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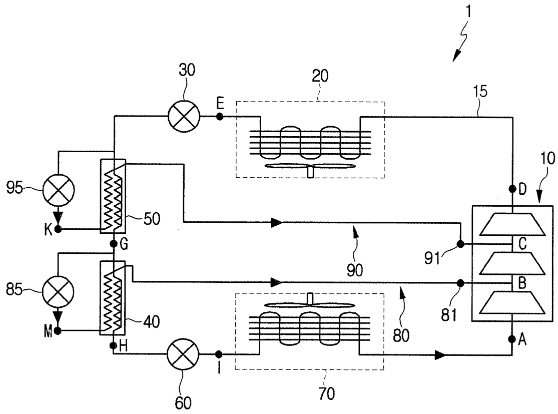
(54) **Scroll compressor and air conditioner including the same**

(57) Provided are a scroll compressor (10) and an air conditioner (1) including the same. The scroll compressor (10) includes a motor (160) generating a driving force, a driving shaft (150) passing through the motor to rotate, a main frame(140) supporting an upper portion (150) of the driving shaft, a fixed scroll (120) including at least one coupling part coupled to the main frame and a first wrap (123), an orbiting scroll (130) disposed to have a phase different with respect to the fixed scroll, the orbiting scroll including a second wrap (132) defining a compression chamber that is rotatable between the first wrap (123) and the second wrap (132), a suction part (111) suctioning a refrigerant into the compression chamber, a first inflow part (81) disposed on one side of the fixed scroll (120) to inject the refrigerant into the compression chamber, and a second inflow part (91) disposed on the other side of the fixed scroll (120) to inject a refrigerant, which has a pressure different from that of the refrigerant introduced into the first inflow part, into the compression chamber. The first inflow part (81) is disposed at a position at which a first extension line (l1) connecting a central portion of the fixed scroll (120) to a central portion of the suction part (111) rotates by a first preset angle in a direction opposite to the rotation direction of the compression chamber.

Fig. 2



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Description

[0001] The present disclosure relates to a scroll compressor and an air conditioner including the same.

[0002] Air conditioners are home appliances that maintain indoor air into the most proper state according to use and purpose thereof. For example, such an air conditioner controls indoor air into a cold state during summer and controls indoor air into a warm state during winter. Furthermore, the air conditioner controls humidity of the indoor air and purifies the indoor air to become a pleasant and clean state.

[0003] In detail, the air conditioner has a refrigerant cycle in which compression, condensation, expansion, and evaporation processes of a refrigerant are performed. Thus, a cooling or heating operation of the air conditioner may be performed to cool or heat the indoor air according to the refrigerant cycle.

[0004] The air conditioners may be classified into split type air conditioners in which indoor and outdoor units are separated from each other and integral type air conditioners in which indoor and outdoor units are integrally coupled to each other as a single unit according to whether the indoor and outdoor units are separated from each other.

[0005] The outdoor unit includes an outdoor heat exchanger heat-exchanging with external air, and the indoor unit includes an indoor heat exchanger heat-exchanging with indoor air. Such an air conditioner may be converted into a cooling mode or heating mode on the basis of the selected mode.

[0006] When the air conditioner operates in the cooling mode, the outdoor heat exchanger serves as a condenser, and the indoor heat exchanger servers as an evaporator. On the other hand, when the air conditioner operates in the heating mode, the outdoor heat exchanger serves as an evaporator, and the indoor heat exchanger serves as a condenser.

[0007] Fig. 1 is a pressure-enthalpy (p-h) diagram of a refrigerant cycle in an air conditioner according to a related art. Referring to Fig. 1, a refrigerant is suctioned into a compressor in a state "a". Then, the refrigerant is compressed in the compressor and discharged in a state "b" and then introduced into the condenser. The refrigerant having the state "b" may be in a liquid phase.

[0008] Also, the refrigerant is condensed in the condenser and the discharged in a state "c". Thereafter, the refrigerant is throttled in an expansion device and thus changed into a state "d", i.e., a two-phase state. The refrigerant throttled in the expansion device is introduced into the evaporator. Then, the refrigerant is heat-exchanged in the evaporator and thus changed into the state "a". The refrigerant having the state "a" may be in a gaseous phase. In this state, the refrigerant is introduced into the compressor. This refrigerant cycle may be repeatedly performed.

[0009] According to the related art, heating performance or cooling performance may be limited.

[0010] In detail, if an external air condition is severe, i.e., external air around an area on which the air conditioner is installed has a very high or low temperature, a sufficient refrigerant circulation amount has to be secured so as to obtain desired cooling/heating performance.

[0011] For this, to improve performance of the compressor, a compressor having a large capacity has to be provided. In this case, there is a limitation in that the air conditioner increases in manufacturing or installation cost.

[0012] Also, if the refrigerant discharged from the condenser is in a supercooled state, i.e., a supercooling degree of the refrigerant is secured, it may be difficult to secure the supercooling of the refrigerant in the system of Fig. 1 even though evaporation performance of the evaporator, i.e., an area of a lower portion of a line connecting points d and a to each other increases. Thus, it may not expect the improvement in performance.

[0013] To solve the above-described limitation, this applicant has been applied and registered a heat pump system in which a refrigerant is injected into a scroll compressor by using a refrigerant injection passage (Title: heat pump, Registration number: KR10-1280381, hereinafter, referred to as a "prior art").

[0014] However, in the case of the prior art, first and second refrigerant injection ports are simply provided to perform injection of a refrigerant, but relative positions between an injection hole formed in a compressor and a suction port (a refrigerant suction part) of the compressor are not specialized.

[0015] Substantially, the position of the injection hole with respect to the suction port may have a great influence on whether a flow rate of the suction refrigerant or injection refrigerant increases.

[0016] For example, if the injection hole is formed in a predetermined position to inject the refrigerant so early before the refrigerant within the scroll compressor is completely suctioned, an inner pressure of a suction chamber increases to reduce a flow rate of the suction refrigerant.

[0017] For another example, if the injection hole is formed in the other position to inject the refrigerant too late after the refrigerant within the scroll compressor is completely suctioned, since the injection of the refrigerant is performed after the inner pressure of a compression chamber already increases, an injection flow rate may decrease.

[0018] In the scroll compressor according to the related art, the above-described limitations may frequently occur.

[0019] Embodiments provide a scroll compressor that is capable of increasing a flow rate of a refrigerant injected into a compressor and an air conditioner including the same.

[0020] In one embodiment, a scroll compressor includes: a motor generating a driving force; a driving shaft passing through the motor to rotate; a main frame supporting an upper portion of the driving shaft; a fixed scroll including at least one coupling part coupled to the main frame and a first wrap; an orbiting scroll disposed to have a phase different with respect to the fixed scroll, the orbiting scroll including a second wrap defining a compression chamber that is rotatable between the first wrap and the second wrap; a suction part suctioning a refrigerant into the compression chamber; a first inflow part disposed on one side of the fixed scroll to inject the refrigerant into the compression chamber; and a second inflow part disposed on the other side of the fixed scroll to inject a refrigerant, which has a pressure different from that of the refrigerant introduced into the first inflow part, into the compression chamber, wherein the first inflow part is disposed at a position at which a first extension line (11) connecting a central portion of the fixed scroll to a central portion of the suction part rotates by a first preset angle in a direction opposite to the rotation direction of the compression chamber.

[0021] The first preset angle may range from about 80° to about 110°.

[0022] The second inflow part may be disposed at a position at which the first extension line (11) connecting the central portion of the fixed scroll to the central portion of the suction part rotates by a second preset angle in the rotation direction of the compression chamber.

[0023] The second preset angle may range from about 70° to about 100°.

[0024] The second inflow part may have a phase difference of about 180° with respect to the first inflow part.

[0025] The first preset angle may range from about 45° to about 65°.

[0026] The second preset angle may range from about 115° to about 135°.

[0027] The central portion of the fixed scroll may define a center of gravity of the fixed scroll.

[0028] The central portion of the fixed scroll may be defined at a point at which a virtual line connecting two facing coupling parts of the plurality of coupling parts to each other and a virtual line connecting the other two facing coupling parts to each other meet each other.

[0029] The plurality of coupling parts may include a first coupling part, a second coupling part, a third coupling part facing the first coupling part, and a fourth coupling part facing the second coupling part, the first coupling part and the second coupling part may be disposed on one side with respect to a second extension line (12) perpendicular to the first extension line (11), and the third coupling part and the fourth coupling part may be disposed on the other side with respect to the second extension line (12).

[0030] An opening of the first inflow part may start before a time point at which the suction of the refrigerant through the suction part is completed.

[0031] When the driving shaft has a rotation angle of about 0° at the time point at which the suction of the refrigerant through the suction part is completed, the opening of the first inflow part may start when the driving shaft has a rotation angle of about -60° to about -30°.

[0032] When the driving shaft has a rotation angle of about 0° at the time point at which the suction of the refrigerant through the suction part is completed, the opening of the first inflow part may start when the driving shaft has a rotation angle of about -10° to about 10°.

[0033] The fixed scroll may have a discharge hole through which the compressed refrigerant is discharged, and the central portion of the fixed scroll may correspond to a central portion of the discharge hole.

[0034] In another embodiment, a scroll compressor includes: a fixed scroll including a first wrap; an orbiting scroll disposed to have a phase different with respect to the fixed scroll, the orbiting scroll including a second wrap defining a compression chamber that is rotatable between the first wrap and the second wrap; a suction part suctioning a refrigerant into the compression chamber; a first inflow part disposed on one side of the fixed scroll to inject the refrigerant into the compression chamber; and a second inflow part disposed on the other side of the fixed scroll to inject a refrigerant, which has a pressure different from that of the refrigerant introduced into the first inflow part, into the compression chamber, wherein the first inflow part is disposed at a position at which a first extension line (11) connecting two points defined on the fixed scroll to each other rotates by an angle of about 80° to about 110° in a direction opposite to the rotation direction of the compression chamber.

[0035] The two points may include one point representing a central portion of the fixed scroll and the other point representing a central portion of the suction part.

[0036] The central portion of the fixed scroll may be defined at a point at which a virtual line connecting two facing coupling parts of the plurality of coupling parts to each other and a virtual line connecting the other two facing coupling parts to each other meet each other.

[0037] The fixed scroll may have a discharge hole through which the compressed refrigerant is discharged, and the central portion of the fixed scroll may correspond to a central portion of the discharge hole.

[0038] The scroll compressor may further include: a motor generating a driving force; a driving shaft passing through the motor to rotate; and a main frame supporting an upper portion of the driving shaft, wherein the fixed scroll may include a plurality of coupling parts coupled to the main frame.

[0039] An air conditioner including the scroll compressor may be provided.

[0040] The details of one or more embodiments are set forth in the accompanying drawings and the description below. Other features will be apparent from the description and drawings, and from the claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0041]

Fig. 1 is a pressure-enthalpy (p-h) diagram illustrating a refrigerant system depending on an operation of an air conditioner according to a related art.

Fig. 2 is a system view of an air conditioner according to an embodiment.

Fig. 3 is a pressure-enthalpy (p-h) diagram illustrating a refrigerant system depending on an operation of the air conditioner according to an embodiment.

Fig. 4 is a cross-sectional view illustrating a structure of a scroll compressor according to a first embodiment.

Fig. 5 is a view of a discharge cover of the scroll compressor according to the first embodiment.

Fig. 6 is a view illustrating a portion of the scroll compressor according to the first embodiment.

Fig. 7 is a view illustrating arrangements of a scroll wrap and an injection inflow part in the scroll compressor according to the first embodiment.

Fig. 8 is a graph illustrating an effect generated due to the arrangement of the injection inflow part according to the first embodiment.

Fig. 9 is a view illustrating an arrangement of a scroll wrap and an injection inflow part in a scroll compressor according to a second embodiment.

Fig. 10 is a graph illustrating an effect generated due to the arrangement of the injection inflow part according to the second embodiment.

Fig. 11 is a view illustrating arrangements of a scroll wrap and an injection inflow part in a scroll compressor according to the third embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0042] Hereinafter, exemplary embodiments will be described with reference to the accompanying drawings. The invention may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, that alternate embodiments included in other retrogressive inventions or falling within the spirit and scope of the present disclosure will fully convey the concept of the invention to those skilled in the art.

[0043] Fig. 2 is a system view of an air conditioner according to an embodiment, and Fig. 3 is a pressure-enthalpy (p-h) diagram illustrating a refrigerant system depending on an operation of the air conditioner according to an embodiment.

[0044] Referring to Figs. 2 and 3, an air conditioner 1 according to an embodiment operates a refrigeration cycle in which a refrigerant is circulated. The air conditioner 1 may perform a cooling or heating operation according to a circulation direction of the refrigerant.

[0045] When the air conditioner 1 perform the cooling operation, the air conditioner 1 includes a compressor 10 for compressing the refrigerant, a condenser 20 for condensing the refrigerant compressed in the compressor 10, first and second expansion devices 30 and 60 for selectively expanding the refrigerant condensed in the condenser 20, an evaporator 70 for evaporating the refrigerant passing through the first and second expansion devices 30 and 60, and a refrigerant tube 15 connecting the above-described components to each other to guide a flow of the refrigerant.

[0046] The compressor 10 may perform multi-stage compression. The compressor 10 may be a scroll compressor in which the refrigerant is compressed by a relative phase difference between a fixed scroll and an orbiting scroll. Descriptions relating to the above-described structure will be described later.

[0047] The air conditioner 1 includes a plurality of supercooling devices 40 and 50 for supercooling the refrigerant passing through the condenser 20. The plurality of supercooling devices 40 and 50 include a second supercooling device 50 for supercooling the refrigerant passing through the first expansion device 30 and a second supercooling device 40 for supercooling the refrigerant passing through the second supercooling device 50. The refrigerant discharged from the condenser 20 may not be expanded while passing through the first expansion device 30.

[0048] The air conditioner 1 includes a second injection passage 90 for bypassing at least one portion of the refrigerant passing through the first expansion device 30 and a second injection expansion part 95 disposed in the second injection passage 90 to adjust an amount of bypassed refrigerant. The refrigerant may be expanded while passing through the second injection expansion part 95.

[0049] The bypassed refrigerant of the refrigerant passing through the first expansion device 30 may be called a "first branch refrigerant", and the rest of the refrigerant except for the first branch refrigerant may be called a "main refrigerant". In the second supercooling device 50, the main refrigerant and the first branch refrigerant are heat-exchanged with each other.

[0050] Since the first branch refrigerant is changed into a low-temperature low-pressure refrigerant while passing through the second injection expansion part 95, the first branch refrigerant absorbs heat while the first branch refrigerant is heat-exchanged with the main refrigerant. Also, the main refrigerant releases heat into the first branch refrigerant. Thus, the main refrigerant may be supercooled. Also, the first branch refrigerant passing through the second supercooling device 50 is injected into the compressor 10 through the second injection passage 90.

[0051] The second injection passage 90 includes a second injection inflow part 91 for injecting the refrigerant into the compressor 10. The second injection inflow part 91 is connected to a first position of the compressor 10.

[0052] The air conditioner 1 includes a first injection passage 80 for bypassing at least one portion of the refrigerant passing through the second supercooling device 50 and a first injection expansion part 85 disposed in the first injection passage 80 to adjust an amount of bypassed refrigerant. The refrigerant may be expanded while passing through the first injection expansion part 85.

[0053] The refrigerant bypassed into the first injection passage 80 may be called a "second branch refrigerant". In the first supercooling device 40, the main refrigerant and the second branch refrigerant are heat-exchanged with each other.

[0054] Since the second branch refrigerant is changed into a low-temperature low-pressure refrigerant while passing through the first injection expansion part 85, the second branch refrigerant absorbs heat while the second branch refrigerant is heat-exchanged with the main refrigerant. Also, the main refrigerant releases heat into the second branch refrigerant. Thus, the main refrigerant may be supercooled. Also, the second branch refrigerant passing through the first overcooling device 40 is injected into the compressor 10 through the first injection passage 80.

[0055] The first injection passage 80 includes a first injection inflow part 81 injecting the refrigerant into the compressor. The first injection inflow part 81 is connected to a second position of the compressor 10. That is, the first injection inflow part 81 and the second injection inflow part 91 are respectively connected to positions different from each other on the compressor 10.

[0056] The refrigerant passing through the first supercooling device 40 is expanded while passing through the expansion device 60 and then introduced into the evaporator 70. Thereafter, the refrigerant is evaporated in the evaporator 70 and then suctioned into a suction part of the compressor 10.

[0057] A pressure-enthalpy (P-H) diagram in the refrigerant system of the air conditioner will be described with reference to Fig. 3.

[0058] The refrigerant (a state A) suctioned into the compressor 10 is compressed in the compressor 10. Then, the refrigerant is mixed with the refrigerant injected into the compressor 10 through the first injection passage 80. The mixed refrigerant is in a state B. A process in which the refrigerant is compressed from the state A to the state B is called a "first compression".

[0059] The refrigerant (a state B) is compressed again, and then the compressed refrigerant is mixed with the refrigerant injected into the compressor 10 through the second injection passage 90. The mixed refrigerant is in a state C. A process in which the refrigerant is compressed from the state B to the state C is called a "second compression".

[0060] The refrigerant (the state C) is compressed again and then is in a state D. A process in which the refrigerant is compressed from the state C to the state D is called a "third compression". Also, the refrigerant is introduced into the condenser 20 in the state D. Thereafter, when the refrigerant is discharged from the condenser 20, the refrigerant is in a state E.

[0061] The refrigerant (the first branch refrigerant) bypassed while passing through the condenser 20 to pass through the second injection expansion part 95 is expanded (a state K) and heat-exchanged with a main refrigerant having the state E. In this process, the main refrigerant having the state E is supercooled to a state G. Also, the first branch refrigerant having the state K is injected into the compressor 10 and then is mixed with the refrigerant within the compressor 10. As a result, the refrigerant is in the state C.

[0062] The refrigerant (the second branch refrigerant) bypassed while passing through the second supercooling device 50 to pass through the first injection expansion part 85 is expanded to a state M and heat-exchanged with the main refrigerant having the state M. In this process, the main refrigerant having the state G is supercooled to a state H. Also, the second branch refrigerant having the state M is injected into the compressor 1 0 and then is mixed with the refrigerant within the compressor 10. As a result, the refrigerant is in the state B.

[0063] The main refrigerant supercooled to a state H is expanded in the expansion device 60 to become to a state I. Then, the refrigerant having the state I is introduced into the evaporator 70 and heat-exchanged in the evaporator 70. Thereafter, the refrigerant is introduced into the compressor 10.

[0064] In the P-H diagram, a pressure corresponding to a D-H line connecting a point D to a point H may be called a "high pressure", and a pressure corresponding to a C-K line connecting a point C to a point K, i.e., a pressure within the second injection passage 90 may be called a "second middle pressure". Also, a pressure corresponding to a B-M line connecting a point B to a point M, i.e., a pressure within the first injection passage 80 may be called a "first middle pressure", and a pressure corresponding to an A-I line connecting a point A to a point I may be called a "low pressure". The pressure amplitude may satisfy the following relational expression: the high pressure > the second middle pressure > the first middle pressure > the low pressure.

[0065] Here, a flow rate Q1 of the refrigerant injected into the compressor 10 through the first injection passage 80 may be proportional to a pressure difference between the high pressure and the first middle pressure. Also, a flow rate Q2 of the refrigerant injection into the compressor 10 through the second injection passage 90 may be proportional to a pressure difference between the high pressure and the second middle pressure.

[0066] Thus, when the first and second middle pressures are defined at the low pressure side, a flow rate of the refrigerant injected into the compressor 10 may increase.

[0067] Fig. 4 is a cross-sectional view illustrating a structure of a scroll compressor according to a first embodiment, Fig. 5 is a view of a discharge cover of the scroll compressor according to the first embodiment, and Fig. 6 is a view illustrating a portion of the scroll compressor according to the first embodiment.

[0068] Referring to Figs. 4 and 5, a scroll compressor 10 according to a first embodiment includes a housing 110 defining an exterior thereof, a discharge cover 112 covering an upper side of the housing 110, and a base cover 116 disposed on a lower portion of the housing 110 to store oil.

[0069] A refrigerant suction part 111 for suctioning a refrigerant evaporated in the evaporator 70 into the compressor 10 is coupled to the discharge cover 112. The refrigerant suction part 111 passes through the discharge cover 112 to extend downward and then is coupled to a fixed scroll 120.

[0070] The scroll compressor 10 includes a motor 160 received within the housing 110 to generate a rotation force, a rotatable driving shaft 150 passing through a center of the motor 160, a main frame 140 supporting an upper portion of the driving shaft 150, and a compression part disposed above the main frame 140 to compress a refrigerant.

[0071] The motor 160 includes a stator 161 coupled to an inner circumferential surface of the housing 11 0 and a rotor 1 62 rotating within the stator 161. The driving shaft 150 is disposed to pass through a central portion of the rotor 162.

[0072] An oil supply passage 157 is eccentrically disposed toward one side at a central portion of the driving shaft 150. Thus, oil introduced into the oil supply passage 157 may ascend by a centrifugal force generated by the rotation of the driving shaft 150.

[0073] An oil supply part 155 is coupled to a lower portion of the driving shaft 150. The oil supply part 155 may integrally rotate together with the driving shaft 150 to allow the oil stored in the base cover 116 to move to the oil supply passage 157.

[0074] The compression part includes a fixed scroll 120 disposed on a top surface of the main frame 140 to communicate with the refrigerant suction part 111, orbiting scroll 130 rotatably supported on the top surface of the main frame 140 so that the orbiting scroll 130 is engaged with the fixed scroll 120 to define a compression chamber, and an Oldham' s ring disposed between the orbiting scroll 130 and the main frame 140 to prevent the orbiting scroll 130 from rotating while orbiting the orbiting scroll 130. The orbiting scroll 130 is coupled to the driving shaft 150 to receive the rotation force from the driving shaft 150.

[0075] The fixed scroll 120 and the orbiting scroll 130 are disposed so that a phase difference between the fixed scroll 120 and the orbiting scroll 130 is defined at an angle of about 180°. A fixed scroll Wrap 123 having a spiral shape is disposed on the fixed scroll 120. Also, an orbiting scroll wrap 132 having a spiral shape is disposed on the orbiting scroll 130. For convenience, the fixed scroll wrap 123 is called a "first wrap", and the orbiting scroll wrap 132 is called a "second wrap".

[0076] The compression chamber may be provided in plurality by engaging the fixed scroll wrap 123 with the orbiting scroll wrap 132. The orbiting scroll 130 may orbit to compress the refrigerant introduced into the plurality of compression chambers at a high pressure. A discharge hole 121 through which the refrigerant compressed at the high pressure and an oil fluid are discharged is defined at an approximately central portion of an upper portion of the fixed scroll 120.

[0077] In detail, when the orbiting scroll 130 rotates, the plurality of compression chambers may be reduced in volume while moving from the outside of the fixed scroll 120 toward a central direction of the discharge hole 121. The refrigerant is compressed within the compression chambers each of which has the reduced volume and then is discharged to the outside of the fixed scroll 120 through the discharge hole 121.

[0078] The fluid discharged through the discharge hole 121 is introduced into the housing 110 and then discharged through a discharge tube 114. The discharge tube 114is disposed on a side of the housing 110.

[0079] A first injection inflow part for injecting the refrigerant, which flows into the first injection passage 80, into the compressor 10 and a second injection inflow part 91 for injecting the refrigerant, which flows into the second injection passage 90, into the compressor 10 are coupled to the compressor 10.

[0080] The first and second injection inflow parts 81 and 91 may be coupled to both sides of the discharge cover 112, respectivley.

[0081] In detail, the first injection inflow part 81 may pass through the discharge cover 112 and then be inserted into the fixed scroll 120 at one side of the discharge cover 112. Also, the second injection inflow part 91 may pass through the discharge cover 112 and then be inserted into the fixed scroll 120 at the other side of the discharge cover 112.

[0082] A plurality of injection holes 124 and 125 for injecting the refrigerant into the plurality of compression chambers are defined in the fixed scroll 120.

[0083] The plurality of injection holes 124 and 125 include a first injection hole 124 to which the first injection inflow part 81 is coupled and a second injection hole 125 to which the second injection inflow part 91 is coupled. For example, the first and second injection inflow parts 81 and 91 may be inserted into the injection holes 124 and 125, respectively.

[0084] While the orbiting scroll 130 rotates, the orbiting scroll wrap 132 may selectively open or close the first and second injection holes 124 and 125.

[0085] In detail, when the orbiting scroll wrap 132 is located at a first position, or the driving shaft 150 is angled at a first angle, the refrigerant suctioned through the refrigerant suction part 111 may be introduced into an opened space that is defined by the fixed scroll warp 123 and the orbiting scroll warp 132.

[0086] Also, when the orbiting scroll 130 continuously rotates, the opened space may be covered by the orbiting scroll wrap 132 to define a suction chamber. Here, the suction chamber may be understood as a storage space that is in a state in which the refrigerant is completely suctioned. When the orbiting scroll warp 132 rotates, the suction chamber may be converted into a compression chamber while being compressed.

[0087] When the orbiting scroll 130 continuously rotates, the orbiting scroll 130 may be compressed while moving from an outer region of the fixed scroll 120 in a radius direction toward an inner region of the fixed scroll 120. Here, the compression chamber may move in a counterclockwise direction (see Fig. 7).

[0088] The compression chamber moves to approach the discharge hole 121. When the compression chamber reaches the discharge hole 121, the refrigerant is discharged through the discharge hole 121. As described above, the formation of the compression chamber and the compression of the refrigerant may be repeatedly performed by the rotation movement of the orbiting scroll 130.

[0089] In the compression process of the refrigerant, the refrigerant within the first and second injection passages 80 and 90 may be selectively injected into the plurality of compression chambers through the first and second injection inflow parts 81 and 91.

[0090] While the orbiting scroll 130 rotates, the orbiting scroll wrap 132 may move to selectively open or close the first or second injection hole 124 or 125. In the state where the compression chamber moves to one side of the first or second injection hole 124 or 125, when the first or second injection hole 124 or 125 is opened, the refrigerant may be injected into the corresponding compression chamber.

[0091] Since the refrigerant injected through the first injection inflow part 81 has the first middle pressure, the refrigerant may be injected into the compression chamber before the refrigerant is relatively further compressed. On the other hand, since the refrigerant injected through the second injection inflow part 91 has the second middle pressure (that is greater than the first middle pressure), the refrigerant may be injected into the compression chamber before the refrigerant is relatively further compressed.

[0092] Thus, the first injection hole 124 may be defined at a position that is relatively far away from the discharge hole 121 in the radius direction, i.e., a position that communicates with the compression chamber having a relatively low pressure. On the other hand, the second injection hole 125 may be defined at a position that is relatively adjacent to the discharge hole 121 in the radius direction than the first injection hole 124, i.e., a position that communicates with the compression chamber having a relatively high pressure.

[0093] An opening degree of each of the injection holes 124 and 125 when the refrigerant is injected into the compressor may vary according to the positions of the first and second injection inflow parts 81 and 91, i.e., the positions of the first and second injection holes 124 and 125.

[0094] For example, the position of the compression chamber may be changed according to the rotation of the orbiting scroll warp 132. Each of the first and second injection holes 124 and 125 may be fully closed, opened by a degree of about 50%, or fully opened according to the positions of the first and second injection holes 124 and 125 with respect to a specific position of the compression chamber.

[0095] The positions of the first and second injection inflow parts 81 and 82 may be understood as the concept with respect to whether the injection inflow part is opened when the orbiting scroll 130 rotates to a certain angle at a time point at which the refrigerant is completely suctioned through the refrigerant suction part 111. The rotating degree of the orbiting scroll 130 may correspond to the rotation degree of the driving shaft 150.

[0096] In other words, when the compression is performed somewhat on the basis of the time point at which the refrigerant is suctioned through the refrigerant suction part 111, the current embodiment specifies a position of the first injection inflow part 81 or the first injection hole 124 and a position of the second injection inflow part 91 or the second injection hole 125 with respect to whether the refrigerant is injected through the first and second injection inflow parts 81 and 91.

[0097] Hereinafter, detailed descriptions relating to the above-described process will be described with reference to the accompanying drawings.

[0098] Fig. 7 is a view illustrating arrangements of the scroll wrap and the injection inflow part in the scroll compressor according to the first embodiment, and Fig. 8 is a graph illustrating an effect generated due to the arrangement of the injection inflow part according to the first embodiment.

[0099] Referring to Fig. 7, the orbiting scroll 130 and the fixed scroll 120 according to the first embodiment are engaged with each other to define the compression chamber. Also, the orbiting scroll 130 may rotate to move the compression chamber in a center direction of the fixed scroll 120 from the outside of the fixed scroll 120, thereby reducing a volume of the compression chamber.

[0100] For example, the compression chamber includes a first compression chamber 181 and a second compression chamber 183. As the orbiting scroll wrap 132 rotates, the first and second compression chambers 181 and 183 rotate in a counterclockwise direction. For example, when the first compression chamber 181 continuously moves, the first compression chamber 181 may be disposed at a position of the second compression chamber 183.

[0101] Also, while the first and second compression chambers 181 and 183 rotate, when the orbiting scroll warp 132 opens the first or second injection hole 124 or 125, the refrigerant may be injected into the first or second compression chamber 181 or 183.

[0102] In detail, as illustrated in Fig. 7, while the first compression chamber 181 rotates in the counterclockwise direction, when the first injection hole 124 is opened, the refrigerant may be injected into the first compression chamber 181 through the first injection hole 124.

[0103] Here, the opening and closing of the first injection hole 124 may not represent the momentary turn-on/off concept, but represent the gradual opening/closing concept according to the rotation of the orbiting scroll wrap 132.

[0104] While the second compression chamber 183 rotates in the counterclockwise direction, when the second injection hole 125 is opened, the refrigerant may be injected into the second compression chamber 183 through the second injection hole 125.

[0105] Similarly, the opening and closing of the second injection hole 125 may not represent the momentary turn-on/off concept, but represent the gradual opening/closing concept according to the rotation of the orbiting scroll wrap 132.

[0106] The first injection inflow part 81 or the first injection hole 124 may be defined at a position at which the first injection hole 124 is opened before the refrigerant is completely suctioned through the refrigerant suction part 111, i.e., before the suction chamber is completed (before being closed).

[0107] In detail, a central portion or a centroidal portion C1 and a centroidal portion C2 corresponding to a center of the refrigerant suction part 111 may be defined in the fixed scroll 120. The centroidal portion C1 may be understood as a position that corresponds to a center of gravity of the fixed scroll 120 or the main frame 140. Also, the centroidal portion C1 may be called a "first central portion", and the centroidal portion C2 may be called a "second central portion".

[0108] The fixed scroll 120 includes a plurality of coupling parts 190 coupled to the main frame 140. The coupling parts 190 may be provided in even number. For example, as illustrated in Fig. 7, the plurality of coupling parts 190 may be provided in four. That is, the four coupling parts 190 includes a first coupling part 190a, a second coupling part 190b, a third coupling part 190c, and a fourth coupling part 190d, which are spaced apart from each other. However, the current embodiment is not limited to the number of coupling parts 190. For example, six, eight, or twelve coupling parts may be provided.

[0109] The first coupling part 190a and the second coupling parts 190b may be disposed on one side with respect to a center of a second extension line 12, and the third coupling part 190c and the fourth coupling part 190d may be disposed on the other side with respect to the center of the second extension line 12.

[0110] The fixed scroll 120 may be coupled to the main frame 140 through the plurality of coupling parts 190. Thus, the fixed scroll 120 may be stably supported on an upper portion of the main frame 140.

[0111] Also, the centroidal portion C1 of the fixed scroll 120 may be defined at a position at which a first line connecting the two facing coupling parts to each other and a second line connecting the other two coupling parts to each other meet each other.

[0112] That is, the centroidal portion C1 may be defined at a position at which a first line connecting the first coupling part 190a to the third coupling part 190c and a second line connecting the second coupling part 190b to the fourth coupling part 190d meet each other.

[0113] A virtual line extending from the first central portion C1 toward the second central portion C2 may be referred to as the first extension line 11, and a virtual line extending from the first central portion C1 in a direction perpendicular to the first extension line 11 may be referred to as the second extension line 12.

[0114] The first injection inflow part 81 or the first injection hole 124 may be defined at a position at which the first extension line 11 rotates by a first angle $\theta 1$ in a clockwise direction with respect to the center of the first central portion C1. Here, the clockwise direction may be understood as a direction opposite to the rotation direction (the counterclockwise direction) of the compression chamber.

[0115] For example, the first angle $\theta 1$ may range from about 80° to about 110°. Also, when the first injection inflow part 81 or the first injection hole 124 are defined at the position corresponding to the first angle $\theta 1$, the opening of the first injection hole 124 may start before a time point at which the suction of the refrigerant is completed, i.e., a time point at which the suction chamber is completed.

[0116] In detail, if the time point at which the suction of the refrigerant through the refrigerant suction part 111 is completed corresponds to a time point at which the driving shaft 150 has a rotation angle of about 0°, the opening of the first injection hole 124 may start when the driving shaft 150 has a rotation angle of about -30° to about -60°. That is, the range of the first angle $\theta 1$ may correspond to the angle range of about -30° to about -60° with respect to the rotation angle of the driving shaft 150.

[0117] Here, when the driving shaft 150 has the rotation angle of about 0°, the suction of the refrigerant may be completed. Here, if the rotation angle gradually increases to angles of about 10° and about 20°, an opening degree of the first injection hole 124 may gradually increase to further perform the injection of the refrigerant. In addition, the compression of the refrigerant may be continuously performed.

[0118] In summary, even though the first injection hole 124 is opened to start the injection of the refrigerant before the suction of the refrigerant through the refrigerant suction part 111 is completed, a time point at which an amount of injected refrigerant increases because the first injection hole 124 may be fully opened may be a time point at which the compression of the refrigerant starts after the suction of the refrigerant through the refrigerant suction part 111 is completed.

[0119] As a result, the injection hole may be gradually opened for a predetermined time, and the compression of the refrigerant may be performed in the compression chamber just when the injection of the refrigerant is performed.

[0120] Thus, according to the current embodiment, in a case where the injection hole is opened too late, since the injection of the refrigerant is performed in a state where a pressure within the compression chamber is already high, i.e., internal resistance of the compression chamber is large, a flow rate of the refrigerant to be injected may decrease due to the pressure difference.

[0121] The second injection inflow part 91 or the second injection hole 125 may be defined at a position at which the first extension line 11 rotates at a second angle θ2 in a counterclockwise direction with respect to the center of the first central portion C1. Here, the counterclockwise direction may be understood as a direction corresponding to the rotation direction of the compression chamber.

[0122] For example, the second angle θ2 may range from about 70° to about 100°. Also, the second injection inflow part 91 or the second injection hole 125 may have a phase difference of about 180° with respect to the first injection inflow part 81 or the first injection hole 124 and with respect to the basis of the first central portion C1.

[0123] That is, while the first compression chamber 181 rotates, when the first compression chamber 181 further rotates at an angle of about 180° after the refrigerant is injected into the first compression chamber 181 through the first injection inflow part 81, the refrigerant may be injected into the first compression chamber 181 through the second injection inflow part 91.

[0124] That is to say, the opening of the second injection hole 125 may start at a time point at which the second injection hole 125 rotates at an angle of about 180° with respect to the rotation angle of the driving shaft 150 (or the rotation angle of the orbiting scroll wrap 132) after a time point at which the opening of the first injection hole 124 starts.

[0125] Also, the first injection hole 124 may be covered by the orbiting scroll wrap 132 at the time point at which the opening of the second injection hole 125 starts.

[0126] Also, the compressor 10 may be compressed in two stages while the driving shaft 150 further rotates at an angle of about 180° after the opening of the first injection hole 124 starts. The time point at which the opening of the second injection hole 125 starts may be a time point before the two-stage compression is completed.

[0127] When the driving shaft 150 further rotates from a time point at which the opening of the second injection hole 125 starts, an opening degree of the second injection hole 125 may increase to increase an amount of injected refrigerant.

[0128] The refrigerant injected through the second injection hole 125 may be mixed with the refrigerant within the compressor 10 and then compressed in three stages. The refrigerant that is compressed in the three stages may be discharged to the outside of the fixed scroll 120 through the discharge hole 121.

[0129] Referring to Fig. 8, while the orbiting scroll wrap 132 rotates, the first injection hole 124 may be opened or closed according to a predetermined period.

[0130] Fig. 8 illustrates a variation in opening degree of the first injection hole 124 according to the rotation angle of the driving shaft 150. A pattern of the opening and closing of the first injection hole 124 may have a waveform similar to an approximately sine wave.

[0131] That is, when the rotation angle of the driving shaft 150 increases by an angle of about 180°, a first cycle in which the first injection hole 124 is opened and closed may be completed. Also, a lower area of the waveform may be understood as the sum of opened areas of the first injection hole 124 for a corresponding time. Here, the corresponding time may be a time for which the rotation angle of the driving shaft 150 rotates by the first cycle.

[0132] For example, when the first angle θ1 of the first injection hole 124 is about 80°, the opening of the first injection hole 124 may start when the rotation angle of the driving shaft 150 is about -30°. Also, the first injection hole 124 may have an opening degree of about 5% at a time point at which the driving shaft 150 further rotates to finish the suction of the refrigerant.

[0133] In detail, Fig. 8 illustrates a rotation angle of the driving shaft 150 corresponding when the first angle θ1 of the first injection hole 124 is about 80°. That is, the first injection hole 124 may be opened by an opening degree of about 5% at the time point at which the suction of the refrigerant is completed, i.e., when the rotation angle of the driving shaft 150 is about 0°.

[0134] For another example, when the first angle θ1 of the first injection hole 124 is about 110°, the opening of the first injection hole 124 may start when the rotation angle of the driving shaft 150 is about -60°. Also, the first injection hole 124 may have an opening degree of about 23% at a time point at which the driving shaft 150 further rotates to finish the suction of the refrigerant.

[0135] As a result, in the current embodiment, when the first angle θ1 of the first injection hole 124 ranges from about 80° to about 110°, the first injection hole 124 may be opened by an opening degree of about 5% to about 23% at the time point at which the suction chamber is completed. That is, since the first injection hole 124 is opened by a predetermined opening degree just when the suction chamber is completed, the injection of the refrigerant may be easily performed, and thus, an amount of injected refrigerant may increase.

[0136] That is to say, when the refrigerant is injected into the compression chamber just when the suction chamber is completed, if the first injection hole 124 is opened by a preset opening degree, a flow rate of refrigerant that is initially injected may large somewhat. Thus, the pressure (internal resistance) of the compression chamber may be overcome by an inertial force of the refrigerant to increase a flow rate of the injected refrigerant.

[0137] However, when an opening degree of the first injection hole 124 is less than about 5%, the opening degree may be substantially slight. Thus, a flow rate of refrigerant that is initially injected may not be much. As a result, when the refrigerant is injected, an amount of refrigerant to be injected may be limited by the pressure (the internal resistance) of the compression chamber.

[0138] On the other hand, when an opening degree of the first injection hole 124 is about 23%, i.e., when the first injection hole 124 is opened too fast to inject the refrigerant before the suction of the refrigerant is completed, the suction of the refrigerant through the refrigerant suction part 111 may be rather limited by the pressure of the injected refrigerant to reduce a flow rate of suctioned refrigerant and allow the refrigerant to reversely flow toward the refrigerant suction part 111.

[0139] Thus, in the current embodiment, the first injection hole 124 may be determined in position so that the first injection hole 124 is opened by an opening degree of about 5% to about 23% at the time point at which the suction of the refrigerant is completed.

[0140] Due to the above-described structure, when the refrigerant is injected through the first injection hole 124 at the time point at which the suction of the refrigerant is completed, since the first middle pressure is low in the P-H diaphragm, an amount of injected refrigerant may increase.

[0141] Hereinafter, descriptions will be made according to a second embodiment. Since the current embodiment is the same as the first embodiment except for portions of the constitutions, different parts between the first and second embodiments will be described principally, and descriptions of the same parts will be denoted by the same reference numerals and descriptions of the first embodiment.

[0142] Fig. 9 is a view illustrating an arrangement of a scroll wrap and an injection inflow part in a scroll compressor according to a second embodiment, and Fig. 10 is a graph illustrating an effect generated due to the arrangement of the injection inflow part according to the second embodiment.

[0143] Referring to Fig. 9, a first injection inflow part 81 or a first injection hole 124 may be defined at a position at which a first extension line 11 rotates by a third angle θ3 in a clockwise direction with respect to a center of a first central portion C1. Here, the clockwise direction may be understood as a direction opposite to a rotation direction (a counterclockwise direction) of a compression chamber.

[0144] For example, the third angle θ3 may range from about 45° to about 65°. Also, when the first injection inflow part 81 or the first injection hole 124 are defined at the position corresponding to the third angle θ3, the opening of the first injection hole 124 may start at a time point that is close to a time point at which suction of the refrigerant is completed.

[0145] In detail, if the time point at which the suction of the refrigerant through the refrigerant suction part 111 is completed corresponds to a time point at which a driving shaft 150 has a rotation angle of about 0°, the opening of the first injection hole 124 may start when the driving shaft 150 has a rotation angle of about -10° to about 10°. That is, the range of the third angle θ3 may correspond to the angle range of about-10° to about 10° with respect to the rotation angle of the driving shaft 150.

[0146] Here, when the driving shaft 150 has the rotation angle of about 0°, the suction of the refrigerant may be completed. Here, if the rotation angle gradually increases to angles of about 10° and about 20°, an opening degree of the first injection hole 124 may gradually increase to further perform the injection of the refrigerant. In addition, the compression of the refrigerant may be continuously performed.

[0147] A second injection inflow part 91 or a second injection hole 125 may be defined at a position at which the first extension line 11 rotates at a fourth angle θ4 in a counterclockwise direction with respect to the center of the first central portion C1. Here, the counterclockwise direction may be understood as a direction corresponding to the rotation direction of a compression chamber.

[0148] For example, the fourth angle θ4 may range from about 115° to about 135°. Also, the second injection inflow part 91 or the second injection hole 125 may have a phase difference of about 180° with respect to the first injection inflow part 81 or the first injection hole 124 on the basis of the first central portion C1.

[0149] That is, while a first compression chamber 181 rotates, when the first compression chamber 181 further rotates at an angle of about 180° after the refrigerant is injected into the first compression chamber 181 through the first injection inflow part 81, the refrigerant may be injected into the first compression chamber 181 through the second injection inflow part 91.

[0150] That is to say, the opening of the second injection hole 125 may start at a time point at which the second injection hole 125 rotates at an angle of about 180° with respect to the rotation angle of the driving shaft 150 (or a rotation angle of an orbiting scroll wrap 132) after a time point at which the opening of the first injection hole 124 starts.

[0151] Also, the first injection hole 124 may be covered by the orbiting scroll wrap 132 at the time point at which the opening of the second injection hole 125 starts.

[0152] When the rotation angle of the driving shaft 150 ranges from about -10° to about 0°, since the refrigerant is injected through the first injection hole 124 before the suction of the refrigerant is completed, a flow rate of injected refrigerant may increase.

[0153] Also, when the rotation angle of the driving shaft 150 ranges from about 0° to about 10°, the refrigerant may be injected through the first injection hole 124 after the suction of the refrigerant is completed. Thus, the increase in the flow rate of injected refrigerant may be limited somewhat. However, when compared to a case in which the rotation angle of the driving shaft 150 is above about 10°, the limited amount may not be much.

[0154] In detail, a variation in pressure of the first compression chamber according to the rotation angle of the driving shaft 150 will be described with reference to Fig. 10.

[0155] For example, a suction pressure of the refrigerant in the suction chamber may be about 3 kgf/cm^2, and a discharge pressure may be about 27 kgf/cm^2.

[0156] In a case where the opening of the first injection hole 124 starts when the rotation angle of the driving shaft 150 is about 10°, an inner pressure of the first compression chamber 181 in which the refrigerant is injected may range from about 3 kgf/cm^2 to about 4 kgf/cm^2.

[0157] Also, the opening of the second injection hole 125 may start when the driving shaft further rotates to have a rotation angle of about 190°. Here, an inner pressure of the second compression chamber 183 in which the refrigerant is injected may range from about 10 kgf/cm^2 to about 12 kgf/cm^2.

[0158] That is, when the refrigerant is injected through the second injection hole 125, the inner pressure of the second compression chamber 183 may not be relatively high. The inner pressure of the second compression chamber 183 may be lower than a pressure of the refrigerant injected through the second injection hole 125.

[0159] On the other hand, In a case where the opening of the first injection hole 124 starts when the rotation angle of the driving shaft 150 is about 30° (a tangential circle), an inner pressure of the first compression chamber 181 in which the refrigerant is injected may range from about 4 kgf/cm^2 to about 5 kgf/cm^2.

[0160] Also, the opening of the second injection hole 125 may start when the driving shaft further rotates to have a rotation angle of about 210° (a dotted square shape). Here, an inner pressure of the second compression chamber 183 in which the refrigerant is injected may range from about 23 kgf/cm^2 to about 24 kgf/cm^2.

[0161] That is, when the refrigerant is injected through the second injection hole 125, the inner pressure of the second compression chamber 183 may very high. In this case, the inner pressure (internal resistance) of the second compression chamber 183 may be greater than or slightly different from the pressure of the injected refrigerant. Thus, the limitation in which the injection of the refrigerant through the second injection hole 125 is limited may be prevented.

[0162] Thus, in the current embodiment, since the opening of the first injection hole 124 starts when the driving shaft 150 has a rotation angle of about 10° or less, the refrigerant may be easily injected through the second injection hole 125. Therefore, a flow rate of the injected refrigerant may increase.

[0163] Hereinafter, a description will be made according to a third embodiment. When comparing the current embodiment to the first embodiment, the current embodiment is similar to the first embodiment except for a method for setting a reference point for determining a first injection inflow part (or a first injection hole) and a second injection part (or a second injection hole). Thus, different points therebetween will be mainly described, and also duplicated descriptions will be derived from those of the first embodiment.

[0164] Fig. 11 is a view illustrating arrangements of a scroll wrap and an injection inflow part in a scroll compressor according to the third embodiment.

[0165] Referring to Fig. 11, a first injection inflow part 81 or a first injection hole 124 according to a third embodiment may be defined at a position at which the first injection hole 124 is opened before a refrigerant is completely suctioned through the refrigerant suction part 111, i.e., before a suction chamber is completed (before being closed).

[0166] In detail, a central portion C3 of a discharge hole 121 and a central portion C2 corresponding to a center of the refrigerant suction part 111 may be defined in a fixed scroll 120. A central portion C3 of the discharge hole 121 may be called a "first central portion", and the central portion C2 may be called a "second central portion".

[0167] The central portion C3 of the discharge hole 121 may be defined at an approximately central portion of the fixed scroll 120 and be adjacent to the centroidal portion C1 that is described in the first embodiment.

[0168] In the current embodiment, when the plurality of coupling parts 190 that is described in the first embodiment are not provided in even number, for example, the fixed scroll 120 does not have a circular shape, but has a polygonal or an asymmetric shape, it may be difficult to determine the centroidal portion by using the two coupling parts facing each other or the other two coupling parts.

[0169] Thus, each of the first and second injection inflow parts 81 and 91 may be determined in position by using the central portion C3 of the discharge hole 121 that is adjacent to the centroidal portion of the fixed scroll.

[0170] In detail, a virtual line extending from the first central portion C3 toward the second central portion C2 may be referred to as the first extension line 13, and a virtual line extending from the first central portion C3 in a direction perpendicular to the first extension line 13 may be referred to as the second extension line 12.

[0171] The first injection inflow part 81 or the first injection hole 124 may be defined at a position at which the first extension line 13 rotates by a first angle 65 in a clockwise direction with respect to the center of the first central portion C1. Here, the clockwise direction may be understood as a direction opposite to a rotation direction (a counterclockwise direction) of a compression chamber.

[0172] For example, the first angle $\theta 5$ may range from about 80° to about 110°. Also, when the first injection inflow part 81 or the first injection hole 124 are defined at the position corresponding to the first angle $\theta 5$, the opening of the first injection hole 124 may start before a time point at which the suction of the refrigerant is completed, i.e., a time point at which the suction chamber is completed.

[0173] In detail, if the time point at which the suction of the refrigerant through the refrigerant suction part 111 is completed corresponds to a time point at which a driving shaft 150 has a rotation angle of about 0°, the opening of the first injection hole 124 may start when the driving shaft 150 has a rotation angle of about -30° to about -60°. That is, the range of the first angle 65 may correspond to the angle range of about -30° to about -60° with respect to the rotation angle of the driving shaft 150.

[0174] Here, when the driving shaft 150 has the rotation angle of about 0°, the suction of the refrigerant may be completed. Here, if the rotation angle gradually increases to angles of about 10° and about 20°, an opening degree of the first injection hole 124 may gradually increase to further perform the injection of the refrigerant. In addition, the compression of the refrigerant may be continuously performed.

[0175] In summary, even though the first injection hole 124 is opened to start the injection of the refrigerant before the suction of the refrigerant through the refrigerant suction part 111 is completed, a time point at which an amount of injected refrigerant increases because the first injection hole 124 may be fully opened may be a time point at which the compression of the refrigerant starts after the suction of the refrigerant through the refrigerant suction part 111 is completed.

[0176] As a result, the compression of the refrigerant may be performed together when the injection hole is slowly opened for a predetermined time to inject the refrigerant. Thus, if the injection hole is opened too late, since a pressure within the compression chamber is above a predetermined pressure, i.e., internal resistance of the compression chamber is large, a flow rate of the refrigerant to be injected may decrease due to the pressure difference.

[0177] A second injection inflow part 91 or a second injection hole 125 may be defined at a position at which the first extension line 13 rotates at a second angle θ6 in a counterclockwise direction with respect to the center of the first central portion C3. Here, the counterclockwise direction may be understood as a direction corresponding to the rotation direction of a compression chamber.

[0178] For example, the second angle θ6 may range from about 70° to about 100°. Also, the second injection inflow part 91 or the second injection hole 125 may have a phase difference of about 180° with respect to the first injection inflow part 81 or the first injection hole 124.

[0179] That is, while a first compression chamber 181 rotates, when the first compression chamber 181 further rotates at an angle of about 180° after the refrigerant is injected into the first compression chamber 181 through the first injection inflow part 81, the refrigerant may be injected into the first compression chamber 181 through the second injection inflow part 91.

[0180] That is to say, the opening of the second injection hole 125 may start at a time point at which the second injection hole 125 rotates at an angle of about 180° with respect to the rotation angle of the driving shaft 150 (or a rotation angle of an orbiting scroll wrap 132) after a time point at which the opening of the first injection hole 124 starts.

[0181] Also, the first injection hole 124 may be covered by the orbiting scroll wrap 132 at the time point at which the opening of the second injection hole 125 starts.

[0182] Also, the compressor 10 may be compressed in two stages while the driving shaft 150 further rotates at an angle of about 180° after the opening of the first injection hole 124 starts. The time point at which the opening of the second injection hole 125 starts may be a time point before the two-stage compression is completed.

[0183] When the driving shaft 150 further rotates from a time point at which the opening of the second injection hole 125 starts, an opening degree of the second injection hole 125 may increase to increase an amount of injected refrigerant.

[0184] The refrigerant injected through the second injection hole 125 may be mixed with the refrigerant within the compressor 10 and then compressed in three stages. The refrigerant that is compressed in the three stages may be discharged to the outside of the fixed scroll 120 through the discharge hole 121.

[0185] According to the embodiments, the refrigerant may be injected into different positions of the scroll compressor to increase a circulating amount of refrigerant in the system. Therefore, the cooling/heating performance may be improved.

[0186] Also, since the refrigerant having the middle pressure is injected into the compressor, a power required for compressing the refrigerant in the compressor may be reduced to improve the cooling/heating efficiency.

[0187] Also, since the opening of the first injection inflow part starts before the suction of the refrigerant into the compressor through the refrigerant suction part is completed, and the refrigerant is injected when the refrigerant is compressed in one stage by the compressor, the pressure (the middle pressure) of the injected refrigerant may be reduced to increase the flow rate of injected refrigerant.

[0188] Also, since the first injection inflow part and the second injection inflow part are provided to have a predetermined phase difference therebetween, the opening/closing time points of the first and second injection inflow parts may be optimized, thereby effectively injecting and compressing the refrigerant.

[0189] Particularly, the first injection inflow part may be defined at a predetermined position in a direction opposite to the compression direction with respect to the virtual line 11 connecting the central portion C1 of the fixed scroll and the central portion C2 of the refrigerant suction part, and the second injection inflow part may be defined at a predetermined position in the compression direction with respect to the virtual line 11.

[0190] Therefore, the injection hole may be opened by a predetermined opening degree at the time point at which the suction of the refrigerant is completed. Then, while the compression is performed, the opening degree of the injection hole may increase to increase the flow rate of injected refrigerant.

[0191] Although embodiments have been described with reference to a number of illustrative embodiments thereof, it should be understood that numerous other modifications and embodiments can be devised by those skilled in the art that will fall within the spirit and scope of the principles of this disclosure. More particularly, various variations and modifications are possible in the component parts and/or arrangements of the subject combination arrangement within the scope of the disclosure, the drawings and the appended claims. In addition to variations and modifications in the component parts and/or arrangements, alternative uses will also be apparent to those skilled in the art.

Claims

1. A scroll compressor comprising:

   a motor generating a driving force;
   a driving shaft passing through the motor to rotate;
   a main frame supporting an upper portion of the driving shaft;
   a fixed scroll comprising at least one coupling part coupled to the main frame and a first wrap;
   an orbiting scroll disposed to have a phase different with respect to the fixed scroll, the orbiting scroll comprising a second wrap defining a compression chamber that is rotatable between the first wrap and the second wrap;
   a suction part suctioning a refrigerant into the compression chamber;
   a first inflow part disposed on one side of the fixed scroll to inject the refrigerant into the compression chamber; and
   a second inflow part disposed on the other side of the fixed scroll to inject a refrigerant, which has a pressure different from that of the refrigerant introduced into the first inflow part, into the compression chamber,
   wherein the first inflow part is disposed at a position at which a first extension line (11) connecting a central portion of the fixed scroll to a central portion of the suction part rotates by a first preset angle in a direction opposite to the rotation direction of the compression chamber.

2. The scroll compressor according to claim 1, wherein the first preset angle ranges from about 80° to about 110°.

3. The scroll compressor according to claim 1 or 2, wherein the second inflow part is disposed at a position at which the first extension line (11) connecting the central portion of the fixed scroll to the central portion of the suction part rotates by a second preset angle in the rotation direction of the compression chamber.

4. The scroll compressor according to claim 3, wherein the second preset angle ranges from about 70° to about 100°.

5. The scroll compressor according to any of claims 1 to 4, wherein the second inflow part has a phase difference of about 180° with respect to the first inflow part.

6. The scroll compressor according to claim 1, wherein the first preset angle ranges from about 45° to about 65°.

7. The scroll compressor according to claim 6, wherein the second preset angle ranges from about 115° to about 135°.

8. The scroll compressor according to any of claims 1 to 7, wherein the central portion of the fixed scroll defines a center of gravity of the fixed scroll.

9. The scroll compressor according to any of claims 1 to 8, wherein the central portion of the fixed scroll is defined at a point at which a first virtual line connecting two facing coupling parts of a plurality of coupling parts to each other and a second virtual line connecting the other two facing coupling parts to each other meet each other.

10. The scroll compressor according to claim 9, wherein the plurality of coupling parts comprises a first coupling part, a second coupling part, a third coupling part facing the first coupling part, and a fourth coupling part facing the second coupling part,
    the first coupling part and the second coupling part are disposed on one side with respect to a second extension line (12) perpendicular to the first extension line (11), and
    the third coupling part and the fourth coupling part are disposed on the other side with respect to the second extension line (12).

11. The scroll compressor according to any of claims 1 to 10, wherein an opening of the first inflow part starts before a time point at which the suction of the refrigerant through the suction part is completed.

12. The scroll compressor according to claim 11, wherein, when the driving shaft has a rotation angle of about 0° at the time point at which the suction of the refrigerant through the suction part is completed, the opening of the first inflow part starts when the driving shaft has a rotation angle of about -60° to about -30°.

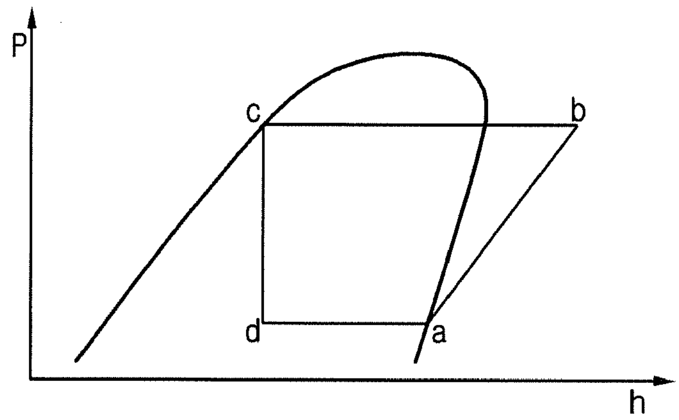
13. The scroll compressor according to claim 11, wherein, when the driving shaft has a rotation angle of about 0° at the time point at which the suction of the refrigerant through the suction part is completed, the opening of the first inflow part starts when the driving shaft has a rotation angle of about -10° to about 10°.

14. The scroll compressor according to any of claims 1 to 13, wherein the fixed scroll has a discharge hole through which the compressed refrigerant is dis-

charged, and
the central portion of the fixed scroll corresponds to a central portion of the discharge hole.

15. An air conditioner comprising the scroll compressor according to any one of claims 1 to 14.

Fig. 1



- Prior Art -

Fig. 2

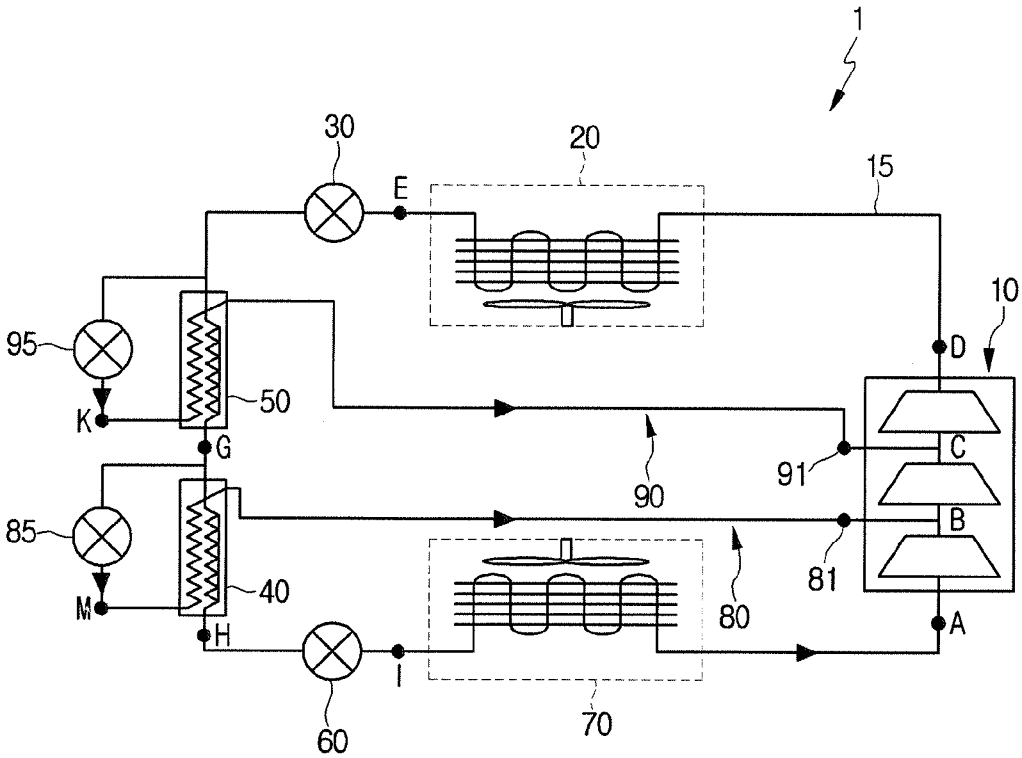


Fig. 3

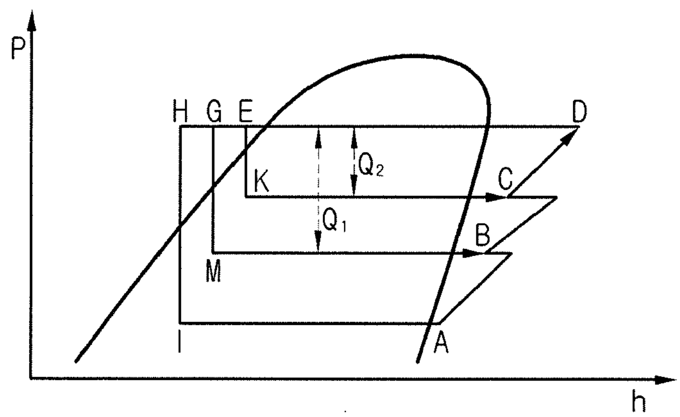
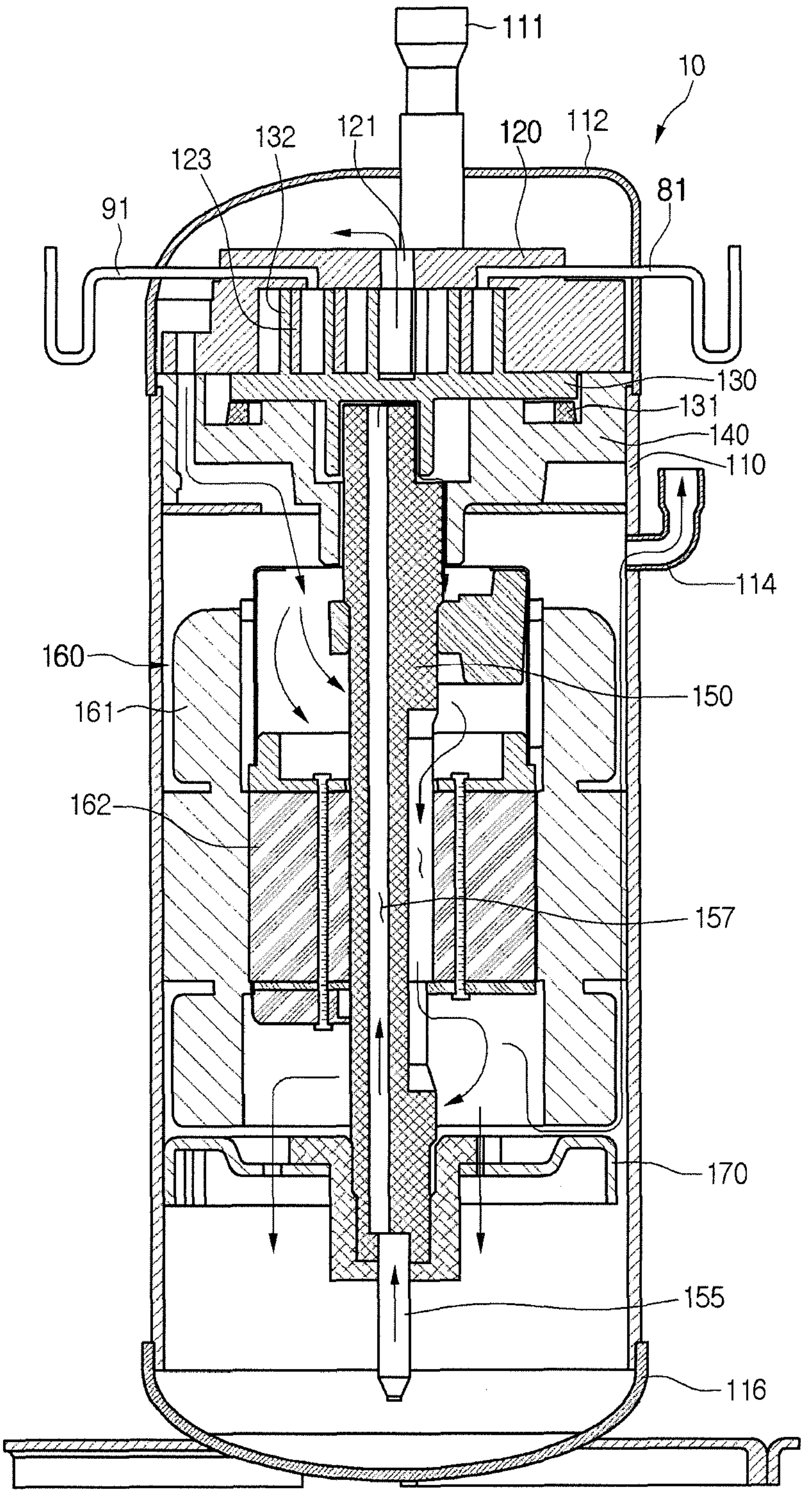


Fig. 4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162
157
170
155
116

Fig. 5

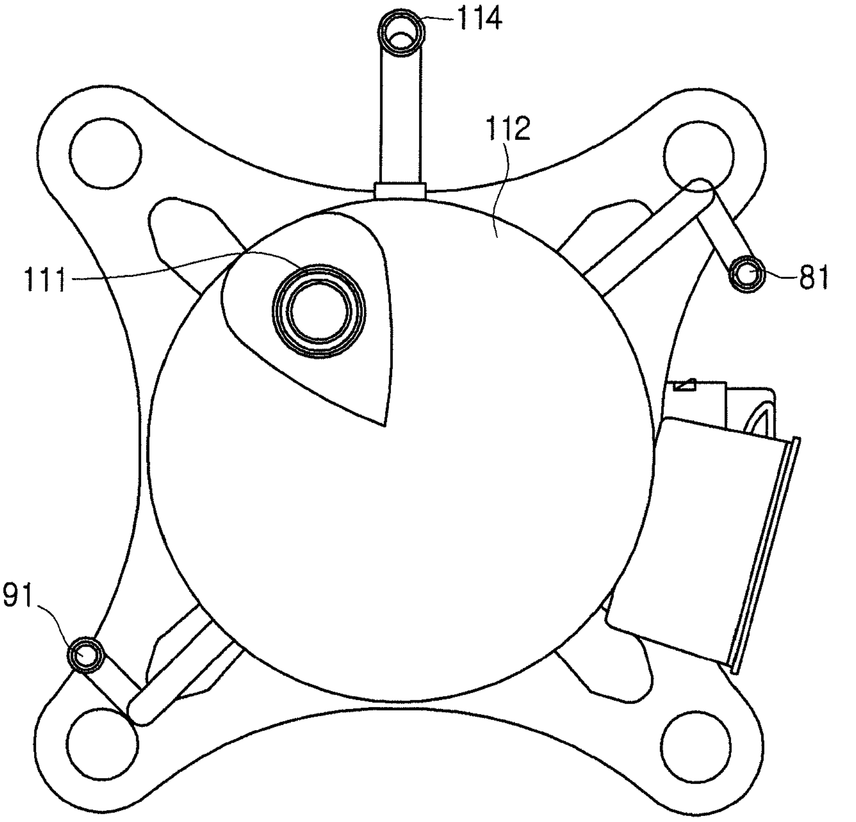


Fig. 6

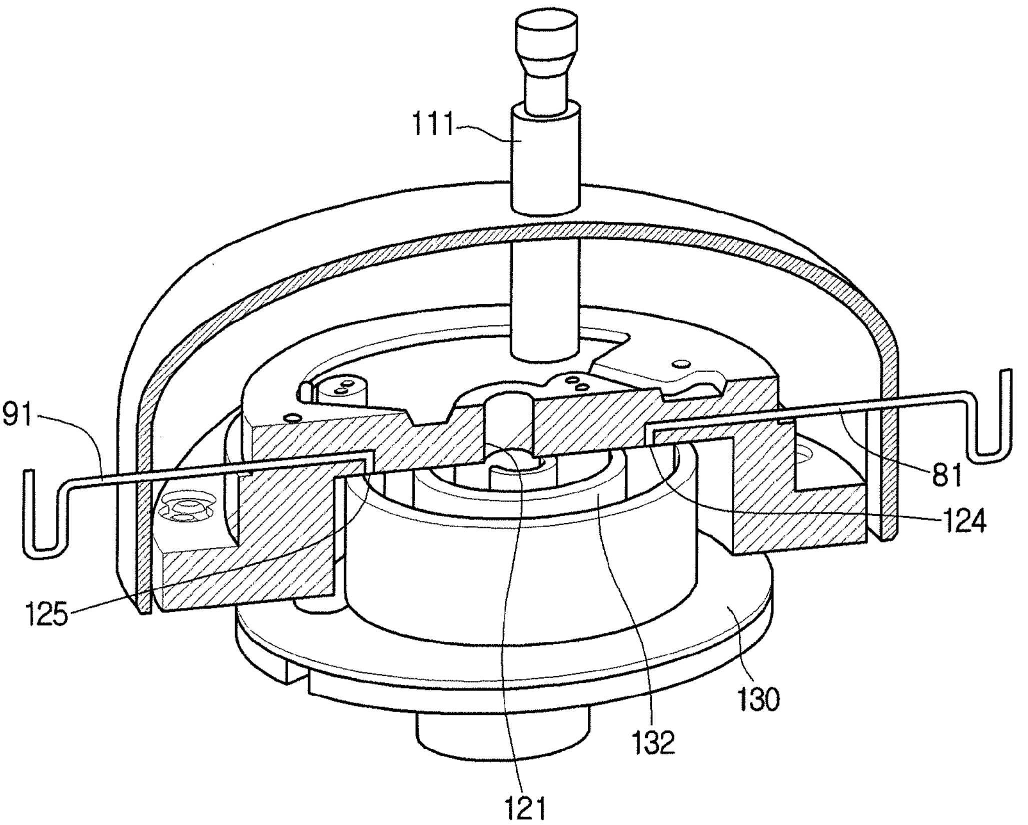


Fig. 7

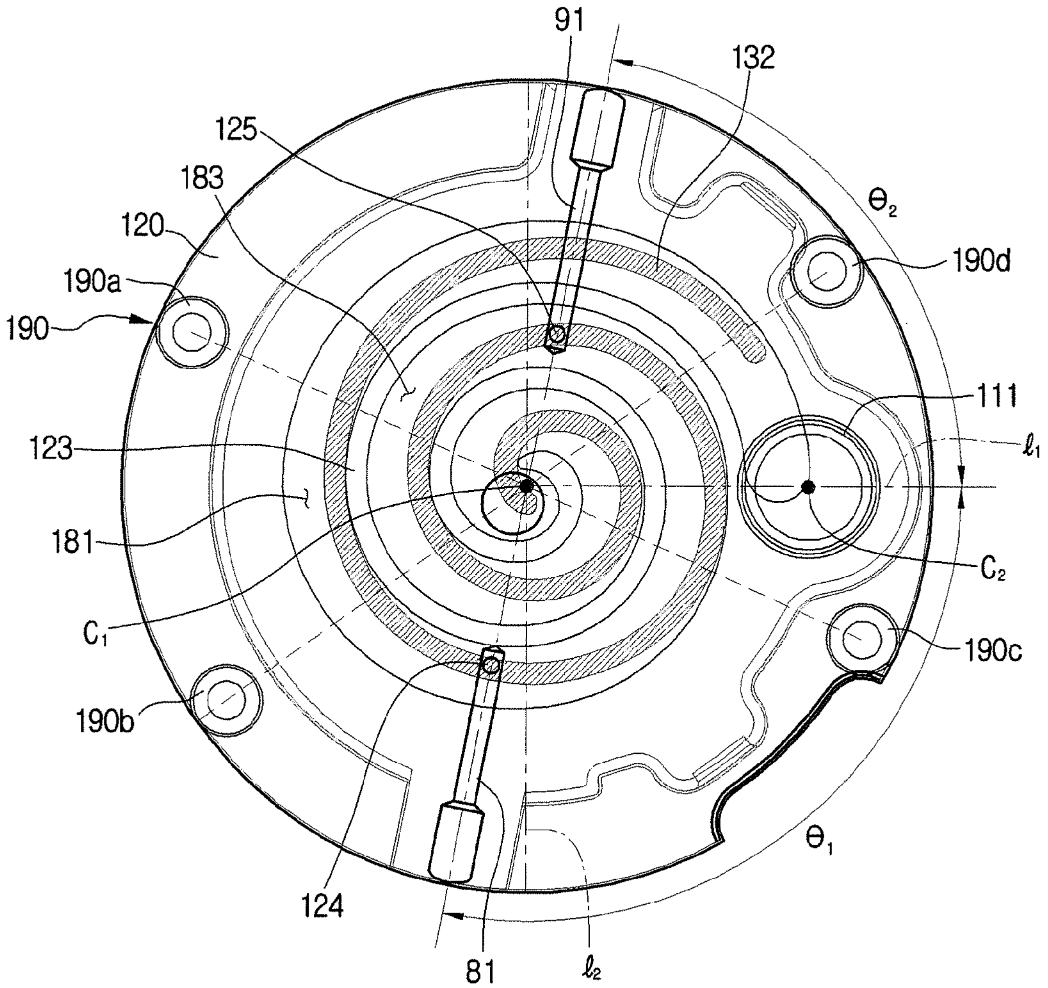

91
132
125
183
120
190a
190
190d
111
123
181
C1
C2
190c
190b
124
81
θ2
θ1
ℓ1
ℓ2

Fig. 8

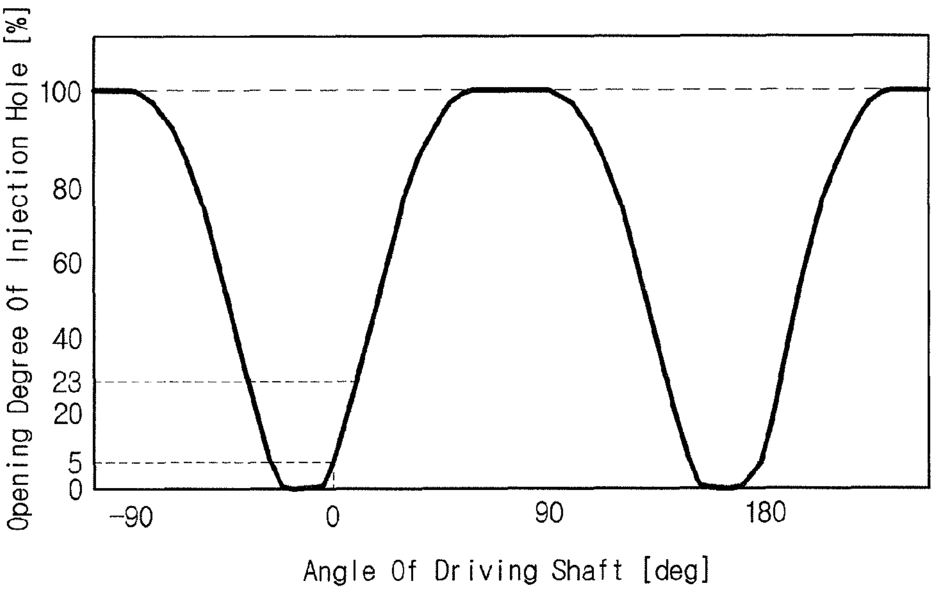
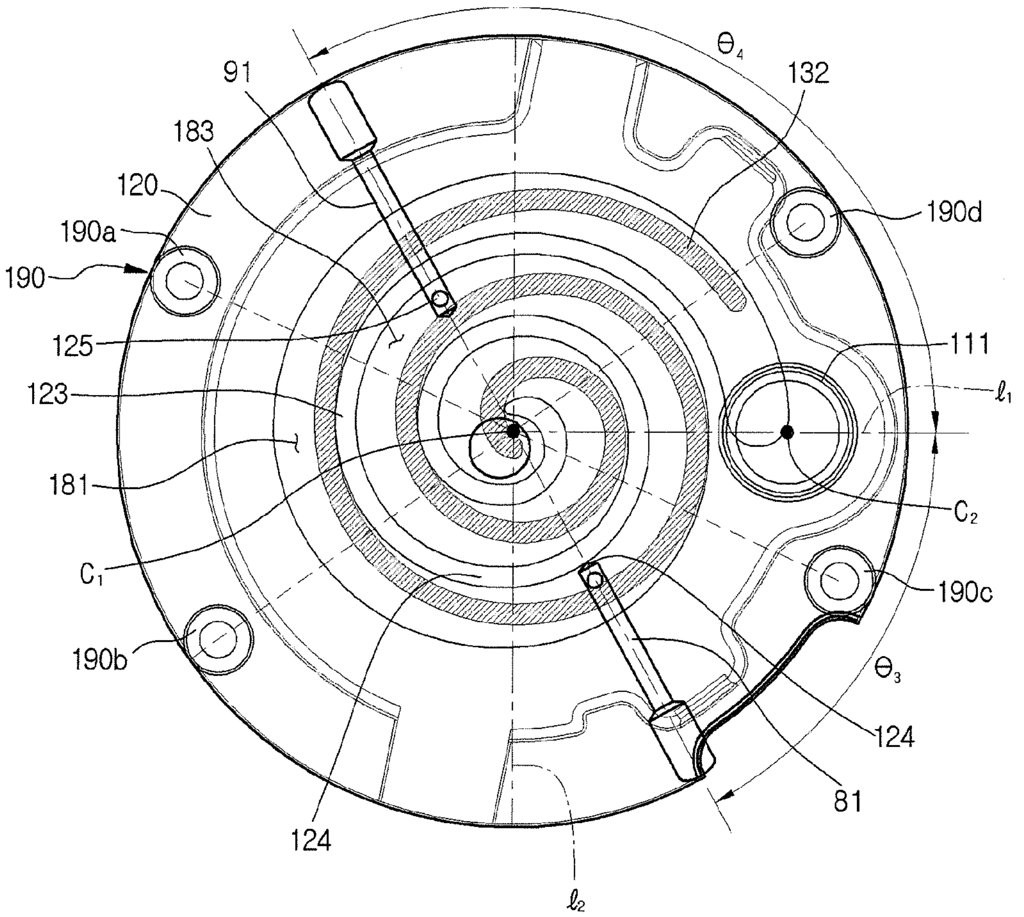
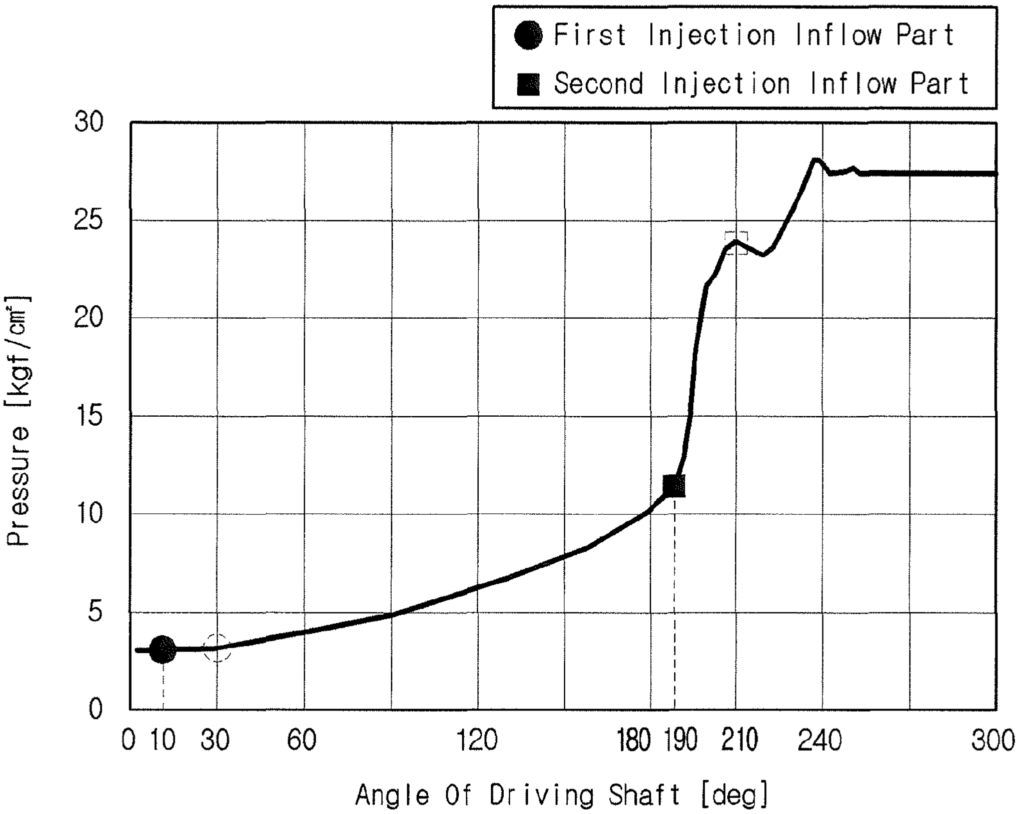

Opening Degree Of Injection Hole [%]
100
80
60
40
23
20
5
0
-90
0
90
180
Angle Of Driving Shaft [deg]

Fig. 9



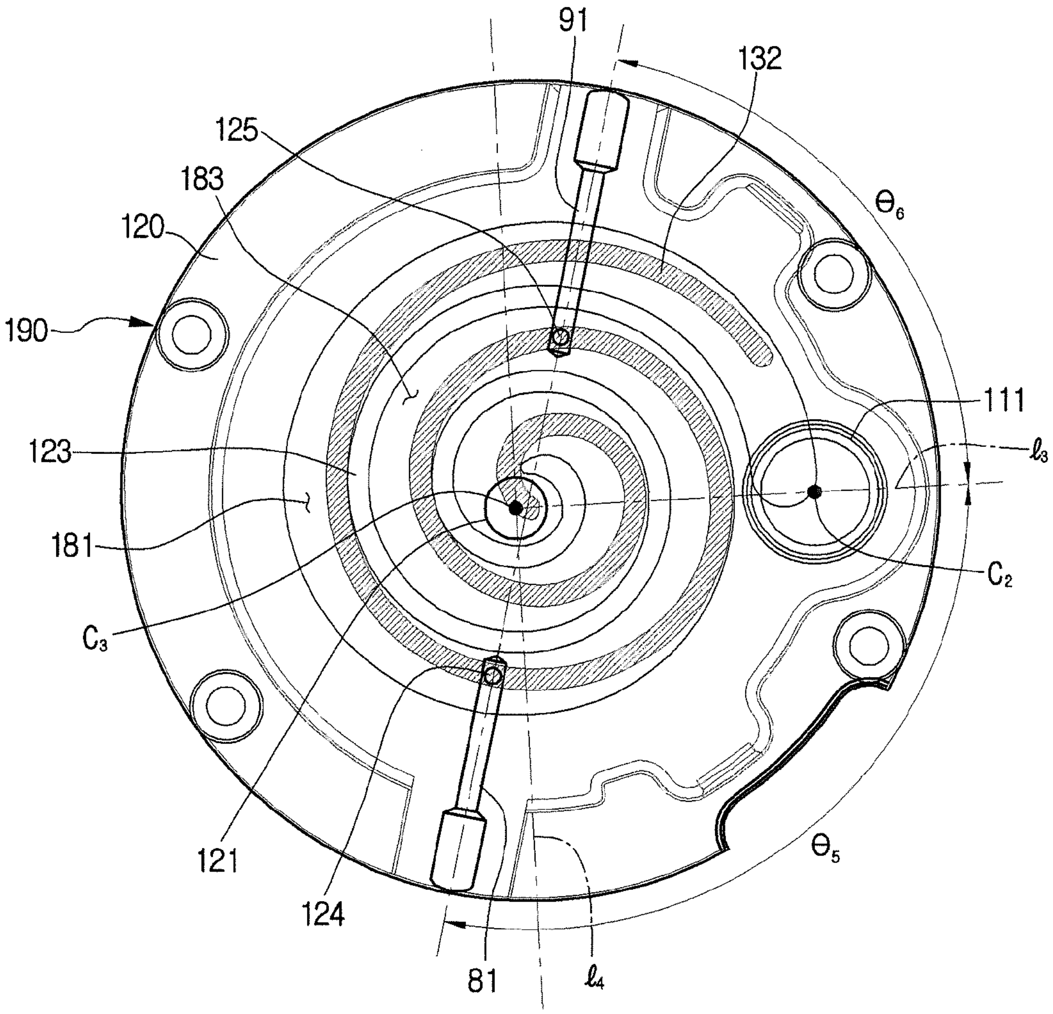
Θ4
91
132
183
120
190a
190
190d
125
111
123
ℓ1
181
C2
C1
190c
190b
Θ3
124
81
124
ℓ2

Fig. 10



First Injection Inflow Part
Second Injection Inflow Part
30
25
20
15
10
5
0
Pressure [kgf/cm²]
0 10 30 60 120 180 190 210 240 300
Angle Of Driving Shaft [deg]

Fig. 11



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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 6580

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Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 2 578 885 A1 (LG ELECTRONICS INC [KR]) 10 April 2013 (2013-04-10) * column 53 - column 88 * * figures 1,2,4,5 * -----	1-15	INV. F04C18/02 F04C29/04
X	JP 2009 036140 A (HITACHI APPLIANCES INC) 19 February 2009 (2009-02-19) * abstract * * paragraph [0008] - paragraph [0032] * * figures 1-8 * -----	1-15	
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The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	28 January 2015	Papastefanou, M

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