the outlet of an injection pipe and an injection port of a fixed scroll.

[Solution to Problem]

[0009] To solve the above problem, a compressor of the present invention adopts the following solutions.

[0010] Specifically, a compressor of the present invention includes: a housing; a scroll type mechanical compression unit accommodated in the housing and having a fixed scroll; a discharge cover accommodated in the housing and installed on a side of the mechanical compression unit on which a refrigerant is discharged; and an injection pipe having one end connected to the discharge cover and through which a refrigerant introduced into a compression chamber of the mechanical compression unit flows. An injection port that introduces the refrigerant passing through the injection pipe into the compression chamber of the mechanical compression unit is formed in the fixed scroll. A check valve that is capable of opening and closing an outlet of the injection pipe on a tip end side of the check valve and prevents backflow of the refrigerant supplied from the injection pipe is installed. The injection port of the fixed scroll is formed closer to a fixing point of the check valve than to a tip end of the check valve.

[0011] According to this configuration, one end of the injection pipe is connected to the discharge cover, and the refrigerant flows through the injection pipe and is introduced into the compression chamber of the mechanical compression unit through the injection port formed in the fixed scroll. The check valve is capable of opening and closing the outlet of the injection pipe on the tip end side of the check valve and prevents backflow of the refrigerant supplied from the injection pipe. The injection port of the fixed scroll is formed closer to the fixing point of the check valve than to the tip end of the check valve. Accordingly, since the refrigerant injected from the injection pipe flows into the wide space between the check valve and the injection port, the refrigerant is guided to the injection port without increase in pressure loss.

[0012] The above invention may further include a cover member installed between the discharge cover and the fixed scroll. The cover member may have a refrigerant passage penetrating a first face on the discharge cover side and a second face on the fixed scroll side, and through which the refrigerant supplied from the injection

pipe flows. The check valve may be installed in the cover member so as to be capable of opening and closing the refrigerant passage, and prevent backflow of the refrigerant passing through the refrigerant passage.

[0013] In the above invention, assuming that a maximum lift amount of the tip end of the check valve is 100%, the injection port may be formed within a projection range of an area of the check valve lifted by a lift amount equal to or lower than 95% when the check valve is lifted by the maximum lift amount.

[0014] The above invention may further include a long retainer that limits opening of the check valve. The injection port may be formed within a maximum width of the retainer perpendicular to a longitudinal direction of the retainer.

[0015] In the above invention, the injection port may be formed within a projection range when the retainer is projected on the fixed scroll.

[0016] In the above invention, a width of an intermediate portion in the longitudinal direction of the retainer may be narrower than the maximum width of the retainer, and the injection port may be formed in a position corresponding to the intermediate portion of the retainer.

[0017] In the above invention, an edge portion of the injection port may be tapered.

[0018] In the above invention, the check valve may be fixed with a bolt, and a recess that accommodates a head of the bolt may be formed in the fixed scroll.

[Advantageous Effects of Invention]

[0019] According to the present invention, pressure loss near a check valve can be further reduced by focusing on the layout of the outlet of an injection pipe and an injection port of a fixed scroll.

[Brief Description of Drawings]

[0020]

Fig. 1 is a configuration diagram showing a refrigeration cycle of an embodiment of the present invention.

Fig. 2 is a partial longitudinal section showing a main part of a scroll compressor of the embodiment of the present invention.

Fig. 3 is a cross section showing the scroll compressor of the embodiment of the present invention, and is a view on arrow III-III of Fig. 2.

Fig. 4 is a plan view showing a check valve and a retainer of the scroll compressor of the embodiment of the present invention.

Fig. 5 is a longitudinal section showing a check-valve chamber, the check valve, and the retainer of the scroll compressor of the embodiment of the present invention.

Fig. 6 is a longitudinal section showing a first modification of the check-valve chamber, the check valve,

and the retainer of the scroll compressor of the embodiment of the present invention.

Fig. 7 is a longitudinal section showing a second modification of the check-valve chamber, the check valve, and the retainer of the scroll compressor of the embodiment of the present invention.

[Description of Embodiments]

[0021] Hereinafter, an embodiment of the present invention will be described with reference to the drawings.

[0022] As shown in Fig. 1, a refrigeration cycle 10 includes components such as a scroll compressor 1 that compresses a refrigerant (fluid), a condenser 2 that dissipates heat of the compressed refrigerant to the outside, a first expansion valve 3 provided on the high-pressure side for decompression of the refrigerant flowing out of the condenser 2, an economizer (gas-liquid separator) 4 that separates the decompressed refrigerant into a liquid refrigerant and a gas refrigerant, a second expansion valve 5 provided on the low-pressure side for further decompression of the liquid refrigerant, an evaporator 6 that causes the decompressed refrigerant to absorb heat, and an injection passage 7 that guides the gas refrigerant from the economizer 4 to the scroll compressor 1.

[0023] The scroll compressor 1 is a closed compressor, and as shown in Fig. 2, is mainly configured of a housing 11 that has a closed space formed therein, a scroll type mechanical compression unit 12 that is accommodated in the housing 11 and compresses a refrigerant taken into the closed space, a rotating shaft 13 that transmits rotary force to the scroll type mechanical compression unit 12, and an electric motor that makes a rotating scroll 19 of the scroll type mechanical compression unit 12 orbit through the rotating shaft 13.

[0024] A bottom portion of the housing 11 is closed with a lower cover, and the housing 11 includes a vertically long cylindrical middle cover 14 above the lower cover. A discharge cover 15 and an upper cover 16 are provided above the middle cover 14 to close the housing 11. A discharge chamber 17 into which compressed high-pressure gas is discharged is formed between the discharge cover 15 and the upper cover 16.

[0025] The scroll type mechanical compression unit 12 is incorporated in the housing 11, and the electric motor formed of a stator and a rotor is installed below the scroll type mechanical compression unit 12. The electric motor is incorporated by fixing the stator to the housing 11, and the rotating shaft 13 is fixed to the rotor.

[0026] The scroll type mechanical compression unit 12 includes components such as a fixed scroll 18 fixed to the housing 11, and the rotating scroll 19 slidably supported and meshed with the fixed scroll 18 to form a compression chamber 20.

[0027] A suction port 28 for sucking in a refrigerant is formed on a side face of the housing 11 so as to communicate into the closed space, and a discharge port 16a for discharging a compressed refrigerant gas is formed

on the top side of the upper cover 16 so as to communicate with the discharge chamber 17.

[0028] The scroll type mechanical compression unit 12 sucks in the refrigerant gas, which is sucked into the housing 11 through suction piping and the suction port 28, into the compression chamber 20 through an external suction port 21 open to the inside of the housing 11, and compresses the refrigerant gas. The compressed refrigerant gas is discharged into the discharge chamber 17 through a discharge port 22 provided in a center portion of the fixed scroll 18, a refrigerant passage 30 provided in a block member 29, and a discharge port 23 provided in the discharge cover 15, and is further transmitted to the outside of the compressor through a discharge pipe 24 provided in the upper cover 16 and communicating with the discharge chamber 17.

[0029] Additionally, an injection pipe 25 that introduces an intermediate-pressure refrigerant into the compression chamber 20 of the scroll type mechanical compression unit 12 from outside is connected to the discharge cover 15. The injection pipe 25 penetrates the upper cover 16. The refrigerant is supplied to the compression chamber 20 through the injection pipe 25, a refrigerant passage 31 provided in the discharge cover 15, a refrigerant passage 32 provided in the block member 29, and an injection port 26 provided in the fixed scroll 18. By supplying the refrigerant to the compression chamber 20 through the injection pipe 25, the discharged refrigerant amount can be increased to increase capacity.

[0030] A lead valve 27 is a thin plate-like member, is provided in an outlet portion of the discharge port 22, and opens and closes the discharge port 22. The lead valve 27 allows the refrigerant to flow only in one direction. Since the lead valve 27 is provided, the refrigerant flows to the discharge chamber 17 side from the compression chamber 20.

[0031] A retainer 33 that limits the movable range (opening upper limit) of the lead valve 27 is provided in the movable direction of the lead valve 27. The lead valve 27 hits the retainer 33 when the lead valve 27 opens, whereby the retainer 33 can keep the lead valve 27 from opening too wide. The retainer 33 is a member with high rigidity that is less likely to deform.

[0032] The lead valve 27 is a member long in one direction, and has an arcuate end portion, for example. One end side of the lead valve 27 is fixed to the fixed scroll 18 with a bolt 34 (see Fig. 3), and the other end side of the lead valve 27 is capable of opening and closing the discharge port 22. As in the case of the lead valve 27, the retainer 33 is also a member long in one direction, and has one end side fixed together with the lead valve 27 with the bolt 34.

[0033] As shown in Fig. 2, the fixed scroll 18 includes a substantially disk-shaped end plate 18a, and a scroll wall body 18b installed in a standing manner on one side face of the end plate 18a. As shown in Fig. 2, the rotating scroll 19 includes a substantially disk-shaped end plate 19a, and a scroll wall body 19b installed in a standing

manner on one side face of the end plate 19a. The scroll shape of each of the wall bodies 18b, 19b is defined by use of an involute curve or an Archimedean spiral. The fixed scroll 18 has the discharge port 22 and the injection port 26 both penetrating the end plate 18a in the thickness direction.

[0034] The fixed scroll 18 and the rotating scroll 19 have centers O_1 , O_2 thereof spaced apart by a turning radius p , are meshed by shifting the phases of the wall bodies 18b, 19b by 180 degrees, and are assembled such that a slight clearance (tip clearance) in the height direction is formed between the tooth tip and bottom of the wall bodies 18b, 19b of both scrolls 18, 19 at ordinary temperature. As a result, multiple pairs of compression chambers 20 surrounded by the end plates 18a, 19a and wall bodies 18b, 19b of both scrolls 18, 19 are formed between both scrolls 18, 19, so as to be symmetrical with respect to the scroll center. The rotating scroll 19 orbits around the fixed scroll 18 by an anti-rotation mechanism such as an Oldham ring.

[0035] The block member 29 is an example of a cover member, and is installed on a face of the fixed scroll 18 on the discharge cover 15 side with a bolt 35, between the fixed scroll 18 and the discharge cover 15.

[0036] The refrigerant passage 30, and the refrigerant passage 32 through which the refrigerant from the injection pipe 25 flows are formed in the block member 29. The refrigerant passage 32 penetrates the block member 29 from a face on the discharge cover 15 side to the fixed scroll 18 side.

[0037] As shown in Figs. 2 to 5, a recessed lead valve chamber 36 is formed on the face of the fixed scroll 18 on the discharge cover 15 side. The refrigerant having flowed through the injection pipe 25 is supplied to the refrigerant passages 31, 32, and then is supplied to the lead valve chamber 36. As shown in Fig. 4, the lead valve chamber 36 has a side face surrounding a retainer 39, and the injection port 26 is formed in a bottom face inside the lead valve chamber 36. Additionally, the refrigerant passage 32 is formed and a bolt 38 fixing a lead valve 37 and the retainer 39 is fastened on the block member 29 side of the lead valve chamber 36.

[0038] The fixed scroll 18 has the injection port 26 open in the lead valve chamber 36, and the injection port 26 is formed closer to the bolt 38 fixing the lead valve 37 than to the tip end of the lead valve 37.

[0039] The lead valve 37 is a thin plate-like member, is provided in an outlet portion of the refrigerant passage 32, and opens and closes the refrigerant passage 32. The lead valve 37 allows the refrigerant to flow only in one direction. Since the lead valve 37 is provided, the refrigerant flows to the side of the compression chamber 20 of the fixed scroll 18 from the injection pipe 25.

[0040] A retainer 39 that limits the movable range (opening upper limit) of the lead valve 37 is provided in the movable direction of the lead valve 37. The lead valve 37 hits the retainer 39 when the lead valve 37 opens, whereby the retainer 39 can keep the lead valve 37 from

opening too wide. The retainer 39 is a member with high rigidity that is less likely to deform.

[0041] The lead valve 37 is a member long in one direction, and has an arcuate end portion, for example. One end side of the lead valve 37 is fixed to the block member 29 with the bolt 38, and the other end side of the lead valve 37 is capable of opening and closing the refrigerant passage 32. As in the case of the lead valve 37, the retainer 39 is also a member long in one direction, and has one end side fixed together with the lead valve 37 with the bolt 38.

[0042] In the embodiment, one end of the injection pipe 25 is connected to the discharge cover 15. When a refrigerant is introduced into the compression chamber 20 in the middle of a compression process, the refrigerant is supplied to the refrigerant passages 31, 32 through the injection pipe 25, and then is supplied to the lead valve chamber 36. Then, the refrigerant gas is introduced into the compression chamber 20 of the scroll type mechanical compression unit 12 through the injection port 26 formed in the fixed scroll 18.

[0043] The lead valve 37 is capable of opening and closing the refrigerant passage 32, which is the outlet of the injection pipe, on the tip end side of the lead valve 37, and prevents backflow of the refrigerant supplied from the injection pipe 25. The injection port 26 of the fixed scroll 18 is formed closer to the fixing point of the lead valve 37 than to the tip end of the lead valve 37. Accordingly, since the refrigerant injected from the injection pipe 25 flows into the wide space between the lead valve 37 and the injection port 26, the refrigerant is guided to the injection port 26 without increase in pressure loss.

[0044] Assuming that the maximum lift amount of the tip end of the lead valve 37 is 100%, the injection port 26 should not be formed within a projection range of the area of the lead valve 37 lifted by a lift amount higher than 95% and equal to or lower than 100% when the lead valve 37 is lifted by the maximum lift amount. That is, the injection port 26 is preferably formed within a projection range of the area of the lead valve 37 lifted by a lift amount equal to or lower than 95% when the lead valve 37 is lifted by the maximum lift amount. As a result, the injection port 26 is formed in a position away from the check valve.

[0045] The injection port 26 is preferably formed within the maximum width of the retainer 39 perpendicular to the longitudinal direction of the retainer 39. The injection port 26 is more preferably formed within a projection range when the retainer 39 is projected on the fixed scroll 18. With this, the injection port 26 is formed within a range where the injection port 26 is not far from the outlet of the refrigerant passage 32, whereby the volume of the lead valve chamber 36 can be reduced.

[0046] A retainer 39 whose width of an intermediate portion in the longitudinal direction is narrower than the maximum width of the retainer 39 may be applied as the retainer 39. In this case, the area of a passage inside the lead valve chamber 36 is increased, and the refrigerant from the refrigerant passage 32 can more easily pass a

side end portion of the retainer 39, so that pressure loss can be reduced. Moreover, the injection port 26 is preferably formed in a position corresponding to the intermediate portion of the retainer 39. With this, the injection port 26 is formed within a range where the injection port 26 is not far from the outlet of the refrigerant passage 32.

[0047] As shown in Fig. 6, an edge portion of an inlet portion of the injection port 26 may be tapered. As a result, even when the injection port 26 is provided directly below the bolt 38, the large inlet area of the injection port 26 can reduce pressure loss. Instead, as shown in Fig. 7, a recess may be formed in a part where the head of the bolt 38 is installed. In this case, too, pressure loss inside the lead valve chamber 36 can be reduced.

[Reference Signs List]

[0048]

1	scroll compressor
2	condenser
3	first expansion valve
4	economizer
5	second expansion valve
6	evaporator
7	injection passage
10	refrigeration cycle
11	housing
12	scroll type mechanical compression unit
13	rotating shaft
14	middle cover
15	discharge cover
16	upper cover
17	discharge chamber
18	fixed scroll
19	rotating scroll
20	compression chamber
21	suction port
22	discharge port
23	discharge port
24	discharge pipe
25	injection pipe
26	injection port
27	lead valve
29	block member (cover member)
30, 31, 32	refrigerant passage
33, 39	retainer
34, 35, 38	bolt
36	lead valve chamber
37	lead valve (check valve)

Claims

1. A compressor (1) comprising:
 - a housing (11);
 - a scroll type mechanical compression unit (12)

accommodated in the housing and having a fixed scroll (18);
 a discharge cover (15) accommodated in the housing and installed on a side of the mechanical compression unit (12) on which a refrigerant is discharged; and
 an injection pipe (25) having one end connected to the discharge cover (15) and configured to introduce a refrigerant flowing therethrough into a compression chamber (20) of the mechanical compression unit, wherein:

an injection port (26) that is configured to introduce the refrigerant passing through the injection pipe (25) into the compression chamber (20) of the mechanical compression unit (12) is formed in the fixed scroll (18);
 a check valve (37) that is capable of opening and closing an outlet of the injection pipe (25) on a tip end side of the check valve and that is configured to prevent backflow of the refrigerant supplied from the injection pipe (25) is installed; and
 the injection port (26) of the fixed scroll (18) is formed closer to a fixing point of the check valve (37) than to a tip end of the check valve (37).

2. The compressor (1) according to claim 1 further comprising a cover member (29) installed between the discharge cover (15) and the fixed scroll (18), wherein:

the cover member (29) has a refrigerant passage (30, 31, 32) penetrating a first face on the discharge cover side and a second face on the fixed scroll side, and through which the refrigerant supplied from the injection pipe (25) is configured to flow; and
 the check valve (37) is installed in the cover member (29) so as to be capable of opening and closing the refrigerant passage (30, 31, 32), and is configured to prevent backflow of the refrigerant passing through the refrigerant passage.

3. The compressor (1) according to any one of claims 1 and 2, wherein
 assuming that a maximum lift amount of the tip end of the check valve (37) is 100%, the injection port (26) is formed within a projection range of an area of the check valve (37) lifted by a lift amount equal to or lower than 95% when the check valve (37) is lifted by the maximum lift amount.
4. The compressor (1) according to any one of claims 1 to 3 further comprising a long retainer (39) that is configured to limit opening of the check valve (37),

wherein

the injection port (26) is formed within a maximum width of the retainer perpendicular to a longitudinal direction of the retainer (39).

5. The compressor (1) according to claim 4, wherein the injection port (26) is formed within a projection range when the retainer (39) is projected on the fixed scroll (18).

6. The compressor (1) according to claim 5, wherein:

a width of an intermediate portion in the longitudinal direction of the retainer (39) is narrower than the maximum width of the retainer (39); and the injection port (26) is formed in a position corresponding to the intermediate portion of the retainer (39).

7. The compressor (1) according to any one of claims 1 to 6, wherein an edge portion of the injection port (26) is tapered.

8. The compressor (1) according to any one of claims 1 to 7, wherein:

the check valve (37) is fixed with a bolt (38); and a recess that accommodates a head of the bolt (38) is formed in the fixed scroll (18).

FIG. 1

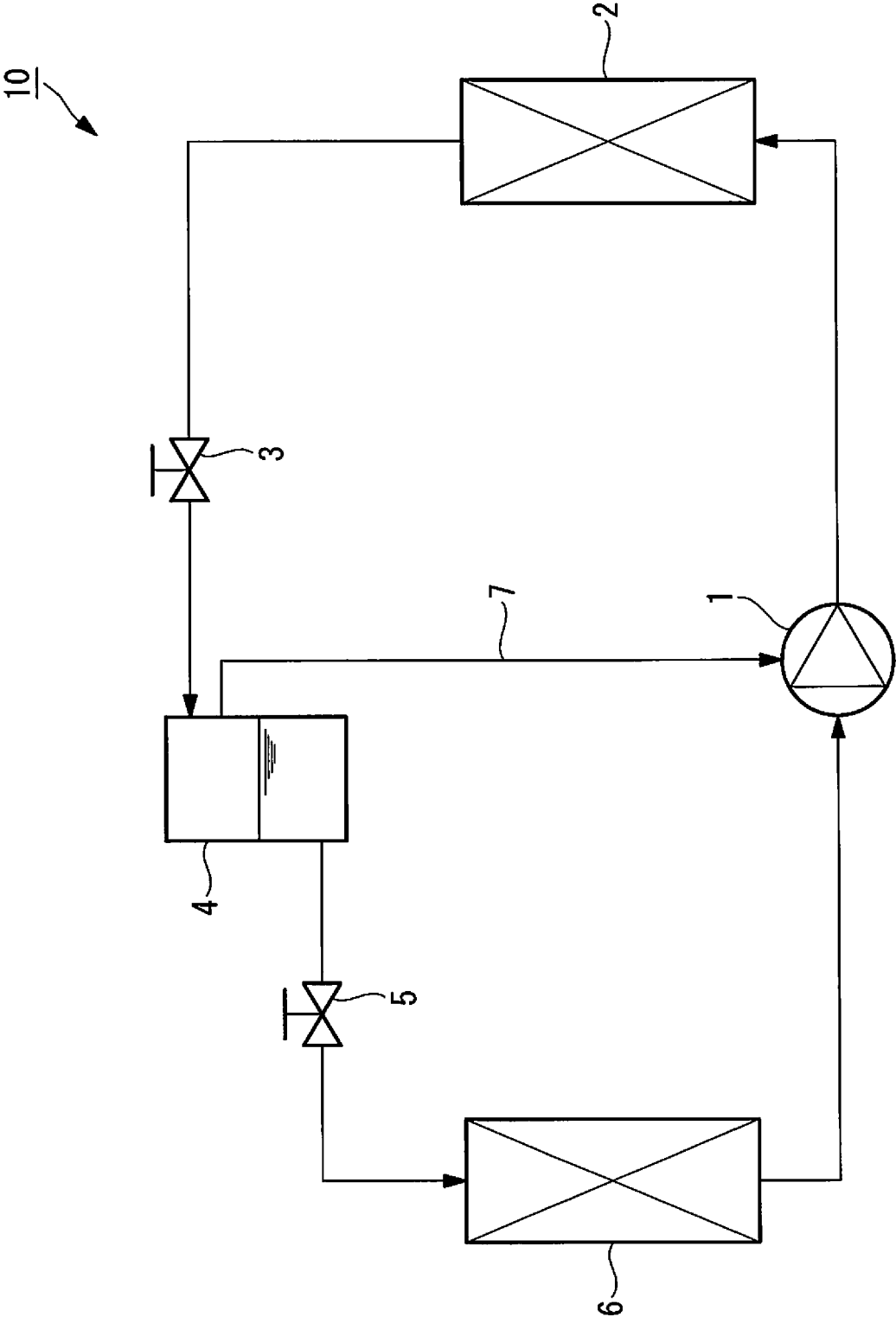


FIG. 2

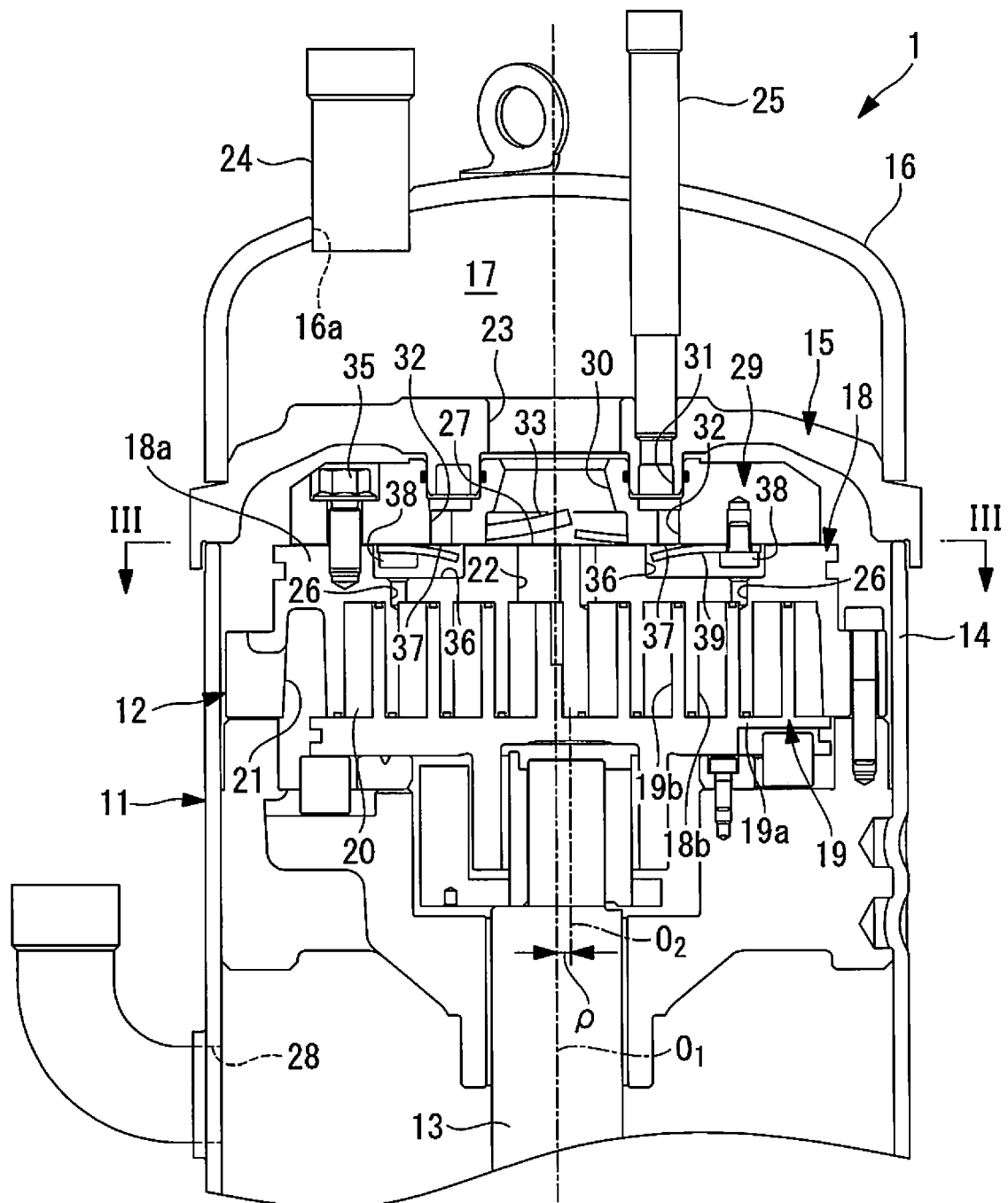


FIG. 3

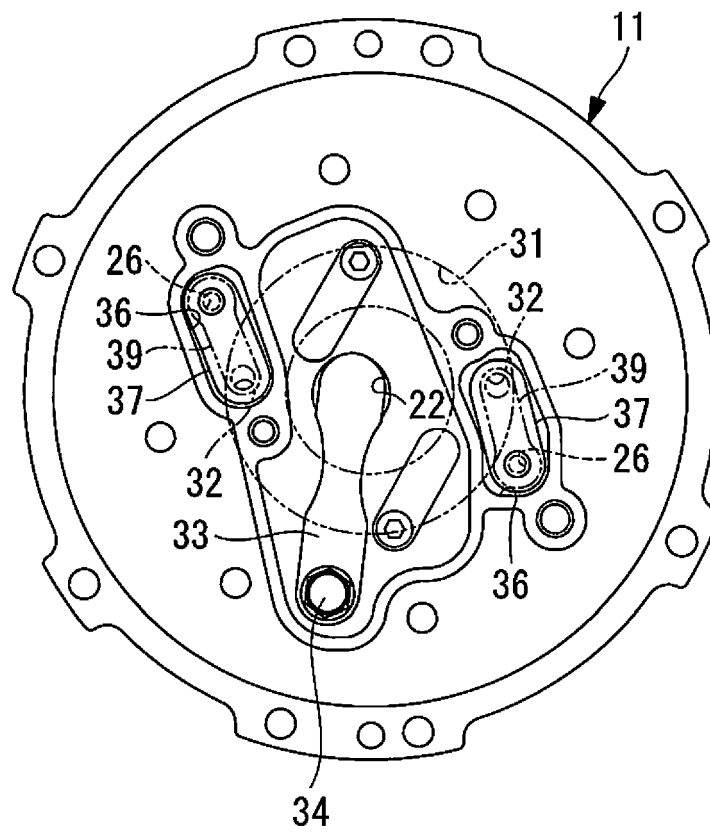


FIG. 4

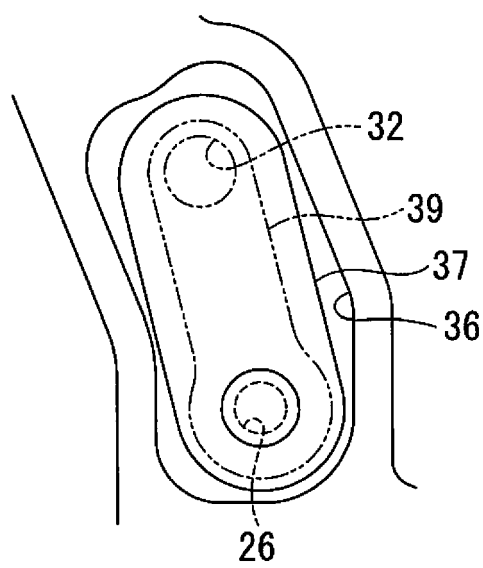


FIG. 5

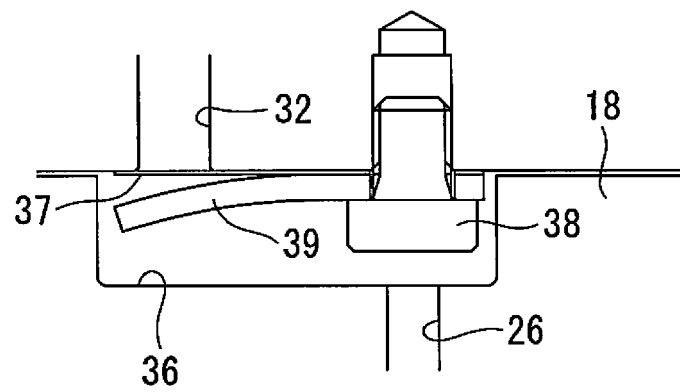


FIG. 6

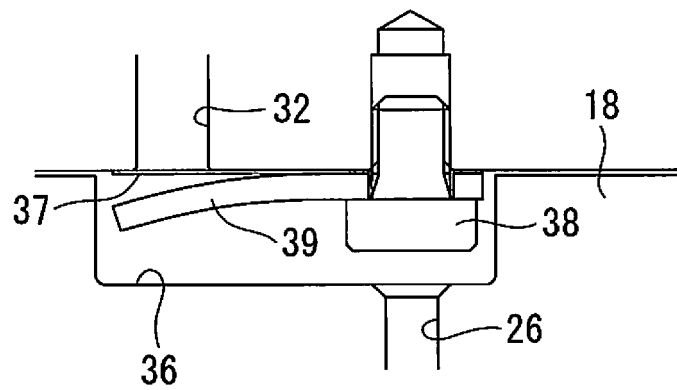
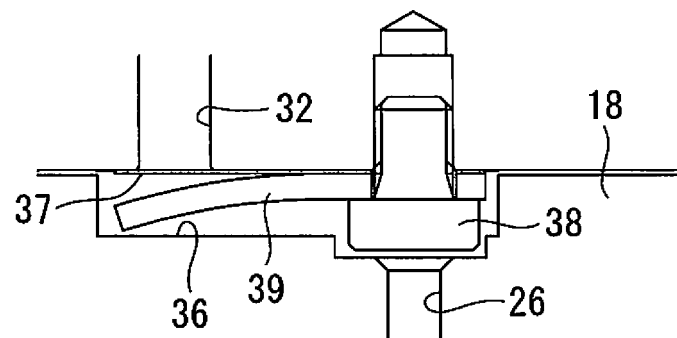


FIG. 7





EUROPEAN SEARCH REPORT

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Place of search Munich		Date of completion of the search 11 October 2019	Examiner Sbresny, Heiko
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