

Case of the Mock Trial

1 Case Summary

Pony Corp. (P) filed a patent application for an invention relating to a piston compressor. The patent based on this application was registered on 21 Nov. 2007 (JP/US/EP 35811710. Patented Invention, Patent).

Donkey Corp. (D) started to produce and sell piston compressor Y (Product Y) from 30 Mar. 2010. Upon research and development, D launched piston compressor X (Product X) on 5 May 2015. Since then, Product X has become the main product of D.

P sent a cease and desist letter to D on 16 Sep. 2017, asserting that Products X and Y fell within the technical scope of the Patented Invention.

However, D refuted that Product Y does not fall within the technical scope of the Patented Invention. D also refuted that although Product X does fall within the technical scope of the Patented Invention, Patent should be invalidated because the Patented Invention lacks an inventive step (non-obviousness) based on the invention pertaining to Patent Gazette 34085 (Gazette 085, Main Cited Invention) and the invention pertaining to Patent Gazette 63165 (Gazette 165, Sub Cited Invention).

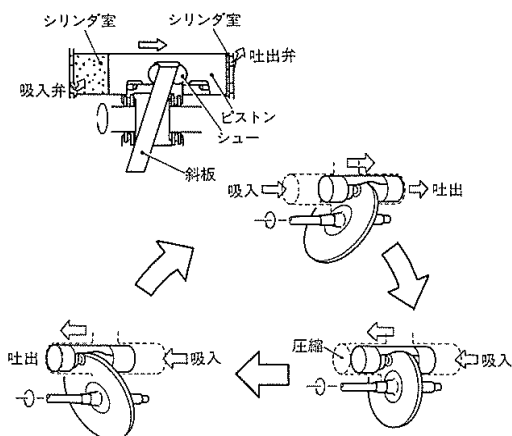
P filed the infringement lawsuit against D on 4 Jul. 2018, in which P seeks [i] an injunction against the act of producing and assigning Product X, Y and [ii] a payment of 450M Yen (4.5M US Dollars, 4.5M Euro) for Product X, 50M Yen (0.5M US Dollars, 0.5M Euro) for Product Y, 500M Yen (5M US Dollars, 5M Euro) in total.

2 Brief illustration on a piston compressor

(1) Piston compressor

A piston compressor can be used as a refrigerant compressor for an automobile air conditioning system.

In a piston compressor, the swash plate(1) is supported by the rotary shaft(2) and



rotates with it integrally. The piston(4) makes reciprocal motion through this swash plate(1) in accordance with the rotation of the rotary shaft(2). This reciprocal motion of the piston(4) makes refrigerant be taken into the cylinder(3), compressed in it, then exhausted from it.

(Abr. General editor; Kenichi Fujiwara, Author and editor; A study group for car air-con “Car air-con” (Sankaidou, 1996) p113)

(2) Reed valve compressor / Rotary valve compressor

In a piston compressor, refrigerant shall be taken into compression chambers(3) from suction chambers(10), and its one-way current shall be controlled by suction valves.

Piston compressor is classified into reed valve compressor and rotary valve compressor according to the differences in suction valves structures.

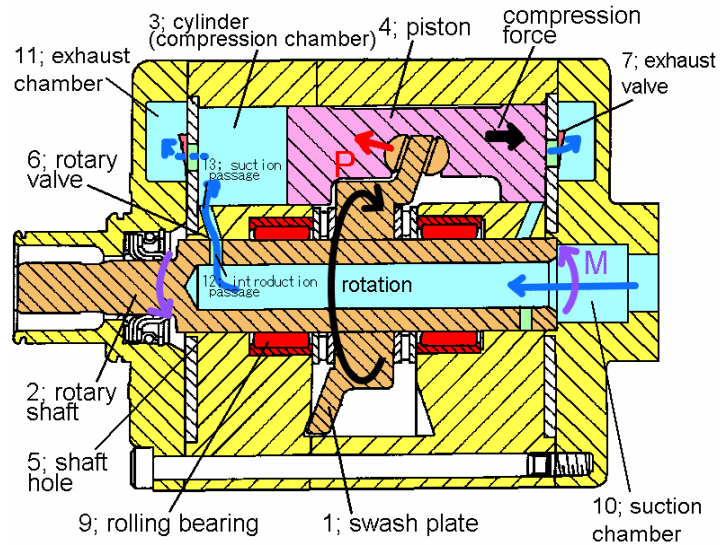
Reed valve compressor uses one-way flap valves (reed valve) as such suction valves. The Main Cited Invention corresponds to a reed valve compressor.

Rotary valve compressor is rather complex. In a rotary valve compressor, rotary valves are integrated with a rotary shaft(2). Rotary valves have, on the outer peripheral surfaces, the outlets of introduction passages(12). Shaft hole(5) has, on the inner peripheral surface, the inlets of suction passages(13). The outlet of introduction passages(12) intermittently communicate with the inlets of the suction passages(13) in accordance with the rotation of the rotary shaft(2). This intermittent communication is equivalent to the openings and closings of valves. The Patented Invention and the Sub Cited Invention correspond to a rotary valve compressor.

Concerning exhaust valves(7) structure, same structures are adopted in both reed valve compressor and rotary valve compressor.

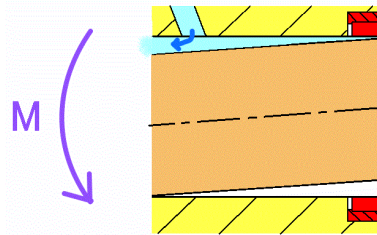
(3) Problems in a piston compressor

In a piston compressor, the compression reaction force is generated on the piston(4) at the time of compressing motion. As the piston(4) is being synchronized with the swash plate(1), the compression reaction force acts on the swash plate(1) as the reaction force (P).



Since the reaction force (P) acts on a position away from the center of the rotary shafts(2), the reaction force (P) generates moment(M) which may cause the tilt of the rotary shaft(2).

Enlarged view of the clearance between the rotary shaft(2) and the shaft hole(5)



The tilt of the rotary shaft(2) disturbs the smooth rotation of the rotary shaft(2).

Furthermore, in a rotary valve compressor, due to the tilt of the rotary shaft(2), clearance between the outer peripheral surfaces of rotary valves(6) and the inner peripheral surface of a shaft hole(5) tends to become wide. It causes refrigerant to leak into the clearance through the inlets of suction passages(13).

(4) Means adopted in a prior art

In a conventional piston compressor, rolling bearings(9) were used between the outer peripheral surfaces of rotary valves(6) and the inner peripheral surface of a shaft hole(5). Those rolling bearings(9) held the rotary shaft(2) so firmly that they could prevent the tilt of the rotary shaft(2) and mitigate the expansion of the clearance even when the reaction force (P) generates moment(M) which may cause the tilt of the rotary shaft(2).

However, rolling bearings(9) were obstacles for cost reduction of compressors because they were expensive and assembly procedures became complex by using them.

The Sub Cited Invention adopts such rolling bearings(9) in prior art in order to mitigate the tilt of the rotary shaft(2).

Components other than rolling bearings(9) are adopted in the Patented Invention and the Main Cited Invention respectively for mitigating the tilt of the rotary shaft(2).

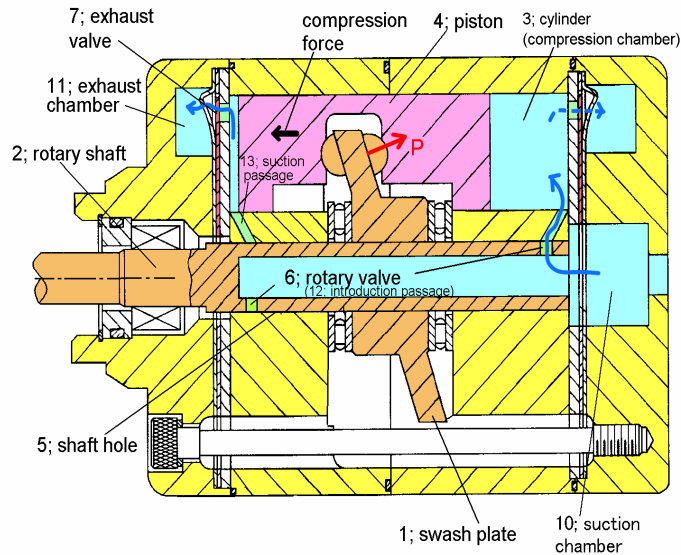
3 Patented Invention

(1) Claim No.1

A: A piston compressor,

B: which has rotary valves(6), has rotary shafts(2) that are integrated with said rotary valves(6) and has a shaft hole(5) that accommodates said rotary valves(6) in a rotatable manner,

C: which causes pistons(4) to make reciprocal motions through swash plates(1) in accordance with the rotation of said rotary shaft(2),



Drawing of the Patented Invention

D: said shaft hole(5) has, on the inner peripheral surface, the inlets of suction passages(13) to intake refrigerant into compression chambers(3),

E: said rotary valves(6) have, on the outer peripheral surfaces, the outlets of introduction passages(12) that intermittently communicate with the inlets of said suction passages(13) in accordance with the rotation of said rotary shafts(2),

F: the inner peripheral surface of said shaft hole(5) directly supports the outer peripheral surfaces of said rotary valves(6) and the clearance between them is set as less than 20µm.

(2) Corrected claim or dependent claim

The claim can be corrected during the litigation procedure. In the country in which claim correction is unrealistic in this procedure, a dependent claim(Claim No.2) can be set beforehand. While correcting the claim or setting the dependent claim, each country is only allowed to add the following underlined elements to the abovementioned Element E.

E': said rotary valves(6) have, on the outer peripheral surfaces, the outlets of

introduction passages(12) that intermittently communicate with the inlets of said suction passages(13) in accordance with the rotation of said rotary shafts(2), the outer peripheral surfaces of said rotary valves(6) are cylindrically-shaped, except for the outlets of said introduction passages(12).

(3) Description

[0001] This invention relates to a rotary valve compressor.

[0002] Rotary valve compressor is superior to reed valve compressor in terms of energy conversion efficiency.

[0003] In a rotary valve compressor, the compression reaction force generates moment(M) which may cause the tilt of the rotary shaft(2). The tilt of the rotary shaft(2) tends to make clearance between the outer peripheral surfaces of rotary valves(6) and the inner peripheral surface of shaft hole(5) wider. It causes the problem that refrigerant leaks into the clearance through the inlets of suction passages(13).

[0004] In the conventional rotary valve compressor, rolling bearings were used to hold the rotary shaft(2) firmly, between the outer peripheral surfaces of rotary valves(6) and the inner peripheral surface of shaft hole(5). However, rolling bearings were obstacles for cost reduction of compressors because they were expensive and assembly procedures became complex by using them.

[0005] Inventors recognized it crucial that the clearance between the inner peripheral surface of the shaft hole(5) and the outer peripheral surfaces of the rotary valves(6) should be adjusted precisely. Surprisingly, inventors found that the clearance being set as less than 20 μ m mitigates the expansion of it drastically without using rolling bearings.

[0030] This invention can reduce production costs because it does not have to use rolling bearings.

(4) Drawings

Above "Drawing of the Patented Invention" is shown as description of one of the embodiments. In all drawings to describe embodiments, the outer peripheral surfaces of rotary valves(6) are being cylindrically-shaped except for the outlets of introduction passages(12).

(5) Prosecution history

Initial claim did not mention "the clearance between them is set as less than 20 μ m", therefore, there was no limitation on the width of the clearance between the inner

peripheral surface of the shaft hole(5) and the outer peripheral surfaces of the rotary valves(6).

In the application process, P received a notice of reasons for refusal from the Patent Office examiner, pointing that the invention for which a patent is sought is not explained in the description since the description only shows an invention in which clearance is being set as less than 20 μ m.

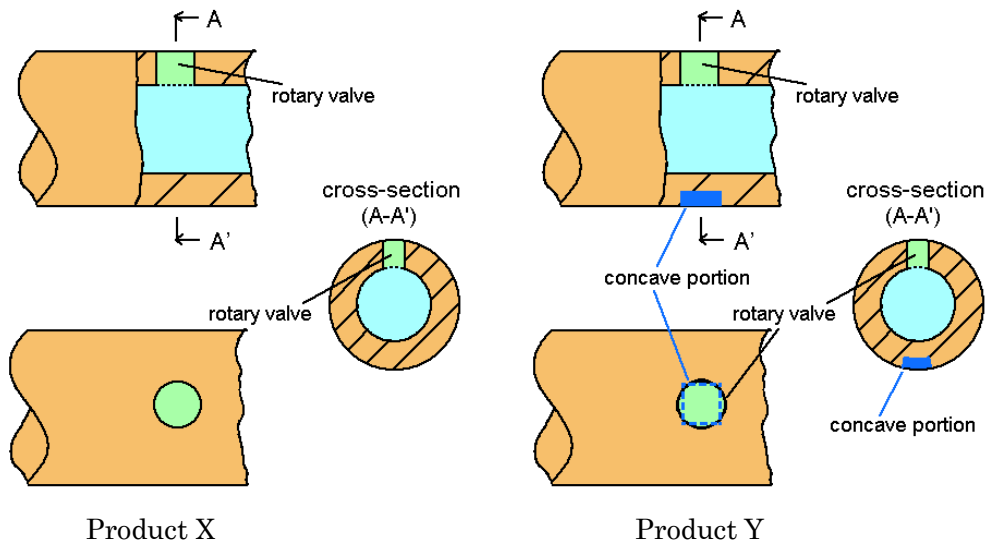
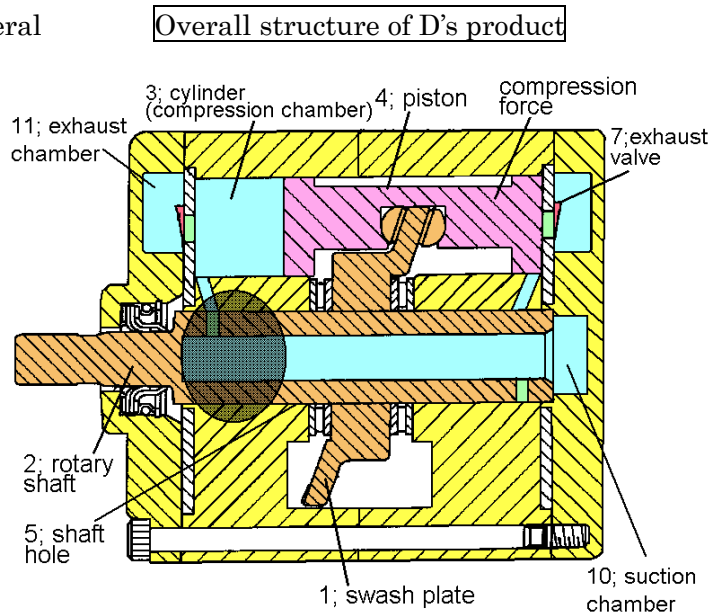
Therefore, P amended the scope of the claim, wherein P added “the clearance between them is set as less than 20 μ m”.

P also submitted a written opinion (Written Opinion). Written Opinion stated “Reason for refusal indicated by the examiner should have been resolved because of the amendment in which the element “the clearance between them is set as less than 20 μ m” was added. The tilt of a rotary shaft(2) could be prevented if all clearance was being set as less than 20 μ m, between the inner peripheral surface of the shaft hole(5) and the outer peripheral surfaces of the rotary valves(6).

4 Products X and Y

In Product X, the outer peripheral surface of the rotary valve(6) is cylindrically-shaped. All other components fall within the technical scope of the Patented Invention.

In Product Y, the outer peripheral surface of the rotary valve(6) has concave portions, which high-pressure gas is introduced into, although most of it is cylindrically-shaped. All other components fall within the technical scope of the Patented Invention.



5 Main Cited Invention

(1) Distinctive Features

Gazette 085 describes the Main Cited Invention. The Main Cited Invention corresponds to a reed valve compressor.

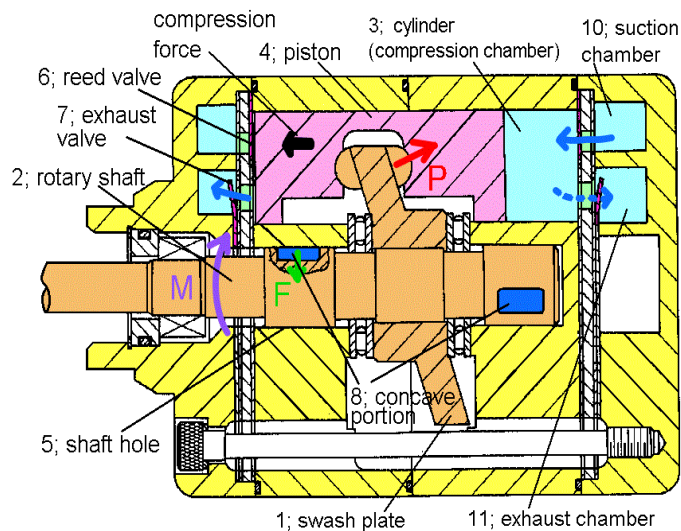
One of the embodiments shows; a shaft hole(5) accommodates a rotary shaft(2) in a rotatable manner, and pistons(4) make reciprocal motion through swash plates(1) in accordance with the rotation of the rotary shaft(2).

That embodiment also shows; the outer peripheral surface of the rotary shaft(2) has a concave portion(8), the inner peripheral surface of the shaft hole(5) directly supports the outer peripheral surfaces of the rotary shaft(2) without using rolling bearings.

(2) Description of Gazette 085

[0003] In a piston compressor, the compression reaction force causes the tilt of the rotary shaft(2). Such tilt of the rotary shaft(2) disturbs the smooth rotation of the rotary shaft(2).

[0004] In the conventional piston compressor, rolling bearings were used to hold the rotary shaft(2). However, they were increasing costs of compressors.



Drawing of the Main Cited Invention

[0007] The invention adopts a system, in which a concave portion(8) is formed on the outer surface of the rotary shaft(2) and high-pressure gas is introduced into the concave portion(8).

[0008] In the invention, the moment(M), which is generated on the rotary shaft(2), is offset by the opposite force(F) applied to the rotary shaft(2) by the high-pressure gas. Therefore, the rotary shaft(2) is not firmly pressed against the shaft hole(5) without using rolling bearings.

[0020] The invention can reduce production costs because it does not use rolling bearings.

[0048] The size of the concave portion(8) is designed appropriately in accordance with the moment(M) acted on the rotary shaft(2) in order to ensure the smooth rotation of the rotary shaft(2).

[0049] For example, as disclosed in Patent Gazette 63165 (Gazette 165), in a compressor in which rotary valves are provided on the parts corresponding to the rotary shaft, this invention can be applied to these rotary valves.

[0058] It is preferable that the width of the clearance is adjusted, for example, being less than 20µm, between the inner peripheral surface of the shaft hole(5) and the outer peripheral surfaces of the rotary shaft(2)

(3) Drawings of Gazette 085

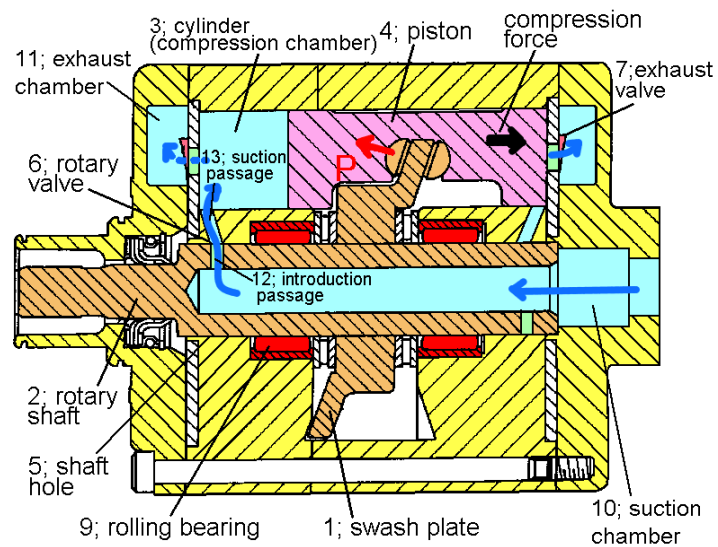
Above “Drawing of the Main Cited Invention” is shown as description of one of the embodiments. In all drawings to describe embodiments, suction valves(6) are one-way flap valves (reed valve) .

6 Sub Cited Invention

(1) Distinctive Features

Gazette 165 describes the Sub Cited Invention. The Sub Cited Invention corresponds to a rotary valve compressor in a piston compressor.

One of the embodiments shows; rotary valves(6) and a rotary shaft(2) are integrated, a shaft hole(5) accommodates rotary valves(6) in a rotatable manner, rotary valves(6) have, on the outer peripheral surfaces, the outlets of introduction passages(12) to introduce refrigerant



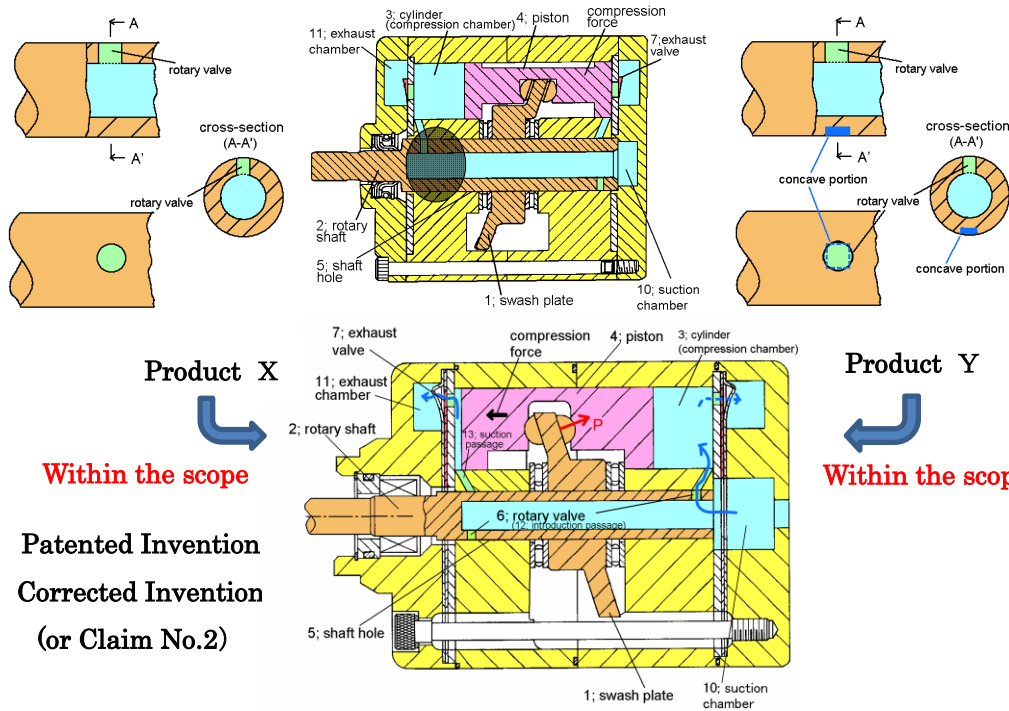
Drawing of the Sub Cited Invention

into compression chambers(3), a shaft hole(5) has, on the inner peripheral surface, the inlets of suction passages(13) to take refrigerant into compression chambers(3), the outlets of introduction passages(12) and the inlets of suction passages(13) are intermittently communicated in accordance with the rotation of a rotary shaft(2), pistons(4) make reciprocal motion through swash plates(1) in accordance with the rotation of the rotary shaft(2). That embodiment also shows; the outer peripheral surfaces of rotary valves(6) are cylindrically-shaped, and the inner peripheral surface of a shaft hole(5) supports the outer peripheral surfaces of rotary shaft(2) through rolling bearings(9).

(2) Drawing of Gazette 165

Above “Drawing of the Sub Cited Invention” is shown as description of one of the embodiments.

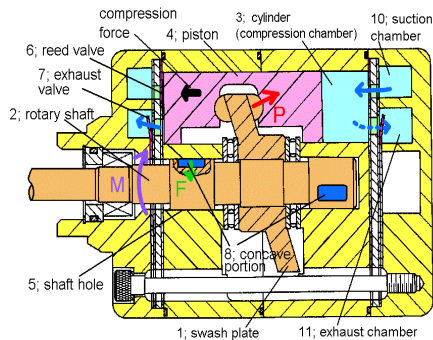
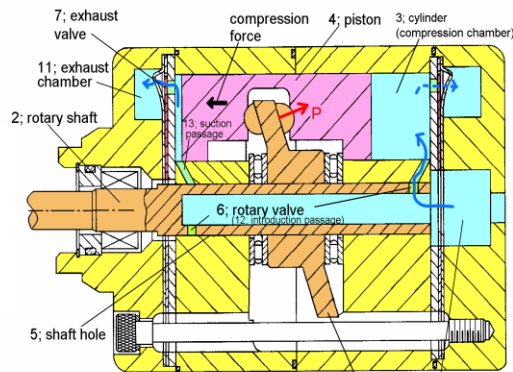
Fall within the technical scope



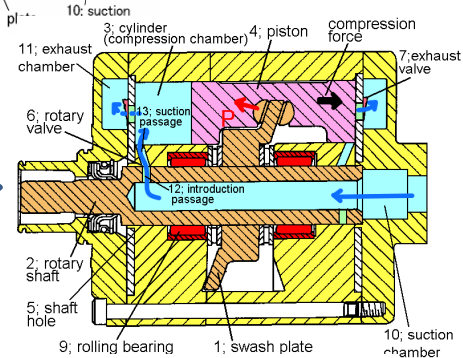
Patented Invention (Claim No.1)		X	Y
A	A piston compressor,	✓	✓
B	which has rotary valves(6), has a rotary shaft(2) that is integrated with said rotary valves(6) and has a shaft hole(5) that accommodates said rotary valves(6) in a rotatable manner,	✓	✓
C	which causes pistons(4) to make reciprocal motions through swash plates(1) in accordance with the rotation of said rotary shaft(2),	✓	✓
D	said shaft hole(5) has, on the inner peripheral surface, the inlets of suction passages(13) to intake refrigerant into compression chambers(3),	✓	✓
E	said rotary valves(6) have, on the outer peripheral surfaces, the outlets of introduction passages(12) that intermittently communicate with the inlets of said suction passages(13) in accordance with the rotation of said rotary shafts(2),	✓	✓
F	the inner peripheral surface of said shaft hole(5) directly supports the outer peripheral surfaces of said rotary valves(6) and the clearance between them is set as less than 20μm.	✓	?
Corrected Invention (or Claim No.2)		X	Y
A~D, F	Same as above	Same as above	
E'	said rotary valves(6) have, on the outer peripheral surfaces, the outlets of introduction passages(12) that intermittently communicate with the inlets of said suction passages(13) in accordance with the rotation of said rotary shafts(2), <u>the outer peripheral surfaces of said rotary valves(6) are cylindrically-shaped, except for the outlets of said introduction passages(12).</u>	✓	✗

Invalidity

Patented Invention
Corrected Invention
(Claim No.2)



Inventive / Obvious ?



Main Cited Invention 1 / Main Cited Invention 2

Sub Cited Invention

Comparison between Patented Invention and Main Cited Invention 1

(Difference 1) Patented Invention has rotary valves(6), has a rotary shaft(2) that is integrated with said rotary valves(6) and has a shaft hole(5) that has, on the inner peripheral surface, the inlets of suction passages(13) to intake refrigerant into compression chambers(3), said rotary valves(6) have, on the outer peripheral surfaces, the outlets of introduction passages(12) that intermittently communicate with the inlets of said suction passages(13) in accordance with the rotation of said rotary shafts(2) and the inner peripheral surface of said shaft hole(5) directly supports the outer peripheral surfaces of said rotary valves(6).

On the other hand, Main Cited Invention 1 does not have rotary valves so that a rotary shaft(2) is not integrated with rotary valves, it's shaft hole(5) does not have, on the inner peripheral surface, the inlets of suction passages to intake refrigerant into compression chambers(3) and the inner peripheral surface of said shaft hole(5) directly supports the outer peripheral surfaces of said rotary shaft(2).

Comparison between Corrected Invention (or Claim No.2) and Main Cited Invention 2

(Difference 1) Same as above

(Difference 2) Corrected Invention (or Claim No.2) has rotary valves(6) whose outer peripheral surfaces are cylindrically-shaped, except for the outlets of said introduction passages(12).

On the other hand, Main Cited Invention 2 has a rotary shaft(2) that has concave portions(8) on the outer peripheral surfaces.