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(54) **Structure for oil recovery in a compressor**

(57) In a structure for oil recovery in a compressor for separating oil from refrigerant and supplying the separated oil into the compressor through an oil supply passage, the compressor includes a rotary shaft, a cylinder block having a plural cylinder bores, a cam member rotated integrally with the rotary shaft, a piston received in each cylinder bore being operable in conjunction with the rotation of the rotary shaft through the cam member, a

suction port for allowing the refrigerant to be drawn from a suction-pressure region of the compressor to the corresponding cylinder bore, a discharge port for allowing the refrigerant to be discharged from the corresponding cylinder bore to a discharge-pressure region of the compressor, and a flexible reed valve for opening and closing one of the suction port and the discharge port. The oil supply passage is opened and closed in accordance with motion of the reed valve.

FIG. 1A

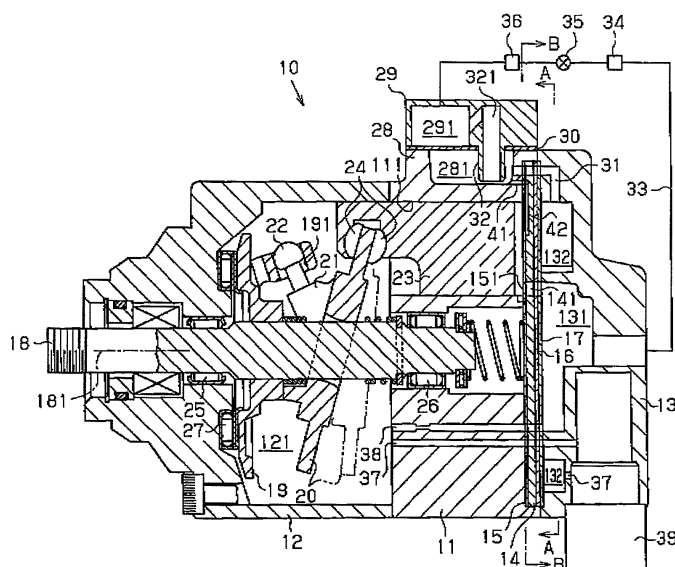
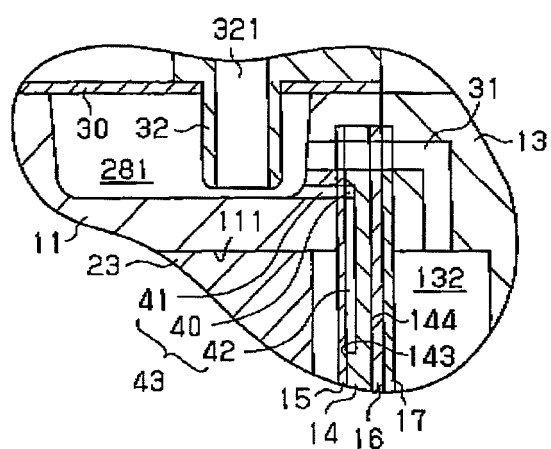


FIG. 1B



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a structure for oil recovery in a compressor.

[0002] Japanese Patent Application Publication No. 2001-173563 discloses a compressor wherein a rotary body is mounted on a drive shaft of the compressor for rotation therewith adjacent to a radial bearing. The rotary body is rotatably fitted in a circular hole formed in a cylinder block of the compressor and a groove is formed in the outer peripheral surface of the rotary body. Lubricating oil is separated from refrigerant in the discharge-pressure region of the compressor by an oil separator, and is supplied through an oil supply hole into a gap between the outer peripheral surface of the rotary body and the inner peripheral surface of the circular hole. In the meantime, the above gap is in communication with a drive chamber through a bleed hole. The groove is communicable with the oil supply hole and the bleed hole alternately one time for each rotation of the drive shaft. When the groove is connected with the oil supply hole, the oil is supplied into the groove. When the groove into which the oil is supplied is then connected with the bleed hole, the oil in the groove is supplied into the drive chamber through the bleed hole thereby to lubricate parts or elements in the drive chamber which need to be lubricated.

[0003] The gap between the outer peripheral surface of the rotary body and the inner peripheral surface of the circular hole is necessary for allowing the rotary body to rotate. In addition, an oil separation chamber in which the oil separator is disposed is a part of the discharge-pressure region of the compressor and the drive chamber is lower in pressure than the discharge-pressure region. Therefore, the above separated oil constantly leaks into the drive chamber through the gap between the outer peripheral surface of the rotary body and the inner peripheral surface of the circular hole because of the pressure differential between the drive chamber and the oil separation chamber. Such leakage may cause the oil reserved at the bottom of the oil separation chamber to be drained.

[0004] The present invention is directed to a structure for oil recovery in a compressor which can prevent the oil separated from the refrigerant from being drained.

SUMMARY OF THE INVENTION

[0005] An aspect of the present invention provides a structure for oil recovery in a compressor for separating oil from refrigerant and supplying the separated oil into the compressor through an oil supply passage. The compressor includes a rotary shaft, a cylinder block having a plurality of cylinder bores formed therethrough to be arranged around the rotary shaft, a cam member rotated integrally with the rotary shaft, a piston received in each cylinder bore being operable in conjunction with the ro-

tation of the rotary shaft through the cam member, a suction port for allowing the refrigerant to be drawn from a suction-pressure region of the compressor to the corresponding cylinder bore, a discharge port for allowing the refrigerant to be discharged from the corresponding cylinder bore to a discharge-pressure region of the compressor, and a flexible reed valve for opening and closing one of the suction port and the discharge port. The oil supply passage is opened and closed in accordance with motion of the reed valve.

[0006] Other aspects and advantages of the invention will become apparent from the following description, taken in conjunction with the accompanying drawings, illustrating by way of example the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The features of the present invention that are believed to be novel are set forth with particularity in the appended claims. The invention together with objects and advantages thereof, may best be understood by reference to the following description of the presently preferred embodiments together with the accompanying drawings in which:

FIG. 1A is a longitudinal sectional view showing a variable displacement compressor according to a first embodiment of the present invention;

FIG. 1B is a partially enlarged view of FIG. 1A;

FIG 2A is a cross sectional view as seen from the line A-A of FIG. 1A;

FIG. 2B is a partially enlarged longitudinal sectional view as seen from the line C-C of FIG 2A;

FIG 3 is a partially enlarged view of FIG 1A;

FIG. 4 is a cross sectional view as seen from the line B-B of FIG. 1A;

FIG 5 is a partially enlarged view of FIG. 4;

FIG 6 is a partially enlarged cross sectional view showing a variable displacement compressor according to a second embodiment of the present invention;

FIG. 7 is a longitudinal sectional view showing a fixed displacement compressor according to a third embodiment of the present invention;

FIG. 8 is a cross sectional view as seen from the line D-D of FIG. 7;

FIG. 9A is a partially enlarged view of FIG. 7; and

FIG. 9B is a partially enlarged view of FIG 7.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0008] The following will describe a first embodiment of an oil recovery structure according to the present invention as applied to a variable displacement compressor with reference to FIGS. 1A through 5. Referring firstly to FIG 1A, the variable displacement compressor designated generally by numeral 10 includes a cylinder block 11 and a front housing 12 which is joined to the front end of the cylinder block 11. A rear housing 13 is fixedly joined to the rear end of the cylinder block 11 through a valve plate 14, a suction valve plate 15, a discharge valve plate 16 and a retainer plate 17. The cylinder block 11, the front housing 12 and the rear housing 13 cooperate to form a housing of the variable displacement compressor 10.

[0009] A rotary shaft 18 is rotatably supported by the front housing 12 and the cylinder block 11 through radial bearings 25, 26, respectively. As shown in FIG. 1A, the front housing 12 and the cylinder block 11 cooperate to form a pressure control chamber 121. A rotary support 19 is fixedly mounted on the rotary shaft 18, and a swash plate 20 is supported by the rotary shaft 18 in such a way that it is slidable in the direction of the axis 181 of the rotary shaft 18 and also inclinable relative to the axis 181. A pair of connecting elements 21 (only one being shown in FIG. 1A) is fixedly mounted on the swash plate 20 that serves as a cam member. A guide pin 22 (only one being shown in FIG. 1A) is fixedly mounted on each connecting element 21. A pair of guide holes 191 (only one being shown in FIG. 1A) is formed in the rotary support 19. The heads of the guide pins 22 are slidably fitted in the guide holes 191. The swash plate 20 is inclinable relative to the axis 181 of the rotary shaft 18 and rotatable integrally with the rotary shaft 18 through the connection between the paired guide holes 191 and the paired guide pins 22. The inclination of the swash plate 20 is guided by the guide holes 191 receiving therein the guide pins 22 and the rotary shaft 18 slidably supporting the swash plate 20.

[0010] In operation of the compressor 10, as the center of the swash plate 20 adjacent to the rotary shaft 18 moves toward the rotary support 19, the inclination of the swash plate 20 increases. The maximum inclination of the swash plate 20 is restricted by the contact between the rotary support 19 and the swash plate 20. The swash plate 20 of FIG. 1A which is indicated by solid line is at the position of the maximum inclination of the swash plate 20. As the center of the swash plate 20 moves toward the cylinder block 11, the inclination of the swash plate 20 decreases. The swash plate 20 of FIG. 1A which is indicated by two-dot chain line is at the position of the minimum inclination of the swash plate 20.

[0011] The cylinder block 11 has formed therethrough a plurality of cylinder bores 111, each of which receives therein a piston 23. The rotary motion of the swash plate

20 is converted into the reciprocating motion of each piston 23 in its corresponding cylinder bore 111 through a pair of shoes 24.

[0012] As shown in FIGs. 1A and 2A, the rear housing 13 has a suction chamber 131 and a discharge chamber 132 formed therein. The cylinder bores 111 are separated from the suction chamber 131 and the discharge chamber 132 by the valve plate 14. The suction chamber 131 forms a part of the suction-pressure region of the compressor 10 and the discharge chamber 132 forms a part of the discharge-pressure region of the compressor 10.

[0013] As shown in FIG. 2B, the valve plate 14 and the discharge valve plate 16 have suction ports 141 formed therethrough. The valve plate 14 and the suction valve plate 15 have discharge ports 142 formed therethrough. The valve plate 14 serves as a partition plate of the present invention. The suction valve plate 15 has flexible plate-like suction valves 151 and the discharge valve plate 16 has flexible plate-like discharge valves 161.

[0014] During the suction stroke of the piston 23 moving leftward as seen in FIG. 1A, refrigerant gas in the suction chamber 131 is drawn through the suction valve 151 (or reed valve) into the cylinder bore 111 corresponding to the piston 23 in the suction stroke. The refrigerant gas drawn into the cylinder bore 111 is then compressed by the piston 23 moving rightward in FIG. 1A and discharged into the discharge chamber 132 while pushing open the discharge valve 161 (or reed valve). The pressure in the cylinder bore 111 varies between the suction pressure and the discharge pressure in accordance with the reciprocating motion of the piston 23.

[0015] As shown in FIG. 2B, the suction valve 151 is movable away from or toward and into contact with the front face 143 of the valve plate 14 adjacent to the cylinder bore 111 thereby to open or close the suction port 141. The discharge valve 161 is movable away from or toward and into contact with the rear face 144 of the valve plate 14 on the side opposite to the cylinder bore 111 thereby to open or close the discharge port 142. The discharge valve 161 is brought into contact with a retainer 171 of a retainer plate 17 for restricting the opening of the discharge valve 161.

[0016] As shown in FIG 1A, a thrust bearing 27 is interposed between the rotary support 19 and the front housing 12 for receiving reaction force of refrigerant gas being discharged from the cylinder bores 111 through the pistons 23, the shoes 24, the swash plate 20, the connecting elements 21 and the guide pins 22.

[0017] A projecting portion 28 is formed integrally with the cylinder block 11 on the top peripheral surface thereof. A muffler forming portion 29 is connected to the top end of the projecting portion 28 through a gasket 30. The projecting portion 28 has formed therein an oil separation chamber 281 which is in communication with the discharge chamber 132 through a discharge passage 31. The muffler forming portion 29 is formed integrally with a cylinder portion 32 for whirling the refrigerant gas, pro-

jecting into the oil separation chamber 281 from the muffler forming portion 29. The muffler forming portion 29 has formed therein a muffler chamber 291 which is in communication with the passage 321 of the cylinder portion 32.

[0018] The suction chamber 131 and the muffler chamber 291 are connected by an external refrigerant circuit 33 having therein a condenser 36 for allowing the refrigerant gas from the compressor 10 to be condensed by transferring its heat to cooler surrounding air, an expansion valve 35 and an evaporator 34 for allowing the refrigerant liquid to vaporize by absorbing ambient heat. The expansion valve 35 is a thermal expansion valve for automatically controlling the flow rate of the refrigerant in accordance with temperature change of the gas at the exit of the evaporator 34.

[0019] The discharge chamber 132 and the pressure control chamber 121 are connected by a supply passage 37. The pressure control chamber 121 and the suction chamber 131 are connected by a bleed passage 38. The refrigerant in the pressure control chamber 121 flows into the suction chamber 131 through the bleed passage 38.

[0020] An electromagnetic displacement control valve 39 is disposed in the supply passage 37. The supply of the refrigerant from the discharge chamber 132 to the pressure control chamber 121 through the supply passage 37 is increased or decreased in accordance with the opening of the displacement control valve 39. Since the refrigerant in the pressure control chamber 121 flows into the suction chamber 131 through the bleed passage 38, the pressure in the pressure control chamber 121 is changed depending on the supply of the refrigerant from the discharge chamber 132 to the pressure control chamber 121 through the supply passage 37. As the supply of the refrigerant increases, the pressure in the pressure control chamber 121 rises, while as the supply of the refrigerant decreases, the pressure in the pressure control chamber 121 falls. Therefore, the inclination of the swash plate 20 is increased or decreased thereby to control the displacement of the compressor 10. The pressure control chamber 121 is in a pressure region other than the discharge-pressure region.

[0021] As shown in FIG. 4, an annular groove 40 is formed in the front face 143 of the valve plate 14 adjacent to the suction valve plate 15 so as to entirely surround the axis 181 of the rotary shaft 18. The annular groove 40 that serves as an annular passage is formed so as to encompass all the cylinder bores 111. As shown in FIG 1B, the annular groove 40 is in communication with the oil separation chamber 281 through a return passage 41 formed in the suction valve plate 15 and the cylinder block 11. The annular groove 40 is covered by part of the suction valve plate 15 other than the suction valves 151.

[0022] As shown in FIG 5, an oil supply groove 42 is radially formed in the front face 143 which is covered by the flexible suction valve 151. The oil supply groove 42 is located adjacent to the proximal side of the suction valve 151 and connected to the annular groove 40. The

oil supply groove 42 is provided for each suction valve 151.

[0023] The refrigerant discharged into the discharge chamber 132 that is a part of the discharge-pressure region is flowed into the external refrigerant circuit 33 through the discharge passage 31, the oil separation chamber 281, the passage 321 of the cylinder portion 32 and the muffler chamber 291 each of which is also a part of the discharge-pressure region of the compressor 10. The refrigerant flowed into the external refrigerant circuit 33 returns to the suction chamber 131 that forms a part of the suction-pressure region.

[0024] The refrigeration circuit formed by the variable displacement compressor 10 and the external refrigerant circuit 33 contains therein lubricating oil which flows with the refrigerant in the circuit. The refrigerant flowed from the discharge passage 31 into the oil separation chamber 281 is transferred toward the bottom of the oil separation chamber 281 while swirling around the outer peripheral surface of the cylinder portion 32, so that the oil in mist form flowing with the refrigerant is separated from the refrigerant. The oil separated from the refrigerant is transferred to the oil supply groove 42 through the return passage 41 and the annular groove 40. The return passage 41, the annular groove 40 and the oil supply groove 42 form an oil supply passage 43 (shown in FIG. 3), which is opened or closed in accordance with the motion of the suction valve 151. The oil supply groove 42 forms the outlet of the oil supply passage 43.

[0025] In operation of the compressor 10 during the compression or discharge stroke of the piston 23 (rightward movement of the piston 23 as seen in FIG. 1A), the suction valve 151 is in tight contact with the front face 143 of the valve plate 14 thereby to close the suction port 141. In this state, the oil supply groove 42 that is a part of the oil supply passage 43 is closed by the suction valve 151, so that oil does not leak from the oil supply groove 42 into the cylinder bore 111. During the suction stroke of the piston 23 (leftward movement of the piston 23 in FIG. 1A), the suction valve 151 is moved away from the front face 143 of the valve plate 14 thereby to open the suction port 141, which enables the oil supply groove 42 to communicate with the cylinder bore 111. Therefore, the oil in the oil supply groove 42 is fed into the cylinder bore 111.

[0026] According to the first embodiment, the following advantageous effects are obtained.

(1) The flexible plate-like suction valve 151 is caused to open and close the suction port 141 and the oil supply passage 43 each time the piston 23 makes a reciprocating motion. During the suction stroke of the piston 23, the oil supply passage 43 is opened and, therefore, the oil in the oil supply groove 42 which is separated from the refrigerant is supplied into the cylinder bore 111. Since the suction valve 151 is brought into tight contact with the front face 143 of the valve plate 14 by the discharge pressure,

oil in the oil supply passage 43 which is then closed by the suction valve 151 does not leak into the cylinder bore 111 through the gap between the suction valve 151 and the valve plate 14. Therefore, the oil reserved in the oil separation chamber 281 will not be drained and the refrigerant in the discharge-pressure region will not leak into the cylinder bore 111 through the oil supply passage 43.

(2) The oil supplied into the cylinder bore 111 lubricates the sliding portion between the inner peripheral surface of the cylinder bore 111 and the outer peripheral surface of the piston 23. Since the oil separated in the oil separation chamber 281 is directly supplied into the cylinder bore 111 through the oil supply passage 43, a relatively large amount of oil will be supplied into the cylinder bore 111. Therefore, the sliding portion between the inner peripheral surface of the cylinder bore 111 and the outer peripheral surface of the piston 23 is sufficiently lubricated thereby to improve abrasion resistance of the inner peripheral surface of the cylinder bore 111 and the outer peripheral surface of the piston 23.

(3) The oil is supplied from the oil supply passage 43 into the cylinder bore 111 only when the suction port 141 is opened by the suction valve 151. Therefore, compared to the case where the oil supply passage between the oil separation chamber 281 and the cylinder bore 111 is constantly opened, the cross sectional area of the oil supply passage 43 is enlarged. This is advantageous in that clogging of the oil supply passage 43 with foreign substance is prevented successfully.

(4) The oil supply groove 42 opened or closed by the suction valve 151 for each cylinder bore 111 is in communication with the oil separation chamber 281 through the annular groove 40. The annular groove 40 enables the oil to be supplied from the oil separation chamber 281 to all the cylinder bores 111.

(5) A large amount of oil should be supplied from the oil supply passage 43 to the cylinder bore 111 in case of a compressor having a large displacement or a piston with a large stroke distance, while a small amount of oil may be supplied in case of a compressor with a smaller displacement or a piston with a shorter stroke distance.

[0027] The large displacement increases the moving distance or the opening of the suction valve 151 from the front face 143 of the valve plate 14, whereas the small displacement decreases the distance or the opening. That is, in the case of the large displacement which needs a large amount of oil supplied into the cylinder bore 111, the amount of oil supplied from the oil supply passage 43 to the cylinder bore 111 is large, while in the case of

the small displacement which needs only a small amount of oil to be supplied into the cylinder bore 111, the amount of oil supplied from the oil supply passage 43 to the cylinder bore 111 is small.

[0028] The above-described structure wherein the oil supply passage 43 is opened and closed by the suction valve 151 enables appropriate oil supply as desired by a specific displacement of the variable displacement compressor 10.

(6) By changing design value of the maximal moving distance of the suction valve 151 when it is moved away from the front face 143 of the valve plate 14, the oil supply from the oil supply passage 43 to the cylinder bore 111 may be set appropriately.

(7) By changing design value of the length or width of the oil supply groove 42, the oil supply from the oil supply passage 43 to the cylinder bore 111 may be set appropriately.

[0029] The following will describe a second embodiment of an oil recovery structure according to the present invention as applied to a variable displacement compressor with reference to FIG. 6. The same reference numerals will be used for the same components or elements of the second embodiment as those of the first embodiment.

[0030] In the second embodiment, a pair of oil supply grooves 42, 42A is formed in the front face 143 of the valve plate 14 on each side of the suction valve 151 adjacent to the proximal side thereof and in facing relation to the suction valve 151. The oil supply grooves 42, 42A are connected to the annular groove 40. By so arranging the paired oil supply grooves 42, 42A, the pressure for supplying the oil from the oil supply grooves 42, 42A to the cylinder bore 111 is substantially the same on both sides of the suction valve 151, so that the suction valve 151 is smoothly opened and closed without being twisted. Therefore, the suction valve 151 is highly in tight contact with the front face 143 of the valve plate 14, with the result that leakage of high-pressure gas in the cylinder bore 111 through the suction port 141 into the suction chamber 131 is prevented (refer to FIG. 1A).

[0031] The following will describe a third embodiment of an oil recovery structure according to the present invention as applied to a fixed displacement compressor with reference to FIGs. 7 through 9B. The same reference numerals will be used for the same components or elements of the third embodiment as those of the first embodiment. As shown in FIG 7, the rear housing 13 has the discharge chamber 132 formed therein. The front housing 12 and the cylinder block 11 rotatably support a rotary shaft 44 through a bearing 45 and a rotary valve portion 46, respectively. A cam 47 of a swash-plate shape is disposed in a cam chamber 48 and fixed to the rotary shaft 44.

[0032] A thrust bearing 49 is interposed between the front housing 12 and the cam 47. A plate 50 and a com-

pression spring 51 are provided between the end of the rotary valve portion 46 and the valve plate 14. The resilient force of the compression spring 51 prevents free axial movement in the direction of an axis 441 of the rotary shaft 44.

[0033] The rotary motion of the cam 47 which is rotatable with the rotary shaft 44 is transmitted to the piston 23 through its shoes 24 which are in slide contact with the cam 47, thereby causing the piston 23 to reciprocate in its cylinder bore 111.

[0034] The rotary shaft 44 has an axial passage 52 formed therein. The rotary shaft 44 also has an inlet 53 formed on the peripheral surface thereof, through which the axial passage 52 is in communication with the cam chamber 48. The refrigerant in the cam chamber 48 is flowed into the axial passage 52 through the inlet 53.

[0035] The rotary valve portion 46 has formed therein a communication hole 461 which is in communication with the axial passage 52. The cylinder block 11 has formed therein a suction port 54 which is in communication with the cylinder bore 111. The communication hole 461 is brought into communication intermittently with the suction port 54 in accordance with the rotation of the rotary shaft 44.

[0036] During the suction stroke of the piston 23 (leftward movement of the piston 23 as seen in FIG. 7), the suction port 54 in communication with the cylinder bore 111 for the piston 23 is in communication with the communication hole 461. During the above suction stroke, the refrigerant in the axial passage 52 of the rotary valve portion 46 is drawn into the cylinder bore 111 through the communication hole 461 and the suction port 54.

[0037] On the other hand, during the compression or discharge stroke of the piston 23 (rightward movement of the piston 23 as seen in FIG. 7), the communication between the suction port 54 and the communication hole 461 is shut off. During the above compression or discharge stroke, the refrigerant in the cylinder bore 111 forces the discharge valve 161 away from the discharge port 142 and is discharged into the discharge chamber 132. The refrigerant discharged into the discharge chamber 132 flows into the external refrigerant circuit 33 through the discharge passage 31, the oil separation chamber 281 and the muffler chamber 291. The refrigerant flowing through the external refrigerant circuit 33 returns to the cam chamber 48 which forms a part of the suction-pressure region of the compressor.

[0038] As shown in FIG. 8, the cylinder block 11 has formed in the rear end face thereof an annular groove 55, a communication groove 56 and a plurality of oil supply grooves 57. The annular groove 55 is formed so as to encompass all the cylinder bores 111. Each oil supply groove 57 is in communication with the return passage 41 through the annular groove 55 and the communication groove 56 and also in communication with the respective cylinder bore 111.

[0039] As shown in FIGs. 9A and 9B, a rod-shaped shutter 58 extends through the valve plate 14 for opening

and closing the communication groove 56. The shutter 58 is attached to the discharge valve 161. The shutter 58 is operable to open and close the communication groove 56 in conjunction with the operation of the discharge valve 161 to open and close the discharge port 142. FIG. 9A shows the closed state of the communication groove 56. In this state, oil is not transferred from the return passage 41 to the annular groove 55. FIG. 9B shows the opened state of the communication groove 56, wherein the oil in the return passage 41 is transferred to the annular groove 55. The return passage 41, the communication groove 56, the annular groove 55 and the oil supply grooves 57 cooperate to form the oil supply passage 59, which is opened and closed in accordance with the operation of the discharge valve 161. The oil supply grooves 57 forms the outlet of the oil supply passage 59.

[0040] The oil recovery structure of this third embodiment is so arranged that a slight clearance is formed between the outer peripheral surface of the shutter 58 and the cylinder block 11 even when the shutter 58 closes the communication groove 56. Since the cross sectional area of the communication groove 56 is relatively small, however, the cross sectional area of the clearance is extremely small. Therefore, leakage of the oil through the oil supply passage 59 hardly occurs when the oil supply passage 59 is closed.

[0041] The oil is supplied from the oil supply passage 59 to the cylinder bore 111 only when the discharge port 142 is opened by the discharge valve 161. Therefore, compared to the case where an oil supply passage between the oil separation chamber 281 and the cylinder bore 111 is constantly opened, the cross sectional area of the oil supply passage 59 of the third embodiment is enlarged. This is advantageous in that clogging of the oil supply passage 59 with foreign substance is prevented successfully.

[0042] According to the third embodiment, the effects similar to the effects as described under (2) and (4) of the first embodiment are obtained.

[0043] The present invention may be practiced in the following modifications of the above embodiments.

[0044] The shape of the oil supply passage formed in the valve plate 14 may be a hole that extends through the valve plate 14, so that the outlet of the oil supply passage (oil supply port) in the valve plate 14 is opened to the cylinder bore 111.

[0045] The first through third embodiments may be modified such that the oil in the oil supply passage is supplied to only one of the plural cylinder bores 111.

[0046] The first embodiment may be modified such that the oil in the oil supply passage is supplied to the pressure control chamber 121 (pressure region other than the discharge-pressure region).

[0047] The first embodiment may be modified such that the oil in the oil supply passage is supplied to the suction chamber 131.

[0048] The third embodiment may be modified such

that the oil in the oil supply passage is supplied to the cam chamber 48.

[0049] The first embodiment may be modified such that the annular groove 40 is formed in the cylinder block 11 or alternatively in a space surrounded by the cylinder block 11 and the valve plate 14.

[0050] The present invention is also applicable to a piston type fixed displacement compressor having a flexible plate-like suction valve.

[0051] The first through third embodiments may be modified such that the oil is separated from the refrigerant in the external refrigerant circuit 33 and the separated oil is supplied into the compressor through the oil supply passage.

[0052] The first through third embodiments may be modified such that the oil is separated from the refrigerant in the pressure region in the pressure control chamber 121 or in the suction-pressure region of the compressor and the separated oil is supplied through the oil supply passage.

[0053] The present invention is also applicable to a piston compressor having a cam member with a shape other than that of a swash plate.

[0054] Therefore, the present examples and embodiments are to be considered as illustrative and not restrictive, and the invention is not to be limited to the details given herein but may be modified within the scope of the appended claims.

[0055] In a structure for oil recovery in a compressor for separating oil from refrigerant and supplying the separated oil into the compressor through an oil supply passage, the compressor includes a rotary shaft, a cylinder block having a plural cylinder bores, a cam member rotated integrally with the rotary shaft, a piston received in each cylinder bore being operable in conjunction with the rotation of the rotary shaft through the cam member, a suction port for allowing the refrigerant to be drawn from a suction-pressure region of the compressor to the corresponding cylinder bore, a discharge port for allowing the refrigerant to be discharged from the corresponding cylinder bore to a discharge-pressure region of the compressor, and a flexible reed valve for opening and closing one of the suction port and the discharge port. The oil supply passage is opened and closed in accordance with motion of the reed valve.

Claims

1. A structure for oil recovery in a compressor for separating oil from refrigerant and supplying the separated oil into the compressor through an oil supply passage, the compressor including a rotary shaft, a cylinder block having a plurality of cylinder bores formed therethrough to be arranged around the rotary shaft, a cam member rotated integrally with the rotary shaft, a piston received in each cylinder bore being operable in conjunction with the rotation of the

rotary shaft through the cam member, a suction port for allowing the refrigerant to be drawn from a suction-pressure region of the compressor to the corresponding cylinder bore, a discharge port for allowing the refrigerant to be discharged from the corresponding cylinder bore to a discharge-pressure region of the compressor, and a flexible reed valve for opening and closing one of the suction port and the discharge port, **characterized in that**

the oil supply passage is opened and closed in accordance with motion of the reed valve.

2. The structure according to claim 1, wherein the cylinder bores are separated from the suction-pressure region and the discharge-pressure region by a partition plate, the reed valve being movable away from or toward and into contact with a face of the partition plate adjacent to the cylinder bores to open or close the corresponding suction port, an outlet of the oil supply passage being covered by the reed valve when the reed valve closes the suction port.
3. The structure according to claim 2, wherein the outlet of the oil supply passage is divided into two parts which are formed on each side of the reed valve adjacent to the proximal side thereof.
4. The structure according to claim 2 or 3, wherein the oil supply passage includes an annular passage which is formed so as to encompass all the cylinder bores, the annular passage being connected to the outlet through an oil supply groove.
5. The structure according to any one of claims 2 through 4, wherein the oil supply passage includes an annular passage which is formed so as to entirely surround an axis of the rotary shaft, the annular passage being connected to the outlet through an oil supply groove.
6. The structure according to claim 5, wherein the oil supply groove is radially formed in the face of the partition plate.
7. The structure according to claim 5 or 6, wherein the annular passage is formed in the partition plate.
8. The structure according to claim 1, wherein the cylinder bores are separated from the suction-pressure region and the discharge-pressure region by a partition plate, the reed valve being movable away from or toward and into contact with a face of the partition plate on the opposite side to the cylinder bores to open or close the corresponding discharge port, a part of the oil supply passage being provided in the partition plate, a shutter being operable to open and close the part of the oil supply passage provided in the partition plate in conjunction with the motion of

the reed valve.

9. The structure according to any one of claims 1 through 8, wherein the oil in the oil supply passage is directly supplied into the plural cylinder bores. 5

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FIG. 1B

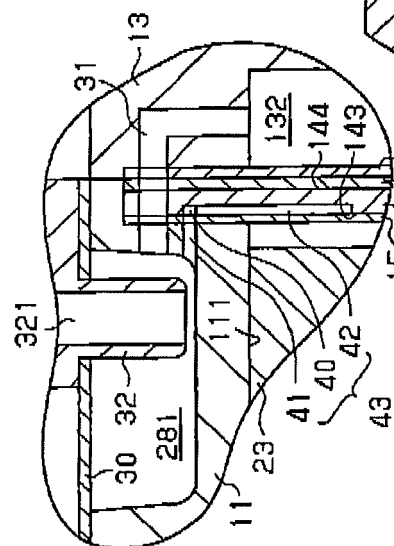


FIG. 1A

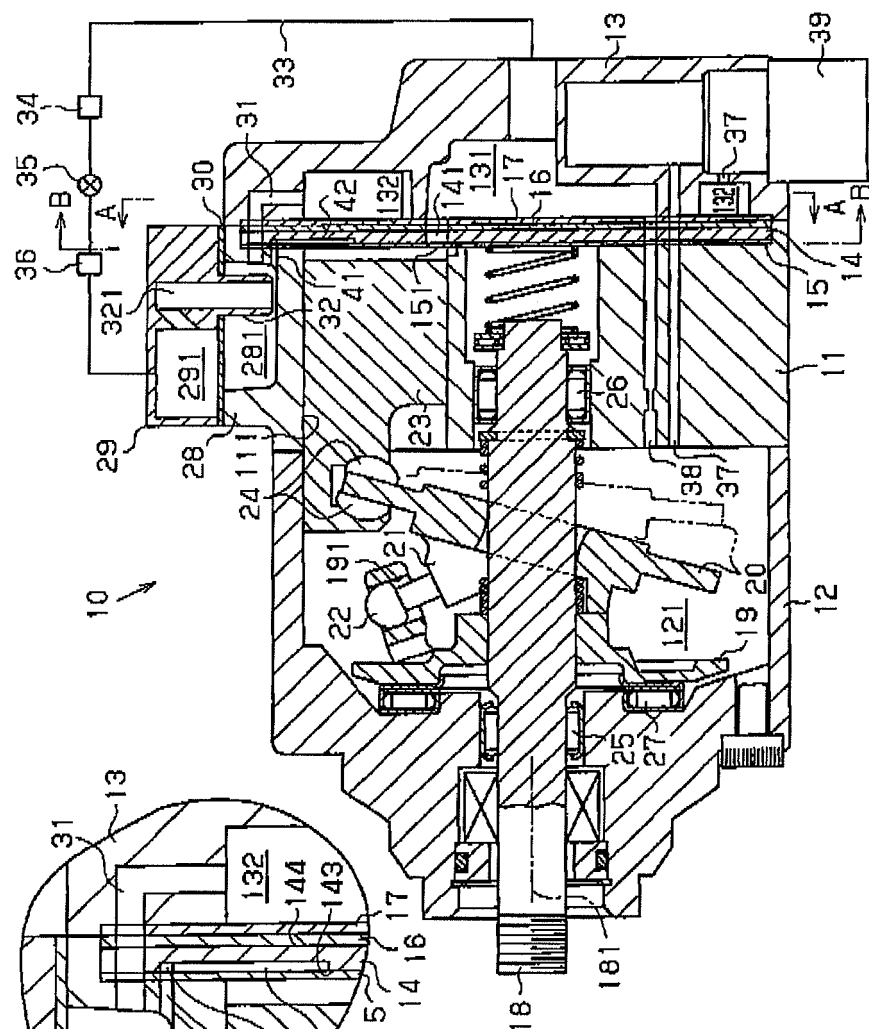


FIG. 3

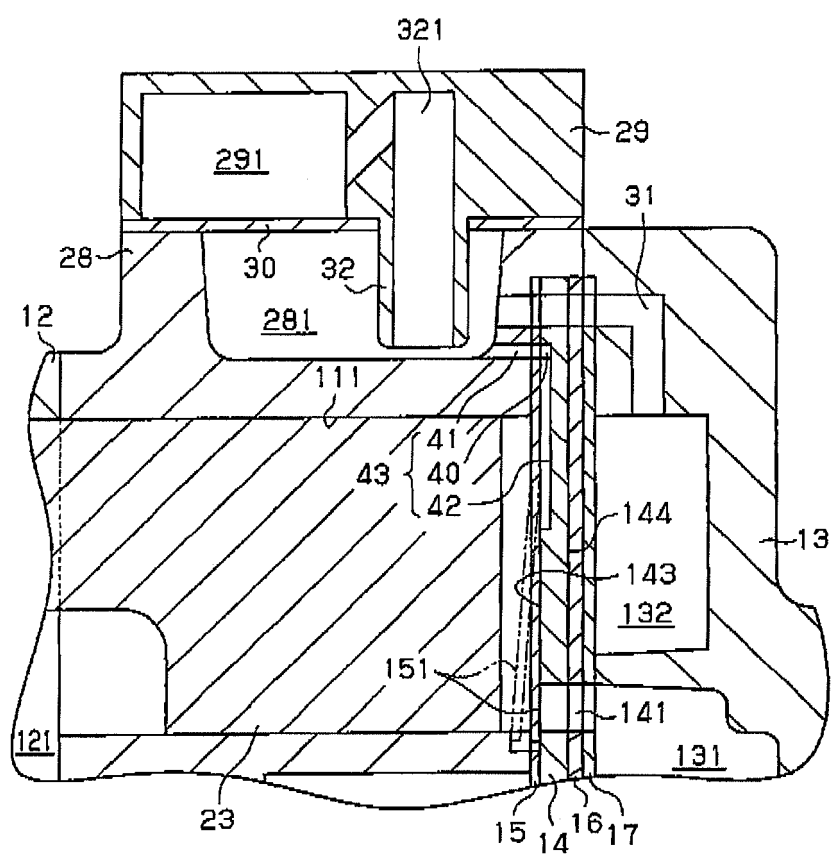


FIG. 4

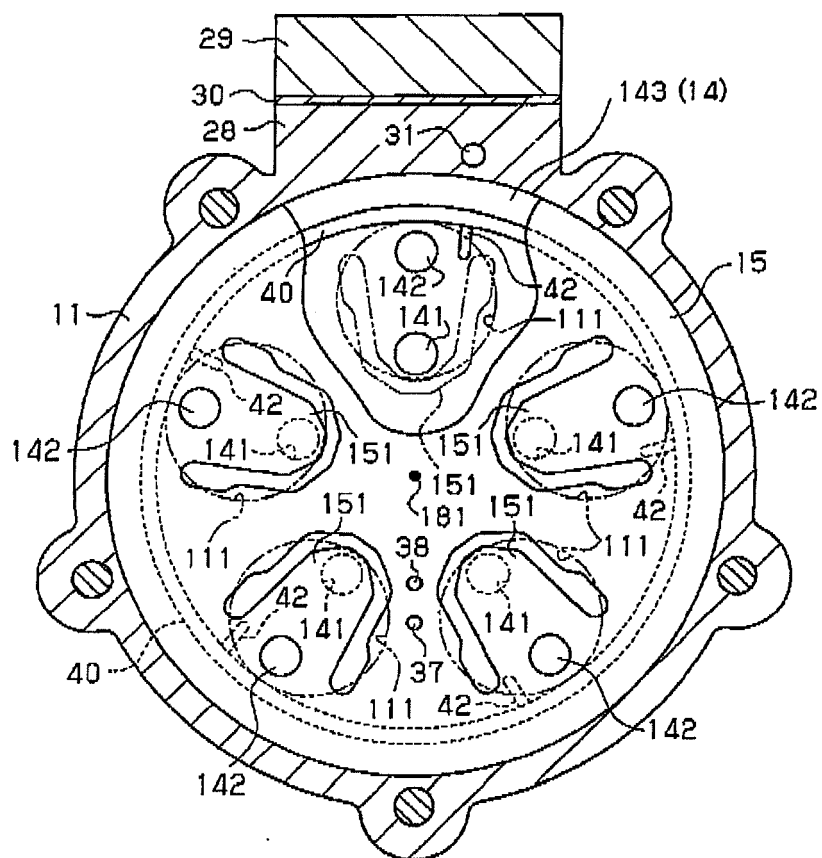


FIG. 5

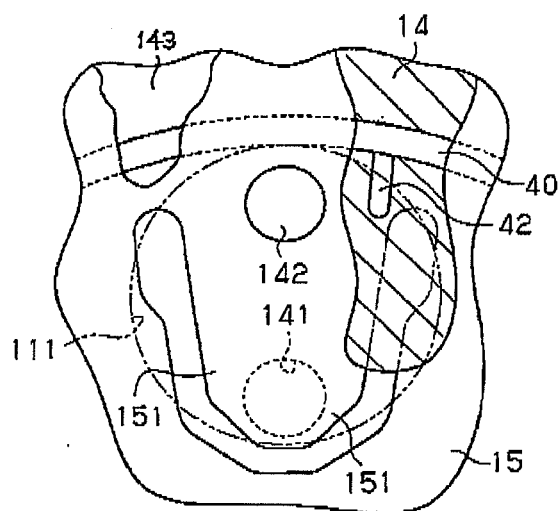


FIG. 6

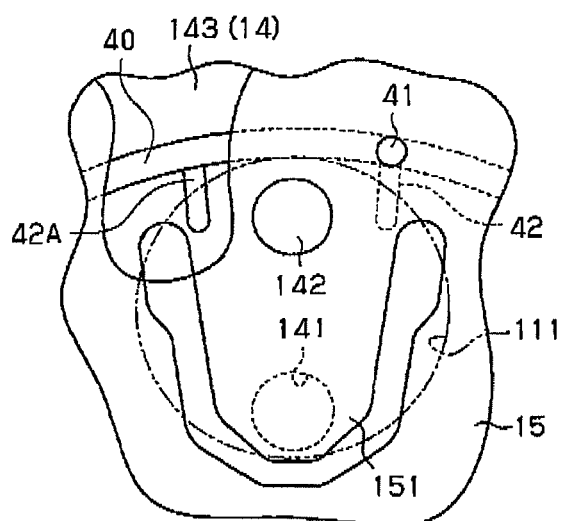


FIG. 7

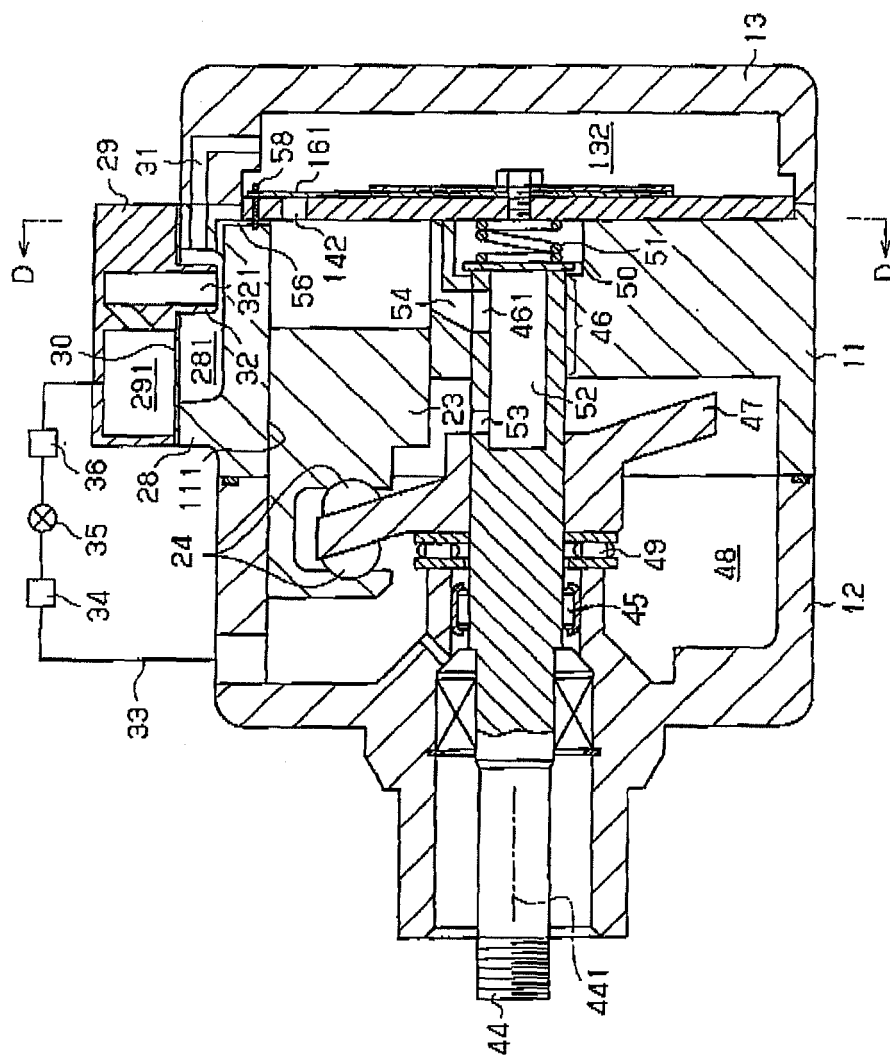


FIG. 8

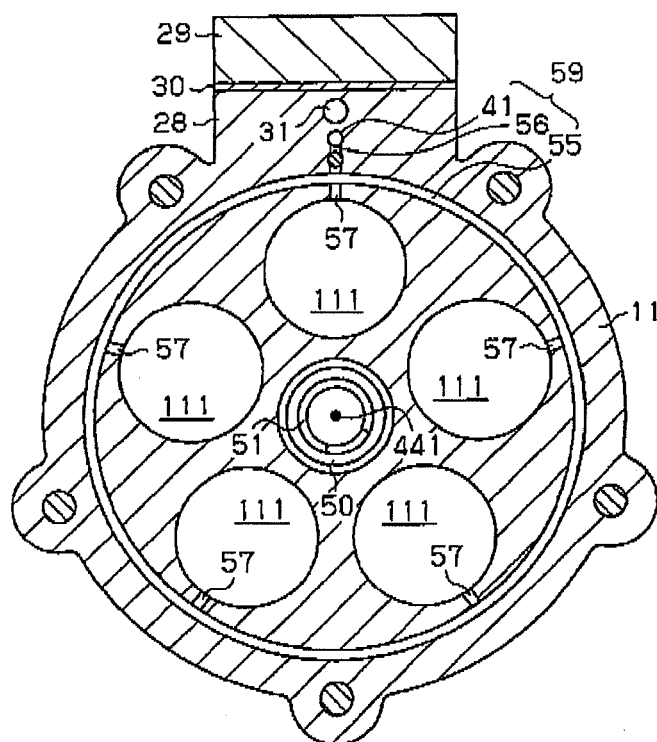
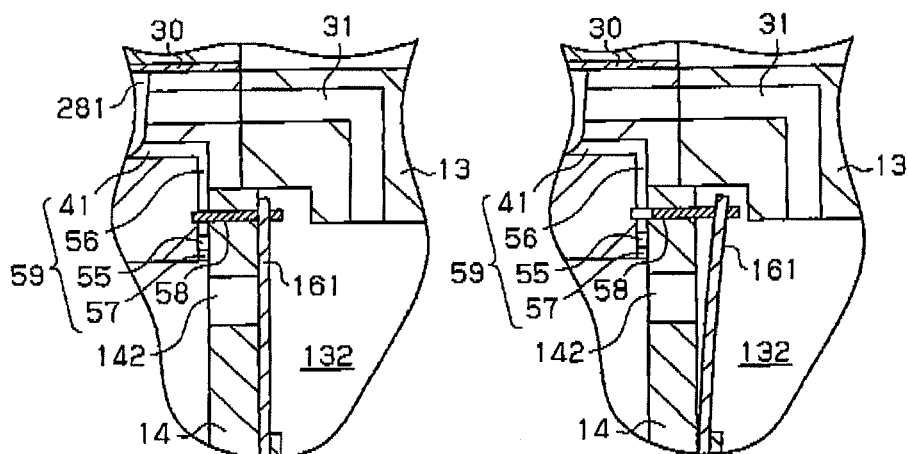


FIG. 9A

FIG. 9B



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Patent documents cited in the description

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