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

(11) EP 2 243 958 A2

(12) EUROPEAN PATENT APPLICATION

(43) Date of publication:
27.10.2010 Bulletin 2010/43

(51) Int Cl.:
F04C 18/02 *(2006.01)* ***F04C 27/00*** *(2006.01)*
F04C 29/04 *(2006.01)*

(21) Application number: **10154576.2**

(22) Date of filing: **24.02.2010**

(84) Designated Contracting States:
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 SE SI SK SM TR

(30) Priority: **25.02.2009 KR 20090015847**

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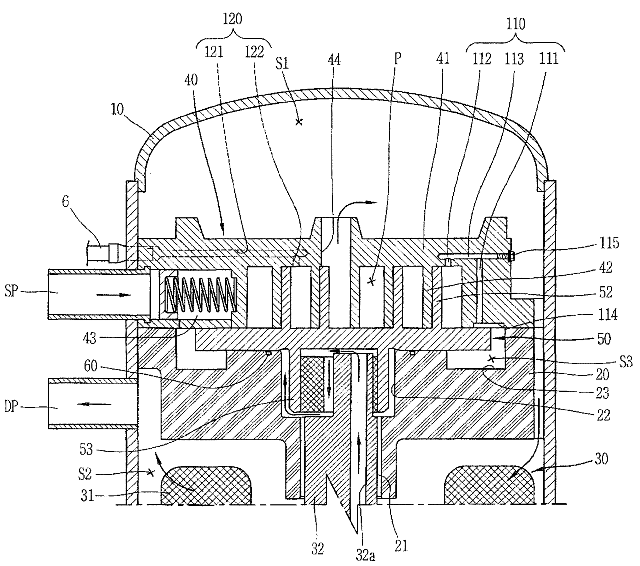
(54) **Compressor and refrigerating apparatus having the same**

(57) A scroll compressor and a refrigerating apparatus having the same are provided. In the scroll compressor, an angle formed between an injection passage that guides refrigerant from a condenser back into an intermediate compression chamber and a back pressure passage that guides refrigerant from the intermediate compression chamber into a back pressure chamber may be designed so as to prevent leakage of refrigerant from the intermediate compression chamber into the back pressure chamber. This allows an appropriate pressure to be maintained the back pressure chamber, and increases an amount of refrigerant supplied into the compression chambers, thereby improving performance of the scroll compressor and a refrigerating apparatus in which such a scroll compressor is installed.

FIG. 1



Printed by Jouve, 75001 PARIS (FR)

Description

[0001] This relates to a compressor and, in particular, to a compressor including refrigerant bypasses, and a refrigerating apparatus including such a compressor.

[0002] A compressor is a component of a refrigerating cycle that compresses refrigerant gas. Types of compressors may include, for example, a reciprocating compressor in which a refrigerant is compressed by a piston and crank shaft, a rotary compressor in which refrigerant gas is compressed by a rotor and vanes, or a scroll compressor in which refrigerant gas is compressed in compression chambers formed by two inter-engaged scrolls, one rotating relative to the other. The scroll compressor may exhibit higher efficiency and lower vibration and noise compared to the reciprocating compressor or the rotary compressor.

[0003] According to a first aspect, the invention provides a scroll compressor, comprising:a casing, a fixed scroll fixed to an interior of the casing, an orbiting scroll movably engaged with the fixed scroll so as to form compression chambers therebetween that are consecutively moved as the orbiting scroll moves relative to the fixed scroll, a back pressure chamber formed at a bearing surface formed between the fixed and orbiting scrolls, wherein the back pressure chamber is configured to support a position of the orbiting scroll against the fixed scroll; a first passage formed in one of the fixed scroll or the orbiting scroll and configured to guide refrigerant compressed in the compression chambers back into the back pressure chamber; and a second passage formed at the one of the fixed scroll or the orbiting scroll and configured to guide refrigerant, which has been discharged from the compression chambers into a refrigerating cycle, back into the compression chambers from an intermediate portion of the refrigerating cycle.

[0004] According to a second aspect, the invention provides a refrigerating apparatus, comprising: a compressor, a condenser connected to a discharge side of the compressor, an expansion apparatus connected to the condenser, an evaporator connected to the expansion apparatus and to a suction side of the compressor, a valve positioned between the condenser and the expansion apparatus so as to direct a flow of refrigerant therethrough, and a bypass pipe connected to the valve and to the compressor, wherein the valve directs a portion of refrigerant from the condenser through the bypass pipe and back into the compressor.

[0005] The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements wherein:

[0006] FIG. 1 is a longitudinal sectional view of an upper portion of a scroll compressor in accordance with an embodiment as broadly described herein;

[0007] FIG. 2 is a cut-away view of a compression unit of the scroll compressor shown in FIG. 1;

[0008] FIG. 3 is a view taken along the line "II-II" of FIG. 2;

[0009] FIG. 4 is an enlarged longitudinal sectional view of a back pressure passage shown in FIG. 3;

[0010] FIG. 5 is an enlarged longitudinal sectional view of an injection passage shown in FIG. 3;

[0011] FIG. 6 is a view taken along the line "I-I" of FIG. 2;

[0012] FIG. 7 is an enlarged view of a phase difference between the back pressure passage and the injection passage shown in FIG. 6;

[0013] FIG. 8 is a schematic view of a refrigerating cycle including a scroll compressor as embodied and broadly described herein;

[0014] FIGS. 9A and 9B are graphs of pressure variation inside the back pressure chamber of the scroll compressor based on the phase difference between the back pressure passage and the injection passage in the refrigerating cycle shown in FIG. 8; and

[0015] FIG. 10 is a perspective view of an exemplary air conditioner having the scroll compressor shown in FIG. 1.

[0016] Scroll compressors may be divided into low pressure type scroll compressors and high pressure type scroll compressors based on how refrigerant is supplied into its compression chambers. That is, in a low pressure type scroll compressor, refrigerant may be indirectly drawn into a compression chamber via an inner space of a casing, the inner space of the casing being divided into a suction space and a discharge space. In a high pressure type scroll compressor, refrigerant may be supplied directly into a compression chamber without flowing through the inner space of the casing, and may then be discharged into the inner space of the casing, such that a majority of the inner space of the casing defines a discharge space.

[0017] Scroll compressors may also be divided into a tip seal type scroll compressor and a back pressure type scroll compressor based on a sealing mechanism used in the compression chamber. That is, in a tip seal mechanism, a tip chamber disposed at an upper end of wraps of each scroll is raised so as to be closely adhered to a plate portion of a facing scroll. In a back pressure mechanism, a back pressure chamber is formed at a rear surface of one scroll and intermediate pressure oil or refrigerant is induced into the back pressure chamber to render the scroll closely adhered to an opposite scroll due to pressure applied by the back pressure chamber. Typically, a tip seal mechanism is used with a low pressure type scroll compressor, and a back pressure mechanism is used with a high pressure type scroll compressor.

[0018] Scroll compressors may also be divided into a fixed capacity type and a variable capacity type based on how refrigerant circulates therethrough. That is, in a fixed capacity type scroll compressor substantially all of the refrigerant discharged therefrom circulates through a closed loop refrigerating cycle, i.e., sequentially through the compressor, a condenser, an expansion apparatus and an evaporator and then back into the compressor. In a variable capacity type compressor, a portion of the refrigerant discharged therefrom is bypassed at a middle portion of a refrigerating cycle and introduced into an intermediate compression chamber of the compressor, while the remainder of the refrigerant sequentially flows through the devices of a closed loop refrigerating cycle and is introduced back into the compressor.

[0019] In a variable capacity type scroll compressor having a back pressure passage through which an intermediate compression chamber communicates with a back pressure chamber and an injection passage through which an outlet of the condenser communicates with the intermediate compression chamber of the compressor, an interval between the back pressure passage and the injection passage may adversely affect the performance of the compressor. That is, since a refrigerant at intermediate pressure within the refrigerating cycle is introduced into the intermediate compression chamber via the injection passage, if the back pressure passage and the injection passage are too close to a proceeding direction of a compression chamber, the intermediate pressure refrigerant in the injection passage may leak into the back pressure chamber via the back pressure passage, thereby increasing the pressure inside the back pressure chamber to an unacceptable level, thus not properly maintaining pressure of the back pressure chamber. As a result, a scroll supported by the pressure of the back pressure chamber may be excessively adhered to or pressed against the opposite scroll, thereby incurring frictional loss and abrasion of the wraps, and degrading reliability and performance of the compressor.

[0020] As shown in FIG. 1, a high pressure type scroll compressor as embodied and broadly described herein may include a casing 10 that forms a hermetic inner space, a main frame 20 and a sub frame (not shown in FIG. 1) respectively positioned in an upper inner space and a lower inner space of the casing 10, a driving motor 30 mounted between the main frame 20 and the sub frame for generating a rotational force, a fixed scroll 40 fixed to an upper surface of the main frame 20 and directly coupled to a gas suction pipe SP, an orbiting scroll 50 positioned on the upper surface of the main frame 20 so as to form compression chambers P through its engagement with the fixed scroll 40, and an Oldham's ring installed between the orbiting scroll 50 and the main frame 20 so that the orbiting scroll 50 orbits without being rotated.

[0021] The hermetic inner space of the casing 10 may be divided into an upper space S1 and a lower space S2 by the main frame 20 and the fixed scroll 40 so that both the upper and lower spaces S1 and S2 are maintained at a high pressure. A bottom portion of the lower space S2 of the casing 10 may be filled with oil for lubrication of the friction components of the compressor. The gas suction pipe SP may penetrate the outer wall of the casing 10 so as to communicate with the upper space S1 of the casing 10, while a gas discharge pipe DP communicates with the lower space S2 of the casing 10.

[0022] A shaft accommodation hole 21 may be formed through a center of the main frame 20, and an oil pocket 22 in which oil drawn up through an oil passage 32a of a driving shaft 32 may be formed at an upper end of the shaft accommodation hole 21. A back pressure groove 23 may be formed at an edge of the upper surface of the main frame 20 so as to create a back pressure chamber S3 having an intermediate pressure that is generated when a portion of refrigerant and oil drawn in are mixed together. A sealing groove may be formed in an annular shape within the back pressure groove 23 to receive a sealing member 60 therein such that oil collected in the oil pocket 22 may be maintained at a high pressure. The back pressure chamber S3 may be defined by a combination of the back pressure groove 23 of the main frame 20, a plate portion 41 of the fixed scroll 40 and a plate portion 51 of the orbiting scroll 50.

[0023] The driving motor 30 may include a stator secured to the inside of the casing 10 and having a coil 31 to which external power is supplied, a rotor disposed within the stator 31 with a predetermined air gap therebetween so as to rotate by interaction with the stator, and a driving shaft 32 coupled to the rotor by, for example, a shrink fitting, for transferring the rotational force of the driving motor 30 to the orbiting scroll 50. An oil passage 32a may be formed through the driving shaft 32 in a longitudinal direction of the shaft 32, and an oil pump may be installed at a lower end of the oil passage 32a to pump oil from the bottom of the casing 10 into the oil passage 32a.

[0024] The fixed scroll 40 may include fixed wraps 42 spirally formed at a lower surface of the plate portion 41 so as to form a pair of compression chambers P. An intake port 43 in direct communication with the gas suction pipe SP may be formed at a side surface of the plate portion 41, and a discharge port 44 through which a compressed refrigerant is discharged up to the upper space S1 of the casing 10 may be formed at a center of the upper surface of the plate portion 41. A back pressure passage 110 that defines a first passage between the compression chambers P and the back pressure chamber S3 may be formed between the wraps 42 forming the compression chambers P at a lower surface of the plate portion 41, namely, at a surface thereof that defines a thrust bearing surface together with the orbiting scroll 50.

[0025] The back pressure passage 110, as shown in FIGS. 2 to 4, may include a first back pressure hole 111 that communicates with the back pressure chamber S3, a second back pressure hole 112 that communicates with the compression chamber P, and a third back pressure hole 113 that provides for communication between the first back pressure hole 111 and the second back pressure hole 112. A communication groove 114 may be formed at an end of the first back pressure hole 111, namely, at a surface facing the back pressure groove 23, to provide for communication between the first back pressure hole 111 and the back pressure groove 23. The communication groove 114 may be radially formed and have a long, substantially rectangular shape such that its width is greater than that of the first back pressure hole 111. Diameters d1, d2 and d3 of the back pressure holes 111, 112 and 113, respectively may be approximately the same so as to minimize flow resistance.

[0026] The first, second and third back pressure holes 111, 112 and 113 may define one passage that alternately communicates with the pair of compression chambers P. That is, the second back pressure hole 112 may be located between adjacent fixed wraps 42, and the diameter d2 of the second back pressure hole 112 may be less than a thickness t of the wrap 52 of the orbiting scroll 50, as shown in FIG. 4 so as to prevent refrigerant leakage from an inner compression chamber P to an outer compression chamber P due to a pressure difference.

[0027] A blocking member 115 may be coupled to the third back pressure hole 113. For example, in the embodiment shown in FIG. 4, the blocking member 115 may be inserted into an external end of the third back pressure hole 113 by a predetermined depth so as to isolate the third back pressure hole 113 from the inner space of the casing 10. In certain embodiments, the blocking member 115 may be formed of a comparatively elastic non-ferrous metal so as to be hermetically press-fitted within the external end of the third bypass hole 113. Alternatively, as shown in FIGS. 3 and 4, the blocking member 115 may be a metallic bolt that is threadly coupled to a predetermined depth into the external end of the third bypass hole 113. When using such a metallic bolt, a sealing washer 116 may be hermetically inserted at a head portion of the metallic bolt for coupling.

[0028] As shown in FIG. 1, the orbiting scroll 50 may include orbiting wraps 52 spirally formed on an upper surface of a plate portion 51 so as to form a pair of compression chambers P together with the fixed wraps 42 of the fixed scroll 40. A boss portion 53 may extend from a central portion of a lower surface of the plate portion 51 and be coupled to the driving shaft 32 so as to receive a driving force from the driving motor 30.

[0029] In certain embodiments, the fixed wrap 42 and the orbiting wrap 52 may be symmetrically formed with substantially the same wrap length. In certain embodiments, they may be asymmetrically formed with different wrap lengths. For example, the orbiting wrap 52 may be approximately 180° longer than the fixed wrap 42. Other arrangements may also be appropriate.

[0030] During operation, when power is applied to the driving motor 30, the driving shaft 32 rotates together with the rotor to transfer a rotational force to the orbiting scroll 50. The orbiting scroll 50 performs an orbiting motion by an eccentric distance on the upper surface of the main frame 20 due to the Oldham's ring, thereby forming a pair of compression chambers P which are consecutively moved between the fixed wrap 42 of the fixed scroll 40 and the orbiting wrap 52 of the orbiting wrap 50. The volumes of the compression chambers P are decreased as are moved toward the center in response to the consecutive orbiting motion of the orbiting scroll 50, thereby compressing refrigerant therein.

[0031] Simultaneously, an oil pump provided at the lower end of the driving shaft 32 pumps oil contained in the casing 10 up via the oil passage 32a of the driving shaft 32. A portion of the oil is supplied into the shaft accommodation hole 21 of the main frame 20, and a portion of the oil is dispersed at the upper end of the driving shaft 32 so as to be introduced into the back pressure chamber S3 of the main frame 20. The oil introduced into the back pressure chamber S3 supports the orbiting scroll 50, which is accordingly raised upward the fixed scroll 40. Hence, the fixed wraps 42 and the orbiting wraps 52 are closely adhered to the corresponding plate portions 51 and 41, respectively, thereby sealing the compression chambers P.

[0032] In this state, refrigerant is compressed by the continuous orbiting motion of the orbiting scroll 50. The compressed refrigerant partially flows into the back pressure chamber S3 via the back pressure passage 110, so that the pressure within the back pressure chamber S3 may be maintained at a predetermined level. Although only one outlet of the back pressure passage 110, namely, the second back pressure hole 112, is provided, the second back pressure hole 112 alternately communicates with both compression chambers P as the orbiting scroll 50 orbits, allowing oil to be uniformly supplied into each compression chamber P via the back pressure passage 110.

[0033] In a variable capacity type compressor, refrigerant may be reintroduced into an intermediate compression chamber of the compressor at a middle portion of a refrigerating cycle, namely, from an outlet of a condenser, so as to increase an amount of refrigerant to be compressed, resulting in an increase in the compression capacity of the compressor.

[0034] For example, as shown in Fig. 8, an injection pipe 6 may diverge at a middle portion of a refrigerant pipe 5 that connects a condenser 2 and an expansion apparatus 3 of the refrigerating cycle, namely, at an outlet of the condenser 2. The injection pipe 6 may be connected to an injection passage 120 that forms a second passage at the fixed scroll 40 of the scroll compressor 1 shown in FIGS. 1 and 2. A bypass valve 7 for controlling the flow of refrigerant through the injection pipe 6 may be installed at a middle portion of the injection pipe 6 or at an area where the injection pipe 6 diverges from the refrigerant pipe 5.

[0035] The injection passage 120, as shown in FIGS. 2, 3 and 5, may include a first injection hole 121 formed in a radial direction at a predetermined depth in the fixed scroll 40, and a second injection hole 122 that extends in a shaft direction from an end portion of the first injection hole 121 through the intermediate compression chamber.

[0036] Depending on the position of the second injection hole 122, refrigerant injected therethrough from the middle portion of the refrigerating cycle may leak into the back pressure chamber S3, possibly degrading compression performance. In order to enhance performance of the compressor, specific positioning of the injection passage 120 with respect to the back pressure passage 110, and more particularly, the second back pressure hole 112 of the back pressure passage 110 and the second injection passage 122 of the injection passage 120, may be established.

[0037] To this end, the second injection hole 122 of the injection passage 120 may be formed, as shown in FIGS. 6 and 7, closer to the discharge side of the compression chamber than the second back pressure hole 112 of the back pressure passage 110. More particularly, the second injection hole 122 may be formed so that an angle at which a refrigerant starts to be injected into the intermediate compression chamber P and an angle at which the refrigerant within the intermediate compressor chamber starts to be introduced into the back pressure chamber S3 is greater than approximately 30°. Consequently, leakage of the refrigerant injected into the intermediate compression chamber via the injection passage 120 into the back pressure passage 110 may be prevented. The greater the phase difference between the second back pressure passage 112 of the back pressure passage 110 and the second injection passage 122 of the injection passage 120, the greater the leakage prevention.

[0038] A diameter 24 of the second injection hole 122 may be substantially the same as a diameter of the second back pressure hole 112, so as to smoothly control the amount of refrigerant injected. The diameter d4 of the second injection hole 122 may be less than a thickness t of the orbiting wrap 52 of the orbiting scroll 50 so as to prevent a refrigerant injected via the injection passage 120 from being leaked into both the compression chambers P due to the injection passage 120 communicating with the compression chambers P.

[0039] A temperature of the refrigerant injected into the intermediate compression chamber may be lower than a temperature at the outlet of the condenser 2 but higher than a temperature at a suction side of the compression chamber P, so as to increase the amount of the refrigerant to be injected. That is, as shown in FIG. 8, after a refrigerant discharged from the compressor 1 flows through the condenser 2, part of the refrigerant is bypassed into the injection pipe 6 at the outlet of the condenser 2. The high temperature and high pressure bypassed liquid refrigerant is expanded and converted into a mixed refrigerant (gaseous refrigerant + liquid refrigerant) with a temperature of about 20 °C. The mixed refrigerant is re-heat-exchanged via a re-heat exchanger 6a positioned between the condenser 2 and the injection pipe 6 for heat exchange with the condenser 2 so as to be converted into a low temperature gaseous refrigerant. The low temperature gaseous refrigerant is then injected into the intermediate compression chamber via the injection passage 120.

[0040] As described above, in a scroll compressor 1 having the back pressure passage 110 and the injection passage 120, if an angle α formed between the back pressure passage 110 and the injection passage 120 is greater than approximately 30°, the actual pressure within the back pressure chamber 53, as shown in FIG. 9A, may be maintained substantially close to/at the design pressure, thereby stably supporting the orbiting scroll 50. If the angle α therebetween is 20°, the actual pressure within the back pressure chamber, as shown in FIG. 9B, is greater than the design pressure, which may cause the orbiting scroll 50 to be excessively raised and pressed against the fixed scroll 40. Accordingly, frictional loss or abrasion may occur between the orbiting scroll 50 and the fixed scroll 40, thereby lowering the performance and/or reliability of the compressor 1.

[0041] Consequently, the angle between the injection passage 120 and the back pressure passage 110 may maintain an appropriate phase difference, or angle α therebetween, so as to effectively prevent a refrigerant injected into the intermediate compression chamber via the injection passage from leaking into the back pressure chamber via the back pressure passage without flowing along the proceeding direction of the compression chamber. Hence, during a high capacity operation of the scroll compressor, a refrigerant injected into the intermediate compression chamber via the injection passage at the middle portion of the refrigerant cycle may be combined with a refrigerant sucked into a suction side of the compression chamber, thereby increasing the amount of refrigerant to be compressed, resulting in improved performance.

[0042] Similarly, if a scroll compressor as embodied and broadly described herein is applied to a refrigerating apparatus, the efficiency of the refrigerating apparatus may also be improved.

[0043] As shown in FIG. 10, an exemplary refrigerating apparatus 700 as embodied and broadly described herein may include a refrigerant compression type refrigerating cycle provided with a scroll compressor 1, a condenser 2, an expansion apparatus 3, and an evaporator 4 as shown in FIG. 8. The compressor 1 may include an injection passage through which a portion of refrigerant flowing through the condenser 2 is injected back into an intermediate compression chamber of the scroll compressor 1. Within the refrigerating apparatus 700, the scroll compressor 1 may be connected to a main substrate 710, which controls an overall operation of the refrigerating apparatus 700. A fixed scroll installed within the scroll compressor 1 may include a back pressure passage through which refrigerant is discharged from the intermediate compression chamber into a back pressure chamber, and an injection passage through which refrigerant flows back into the intermediate compression chamber via an outlet of the condenser 2. The back pressure passage and the injection passage may form an angle therebetween of at least more than 30°, as described above. Consequently, leakage of the refrigerant injected into the intermediate compression chamber via the injection passage into the back pressure passage may be prevented, resulting in improved performance of the refrigerating apparatus having such a scroll compressor.

[0044] In the scroll compressor according to the present invention and a refrigerating apparatus having the same, leakage of the refrigerant from the intermediate compression chamber into the back pressure chamber may be prevented, thereby appropriately maintaining the pressure of the back pressure chamber, and also increasing the amount of refrigerant within the compression chamber, resulting in improved performance of the scroll compressor and the refrigerating apparatus in which it is installed.

[0045] A scroll compressor as embodied and broadly described herein may be applied to numerous different types of refrigerating apparatuses, such as, for example, an air conditioning apparatus, a refrigerating/freezing apparatus, or other refrigerating apparatus in which compression of refrigerant is employed.

[0046] A scroll compressor as embodied and broadly described herein is capable of maintaining an appropriate pressure inside the back pressure chamber by preventing a refrigerant, injected from the refrigerating cycle into the intermediate pressure via the injection passage, from being drastically leaked from the intermediate compression chamber into the back pressure chamber, and a refrigerating apparatus having the same.

[0047] A scroll compressor as embodied and broadly described herein may include compression chambers formed to be consecutively moved as a plurality of scrolls perform a relative motion with being engaged with each other, a back pressure chamber formed at a bearing surface at which the plurality of scrolls come in contact with each other and configured to support the neighboring scrolls, a first passage formed at a scroll and configured so that part of refrigerant compressed in the compression chambers is bypassed to be guided into the back pressure chamber, and a second passage formed at a scroll and configured so that part of refrigerant discharged from the compression chambers into a refrigerating cycle is bypassed at a middle portion of the refrigerating cycle to be supplied back into the compression chambers.

[0048] A scroll compressor in accordance with another embodiment as broadly described herein may include a fixed scroll having spiral wraps, and an orbiting scroll having spiral wraps, the spiral wraps orbiting with being engaged with the wraps of the fixed scroll so as to form a pair of compression chambers consecutively moved during the orbiting motion, a back pressure chamber for containing a refrigerant bypassed from the compression chambers being formed at a rear surface of the orbiting scroll, wherein the fixed scroll is provided with at least one back pressure passage formed at the fixed scroll for communicating the compression chambers with the back pressure chamber, and an injection passage through which part of a refrigerant discharged from the compression chambers into the refrigerating cycle is injected back into the compression chambers.

[0049] A refrigerating apparatus as embodied and broadly described herein may include a compressor, a condenser connected to a discharge side of the compression, an expansion apparatus connected to the condenser, and an evaporator connected to the expansion apparatus and to a suction side of the compressor, wherein the compressor is a scroll compressor configured so that an angle between an injection passage communicating with an intermediate compression chamber at a middle portion of a refrigerating cycle and a back pressure passage is approximately more than 30°.

[0050] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the invention. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

Claims

1. A scroll compressor, comprising:

a casing;
a fixed scroll fixed to an interior of the casing;
an orbiting scroll movably engaged with the fixed scroll so as to form compression chambers therebetween that are consecutively moved as the orbiting scroll moves relative to the fixed scroll;
a back pressure chamber formed at a bearing surface formed between the fixed and orbiting scrolls, wherein the back pressure chamber is configured to support a position of the orbiting scroll against the fixed scroll;
a first passage formed in one of the fixed scroll or the orbiting scroll and configured to guide refrigerant compressed in the compression chambers back into the back pressure chamber; and
a second passage formed at the one of the fixed scroll or the orbiting scroll and configured to guide refrigerant, which has been discharged from the compression chambers into a refrigerating cycle, back into the compression chambers from an intermediate portion of the refrigerating cycle.

2. The compressor of claim 1, further comprising a main frame fixed to the interior of the casing so as to support the fixed scroll and the orbiting scroll.

3. The compressor of claim 2, wherein the back pressure chamber is defined by a recess formed in an upper surface of the main frame, a lower surface of the fixed scroll, and an outer peripheral portion of the orbiting scroll.

4. The compressor of claim 3, further comprising a groove formed in the lower surface of the fixed scroll so as to provide for communication between the first passage, which is formed in the fixed scroll, and the back pressure chamber.

5. The compressor of claim 4, wherein the first passage comprises:

a first bypass hole having a first end connected to the communication groove;
a second bypass hole having a first end alternately connected to the compression chambers as the orbiting scroll moves relative to the fixed scroll; and
a third bypass hole that connects second ends of the first and second bypass holes.

6. The compressor of claim 5, further comprising a blocking member positioned in an external end of the third bypass hole so as to seal the first passage.

7. The compressor of claim 1, wherein the second passage comprises:

a first injection hole that extends into a plate portion of the fixed scroll; and
a second injection hole having a first end connected to the first injection hole and a second end that alternately communicates with the compression chambers.

8. The compressor of claim 7, wherein an inlet end of the first injection hole is connected to an injection pipe that extends through an outer wall of the casing so as to receive refrigerant from an intermediate section of a refrigerating cycle and to direct the received refrigerant back into the compression chambers through the second passage.

9. The compressor of claim 1, wherein the first passage is formed in the fixed scroll and is configured to communicate with one of the compression chambers at an intermediate pressure between a suction pressure and a discharge pressure.

10. The compressor of claim 1, wherein the second passage is formed in the fixed scroll and is configured to with one of the compression chambers at an intermediate pressure between a suction pressure and a discharge pressure.

11. The compressor of claim 1, wherein an angle between the first passage and the second passage is greater than approximately 30°.

12. The compressor of claim 11, wherein an outlet of the first passage is closer to a discharge side of the compression chambers than an outlet of the second passage is.

13. The compressor of claim 1, wherein a diameter of an outlet of the second passage is greater than or equal to a diameter of an outlet of the first passage.

14. A refrigerating apparatus, comprising:

a compressor;
a condenser connected to a discharge side of the compressor;
an expansion apparatus connected to the condenser;
an evaporator connected to the expansion apparatus and to a suction side of the compressor;
a valve positioned between the condenser and the expansion apparatus so as to direct a flow of refrigerant therethrough; and
a bypass pipe connected to the valve and to the compressor, wherein the valve directs a portion of refrigerant from the condenser through the bypass pipe and back into the compressor.

15. The apparatus of claim 14, further comprising a heat exchanger provided at the bypass pipe, wherein the heat exchanger is configured to perform a re-heat-exchange process with the condenser.

FIG. 1

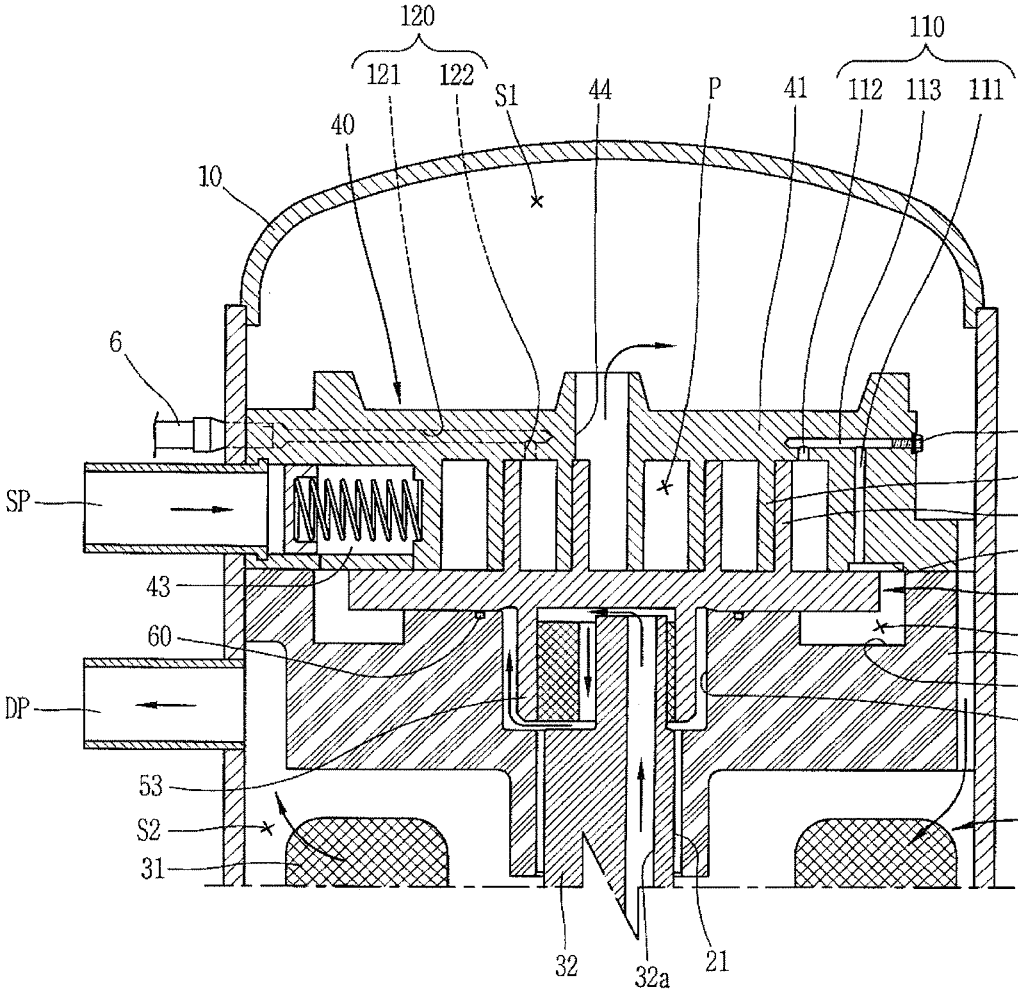

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FIG. 2

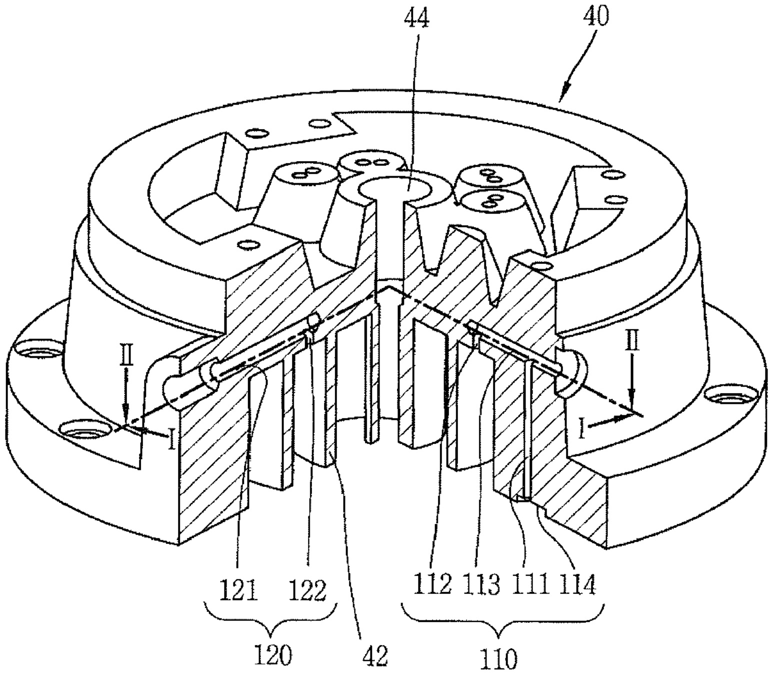
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FIG. 3

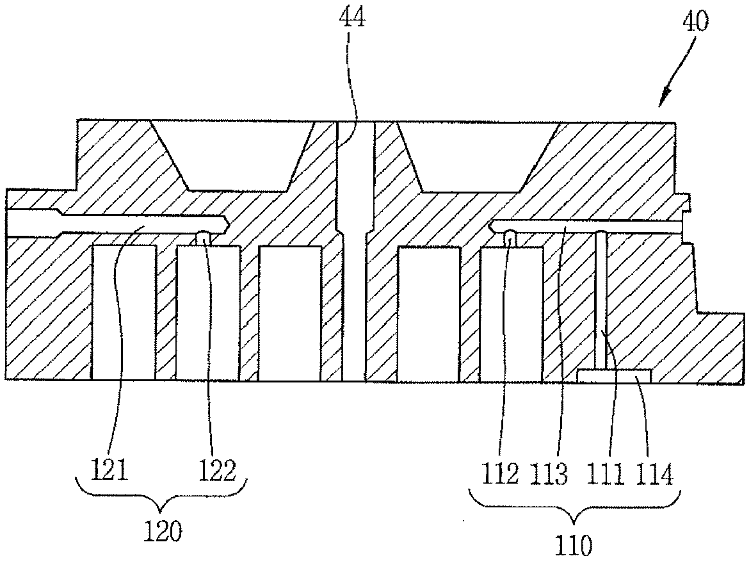
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FIG. 4

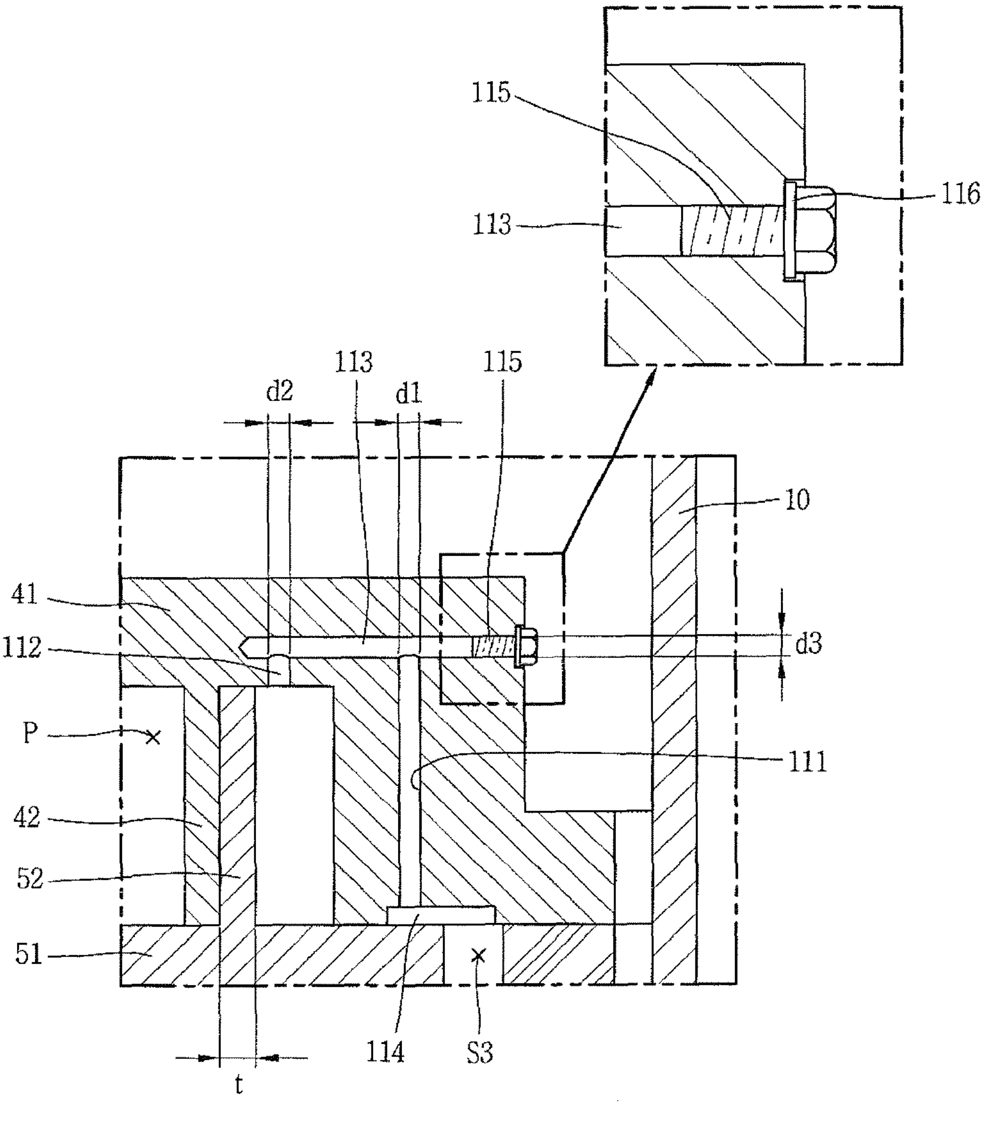

FIG. 5

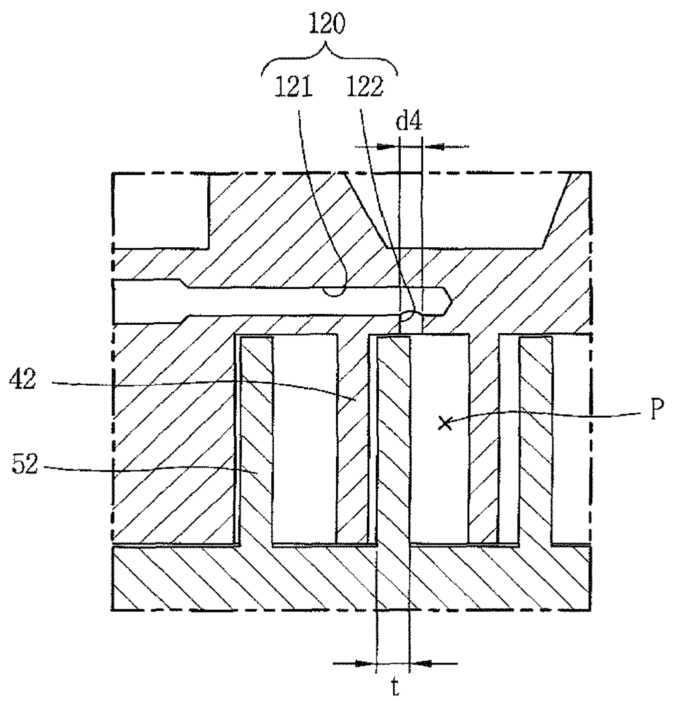

FIG. 6

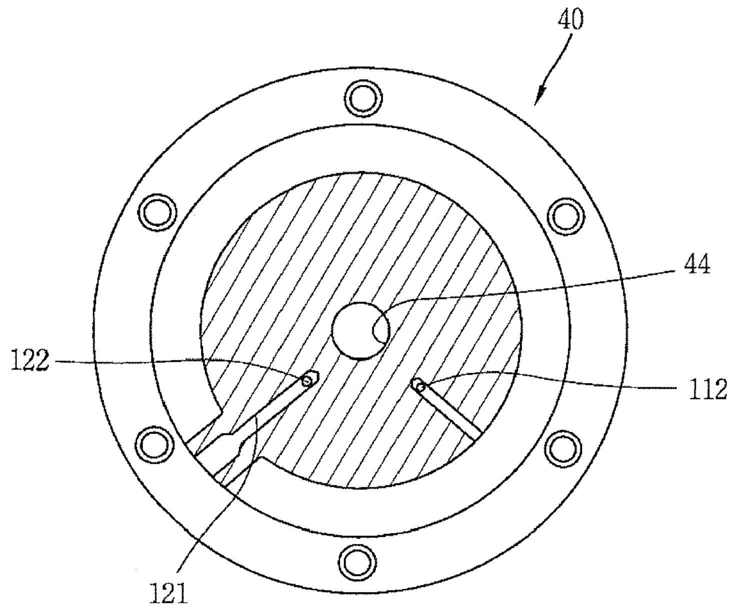

FIG. 7

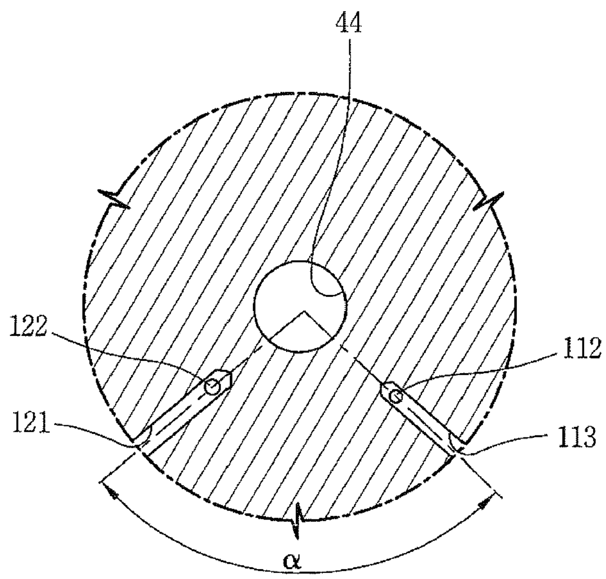

FIG. 8

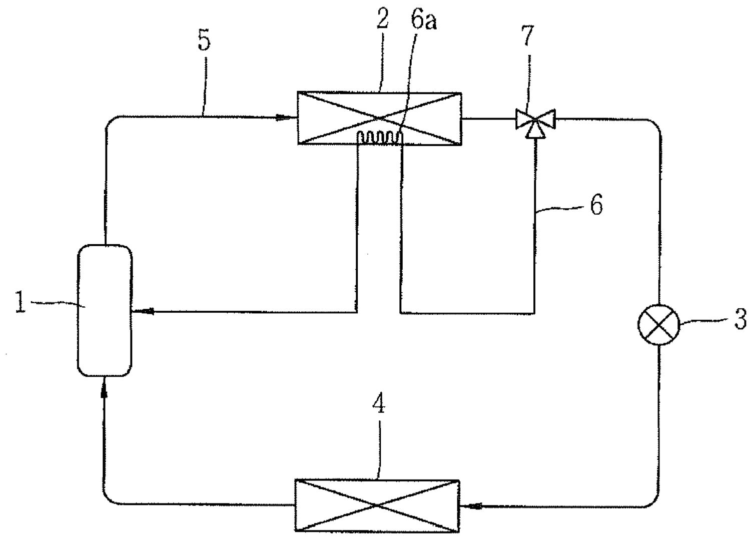

FIG. 9A

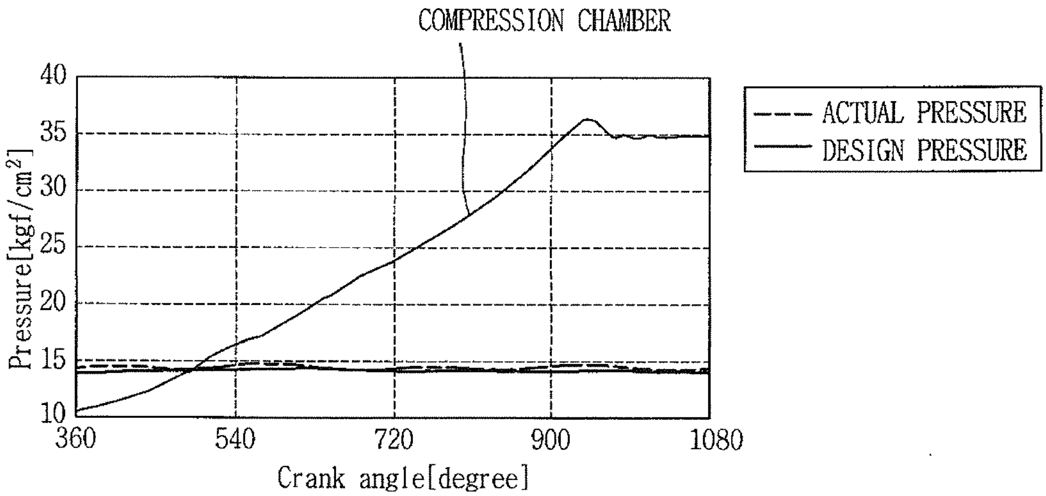
COMPRESSION CHAMBER
ACTUAL PRESSURE
DESIGN PRESSURE
40
35
30
25
20
15
10
Pressure[kgf/cm2]
360
540
720
900
1080
Crank angle[degree]

FIG. 9B

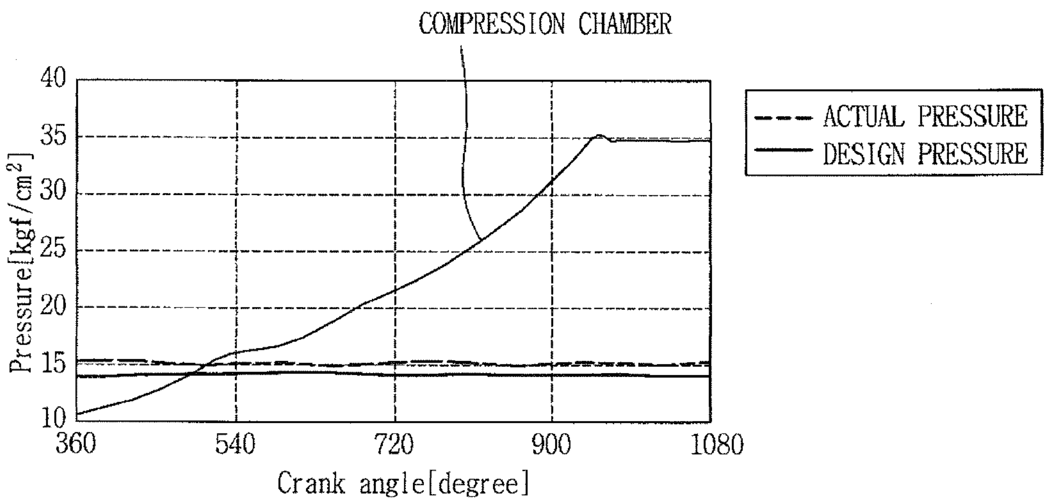
COMPRESSION CHAMBER
ACTUAL PRESSURE
DESIGN PRESSURE
40
35
30
25
20
15
10
Pressure[kgf/cm2]
360
540
720
900
1080
Crank angle[degree]

FIG. 10