

(11)

EP 4 772 745 A1

(12)

EUROPEAN PATENT APPLICATION
published in accordance with Art. 153(4) EPC

(43) Date of publication:
08.07.2026 Bulletin 2026/28

(21) Application number: **24859864.1**

(22) Date of filing: **29.08.2024**

(51) International Patent Classification (IPC):
F04B 39/06 ^(2006.01) **F04C 23/00** ^(2006.01)
F04C 29/04 ^(2006.01) **F04C 29/12** ^(2006.01)

(52) Cooperative Patent Classification (CPC):
F04B 39/06; F04C 23/00; F04C 29/04; F04C 29/12

(86) International application number:
PCT/JP2024/030843

(87) International publication number:
WO 2025/047835 (06.03.2025 Gazette 2025/10)

(84) Designated Contracting States:
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**
Designated Extension States:
BA
Designated Validation States:
GE KH MA MD TN

(30) Priority: **29.08.2023 JP 2023138736**

(71) Applicant: **Valeo Electrification**
95800 Cergy Pontoise (FR)

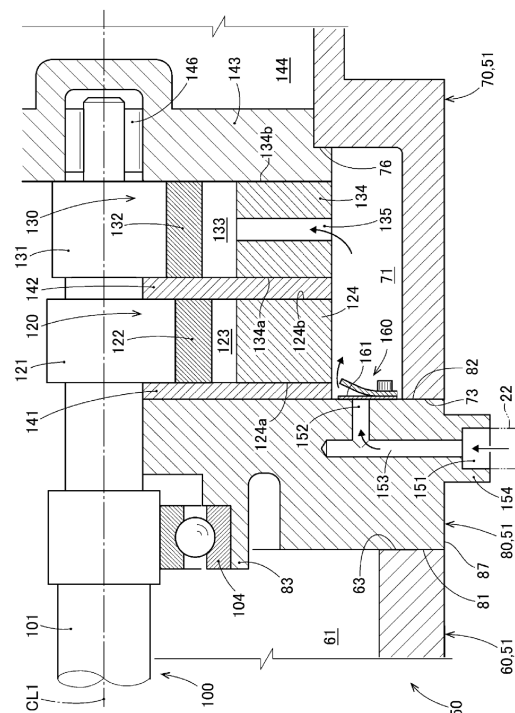
(72) Inventors:
• **KOSTAL, Josef**
10800 (CZ)
• **PERROTIN, Marian**
78320 Le Mesnil-Saint-Denis (FR)

(74) Representative: **Valeo Powertrain Systems**
Service Propriété Intellectuelle
Immeuble le Delta
14, avenue des Béguines
95892 Cergy Pontoise (FR)

(54) **ELECTRIC COMPRESSOR**

(57) An electric compressor (50) comprises: a motor housing (60) including a motor chamber (61) that houses a motor (100); a rear head (70) including an intermediate pressure chamber (71) that houses a two-stage compression mechanism (110); and a dividing block (80) that is held between the motor housing (60) and the rear head (70), and partitions the motor chamber (61) from the intermediate pressure chamber (71). The dividing block (80) includes : an injection inlet (151) through which an injection gas refrigerant can be introduced; an injection outlet (152) through which the injection gas refrigerant can be introduced to the intermediate pressure chamber (71); and an injection passage (153) that provides communication between the injection inlet (151) and the injection outlet (152).

[Fig.6]



EP 4 772 745 A1

Description

Technical Field

[0001] The present invention relates to technology for improving an electric compressor comprising a compressing mechanism that performs two-stage compression of a refrigerant, and a motor that drives the compressing mechanism.

Background Art

[0002] Among electric compressors, there are rolling piston type rotary compressors that perform two-stage compression, have an intermediate pressure chamber around a compressing mechanism, and perform gas injection of intermediate-pressure refrigerant from an air conditioning device circuit into the intermediate pressure chamber. For example, the technology of Patent Document 1 is known as such an electric compressor.

[0003] According to the technology known from Patent Document 1, a low-stage compressor is disposed below a motor inside a housing, and a high-stage compressor is disposed below the low-stage compressor, resulting in what is known as a vertically-oriented electric compressor configuration. The interior of the housing is divided by a dividing member into a first hermetically sealed chamber that accommodates the motor and a second hermetically sealed chamber that accommodates the compressing mechanism.

[0004] An injection pipe for the intermediate-pressure refrigerant is provided in the housing and is connected to the second hermetically sealed chamber. The second hermetically sealed chamber is thus configured to have an intermediate-pressure atmosphere. An intake passage of the low-stage compressing mechanism communicates with the first hermetically sealed chamber. A discharge passage of the low-stage compressing mechanism opens into the second hermetically sealed chamber. An intake passage of the high-stage compressing mechanism communicates with the second hermetically sealed chamber. A discharge passage of the high-stage compression mechanism communicates with a discharge pipe for high-pressure refrigerant.

Prior Art Documents

Patent literature

[0005] Patent Document 1: JP 2000-054975 A

Summary of the Invention

Problems to be Solved by the Invention

[0006] Now, automotive air conditioning devices are exposed to vehicle vibrations and high refrigerant pressure due to high temperatures under blazing sun, and

therefore have extremely strict reliability requirements. As such, if the injection pipe is formed so as to penetrate through the housing wall, the support for the injection pipe may become weak, and there is a risk that an adequate reliability requirement may not be met.

[0007] The present invention has been devised in order to solve the above-mentioned problems, and an objective of the present invention is to provide technology that enables an injection pipe to be firmly supported by an electric compressor.

Means for Solving the Problems

[0008] The reference symbols used in the appended drawings are added in parentheses in the description below in order to make the present invention easier to understand, but this does not limit the present invention to the forms depicted.

[0009] According to the present invention, there is provided an electric compressor (50) including a two-stage compressing mechanism (110) that has a low-stage compressor (120) and a high-stage compressor (130), a motor (100) that drives the two-stage compressing mechanism (110), a motor housing (60) that is provided with a motor chamber (61) for accommodating the motor (100), a rear head (70) that is provided with an intermediate pressure chamber (71) for accommodating the two-stage compressing mechanism (110), and a dividing block (80) that is sandwiched between the rear head (70) and the motor housing (60) and that divides the motor chamber (61) from the intermediate pressure chamber (71), characterized in that the dividing block (80) is provided with an injection inlet (151) through which an injection gas refrigerant can be introduced, an injection outlet (152) through which the injection gas refrigerant can be led out to the intermediate pressure chamber (71), and an injection passage (153) which provides communication between the injection inlet (151) and the injection outlet (152).

[0010] Preferably, a check valve (160) is disposed at the injection outlet (152) to allow the injection gas refrigerant to flow only from the injection passage (153) to the intermediate pressure chamber (71).

[0011] More preferably, the injection outlet (152) and the check valve (160) are provided on a flat surface (82) of the dividing block (80) that faces the intermediate pressure chamber (71).

[0012] Preferably, the check valve (160) is configured by a reed valve (161).

[0013] More preferably, the dividing block (80) has an intake passage (84), inside the dividing block (80), that provides communication between the motor chamber (61) and an intake port (125a) of the low-stage compressor (120).

[0014] In another preferred example, the dividing block (80) is integrally provided with a shaft supporting portion (83) that supports a rotating shaft (101) of the two-stage compressing mechanism (110).

Effects of the Invention

[0015] According to the present invention, an injection pipe can be firmly supported by an electric compressor.

Brief Description of the Drawings

[0016]

[Fig. 1] Fig. 1A is a conceptual diagram showing an example of an injection type refrigeration cycle according to an exemplary embodiment, and fig. 1B is a conceptual diagram showing another example of an injection type refrigeration cycle according to an exemplary embodiment.

[Fig. 2] is a cross-sectional view of the electric compressor shown in fig. 1.

[Fig. 3] is an enlarged view around the two-stage compressing mechanism shown in fig. 2.

[Fig. 4] is a cross-sectional view of the low-stage compressor shown in fig. 3 as seen from the axial direction of the motor spindle.

[Fig. 5] is a cross-sectional view of the high-stage compressor shown in fig. 3 as seen from the axial direction of the motor spindle.

[Fig. 6] is a cross-sectional view around the injection inlet in the dividing block shown in fig. 3.

Embodiments of the Invention

[0017] Embodiments of the present invention will be described below with reference to the appended drawings. It should be noted that the forms depicted in the appended drawings are examples of the present invention, and the present invention is not limited to those forms.

<Exemplary embodiments>

[0018] An electric compressor 50 according to an exemplary embodiment, and injection-type refrigeration cycles 10 and 30 including the electric compressor 50 will be described with reference to fig. 1 to fig. 6.

[0019] Fig. 1A shows an example of an injection type refrigeration cycle 10 (hereinafter abbreviated as "refrigeration cycle 10"). The refrigeration cycle 10 is used, for example, in an automotive air conditioning device, and performs space cooling and space heating by means of an interior air conditioning unit (not shown). It should be noted that there is no limitation to the purpose of use of the refrigeration cycle 10. Furthermore, although the refrigeration cycle 10 is suitable for use with R744 refrigerant, other refrigerants (for example, R134a refrigerant or R1234yf refrigerant) can also be used.

[0020] Here, injection type refers to a system in which the refrigeration cycle 10 causes high-pressure refrigerant to expand in two stages, and returns intermediate-pressure gas refrigerant (gas phase refrigerant) ob-

tained by gas-liquid separation to the electric compressor 50. The intermediate-pressure gas refrigerant returned to the electric compressor 50 is called injection gas refrigerant.

[0021] More specifically, the refrigeration cycle 10 includes an evaporator 11, a gas cooler 12, a first expansion valve 13, a second expansion valve 14, a gas-liquid separator 15, and the electric compressor 50.

[0022] The electric compressor 50 includes a two-stage compressing mechanism 110. The two-stage compressing mechanism 110 has a low-stage compressor 120 and a high-stage compressor 130. In addition, the electric compressor 50 is provided with an intake port 68 capable of drawing in the refrigerant from the outside (evaporator 11), a discharge port 75 capable of discharging the refrigerant to the outside (gas cooler 12), and an injection inlet 151 through which the injection gas refrigerant can be introduced.

[0023] A refrigerant outlet of the gas cooler 12 is connected to a refrigerant inlet of the gas-liquid separator 15 by a first flow passage 21, via the first expansion valve 13. A refrigerant outlet of the gas-liquid separator 15 is connected to an injection pipe 22 through which the injection gas refrigerant flows, and to a second flow passage 23 through which the liquid refrigerant flows. The injection pipe 22 is connected to the injection inlet 151 of the electric compressor 50.

[0024] The second flow passage 23 is connected to a refrigerant inlet of the evaporator 11 via a second expansion valve 14. A refrigerant outlet of the evaporator 11 is connected to the intake port 68 of the electric compressor 50 by a third flow passage 24. The discharge port 75 of the electric compressor 50 is connected to a refrigerant inlet of the gas cooler 12 by a fourth flow passage 25.

[0025] The refrigerant flows in the direction indicated by the solid lines in fig. 1A. That is, refrigerant that has been subjected to heat exchange with outside air by the gas cooler 12 flows through the first flow passage 21, the first expansion valve 13, the gas-liquid separator 15, the second expansion valve 14, and the evaporator 11 to the intake port 68 of the electric compressor 50, and is compressed to a high pressure. The refrigerant that has been compressed to a high pressure by the electric compressor 50 flows to the gas cooler 12 through the fourth flow passage 25.

[0026] In this way, the refrigerant that has been subjected to heat exchange with outside air by the gas cooler 12 is subjected to rapid adiabatic expansion by the first expansion valve 13 and the second expansion valve 14, and then returns to the evaporator 11. That is, the refrigerant discharged from the gas cooler 12 is expanded in two stages by the first expansion valve 13 and the second expansion valve 14.

[0027] The intermediate-pressure refrigerant that has passed through only the first expansion valve 13, among the two expansion valves 13 and 14, passes through the gas-liquid separator 15 and flows through the injection pipe 22 to the injection inlet 151 of the electric compressor 50.

sor 50. The amount branched to the injection inlet 151 of the compressor 50 can be adjusted by appropriately adjusting the opening degrees of the first expansion valve 13 and the second expansion valve 14 in accordance with the operating requirements.

[0028] Fig. 1B shows another example of an injection type refrigeration cycle 30 (hereinafter abbreviated as "refrigeration cycle 30"). The refrigeration cycle 30 in this other example is provided with an internal heat exchanger 31 instead of the gas-liquid separator 15 of the refrigeration cycle 10. The refrigerant outlet of the gas cooler 12 is connected to a refrigerant inlet of the internal heat exchanger 31 by the first flow path 21. A branch path 41 branches from a portion 21a of the first flow path 21 between the gas cooler 12 and the internal heat exchanger 31, i.e., from a branch point 21a, and is connected to an inlet of the internal heat exchanger 31 via the first expansion valve 13. An outlet of the internal heat exchanger 31 is connected to the injection inlet 151 of the electric compressor 50 by the injection pipe 22.

[0029] In this other example of the refrigeration cycle 30, the refrigerant branched from the portion 21a between the gas cooler 12 and the internal heat exchanger 31, i.e., from the branch point 21a, is subjected to adiabatic expansion by the first expansion valve 13 and is then heated by the internal heat exchanger 31, and the heated gas refrigerant flows through the injection pipe 22 to the injection inlet 151 of the electric compressor 50.

[0030] The overall configuration of the electric compressor 50 will next be described. As shown in fig. 2, the electric compressor 50 has what is known as a horizontally-oriented electric compressor configuration in which the two-stage compressing mechanism 110 is disposed beside the motor 100, for example. The electric compressor 50 includes the housing 51, the motor 100, and the two-stage compressing mechanism 110, which is driven by the motor 100.

[0031] The housing 51 is configured to be capable of being installed horizontally. The housing 51 includes a motor housing 60 provided with a motor chamber 61 for accommodating the motor 100, a rear head 70 provided with an intermediate pressure chamber 71 for accommodating the two-stage compressing mechanism 110, and a dividing block 80 sandwiched between the motor housing 60 and the rear head 70. The motor housing 60, the rear head 70, and the dividing block 80 are made of castings of a metal material such as aluminum (including aluminum alloys).

[0032] The motor housing 60 is a bottomed cylindrical member. One end of the motor housing 60 in the axial direction is closed by a bottom wall 62. The bottom wall 62 is formed integrally with the motor housing 60, for example. The other end of the motor housing 60 in the axial direction is completely open. An open end surface 63 of the motor housing 60 may be referred to as a first end surface 63. The first end surface 63 is a flat surface that is perpendicular to an axial direction center line CL1 of the motor housing 60. The motor chamber 61 is formed

inside the motor housing 60. An inverter housing 65 is assembled to an outer wall surface 62a of the bottom wall 62 of the motor housing 60. An inverter device 66 for supplying driving electric power to the motor 100 is accommodated in the inverter housing 65.

[0033] The motor housing 60 additionally includes an intake port 68 through which refrigerant is drawn into the motor chamber 61 from the outside. More specifically, a boss portion 69 that protrudes radially outward is provided on an outer peripheral surface 60a of the motor housing 60. The intake port 68 opens in the boss portion 69. The third flow passage 24 (refrigerant supply pipe 24) shown in fig. 1 is connected to the intake port 68.

[0034] The rear head 70 (compressor housing 70) is a bottomed cylindrical member. One end of the rear head 70 in the axial direction is closed by a bottom wall 72. The bottom wall 72 is formed integrally with the rear head 70, for example. The other end of the rear head 70 in the axial direction is completely open. An open end surface 73 of the rear head 70 may be referred to as a second end surface 73. The second end surface 73 is a flat surface that is perpendicular to the axial direction center line CL1 of the motor housing 60, and faces the first end surface 63 of the motor housing 60. The interior of the rear head 70 is formed as the intermediate pressure chamber 71.

[0035] The rear head 70 additionally includes an oil separation chamber 74 for separating oil from the refrigerant compressed by the two-stage compressing mechanism 110, and a discharge port 75 for discharging, to the outside, gaseous refrigerant from which the oil has been separated by the oil separation chamber 74. The discharge port 75 is connected to the fourth flow passage 25 (refrigerant discharge pipe 25) shown in fig. 1.

[0036] The dividing block 80 is a disk-shaped member that divides the motor chamber 61 from the intermediate pressure chamber 71, and is sandwiched between the first end surface 63 of the motor housing 60 and the second end surface 73 of the rear head 70. More specifically, as shown in fig. 3, the dividing block 80 has a first mating surface 81 facing the first end face 63 of the motor housing 60 and the motor chamber 61, and a second mating surface 82 facing the second end face 73 of the rear head 70 and the intermediate pressure chamber 71. The first mating surface 81 and the second mating surface 82 are flat surfaces that are perpendicular to the axial direction center line CL1 of the motor housing 60. The first mating surface 81 and the second mating surface 82 may be referred to as the "first flat surface 81 and the second flat surface 82" as appropriate.

[0037] Gaps between the first end surface 63 of the motor housing 60 and the first mating surface 81 of the dividing block 80, and between the second end surface 73 of the rear head 70 and the second mating surface 82 of the dividing block 80 are each sealed by a sealing member (not shown) such as a gasket or an O-ring. The dividing block 80 is restricted in terms of both relative rotation and relative axial movement with respect to the motor housing 60 and the rear head 70. For example, the

dividing block 80 is fixed integrally together with the motor housing 60 and the rear head 70 by means of fastening members 91 such as bolts.

[0038] The motor 100 will be described next.

As shown in fig. 2, the motor 100 includes an output shaft 101 (motor spindle 101), a rotor 102 fixed to the output shaft 101, and a cylindrical stator 103 surrounding the periphery of the rotor 102.

[0039] The output shaft 101 has its center of rotation at the axial direction center line CL1 of the motor housing 60, extends from the motor chamber 61 toward the intermediate pressure chamber 71, penetrates through the dividing block 80, and is drivably coupled to the two-stage compressing mechanism 110. In other words, the output shaft 101 of the motor 100 also serves as the rotating shaft 101 of the two-stage compressing mechanism 110. Hereinafter, the output shaft 101 of the motor 100 may alternatively be referred to as the "rotating shaft 101 of the two-stage compressing mechanism 110" as appropriate. The output shaft 101 (rotating shaft 101) is rotatably supported by a first bearing 104 provided in the dividing block 80 and a second bearing 105 provided in the bottom wall 62 of the motor housing 60.

[0040] As shown in fig. 3, the dividing block 80 is formed integrally with a shaft supporting portion 83 in which to install the first bearing 104. That is, the dividing block 80 is provided integrally with the shaft supporting portion 83, which supports the rotating shaft 101 of the two-stage compressing mechanism 110. The shaft supporting portion 83 protrudes from the first mating surface 81 of the dividing block 80 toward the motor chamber 61. It should be noted that the shaft supporting portion 83 includes a configuration that directly supports the rotating shaft 101 without the first bearing 104 interposed therebetween.

[0041] The axial direction center line CL1 of the motor housing 60 may alternatively be referred to as the "center line CL1 of the output shaft 101 (rotating shaft 101)." It should be noted that the output shaft 101 of the motor 100 may equally be configured as a separate member from the output shaft of the two-stage compressing mechanism 110. In this case, the output shaft 101 of the motor 100 is configured with a linking member such as a coupling that is coupled to the output shaft of the two-stage compressing mechanism 110.

[0042] The rotor 102 is capable of rotating about the center line CL1 of the output shaft 101 (rotating shaft 101). The stator 103 is disposed radially outward of the rotor 102 and is fixed to an inner circumferential surface 60b of the motor housing 60.

[0043] The two-stage compressing mechanism 110 will next be described.

As shown in fig. 3, the low-stage compressor 120 and the high-stage compressor 130 constituting the two-stage compressing mechanism 110 are both configured as what is known as a rolling piston type rotary compressor that perform compression using rotating bodies 122, 132 (pistons 132, 132) that perform a rotating motion, and

cylinders 124, 134. The low-stage compressor 120 and the high-stage compressor 130 have substantially the same configuration, and are aligned on the center line CL1 of the rotating shaft 101 (output shaft 101). The low-stage compressor 120 is located on the dividing block 80 side of the intermediate pressure chamber 71. The high-stage compressor 130 is located in the intermediate pressure chamber 71 on the bottom wall 72 side of the rear head 70.

[0044] More specifically, as shown in fig. 3 and fig. 4, the low-stage compressor 120 includes a first eccentric shaft 121 provided integrally with the rotating shaft 101, an annular first piston 122 (first rotating body 122) fitted onto the first eccentric shaft 121, and a flat plate-shaped first cylinder 124 having a first cylinder chamber 123 that permits the rotating motion of the first piston 122. A center line CL2 of the first eccentric shaft 121 is offset from the center line CL1 of the rotating shaft 101.

[0045] The first cylinder 124 is restricted from rotating relative to the rear head 70. The first cylinder 124 has a first surface 124a facing the second mating surface 82 of the dividing block 80 and a second surface 124b facing the second cylinder 134 of the high-stage compressor 130. The first surface 124a and the second surface 124b of the first cylinder 124 are flat surfaces that are perpendicular to the axial direction center line CL1 of the motor housing 60.

[0046] The first cylinder chamber 123 is a circular hole that is concentric with the center line CL1 of the rotary shaft 101, and that penetrates through the first cylinder 124. The first cylinder 124 additionally includes a first intake passage 125 and a first discharge passage 126 that communicate with the first cylinder chamber 123. The first intake passage 125 and the first discharge passage 126 open at a first surface 124a of the first cylinder 124.

[0047] The outer diameter of the first piston 122 is smaller than the inner diameter of the first cylinder chamber 123. A first vane 127 in the shape of a vertical plate is in contact with an outer circumferential surface of the first piston 122 so as to be capable of moving forward and backward. The first vane 127 partitions the first cylinder chamber 123 into an intake chamber and a compression chamber. The tip of the first vane 127 is pressed against the outer circumferential surface of the first piston 122 by a first spring 128. The first piston 122 revolves around the inside of the first cylinder chamber 123. The refrigerant introduced into the first cylinder chamber 123 from the first intake passage 125 is compressed through the revolving motion of the first piston 122 and is discharged from the first discharge passage 126.

[0048] As shown in fig. 3 and fig. 5, similarly to the low-stage compressor 120, the high-stage compressor 130 includes a second eccentric shaft 131 provided integrally with the rotating shaft 101, an annular second piston 132 (second rotating body 132) fitted onto the second eccentric shaft 131, and a flat plate-shaped second cylinder 134 having a second cylinder chamber 133 that permits

the rotating motion of the second piston 132. A center line CL3 of the second eccentric shaft 131 is offset from the center line CL1 of the rotating shaft 101.

[0049] The second cylinder 134 is restricted from rotating relative to the rear head 70. The second cylinder 134 additionally has a first surface 134a facing the second surface 124b of the first cylinder 124 and a second surface 134b facing the bottom wall 72 of the rear head 70. The first surface 134a and the second surface 134b of the second cylinder 134 are flat surfaces that are perpendicular to the axial direction center line CL1 of the motor housing 60.

[0050] The second cylinder chamber 133 is a circular hole that is concentric with the center line CL1 of the rotary shaft 101, and that penetrates through the second cylinder 134. The second cylinder 134 additionally includes a second intake passage 135 and a second discharge passage 136 that communicate with the second cylinder chamber 133. The second intake passage 135 opens at the outer circumferential surface of the second cylinder 134, thereby providing communication between the second cylinder chamber 133 and the intermediate pressure chamber 71. The second discharge passage 136 opens at the second surface 134b of the second cylinder 134.

[0051] The outer diameter of the second piston 132 is smaller than the inner diameter of the second cylinder chamber 133. A second vane 137 in the shape of a vertical plate is in contact with an outer circumferential surface of the second piston 132 so as to be capable of moving forward and backward. The second vane 137 partitions the second cylinder chamber 133 into an intake chamber and a compression chamber. The tip of the second vane 137 is pressed against the outer circumferential surface of the second piston 132 by a second spring 138. The second piston 132 revolves around the inside of the second cylinder chamber 133. The refrigerant introduced into the second cylinder chamber 133 from the second intake passage 135 is compressed through the revolving motion of the second piston 132 and is discharged from the second discharge passage 136.

[0052] The center line CL2 of the first eccentric shaft 121 and the center line CL3 of the second eccentric shaft 131 are provided in positions that are symmetrical with respect to the center line CL1 of the rotating shaft 101.

[0053] As shown in fig. 3, the first cylinder chamber 123 is closed on the dividing block 80 side by a flat plate-shaped first closing plate 141. The first closing plate 141 is sandwiched between the second mating surface 82 of the dividing block 80 and the first surface 124a of the first cylinder 124.

[0054] Furthermore, the first closing plate 141 has a first through-hole 141a that communicates with an intake port 125a of the first intake passage 125, and a second through-hole 141b that communicates with the first discharge passage 126. The first through-hole 141a and the second through-hole 141b penetrate through the first

closing plate 141 in the thickness direction.

[0055] The intake port 125a of the first intake passage 125 communicates with an intake passage 84 of the dividing block 80 through the first through-hole 141a of the first closing plate 141. The intake passage 84 penetrates through the dividing block 80 in the axial direction of the motor housing 60. That is, the intake passage 84 is located inside the dividing block 80. Therefore, the first cylinder chamber 123 communicates with the intake port 68 (see fig. 2) of the motor housing 60 via the first intake passage 125, the first through-hole 141a of the first closing plate 141, the intake passage 84 of the dividing block 80, and the motor chamber 61.

[0056] The dividing block 80 has a communication groove 85 that provides communication between the second through-hole 141b of the first closing plate 141 and the intermediate pressure chamber 71. The communication groove 85 is formed in the second mating surface 82 of the dividing block 80. A discharge valve 86 that opens and closes the opening of the second through-hole 141b is provided within the communication groove 85. The discharge valve 86 is configured by a check valve, such as a reed valve, that allows the injection gas refrigerant to flow only from the first discharge passage 126 to the communication groove 85. The first cylinder chamber 123 communicates with the second cylinder chamber 133 via the first discharge passage 126, the second through-hole 141b, the communication groove 85, the intermediate pressure chamber 71, and the second intake passage 135.

[0057] A gap between the first cylinder chamber 123 and the second cylinder chamber 133 is closed by a flat plate-shaped second closing plate 142. The second closing plate 142 is sandwiched between the second surface 124b of the first cylinder 124 and the first surface 134a of the second cylinder 134.

[0058] The second cylinder chamber 133 is closed by a flat plate-shaped third closing plate 143 on the bottom wall 72 side of the rear head 70. The third closing plate 143 covers the entire second surface 134b of the second cylinder 134. Furthermore, the third closing plate 143 is restricted from moving toward the bottom wall 72 of the rear head 70 by a stepped surface 76 inside the rear head 70.

[0059] The first cylinder 124, the second cylinder 134, the first closing plate 141, the second closing plate 142, and the third closing plate 143 are sandwiched in the axial direction of the rear head 70 between the stepped surface 76 of the rear head 70 and the dividing block 80.

[0060] A discharge chamber 144 demarcated by the bottom wall 72 and the third closing plate 143 is formed inside the rear head 70. The third closing plate 143 has a communicating hole 143a that provides communication between the second discharge passage 136 of the second cylinder 134 and the discharge chamber 144. A discharge valve 145 that opens and closes the opening of the through-hole 143a is provided within the discharge chamber 144. The discharge valve 145 is configured by a

check valve, such as a reed valve, that allows the injection gas refrigerant to flow only from the second discharge passage 136 to the discharge chamber 144. The discharge chamber 144 communicates with the oil separation chamber 74. The refrigerant in the high-stage compressor 130 can flow into the oil separation chamber 74 through the second discharge passage 136, the communicating hole 143a and the discharge chamber 144. It should be noted that the tip end portion of the rotating shaft 101 is preferably rotatably supported by a third bearing 146 provided in the third closing plate 143.

[0061] As shown in fig. 6, the dividing block 80 includes the injection inlet 151, an injection outlet 152, and an injection passage 153. The injection passage 153 provides communication between the injection inlet 151 and the injection outlet 152. At least the injection outlet 152 and the injection passage 153 are disposed within the dividing block 80.

[0062] The injection inlet 151 is formed integrally with the dividing block 80, for example. More specifically, a boss portion 154 that protrudes radially outward is provided on an outer peripheral surface 87 of the dividing block 80. The injection inlet 151 opens in the boss portion 154. The injection pipe 22 (see fig. 1) is connected to the injection inlet 151 to allow the injection gas refrigerant to be introduced.

[0063] The injection outlet 152 opens at the second mating surface 82 (second flat surface 82) of the dividing block 80 that faces the intermediate pressure chamber 71, thereby communicating with the intermediate pressure chamber 71. The injection outlet 152 can therefore guide the injection gas refrigerant out to the intermediate pressure chamber 71.

[0064] The injection outlet 152 is provided with a check valve 160. The check valve 160 allows the injection gas refrigerant to flow only from the injection passage 153 to the intermediate pressure chamber 71. That is, when the pressure in the injection passage 153 increases above the pressure in the intermediate pressure chamber 71, the pressure difference causes the check valve 160 to open.

[0065] The check valve 160 is provided on the flat second mating surface 82 of the dividing block 80 that faces the intermediate pressure chamber 71. The check valve 160 is configured by a reed valve 161, for example. The reed valve 161 is a thin elastic plate having one end fixed, and opens in only one direction, that is, only in the direction that allows the injection gas refrigerant to flow from the injection passage 153 to the intermediate pressure chamber 71.

[0066] The flow action of refrigerant within the electric compressor 50 will next be described. As shown in fig. 2, the refrigerant drawn in from the intake port 68 of the motor housing 60 passes through gaps in the motor 100 installed in the motor chamber 61, thereby cooling the motor 100, and then flows into the intake passage 84 of the dividing block 80. The refrigerant that has passed

through the intake passage 84 passes through the first through-hole 141a of the first closing plate 141 and the first intake passage 125 of the low-stage side compressor 120 and enters the first cylinder chamber 123.

[0067] As shown in fig. 3, the refrigerant compressed by the low-stage compressor 120 flows from the first cylinder chamber 123 through the first discharge passage 126, the second through-hole 141b of the first closing plate 141, the communication groove 85 of the dividing block 80, the intermediate pressure chamber 71, and the second intake passage 135 to the second cylinder chamber 133. The refrigerant that has been further compressed by the high-stage compressor 130 flows from the second cylinder chamber 133 through the second discharge passage 136, the communication hole 143a of the third closing plate 143, the discharge chamber 144, and the oil separation chamber 74 to the discharge port 75 of the rear head 70.

[0068] A summary of the description above is as follows.

[0069] As shown in fig. 2, an electric compressor 50 includes a two-stage compressing mechanism 110 that has a low-stage compressor 120 and a high-stage compressor 130, a motor 100 that drives the two-stage compressing mechanism 110, a motor housing 60 that is provided with a motor chamber 61 for accommodating the motor 100, a rear head 70 that is provided with an intermediate pressure chamber 71 for accommodating the two-stage compressing mechanism 110, and a dividing block 80 that is sandwiched between the rear head 70 and the motor housing 60 and that divides the motor chamber 61 from the intermediate pressure chamber 71.

[0070] As shown in fig. 6, the dividing block 80 is provided with an injection inlet 151 through which an injection gas refrigerant can be introduced, an injection outlet 152 through which the injection gas refrigerant can be led out to the intermediate pressure chamber 71, and an injection passage 153 which provides communication between the injection inlet 151 and the injection outlet 152.

In this way, the dividing block 80 is sandwiched between the motor housing 60 and the rear head 70, and is therefore extremely robust. The injection inlet 151, the injection outlet 152, and the injection passage 153 are provided in the robust dividing block 80. The injection pipe 22 can therefore be firmly supported by the electric compressor 50.

[0071] As shown in fig. 6, a check valve 160 is disposed at the injection outlet 152 to allow the injection gas refrigerant to flow only from the injection passage 153 to the intermediate pressure chamber 71. It is therefore possible to prevent the refrigerant from flowing back from the intermediate pressure chamber 71 toward the injection inlet 151 side. As a result, the efficiency of the injection type refrigeration cycle 10, 30 (see fig. 1A and fig. 1B) can be improved.

[0072] As shown in fig. 6, the injection outlet 152 and the check valve 160 are provided at the flat surface 82

(second flat surface 82, second mating surface 82) of the dividing block 80 that faces the intermediate pressure chamber 71. By providing the check valve 160 on the flat surface 82 of the dividing block 80 in this way, the configuration and attachment structure of the check valve 160 can be simplified.

[0073] As shown in fig. 6, the check valve 160 is configured by a reed valve 161. The check valve 160 is configured by assembling the reed valve 161 to the flat surface 82 (second flat surface 82, second mating surface 82) of the dividing block 80 that faces the intermediate pressure chamber 71, and can therefore have a simple configuration.

As shown in fig. 3, the dividing block 80 has an intake passage 84, inside the dividing block 80, that provides communication between the motor chamber 61 and the intake port 125a of the low-stage compressor 120.

[0074] In this way, the intake passage 84 providing communication between the motor chamber 61 and the intake port 125a of the low-stage compressor 120, and the injection inlet 151, injection outlet 152, and injection passage 153 are provided inside the dividing block 80. In other words, the intake passage 84, the injection inlet 151, the injection outlet 152, and the injection passage 153 can all be consolidated into the dividing block 80 alone, thereby making it possible to simplify the configuration of the electric compressor 50.

[0075] As shown in fig. 3, the dividing block 80 is provided integrally with a shaft supporting portion 83 which supports the rotating shaft 101 of the two-stage compressing mechanism 110. As a result, the dividing block 80 that divides the motor chamber 61 from the intermediate pressure chamber 71 can be utilized to support the rotating shaft 101 of the two-stage compressing mechanism 110. It is not necessary to provide a separate member for supporting the rotating shaft 101. The configuration of the electric compressor 50 can be simplified. In addition, since the rotating shaft 101 is supported by the dividing block 80 that is sandwiched between the motor housing 60 and the rear head 70, the overall electric compressor 50 becomes robust. The shaft supporting portion 83 can support the rotating shaft 101 directly or via a bearing 104 or a plain bearing.

[0076] It should be noted that the present invention is not limited to the exemplary embodiments, provided that the actions and effects of the present invention are demonstrated. For example, the electric compressor 50 is not limited to a horizontally-oriented electric compressor, and may equally be a vertically-oriented electric compressor.

Industrial Applicability

[0077] The electric compressor 50 of the present invention is suitable for use in the injection type refrigeration cycles 10 and 30.

Key to Symbols

[0078]

5	10, 30	Injection type refrigeration cycle
	50	Electric compressor
	60	Motor housing
	61	Motor chamber
	68	Intake port
10	70	Rear head (compressor housing)
	71	Intermediate pressure chamber
	75	Discharge port
	80	Dividing block
	82	Flat surface (second mating surface, second flat surface)
15	83	Shaft supporting portion
	84	Intake passage
	85	Communication groove
	100	Motor
20	101	Rotating shaft (output shaft)
	110	Two-stage compressing mechanism
	120	Low-stage compressor
	125	First intake passage
	125a	Intake port
25	130	High-stage compressor
	135	Second intake passage
	136	Second discharge passage
	151	Injection inlet
	152	Injection outlet
30	153	Injection passage
	160	Check valve
	161	Reed valve

Claims

- 35 1. An electric compressor (50) including a two-stage compressing mechanism (110) that has a low-stage compressor (120) and a high-stage compressor (130),
 - 40 a motor (100) that drives the two-stage compressing mechanism (110),
 - a motor housing (60) that is provided with a motor chamber (61) for accommodating the motor (100),
 - 45 a rear head (70) that is provided with an intermediate pressure chamber (71) for accommodating the two-stage compressing mechanism (110), and
 - 50 a dividing block (80) that is sandwiched between the rear head (70) and the motor housing (60) and that divides the motor chamber (61) from the intermediate pressure chamber (71),
- 55 **characterized in that** the dividing block (80) is provided with an injection inlet (151) through which an injection gas refrigerant can be introduced, an injection outlet (152) through which the in-

jection gas refrigerant can be led out to the intermediate pressure chamber (71), and an injection passage (153) which provides communication between the injection inlet (151) and the injection outlet (152).

5

2. The electric compressor as claimed in claim 1, wherein a check valve (160) is disposed at the injection outlet (152) to allow the injection gas refrigerant to flow only from the injection passage (153) to the intermediate pressure chamber (71). 10
3. The electric compressor as claimed in claim 2, wherein the injection outlet (152) and the check valve (160) are provided on a flat surface (82) of the dividing block (80) that faces the intermediate pressure chamber (71). 15
4. The electric compressor as claimed in claim 3, wherein the check valve (160) is configured by a reed valve (161). 20
5. The electric compressor as claimed in any one of claims 1 to 4, wherein the dividing block (80) has an intake passage (84), inside the dividing block (80), that provides communication between the motor chamber (61) and an intake port (125a) of the low-stage compressor (120). 25
6. The electric compressor as claimed in claim 1, wherein the dividing block (80) is integrally provided with a shaft supporting portion (83) that supports a rotating shaft (101) of the two-stage compressing mechanism (110). 30

35

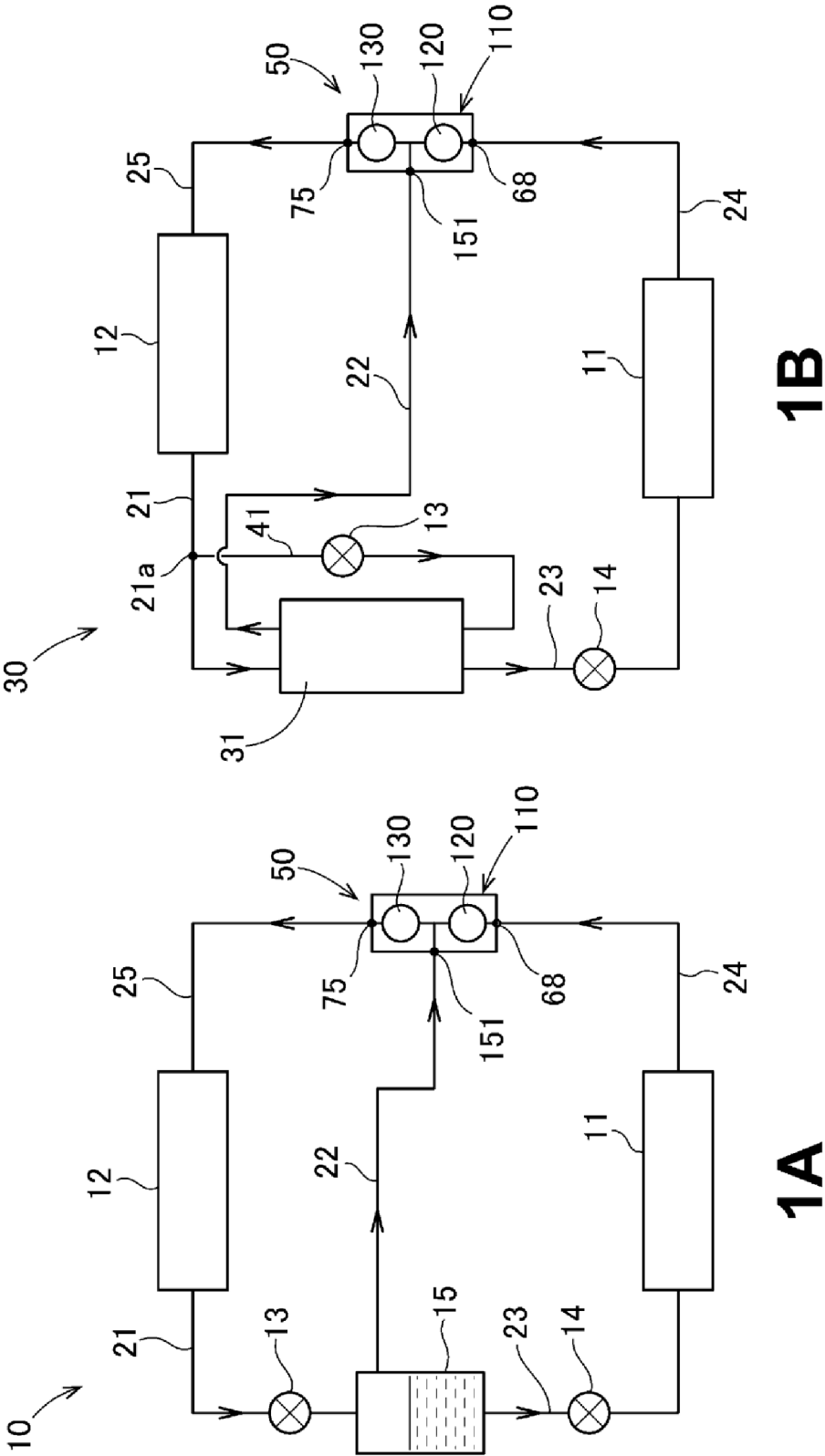
40

45

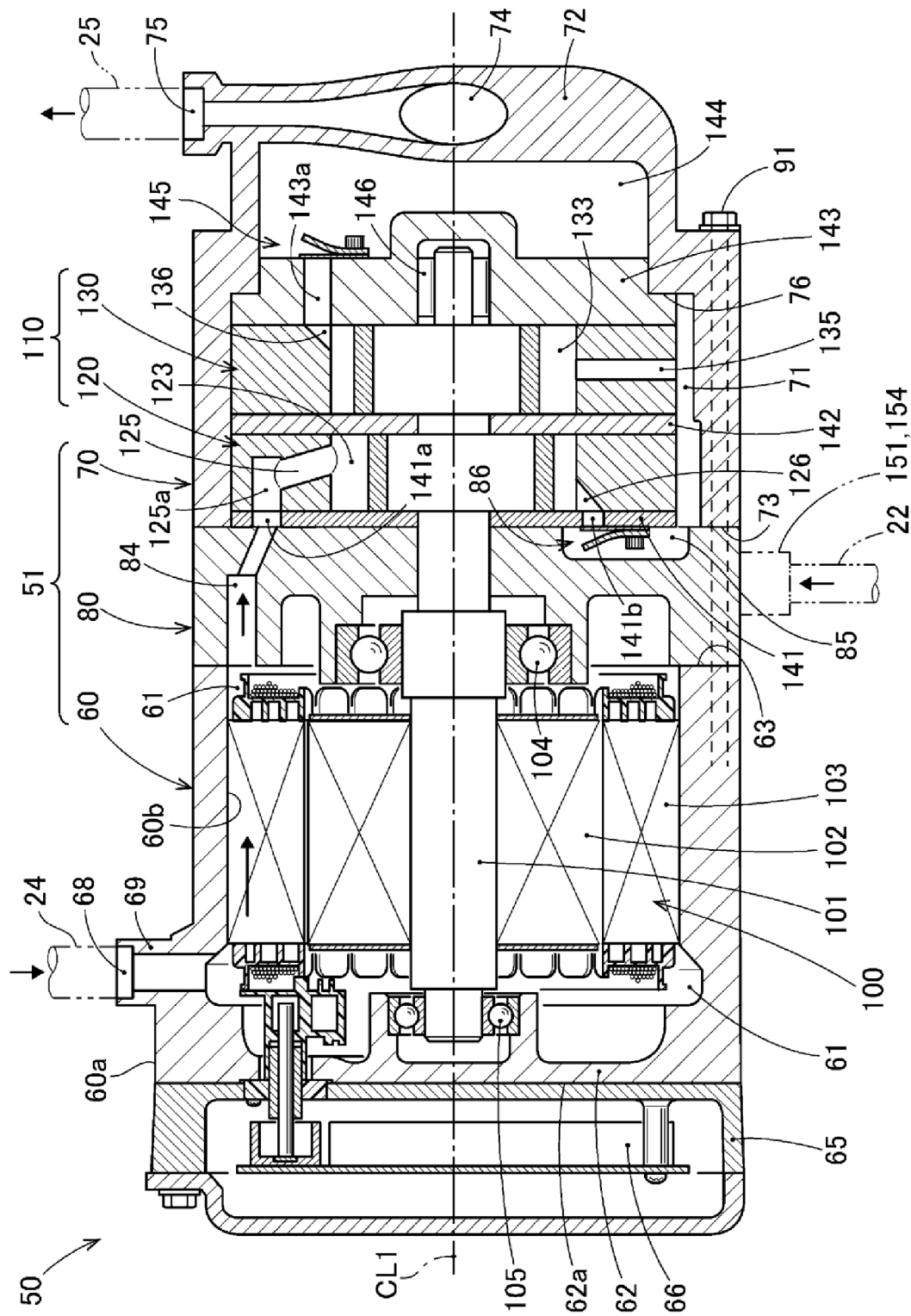
50

55

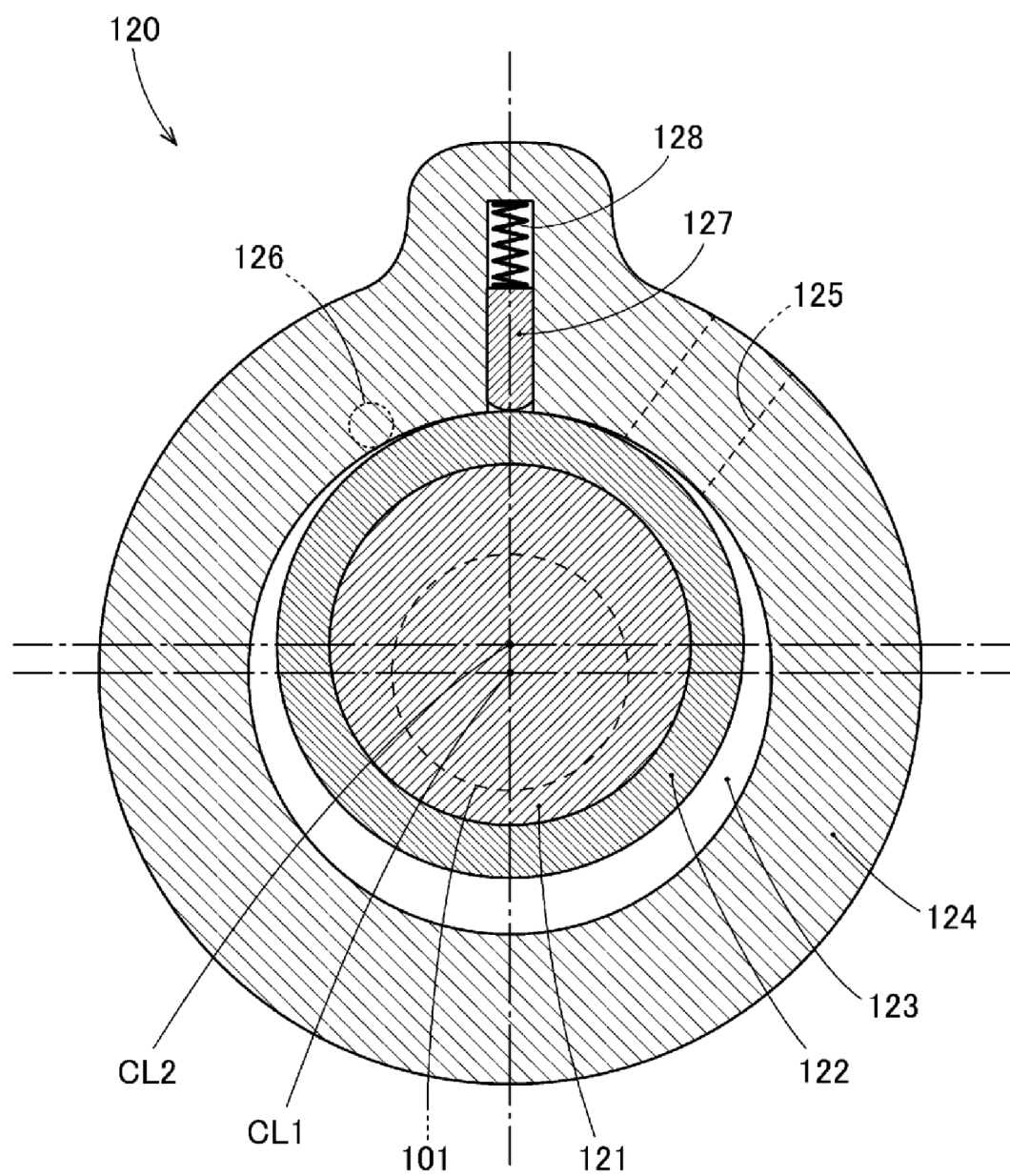
[Fig.1]



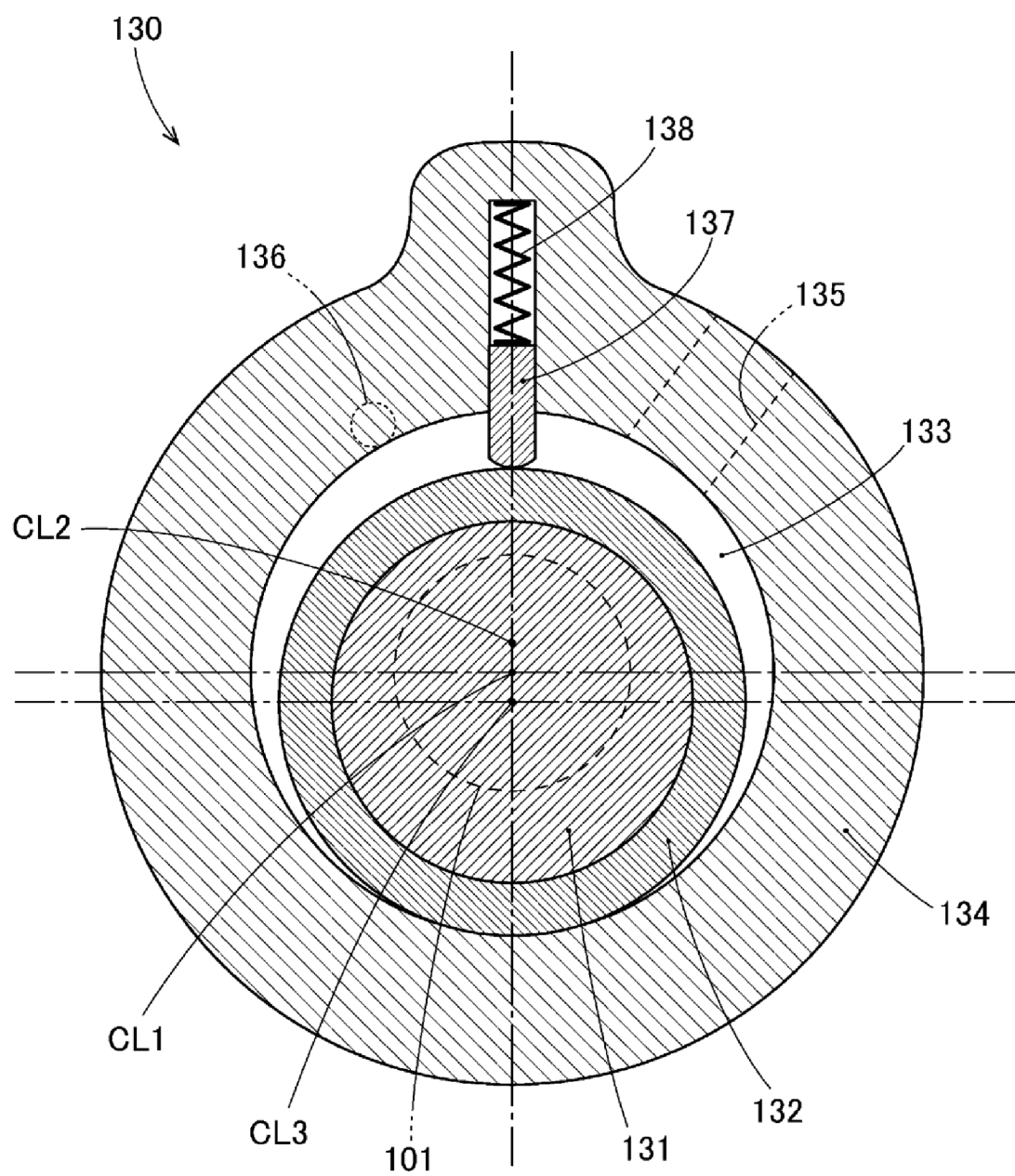
[Fig.2]



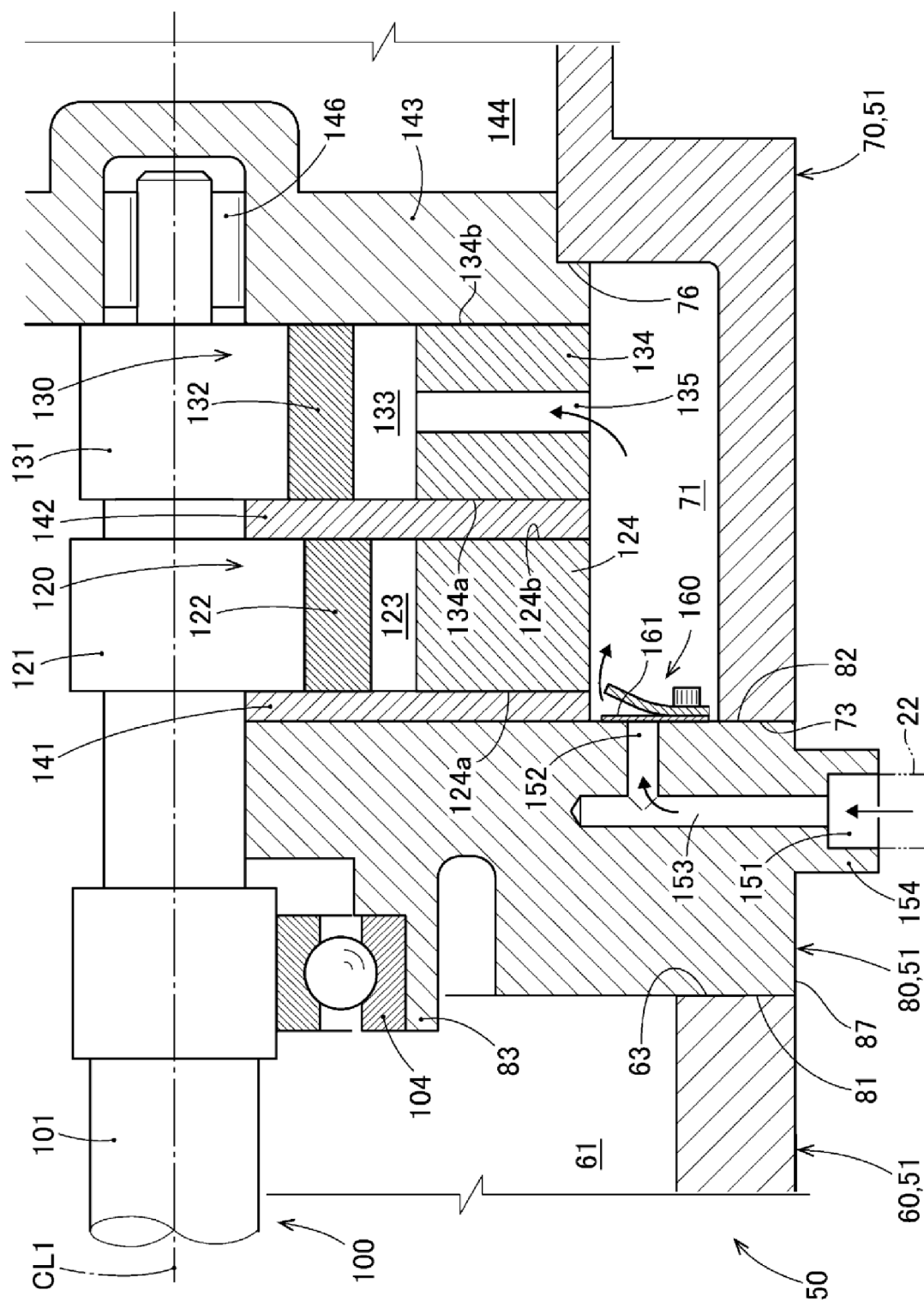
[Fig.4]



[Fig.5]



[Fig.6]



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2024/030843

A. CLASSIFICATION OF SUBJECT MATTER

F04B 39/06(2006.01)i; **F04C 23/00**(2006.01)i; **F04C 29/04**(2006.01)i; **F04C 29/12**(2006.01)i
 FI: F04B39/06 R; F04C23/00 F; F04C29/04 B; F04C29/12 D

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)

F04B39/06; F04C23/00; F04C29/04; F04C29/12

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	JP 2014-124030 A (DENSO CORPORATION) 03 July 2014 (2014-07-03) paragraphs [0026], [0103]-[0109], fig. 10	1, 6
A		2-5
A	JP 2012-2473 A (NIPPON SOKEN, INC.) 05 January 2012 (2012-01-05) fig. 3	1-6
A	JP 2015-214954 A (NIPPON SOKEN, INC.) 03 December 2015 (2015-12-03) fig. 2	1-6
A	JP 2012-57568 A (PANASONIC CORPORATION) 22 March 2012 (2012-03-22) fig. 2	1-6
A	KR 10-2018-0032960 A (LG ELECTRONICS INC.) 02 April 2018 (2018-04-02) fig. 5, 6	1-6

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

* Special categories of cited documents:

“A” document defining the general state of the art which is not considered to be of particular relevance

“D” document cited by the applicant in the international application

“E” earlier application or patent but published on or after the international filing date

“L” document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

“O” document referring to an oral disclosure, use, exhibition or other means

“P” document published prior to the international filing date but later than the priority date claimed

“T” later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

“X” document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

“Y” document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

“&” document member of the same patent family

Date of the actual completion of the international search

23 October 2024

Date of mailing of the international search report

05 November 2024

Name and mailing address of the ISA/JP

Japan Patent Office (ISA/JP)
 3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915
 Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2024/030843

5

10

15

20

25

30

35

40

45

50

55

C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2008-208758 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 11 September 2008 (2008-09-11) fig. 1, 4	2-4
P, A	CN 117052659 A (GREE ELECTRIC APPLIANCES INC ZHUHAI) 14 November 2023 (2023-11-14) fig. 1	1-6

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2024/030843

5

10

15

20

25

30

35

40

45

50

55

Patent document cited in search report	Publication date (day/month/year)	Patent family member(s)	Publication date (day/month/year)
JP 2014-124030 A	03 July 2014	US 2015/0338143 A1 paragraphs [0035], [0113]- [0119], fig. 10 WO 2014/097560 A1 CN 104854780 A	
JP 2012-2473 A	05 January 2012	(Family: none)	
JP 2015-214954 A	03 December 2015	(Family: none)	
JP 2012-57568 A	22 March 2012	(Family: none)	
KR 10-2018-0032960 A	02 April 2018	(Family: none)	
JP 2008-208758 A	11 September 2008	(Family: none)	
CN 117052659 A	14 November 2023	(Family: none)	

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2000054975 A [0005]