



US 20080159886A1

(19) **United States**  
(12) **Patent Application Publication**  
**Ku et al.**

(10) **Pub. No.: US 2008/0159886 A1**  
(43) **Pub. Date: Jul. 3, 2008**

(54) **COMPRESSOR AND AIR CONDITIONER HAVING THE SAME**

**Publication Classification**

(51) **Int. Cl.**  
**F04B 17/00** (2006.01)  
(52) **U.S. Cl.** ..... **417/410.5**  
(57) **ABSTRACT**

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(21) Appl. No.: **11/646,257**

(22) Filed: **Dec. 28, 2006**

A scroll compressor uses fatty-acid ester oil for lubrication when a hydro-fluorocarbon (HFC) based-refrigerant is used, and uses fatty-acid mineral oil when a hydro-chlorofluorocarbon (HCFC)-based refrigerant is used. The driving motor is a synchronous reluctance motor with a rotor comprised of a plurality of flat plates. Each plate has a plurality of magnetic flux barriers that extend in both a circumferential direction and a radius direction. An insulation film formed of a crystalline plastic film is interposed between a coil and a stator of the motor, and the coil is formed of wire with an enamel coating layer. These features result in less deformation of the driving motor. In addition, losses due to slippage at the driving motor are lowered. Further, thermal loss due to emission of the rotor is decreased.

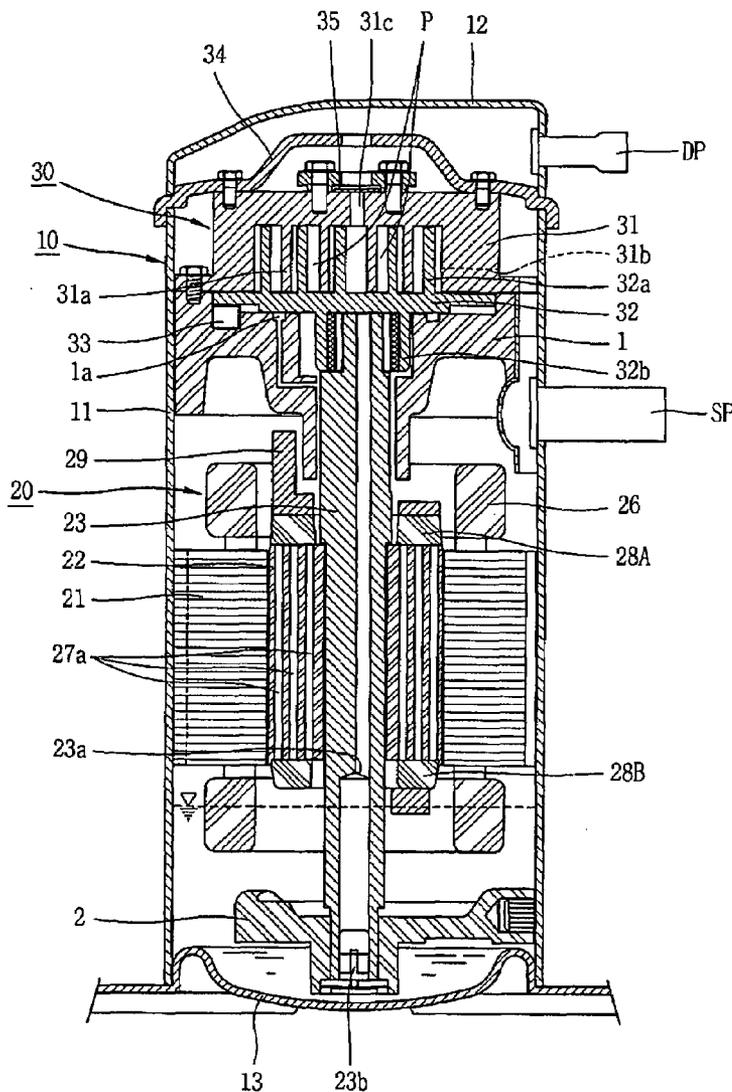


FIG. 1

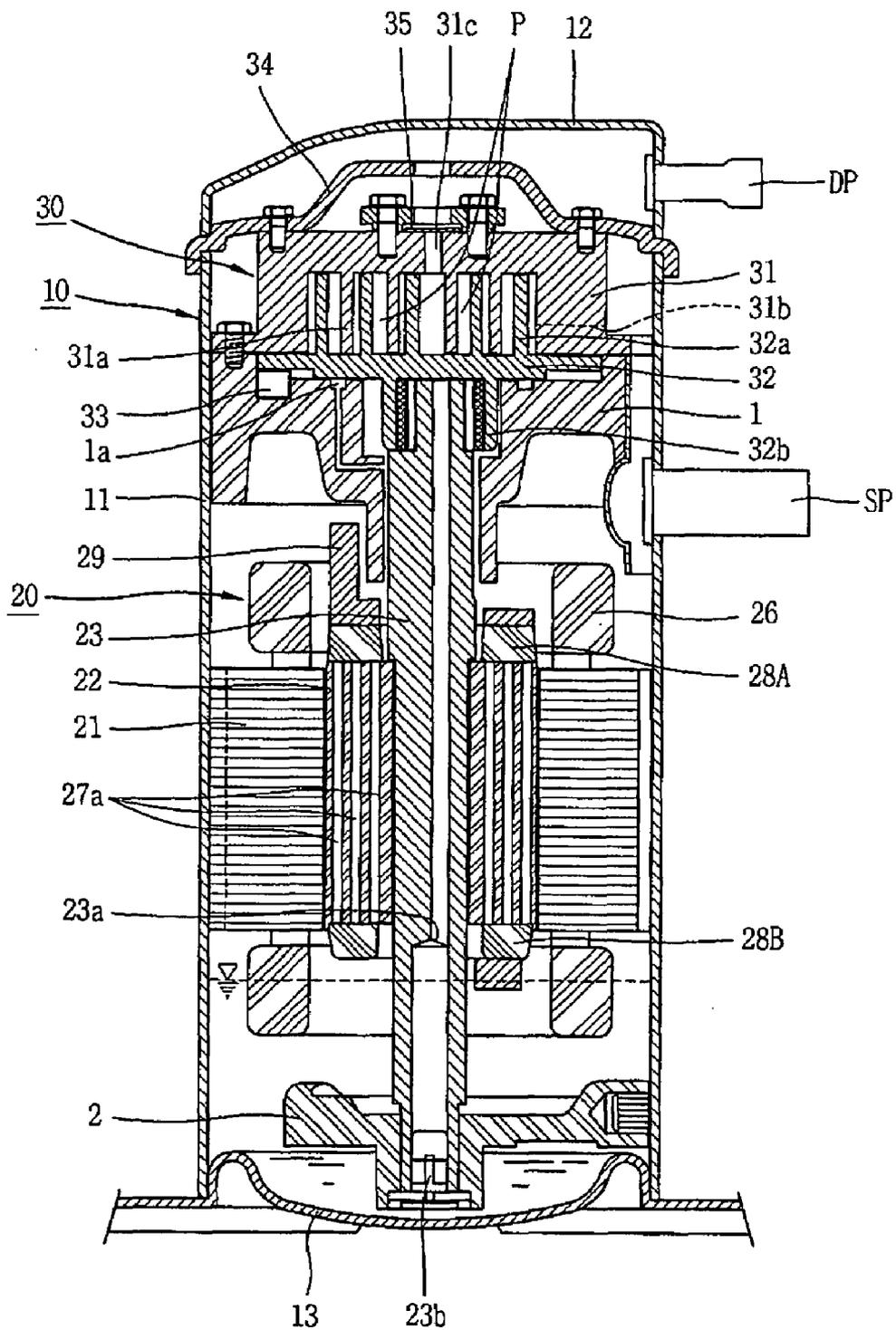


FIG. 2

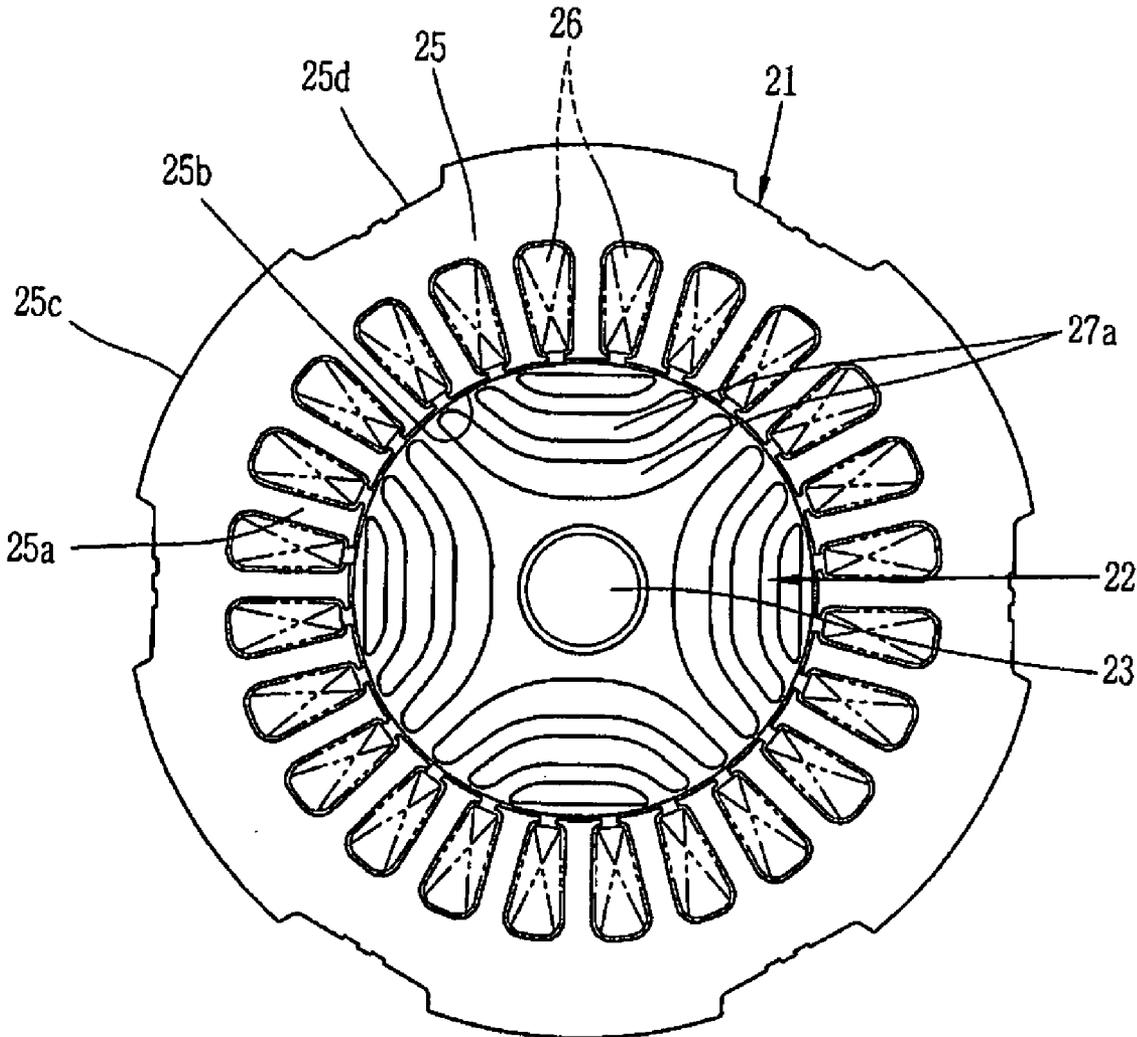


FIG. 3

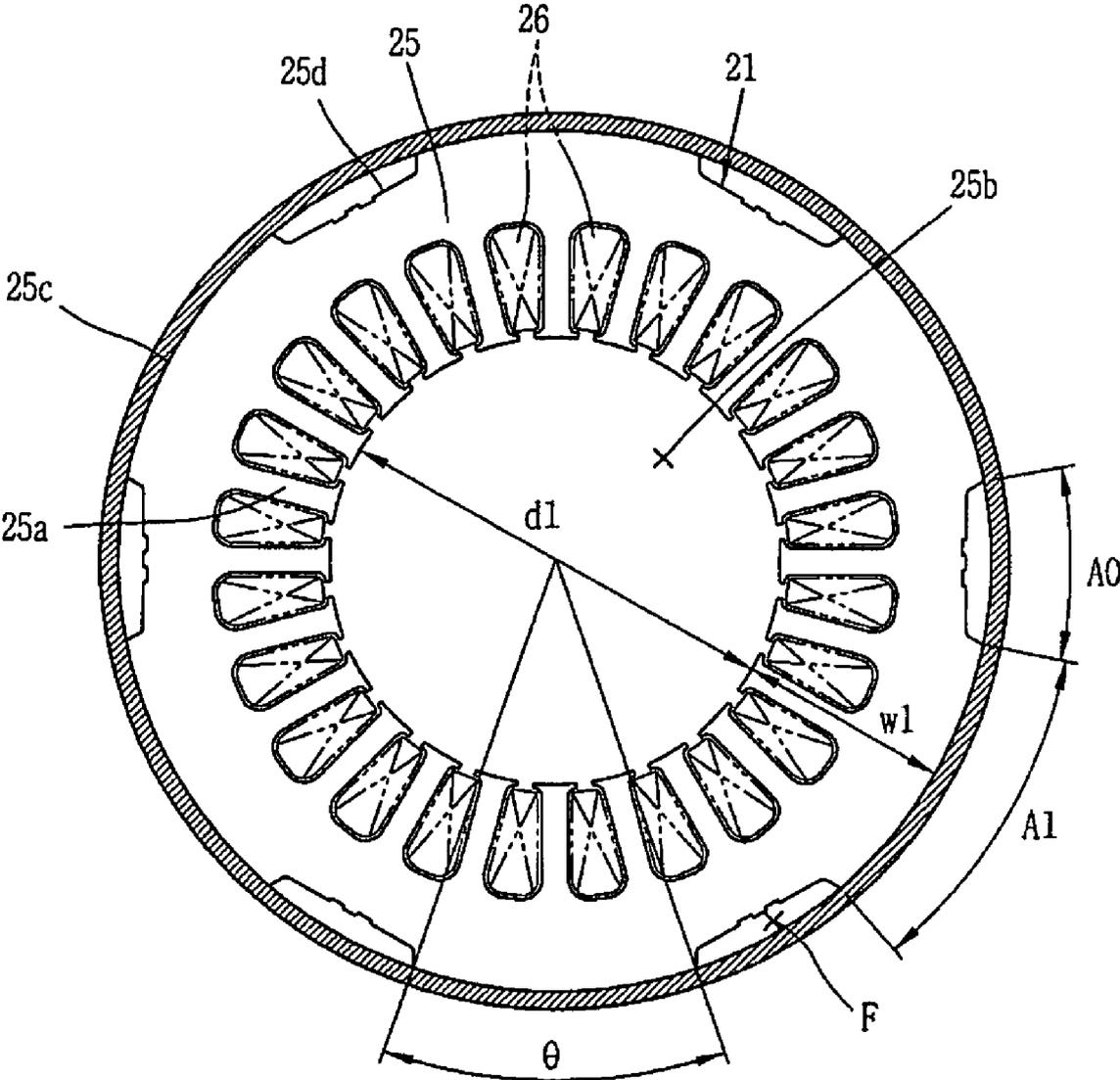


FIG. 4

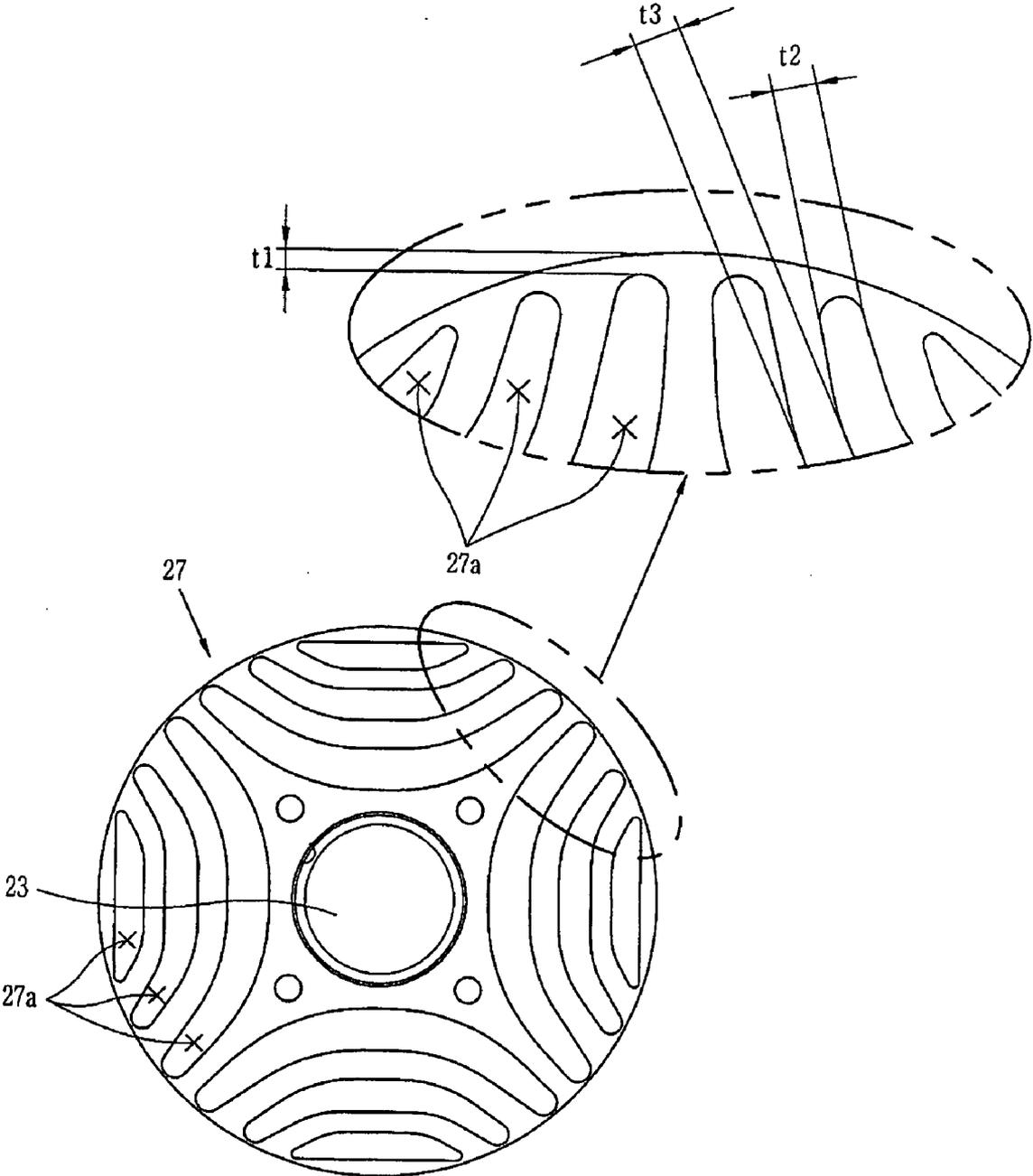


FIG. 5

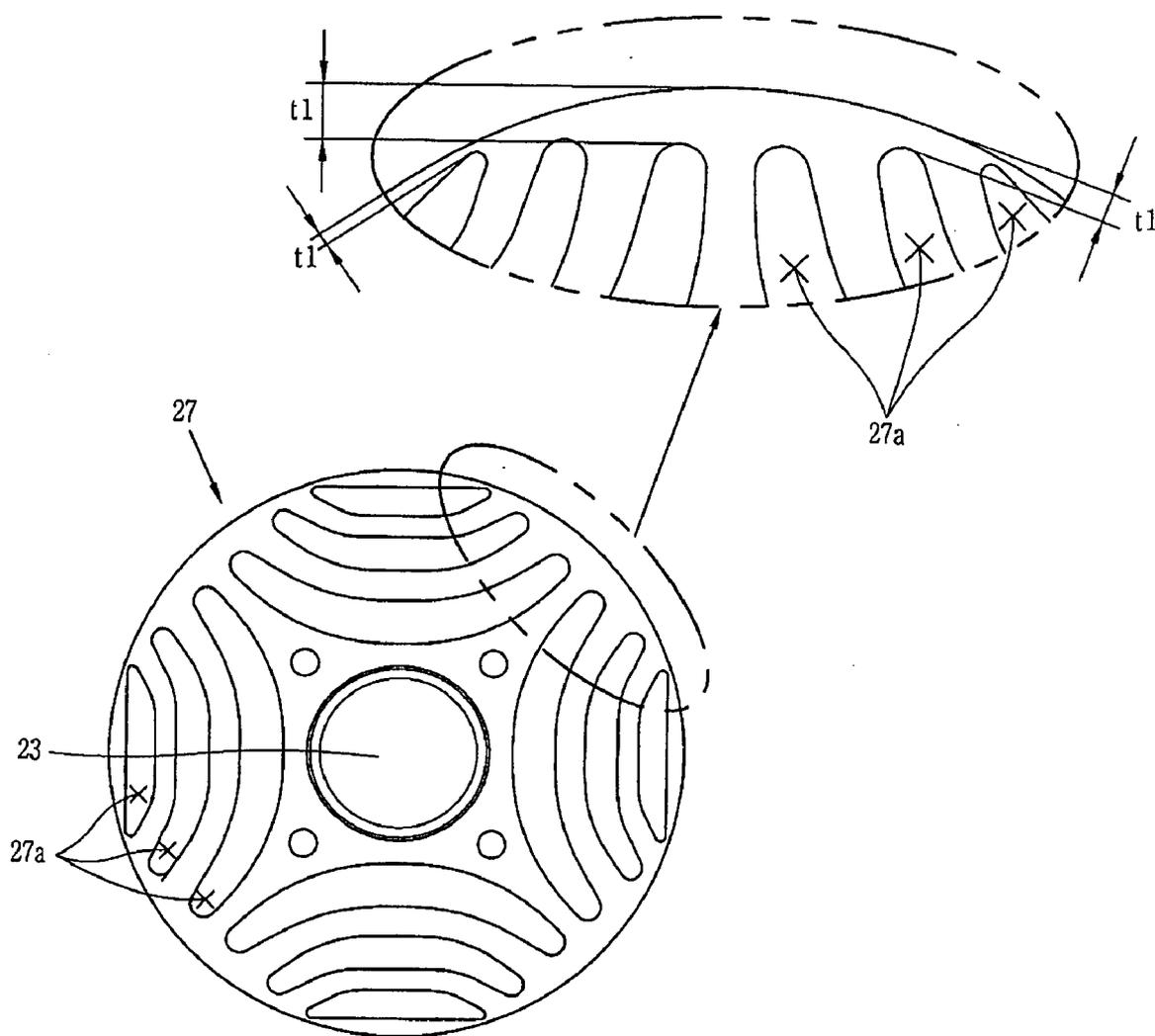


FIG. 6

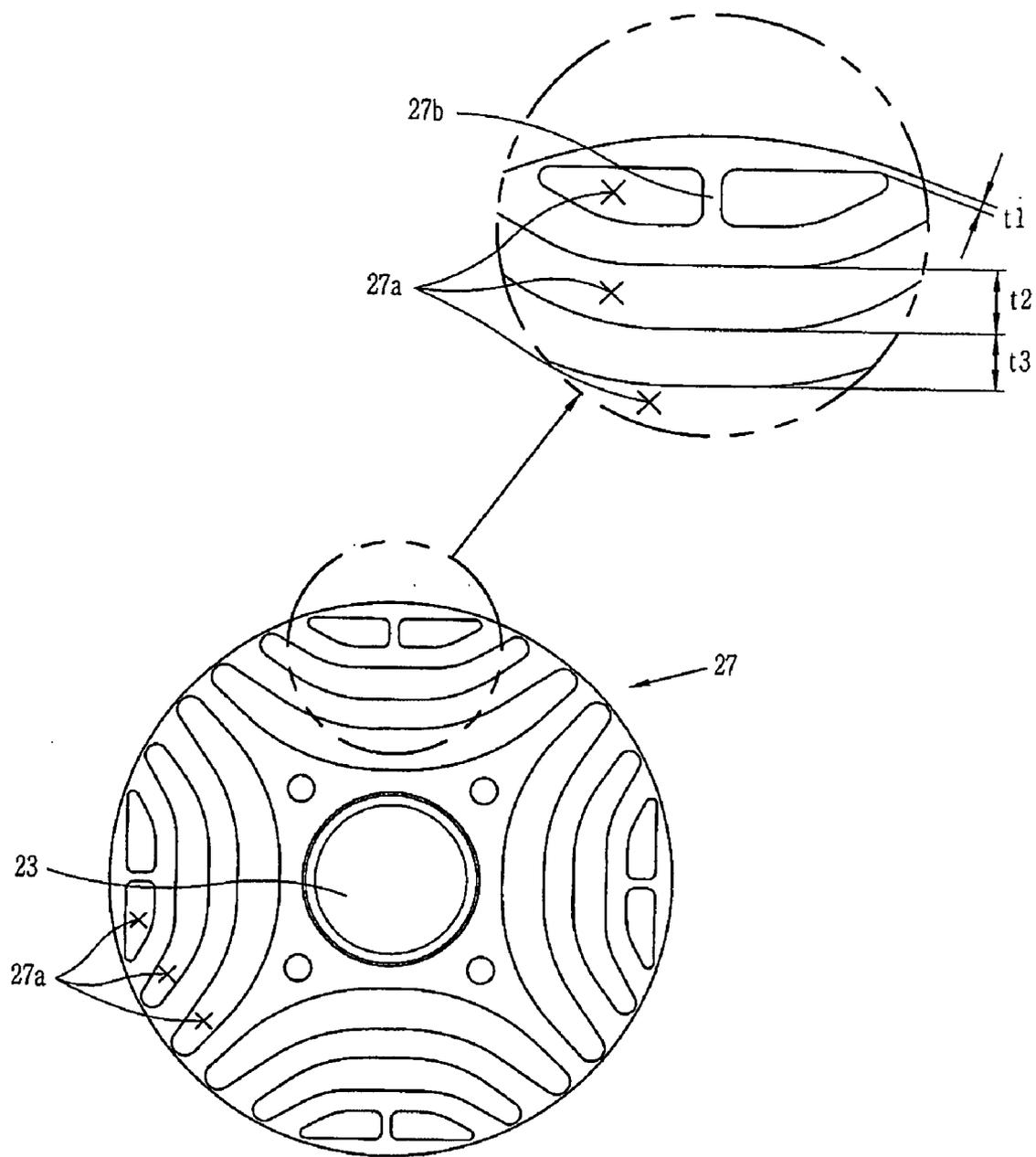


FIG. 7

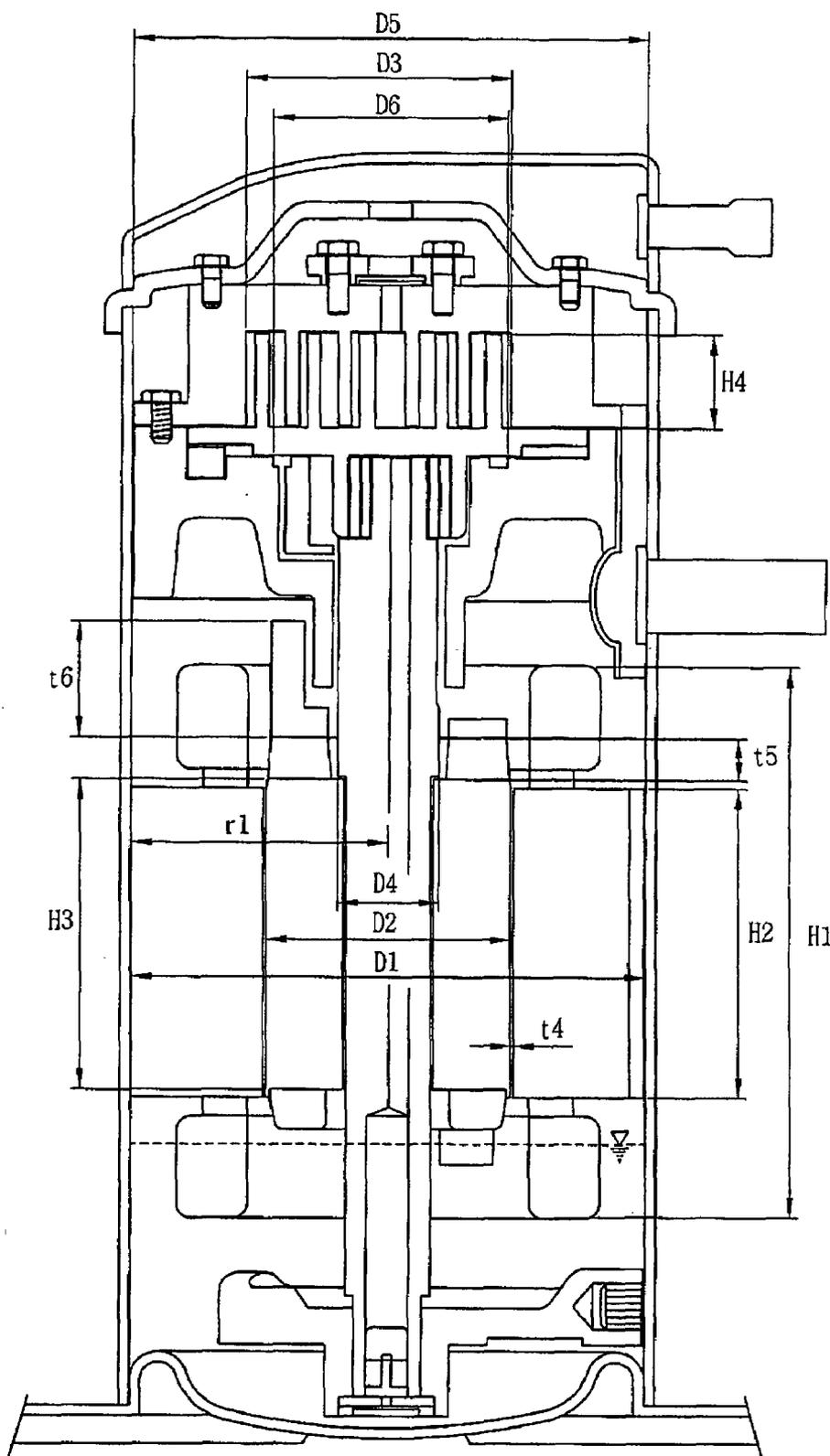


FIG. 8

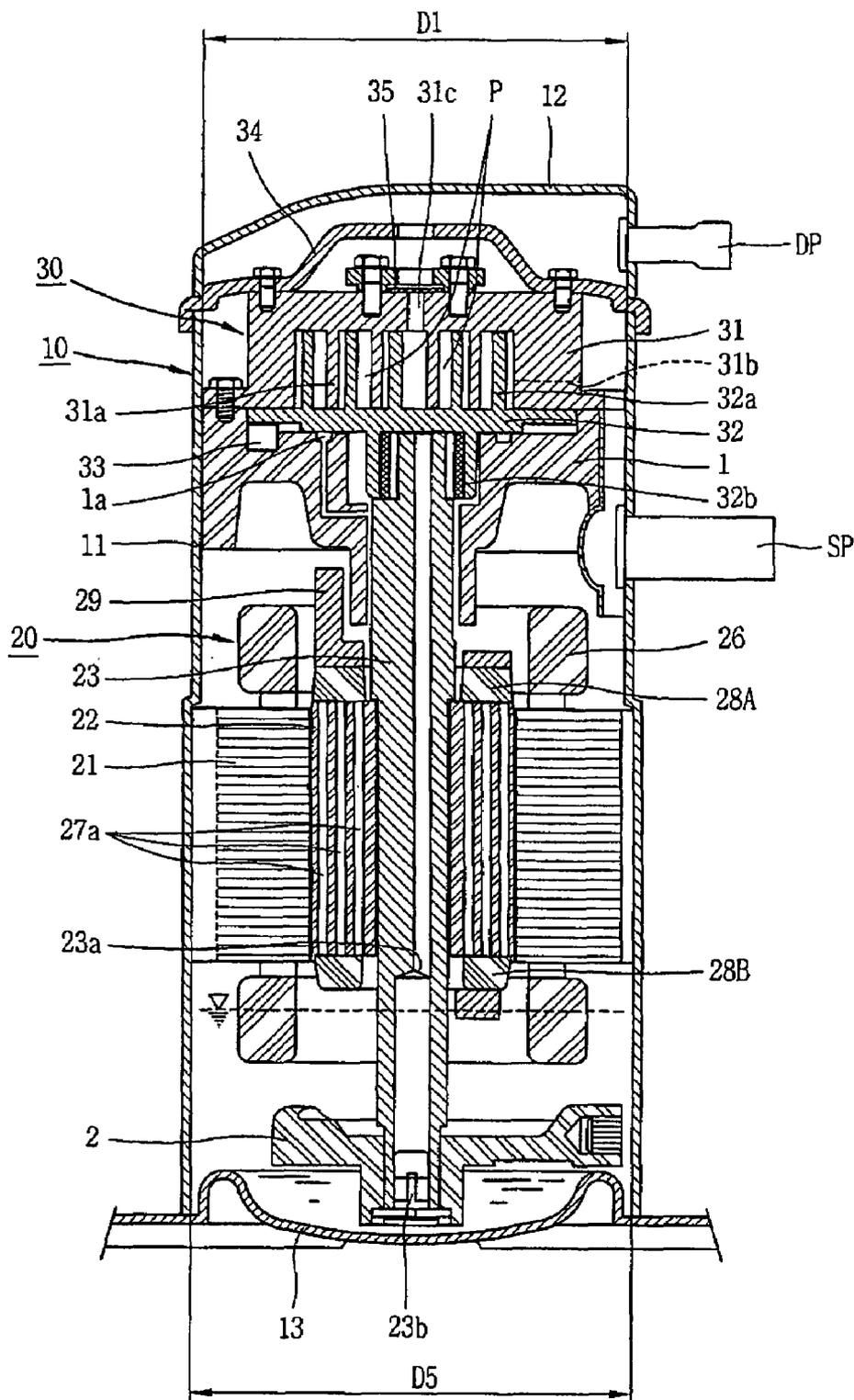
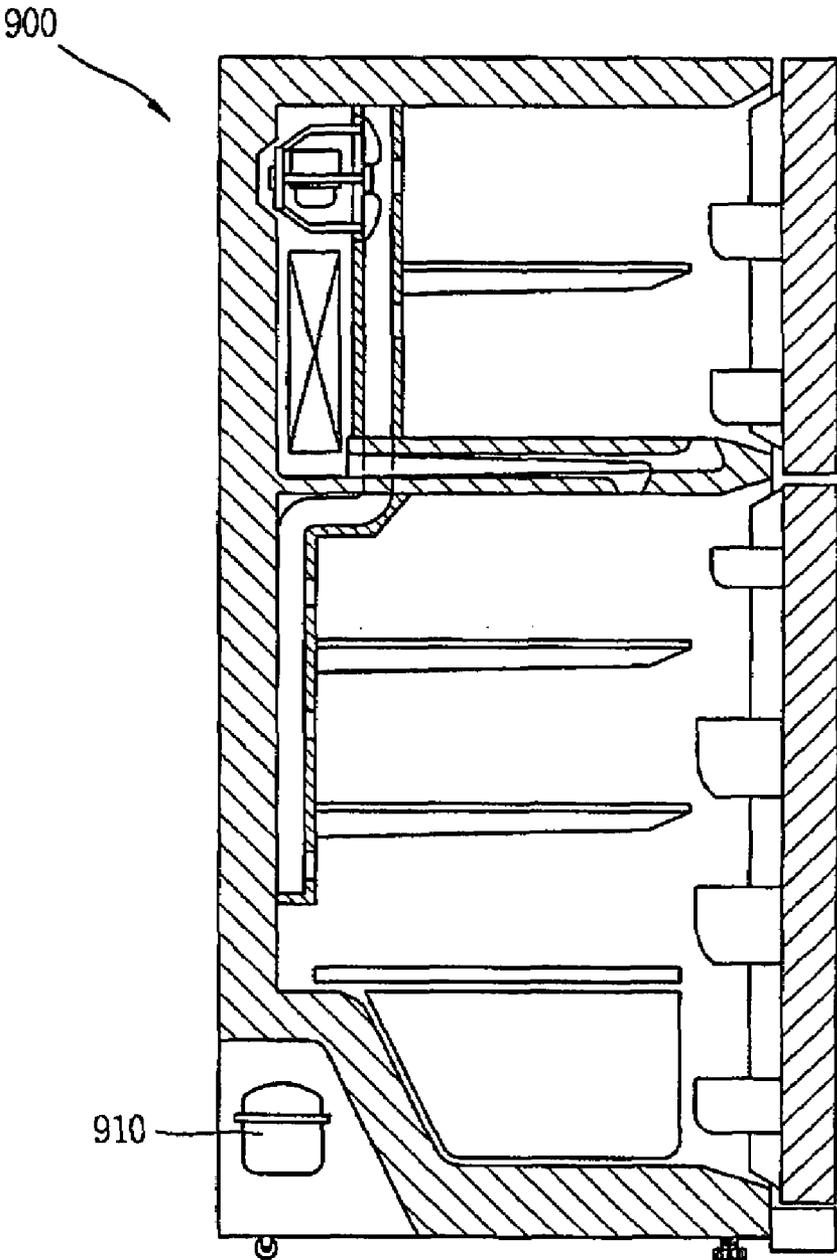
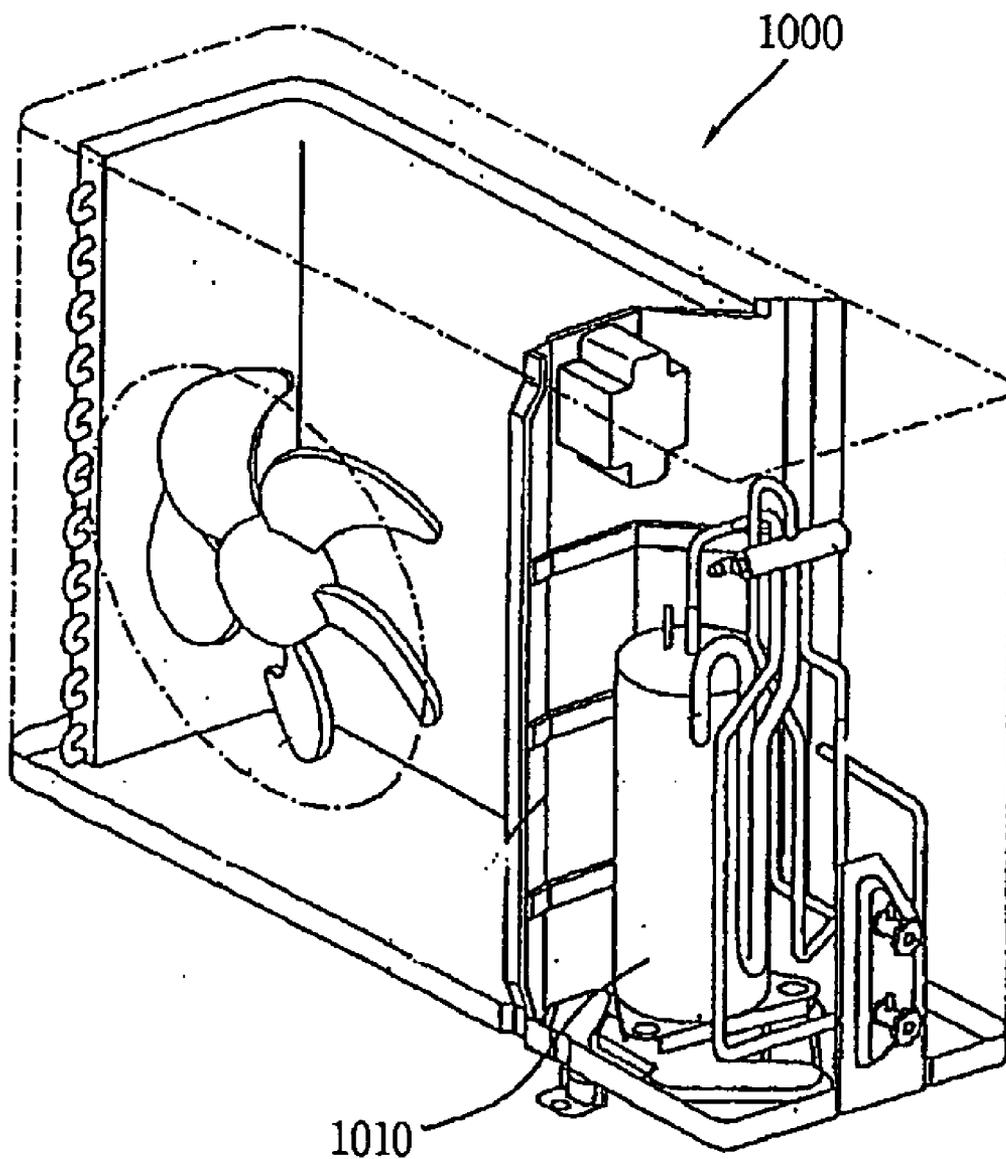


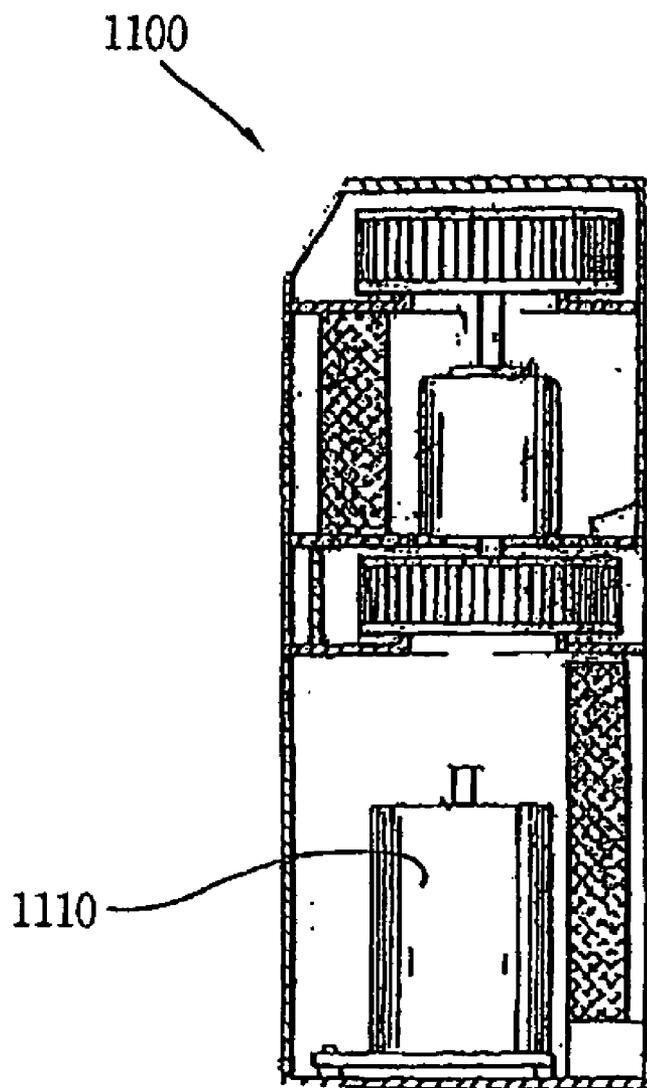
FIG. 9



# FIG. 10



# FIG. 11



## COMPRESSOR AND AIR CONDITIONER HAVING THE SAME

### BACKGROUND

[0001] 1. Field

[0002] The present invention relates to a compressor, and more particularly, to a compressor and an air conditioner having the same.

[0003] 2. Background

[0004] In general, a compressor converts mechanical energy into compressive energy. Compressors may be categorized into a reciprocating type, a scroll type, a centrifugal type, a rotary type and a vane type. The scroll compressor may include a driving motor which drives a compression part to compress fluid.

[0005] The driving motor may be, for example, an induction motor, which has a simple structure, low cost, and is easily handled. However, slippage between the stator and the rotor of a motor can degrade performance in an induction motor. Further, induction current can generate heat, which lowers efficiency due to thermal losses.

### BRIEF DESCRIPTION OF THE DRAWINGS

[0006] The embodiments will be described in detail with reference to the following drawings in which like reference numerals refer to like elements, and wherein:

[0007] FIG. 1 is a cross-sectional view of a compressor;

[0008] FIG. 2 is a cross-sectional view of a synchronous reluctance motor which may be applied to the compressor of FIG. 1;

[0009] FIG. 3 is a cross-sectional view of a stator of a synchronous reluctance motor which may be applied to the compressor of FIG. 1;

[0010] FIGS. 4 to 6 are plan views of a rotor of a driving motor which may be applied to the exemplary compressor of FIG. 1;

[0011] FIG. 7 is a schematic view of a compressor;

[0012] FIG. 8 is a sectional view of an alternative embodiment of a compressor;

[0013] FIG. 9 shows a refrigerator incorporating the compressor shown in FIG. 1;

[0014] FIG. 10 shows an air conditioner incorporating the compressor shown in FIG. 1; and

[0015] FIG. 11 shows another air conditioner incorporating the compressor shown in FIG. 1.

### DETAILED DESCRIPTION

[0016] Reference will now be made in detail to preferred embodiments, examples of which are illustrated in the accompanying drawings.

[0017] A compressor and components thereof in accordance with embodiments as broadly described herein are shown in FIGS. 1 to 7. Although a scroll compressor is used for ease of discussion, it is well understood that a motor as embodied and broadly described herein may be applied to other types of compressors and/or used in other applications. That said, some of the features described below are specific to scroll compressors. The fact that some features are specific to scroll compressors does not mean that the other aspects of the disclosed and claimed compressors, and driving motors, could not be applied to other types of compressors. Thus, the scope of the claims of this application are not to be limited to

scroll compressors, except where the claims are specifically directed to scroll compressor features.

[0018] Some compressors have used a chlorofluorocarbon (CFC)-based refrigerant such as CFC 11, CFC 12, CFC 113, CFC 114 and CFC 115. However, the use of these CFC-based refrigerants has been restricted worldwide, and thus HFC-based refrigerants, such as, for example, CFC 134a (1,1,1-tetrafluoroethane, CH<sub>2</sub>FCF<sub>3</sub>) has replaced many of the earlier CFC-based refrigerants. However, since HFC-based refrigerants have different chemical structure, they are not as easily mixed with lubrication fluids, such as, for example, oil. In addition, they may have inferior abrasion resistance. Accordingly, when an HFC-based refrigerant is used in a compressor, performance of the compressor is typically degraded.

[0019] The exemplary compressor shown in FIG. 1 includes a hermetic casing 10 to which a refrigerant suction pipe (SP) and a refrigerant discharge pipe (DP) are connected. A driving motor 20 is disposed at a lower portion of the casing 10, and a compression device 30 is disposed at an upper portion of the casing 10.

[0020] The casing 20 includes a body 11 having a substantially cylindrical shape. The driving motor 20 and the compression device 30 are provided at lower and upper portions of the casing, respectively. An upper cap 12 and a lower cap 13 cover upper and lower ends of the body 11. The body 11 is formed with a cylindrical shape, and the upper and lower ends have substantially the same diameter. However, when an outer diameter (D1) of the driving motor 20 is larger than an outer diameter of the compression device 30 (in this embodiment, an outer diameter of a plate portion of a fixed scroll), a stepped portion may be formed between the driving motor 20 and the compression device 30.

[0021] As shown in FIGS. 1 and 2, the driving motor 20 includes a stator fixed to an inner portion of the casing 10 which receives power from an external source. A rotor 22 is disposed inside the stator 21 with a gap therebetween. A rotation shaft 23 is coupled to the rotor 22 so as to transmit a rotational force from the driving motor to the compression device 30. The rotation shaft 23 may be coupled to the rotor 22 by pressfit, shrinkage fit, or other coupling methods, as appropriate.

[0022] The stator 21 includes a stator laminator 25 which has a cylindrical shape so as to rotatably position the rotor 22 at the center thereof. A coil 26 is wound on the stator laminator 25 and connected to an external power source. The stator laminator 25 may form a ring-shaped magnetic path with a plurality of protruding poles 25a extending from an inner circumferential surface of the magnetic path. As shown in FIG. 7, the stator laminator 25 is formed so that an outer diameter thereof, D1 can be larger than its height H2 in a shaft direction. A radius r1 of the stator can be smaller than an outer diameter D2 of the rotor 22. Also, the stator laminator 25 is formed so that the outer diameter thereof, D1 can be larger than an outer diameter D3 of the outermost compression chamber between a fixed scroll 31 and an orbiting scroll 32. In certain embodiments, a height difference between a center of a rotor laminator 27 in a shaft direction and a center of the stator laminator 25 in a shaft direction is within the range of 2~3 mm, thereby preventing physical interference between the stator 21 and the rotor 22 due to an eccentric load on the rotation shaft 23.

[0023] The stator laminator 25 may include a rotor insertion hole 25b having a substantially circular shape at its

center. A plurality of protruding fixing portions **25c** and cut-passages **25d** are alternately formed along an outer circumferential surface of the stator laminator **25** so as to form a gas passage F with the casing **10**.

[0024] As shown in FIG. 3, the protruding fixing portions **25c** and the cut-passages **25d** may be symmetrical with each other with the same interval therebetween. For example, a circumferential length between the protruding fixing portions **25c** may be equal to a circumferential length between the cut-passages **25d** so as to minimize any deformation of the stator laminator **25**.

[0025] A ratio ( $d1/w1$ ) between a diameter ( $d1$ ) of the rotor insertion hole **25b** and a width ( $w1$ ) of the stator laminator **25** may be greater than or equal to 2.1. Additionally, an angle  $\theta$  formed between both ends of the protruding fixing portion **25c** and a center of the stator **21** may be  $15^\circ\sim 35^\circ$ . In certain embodiments, at least two cut-passages **25d** are formed so that a ratio ( $QA_0/QA_1$ ) between a sum ( $QA_0$ ) of a circumferential length of each cut-passage **25d** and a sum ( $QA_1$ ) of a circumferential length of each protruding fixing portion **25c** is 0.2~0.8.

[0026] The coil **26** may be successively wound on each of the protruding poles **25a** of the stator laminator **25**. The coil **26** may be implemented with a copper wire having an enamel coating layer with a separation transition temperature of more than approximately  $120^\circ\text{C}$ . formed on an outer circumferential surface of the copper wire. An insulation film formed of a crystalline plastic film having a separation transition temperature of more than approximately  $50^\circ\text{C}$ . may be interposed between an outer circumferential surface of the coil and an inner circumferential surface of the stator laminator **25** contacting the coil. The coil **26** is formed so as to have a height H1 corresponding to 1.5~3 times of the height H2 of the stator laminator **25**.

[0027] The rotor **22** includes a rotor laminator **27**. In certain embodiments, the rotor laminator **27** may be formed from a plurality of thin steel plates laminated in a shaft direction with an upper end plate **28A** and a lower end plate **28B** disposed at upper and lower ends of the rotor laminator **27**, respectively.

[0028] In the embodiment shown in FIG. 4, each steel plate may be provided with a plurality of magnetic flux barriers **27a** formed in a circumferential direction and a radius direction, each plate having a substantially circular shape. In this embodiment, a distance ( $t1$ ) from an outer circumferential surface of the steel plate to ends of the magnetic flux barriers **27a** is uniform. A width ( $t2$ ) of the magnetic flux barrier **27a** in the radius direction, and a distance ( $t3$ ) between adjacent magnetic flux barriers **27a** in the radius direction each increase towards the center of the steel plate.

[0029] As shown in FIGS. 7 and 8, a gap ( $t4$ ) of approximately 0.4~0.8 mm may be formed between an inner circumferential surface of the stator laminator **25** and an outer circumferential surface of the rotor laminator **27** so as to improve efficiency of the motor **22**.

[0030] The steel plate constituting the stator laminator **25** of the driving motor **20** or the rotor laminator **27** may have a thickness of less than  $1/100$  of the total heights of the stator and rotor, respectively. The rotor laminator **27** is formed so that its height (H3) may be 3~7 times of a wrap height (H4) of a fixed scroll **31** and an orbiting scroll **32**.

[0031] The upper and lower end plates **28A** and **28B** are respectively formed to have a thickness ( $t5$ ) of approximately 1~4 mm. A balance weight **29** eccentric at a certain angle in a circumferential direction is formed on the upper end plate

**28A** either integrally, or at a later point in fabrication. A thickness ( $t6$ ) of the balance weight **29** may be less than two times the thickness ( $t5$ ) of the upper end plate **28A** so as to enhance reliability of the motor **20**.

[0032] The upper and lower end plates **28A** and **28B** may either completely or partially cover the magnetic flux barriers **27a** of the rotor **22** so as to form a path through the rotor **22** in the upper and lower directions.

[0033] The rotation shaft **23** may have a substantially circular cross-section so as to fit into the shaft hole of the rotor **22**. An oil hole **23a** penetrates the length of the shaft **23**. An oil feeder **23b**, which may be implemented as a Trochoid pump, is disposed at the lowest end of the oil hole **23a** for drawing oil in from the casing **10**.

[0034] The rotation shaft **23** may be coupled to the shaft hole of the rotor **22** by numerous methods including, for example shrinkage fit of an outer diameter or shrinkage fit of an inner diameter. Deformation of the outer circumferential surface of the rotor **22**, which in some instances is relatively weak, can be minimized by shrinkage fit of an inner diameter.

[0035] The rotation shaft **23** is formed so that its length may be 2~6 times of a height of the rotor laminator **27**, and so that its diameter (D4) may be  $1/6\sim 1/4$  times a diameter (D5) of a plate portion of a fixed scroll **31**.

[0036] In this embodiment, the compression part **30** includes a fixed scroll **31** fixed on an upper surface of a main frame **1** and an orbiting scroll **32** orbitably disposed on an upper surface of the main frame **1** so as to form a plurality of compression chambers P by being engaged with the fixed scroll **31**. An Oldham's ring **33** is disposed between the orbiting scroll **32** and the main frame **1**, for orbiting the orbiting scroll **32** and preventing a rotation of the orbiting scroll **32**. A high/low pressure separating plate **34** is installed at a rear surface of the plate portion of the fixed scroll **31**, for dividing the inside of the casing **10** into a high pressure portion and a low pressure portion. A backflow preventing valve **35** acts to prevent backflow of discharge gas by opening and closing a discharge port **31c** of the fixed scroll **31**.

[0037] The fixed scroll **31** includes a fixed wrap **31**, which is an involutely formed at a lower surface of the plate portion and which constitutes one pair of compression chambers P. An inlet **31b** is formed at a side surface of the plate portion and is connected to the suction pipe SP. A discharge port **31c** formed at the center of an upper surface of the plate portion and is connected to the center of the fixed wrap **31a**, for discharging compressed gas the upper portion of the casing **10**.

[0038] The orbiting scroll **32** includes an orbiting wrap **32**, which is an involutely formed on an upper surface of the plate portion, and which constitutes one pair of compression chambers P together with the fixed wrap **31a**. A boss portion **32b** is formed at the center of a lower surface of the plate portion for receiving a driving force of the driving motor **20** by being coupled to the rotation shaft **23**. A back pressure chamber **1a** is formed on an upper surface of the main frame **1** and supports the orbiting scroll **32** and contains oil therein. The back pressure chamber **1a** is formed at a position where its outer diameter (P6) is smaller than an outer diameter (P2) of the rotor of the driving motor **20** so as to stabilize the operation of the orbiting scroll **32**.

[0039] The fixed scroll **31** and the orbiting scroll **32** are formed by a casting method. Either the fixed scroll **31** and/or the orbiting scroll **32** may be solid-lubrication processed using a solid lubricant such as MoS2 and Lub so as to reduce

a frictional loss. The orbiting scroll 32 may be formed of a material having a weight less than that of the fixed scroll 31 so as to improve efficiency of the driving motor 20.

[0040] Oil having acceptable mixture characteristics with a given refrigerant may be used, thereby preventing a 'double-separation' phenomenon in which the refrigerant and the oil are separated from each other at a sliding or friction portion of the compression part 30. Accordingly, frictional losses and abrasion of the compression part 30 can be reduced.

[0041] When a hydro-fluorocarbon (HFC) based-refrigerant is used, fatty-acid ester oil is used for lubrication. Also, when a hydro-chlorofluorocarbon (HCFC)-based refrigerant is used, fatty-acid mineral oil is used for lubrication. The fatty-acid ester oil typically has a viscosity of 2~70 cSt at a temperature of 40° C., and a viscosity of 1~9 cSt at a temperature of 100° C., and is ester-coupled in a molecule at least two times. The fatty-acid mineral oil typically has a viscosity of 32~68 cSt at a temperature of 40° C. and is ester-coupled in a molecule at least two times.

[0042] In order to ensure a continuous supply of oil to the compression part 30, oil is filled in the casing 10 to a height lower than a lowest end of the stator 21. Further, by minimizing the length of the rotor, and by sizing the various components and gaps therebetween as discussed above, interference between the stator 21 and the rotor 22 due to an eccentric load on the rotation shaft 23 can be prevented.

[0043] A bearing 2 supporting a lower end of the rotating shaft 23 is mounted on the bottom of the casing 10. When power is supplied to the driving motor 20, and the rotation shaft 23 rotates together with the rotor 22, the orbiting scroll 32 moves in an orbital fashion on an upper surface of the main frame 1, as guided by the Oldham ring 33. One pair of compression chambers P are consecutively moved between the orbiting wrap 32a of the orbiting scroll 32 and the fixed wrap 31a of the fixed scroll 31. As the orbiting scroll 32 continuously orbits, the compression chambers P have a decreased volume, thereby sucking, compressing, and discharging refrigerant gas.

[0044] In certain embodiments, the driving motor 20 is a synchronous reluctance motor which generates a rotation force by being synchronously rotated by a reluctance torque in a direction such that magnetic resistance is minimized. Accordingly, slippage between the stator 21 and the rotor 22 may be greatly reduced. Additionally, when an induction current flows into the rotor 22, thermal loss from the rotor 22 may be reduced to enhance efficiency of the motor 20.

[0045] In order to ensure that contraction of the stator laminator 25 in the radius direction is uniform, if the stator 21 is shrinkage fit into the casing 10, the stator laminator 25 may be symmetrically formed, and a width of the stator laminator 25 and a length of the protruding fixing portion 25c may be sized to maintain a certain strength. Accordingly, the rotor insertion hole 25b of the stator laminator 25 maintains a substantially circular shape, and an air gap between the stator 21 and the rotor 22 is uniformly maintained. This prevents interference between the rotor 22 and the stator 21, and enhances reliability of the driving motor 20 and the compressor.

[0046] The coil 26 may be implemented by forming an enamel coating layer on an outer circumferential surface of a copper wire, thereby preventing a voltage loss due to hydrolysis, cracking, softening, expansion, and/or breakdown. Also, an insulation film formed of a crystalline plastic film may be interposed between the coil 26 and an inner circumferential surface of the protruding poles 25a of the stator 21, thereby

preventing any lowering in strength, tensile characteristics, or electrical insulating characteristics and enhancing reliability of the driving motor 20.

[0047] As discussed above, in certain embodiments, the rotor laminator 27 is comprised of a plurality of steel plates. In some embodiments, the steel plates are formed such that a distance (t1) from ends of the magnetic flux barriers 27a to an outer circumferential surface of the steel plate is substantially the same for all of the magnetic flux barriers. Further, a width (t2) of the magnetic flux barriers 27a in the radius direction, and a separation distance (t3) between adjacent magnetic flux barriers 27a in the radius direction increases towards the center. This helps to minimize deformation of the steel plate when the rotation shaft 23 is shrinkage fit into the rotor laminator 27.

[0048] In the aforementioned embodiment shown in FIG. 4, the distance (t1) from the ends of the magnetic flux barriers 27a to an outer circumferential surface of the steel plate was uniform for all of the magnetic flux barriers. However, in the embodiment shown in FIG. 5, the distance (t1) from each end of the magnetic flux barriers 27a to an outer circumferential surface of the steel plate varies for different ones of the magnetic flux barriers. The distance t1 from the end of the longest flux barriers to the outer circumferential surface of the steel plate is greater than the distance t1 for the shortest flux barriers.

[0049] In yet another alternate embodiment, as shown in FIG. 6, a bridge 27b for connecting an inner surface and an outer surface of some of the magnetic flux barriers 27a is provided. In this embodiment, the distance (t1) between an end of each of the magnetic flux barriers 27a and an outer circumferential surface of the steel plate can be uniform as shown in FIG. 4, or can be different from each other as shown in FIG. 5. Further, although the embodiment shown in FIG. 6 has only the shortest magnetic flux barriers with a bridge 27b, in other embodiments some or all of the other magnetic flux barriers may also have a bridge 27b.

[0050] When the distance (t1) between an end of each of the magnetic flux barriers 27a and an outer circumferential surface of the steel plate varies as shown in FIG. 5, or when a bridge 27b is formed at a middle portion of one or more of the magnetic flux barriers 27a as shown in FIG. 6, the strength of the steel plate is enhanced. This helps to prevent thermal deformation of the steel plate.

[0051] When the a compressor in accordance with embodiments as broadly described herein is applied to an air conditioner, a thermal loss due to slippage of the driving motor is decreased, thus enhancing the function of the compressor and the air conditioner. Furthermore, losses due to emissions are decreased, thus enhancing the function of the compressor and the air conditioner having the same.

[0052] Further, when an eco-friendly refrigerant is used, oil easily mixed with the eco-friendly refrigerant has improved abrasion resistance and lubricating characteristics. Accordingly, reliability, durability and capacity of the scroll compressor and the air conditioner having the same is improved.

[0053] FIG. 9 shows an air conditioner 100 that incorporates a compressor as shown in FIGS. 1-8. As a result, the air conditioner has all of the benefits and advantages discussed above.

[0054] A compressor having an oil pumping system as embodied and broadly described herein has numerous applications in which compression of fluids is required, and in different types of compressors. Such applications may

include, for example, air conditioning and refrigeration applications. One such exemplary application is shown in FIG. 9, in which a compressor 910 having an oil pumping assembly as embodied and broadly described herein is installed in a refrigerator/freezer 900. Installation and functionality of a compressor in a refrigerator is discussed in detail in U.S. Pat. Nos. 7,082,776, 6,955,064, 7,114,345, 7,055,338 and 6,772,601, the entirety of which are incorporated herein by reference.

[0055] Another such exemplary application is shown in FIG. 10, in which a compressor 1010 having an oil pumping assembly as embodied and broadly described herein is installed in an outdoor unit of an air conditioner 1000. Installation and functionality of a compressor in an air conditioner is discussed in detail in U.S. Pat. Nos. 7,121,106, 6,868,681, 5,775,120, 6,374,492, 6,962,058, 6,951,628 and 5,947,373, the entirety of which are incorporated herein by reference.

[0056] Another such exemplary application is shown in FIG. 11, in which a compressor 1110 having an oil pumping assembly as embodied and broadly described herein is installed in a single, integrated air conditioning unit 1100. Installation and functionality of a compressor in such an air conditioner is discussed in detail in U.S. Pat. Nos. 7,032,404, 6,412,298, 7,036,331, 6,588,228, 6,182,460 and 5,775,123, the entirety of which are incorporated herein by reference.

[0057] Any reference in this specification to “one embodiment”, “an exemplary”, “example embodiment”, “certain embodiment”, “alternative embodiment”, and the like means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment as broadly described herein. 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 affect such feature, structure, or characteristic in connection with other ones of the embodiments.

[0058] 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, numerous variations and modifications are possible in the component parts and/or arrangements. 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.

What is claimed is:

1. A compressor, comprising:

- a casing having an inner space to which a suction pipe and a discharge pipe are connected;
- a compressor device installed in the casing and configured to compress a fluid received through the suction pipe and configured to output the compressed fluid through the discharge pipe;
- a driving motor installed in the casing and coupled to the compression device, wherein the driving motor comprises:
  - a stator comprising a plurality of stator plates laminated together and configured to be inserted into an inner circumferential surface of the casing, each stator plate having a plurality of protruding poles on which a coil is wound;

- a rotor comprising a plurality of rotor plates laminated together and configured to be rotatably disposed in the stator, wherein each rotor plate comprises a plurality of magnetic flux barriers formed therein, and wherein a width of each magnetic flux barrier in a radius direction and a separation distance between adjacent magnetic flux barriers in the radius direction both increase towards the center of the driving motor; and

- a rotation shaft coupled to the center of the rotor and having one end coupled to the compression device.

2. The compressor of claim 1, wherein each of the stator plates includes a rotor insertion hole at the center, and a plurality of protruding fixing portions formed on a peripheral portion of the plate, and wherein a ratio of  $(d1/w1)$  is greater than or equal to 2.1, wherein  $d1$  is a diameter of the rotor insertion hole, and wherein  $w1$  is a width of the stator plate in the radial direction from an edge of the rotor insertion hole to an outer edge of one of the protruding fixing portions.

3. The compressor of claim 1, wherein each of the stator plates includes a plurality of protruding fixing portions and a plurality of cut-passages which alternate with one another along an outer peripheral edge of the stator plate, and wherein the protruding fixing portions couple the stator to an inner surface of the casing.

4. The compressor of claim 3, wherein an angle  $\theta$  formed between ends of a protruding fixing portion and a center of the stator is approximately  $15^\circ$ – $35^\circ$ .

5. The compressor of claim 3, wherein the cut-passages are formed so that a ratio  $(QA_0/QA_1)$  between a sum  $(QA_0)$  of a circumferential length of all the cut-passages and a sum  $(QA1)$  of a circumferential length of all the protruding fixing portions is 0.3–0.7.

6. The compressor of claim 1, wherein each of the rotor plates is configured such that distances from an outer circumferential surface of the rotor to ends of the magnetic flux barriers is substantially uniform for each of the magnetic flux barriers.

7. The compressor of claim 6, wherein each of the rotor plates is configured such that at least one bridge connects an inner surface and an outer surface of at least one of the magnetic flux barriers.

8. The compressor of claim 1, wherein each of the rotor plates is configured such that distances between ends of the magnetic flux barriers and an outer circumferential surface of the rotor are different for different ones of the magnetic flux barriers.

9. The compressor of claim 8, wherein each of the rotor plates is configured such that at least one bridge connects an inner surface and an outer surface of at least one of the magnetic flux barriers.

10. The compressor of claim 1, wherein an outer diameter of the stator of the driving motor is larger than its height in a shaft direction.

11. The compressor of claim 1, wherein a radius of the stator of the driving motor is smaller than an outer diameter of the rotor.

12. The compressor of claim 1, wherein upper and lower ends of the rotor of the driving motor are supported by upper and lower end plates, respectively, and wherein each of the end plates has a thickness of approximately 1–4 mm.

13. The compressor of claim 12, wherein a balance weight, eccentric at a certain angle in a circumferential direction, is integrally formed on at least one of the end plates, and

wherein a thickness of the balance weight is less than two times the thickness of the end plate to which it is coupled.

**14.** The compressor of claim **12**, wherein either the upper or the lower end plate completely covers the magnetic flux barriers.

**15.** The compressor of claim **12**, wherein either the upper or the lower end plate partially covers the magnetic flux barriers so as to form a path through the rotor in the upper and lower directions.

**16.** The compressor of claim **1**, wherein at least one of the stator plates is formed of steel and has a thickness less than approximately  $\frac{1}{100}$  of the total height of the stator.

**17.** The compressor of claim **1**, wherein at least one of the rotor plates is formed of steel and has a thickness less than approximately  $\frac{1}{100}$  of the total height of the rotor.

**18.** The compressor of claim **1**, wherein the coil wound on the poles of the stator has a height that is approximately 1.5~3 times a height of the laminated stator.

**19.** The compressor of claim **1**, further comprising a Trochoid pump configured to draw oil in from the casing, wherein the Trochoid pump is disposed at a lower end of the rotation shaft.

**20.** The compressor of claim **1**, wherein oil is filled in the casing up to a height lower than a lowest end of the stator.

**21.** The compressor of claim **1**, wherein the rotation shaft has a length that is approximately 2~6 times a height of the driving motor.

**22.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, and wherein the rotation shaft is formed so that its diameter is  $\frac{1}{6}$ ~ $\frac{1}{4}$  times a diameter of the plate portion of the fixed scroll.

**23.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, and wherein the rotor of the driving motor is formed so that a height of the laminated rotor plates is 3~7 times of a wrap height of the fixed scroll and the orbiting scroll.

**24.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, and wherein the stator is formed so that its outer diameter is larger than an outer diameter of the outermost compression chamber between the fixed scroll and the orbiting scroll.

**25.** The compressor of claim **24**, wherein a stepped portion is formed between the driving motor and the compression device.

**26.** The compressor of claim **1**, wherein a gap of 0.4~0.8 mm is formed between the stator and the rotor of the driving motor.

**27.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, wherein the fixed scroll and the orbiting scroll are formed by a casting method, and wherein either the fixed scroll or the orbiting scroll is solid-lubrication processed.

**28.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, and wherein the orbiting scroll is formed of a material having a weight less than that of the fixed scroll.

**29.** The compressor of claim **1**, wherein the compressor device comprises a scroll compressor that includes a fixed scroll formed on a lower portion of a plate portion, and an orbiting scroll, wherein the orbiting scroll is coupled to the rotation shaft of the driving motor, and wherein a back pressure chamber for supporting the orbiting scroll by containing oil therein is formed on an upper surface of a main frame located under a lower surface of the orbiting scroll.

**30.** The compressor of claim **1**, wherein a height difference between a center of the rotor and a center of the stator is within the range of approximately 2~3 mm.

**31.** The compressor of claim **1**, wherein the rotation shaft is coupled to the rotor by a shrinkage fit.

**32.** The compressor of claim **1**, wherein the driving motor is synchronously rotated by a reluctance torque in a direction such that magnetic resistance is minimized.

**33.** The compressor of claim **1**, wherein when a hydro-fluorocarbon (HFC) based-refrigerant is used, fatty-acid ester oil is used for lubrication, and when a hydro-chlorofluorocarbon (HCFC)-based refrigerant is used, fatty-acid mineral oil is used for lubrication.

**34.** The scroll compressor of claim **33**, wherein the fatty-acid ester oil has a viscosity of 2~70 cSt at a temperature of 40° C. and a viscosity of 1~9 cSt at a temperature of 100° C. and is ester-coupled in a molecule at least two times, and the fatty-acid mineral oil has a viscosity of 32~68 cSt at a temperature of 40° C. and is ester-coupled in a molecule at least two times.

**35.** The compressor of claim **1**, wherein the magnetic flux barriers are formed to penetrate the rotor in a shaft direction.

**36.** The compressor of claim **1**, wherein an insulation film formed of a crystalline plastic film having a separation transition temperature of more than approximately 50° C. is interposed between the coil and the stator.

**37.** The compressor of claim **1**, wherein the coil comprises an enamel coating layer having a separation transition temperature greater than approximately 120° C.

**38.** The compressor of claim **3**, wherein each of the protruding fixing portions and each of the cut-passages are respectively formed so as to have the same shape and area with the same interval.

**39.** An air conditioner comprising the compressor of claim **1**.

**40.** A compressor, comprising:

a casing having an inner space to which a suction pipe and a discharge pipe are connected;

a compressor device installed in the casing;

a driving motor installed in the casing and coupled to the compressor device, wherein the driving motor comprises:

a stator comprising a plurality of stator plates laminated together and configured to be inserted into an inner circumferential surface of the casing, each stator plate having a plurality of protruding poles on which a coil is wound;

a rotor comprising a plurality of rotor plates laminated together and configured to be rotatably disposed in the

stator, wherein each rotor plate comprises a plurality of magnetic flux barriers formed therein, wherein at least one bridge connects an inner surface and an outer surface of at least one of the magnetic flux barriers; and

a rotation shaft coupled to the center of the rotor and having one end coupled to the compression device.

**41.** The compressor of claim **40**, wherein a width of each magnetic flux barrier in a radius direction and a separation distance between adjacent magnetic flux barriers in the radius direction each increase towards the center of the driving motor.

**42.** A compressor, comprising:

a casing having an inner space to which a suction pipe and

a discharge pipe are connected;

a compressor device installed in the casing;

a driving motor installed in the casing and coupled to the compressor device, wherein the driving motor comprises:

a stator comprising a plurality of stator plates laminated together and configured to be inserted into an inner circumferential surface of the casing, each stator plate having a plurality of protruding poles on which a coil is wound;

a rotor comprising a plurality of rotor plates laminated together and configured to be rotatably disposed in the stator, wherein each rotor plate comprises a plurality of magnetic flux barriers formed therein, and wherein distances between ends of the magnetic flux barriers and an outer circumferential surface of the rotor plate are different for different ones of the magnetic flux barriers; and

a rotation shaft coupled to the center of the rotor by shrinkage fit and having one end coupled to the compression device.

**43.** The compressor of claim **42**, wherein a width of each magnetic flux barrier in a radius direction and a width between adjacent magnetic flux barriers in the radius direction each increase towards the center of the driving motor.

**44.** The compressor of claim **43**, wherein at least one bridge connects an inner surface and an outer surface of at least one of the magnetic flux barriers.

**45.** The compressor of claim **42**, wherein at least one bridge connects an inner surface and an outer surface of at least one of the magnetic flux barriers.

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