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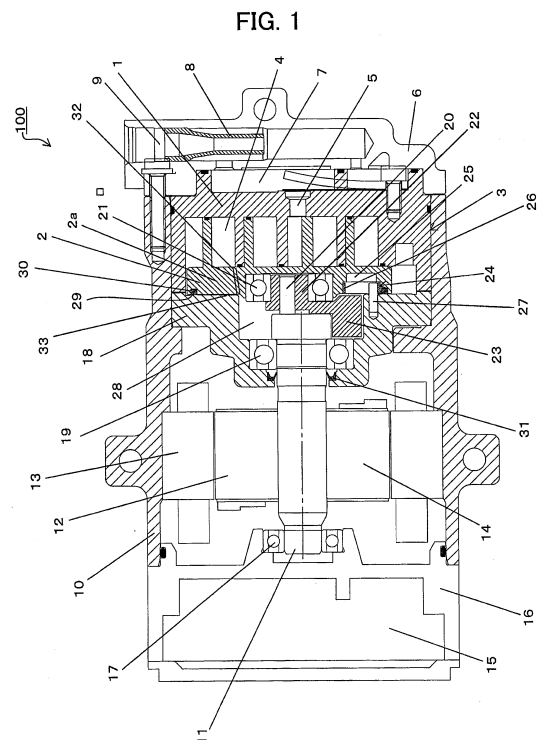
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(54) **SCROLL COMPRESSOR**

(57) A scroll compressor configured in such a manner that a back pressure chamber is formed on the back surface side of the movable scroll using an annular seal means, and pressurized fluid is introduced into the back pressure chamber through a pressure introduction hole. A thrust bearing member which is a separate member from the seal means and which bears a thrust force acting toward the main bearing member from the bottom plate section side of the movable scroll is disposed between the back surface of the bottom plate section of the movable scroll and the front surface of the main bearing member which faces the back surface of the bottom plate section. The scroll compressor is configured in such a manner that the scroll compressor can satisfy the demand for more compactness and that a reduction in the durability and sealing function of the annular seal means can be minimized.



Description

Technical Field of the Invention

[0001] The present invention relates to a scroll compressor, and specifically relates to improvements of a back pressure mechanism section provided at the back side of a movable scroll constituting the scroll compression mechanism.

Background Art of the Invention

[0002] Well known is a scroll compressor having a scroll compression mechanism made by a fixed scroll and a movable scroll to swing around the fixed scroll. In such a scroll compressor, a compressive reaction force of fluid being compressed might generate a thrust load on the movable scroll, so as to cause the abrasion between the movable scroll and a housing supporting the movable scroll. In order to suppress such an abrasion, known is an effective measure where the pressurized fluid is introduced from the inside of the compression mechanism to the back side of the movable scroll so as to react a back pressure to the movable scroll in a direction opposing the thrust load, so that the back pressure reduces the thrust load which might cause the abrasion, etc.

[0003] Patent document 1 discloses a scroll compressor, comprising a back pressure chamber formed as a space between a back face of a bottom plate section of a movable scroll and a front face of main bearing member surface facing it, at least one annular groove formed on either the back face or the front face, an annular seal means which is movably attached to the inside of the annular groove and is brought into sliding contact with the other face, an annular shaft seal means which is movably attached to the inside of a gap between a crankshaft to drive the movable scroll and the main bearing member, and a pressure inlet hole to supply pressurized fluid to the back pressure chamber which is formed by sealing the gap with the seal means and the shaft seal means at the back face side of the bottom plate of the movable scroll.

Prior art documents

Patent documents

[0004]

Patent document 1: JP-4262949-B

Summary of the Invention

Problems to be solved by the Invention

[0005] However, it may be difficult to provide the back pressure mechanism on the back plate side of the bottom

plate section of the movable scroll in the same radius as a compressor without the back pressure mechanism, because the above-described annular groove and an annular seal means to be attached to the groove are required while it is necessary to provide a rotation preventing mechanism of the movable scroll at the back face side thereof. In addition, because the annular groove and the annular seal means to form the back pressure chamber are located at the side of inside diameter of the rotation preventing mechanism of the movable scroll in a structure disclosed in Patent document 1, such a seal means, etc., which define the radial directional size of the back pressure chamber, are positioned as corresponding to comparatively small radius, so that the area to bear the back pressure in the back pressure chamber becomes comparatively small. In order to increase the pressure-bearing area of the back pressure chamber, it is necessary for the compressor to make its shell diameter larger, and therefore, it becomes difficult for the compressor to make compact as a whole. On the other hand, in order to generate a predetermined force from the back pressure without increasing the shell diameter of the compressor, it is necessary to increase pressure in the back pressure chamber. In such a case, fluid which has been introduced from the compression mechanism to the inside of the back pressure chamber tends to leak from the seal section forming the back pressure chamber. And then, the volume efficiency of the compressor might deteriorate when the leakage becomes great. Further, when the pressure increases in the back pressure chamber, the annular seal means might deteriorate greatly in durability and sealing performance with age, etc.

[0006] Accordingly, focused on the above-described problems, an object of the present invention is to provide a scroll compressor, in which a desirable back pressure mechanism can be realized without increasing the shell diameter of the compressor and the pressure can be kept low in the back pressure chamber as making the pressure-bearing area in the back pressure chamber greater, so as to meet a demand to downsize compressors and to improve the volume efficiency of the compressor by reducing the leakage at the sealed region in the back pressure chamber, while the annular seal means is prevented from aging deterioration, etc., in durability and sealing performance by reducing pressure in the back pressure chamber, the rotation preventing mechanism of the movable scroll is well lubricated and the reliability is improved.

Means for solving the Problems

[0007] To achieve the above-described object, a scroll compressor according to the present invention is a scroll compressor which has a scroll type compression mechanism consisting of a fixed scroll and a movable scroll to swing relatively to the fixed scroll and which comprises a shaft having an eccentric crank part on an end and driving the movable scroll by the crank part, a main bear-

ing member to rotatably support the shaft through a main bearing, a rotation preventing mechanism which is provided between a back face of a bottom plate part of the movable scroll and a front face of the main bearing member facing the back face and which prevents the movable scroll from rotating, a back pressure chamber formed as a space between the back face of the bottom plate part of the movable scroll and the front face of the main bearing member facing the back face, at least one annular groove formed on a side either of the back face of the bottom plate part of the movable scroll or the front face of the main bearing member, a seal means which is movably attached in the annular groove and which is brought into sliding contact with another side, a shaft seal means attached between the shaft and the main bearing member, and a pressure inlet hole through which a pressurized fluid is supplied into the back pressure chamber as a sealed space sealed by the seal means and the shaft seal means, characterized in that a thrust bearing member, which bears a thrust force subjected from the bottom plate side of the movable scroll to the main bearing member side, is interposed as a member other than the seal means.

[0008] In such a scroll compressor according to the present invention, a thrust bearing member is interposed separately from the annular seal means which is attached to the annular groove to form the back pressure chamber, so that the annular seal means, which has had both functions of the seal function and the thrust force bearing function in a conventional structure, chiefly has charge of only the seal function and that the thrust bearing member has charge of the thrust force bearing function. Namely, the annular seal means can specialize in the seal function by omitting the function for bearing a thrust force. Consequently, the annular seal means can be designed flexibly, so as to increase the seal performance and the durability. Such a high seal performance and a high durability makes it possible that the back pressure chamber has charge of desirable back pressure function, such as thrust load reduction function and pushing function toward the fixed scroll side, with respect to the movable scroll. Therefore, it is possible that the abrasion derived from the thrust load is suppressed so as to improve the volume efficiency and the coefficient of performance of the compressor.

[0009] In the scroll compressor according to the present invention, it is preferable that the thrust bearing member is interposed such that the bottom plate part of the movable scroll contacts the thrust bearing member when the compressor starts up and the bottom plate part doesn't contact thrust bearing members in a steady operation. Because inner pressure of the back pressure chamber may not be sufficient at the start up, comparatively great thrust load might be applied to the front face of the main bearing member from the bottom plate part of the movable scroll. If the bottom plate part of the movable scroll contacts the thrust bearing member, the thrust bearing member can surely bear the thrust load to pre-

vent the annular seal means from being subjected to the thrust load undesirably. Therefore, the abrasion derived from the thrust load can be suppressed while the annular seal means have further excellent seal performance and further excellent durability. On the other hand, since the pressurized fluid is supplied into the back pressure chamber sufficiently in a stable operation so that the inner pressure of the back pressure chamber is kept high enough to bear the thrust load, the non-contact between the bottom plate part of the movable scroll and the thrust bearing member can improve the durability and the lifetime of the thrust bearing member.

[0010] In the scroll compressor according to the present invention, various embodiments can be employed for the thrust bearing member. For example, it is possible that the thrust bearing member is made of a plate member which annularly extends on the front face of the main bearing member in a circumferential direction, or that the thrust bearing member is made of a plurality of circular members which are formed on the front face of the main bearing member and which are freely fitted (namely, which are movably attached) in a plurality of circular grooves placed intermittently in the circumferential direction. In each embodiment, it is preferable that the thrust bearing member is made of material, such as metal and resin, having high abrasion resistance to have charge of the thrust load.

[0011] In addition to the above-described improvement of the seal performance and the durability achieved by increasing the flexibility in designing the annular seal means, it is possible that the annular groove and the seal means are placed at a position including the rotation preventing mechanism in a radial direction so that the annular seal means is provided as having larger outer shape than the position disclosed in Patent document 1. Then the radial dimension of the back pressure chamber is increased, so as to enlarge the pressure-bearing area in the back pressure chamber. Namely, the pressure-bearing area can be extended in the back pressure chamber without extending the shell diameter of the compressor. Therefore, demand to downsize the compressor can be satisfied and the lowered pressure in the back pressure chamber can reduce the leakage at the sealed region in the back pressure chamber, so as to improve the volume efficiency of the compressor. Further, the lowered pressure in the back pressure chamber can reduce the loading condition of the annular seal means, so that the annular seal means are prevented from deteriorating in durability and the seal performance across the ages, etc, so as to improve the seal performance and the durability further. Furthermore, because the rotation preventing mechanism section of the movable scroll can be incorporated substantively in the back pressure chamber, the pressurized fluid containing lubricant oil introduced in the back pressure chamber through the pressure inlet hole from the compression mechanism can be utilized to lubricate the rotation preventing mechanism section, so as to improve the durability and the reliability.

[0012] Thus the present invention makes it possible that the back pressure chamber which allows low pressure and has desirable pressure-bearing area can be configured without extending the shell diameter of the compressor, as achieving the excellent seal performance, durability and reliability of the back pressure mechanism section. Therefore, the present invention is suitable to a compressor in an air-conditioning system for vehicles, which strongly demands downsizing and durability improvement.

Effect according to the Invention

[0013] In the scroll compressor according to the present invention, the sealing performance, durability and reliability, etc., can be excellent in the back pressure chamber, so as to achieve higher volume efficiency and higher coefficient of performance compared to a compressor which doesn't have a back pressure mechanism. In addition, a compact and highly efficient scroll compressor can be provided without increasing the shell diameter of the compressor, because the back pressure chamber, of which sealing performance and durability are excellent and of which pressure-bearing area is kept large so as to require only low pressure, can be designed while the shell diameter of the compressor is the same as a compressor which doesn't have a back pressure mechanism.

Brief explanation of the drawings

[0014]

[Fig. 1] Fig. 1 is a longitudinal section view of a scroll compressor according to the first embodiment of the present invention.

[Fig. 2] Fig. 2 is a longitudinal section view of a scroll compressor according to the second embodiment of the present invention.

[Fig. 3] Fig. 3 is an enlarged section view of a main part of the first embodiment.

[Fig. 4] Fig. 4 is an enlarged section view of a main part of the second embodiment.

[Fig. 5] Fig. 5 is a plan view of a main bearing member provided with thrust bearing member in the first embodiment.

[Fig. 6] Fig. 6 is a plan view of a main bearing member provided with thrust bearing member in the second embodiment.

[Fig. 7] Fig. 7 is a plan view showing a back face of a bottom plate of a movable scroll in the present invention.

Embodiments for carrying out the Invention

[0015] Hereinafter, desirable embodiments will be explained as referring to figures.

Fig. 1 shows scroll compressor 100 according to the first embodiment of the present invention and Fig. 2 shows

scroll compressor 200 according to the second embodiment of the present invention. Both of them are configured to be an electric compressor having built-in motor. Scroll compressors 100 and 200 are used as a compressor for compressing refrigerant for an air conditioning system for vehicles, etc. The first embodiment and the second embodiment are different only in thrust bearing members. Because the other parts are substantively the same, thrust bearing members are explained by different symbols while the same symbols are used to explain the same component parts as referring to Figs. 1 and 2 together.

[0016] In Fig. 1 and Fig. 2, scroll compressors 100 and 200 have scroll compression mechanism 3 consisting of fixed scroll 1 and movable scroll 2 to swing around fixed scroll 1. While moving toward the center of fluid pocket 4 formed in scroll compression mechanism 3, fluid, such as refrigerant, taken into fluid pocket 4 is supposed to be compressed. The compressed fluid is discharged in discharge chamber 7 formed in rear plate 6 from discharge hole 5 provided at the center of fixed scroll 1, and is delivered to the external circuit (not shown) through discharge port section 9 after lubricating oil contained is separated therefrom in separator pipe 8.

[0017] In this embodiment, fixed scroll 1 is fixed inside of an end of stator housing 10, and rear plate 6 is fixed to an end face of stator housing 10 with bolts, etc. Motor 12 which drives to rotate shaft 11 for driving movable scroll 2 is built inside the other end of stator housing 10. Motor 12 comprises stator 13 fixed inside stator housing 10 and rotor 14 to rotate around stator 13, and shaft rotates together with rotor 14. Shaft 11 is rotatably supported by front bearing 17 attached to inverter case 16 housing inverter section 15 and main bearing 19 attached to main bearing member 18 fixed inside stator housing 10. Crank section (crank pin) 20 is formed at a position eccentric to the center of shaft 11 at an end of shaft 11. Crank section 20 is inserted in eccentric bushing 22 which is rotatably supported by drive bearing 21 at the back side of movable scroll 2, and is swung as accompanied by the rotation of shaft 11 through crank section 20, eccentric bushing 22 and drive bearing 21 in a condition where movable scroll 2 is prevented from rotating. Counter weight 23 is formed integrally with eccentric bushing 22. Rotation preventing mechanism 24 of movable scroll 2 comprises rotation preventing ring 26 attached in hole 25 formed on the back face of movable scroll 2 and rotation preventing pin 27 provided as extruding from main bearing member 18 in rotation preventing ring 26, while a plurality of rotation preventing mechanisms 24 consisting of ring 26 and pin 27 are arranged in a circumferential direction.

[0018] Back pressure chamber 28 is formed as a space between the back face of bottom plate part 2a of movable scroll 2 and the front face of main bearing member 18 facing the back face. Back pressure chamber 28 is formed into a sealed space sealed by a seal section comprising at least one annular groove 29 formed on the back

face of bottom plate part 2a of movable scroll 2 and annular seal 30 as an annular seal means, which is attached in groove 29 and is brought into sliding contact with the front face of main bearing member 18, and another seal section having shaft seal 31 attached between the outer peripheral surface of shaft 11 and the inner peripheral surface of main bearing member 18 at the side of main bearing 19. In back pressure chamber 28, pressurized fluid is supplied from the inside of compression mechanism 3 through pressure inlet hole 32 perforated on bottom plate part 2a of movable scroll 2. The pressurized fluid introduced into back pressure chamber 28 makes inner pressure of back pressure chamber 28 act on movable scroll 2, so that the thrust load, which is a force to push movable scroll 2 toward main bearing member 18 and is caused by compressive reaction force to act on movable scroll 2, is reduced, or that movable scroll 2 is pushed toward fixed scroll 1. In this embodiment, the fluid pressurized in compression mechanism 3 is supplied into back pressure chamber 28 through pressure inlet hole 32 from compression mechanism 3. Alternatively, it is possible that the fluid is supplied from a discharge chamber or an oil separation chamber of the compressor into back pressure chamber 28.

[0019] A seal section comprising annular groove 29 and annular seal 30 which make back pressure chamber 28 a sealed space is positioned at a place including rotation preventing mechanism 24, and the pressure-bearing area is sufficiently ensured at bottom plate part 2a of movable scroll 2 in back pressure chamber 28. Enlargement of such positioned pressure-bearing area in back pressure chamber 28 makes it possible to reduce inner pressure of back pressure chamber 28, so as to design annular seal 20 more flexibly and to improve the sealing performance and the durability of annular seal 30. Such a positioning makes it possible that the pressure-bearing area in back pressure chamber 28 is increased without increasing the shell diameter of the compressor and the compressor is prevented from growing in size caused by providing a back pressure mechanism, so that the compressor is downsized while high seal performance and durability is ensured.

[0020] Between the back face of bottom plate part 2a of movable scroll 2 and the front face of main bearing member 18 facing it, thrust bearing members 33 (shown in Fig. 1) and 34 (shown in Fig. 2) are interposed separately from annular seal 30 and movably in an axial direction, at a position closer to the inside diameter than annular seal 30. With such a positioning of thrust bearing members 33 and 34, it is possible that annular seal 30 is designed to specialize the seal performance since the thrust force which is applied from the side of movable scroll 2 toward main bearing member 18 is born only by thrust bearing members 33 and 34 without making annular seal 30 bear the thrust force. Therefore, the seal performance and durability of annular seal 30 can be improved greatly. Namely, annular seal 30 doesn't have to bear the thrust force and can be designed especially focused on its seal

performance. Therefore, annular seal 30 can be designed in a great flexibility, so that appropriate design with appropriate materials make the seal performance and the durability of annular seal 30 greatly improved. In addition to the reduction of inner pressure of back pressure chamber 28 by increasing the pressure-bearing area in back pressure chamber 28, such a great improvement in seal performance and durability of annular seal 30 can greatly reduce the leakage of the fluid introduced into back pressure chamber 28 from a region of annular seal 30, so as to improve the volume efficiency and the coefficient of performance of the compressor. As described above, thrust bearing members 33 and 34 can be designed such that bottom plate part 2a of movable scroll 2 contacts thrust bearing members 33 and 34 when the compressor starts up and the bottom plate part doesn't contact thrust bearing members substantively in a steady operation. Therefore the durability of annular seal 30 and thrust bearing members 33 and 34 can be improved.

[0021] The above-described superior function effect is accomplished by function separation, where annular seal 30 only takes charge of the seal function and thrust bearing members 33 and 34 only take charge of being subjected to the thrust load. This function separation can be achieved by thrust bearing members 33 and 34 as members provided other than annular seal 30.

[0022] Hereinafter, thrust bearing members 33, 34 will be explained concretely as referring to examples. The first embodiment as shown in Fig. 1 can also be configured as shown in Fig. 3 and Fig. 5. The second embodiment as shown in Fig. 2 can also be configured as shown in Fig. 4 and Fig. 6. In the first embodiment, shallow annular low-level step 41 may be formed on the front face of main bearing member 18 which faces movable scroll 2 as shown in Fig. 3. Thrust bearing member 33, which has been made of comparatively thin plate material as extending annularly, can be placed on low-level step 41 so that thrust bearing member 33 is supported between low-level step 41 and the back face of bottom plate part 2a of movable scroll 2. In order to prevent thrust bearing member 33 from interfering with rotation preventing pin 27 extruding from the front face of main bearing member 18, it is possible that opening 42 through which rotation preventing pin 27 is inserted is formed on thrust bearing member 33 as shown in Fig. 5. Further, outer peripheral surface of thrust bearing member 33 on the front face of main bearing member 18 can be ensured as a broad area of seal surface 43 brought into sliding contact with annular seal 30 to swing together with movable scroll 2 as shown in Fig. 5. It is preferable that an abrasion-resistant metal plate, such as carbon tool steels called SK material in Japan, is employed as the comparatively thin plate material to form thrust bearing member 33. Such a metal plate can achieve a desirable surface roughness easily.

[0023] In the second embodiment, a plurality of grooves 51 extending circularly in a circumferential direction are intermittently formed on the front face of main

bearing member 18 facing movable scroll 2 in a condition where arc-like thrust bearing member 34 freely fits in each groove 51, as shown in Fig. 4 and Fig. 6. Arc-like grooves 51 and arc-like thrust bearing members 34 are placed away from rotation preventing pins 27. Outer peripheral surface of grooves 51 and thrust bearing members 34 on the front face of main bearing member 18 can be ensured as a broad area of seal surface 52 brought into sliding contact with annular seal 30 to swing together with movable scroll 2 as shown in Fig. 6. It is preferable that an abrasion-resistant resin (particularly engineering plastic), such as polyphenylene sulfide, is employed as the arc-like member material to form thrust bearing material 34. Such a resin can achieve a desirable sliding performance easily.

[0024] On the other hand, as to a structure at the side of back face 61 of bottom plate 2a of movable scroll 2, rotation preventing rings 26 are attached to holes 25 for a rotation preventing rings which are formed at the outer side of hole 62 for drive bearing 21 which is formed at the center as shown in Fig. 7. Annular groove 29 is formed as surrounding a plurality of rotation preventing rings 26 (rotation preventing mechanism), and annular seal 30 is attached to groove 29.

Industrial Applications of the Invention

[0025] The structure of the scroll compressor according to the present invention is applicable to every scroll compressor, and is suitable for a compressor for an air-conditioning system for vehicles, which strongly requires downsizing and durability improvement.

Explanation of symbols

[0026]

- 1: fixed scroll
- 2: movable scroll
- 2a: bottom plate part of movable scroll
- 3: scroll compression mechanism
- 4: fluid pocket
- 5: discharge hole
- 6: rear plate
- 7: discharge chamber
- 8: separator pipe
- 9: discharge port section
- 10: stator housing
- 11: shaft
- 12: motor
- 13: stator
- 14: rotor
- 15: inverter section
- 16: inverter case
- 17: front bearing
- 18: main bearing member
- 19: main bearing
- 20: crank section

- 21: drive bearing
- 22: eccentric bushing
- 23: counter weight
- 24: rotation preventing mechanism
- 25: hole
- 26: rotation preventing ring
- 27: rotation preventing pin
- 28: back pressure chamber
- 29: annular groove
- 30: annular seal
- 31: shaft seal
- 32: pressure inlet hole
- 33, 34: thrust bearing member
- 41: low-level step
- 42: opening
- 43: seal surface of annular seal
- 51: circular groove
- 52: seal surface of annular seal
- 61: back face of bottom plate
- 62: hole of drive bearing
- 100, 200: scroll compressor

Claims

1. A scroll compressor, which has a scroll type compression mechanism consisting of a fixed scroll and a movable scroll to swing relatively to the fixed scroll and which comprises
 - a shaft having an eccentric crank part on an end and driving the movable scroll by the crank part,
 - a main bearing member to rotatably support the shaft through a main bearing,
 - a rotation preventing mechanism which is provided between a back face of a bottom plate part of the movable scroll and a front face of the main bearing member facing the back face and which prevents the movable scroll from rotating,
 - a back pressure chamber formed as a space between the back face of the bottom plate part of the movable scroll and the front face of the main bearing member facing the back face,
 - at least one annular groove formed on a side either of the back face of the bottom plate part of the movable scroll or the front face of the main bearing member,
 - a seal means which is movably attached in the annular groove and which is brought into sliding contact with another side,
 - a shaft seal means attached between the shaft and the main bearing member, and
 - a pressure inlet hole through which a pressurized fluid is supplied into the back pressure chamber as a sealed space sealed by the seal means and the shaft seal means, **characterized in that**
 - a thrust bearing member, which bears a thrust force subjected from the bottom plate side of the movable scroll to the main bearing member side, is interposed

as a member other than the seal means.

2. The scroll compressor according to claim 1, wherein the thrust bearing member is interposed such that the bottom plate part of the movable scroll contacts the thrust bearing member when the compressor starts up and the bottom plate part doesn't contact thrust bearing members in a steady operation. 5
3. The scroll compressor according to claim 1 or 2, wherein the thrust bearing member is made of a plate member which annularly extends on the front face of the main bearing member in a circumferential direction. 10
4. The scroll compressor according to claim 1 or 2, wherein the thrust bearing member is made of a plurality of circular members which are formed on the front face of the main bearing member and which are freely fitted in a plurality of circular grooves placed intermittently in the circumferential direction. 15 20
5. The scroll compressor according to any of claims 1-4, wherein the thrust bearing member is made of metal or resin being of abrasion resistance. 25
6. The scroll compressor according to any of claims 1-5, wherein the annular groove and the seal means are placed at a position including the rotation preventing mechanism in a radial direction. 30
7. The scroll compressor according to any of claims 1-6, wherein the compressor is mounted in an air-conditioning system for vehicles. 35

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FIG. 1

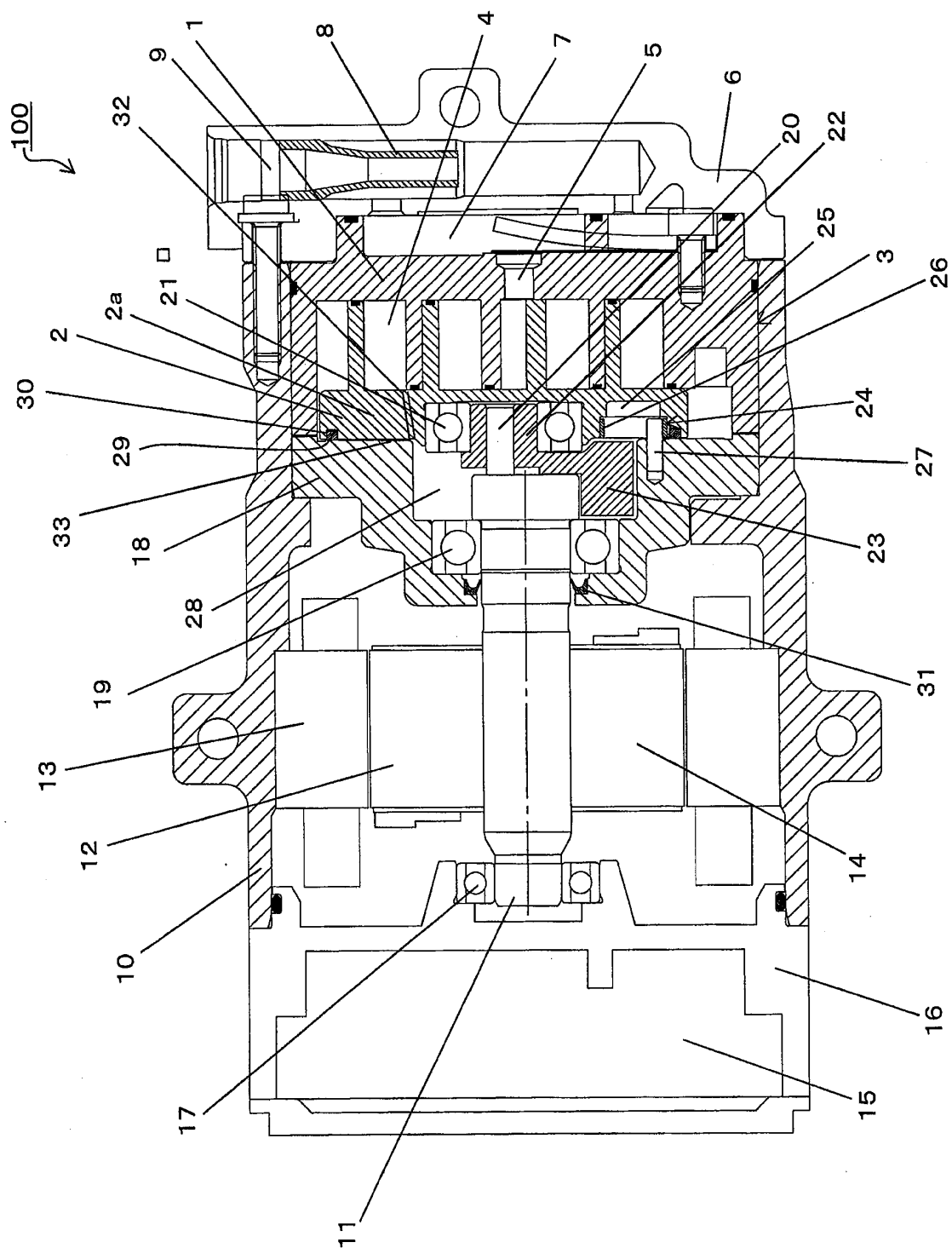


FIG. 2

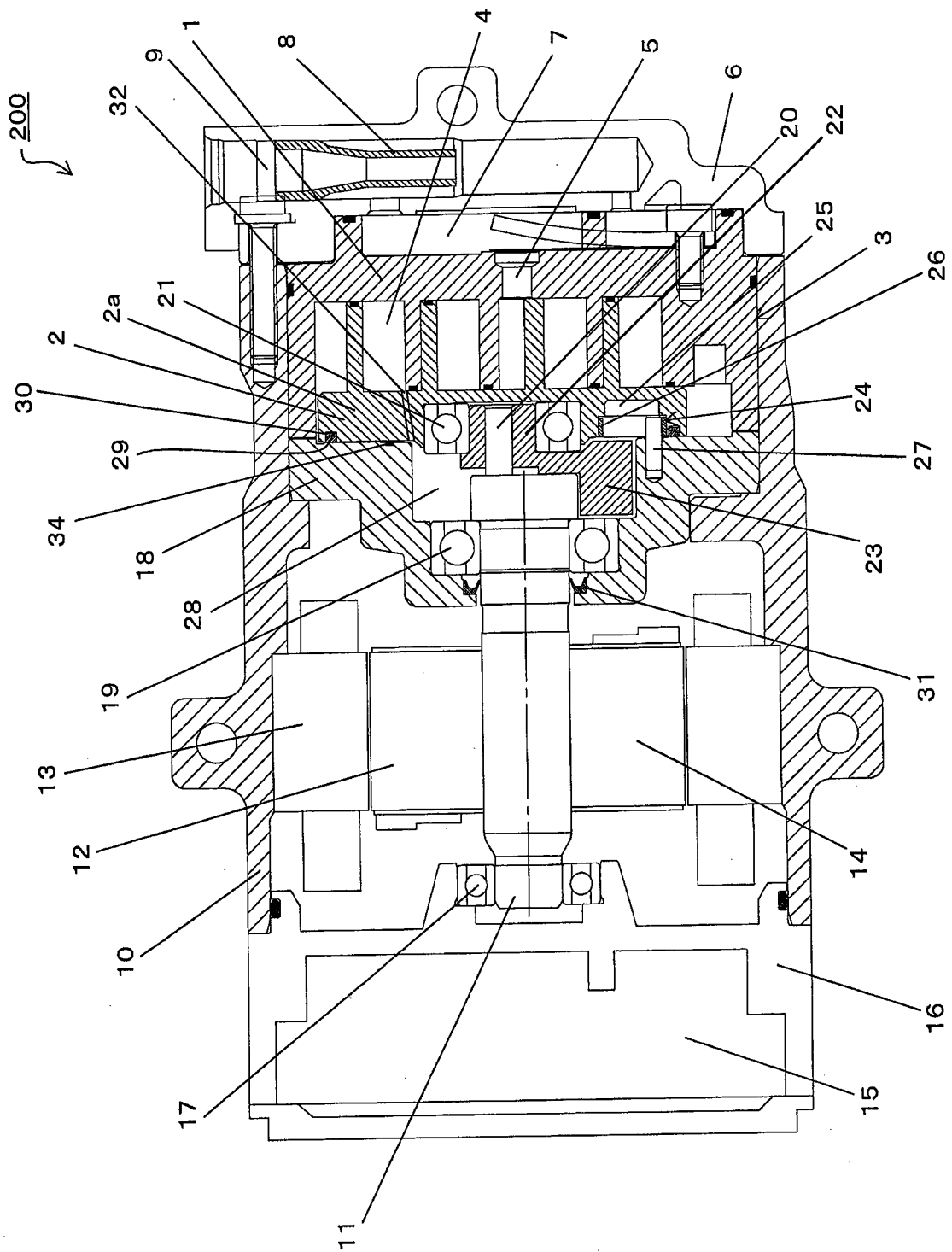


FIG. 3

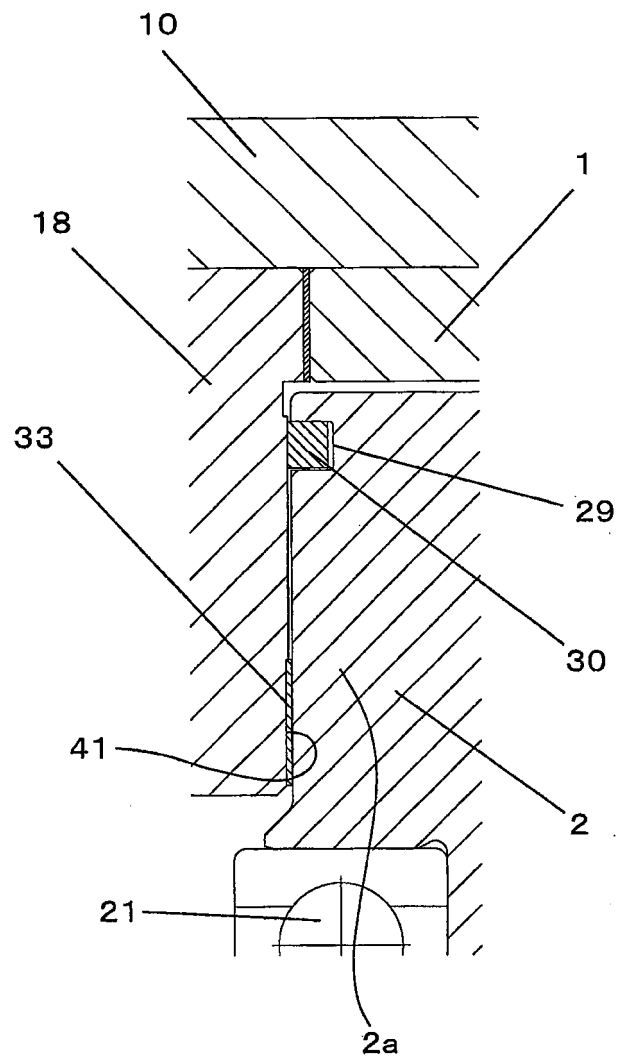


FIG. 4

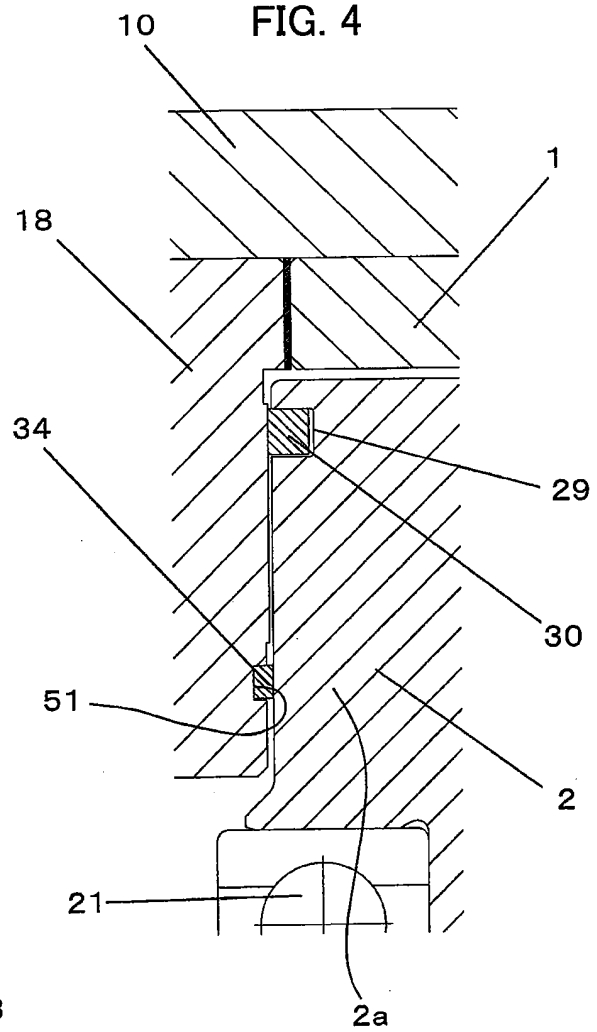


FIG. 5

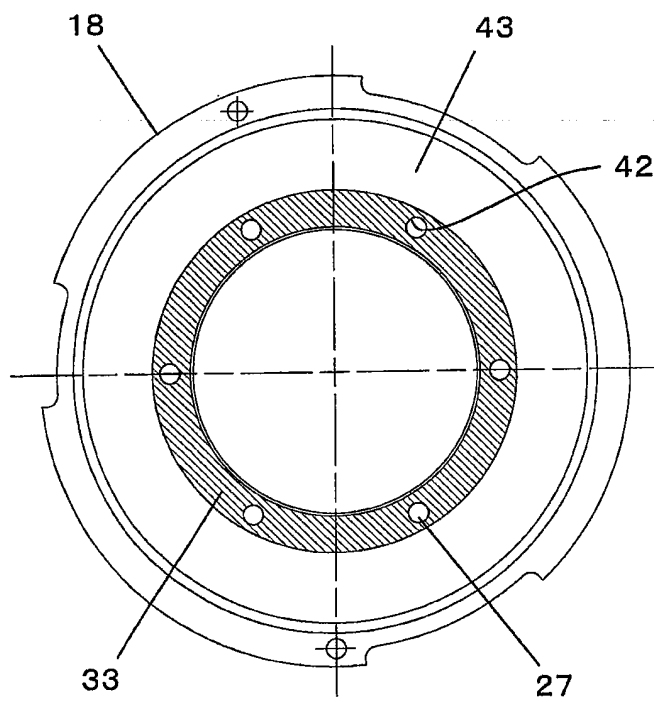


FIG. 6

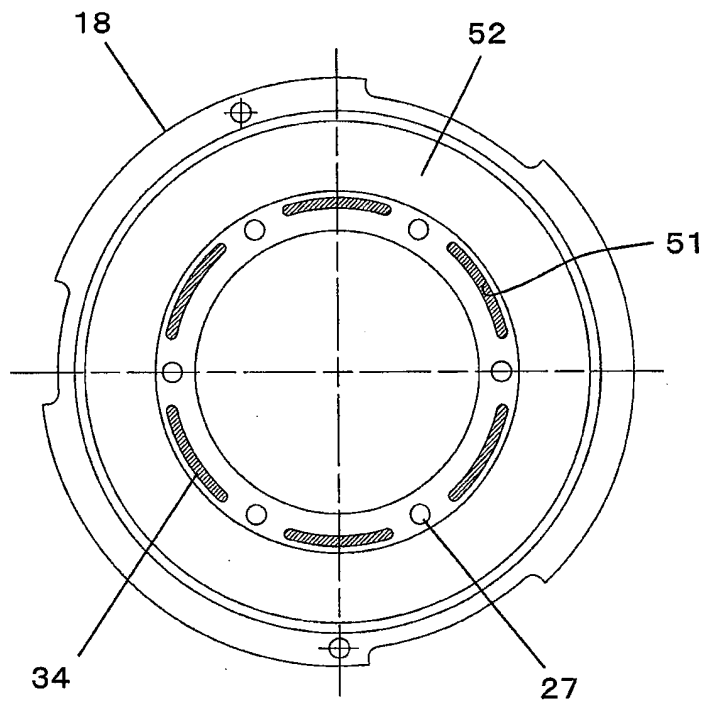
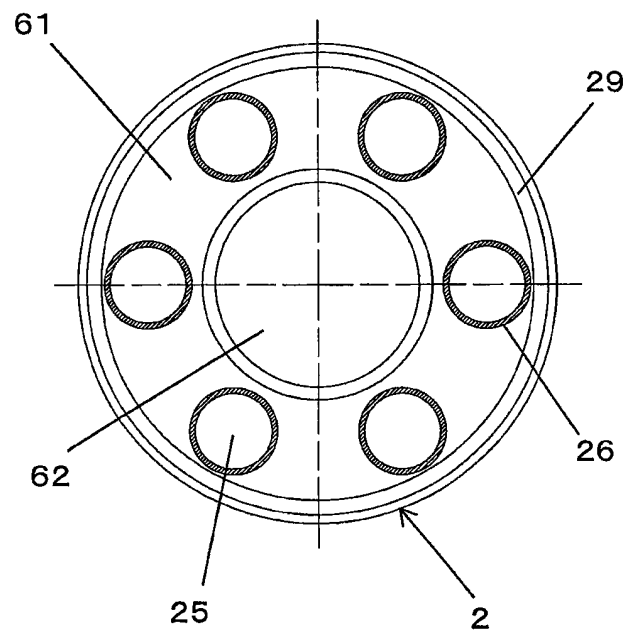


FIG. 7



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/064885

A. CLASSIFICATION OF SUBJECT MATTER

F04C18/02 (2006.01) i, F04C29/00 (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)

F04C18/02, F04C29/00

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	1996-2011
Kokai Jitsuyo Shinan Koho	1971-2011	Toroku Jitsuyo Shinan Koho	1994-2011

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.
Y	JP 8-74754 A (Toyoda Automatic Loom Works, Ltd.), 19 March 1996 (19.03.1996), paragraphs [0018] to [0023]; fig. 1 to 2 (Family: none)	1-7
Y	JP 4262949 B2 (Nippon Soken, Inc.), 13 May 2009 (13.05.2009), paragraphs [0016] to [0028]; fig. 1 to 2 & DE 10341104 A1	1-7
Y	JP 2000-220582 A (Sanyo Electric Co., Ltd.), 08 August 2000 (08.08.2000), paragraphs [0019] to [0026]; fig. 2 to 3 (Family: none)	3, 5

☒ Further documents are listed in the continuation of Box C.☐ See patent family annex.

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18 August, 2011 (18.08.11)Date of mailing of the international search report
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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2011/064885

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2009-24663 A (Sanden Corp.), 05 February 2009 (05.02.2009), paragraphs [0024] to [0026] (Family: none)	4-5

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

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Patent documents cited in the description

- JP 4262949 B [0004]