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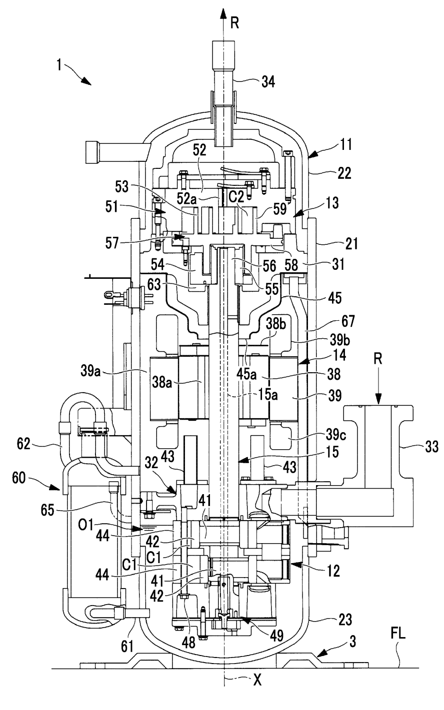
(54) COMPRESSOR

(57) Provided is a compressor capable of introducing as little oil as possible to a higher-side compressing mechanism. A compressor (1) comprises: a rotary compressing mechanism (12) connected to a lower end of a rotation shaft (15), and which compresses and ejects a refrigerant into a housing (11); a scroll compressing mechanism (13) connected to an upper end of the rotation shaft (15), and which takes in and compresses the refrigerant ejected into the housing (11); and a cover (45) having, at a lower end thereof, an intake opening (45a) through which the refrigerant ejected from the scroll compressing mechanism (13) is taken in from around the rotation shaft (15), and partitioning a space inside the housing (11) so as to guide the refrigerant to an intake side of the scroll compressing mechanism (13). The intake opening (45a) of the cover (45) is provided inside an upper coil end (39b) of an electric motor (14) and below an upper end of the upper coil end (39b).

FIG. 1



EP 4 400 722 A1

Description

Technical Field

[0001] The present disclosure relates to a compressor, and more specifically, to a two-stage compressor including a low-stage-side compression mechanism and a high-stage-side compression mechanism.

Background Art

[0002] A two-stage compressor including a rotary compression mechanism and a scroll compression mechanism in a housing is known. In a two-stage compressor disclosed in PTL 1, a refrigerant compressed by a rotary compression mechanism on a low-stage side is discharged into a housing, and the discharged refrigerant is further compressed by a scroll compression mechanism on a high-stage side. An oil reservoir that stores a lubricant is provided in the housing. The oil stored in the oil reservoir may accompany the refrigerant discharged from the rotary compression mechanism and be guided to the scroll compression mechanism. Since performance is lowered when the oil is guided to the scroll compression mechanism, in PTL 1, a flow restriction plate having a conical shape (refer to reference sign 81 and Fig. 4 in PTL 1) is provided to restrict the flow of the refrigerant guided to the scroll compression mechanism.

Citation List

Patent Literature

[0003] [PTL 1] Japanese Unexamined Patent Application Publication No. 2017-190732 (Fig. 4, etc.)

Summary of Invention

Technical Problem

[0004] However, in the flow restriction plate of PTL 1, a position of a lower end serving as a suction opening is located above a coil end of an electric motor. Therefore, the refrigerant accompanied by the oil may be sucked.

[0005] The present disclosure has been made in view of such circumstances, and an object thereof is to provide a compressor capable of reducing oil guided to a high-stage-side compression mechanism as much as possible.

Solution to Problem

[0006] In order to solve the above problems, according to the present disclosure, there is provided a compressor including: a housing having an oil reservoir in a lower portion; a rotary shaft portion accommodated in the housing and rotating around a longitudinal axis; an electric motor provided at a center of the rotary shaft portion in a direction of the longitudinal axis to rotationally drive the rotary shaft portion; a low-stage-side compression mechanism connected to a lower end of the rotary shaft portion to compress a refrigerant and discharge the refrigerant into the housing; a high-stage-side compression mechanism connected to an upper end of the rotary shaft portion to suck the refrigerant discharged into the housing from the low-stage-side compression mechanism and compress the refrigerant; and a cover that has, at a lower end thereof, a suction opening for sucking the refrigerant discharged from the low-stage-side compression mechanism from around the rotary shaft portion and that partitions a space in the housing such that the refrigerant is guided to a suction side of the high-stage-side compression mechanism, in which the suction opening of the cover is provided on an inner side of a coil end of the electric motor and below an upper end of the coil end.

Advantageous Effects of Invention

[0007] The oil guided to the high-stage-side compression mechanism can be reduced as much as possible.

Brief Description of Drawings

[0008]

Fig. 1 is a longitudinal cross-sectional view of a compressor according to an embodiment of the present disclosure.
Fig. 2 is a longitudinal cross-sectional view showing a main part of the compressor of Fig. 1.
Fig. 3 is a cross-sectional view taken along cutting line III-III of Fig. 2.
Fig. 4 is a longitudinal cross-sectional view showing the compressor in an enlarged manner at a height position of a lower end of an oil return pipe.
Fig. 5 is a longitudinal cross-sectional view showing a flow of a refrigerant by a cover.
Fig. 6 is a longitudinal cross-sectional view showing a modification example of Fig. 5.

Description of Embodiments

[0009] Hereinafter, an embodiment according to the present disclosure will be described with reference to the drawings.

[0010] As shown in Fig. 1, a compressor 1 is used for an air conditioner and compresses a refrigerant R, which is, for example, a gas such as carbon dioxide, in two stages. The compressor 1 is fixed to an installation surface FL via leg portions 3. The compressor 1 includes a housing 11 and includes a rotary compression mechanism (low-stage-side compression mechanism) 12, a scroll compression mechanism (high-stage-side compression mechanism) 13, an electric motor 14, and a rotary shaft (rotary shaft portion) 15, which are provided inside the housing 11.

[0011] The housing 11 has a main body portion 21 having a cylindrical shape, and an upper cover portion 22 and a lower cover portion 23 that close upper and lower openings of the main body portion 21. The inside of the housing 11 forms a sealed space.

[0012] The rotary shaft 15 is provided to extend vertically along an axis X inside the housing 11. An upper end (one end) side of the rotary shaft 15 is rotatably supported by an upper bearing 31. A lower end (other end) side of the rotary shaft 15 is rotatably supported by a lower bearing 32.

[0013] The electric motor 14 is disposed at a center of the rotary shaft 15 in a longitudinal direction and on an outer peripheral side of the rotary shaft 15, and rotates the rotary shaft 15 around the axis X. The electric motor 14 includes a rotor 38 fixed to an outer peripheral surface of the rotary shaft 15, and a stator 39 that faces the rotor 38 in a radial direction with a gap from an outer peripheral surface of the rotor 38 and that is fixed to an inner wall of the main body portion 21 of the housing 11 by shrink fitting or the like.

[0014] The rotor 38 is provided with rotor passages 38a provided at a predetermined interval in a circumferential direction. Each rotor passage 38a penetrates the rotor 38 in a vertical direction (axis X direction). The refrigerant discharged from a rotary compression mechanism 12 flows upward through the rotor passages 38a. An oil separation plate (baffle plate) 38b is fixed to an upper portion of the rotor 38. The oil separation plate 38b has a circular plate shape and is disposed to extend in a horizontal direction. The oil separation plate 38b rotates around the axis X together with the rotor 38.

[0015] A plurality of stator passages 39a are formed in an outer periphery of the stator 39 at a predetermined angular interval in a circumferential direction (specifically, it will be described later with reference to Fig. 3).

[0016] As shown in Fig. 1, an upper coil end 39b in which a winding is folded back is located at an upper portion of the stator 39, and a lower coil end 39c in which a winding is folded back is located at a lower portion of the stator 39. The electric motor 14 is connected to a power source via an inverter (not shown) and rotates the rotary shaft 15 with a variable frequency.

[0017] The rotary compression mechanism 12 is provided on the lower end (other end) side of the rotary shaft 15 inside the housing 11. The rotary compression mechanism 12 is a two-cylinder mechanism in the present embodiment, and includes an eccentric shaft portion 41 provided in the rotary shaft 15, a rotor 42 fixed to the eccentric shaft portion 41 and rotating in a compression chamber C1 eccentrically with respect to the axis X as the rotary shaft 15 rotates, and a cylinder 44 in which the compression chamber C1 is formed.

[0018] The refrigerant R is supplied to the compression chamber C1 formed in the cylinder 44 from a suction pipe 33. The refrigerant compressed in the compression chamber C1 is discharged from a rotary discharge pipe 43 to a region below the electric motor 14 in the housing 11 via the lower bearing 32.

[0019] The cylinder 44 is fixed to the lower bearing 32 from below by a bolt 48. An oil pump 49 fixed by the bolt 48 together with the cylinder 44 is provided below the cylinder 44. The oil is sucked from an oil reservoir O1 in a lower portion of the housing 11 by the oil pump 49, and is guided to the upper bearing 31 side through an oil supply hole 15a penetrating the rotary shaft 15 along the axis X.

[0020] The scroll compression mechanism 13 is disposed above the electric motor 14 inside the housing 11. The scroll compression mechanism 13 includes a fixed scroll 51 fixed to the upper bearing 31, and an orbiting scroll 57 disposed below the fixed scroll 51 to face the fixed scroll 51.

[0021] The fixed scroll 51 has an end plate 52 fixed to an upper surface of the upper bearing 31 and a fixed wrap 53 protruding downward from the end plate 52. A discharge hole 52a vertically penetrating the end plate 52 is formed in a central portion (vicinity of the axis X) of the end plate 52.

[0022] The orbiting scroll 57 is disposed to be interposed between the upper bearing 31 and the fixed scroll 51. The orbiting scroll 57 has an end plate 58 connected to an upper end side of the rotary shaft 15 and an orbiting wrap 59 protruding upward from the end plate 58.

[0023] The end plate 58 is fixed to the eccentric shaft portion 56 provided at the upper end of the rotary shaft 15 via a bush 55, and rotates eccentrically with respect to the axis X as the rotary shaft 15 rotates.

[0024] The orbiting wrap 59 forms a compression chamber C2 for compressing the refrigerant R between the orbiting wrap 59 and the fixed wrap 53 by meshing with the fixed wrap 53.

[0025] A balance weight chamber 63 is formed between a recessed portion on a central side of the upper bearing 31 and a lower side of the orbiting scroll 57. In the balance weight chamber 63, a balance weight 54 rotates together with the rotary shaft 15.

[0026] The refrigerant R compressed by the rotary compression mechanism 12 and discharged into the housing 11 is sucked into the compression chamber C2 from an outer peripheral side of the scroll compression mechanism 13 and is compressed toward a center side. The compressed refrigerant R is discharged from a discharge pipe 34 to the outside of the housing 11 via the discharge hole 52a of the fixed scroll 51.

[0027] A cover 45 is provided below the upper bearing 31 so as to cover the upper bearing 31. The cover 45 is formed by sheet metal processing, and has a substantially conical shape that is expanded in diameter from the lower side to the upper side. An upper end of the cover 45 on an outer peripheral side is fixed to the upper bearing 31 by a bolt 45b (refer to Fig. 2).

[0028] A suction opening 45a is provided at a lower end of the cover 45. That is, the suction opening 45a faces downward and is an annular region formed between the cover 45 and the rotary shaft 15. A space below the housing 11 and a space on the upper bearing 31 side are partitioned by the cover 45, and only the refrigerant sucked from the suction opening 45a is guided to the scroll compression mechanism 13.

[0029] An oil level tank 60 is provided outside and below the housing 11. The oil level tank 60 is a hollow container and communicates with the inside of the housing 11 via a lower pipe 61 and an upper pressure equalization pipe 62. The oil level tank 60 measures an oil level of the oil reservoir O1 by guiding the oil from the oil reservoir O1 in the housing 11 via the lower pipe 61.

[0030] A downstream end of an oil separator oil return pipe 65 is connected to a lower side portion of the housing 11. An upstream end of the oil separator oil return pipe 65 is connected to an oil separator (not shown). The oil separated by the oil separator from the refrigerant discharged from the compressor 1 is returned to the oil reservoir O1 in the housing 11 via the oil separator oil return pipe 65. A height position where the downstream end of the oil separator oil return pipe 65 is connected to the housing 11 is below the lower bearing 32.

[0031] An oil return pipe 67 that is in contact with an inner wall of the housing 11 and extends in a vertical direction is provided in the housing 11. As shown in Fig. 2, an upper end (one end) of the oil return pipe 67 is fixed to the upper bearing 31 via a boss 68, and a lower end (other end) is provided to be located in the oil reservoir O1 in the lower portion of the housing 11. The lower end of the oil return pipe 67 is fixed to the inner wall of the housing 11 via a rod-shaped member 70.

[0032] The oil return pipe 67 is provided to penetrate a space formed between the stator 39 and the housing 11. Specifically, as shown in Fig. 3, cutouts are provided in the outer periphery of the stator 39 in a circumferential direction at a predetermined angular interval so that the plurality of stator passages 39a are formed with the inner wall of the housing 11. The refrigerant or the oil flows through the stator passages 39a. Two oil return pipes 67 are inserted through one or a plurality of the stator passages 39a.

[0033] As can be seen from Fig. 3, the rotor passages 38a are provided at a predetermined interval in the circumferential direction. The refrigerant discharged from a rotary compression mechanism 12 flows upward through the rotor passages 38a.

[0034] In addition, as shown in Fig. 4, a stabilizing plate 75 is fixed to a lower surface of the lower bearing 32. The stabilizing plate 75 is fixed to the lower bearing 32 (specifically, a leg portion protruding in a radial direction of the lower bearing 32) by a bolt 76. The stabilizing plate 75 is a circular plate in which an opening is formed at the center. The stabilizing plate 75 covers an upper side of an oil surface of the oil reservoir O1 to stabilize the oil surface.

[0035] Details of the cover 45 will be described with reference to Fig. 5. The suction opening 45a provided at the lower end of the cover 45 faces downward and is located on an inner side (axis X side) of the upper coil end 39b. Furthermore, a height position of the suction opening 45a is located below an upper end of the upper coil end 39b. The oil separation plate 38b is provided at a position where the suction opening 45a faces downward.

[0036] The cover 45 has a shape in which a plurality of stepped portions having diameters that change in a stepped manner are provided upward from the suction opening 45a. The cover 45 having such a shape forms a flow path through which the refrigerant flows along a lower surface shape of the upper bearing 31.

[0037] The compressor 1 having the above-described configuration operates as follows.

[0038] The refrigerant evaporated in an evaporator (not shown) is sucked into the compressor 1 from the suction pipe 33 and is compressed by the rotary compression mechanism 12. The refrigerant compressed by the rotary compression mechanism 12 is discharged from the rotary discharge pipe 43 into the housing 11.

[0039] The refrigerant discharged into the housing 11 is sucked from the suction opening 45a of the cover 45, and is guided to the scroll compression mechanism 13 through a flow path in the cover 45 to be compressed. The refrigerant compressed by the scroll compression mechanism 13 is discharged from the discharge pipe 34 to an external gas cooler or condenser through the discharge hole 52a of the fixed scroll 51.

[0040] The oil is separated from the refrigerant discharged from the discharge pipe 34 by an oil separator (not shown). The separated oil is returned to the housing 11 through the oil separator oil return pipe 65, and is stored in the oil reservoir O1.

[0041] The oil stored in the oil reservoir O1 is sucked up by the oil pump 49, and is guided to the scroll compression mechanism 13 side through the oil supply hole 15a formed in the rotary shaft 15. The oil guided to the scroll compression mechanism 13 side is returned to the oil reservoir O1 on the lower side after lubricating a sliding portion such as a bearing portion of the upper bearing 31 and the bush 55. The oil after lubrication, which is guided to the balance weight chamber 63, is guided to the oil return pipe 67 through the oil return hole 31a and the vertical hole 31b (refer to Fig. 2) formed in the upper bearing 31.

[0042] The oil guided to the oil return pipe 67 is discharged from the lower end through a flow path inside the oil return pipe 67, and is returned to the oil reservoir O1.

[0043] Fig. 5 schematically shows the flow of the refrigerant and the oil formed by the cover 45. In the drawing, the flow of the refrigerant is indicated by a white arrow, and the flow of the oil is indicated by a black arrow.

[0044] The refrigerant compressed by the rotary compression mechanism 12 and discharged into the housing 11 is first guided from below to above the rotor 38 through the rotor passage 38a formed in the rotor 38. At this time, the oil is carried with the refrigerant.

[0045] The refrigerant and the oil that have come out of the rotor passage 38a collide with the oil separation plate 38b and are guided in a radial direction about the axis X by a centrifugal force. Then, the oil having a larger specific gravity than the refrigerant collides with the inner wall of the housing 11 and flows downward by gravity. However, a part of the oil flows upward together with the refrigerant in a space between the inner wall of the housing 11 and the upper coil end 39b.

[0046] The part of the oil that has ascended together with the refrigerant collides with an upper end of an outer periphery of the cover 45, and then falls downward by gravity.

[0047] The refrigerant flows from an inner wall side of the housing 11 to an inner periphery and flows through the upper end of the upper coil end 39b. Thereafter, the refrigerant flows into a space between an inner peripheral side of the upper coil end 39b and the outer peripheral side of the cover 45 and changes a direction downward. The refrigerant collides with an upper end of the oil separation plate 38b, and then changes the direction to the inner peripheral side to be turned upward. Thereafter, the refrigerant flows into the flow path in the cover 45 from the suction opening 45a.

[0048] According to the present embodiment, the following operations and effects are achieved.

[0049] The refrigerant discharged from the rotary compression mechanism 12 is discharged into the housing 11, and the discharged refrigerant is guided to the scroll compression mechanism 13 via the suction opening 45a of the cover 45. Since the cover 45 partitions the inside of the housing 11, only the refrigerant that has passed through the suction opening 45a of the cover 45 is guided to the scroll compression mechanism 13.

[0050] The suction opening 45a of the cover 45 is provided on the inner side of the upper coil end 39b of the electric motor 14 and below the upper end of the upper coil end 39b. Accordingly, the refrigerant guided from the outer periphery to the inner periphery of the upper coil end 39b is turned downward to flow, and then is inverted to flow into the suction opening 45a of the lower end of the cover 45. Since the refrigerant is guided into the cover 45 after the direction of the flow of the refrigerant is repeatedly deflected in this way, the oil carried with the refrigerant can be separated as much as possible.

[0051] The oil separation plate 38b is provided below the suction opening 45a, so that the flow of the refrigerant toward the suction opening 45a is blocked. Accordingly, it is possible to prevent the oil guided from the oil reservoir below the housing 11 from being guided to the suction opening 45a together with the refrigerant.

[0052] The cover 45 is provided with the stepped portions having diameters that change in a stepped manner. Accordingly, the direction of the refrigerant flowing along the cover 45 can be changed, and the oil carried with the refrigerant can be separated.

[0053] In the above-described embodiment, the shape of the cover 45 is provided with the stepped portion. However, the present invention is not limited thereto, and a cover 45' having a conical shape without the stepped portion as shown in Fig. 6 may be used.

[0054] The compressor described in the embodiments described above is understood as follows, for example.

[0055] A compressor according to an aspect of the present disclosure includes: a housing (11) having an oil reservoir in a lower portion; a rotary shaft portion (15) accommodated in the housing and rotating around a longitudinal axis; an electric motor (14) provided at a center of the rotary shaft portion in a direction of the longitudinal axis to rotationally drive the rotary shaft portion; a low-stage-side compression mechanism (12) connected to a lower end of the rotary shaft portion to compress a refrigerant and discharge the refrigerant into the housing; a high-stage-side compression mechanism (13) connected to an upper end of the rotary shaft portion to suck the refrigerant discharged into the housing from the low-stage-side compression mechanism and compress the refrigerant; and a cover (45) that has, at a lower end thereof, a suction opening (45a) for sucking the refrigerant discharged from the low-stage-side compression mechanism from around the rotary shaft portion and that partitions a space in the housing such that the refrigerant is guided to a suction side of the high-stage-side compression mechanism, in which the suction opening of the cover is provided on an inner side of a coil end (39b) of the electric motor and below an upper end of the coil end.

[0056] The refrigerant discharged from the low-stage-side compression mechanism is discharged into the housing, and the discharged refrigerant is guided to the high-stage-side compression mechanism via the suction opening of the cover. Since the cover partitions the inside of the housing, only the refrigerant that has passed through the suction opening of the cover is guided to the high-stage-side compression mechanism.

[0057] The suction opening of the cover is provided on the inner side of the coil end of the electric motor and below the upper end of the coil end. Accordingly, the refrigerant guided from the outer periphery to the inner periphery of the coil end is turned downward to flow, and then is inverted to flow into the suction opening of the lower end of the cover. Since the refrigerant is guided into the cover after the direction of the flow of the refrigerant is repeatedly deflected in this way, the oil carried with the refrigerant can be separated as much as possible.

[0058] For example, a scroll compression mechanism is used as the high-stage-side compression mechanism, and for example, a rotary compression mechanism is used as the low-stage-side compression mechanism.

[0059] In the compressor according to the aspect of the present disclosure, a baffle plate (38b) that blocks a flow of the refrigerant toward the suction opening is provided below the suction opening.

[0060] The baffle plate is provided below the suction opening to block the flow of the refrigerant toward the suction opening. Accordingly, it is possible to prevent the oil guided from the oil reservoir below the housing from being guided to the suction opening together with the refrigerant.

[0061] In the compressor according to the aspect of the present disclosure, the cover has a substantially conical shape of which a diameter increases upward from the suction opening.

[0062] Since the cover has a substantially conical shape of which a diameter increases upward from the suction opening, the refrigerant sucked from the suction opening can be smoothly guided to a suction portion located on the outer peripheral side of the high-pressure-side compression mechanism.

[0063] In the compressor according to the aspect of the present disclosure, the cover has stepped portions having diameters that change in a stepped manner.

[0064] The cover is provided with the stepped portions having diameters that change in a stepped manner. Accordingly, the direction of the refrigerant flowing along the cover can be changed, and the oil carried with the refrigerant can be separated. The number of the stepped portions may be one or a plurality.

Reference Signs List

[0065]

- 1: compressor
- 3: leg portion
- 11: housing
- 12: rotary compression mechanism (low-stage-side compression mechanism)
- 13: scroll compression mechanism (high-stage-side compression mechanism)
- 14: electric motor
- 15: rotary shaft (rotary shaft portion)
- 15a: oil supply hole
- 21: main body portion
- 22: upper cover portion
- 23: lower cover portion
- 31: upper bearing (bearing portion)
- 31a: oil return hole
- 31b: vertical hole
- 32: lower bearing
- 33: suction pipe
- 34: discharge pipe
- 38: rotor
- 38a: rotor passage
- 38b: oil separation plate (baffle plate)
- 39: stator
- 39a: stator passage
- 39b: upper coil end
- 39c: lower coil end
- 41: eccentric shaft portion
- 42: rotor
- 43: rotary discharge pipe
- 44: cylinder
- 45, 45': cover
- 45a: suction opening
- 48: bolt
- 49: oil pump
- 51: fixed scroll
- 52: end plate
- 52a: discharge hole
- 53: fixed wrap
- 54: balance weight
- 55: bush
- 56: eccentric shaft portion
- 57: orbiting scroll
- 58: end plate
- 59: orbiting wrap
- 60: oil level tank
- 61: lower pipe
- 62: pressure equalization pipe
- 63: balance weight chamber
- 65: oil separator oil return pipe
- 67: oil return pipe
- 68: boss
- 70: rod-shaped member
- 75: stabilizing plate
- C1: compression chamber
- C2: compression chamber
- FL: installation surface
- O1: oil reservoir
- X: axis

Claims

1. A compressor comprising:

a housing having an oil reservoir in a lower portion;
a rotary shaft portion accommodated in the housing and rotating around a longitudinal axis;
an electric motor provided at a center of the rotary shaft portion in a direction of the longitudinal axis to rotationally drive the rotary shaft portion;
a low-stage-side compression mechanism connected to a lower end of the rotary shaft portion to compress a refrigerant and discharge the refrigerant into the housing;
a high-stage-side compression mechanism connected to an upper end of the rotary shaft portion to suck the refrigerant discharged into the housing from the low-stage-side compression mechanism and compress the refrigerant; and
a cover that has, at a lower end thereof, a suction opening for sucking the refrigerant discharged from the low-stage-side compression mechanism from around the rotary shaft portion and that partitions a space in the housing such that the refrigerant is guided to a suction side of the high-stage-side compression mechanism,
wherein the suction opening of the cover is provided on an inner side of a coil end of the electric

motor and below an upper end of the coil end.

2. The compressor according to Claim 1, wherein a baffle plate that blocks a flow of the refrigerant toward the suction opening is provided below the suction opening.

3. The compressor according to Claim 1 or 2, wherein the cover has a substantially conical shape of which a diameter increases upward from the suction opening.

4. The compressor according to Claim 3, wherein the cover has stepped portions having diameters that change in a stepped manner.

FIG. 1

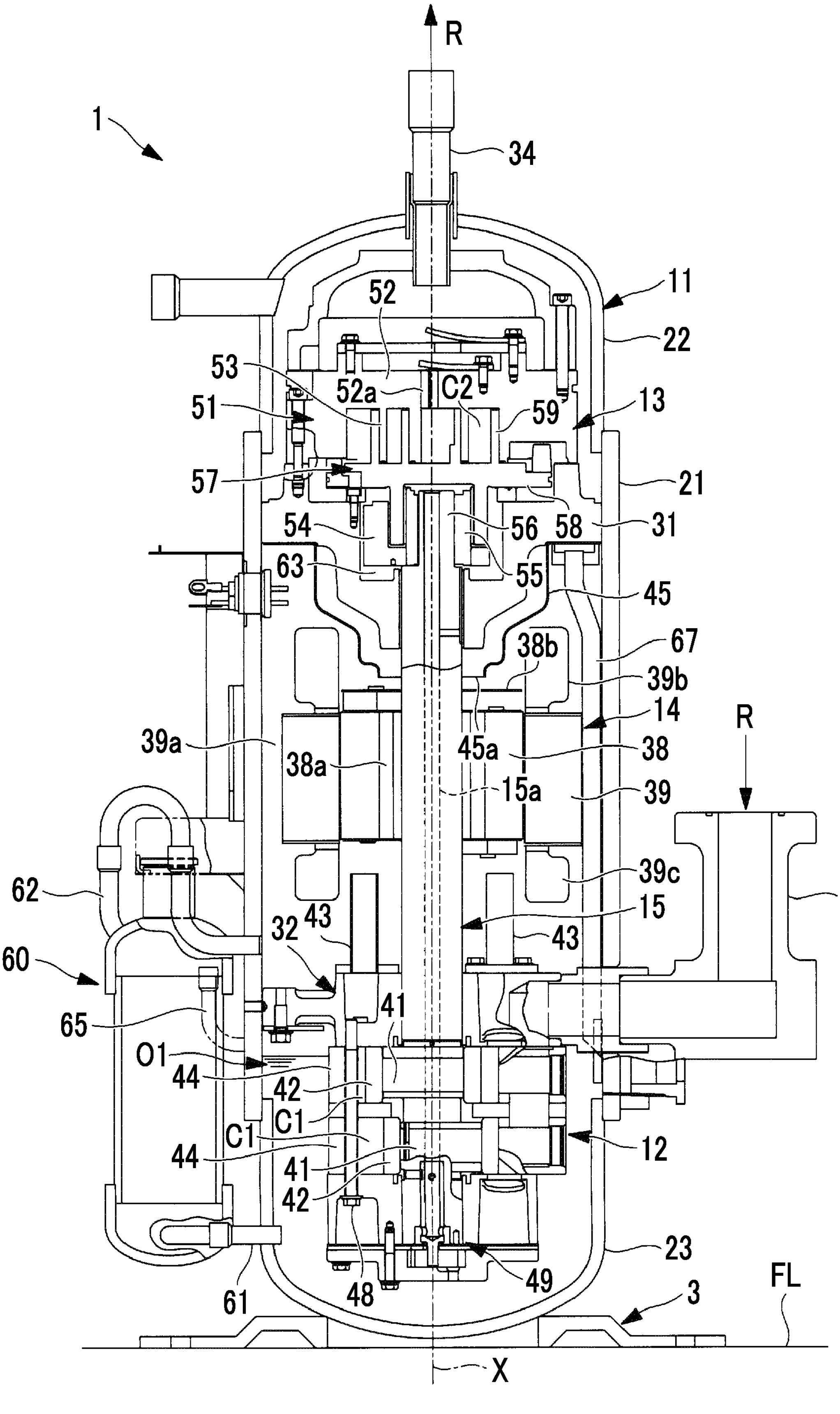

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FIG. 2

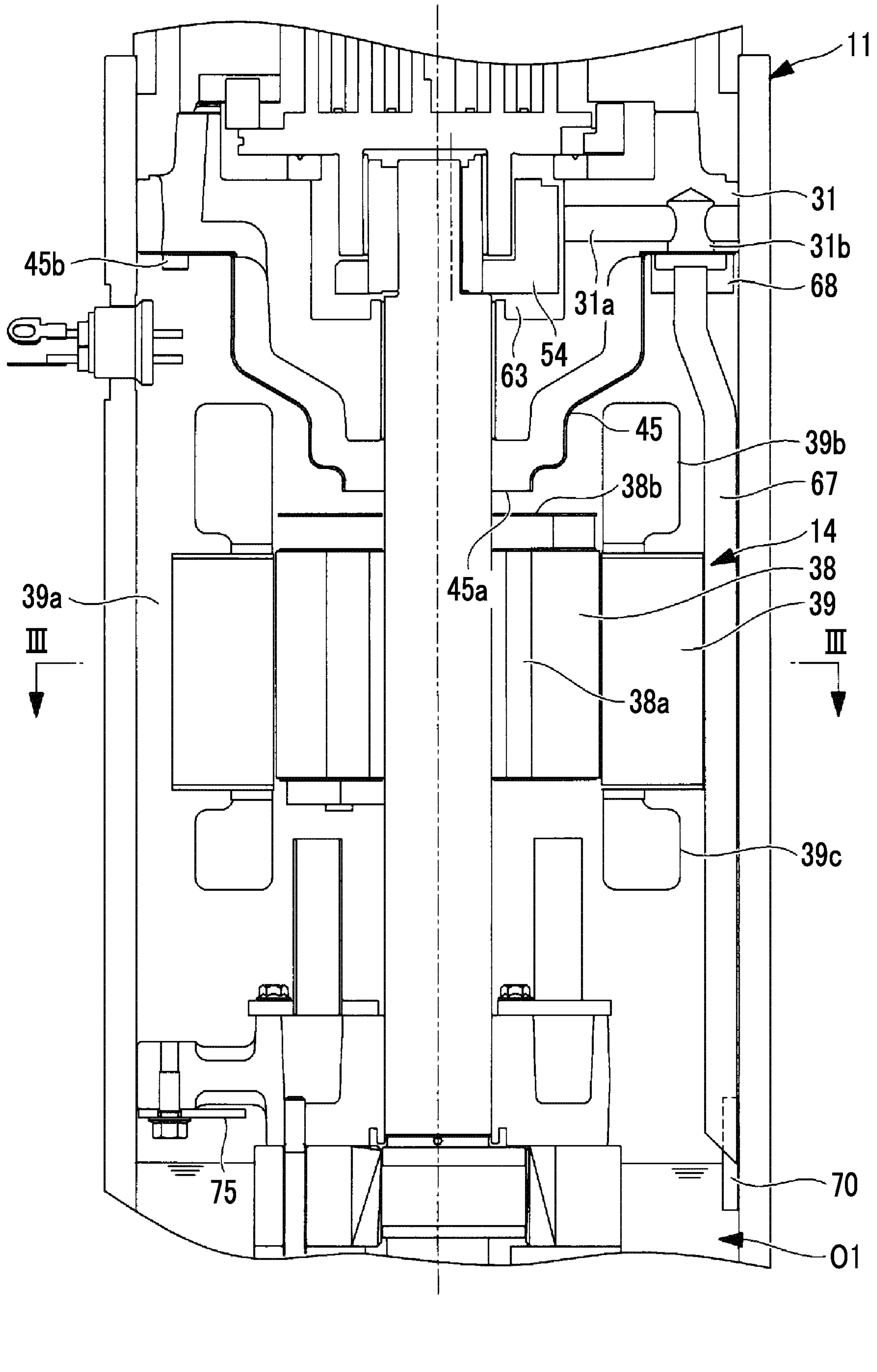
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FIG. 3

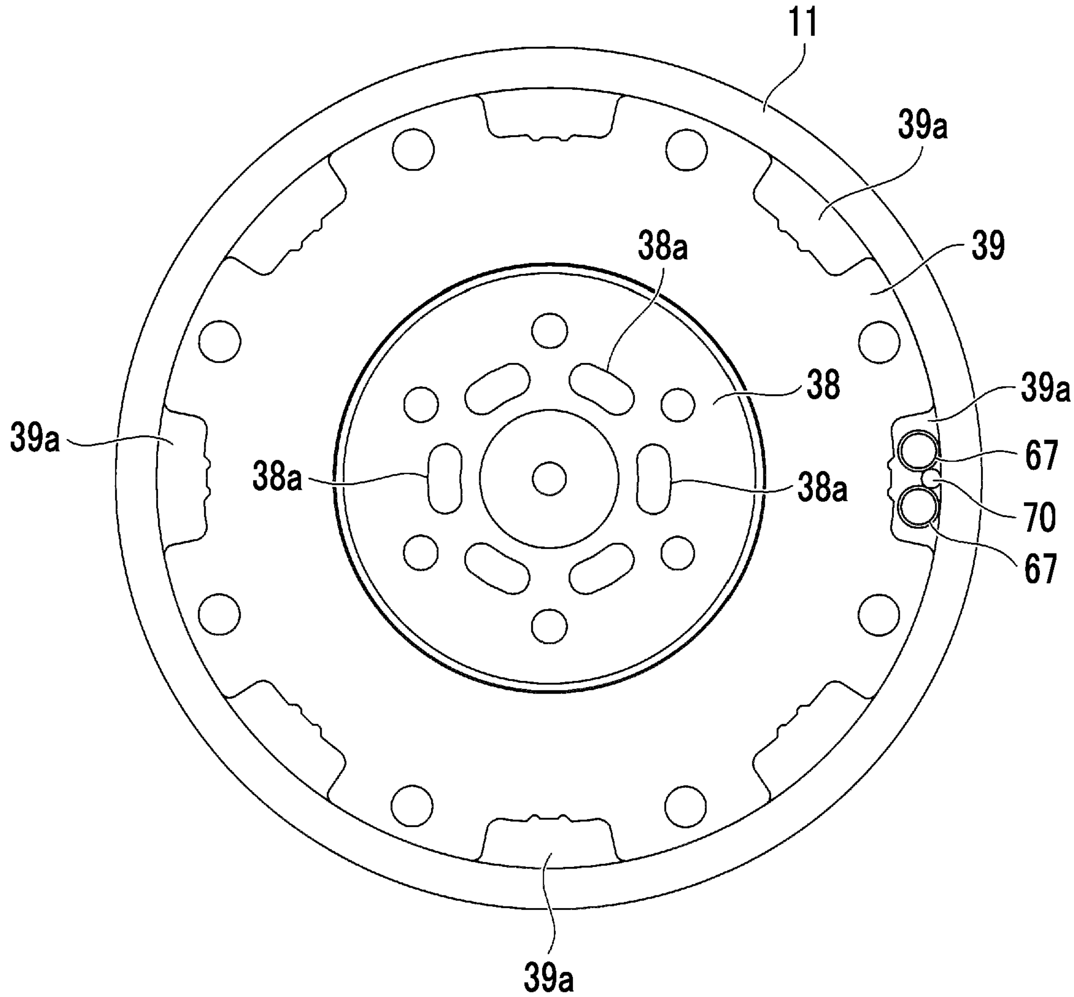


FIG. 4

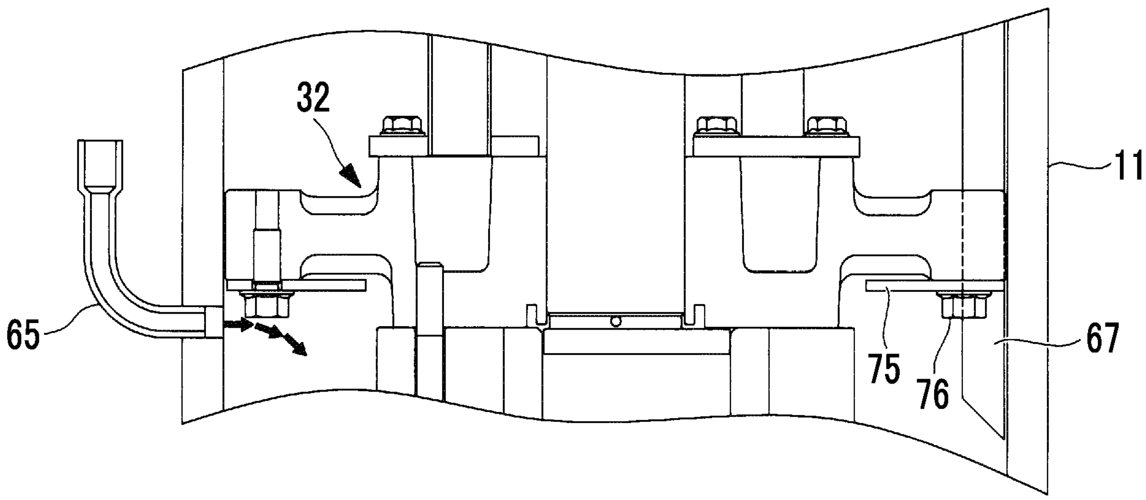


FIG. 5

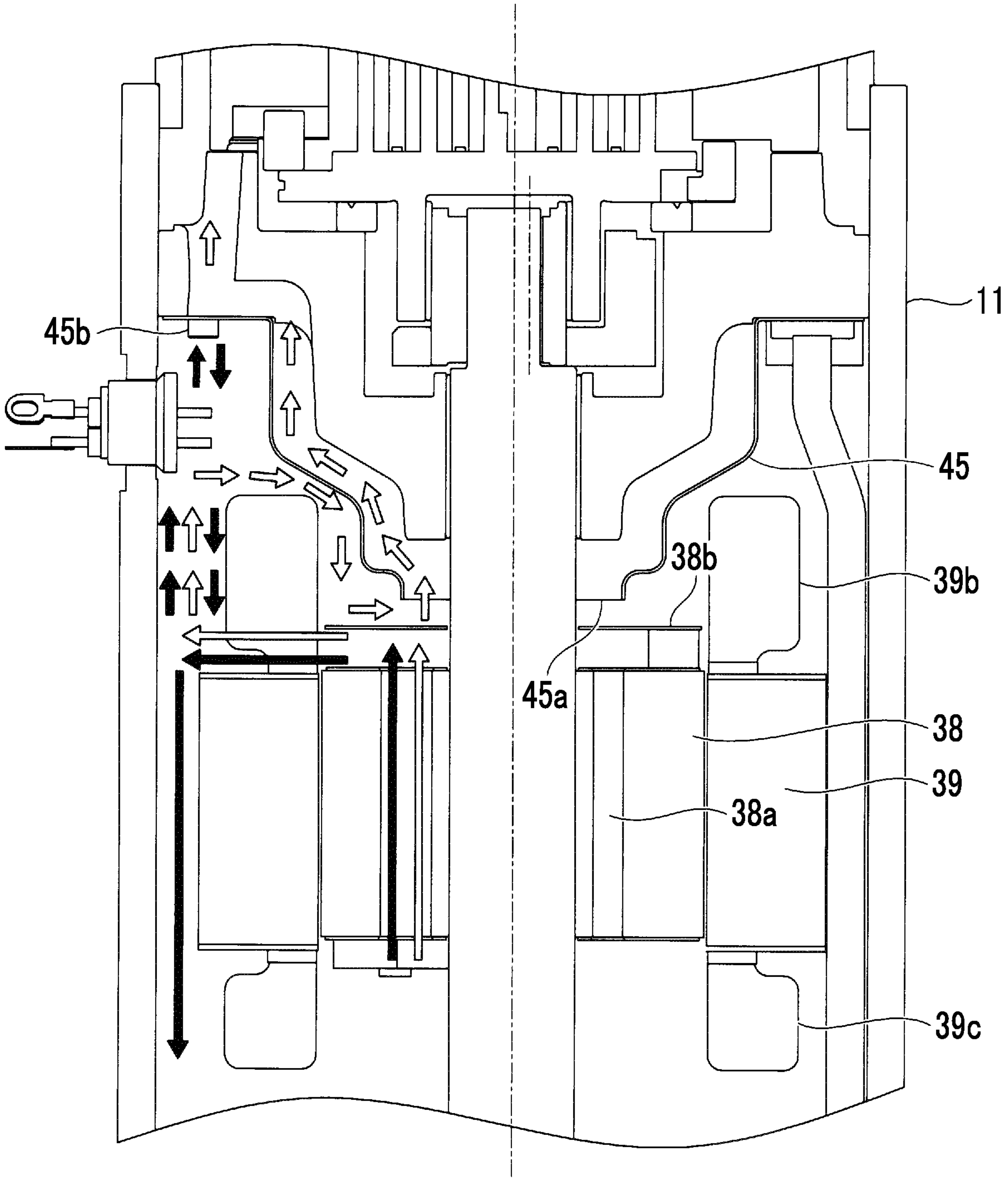
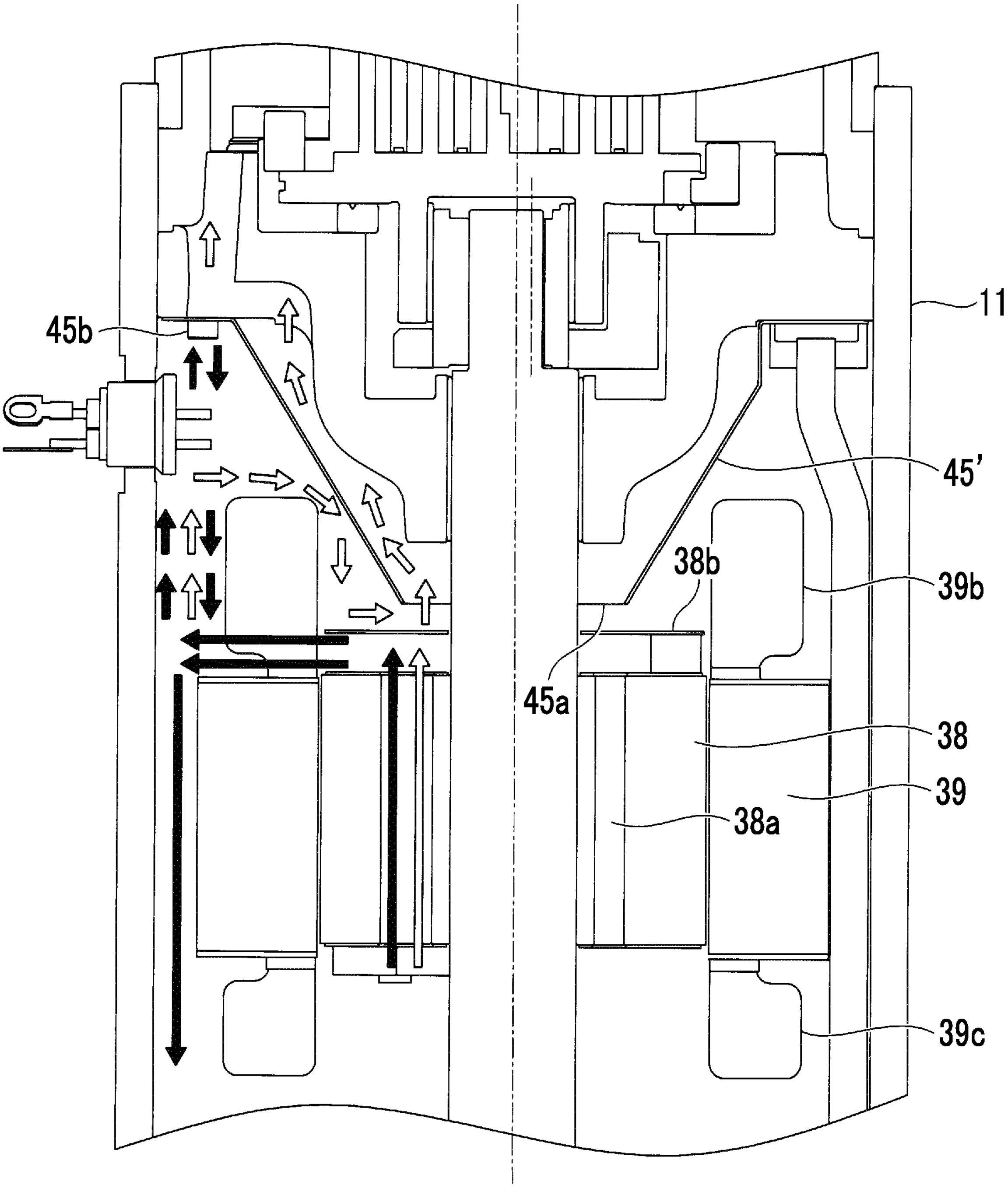


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2022/040825

A. CLASSIFICATION OF SUBJECT MATTER

F04C 23/00(2006.01)i; ***F04C 29/02***(2006.01)i; ***F04B 39/02***(2006.01)i
FI: F04C29/02 351A; F04C23/00 F; F04B39/02 Y

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04B39/02; F04C23/00; 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 1971-2022
Registered utility model specifications of Japan 1996-2022
Published registered utility model applications of Japan 1994-2022

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.
Y	JP 2004-132353 A (TECUMSEH PRODUCTS CO.) 30 April 2004 (2004-04-30) paragraphs [0022]-[0024], [0049], fig. 1	1-4
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☐ Further documents are listed in the continuation of Box C. ☑ See patent family annex.

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Date of the actual completion of the international search	Date of mailing of the international search report
08 December 2022	**20 December 2022**

Name and mailing address of the ISA/JP	Authorized officer
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INTERNATIONAL SEARCH REPORT
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