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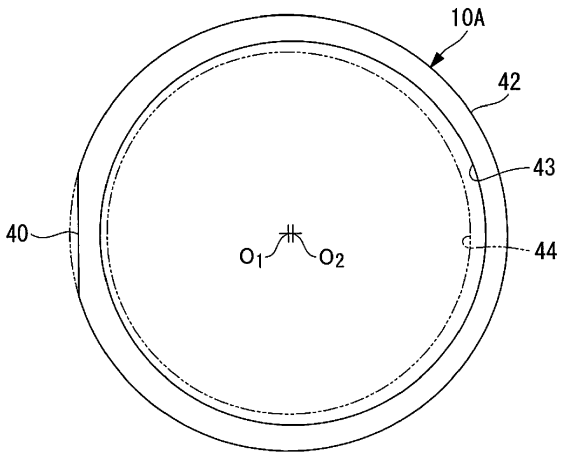
(54) HERMETIC COMPRESSOR AND METHOD OF PRODUCING HERMETIC COMPRESSOR

(57) Provided is a hermetic compressor, including a cylindrical member with a flat surface formed in the outer circumferential surface thereof, prevented from deforming, thereby ensuring the reliability. Also provided is a method of producing the hermetic compressor. The hermetic compressor includes a center housing (10A) including a cylindrical member. The cylindrical member includes an outer surface (42) of which cross-section obtained by cutting the cylindrical member in a direction perpendicular to an axial direction has an outer circumferential surface with a predetermined outer diameter and a cylindrical inner surface (43) of which cross-section of the cylindrical member has a predetermined inner diameter.

The outer surface (42) includes a flat surface (40) located closer to a center (O_1) of the outer circumferential surface than the outer circumferential surface is. A center (O_2) of the inner surface (43) of the cylindrical member is located on a side of the center (O_1) of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface (40) lies.

FIG. 2



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Description

[Technical Field]

[0001] The present invention relates to airtight compressors and methods of producing hermetic compressors.

[Background Art]

[0002] Some compressors are installed in air conditioning devices, refrigerating devices, and the like provided with refrigeration circuits through which refrigerant circulates. Among such compressors, those with a compressing mechanism and an electric motor installed in an airtight container are also referred to as hermetic compressors. The compressing mechanism installed in the hermetic compressor is of, for example, scroll type or rotary type, and one or more compressing mechanisms may be mounted on a rotating shaft.

[0003] The housing of the hermetic compressor usually has a cylindrical shape, and thus the outer circumferential surface thereof is curved. The housing is provided with connecting terminals for supplying power to the electric motor installed in the housing. The connecting terminals are secured to the housing by welding.

[0004] To connect the connecting terminals to the housing, a flat surface is formed in the curved outer circumferential surface of the housing by, for example, cutting such that welding electrodes can closely adhere to the surface during welding.

[0005] Patent Literature 1 described below discloses a technology regarding an airtight container in which compressor components (compressing mechanism) of a scroll compressor are installed. In Patent Literature 1, a flat surface to which connecting terminals are resistance welded is formed in the body of the airtight container on the outer side of the inner circumferential surface of the body.

[Citation List]

[Patent Literature]

[0006] [PTL 1] Japanese Unexamined Patent Application, Publication No. H09-14158

[Summary of Invention]

[Technical Problem]

[0007] The housing of hermetic compressors known in the art has been cylindrical, and the cross-sectional shape obtained by cutting the housing in a direction perpendicular to the axial direction has a predetermined thickness. In other words, the center of the outer surface and the center of the inner surface of the cylindrical housing correspond to each other. The cylindrical member of the housing may be produced by bending a steel element into a cylindrical shape and then by welding the opposing faces of the steel element to each other.

[0008] In a case where a refrigerant with a relatively high pressure such as CO_2 is used in a hermetic compressor, the housing is produced by machining a general-purpose (commercial) cylindrical steel pipe. In this case, the housing made of the steel pipe, which is integrally molded, can withstand high pressure compared with the case where a steel element is bent and welded.

[0009] The outer diameters and the thicknesses of general-purpose steel pipes are defined in accordance with standards such as Japanese Industrial Standards (JIS). In the case where a general-purpose steel pipe is used to produce the housing, a flat surface formed in the outer circumferential surface of the above-described housing is located on the inner side of the outer circumferential surface of the housing, and thus the thickness of the housing at the flat surface is smaller than the thickness of the other part.

[0010] Since the cylindrical member is reduced in thickness at the flat surface of the housing to which the connecting terminals are connected, the cylindrical member has a lower strength at the flat surface and thus readily deforms. This reduces the reliability of the housing as a pressure vessel. For example, in order for the housing to attain a sufficient thickness at the flat surface, the cylindrical member needs to be formed using a steel pipe that does not conform to standards such as JIS or a steel pipe that is not distributed as a general-purpose product. In a case where a steel pipe distributed as a general-purpose product is used, a large steel pipe needs to be chosen and cut from the outer circumferential surface thereof to obtain a housing with a desired thickness.

[0011] The present invention has been made in consideration of the above-described circumstances. An object of the present invention is to provide a hermetic compressor, including a cylindrical member with a flat surface formed in the outer circumferential surface thereof and prevented from deforming, thereby ensuring the reliability more readily. Another object of the present invention is to provide a method of producing the hermetic compressor.

[Solution to Problem]

[0012] A hermetic compressor according to a first aspect of the present invention includes a housing including a cylindrical member. The cylindrical member includes an outer surface of which cross-section obtained by cutting the cylindrical member in a direction perpendicular to an axial direction has an outer circumferential surface with a predetermined outer diameter and a cylindrical inner surface of which cross-section of the cylindrical member has a predetermined inner diameter. The outer surface includes a flat surface located closer to a center of the outer circumferential surface than the outer circumferential surface is. A center of the inner surface of

the cylindrical member is located on a side of the center of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface lies.

[0013] According to this configuration, the housing includes the cylindrical member. The outer surface of the cylindrical member having the outer circumferential surface with the predetermined outer diameter includes the flat surface located closer to the center of the outer circumferential surface than the outer circumferential surface of the cylindrical member is, and the inner surface of the cylindrical member has the predetermined inner diameter. The center of the inner surface of the cylindrical member is located on the side of the center of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface lies. Thus, although the flat surface formed in the outer surface is located closer to the center than the outer circumferential surface of the cylindrical member is, the cylindrical member is made thick at a portion corresponding to the flat surface compared with a case where the center of the outer surface and the center of the inner surface of the cylindrical member correspond to each other. This increases the strength of the cylindrical member, and prevents deformation.

[0014] In the first aspect described above, a thickness of a thinnest portion between the outer surface and the inner surface at the flat surface formed in the outer surface may be equal to a thickness of a thinnest portion between the outer surface and the inner surface on a side remote from the flat surface formed in the outer surface.

[0015] According to this configuration, the stress acting on the thinnest portion between the outer surface and the inner surface at the flat surface formed in the outer surface and the stress acting on the thinnest portion between the outer surface and the inner surface on the side remote from the flat surface formed in the outer surface can be substantially equal.

[0016] In the first aspect described above, the flat surface formed in the outer surface may have a through-hole, and a connecting terminal electrically connected to an electric motor may be secured to the through-hole.

[0017] According to this configuration, the through-hole is formed in the flat surface formed in the outer surface, and the connecting terminal electrically connected to the electric motor is secured to the through-hole. When the connecting terminal is secured to the through-hole in the flat surface formed in the outer surface, the securing portion of the connecting terminal is thick enough to ensure the strength.

[0018] A method of producing an hermetic compressor according to a second aspect of the present invention, the hermetic compressor including a housing including a cylindrical member, the cylindrical member including an outer surface of which cross-section obtained by cutting the cylindrical member in a direction perpendicular to an axial direction has an outer circumferential surface with a predetermined outer diameter and a cylindrical inner surface of which cross-section of the cylindrical member has a predetermined inner diameter, includes forming a flat surface in the outer surface at a position closer to a center of the outer circumferential surface than the outer circumferential surface is; and forming the inner surface such that a center of the inner surface of the cylindrical member is located on a side of the center of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface lies.

[Advantageous Effects of Invention]

[0019] According to the present invention, a cylindrical member including a flat surface formed in the outer circumferential surface thereof is prevented from deforming, thereby ensuring the reliability more readily.

[Brief Description of Drawings]

[0020]

[Fig. 1] Fig. 1 is a longitudinal sectional view illustrating a hermetic compressor according to an embodiment of the present invention.

[Fig. 2] Fig. 2 is a lateral sectional view of a center housing of the hermetic compressor according to the embodiment of the present invention, illustrating a state before a through-hole is formed in a flat surface.

[Fig. 3] Fig. 3 is a partially enlarged longitudinal sectional view of the center housing of the hermetic compressor according to the embodiment of the present invention, illustrating the state before the through-hole is formed in the flat surface.

[Fig. 4] Fig. 4 is a lateral sectional view of a center housing of a known hermetic compressor, illustrating a state before a through-hole is formed in a flat surface.

[Fig. 5] Fig. 5 is a partially enlarged longitudinal sectional view of the center housing of the known hermetic compressor, illustrating the state before the through-hole is formed in the flat surface.

[Description of Embodiments]

[0021] An embodiment of the present invention will now be described with reference to the drawings. In the description below, a hermetic compressor according to an embodiment of the present invention is applied to an airtight multistage compressor for an air conditioning device or a refrigerating device.

[0022] In this embodiment, the present invention is applied to an airtight multistage compressor (multistage compressor) 1 including a rotary compressor 2 at a lower stage and a scroll compressor 3 at a higher stage as an example. However, the present invention is also applicable to, for example, single-stage scroll compressors or multistage scroll compressors including scroll compressors at both the lower and higher stages.

[0023] As illustrated in Fig. 1, the multistage compressor 1 provided with the rotary compressor 2 and the scroll compressor 3 includes an airtight housing 10. The airtight housing 10 includes a cylindrical center housing 10A, a bearing member 31 swaged to an upper portion of the center housing 10A, a lower housing 10B hermetically sealing a lower portion of the center housing 10A, and an upper housing 10C welded to the entire circumference of the center housing 10A above the bearing member 31 to hermetically seal the upper portion of the center housing 10A.

[0024] An electric motor 4 including a stator 5 and a rotor 6 is securely installed inside the center housing 10A substantially in a central area of the center housing 10A. A rotating shaft (crankshaft) 7 is integrated with the rotor 6. The rotary compressor 2 at the lower stage is disposed below the electric motor 4. The rotary compressor 2 at the lower stage includes a cylinder body 21 provided with a cylinder chamber 20 and secured inside the center housing 10A, an upper bearing 22 secured to the top of the cylinder body 21 to hermetically seal the upper portion of the cylinder chamber 20, a lower bearing 23 secured to the bottom of the cylinder body 21 to hermetically seal the lower portion of the cylinder chamber 20, a rotor 24 engaging with a crank portion 7A of the rotating shaft 7 and rotatable on the inner circumferential surface of the cylinder chamber 20, blades (not illustrated) partitioning the cylinder chamber 20 into a suction side and a discharge side, blade retaining springs, and other components.

[0025] The rotary compressor 2 first sucks low-pressure refrigerant gas into the cylinder chamber 20 via a suction pipe 25, and compresses the refrigerant gas to an intermediate pressure using the rotation of the rotor 24. The rotary compressor 2 then discharges the resultant refrigerant gas into a discharge chamber 26 formed above the cylinder chamber 20 using the upper bearing 22 and into a discharge chamber 27 formed below the cylinder chamber 20 using the lower bearing 23. The refrigerant gas then joins in the discharge chamber 26, and is discharged into the center housing 10A. The intermediate-pressure refrigerant gas is led through a gas channel or other paths formed in the rotor 6 of the electric motor 4 to a space above the electric motor 4, and is sucked into the scroll compressor 3 at the higher stage to be further compressed.

[0026] The scroll compressor 3 at the higher stage is disposed inside the upper housing 10C. The scroll compressor 3 includes the bearing member 31 provided with a bearing 30 supporting the rotating shaft (crankshaft) 7, a fixed scroll member 32 including a spiral lap 32B extending from an end plate 32A, and an orbiting scroll member 33 including a spiral lap 33B extending from an end plate 33A. The fixed scroll member 32 and the orbiting scroll member 33 constitute a pair of compression chambers 34 by engaging and mounting the spiral laps 32B and 33B on the bearing member 31.

[0027] The scroll compressor 3 further includes an orbiting boss 33C joining the orbiting scroll member 33 and an eccentric pin 7B of the rotating shaft 7 via a drive bush 13 to drive the orbiting scroll member 33 to revolve, a rotation prevention mechanism 35 disposed between the orbiting scroll member 33 and the bearing member 31 and preventing the orbiting scroll member 33 from rotating to drive the orbiting scroll member 33 to revolve, a discharge valve 36 formed at the rear side of the fixed scroll member 32 to open and close a discharge port 32C, a discharge cover 38 secured to the rear side of the fixed scroll member 32 to surround the discharge valve 36, and a discharge pipe 39 connected to the central portion of the discharge cover 38 to discharge compressed high-temperature high-pressure gas to the outside.

[0028] The rotary compressor 2 disposed at the lower stage compresses and discharges refrigerant gas at the intermediate pressure to the airtight housing 10, and the scroll compressor 3 sucks the refrigerant gas into the compression chambers 34. The scroll compressor 3 then further compresses the intermediate-pressure refrigerant gas to a higher pressure using compression movement of the orbiting scroll member 33 that is driven to revolve, and discharges the resultant gas into the inside of the discharge cover 38 via the discharge valve 36. The high-temperature high-pressure refrigerant gas is sent to the outside of the multistage compressor 1, that is, to the refrigerating cycle via the discharge pipe 39.

[0029] Furthermore, a known displacement oil pump 14 is disposed between the lowest end portion of the rotating shaft (crankshaft) 7 and the lower bearing 23 of the rotary compressor 2 disposed at the lower stage. The displacement oil pump 14 draws up lubricant 15 filling the bottom portion of the airtight housing 10, and forcibly supplies the lubricant 15 to portions that require lubrication such as bearing portions of the rotary compressor 2 and the scroll compressor 3 through oil supply holes formed in the rotating shaft 7.

[0030] A through-hole 41 is formed in a flat surface 40 formed in an outer surface 42 of the center housing 10A. A connecting terminal 50 is secured to the through-hole 41, and is electrically connected to the electric motor 4. The connecting terminal 50 supplies power to the built-in electric motor 4 via a cable 53. The connecting terminal 50 includes a support portion 51 and a terminal portion 52 secured to the support portion 51. At the flat surface 40, the support portion 51 of the connecting terminal 50 is securely welded to the through-hole 41.

[0031] The center housing 10A of the airtight housing 10 will now be described in detail.

[0032] The center housing 10A of the airtight housing 10 is a cylindrical member having a hollow cylindrical shape and a predetermined length in the axial direction. The center housing 10A is produced by, for example, machining a general-purpose (commercial) cylindrical steel pipe defined by standards such as JIS. The steel pipe is integrally molded, and thus the center housing 10A can withstand high pressure compared with the case

where the steel pipe is produced by bending and welding a steel element. The steel pipe used for producing the center housing 10A has, for example, the JIS nominal diameter of 125A, that is, an outer diameter of 139.8 mm, and has the nominal thickness of Schedule 80, that is, a thickness of 9 mm.

[0033] The center housing 10A serving as a cylindrical member includes the outer surface 42 and an inner surface 43, and has a ring-shaped cross-section as illustrated in Fig. 2 when cut in a direction perpendicular to the axial direction.

[0034] The outer-circumferential-surface diameter of the outer surface 42 of the center housing 10A, that is, the outer diameter is fixed, and the outer circumferential surface is circular in cross section. The diameter of the inner surface 43 of the center housing 10A, that is, the inner diameter is fixed, and the inner surface 43 is circular in cross section.

[0035] The flat surface 40 to which the connecting terminal 50 is connected is formed in the outer surface 42 of the center housing 10A. This allows welding electrodes to closely adhere to the flat surface 40 to which the connecting terminal 50 is connected during welding, and thus allows the connecting terminal 50 to be stably welded to the center housing 10A. The flat surface 40 has, for example, a rectangular shape in the outer surface 42 when seen from the front.

[0036] The flat surface 40 is formed by, for example, cutting the outer circumferential surface of the cylindrical steel pipe. Herein, machining for diameter adjustment is not conducted on the outer circumferential surface of the steel pipe during the production of the center housing 10A.

[0037] The flat surface 40 is formed by cutting the outer circumferential surface of the steel pipe, and thus is located at a position in the center housing 10A closer to the center O_1 of the outer circumferential surface than the outer circumferential surface of the outer surface 42 of the center housing 10A is. In other words, the flat surface 40 is formed on the inner side of the outer circumferential surface of the steel pipe with a fixed outer diameter.

[0038] As illustrated in Fig. 2, the center O_1 of the outer circumferential surface of the center housing 10A does not correspond to the center O_2 of the inner surface 43. Consequently, the outer surface 42 and the inner surface 43 are decentered from each other. In other words, in the center housing 10A, the center O_2 of the inner surface 43 is located at a position different from the position of the center O_1 of the outer circumferential surface, and the center O_2 of the inner surface 43 is located on a side of the center O_1 of the outer circumferential surface opposite the side on which the flat surface 40 lies.

[0039] As illustrated in Figs. 4 and 5, in a case where an inner surface 83 of a known center housing 10A is machined such that the center O_3 of an outer surface 82 and the center O_4 of the inner surface 83 correspond to each other, that is, in a case where the outer surface 82 and the inner surface 83 are concentric, the thickness of the center housing 10A at a thinnest portion A_3 at a flat surface 80 formed in the outer surface 82 is smaller than the thickness at a thick portion A_4 located opposite the thinnest portion A_3 with the centers O_3 and O_4 interposed therebetween. In Figs. 4 and 5, an inner surface 84 of the steel pipe before cutting is indicated by long dashed double-short dashed lines.

[0040] On the other hand, in this embodiment, as illustrated in Figs. 2 and 3, the thickness of the center housing 10A at a thinnest portion A_1 at the flat surface 40 formed in the outer surface 42 is thick, and the thickness at a thinnest portion A_2 located opposite the thinnest portion A_1 with the centers O_1 and O_2 interposed therebetween is thin compared with the case where the center O_3 of the outer surface 82 and the center O_4 of the inner surface 83 of the center housing 10A correspond to each other.

[0041] Thus, although the flat surface 40 formed in the outer surface 42 is located closer to the center than the outer circumferential surface of the outer surface 42 of the center housing 10A is in this embodiment, the center O_1 of the outer circumferential surface and the center O_2 of the inner surface 43 are eccentric to each other, and thus the center housing 10A is made thick at a portion corresponding to the flat surface 40 compared with the case where the center O_3 of the outer surface 82 and the center O_4 of the inner surface 83 of the center housing 10A correspond to each other. This increases the strength of the center housing 10A, and prevents deformation. Consequently, the center housing 10A including the flat surface 40 formed in the outer circumferential surface thereof is prevented from deforming, thereby ensuring the reliability.

[0042] The inner surface 43 of a general-purpose steel pipe is, for example, cut such that the cross-section of the inner surface 43 of the center housing 10A has a circular shape. In Figs. 2 and 3, an inner surface 44 of the steel pipe before cutting is indicated by long dashed double-short dashed line. As a result of cutting or other machining, the center O_2 of the inner surface 43 is located at a position different from the position of the center O_1 of the outer circumferential surface. More specifically, the inner surface 43 is formed such that the center O_2 of the inner surface 43 is located on a side of the center O_1 of the outer circumferential surface opposite the side on which the flat surface 40 lies. Additionally, cutting or other machining yields a surface smoother than the surface before machining, and increases the accuracy of the circular shape.

[0043] The thickness of the thinnest portion A_1 having a smallest thickness between the outer surface 42 and the inner surface 43 at the flat surface 40 formed in the outer surface 42 substantially equals to the thickness of the thinnest portion A_2 having a smallest thickness between the outer surface 42 and the inner surface 43 on the side remote from the flat surface 40. This causes the stress acting on the thinnest portion A_1 at the flat surface 40 formed in the outer surface 42 and the stress acting

on the thinnest portion A_2 on the side remote from the flat surface 40 formed in the outer surface 42 to be substantially equal.

[0044] Alternatively, the thickness of the thinnest portion A_1 may be slightly larger than the thickness of the thinnest portion A_2. This reduces the stress concentrating on the flat surface 40 formed in the outer surface 42.

[0045] The through-hole 41 is formed in the flat surface 40 formed in the outer surface 42, and the support portion 51 of the connecting terminal 50 is secured to the through-hole 41. As described above, in this embodiment, the thickness at the flat surface 40 is large enough to prevent deformation compared with the known art, resulting in an increased strength of the securing portion of the connecting terminal 50.

[0046] According to this embodiment, the flat surface 40 formed in the outer surface 42 is located closer to the center O_1 than the outer circumferential surface of the center housing 10A is. Additionally, as illustrated in Figs. 2 and 3, the center O_1 of the outer circumferential surface and the center O_2 of the inner surface 43 are eccentric to each other, and thus the thickness of the center housing 10A at the portion corresponding to the flat surface 40 is larger than that in the known configuration. This increases the strength of the center housing 10A, and prevents deformation. Consequently, the center housing 10A including the flat surface 40 formed in the outer circumferential surface thereof is prevented from deforming, thereby ensuring the reliability.

[Reference Signs List]

[0047]

1	MULTISTAGE COMPRESSOR
2	ROTARY COMPRESSOR
3	SCROLL COMPRESSOR
4	ELECTRIC MOTOR
5	STATOR
6	ROTOR
7	ROTATING SHAFT
7A	CRANK PORTION
7B	ECCENTRIC PIN
10	AIRTIGHT HOUSING
10A	CENTER HOUSING
10B	LOWER HOUSING
10C	UPPER HOUSING
13	DRIVE BUSH
14	DISPLACEMENT OIL PUMP
15	LUBRICANT
20	CYLINDER CHAMBER
21	CYLINDER BODY
22	UPPER BEARING
23	LOWER BEARING
24	ROTOR
25	SUCTION PIPE
26	DISCHARGE CHAMBER
27	DISCHARGE CHAMBER
30	BEARING
31	BEARING MEMBER
32	FIXED SCROLL MEMBER
32A	END PLATE
32B	SPIRAL LAP
32C	DISCHARGE PORT
33	ORBITING SCROLL MEMBER
33A	END PLATE
33B	SPIRAL LAP
33C	ORBITING BOSS
34	COMPRESSION CHAMBER
35	ROTATION PREVENTION MECHANISM
36	DISCHARGE VALVE
38	DISCHARGE COVER
39	DISCHARGE PIPE
40	FLAT SURFACE
41	THROUGH-HOLE
42	OUTER SURFACE
43	INNER SURFACE
44	INNER SURFACE
50	CONNECTING TERMINAL
51	SUPPORT PORTION
52	TERMINAL PORTION
53	CABLE
82	OUTER SURFACE
83	INNER SURFACE
84	INNER SURFACE

Claims

1. A hermetic compressor comprising:

a housing (10) including a cylindrical member, wherein
the cylindrical member includes:

an outer surface (42) of which cross-section obtained by cutting the cylindrical member in a direction perpendicular to an axial direction has an outer circumferential surface with a predetermined outer diameter; and
a cylindrical inner surface (43) of which cross-section of the cylindrical member has a predetermined inner diameter,

the outer surface (42) includes a flat surface (40) located closer to a center (O_1) of the outer circumferential surface than the outer circumferential surface is,
characterized in that a center (O_2) of the inner surface (43) of the cylindrical member is located on a side of the center (O_1) of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface (40) lies.

2. The hermetic compressor according to claim 1, wherein a thickness of a thinnest portion between

the outer surface (42) and the inner surface (43) at the flat surface (40) formed in the outer surface (42) is equal to a thickness of a thinnest portion between the outer surface (42) and the inner surface (43) on a side remote from the flat surface (40) formed in the outer surface (42).

3. The hermetic compressor according to claim 1 or 2, wherein
the flat surface (40) formed in the outer surface (42) has a through-hole(41), and
a connecting terminal (50) electrically connected to an electric motor (4) is secured to the through-hole (41).

4. A method of producing an hermetic compressor, the hermetic compressor including a housing (10) including a cylindrical member, the cylindrical member including an outer surface (42) of which cross-section obtained by cutting the cylindrical member in a direction perpendicular to an axial direction has an outer circumferential surface with a predetermined outer diameter and a cylindrical inner surface of which cross-section of the cylindrical member has a predetermined inner diameter, the method comprising:

forming a flat surface (40) in the outer surface (42) at a position closer to a center (O_1) of the outer circumferential surface than the outer circumferential surface is; and
forming the inner surface (43) such that a center (O_2) of the inner surface (43) of the cylindrical member is located on a side of the center (O_1) of the outer circumferential surface of the cylindrical member opposite the side on which the flat surface (40) lies.

FIG. 1

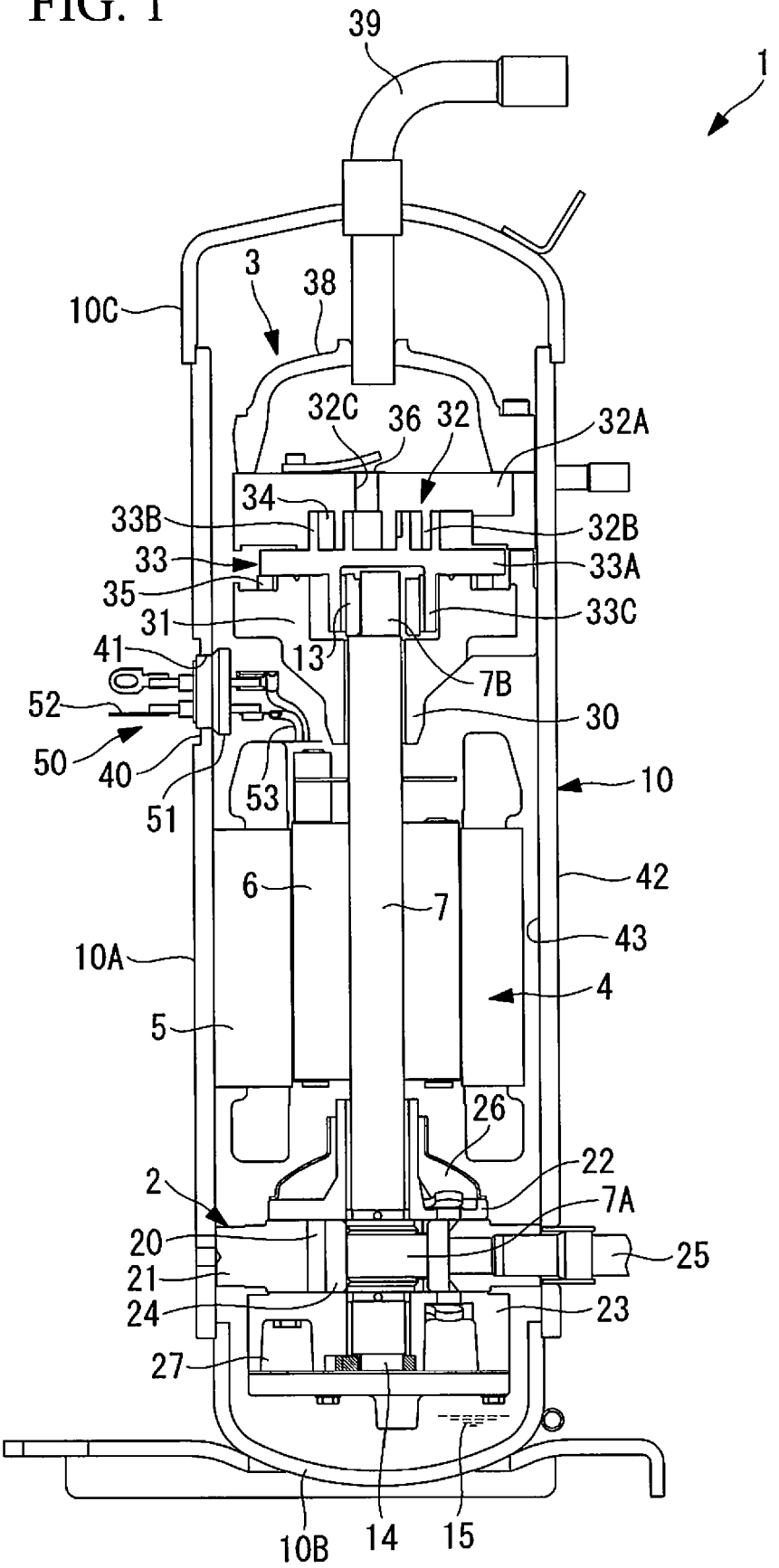
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FIG. 2

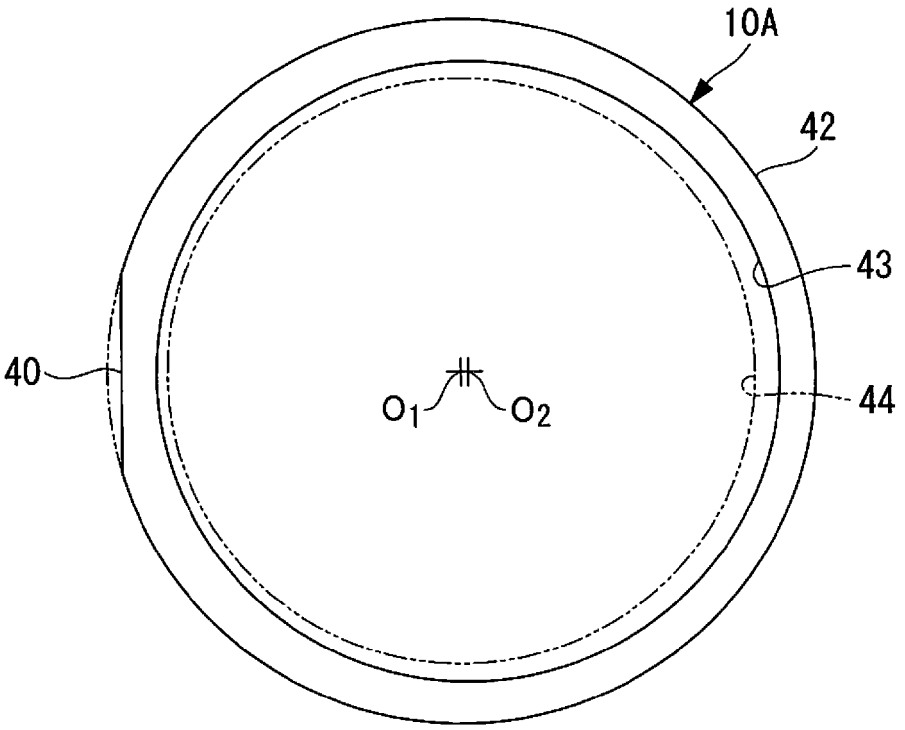


FIG. 3

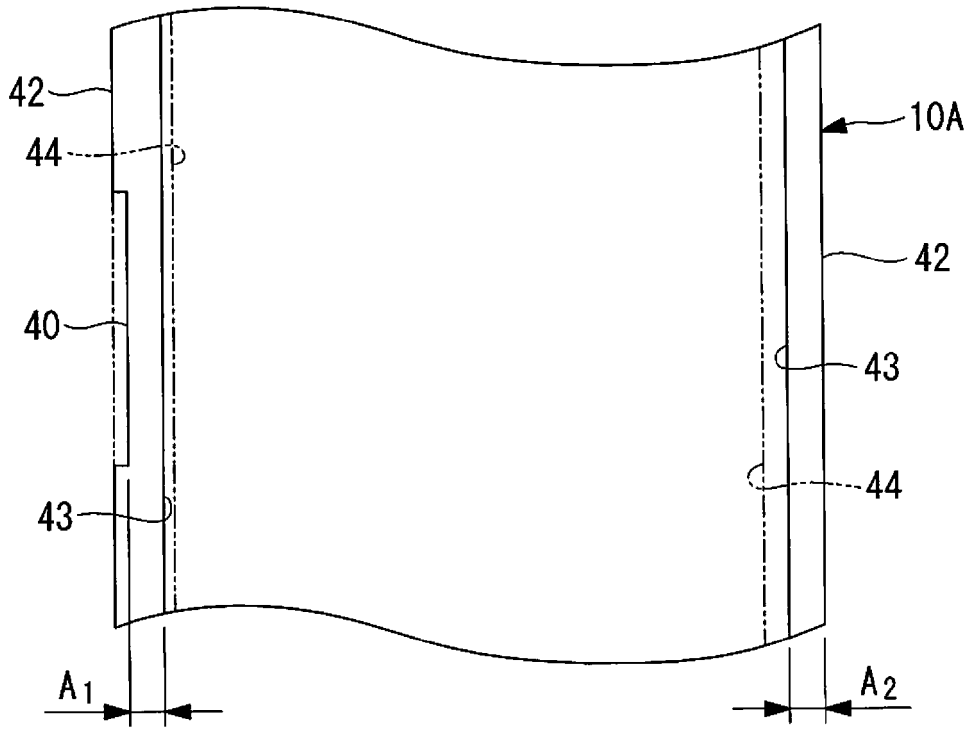


FIG. 4

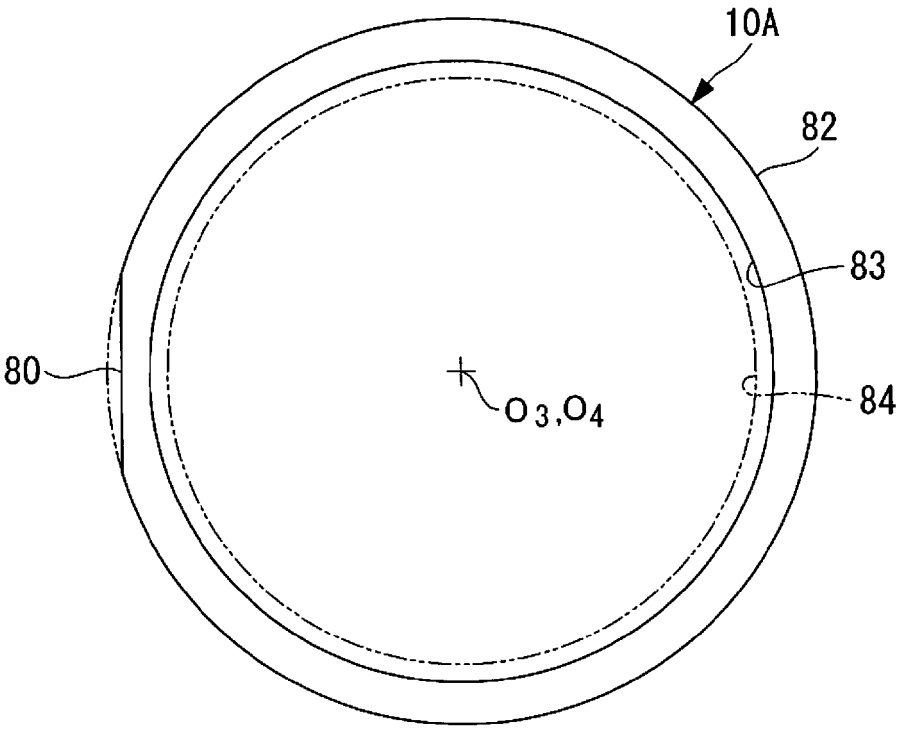
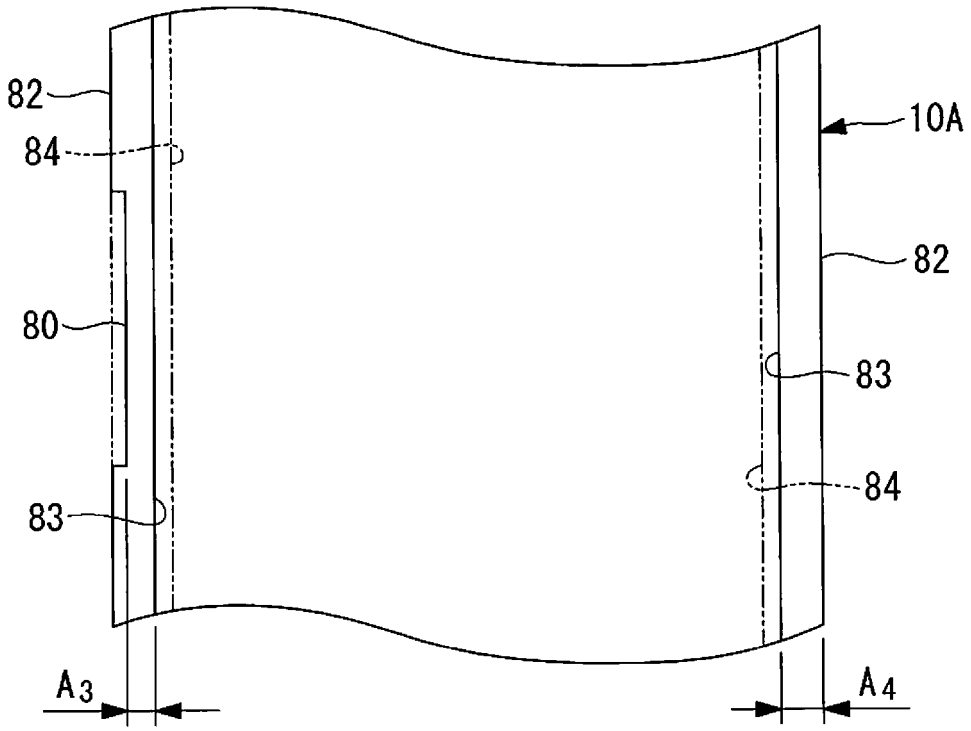


FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 18 17 1772

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A,D	JP H09 14158 A (MATSUSHITA ELECTRIC IND CO LTD) 14 January 1997 (1997-01-14) * abstract * *	1-4	INV. F04B39/12 F04C23/00
A	US 2008/173644 A1 (TOMELL PHILLIP A [US]) 24 July 2008 (2008-07-24) * paragraph [0027]; figures 4,5 *	1-4	ADD. F04C18/02
A	US 5 584 716 A (BERGMAN ERNEST [US]) 17 December 1996 (1996-12-17) * column 7, lines 40-48; figure 8 *	1-4	
A	US 2008/008608 A1 (TADANO MASAYA [JP] ET AL) 10 January 2008 (2008-01-10) * paragraph [0225]; figure 28 *	1-4	

TECHNICAL FIELDS SEARCHED (IPC)

F04B
F04C
F01C

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	7 September 2018	Homan, Peter

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 18 17 1772

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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07-09-2018

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
JP H0914158 A	14-01-1997	NONE	
US 2008173644 A1	24-07-2008	CA 2618356 A1	22-07-2008
		US 2008173644 A1	24-07-2008
US 5584716 A	17-12-1996	CN 1117658 A	28-02-1996
		KR 100359634 B1	14-01-2003
		US 5584716 A	17-12-1996
US 2008008608 A1	10-01-2008	EP 1298324 A2	02-04-2003
		EP 1517036 A2	23-03-2005
		EP 1517041 A2	23-03-2005
		EP 1522733 A2	13-04-2005
		EP 1703129 A2	20-09-2006
		EP 1703130 A2	20-09-2006
		EP 1703131 A2	20-09-2006
		EP 1703132 A2	20-09-2006
		EP 1703133 A2	20-09-2006
		ES 2398245 T3	14-03-2013
		ES 2398363 T3	15-03-2013
		ES 2398963 T3	22-03-2013
		KR 20030028388 A	08-04-2003
		KR 20080071954 A	05-08-2008
		KR 20080071955 A	05-08-2008
		KR 20080071956 A	05-08-2008
		KR 20080071957 A	05-08-2008
		KR 20080071958 A	05-08-2008
		KR 20080071959 A	05-08-2008
		KR 20080071960 A	05-08-2008
		KR 20080071961 A	05-08-2008
		US 2003068236 A1	10-04-2003
		US 2004151603 A1	05-08-2004
		US 2004154329 A1	12-08-2004
		US 2004165998 A1	26-08-2004
		US 2004165999 A1	26-08-2004
		US 2006168994 A1	03-08-2006
		US 2008008608 A1	10-01-2008
		US 2008075609 A1	27-03-2008

EPO FORM P0459

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP H0914158 B **[0006]**