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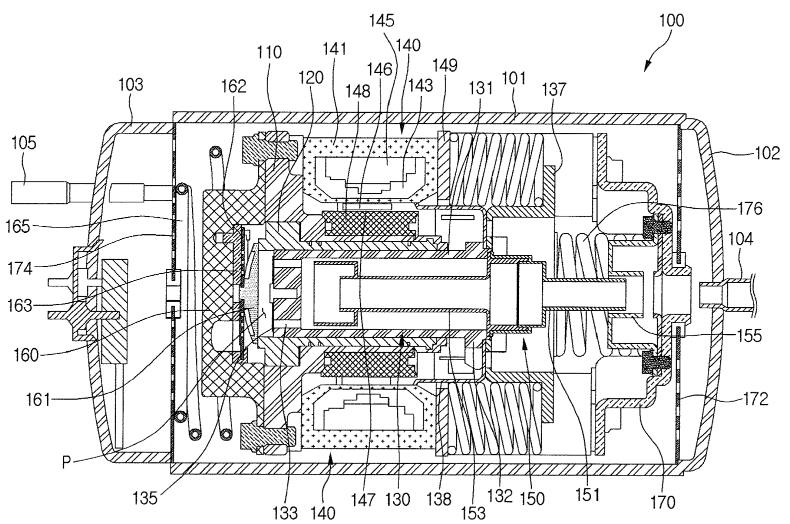
(54) **LINEAR COMPRESSOR AND REFRIGERATOR INCLUDING A LINEAR COMPRESSOR**

(57) A linear compressor and a refrigerator including a linear compressor is provided. The linear compressor may include a shell including a suction inlet, a cylinder provided in the shell to define a compression space for a refrigerant, a piston reciprocated in an axial direction within the cylinder, a discharge valve provided at one side of the cylinder to selectively discharge the refrigerant compressed in the compression space, at least one nozzle disposed in the cylinder to introduce at least a portion of the refrigerant discharged through the discharge valve into the cylinder, and at least one filter provided in the shell. The at least one filter may be disposed in a refrigerant passage defined from the suction inlet to the at least one nozzle via the discharge valve. Foreign substances or oil contained in the refrigerant introduced into the at least one nozzle may be filtered while passing through the at least one filter.

FIG.3



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Description

BACKGROUND

1. Field

[0001] A linear compressor and a refrigerator including a linear compressor are disclosed herein.

2. Background

[0002] In general, compressors are machines that receive power from a power generation device, such as an electric motor or turbine, to compress air, a refrigerant, or various working gases, thereby increasing in pressure. Compressors are being widely used in home appliances, such as refrigerators or air conditioners, or industrial fields.

[0003] Compressors may be largely classified into reciprocating compressors, in which a compression space into and from which a working gas is suctioned and discharged, is defined between a piston and a cylinder to allow the piston to be linearly reciprocated in the cylinder, thereby compressing the working gas; rotary compressors, in which a compression space into and from which a working gas is suctioned or discharged, is defined between a roller that eccentrically rotates and a cylinder to allow the roller to eccentrically rotate along an inner wall of the cylinder, thereby compressing the working gas; and scroll compressors, in which a compression space into and from which a working gas is suctioned and discharged, is defined between an orbiting scroll and a fixed scroll to compress the working gas while the orbiting scroll rotates along the fixed scroll. In recent years, a linear compressor, which is directly connected to a drive motor and in which a piston is linearly reciprocated, to improve compression efficiency without mechanical loss due to movement conversion and having a simple structure, is being widely developed. The linear compressor may suction and compress a working gas, such as a refrigerant, while the piston is linearly reciprocated in a sealed shell by a linear motor and then discharge the working gas.

[0004] The linear motor is configured to allow a permanent magnet to be disposed between an inner stator and an outer stator. The permanent magnet may be linearly reciprocated by an electromagnetic force between the permanent magnet and the inner (or outer) stator. Also, as the permanent magnet operates in a state in which the permanent magnet is connected to the piston, the refrigerant may suctioned and compressed while the piston is linearly reciprocated within the cylinder, and then, may be discharged.

[0005] The present Applicant has filed for a patent (hereinafter, referred to as a "prior art document") and then registered the patent with respect to the linear compressor, as Korean Patent No. 10-1307688, filed in Korea on September 5, 2013, and entitled "linear compressor", which is hereby incorporated by reference. The linear compressor according to the prior art document includes a shell to accommodate a plurality of components. A vertical height of the shell may be somewhat high, as illustrated in the prior art document. An oil supply assembly to supply oil between a cylinder and a piston may be disposed within the shell. When the linear compressor is provided in a refrigerator, the linear compressor may be disposed in a machine room provided at a rear side of the refrigerator.

[0006] In recent years, a major concern of customers is increasing an inner storage space of the refrigerator. To increase the inner storage space of the refrigerator, it may be necessary to reduce a volume of the machine room. To reduce the volume of the machine room, it may be important to reduce a size of the linear compressor.

[0007] However, as the linear compressor disclosed in the prior art document has a relatively large volume, the linear compressor in the prior art document is not applicable to a refrigerator, for which an increase in the inner storage space is sought. To reduce the size of the linear compressor, it may be necessary to reduce a size of a main component of the compressor. In this case, the compressor may deteriorate in performance.

[0008] To compensate for the deteriorated performance of the compressor, it may be necessary to increase a drive frequency. However, the more the drive frequency of the compressor is increased, the more a friction force due to oil circulating in the compressor is increased, deteriorating performance of the compressor.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] Embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements, and wherein:

Fig. 1 is a schematic diagram of a refrigerator according to an embodiment;
Fig. 2 is a cross-sectional view of a dryer of the refrigerator of Fig. 1;
Fig. 3 is a cross-sectional view of a linear compressor of the refrigerator of Fig. 1;
Fig. 4 is a cross-sectional view of a suction muffler of the linear compressor of Fig. 3;
Fig. 5 is a view illustrating a state in which a first filter is coupled to the suction muffler of Fig. 4;
Fig. 6 is a partial cross-sectional view illustrating a position of a second filter according to an embodiment;
Fig. 7 is an exploded perspective view of a cylinder and a frame of the linear compressor of Fig. 3;
Fig. 8 is an exploded perspective of the frame of Fig. 7;
Fig. 9 is a cross-sectional view illustrating a state in which the cylinder and a piston are coupled to each other according to an embodiment;
Fig. 10 is a view of the cylinder according to an em-

bodiment;

Fig. 11 is an enlarged cross-sectional view of portion A of Fig. 9;

Fig. 12 is a cross-sectional view illustrating a refrigerant flow in the linear compressor of Fig. 3; and

Fig. 13 is a cross-sectional view illustrating a position of a second filter according to another embodiment.

DETAILED DESCRIPTION

[0010] Hereinafter, embodiments will be described with reference to the accompanying drawings. Embodiments may, however, be embodied in many different forms and should not be construed as being limited to the embodiments set forth herein; rather, alternate embodiments falling within the spirit and scope will fully convey the concept to those skilled in the art.

[0011] Fig. 1 is a schematic diagram of a refrigerator according to an embodiment. Referring to Fig. 1, a refrigerator 10 according to an embodiment may include a plurality of devices to drive a refrigeration cycle.

[0012] In detail, the refrigerator 10 may include a compressor 100 to compress a refrigerant, a condenser 20 to condense the refrigerant compressed in the compressor 100, a dryer 200 to remove moisture, foreign substances, or oil from the refrigerant condensed in the condenser 20, an expansion device 30 to decompress the refrigerant having passed through the dryer 200, and an evaporator 40 to evaporate the refrigerant decompressed in the expansion device 30. The refrigerator 10 may further include a condensation fan 25 to blow air toward the condenser 20, and an evaporation fan 45 to blow air toward the evaporator 40.

[0013] The compressor 100 may be a linear compressor in which a piston may be directly connected to a motor to compress the refrigerant while the piston is linearly reciprocated within a cylinder. The expansion device 30 may include a capillary tube having a relatively small diameter.

[0014] A liquid refrigerant condensed in the condenser 20 may be introduced into the dryer 200. A gaseous refrigerant may be partially contained in the liquid refrigerant. A filter to filter the liquid refrigerant introduced into the dryer 200 may be provided in the dryer 200. Hereinafter, components of the dryer 200 will be described with reference to the accompanying drawings.

[0015] Fig. 2 is a cross-sectional view of a dryer of the refrigerator of Fig. 1. Referring to Fig. 2, the dryer 200 according to an embodiment may include a dryer body 210 to define a flow space for the refrigerant, a refrigerant inflow 211 disposed on or at one or a first side of the dryer body 210 to guide introduction of the refrigerant, and a refrigerant discharge 215 disposed on or at the other or a second side of the dryer body 210 to guide discharge of the refrigerant. For example, the dryer body 210 may have a long cylindrical shape.

[0016] Dryer filters 220, 230, and 240 may be provided in the dryer body 210. In detail, the dryer filters 220, 230, and 240 may include a first dryer filter 220 disposed adjacent to the refrigerant inflow 211, a third dryer filter 240 spaced apart from the first dryer filter 220 and disposed adjacent to the refrigerant discharge 215, and a second dryer filter 230 disposed between the first dryer filter 220 and the third dryer filter 240.

[0017] The first dryer filter 220 may be disposed adjacent to an inside of the refrigerant inflow 211, that is, disposed at a position closer to the refrigerant inflow 211 than the refrigerant discharge 215.

[0018] The first dryer filter 220 may have an approximately hemispherical shape. An outer circumferential surface of the first dryer filter 220 may be coupled to an inner circumferential surface of the dryer body 210. A plurality of through holes 221 to guide flow of the refrigerant may be defined in the first dryer filer 220. A foreign substance having a relatively large volume may be filtered by the first dryer filter 220.

[0019] The second dryer filter 230 may include a plurality of adsorbents 231. Each of the adsorbents 231 may be a grain having a predetermined size. The adsorbent 231 may be a molecular sieve and have a predetermined size of about 5 mm to about 10 mm.

[0020] A plurality of holes may be defined in the adsorbent 231. Each of the plurality of holes may have a size similar to a size of oil (about 10A). The hole may have a size greater than a size (about 2.8Å to about 3.2A) of the moisture and (about 4.0Å in case of R134a, and about 4.3Å in the case of R600a) of the refrigerant. The term "oil" may refer to a working oil or cutting oil injected when components of the refrigeration cycle are manufactured or processed.

[0021] The refrigerant and moisture passing through the first dryer filter 220 may be easily discharged even though the refrigerant and moisture are easily introduced into the plurality of holes while passing through the adsorbents 231. Thus, the refrigerant and moisture may not be easily adsorbed onto the adsorbents 231. However, if the oil is introduced into the plurality of holes, the oil may not be easily discharged, and thus, may be maintained in a state in which the oil is adsorbed onto the adsorbents 231.

[0022] For example, the adsorbent 231 may include a BASF 13X molecular sieve. A hole defined in the BASF 13X molecular sieve may have a size of about 10Å (1 nm), and the BASF 13X molecular sieve may be expressed as a chemical formula: $Na2O \cdot Al2O3 \cdot mSiO2 \cdot nH20$ ($m \leq 2.35$).

[0023] The oil contained in the refrigerant may be adsorbed into the plurality of adsorbents 231 while passing through the second dryer filter 230. Alternatively, the second dryer filter 230 may include an oil adsorbent paper or an adsorbent having a felt, instead of the plurality of adsorbents each having a grain shape.

[0024] The third dryer filter 240 may include a coupling portion 241 coupled to the inner circumferential surface of the dryer body 210, and a mesh 242 that extends from the coupling portion 241 toward the refrigerant discharge

215. The third dryer filer 240 may be a mesh filter. A foreign substance having a fine size contained in the refrigerant may be filtered by the mesh 242.

[0025] Each of the first dryer filter 220 and the third dryer filter 240 may serve as a support to locate the plurality of adsorbents 231 within the dryer body 210. That is, discharge of the plurality of adsorbents 231 from the dryer 200 may be restricted by the first and third dryer filters 220 and 240.

[0026] As described above, the filters may be provided in the dryer 200 to remove foreign substances or oil contained in the refrigerant, thereby improving reliability of the refrigerant that acts as a gas bearing.

[0027] Fig. 3 is a cross-sectional view of a linear compressor of the refrigerant in Fig. 1. Referring to Fig. 3, the linear compressor 100 according to an embodiment may include a shell 101 having an approximately cylindrical shape, a first cover 102 coupled to a first side of the shell 101, and a second cover 103 coupled to a second side of the shell 101. For example, the linear compressor 100 may be laid out in a horizontal direction. The first cover 102 may be coupled to a right or first lateral side of the shell 101, and the second cover 103 may be coupled to a left or second lateral side of the shell 101 with reference to Fig. 3. Each of the first and second covers 102 and 103 may be understood as one component of the shell 101.

[0028] The linear compressor 100 may further include a cylinder 120 provided in the shell 101, a piston 130 linearly reciprocated within the cylinder 120, and a motor assembly that serves as a linear motor to apply a drive force to the piston 130. When the motor assembly 140 operates, the piston 130 may be linearly reciprocated at a high rate. The linear compressor 100 according to this embodiment may have a drive frequency of about 100 Hz, for example.

[0029] The linear compressor 100 may include a suction inlet 104, through which the refrigerant may be introduced, and a discharge outlet 105, through which the refrigerant compressed in the cylinder 120 may be discharged. The suction inlet 104 may be coupled to the first cover 102, and the discharge outlet 105 may be coupled to the second cover 103.

[0030] The refrigerant in suctioned through the suction inlet 104 may flow into the piston 130 via a suction muffler 150. Thus, while the refrigerant passes through the suction muffler 150, noise may be reduced. The suction muffler 150 may include a first muffler 151 coupled to a second muffler 153. At least a portion of the suction muffler 150 may be disposed within the piston 130.

[0031] The piston 130 may include a piston body 131 having an approximately cylindrical shape, and a piston flange 132 that extends from the piston body 131 in a radial direction. The piston body 131 may be reciprocated within the cylinder 120, and the piston flange 132 may be reciprocated outside of the cylinder 120.

[0032] The piston 130 may be formed of an aluminum material, such as aluminum or an aluminum alloy, which is a nonmagnetic material. As the piston 130 may be formed of the aluminum material, a magnetic flux generated in the motor assembly 140 may not be transmitted into the piston 130, and thus, may be prevented from leaking outside of the piston 130. The piston 130 may be manufactured by a forging process, for example.

[0033] The cylinder 120 may be formed of an aluminum material, such as aluminum or an aluminum alloy, which is a nonmagnetic material. The cylinder 120 and the piston 130 may have a same material composition, that is, a same kind of material and composition.

[0034] As the piston cylinder 120 may be formed of the aluminum material, a magnetic flux generated in the motor assembly 200 may not be transmitted into the cylinder 120, and thus, may be prevented from leaking outside of the cylinder 120. The cylinder 120 may be manufactured by an extruding rod processing process, for example.

[0035] Also, as the piston 130 may be formed of the same material as the cylinder 120, the piston 130 may have a same thermal expansion coefficient as the cylinder 120. When the linear compressor 100 operates, a high-temperature (a temperature of about 100 °C) environment may be created within the shell 100. Thus, as the piston 130 and the cylinder 120 may have the same thermal expansion coefficient, the piston 130 and the cylinder 120 may be thermally deformed by a same degree. As a result, the piston 130 and the cylinder 120 may be thermally deformed with sizes and in directions different from each other to prevent the piston 130 from interfering with the cylinder 120 while the piston 130 moves.

[0036] The cylinder 120 may be configured to accommodate at least a portion of the suction muffler 150 and at least a portion of the piston 130. The cylinder 120 may have a compression space P, in which the refrigerant may be compressed by the piston 130. A suction hole 133, through which the refrigerant may be introduced into the compression space P, may be defined in or at a front portion of the piston 130, and a suction valve 135 to selectively open the suction hole 133 may be disposed on or at a front side of the suction hole 133. A coupling hole, to which a predetermined coupling member may be coupled, may be defined in an approximately central portion of the suction valve 135.

[0037] A discharge cover 160 that defines a discharge space or discharge passage for the refrigerant discharged from the compression space P, and a discharge valve assembly 161, 162, and 163 coupled to the discharge cover 160 to selectively discharge the refrigerant compressed in the compression space P may be provided at a front side of the compression space P. The discharge valve assembly 161, 162, and 163 may include a discharge valve 161 to introduce the refrigerant into the discharge space of the discharge cover 160 when a pressure within the compression space P is above a predetermined discharge pressure, a valve spring 162 disposed between the discharge valve 161 and the discharge cover 160 to apply an elastic force in an axial direction, and a stopper 163 to restrict deformation of the valve spring 162.

[0038] The term "compression space P" may be refer to a space defined between the suction valve 135 and the discharge valve 161. The term "axial direction" may refer a direction in which the piston 130 may be reciprocated, that is, a transverse direction in Fig. 3. Also, in the axial direction, a direction from the suction inlet 104 toward the discharge outlet 105, that is, a direction in which the refrigerant flows, may be referred to as a "frontward direction", and a direction opposite to the frontward direction may be referred to as a "rearward direction". On the other hand, the term "radial direction" may refer to a direction perpendicular to the direction in which the piston 130 is reciprocated, that is, a vertical direction in Fig. 3.

[0039] The stopper 163 may be seated on the discharge cover 160, and the valve spring 162 may be seated at a rear side of the stopper 163. The discharge valve 161 may be coupled to the valve spring 162, and a rear portion or rear surface of the discharge valve 161 may be supported by a front surface of the cylinder 120. The valve spring 162 may include a plate spring, for example.

[0040] The suction valve 135 may be disposed on or at a first side of the compression space P, and the discharge valve 161 maybe disposed on or at a second side of the compression space P, that is, a side opposite of the suction valve 135.

[0041] While the piston 130 is linearly reciprocated within the cylinder 120, when the pressure of the compression space P is below the predetermined discharge pressure and a predetermined suction pressure, the suction valve 135 may be opened to suction the refrigerant into the compression space P. On the other hand, when the pressure of the compression space P is above the predetermined suction pressure, the refrigerant may be compressed in the compression space P in a state in which the suction valve 135 is closed.

[0042] When the pressure of the compression space P is above the predetermined discharge pressure, the valve spring 162 may be deformed to open the discharge valve 161. The refrigerant may be discharged from the compression space P into the discharge space of the discharge cover 160.

[0043] The refrigerant flowing into the discharge space of the discharge cover 160 may be introduced into a loop pipe 165. The loop pipe 165 may be coupled to the discharge cover 160 to extend to the discharge outlet 105, thereby guiding the compressed refrigerant in the discharge space into the discharge outlet 105. For example, the loop pipe 165 may have a shape which is wound in a predetermined direction and extends in a rounded shape. The loop pipe 165 may be coupled to the discharge outlet 105.

[0044] The linear compressor 100 may further include a frame 110. The frame 110 may fix the cylinder 120 and be coupled to the cylinder 120 by a separate coupling member, for example. The frame 110 may be disposed to surround the cylinder 120. That is, the cylinder 120 may be accommodated within the frame 110. The discharge cover 172 may be coupled to a front surface of the frame 110.

[0045] At least a portion of the high-pressure gaseous refrigerant discharged through the open discharge valve 161 may flow toward an outer circumferential surface of the cylinder 120 through a space formed at a portion at which the cylinder 120 and the frame 110 are coupled to each other. The refrigerant may be introduced into the cylinder 120 through one or more gas inflow (see reference numeral 122 of Fig. 7) and one or more nozzle (see reference numeral 123 of Fig. 11), which may be defined in the cylinder 120. The introduced refrigerant may flow into a space defined between the piston 130 and the cylinder 120 to allow an outer circumferential surface of the piston 130 to be spaced apart from an inner circumferential surface of the cylinder 120. Thus, the introduced refrigerant may serve as a "gas bearing" that reduces friction between the piston 130 and the cylinder 120 while the piston 130 is reciprocated.

[0046] The motor assembly 140 may include outer stators 141, 143, and 145 fixed to the frame 110 and disposed to surround the cylinder 120, an inner stator 148 disposed to be spaced inward from the outer stators 141, 143, and 145, and a permanent magnet 146 disposed in a space between the outer stators 141, 143, and 145 and the inner stator 148. The permanent magnet 146 may be linearly reciprocated by a mutual electromagnetic force between the outer stators 141, 143, and 145 and the inner stator 148. Also, the permanent magnet 146 may be a single magnet having one polarity, or a plurality of magnets having three polarities.

[0047] The permanent magnet 146 may be coupled to the piston 130 by a connection member 138. In detail, the connection member 138 may be coupled to the piston flange 132 and be bent to extend toward the permanent magnet 146. As the permanent magnet 146 is reciprocated, the piston 130 may be reciprocated together with the permanent magnet 146 in the axial direction.

[0048] The motor assembly 140 may further include a fixing member 147 to fix the permanent magnet 146 to the connection member 138. The fixing member 147 may be formed of a composition in which glass fiber or carbon fiber is mixed with a resin. The fixing member 147 may surround an outside of the permanent magnet 146 to firmly maintain a coupled state between the permanent magnet 146 and the connection member 138.

[0049] The outer stators 141, 143, and 145 may include coil winding bodies 143 and 145, and a stator core 141. The coil winding bodies 143 and 145 may include a bobbin 143, and a coil 145 wound in a circumferential direction of the bobbin 145. The coil 145 may have a polygonal cross-section, for example, a hexagonal cross-section. The stator core 141 may be manufactured by stacking a plurality of laminations in the circumferential direction and be disposed to surround the coil winding bodies 143 and 145.

[0050] A stator cover 149 may be disposed on or at one side of the outer stators 141, 143, and 145. A first side of the outer stators 141, 143, and 145 may be supported by the frame 110, and a second side of the outer stators 141, 143, and 145 may be supported by the stator cover 149. The inner stator 148 may be fixed to a circumference of the frame 110. In the inner stator 148, a plurality of laminations may be stacked in the circumferential direction outside of the cylinder 120.

[0051] The linear compressor 100 may further include a support 137 to support the piston 130, and a back cover 170 spring-coupled to the support 137. The support 137 may be coupled to the piston flange 132 and the connection member 138 by a predetermined coupling member, for example.

[0052] A suction guide 155 may be coupled to a front portion of the back cover 170. The suction guide 155 may guide the refrigerant suctioned in through the suction inlet 104 to introduce the refrigerant into the suction muffler 150.

[0053] The linear compressor 100 may further include a plurality of springs 176 which are adjustable in natural frequency to allow the piston 130 to perform a resonant motion. The plurality of springs 176 may include a first spring supported between the support 137 and the stator cover 149, and a second spring supported between the support 137 and the back cover 170.

[0054] The linear compressor 100 may additionally further include plate springs 172 and 174, respectively, disposed on both sides of the shell 101 to allow inner components of the compressor 100 to be supported by the shell 101. The plate springs 172 and 174 may include a first plate spring 172 coupled to the first cover 102, and a second plate spring 174 coupled to the second cover 103. For example, the first plate spring 172 may be fitted into a portion at which the shell 101 and the first cover 102 are coupled to each other, and the second plate spring 174 may be fitted into a portion at which the shell 101 and the second cover 103 are coupled to each other.

[0055] Fig. 4 is a cross-sectional view of a suction muffler of the linear compressor of Fig. 1. Fig. 5 is a view illustrating a state in which a first filter is coupled to the suction muffler of Fig. 4.

[0056] Referring to Figs. 4 and 5, the suction muffler 150 according to this embodiment may include the first muffler 151, the second muffler 153 coupled to the first muffler 151, and a first filter 310 supported by the first and second mufflers 151 and 153. A flow space, in which the refrigerant may flow, may be defined in each of the first and second mufflers 151 and 153. The first muffler 151 may extend from an inside of the suction inlet 104 in a direction of the discharge outlet 105, and at least a portion of the first muffler 151 may extend inside of the suction guide 155. The second muffler 153 may extend from the first muffler 151 inside of the piston body 131.

[0057] The first filter 310 may be disposed in the flow space to filter foreign substances. The first filter 310 may be formed of a material having a magnetic property. Thus, foreign substances contained in the refrigerant, in particular, metallic substances, may be easily filtered.

[0058] For example, the first filter 310 may be formed of stainless steel, and thus, may have a magnetic property to prevent the first filter 310 from rusting. Alternatively, the first filter 310 may be coated with a magnetic material, or a magnet may be attached to a surface of the first filter 310.

[0059] The first filter 310 may be provided as a mesh-type structure having a plurality of filter holes and have an approximately circular plate shape. Each of the filter holes may have a diameter or width less than a predetermined diameter or width, that is, a predetermined size. For example, the predetermined size may be about 25 μm.

[0060] The first muffler 151 and the second muffler 153 may be assembled with each other using a press-fit manner, for example. The first filter 310 may be fitted into a portion into which the first and second mufflers 151 and 153 are press-fitted and then be assembled. In detail, a groove 151a, to which at least a portion of the second muffler 153 may be coupled, may be defined in the first muffler 151. The second muffler 153 may include a protrusion 153a inserted into the groove 151 a of the first muffler 151.

[0061] The first filter 310 may be supported by the first and second mufflers 151 and 153 in a state in which both sides of the first filter 310 are disposed between the groove 151a and the protrusion 153a. In the state in which the first filter 310 is disposed between the first and second mufflers 151 and 153, when the first and second mufflers 151 and 153 move in a direction that approach each other and then are press-fitted, both sides of the first filter 310 may be inserted and fixed between the groove 151 a and the protrusion 153a.

[0062] As described above, as the first filter 310 may be provided on the suction muffler 150, a foreign substance having a size greater than a predetermined size of the refrigerant suctioned in through the suction inlet 104 may be filtered by the first filter 310. Thus, the first filter 310 may filter the foreign substance from the refrigerant acting as the gas bearing between the piston 130 and the cylinder 120 to prevent the foreign substance from being introduced into the cylinder 120. Also, as the first filter 310 is firmly fixed to the portion at which the first and second mufflers 151 and 153 are coupled or press-fitted, separation of the first filter 310 from the suction muffler 150 may be prevented.

[0063] In this embodiment, although the groove 151 a is defined in the first muffler 151, and the protrusion 153a is disposed on the second muffler 153, embodiments are not limited thereto. For example, the protrusion 153a may be disposed on the first muffler 151, and the groove 151a may be defined in the second muffler 153.

[0064] Fig. 6 is a partial cross-sectional view illustrating a position of a second filter according to an embodiment. Fig. 7 is an exploded perspective view of a cylinder and a frame of the linear compressor of Fig. 3. Fig. 8 is an exploded perspective of the frame of Fig. 7.

[0065] Referring to Figs. 6 to 8, the linear compressor

100 according to an embodiment may include a second filter 320 disposed between the frame 110 and the cylinder 120 to filter a high-pressure gas refrigerant discharged through the discharge valve 161. The second filter 320 may be disposed on or at a portion of a coupled surface at which the frame 110 and the cylinder 120 are coupled to each other.

[0066] In detail, the cylinder 120 may include a cylinder body 121 having an approximately cylindrical shape, and a cylinder flange 125 that extends from the cylinder body 121 in a radial direction. The cylinder body 121 may include at least one gas inflow 122, through which the discharged gas refrigerant may be introduced. The gas inflow 122 may be formed in a circular shape along a circumferential surface of the cylinder body 121.

[0067] The at least one gas inflow 122 may include a plurality of gas inflows 122. The plurality of gas inflows 122 may include gas inflows (see reference numerals 122a and 122b of Fig. 10) disposed on a first side with respect to a center or central portion 121c of the cylinder body 121 in an axial direction, and a gas inflow (see reference numeral 122c of Fig. 10) disposed on a second side with respect to the center or central portion 121c of the cylinder body 121 in the axial direction.

[0068] One or more coupling portion 126 coupled to the frame 110 may be disposed on the cylinder flange 125. Each coupling portion 126 may protrude outward from an outer circumferential surface of the cylinder flange 125, and be coupled to a cylinder coupling hole 118 of the frame 110 by a predetermined coupling member, for example.

[0069] The cylinder flange 125 may have a seat surface 127 seated on the frame 110. The seat surface 127 may be a rear surface of the cylinder flange 125 that extends from the cylinder body 121 in a radial direction.

[0070] The frame 110 may include a frame body 111 that surrounds the cylinder body 121, and a cover coupling portion 115 that extends in a radial direction of the frame body and is coupled to the discharge cover 160.

[0071] The cover coupling portion 115 may have a plurality of cover coupling holes 116, in which the coupling member coupled to the discharge cover 160 may be inserted, and a plurality of the cylinder coupling holes 118, in which the coupling member coupled to the cylinder flange 125 may be inserted. The plurality of cylinder coupling holes 118 may be defined at positions recessed somewhat from the cover coupling portion 115.

[0072] The frame 110 may have a recess 117 recessed backward from the cover coupling portion 115 to allow the cylinder flange 125 to be inserted therein. That is, the recess 117 may be disposed to surround the outer circumferential surface of the cylinder flange 125. The recess 117 may have a recessed depth corresponding to a front to rear width of the cylinder flange 125.

[0073] A predetermined refrigerant flow space may be defined between an inner circumferential surface of the recess 117 and the outer circumferential surface of the cylinder flange 125. The high-pressure gas refrigerant discharged from the discharge valve 161 may flow toward the outer circumferential surface of the cylinder body 121 via the refrigerant flow space. The second filter 320 may be disposed in the refrigerant flow space to filter the refrigerant.

[0074] In detail, a seat 113 having a stepped portion maybe disposed on or at a rear end of the recess 117. The second filter 320 having a ring shape may be seated on the seat 113.

[0075] In a state in which the second filter 320 is seated on the seat 113, when the cylinder 120 is coupled to the frame 110, the cylinder flange 125 may push the second filter 320 from a front side of the second filter 320. That is, the second filter 320 may be disposed and fixed between the seat 113 of the frame 110 and the seat surface 127 of the cylinder flange 125.

[0076] The second filter 320 may prevent foreign substances in the high-pressure gas refrigerant discharged through the opened discharge valve 161 from being introduced into the gas inflow 122 of the cylinder 120 and be configured to adsorb oil contained in the refrigerant thereon. For example, the second filter 320 may include a felt formed of polyethylene terephthalate (PET) fiber or an adsorbent paper. The PET fiber may have superior heat-resistance and mechanical strength. Also, a foreign substance having a size of about 2 μm or more, which is contained in the refrigerant, may be blocked.

[0077] The high-pressure gas refrigerant passing through the flow space defined between the inner circumferential surface of the recess 117 and the outer circumferential surface of the cylinder flange 125 may pass through the second filter 320. In this process, the refrigerant may be filtered by the second filter 320.

[0078] Fig. 9 is a cross-sectional view illustrating a state in which the cylinder and a piston are coupled to each other according to an embodiment. Fig. 10 is a view of the cylinder according to an embodiment. Fig. 11 is an enlarged cross-sectional view of portion A of Fig. 9.

[0079] Referring to Figs. 9 to 11, the cylinder 120 according to an embodiment may include the cylinder body 121 having an approximately cylindrical shape to form a first body end 121 a and a second body end 121b, and the cylinder flange 125 that extends from the second body end 121b of the cylinder body 121 in a radial direction. The first body end 121 a and the second body end 121 b form both ends of the cylinder body 121 with respect to the central portion 121c of the cylinder body 121 in an axial direction.

[0080] The cylinder body 121 may include a plurality of the gas inflows 122, through which at least a portion of the high-pressure gas refrigerant discharged through the discharge valve 161 may flow. A third filter 330 may be disposed in the plurality of gas inflows 122.

[0081] Each of the plurality of gas inflows 122 may be recessed from the outer circumferential surface of the cylinder body 121 by a predetermined depth and width. The refrigerant may be introduced into the cylinder body 121 through the plurality of gas inflows 122 and the nozzle

123.

[0082] The introduced refrigerant may be disposed between the outer circumferential surface of the piston 130 and the inner circumferential surface of the cylinder 120 to serve as the gas bearing with respect to movement of the piston 130. That is, the outer circumferential surface of the piston 130 may be maintained in a state in which the outer circumferential surface of the piston 130 is spaced apart from the inner circumferential surface of the cylinder 120 by pressure of the refrigerant.

[0083] The plurality of gas inflows 122 may include first and second gas inflows 122a and 122b disposed on a first side with respect to the central portion 121c in an axial direction of the cylinder body 121, and a third gas inflow 122c disposed on a second side with respect to the central portion 121c in the axial direction. The first and second gas inflows 122a and 122b may be disposed at positions closer to the second body end 121b with respect to the central portion 121c in the axial direction of the cylinder body 121, and the third gas inflow 122c may be disposed at a position closer to the first body end 121a with respect to the central portion 121c in the axial direction of the cylinder body 121. That is, the plurality of gas inflows 122 may be provided in numbers which are not symmetrical to each other with respect to the central portion 121c in the axial direction of the cylinder body 121.

[0084] Referring to Fig. 10, the cylinder 120 may have a relatively high inner pressure at a side of the second body end 121 b, which may be closer to a discharge-side of the compressed refrigerant when compared to that of the first body end 121 a, which may be closer to a suction-side of the refrigerant. Thus, more gas inflows 122 may be provided at the side of the second body end 121 b to enhance a function of the gas bearing, and relatively less gas inflows 122 may be provided at the side of the first body end 121 a.

[0085] The cylinder body 121 may further include one or more nozzle 123 that extends from the plurality of gas inflows 122 toward the inner circumferential surface of the cylinder body 121. Each nozzle 123 may have a width or size less than a width or size of the gas inflow 122.

[0086] A plurality of the nozzles 123 may be provided along the gas inflow 122, which may extend in a circular shape. The plurality of nozzles 123 may be disposed to be spaced apart from each other.

[0087] The plurality of nozzles 123 may each include an inlet 123a connected to the gas inflow 122, and an outlet 123b connected to the inner circumferential surface of the cylinder body 121. Each nozzle 123 may have a predetermined length from the inlet 123a toward the outlet 123b.

[0088] A recessed depth and width of each of the plurality of gas inflows 122 and a length of the nozzle 123 may be determined to have adequate dimensions in consideration of a rigidity of the cylinder 120, an amount of third filter 330, or a intensity in pressure drop of the refrigerant passing through the nozzle 123. For example, if the recessed depth and width of each of the plurality of gas inflows 122 are too large, or the length of the nozzle 123 is too short, rigidity of the cylinder 120 may be weak. On the other hand, if the recessed depth and width of each of the plurality of gas inflows 122 are too small, an amount of third filter 330 provided in the gas inflow 122 may be too small. Also, if the length of the nozzle 123 is too long, a pressure drop of the refrigerant passing through the nozzle 123 may be too large, and it may be difficult to perform the function as the gas bearing.

[0089] The inlet 123a of the nozzle 123 may have a diameter greater than a diameter of the outlet 123b. In detail, if the diameter of the nozzle 123 is too small, an amount of refrigerant, which may be introduced from the nozzle 123, of the high-pressure gas refrigerant discharged through the discharge valve 161 may be too large, increasing flow loss in the compressor. On the other hand, if the diameter of the nozzle 123 is too small, the pressure drop in the nozzle 123 may increase, reducing a performance of the gas bearing.

[0090] Thus, in this embodiment, the inlet 123a of the nozzle 123 may have a relatively large diameter to reduce the pressure drop of the refrigerant introduced into the nozzle 123. In addition, the outlet 123b may have a relatively small diameter to control an inflow amount of gas bearing through the nozzle 123 to a predetermined value or less.

[0091] The third filter 330 may prevent a foreign substance having a predetermined size or more from being introduced into the cylinder 120 and perform a function of adsorbing oil contained in the refrigerant. The predetermined size may be about 1 μm.

[0092] The third filter 330 may include a thread which is wound around the gas inflow 122. In detail, the thread may be formed of a polyethylene terephthalate (PET) material and have a predetermined thickness or diameter.

[0093] The thickness or diameter of the thread may be determined to have adequate dimensions in consideration of a rigidity of the thread. If the thickness or diameter of the thread is too small, the thread may be easily broken due to a very weak strength thereof. On the other hand, if the thickness or diameter of the thread is too large, a filtering effect with respect to foreign substances may be deteriorated due to a very large pore in the gas inflow 122 when the thread is wound.

[0094] For example, the thickness or diameter of the thread maybe several hundreds μm. The thread may be manufactured by coupling a plurality of strands of a spun thread having several tens μm to each other, for example.

[0095] The thread may be wound several times, and an end of the thread may be fixed with a knot, for example. A number of windings of the thread may be adequately selected in consideration of the pressure drop of the gas refrigerant and the filtering effect with respect to foreign substances. If the number of thread windings is too large, the pressure drop of the gas refrigerant may increase. On the other hand, if the number of thread windings is too small, the filtering effect with respect to foreign substances may be reduced.

[0096] Also, a tension force of the wound thread may be adequately controlled in consideration of deformation of the cylinder and fixation of the thread. If the tension force is too large, deformation of the cylinder 120 may occur. On the other hand, if the tension force is too small, the thread may not be adequately fixed to the gas inflow 122.

[0097] Fig. 12 is a cross-sectional view illustrating a refrigerant flow in the linear compressor of Fig. 3. Referring to Fig. 12, refrigerant flow in the linear compressor according to an embodiment will be described hereinbelow.

[0098] Referring to Fig. 12, the refrigerant may be introduced into the shell 101 through the suction inlet 104 and flow into the suction muffler 150 through the suction guide 155. The refrigerant may be introduced into the second muffler 153 via the first muffler 151 of the suction muffler 150 to flow into the piston 130. In this way, suction noise of the refrigerant may be reduced.

[0099] A foreign substance having a predetermined size (about 25 μm) or more, which is contained in the refrigerant, may be filtered while passing through the first filter 310 provided on or in the suction muffler 150. The refrigerant within the piston 130 after passing though the suction muffler 150 may be suctioned into the compression space P through the suction hole 133 when the suction valve 135 is opened.

[0100] When the refrigerant pressure in the compression space P is above the predetermined discharge pressure, the discharge valve 161 may be opened. Thus, the refrigerant may be discharged into the discharge space of the discharge cover 160 through the opened discharge valve 161, flow into the discharge outlet 105 through the loop pipe 165 coupled to the discharge cover 160, and be discharged outside of the compressor 100.

[0101] At least a portion of the refrigerant within the discharge space of the discharge cover 160 may flow toward the outer circumferential surface of the cylinder body 121 via the space defined between the cylinder 120 and the frame 110, that is, the inner circumferential surface of the recess 117 of the frame 110 and the outer circumferential surface of the cylinder flange 125 of the cylinder 120. The refrigerant may pass through the second filter 320 disposed between the seat surface 127 of the cylinder flange 125 and the seat 113 of the frame 110. In this way, a foreign substance having a predetermined size (about 2 μm) or more may be filtered. Also, oil in the refrigerant may be adsorbed onto or into the second filter 320.

[0102] The refrigerant passing through the second filter 320 may be introduced into the plurality of gas inflows 122 defined in the outer circumferential surface of the cylinder body 121. Also, while the refrigerant passes through the third filter 330 provided on or in the gas inflows 122, a foreign substances having a predetermined size (about 1 μm) or more, which is contained in the refrigerant, may be filtered, and oil contained in the refrigerant may be adsorbed.

[0103] The refrigerant passing through the third filter 330 may be introduced into the cylinder 120 through the nozzle 123 and be disposed between the inner circumferential surface of the cylinder 120 and the outer circumferential surface of the piston 130 to space the piston 130 from the inner circumferential surface of the cylinder 120 (gas bearing). As described above, the high-pressure gas refrigerant may be bypassed within the cylinder 120 to serve as the gas bearing with respect to the piston 130 which is reciprocated, thereby reducing abrasion between the piston 130 and the cylinder 120. Also, as oil is not used for the bearing, friction loss due to oil may not occur even though the compressor 100 operates at a high rate.

[0104] Also, as the plurality of filters may be provided on the path or passage of the refrigerant flowing in the compressor 100, foreign substances contained in the refrigerant may be removed. Thus, the refrigerant acting as the gas bearing may be improved in reliability. Thus, it may prevent the piston 130 or the cylinder 120 from being worn by foreign substances contained in the refrigerant. Also, as the oil contained in the refrigerant may be removed by the plurality of filters, it may prevent friction loss due to the oil from occurring.

[0105] The first, second, and third filters 310, 320, and 330 may be referred to as a "filter device" in that the filters 310, 320, and 330 filter the refrigerant that serves as the gas bearing. That is, the filter device may include at least one filter member disposed on or in the "refrigerant passage" from the suction inlet 104 to the nozzle 123 via the discharge valve 161. Thus, foreign substances and oil in the refrigerant to be introduced into the nozzle 123 may be filtered while passing through the filter member.

[0106] Hereinafter, another embodiment will be described. This embodiment may be the same as the previous embodiment except for an arrangement of a second filter, and thus, different points therebetween will be mainly described, and repetitive disclosure has been omitted.

[0107] Fig. 13 is a cross-sectional view of illustrating a position of a second filter is disposed according to another embodiment. Referring to Fig. 13, linear compressor 100 according to this embodiment may include a second filter 420 disposed between an outer circumferential surface of cylinder flange 125 and an inner circumferential surface of recess 117 of frame 110.

[0108] The second filter 420 may extend from a front end of the cylinder flange part 125 in an axial direction of the compressor 100. Thus, at least a portion of a refrigerant discharged through discharge valve 161 may flow backward along a longitudinal direction of the second filter 420.

[0109] For example, the second filter 420 may include a felt formed of polyethylene terephthalate (PET) fiber or an adsorbent paper. The PET fiber may have superior heat-resistance and mechanical strength. Also, a foreign substance having a size of about 2 μm or more, which may be contained in the refrigerant, may be blocked.

[0110] As the second filter 420 may be disposed in a refrigerant flow space defined between the cylinder 120 and the frame 110, foreign substances in the refrigerant may be filtered, and oil contained in the refrigerant may be adsorbed onto or into the second filter 420.

[0111] According to embodiments disclosed herein, a compressor including inner components may decrease in size to reduce a volume of a machine room of a refrigerator and increase an inner storage space of the refrigerant. Also, a drive frequency of the compressor may increase to prevent performance of inner components from being deteriorated due to the decreasing size thereof. In addition, as the gas bearing may be applied between the cylinder and the piston, friction force occurring due to oil may be reduced.

[0112] Further, as the plurality of filter devices may be provided in the compressor, foreign substances or oil contained in the compressed gas (or discharge gas) introduced to the outside of the piston may be prevented from being introduced into the nozzle of the cylinder. More particularly, the first filter may be provided on the suction muffler to prevent the foreign substances contained in the refrigerant from being introduced into the compression chamber. Also, the second filter may be provided on the coupling between the cylinder and the frame to prevent the foreign substances and oil contained in the compressed refrigerant gas from flowing into the gas inflow of the cylinder.

[0113] Also, the third filter may be provided on the gas inflow of the cylinder to prevent the foreign substances and oil from being introduced into the nozzle of the cylinder from the gas inflow. Additionally, the filter device may be provided in the dryer provided in the refrigerator to filter the moisture, foreign substances, or oil contained in the refrigerant.

[0114] As described above, as foreign substances or oil contained in the compression gas that acts as a bearing may be filtered through the plurality of filtering devices provided in the compressor and dryer, it may prevent the nozzle of the cylinder from being blocked by the foreign substances or oil. As the blocking of the nozzle of the cylinder is prevented, a gas bearing effect may be effectively performed between the cylinder and the piston, and thus, abrasion of the cylinder and the piston may be prevented.

[0115] Embodiments disclosed herein provide a linear compressor in which a gas bearing may easily operate between a cylinder and a piston, and a refrigerant including a linear compressor.

[0116] Embodiments disclosed herein provide a linear compressor that may include a shell including a suction inlet; a cylinder provided in the shell to define a compression space for a refrigerant; a piston reciprocated in an axial direction within the cylinder; a discharge valve provided on or at one side of the cylinder to selectively discharge the refrigerant compressed in the compression space; a nozzle part or nozzle disposed in the cylinder to introduce at least a portion of the refrigerant discharged through the discharge valve into the cylinder; and a filter device or filter provided in the shell. The filter device may include at least one filter member disposed on or in a refrigerant passage defined from the suction inlet to the nozzle part via the discharge valve. Foreign substances or oil contained in the refrigerant to be introduced into the nozzle part may be filtered while passing through the at least one filter member.

[0117] The linear compressor may further include a suction muffler provided in the shell to reduce noise of the refrigerant suctioned through the suction inlet. The filter device may include a first filter provided on the suction muffler. The suction muffler may include a first muffler and a second muffler, and the first filter may be disposed at a coupled portion between the first and second mufflers.

[0118] The linear compressor may further include a groove part or groove defined in one of the first muffler or the second muffler, and a protrusion disposed on the other one of the first muffler or the second muffler. The protrusion may be coupled to the groove part. Both sides of the first filter may be disposed between the groove part and the protrusion.

[0119] The first filter may include a magnetic material. The first filter may be formed of a stainless steel material.

[0120] The linear compressor may further include a frame fixed to an outside of the cylinder. The filter device may include a second filter disposed in a refrigerant flow space between the cylinder and the frame.

[0121] The cylinder may include a cylinder body, and a cylinder flange part or flange that extends in a radial direction of the cylinder body. A recess part or recess, in which the cylinder flange part may be inserted, and a seat part or seat, on which one surface of the cylinder flange part may be seated, may be provided on the frame.

[0122] The second filter may be placed on the seat part of the frame. The second filter may be placed between an outer circumferential surface of the cylinder flange part, and an inner circumferential surface of the recess part. The second filter may have a ring shape. Further, the second filter may include a felt formed of polyethylene terephthalate (PET) fiber.

[0123] The linear compressor may further include a gas inflow part or gas inflow recessed from an outer circumferential surface of the cylinder to communicate with the nozzle part. The filter device may include a third filter disposed on or in the gas inflow part. The third filter may include a thread having a preset or predetermined thickness or diameter. The thread may be formed of a polyethylene terephthalate (PET) material. The thread may be wound several times around the gas inflow part.

[0124] Embodiments disclosed herein further provide a refrigerator that may include a linear compressor including a reciprocating piston and a cylinder to accommodate the piston and having an outer circumferential surface to introduce a refrigerant; a filter device provided in the linear compressor to filter the refrigerant introduced through the outer circumferential surface of the cylinder; a condenser to condense the refrigerant compressed in the linear compressor; and a dryer to remove foreign substances or oil contained in the refrigerant condensed in the condenser. The dryer may include an adsorbent to adsorb the oil contained in the refrigerant. The adsorbent may include a molecular sieve having a grain shape and a plurality of holes to adsorb the oil. The adsorbent may include an oil adsorbent paper or felt.

[0125] The dryer may include a first dryer filter disposed within an inlet-side of the dryer; a second dryer filter that supports the first dryer filter, the second dryer filter including the adsorbent; and a third dryer filter that supports the second dryer, the third dryer filter being disposed within an outlet-side of the dryer.

[0126] The filter device may include a first filter including a suction muffler to reduce flow noise of the refrigerant suctioned into the linear compressor. The filter device may include a second filter disposed on one side of the cylinder to filter at least a portion of the refrigerant discharged from the cylinder. The filter device may include a third filter wound around the outer circumferential surface of the cylinder.

[0127] Any reference in this specification to "one embodiment," "an embodiment," "example embodiment," etc., means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. The appearances of such phrases in various places in the specification are not necessarily all referring to the same embodiment. Further, when a particular feature, structure, or characteristic is described in connection with any embodiment, it is submitted that it is within the purview of one skilled in the art to effect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0128] 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 linear compressor, comprising:

a shell (101) comprising a suction inlet (104);
a cylinder (120) provided in the shell, defining a compression space for a refrigerant;
a piston (130) for reciprocating within the cylinder in an axial direction thereof;
a discharge valve (161) provided at one end of the cylinder to selectively discharge the refrigerant compressed in the compression space;
at least one nozzle (123) disposed in the cylinder to introduce at least a portion of the refrigerant discharged through the discharge valve into the cylinder; and
at least one filter (310, 320, 330) provided in the shell, wherein the at least one filter is installed in a refrigerant passage that extends from the suction inlet (104) to the at least one nozzle (123) via the discharge valve (161), and wherein foreign substances and/or oil contained in the refrigerant flowing through the refrigerant passage is filtered by the at least one filter.

2. The linear compressor according to claim 1, further comprising a suction muffler (150) provided in the shell to reduce noise of the refrigerant suctioned in through the suction inlet (104), wherein the at least one filter comprises a first filter (310) installed in the suction muffler.

3. The linear compressor according to claim 2, wherein the suction muffler (150) comprises a first muffler (151) and a second muffler (153), and wherein the first filter (310) is installed between the first muffler and the second muffler.

4. The linear compressor according to claim 3,
wherein one of the first muffler and the second muffler has a groove (151a) formed therein, and
wherein the other one of the first muffler and the second muffler has a protrusion (153a),
wherein the protrusion is coupled to the groove, having the first filter (310) interposed therebetween.

5. The linear compressor according to any of claims 2 to 4, wherein the first filter (310) comprises a magnetic member.

6. The linear compressor according to any of claims 2 to 5, wherein the first filter (310) is formed of a stainless steel material.

7. The linear compressor according to any of preceding claims, further comprising a frame (110) installed outside of the cylinder (120), wherein the at least one filter comprises a second filter (320) installed in a space between the cylinder and the frame.

8. The linear compressor according to claim 7, wherein the cylinder (120) comprises a cylinder body (121) and a cylinder flange (125) that extends from the cylinder body in a radial direction thereof, and wherein the frame (110) comprises a recess (117) in which the cylinder flange (125) is inserted, the recess (117) having as a bottom surface thereof a seat (113) on which the cylinder flange (125) seats.

9. The linear compressor according to claim 8, wherein the second filter (320) is positioned on the seat (113) of the frame (110).

10. The linear compressor according to claim 8, wherein the second filter (320) is positioned between an outer circumferential surface of the cylinder flange (125) and an inner circumferential surface of the recess (117).

11. The linear compressor according to any of claims 7 to 10, wherein the second filter (320) has a ring shape.

12. The linear compressor according to any of claims 7 to 11, wherein the second filter (320) comprises a felt formed of polyethylene terephthalate (PET) fiber.

13. The linear compressor according to any of preceding claims,
wherein the cylinder (120) further comprises at least one recessed gas inflow (122)on an outer circumferential surface thereof, the at least one gas inflow (122) communicating with the at least one nozzle (123), and
wherein the at least one filter comprises a third filter (330) installed in the at least one gas inflow (122).

14. The linear compressor according to claim 13, wherein the third filter (330) comprises a thread having a predetermined thickness, being wound a preset number of times along the at least one gas inflow (122).

15. The linear compressor according to claim 14, wherein the thread is formed of a polyethylene terephthalate (PET) material.

FIG.1

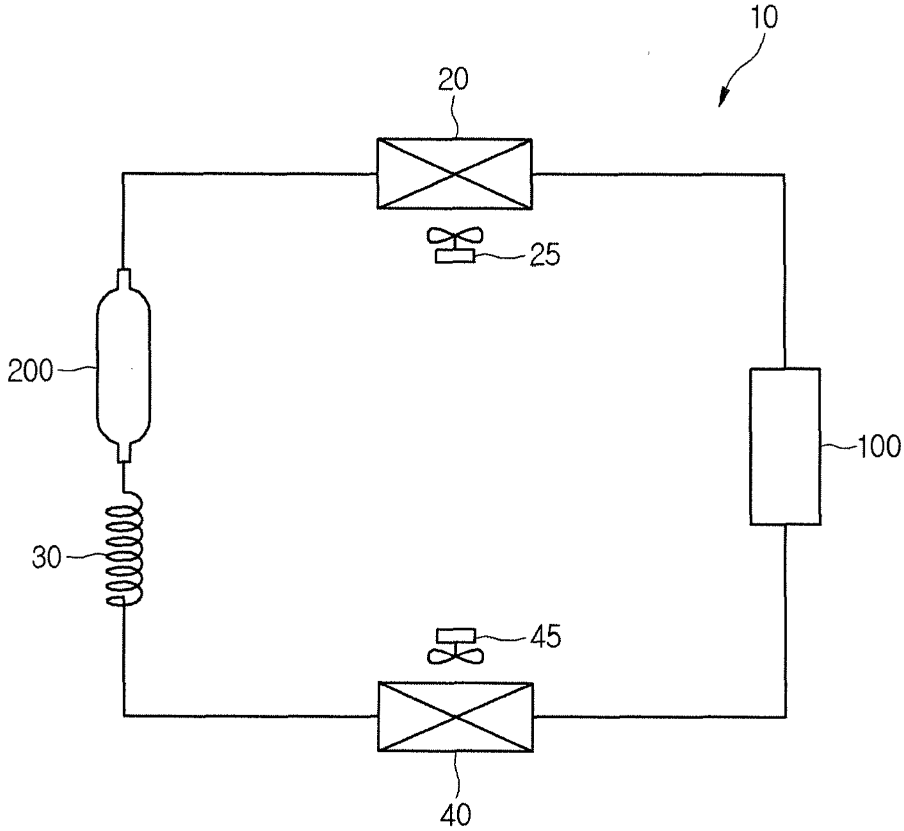

FIG.2

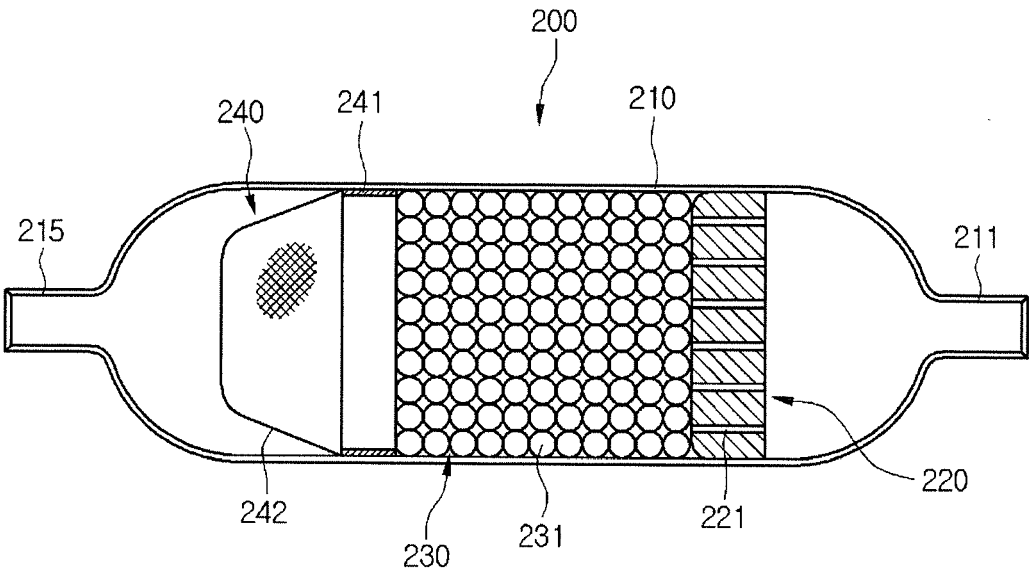

FIG.3

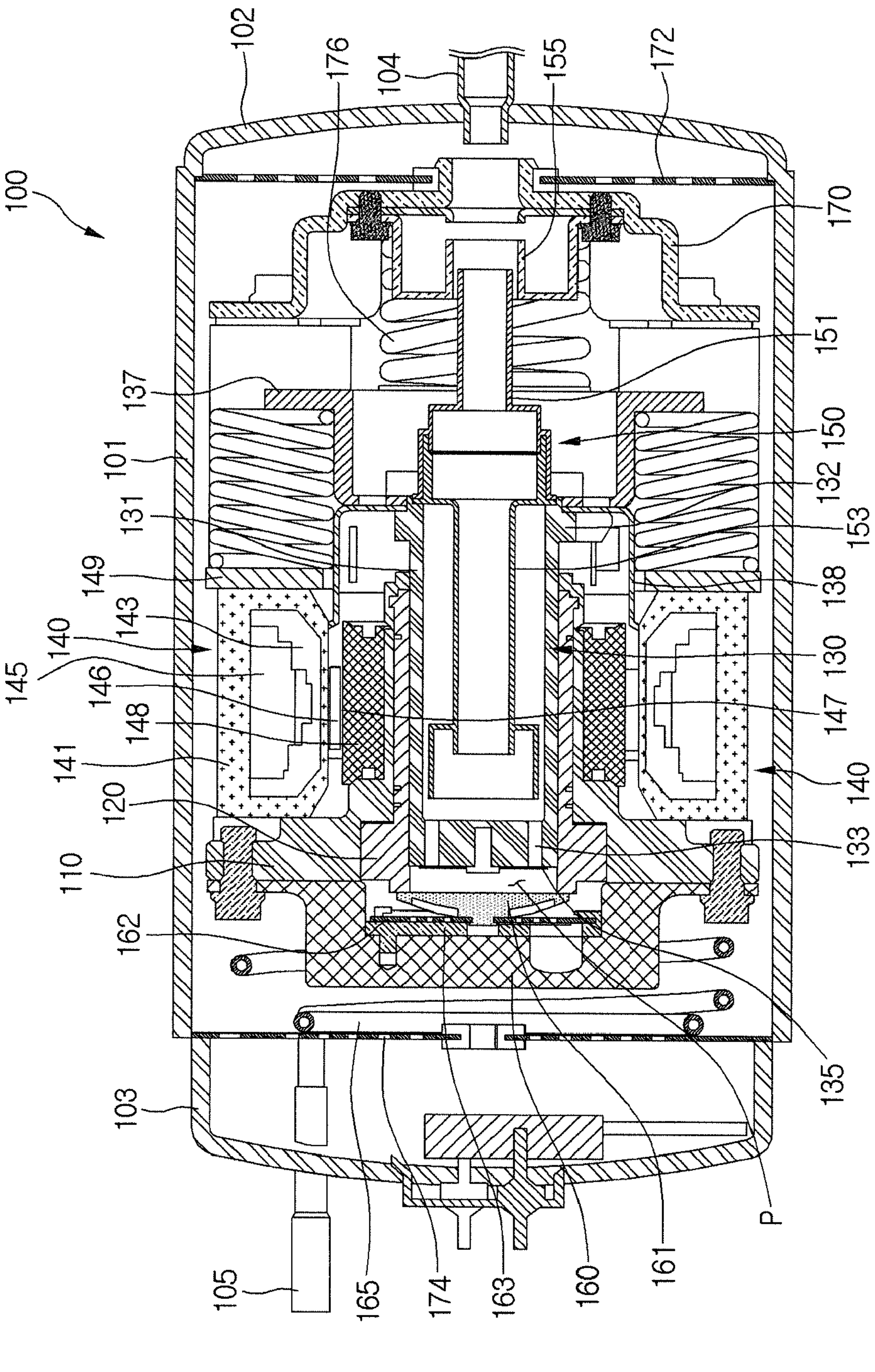
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FIG.4

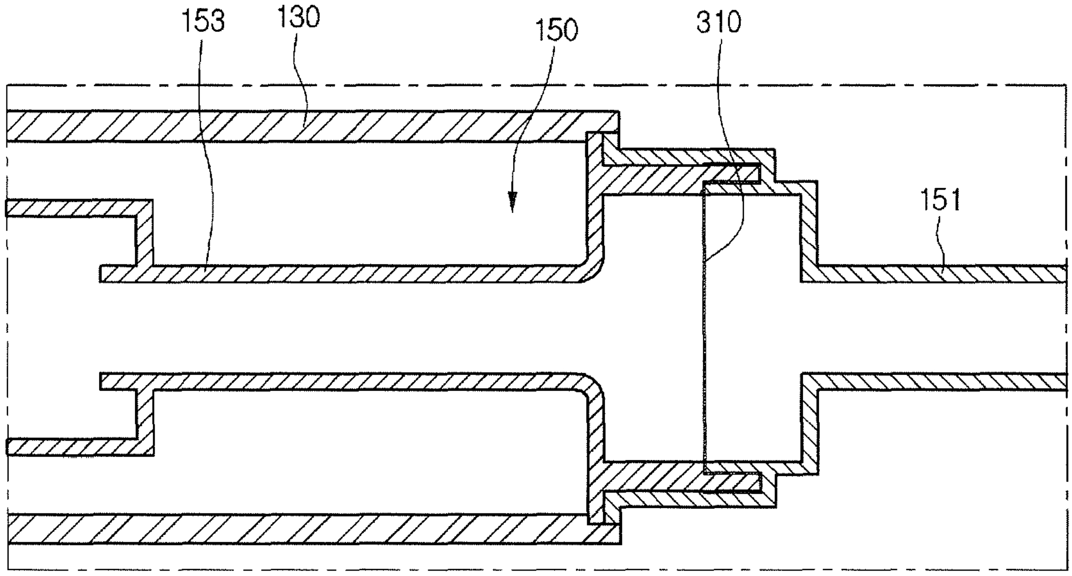

FIG.5

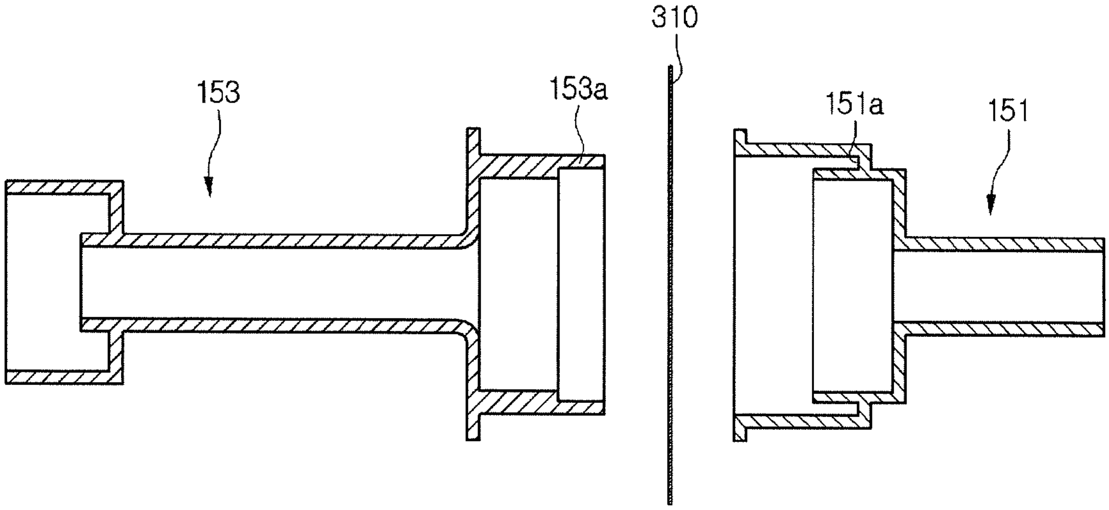

FIG.6

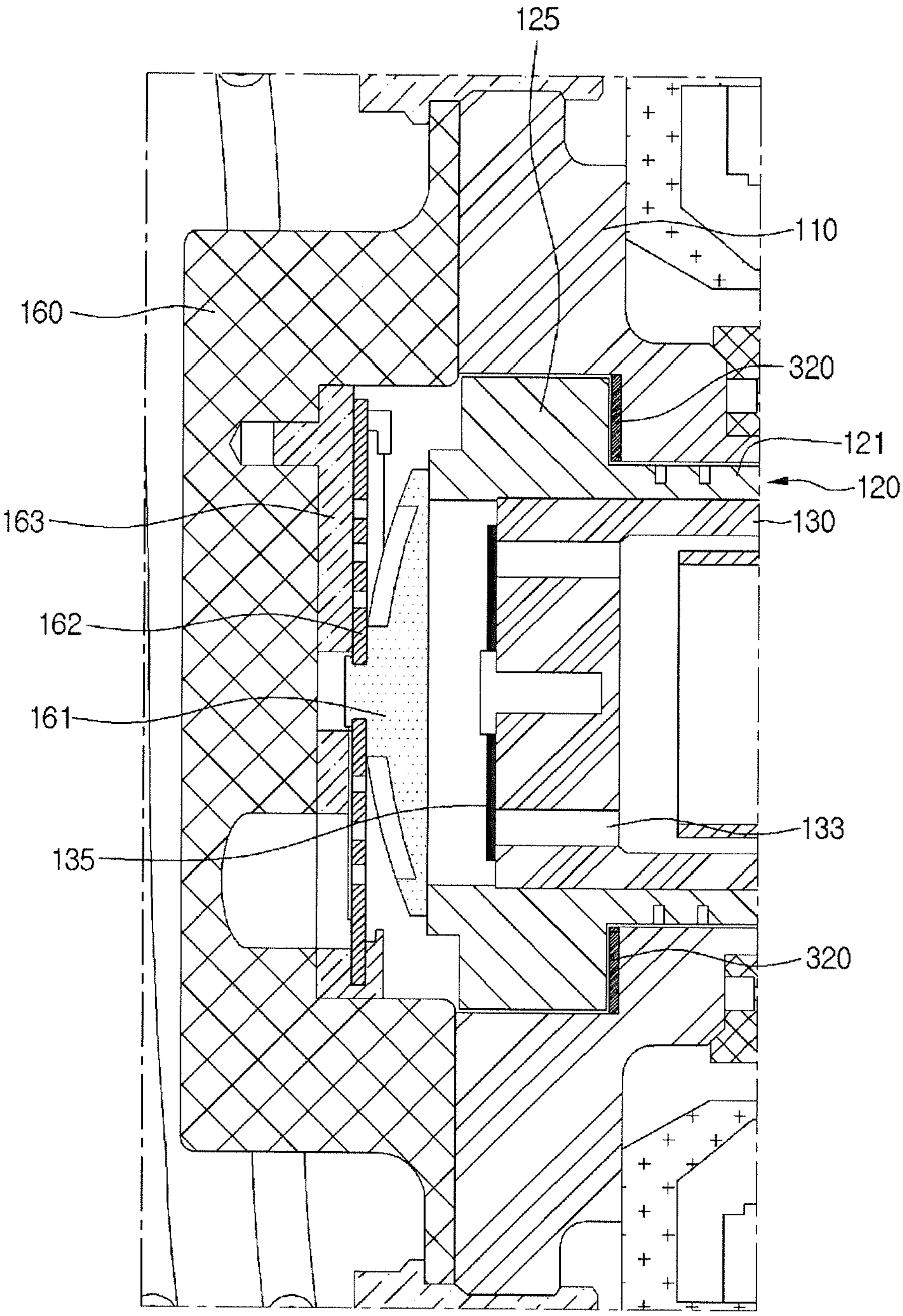

FIG.7

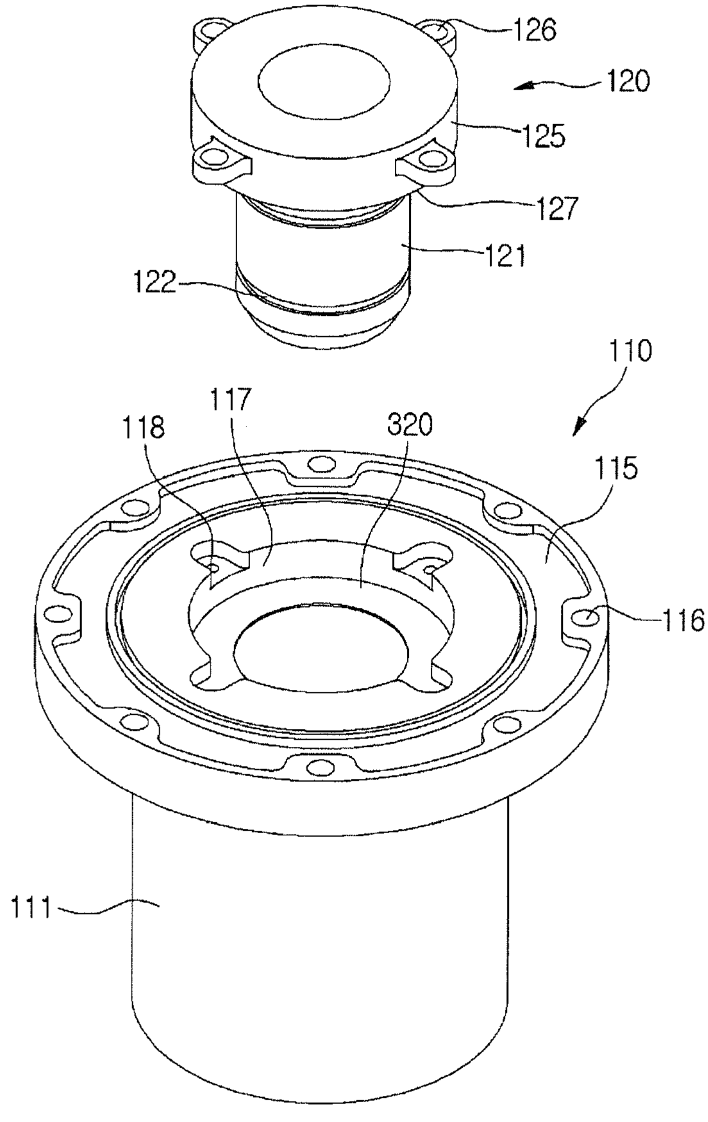

FIG.8

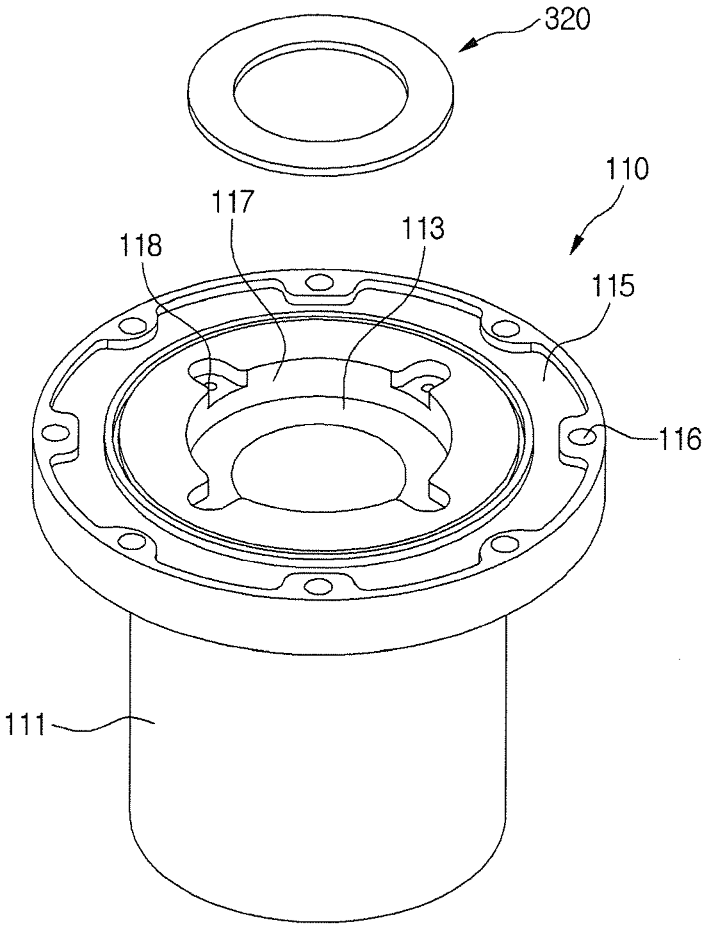

FIG.9

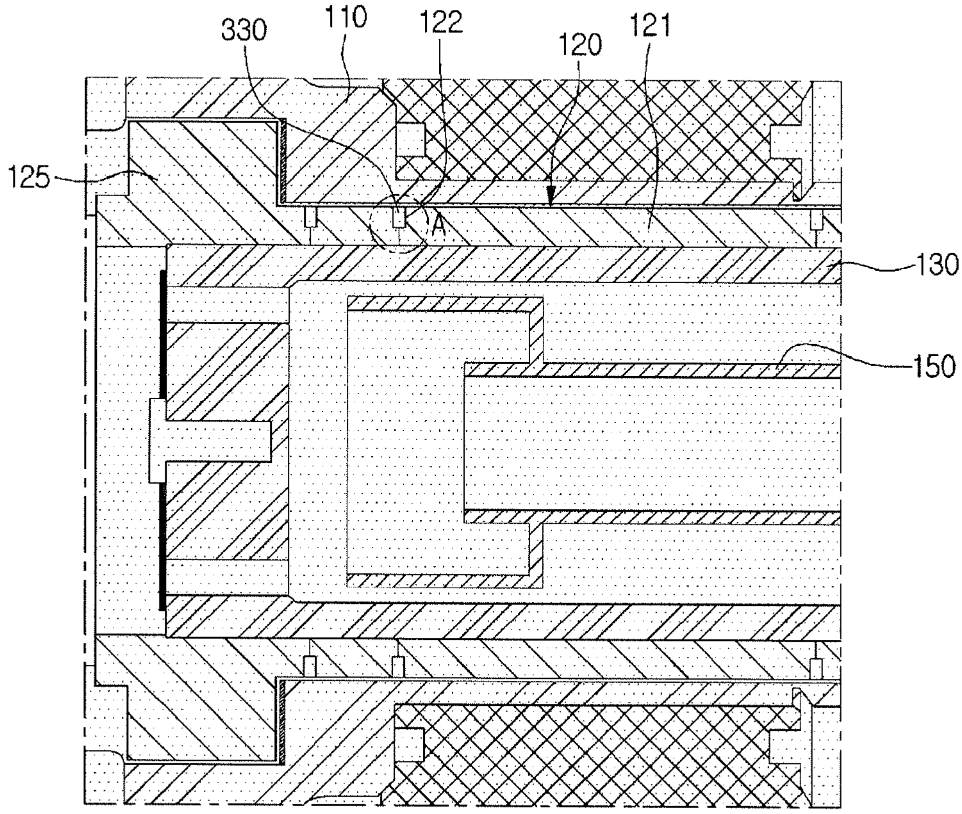

FIG.10

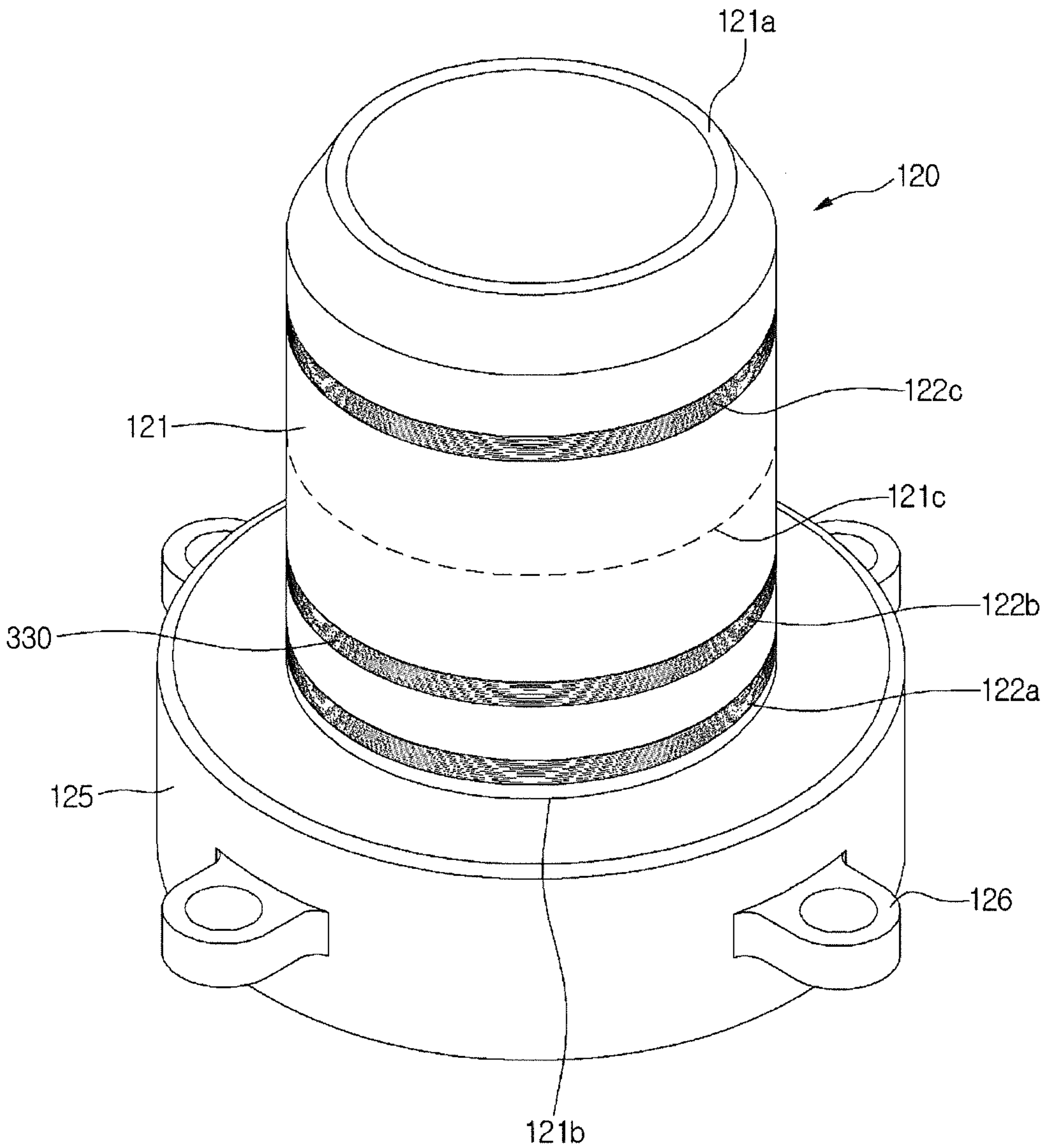

FIG.11

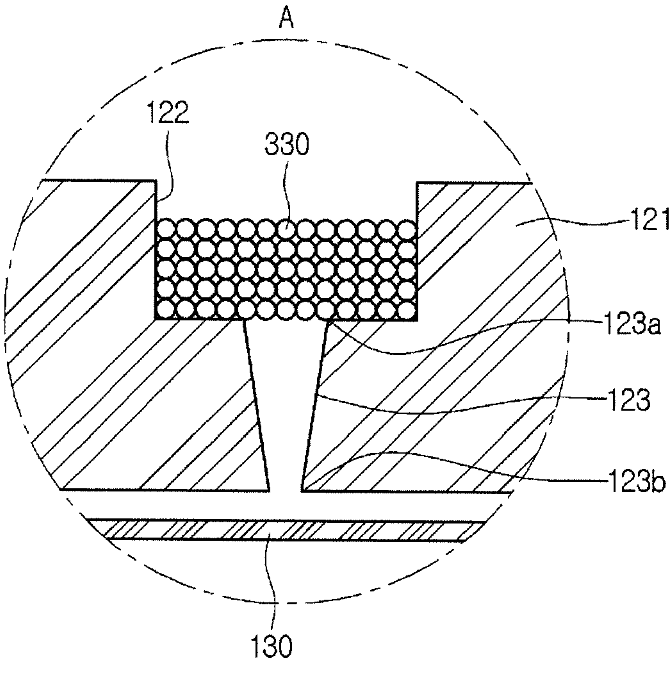

FIG.12

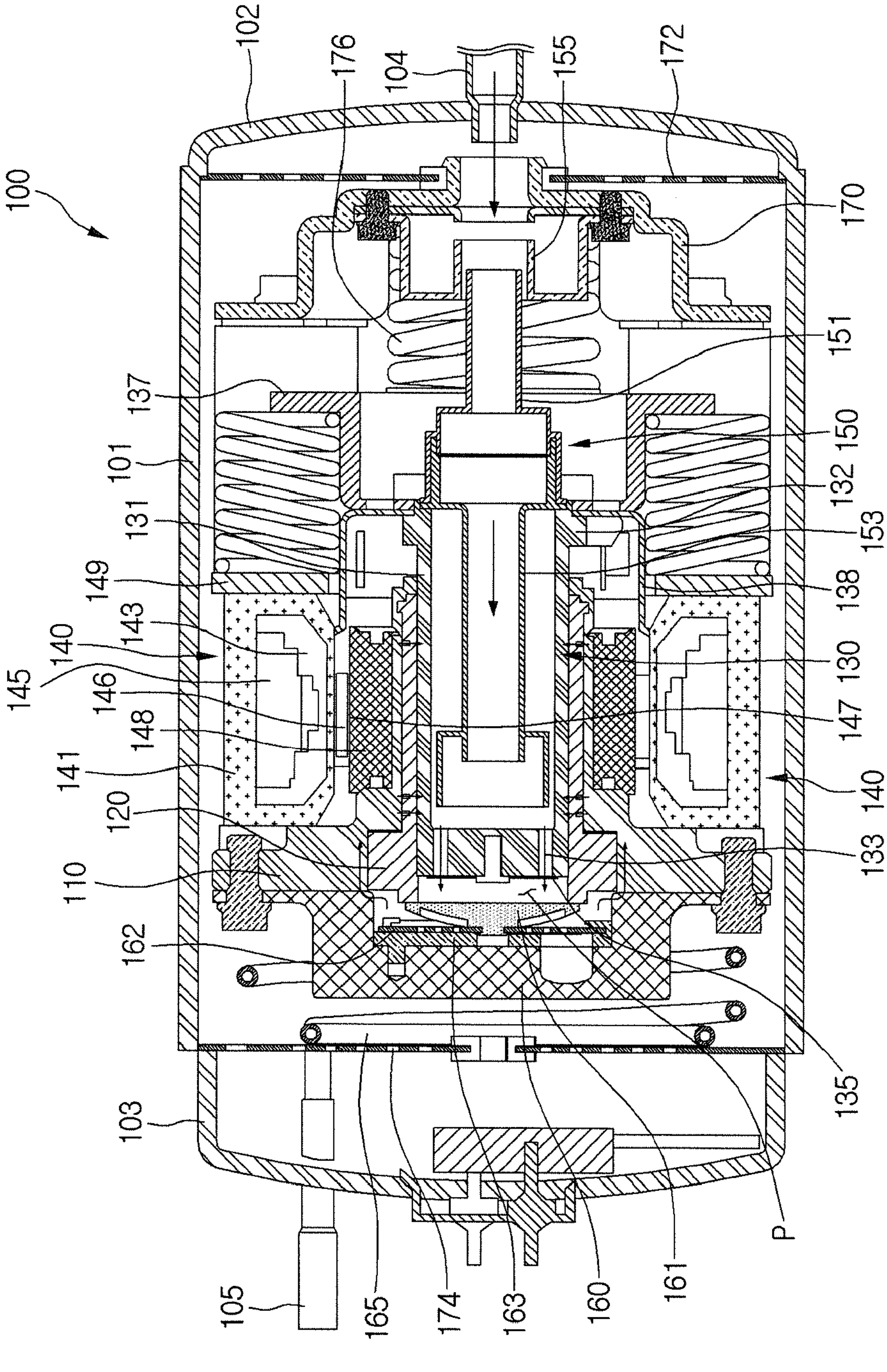
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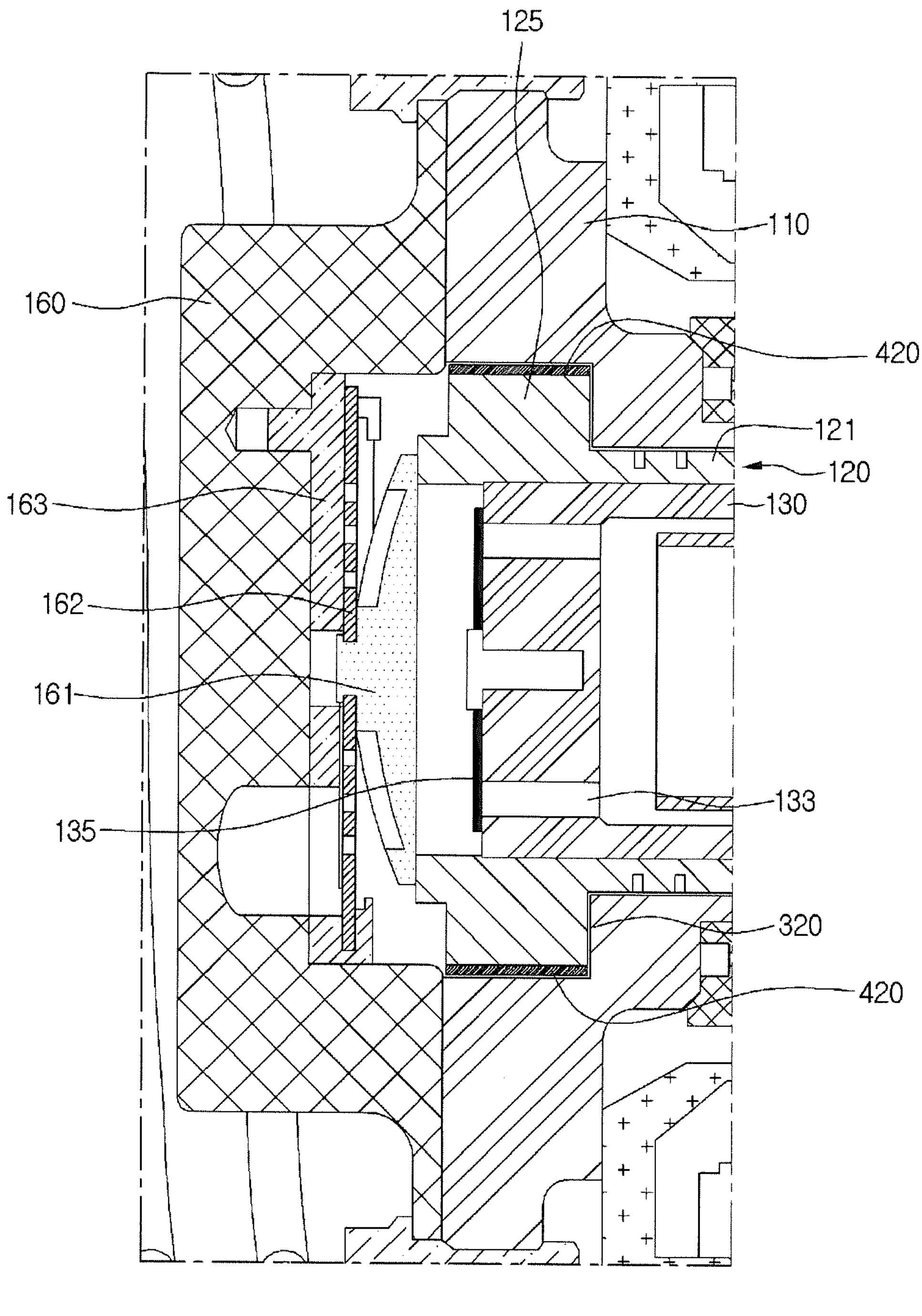
FIG.13



REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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