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

(11) EP 2 940 304 A1

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
04.11.2015 Bulletin 2015/45

(21) Application number: **15165844.0**

(22) Date of filing: **30.04.2015**

(51) Int Cl.:
F04C 23/00 *(2006.01)* ***F04C 15/00*** *(2006.01)*
F04C 18/02 *(2006.01)*

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

(30) Priority: **02.05.2014 KR 20140053652**

(71) Applicant: **LG Electronics Inc.**
Yeongdeungpo-gu
Seoul 150-721 (KR)

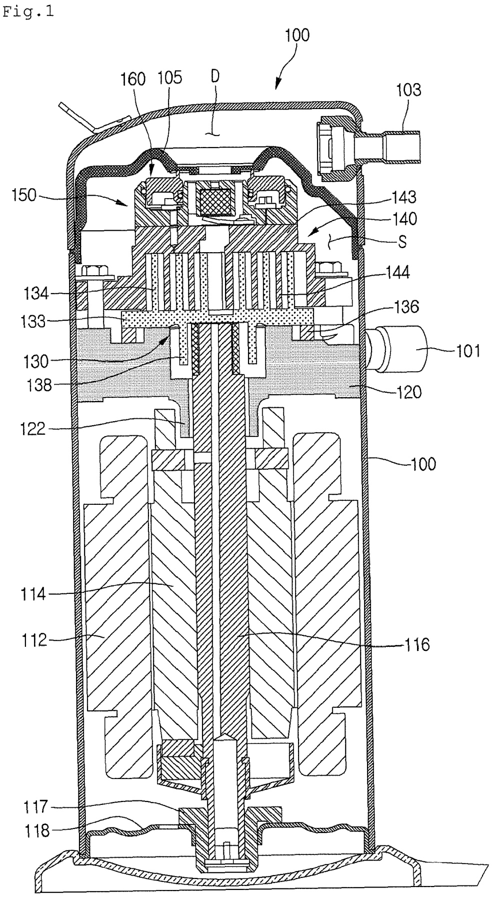
(72) Inventors:
- **Jin, Honggyun**
153-802 Seoul (KR)
- **Kim, Minjae**
153-802 Seoul (KR)
- **Park, Kiwon**
153-802 Seoul (KR)

(74) Representative: **Vossius & Partner**
Patentanwälte Rechtsanwälte mbB
Siebertstrasse 3
81675 München (DE)

(54) **SCROLL COMPRESSOR**

(57) The scroll compressor includes a casing comprising a rotation shaft; a discharge cover fixed inside the casing to partition the inside of the casing into a suction space and a discharge space; a back pressure plate defining a back pressure chamber for accommodating a refrigerant, a floating plate to define the back pressure chamber together with the back pressure plate, the floating plate including a contact part that is capable of contacting the discharge cover, and a coating layer defining an outer surface of the contact part. The discharge cover has a first hardness value, the floating plate has a second hardness value, and the coating layer has a third hardness value, and the third hardness value is less than the first hardness value and greater than the second hardness value.

Fig.1



EP 2 940 304 A1

Description

BACKGROUND

[0001] A scroll compressor represents a compressor using a fixed scroll having a spiral wrap and an orbiting scroll that revolves with respect to the fixed scroll, i.e., a compressor in which the fixed scroll and the orbiting scroll are engaged with each other to revolve, thereby reducing a volume of a compression chamber, which is formed between the fixed scroll and the orbiting scroll according to the orbiting motion of the orbiting scroll, and thus to increase in pressure of a fluid to discharge the fluid through a discharge hole formed in a central portion of the fixed scroll.

[0002] In the scroll compressor, suction, compression, and discharge of a fluid are successively performed while the orbiting scroll revolves. Accordingly, a discharge valve and suction valve may be unnecessary in principle. Also, since the number of parts constituting the scroll compressor is less, the scroll compressor may be simplified in structure and rotate at a high speed. Also, since a variation in torque required for the compression is less, and the suction and compression successively occur, a relatively small amount of noise and vibration may occur.

[0003] A scroll compressor including a back pressure discharge unit is disclosed in Korean Patent Registration No. 10-1378886 that is a prior document.

[0004] The scroll compressor includes a back pressure chamber assembly defining a back pressure chamber. The back pressure chamber assembly includes a back pressure plate and a floating plate. A sealing end is disposed on an upper end of an inner space part of the floating plate. The sealing end contacts a bottom surface of a discharge cover to seal the inner space so that the discharged refrigerant does not leak into the suction space, but is discharged into a discharge space.

[0005] However, according to the prior document, the sealing end of the floating plate continuously collides with a discharge cover while the scroll compressor operates. In this case, the sealing end of the floating plate colliding with the discharge cover may be worn out to allow the suction space to communicate with the discharge space. As a result, the scroll compressor may abnormally operate.

[0006] Also, according to the prior document, it is necessary to quickly space the floating plate from the discharge cover. This is done for a reason in which an equilibrium pressure reaching time within the compressor is reduced to reduce a re-operating time of the compressor when the floating plate is quickly spaced apart from the discharge cover.

SUMMARY

[0007] Embodiments provide a scroll compressor.

[0008] In one embodiment, a scroll compressor includes: a casing including a rotation shaft; a discharge cover fixed inside the casing to partition the inside of the casing into a suction space and a discharge space; a first scroll revolving by rotation of the rotation shaft; a second scroll defining a plurality of compression chambers together with the first scroll, the second scroll having an intermediate pressure discharge hole communicating with a compression chamber having an intermediate pressure of the plurality of compression chambers; a back pressure plate defining a back pressure chamber for accommodating a refrigerant discharged from the intermediate pressure discharge hole; a floating plate movably disposed on a side of the back pressure plate to define the back pressure chamber together with the back pressure plate, the floating plate including a contact part that is capable of contacting the discharge cover; and a coating layer defining an outer surface of the contact part, wherein the discharge cover has a first hardness value, the floating plate has a second hardness value, and the coating layer has a third hardness value, and the third hardness value is less than the first hardness value and greater than the second hardness value.

[0009] In another embodiment, a scroll compressor includes: a casing including a rotation shaft; a discharge cover fixed inside the casing to partition the inside of the casing into a suction space and a discharge space; a first scroll revolving by rotation of the rotation shaft; a second scroll defining a plurality of compression chambers together with the first scroll, the second scroll having an intermediate pressure discharge hole communicating with a compression chamber having an intermediate pressure of the plurality of compression chambers; a back pressure plate defining a back pressure chamber for accommodating a refrigerant discharged from the intermediate pressure discharge hole; a floating plate movably disposed on a side of the back pressure plate to define the back pressure chamber together with the back pressure plate, the floating plate including a contact part that is capable of contacting the discharge cover; a coating layer defining an outer surface of the contact part; and an impact absorption layer disposed on a portion of the discharge cover facing the contact part.

[0010] 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

[0011]

Fig. 1 is a cross-sectional view of a scroll compressor according to an embodiment.
Fig. 2 is a partial exploded cross-sectional view of the scroll compressor according to an embodiment.
Fig. 3 is a partial cross-sectional view of the scroll compressor according to an embodiment.
Fig. 4 is a view illustrating a bottom surface of a back pressure plate according to an embodiment.
Fig. 5 is a graph illustrating a variation in abrasion depending on a thickness of a coating layer according to an embodiment.
Fig. 6 is a perspective view of a fixed scroll according to an embodiment.
Fig. 7 is a partial view of an orbiting scroll according to an embodiment.
Fig. 8 is a cross-sectional view illustrating a state in which the fixed scroll and the orbiting scroll are coupled to each other according to an embodiment.
Figs. 9A to 9C are views illustrating relative positions of an intermediate pressure discharge hole of the fixed scroll and a discharge guide of the orbiting scroll while the orbiting scroll revolves.
Fig. 10 is a partial cross-sectional view of a scroll compressor according to another embodiment.

DETAILED DESCRIPTION OF THE EMBODIMENTS

[0012] Reference will now be made in detail to the embodiments of the present disclosure, examples of which are illustrated in the accompanying drawings.

[0013] In the following detailed description of the preferred embodiments, reference is made to the accompanying drawings that form a part hereof, and in which is shown by way of illustration specific preferred embodiments in which the invention may be practiced. These embodiments are described in sufficient detail to enable those skilled in the art to practice the invention, and it is understood that other embodiments may be utilized and that logical structural, mechanical, electrical, and chemical changes may be made without departing from the spirit or scope of the invention. To avoid detail not necessary to enable those skilled in the art to practice the invention, the description may omit certain information known to those skilled in the art. The following detailed description is, therefore, not to be taken in a limiting sense.

[0014] Also, in the description of embodiments, terms such as first, second, A, B, (a), (b) or the like may be used herein when describing components of the present invention. Each of these terminologies is not used to define an essence, order or sequence of a corresponding component but used merely to distinguish the corresponding component from other component(s). It should be noted that if it is described in the specification that one component is "connected," "coupled" or "joined" to another component, the former may be directly "connected," "coupled," and "joined" to the latter or "connected", "coupled", and "joined" to the latter via another component.

[0015] Fig. 1 is a cross-sectional view of a scroll compressor according to an embodiment, Fig. 2 is a partial exploded cross-sectional view of the scroll compressor according to an embodiment, Fig. 3 is a partial cross-sectional view of the scroll compressor according to an embodiment, and Fig. 4 is a view illustrating a bottom surface of a back pressure plate according to an embodiment.

[0016] Referring to Figs. 1 to 4, a scroll compressor 100 according to the current embodiment includes a casing 110 having a suction space S and a discharge space D.

[0017] In detail, a discharge cover 105 is disposed in an inner upper portion of the casing 110. An inner space of the casing 110 is partitioned into the suction space S and the discharge space D by the discharge cover 105. Here, an upper space of the discharge cover 105 may be the discharge space D, and a lower space of the discharge cover 105 may be the suction space S. A discharge hole 105a through which a refrigerant compressed at a high pressure is discharged may be defined in an approximately central portion of the discharge cover 105.

[0018] The scroll compressor 100 may further include a suction port 101 communicating with the suction space S and a discharge port 103 communicating with the discharge space D. Each of the suction port 101 and the discharge port 103 may be fixed to the casing 101 to allow the refrigerant to be suctioned into the casing 110 or discharged to the outside of the casing 110.

[0019] A motor may be disposed in the suction space S. The motor may include a stator 112 coupled to an inner wall of the casing 110, a rotor 114 rotatably disposed within the stator 112, and a rotation shaft 116 passing through a central portion of the stator 114.

[0020] A lower portion of the rotation shaft 116 is rotatably supported by an auxiliary bearing 117 that is disposed on a lower portion of the casing 110. The auxiliary bearing 117 may be coupled to a lower frame 118 to stably support the rotation shaft 116.

[0021] The lower frame 118 may be fixed to the inner wall of the casing 110, and an upper space of the lower frame

118 may be used as an oil storage space. An oil stored in the oil storage space may be transferred upward by an oil supply passage 116 defined in the rotation shaft 116 and uniformly supplied into the casing 110.

[0022] The oil supply passage 116a may be eccentrically disposed toward one side of the rotation shaft 116 so that the oil introduced into the oil supply passage 116a flows upward by a centrifugal force generated by the rotation of the rotation shaft 116.

[0023] The scroll compressor 100 may further include a main frame 120. The main frame 120 may be fixed to the inner wall of the casing 110 and disposed in the suction space S.

[0024] An upper portion of the rotation shaft 116 is rotatably supported by the main frame 120. A main bearing part 122 protruding downward is disposed on a bottom surface of the main frame 120. The rotation shaft 116 is inserted into the main bearing part 122. An inner wall of the main bearing part 122 may function as a bearing surface so that the rotation shaft 116 smoothly rotates.

[0025] The scroll compressor 100 may further include an orbiting scroll 130 and a fixed scroll 140. The orbiting scroll 130 is seated on a top surface of the main frame 120.

[0026] The orbiting scroll 130 includes a first head plate 133 having an approximately disk shape and placed on the main frame 120 and an orbiting wrap 134 having a spiral shape and extending from the first head plate 133.

[0027] The first head plate 133 may define a lower portion of the orbiting scroll 130 as a main body of the orbiting scroll 130, and the orbiting wrap 134 may extend upward from the first head plate 133 to define an upper portion of the orbiting scroll 130. Also, the orbiting wrap 134 together with a fixed wrap 144 of the fixed scroll 140 may define a compression chamber. The orbiting scroll 130 may be called a "first scroll", and the fixed scroll 140 may be called a "second scroll".

[0028] The first head plate 133 of the orbiting scroll 130 may revolve in a state where the first head plate 133 is supported on the top surface of the main frame 120. Here, an Oldham ring 136 may be disposed between the first head plate 133 and the main frame 120 to prevent the orbiting scroll 130 from revolving. Also, a boss part 138 into which the upper portion of the rotation shaft 116 is inserted is disposed on a bottom surface of the first head plate 133 of the orbiting scroll 130 to easily transmit a rotation force of the rotation shaft 116 to the orbiting scroll 130.

[0029] The fixed scroll 140 engaged with the orbiting scroll 130 is disposed on the orbiting scroll 130.

[0030] The fixed scroll 140 may include a plurality of coupling guide parts 141, each of which defines a guide hole 141a.

[0031] The orbiting scroll 100 may further includes a guide pin 142 inserted into the guide hole 141a and placed on a top surface of the main frame 120 and a coupling member 145a inserted into the guide pin 142 and fitted into an insertion hole 125 of the main frame 120.

[0032] The fixed scroll 140 may include a second head plate 143 having an approximately disk shape and a fixed wrap 144 extending from the second head plate 143 toward the first head plate 133 and engaged with the orbiting wrap 134 of the orbiting scroll 130.

[0033] The second head plate 143 may define an upper portion of the fixed scroll 140 as a main body of the fixed scroll 140, and the fixed wrap 144 may extend downward from the second head plate 143 to define a lower portion of the fixed scroll 140. The orbiting wrap 134 may be called a "first wrap", and the fixed wrap may be called a "second wrap".

[0034] An end of the fixed wrap 144 may be disposed to contact the first head plate 133, and an end of the orbiting wrap 134 may be disposed to contact the second head plate 143.

[0035] The fixed wrap 144 may disposed in a predetermined spiral shape, and a discharge hole 145 through which the compressed refrigerant is discharged may be defined in an approximately central portion of the second head plate 143. Also, a suction hole (see reference numeral 146 of Fig. 6) through which the refrigerant within the suction space S is suctioned is defined in a side surface of the fixed scroll 140. The refrigerant suctioned through the suction hole 146 is introduced into the compression chamber that is defined by the orbiting wrap 134 and the fixed wrap 144.

[0036] In detail, the fixed wrap 144 and the orbiting wrap 134 may define a plurality of compression chambers. Each of the plurality of compression chambers may be reduced in volume while revolving and moving toward the discharge part 145 to compress the refrigerant. Thus, the compression chamber, which is adjacent to the suction hole 146, of the plurality of compression chambers may be minimized in pressure, and the compression chamber communicating with the discharge hole 145 may be maximized in pressure. Also, the compression chamber between the above-described compression chambers may have an intermediate pressure that corresponds between a suction pressure of the suction hole 146 and a discharge pressure of the discharge hole 145. The intermediate pressure may be applied to a back pressure chamber BP that will be described later to press the fixed scroll 140 toward the orbiting scroll 130.

[0037] An intermediate pressure discharge hole 147 for transferring the refrigerant of the compression chamber having the intermediate pressure to the back pressure chamber BP is defined in the second head plate 143 of the fixed scroll 140. That is, the intermediate pressure discharge hole 147 may be defined in one portion of the fixed scroll 140 so that the compression chamber communicating with the intermediate pressure discharge hole 147 has a pressure greater than that in the suction space S and less than that in the discharge space D. The intermediate pressure discharge hole 147 may pass through the second head plate 143 from a top surface to a bottom surface of the second head plate 143.

[0038] Back pressure chamber assemblies 150 and 160 disposed above the fixed scroll 140 to define the back pressure chamber are disposed on the fixed scroll 140. The back pressure chamber assemblies 150 and 160 may include a back pressure plate 150 and a floating plate 160 separably coupled to the back pressure plate 150. The back pressure plate 150 may be fixed to an upper portion of the second head plate 143 of the fixed scroll 140.

[0039] The back pressure plate 150 may have an approximately annular shape with a hollow and include a support 152 contacting the second head plate 143 of the fixed scroll 140. An intermediate pressure suction hole 153 communicating with the intermediate pressure discharge hole 147 may be defined in the support 152. The intermediate pressure suction hole 153 may pass through the support 152 from a top surface to a bottom surface of the support 152.

[0040] Also, a second coupling hole 154 communicating with the first coupling hole 148 defined in the second head plate 143 of the fixed scroll 140 may be defined in the support 152. The first coupling hole 148 and the second coupling hole 154 are coupled to each other by a coupling member (not shown).

[0041] The back pressure plate 150 includes a plurality of walls 158 and 159 extending upward from the support 152. The plurality of walls 158 and 159 include a first wall 158 extending upward from an inner circumferential surface of the support 152 and a second wall 159 extending upward from an outer circumferential surface of the support 152. Each of the first and second walls 158 and 159 may have an approximately cylindrical shape.

[0042] The first and second walls 158 and 159 together with the support 152 may define a space part. A portion of the space part may be the back pressure chamber BP.

[0043] The first wall 158 includes a top surface part 158a defining a top surface of the first wall 158. Also, the first wall 158 may include at least one intermediate discharge hole 158b communicating with the discharge hole 145 of the second head plate 143 to discharge the refrigerant discharged from the discharge hole 145 toward the discharge cover 105. The intermediate discharge hole 158b may pass from a bottom surface of the first wall 158 to the top surface part 158a.

[0044] An inner space of the first wall 158 having a cylindrical shape may communicate with the discharge hole 145 to define a portion of a discharge passage through which the discharged refrigerant flows into the discharge space D.

[0045] A discharge valve device 108 having an approximately circular pillar shape is disposed inside the first wall 158. The discharge valve device 108 is disposed above the discharge hole 145 and has a size enough to completely cover the discharge hole 145. For example, the discharge valve device 108 may have an outer diameter greater than a diameter of the discharge hole 145.

[0046] Thus, when the discharge valve device 108 contacts the second head plate 143 of the fixed scroll 140, the discharge valve device 108 may close the discharge hole 145.

[0047] The discharge valve device 108 may be movable upward or downward according to a variation in pressure that is applied to the discharge valve device 108. Also, the inner circumferential surface of the first wall 158 may define a moving guide part 158c for guiding movement of the discharge valve device 108.

[0048] A discharge pressure apply hole 158d is defined in the top surface part 158a of the first wall 158. The discharge pressure apply hole 158d communicates with the discharge hole D. The discharge pressure apply hole 158d may be defined in an approximately central portion of the top surface part 158a, and the plurality of intermediate discharge holes 158b may be disposed to surround the discharge pressure apply hole 158d.

[0049] For example, when the operation of the scroll compressor 100 is stopped, if the refrigerant flows backward from the discharge space D toward the discharge hole 145, the pressure applied to the discharge pressure apply hole 158d may be greater than the discharge hole-side pressure. That is, the pressure may be applied downward to a top surface of the discharge valve device 108, and thus, the discharge valve device 108 may move downward to close the discharge hole 145.

[0050] On the other hand, if the scroll compressor 100 operates to compress the refrigerant in the compression chamber, when the discharge hole-side pressure is greater than a pressure in the discharge space D, an upward pressure may be applied to the bottom surface of the discharge valve device 108, and thus, the discharge valve device 108 may move upward to open the discharge hole 145.

[0051] When the discharge hole 145 is opened, the refrigerant discharged from the discharge hole 145 flows toward the discharge cover 105 via the intermediate discharge hole 158b and then be discharged to the outside of the compressor 100 through the discharge port 103 via the discharge hole 105a.

[0052] The back pressure plate 150 may further include a stepped portion 158e disposed inside a portion at which the first wall 158 and the support 152 are connected to each other. The refrigerant discharged from the discharge hole 145 may reach a space defined by the stepped portion 158e and then flow to the intermediate discharge hole 158b.

[0053] The second wall 159 is spaced a predetermined distance from the first wall 158 to surround the first wall 158.

[0054] The back pressure plate 150 may have a space part having an approximately U-shaped cross-section by the first wall 158, the second wall 159, and the support 152. Also, the floating plate 160 is accommodated in the space part. A space of the space part, which is covered by the floating plate 160, may become to the back pressure chamber BP.

[0055] On the other hand, the first and second walls 158 and 159 of the back pressure plate 150, the support 152, and the floating plate 160 may define the back pressure chamber BP.

[0056] The floating plate 160 includes an inner circumferential surface facing the outer circumferential surface of the first wall 158 and an outer circumferential surface facing the inner circumferential surface of the second wall 159. That is, the inner circumferential surface of the floating plate 160 may contact the outer circumferential surface of the first wall 158, and the outer circumferential surface of the floating plate 160 may contact the inner circumferential surface of the second wall 159.

[0057] Here, the floating plate 160 may have an inner diameter that is equal to or grater than an outer diameter of the first wall 158 of the back pressure plate 150. The floating plate 160 may have an outer diameter that is equal to or less than an inner diameter of the second wall 159 of the back pressure plate 150.

[0058] A sealing member 159a for prevent the refrigerant within the back pressure chamber BP from leaking may be disposed on at least one of the first and second walls 158 and 159 and the floating plate 160.

[0059] The sealing member 159a may prevent the refrigerant from leaking between an inner circumferential surface of the second wall 159 and an outer circumferential surface of the floating plate 160. Also, the sealing member for preventing the refrigerant from leaking between an outer circumferential surface of the first wall 158 and an inner circumferential surface of the floating plate 160 may be disposed on the first wall 158 or the inner circumferential surface of the floating plate 160.

[0060] A contact part 164 extending upward may be disposed on the top surface of the floating plate 160. For example, the contact part 164 may extend upward from the inner circumferential surface of the floating plate 160.

[0061] When the floating plate 160 ascends, the contact part 164 may contact a bottom surface of the discharge cover 105. When the contact part 164 contacts the discharge cover 105, the communication between the suction space S and the discharge space D may be blocked. On the other hand, when the contact part 164 is spaced apart from the bottom surface of the discharge cover 105, i.e., when the contact part 164 moves in a direction that is away from the discharge cover 105, the suction space S and the discharge space D may communicate with each other.

[0062] In detail, while the scroll compressor 100 operates, the floating plate 160 may move upward to allow the contact part 164 to contact the bottom surface of the discharge cover 105. Thus, the refrigerant discharged from the discharge hole 145 to pass through the intermediate discharge hole 158b may not leak into the suction space S, but be discharged into the discharge space D.

[0063] On the other hand, when the scroll compressor 100 is stopped, the floating plate moves downward to allow the contact part 164 to be spaced apart from the bottom surface of the discharge cover 105. Thus, the discharge refrigerant disposed at the discharge cover-side may flow toward the suction space S through the space between the contact part 164 and the discharge cover 105.

[0064] Also, when the scroll compressor 100 is stopped, the floating plate 160 may move upward to allow the contact part 164 to be spaced apart from the bottom surface of the discharge cover 105.

[0065] For example, the floating plate 160 may be formed of a aluminum material by using casting. The floating plate 160 may be relatively light when compared to other materials. Thus, when the operation of the compressor is stopped, the floating plate 160 may quickly move downward by a pressure of the refrigerant of the discharge space. That is, the contact part 164 of the floating plate 160 may be quickly spaced apart from the discharge cover 105.

[0066] In the current embodiment, the sealing member 159a is disposed on the first wall 158 or the second wall 159 of the back pressure plate 160 and the floating plate 160. Thus, even though a descending speed of the floating plate 150 increases due to a self-weight of the floating plate 160 when the floating plate 160 is heavy, a friction force between the sealing member 159a and the floating plate 160 may increase. As a result, the descending speed of the floating plate 160 may substantially decrease. However, according to the current embodiment, since the floating plate 160 is formed of the aluminum material, the floating plate 160 may quickly descend to reduce a re-operation time of the compressor.

[0067] In the current embodiment, the discharge cover 105 may be formed of a steel material. In this case, a Vickers hardness (referred to as a "first hardness value") of the discharge cover 105 may be above about 500 HV. On the other hand, a Vickers hardness (referred to as a "second hardness value") of the floating plate 160 may be about 100 HV. That is, while the contact part 164 of the floating plate 160 continuously collides with the discharge cover 105, the contact part may be worn out.

[0068] Particularly, when a liquid refrigerant is compressed, the abrasion of the contact part 164 may increase. In this case, the contact part 164 may not block the communication between the suction space S and the discharge space D.

[0069] Thus, in the current embodiment, a coating layer 160b may be disposed on at least the contact part 164 on the floating plate 160. That is, the floating plate 160 may include a plate body 160 that serves as a mother material and the coating layer 160 disposed on at least the contact part 164 on the plate body 160. Also, the coating layer 160b may define an outer surface of the contact part 164.

[0070] For example, Fig. 3 illustrates the coating layer 160b applied on an entire surface of the plate body 160.

[0071] A Vickers hardness (referred to as a "third hardness value") of the coating layer 160b may range from about 300 HV to about 420 HV. Thus, a difference between the Vickers hardness of the coating layer 160b disposed on the floating plate 160 and the Vickers hardness of the discharge cover 105 may be above about 80 HV. If a difference between the Vickers hardness of the coating layer 160b and the Vickers hardness of the discharge cover 105 is less than about 80 HV, a portion of the coating layer 160b may be attached to the discharge cover 105, and thus the contact part 164 may be worn out while the contact part 164 repeatedly collides with the discharge cover 105.

[0072] Thus, since the third hardness value of the coating layer 160b ranges from about 300 HV to about 420 HV in the current embodiment, a difference between the third hardness value of the coating layer 160b disposed on the floating plate 160 and the first hardness value of the discharge cover 105 may be above about 80 HV to prevent the contact part 164 from being worn out.

[0073] The floating body 160a may be formed of, for example, AL6061 T6. The coating layer 180b may include an anodizing film that is manufactured by using an anodizing technology.

[0074] The anodizing technology may be a processing technology in which an aluminum surface is oxidized by oxygen generated from a positive electrode when a power is applied to aluminum that serves as the positive electrode to form an oxidized aluminum layer. In the current embodiment, the anodizing film may be formed on the floating body 160a by using a hard anodizing technology.

[Table 1]

Sample	ALDC 12 A1 alloy	AL7075-T6	AL6061-T6
Friction coefficient	0.035	0.083	0.052
Coating thickness (μm)	Soft 5~7	Soft 10	Soft 30
Straightness (μm)	80	12	1

[0075] Table 1 illustrates a friction coefficient and surface straightness according to a kind of aluminum. The AL6061-T6 may have pure aluminum of about 95% or more, and the coating using the hard anodizing technology may be effective on pure aluminum.

[0076] Thus, ALDC 12 Al alloy and AL7075-T6 formed a coating layer by using a soft anodizing technology, and the AL6061-T6 formed a coating layer by using the hard anodizing technology.

[0077] In general, the more each of the friction coefficient and surface straightness decreases, the more abrasion performance may be improved. That is, if the surface straightness of aluminum itself is high, even though the coating layer is formed, since the surface straightness of the coating layer itself is high, the abrasion may increase.

[0078] Referring to Table 1, although the friction coefficient of the ALDC 12 Al alloy is lowest, when the coating layer is formed by using the hard anodizing technology, the straightness of the ALDC 12 Al alloy may be high, for example, about 80.

[0079] On the other hand, although the friction coefficient of the AL6061-T6 is higher than that of the ALDC 12 Al alloy, the AL6061-T6 may have straightness of about 1, i.e., have very low straightness when compared to that of the ALDC 12 Al alloy.

[0080] Thus, in the current embodiment, the plate body 160a may be manufactured by using the AL6061-T6 having low straightness, and the coating layer 160b may be formed by using the hard anodizing technology. Here, the plate boy 160a itself may have a Vickers hardness of about 110 HV or less. However, in the current embodiment, the material of the plate body 160a is not limited to the AL6061-T6. For example, the plate body 160a may be manufactured by using other aluminum alloys having low straightness and high purity.

[0081] Fig. 5 is a graph illustrating a variation in abrasion depending on a thickness of the coating layer according to an embodiment.

[0082] Fig. 5 is a graph illustrating results obtained by experimentally measuring a variation in abrasion depending on a thickness of the coating layer when the plate body is manufactured by using the AL6061-T6.

[0083] Referring to Fig. 5, when the coating layer is formed on the plate body formed of the AL6061-T6, and then the compressor operates for a predetermined time (for example, about 3,500 hours), it was seen that the more the coating layer increases in thickness, the more abrasion decreases.

[0084] In the graph, if the coating layer has a thickness of about 25 μm or less, the abrasion may significantly increase above about 1 μm. Thus, this is not preferable. Also, if the coating layer has a thickness of about 35 μm, even though the thickness does not have an influence on the abrasion, a time and cost for forming the coating layer may increase. Thus, this is not preferable.

[0085] As a result, it is preferable that the coating layer 160b has a thickness of about 25 μm to about 35 μm.

[0086] According to the proposed embodiment, since the coating layer is formed on the plate body to absorb an impact, the abrasion of the contact part of the plate may be prevented. Thus, when the compressor operates, the communication between the suction space and the discharge space due to the abrasion of the contact part may be prevented.

[0087] Fig. 6 is a perspective view of a fixed scroll according to an embodiment.

[0088] Referring to Figs. 2 and 6, the fixed scroll 140 according to an embodiment includes at least one bypass hole 149 defined in one side of the discharge hole 145.

[0089] Although two bypass holes 149 are defined in the fixed scroll 140 in Fig. 6, the current embodiment is not limited to the number of bypass holes 149. The bypass hole 149 passes through the second head plate 143 to extend up to the compression chamber defined by the fixed wrap 144 and the orbiting wrap 134.

[0090] Here, the bypass hole 149 may be defined in a different position according to the operation conditions. For example, the bypass hole 149 may communicate with the compression chamber having a pressure that is greater by about 1.5 times than the suction pressure. Also, the compression chamber communicating the bypass hole 149 may have a pressure greater than that of the compression chamber communicating with the intermediate pressure discharge hole 147.

[0091] The scroll compressor 100 may further include a bypass valve 124 for opening/closing the bypass hole 149, a stopper 220 for restricting a moving distance of the bypass valve 124 when the bypass valve 124 opens the bypass hole 149, and a coupling member 230 for coupling the bypass valve 124 and the stopper 220 to the fixed scroll 140 at the same time.

[0092] In detail, the bypass valve 124 may include a valve support 124a fixed to the second head plate 143 of the fixed scroll 140 by the coupling member 230.

[0093] The bypass valve 124 may further include a connection part 124b extending from the valve support 124a and a valve body 124c disposed on a side of the connection part 124b. Each of the connection part 124b and the valve body 124c may have the same number as the bypass hole 149. For example, Fig. 6 illustrates the bypass valve 124 including two connection parts 124b and two valve bodies 124c.

[0094] The valve body 124c may be maintained in contact with the top surface of the second head plate 143 and have a size that is enough to sufficiently cover the bypass hole 149.

[0095] Here, the valve body 124c may move by a pressure of the refrigerant flowing along the bypass hole 149 to open the bypass hole 149. Thus, the connection width 124b may have a size less than a diameter of the valve body 124c so that the valve body 124c smoothly moves.

[0096] When the bypass valve 124 opens the bypass hole 149, the refrigerant of the compression chamber communicating with the bypass hole 149 may flow into a space between the fixed scroll 140 and the back pressure plate 150 through the bypass hole 149 to bypass the discharge hole 145. Also, the bypassed refrigerant flows toward the discharge hole 105a of the discharge cover 105 via the intermediate discharge hole 158b.

[0097] The stopper 220 may be disposed above the bypass valve 124. The stopper 220 may have a shape corresponding to the bypass valve 124.

[0098] The bypass valve 124 may be elastically deformed by the refrigerant pressure. Also, since the stopper 220 restricts the movement of the bypass valve 124, the stopper 220 may have a thickness greater than that of the bypass valve 124.

[0099] The stopper 220 may include a stopper support 221 contacting the valve support 124a. Also, the stopper 220 may further include a connection part 225 extending from the stopper support 221 and a stopper body 228 disposed on one side of the connection part 225.

[0100] Each of the connection part 225 of the stopper 220 and the stopper body 228 may have the same number as each of the connection part 124b of the bypass valve 124 and the valve body 124c.

[0101] The connection part 225 of the stopper 220 may be inclined upward in a direction that is away from the stopper support 221. Thus, the valve body 124c may contact the top surface of the second head plate 143, and the stopper body 228 may be spaced apart from the top surface of the valve body 124c in the state where the bypass valve 124 and the stopper 220 are coupled to the second head plate 143 by the coupling member 230.

[0102] Also, when the valve body 124c is lifted upward by the refrigerant flowing through the bypass hole 149, the top surface of the valve body 124c may contact the stopper body 228, and thus, the valve body 124c may be stopped.

[0103] Coupling holes 223 and 124c to which the coupling member 230 is coupled may be defined in the stopper support 221 and the bypass valve 124. A coupling groove 148a to which the coupling member 230 is coupled may be defined in the second head plate 143.

[0104] At leas tone guide protrusion 222 for maintaining the arranged state of the coupling holes 223 and 124d and the coupling groove 148a before the coupling member 230 is coupled to each of the coupling holes 223 and 124d and the coupling groove 149a may be disposed on the stopper support 221. A protrusion through-hole 124e through which the guide protrusion 222 passes may be defined in the valve support 221. Also, a protrusion accommodation groove 148b for accommodating the guide protrusion 222 may be defined in the second head plate 143.

[0105] Thus, when the guide protrusion 222 of the stopper 220 is accommodated into the protrusion accommodation groove 148b in the state where the guide protrusion 222 passes through the protrusion through-hole 124e of the bypass valve 124, the stopper support 221, the bypass valve 124, and each of the coupling holes 223 and 124d and the coupling groove 149a of the second head plate 143 may be aligned with each other.

[0106] The stopper 220 may include the plurality of guide protrusions 222, the bypass valve 124 may include the plurality of through-holes 124e, and the fixed scroll 140 may include the plurality of protrusion accommodation grooves 148b so that the stopper support 221, the bypass valve 124, and the coupling holes 223 and 124d and coupling groove

148a of the second head plate 143 are more accurately aligned with each other. In this case, the coupling groove 223 may be disposed between the plurality of guide protrusions 222 of the stopper 220. Also, the coupling groove 124d may be disposed between the plurality of through-holes 124e of the bypass valve 124, and the coupling groove 148a may be disposed between the plurality of protrusion accommodation grooves 148b of the second head plate 143.

[0107] For example, the coupling member 230 may be a rivet. The coupling member 230 may include a coupling body 231 coupled to the stopper support 221, the bypass valve 124, and the coupling holes 223 and 124d and the coupling groove 148a of the second head plate 143, a head 232 disposed on the coupling body 231 to contact a top surface of the stopper support 221, and a separation part 233 passing through the head 232, disposed inside the coupling body 231, and being separable from the coupling body 231. Also, when the separation part 233 is pulled upward in Fig. 5, the separation part 233 may be separated from the coupling body 231.

[0108] In the current embodiment, the configuration and coupling method of the coupling member 230 may be realized through the well-known technology, and thus, its detailed description will be omitted.

[0109] The intermediate pressure discharge hole 147 of the fixed scroll 140 and the intermediate pressure suction hole 153 of the back pressure plate 150 are disposed to be aligned with each other. The refrigerant discharged from the intermediate pressure discharge hole 147 may be introduced into the back pressure chamber BP via the intermediate pressure suction hole 153. The intermediate pressure discharge hole 147 and the intermediate pressure suction hole 153 may be called a "bypass passage" in that the refrigerant of the back pressure chamber BP is bypassed to the compression chamber through the intermediate pressure discharge hole 147 and the intermediate pressure suction hole 153.

[0110] Fig. 7 is a partial view of an orbiting scroll according to an embodiment, Fig. 8 is a cross-sectional view illustrating a state in which the fixed scroll and the orbiting scroll are coupled to each other according to an embodiment, and Figs. 9A to 9C are views illustrating relative positions of an intermediate pressure discharge hole of the fixed scroll and a discharge guide of the orbiting scroll while the orbiting scroll revolves.

[0111] Referring to Figs. 7 and 8, an orbiting scroll 130 may include a discharge guide part 139 for guiding the refrigerant flowing into the intermediate pressure discharge hole 147 so that the refrigerant is introduced into a space (region) having a pressure that is less than that of the back pressure chamber BP.

[0112] In detail, when the operation of the scroll compressor 100 is stopped, the compression chamber defined by the orbiting wrap 134 and the fixed wrap 144 are vanished, and thus, the refrigerant flows into the space (region) between the orbiting wrap 134 and the fixed wrap 144. Here, the space (region) may have a pressure less than that of the back pressure chamber BP. The space (region) is called a "wrap space part".

[0113] The discharge guide part 139 is recessed from an end surface of the orbiting wrap 134 of the orbiting scroll 130. Thus, the discharge guide part 139 may be called a "recess part". The end surface of the orbiting wrap 134 may be understood as a surface of the orbiting wrap 134 facing the second head plate 143 of the fixed scroll 140 or a surface of the orbiting wrap 134 contacting the second head plate 143.

[0114] A width of the end surface of the orbiting wrap 134, i.e., a thickness of the orbiting wrap 134 may be greater than a width of the intermediate pressure discharge hole 147. Also, the discharge guide part 139 may be recessed from the end surface of the orbiting wrap 134 by a preset width and depth.

[0115] While the orbiting scroll 130 revolves, the orbiting wrap may be disposed directly below the intermediate pressure discharge hole 147 or be disposed to be spaced horizontally from a lower end of the intermediate pressure discharge hole 147 to open the intermediate pressure discharge hole 147.

[0116] If the discharge guide part 139 is not provided, when the orbiting wrap 134 is disposed directly below the intermediate pressure discharge hole 147 (in Fig. 9), the orbiting wrap 134 may cover the intermediate pressure discharge hole 147. On the other hand, when the orbiting wrap 134 moves horizontally by a predetermined distance, at least a portion of the intermediate pressure discharge hole 147 may be opened. Also, while the scroll compressor 100 operates, when the intermediate pressure discharge hole 147 is opened, the intermediate pressure refrigerant of the compression chamber may be introduced into the back pressure chamber BP through the intermediate pressure discharge hole 147.

[0117] On the other hand, in the state where the scroll compressor 100 is stopped, when the orbiting wrap 134 is disposed directly below the intermediate pressure discharge hole 147 to block the intermediate pressure discharge hole 147, the refrigerant of the back pressure chamber BP may not be introduced into the wrap space part through the intermediate pressure discharge hole 147. As a result, the equilibrium pressure may not be maintained, and thus the quick re-operation of the compressor may be limited.

[0118] Thus, according to the current embodiment, the discharge guide 139 may be disposed in the orbiting wrap 134 to prevent the intermediate pressure discharge hole 147 from being completely covered or shielded, and thus, even though the orbiting wrap 134 is disposed directly below the intermediate pressure discharge hole 147, the intermediate pressure discharge hole 147 and the compression chamber (when the compressor operates) or the intermediate pressure discharge hole 147 and the wrap space part (when the compressor stops) may communicate with each other.

[0119] Referring to Figs. 9A to 9C, the plurality of compression chambers are formed while the orbiting scroll 130 revolves, and then, the plurality of compression chambers move toward the discharge hole 145 while being reduced in volume.

[0120] In this process, the orbiting wrap 134 of the orbiting scroll 130 may selectively open the bypass hole 149. For example, when the orbiting wrap 134 opens the bypass hole 149, the refrigerant of the compression chamber communicating with the bypass hole 149 may flow into the bypass hole 149 to bypass the discharge hole 145. On the other hand, when the orbiting wrap 134 covers the bypass hole 149, the flow of the refrigerant of the compression chamber into the bypass hole 149 may be limited.

[0121] The back pressure chamber BP and the intermediate pressure discharge hole 147 may always communicate with the compression chamber by the discharge guide part 139. That is, the discharge guide part 139 is disposed on an end of the orbiting wrap 134 at a position at which the back pressure chamber BP and the intermediate pressure discharge hole 147 always communicate with the compression chamber.

[0122] In summary, even though the orbiting wrap 134 is disposed directly below the intermediate pressure discharge hole 147 while the orbiting wrap 134 revolves, the lower end of the intermediate pressure discharge hole 147 and the end surface of the orbiting wrap 134 may be spaced apart from each other by the recessed discharge guide part 139. Thus, when the scroll compressor operates, the refrigerant of the compression chamber may be introduced into the back pressure chamber BP through the intermediate pressure discharge hole 147. Also, when the scroll compressor is stopped, the refrigerant of the back pressure chamber BP may be introduced into the wrap space part through the intermediate pressure discharge hole 147.

[0123] In detail, Figs. 9A to 9C illustrate the state in which the orbiting wrap 134 is disposed directly below the intermediate pressure discharge hole 147 while the orbiting wrap 134 revolves, i.e., the state in which the end surface of the orbiting wrap 134 is disposed to block the intermediate pressure discharge hole 147 if the discharge guide part 139 is not provided.

[0124] Even though the orbiting wrap 134 is disposed as illustrated in Figs. 9A to 9C, the intermediate pressure discharge hole 147 may communicate with the compression chamber by the discharge guide part 139. Thus, the refrigerant of the back pressure chamber BP having an intermediate pressure Pm may be introduced into the wrap space part between the orbiting wrap 134 and the fixed wrap 144 via the intermediate pressure discharge hole 147 and the discharge guide part 139.

[0125] If the orbiting wrap 134 is disposed at a position that is not illustrated in Figs. 9A to 9C, at least a portion of the intermediate pressure discharge hole 147 is opened. That is, the orbiting wrap 134 may be in the state in which the orbiting wrap 134 moves horizontally to open the at least a portion of a lower end of the intermediate pressure discharge hole 147.

[0126] Fig. 10 is a partial cross-sectional view of a scroll compressor according to another embodiment.

[0127] The current embodiment is the same as the forgoing embodiment except for a structure of a discharge cover. Thus, only characterized parts in the current embodiment will be described below.

[0128] Referring to Fig. 10, a discharge cover 105 according to another embodiment may include an impact absorption layer 108 on a portion (for example, a bottom surface of the discharge cover 105 in Fig. 10) of a floating plate 160 facing a contact part 164. A groove 107 for accommodating the impact absorption layer 108 may be defined in the discharge cover 105.

[0129] The impact absorption layer 108 may be formed of, for example, a Teflon material. Particularly, the impact absorption layer 108 may be formed of a poly tetra fluoro ethylene (PTFE) material.

[0130] The PTFE may be sprayed onto a groove 107 of the discharge cover 105 in a fluoride resin is formed as a paint form to perform heating and plasticizing process on the applied fluoride resin at a predetermined temperature, thereby forming an inactive coating layer.

[0131] When the scroll compressor 100 operates to allow a floating plate 160 to ascend by an intermediate pressure of a back pressure chamber BP, a contact part 164 (substantially, the coating layer 160b) of the floating plate 160 may contact the impact absorption layer 108.

[0132] Here, if the impact absorption layer 108 is formed of Teflon, the impact absorption layer 108 may have a low Vickers hardness of about 15 HV that is relatively soft when compared to the discharge cover. Thus, the Teflon may not be broken and absorb an impact applied to the contact 164. Also, since the coating layer 160a of the contact part 164 has a hardness value greater than that of the impact absorption layer 108, abrasion of the contact part 164 may also be prevented.

[0133] Here, to effectively absorb the impact through the impact absorption layer 108, the impact absorption layer 108 may have a thickness of about 50 μm or more.

[0134] Although the impact absorption layer 108 is disposed in the groove 107 of the discharge cover 105 in the current embodiment, the present disclosure is not limited thereto. For example, the impact absorption layer may be applied to a portion of the floating plate 160 facing the contact part 164 on the discharge cover 105, a portion of the discharge cover 105 facing the floating plate 160, or an entire bottom surface of the discharge cover 105.

[0135] 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 (100) comprising:

   a casing (110) comprising a rotation shaft (116);
   a discharge cover (105) fixed inside the casing (110) to partition the inside of the casing (110) into a suction space (S) and a discharge space (D);
   a first scroll (130) revolving by rotation of the rotation shaft (116);
   a second scroll (140) defining a plurality of compression chambers together with the first scroll (130), the second scroll (140) having an intermediate pressure discharge hole (147) communicating with a compression chamber having an intermediate pressure of the plurality of compression chambers;
   a back pressure plate (150) defining a back pressure chamber (BS) for accommodating a refrigerant discharged from the intermediate pressure discharge hole (147);
   a floating plate (160) movably disposed on a side of the back pressure plate (150) to define the back pressure chamber (BS) together with the back pressure plate (150), the floating plate (160) comprising a contact part (164) that is capable of contacting the discharge cover (105); and
   a coating layer (164b) defining an outer surface of the contact part (164),
   wherein the discharge cover (105) has a first hardness value, the floating plate (160) has a second hardness value, and the coating layer (164b) has a third hardness value, and
   the third hardness value is less than the first hardness value and greater than the second hardness value.

2. The scroll compressor (100) according to claim 1, wherein the floating plate (160) is formed of an aluminum material, and
   the coating layer (164b) comprises an anodizing film.

3. The scroll compressor (100) according to claim 1 or 2, wherein the coating layer (164b) has a thickness of about 25 μm to about 35 μm.

4. The scroll compressor (100) according to any of claims

   1 to 3, wherein a difference between the first hardness value and the third hardness value is above about 80 HV and/or wherein the first hardness value is above about 500 HV,
   the second hardness value is below about 110 HV, and
   the third hardness value ranges from about 300 HV to about 420 HV.

5. The scroll compressor (100) according to any of claims 1 to 4, wherein the coating layer (164b) is formed on an entire outer circumferential surface of the floating plate (160).

6. The scroll compressor (100) according to any of claims 1 to 5, wherein a discharge guide part (139) for guiding discharge of a refrigerant within the back pressure chamber (BS) is disposed on the first or second scroll (130, 140).

7. The scroll compressor (100) according to any of claims 1 to 6, wherein the discharge cover (105) comprises an impact absorption layer (108) disposed at a portion thereof that faces the contact part (164).

8. The scroll compressor (100) according to claim 7, wherein the coating layer (164b) has a hardness value greater than that of the impact absorption layer (108).

9. The scroll compressor (100) according to claim 7 or 8, wherein the impact absorption layer (108) is formed of a Teflon material and/or wherein the impact absorption layer (108) is applied to the discharge cover (105) or inserted into a groove (107) of the discharge cover (105).

10. A scroll compressor (100) comprising:

a casing (110) comprising a rotation shaft (116);
a discharge cover (105) fixed inside the casing (110) to partition the inside of the casing (110) into a suction space (S) and a discharge space (D);
a first scroll (130) revolving by rotation of the rotation shaft (116);
a second scroll (140) defining a plurality of compression chambers together with the first scroll (130), the second scroll (140) having an intermediate pressure discharge hole (147) communicating with a compression chamber having an intermediate pressure of the plurality of compression chambers;
a back pressure plate (150) defining a back pressure chamber (BS) for accommodating a refrigerant discharged from the intermediate pressure discharge hole (147);
a floating plate (160) movably disposed on a side of the back pressure plate (150) to define the back pressure chamber (BS) together with the back pressure plate (150), the floating plate (160) comprising a contact part (164) that is capable of contacting the discharge cover (105);
a coating layer (164b) defining an outer surface of the contact part (164); and
an impact absorption layer (108) disposed on a portion of the discharge cover (105) facing the contact part (164).

11. The scroll compressor (100) according to claim 10, wherein the coating layer (164b) has a hardness value greater than that of the impact absorption layer (108).

12. The scroll compressor (100) according to claim 10 or 11, wherein the impact absorption layer (108) is formed of a Teflon material.

13. The scroll compressor (100) according to any of claims 10 to 12, wherein a groove (107) for accommodating the impact absorption layer (108) is defined in the discharge cover (105).

14. The scroll compressor (100) according to any of claims 10 to 13, wherein the impact absorption layer (108) is applied to a surface of the discharge cover (105) facing the back pressure plate (150).

15. The scroll compressor (100) according to any of claims 10 to 14, wherein the impact absorption layer (108) has a thickness thicker than that of the coating layer (164b) and/or wherein the impact absorption layer (108) has a thickness of about 50 μm and/orwherein the coating layer (164b) has a thickness of about 25 μm to about 35 μm.

Fig.1

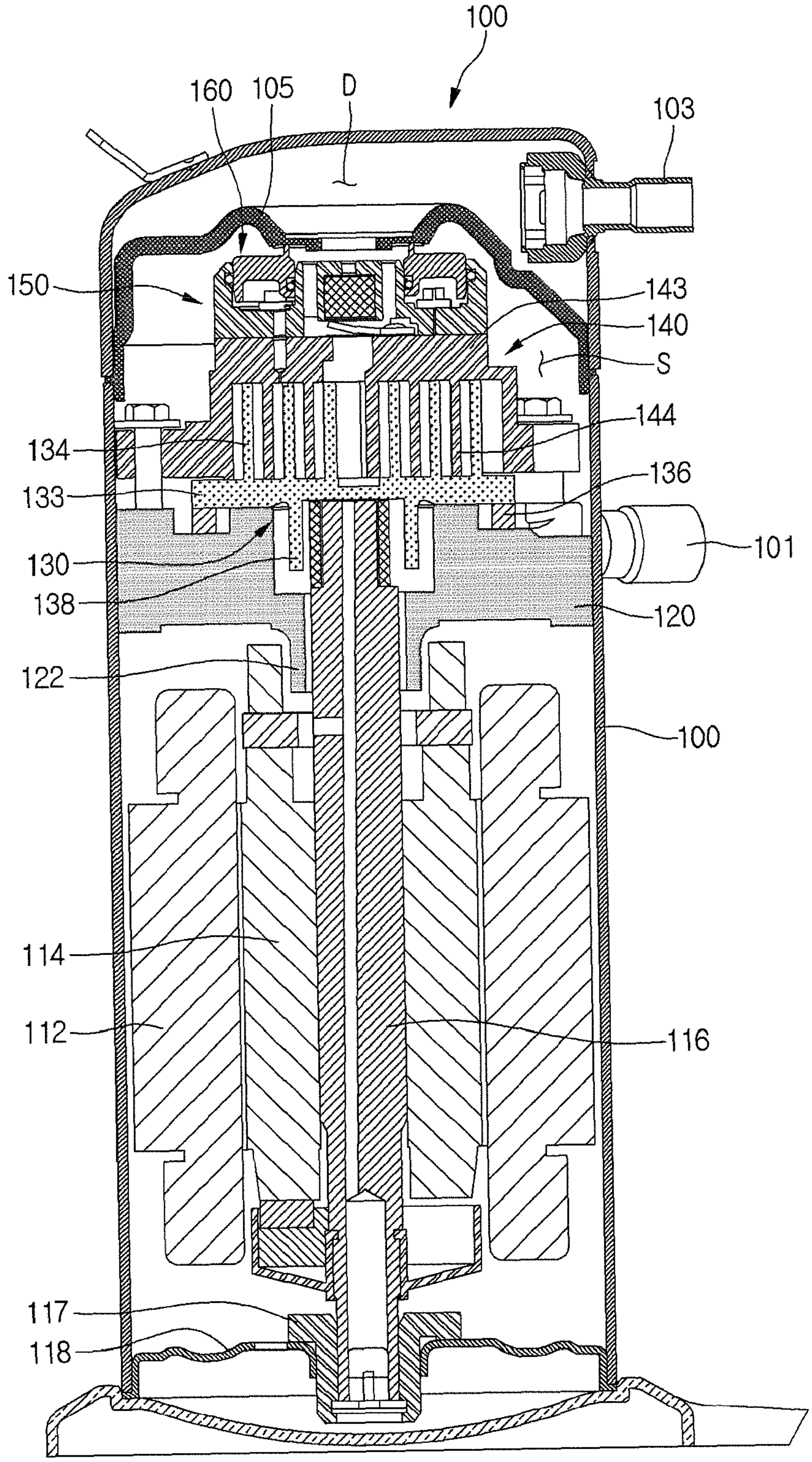

100
160
105
D
103
150
143
140
S
144
134
136
133
101
130
138
120
122
100
114
112
116
117
118

Fig.2

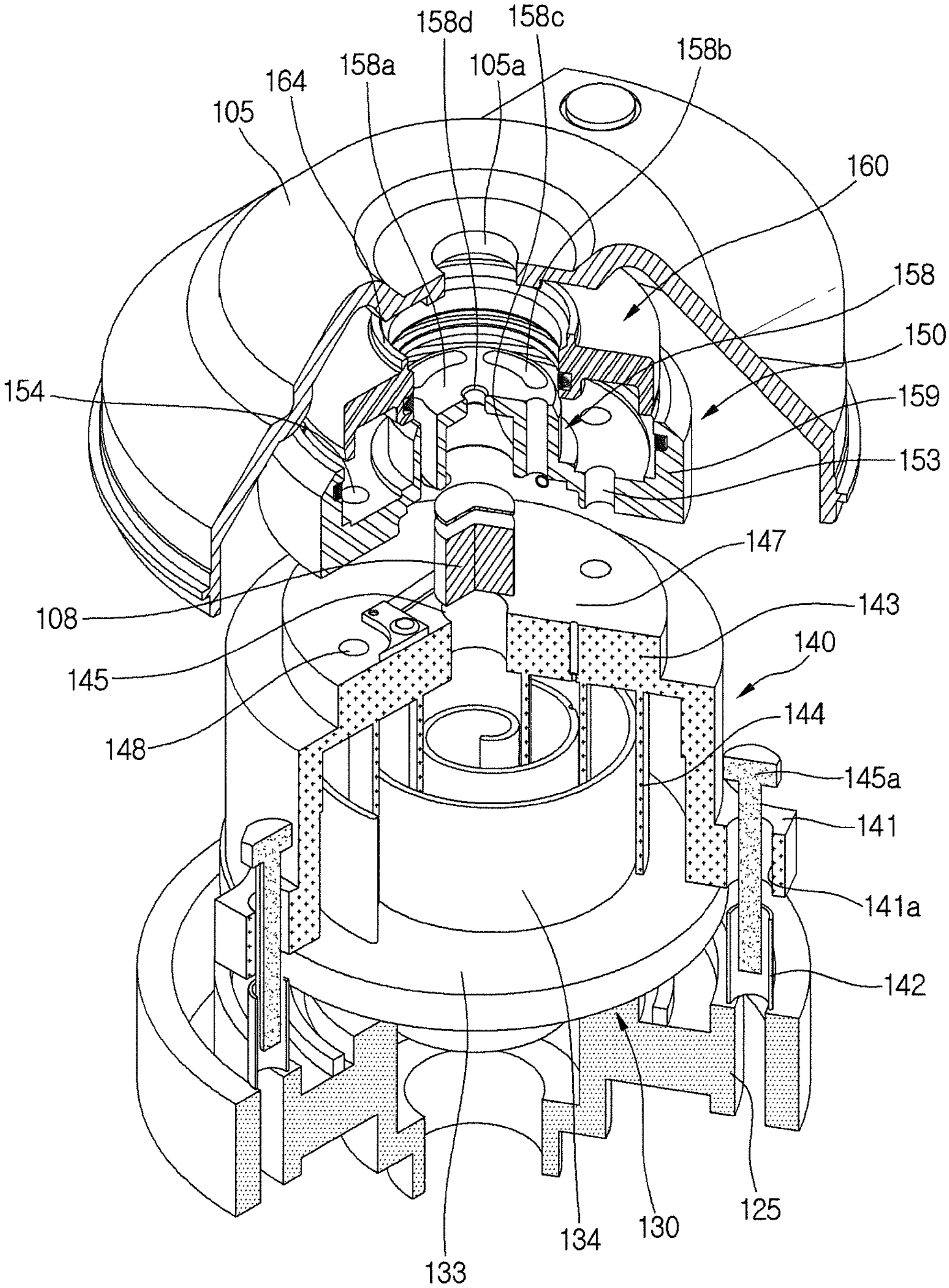

158d
158c
158b
164
158a
105a
105
160
158
150
154
159
153
147
108
143
140
145
148
144
145a
141
141a
142
133
134
130
125

Fig.3

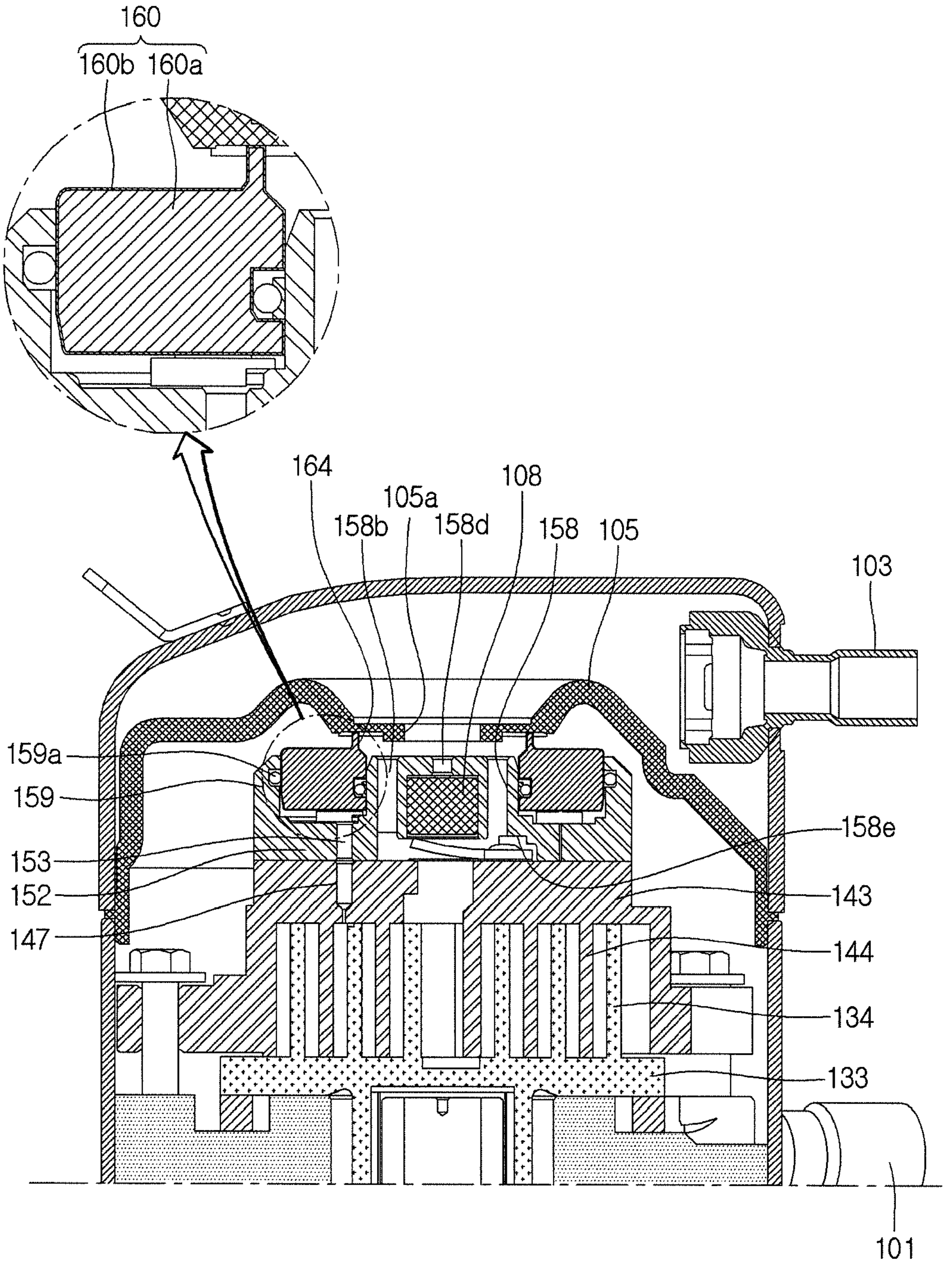

160
160b 160a
164
105a
108
158b
158d
158
105
103
159a
159
153
152
147
158e
143
144
134
133
101

Fig.4

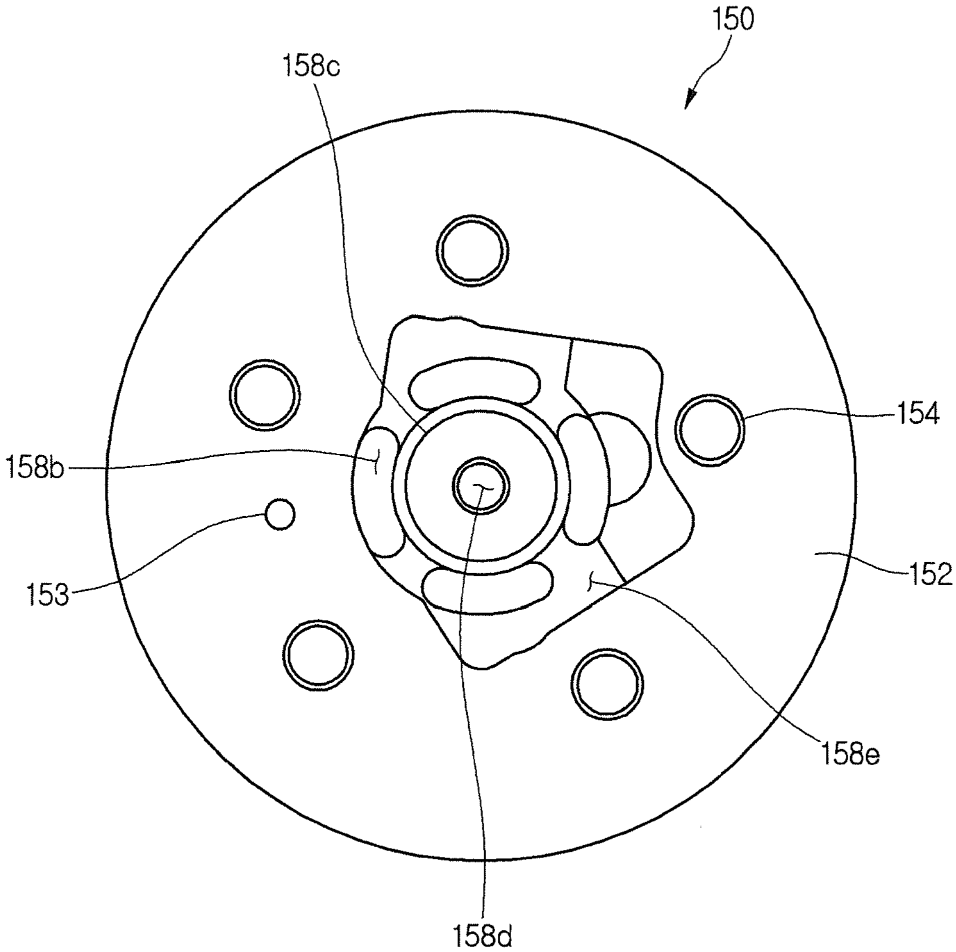


Fig.5

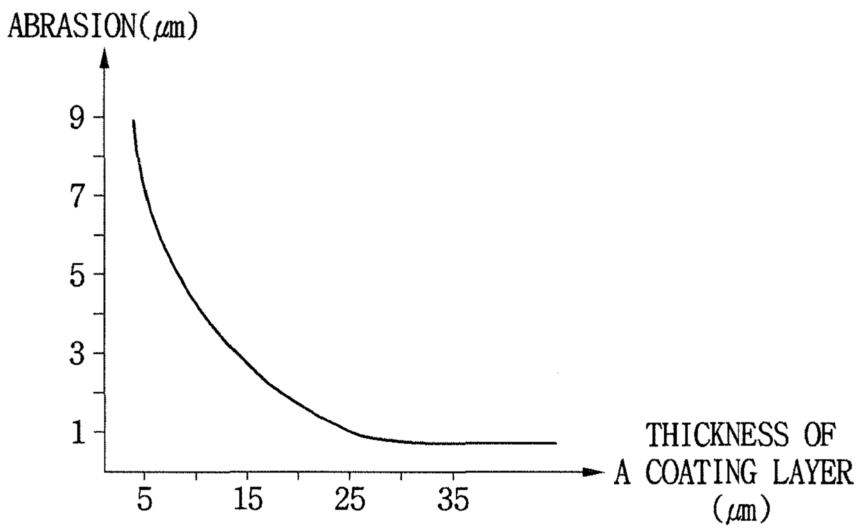


Fig.6

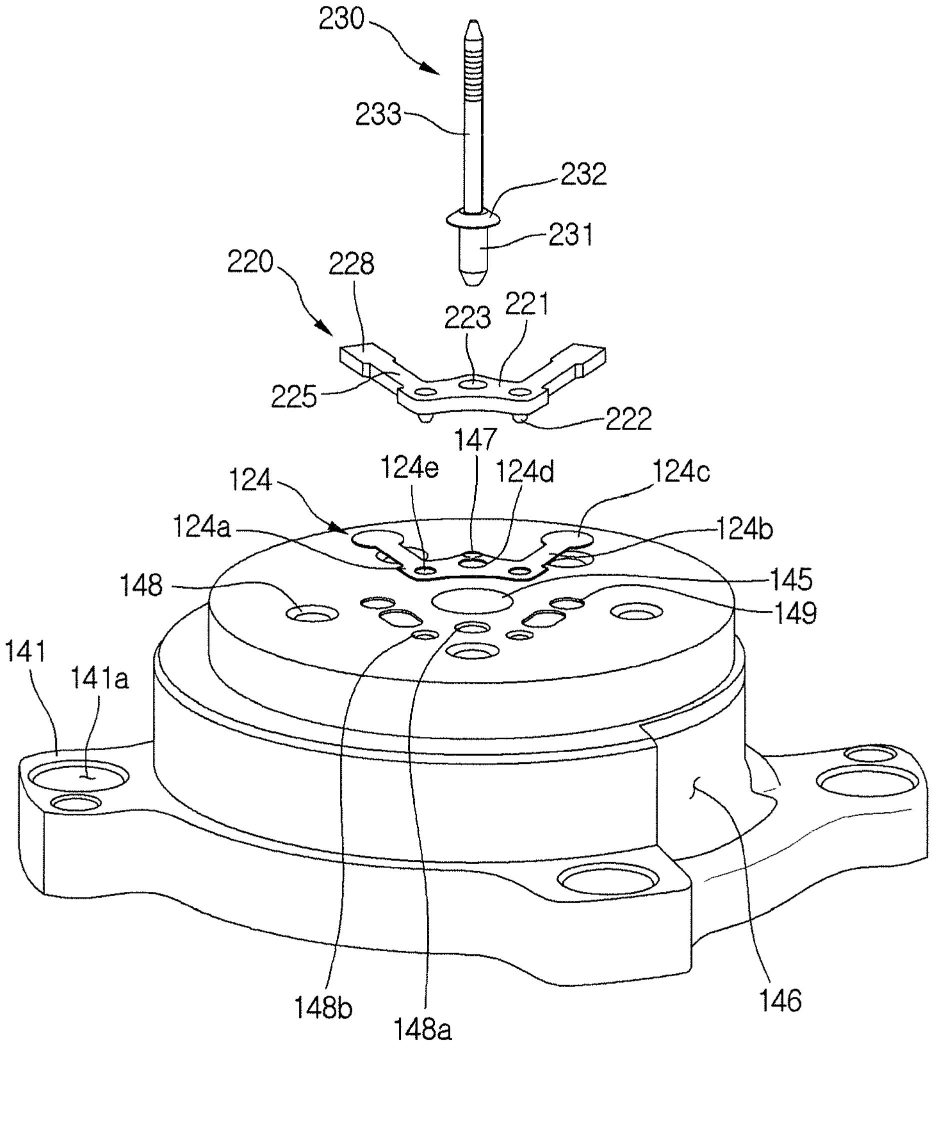

230
233
232
231
220
228
223
221
225
222
147
124
124e
124d
124c
124a
124b
145
148
149
141
141a
146
148b
148a

Fig.7

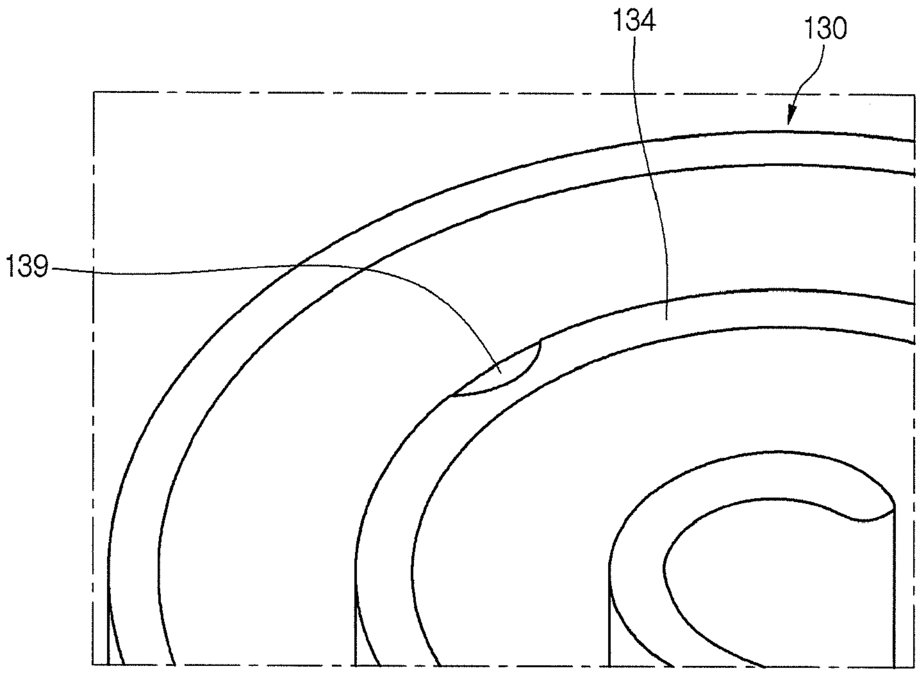


Fig.8

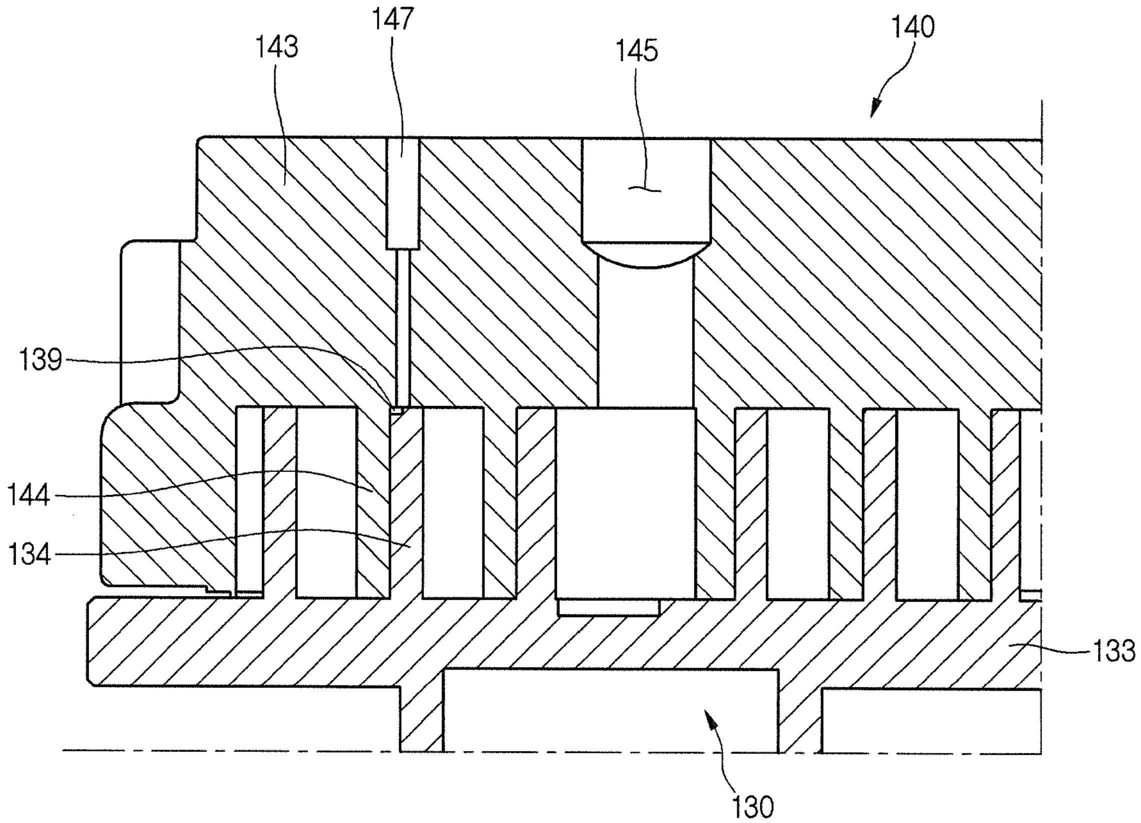


Fig.9a

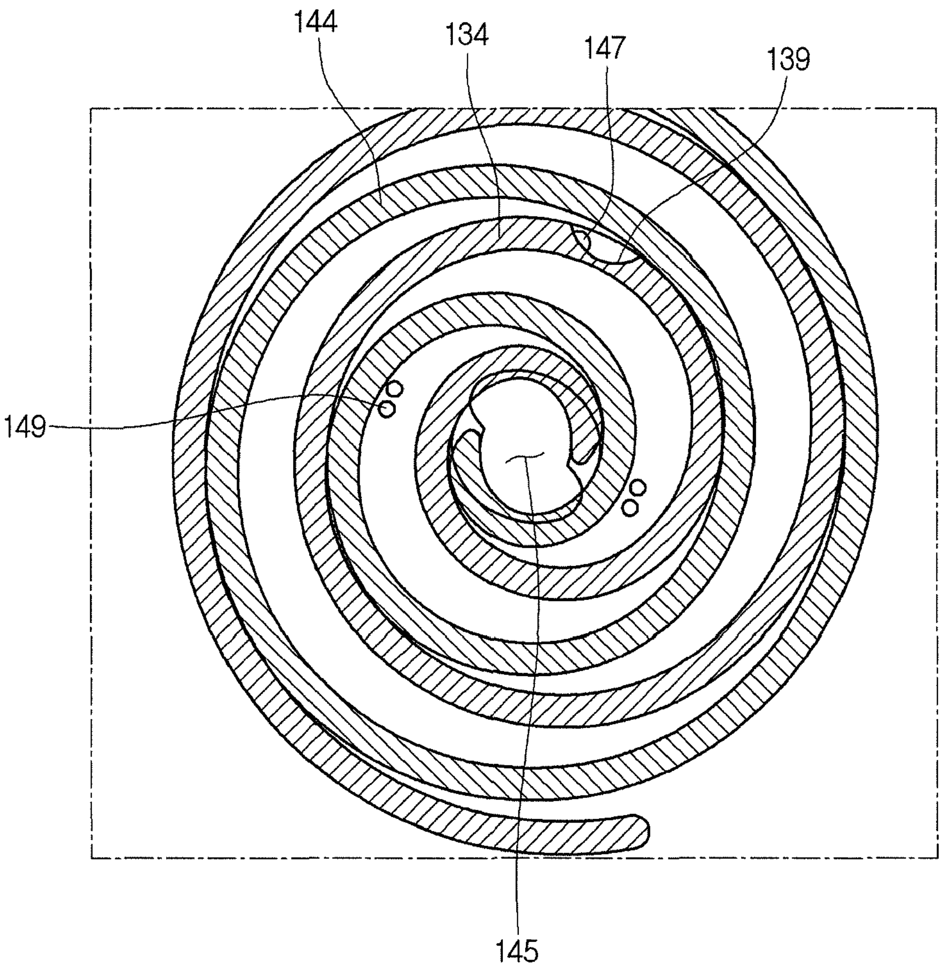


Fig.9b

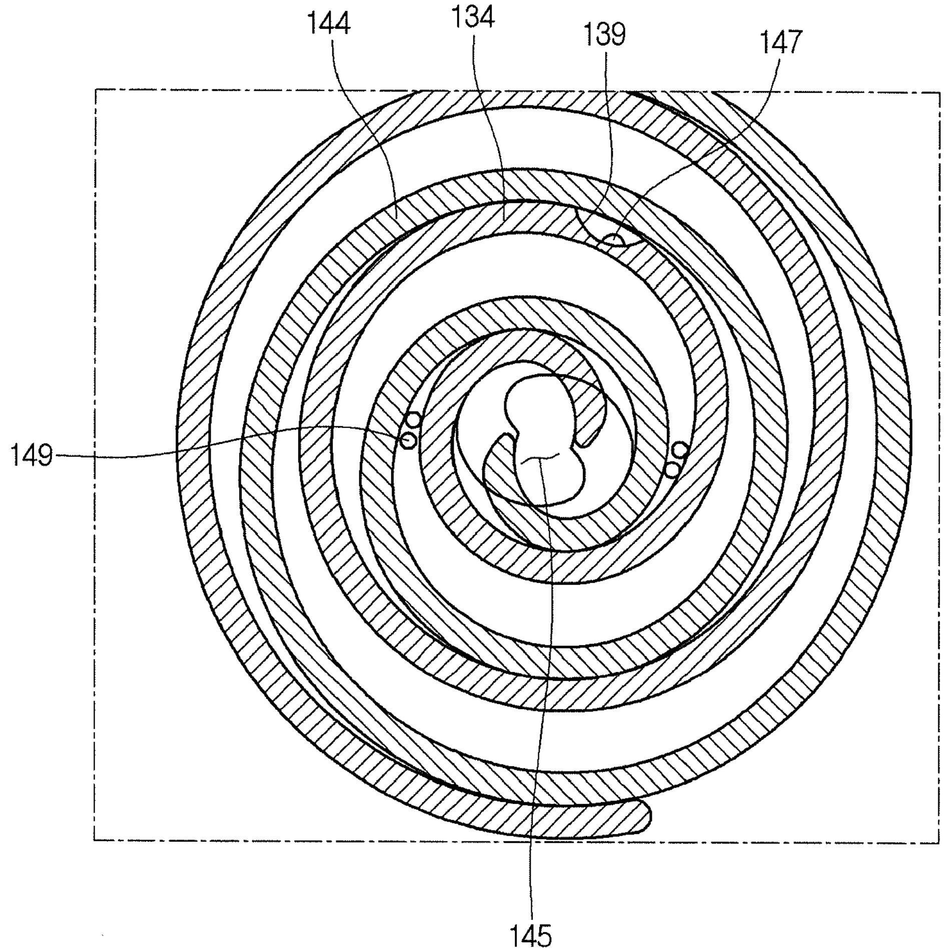


Fig.9c

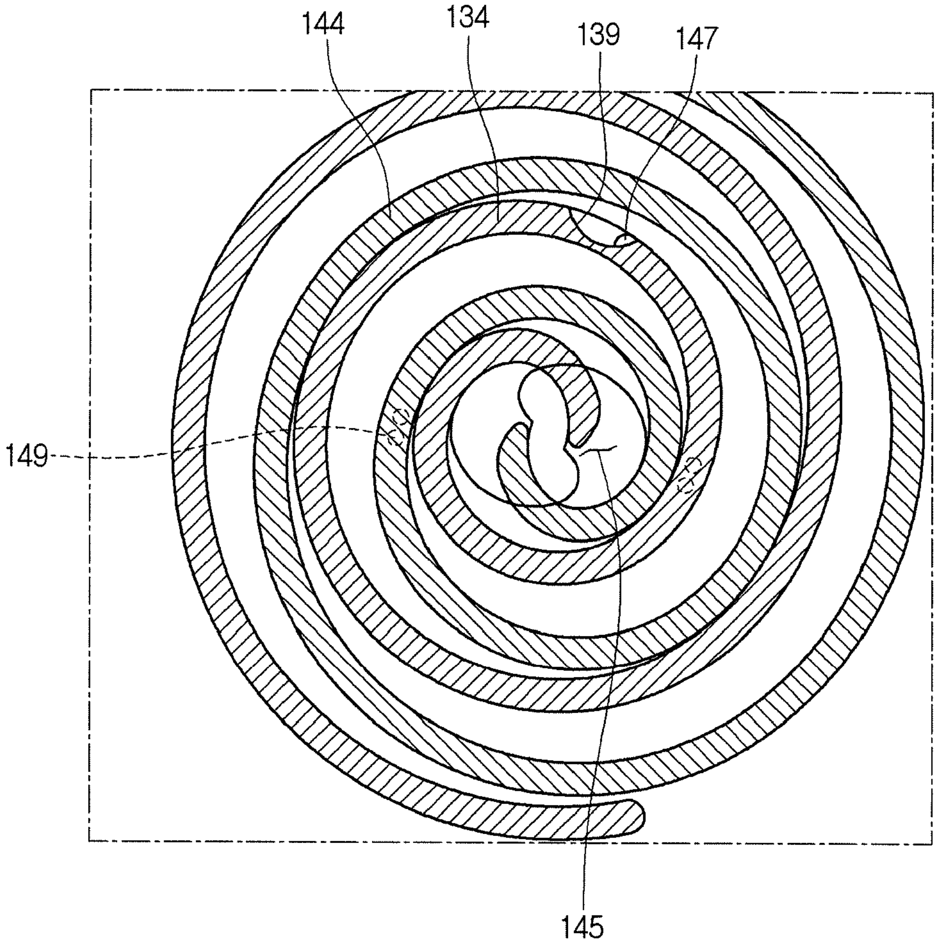
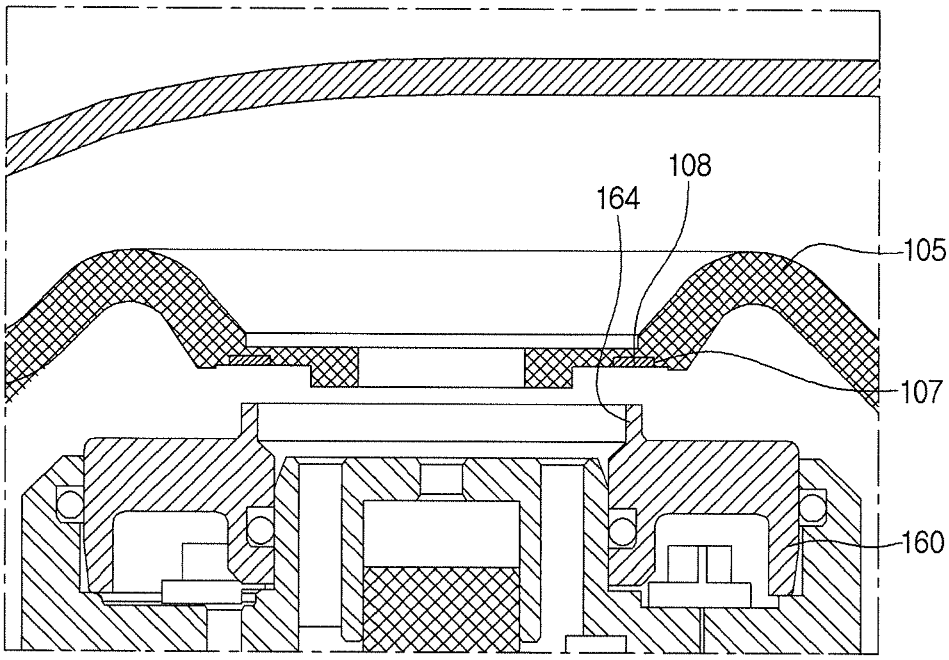


Fig.10



Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 15 16 5844

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 2014/023540 A1 (HEIDECKER MATTHEW J [US] ET AL) 23 January 2014 (2014-01-23)	1,3,5-7, 9,10, 12-15	INV. F04C23/00 F04C15/00 F04C18/02
Y	* figures 15A, 15B, 16 *	2,4	
A	* paragraph [0121] - paragraph [0127] * -----	8,11	
Y	WO 2009/055009 A2 (EMERSON CLIMATE TECHNOLOGIES [US]; FONTAINE ANNE-FRANCE [BE]; COOPER K) 30 April 2009 (2009-04-30)	2,4	
A	* figure 1 * * paragraph [0030] - paragraph [0033] * -----	8,11	
A	US 6 821 092 B1 (GEHRET NATALIE [US] ET AL) 23 November 2004 (2004-11-23) * figures 16-20 * * column 10, line 66 - column 11, line 38 * * column 13, line 14 - line 57 * -----	1-15	
			TECHNICAL FIELDS SEARCHED (IPC)
			F04C

1 The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	18 September 2015	Durante, Andrea

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
Y : particularly relevant if combined with another document of the same category
A : technological background
O : non-written disclosure
P : intermediate document

T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
D : document cited in the application
L : document cited for other reasons

& : member of the same patent family, corresponding document

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 15 16 5844

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

18-09-2015

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 2014023540 A1	23-01-2014	CN 104662199 A	27-05-2015
		EP 2875169 A1	27-05-2015
		US 2014023540 A1	23-01-2014
		US 2014024563 A1	23-01-2014
		WO 2014018530 A1	30-01-2014
WO 2009055009 A2	30-04-2009	CN 201972923 U	14-09-2011
		EP 2215363 A2	11-08-2010
		US 2009110581 A1	30-04-2009
		WO 2009055009 A2	30-04-2009
US 6821092 B1	23-11-2004	AU 2004202792 A1	03-02-2005
		BR PI0401964 A	24-05-2005
		CN 1576605 A	09-02-2005
		EP 1498610 A2	19-01-2005
		JP 2005036801 A	10-02-2005
		KR 20050008475 A	21-01-2005
		MX PA04006823 A	20-01-2005
		TW I332057 B	21-10-2010
		US 6821092 B1	23-11-2004

EPO FORM P0459

For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- KR 101378886 **[0003]**