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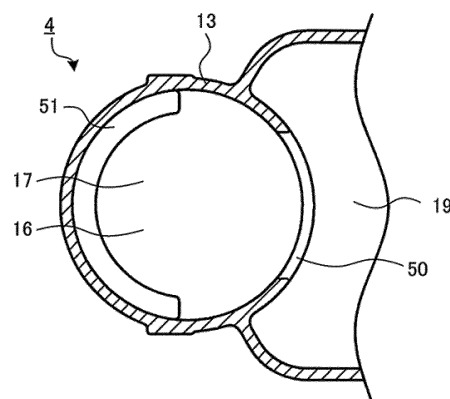
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(54) **SCREW COMPRESSOR**

(57) Provided is a screw compressor that prevents refrigerating machine oil in an oil reservoir from re-scattering because of a swirling flow, enabling high oil separation efficiency. The screw compressor includes an oil separation unit including an outer cylinder and a tubular inner cylinder, the outer cylinder allowing gas and oil discharged from a compressor body to enter the outer cylinder, the inner cylinder being provided inside the outer cylinder coaxially with the outer cylinder; the oil reservoir provided below the oil separation unit; and a partition plate provided on an inner wall of the outer cylinder, the partition plate partitioning the oil separation unit from the oil reservoir. The outer cylinder has a first oil return hole at a position in which the partition plate is provided, the first oil return hole passing through a side face of the outer cylinder that faces the compressor body to communicate with the oil reservoir, the partition plate has a second oil return hole at a position axisymmetric to the first oil return hole, the second oil return hole being provided along half a circumference of the partition plate, the second oil return hole passing through the partition plate to cause the oil reservoir and the oil separation unit to communicate with each other, and the partition plate is integrally formed with the outer cylinder.

FIG. 2



Description

Technical Field

[0001] The present invention relates to screw compressors, and more particularly, to a structure to separate refrigerating machine oil.

Background Art

[0002] In screw compressors, a large amount of refrigerating machine oil is supplied to a bearing and compression chambers for lubrication of the bearing, cooling of compression heat, and sealing of gaps. This supplied refrigerating machine oil is discharged from the compression chambers to a discharge section together with compressed refrigerant gas. For this reason, it is necessary to separate the refrigerating machine oil from the refrigerant gas by an oil separation mechanism and to resupply the refrigerating machine oil to the bearing and the compression chambers. In addition, when the refrigerating machine oil discharged into the discharge section is discharged to a part of a refrigeration cycle other than the compressor, it may adversely affect heat exchange in a condenser or an evaporator and diminish their performance. Thus, it is necessary to recover the refrigerating machine oil by separating it from the refrigerant gas by the oil separation mechanism, so that it is not discharged to the other part of the refrigeration cycle.

[0003] In a known screw compressor, its compressor body is integrated with an oil separator to separate refrigerating machine oil and refrigerant gas. Methods for separating the refrigerating machine oil and the refrigerant gas include one called cyclone method, which separates the refrigerating machine oil and the refrigerant gas by centrifugal force using density difference between liquid and gas. An oil separator employing the cyclone method has a double-cylinder structure, and includes a centrifugal separation unit, an oil separation unit, and an oil reservoir. The centrifugal separation unit generates centrifugal force to enable oil separation. The oil separation unit swirls down the refrigerant gas separated from the refrigerating machine oil by the centrifugal force, and then swirls up the refrigerant gas into an inner cylinder to discharge it to a part of the refrigeration cycle other than the compressor. The oil reservoir retains the separated refrigerating machine oil.

[0004] When the oil reservoir is disposed in a lower part of the oil separator, depending on proximity of the oil reservoir to the oil separation unit, an airflow swirling up into the inner cylinder may cause the oil in the oil reservoir to re-scatter and flow out to the part of the refrigeration cycle other than the compressor. To prevent this inconvenience, a partition plate is disposed between the oil reservoir and the oil separator, and for example a ring-like opening port is formed along the entire circumference of the partition plate. Patent Literature 1 discloses integrating the oil separation unit of the compressor

with a support and a support fixing part for fixing the support, and attaching the partition plate to the support.

Citation List

Patent Literature

[0005] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2015-042846

Summary of Invention

Technical Problem

[0006] Providing a ring-like oil return hole along the entire circumference of the partition plate leads to a situation where the oil return hole, through which the separated refrigerating machine oil is retained in the oil reservoir, faces an oil surface in the oil reservoir. This structure may cause a swirling flow to reach and disturb the oil surface, diminishing oil separation performance of the compressor. When the partition plate as disclosed in Patent Literature 1 is used to prevent re-scattering of refrigerating machine oil due to an upward swirling flow, such a structure requires an assembly work of attaching the partition plate to the support. This structure leads to increased manufacturing time and cost.

[0007] The present invention has been made to address the above problems, and aims to provide a screw compressor that has a simple structure but can prevent re-scattering of refrigerating machine oil from the oil reservoir due to a swirling flow, enabling high oil separation efficiency.

Solution to Problem

[0008] According to an embodiment of the present invention, there is provided a screw compressor including an oil separation unit including an outer cylinder and a tubular inner cylinder, the outer cylinder allowing gas and oil discharged from a compressor body to enter the outer cylinder, the inner cylinder being provided inside the outer cylinder coaxially with the outer cylinder; an oil reservoir provided below the oil separation unit; and a partition plate provided on an inner wall of the outer cylinder, the partition plate partitioning the oil separation unit from the oil reservoir. The outer cylinder has a first oil return hole at a position in which the partition plate is provided, the first oil return hole passing through a side face of the outer cylinder that faces the compressor body to communicate with the oil reservoir, the partition plate has a second oil return hole at a position axisymmetric to the first oil return hole, the second oil return hole being provided along half a circumference of the partition plate, the second oil return hole passing through the partition plate to cause the oil reservoir and the oil separation unit to communicate with each other, and the partition plate is integrally formed with the outer cylinder.

Advantageous Effects of Invention

[0009] According to an embodiment of the present invention, a first oil return hole is provided on a side face of the outer cylinder of the oil separation unit, and a second oil return hole is provided axisymmetric to the first oil return hole along half the circumference of the partition plate partitioning the oil separation unit from the oil reservoir. The refrigerating machine oil discharged from the compressor body together with gas is separated from the gas as they swirl in the oil separation unit, and quickly flows out through the first oil return hole and the second oil return hole to be retained in the oil reservoir. This action prevents the refrigerating machine oil from staying in the oil separation unit. In addition, the swirling flow hardly enters the oil reservoir, leaving the oil surface of oil retained in the oil separator undisturbed. Further, the outer cylinder and the partition plate are integrally formed, resulting in the screw compressor with reduced assembly steps and reduced manufacturing and assembly cost.

Brief Description of Drawings

[0010]

[Fig. 1] Fig. 1 is a schematic cross-sectional view of a compressor according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a cross-sectional view taken along the line X-X of Fig. 1.

[Fig. 3] Fig. 3 is a schematic cross-sectional view of second oil return holes of the compressor according to Modification 1 of the embodiment of the present invention.

[Fig. 4] Fig. 4 is a schematic cross-sectional view of the second oil return holes of the compressor according to Modification 1 of the embodiment of the present invention.

[Fig. 5] Fig. 5 is a schematic cross-sectional view of the second oil return holes of the compressor according to Modification 2 of the embodiment of the present invention.

[Fig. 6] Fig. 6 is a schematic cross-sectional view of the second oil return holes of the compressor according to Modification 2 of the embodiment of the present invention.

Description of Embodiments

[0011] Preferred embodiments of a screw compressor according to the present invention will be described below with reference to the drawings. It should be noted that the embodiments given below are not intended to limit the scope of the present invention.

Embodiment

[0012] Fig. 1 is a schematic cross-sectional view of a compressor 1 according to an embodiment of the present invention. In Fig. 1, the part on the right side of the two-dotted dashed line, namely on the A-side shows a compressor body 2, and the part on the left side of the two-dotted dashed line, namely on the B-side shows an oil separator 4 of the compressor 1. The compressor 1 according to the embodiment of the present invention is for example a screw compressor, such as a single screw compressor, having the oil separator 4.

[0013] As shown in Fig. 1, the compressor 1 includes the compressor body 2 and the oil separator 4, which are fastened to a casing 3 with bolts (not shown in the figure).

[0014] The casing 3 defining an outer shape of the compressor body 2 has a cylindrical shape and contains a motor 5, a screw shaft 6, a screw rotor 7, and a bearing 8. A motor rotor 5b is fixed to the screw shaft 6, and the screw rotor 7 is also fixed to the screw shaft 6. The motor rotor 5b is fixed to one end of the screw shaft 6 (not shown in the figure). The other end of the screw shaft 6 to which the motor rotor 5b is not fixed is supported by the bearing 8 in such a manner that the screw shaft 6 is rotatable.

The motor 5 causes the screw shaft 6 to rotate.

[0015] The screw rotor 7 is provided with a pair of gate rotors 9 each provided on the corresponding one of both sides of the screw rotor 7. The pair of gate rotors 9 are placed axisymmetric to each other around the screw shaft 6. The screw rotor 7 is also provided with a slide valve 10 slidable along an outer surface of the screw rotor 7 between a suction pressure part and a discharge pressure part. The slide valve 10 includes an opening port 10a at the center of the slide valve 10.

[0016] The motor 5 consists of a stator 5a fixed in internal contact with the casing 3, and the motor rotor 5b placed inside the stator 5a. The motor rotor 5b is fixed to the screw shaft 6 and placed coaxially with the screw rotor 7.

[0017] The screw rotor 7 has a columnar shape and includes on its outer surface multiple screw grooves 7a running helically from one end to the other end of the screw rotor 7. The interior of the casing 3 is partitioned into the suction pressure part filled with low-pressure refrigerant gas and the discharge pressure part filled with high-pressure refrigerant gas. The one end of the screw rotor 7 is a refrigerant gas suction port, communicating with the suction pressure part. The other end of the screw rotor 7 is a refrigerant gas discharge port, so that the screw grooves 7a communicate with the discharge pressure part.

[0018] Each gate rotor 9 has a disk shape with teeth 9a on its outer surface. The gate rotor 9 has an axial direction perpendicular to that of the screw rotor 7. The teeth 9a of the gate rotor 9 are arranged to mesh with the screw grooves 7a of the screw rotor 7. Spaces surrounded by the screw grooves 7a, the teeth 9a of each gate rotor 9, an inner surface of the casing 3, and the

slide valve 10 serve as compression chambers 11 filled with compressed refrigerant gas. The compression chambers 11 are injected with refrigerating machine oil for lubrication of the bearing 8 supporting the screw shaft 6 and for sealing of the compression chambers 11.

[0019] The casing 3 includes on an inner surface of the discharge pressure part a discharge port (not shown in the figure) that opens and communicate with a discharge chamber 12. The discharge chamber 12 is filled with high-pressure refrigerant gas and refrigerating machine oil discharged from the compression chambers 11 into the discharge chamber 12. These high-pressure refrigerant gas and refrigerating machine oil discharged from the compression chambers 11 through the opening port 10a that opens on the slide valve 10 and the discharge port are delivered to the oil separator 4 via the discharge chamber 12.

[0020] The oil separator 4 is fastened to the casing 3 of the compressor body 2 with bolts. The oil separator 4, which for example uses a cyclone method, separates the refrigerating machine oil and the refrigerant gas discharged from the compressor body 2. The oil separator 4 consists of an oil separation unit 16, an oil reservoir 19, and a partition plate 17.

[0021] The oil separation unit 16 consists of an outer cylinder 13, an inner cylinder 14 inside the outer cylinder 13, and a lid 15 covering upper openings of the outer cylinder 13 and the inner cylinder 14. The outer cylinder 13 and the inner cylinder 14 are coaxially arranged, constituting a double cylinder. The outer cylinder 13 allows the refrigerant gas and the refrigerating machine oil discharged from the compressor body 2 to enter the outer cylinder 13 and causes them to swirl between the outer cylinder 13 and the inner cylinder 14, thereby centrifuging the refrigerant gas and the refrigerating machine oil. The inner cylinder 14 allows the refrigerant gas that is separated and directed back by the partition plate 17 to go upward.

[0022] The oil reservoir 19 is disposed below the oil separation unit 16 and retains the refrigerating machine oil separated from the refrigerant gas. The oil reservoir 19 has an elliptical or similar cross-section protruding toward the compressor body 2 further than the oil separation unit 16.

[0023] The partition plate 17 extends from an inner wall of the outer cylinder 13 and provides partition between the oil separation unit 16 and the oil reservoir 19. For example, the partition plate 17 is only required to be placed parallel to the opening plane at an end face of the inner cylinder 14. The partition plate 17 is integrally formed with the outer cylinder 13 by casting or similar methods.

[0024] The lid 15 has a disk shape and has at its center a hole with a diameter smaller than an inner diameter of the inner cylinder 14. The hole passes through the lid 15 and serves as an outlet 15a through which the refrigerant gas separated from the refrigerating machine oil by the oil separator 4 is discharged to the outside of the com-

pressor 1. A check valve 18 is disposed downstream of the outlet 15a. The check valve 18 may be embedded inside the lid 15.

[0025] Fig. 2 is a cross-sectional view taken along the line X-X of Fig. 1. As shown in Fig. 2, the outer cylinder 13 has a first oil return hole 50, and the partition plate 17 has a second oil return hole 51.

[0026] The first oil return hole 50 passes through the outer cylinder 13 and is provided in such a manner that its lowest edge lies flush with a top face of the partition plate 17. The first oil return hole 50 is provided on a side face of the outer cylinder 13 adjacent to the compressor body 2, and has a belt shape along the circumference direction of the outer cylinder 13. The first oil return hole 50 causes the oil separation unit 16 and the oil reservoir 19 below the oil separation unit 16 to communicate with each other. The first oil return hole 50 allows both of the refrigerating machine oil swirled in the oil separation unit 16 and blown onto the inner wall of the outer cylinder 13 by centrifugal force and the refrigerating machine oil that has fallen onto the partition plate 17 and has moved on the top face of the partition plate 17 to pass through the first oil return hole 50. This action results in the refrigerating machine oil being retained in the oil reservoir 19.

[0027] The first oil return hole 50 is not limited to a particular size. The first oil return hole 50 is only required to be at a position that allows the refrigerating machine oil passing through the first oil return hole 50 to fall onto the oil reservoir 19. For example, the first oil return hole 50 is provided in a quarter area of the circumference of the outer cylinder 13. An axial width of the first oil return hole 50 is not limited to a particular length. The axial width of the first oil return hole 50 is only required to be small enough to prevent entry of a swirling flow into the oil reservoir 19.

[0028] The second oil return hole 51 passes through the partition plate 17 and is provided along about half a circumference of the partition plate 17 at a position axisymmetric to the first oil return hole 50. In the partition plate 17, the second oil return hole 51 runs along the inner wall of the outer cylinder 13, having an arc shape. The second oil return hole 51 allows the refrigerating machine oil that is separated in the oil separation unit 16 and falls to pass through the second oil return hole 51. This action results in the refrigerating machine oil being retained in the oil reservoir 19. The second oil return hole 51 is not limited to a particular width. The second oil return hole 51 is only required to have a width small enough to restrict entry of a swirling flow into the oil reservoir 19, for example a quarter of the radius of the partition plate 17. This structure ensures that the swirling flow hardly enters the oil reservoir 19 through the second oil return hole 51, which in turn prevents disturbance of an oil surface in the oil reservoir 19 because of the swirling flow and resultant re-scattering of the refrigerating machine oil. For example, the second oil return hole 51 may be a cast hole provided in the partition plate 17.

[0029] The first oil return hole 50 and the second oil

return hole 51 are provided axisymmetric to each other at positions most distant from each other. This structure allows the separated and fallen refrigerating machine oil to flow out through any one of the first oil return hole 50 and the second oil return hole 51 that is more accessible to the refrigerating machine oil. Thus, the refrigerating machine oil quickly leaves the oil separation unit 16 to be retained in the oil reservoir 19.

[0030] A description will be given below of flow of the refrigerant gas and the refrigerating machine oil in the compressor 1 according to Embodiment 1.

[0031] Low-pressure refrigerant gas suctioned from the suction pressure part to the screw rotor 7 is compressed in the compression chambers 11 as it is delivered to the discharge pressure part from the screw rotor 7 by rotation of the motor 5 fixed coaxially with the screw rotor 7. This compressed high-pressure refrigerant gas is discharged from the opening port 10a through a discharge section (not shown in the figure) into the discharge chamber 12 together with the refrigerating machine oil injected into the compression chambers 11. The refrigerant gas and the refrigerating machine oil are then introduced into the oil separator 4 from the discharge chamber 12.

[0032] When the refrigerant gas and the refrigerating machine oil reaches the oil separator 4, the refrigerant gas and the refrigerating machine oil enter the outer cylinder 13 through an inlet 20 that opens on a side face of the outer cylinder 13, and move downward while swirling in the space between the outer cylinder 13 and the inner cylinder 14. During their downward swirl, the refrigerating machine oil, which has a higher density than does the refrigerant gas, is separated from the refrigerant gas by the centrifugal force.

[0033] The refrigerating machine oil blown by the centrifugal force, which is part of the separated refrigerating machine oil, hits the inner wall of the outer cylinder 13 to fall along the inner wall by gravity. This refrigerating machine oil then passes through any one or both of the first oil return hole 50 and the second oil return hole 51 to be retained in the oil reservoir 19.

[0034] The refrigerating machine oil that has fallen onto the top face of the partition plate 17 moves on the top face radially by the centrifugal force. This refrigerating machine oil then passes through any one of the axisymmetric first and second oil return holes 50, 51 to which the refrigerating machine oil reaches, to be retained in the oil reservoir 19. Further, the refrigerating machine oil that has fallen to a position right above the second oil return hole 51, which opens along half the circumference of the partition plate 17, passes through the second oil return hole 51 to directly reach the oil reservoir 19.

[0035] The refrigerating machine oil retained in the oil reservoir 19 is supplied to the compression chambers 11 and the bearing 8 through a path (not shown in the figure) inside the casing 3. The refrigerant gas separated from the refrigerating machine oil during downward movement in the oil separation unit 16 is directed back by the par-

tition plate 17 and goes up while swirling, thus entering the inner cylinder 14. Subsequently, the refrigerant gas goes through the inside of the inner cylinder 14, and passes through the outlet 15a of the lid 15, and then the check valve 18, to flow out to the other part of the refrigeration cycle for circulation of the refrigerant gas.

[0036] When the partition plate 17 has a ring-like opening port along the entire circumference of the partition plate 17 as in an existing oil separation unit, the swirling refrigerant gas may enter the oil reservoir 19 through the opening port of the partition plate 17 provided above the oil surface. This airflow of the swirling refrigerant gas causes disturbance in the oil surface, causing the oil to re-scatter. When an opening port is not provided in the partition plate 17, the oil surface in the oil reservoir 19 can stay undisturbed, but the first oil return hole 50 is the only hole that allows the oil to flow out. This means that the separated refrigerating machine oil lies at a position axisymmetric to the first oil return hole 50 needs to flow through the center of the partition plate 17 before flowing out from the first oil return hole 50, and in the meantime, the refrigerating machine oil is blown up by the upward swirling flow and re-scatters. In both of the above cases, the separated refrigerating machine oil re-scatters to mix with the refrigerant gas, resulting in the refrigerating machine oil getting mixed into refrigerant circulating in a refrigeration cycle.

[0037] In the present embodiment, the second oil return hole 51 is provided along half the circumference of the partition plate 17. This structure ensures that the swirling flow hardly enters the oil reservoir 19 and thus the oil surface of the retained refrigerating machine oil is unlikely to be disturbed, preventing re-scattering of the refrigerating machine oil in the oil reservoir 19. Further, providing the second oil return hole 51 in the partition plate 17 axisymmetric to the first oil return hole 50 can shorten the distance on the partition plate 17 to be traveled by the refrigerating machine oil that has fallen onto the partition plate 17. This structure can also prevent the refrigerating machine oil from re-scattering during its moving on the partition plate 17.

[0038] The partition plate 17 is integrally formed with the outer cylinder 13, and the refrigerating machine oil is allowed to flow out of the first oil return hole 50 in the outer cylinder 13 and the second oil return hole 51 in the partition plate 17. Thus, with reduced manufacturing cost, the compressor 1 can prevent re-scattering of the refrigerating machine oil.

<Modification 1>

[0039] Fig. 3 is a schematic cross-sectional view of second oil return holes 51a of the compressor 1 according to Modification 1 of the present embodiment. Fig. 4 is a schematic cross-sectional view of second oil return holes 51b of the compressor 1 according to Modification 1 of the present embodiment. The compressor 1 according to Modification 1 has multiple second oil return holes

51a or multiple second oil return holes 51b at positions axisymmetric to the first oil return hole 50.

[0040] As shown in Fig. 3, the compressor 1 according to Modification 1 may have two arc-like second oil return holes 51a in the partition plate 17 along half the circumference of the partition plate 17. In addition, as shown in Fig. 4, the compressor 1 according to Modification 1 may have three arc-like second oil return holes 51b in the partition plate 17 along half the circumference of the partition plate 17.

[0041] The second oil return holes 51a, 51b may be provided by machining or casting, in particular, casting can reduce manufacturing cost.

[0042] These multiple second oil return holes 51a, 51b in the partition plate 17 secure an opening port area to allow for passage of the refrigerating machine oil. Further, the partition plate 17, which gives separation between each adjacent two of the second oil return holes 51a, 51b, prevents entry of the swirling flow into the oil reservoir 19 and also straightens the swirling flow. This action in turn prevents disturbance of the oil surface in the oil reservoir 19, which is otherwise caused by entry of the swirling flow into the oil reservoir 19. This action hence allows to prevent re-scattering of oil, providing for a higher oil separation capability of the compressor 1.

<Modification 2>

[0043] Figs. 5 and 6 are cross sectional views of second oil return holes 51c of the compressor 1 according to Modification 2 of the present embodiment. As shown in Fig. 5, the compressor 1 according to Modification 2 may have multiple round second oil return holes 51c at positions axisymmetric to the first oil return hole 50. In addition, as shown Fig. 6, the compressor 1 according to Modification 2 may have multiple second oil return holes 51c, each of which has an elliptical shape.

[0044] The multiple second oil return holes 51c are provided along the circumference of the partition plate 17 over an area half the circumference of the partition plate 17. Each second oil return hole 51c is round or elliptical. In this case again, giving separation between each adjacent two of the second oil return holes 51c can prevent entry of the swirling flow. The swirling flow thus hardly enters the oil reservoir 19, leaving the oil surface in the oil reservoir 19 undisturbed. The compressor 1 thus can prevent re-scattering of oil.

[0045] Provision of the second oil return holes 51c is not limited to a particular method. The second oil return holes 51c is only required to be provided by machining or casting. While Modification 2 exemplarily describes the case in which the second oil return holes 51c are round, the shape of the second oil return holes 51c is not limited to this example. The second oil return holes 51c are only required to be provided along half the circumference of the partition plate 17.

[0046] The above-described compressor 1 according to the present embodiment has the first oil return hole 50

on the side face of the outer cylinder 13 of the oil separation unit 16, and has the second oil return hole 51 that opens along half the circumference of the partition plate 17 at a position axisymmetric to the first oil return hole 50. The refrigerating machine oil, after being separated as it swirls in the outer cylinder 13, passes through any one of the first oil return hole 50 and the second oil return hole 51 that is more accessible to the refrigerating machine oil, to be retained in the oil reservoir 19. This action allows to quickly recover the refrigerating machine oil while preventing entry of the swirling flow into the oil reservoir 19. This action provides a high oil separation capability of the compressor 1 as the compressor 1 can prevent the separated refrigerating machine oil from re-scattering and mixing with refrigerant. Further, the partition plate 17 is integrally formed with the outer cylinder 13. This structure enables easy assembly and reduces manufacturing and assembly cost of the compressor 1.

[0047] The outer cylinder 13, the oil reservoir 19, and the partition plate 17 may be integrally formed by casting. This method reduces the number of components and assembly steps, reducing manufacturing and assembly cost.

[0048] The second oil return hole 51 may be a cast hole provided by casting, and this method reduces manufacturing and assembly cost.

[0049] The second oil return hole 51 may have a fan shape, and this shape prevents entry of the swirling flow into the oil reservoir 19.

[0050] The second oil return hole 51 may include multiple round holes. This structure prevents entry of the swirling flow into the oil reservoir 19 with the partition plate 17 while increasing or securing an opening port area of the oil return holes. This structure also prevents the oil from flowing into the oil separation unit 16 even when the oil re-scatters.

[0051] The second oil return hole 51 may include multiple elliptical holes. This structure also prevents entry of the swirling flow into the oil reservoir 19 with the partition plate 17 while increasing or securing an opening port area of the oil return holes. This structure also prevents the oil from flowing into the oil separation unit 16 even when the oil re-scatters.

[0052] The second oil return hole 51 may be divided into multiple separate sections along half the circumference of the partition plate 17. This structure prevents entry of the swirling flow into the oil reservoir 19 with the partition plate 17. This structure also increases or secures an opening port area of the oil return holes.

[0053] The second oil return hole 51 may have an arc shape along the inner wall of the outer cylinder 13. This shape increases or secures an opening port area of the oil return hole. Further, the partition plate 17 prevents entry of the swirling flow into the oil reservoir 19, and prevents the oil from flowing into the oil separation unit 16 even when the oil re-scatters.

Reference Signs List

[0054]

1 compressor 2 compressor body 3 casing 4 oil separator 5 motor 5a stator 5b motor rotor 6 screw shaft 7 screw rotor 7a screw groove 8 bearing 9 gate rotor 9a tooth 10 slide valve 10a opening port 11 compression chamber 12 discharge chamber 13 outer cylinder 14 inner cylinder 15 lid 15a outlet 16 oil separation unit 17 partition plate 18 check valve 19 oil reservoir 20 inlet 50 first oil return hole 51, 51a, 51b, 51c second oil return hole

5. The screw compressor of any one of claims 1 to 3, wherein the second oil return hole has an elliptical shape.

5 6. The screw compressor of any one of claims 1 to 3, wherein the second oil return hole has an arc shape along the inner wall of the outer cylinder.

7. The screw compressor of any one of claims 1 to 6, wherein the second oil return hole includes a plurality of holes along half the circumference of the partition plate.

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Claims

1. A screw compressor, comprising:

an oil separation unit including an outer cylinder and a tubular inner cylinder, the outer cylinder allowing gas and oil discharged from a compressor body to enter the outer cylinder, the inner cylinder being provided inside the outer cylinder coaxially with the outer cylinder; 20

an oil reservoir provided below the oil separation unit; and 25

a partition plate provided on an inner wall of the outer cylinder, the partition plate partitioning the oil separation unit from the oil reservoir, the outer cylinder having a first oil return hole at a position in which the partition plate is provided, the first oil return hole passing through a side face of the outer cylinder that faces the compressor body to communicate with the oil reservoir, 30

the partition plate having a second oil return hole at a position axisymmetric to the first oil return hole, the second oil return hole being provided along half a circumference of the partition plate, the second oil return hole passing through the partition plate to cause the oil reservoir and the oil separation unit to communicate with each other, 40

the partition plate being integrally formed with the outer cylinder. 45

2. The screw compressor of claim 1, wherein the outer cylinder, the oil reservoir, and the partition plate are integrally formed by casting. 50

3. The screw compressor of claim 2, wherein the second oil return hole is a cast hole.

4. The screw compressor of any one of claims 1 to 3, wherein the second oil return hole includes a plurality of round holes. 55

FIG. 1

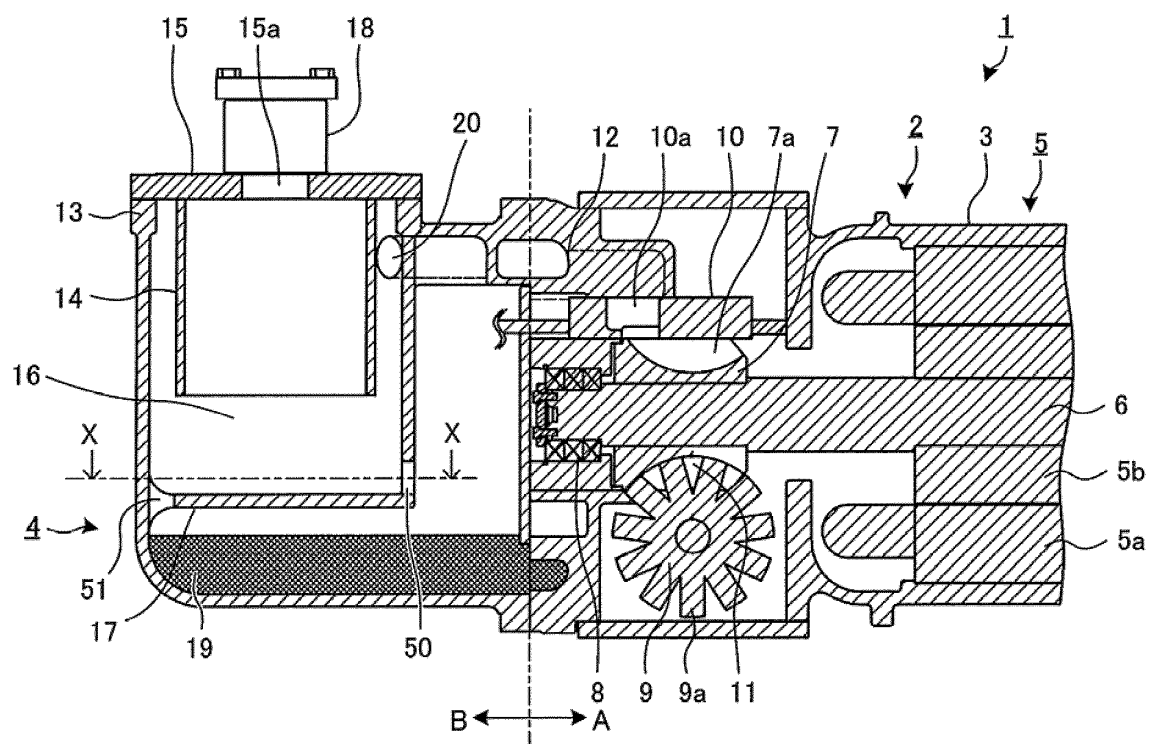


FIG. 2

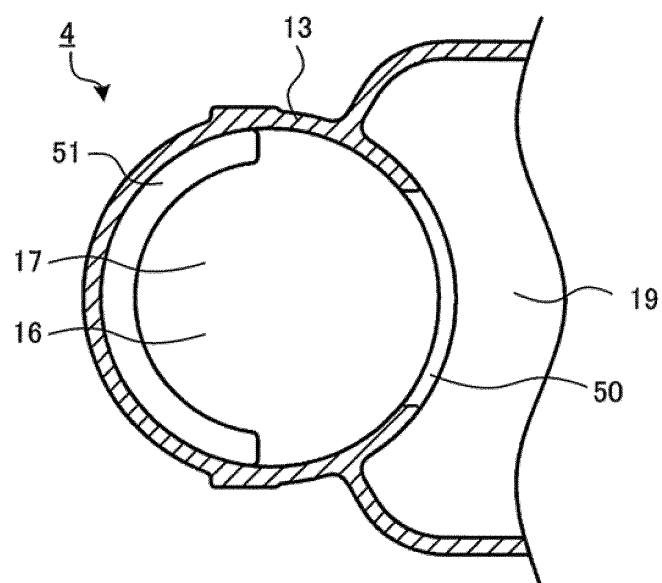


FIG. 3

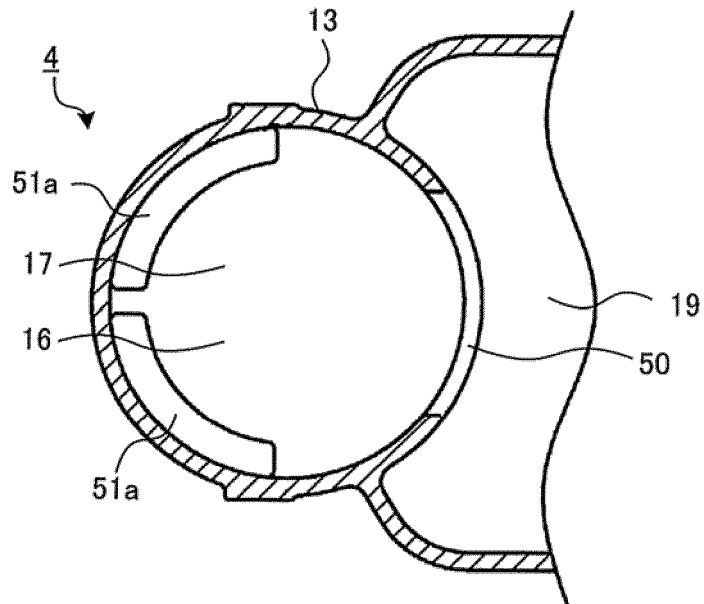


FIG. 4

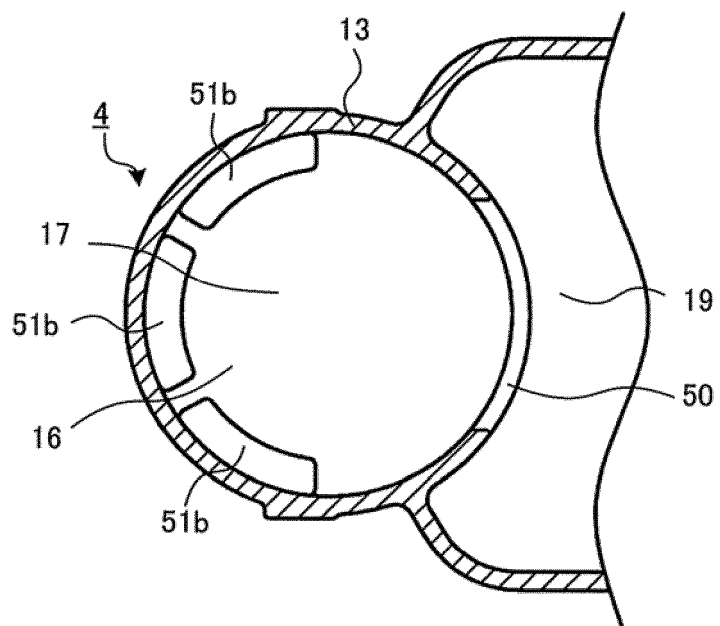


FIG. 5

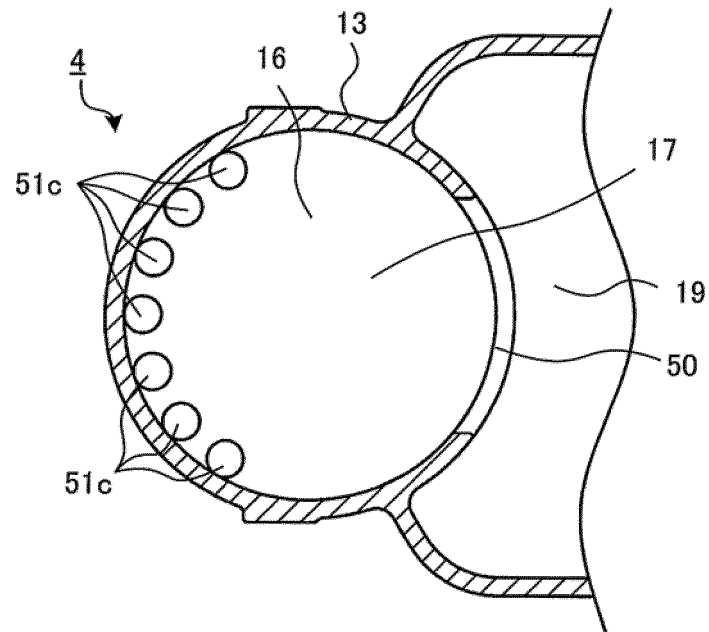
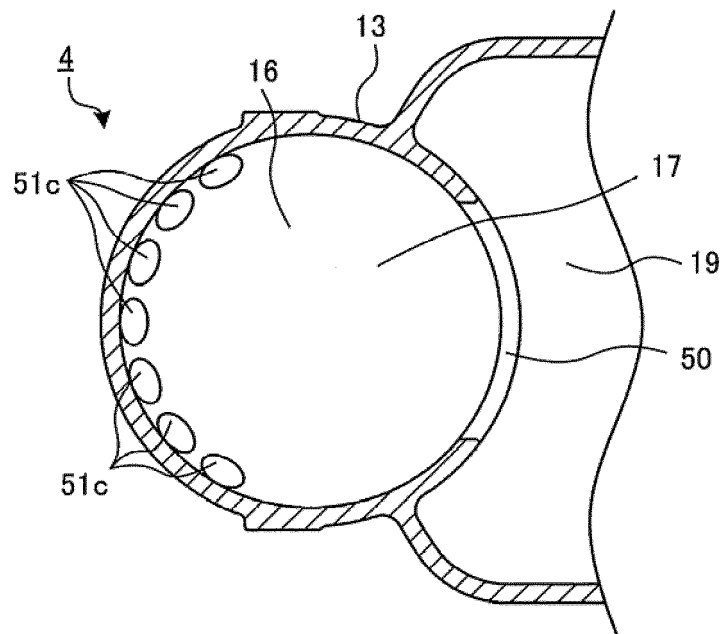


FIG. 6



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/014385

A. CLASSIFICATION OF SUBJECT MATTER

F04C29/02(2006.01)i, F04B39/04(2006.01)i, F04C18/16(2006.01)i

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04C29/02, F04B39/04, F04C18/16

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
 Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2014-211101 A (Mitsubishi Electric Corp.), 13 November 2014 (13.11.2014), paragraphs [0013] to [0052]; fig. 1, 4 (Family: none)	1-7
Y	JP 2009-74756 A (Mitsubishi Electric Corp.), 09 April 2009 (09.04.2009), paragraphs [0019] to [0021]; fig. 7 to 9 (Family: none)	1-7
A	JP 2010-1837 A (Calsonic Kansei Corp.), 07 January 2010 (07.01.2010), entire text; all drawings (Family: none)	1-7

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

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Date of the actual completion of the international search
19 June 2017 (19.06.17)Date of mailing of the international search report
27 June 2017 (27.06.17)Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2015042846 A [0005]