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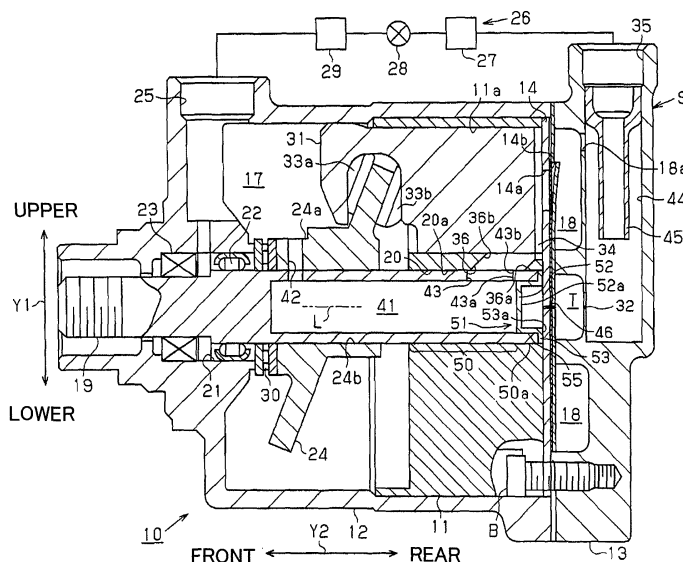
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(54) Swash plate compressor

(57) A piston type compressor comprises a housing, a rotary shaft supported by the housing, a cam mounted on the rotary shaft. The housing includes a discharge-pressure region and a suction-pressure region. The compressor further comprises an oil separator provided in the discharge-pressure region and an oil reservoir for storing lubricating oil from the oil separator. The rotary shaft has a regulating means for regulating the axial

movement of the rotary shaft and for forming a clearance between the regulating means and the valve plate assembly. The clearance is communicated with the oil reservoir through a communication hole formed in the valve plate assembly so that the clearance functions as a throttle in an oil return passage extending from the oil separator to the inside of the compressor. A supply passage is formed in the rotary valve and in communication with the cam chamber in which a suction port is provided.

FIG. 1



Description

BACKGROUND OF THE INVENTION

[0001] The present invention relates to a piston type compressor having an oil separator for separating lubricating oil from discharged refrigerant gas.

[0002] In a piston type compressor for a vehicle air conditioner, lubricating oil in the form of mist is mixed with refrigerant gas for flowing therewith within the compressor thereby to lubricate inner parts of the compressor. In such a compressor, the oil is contained in the discharged refrigerant gas. To prevent oil from being carried by the refrigerant gas to an external refrigerant circuit of the vehicle air conditioner, an oil separator is provided in a discharge-pressure region within the compressor for separating oil from the refrigerant gas. This is because the oil flowing with the refrigerant gas into the external refrigerant circuit tends to adhere to an inner wall surface of a heat exchanger in the external refrigerant circuit thereby to deteriorate the heat exchanging efficiency of the heat exchanger. A typical piston type compressor having an oil separator is disclosed, for example, in Japanese Patent Application Publication No. 2004-218601.

[0003] The piston type compressor has such a structure in which oil separated from refrigerant gas by the oil separator returns into the compressor (specifically, returns into a compression chamber) in order to keep efficient lubrication of inner parts of the compressor. For this purpose, the oil separator and the interior of the compressor are in communication through an oil return passage.

[0004] The oil return passage connects the oil separator with the compression chamber, so that there is a pressure differential between the oil separator and the compression chamber when the oil return passage connects the compression chamber that has just completed the suction stroke (namely, a suction-pressure region) with the oil separator (namely, a discharge-pressure region).

[0005] If the cross-sectional area of the oil return passage is excessively large, not only the oil but high-pressure refrigerant gas discharged into the oil separator would flow back into the compression chamber and a large amount of refrigerant gas will leak from the oil separator to the compression chamber. For this reason, the oil return passage should be formed with an extremely small cross-sectional area or the oil return passage should have a throttle portion therein to provide a throttle function in the oil return passage, thereby preventing the refrigerant gas from flowing back.

[0006] In the structure having a throttle with an extremely small cross-sectional area, however, foreign matters tend to clog the oil return passage and/or the throttle portion. If the foreign matters clog the oil return passage and/or the throttle portion, the quantity of lubricating oil that returns into the compressor through the oil return passage will be decreased, with the result that

efficient lubrication of the compressor cannot be performed.

[0007] The present invention is directed to a piston type compressor that prevents the leakage of refrigerant gas from a discharge-pressure region to a suction-pressure region of the compressor and effectively returns lubricating oil to the suction-pressure region of the compressor.

SUMMARY OF THE INVENTION

[0008] In accordance with the present invention, a piston type compressor comprises a housing, a rotary shaft supported by the housing, a cam mounted on the rotary shaft. The housing is formed with a cylinder bore in which a piston is accommodated and a cam chamber in which the cam is accommodated. The housing is further provided with a discharge-pressure region and a suction-pressure region therein. The compressor further comprises an oil separator provided in the discharge-pressure region and an oil reservoir for storing lubricating oil from the oil separator. The rotary shaft is provided with a regulating means for regulating the axial movement of the rotary shaft and for forming a clearance between the regulating means and the valve plate assembly. The clearance is communicated with the oil reservoir through a communication hole formed in the valve plate assembly so that the clearance functions as a throttle in an oil return passage extending from the oil separator to the inside of the compressor. The rotary shaft may be provided with a rotary valve. A supply passage as a suction passage is formed in the rotary valve and in communication with the cam chamber in which a suction port is provided to be connected to an evaporator in an external refrigerant circuit.

[0009] 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

[0010] 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. 1 is the longitudinal cross-sectional view of a piston type compressor according to an embodiment; and

FIG. 2 is the partially enlarged cross-sectional view of a rotary valve around a closure cap.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

[0011] The following will describe a preferred embodiment of a piston type compressor according to the present invention with reference to FIGs. 1 and 2. Note that the double-headed arrow Y1 indicates the upper and lower sides of a piston type compressor 10 and the double-headed arrow Y2 indicates the front and rear sides of the compressor 10 in FIG. 1.

[0012] Now referring to FIG. 1, the piston type compressor 10 includes a front housing 12 and a rear housing 13 connected to the rear end of the front housing 12. A cylinder block 11 is fixedly connected inside the front housing 12. A valve plate assembly 14 is interposed between the cylinder block 11 and the rear housing 13. The cylinder block 11, the rear housing 13 and the valve plate assembly 14 are fastened together by a plurality of bolts B (only one bolt B shown in FIG. 1). The front housing 12 and the rear housing 13 cooperate to form the housing assembly of the compressor 10.

[0013] The housing assembly has a discharge chamber 18 formed between the rear housing 13 and the valve plate assembly 14 on the radially outer side in the rear housing 13. The rear housing 13 is provided with an oil separator S for separating lubricating oil contained in refrigerant gas. The oil separator S is in fluid communication with the discharge chamber 18 through a communication port 18a. Hence, the oil separator S is located in a discharge-pressure region of the compressor 10.

[0014] The oil separator S includes an oil separation chamber 44 and an oil separation cylinder 45 accommodated in the oil separation chamber 44. The oil separation chamber 44 is in communication with the discharge chamber 18 through the communication port 18a. The communication port 18a is opened to the oil separation chamber 44 at a position which faces the outer peripheral surface of the oil separation cylinder 45.

[0015] The oil separator S has a discharge hole 35 formed therein for allowing refrigerant gas from which lubricating oil has been separated to be discharged out from the compressor 10. The discharge chamber 18 is in communication with an external refrigerant circuit 26 through the discharge hole 35. The external refrigerant circuit 26 includes a condenser 27 for removing heat from refrigerant gas, an expansion valve 28 and an evaporator 29 for transferring ambient heat in vehicle compartment to refrigerant gas. The discharge hole 35 is in communication with the condenser 27.

[0016] An oil reservoir T is formed at the center of the rear housing 13 between the rear housing 13 and the valve plate assembly 14. The oil reservoir T and the oil separation chamber 44 of the oil separator S are in communication through an oil passage 32, through which lubricating oil separated from refrigerant gas in the oil separator S is carried into the oil reservoir T for storage therein.

[0017] The oil reservoir T is in communication with a

shaft hole 20, or the like, at the center of the cylinder block 11 through a communication hole 46 formed in the valve plate assembly 14, so that the lubricating oil stored in the oil reservoir T flows back toward the cylinder block 11 through the communication hole 46. Additionally, the valve plate assembly 14 has discharge ports 14a and discharge valves 14b formed therein in association with the discharge chamber 18. The discharge valves 14b are operable to open and close the respective discharge ports 14a. In this embodiment, the discharge chamber 18, the oil separation chamber 44, the discharge hole 35, the oil reservoir T and the compression chamber 34 in discharge stroke form the discharge-pressure region of the compressor 10.

[0018] A crank chamber 17, which serves as a cam chamber, is defined between the front housing 12 and the cylinder block 11. A rotary shaft 19 is rotatably supported in the crank chamber 17 by the cylinder block 11 and the front housing 12. The rotary shaft 19 is inserted at one end thereof into the shaft hole 20 formed in the cylinder block 11 and at the other end thereof into a shaft hole 21 formed in the front housing 12. The shaft hole 20 is located in alignment with the oil reservoir T through the valve plate assembly 14, and the communication hole 46 adjacent to the cylinder block 11 is opened to the shaft hole 20.

[0019] The rotary shaft 19 is supported at its front side by the front housing 12 through a radial bearing 22 placed in the shaft hole 21. The rotary shaft 19 is directly supported at its rear side by the cylinder block 11 through a peripheral sealing surface 20a formed on the inner peripheral surface of the shaft hole 20. Thus, the communication hole 46 adjacent to the cylinder block 11 is opened to the rear end of the rotary shaft 19. The radial bearing 22 and the peripheral sealing surface 20a of the shaft hole 20 receive radial loads on the front and rear sides of the rotary shaft 19, respectively. A shaft seal 23 of a lip seal type is interposed between the front housing 12 and the rotary shaft 19.

[0020] A swash plate 24 which serves as a cam is secured on the rotary shaft 19 within the crank chamber 17. The swash plate 24 has at its boss portion 24a an inserting hole 24b which is formed along the axis of the swash plate 24 (that is, along the axis L of the rotary shaft 19), and the rotary shaft 19 is press-fitted in the inserting hole 24b.

[0021] The crank chamber 17 is in communication with the evaporator 29 in the external refrigerant circuit 26 through a suction hole 25 formed in the front housing 12. Refrigerant gas, which is discharged into the discharge chamber 18 and the lubricating oil separated therefrom at the oil separator S, flows into the condenser 27 in the external refrigerant circuit 26 through a discharge hole 35 adjacent to the oil separator S. After passing through the expansion valve 28 and the evaporator 29, refrigerant gas flows into the crank chamber 17 through the suction hole 25. The shaft seal 23 prevents the leakage of refrigerant gas through a clearance between the peripheral

surface of the rotary shaft 19 and the front housing 12. A thrust bearing 30 is interposed between the front housing 12 and the boss portion 24a of the swash plate 24 for receiving an axial load (or thrust load) of the rotary shaft 19.

[0022] A plurality of cylinder bores 11a (five cylinder bores in this embodiment but only one being shown in FIG. 1) are formed in the cylinder block 11 around the rotary shaft 19. Each of the cylinder bores 11a is closed by the valve plate assembly 14 and accommodates therein a reciprocally slidable single-headed piston 31. Each piston 31 slidably engages with the periphery of the swash plate 24 through a pair of shoes 33a, 33b.

[0023] The rotation of the swash plate 24 with the rotary shaft 19 is converted into the reciprocal movement of the pistons 31 in the cylinder bore 11 a through the shoes 33a, 33b. In other words, the pistons 31 are operatively associated with the rotation of the rotary shaft 19 through the swash plate 24 secured to the rotary shaft 19. The pistons 31 and the valve plate assembly 14 define compression chambers 34 in the respective cylinder bores 11 a.

[0024] The shaft hole 20 of the cylinder block 11 surrounded by the cylinder bores 11a serves also as a valve chamber. The shaft hole 20 and the compression chambers 34 (cylinder bores 11a) are in communication with each other through respective suction ports 36 formed in the cylinder block 11. Each suction port 36 has an inlet 36a opened at the peripheral sealing surface 20a of the shaft hole 20 and an outlet 36b opened at the inner peripheral surface of the cylinder bore 11 a.

[0025] As mentioned earlier, the rotary shaft 19 is rotatably received at the rear end thereof (or the side thereof adjacent to the valve plate assembly 14) in the shaft hole 20. The rotary shaft 19 has a supply passage 41 extending axially from the thrust bearing 30 to the rear end of the rotary shaft 19. An introducing hole 42 extends through the boss portion 24a of the swash plate 24 and the rotary shaft 19 for fluid communication between the supply passage 41 and the crank chamber 17. That is, the introducing hole 42 permits refrigerant gas in the crank chamber 17 to flow into the supply passage 41.

[0026] An introducing port 43 is formed in the rotary shaft 19 adjacent to the valve plate assembly 14 for communication with the supply passage 41. The introducing port 43 has an inlet 43a which is opened at the inner peripheral surface of the rotary shaft 19 and an outlet 43b which is opened at the outer peripheral surface of the rotary shaft 19. As the rotary shaft 19 is rotated in operation of the compressor 10, the outlet 43b of the introducing port 43 communicates intermittently with the inlet 36a of the suction port 36. The supply passage 41, the introducing hole 42 and the introducing port 43 in the rotary shaft 19 are provided to introduce refrigerant gas from the crank chamber 17 into the compression chamber 34. The rear portion of the rotary shaft 19 which is surrounded by the peripheral sealing surface 20a of the shaft hole 20 functions as a rotary valve 50 formed inte-

grally with the rotary shaft 19 adjacent to the valve plate assembly 14. In this embodiment, the crank chamber 17, the shaft hole 20, the supply passage 41 and the compression chamber 34 in suction stroke form a suction-pressure region of the compressor 10.

[0027] In the above compressor 10, during the suction stroke of the piston 31 (or the stroke when the piston 31 moves frontward), the inlet 36a of the suction port 36, which communicates with the cylinder bore 11a, communicates with the outlet 43b of the introducing port 43. Therefore, refrigerant gas in the supply passage 41 of the rotary shaft 19 is drawn into the compression chamber 34 in the cylinder bore 11 a through the introducing port 43 and the suction port 36.

[0028] On the other hand, during the discharge stroke of the piston 31 (or the stroke when the piston 31 moves rearward), communication between the inlet 36a of the suction port 36 that communicates with the cylinder bore 11a and the outlet 43b of the introducing port 43 is shut off. Thus, refrigerant gas in the compression chamber 34 is discharged into the discharge chamber 18 through the discharge port 14a while pushing and opening the discharge valve 14b. Refrigerant gas thus discharged into the discharge chamber 18 flows into the oil separator S and then further flows to the external refrigerant circuit 26 through the discharge hole 35 of the separator S. Refrigerant that flows out to the external refrigerant circuit 26 returns to the crank chamber 17 of the compressor 10 afterward.

[0029] Referring to FIG. 2, the rotary valve 50 has an opening at its rear end. A closure cap 51, which serves as a closure means, is fitted to the rear end of the rotary valve 50 at a position that is closer to the valve plate assembly 14 than the introducing port 43. This closure cap 51 includes a cylindrical and hollow cap portion 52 and a flange portion 53. The flange portion 53 extends radially from the rear end periphery of the cap portion 52. The flange portion 53 extends all around the cap portion 52. The closure cap 51 is fitted in the rotary valve 50 by the portion 52 press-fitted into the supply passage 41. The closure cap 51 is rotatable with the rotary valve 50. With the cap portion 52 fitted in the supply passage 41, the flange portion 53 covers the entire end face of the rotary valve 50 (or the rotary shaft 19).

[0030] The length of the cap portion 52 in the axial direction of the closure cap 51 is slightly shorter than the distance from the rear end of the rotary valve 50 to the introducing port 43. In other words, the introducing port 43 is not closed by the cap portion 52. In addition, the diameter of the cap portion 52 is slightly greater than the inner diameter of the rotary valve 50 (that is, the inner diameter of the rotary shaft 19 or the diameter of the supply passage 41).

[0031] Therefore, with the closure cap 51 fitted in the rotary valve 50, the cap portion 52 closes the supply passage 41 and is pressed against the peripheral surface of the supply passage 41 (or the inner peripheral surface of the rotary shaft 19) thereby to form a sealing surface

55. In other words, the cap portion 52 seals to prevent the leakage of refrigerant gas through the rear end of the rotary valve 50 from the supply passage 41.

[0032] A clearance CL is formed between the valve plate assembly 14 and the end face 53a of the flange portion 53 adjacent to the valve plate assembly, as shown in FIG. 2. This clearance CL is provided to prevent sliding contact between the closure cap 51 and the valve plate assembly 14 during operation of the piston type compressor 10.

[0033] The closure cap 51 also functions as a regulating means for regulating the axial sliding movement of the rotary shaft 19 to a specified amount. The rotary shaft 19 is movable slightly in its axial direction though this axial sliding movement of the rotary shaft 19 in forward direction is so regulated that the boss portion 24a of the swash plate 24 contacts with the thrust bearing 30. When the compressor 10 is stopped (e.g. when a clutch for transmitting power from a drive source to the rotary shaft 19 is just disengaged), the compression reaction force that acts on the pistons 31 from the compression chambers 34 is decreased rapidly, so that the rotary shaft 19 tends to slide axially rearward. However, such axial sliding movement of the rotary shaft 19 in a rearward direction is regulated by the end face 53a of the flange portion 53 of the closure cap 51 to be brought into contact with the valve plate assembly 14.

[0034] Depending on the depth of press-fitting of the portion 52 of the closure cap 51 into the supply passage 41 or the thickness of the flange portion 53, the clearance CL between the end face 53a and the valve plate assembly 14 may be adjusted. By the clearance CL so adjusted, the axial sliding movement of the rotary shaft 19 may be regulated to any desired amount. Note that the clearance CL should preferably be as small as possible to prevent the leakage of refrigerant gas. In this embodiment, the clearance CL is formed with a cross-sectional area smaller than the communication hole 46.

[0035] The communication hole 46 is formed in the valve plate assembly 14 for providing communication between the oil reservoir T and the clearance CL. That is, the communication hole 46 is opened at one end thereof to the oil reservoir T and at the other end to the clearance CL. The clearance CL is in communication with the communication hole 46 and has a smaller cross-sectional area than the communication hole 46, so that it functions as a throttle to prevent the refrigerant gas from flowing back from the oil separator S through the oil passage 32, the oil reservoir T and the communication hole 46. The end face 53a of the flange portion 53 and the inner surface 52a of the cap portion 52 (or the end face thereof adjacent to the valve plate assembly 14) cooperate to form a surface receiving back pressure from the oil reservoir T.

[0036] In operation of the above-described piston type compressor 10, refrigerant gas discharged from the compression chamber 34 into the discharge chamber 18 then flows into the oil separator S through the communication port 18a. Refrigerant gas introduced into the oil separa-

tion chamber 44 in the oil separator S is whirled in the space between the inner peripheral surface of the oil separation chamber 44 and the outer peripheral surface of the oil separations cylinder 45, and the lubricating oil contained in the refrigerant gas is separated therefrom under the influence of centrifugal force. Refrigerant gas the lubricating oil is separated therefrom flows into the oil separation cylinder 45 through the bottom opening thereof and then flows out to the external refrigerant circuit 26 (specifically, to the condenser 27) through the discharge hole 35 formed at the top of the oil separation cylinder 45.

[0037] On the other hand, lubricating oil separated from refrigerant gas in the oil separation chamber 44 is conveyed to the oil reservoir T through the oil passage 32. Furthermore, lubricating oil stored in the oil reservoir T is supplied to the shaft hole 20 through the communication hole 46. In other words, lubricating oil separated from refrigerant gas returns to the shaft hole 20 from the oil separator S.

[0038] The oil separator S and the shaft hole 20 are in communication through the oil passage 32, the oil reservoir T and the communication hole 46. The communication hole 46 communicates with the clearance CL, which functions as a throttle for the oil return passage extending from the oil separator S to the inner side of the compressor 10. Therefore, high-pressure refrigerant gas in the oil separator S is prevented from leaking in large amount into the low-pressure shaft hole 20 which forms a part of a suction-pressure region of the compressor 10.

[0039] The closure cap 51 which rotates integrally with the rotary valve 50 prevents the clearance CL from being clogged with foreign matters, thereby maintaining the clearance CL for constant communication between the hole 46 and the shaft hole 20. Accordingly, there will not occur a trouble that the clearance CL clogs thereby to block the flow of lubricating oil returning from the oil separator S to the shaft hole 20. Thus, lubricating oil returned to the shaft hole 20 through the clearance CL is supplied between the outer peripheral surface 50a of the rotary valve 50 and the peripheral sealing surface 20a and further supplied into the crank chamber 17 along the rotary shaft 19. As a result, lubricating oil circulates in the compressor 10, thus ensuring lubrication of its parts.

[0040] In addition, when lubricating oil returns from the oil reservoir T to the shaft hole 20 through the communication hole 46, high pressure is applied to the end face 53a of the flange portion 53 and the inner surface 52a of the cap portion 52 in the frontward axial direction. As the closure cap 51 is subjected to such back pressure at the end face 53a and the inner surface 52a, the rotary shaft 19 to which the closure cap 51 is fitted is urged axially forward by the back pressure, that is, toward the crank chamber 17.

[0041] Subsequently, the swash plate 24 secured to the rotary shaft 19 is also urged forward in the axial direction of the rotary shaft 19, and its front surface of the boss portion 24a is entirely pressed against the thrust bearing 30. Urging the swash plate 24 against the thrust

bearing 30 prevents the swash plate 24 from being inclined by compression reaction force via the pistons 31, otherwise the front face of the swash plate boss portion 24a would be inclined by the reaction force with respect to the thrust bearing 30, perpendicular to the axis of the rotary shaft 19. This ensures the entire circumferential contact between the front surface of the swash plate boss portion 24a and the thrust bearing 30, and prevents their partial contact.

[0042] According to the preferred embodiment, the following advantageous effects are obtained.

(1) The clearance CL which is formed between the valve plate assembly 14 and the end of the closure cap 51 adjacent to the valve plate assembly 14 is in communication with the oil reservoir T through the communication hole 46. The clearance CL functions as a throttle for the oil return passage which extends from the oil separator S, the discharge-pressure region, to the shaft hole 46, the suction-pressure region. Thus, the clearance CL restricts refrigerant gas in the oil separator S to flow back to the shaft hole 20, thereby preventing a large amount of refrigerant gas from leaking from the discharge-pressure region to the suction-pressure region.

In addition, the closure cap 51 rotates integrally with the rotary valve 50 (or the rotary shaft 19), so that the closure cap 51 which forms the clearance CL rotates relatively to the valve plate assembly 14. As a result, the clearance CL will not be clogged with any foreign matters may be contained in lubricating oil and/or refrigerant gas. This keeps the clearance CL free from blockage and ensures lubricating oil to return smoothly from the oil reservoir T through the communication hole 46, thus appropriate lubrication within the compressor 10 is obtained.

(2) The clearance CL is formed between the closure cap 51 and the valve plate assembly 14 for allowing the slight axial movement of the rotary shaft 19. This clearance CL is utilized as a throttle for the oil return passage from the oil separator S. Thus, the preferred embodiment provides a structure made in a similar way for preventing the leakage of refrigerant gas from the discharge-pressure region to the suction-pressure region, compared to, for example, the cross-sectional area of the communication hole 46 made small for the same purpose.

(3) The oil reservoir T and the shaft hole 20 are made in communication with each other through the communication hole 46 so that lubricating oil in the oil reservoir T returns to the shaft hole 20 (suction-pressure region) through the communication hole 46. Thus, back pressure in the oil reservoir T may be applied to the inner surface 52a of the cap portion 52 and the end face 53a of the flange portion 53. With the closure cap 51 subjected to the back pres-

sure, the rear end of the rotary shaft 19 is urged toward the crank chamber 17. As a result, the swash plate 24 is pressed at the entire side surface of the boss portion 24a thereof against the thrust bearing 30. Accordingly, the swash plate 24 is prevented from being inclined with respect to the thrust bearing 30 by compression reaction force acting on the pistons 31. This prevents the front face of the swash plate boss portion 24a from partially pressing and contacting to the thrust bearing 30. Hence, rattling of the rotary shaft 19 causing the above partial press and contact between the swash plate 24 and the thrust bearing 30 is reduced, thereby preventing generation of noise and vibration.

(4) The clearance CL is supplied and filled with lubricating oil from the oil reservoir T. Thus, leakage of refrigerant gas through the clearance CL is prevented.

(5) Means for closing the supply passage 41 of the rotary valve 50 is provided as the closure cap 51 which is press-fitted in the supply passage 41. The closure cap 51 is simply fitted to the rotary valve 50 merely by press-fitting it into the supply passage 41. This simplifies the process of assembling the compressor 10.

(6) The closure cap 51 includes the cap portion 52 and the flange portion 53. When the portion 52 of the closure cap 51 is press-fitted in the supply passage 41, the flange portion 53 may contact with the axial rear end of the rotary valve 50 in order to limit its further press-fitting into the supply passage 41 for the clearance CL not so enlarged.

(7) The closure cap 51 to receive the back pressure but also to serve as a regulating member for regulating the axial displacement of the rotary shaft 19. This simplifies the structure of the compressor 10 in comparison to a structure in which components for respective functions are provided individually.

[0043] The present invention is not limited to the above-described embodiment but it may be modified into various alternative embodiments as exemplified below.

[0044] In an alternative embodiment, the cap portion 52 is not limited to a hollow structure, but it may be of solid provided that the cap portion 52 press-fitted in a position closes the supply passage 41.

[0045] In an alternative embodiment, if the cap portion 52 press-fitted in a position is prevented from moving further into the supply passage 41, the closure cap 51 may be formed only by the cap portion 52 without the flange portion 53.

[0046] In an alternative embodiment, the present invention is also applicable to a piston type compressor equipped with a cam having a shape other than that of

the swash plate 24.

[0047] In an alternative embodiment, the oil separator S is not limited to a centrifugal separator, but it may be, for example, an inertial separator for separating lubricating oil from refrigerant gas by allowing the refrigerant gas to collide against a wall surface.

[0048] In an alternative embodiment, a filter may be provided in the oil reservoir T.

[0049] In an alternative embodiment, a cylindrical valve body having a bottom at one end may be fitted in the inserting hole 24b of the swash plate 24 for forming the rotary valve 50. In this case, the bottom of the valve body closes the supply passage 41, and the clearance CL is formed between the bottom and the valve plate assembly 14. In other words, the bottom of the valve body may serve as a closure means, a pressure receiving surface and a regulating means.

[0050] 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.

[0051] A piston type compressor comprises a housing, a rotary shaft supported by the housing, a cam mounted on the rotary shaft. The housing includes a discharge-pressure region and a suction-pressure region. The compressor further comprises an oil separator provided in the discharge-pressure region and an oil reservoir for storing lubricating oil from the oil separator. The rotary shaft has a regulating means for regulating the axial movement of the rotary shaft and for forming a clearance between the regulating means and the valve plate assembly. The clearance is communicated with the oil reservoir through a communication hole formed in the valve plate assembly so that the clearance functions as a throttle in an oil return passage extending from the oil separator to the inside of the compressor. A supply passage is formed in the rotary valve and in communication with the cam chamber in which a suction port is provided.

Claims

1. A piston type compressor comprising:

a housing having a plurality of cylinder bores and a cam chamber, the housing being provided with a discharge-pressure region and a suction-pressure region therein;

a rotary shaft rotatably supported by the housing, the cylinder bores being arranged around the rotary shaft;

a cam accommodated in the cam chamber and rotatable integrally with the rotary shaft;

a valve plate assembly provided between the cylinder bores and the discharge-pressure region, the valve plate assembly having a communication hole thereon;

a piston accommodated in each of the cylinder bores and operatively connected to the rotary shaft, the piston and the valve plate assembly defining compression chamber in the respective cylinder bore;

an oil separator provided in the discharge-pressure region for separating lubricating oil contained in refrigerant discharged from the compression chambers;

an oil reservoir formed in the discharge-pressure region to store the lubricating oil separated by the oil separator, the oil reservoir being connected to the communication hole; and

a regulating means provided on the rotary shaft at an end position close to the valve plate assembly, the regulating means and the valve plate assembly forming a clearance in-between, wherein the regulating means is aligned with the communication hole so that the clearance is connected to the oil reservoir through the communication hole.

2. The piston type compressor according to claim 1 further comprising:

a rotary valve formed integrally with the rotary shaft and located adjacent to the valve plate assembly, the rotary valve having a supply passage and an introducing port, the supply passage extending axially inside the rotary valve and being in communication with the introducing port, the introducing port being capable of communicating with the cylinder bore in which the piston is in suction stroke, the supply passage being open at the end surface of the rotary valve, wherein the regulating means includes a closure cap closing the open end of the supply passage on the rotary valve.

3. The piston type compressor according to claim 2, wherein the cam chamber is provided with a suction port connected to an evaporator in an external refrigerant circuit, the cam chamber being connected to the supply passage of the rotary valve.

4. The piston type compressor according to any one of claims 2 and 3, wherein the closure cap is press-fitted in the supply passage.

5. The piston type compressor according to claim 4, wherein the closure cap includes:

a cap portion press-fitted in the supply passage; and

a flange portion which extends radially from a circumferential end of the cap portion, wherein the clearance is formed between the flange portion and the valve plate assembly.

6. The piston type compressor according to claim 4, wherein the closure cap includes a cylindrical and hollow cap portion press-fitted in the supply passage.
7. The piston type compressor according to any one of claims 1 through 6, further comprising: 5
- a thrust bearing provided for receiving axial load of the rotary shaft, wherein the regulating means has a surface for receiving pressure from the oil reservoir to urge the rotary shaft and the cam to the thrust bearing. 10
8. The piston type compressor according to any one of claims 1 through 7, wherein the oil separator is a centrifugal separator. 15
9. The piston type compressor according to any one of claims 1 through 8, wherein the compressor is of a fixed displacement type. 20
10. The piston type compressor according to any one of claims 1 through 9, wherein the clearance is a throttle for a passage between the discharge-pressure region and the suction-pressure region. 25

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FIG. 1

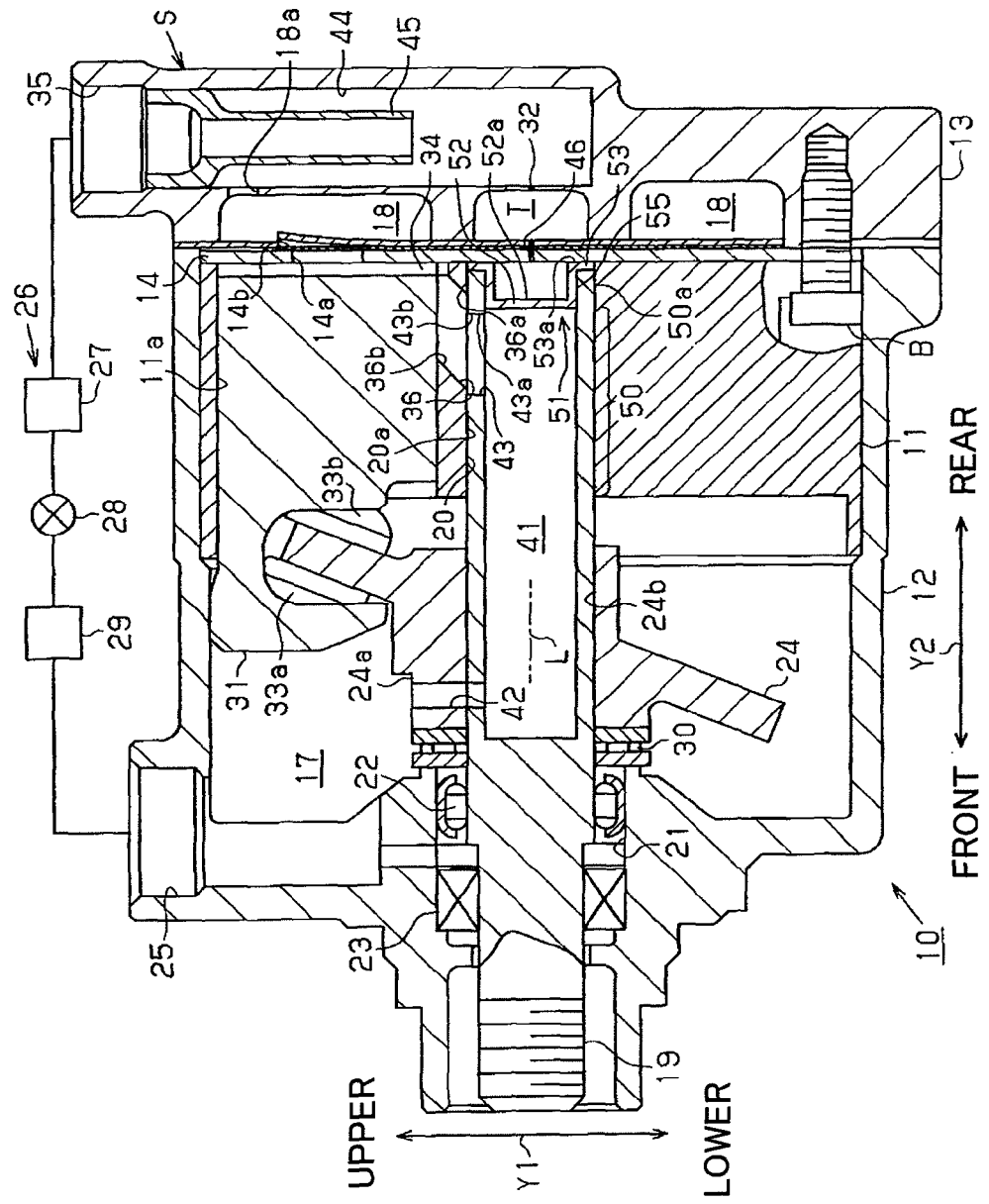
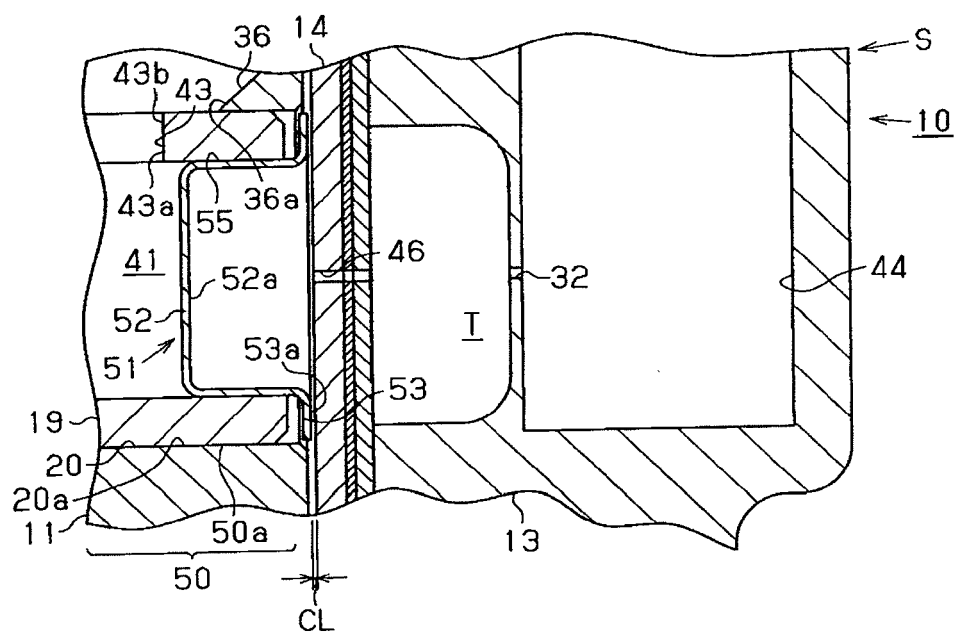


FIG. 2



REFERENCES CITED IN THE DESCRIPTION

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