A compressor with a built-in centrifugal oil separator is characterized in that the oil separator is formed between a first member and a second member constituting a compressor by the coupled structure of the first member and the second member. In the compressor, by simplifying the structure of the oil separation part, the productivity can be improved, the cost can be reduced, and the freedom of the design of the discharge port position can be ensured.
COMPRESSOR WITH BUILT-IN OIL SEPARATOR

TECHNICAL FIELD OF THE INVENTION

[0001] The present invention relates to a compressor with a built-in oil separator, and specifically, to a compressor with a built-in oil separator which intends to simplify the oil separator built-in mechanism, decrease the number of parts, facilitate the assembly, reduce the cost, etc.

BACKGROUND ART OF THE INVENTION

[0002] As a conventional compressor, for example, as a compressor incorporated into a refrigeration system in an air conditioning system for vehicles, known is a compressor with a built-in oil separator in which a centrifugal separation type oil separator is incorporated into the compressor (for example, Patent document 1). In the conventional compressor with a built-in oil separator, for example, as depicted in FIG. 6 with an example of a case of a scroll-type compressor which has a compression mechanism 103 comprising a fixed scroll 101 and a movable scroll 102, a centrifugal type oil separator 107 is incorporated in a rear casing 106 forming a discharge chamber 105 into which gas (for example, refrigerant gas) compressed by compression mechanism 103 is introduced through a discharge hole 104. In such an oil separator 107, a structure is employed wherein a cylindrical cylinder (oil separation chamber 108) is provided in casing 106, along its axis a separation pipe 109 is inserted or press-fitted, and its upper end side is fixed or engaged by a snap ring 110. Since the oil separation part is provided only in casing 106 and the oil separation part is formed by machine processing, a seal bolt 111 is required in order to keep the inside pressure. Further, a discharge port 112 connected to the outside of the compressor (to an external tube) is communicated with a space formed between the upper part of separation pipe 109 and the lower end of seal bolt 111.

[0003] The gas compressed by compression mechanism 103 is discharged into discharge chamber 105 through discharge hole 104 provided in the fixed scroll, and the gas in discharge chamber 105 containing oil is introduced into oil separation chamber 108 through communication hole 113. The introduced gas is rotated around separation pipe 109, and separated into oil and gas by utilizing the centrifugal force. The separated gas passes through the inside of separation pipe 109 and discharged through discharge port 112, and the oil separated by the centrifugal force is stored in the lower oil storage chamber 115 through lower hole 114 (oil return hole). The oil stored in oil storage chamber 115 is returned to suction chamber 117 through orifice 116. Patent document 1: JP-A-11-93880

DISCLOSURE OF THE INVENTION

Problems to be Solved by the Invention

[0004] In the above-described conventional oil separator structure, there are the following problems.

[0005] Because it is necessary to process by machine all of oil separation chamber 108 (cylinder part), lower hole 114 (oil return hole), the insertion part or the press fitting part for separation pipe 109, the screw part for seal bolt 111, etc. and there are many machine processing parts, the productivity is not good and the cost is high.

[0006] Further, because parts such as separation pipe 109 and seal bolt 111 are necessary and the entire length of oil separation chamber 108 becomes relatively great, the process ability of this portion is bad. Further, because oil separation chamber 108 (cylinder part) is formed in a cylindrical shape, there is a restriction in the space for installing the oil separation part, and the entire length of the casing also becomes great. Therefore, the productivity is bad and the freedom of layout is small.

[0007] Further, because parts such as separation pipe 109, snap ring 110 and seal bolt 111 are necessary and the number of parts is great, the time required for assembly is long. Further, defectives are liable to occur in the press fitting process of separation pipe 109 or the fastening process of seal bolt 111. Therefore, there are problems that the productivity is bad and that the cost for both the production and the assembly is high.

[0008] Furthermore, although the compressed gas after oil separation is discharged from discharge port 112 communicated with the space between the lower end of seal bolt 111 and the upper end of separation pipe 109 to outside of the compressor, because the freedom of the layout of the separation mechanism part is small, the position of discharge port 112 is also restricted. Therefore, there is a problem that there is not a great freedom in position of discharge port 112 and restriction occurs in design of compressor itself or in connection structure to outside.

[0009] Accordingly, paying attention to the above-described problems, an object of the present invention is to provide a compressor with a built-in oil separator which can improve the productivity and reduce the cost and which can ensure the design freedom for the position of discharge port, by simplifying the structure of an oil separation part.

Means for solving the Problems

[0010] To achieve the above-described object, the present invention provides a with a built-in centrifugal oil separator characterized in that the oil separator is formed between a first member and a second member constituting a compressor by a coupled structure of the first member and the second member.

[0011] More concretely, for example, the oil separator includes at least a separation chamber separating an oil component and a gas component of oil-containing gas introduced from a discharge chamber from each other by utilizing a centrifugal force, a communication hole provided between the separation chamber and the discharge chamber, and a lower hole leading oil separated in the separation chamber down to an oil storage chamber positioned under the separation chamber, and these are formed between the first member and the second member by the coupled structure of the first member and the second member.

[0012] Namely, since the cylinder part (separation chamber) of the oil separation mechanism, the communication hole part and the lower hole part are formed by the coupled structure of the first member and the second member constituting the compressor, it becomes possible to form these parts without performing machine processing, and therefore, the productivity can be greatly improved, and it becomes possible to reduce the cost. Further, because the separation pipe in the conventional structure can be abolished and the fixing or engaging mechanism thereof, and further the seal bolt, can be abolished, the structure of the whole of the separation mechanism can be simplified, and because the number of parts can be greatly decreased, shortening of the assembly time, facilitation of the assembly and reduction of the cost may be expected. Further, as the result of abolishment of the seal bolt, etc., it becomes possible to shorten the entire length of the oil
Further, in the present invention, a structure may be employed wherein a gas passageway is provided between the above-described oil separator and a discharge port connected to outside of the compressor, and the gas passageway is also formed between the first member and the second member by the coupled structure of the first member and the second member. The discharge port may be communicated to this gas passageway, thereby smoothly discharging the gas separated from oil to outside from the discharge port.

In this compressor with a built-in oil separator according to the present invention, although the oil separator is formed basically as a centrifugal oil separator, because the number of parts is small and there is no part performed with machine processing, the freedom of shape of the separation chamber is kept remarkably high. Therefore, the separation chamber can be formed either in a cylindrical shape whose generating line extends straightly, or in a cylindrical shape whose generating line is curved (a separation chamber formed as a doughnut-like shape as a whole (a shape forming a part of a doughnut shape)). In particular, by forming this separation chamber in a cylindrical shape (a doughnut shape) having a curvature, the freedom for layout may be greatly increased, and it becomes possible to make the whole of the compressor compact.

Further, with respect to the cross-sectional shape in the above-described cylindrical shape, although a substantially perfect circle is preferable, from the viewpoint of the coupled structure of the first member and the second member, it may be a structure wherein there is a small step in the inner surface of the cylindrical shape or wherein there is a difference in curvature between the arcs in the cross sections of the cylindrical shapes of the first member and the second member which form the inner surface of the entire cylindrical shape. Further, with forming the inner surface of the cylindrical shape, a difference in circumferential length may occur between the first member and the second member. Furthermore, a difference in depth may occur between arc-like grooves in the respective cylindrical cross sections of the first member and the second member which form the inner surface of the entire cylindrical shape.

Further, in order to avoid reduction of separation ability caused by the abolishment of a separation pipe, it can be realized to exhibit the same level of separation ability as that in the conventional structure by changing the discharge direction of the compressed gas being discharged through the communication hole into the oil separation chamber as compared with the discharge direction in the conventional structure. For example, by employing a structure wherein an opening of the communication hole toward the separation chamber is directed to the oil storage chamber side, it becomes possible to efficiently separate oil toward the oil storage chamber side while effectively operating the centrifugal force for separation on the oil.

It is possible to provide a plurality of communication holes directed to the separation chamber. In this case, a structure may be employed wherein openings of the plurality of communication holes toward the separation chamber are directed in a same direction. In such a structure, even in a case where the amount of gas discharged to the oil separation chamber is relatively great, the discharge conditions of the respective communication holes may be optimized, and it becomes possible to introduce the efficiently separated oil into the oil storage chamber. Further, a structure may also be employed wherein directions of openings of the plurality of communication holes toward the separation chamber are changed from each other. In such a structure, the direction of gas discharged into the oil separation chamber is changed in angle for each communication hole, it becomes possible to discharge the gas in accordance with the shape of the oil separation chamber, an efficient separation becomes possible, and it becomes possible to introduce the efficiently separated oil into the oil storage chamber.

Further, a structure may also be employed wherein a stepped portion or a weir portion is provided in the above-described gas passageway. By such a device of the shape of the gas passageway provided between the separation chamber and the discharge port, the flow of oil out of the discharge port may be decreased.

Furthermore, a structure may also be employed wherein a second discharge chamber (a chamber provided immediately before the discharge port, which is different from the aforementioned discharge chamber) is formed between the above-described separation chamber and the above-described discharge port. In such a structure, because the second discharge chamber may be merely communicated with the discharge port, the freedom in position to be set for discharge port may be greatly increased by adequately setting the region to be formed with the second discharge chamber and the shape thereof.

Although such a structure for the compressor with a built-in oil separator according to the present invention can be applied to substantially any type compressor, and in particular, it is suitable for a scroll-type compressor. In case of a scroll-type compressor, a structure may be employed wherein one of the above-described first member and the above-described second member is a fixed scroll forming member, and the other is a compressor casing.

Effect According to the Invention

Thus, in the compressor with a built-in oil separator according to the present invention, an oil separator can be formed by the coupled structure of the first member (for example, a fixed scroll forming member) and the second member (for example, a casing) without machining cylinder, communication hole, separation pipe holding part, lower hole, etc. in the conventional structure, and the separation pipe in the conventional structure can be abolished, and therefore, the following effects may be obtained.

1. Improvement in productivity on processing and reduction in cost may be achieved by abolishment of machining for oil separation part.
2. Reduction in cost and improvement in assembly as a single structural part may be achieved by decrease of the number of parts.
3. The process for assembly may be greatly simplified, the processes for press-fitting of a separation pipe and fastening of a seal bolt, which were necks in the conventional structure, can be omitted, defects in those processes in the conventional structure do not occur, and the rate of defects in the assembling process may be greatly reduced.
4. The freedom in position of discharge port may be greatly increased, thereby greatly improving the layout performance.
of the discharge port, ultimately, the layout performance as the whole of the compressor incorporated into a system.

BRIEF EXPLANATION OF THE DRAWINGS

[0022] FIG. 1 is a cross-sectional view of a portion including a discharge chamber in a compressor with a built-in oil separator according to an embodiment of the present invention.

[0023] FIG. 2 is a partial sectional view (a sectional view in a direction across an oil separator) of an oil separator part of the compressor depicted in FIG. 1.

[0024] FIG. 3 is a partial sectional view of a lower hole part at the lower end of an oil separator of the compressor depicted in FIG. 1.

[0025] FIG. 4 is a partial sectional view (a sectional view in a vertical direction of an oil separator), showing examples of sectional shapes for an oil separator part of the compressor depicted in FIG. 1.

[0026] FIG. 5 is a partial sectional view of a gas passage-way part of the compressor depicted in FIG. 1.

[0027] FIG. 6 is a partial vertical sectional view of a conventional compressor with a built-in oil separator.

EXPLANATION OF SYMBOLS

[0028] 1: compressor with a built-in oil separator
2: discharge chamber
3: oil separator
4: fixed scroll forming member as first member
5: casing as second member
6: separation chamber
7: communication hole
8: oil storage chamber
9: lower hole
10: orifice
11: gas passageway
12: discharge port
13: stepped portion (or weir portion)
14: second discharge chamber
15: region capable of being formed with discharge port

THE BEST MODE FOR CARRYING OUT THE INVENTION

[0029] Hereinafter, desirable embodiments of the present invention will be explained referring to figures.

[0030] FIG. 1 depicts a cross section of a part including a discharge chamber 2 of a compressor with a built-in oil separator 1 according to an embodiment of the present invention. This compressor 1 is formed as, for example, a scroll-type compressor having the aforementioned compression mechanism 103 comprising fixed scroll 101 and movable scroll 102 as shown in FIG. 6. In the compression mechanism 103, compressed gas (for example, refrigerant gas) is introduced into discharge chamber 2 through discharge hole (refer to FIG. 6).

[0031] Oil separator 3 is built in at an appropriate position around discharge chamber 2. As shown also in FIGS. 2 and 3, this oil separator 3 is formed by the coupled structure of a fixed scroll forming member 4 provided as a first member and a casing 5 provided as a second member. Oil separator 3 has a cylinder-structured separation chamber 6 which separates oil from the compressed gas by centrifugal force, and in this embodiment, separation chamber 6 is formed in a cylindrical shape whose generating line is curved (a cylindrical shape forming a part of a doughnut shape). A communication hole 7 is provided between separation chamber 6 and discharge chamber 2 for discharging gas containing oil from discharge chamber 2 into separation chamber 6, and in this embodiment, a plurality of (two) communication holes 7 are provided. As depicted in FIG. 2, oil containing gas (shown by arrow) is introduced into separation chamber 6 through communication hole 7 at a position eccentric from the center axis of the cylindrical shape of separation chamber 6, the flow along the inner surface of separation chamber 6 is formed, and oil in the gas is separated by centrifugal force. As depicted in FIG. 4, the openings of two communication holes 7 are directed toward the side of oil storage chamber 8 formed under separation chamber 6, and in the embodiment depicted in FIG. 1, as shown in FIG. 4(B), the directions of the openings toward separation chamber 6 are changed for the respective communication holes 7 from each other, namely, the angles of the hole extending directions of the respective communication holes 7 are changed from each other. Communication hole 7 located at a lower position is set in angle so as to be more directed to oil storage chamber 8 side. In such a case where a plurality of communication holes 7 are provided, as shown in FIG. 4(A), a structure may be employed wherein the openings toward separation chamber 6 of the respective communication holes 7 are set in the same direction and the openings of all communication holes 7 are directed in an optimum direction. The separated oil is stored in oil storage chamber 8 through a lower hole 9 provided at the lower end of separation chamber 6. As depicted in FIG. 3, lower hole 9 is formed at a position eccentric from the center of the cylindrical shape of separation chamber 6. The oil stored in oil storage chamber 8 is returned to the suction chamber side through orifice 10.

[0032] The oil separate in separation chamber 6 is discharged to outside of the compressor from discharge port 12 through gas passageway 11 communicated with the upper end of separation chamber 6. In this embodiment, as depicted in FIG. 5, a stepped portion 13 (or a weir portion) is provided in gas passageway 11, and by the presence of stepped portion 13, the flow in gas passageway 11 is bent, and it is suppressed that the oil flows out to outside from discharge port 12.

[0033] Further, in this embodiment, between separation chamber 6 and discharge port 12 (in this embodiment, at a position after the above-described stepped portion 13), a second discharge chamber 14 different from the above-described discharge chamber 2 is formed. Although discharge port 12 is communicated with this second discharge chamber 14, because second discharge chamber 14 is formed as a chamber having a certain length in the circumferential direction of the compressor as shown in FIG. 1, the position of discharge port 12 capable of being located may be freely set as long as it is within the range corresponding to the extending region of this second discharge chamber 14 (15: region capable of being formed with discharge port).

[0034] In the compressor with a built-in oil separator 1 forming a scroll-type compressor thus constructed, in particular, by forming separation chamber 6, lower hole 9 and communication hole 7 by the coupled structure of fixed scroll forming member 4 and casing 5, they can be easily formed merely by assembling fixed scroll forming member 4 and casing 5. Namely, because the oil separator forming part comprising fixed scroll forming member 4 and casing 5 can be formed by casting, machine processing for the cylinder part, etc. in the conventional structure is not necessary at all. Further, the separation pipe, the seal bolt, etc. in the conven-
tional structure become unnecessary, and the number of parts may also be greatly decreased. Consequently, the assembly may be facilitated, the time for assembly may be shortened, occurrence of defects in assembly may be greatly decreased, and great improvement in productivity and reduction in cost become possible.

[0035] Further, with respect to a fear of reduction in oil separation ability which may be ascribed to abolition of a conventional separation pipe, by setting the discharge direction from one or a plurality of communication holes 7 to oil separation chamber 6 at a direction toward a lower part, it becomes easy to introduce oil into oil storage chamber 8 side (in the conventional separation structure, the discharge has been carried out in a direction perpendicular to the axial direction of the separation chamber), and further, by changing the angles of the respective communication holes 7 from each other, a more efficient separation becomes possible.

[0036] Further, as the shape of separation chamber 6, although any of the cylindrical shape whose generating line extends straightly similarly in the conventional structure and the doughnut-like cylindrical shape having a curvature as in this embodiment is possible, by employing the doughnut-like cylindrical shape as in this embodiment, the freedom in location and shape of separation chamber 6 may be increased, the freedom in layout thereof may be greatly increased, and it may contribute to make the whole of the compressor compact. As to the cross-sectional shape of the cylindrical shape, as aforementioned, as needed, it is not always a perfect circle, and further, there may be a difference in function for forming the cross-sectional circular shape between the first and second members.

[0037] Further, by providing stepped portion 13 in gas passageway 11 after passing through oil separation chamber 6, it becomes possible to greatly reduce the amount of oil flowing out to an external circuit side from discharge port 12. Furthermore, by providing second discharge chamber 14 at a position after passing through separation chamber 6, the freedom in setting of position of discharge port 12 may be greatly increased.

INDUSTRIAL APPLICATIONS OF THE INVENTION

[0038] The structure of the compressor with a built-in oil separator according to the present invention can be applied to any type compressor incorporated with an oil separator, and in particular, it is suitable for a scroll-type compressor.

1. A compressor with a built-in centrifugal oil separator characterized in that said oil separator is formed between a first member and a second member constituting a compressor by a coupled structure of said first member and said second member.

2. The compressor with a built-in oil separator according to claim 1, wherein said oil separator includes at least a separation chamber separating an oil component and a gas component of oil-containing gas introduced from a discharge chamber from each other by utilizing a centrifugal force, a communication hole provided between said separation chamber and said discharge chamber, and a lower hole leading oil separated in said separation chamber down to an oil storage chamber positioned under said separation chamber.

3. The compressor with a built-in oil separator according to claim 1, wherein a gas passageway is provided between said oil separator and a discharge port connected to outside of said compressor, and said gas passageway is also formed between said first member and said second member by said coupled structure of said first member and said second member.

4. The compressor with a built-in oil separator according to claim 2, wherein said separation chamber is formed in a cylindrical shape whose generating line extends straightly.

5. The compressor with a built-in oil separator according to claim 2, wherein said separation chamber is formed in a cylindrical shape whose generating line is curved.

6. The compressor with a built-in oil separator according to claim 2, wherein an opening of said communication hole toward said separation chamber is directed to said oil storage chamber side.

7. The compressor with a built-in oil separator according to claim 2, wherein a plurality of communication holes are provided.

8. The compressor with a built-in oil separator according to claim 7, wherein openings of said plurality of communication holes toward said separation chamber are directed in a same direction.

9. The compressor with a built-in oil separator according to claim 7, wherein directions of openings of said plurality of communication holes toward said separation chamber are changed from each other.

10. The compressor with a built-in oil separator according to claim 3, wherein a stepped portion or a weir portion is provided in said gas passageway.

11. The compressor with a built-in oil separator according to claim 2, wherein a second discharge chamber different from said discharge chamber is formed between said separation chamber and a discharge port connected to outside of said compressor.

12. The compressor with a built-in oil separator according to claim 1, wherein said compressor is a scroll-type compressor, one of said first member and said second member is a fixed scroll forming member, and the other is a compressor casing.

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