



(11) **EP 3 015 712 A1**

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

(43) Date of publication:  
**04.05.2016 Bulletin 2016/18**

(51) Int Cl.:  
**F04C 23/00<sup>(2006.01)</sup> F04C 18/356<sup>(2006.01)</sup>**

(21) Application number: **14849841.3**

(86) International application number:  
**PCT/JP2014/071702**

(22) Date of filing: **20.08.2014**

(87) International publication number:  
**WO 2015/045678 (02.04.2015 Gazette 2015/13)**

(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**  
Designated Extension States:  
**BA ME**

(72) Inventors:  
• **OGAWA, Makoto**  
Tokyo 108-8215 (JP)  
• **ESAKI, Ikuo**  
Tokyo 108-8215 (JP)  
• **UNO, Masanari**  
Tokyo 108-8215 (JP)

(30) Priority: **27.09.2013 JP 2013201575**

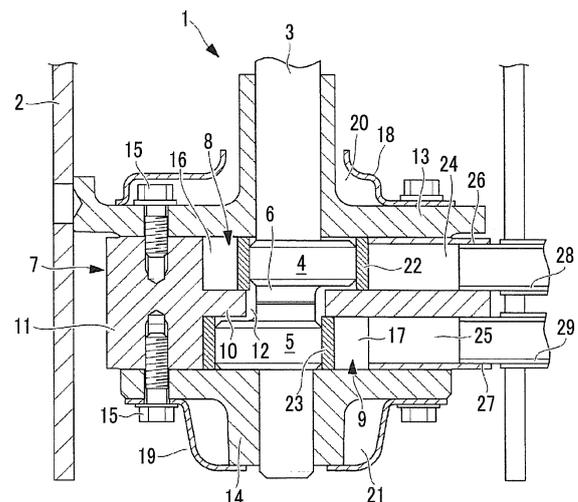
(74) Representative: **Intès, Didier Gérard André et al**  
**Cabinet Beau de Loménie**  
**158, rue de l'Université**  
**75340 Paris Cedex 07 (FR)**

(71) Applicant: **Mitsubishi Heavy Industries, Ltd.**  
**Tokyo 108-8215 (JP)**

(54) **ROTARY COMPRESSOR**

(57) Provided is a rotary compressor that: removes limitations such as restrictions on intake pipe diameter, seal limits on a separator plate, and assembly limits on a rotating shaft; makes possible a limit design exceeding that of the present situation; and achieves increased efficiency, a reduced number of components, and a simplified assembly. A multi-cylinder rotary compressor (1) provided with a plurality of cylinders (8, 9), wherein a rotating shaft (3) provided with a plurality of eccentric shaft parts (4, 5) at prescribed intervals in an axial direction is divided by a center shaft part (6) between the eccentric shaft parts (4, 5) into a rotating shaft having a divided structure that can be integrally linked, and the plurality of cylinders (8, 9) have cylinder chambers (16, 17) formed in both end surfaces, resulting in an integrated-structure cylinder (11) in which a separator plate (10) partitioning the cylinder chambers (16, 17) is integrally formed in the center.

FIG. 1



**EP 3 015 712 A1**

**Description****[0006]**

## Technical Field

**[0001]** The present invention relates to a multi-cylinder rotary compressor provided with a plurality of cylinders.

## Background Art

**[0002]** In single-stage multi-cylinder rotary compressors or multi-stage rotary compressors, a plurality of cylinder chambers are constituted by providing a plurality of cylinders in the direction of a rotating shaft, sandwiching a separator plate between the cylinders, closing one end of each cylinder using the separator plate, and closing the other end using each bearing member. A rotor (piston) that rotates along an inner peripheral surface of each cylinder chamber is rotatably provided in an eccentric shaft part of the rotating shaft (crankshaft), and a compression operation is performed by the eccentric rotation of the rotor.

**[0003]** In such rotary compressors, during assembling, it is necessary to pass the eccentric shaft part of the rotating shaft through a through-hole of the separator plate. Therefore, the diameter of the hole is increased, and assembling is made easy. However, this makes it impossible to ensure the sealing performance of the cylinder chambers. Therefore, as illustrated in Patent Document 1, there is provided a rotary compressor in which a rotating shaft is made dividable by a center shaft part between eccentric shaft parts, and the divided rotating shafts are integrally linked with each other after a separator plate is inserted into the center shaft part.

## Citation List

## Patent Literature

**[0004]** [PTL 1] Japanese Unexamined Patent Application Publication No. 2010-121481

## Summary of Invention

## Technical Problem

**[0005]** The points for increasing the efficiency of the multi-cylinder rotary compressors are as follows. (1) To reduce leakage loss by making the cylinder width (thickness) small, and shortening the axial seal length between the outer peripheral surface of the rotor and the inner peripheral surface of the cylinder, and (2) To make the diameter of a journal part, the diameter of an eccentric shaft part, and the external diameter of the rotor small, respectively, and reduce the sliding loss during the rotation of the rotor. However, in the structures of the rotary compressors in the present situation, there were the following restrictions, and it was difficult to make a design that satisfies all of these points.

A. Restrictions on intake pipe diameter: if the cylinder width (thickness) is made small, the pipe diameter of an intake pipe connected to the cylinder is restricted along with this, it is impossible to ensure a required pipe diameter, and efficiency is lowered due to an increase in intake pressure loss.

B. Seal limits on separator plate: the diameter of the through-hole of the separator plate becomes a restriction on ensuring sealing performance, and consequently, the diameter cannot be made large unnecessarily, which becomes a restriction on assembling.

C. Assembly limits on rotating shaft: although the eccentric shaft part of the rotating shaft should be passed through the diameter of the through-hole of the separator plate, the diameter of the through-hole cannot be increased. This hinders assembly performance, and becomes a hindrance on increasing the eccentricity of the eccentric shaft part.

**[0007]** Although the seal limits on the separator plate and the assembly limits on the rotating shaft can be relaxed by configuring the rotating shaft so as to be dividable between the eccentric shaft parts as in Patent Document 1, the restrictions on intake pipe diameter cannot be eliminated. Additionally, even if the rotating shaft has the divided structure, it is necessary to assemble a compression mechanism by individually incorporating a plurality of cylinders and separator plates, a pair of bearing members provided at both ends of the cylinders, and the like, and install these within a housing, and improvements in the reduction of the number of components, simplified assembly, and the like could not be expected.

**[0008]** The invention has been made in view of such circumstances, and an object thereof is to provide a rotary compressor that removes restrictions on intake pipe diameter, seal limits on a separator plate, assembly limits on a rotating shaft, and the like, makes possible a design with limitations exceeding that of the present situation, and achieves increased efficiency, a reduced number of components, and simplified assembly.

## 45 Solution to Problem

**[0009]** In order to solve the above problems, the rotary compressor of the invention adopts the following means. That is, the multi-cylinder rotary compressor related to the invention is a multi-cylinder rotary compressor including a plurality of cylinders. A rotating shaft provided with a plurality of eccentric shaft parts at predetermined intervals in an axial direction is divided by a center shaft part between the eccentric shaft parts into a rotating shaft having a divided structure that can be integrally linked. The plurality of cylinders have cylinder chambers formed in both end surfaces, resulting in an integrated-structure cylinder in which a separator plate partitioning the cylinder

der chambers is integrally formed in the center.

**[0010]** According to this configuration, even if a through-hole provided in the separator plate has a hole diameter that gives priority to ensuring of sealing performance, the eccentric shaft parts can be easily assembled without being passed through the through-hole of the separator plate by passing the center shaft part of the rotating shaft having the divided structure through the through-hole of the separator plate, and then integrally linking the center shaft part with the through-hole. Additionally, even if leakage loss is reduced by making the width (thickness) small, the width (thickness) of the integrated-structure cylinder can be increased by the thickness of the separator plate, and an intake port and an intake pipe connection hole can be provided within the increased cylinder width (thickness). Therefore, it is possible to set the diameter of the intake port or the pipe diameter of an intake pipe without being restricted by the cylinder width. Therefore, a design in which restrictions on the intake pipe diameter of the intake pipe, seal limits on the separator plate, assembly limits on the rotating shaft, and the like are removed is made possible, and increased efficiency of the multi-cylinder rotary compressor, a reduced number of components, and simplified assembly can be achieved.

**[0011]** In the above rotary compressor, the plurality of cylinder chambers of which both ends are closed may be formed by bearing members being installed in both end surfaces of the integrated-structure cylinder, and the rotating shaft may be rotatably supported via the bearing members in both the end surfaces.

**[0012]** According to this configuration, the plurality of cylinder chambers of which both ends are closed by the integrally formed separator plate can be formed by installing the bearing members, respectively, in both the end surfaces of the integrated-structure cylinder, and the rotating shaft can be rotatably supported via the pair of bearing members. Therefore, compared to a multi-cylinder rotary compressor of a related-art type in which a separator plate that is a separate component is sandwiched and assembled between a plurality of cylinders having separate configurations, and bearing members are incorporated into both ends of the separator plate, the number of components can be reduced, and simplification of the configuration and assembly of the components, downsizing, and the like can be achieved.

**[0013]** In any rotary compressor of the above-described rotary compressors, an intake port and an intake pipe connection hole that extend radially outward from each of the cylinder chambers may be provided in the integrated-structure cylinder, and at least a portion from one end of a peripheral region around the intake port and the intake pipe connection hole to the other end thereof may be a continuous wall.

**[0014]** According to this configuration, by forming the cylinder wall from one end of the peripheral region around the intake port and the intake pipe connection hole that extend in the radial direction from each of the cylinder

chambers to the other end thereof as the continuous wall, an intake port and an intake pipe connection hole with larger diameter can be provided without being restricted by the width of the individual cylinder. Therefore, even if the cylinder width is made small, the diameter of the intake port or the pipe diameter of the intake pipe is not restricted, a problem such that intake efficiency is lowered due to an increase in pressure loss can be solved, and increased efficiency can be achieved.

**[0015]** In the above rotary compressor, a plurality of intake ports and intake pipe connection holes may be provided to correspond to the plurality of cylinder chambers.

**[0016]** According to this configuration, even if a plurality of intake ports and intake pipe connection holes are provided to correspond to the plurality of cylinder chambers, the integrated-structure cylinder is adopted. Accordingly, intake ports and intake pipe connection holes with larger diameter can be provided without being restricted by the width of the individual cylinders. Therefore, even if the cylinder width is made small, the diameter of the intake ports or the pipe diameter of the intake pipes is not restricted, a problem such that intake efficiency is lowered due to an increase in pressure loss can be solved, and increased efficiency can be achieved.

**[0017]** In the above rotary compressor, the intake port may be one intake port that branches so as to straddle the separator plate and communicate with the plurality of cylinder chambers, and one intake pipe connection hole may be provided to communicate with the intake port.

**[0018]** According to this configuration, the one larger common intake port and the one intake pipe connection hole communicating with this common intake port can be provided in the integrated-structure cylinder corresponding to the width of the plurality of cylinders. Accordingly, refrigerant gas can be made to be taken into the plurality of cylinder chambers via the intake port having the branch configuration. Therefore, even if the cylinder width is made small, the diameter of the intake port or the pipe diameter of the intake pipe is not restricted, a problem such that intake efficiency is lowered due to an increase in pressure loss can be solved, increased efficiency can be achieved, and the simplification of configuration and cost reduction can be achieved by making an intake pipe system a single system.

**[0019]** In the above rotary compressor, the intake port may be one intake port that communicates with the plurality of cylinder chambers so as to straddle the separator plate, and one intake pipe connection hole may be provided in communication with the intake port.

**[0020]** According to this configuration, the one larger common intake port and the one intake pipe connection hole communicating with this common intake port can be provided in the integrated-structure cylinder corresponding to the width of the plurality of cylinders. Accordingly, refrigerant gas can be made to be taken into the plurality of cylinder chambers via the intake port having a size so

as to straddle the separator plate. Therefore, even if the cylinder width is made small, the diameter of the intake port or the pipe diameter of the intake pipe is not restricted, a problem such that intake efficiency is lowered due to an increase in pressure loss can be solved, increased efficiency can be achieved, and the simplification of configuration and cost reduction can be achieved by making an intake pipe system a single system. Advantageous Effects of Invention

**[0021]** According to this invention, even if the through-hole provided in the separator plate has a hole diameter that gives priority to ensuring of sealing performance, the eccentric shaft parts can be easily assembled without being passed through the through-hole of the separator plate by passing the center shaft part of the rotating shaft having the divided structure through the through-hole of the separator plate, and then integrally linking the center shaft part with the through-hole. Additionally, even if leakage loss is reduced by making the cylinder width (thickness) small, the width (thickness) of the integrated-structure cylinder can be increased by the thickness of the separator plate, and the intake port and the intake pipe connection hole can be provided within the increased cylinder width (thickness). Therefore, it is possible to set the diameter of the intake port or the pipe diameter of the intake pipe without being restricted by the cylinder width. Therefore, a design in which restrictions on the intake pipe diameter of the intake pipe, seal limits on the separator plate, assembly limits on the rotating shaft, and the like are removed is made possible, and increased efficiency of the multi-cylinder rotary compressor, a reduced number of components, and simplified assembly can be achieved.

#### Brief Description of Drawings

#### **[0022]**

Fig. 1 is a longitudinal sectional view of a rotary compressor related to a first embodiment of the invention.

Fig. 2 is a longitudinal sectional view of a rotary compressor related to a second embodiment of the invention.

Fig. 3 is a longitudinal sectional view of a rotary compressor related to a third embodiment of the invention.

#### Description of Embodiments

**[0023]** Hereinafter, embodiments related to the invention will be described with reference to the drawings.

#### [First Embodiment]

**[0024]** Hereinafter, a first embodiment of the invention will be described with reference to Fig. 1.

**[0025]** A longitudinal sectional view of a rotary compressor related to the first embodiment of the invention

is illustrated in Fig. 1.

**[0026]** A rotary compressor 1 of the present embodiment can be applied to a single-stage multi-cylinder rotary compressor or a multi-stage rotary compressor, and a two-cylinder type hermetic rotary compressor provided with two cylinders is illustrated herein. The rotary compressor 1 is provided with a sealed housing 2, and has a configuration in which a rotary compression mechanism 7 driven via a rotating shaft (crankshaft) 3 by a motor (not illustrated) provided at an upper part within the sealed housing 2 is provided in a lower part in the sealed housing 2.

**[0027]** The rotating shaft (crankshaft) 3 has an upper part inked with a rotor of the electric motor and is rotationally driven by the electric motor, and has first and second eccentric shaft parts (crank part) 4 and 5 provided at a lower part thereof so as to shift from each other with a phase of about 180 degrees in two upper and lower places at a predetermined interval. The rotating shaft 3 is divided by a center shaft part 6 between the first and second eccentric shaft parts 4 and 5 into two upper and lower pieces, and is configured such that the eccentric shaft parts are capable of being integrally linked with each other by screw linking or concavo-convex linking. In addition, it is natural that the linking of the rotating shaft 3 divided into two pieces may be performed by means other than the screw linking or the concavo-convex linking.

**[0028]** The rotary compression mechanism 7 is provided with an integrated-structure cylinder 11 having a configuration in which a first cylinder 8 is formed in an upper end surface, a second cylinder 9 is formed in a lower end surface, and a separator plate 10 partitioning the first cylinder 8 and the second cylinder 9 is integrally formed in the center. The separator plate 10 is provided with a through-hole 12 having a diameter such that at least the center shaft part 6 of the rotating shaft 3 is capable of passing through the through-hole.

**[0029]** When an upper bearing member 13 and a lower bearing member 14 are respectively fixed to and installed in an upper end surface and a lower end surface of the integrated-structure cylinder 11 via a plurality of bolts 15, an upper surface and a lower surface of the first cylinder 8 and the second cylinder 9 are sealed, respectively. This allows the first cylinder chamber 16 and the second cylinder chamber 17 serving as closed spaces to be configured.

**[0030]** The upper bearing member 13 and the lower bearing member 14 rotatably support lower regions of the rotating shaft 3 in two upper and lower places with the integrated-structure cylinder 11 interposed therebetween. Covers 18 and 19 are respectively and integrally tightened to and formed in outer surfaces of the upper bearing member 13 and the lower bearing member 14 via the plurality of bolts 15, and discharge chambers 20 and 21 that discharge compressed gas are formed in the outer surfaces.

**[0031]** Additionally, the upper bearing member 13 has a configuration in which the rotary compression mecha-

nism 7 is fixed to and installed within the sealed housing 2 by being plug-welded or crimped to an inner peripheral surface of the sealed housing 2 in a plurality of places (for example, three places). In addition, the integrated-structure cylinder 11 is fixed to and installed in the upper bearing member 13, and the lower bearing member 14 is fixed to and installed in the integrated-structure cylinder 11.

**[0032]** The first and second eccentric shaft parts 4 and 5 provided at the rotating shaft 3 are respectively provided to correspond to the inside of the first cylinder chamber 16 and the inside of the second cylinder chamber 17. Rotors (pistons) 22 and 23 are respectively and rotatably fitted to outer peripheries of the first and second eccentric shaft parts 4 and 5. Rotors 22 and 23 are rotated along inner peripheral surfaces of the first cylinder chamber 16 and the second cylinder chamber 17 by the eccentric rotation of the first and second eccentric shaft parts 4 and 5.

**[0033]** Additionally, blade grooves (not illustrated) are respectively provided to correspond to the first cylinder chamber 16 and the second cylinder chamber 17, as being publicly known, in the integrated-structure cylinder 11. Blades (not illustrated) that slide in the blade grooves are assembled into the blade grooves in a state where the blades are pressed against and biased to outer peripheries of the rotors 22 and 23. The inside of the first cylinder chamber 16 and the inside of the second cylinder chamber 17 are configured so as to be partitioned into a discharge side and an intake side by the blades.

**[0034]** Moreover, a plurality of intake ports 24 and 25 and a plurality of intake pipe connection holes 26 and 27 that extend radially outward from the cylinder chambers 16 and 17 are respectively provided to correspond to the first cylinder chamber 16 and the second cylinder chamber 17 in the integrated-structure cylinder 11. Intake pipes 28 and 29 from an accumulator or the like are configured so as to be connectable to the intake pipe connection holes 26 and 27. Accordingly, low-pressure refrigerant gas is taken into the first cylinder chamber 16 and the second cylinder chamber 17 via the intake ports 24 and 25 from the intake pipes 28 and 29.

**[0035]** In the integrated-structure cylinder 11, a peripheral region in which at least the intake ports 24 and 25 and the intake pipe connection holes 26 and 27 are provided is configured such that a cylinder wall from one end of the integrated-structure cylinder 11 to the other end thereof is a continuous wall and intake ports 24 and 25 and intake pipe connection holes 26 and 27 with larger diameter are capable of being drilled therein within the cylinder width (thickness) without being restricted by the width (thickness) of the first cylinder chamber 16 and the second cylinder chamber 17. In addition, the integrated-structure cylinder 11 may be adapted so as to provide cutout parts or thickness-reducing parts in other parts than the intake ports 24 and 25 and the intake pipe connection holes 26 and 27 and further the parts in which the above blade grooves are provided and to reduce ma-

terial cost or weight.

**[0036]** By virtue of the configuration described above, according to the present embodiment, the following working effects are exhibited.

5 **[0037]** In the above rotary compressor 1, the low-pressure refrigerant gas taken into the first cylinder chamber 16 and the second cylinder chamber 17 through the intake ports 24 and 25 from the intake pipes 28 and 29 is compressed when the rotating shaft 3 is rotationally driven, and the rotors 22 and 23 are eccentrically rotated along the inner peripheral surfaces of the first cylinder chamber 16 and the second cylinder chamber 17 along with this. Then, the gas compressed to a set pressure is discharged into the discharge chambers 20 and 21 via discharge valves and discharge ports, which are not illustrated, is discharged into the sealed housing 2 from the discharge chambers, and is then delivered to the outside of the compressor 1.

10 **[0038]** In this multi-cylinder rotary compressor, leakage loss can be reduced by making the cylinder width (thickness) small as mentioned above. However there were the following problems. That is, if the cylinder width is made small, the intake pipe diameter is restricted, and efficiency is lowered due to an increase in intake pressure loss. Additionally, although it is desired to increase the diameter of the through-hole of the separator plate to allow the eccentric shaft part of the rotating shaft to easily pass therethrough, if the diameter of the through-hole is increased, ensuring of sealing performance becomes difficult and lowering in efficiency is caused. Moreover, the assembly performance of the rotating shaft having the eccentric shaft part is limited by the diameter of the through-hole of the separator plate, and eccentricity of the eccentric shaft part cannot be increased.

15 **[0039]** However, in the present embodiment, the rotating shaft 3 provided with the plurality of eccentric shaft parts 4 and 5 at predetermined intervals in the axial direction is divided by the center shaft part 6 between the eccentric shaft parts 4 and 5 into upper and lower pieces and into a rotating shaft 3 having a divided structure that can be integrally linked. The plurality of first cylinder 8 and second cylinder 9 have the first cylinder chamber 16 and the second cylinder chamber 17 formed in both end surfaces, and are configured as the integrated-structure cylinder 11 in which the separator plate 10 partitioning the cylinder chambers 16 and 17 is integrally formed in the center.

20 **[0040]** For this reason, even if the through-hole 12 provided in the separator plate 10 has a hole diameter that gives priority to ensuring of sealing performance, the eccentric shaft parts 4 and 5 can be easily assembled without being passed through the through-hole 12 of the separator plate 10 by passing the center shaft part 6 of the rotating shaft 3 having the divided structure through the through-hole 12 of the separator plate 10, and then integrally linking the center shaft part with the through-hole. Additionally, even if leakage loss is reduced by making the width (thickness) of the respective cylinders 8 and 9

small, the width (thickness) of the integrated-structure cylinder 11 can be increased by the thickness of the separator plate 10, and the intake ports 24 and 25 and the intake pipe connection holes 26 and 27 can be provided within the increased cylinder width (thickness). Therefore, it is possible to set the diameter of the intake ports 24 and 25 or the pipe diameter of the intake pipes 28 and 29 without being restricted by the cylinder width.

**[0041]** Accordingly, it is possible to remove limitations or restrictions, such as restrictions on the intake pipe diameter of the intake pipes 28 and 29, seal limits on the separator plate 10, and assembly limits on the rotating shaft 3, a design exceeding that in the present situation is made possible, and increased efficiency of the multi-cylinder rotary compressor 1, a reduced number of components, and simplified assembly can be achieved.

**[0042]** Additionally, the present embodiment has a configuration in which the plurality of first cylinder chamber 16 and second cylinder chamber 17 of which both ends are closed by installing the upper bearing member 13 and the lower bearing member 14 are formed in both the end surfaces of the integrated-structure cylinder 11, and the rotating shaft 3 is rotatably supported by the upper bearing member 13 and the lower bearing member 14 on both the end surfaces. For this reason, the plurality of first cylinder chamber 16 and second cylinder chamber 17 of which both ends are closed by the integrally formed separator plate 10 can be formed by installing the upper bearing member 13 and the lower bearing member 14 in both the end surfaces of the integrated-structure cylinder 11, and the rotating shaft 3 can be rotatably supported by the pair of upper bearing member 13 and lower bearing member 4.

**[0043]** Therefore, compared to a multi-cylinder rotary compressor of a related-art type in which a separator plate that is a separate component is sandwiched and assembled between a plurality of cylinders that are separately configured, and bearing members are incorporated into both ends of the separator plate, the number of components can be markedly reduced, and simplification of the configuration and assembly of the components, downsizing, and the like can be achieved.

**[0044]** Moreover, the intake ports 24 and 25 and the intake pipe connection holes 26 and 27 that extend radially outward from the cylinder chambers 16 and 17 are provided in the integrated-structure cylinder 11, and at least a portion from one end of a peripheral region around the intake ports and the intake pipe connection holes to the other end thereof is configured as a continuous wall. In this way, by forming the cylinder wall from one end of the peripheral region around the intake ports 24 and 25 and the intake pipe connection holes 26 and 27 that extend in the radial direction from the cylinder chambers 16 and 17 to the other end thereof as the continuous wall, intake ports 24 and 25 and intake pipe connection holes 26 and 27 with larger diameter can be provided without being restricted by the width (thickness) of the first cylinder 8 and the second cylinder 9.

**[0045]** For this reason, even if leakage loss is reduced by making the cylinder width of the first cylinder 8 and the second cylinder 9 small, the diameter of the intake ports 24 and 25 or the pipe diameter of the intake pipes 28 and 29 is not restricted by this, and a problem such that intake efficiency is lowered due an increase in pressure loss can be solved.

**[0046]** Additionally, in the present embodiment, the plurality of intake ports 24 and 25 and the plurality of intake pipe connection holes 26 and 27 are provided to correspond to the plurality of cylinder chambers 16 and 17. For this reason, even in a configuration in which the plurality of intake ports 24 and 25 and intake pipe connection holes 26 and 27 are provided to correspond to the plurality of cylinder chambers 16 and 17, the integrated-structure cylinder 11 is adopted. Accordingly, intake ports 24 and 25 and intake pipe connection holes 26 and 27 with larger diameter can be provided without being restricted by the respective cylinder width (thickness). Accordingly, even if the cylinder width (thickness) is made small, the diameter of the intake ports 24 and 25 or the pipe diameter of the intake pipes 28 and 29 is not restricted, a problem such that intake efficiency is lowered due to an increase in pressure loss can be solved, and increased efficiency can be achieved.

[Second Embodiment]

**[0047]** Next, a second embodiment of the invention will be described with reference to Fig. 2.

**[0048]** The present embodiment is different from the above-described first embodiment in the configuration of an intake port 30 and an intake pipe connection hole 31. Since the other points are the same as those of the first embodiment, the description thereof will be omitted.

**[0049]** In the present embodiment, as illustrated in Fig. 2, one thick intake pipe 32 is made connectable by providing one large common intake port 30 that branches so as to straddle the separator plate 10 and communicate with the plurality of cylinder chambers 16 and 17 and by providing one large common intake pipe connection hole 31 communicating with the intake port 30.

**[0050]** In this way, by forming the intake port 30 into the one common intake port 30 that branches so as to straddle the separator plate 10 and communicates with the plurality of cylinder chambers 16 and 17 and by providing the one common intake pipe connection hole 31 communicating with the intake port 30, the one larger common intake port 30 and the one intake pipe connection hole 31 communicating with this common intake port can be provided in the integrated-structure cylinder 11 corresponding to the width of the plurality of cylinders, and refrigerant gas can be made to be taken into the plurality of cylinder chambers 16 and 17 via the larger intake port 30 having the branch configuration.

**[0051]** For this reason, even if the cylinder width (thickness) is made small, the diameter of the intake port 30 or the pipe diameter of the intake pipe 32 is not restricted

by this, a problem such that intake efficiency is lowered due an increase in pressure loss can be solved, further increased efficiency can be achieved, and the simplification of configuration and cost reduction can be achieved by making an intake pipe system a single system.

[Third Embodiment]

**[0052]** Next, a third embodiment of the invention will be described with reference to Fig. 3.

**[0053]** The present embodiment is different from the above-described first embodiment in the configuration of an intake port 33 and an intake pipe connection hole 34. Since the other points are the same as those of the first embodiment, the description thereof will be omitted.

**[0054]** In the present embodiment, as illustrated in Fig. 3, one thick intake pipe 35 is made connectable by providing one large common intake port 33 communicating with the plurality of cylinder chambers 16 and 17 so as to straddle the separator plate 10 and providing one large common intake pipe connection hole 34 communicating with the intake port 33.

**[0055]** In this way, by forming the intake port 33 into the one common intake port 33 communicating with the plurality of cylinder chambers 16 and 17 so as to straddle the separator plate 10 and by providing the one common intake pipe connection hole 34 communicating with the intake port 33, the one larger common intake port 33 and the one intake pipe connection hole 34 communicating with this common intake port can be provided in the integrated-structure cylinder 11 corresponding to the width of the plurality of cylinders, and refrigerant gas can be made to be taken into the plurality of cylinder chambers 16 and 17 via the single larger intake port 33.

**[0056]** For this reason, even if the cylinder width (thickness) is made small, the diameter of the intake port 33 or the pipe diameter of the intake pipe 35 is not restricted by this, a problem such that intake efficiency is lowered due an increase in pressure loss can be solved, further increased efficiency can be achieved, and the simplification of configuration and cost reduction can be achieved by making an intake pipe system a single system.

**[0057]** In addition, the invention is not limited to the inventions related to the above embodiments, and appropriate changes can be made without departing from the scope of the invention. For example, an example in which the upper bearing member 13 is fixed to and installed in the sealed housing 2 by welding, crimping, or the like, the integrated-structure cylinder 11 is installed in the resulting sealed housing with the bolts 15, and the lower bearing member 14 is installed in the integrated-structure cylinder 11 with the bolts 15 has been described in the above embodiment. However, the invention is not limited to this. A configuration may be adopted in which the integrated-structure cylinder 11 is fixed to and installed in the sealed housing 2, and the upper bearing member 13 and the lower bearing member 14 are fixed and installed with the bolts 15.

**[0058]** Additionally, in the above embodiment, the single-stage multi-cylinder rotary compressor 1 has been described. However, it is natural that the rotary compressor 1 may be applied to a multi-stage rotary compressor in which one cylinder of the first cylinder 8 and the second cylinder 9 is a low-stage compressing cylinder, and the other cylinder is a high-stage compressing cylinder.

Reference Signs List

**[0059]**

- 1: ROTARY COMPRESSOR
- 3: ROTATING SHAFT
- 4: FIRST ECCENTRIC SHAFT PART
- 5: SECOND ECCENTRIC SHAFT PART
- 6: CENTER SHAFT PART
- 8: FIRST CYLINDER
- 9: SECOND CYLINDER
- 10: SEPARATOR PLATE
- 11: INTEGRATED-STRUCTURE CYLINDER
- 13: UPPER BEARING MEMBER
- 14: LOWER BEARING MEMBER
- 16: FIRST CYLINDER CHAMBER
- 17: SECOND CYLINDER CHAMBER
- 23, 24, 30, 33: INTAKE PORT
- 25, 26, 31, 34: INTAKE PIPE CONNECTION HOLE

**Claims**

1. A multi-cylinder rotary compressor comprising a plurality of cylinders, wherein a rotating shaft provided with a plurality of eccentric shaft parts at predetermined intervals in an axial direction is divided by a center shaft part between the eccentric shaft parts into a rotating shaft having a divided structure that can be integrally linked, and wherein the plurality of cylinders have cylinder chambers formed in both end surfaces, resulting in an integrated-structure cylinder in which a separator plate partitioning the cylinder chambers is integrally formed in the center.
2. The rotary compressor according to Claim 1, wherein the plurality of cylinder chambers of which both ends are closed are formed by bearing members being installed in both end surfaces of the integrated-structure cylinder, and the rotating shaft is rotatably supported via the bearing members in both the end surfaces.
3. The rotary compressor according to Claim 1 or 2, wherein an intake port and an intake pipe connection hole that extend radially outward from each of the

cylinder chambers are provided in the integrated-structure cylinder, and at least a portion from one end of a peripheral region around the intake port and the intake pipe connection hole to the other end thereof is a continuous wall.

5

4. The rotary compressor according to Claim 3, wherein a plurality of the intake ports and the intake pipe connection holes are provided to correspond to the plurality of cylinder chambers.

10

5. The rotary compressor according to Claim 3, wherein the intake port is one intake port that branches so as to straddle the separator plate and communicate with the plurality of cylinder chambers, and one intake pipe connection hole is provided in communication with the intake port.

15

6. The rotary compressor according to Claim 3, wherein the intake port is one intake port that communicates with the plurality of cylinder chambers so as to straddle the separator plate, and one intake pipe connection hole is provided to communicate with the intake port.

20

25

30

35

40

45

50

55

FIG. 1

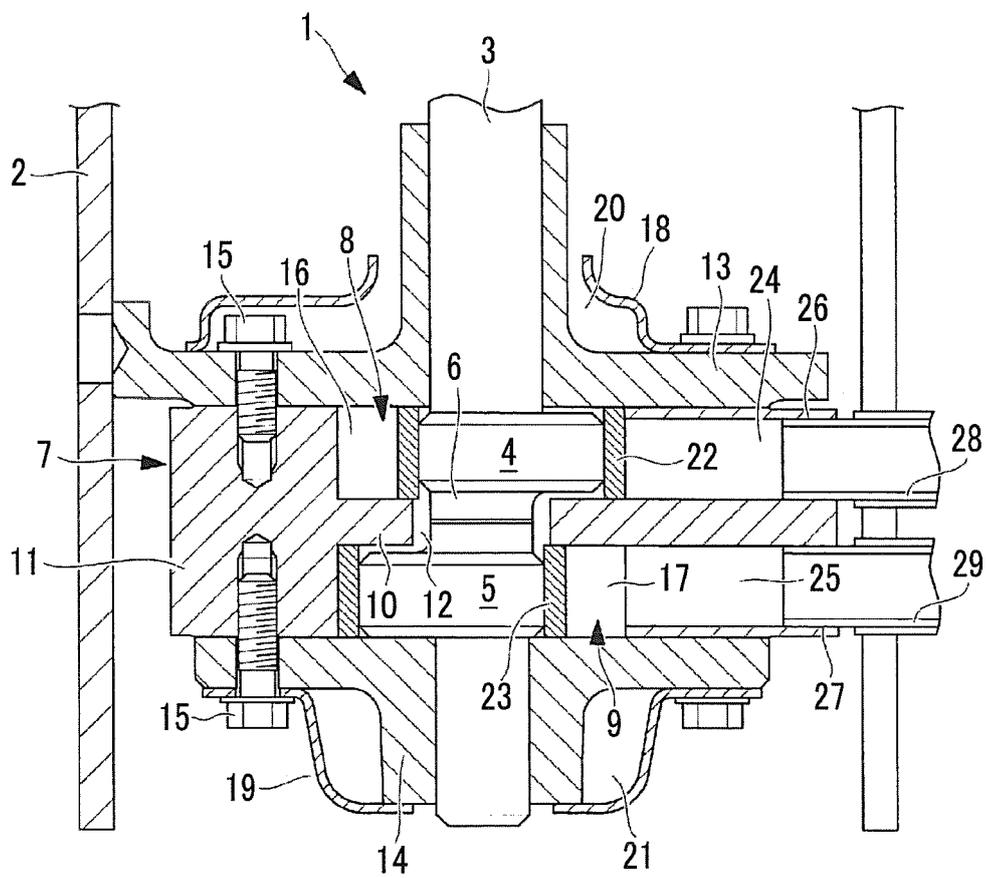


FIG. 2

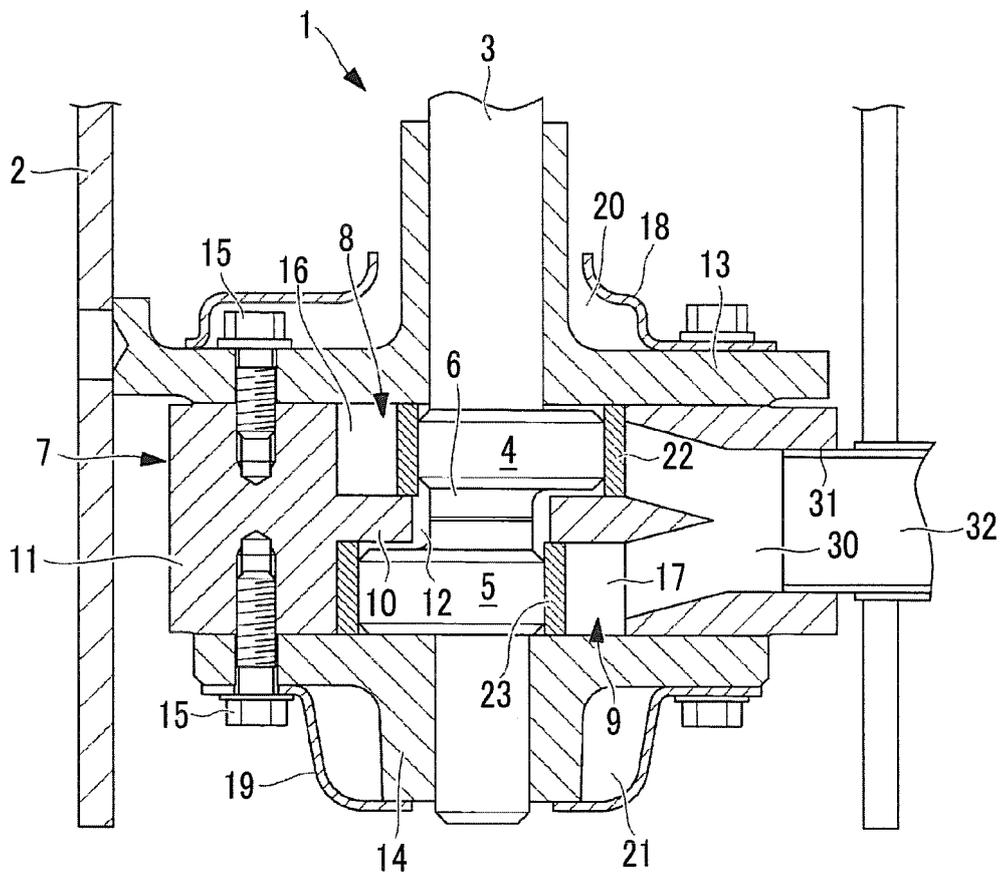
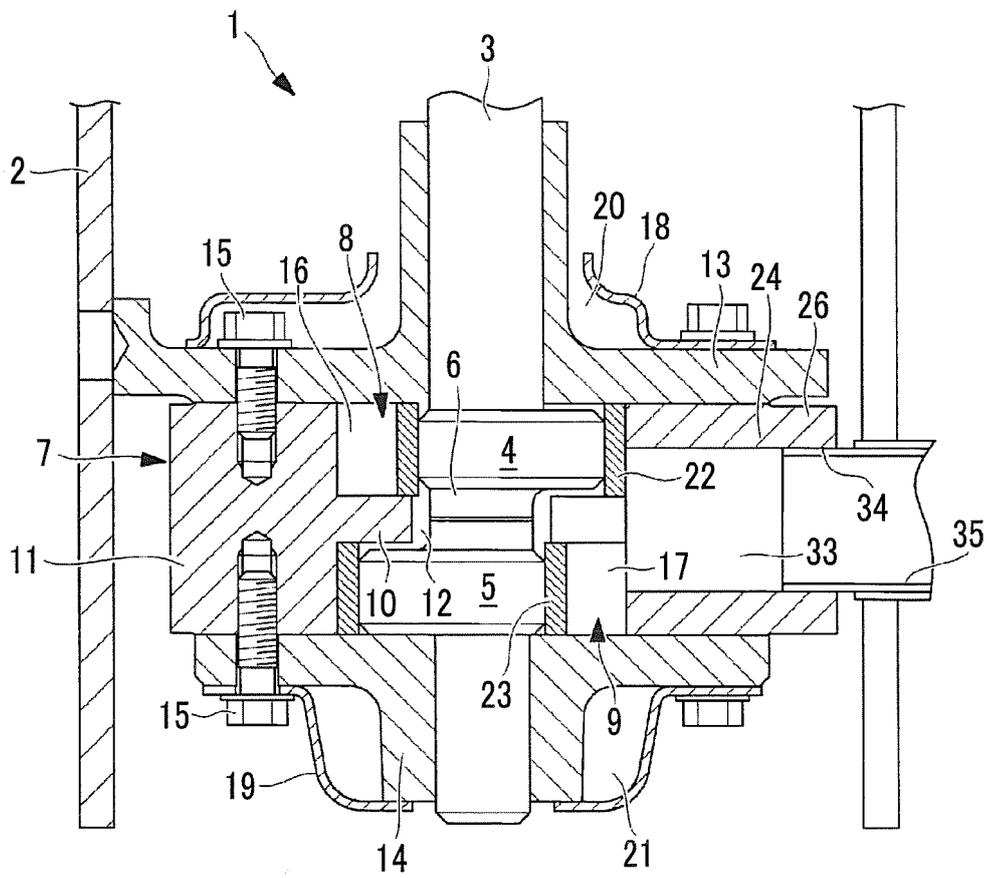


FIG. 3



## INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2014/071702

5	A. CLASSIFICATION OF SUBJECT MATTER F04C23/00(2006.01)i, F04C18/356(2006.01)i	
	According to International Patent Classification (IPC) or to both national classification and IPC	
10	B. FIELDS SEARCHED	
	Minimum documentation searched (classification system followed by classification symbols) F04C23/00, F04C18/356	
15	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 1996-2014 Kokai Jitsuyo Shinan Koho 1971-2014 Toroku Jitsuyo Shinan Koho 1994-2014	
	Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)	
20	C. DOCUMENTS CONSIDERED TO BE RELEVANT	
	Category*	Citation of document, with indication, where appropriate, of the relevant passages
25	Y A	JP 3-222887 A (Mitsubishi Heavy Industries, Ltd.), 01 October 1991 (01.10.1991), page 3, lines 3 to 11; fig. 2 (Family: none)
30	Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 19515/1987(Laid-open No. 126580/1988) (Mitsubishi Electric Corp.), 18 August 1988 (18.08.1988), specification, page 5, line 8 to page 6, line 2; fig. 1 (Family: none)
35		Relevant to claim No. 1,2 3-6  1,2 3-6
40	<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.	
45	* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier application or patent but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed	"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
50	Date of the actual completion of the international search 10 November, 2014 (10.11.14)	Date of mailing of the international search report 18 November, 2014 (18.11.14)
55	Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer
	Facsimile No.	Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.  
PCT/JP2014/071702

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

5  
10  
15  
20  
25  
30  
35  
40  
45  
50  
55

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2010-121481 A (Mitsubishi Electric Corp.), 03 June 2010 (03.06.2010), claim 3; paragraph [0018]; fig. 4 (Family: none)	1, 2 3-6
A	JP 2012-12976 A (Mitsubishi Electric Corp.), 19 January 2012 (19.01.2012), entire text; all drawings & CN 102312836 A	1-6

**REFERENCES CITED IN THE DESCRIPTION**

*This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.*

**Patent documents cited in the description**

- JP 2010121481 A [0004]