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(54) SCROLL COMPRESSOR WITH BYPASS PORT

SPIRALVERDICHTER MIT BYPASS

COMPRESSEUR À SPIRALES COMPRENANT UNE DÉRIVATION

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Description

Field of the Invention

[0001] The present invention relates to a scroll compressor.

Description of Related Art

[0002] Conventionally, scroll compressors are sometimes used as, for instance, outdoor units of commercial multiple air conditioners. In this case, a plurality of indoor units are connected to one scroll compressor.

[0003] In the commercial multiple air conditioner having the above constitution, the scroll compressor requires the ability to operate all the indoor units, and also the ability to operate only one indoor unit.

[0004] To provide these abilities, the scroll compressor has a bypass port (a bypass hole) and a first check valve that opens/closes the bypass port (e.g., see Patent Document 1).

[0005] The bypass port passes through an end plate of a fixed scroll that is located outside a discharge port provided in the end plate of the fixed scroll. The first check valve is fixed to first surface of the end plate of the fixed scroll. The first check valve opens/closes the bypass port.

[0006] A fluid discharged from the bypass port returns a mid-compression fluid (a refrigerant) to a suction space in a housing through a bypass line.

[0007] Among the conventional scroll compressors, there is a compressor having a discharge port and a second check valve.

[0008] The discharge port is provided to pass through an end plate of a fixed scroll that is located outside the discharge port. The second check valve is fixed to first surface of the end plate of the fixed scroll, and opens/closes the discharge port.

[0009] With this constitution, when a pressure difference between a discharge chamber, which is disposed inside an intermediate chamber in which the first check valve and the second check valve are disposed, and the intermediate chamber is small, the fluid can be drawn to a discharge space before the fluid is excessively compressed. Thereby, excessive compression can be inhibited.

[Patent Documents]

[0010]

[Patent Document 1] Japanese Unexamined Patent Application, First Publication No. H08-61269
EP1953388, EP2541066, EP2679823 and US2013/136640 disclose scroll compressors.

SUMMARY OF THE INVENTION

[0011] Meanwhile, it is considered to connect a fluid feed line, which connects the discharge chamber and the indoor unit, and a branch line, which is branched from the bypass line, on the outside of the casing to also use the bypass port and the discharge port.

[0012] However, in this case, a compressed flowing in the bypass line is made to directly flow into the fluid feed line. For this reason, pulsation of the fluid may occur.

[0013] Therefore, an object of the present invention is to provide a scroll compressor capable of inhibiting occurrence of pulsation of a fluid.

[0014] To solve the above problems, a scroll compressor according to claim 1 includes: a suction chamber into which a fluid is introduced; a discharge chamber configured to lead to a discharge pipe; a scroll compressor main body having a fixed scroll and an orbiting scroll provided between the suction chamber and the discharge chamber and configured to discharge the fluid that is compressed from a discharge port, which is provided in the fixed scroll, to the discharge chamber; a bypass port configured to remove a mid-compression fluid from the scroll compressor main body located outside the discharge port; an intermediate chamber provided between the scroll compressor main body and the discharge chamber and outside the discharge port; a first check valve configured to discharge the mid-compression fluid to the intermediate chamber via the bypass port; an on/off valve configured to become open when capacity control operation of the fluid is turned on, and to return the mid-compression fluid, which is discharged to the intermediate chamber, to the suction chamber; and a second check valve configured to become open when the capacity control operation is turned off and when a pressure in the intermediate chamber becomes higher than a pressure in the discharge chamber, and to discharge the mid-compression fluid, which is discharged to the intermediate chamber, to the discharge chamber via the discharge port.

[0015] According to the present invention, the discharge chamber communicating with the discharge pipe is provided. Thereby, since the fluid discharged from the discharge port is guided to the discharge pipe after flowing through the discharge chamber, pulsation of the fluid can be reduced in the discharge chamber. Thereby, occurrence of the pulsation of the fluid can be inhibited.

[0016] In the scroll compressor according to the aspect of the present invention, the first check valve is provided on first surface of an end plate of the fixed scroll located close to the discharge chamber.

[0017] In this way, the first check valve is provided on first surface of an end plate of the fixed scroll located close to the discharge chamber, and thereby the mid-compression fluid can be discharged to the intermediate chamber via the bypass port.

[0018] The scroll compressor according to the aspect of the present invention further includes a bypass pipe configured to guide the mid-compression fluid, which is removed from the bypass port, into the suction chamber. The on/off valve may be provided for the bypass pipe.

[0019] The bypass pipe having this constitution is provided, and the on/off valve is provided for the bypass pipe. Thereby, the mid-compression fluid discharged to the intermediate chamber can return to the suction chamber.

[0020] The scroll compressor according to the aspect of the present invention further includes a cover provided to face the once surface of the end plate and configured to define the intermediate chamber along with the end plate of the fixed scroll. The discharge port and the second check valve are provided for the cover.

[0021] In this way, the discharge port is provided for the cover that is a member different from the end plate of the fixed scroll for which the bypass port is provided. Thereby, a position at which the bypass port is formed and a position at which the discharge port is formed do not interfere with each other. Thus, the degree of freedom for the position at which the bypass port is formed and the degree of freedom for the position at which the discharge port is formed can be enhanced.

[0022] In the scroll compressor according to the aspect of the present invention, the cover may be a member formed in an annular shape that surrounds a portion located outside the discharge port within first surface of the end plate.

[0023] In this way, the cover is provided to surround the portion located outside the discharge port within the first surface of the end plate, and thereby a region in which an outlet of the discharge port is formed and a region in which an outlet of the bypass port is formed can be separated from each other. Thereby, the high-pressure fluid discharged from the discharge port and the low- or medium-pressure fluid (the fluid having a lower pressure than the fluid discharged from the discharge port) discharged from the bypass port can be inhibited from being mixed.

[0024] The cover is formed in the annular shape. Thereby, the bypass port can be provided at a desired position of the fixed scroll in a circumferential direction of the fixed scroll. Thereby, the degree of freedom for the position at which the bypass port is formed can be improved.

[0025] The scroll compressor according to the aspect of the present invention further includes a casing in which the scroll compressor main body and the cover are housed and which defines the discharge chamber along with the cover. The discharge pipe is provided for the casing to communicate with the discharge chamber, and the on/off valve is disposed outside the casing.

[0026] With this constitution, the discharge chamber can be defined by the casing and the cover. The on/off valve is provided outside the casing, and thereby maintenance of the on/off valve can be improved.

[0027] In the scroll compressor according to the aspect of the present invention, the bypass port may be made up of a plurality of bypass ports provided in a circumferential direction of the fixed scroll, and the first check valve may be provided for each of the plurality of bypass ports.

[0028] In this way, the plurality of bypass ports and the plurality of first check valves are provided in the circumferential direction of the fixed scroll. Thereby, the fluid can be discharged to the intermediate chamber via the plurality of bypass ports.

[0029] Thereby, the fluid discharged from the plurality of bypass ports can be guided to the discharge pipe through one discharge port, and thus the constitution of the scroll compressor can be simplified.

[0030] In the scroll compressor according to the aspect of the present invention, when an opening area of the bypass port is defined as Sv, an opening area of the discharge port is defined as Sm, an opening area of the discharge port is defined as St, and an opening area of the discharge pipe is defined as Sf, formula (1) below may be satisfied.

$$Sv \leq Sm \leq St \leq Sf \cdots\cdots\cdots\cdots (1)$$

[0031] In this way, to satisfy the formula (1) above, Sv, Sm, St, and Sf are set. Thereby, loss of pressure can be reduced.

[0032] The scroll compressor according to the aspect of the present invention may further include a third check valve provided for the first surface of the end plate of the fixed scroll and configured to open the discharge port when a pressure in the discharge port is higher than a pressure of the discharge chamber. The third check valve may be more hardly lifted than the first check valve and the second check valve, and the second check valve may be more hardly lifted than the first check valve.

[0033] With this constitution, the loss of pressure can be reduced.

[0034] In the scroll compressor according to the aspect of the present invention, the discharge port may be disposed opposite to the discharge pipe in an extending direction of the casing.

[0035] The discharge port is provided at this position, and thereby the loss of pressure can be reduced.

[0036] According to the present invention, a degree of freedom for a position at which a bypass port is formed and a degree of freedom for a position at which a discharge port is formed can be enhanced, and then occurrence of pulsation of a fluid can be inhibited.

BRIEF DESCRIPTION OF THE DRAWINGS

[0037]

FIG. 1 is a sectional view schematically showing an outline constitution of principal sections of a scroll compressor according to a first embodiment of the present invention.

FIG. 2 is an enlarged sectional view of a portion enclosed by a region A out of the scroll compressor shown in FIG. 1.

FIG. 3 is an enlarged sectional view of a portion en-

closed by a region B out of the scroll compressor shown in FIG. 1.

FIG. 4 is a schematic view showing a fluid capacity control operation and a full load operation at the scroll compressor shown in FIG. 1.

FIG. 5 is a sectional view schematically showing an outline constitution of principal sections of a scroll compressor according to a second embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0038] Hereinafter, embodiments of the present invention will be described in detail with reference to the attached drawings.

(First embodiment)

[0039] A scroll compressor 10 of a first embodiment of the present invention will be described with reference to FIG. 1. In FIG. 1, O_1 indicates an axis (hereinafter referred to as "axis O_1") of a rotary shaft main body 45, and O_2 indicates an eccentric axis (hereinafter referred to as "eccentric axis O_2") of an eccentric shaft 46.

[0040] The scroll compressor 10 has a casing 11, a suction pipe 12, a discharge pipe 14, a main bearing 21, a sub-bearing 22, a rotary shaft 23, an oil feed pump 24, a driver 25, a scroll compressor main body 26, a bush assembly 28, an Oldham ring 31, a first check valve 32, a third check valve 33, a cover 35, a bypass pipe 37, an on/off valve 38, a support member 39, and a second check valve 42.

[0041] The casing 11 is formed in a sealed structure, and has a hollow portion at an interior thereof. The casing 11 extends in a direction of the axis O_1. The casing 11 has first end 11A at which the discharge pipe 14 is provided, and the second end 11B. The first end 11A and the second end 11B are disposed in the direction of the axis O_1.

[0042] The casing 11 houses the scroll compressor main body 26 and the cover 35. The interior of the casing 11 is divided into a discharge chamber 16 and a suction chamber 17 by the scroll compressor main body 26. The discharge chamber 16 is divided between the first end 11A of the casing 11 and the cover 35. A part of the suction chamber 17 is divided by the second end 11B and the middle of the casing 11.

[0043] The suction pipe 12 is provided at a middle sidewall of the casing 11. The suction pipe 12 leads to the suction chamber 17. The suction pipe 12 introduces a fluid (e.g., a refrigerant gas that is a working fluid) into the suction chamber 17 from an exterior of the casing 11.

[0044] The discharge pipe 14 is provided at the first end 11A of the casing 11. The discharge pipe 14 communicates with the discharge chamber 16. When the scroll compressor 10 is used as an outdoor unit of a commercial multiple air conditioner, the discharge pipe 14 is connected to, for instance, a plurality of indoor units (not shown) that are places of use.

[0045] A compressed fluid (hereinafter referred to as "high-pressure fluid") is discharged from a discharge port 55 constituting the scroll compressor main body 26, and then is discharged to the discharge pipe 14 via the discharge chamber 16. The discharged high-pressure fluid is supplied to the places of use.

[0046] The main bearing 21 is housed in the casing 11, and is fixed to an inner wall of the casing 11. The main bearing 21 is disposed between a position at which the suction pipe 12 and the casing 11 are connected and the scroll compressor main body 26.

[0047] The main bearing 21 supports a first end 45A of the rotary shaft main body 45 extending in the direction of the axis O_1 in a rotatable state.

[0048] The sub-bearing 22 is housed in the casing 11. The sub-bearing 22 is fixed to an inner wall of the casing 11 which is located closer to the second end 11B than the main bearing 21. The sub-bearing 22 supports the second end 45B of the rotary shaft main body 45 extending in the direction of the axis O_1 in a rotatable state.

[0049] The rotary shaft 23 has the rotary shaft main body 45 and the eccentric shaft 46. The rotary shaft main body 45 is formed in a columnar shape. The rotary shaft main body 45 has first end 45A disposed close to the scroll compressor main body 26, and the second end 45B disposed close to the second end 11B of the casing 11.

[0050] The rotary shaft main body 45 is supported by the main bearing 21 and the sub-bearing 22 in a state in which it is rotatable about the axis O_1.

[0051] The eccentric shaft 46 is provided at the other tip (a tip of the first end 45A) of the rotary shaft main body 45. The eccentric shaft 46 uses the eccentric axis O_2, which is offset with respect to the axis O_1 (situated away from the axis O_1), as the central axis. The eccentric shaft 46 is a columnar shaft that has a smaller outer diameter than the rotary shaft main body 45.

[0052] When the rotary shaft main body 45 rotates about the axis O_1, the eccentric shaft 46 configured in this way revolves on the axis O_1.

[0053] The oil feed pump 24 is provided under the sub-bearing 22. The oil feed pump 24 supplies a lubricant to a bearing main body that constitutes the main bearing 21 and the sub-bearing 22.

[0054] The driver 25 is housed in the casing 11. The driver 25 is disposed to surround an outer circumferential surface of the midsection of the rotary shaft main body 45. The driver 25 rotates the rotary shaft main body 45. For example, an electric generator may be used as the driver 25.

[0055] The scroll compressor main body 26 is housed in the casing 11, and is provided between the main bearing 21 and the discharge chamber 16 (between the suction chamber 17 and the discharge chamber 16). The scroll compressor main body 26 has a fixed scroll 48 and an orbiting scroll 49.

[0056] The fixed scroll 48 is disposed between the or-

biting scroll 49 and the discharge chamber 16. The fixed scroll 48 has an end plate 51 and a fixed wrap 53.

[0057] The end plate 51 is a disc-like plate, and is fixed to the inner wall of the casing 11. The end plate 51 has a first surface 51a, a second surface 51b, a discharge port 55, and a bypass port 57.

[0058] The first surface 51a faces the first end 11A of the casing 11 across the discharge chamber 16. The second surface 51b is disposed on a side opposite to the first surface 51a. The second surface 51b faces the orbiting scroll 49.

[0059] The discharge port 55 (a fixed-scroll discharge port) is a hole formed to pass through the center of the end plate 51. The discharge port 55 extends in the direction of the axis O_1. The discharge port 55 discharges the high-pressure fluid, compression of which is completed by the scroll compressor main body 26, to the discharge chamber 16.

[0060] The bypass port 57 is a hole formed to pass through the end plate 51 located outside a position at which the discharge port 55 is formed. The bypass port 57 removes a mid-compression fluid (which may be referred to hereinafter as "low- or medium-pressure fluid"), which has a lower pressure than the high-pressure fluid discharged from the discharge port 55, from an interior of the scroll compressor main body 26.

[0061] The fixed wrap 53 is provided on the second surface 51b of the end plate 51. The fixed wrap 53 is erected in the direction of the axis O_1. The fixed wrap 53 is a wall formed in a spiral shape when viewed in the direction of the axis O_1. The fixed wrap 53 is formed of, for instance, a plate-like member that is wound around the center of the end plate 51.

[0062] The orbiting scroll 49 is disposed between the fixed scroll 48 and the main bearing 21. The orbiting scroll 49 has an end plate 61, an orbiting wrap 62, a boss part 64, and a bearing 66.

[0063] The end plate 61 is a disc-like plate, and has a first surface 61a and a second surface 61b.

[0064] The first surface 61a is disposed to face the second surface 51b of the end plate 51. The second surface 61b is a surface provided on a side opposite to the first surface 61a.

[0065] The orbiting wrap 62 is provided on the first surface 61a of the end plate 61. The orbiting wrap 62 is erected in the direction of the axis O_1. The orbiting wrap 62 is a wall formed in a spiral shape when viewed in the direction of the axis O_1. The orbiting wrap 62 is formed of, for instance, a plate-like member that is wound around the center of the end plate 61.

[0066] The orbiting wrap 62 having the above constitution is disposed to be meshed with the fixed wrap 53 described above. Thereby, a compression chamber 26A that is a space for compressing a fluid is divided between the orbiting wrap 62 and the fixed wrap 53. The orbiting wrap 62 is orbited in relation to the fixed scroll 48, and thereby a volume of the compression chamber 26A is changed. Thereby, the fluid in the compression chamber 26A is compressed.

[0067] The boss part 64 is provided in the center of the second surface 61b of the end plate 61. The boss part 64 is a cylindrical member, and protrudes in a direction from the second surface 61b of the end plate 61 to the sub-bearing 22. The boss part 64 is disposed to surround an outer circumference of the eccentric shaft 46.

[0068] The bearing 66 is provided on an outer circumferential surface of the boss part 64. A lubricant is supplied from the oil feed pump 24 to the bearing 66.

[0069] The bush assembly 28 is provided between the orbiting scroll 49 and the rotary shaft 23. The bush assembly 28 couples the orbiting scroll 49 and the rotary shaft 23. The bush assembly 28 has a bush 28A provided between the eccentric shaft 46 and the boss part 64.

[0070] The Oldham ring 31 is provided between the orbiting scroll 49 and the main bearing 21. The Oldham ring 31 has a lug fitted into a groove formed in the end plate 61 of the orbiting scroll 49. The Oldham ring 31 is a member for inhibiting rotation of the orbiting scroll 49 (turning around the eccentric axis O_2).

[0071] Next, the first check valve 32 and the third check valve 33 will be described in turn with reference to FIGS. 1 and 2. In FIG. 2, a state in which the first check valve 32 and the third check valve 33 are closed is schematically shown.

[0072] The first check valve 32 is a valve for checking a backflow of the fluid from the first surface 51a side of the end plate 51. The first check valve 32 has a valve main body 71, a valve travel adjusting member 72, and a bolt 73.

[0073] The valve main body 71 is a plate-like member. The valve main body 71 is disposed on the first surface 51a of the end plate 51 to block an outlet side of the bypass port 57. A first end of the valve main body 71 is fixed to the end plate 51 by the bolt 73.

[0074] The valve travel adjusting member 72 is a plate-like member for setting a maximum valve travel of the valve main body 71. The valve travel adjusting member 72 has higher rigidity than the valve main body 71. The valve travel adjusting member 72 is disposed on the valve main body 71. A first end of the valve travel adjusting member 72 is fixed to the end plate 51 via the valve main body 71 by the bolt 73.

[0075] When a pressure in the bypass port 57 is higher than a pressure of an intermediate chamber 81 (close to the first surface 51a of the end plate 51), the valve main body 71 is open, and the first check valve 32 having the above constitution discharges the low- or medium-pressure fluid (the fluid having a lower pressure than the high-pressure fluid discharged from the discharge port 55) to the intermediate chamber 81 via the bypass port 57.

[0076] The third check valve 33 has a valve main body 75, a valve travel adjusting member 76, and a bolt 77 which are the same constitution as the valve main body 71, the valve travel adjusting member 72, and the bolt 73 described above.

[0077] The third check valve 33 is different from the

first check valve 32 in that the valve main body 75 is disposed on the first surface 51a of the end plate 51 to block an outlet side of the discharge port 55.

[0078] In the third check valve 33 having the above constitution, when a pressure in the discharge port 55 is higher than a pressure of the first surface 51a side of the end plate 51, the valve main body 75 is open, and the high-pressure fluid is discharged to the first surface 51a side of the end plate 51.

[0079] The cover 35 will be described with reference to FIGS. 1 to 3. In FIG. 3, a state in which the second check valve 42 is closed is schematically shown.

[0080] The cover 35 is provided in the discharge chamber 16 to face the first surface 51a of the end plate 51. An outer circumferential portion of the cover 35 is fixed to the casing 11.

[0081] The cover 35 is a member formed in an annular shape that surrounds a portion located outside the discharge port 55 within the first surface 51a of the end plate 51 (to be specific, a portion at which the bypass port 57 and the first check valve 32 are formed). The cover 35 defines the annular intermediate chamber 81 along with the first surface 51a of the end plate 51. The intermediate chamber 81 is provided between the scroll compressor main body 26 and the discharge chamber 16 and outside the discharge port 55. The mid-compression fluid is discharged from the bypass port 57 to the intermediate chamber 81.

[0082] In this way, the cover 35 is provided to surround the portion located outside the discharge port 55 within the first surface 51a of the end plate 51, and thereby a region in which an outlet of the discharge port 55 is formed and a region in which an outlet of each of the bypass port 57 is formed can be separated from each other.

[0083] Thereby, the high-pressure fluid discharged from the discharge port 55 and the low- or medium-pressure fluid discharged from the bypass port 57 can be inhibited from being mixed.

[0084] The cover 35 defines the annular intermediate chamber 81 along with the first surface 51a of the end plate 51, and thereby the bypass port 57 can be provided at a desired position in a circumferential direction of the fixed scroll 48. Thereby, a degree of freedom in a position at which the bypass port 57 is formed can be improved.

[0085] The cover 35 has an opening 83 and a discharge port 85 (an intermediate chamber discharge port). The opening 83 is provided in the center of the cover 35, and exposes the third check valve 33. The opening 83 communicates with the discharge chamber 16.

[0086] When the third check valve 33 is open, the high-pressure fluid in the scroll compressor main body 26 is discharged to the discharge chamber 16 via the opening 83.

[0087] The discharge port 85 is provided to pass through the cover 35. The discharge port 85 is a hole for spatially connecting the discharge chamber 16 and the intermediate chamber 81. The discharge port 85 has a function of inhibiting excessive loss of compression.

[0088] Opening/closing of the discharge port 85 is controlled by the second check valve 42. When the first check valve 32 and the second check valve 42 are open, the discharge port 85 discharges the low- or medium-pressure fluid, which is drawn from the bypass port 57, to the discharge chamber 16.

[0089] As described above, the bypass port 57 are provided in the end plate 51 of the fixed scroll 48, and the discharge port 85 is provided in the cover 35 that is a member different from the fixed scroll 48. Thereby, the position at which the bypass port 57 is formed and a position at which the discharge port 85 is formed do not interfere with each other. Thus, the degree of freedom in the position at which the bypass port 57 is formed and the degree of freedom in the position at which the discharge port 85 is formed can be enhanced.

[0090] The discharge port 85 may be provided at a position at which it is disposed opposite to the discharge pipe 14 in a direction in which the casing 11 extends (the direction of the axis O_1).

[0091] When the discharge port 85 is provided at this position, loss of pressure can be reduced.

[0092] In the bypass pipe 37, a portion located at a tip side thereof passes through the first end 11A of the casing 11 and the cover 35. A first end 37A of the bypass pipe 37 is disposed in the intermediate chamber 81.

[0093] Thereby, the bypass pipe 37 is configured to be able to draw a fluid, which is discharged from the bypass port 57 to the intermediate chamber 81, to the outside of the intermediate chamber 81.

[0094] The rest of the bypass pipe 37 is disposed outside the casing 11. The rest of the bypass pipe 37 includes the second end 37B. The second end 37B is connected to the middle of the casing 11. The second end 37B communicates with the suction chamber 17 in the casing 11.

[0095] The on/off valve 38 is provided for the bypass pipe 37 disposed outside the casing 11. The on/off valve 38 is converted to be open when capacity control operation of the fluid is turned on, and thereby returns the mid-compression fluid discharged to the intermediate chamber 81 to the suction chamber 17. For example, an electromagnetic valve may be used as the on/off valve 38.

[0096] When the first check valve 32 and the on/off valve 38 are open, the low- or medium-pressure fluid discharged from the bypass port 57 returns to the suction chamber 17. Thereby, a volume of the high-pressure fluid discharged from the discharge port 55 is reduced, and thus a volume of the high-pressure fluid supplied from the scroll compressor 10 can be controlled.

[0097] The support member 39 is fixed to an outer side the casing 11. The support member 39 supports the bypass pipe 37 and the on/off valve 38.

[0098] The second check valve 42 has a valve main body 91, a valve travel adjusting member 92, and a bolt 93 which are the same constitution as the valve main body 71, the valve travel adjusting member 72, and the

bolt 73 described above.

[0099] The second check valve 42 is different from the first check valve 32 in that the valve main body 91 is disposed on the first surface 35a of the cover 35 to block an outlet side of the discharge port 85.

[0100] When the capacity control operation is turned on, the second check valve 42 become open when a pressure in the intermediate chamber 81 is higher than a pressure in the discharge chamber 16, and discharges the mid-compression fluid, which is discharged to the intermediate chamber 81, to the discharge chamber 16 via the discharge port 85. Afterwards, the low- or medium-pressure fluid discharged to the discharge chamber 16 is discharged from the discharge pipe 14.

[0101] In this way, the low- or medium-pressure fluid discharged from the discharge port 85 flows through the discharge chamber 16, and then is guided to the discharge pipe 14. Thereby, pulsation of the fluid can be reduced in the discharge chamber 16. Thereby, occurrence of the pulsation of the fluid can be inhibited.

[0102] Here, a capacity control operation of the fluid (an operation when the capacity control operation of the fluid is turned on) and a full load operation of the fluid (operation when the capacity control operation of the fluid is turned off) in the scroll compressor shown in FIG. 1 will be described with reference to FIG. 4. In FIG. 4, the same constitutional portions as in the structure shown in FIGS. 1 to 3 are given the same reference signs.

[0103] First, a case in which the on/off valve 38 is open to perform the capacity control operation will be described. In this case, a pressure of the intermediate chamber 81 becomes equal to that of the suction chamber 17. Thereby, the pressure of the intermediate chamber 81 becomes lower than that of the discharge chamber 16. Accordingly, the second check valve 42 remains closed. That is, even when the first check valve 32 is open, the low- or medium-pressure fluid is not discharged from the intermediate chamber 81 to the discharge chamber 16.

[0104] On the other hand, a case in which the on/off valve 38 is closed to perform the full load operation will be described. In this case, since the intermediate chamber 81 is in a state in which it does not communicate with the suction chamber 17, a pressure of the intermediate chamber 81 becomes higher than that of the suction chamber 17. When the pressure of the intermediate chamber 81 becomes higher than that of the discharge chamber 16, the second check valve 42 opens. Accordingly, the first check valve 32 is open, and the low- or medium-pressure fluid discharged to the intermediate chamber 81 is discharged to the discharge chamber 16 via the intermediate chamber 81, and thereby excessive loss of compression can be inhibited.

[0105] In the scroll compressor 10, for example, when an opening area of the bypass port 57 is defined as Sv, an opening area of the discharge port 85 is defined as Sm, an opening area of the discharge port 55 is defined as St, and an opening area of the discharge pipe 14 is defined as Sf, formula (2) below may be satisfied.

$$Sv \leq Sm \leq St \leq Sf \cdots\cdots\cdots\cdots (2)$$

[0106] In this way, Sv, Sm, St, and Sf are set to satisfy formula (2), and thereby the loss of pressure can be reduced.

[0107] In the scroll compressor 10, for example, the third check valve 33 may be configured to more hardly lifted than the first check valve 32 and the second check valve 42, and the second check valve 42 may be configured to more hardly lifted than the first check valve 32. With this constitution, the loss of pressure can be reduced.

[0108] According to the scroll compressor 10 of the first embodiment, the discharge chamber 16 communicating with the discharge pipe 14 is provided. Thereby, since the fluid discharged from the discharge port 85 flows through the discharge chamber 16 and then is guided to the discharge pipe 14, the pulsation of the fluid can be reduced in the discharge chamber 16. Thereby, the occurrence of the pulsation of the fluid can be inhibited.

[0109] The bypass port 57 is provided in the end plate 51 of the fixed scroll 48, and the discharge port 85 is provided in the cover 35 that is the member different from the fixed scroll 48, and thereby the position at which the bypass port 57 is formed and the position at which the discharge port 85 is formed do not interfere with each other. For this reason, the degree of freedom for the position at which the bypass port 57 is formed and the degree of freedom for the position at which the discharge port 85 is formed can be enhanced.

(Second embodiment)

[0110] A scroll compressor 100 of a second embodiment of the present invention will be described with reference to FIG. 5. In FIG. 5, the same constitutional portions as in the structure shown in FIGS. 1 to 4 are given the same reference signs.

[0111] In FIG. 5, a case in which two bypass ports 57 and two first check valves 32 are provided will be described by way of example. However, the number of bypass ports 57 and the number of first check valves 32 have only to be multiple, and are not limited to two.

[0112] Referring to FIG. 5, the scroll compressor 100 has a structure in which a scroll compressor main body 26 has two compression chambers 26A. The scroll compressor 100 has the same constitution as the scroll compressor 10 of the first embodiment except that the bypass port 57 and the first check valve 32 are provided in each of the compression chambers 26A.

[0113] That is, the scroll compressor 100 has the two bypass ports 57 and the two first check valves 32. The two bypass ports 57 and the two first check valves 32 are disposed in an intermediate chamber 81.

[0114] The two bypass ports are disposed in a circum-

ferential direction of an end plate 51 of a fixed scroll 48. The two bypass ports 57 may be for instance disposed to face each other across an axis O_1.

[0115] According to the scroll compressor 100 of the second embodiment, the plurality of bypass ports 57 and the plurality of first check valves 32 are disposed in the intermediate chamber 81, and thereby a fluid can be discharged from the plurality of bypass ports 57 to the intermediate chamber 81.

[0116] Thereby, since the fluid discharged from the plurality of bypass ports 57 can be guided to a discharge pipe 14 through one discharge port 85, the constitution of the scroll compressor 100 can be simplified.

[0117] Although preferred embodiments of the present invention have been described in detail, the present invention is not limited to the specified embodiments, and various modifications and alterations are possible without departing the scope of the present invention described in the claims.

[0118] In the first and second embodiments, as examples of the scroll compressors 10 and 100, the case in which the cover 35 is provided and the second check valve 42 is provided for the cover 35 has been described by way of example. However, the second check valve 42 may be configured to be embedded in the end plate 51 without providing the cover 35. In this case, the same effects as in the scroll compressor 10 of the first embodiment can be obtained.

EXPLANATION OF REFERENCES

[0119]

10, 100 Scroll compressor
11 Casing
11A, 37A, 45A First end
11B, 37B, 45B Second end
12 Suction pipe
14 Discharge pipe
16 Discharge chamber
17 Suction chamber
21 Main bearing
22 Sub-bearing
23 Rotary shaft
24 Oil feed pump
25 Driver
26 Scroll compressor main body
26A Compression chamber
28 Bush assembly
28A Bush
31 Oldham ring
32 First check valve
33 Third check valve
35 Cover
35a, 51a, 61a First surface
37 Bypass pipe
38 On/off valve
39 Support member
42 Second check valve
45 Rotary shaft main body
46 Eccentric shaft
48 Fixed scroll
49 Orbiting scroll
51, 61 End plate
51b, 61b Second surface
53 Fixed wrap
55 Discharge port
57 Bypass port
62 Orbiting wrap
64 Boss part
66 Bearing
71, 75, 91 Valve main body
72, 76, 92 Valve travel adjusting member
73, 77, 93 Bolt
81 Intermediate chamber
83 Opening
85 Discharge port
O_1 Axis
O_2 Eccentric axis

Claims

1. A scroll compressor (10,100) comprising:

a suction chamber (17) into which a fluid is introduced;
a discharge chamber (16) configured to communicate with a discharge pipe (14);
a scroll compressor main body (26) having a fixed scroll (48) and an orbiting scroll (49) provided between the suction chamber and the discharge chamber and configured to discharge the fluid that is compressed from a discharge port (55), which is provided in the fixed scroll, to the discharge chamber;
a bypass port (57) configured to remove a mid-compression fluid from the scroll compressor main body located outside the discharge port;
an intermediate chamber (81) provided between the scroll compressor main body and the discharge chamber and outside the discharge port;
a first check valve (32) configured to discharge the mid-compression fluid to the intermediate chamber via the bypass port;
an on/off valve (38) configured to return the mid-compression fluid, which is discharged to the intermediate chamber, to the suction chamber when the on/off valve is opened; and
a second check valve (42) configured to open when a pressure in the intermediate chamber becomes higher than a pressure in the discharge chamber, and to discharge the mid-compression fluid, which is discharged to the intermediate chamber, to the discharge chamber via the intermediate chamber discharge port (85)

when the on/off valve is closed,
the first check valve (32) is provided on a first surface (51a) of an end plate (51) of the fixed scroll (48) located on the discharge chamber side of the fixed scroll,
the scroll compressor further comprises a cover (35) provided to face the first surface (51a) of the end plate (51) and configured to define the intermediate chamber (81) along with the end plate of the fixed scroll,
characterized in that
the scroll compressor (10, 100) further comprises:

a bypass pipe (37) configured to guide the mid-compression fluid, which is removed from the bypass port (57), into the suction chamber,
wherein the on/off valve (38) is provided for the bypass pipe
and
a casing (11) in which the scroll compressor main body (26) and the cover (35) are housed and which defines the discharge chamber (16) along with the cover,

wherein the discharge pipe (14) is provided for the casing (11) to communicate with the discharge chamber (16), and
the on/off valve (38) is disposed outside the casing,

wherein the intermediate chamber discharge port (85) and the second check valve (42) are provided for the cover (35),
the cover (35) is provide with an opening (83) configured to communicate the discharge port (55) and the discharge chamber (16), and
the mid-compression fluid being compressed to have a lower pressure than that of the fluid discharged from the discharge port (55).

2. The scroll compressor according to claim 1, wherein the cover (35) is a member formed in an annular shape that surrounds a portion located outside the discharge port (55) within the first surface (51a) of the end plate (51).

3. The scroll compressor according to any one of claims 1 to 2,

comprising a plurality of bypass ports (57) provided in a circumferential direction of the fixed scroll (48); and
the first check valve (32) is provided for each of the plurality of bypass ports.

4. The scroll compressor according to any one of claims 1 to 3, wherein, when an opening area of the bypass port (57) is defined as Sv, an opening area of the intermdediate chamber discharge port (85) is defined as Sm, an opening area of the discharge port (55) is defined as St, and an opening area of the discharge pipe (14) is defined as Sf, formula (1) below is satisfied.

$$Sv \leq Sm \leq St \leq Sf \cdots\cdots\cdots\cdots (1)$$

5. The scroll compressor according to any one of claims 1 to 4, further comprising a third check valve (33) provided for the first surface (51a) of the end plate (51) of the fixed scroll (48) and configured to open the discharge port (55) when a pressure in the discharge port is higher than a pressure of the discharge chamber,
wherein third check valve is configured to be more hardly lifted than the first check valve and the second check valve, and the second check valve is configured to be more hardly lifted than the first check valve.

6. The scroll compressor according to any one of claims 1 to 5, wherein the intermediate chamber discharge port (85) is disposed opposite to the discharge pipe (14) in an extending direction of the casing.

Patentansprüche

1. Spiralverdichter (10, 100), umfassend:

eine Ansaugkammer (17), in welche ein Fluid eingeführt wird,
eine Auslasskammer (16), die dazu ausgestaltet ist, mit einem Auslassrohr (14) zu kommunizieren,
einen Spiralverdichter-Hauptkörper (26), der eine stationäre Spirale (48) und eine rollende Spirale (49) aufweist, die zwischen der Ansaugkammer und der Auslasskammer angeordnet und dazu ausgestaltet sind, das Fluid, das von einem Auslassanschluss (55), der in der stationären Spirale vorgesehen ist, verdichtet wird, in die Auslasskammer auszugeben,
einen Umgehungsanschluss (57), der dazu ausgestaltet ist, ein Fluid mittlerer Verdichtung aus dem Spiralverdichter-Hauptkörper, der sich außerhalb des Auslassanschlusses befindet, zu entfernen,
eine Zwischenkammer (81), die zwischen dem Spiralverdichter-Hauptkörper und der Auslasskammer und außerhalb des Auslassanschlus-

ses vorgesehen ist,
ein erstes Rückschlagventil (32), das dazu ausgestaltet ist, das Fluid mittlerer Verdichtung in die Zwischenkammer über den Umgehungsanschluss auszugeben,
ein Ein/Aus-Ventil (38), das dazu ausgestaltet ist, das Fluid mittlerer Verdichtung, das in die Zwischenkammer ausgegeben wird, zu der Ansaugkammer zurückzuführen, wenn das Ein/Aus-Ventil geöffnet ist, und
ein zweites Rückschlagventil (42), das dazu ausgestaltet ist, sich zu öffnen, wenn ein Druck in der Zwischenkammer größer wird als ein Druck in der Auslasskammer, und das Fluid mittlerer Verdichtung, welches in die Zwischenkammer ausgegeben wird, in die Auslasskammer über den Zwischenkammer-Auslassanschluss (85) auszugeben, wenn das Ein/Aus-Ventil geschlossen ist,
wobei das erste Rückschlagventil (32) auf einer ersten Oberfläche (51a) einer Endplatte (51) der stationären Spirale (48) vorgesehen ist, die sich auf der Seite der Auslasskammer der stationären Spirale befindet,
wobei der Spiralverdichter ferner eine Abdeckung (35) umfasst, die der ersten Oberfläche (51a) der Endplatte (51) zugewandt vorgesehen und dazu ausgestaltet ist, die Zwischenkammer (81) zusammen mit der Endplatte der stationären Spirale zu definieren,
dadurch gekennzeichnet, dass
der Spiralverdichter (10, 100) ferner umfasst:

ein Umgehungsrohr (37), das dazu ausgestaltet ist, das Fluid mittlerer Verdichtung, welches aus dem Umgehungsanschluss (57) entfernt wird, in die Ansaugkammer zu leiten,

wobei das Ein/Aus-Ventil (38) für das Umgehungsrohr vorgesehen ist, und ein Gehäuse (11), in welchem der Spiralverdichter-Hauptkörper (26) und die Abdeckung (35) beherbergt sind und welches die Auslasskammer (16) zusammen mit der Abdeckung definiert,
wobei das Auslassrohr (14) für das Gehäuse (11) vorgesehen ist, um mit der Auslasskammer (16) zu kommunizieren, und
das Ein/Aus-Ventil (38) außerhalb des Gehäuses angeordnet ist,

wobei der Zwischenkammer-Auslassanschluss (85) und das zweite Rückschlagventil (42) für die Abdeckung (35) vorgesehen sind,
die Abdeckung (35) mit einer Öffnung (83) vorgesehen ist, die dazu ausgestaltet ist, mit dem Auslassanschluss (55) und der Auslasskammer (16) zu kommunizieren, und
das Fluid mittlerer Verdichtung verdichtet wird, um einen niedrigeren Druck aufzuweisen als jenen des Fluids, das von dem Auslassanschluss (55) ausgegeben wird.

2. Spiralverdichter nach Anspruch 1, wobei die Abdeckung (35) ein Element ist, das in einer ringförmigen Gestalt gebildet ist, die einen Abschnitt umgibt, der sich außerhalb des Auslassanschlusses (55) innerhalb der ersten Oberfläche (51a) der Endplatte (51) befindet.

3. Spiralverdichter nach einem der Ansprüche 1 bis 2,

umfassend mehrere Umgehungsanschlüsse (57), die in einer Umfangsrichtung der stationären Spirale (48) vorgesehen sind, und
wobei das erste Rückschlagventil (32) für jeden der mehreren Umgehungsanschlüsse vorgesehen ist.

4. Spiralverdichter nach einem der Ansprüche 1 bis 3, wobei, wenn ein Öffnungsbereich des Umgehungsanschlusses (57) als Sv definiert ist, ein Öffnungsbereich des Zwischenkammer-Auslassanschlusses (85) als Sm definiert ist, ein Öffnungsbereich des Auslassanschlusses (55) als St definiert ist und ein Öffnungsbereich des Auslassrohres (14) als Sf definiert ist, die Formel (1) unten erfüllt ist.

$$Sv \leq Sm \leq St \leq Sf \quad \ldots\ldots\ldots\ldots (1)$$

5. Spiralverdichter nach einem der Ansprüche 1 bis 4, ferner umfassend ein drittes Rückschlagventil (33), das für die erste Oberfläche (51a) der Endplatte (51) der stationären Spirale (48) vorgesehen und dazu ausgestaltet ist, den Auslassanschluss (55) zu öffnen, wenn ein Druck in dem Auslassanschluss größer als ein Druck der Auslasskammer ist,
wobei das dritte Rückschlagventil dazu ausgestaltet ist, sich schwerer heben zu lassen als das erste Rückschlagventil und das zweite Rückschlagventil, und das zweite Rückschlagventil dazu ausgestaltet ist, sich schwerer heben zu lassen als das erste Rückschlagventil.

6. Spiralverdichter nach einem der Ansprüche 1 bis 5, wobei der Zwischenkammer-Auslassanschluss (85) gegenüber dem Auslassrohr (14) in einer Erstreckungsrichtung des Gehäuses angeordnet ist.

Revendications

1. Compresseur à spirales (10, 100) comprenant :

une chambre d'aspiration (17) dans laquelle est introduit un fluide ;
une chambre de décharge (16) configurée pour communiquer avec un tuyau de décharge (14) ;
un corps principal de compresseur à spirales (26) ayant une spirale fixe (48) et une spirale orbitale (49), prévu entre la chambre d'aspiration et la chambre de décharge, et configuré pour décharger le fluide qui est comprimé par un orifice de décharge (55), qui est prévu dans la spirale fixe, jusqu'à la chambre de décharge ;
un orifice de dérivation (57) configuré pour retirer un fluide de compression moyenne du corps principal de compresseur à spirales positionné à l'extérieur de l'orifice de décharge ;
une chambre intermédiaire (81) prévue entre le corps principal de compresseur à spirales et la chambre de décharge et à l'extérieur de l'orifice de décharge ;
une première valve antiretour (32) configurée pour décharger le fluide de compression moyenne dans la chambre intermédiaire via l'orifice de dérivation ;
une valve de marche/arrêt (38) configurée pour ramener le fluide de compression moyenne, qui est déchargé dans la chambre intermédiaire, à la chambre d'aspiration, lorsque la valve de marche/arrêt est ouverte ; et
une deuxième valve antiretour (42) configurée pour s'ouvrir, lorsqu'une pression dans la chambre intermédiaire devient supérieure à une pression dans la chambre de décharge, et pour décharger le fluide de compression moyenne, qui est déchargé dans la chambre intermédiaire, dans la chambre de décharge, via l'orifice de décharge (85) de chambre intermédiaire, lorsque la valve de marche/arrêt est fermée,
la première valve antiretour (32) est prévue sur une première surface (51a) d'une plaque d'extrémité (51) de la spirale fixe (48) située du côté de la chambre de décharge de la spirale fixe,
le compresseur à spirales comprend en outre un couvercle (35) prévu pour faire face à la première surface (51a) de la plaque d'extrémité (51) et configuré pour définir la chambre intermédiaire (81) conjointement avec la plaque d'extrémité de la spirale fixe,
caractérisé en ce que :
le compresseur à spirales (10, 100) comprend en outre :

un tuyau de dérivation (37) configuré pour guider le fluide de compression moyenne, qui est retiré par l'orifice de dérivation (57), dans la chambre d'aspiration,
la valve de marche/arrêt (38) étant prévue pour le tuyau de dérivation, et
un carter (11) dans lequel le corps principal de compresseur à spirales (26) et le couvercle (35) sont logés, et qui définit la chambre de décharge (16) conjointement avec le couvercle,

le tuyau de décharge (14) étant prévu afin que le carter (11) communique avec la chambre de décharge (16), et
la valve de marche/arrêt (38) étant disposée à l'extérieur du carter,

dans lequel l'orifice de décharge (85) de chambre intermédiaire et la deuxième valve antiretour (42) sont prévus pour le couvercle (35),
le couvercle (35) est prévu avec une ouverture (83) configurée pour faire communiquer l'orifice de décharge (55) et la chambre de décharge (16), et
le fluide de compression moyenne étant comprimé pour avoir une pression inférieure à celle du fluide déchargé par l'orifice de décharge (55).

2. Compresseur à spirales selon la revendication 1, dans lequel le couvercle (35) est un élément formé dans une forme annulaire qui entoure une partie positionnée à l'extérieur de l'orifice de décharge (55) dans la première surface (51a) de la plaque d'extrémité (51).

3. Compresseur à spirales selon l'une quelconque des revendications 1 à 2,

comprenant une pluralité d'orifices de dérivation (57) prévus dans une direction circonférentielle de la spirale fixe (48) ; et
la première valve antiretour (32) est prévue pour chacun de la pluralité d'orifices de dérivation.

4. Compresseur à spirales selon l'une quelconque des revendications 1 à 3, dans lequel, lorsqu'une zone d'ouverture de l'orifice de dérivation (57) est définie comme étant Sv, qu'une zone d'ouverture de l'orifice de décharge (85) de chambre intermédiaire est définie comme étant Sm, qu'une zone d'ouverture de l'orifice de décharge (55) est définie comme étant St, et qu'une zone d'ouverture du tuyau de décharge (14) est définie comme étant Sf, la formule (1) ci-dessous est satisfaite :

$$Sv \leq Sm \leq St \leq Sf \ldots\ldots\ldots (1).$$

5. Compresseur à spirales selon l'une quelconque des revendications 1 à 4, comprenant en outre une troisième valve antiretour (33) prévue pour la première surface (51a) de la plaque d'extrémité (51) de la spirale fixe (48) et configurée pour ouvrir l'orifice de décharge (55) lorsqu'une pression dans l'orifice de décharge est supérieure à une pression de la chambre de décharge,
dans lequel la troisième valve antiretour est configurée pour être plus difficilement levée que la première valve antiretour et que la deuxième valve antiretour, et la deuxième valve antiretour est configurée pour être plus difficilement levée que la première valve antiretour.

6. Compresseur à spirales selon l'une quelconque des revendications 1 à 5, dans lequel l'orifice de décharge (85) de chambre intermédiaire est disposé à l'opposé du tuyau de décharge (14) dans une direction d'extension du carter.

FIG. 1

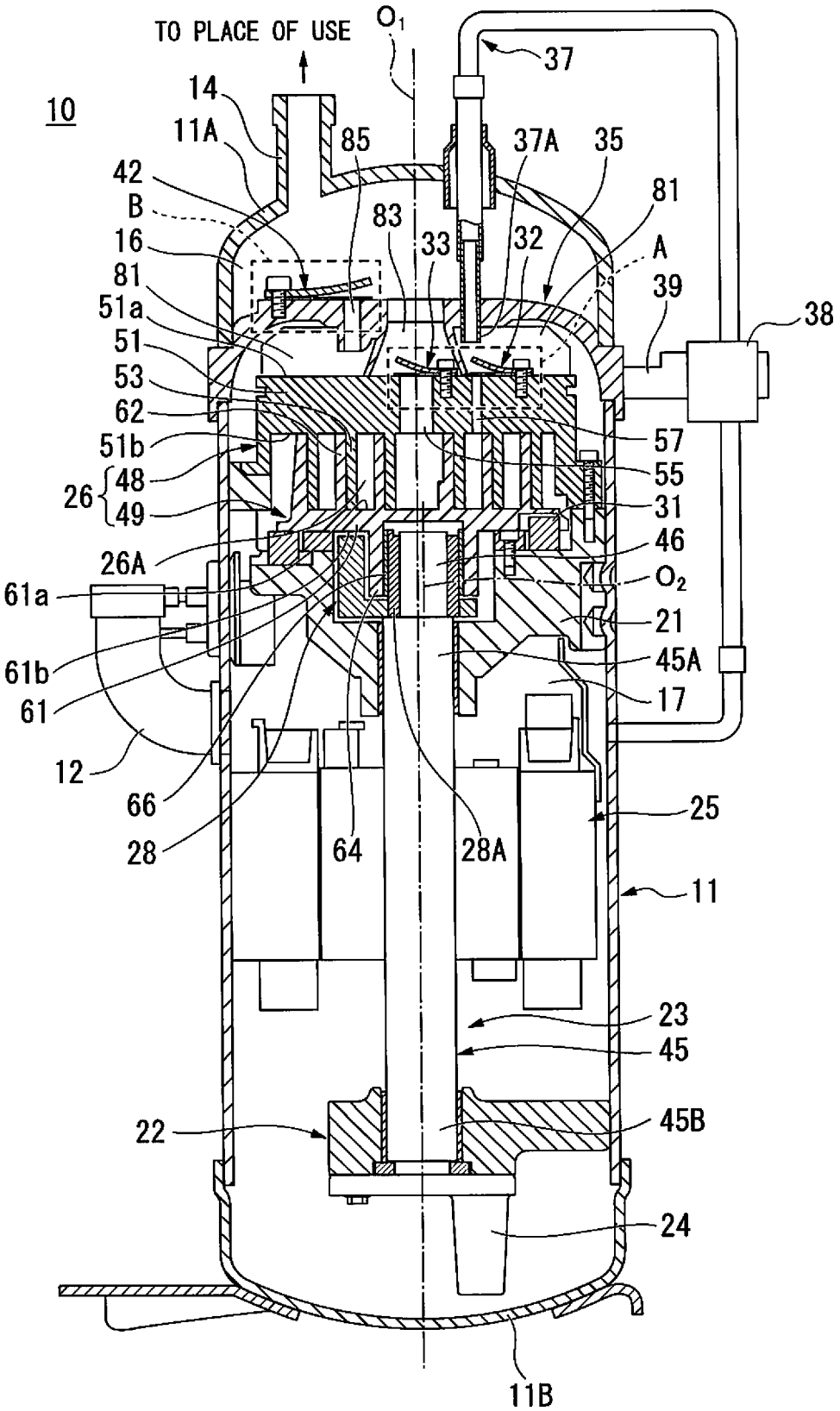

TO PLACE OF USE
O_1
37
10
14
11A
85
37A
35
42
B
83
33
32
81
A
16
81
39
38
51a
51
53
62
57
51b
55
26
48
49
31
46
26A
O_2
61a
21
45A
61b
61
17
12
66
28
64
28A
25
11
23
45
22
45B
24
11B

FIG. 2

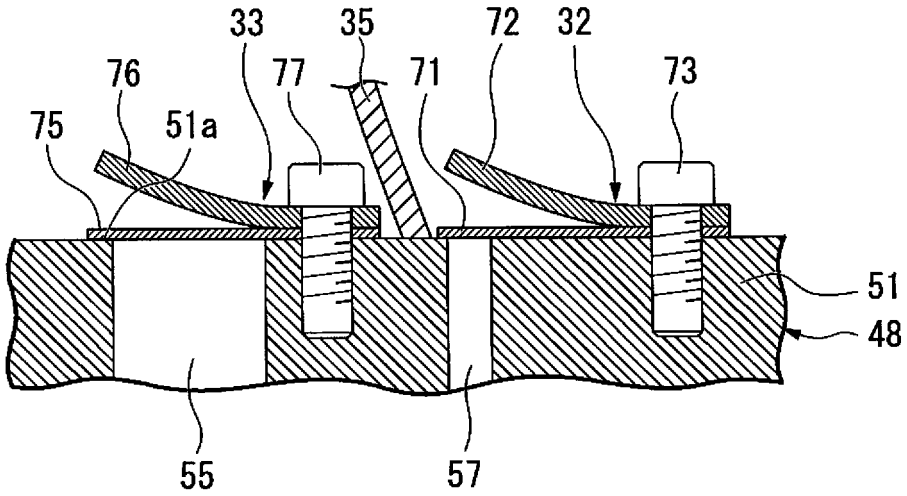


FIG. 3

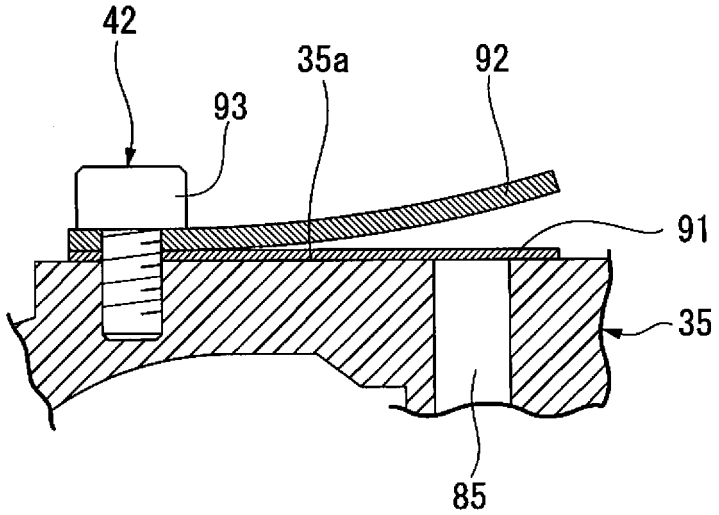


FIG. 4

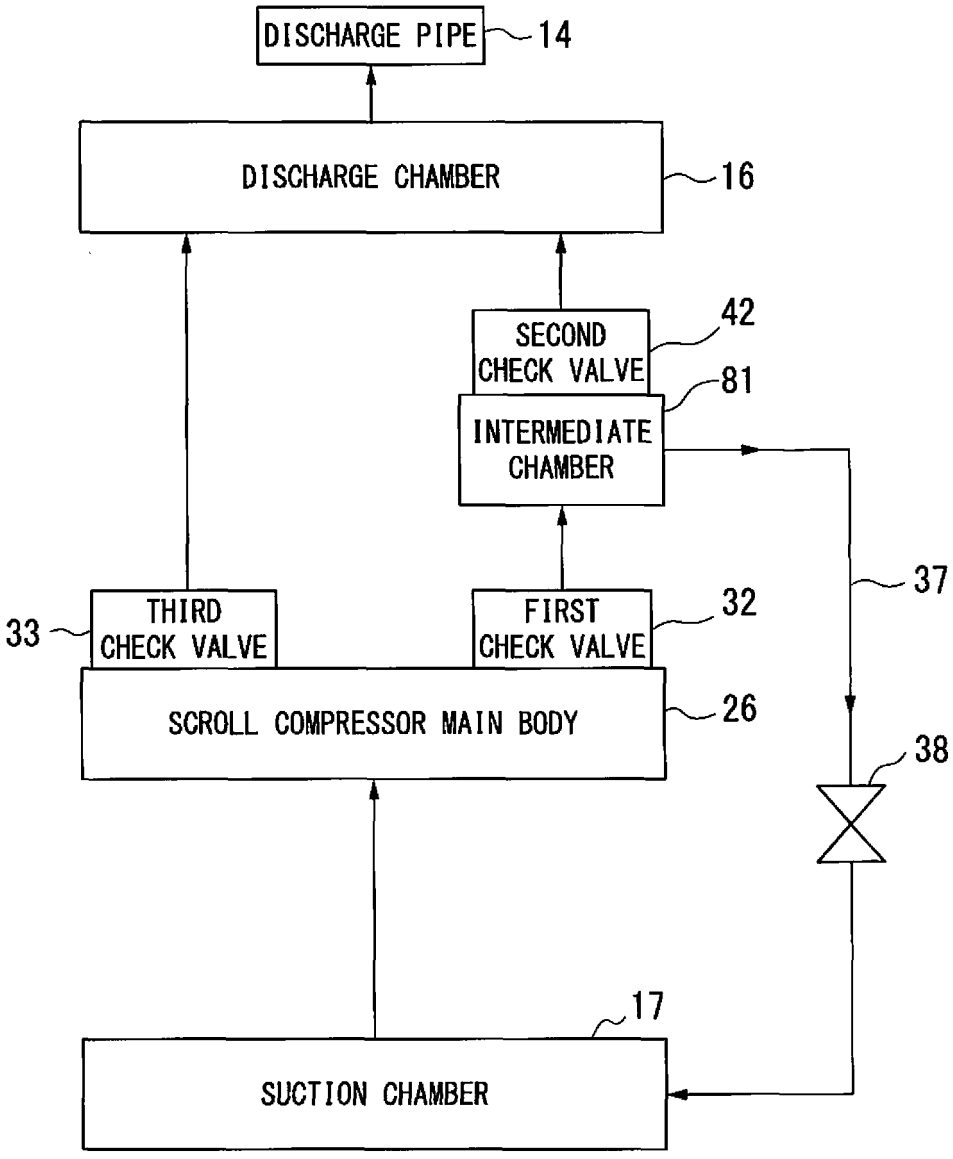
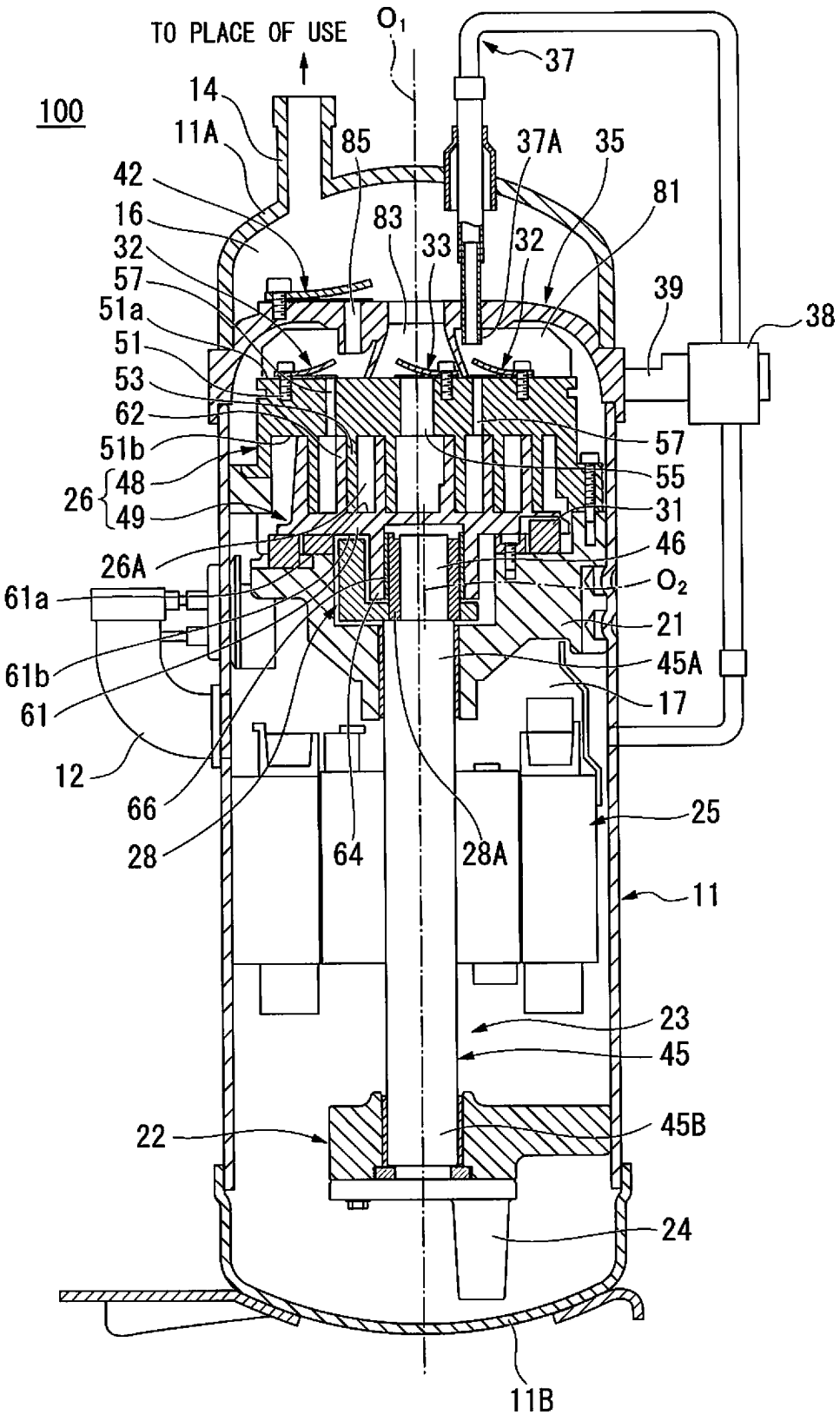

DISCHARGE PIPE
14
DISCHARGE CHAMBER
16
SECOND CHECK VALVE
42
81
INTERMEDIATE CHAMBER
37
THIRD CHECK VALVE
33
FIRST CHECK VALVE
32
SCROLL COMPRESSOR MAIN BODY
26
38
17
SUCTION CHAMBER

FIG. 5


TO PLACE OF USE
O_1
37
100
14
11A
85
37A
35
42
81
16
83
33
32
32
57
39
38
51a
51
53
62
57
51b
55
48
26
49
31
46
26A
O_2
61a
21
45A
61b
17
61
12
25
66
64
28A
28
11
23
45
22
45B
24
11B

REFERENCES CITED IN THE DESCRIPTION

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