(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 2 520 803 A1

(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
07.11.2012 Bulletin 2012/45

(21) Application number: **10840725.5**

(22) Date of filing: **12.11.2010**

(51) Int Cl.:
F04C 29/02 *(2006.01)* ***F04B 39/04*** *(2006.01)*
F04C 18/344 *(2006.01)*

(86) International application number:
PCT/JP2010/006671

(87) International publication number:
WO 2011/080865 (07.07.2011 Gazette 2011/27)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR

(30) Priority: **29.12.2009 JP 2009299090**

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(54) COMPRESSOR

(57) To provide a compressor equipped with a centrifugal separation type oil separator capable of preventing an increase in the number of components with the installation of the oil separator.

A compressor includes a movable member (2) which is movable with a rotation of a shaft (1) and a fixed member (4) which constitutes a compression chamber (3) along with the movable member, in which a working fluid is compressed in the compression chamber (3) with the movement of the movable member (2), and the fixed member (4) is integrated with an oil separator (14) which introduces the working fluid compressed in the compression chamber thereinto and separates oil contained in the working fluid. In the vane-type compressor, the fixed member (4) includes a cylinder (4a) accommodating the movable member (2) and a rear-side block (4b) integrated with the cylinder (4a), and the oil separator (14) is integrated with the rear-side block (4b). An oil separation chamber (22) of the oil separator (14) is covered by a cylindrical portion (5b) of a shell member (5) constituting a housing.

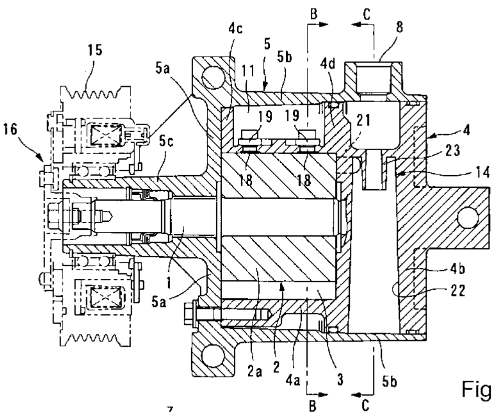

Fig.1A

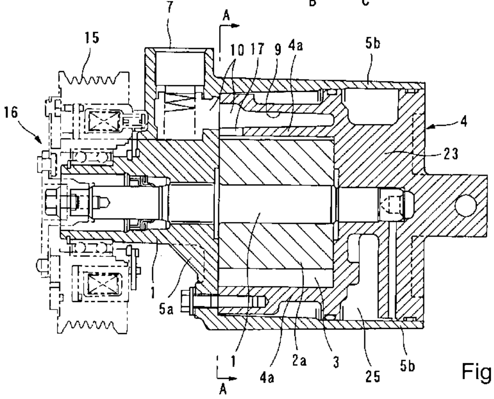

Fig.1B

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Description

TECHNICAL FIELD

[0001] The present invention relates to a compressor equipped with a centrifugal separation type oil separator, and particularly, to a compressor capable of suppressing an increase in the number of components with the installation of a centrifugal separator.

BACKGROUND ART

[0002] Hitherto, as a compressor equipped with a centrifugal separator, for example, a configuration described in Patent Document 1 or Patent Document 2 has been known.
Of these, the compressor described in Patent Document 1 relates to a scroll compressor, where a compression mechanism which suctions and compresses a working fluid includes a fixed scroll (a fixed portion) which is fixed to a front housing and a movable scroll (a movable portion) which moves (revolves) with respect to the fixed scroll, the movable scroll is revolvably driven by a shaft rotatably disposed in the front housing, and a refrigerant is suctioned and compressed by expanding and reducing volume of operation chambers formed by both scrolls with the revolving of the movable scroll. And, a rear housing fixed to the front housing with the fixed scroll interposed therebetween is provided with a centrifugal separation type oil separator which separates lubricant from a refrigerant discharged from a discharge port of the compression mechanism.

[0003] The oil separator includes a separation chamber which is formed in a columnar space in a direction perpendicular to the driving shaft inside the rear housing and a substantially cylindrical separation pipe (a separator pipe) which is coaxially disposed by being press-inserted into the separation chamber, where the inner wall surface of the circumference of the separation chamber is provided with an introduction hole which guides a refrigerant discharged from the compression mechanism into the separation chamber, and the bottom surface thereof is provided with a discharge hole which discharges the separated lubricant to an oil storage chamber.
Furthermore, the same publication also discloses a configuration that a separation chamber of an oil separator is integrated into a fixed scroll (fixed portion) and refrigerant is introduced from an introduction hole opened toward a rear housing into the separation chamber, the separated lubricant is discharged from a discharge hole opened toward the rear housing into an oil storage chamber, and a discharge pipe is connected to the fixed scroll.

[0004] Furthermore, a compressor described in Patent Document 2 relates to a vane-type compressor including a cam ring (a cylinder), a rotor which is rotatably accommodated in the cam ring and is fixed to a shaft, vanes which are inserted into plural vane grooves formed in the rotor, a rear-side block which is fixed to the rear-side end surface of the cam ring, and a front-side block which is formed in a shell shape surrounding the front-side end surface and the outer peripheral surface of the cam ring and is fitted to the rear-side block. In the rear-side block, a centrifugal separation type oil separator for separating lubricating oil mixed in the discharge gas, having the same configuration as that of the description above, is provided at the downstream side of a passage hole formed in the flange portion of the cylinder in a direction perpendicular to the driving shaft.

PRIOR ART DOCUMENTS

PATENT DOCUMENT

[0005]

Patent Document 1: Japanese Patent Application Laid-Open (JP-A) No. 2001-295767

Patent Document 2: JP-A No. 2009-156231

SUMMARY OF THE INVENTION

PROBLEMS TO BE SOLVED BY THE INVENTION

[0006] In the former configuration, the oil separator is formed in the fixed member constituting the compression mechanism or the rear housing fixed to the fixed member, however the outer radial end of the separation chamber is opened, since the separation chamber is formed in a direction perpendicular to the driving shaft. For this reason, the separation pipe needs to be attached as a separate component by being press-inserted into the separation chamber from the opening end, and a problem arises in that the number of components increases with the installation of the oil separator. Furthermore, since the separation pipe is formed as a separate member, there is a need to manage the dimensions of the separation pipe and the separation chamber and also manage the press-inserting position of the separation pipe.

[0007] Furthermore, in the latter configuration, the rear-side block fixed to the rear-side end surface of the cam ring includes a side block which comes into contact with the cam ring and a head portion which is assembled thereto, where the oil separator formed in the rear-side block is formed in the head portion, and the separation pipe is formed as a separate member. Even in this configuration, since the oil separation chamber is formed in a direction perpendicular to the driving shaft, the outer radial end of the oil separation chamber is opened. In this example, since the lower opening end of the oil separation chamber formed in a columnar space is plugged by a plug (a cover member), the number of components increases with the installation of the oil separator.

[0008] This invention is made in view of such circumstances, and it is an object of the invention to provide a compressor equipped with a centrifugal separation type oil separator capable of preventing an increase in the number of components with the installation of the oil separator.

MEANS TO SOLVE THE PROBLEMS

[0009] In order to achieve the above-described object, the inventors have carefully examined a configuration in which a separate member does not need to be installed so as to form a centrifugal separation type oil separator, and have found a fact that the number of components may be decreased by forming the centrifugal separator in a basic member constituting a compression chamber, whereby the invention is obtained.

[0010] That is, according to the invention, there is provided a compressor including, a movable member which is movable with a rotation of a shaft, and a fixed member which constitutes a compression chamber along with the movable member, the compressor compressing a working fluid flowing into the compression chamber with the movement of the movable member, characterized in that the fixed member integrates an oil separator which introduces the working fluid compressed in the compression chamber thereinto and separates oil contained in the working fluid.

[0011] Accordingly, since the oil separator is integrated with the fixed member constituting the compression chamber along with the movable member, it is possible to suppress an increase in the number of components due to the installation of the oil separator. Furthermore, since the distance from the compression chamber to the oil separator can also be shortened, it is possible to shorten the axial dimension of the compressor compared to the related art.

[0012] Here, in a case where the fixed member includes a cylinder accommodating the movable member and a side block integrated with the cylinder, the oil separator may be integrated with the side block.

[0013] Furthermore, the movable member and a part or the entirety of the fixed member may be accommodated in a shell member constituting a housing, the oil separator may include an oil separation chamber which introduces the working fluid compressed in the compression chamber and a separation pipe which is accommodated in the oil separation chamber so as to rotate the introduced working fluid, the oil separation chamber and the separation pipe may be integrated with the fixed member, and the lower opening end of the oil separation chamber may be covered by the shell member.

[0014] With such a configuration, since the oil separation chamber and the separation pipe are integrated with the fixed member and the shell member constituting the housing is used as a cover member which covers the opening end of the oil separation chamber, the number of components does not increase with the installation of the oil separator.

[0015] Furthermore, the lower end portion of the oil separation chamber may communicate with an oil storage chamber through an oil discharge path.
Here, the oil discharge path may be a gap formed between the fixed member and the shell member or may be a groove or a hole formed in the fixed member.

[0016] Accordingly, according to such a configuration, since the communication state between the lower end portion of the oil separation chamber and the oil storage chamber may be adjusted by adjusting the size of the gap formed between the fixed member and the shell member or the shape of the groove or the hole formed in the fixed member, it is possible to stabilize the supply of the oil by suppressing the unsteadiness of the oil stored in the oil storage chamber.

[0017] Furthermore, the oil separation chamber may extend in a direction substantially perpendicular to the axial direction of the shaft and the axis thereof may be obliquely inclined with respect to a vertical line.
According to such a configuration, since the axis of the oil separation chamber is obliquely inclined with respect to the vertical line, the position of the oil discharge path is relatively higher than the level of the oil, and hence it is possible to prevent a problem in which the oil discharge hole is submerged by the level of the oil so that oil is not able to be discharged.

[0018] Furthermore, the oil separation chamber may gradually increase in diameter toward the lower opening end. In such a configuration, even in a case where the oil separation chamber and the oil separation pipe are integrated by casting, a mold can be easily separated.

EFFECTS OF THE INVENTION

[0019] As described above, according to the invention, the compressor includes the movable member which is movable with the rotation of the shaft and the fixed member constituting the compression chamber along with the movable member, and the fixed member is integrated with the oil separator. More specifically, in a case where the fixed member includes the cylinder accommodating the movable member and the side block integrated with the cylinder, since the side block is integrated with the oil separator, the number of components may be decreased.

[0020] Furthermore, in a case where the movable member and a part or the entirety of the fixed member are accommodated in the shell member constituting the housing and the oil separator includes the oil separation chamber introducing the working fluid compressed in the compression chamber and the separation pipe accommodated in the oil separation chamber so as to rotate the introduced working fluid, when the separation pipe is integrated with the fixed member and the lower opening end of the oil separation chamber is covered by the shell member, there is no need to provide additional members even when the oil separation chamber is formed.

[0021] Then, when the oil separation chamber of the oil separator is formed so as to extend in a direction substantially perpendicular to the axial direction of the shaft

and the axis thereof is obliquely inclined with respect to a vertical line, the oil discharge path formed in the lower end portion of the oil separation chamber can be disposed at a position higher than the level of the oil, and oil can be satisfactorily discharged from the oil separation chamber.
Here, when the oil discharge path is formed as the gap formed between the fixed member and the shell member or the groove or the hole formed in the fixed member, the communication state between the lower end portion of the oil separation chamber and the oil storage chamber can be adjusted by adjusting the size of the gap or the shape of the groove or the hole, and the supply of the oil can be stabilized by suppressing the unsteadiness of the oil inside the oil storage chamber.

[0022] Further, when the oil separation chamber gradually increases in diameter toward the lower opening end, a mold can be easily separated in a case where the oil separator is integrated by casting, and hence cast-molding is facilitated.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

FIG. 1 is a diagram illustrating an embodiment of a compressor according to the invention, where FIG. 1(a) is a diagram illustrating a side cross section which is cut away so that a discharge path or an oil separator appears, and FIG. 1(b) is a diagram illustrating a side cross section which is cut away so that a suction path or an oil storage chamber appears.

FIG. 2 is a diagram illustrating a side cross section of each location of the compressor illustrated in FIG. 1, where FIG. 2(a) illustrates a cross-sectional view taken along the line A-A of FIG. 1, FIG. 2(b) illustrates a cross-sectional view taken along the line B-B of FIG. 1, and FIG. 2(c) illustrates a cross-sectional view taken along the line C-C of FIG. 1.

FIG. 3 is a perspective view of a partial notch of the compressor according to the invention, where FIG. 3(a) is a diagram illustrating a state seen from the rear side where a part of a shell member is cut away, FIG. 3(b) is a diagram illustrating a state seen from the rear side where a part of a shell member, a fixed member, and a part of an oil separator formed in the fixed member are cut away, and FIG. 3(c) is a diagram illustrating a fixed member which is cut away at the portion of an oil separator.

FIG. 4(a) is a cross-sectional view illustrating another embodiment taken along the line C-C of the compressor illustrated in FIG. 1, and FIG. 4(b) is a diagram illustrating another embodiment in which a part of a shell member seen from the rear side of the compressor, a fixed member, and a part of an oil separator formed in the fixed member are cut away.

MODE FOR CARRYING OUT THE INVENTION

[0024] Hereinafter, an embodiment of the invention will be described by referring to the accompanying drawings.

[0025] FIG. 1 to FIG. 3 illustrate a vane-type compressor suitable for a refrigeration cycle in which a refrigerant is used as a working fluid. The vane-type compressor includes a movable member 2 which is movable with a rotation of a shaft 1, a fixed member 4 which constitutes a compression chamber 3 along with the movable member 2, and a shell member 5 which constitutes a housing for accommodating the movable member 2 and the fixed member 4.

[0026] The fixed member 4 includes a cylinder 4a which accommodates the movable member 2 and a rear-side block 4b which is integrated so as to be continuous to the rear side of the cylinder 4a.

[0027] The movable member 2 includes a rotor 2a which is rotatably accommodated in the cylinder 4a of the fixed member 4 and is fixed to the shaft 1 and vanes 2b which are inserted into vane grooves 6 formed in the rotor 2a.

[0028] The shell member 5 includes a front-side block 5a which comes into contact with the front-side end surface of the cylinder 4a and a cylindrical portion 5b which is formed so as to surround the outer peripheral surfaces of the cylinder 4a and the rear-side block 4b.

[0029] The shaft 1 is rotatably supported to the front-side block 5a of the shell member 5 and the rear-side block 4b of the fixed member 4 through a plane bearing. The shell member 5 is provided with a suction opening 7 and a discharge opening 8 of a working fluid (a refrigerant gas) and a suction space (a low-pressure space) 10 which communicates with the suction opening 7 and is formed along with a recess portion 9 formed in the cylinder 4a of the fixed member 4. Furthermore, a discharge space (a high-pressure space) 11 to be described later is defined by the cylinder 4a of the fixed member 4 and the cylindrical portion 5b of the shell member 5, and the discharge space 11 communicates with the discharge opening 8 through an oil separator 14 which is formed in the rear-side block 4b of the fixed member 4.

[0030] The cross section of the space surrounded by the cylinder 4a and the cross section of the rotor 2a are formed in a true circular shape, the axis of the cylinder 4a and the axis of the rotor 2a are deviated from each other so that the outer peripheral surface of the rotor 2a comes into contact with the inner peripheral surface of the cylinder 4a at one position in the circumferential direction (the axes are deviated from each other by 1/2 of the difference between the inner diameter of the cylinder and the outer diameter of the rotor 2a), and a compression space 13 is defined between the inner peripheral surface of the cylinder 4a and the outer peripheral surface of the rotor 2a. The compression space 13 is divided by the vanes 2b so that plural compression chambers 3 are formed, and the volume of each compression chamber 3 changes with the rotation of the rotor 2a.

[0031] As for the shell member 5, a pulley 15 which transmits a rotational force to the shaft 1 is rotatably attached to the outside of a boss portion 5c integrated with the front-side block 5a, and the rotational force is transmitted from the pulley 15 to the shaft 1 through an electromagnetic clutch 16.

[0032] Furthermore, both end portions of the cylinder 4a of the fixed member 4 are provided with flange portions 4c and 4d which protrude in the radial direction. The front-side flange portion 4c is formed in a shape which matches the shape of the inner peripheral portion of the shell member 5, and is fitted into the shell member 5 so as to come into contact with the end surface of the front-side block 5a. Furthermore, the rear-side flange portion 4d is also formed in a shape which matches the shape of the inner peripheral portion of the shell member 5, and is fitted into the shell member 5 so that a gap between the rear-side flange portion and the shell member is sealed by a seal member such as an O-ring with high air-tightness.

[0033] The peripheral surface of the cylinder 4a is provided with a suction port 17 which communicates with the suction space 10 so as to correspond to the compression space 13 and a discharge port 18 which communicates with the discharge space 11. Accordingly, when the cylinder 4a is fitted into the shell member 5, the suction space 10 communicates with the compression chamber 3 through the suction port 17, the discharge space 11 of which both side ends are defined by the flange portions 4c and 4d is formed between the outer peripheral surface of the cylinder 4a and the inner peripheral surface of the cylindrical portion 5b, and the discharge space 11 is able to communicate with the compression chamber 3 through the discharge port 18. Then, the discharge port 18 is configured to be opened and closed by a discharge valve 19 which is accommodated in the discharge space 11.

[0034] The discharge space 11 is formed along almost the entire circumference of the cylinder 4a from the portion provided with the discharge valve 19 near a partition wall 20 which protrudes from the vicinity of the discharge port 18 of the cylinder 4a, and communicates with the oil separator 14 described below through a passage hole 21 which is formed in the flange portion 4d at the side opposite to the installation side of the discharge port 18 with respect to the partition wall 20.

[0035] The oil separator 14 is integrated with the rear-side block 4b of the fixed member 4, includes an oil separation chamber 22 which is formed in a columnar space communicating with the passage hole 21 formed in the flange portion 4d, and is formed by coaxially disposing a substantially cylindrical separation pipe (a separator pipe) 23 integrated with the fixed member 4 (the rear-side block 4b) in the oil separation chamber 22.

[0036] The oil separation chamber 22 extends in a direction substantially perpendicular to the axial direction of the shaft 1 and is formed so that the axis is obliquely inclined with respect to a vertical line, where the upper end portion communicates with the discharge opening 8 of the shell member 5 through the separation pipe 23 and the lower end portion is opened to the side surface of the rear-side block 4b. Then, the opening portion of the lower end portion of the oil separation chamber 22 is covered by the cylindrical portion 5b of the shell member 5. In this example, the cylindrical portion 5b extends in the axial direction to an extent in which the entirety of the rear-side block 4b is accommodated, and a gap between the oil separation chamber 22 and the cylindrical portion 5b of the shell member 5 is sealed with high air-tightness by a seal member such as an O-ring which is provided in the circumferential direction of the rear-side block 4b at the front and rear sides of the compressor in the axial direction.

[0037] Furthermore, the lower opening end of the oil separation chamber 22 (the lower end of the cylindrical wall defining the oil separation chamber 22) is covered by the cylindrical portion 5b of the shell member 5. A gap 24 which is set to a predetermined gap (0.1 to 0.2 mm) is formed between the fixed member 4 and the shell member 5 (more specifically, the rear-side block 4b of the fixed member 4 and the cylindrical portion 5b of the shell member 5) (which is exaggerated in FIG. 2(c)), and the gap 24 constitutes an oil discharge path which connects the lower end portion of the oil separation chamber 22 and the oil storage chamber 25.

[0038] Accordingly, a working fluid which flows into the oil separation chamber 22 rotates about the separation pipe 23 accommodated in the oil separation chamber 22, and in the meantime, mixed oil is separated and a discharge gas obtained by separating oil is sent to the discharge opening 8 through the separation pipe 23. Furthermore, the separated oil is accumulated in the oil storage chamber 25 which is formed in the bottom portion of the fixed member 4 through the gap 24 formed between the fixed member 4 and the shell member 5 so as to communicate with the lower end portion of the oil separation chamber 22, and then is supplied to each lubrication portion due to a difference in the pressure between the oil storage chamber 25 and the each lubrication portion through an oil supply path 30.

[0039] In the above-described configuration, the rotational force which is generated by a power source (not illustrated) is transmitted to the shaft 1 through the pulley 15 and the electromagnetic clutch 16, and when the rotor 2a rotates, the working fluid which flows from the suction opening 7 into the suction space 10 is suctioned to the compression space 13 through the suction port 17. Since the each volume of the compression chambers 3 which are divided by the vanes 2b inside the compression space changes with the rotation of the rotor 2a, the working fluid which is closed between the vanes 2b is compressed and is discharged from the discharge port 18 to the discharge space 11 through the discharge valve 19. The working fluid which is discharged into the discharge space 11 moves in the circumferential direction along the outer peripheral surface of the cylinder 4a (along the inner peripheral surface of the cylindrical portion 5b of the shell member 5), and flows substantially around the cylinder 4a so that it is introduced into the oil separation chamber 22 of the oil separator 14 which is integrated with the rear-side block 4b through the passage hole 21 formed in the flange portion 4d. Subsequently, while the working fluid rotates inside the oil separation chamber, oil is separated from the working fluid, the resulting working fluid is discharged from the discharge opening 8 to an external circuit through the separation pipe 23, and the separated oil is guided to the oil storage chamber 25 through the gap 24 which is formed in the lower end of the oil separation chamber 22.

[0040] The pressure pulsation of the discharge gas is reduced in the process where the working fluid discharged from the discharge port 18 moves in the discharge space 11 formed between the cylinder 4a of the fixed member 4 and the cylindrical portion 5b of the shell member 5, from a portion in which the discharge port 18 is disposed to a portion in which the passage hole 21 is disposed. Furthermore, since the working fluid is guided to the oil separation chamber 22 of the oil separator 14 only through the passage hole 21 of the flange portion 4d, the pressure pulsation of the discharge gas is reduced in the process where the working fluid passes through the passage hole 21. Furthermore, the pressure pulsation is reduced even in the process where the working fluid passes through the oil separator 14. Hence the working fluid is discharged from the discharge opening 8 in a state where oil is separated therefrom and the pressure pulsation is small.

[0041] Furthermore, in the above-described compressor, since the fixed member 4 which constitutes the compression chamber 3 along with the movable member 2 is formed by integrating the rear-side block 4b with the cylinder 4a which accommodates the movable member 2 (the rotor 2a and the vanes 2b) movable with the rotation of the shaft 1, and the fixed member 4 is accommodated in the shell member 5 in which the front-side block 5a and the cylindrical portion 5b are integrated with each other, the number of components of the compressor can be decreased. Furthermore, since the oil separator 14 is integrated with the rear-side block 4b of the fixed member 4 and the lower end opening portion of the oil separation chamber 22 is covered by extending the cylindrical portion 5b of the shell member 5 to the rear-side end portion of the rear-side block 4b, there is no need to provide a plug member which covers the oil separation chamber 22, and the number of components does not increase with the installation of the oil separator 14.

[0042] For this reason, since the number of components can be decreased by integrating the oil separator 14 with the rear-side block 4b, the manufacturing cost can be reduced, and the axial dimension of the compression chamber can be shortened compared to the existing vane-type compressor including an oil separator.

[0043] Furthermore, since the oil separation chamber 22 is obliquely formed with respect to the vertical direction and the separated oil is guided to the oil storage chamber 25 through the gap 24 formed in the lower end portion, the discharge of the oil from the oil separation chamber 22 is not disturbed by the oil accumulated in the oil storage chamber 25. Furthermore, the supply of the oil can be stabilized by suppressing the unsteadiness of the oil stored in the oil storage chamber 25 through the appropriate adjustment of the gap 24.

In addition, since the oil separation chamber 22 increases in diameter toward downward (toward the opening end), a mold can be easily separated in a case where the fixed member 4 is integrated with the oil separator 14 by casting, and hence the cast-molding is facilitated.

[0044] Furthermore, in the above-described configuration, an embodiment has been described in which the oil discharge path communicating with the lower end portion of the oil separation chamber 22 and the oil storage chamber 25 is configured by the gap 24 formed between the fixed member 4 and the shell member 5, but as illustrated in FIG. 4, the oil discharge path formed in the lower end portion of the oil separation chamber 22 may be formed by a groove 24' formed in the fixed member 4 or a hole (not illustrated). Even in such a configuration, the supply of the oil can be stabilized by suppressing the unsteadiness of the oil stored in the oil storage chamber 25 through the adjustment of the shape of the groove 24' or the hole.

[0045] Furthermore, an embodiment has been described in which the invention is applied to the vane-type compressor, but the above-described configuration may be adopted, in a case where a fixed member is provided with a centrifugal separation type oil separator, in a scroll-type compressor which includes a fixed scroll (the fixed member) fixed to a housing and a movable scroll (a movable member) moving (rotating) with respect to the fixed scroll, in which the movable scroll is rotationally driven by a shaft rotatably disposed in the housing, and a refrigerant is suctioned and compressed by expanding and contracting the volume of the compression chamber formed by both scrolls with the rotation of the movable scroll. Furthermore, in the above-described configuration, a configuration example has been described in which the oil separator 14 is formed in the rear-side block 4b integrated with the cylinder 4a and is accommodated in the shell member 5, However, the same configuration as that of the description above may be adopted in a configuration in which the oil separator is formed in the front-side block integrated with the cylinder and is accommodated in the shell member.

EXPLANATION OF REFERENCE SIGNS

[0046]

1: shaft
2: movable member
3: compression chamber
4: fixed member
5: shell member

14: oil separator
4a: cylinder
4b: rear-side block
5a: front-side block
5b: cylindrical portion
22: oil separation chamber
23: separation pipe
24: gap
24': oil discharge hole
30: oil supply path

Claims

1. A compressor comprising a movable member (2) which is movable with a rotation of a shaft (1), and a fixed member (4) which constitutes a compression chamber (3) along with the movable member (2), the compressor compressing a working fluid flowing into the compression chamber (3) with the movement of the movable member (2),
characterized in that the fixed member (4) integrates an oil separator (14) which introduces the working fluid compressed in the compression chamber (3) thereinto and separates oil contained in the working fluid.

2. The compressor according to claim 1, **characterized in that** the fixed member (4) includes a cylinder (4a) accommodating the movable member (2) and a side block (4b) integrated with the cylinder (4a), and the oil separator (14) is integrated with the side block (4b).

3. The compressor according to claim 1 or 2, **characterized in that** the movable member (2) and a part or the entirety of the fixed member (4) are accommodated in a shell member (5) constituting a housing, the oil separator (14) includes an oil separation chamber (22) which introduces the working fluid compressed in the compression chamber (3) and a separation pipe (23) which is accommodated in the oil separation chamber (22) so as to rotate the introduced working fluid, the oil separation chamber (22) and the separation pipe (23) are integrated with the fixed member (4), and the lower opening end of the oil separation chamber (22) is covered by the shell member (5).

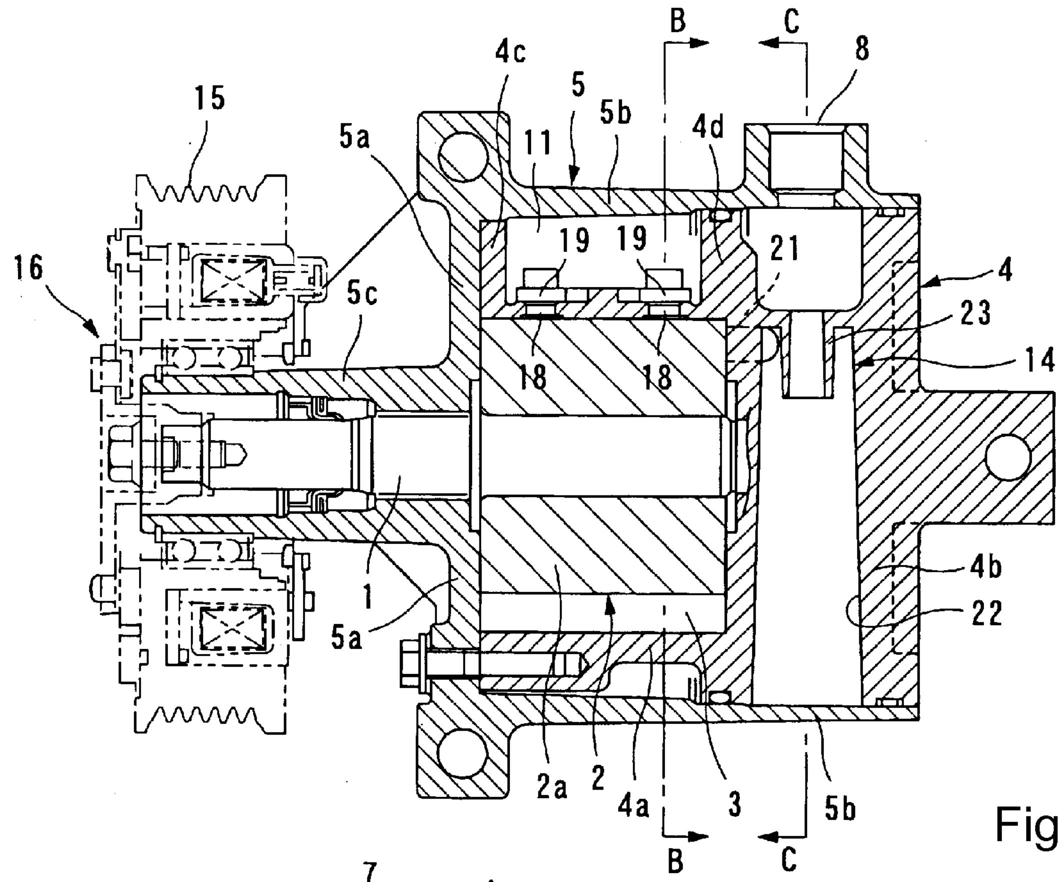
4. The compressor according to claim 3, **characterized in that** the lower end portion of the oil separation chamber (22) communicates with an oil storage chamber (25) through an oil discharge path.

5. The compressor according to claim 4, **characterized in that** the oil discharge path is a gap (24) formed between the fixed member (4) and the shell member (5).

6. The compressor according to claim 4, **characterized in that** the oil discharge path is a groove (24') or a hole formed in the fixed member (4).

7. The compressor according to any one of claims 4 to 6, **characterized in that** the oil separation chamber (22) extends in a direction substantially perpendicular to the axial direction of the shaft (1) and the axis thereof is obliquely inclined with respect to a vertical line.

8. The compressor according to any one of claims 3 to 7, **characterized in that** the oil separation chamber (22) gradually increases in diameter toward the lower opening end.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5c
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14
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5a
22
2a
2
4a
3
5b
B
C

Fig.1A

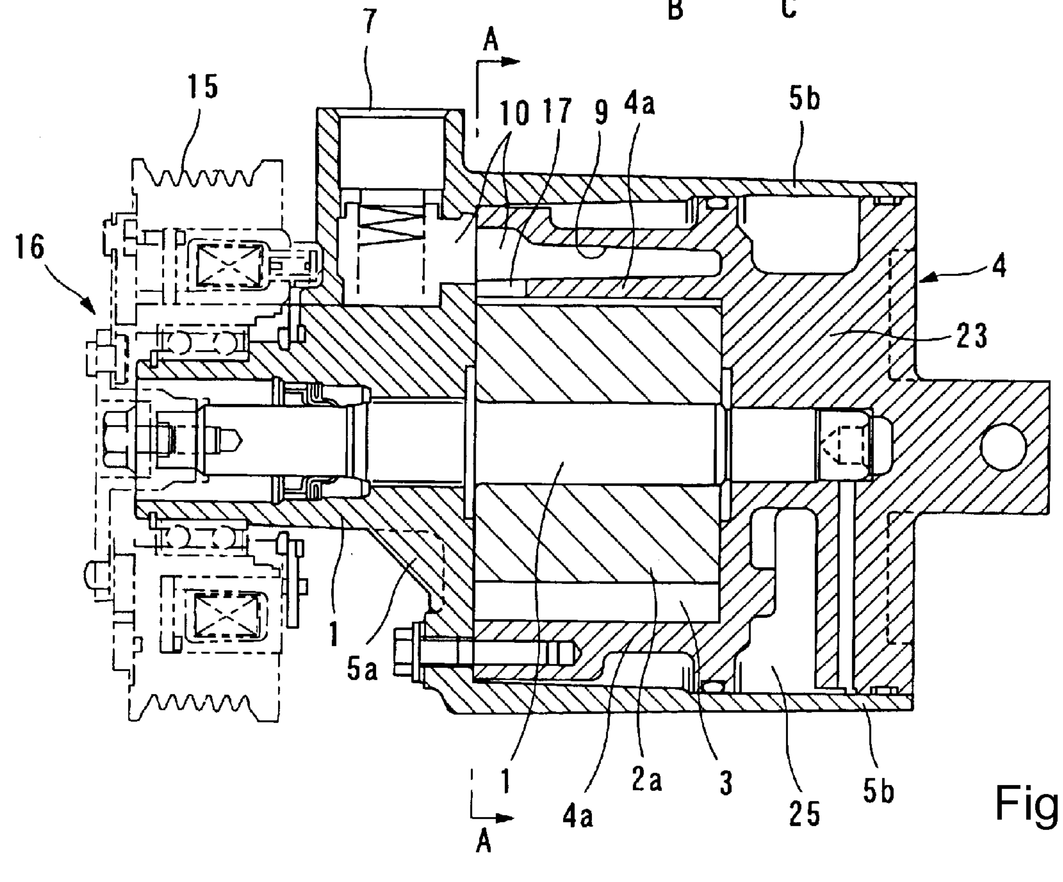
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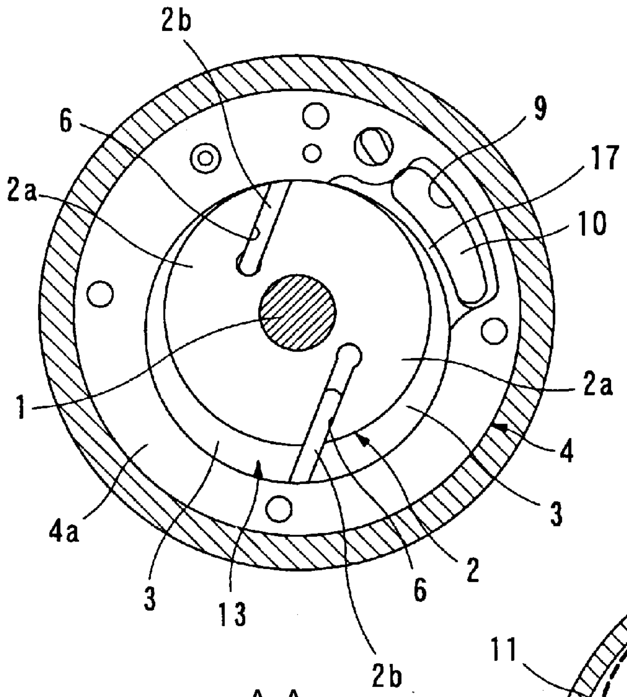
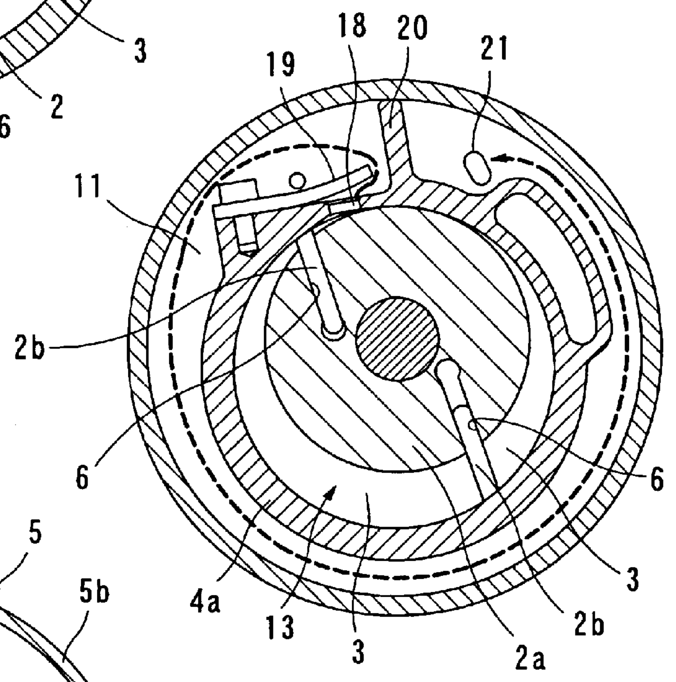
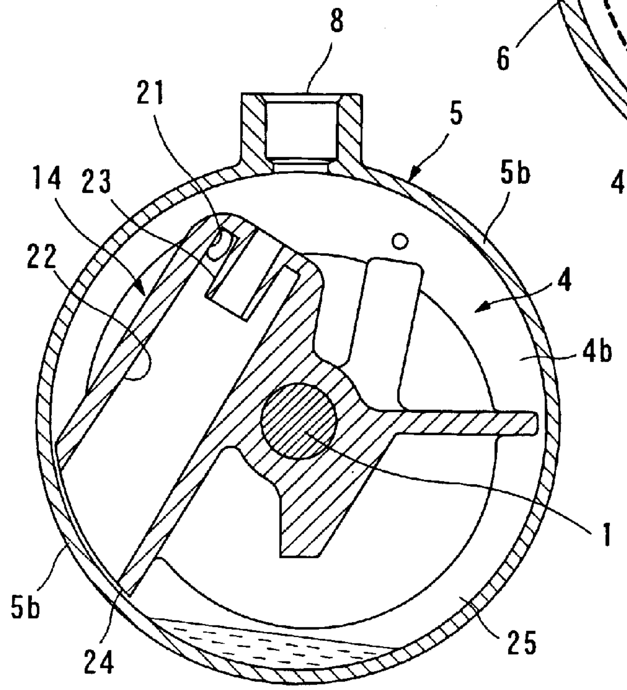
Fig.1B



A-A
Fig.2A



B-B
Fig.2B



C-C
Fig.2C

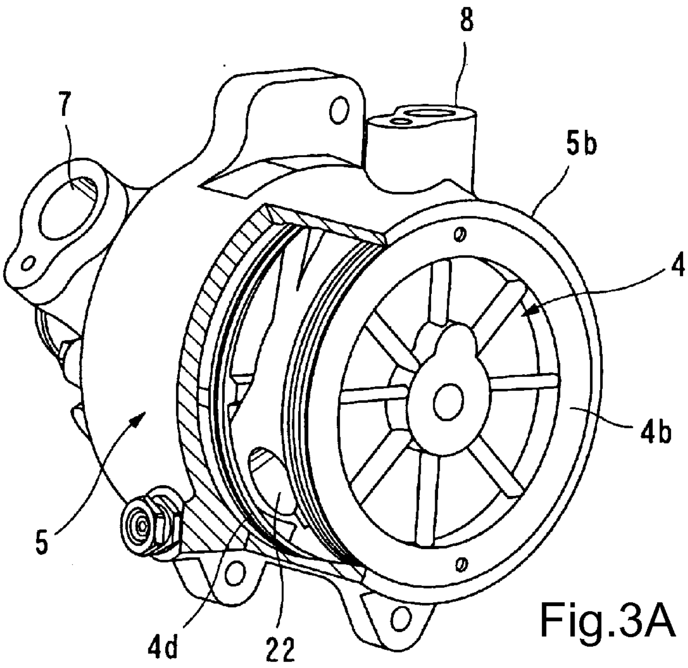


Fig.3A

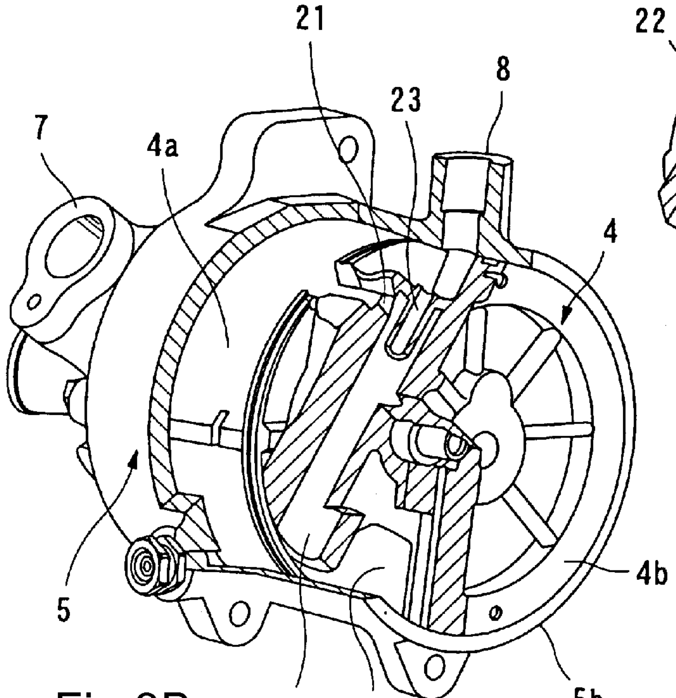


Fig.3B

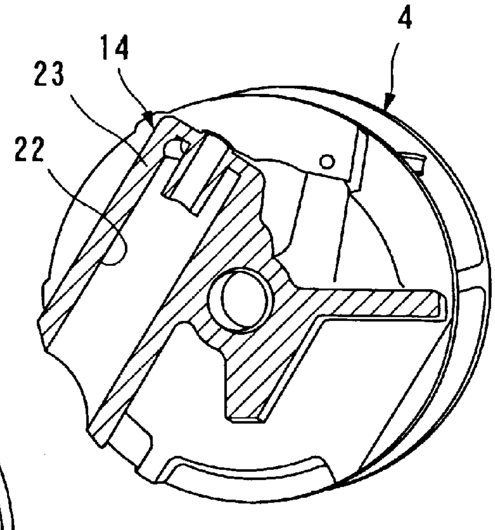
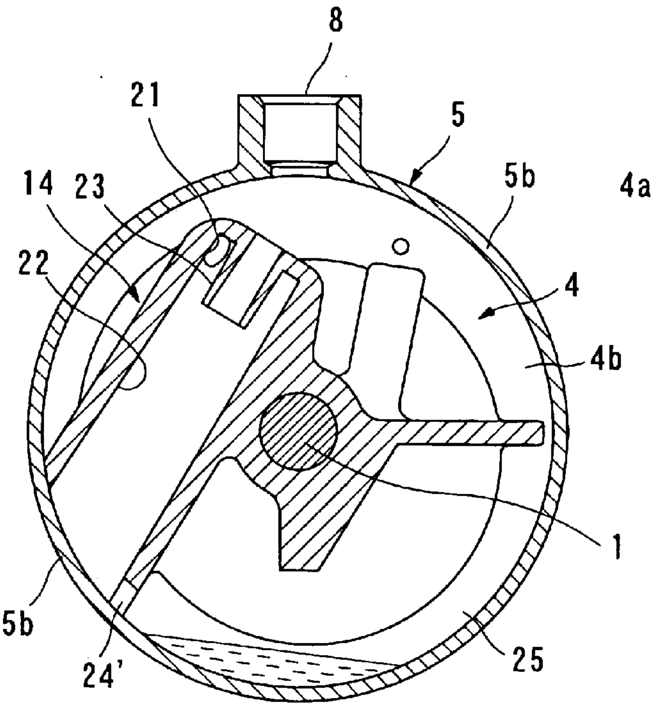


Fig.3C



C-C
Fig.4A

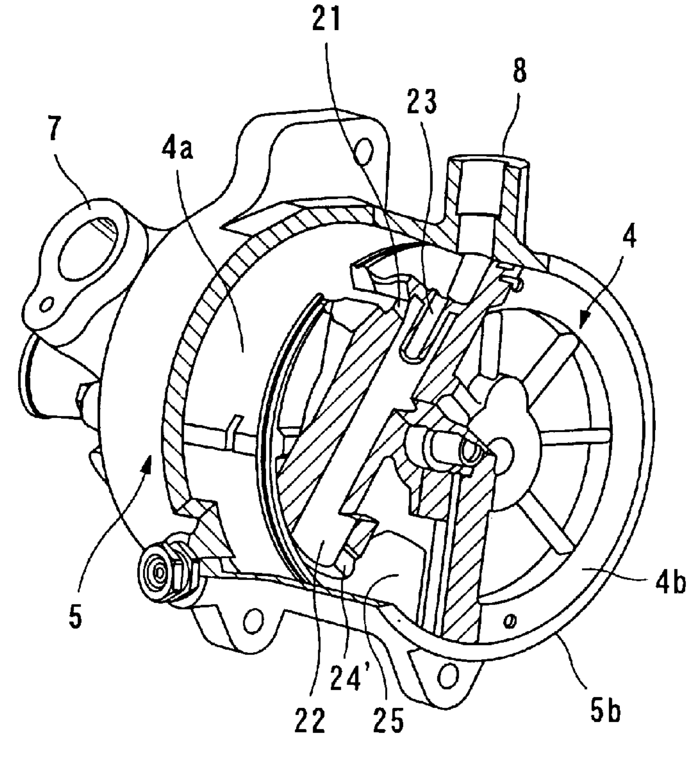


Fig.4B

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/006671

A. CLASSIFICATION OF SUBJECT MATTER
F04C29/02(2006.01)i, *F04B39/04*(2006.01)i, *F04C18/344*(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, F04C18/344

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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.
X A	JP 2001-295767 A (Denso Corp.), 26 October 2001 (26.10.2001), paragraphs [0014] to [0025], [0035]; fig. 1, 5 & US 2001/0029727 A1	1,2 3-8
X A	JP 2006-132487 A (Mitsubishi Heavy Industries, Ltd.), 25 May 2006 (25.05.2006), paragraphs [0012] to [0024]; fig. 1 to 5 (Family: none)	1,2 3-8
A	JP 2009-167834 A (Calsonic Compressor Inc.), 30 July 2009 (30.07.2009), paragraphs [0044] to [0047]; fig. 2 (Family: none)	1-8

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

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- "O" document referring to an oral disclosure, use, exhibition or other means
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- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
03 February, 2011 (03.02.11)	15 February, 2011 (15.02.11)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2010/006671

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2003-336588 A (Matsushita Electric Industrial Co., Ltd.), 28 November 2003 (28.11.2003), entire text; all drawings & JP 2008-291849 A & US 2005/0106041 A1 & WO 2003/081043 A1 & CN 1643255 A	1-8

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2001295767 A **[0005]**
- JP 2009156231 A **[0005]**