



(12) **EUROPEAN PATENT APPLICATION**
published in accordance with Art. 153(4) EPC

(43) Date of publication:
06.03.2019 Bulletin 2019/10

(51) Int Cl.:
F04B 39/00 ^(2006.01) **F04B 39/02** ^(2006.01)
F04C 27/00 ^(2006.01) **F04C 29/02** ^(2006.01)

(21) Application number: **17839316.1**

(86) International application number:
PCT/JP2017/028130

(22) Date of filing: **02.08.2017**

(87) International publication number:
WO 2018/030245 (15.02.2018 Gazette 2018/07)

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

- **MIZUNO, Hisao**
Tokyo 108-8215 (JP)
- **NOGUCHI, Akihiro**
Nagoya-shi
Aichi 453-0862 (JP)
- **GOTO, Takashi**
Nagoya-shi
Aichi 453-0862 (JP)
- **SHIKANAI, Toshiyuki**
Nagoya-shi
Aichi 453-0862 (JP)
- **GOTO, Syusaku**
Nagoya-shi
Aichi 453-0862 (JP)

(30) Priority: **09.08.2016 JP 2016156635**

(71) Applicant: **Mitsubishi Heavy Industries Thermal Systems, Ltd.**
Tokyo 108-8215 (JP)

(72) Inventors:
• **SATO, Hajime**
Tokyo 108-8215 (JP)
• **MIYAMOTO, Yoshiaki**
Tokyo 108-8215 (JP)

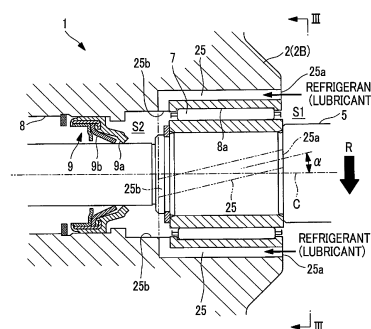
(74) Representative: **Cabinet Beau de Loménie**
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) **OPEN TYPE REFRIGERANT COMPRESSOR**

(57) The objective of the present invention is to improve the lubricating performance of a rolling bearing and a shaft sealing member by making it possible to form a refrigerant guide channel on an inner circumferential surface of a bearing press fitting portion into which the rolling bearing is press fitted, without causing a deterioration in the performance of the rolling bearing. An open type refrigerant compressor (1) is provided with: a housing (2); provided inside the housing (2), a compressing mechanism which compresses a refrigerant gas including lubricating oil, and a drive shaft (5) which drives the compressing mechanism; a rolling bearing (7) which is press fitted into a shaft hole (8) through which the drive shaft (5) projects to the outside from the housing (2), and which axially supports the drive shaft (5); a shaft sealing member (9) which is provided in the shaft hole (8) in such a way as to be positioned to the outside of the rolling bearing (7); and at least one refrigerant guide channel (25) formed in an inner circumferential surface of a bearing press fitting portion (8a) into which the rolling bearing (7)

is press fitted. The refrigerant guide channel (25) is formed in such a way as to have a prescribed angle of inclination α relative to the direction of a central axis line C of the drive shaft (5).

FIG. 2



Description

Citation List

Technical Field

Patent Literature

[0001] The present invention relates to an open type refrigerant compressor in which a rolling bearing for pivotally supporting a drive shaft of a compression mechanism is press-fitted into a housing.

5 **[0005]** [PTL 1] Japanese Unexamined Patent Application Publication No. 2005-23849

Summary of Invention

Background Art

10 Technical Problem

[0002] In a refrigerant compressor (compressor) which compresses refrigerant gas in a car air conditioner or the like, a compression mechanism is accommodated inside a housing formed of an aluminum alloy or the like, a drive shaft driving the compression mechanism protrudes from one side of the housing, and a pulley having an electromagnetic clutch provided on the protrusion portion is driven by an engine or the like via a belt. In the refrigerant compressor, a shaft hole through which the drive shaft protrudes is formed in the housing, and thus, the refrigerant compressor is referred to as an open type refrigerant compressor. Meanwhile, a refrigerant compressor in which a compression mechanism and a drive motor are housed inside a sealed pressure container is referred to as a closed type refrigerant compressor.

[0006] However, as shown in Fig. 7, if a rolling bearing is press-fitted (generally, press-fitted by shrink fitting) to the inner peripheral surface of the bearing press-fitting portion A in which the plurality of guide grooves B are formed, as shown in Fig. 8, an outer ring member C of the rolling bearing tends to spread radially outward inside the bearing press-fitting portion A, and the outer ring member C tends to bulge inside each guide groove B and deform into a petal shape (in Fig. 8, the petal shape is exaggeratedly shown, but actually, the petal shape cannot be visually confirmed).

[0003] In the open type refrigerant compressor, a lip seal (a shaft seal member having a lip) is provided in a protrusion portion of the drive shaft, that is, the shaft hole of the housing to prevent a refrigerant gas inside the housing from leaking to the outside. The lip seal is lubricated by a lubricant (refrigerating machine oil) mixed with the refrigerant gas. However, it is considered that oil supplied to the lip seal is insufficient at a low load operation where a circulation amount of the refrigerant gas decreases or the like. In this case, a tip of the lip wears, and there is a concern that the refrigerant gas and the oil leak.

[0007] The deformation of the outer ring member C causes a reduction in a radial clearance (a radial play) in a rolling bearing such as a needle bearing which is precisely machined, and thereby, decreases in performance such as an increase in a rotational resistance, occurrence of flaking (a damage of a roller contact surface), occurrence of an uneven rotation (rotational vibration), or a decrease in the number of years of life span occur, and thus, a negligible problem occurs in a refrigerant compressor requiring high rotation accuracy.

[0004] In order to solve the concern, for example, as shown in Figs. 2 and 3 of PTL 1, a guide groove for guiding a refrigerant to an inner peripheral surface of a bearing press-fitting portion of a rolling bearing which pivotally supports a vicinity of a tip of a drive shaft is formed, and one end of the guide groove communicates with a lip seal side, the other end thereof communicates with an inside (compression mechanism side) of a housing. Accordingly, a supply amount of the refrigerant to the lip seal side, that is, a supply amount of a lubricant is stabilized by using the guide groove, and wear of the lip seal is prevented. As shown in Fig. 7, if a plurality of guide grooves B are formed on an inner peripheral surface of a bearing press-fitting portion A, the supply amount of the lip seal can increase, which is effective for preventing the wear of the lip seal.

[0008] The present invention is made to solve the above-described problems, and an object thereof is to provide an open type refrigerant compressor capable of forming the refrigerant guide groove on the inner peripheral surface of the bearing press-fitting portion to which the rolling bearing is press-fitted without decreasing performance of the rolling bearing and increasing lubrication performance of the rolling bearing and a shaft seal member.

Solution to Problem

45 **[0009]** According to an aspect of the present invention, there is provided an open type refrigerant compressor including: a housing; a compression mechanism which is provided inside the housing and compresses a refrigerant gas including a lubricant; a drive shaft which drives the compression mechanism; a rolling bearing which is press-fitted to a shaft hole through which the drive shaft protrudes outward from the housing and pivotally supports the drive shaft; a shaft seal member which is provided in the shaft hole so as to be positioned outside the rolling bearing; and at least one refrigerant guide groove which is formed on an inner peripheral surface of a bearing press-fitting portion to which the rolling bearing is press-fitted, in which the refrigerant guide groove is

formed to have a predetermined inclination angle with a center axis direction of the drive shaft.

[0010] According to the open type refrigerant compressor having the above-described configuration, the refrigerant guide groove is formed to have the predetermined inclination angle with respect to the center axis direction of the drive shaft. Therefore, when an outer ring member of the rolling bearing press-fitted to the bearing press-fitting portion spreads radially outward, a linear deformation of the outer ring member over the entire length in the center axis direction of the drive shaft is prevented at a predetermined angular position on an outer peripheral surface of the outer ring member.

[0011] That is, even when the outer ring member of the rolling bearing is deformed so as to bulge inside the refrigerant guide groove inclined with the predetermined inclination angle with respect to the center axis of the drive shaft, a shape of the deformation portion is not a groove shape parallel in the axial direction of the drive shaft and the shape of the deformation portion is a groove shape inclined in the axial direction. Accordingly, rolling members rolling inside the outer ring member do not repeatedly fall into the inside of a deformation groove or do not repeatedly ride over the deformation groove simultaneously over the entire width. In addition, a radial clearance of the rolling bearing is not easily decreased.

[0012] Accordingly, decreases in performance such as an increase in a rotational resistance in the rolling bearing, occurrence of flaking, occurrence of an uneven rotation (rotational vibration), or a decrease in the number of years of life span do not easily occur. This effect becomes more pronounced as the inclination angle of the refrigerant guide groove with respect to the drive shaft increases. In this way, it is possible to form the refrigerant guide groove on the inner peripheral surface of the bearing press-fitting portion to which the rolling bearing is press-fitted without decreasing performance of the rolling bearing and to increase lubrication performance of the rolling bearing and a shaft seal member.

[0013] In the open type refrigerant compressor having the above-described configuration, when viewed in an axial direction of the drive shaft, the refrigerant guide groove may include an inner opening portion which is open toward an inside of the housing and an outer opening portion which is open toward the shaft seal member side, and when viewed in the axial direction of the drive shaft, the refrigerant guide groove may be formed such that an opening range of the inner opening portion and an opening range of the outer opening portion do not overlap with each other.

[0014] Accordingly, even when the outer ring member of the rolling bearing press-fitted to the bearing press-fitting portion is deformed so as to bulge inside the refrigerant guide groove, a portion parallel in the axial direction of the drive shaft does not occur within a range of the deformed shape. Therefore, it is possible to reliably prevent the rolling members from falling into the inside of the deformation groove or riding over the deformation

groove simultaneously over the entire width, and it is possible to prevent the decrease in the performance of the rolling bearing.

[0015] In the open type refrigerant compressor having the above-described configuration, the refrigerant guide groove may be a spiral groove. Accordingly, it is possible to easily form the refrigerant guide groove by CNC processing.

[0016] In the open type refrigerant compressor having the above-described configuration, the refrigerant guide groove may be formed such that a spiral direction from the inner opening portion toward the outer opening portion is matched with a rotational direction of the drive shaft.

[0017] Accordingly, a flow of the refrigerant gas orbited in the housing by the rotation of the drive shaft is easily taken into the refrigerant guide groove, and thus, it is possible to increase the lubrication performance of the rolling bearing and the shaft seal member.

[0018] In the open type refrigerant compressor having the above-described configuration, when viewed in an axial direction of the drive shaft, an interior angle at an intersection between the inner peripheral surface of the bearing press-fitting portion and an inner peripheral surface of the refrigerant guide groove may be an obtuse angle.

[0019] Accordingly, a sharp edge due to the formation of the refrigerant guide groove does not occur in the inner peripheral surface of the bearing press-fitting portion. For this reason, the deformation of the outer ring member of the rolling bearing press-fitted to the bearing press-fitting portion becomes gentle and rolling of the rolling member becomes smooth. Accordingly, it is possible to more effectively prevent the decrease in the performance of the rolling bearing.

[0020] In the open type refrigerant compressor having the above-described configuration, when viewed in an axial direction of the drive shaft, a ratio of a total groove width of the refrigerant guide groove with respect to a circumference of the bearing press-fitting portion may be 30% to 70%. The ratio of the total groove width is set to this range, and thus, a groove width of the refrigerant guide groove is widened as much as possible while press fitting strength of the rolling bearing is secured, amounts of the refrigerant gas and the lubricant flowing through the refrigerant guide groove are secured, and thus, it is possible to increase the lubrication performance of the rolling bearing and the shaft seal member. Advantageous Effects of Invention

[0021] As described above, according to the open type refrigerant compressor of the present invention, it is possible to form a lubricant guide groove on the inner peripheral surface of the bearing press-fitting portion to which the rolling bearing is press-fitted without decreasing performance of the rolling bearing and to increase lubrication performance of the rolling bearing and the shaft seal member.

Brief Description of Drawings

[0022]

Fig. 1 is a partially longitudinal sectional view of an open type compressor showing an embodiment of the present invention.

Fig. 2 is an enlarged view of a II portion of Fig. 1.

Fig. 3 is a view showing an embodiment of the present invention when viewed from an arrow III-III of Fig. 2.

Fig. 4 is a schematic perspective view showing a first embodiment of a bearing press-fitting portion and a guide groove.

Fig. 5 is a schematic perspective view showing a second embodiment of the bearing press-fitting portion and the guide groove.

Fig. 6 is a schematic perspective view showing a third embodiment of the bearing press-fitting portion and the guide groove.

Fig. 7 is a schematic perspective view of a bearing press-fitting portion and a guide groove showing a related art.

Fig. 8 is a schematic plan view of the bearing press-fitting portion and the guide groove showing a problem of the related art.

Description of Embodiments

[0023] Hereinafter, an embodiment of the present invention will be described with reference to Figs. 1 and 2.

[0024] Fig. 1 is a partially longitudinal sectional view of an open type scroll compressor (open type refrigerant compressor) 1 showing an embodiment of the present invention. For example, the open type scroll compressor 1 according to the present embodiment is an open type scroll compressor used in a refrigerated/frozen transport vehicle which is installed in an engine room of an automobile and is configured to be driven by engine power so as to compress a refrigerant gas. However, the present invention is not limited to this, and the present invention can also be widely applied to open type compressors used in car air conditioners, living space air conditioning, refrigerating/freezing systems in shops or the like, heat pump type hot water supply systems, or the like.

[0025] The open type scroll compressor 1 includes an approximately cylindrical housing 2 formed of an aluminum alloy or the like. The housing 2 includes a housing main body 2A constituting a main body, and a housing cover 2B which is fixed by a bolt or the like so as to airtightly close an opening portion provided on one end of the housing main body 2A. The other end (not shown) of the housing main body 2A is closed.

[0026] A scroll compression mechanism 4 (compression mechanism) and a drive shaft 5 which drives the scroll compression mechanism 4 are accommodated in an internal space S1 of the housing 2. A suction port 3 through which a refrigerant gas before being compressed

is sucked and a discharge port (not shown) through which the refrigerant gas compressed by the scroll compression mechanism 4 is discharged are provided on an outer peripheral surface of the housing 2.

[0027] The drive shaft 5 is rotatably supported via a main bearing 6 and a sub bearing 7 which are rolling bearings. The main bearing 6 is press-fitted into a bearing press-fitting portion 2a formed on a rear end portion of the housing cover 2B, and the sub bearing 7 is press-fitted into a bearing press-fitting portion 8a which is provided on a rear half portion of a shaft hole 8 formed in the housing cover 2B. For example, a single row deep groove ball bearing is used as the main bearing 6 and a needle bearing is used as the sub bearing 7. However, the present invention is not limited to this, and it is considered that other types of bearings are used.

[0028] As shown in Fig. 3, the sub bearing 7 is configured to include an outer ring member 7a, an inner ring member 7b, a plurality of roller-shaped rolling members 7c which are disposed between the inner and outer ring members 7a and 7b, and a retainer 7d which holds the plurality of rolling members 7c at equal intervals.

[0029] One end of the drive shaft 5 protrudes outward through the shaft hole 8. A lip seal 9 (shaft seal member) which is positioned outside the sub bearing 7 is press-fitted inside the shaft hole 8. For example, the lip seal 9 includes two lips 9a and 9b which are inclined toward the sub bearing 7 and are in light contact with an outer peripheral surface of the drive shaft 5 (refer to Fig. 2). An annular seal space S2 having a predetermined volume is defined between the sub bearing 7 and the lip seal 9.

[0030] A pulley 12 is rotatably installed on a tip outer peripheral portion of the housing cover 2B via a pulley bearing 11, and a belt (not shown) is wound between the pulley 12 and a drive pulley provided in a driving source such as an engine (not shown). A clutch plate 13 fixed to a tip portion of the drive shaft 5 faces an outer end surface of the pulley 12 to be close to the outer end surface, and if an electromagnetic clutch 14 fixed to the housing cover 2B so as to be positioned inside the pulley 12 is excited, the clutch plate 13 is pulled toward the pulley 12 side to frictionally engage with the outer end surface of the pulley 12, a rotation of the pulley 12 is transmitted to the drive shaft 5, and the drive shaft 5 rotates.

[0031] A crank pin 5a which is eccentric by a predetermined dimension with respect to a center axis C of the drive shaft 5 is integrally formed on a rear end of the drive shaft 5, and the crank pin 5a is fitted to a boss 18a, which is formed on a rear surface of an orbiting scroll 18 of the scroll compression mechanism 4, via a drive bush 16 and a drive bearing 17.

[0032] The scroll compression mechanism 4 has a known configuration in which the orbiting scroll 18 and a fixed scroll (not shown) engage with each other to be shifted by a phase of 180°, and if the drive shaft 5 rotates, the orbiting scroll 18 is driven so as to revolve with respect to the fixed scroll by an operation of a rotation prevention

mechanism 19, a pair of compression chambers (not shown) formed between both scrolls is moved from an outer peripheral position to a center position, and thus, a volume gradually decreases.

[0033] Accordingly, the refrigerant gas sucked from the suction port 3 into the internal space S1 of the housing 2 is sucked and compressed by the scroll compression mechanism 4, is discharged from the discharge port, and is supplied to a condenser (not shown) or the like. A member 20 is a balancer weight.

[0034] The refrigerant gas contains a lubricant (refrigerating machine oil) at a predetermined ratio, and respective internal mechanism portions such as the main bearing 6, the sub bearing 7, the lip seal 9, the crank pin 5a, the drive bush 16, the drive bearing 17, the rotation prevention mechanism 19, or the scroll compression mechanism 4 are lubricated by a mist of the lubricant.

[0035] The lip seal 9 is a seal member which prevents the refrigerant gas and the lubricant from leaking from the inside of the housing 2 to the outside thereof, and the lip seal 9 is lubricated by oil contained in the refrigerant gas so as to prevent wear of the lips 9a and 9b. However, at the time of a low load operation in which a circulation amount of the refrigerant gas decreases or the like, there is a concern that the oil supplied to the lip seal 9 is insufficient and tips of the lips 9a and 9b wear.

[0036] As shown in Figs. 1 to 4, in order to prevent the wear of the lip seal 9, for example, a plurality of refrigerant guide grooves 25 are formed on an inner peripheral surface of the bearing press-fitting portion 8a to which the sub bearing 7 is press-fitted, at equal intervals in a circumferential direction. For example, the refrigerant guide grooves 25 are disposed near the positions of 12 o'clock, 3 o'clock, 6 o'clock, 9 o'clock in a dial of a timepiece (refer to Fig. 3), each inner opening portion 25a (a right end in Fig. 2) communicates with the internal space S1 of the housing 2, and the outer opening portion 25b (a left end in Fig. 2) communicates with a seal space S2 between the sub bearing 7 and the lip seal 9.

[0037] As shown in Figs. 2 to 4, each of the refrigerant guide grooves 25 is formed in an inclined groove shape having a predetermined inclination angle α , for example, a spiral groove shape in the center axis C direction of the drive shaft 5 by CNC processing or the like. For example, a magnitude of the inclination angle α is set to be approximately 10° to 30° in the center axis C when viewed from a side. In this case, as shown in Fig. 3, when viewed in an axial direction of the drive shaft 5, preferably, the inclination angle α of the refrigerant guide groove 25 is set such that an opening range of the inner opening portion 25a and an opening range of the outer opening portion 25b do not overlap with each other. In addition, if the inclination angle α is excessive, the entire length of the refrigerant guide groove 25 increases, and the refrigerant guide groove 25 is not easily formed. Accordingly, preferably, the inclination angle α is set to approximately 50° at the maximum.

[0038] As described above, the refrigerant guide

groove 25 is formed in a spiral shape, and the spiral direction from the inner opening portion 25a toward the outer opening portion 25b is matched with a rotational direction R of the drive shaft 5. That is, as shown in Fig. 3, if a rotation direction R of the drive shaft 5 is a counterclockwise direction when viewed from a rear portion side of the drive shaft 5, the refrigerant guide groove 25 is formed such that the spiral direction thereof becomes the counterclockwise direction.

[0039] As shown in Fig. 3 in an enlarged manner, when viewed in the axial direction of the drive shaft 5, each refrigerant guide groove 25 is formed such that an interior angle β (an angle on an outer peripheral side of the bearing press-fitting portion 8a) at an intersection between the inner peripheral surface of the bearing press-fitting portion 8a and an inner peripheral surface of the refrigerant guide groove 25 is an obtuse angle of 90° or more. In the present embodiment, the interior angle β is approximately 120°.

[0040] In addition, when viewed in the axial direction of the drive shaft 5, a ratio of a total groove width of the refrigerant guide groove 25 with respect to a circumference of the bearing press-fitting portion 8a is approximately 30% to 70%, preferably approximately 40% to 60%.

[0041] In the open type scroll compressor 1 having the above-described configuration, if the drive shaft 5 rotates, the scroll compression mechanism 4 sucks the refrigerant gas to generate a negative pressure in the internal space S1 of the housing 2, the refrigerant gas is introduced from the suction port 3 into the internal space S1 by the negative pressure, the refrigerant gas becomes a compression refrigerant gas compressed by the scroll compression mechanism 4, and the compression refrigerant gas is discharged from the discharge port formed in the housing 2 so as to be supplied to a demand such as a condenser.

[0042] When the open type scroll compressor 1 is operated, the refrigerant gas flows from the internal space S1 to the seal space S2 via the refrigerant guide groove 25 inside the housing 2, and thus, the sub bearing 7 and the lip seal 9 are lubricated by mist or droplets of the lubricant contained in the refrigerant gas. The lubricant supplied for lubricating lubricates the rolling members 7c while passing through a portion between the outer ring member 7a of the sub bearing 7 and the inner ring member 7b, and thereafter, the lubricant is discharged to the internal space S1.

[0043] The refrigerant guide groove 25 is formed to have the predetermined inclination angle α with respect to the center axis C direction of the drive shaft 5. Accordingly, after the outer ring member 7a of the sub bearing 7 press-fitted inside the bearing press-fitting portion 8a is press-fitted by shrinkage fitting, cooling fitting, or the like, when the outer ring member 7a spreads radially outward, a linear deformation of the outer ring member 7a over the entire length in the center axis C direction of the drive shaft 5 is prevented at a predetermined angular

position on an outer peripheral surface of the outer ring member.

[0044] That is, even when the outer ring member 7a of the sub bearing 7 is deformed so as to bulge inside the refrigerant guide groove 25 inclined with the predetermined inclination angle α with respect to the center axis C of the drive shaft 5, a shape of the deformation portion is not a groove shape parallel in the axial direction of the drive shaft 5 and the shape of the deformation portion is a groove shape inclined in the axial direction. Accordingly, the rolling members 7c rolling inside the outer ring member 7a do not repeatedly fall into the inside of a deformation groove or do not repeatedly ride over the deformation groove simultaneously over the entire width. In addition, a radial clearance of the sub bearing 7 is not easily decreased.

[0045] Accordingly, decreases in performance such as an increase in a rotational resistance in the sub bearing 7, occurrence of flaking, occurrence of an uneven rotation (rotational vibration), or a decrease in the number of years of life span do not easily occur. This effect becomes more pronounced as the inclination angle of the refrigerant guide groove 25 with respect to the drive shaft 5 increases. In this way, it is possible to form the refrigerant guide groove 25 on the inner peripheral surface of the bearing press-fitting portion 8a to which the sub bearing 7 is press-fitted without decreasing performance of the sub bearing 7 and to increase lubrication performance of the sub bearing 7 and the lip seal 9.

[0046] When viewed in the axial direction of the drive shaft 5, the refrigerant guide groove 25 is formed such that an opening range of the inner opening portion 25a and an opening range of the outer opening portion 25b do not overlap with each other (refer to Figs. 2 and 3). Accordingly, even when the outer ring member 7a of the sub bearing 7 press-fitted to the bearing press-fitting portion 8a is deformed so as to bulge inside the refrigerant guide groove 25, a portion parallel in the axial direction of the drive shaft 5 does not occur within a range of the deformed shape. Therefore, it is possible to reliably prevent the rolling members 7c from falling into the inside of the deformation groove or riding over the deformation groove simultaneously over the entire width, and it is possible to prevent the decrease in the performance of the sub bearing 7.

[0047] The refrigerant guide groove 25 is a spiral groove, and it is possible to easily form the refrigerant guide groove 25 by CNC processing. In addition, the spiral direction is matched with the rotational direction R of the drive shaft 5, and thus, a flow of the refrigerant gas orbited in the housing 2 by the rotation of the drive shaft 5 is easily taken into the refrigerant guide groove 25, and thus, it is possible to increase the lubrication performance of the sub bearing 7 and the lip seal 9.

[0048] When viewed in the axial direction of the drive shaft 5, the interior angle β at the intersection between the inner peripheral surface of the bearing press-fitting portion 8a and the inner peripheral surface of the refrigerant

guide groove 25 is an obtuse angle, and thus, a sharp edge due to the formation of the refrigerant guide groove 25 does not occur in the inner peripheral surface of the bearing press-fitting portion 8a. For this reason, the deformation of the outer ring member 7a of the sub bearing 7 press-fitted to the bearing press-fitting portion 8a becomes gentle and the rolling of the rolling member 7c becomes smooth. Accordingly, it is possible to more effectively prevent the decrease in the performance of the sub bearing 7.

[0049] In addition, when viewed in the axial direction of the drive shaft 5, a ratio of the total groove width of the refrigerant guide groove 25 with respect to the circumference of the bearing press-fitting portion 8a is set to 30% to 70%, preferably approximately 40 to 60%. Accordingly, the groove width of the refrigerant guide groove 25 is widened as much as possible while the press fitting strength of the sub bearing 7 is secured, amounts of the refrigerant gas and the lubricant flowing through the refrigerant guide groove 25 are secured, and thus, it is possible to increase the lubrication performance of the sub bearing 7 and the lip seal 9.

[0050] As described above, according to the open type scroll compressor 1 of the present embodiment, it is possible to form the refrigerant guide groove 25 on the inner peripheral surface of the bearing press-fitting portion 8a to which the sub bearing 7 is press-fitted without decreasing performance of the sub bearing 7 and to increase the lubrication performance of the sub bearing 7 and the lip seal 9.

[0051] In addition, the present invention is not limited to only the configuration the above-described embodiment, appropriate modifications or improvements can be applied to the present invention, and embodiments to which the modifications and the improvement are applied are included in the scope of the present invention.

[0052] For example, a basic internal structure of the open type scroll compressor 1 and positional relationships of components do not necessarily need to be the same as those shown in the present embodiment. In addition, instead of the scroll type refrigerant compression mechanism, another type refrigerant compression mechanism such as a rotary type compression mechanism, a vane type compression mechanism, or a swash plate type compression mechanism may be adopted.

[0053] In addition, the shape of the refrigerant guide groove 25 is not necessarily the shape of the above-described embodiment, and other shapes are conceivable as long as it has the predetermined inclination angle α with respect to the center axis C of the drive shaft 5. For example, as shown in Fig. 5, the spiral directions of the plurality of refrigerant guide grooves 25 may be alternately reversed, or the refrigerant guide groove 25 may be formed in a loop shape shown in Fig. 6, a wavy line shape, a mesh shape, or the like. In short, any shape may be adopted as long as the refrigerant guide groove 25 is inclined with respect to the center axis C, the one end of the refrigerant guide groove 25 communicates with the

internal space S1 of the housing 2, and the other end thereof communicates with the seal space S2.

Reference Signs List

[0054]

1: open type scroll compressor (open type refrigerant compressor)
 2: housing
 4: scroll compression mechanism (compression mechanism)
 5: drive shaft
 7: sub bearing (rolling bearing)
 8: shaft hole
 8a: bearing press-fitting portion
 9: lip seal (shaft seal member)
 25: refrigerant guide groove
 25a: inner opening portion
 25b: outer opening portion
 C: center axis of drive shaft
 R: rotational direction of drive shaft
 S1: internal space of housing
 S2: seal space between sub bearing and lip seal
 α : inclination angle of refrigerant guide groove
 β : interior angle at intersection between inner peripheral surface of bearing press-fitting portion and inner peripheral surface of refrigerant guide groove

Claims

1. An open type refrigerant compressor comprising:

a housing;
 a compression mechanism which is provided inside the housing and compresses a refrigerant gas including a lubricant;
 a drive shaft which drives the compression mechanism;
 a rolling bearing which is press-fitted to a shaft hole through which the drive shaft protrudes outward from the housing and pivotally supports the drive shaft;
 a shaft seal member which is provided in the shaft hole so as to be positioned outside the rolling bearing; and
 at least one refrigerant guide groove which is formed on an inner peripheral surface of a bearing press-fitting portion to which the rolling bearing is press-fitted,
 wherein the refrigerant guide groove is formed to have a predetermined inclination angle with respect to a center axis direction of the drive shaft.

2. The open type refrigerant compressor according to claim 1,

wherein the refrigerant guide groove includes an inner opening portion which is open toward an inside of the housing and an outer opening portion which is open toward the shaft seal member side, and wherein when viewed in an axial direction of the drive shaft, the refrigerant guide groove is formed such that an opening range of the inner opening portion and an opening range of the outer opening portion do not overlap with each other.

3. The open type refrigerant compressor according to claim 1 or 2, wherein the refrigerant guide groove is a spiral groove.

4. The open type refrigerant compressor according to claim 3, wherein the refrigerant guide groove is formed such that a spiral direction from the inner opening portion toward the outer opening portion is matched with a rotational direction of the drive shaft.

5. The open type refrigerant compressor according to any one of claims 1 to 4, wherein when viewed in an axial direction of the drive shaft, an interior angle at an intersection between the inner peripheral surface of the bearing press-fitting portion and an inner peripheral surface of the refrigerant guide groove is an obtuse angle.

6. The open type refrigerant compressor according to any one of claims 1 to 5, wherein when viewed in an axial direction of the drive shaft, a ratio of a total groove width of the refrigerant guide groove with respect to a circumference of the bearing press-fitting portion is 30% to 70%.

FIG. 1

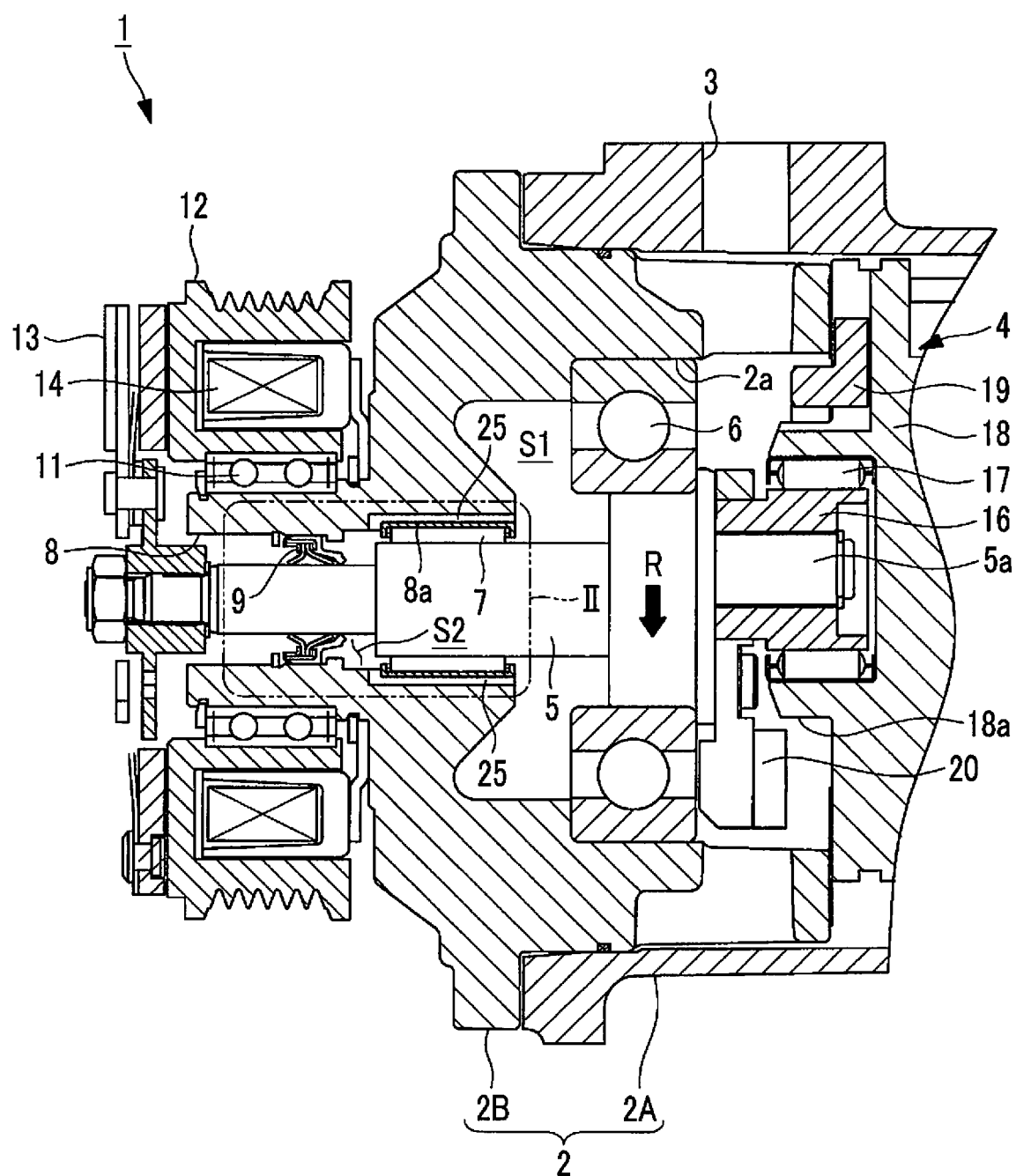


FIG. 2

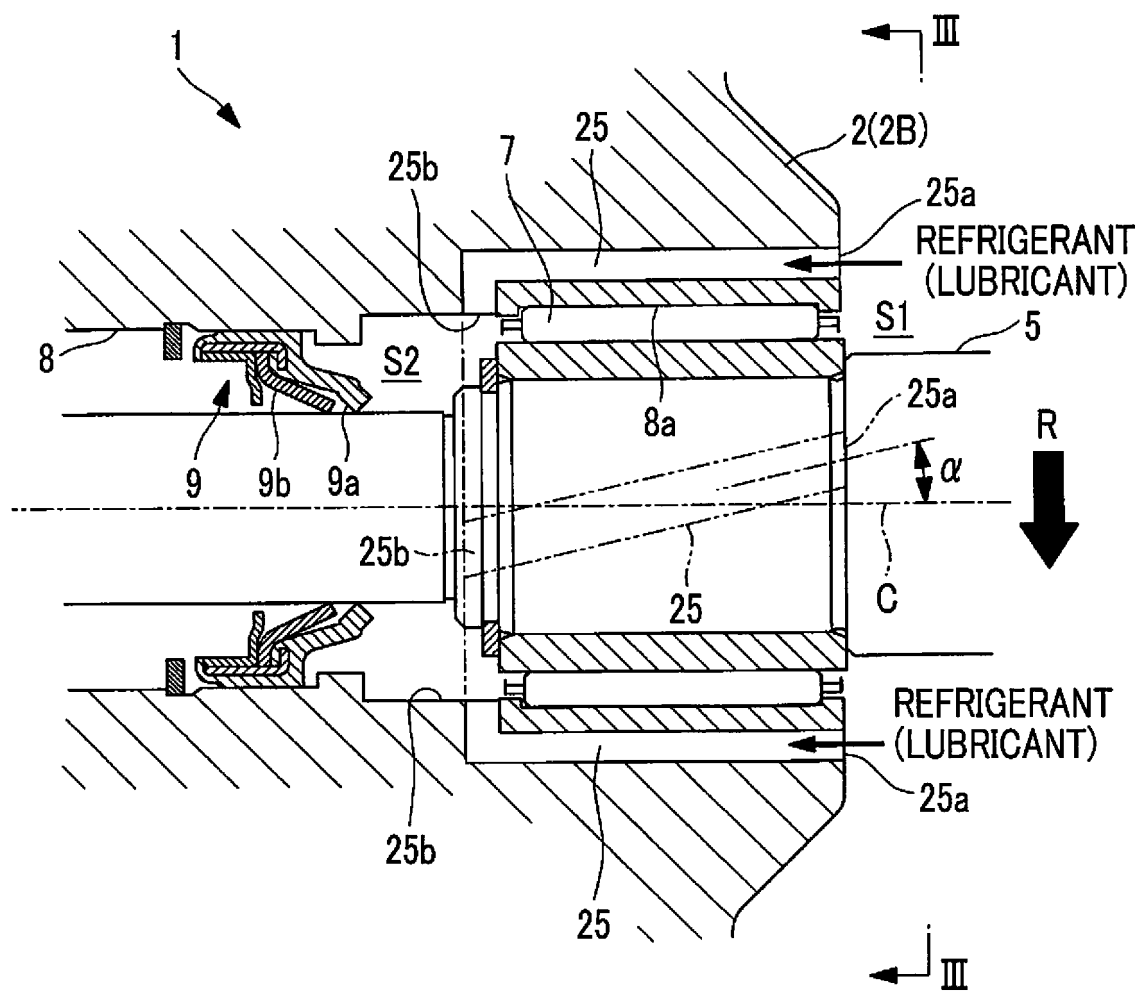


FIG. 3

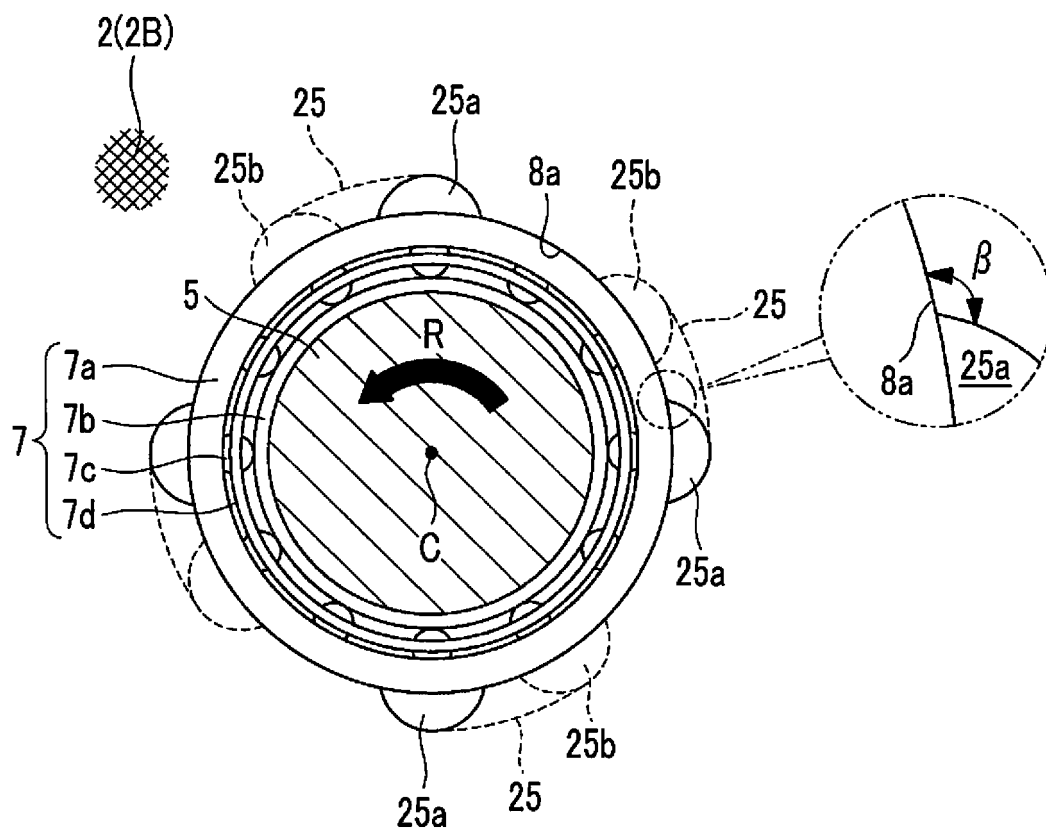


FIG. 4

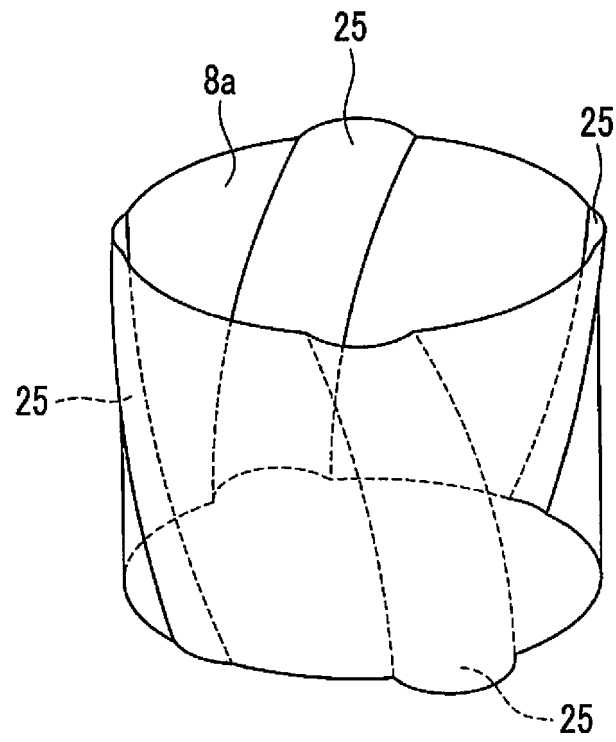


FIG. 5

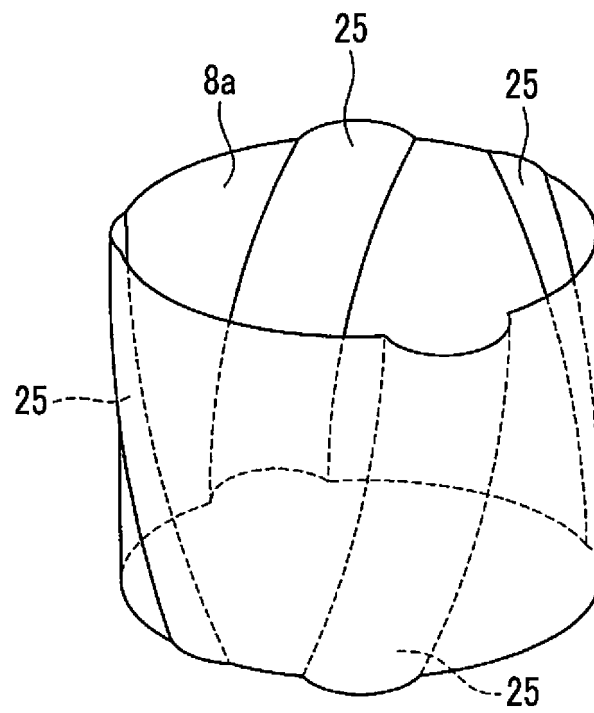


FIG. 6

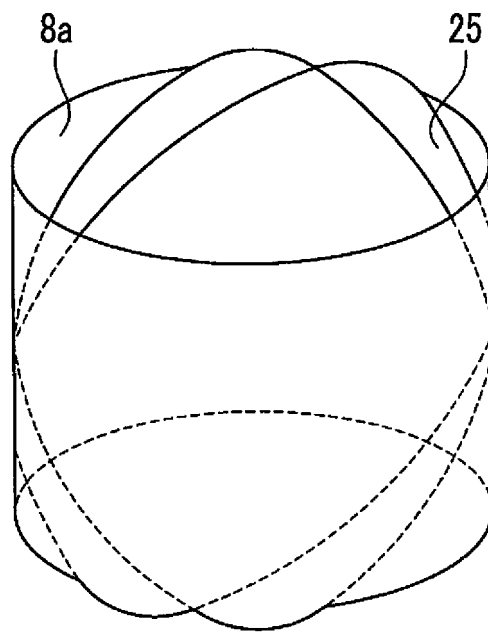


FIG. 7

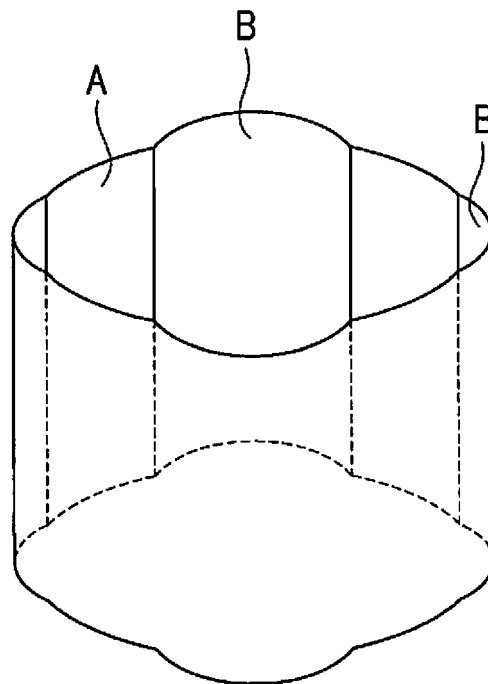
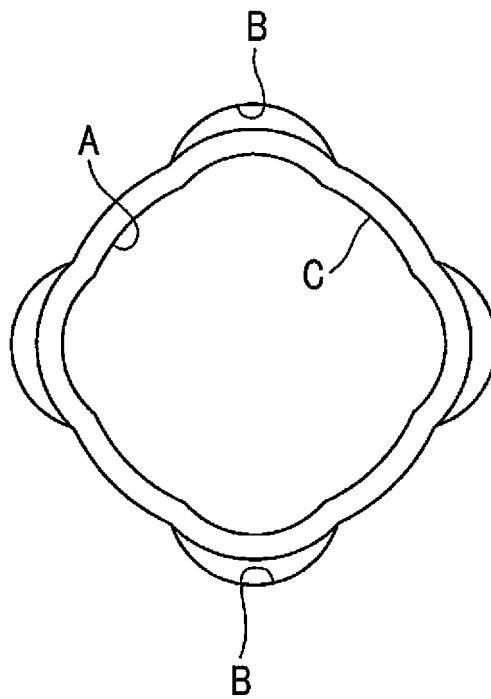


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/028130

A. CLASSIFICATION OF SUBJECT MATTER

F04B39/00(2006.01)i, F04B39/02(2006.01)i, F04C27/00(2006.01)i, F04C29/02(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

F04B39/00, F04B39/02, F04C27/00, F04C29/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Jitsuyo Shinan Koho 1922-1996 Jitsuyo Shinan Toroku Koho 1996-2017
Kokai Jitsuyo Shinan Koho 1971-2017 Toroku Jitsuyo Shinan Koho 1994-2017

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2005-23849 A (Zexel Valeo Climate Control Corp.), 27 January 2005 (27.01.2005), paragraphs [0021] to [0034]; fig. 1 to 3 (Family: none)	1-6
A	JP 10-339286 A (Zexel Corp.), 22 December 1998 (22.12.1998), paragraph [0031]; fig. 1 to 2 (Family: none)	1-6

☐ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

"E" earlier application or patent but published on or after the international filing date

"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)

"O" document referring to an oral disclosure, use, exhibition or other means

"P" document published prior to the international filing date but later than the priority date claimed

"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention

"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone

"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art

"&" document member of the same patent family

Date of the actual completion of the international search
01 September 2017 (01.09.17)

Date of mailing of the international search report
12 September 2017 (12.09.17)

Name and mailing address of the ISA/
Japan Patent Office
3-4-3, Kasumigaseki, Chiyoda-ku,
Tokyo 100-8915, Japan

Authorized officer

Telephone No.

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- JP 2005023849 A [0005]