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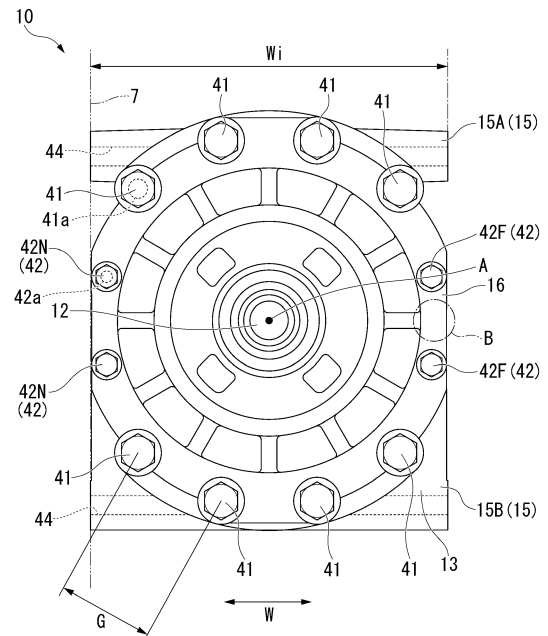
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(54) **COMPRESSOR AND COMPRESSOR SYSTEM**

(57) The compressor 10 includes a compression mechanism having a rotating shaft 12, a housing having a housing main body having a tubular side wall extending along an axial direction and a bottom portion connected to one end of the side wall, the other end of the side wall being a planar first end surface extending in a circumferential direction, a front case 16 blocking the housing, and a plurality of bolts 41 and 42 annularly spaced apart in a circumferential direction of an axis A and fastening the front case 16 to the housing. The bolts have a plurality of first bolts 41 and second bolts 42 disposed between the first bolts 41 adjacent to each other in the circumferential direction, having shaft portions 42a smaller in diameter than shaft portions 41a of the first bolts 41, and fastening the front case 16 to the housing.

FIG. 3



Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a compressor and a compressor system.

Description of Related Art

[0002] Known is a compressor system used in an automotive freezing unit for a large truck or the like and having a compressor compressing a refrigerant gas (see, for example, Japanese Unexamined Patent Application, First Publication No. 2001-18704). For example, the compressor system is used after being connected to an evaporator system by means of refrigerant piping.

[0003] The compressor has a tubular housing accommodating a compression mechanism. In general, the outer surface of the housing is disposed so as to be along a planar attachment surface in the interest of space efficiency when the compressor is mounted.

SUMMARY OF THE INVENTION

[0004] In a case where a vehicle such as a large truck is equipped with the compressor, the compressor and the compressor system are desired to be further reduced in size due to a limited compressor attachment space.

[0005] The present invention provides a compressor capable of improving the degree of freedom in housing design and achieving housing width reduction as a result and a compressor system provided with the compressor.

[0006] According to a first aspect of the present invention, a compressor includes a compression mechanism having a rotating shaft, a housing accommodating the compression mechanism and having a housing main body having a tubular side wall extending along an axial direction of the rotating shaft and a bottom portion connected to one end of the side wall in the axial direction, an other end of the side wall in the axial direction being a first end surface formed in a plane and extending in a circumferential direction of an axis, a front case having a second end surface facing the first end surface and blocking the housing, and a plurality of bolts disposed in annular shape by being spaced apart in the circumferential direction of the axis and fastening the front case to the housing. The plurality of bolts have a plurality of first bolts and second bolts disposed between the first bolts adjacent to each other in the circumferential direction, having shaft portions smaller in diameter than shaft portions of the plurality of first bolts, and fastening the front case to the housing.

[0007] With this configuration, the degree of freedom in housing and front case design can be improved as compared with a case where a front case is fastened by means of a plurality of bolts having the same shaft portion

diameter. Especially, housing width reduction can be achieved from a reduction in the diameter of the shaft portion of the second bolt.

[0008] In the compressor described above, the housing may have a fixing portion for attaching the housing main body to an attachment target such that the side wall of the housing main body is along an attachment surface of the attachment target and the second bolts may include a bolt closest to the attachment surface and a bolt farthest from the attachment surface among the plurality of bolts disposed in annular shape by being spaced apart in the circumferential direction.

[0009] With this configuration, it is possible to reduce the size of the second end surface where bolt holes into which the second bolts are fitted are formed. Accordingly, the width of the compressor can be reduced with ease. In addition, the gaps of the bolts adjacent to each other in the circumferential direction can be equal as a result.

[0010] In the compressor described above, the plurality of bolts may be disposed at equal intervals in the circumferential direction.

[0011] With this configuration, the circumferential distribution of the fastening force resulting from fastening of the plurality of bolts can be close to being uniform.

[0012] In the compressor described above, the plurality of bolts may have a third bolt and a shaft portion of the third bolt may be smaller in diameter than the shaft portions of the plurality of first bolts and larger in diameter than the shaft portions of the second bolts.

[0013] With this configuration, the degree of freedom in housing and front case design can be improved as compared with a case where a front case is fastened by means of a plurality of bolts having the same shaft portion diameter.

[0014] According to a second aspect of the present invention, a compressor system may include a bracket, a drive source fixed to the bracket, and the above-described compressor fixed to the bracket and driven by the drive source.

[0015] With this configuration, the compressor can be more firmly fixed to the bracket against the force applied to the compressor due to vibration, belt tension, or the like by the width of the compressor being reduced. As a result, product reliability can be further improved.

[0016] According to a third aspect of the present invention, a compressor system may include a drive source and the above-described compressor fixed to the drive source and driven by the drive source.

[0017] According to the present invention, the degree of freedom in housing and front case design can be improved as compared with a case where a front case is fastened by means of a plurality of bolts having the same shaft portion diameter. Especially, housing width reduction can be achieved from a reduction in the diameter of the shaft portion of the second bolt.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018]

FIG. 1 is a front view of a compressor system of an embodiment of the present invention.

FIG. 2 is a cross-sectional view showing the configuration of a compressor of the embodiment of the present invention.

FIG. 3 is a III arrow view of FIG. 2 and a front view of the compressor of the embodiment of the present invention.

FIG. 4 is a front view of a compressor of a first modification example of the embodiment of the present invention.

FIG. 5 is a front view of a compressor system of a second modification example of the embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Hereinafter, a compressor and a compressor system according to an embodiment of the present invention will be described in detail with reference to accompanying drawings.

[0020] The compressor system of the present embodiment is used in, for example, an automotive freezing unit for a large truck or the like. For example, the compressor system is used after being connected to an evaporator system by means of refrigerant piping.

[0021] As shown in FIG. 1, a compressor system 1 has a bracket 2, an engine 3 (drive source) fixed to the bracket 2, and a compressor 10 (open type compressor) driven by the engine 3. The compressor system 1 is attached below a freezer 5 of, for example, a large truck equipped with a freezing unit. The bracket 2 is an attachment target of the compressor 10 and has a flat attachment surface 7.

[0022] The engine 3 and the compressor 10 are fixed to the attachment surface 7 of the bracket 2 such that a drive shaft 4 of the engine 3 and a rotating shaft 12 of the compressor 10 are parallel. The power of the engine 3 is transmitted to the compressor 10 via a belt 6.

[0023] As shown in FIG. 2, the compressor 10 is provided with a compression mechanism 11 having the rotating shaft 12, a housing 13 accommodating the compression mechanism 11, and a front case 16 blocking the housing 13.

[0024] In the following description, the direction in which an axis A of the rotating shaft 12 extends is referred to as an axial direction Da and the direction that is orthogonal to the attachment surface 7 (see FIG. 1). The axis A and along the normal of the attachment surface 7 is referred to as a width direction W.

[0025] The housing 13 has a housing main body 14 and two fixing portions 15 for attaching the compressor 10 to the bracket 2 (see FIG. 1).

[0026] The housing main body 14 has a bottomed tubular shape having a tubular side wall 17 extending along

the axial direction Da and a bottom portion 18 connected to one end of the side wall 17 in the axial direction Da. A planar first end surface 19 extending in a circumferential direction is formed at the other end of the side wall 17 in the axial direction Da. The first end surface 19 is the end surface of the opening portion of the housing main body 14 having the bottomed tubular shape. The first end surface 19 is formed in a planar shape orthogonal to the axis A. The first end surface 19 is a surface formed in an annular shape. The first end surface 19 is a surface facing the axial direction Da.

[0027] The front case 16 is attached to the opening portion formed in the housing 13 so as to block the opening portion. The front case 16 has a second end surface 20 facing the first end surface 19. The front case 16 has a boss portion 16A protruding to one side in the axial direction Da. An O-ring 32 is attached to the outer peripheral surface of the boss portion 16A.

[0028] A sealed space is formed inside by the front case 16 being attached to the housing 13 and the O-ring 32 coming into close contact with the inner peripheral surface of the housing 13. The compression mechanism 11 is accommodated in the sealed space. Formed in the outer peripheral surface of the housing 13 is a suction port 21 allowing a fluid (refrigerant gas) to flow into the sealed space and a discharge port 22 through which the fluid is discharged from the sealed space to the outside after being compressed by the compression mechanism 11.

[0029] The compression mechanism 11 has the columnar rotating shaft 12 extending along the axis A and a scroll compression unit 23 connected to the rotating shaft 12. The rotating shaft 12 is rotatably supported by the front case 16 via a main bearing 24 and a sub bearing 25. The other end of the rotating shaft 12 protrudes from the front case 16 to the outside via a seal portion 26. A pulley 28 rotatably installed in the outer peripheral portion of the front case 16 via a bearing 27 is connected to the other end of the rotating shaft 12 via an electromagnetic clutch 29. Power from the engine 3 driving the pulley 28 is transmitted to the rotating shaft 12 via the electromagnetic clutch 29 and rotation occurs around the axis A.

[0030] The electromagnetic clutch 29 has an armature plate 30 integrally provided on the rotating shaft 12 and an electromagnet 31 generating a magnetic force acting on the armature plate 30 by being excited.

[0031] The electromagnet 31 attracts the armature plate 30 to the electromagnet 31 side when the electromagnet 31 is excited by electric power supply from the outside. As a result, the pulley 28 and the armature plate 30 abut against each other and the rotational force of the pulley 28 is transmitted to the armature plate 30. In other words, the armature plate 30 rotates around the axis A integrally with the pulley 28.

[0032] In a case where the electromagnet 31 is not energized, the rotational force of the pulley 28 is not transmitted to the armature plate 30. In other words, the pulley 28 becomes idle. The operations of the armature plate

30 and the rotating shaft 12 are controlled by the operation.

[0033] A crank pin 33 eccentric in the radial direction of the axis A is integrally provided at one end of the rotating shaft 12. An orbiting scroll 34 of the scroll compression unit 23 is connected to one end of the rotating shaft 12 via the crank pin 33.

[0034] The scroll compression unit 23 compresses the fluid flowing in from the suction port 21 and discharges the fluid from the discharge port 22 by being driven by the rotating shaft 12. As for the scroll compression unit 23, a compression chamber 36 is formed between a fixed scroll 35 and the orbiting scroll 34 by the fixed scroll 35 and the orbiting scroll 34 engaging with each other with a shift in phase of 180°.

[0035] The fixed scroll 35 and the orbiting scroll 34 have end plates 34A and 35A and spiral wraps 34B and 35B provided on the respective end plates 34A and 35A. A discharge port 37 allowing the compressed fluid to be discharged is formed in the central portion of the fixed scroll 35. The fixed scroll 35 is fixed to the bottom portion 18 of the housing 13 via a bolt 38. The orbiting scroll 34 is connected to the crank pin 33 of the rotating shaft 12 via a driven crank mechanism 39 and supported so as to be capable of revolving with respect to the fixed scroll 35.

[0036] An O-ring 40 is attached to the outer peripheral portion of the end plate 35A of the fixed scroll 35. The internal space of the housing 13 is divided into a discharge chamber S2 and a suction chamber S1 by the O-ring 40 coming into close contact with the inner peripheral surface of the housing 13.

[0037] The suction chamber S1 communicates with the suction port 21 formed in the housing 13. A low-pressure fluid taken in through the suction port 21 is suctioned into the compression chamber 36 through the suction chamber S1. In addition, the fluid (compressed refrigerant gas) supplied from the compression chamber 36 flows into the discharge chamber S2 via the discharge port 37.

[0038] The main bearing 24 supports the rotating shaft 12 on the axis A. The main bearing 24 is disposed closer to the scroll compression unit 23 side than the sub bearing 25. The main bearing 24 is a ball bearing larger in outer diameter than the sub bearing 25.

[0039] The sub bearing 25 is disposed closer to the scroll compression unit 23 side than the seal portion 26. The sub bearing 25 is a needle bearing smaller in outer diameter than the main bearing 24.

[0040] Next, the fixing portion 15 of the housing 13 will be described.

[0041] As shown in FIG. 3, the fixing portion 15 of the housing 13 has a bolt insertion hole 44 that extends in a direction orthogonal to the axis A and is formed integrally with the housing main body 14 on the outer surface of the housing main body 14 (see FIG. 2). One fixing portion 15 (15A) is provided on one side of the housing 13 in the width direction W. The other fixing portion 15 (15B) is

provided on the other side of the housing 13 in the width direction W. The length of the fixing portion 15 in the width direction W is substantially equal to the width of the housing main body 14 in the width direction W. The compressor 10 is fixed to the bracket 2 by a bolt 8 (see FIG. 1) inserted through the bolt insertion hole 44.

[0042] The front case 16 is fixed to the housing 13 by a plurality of bolts 41 and 42.

[0043] The bolts 41 and 42 are disposed at equal intervals in the circumferential direction of the axis A. In other words, gaps G of the bolts 41 and 42 adjacent to each other in the circumferential direction of the axis A are substantially the same.

[0044] The bolts 41 and 42 have a plurality of (eight in the present embodiment) first bolts 41 and a plurality of (four in the present embodiment) second bolts 42. The nominal diameter of the first bolt 41 is different from the nominal diameter of the second bolt 42. The diameter of the shaft portion of the first bolt 41 is larger than the diameter of the shaft portion of the second bolt 42.

[0045] The four second bolts 42 are disposed at both ends in the normal direction (width direction W) of the attachment surface 7 among the plurality of bolts 41 and 42. In other words, the second bolts 42 include the bolt closest to the attachment surface 7 (a second bolt 42N in FIG. 3) and the bolt farthest from the attachment surface 7 (a second bolt 42F in FIG. 3) among the plurality of bolts 41 and 42. In other words, the second bolts 42 are the bolts disposed at both ends in the width direction W orthogonal to the attachment surface 7 among the plurality of bolts 41 and 42. In this embodiment, these bolts are composed the eight first bolts 41 and the four second bolts 42 disposed outside the eight first bolts 41 in the width direction W.

[0046] Specifically, a set of four first bolts 41 and a set of two second bolts 42 are alternately disposed in the circumferential direction. One set of two second bolts 42 is disposed on one side in the width direction W. The other set of two second bolts 42 is disposed on the other side in the width direction W.

[0047] According to the embodiment described above, the degree of freedom in design of the housing 13 and the front case 16 can be improved as compared with a case where the front case 16 is fastened by means of a plurality of bolts having the same shaft portion diameter. In other words, it is possible to reduce the width of the housing 13 by reducing the diameter of the shaft portion of the second bolt 42.

[0048] In addition, it is possible to reduce the size of the second end surface 20 (B part in FIG. 3) where bolt holes into which the second bolts 42 are fitted are formed by disposing the second bolts 42 at both ends in the normal direction of the attachment surface 7. Accordingly, a width W_i of the compressor 10 can be reduced with ease. In addition, the gaps of the bolts adjacent to each other in the circumferential direction can be equal as a result.

[0049] In addition, the bolts 41 and 42 are disposed at

equal intervals in the circumferential direction. As a result, the circumferential distribution of the fastening force resulting from fastening of the plurality of bolts 41 and 42 can be close to being uniform.

[0050] In addition, the compressor 10 can be more firmly fixed to the bracket 2 against the force applied to the compressor 10 due to vibration, belt tension, or the like by the width W_i of the compressor 10 being reduced. As a result, product reliability can be further improved.

[0051] Although the second bolts 42 are disposed at both ends in the width direction W in the embodiment described above, the present invention is not limited thereto. The first bolt 41 and the second bolt 42 may be mixed. For example, the first bolt 41 and the second bolt 42 may be alternately disposed in the circumferential direction.

<First Modification Example>

[0052] Hereinafter, a first modification example of the embodiment of the present invention will be described in detail with reference to accompanying drawings. The description of the first modification example of the embodiment will focus on differences from the embodiment described above and similar parts will not be described below.

[0053] As shown in FIG. 4, the front case 16 is fixed to the housing 13 by three types of bolts 41, 42, and 43 in a compressor 10B of the first modification example.

[0054] The first bolt 41, the second bolt 42, and the third bolt 43 are the plurality of bolts of the modification example. The third bolt 43 is adjacent to the first bolt 41. The first bolt 41 and the second bolt 42 are adjacent to the third bolt 43. The third bolt 43 is adjacent to the second bolt 42.

[0055] The diameter of the shaft portion of the third bolt 43 is smaller than the diameter of the shaft portion of the first bolt 41 and larger than the diameter of the shaft portion of the second bolt 42. In other words, the third bolt 43 smaller in diameter than the first bolt 41 and larger in diameter than the second bolt 42 is disposed between the first bolt 41 having the largest diameter and the second bolt 42 having the smallest diameter.

[0056] With this configuration, the degree of freedom in design of the housing 13 and the front case 16 can be improved as compared with a case where the front case 16 is fastened by means of a plurality of bolts having the same shaft portion diameter.

<Second Modification Example>

[0057] Hereinafter, a second modification example of the embodiment of the present invention will be described in detail with reference to accompanying drawings. The description of the second modification example will focus on differences from the embodiment described above and similar parts will not be described below.

[0058] As shown in FIG. 5, a compressor system 1C

of the second modification example is provided with a bracket 2C, an engine 3C (drive source) fixed to the bracket 2C, and a compressor 10C fixed to the engine 3C and driven by the engine 3C.

[0059] The engine 3C has a casing 3a. The casing 3a has a flat attachment surface 7C parallel to the drive shaft 4 of the engine 3C.

[0060] The compressor 10C is fixed to the attachment surface 7C of the casing 3a such that the drive shaft 4 of the engine 3C and the rotating shaft 12 of the compressor 10C are parallel. The compressor 10C is fixed to the casing 3a by the bolt 8.

[0061] With this configuration, the compressor system 1C can be more compact by the compressor 10C being directly attached to the high-rigidity casing 3a.

[0062] Although an embodiment of the present invention has been described in detail with reference to accompanying drawings, the specific configuration is not limited to this embodiment and includes design changes and the like within the scope of the present invention.

[0063] Although the compressors 10, 10B, and 10C are displacement type compressors in the embodiment described above, the present invention is not limited thereto. For example, a centrifugal compressor having the rotating shaft 12 may be adopted.

[0064] Although the compressor system 1 is used in an automotive freezing unit for a large truck or the like according to the description, the present invention is not limited thereto. The compressor system 1 can be any compressor system insofar as the compressor system is provided with a drive source such as an engine and an electric motor and a compressor driven by the drive source.

35 Industrial Applicability

[0065] According to the present invention, the degree of freedom in housing and front case design can be improved as compared with a case where a front case is fastened by means of a plurality of bolts having the same shaft portion diameter. Especially, housing width reduction can be achieved from a reduction in the diameter of the shaft portion of the second bolt.

45 EXPLANATION OF REFERENCES

[0066]

1, 1C	Compressor system
2, 2C	Bracket
3, 3C	Engine
3a	Casing
4	Drive shaft
5	Freezer
6	Belt
7, 7C	Attachment surface
8	Bolt
10, 10B, 10C	Compressor

11	Compression mechanism			a front case (16) having a second end surface
12	Rotating shaft			(20) facing the first end surface (19) and blocking
13	Housing			the housing (13); and
14	Housing main body			a plurality of bolts (41, 42, 43) disposed in an-
15	Fixing portion	5		annular shape by being spaced apart in the cir-
16	Front case			cumferential direction of the axis (A) and fasten-
17	Side wall			ing the front case (16) to the housing (13),
18	Bottom portion			wherein the plurality of bolts (41, 42, 43) have a
19	First end surface			plurality of first bolts (41) and second bolts (42)
20	Second end surface	10		disposed between the first bolts (41) adjacent
21	Suction port			to each other in the circumferential direction,
22	Discharge port			having shaft portions smaller in diameter than
23	Scroll compression unit			shaft portions of the plurality of first bolts (41),
24	Main bearing			and fastening the front case (16) to the housing
25	Sub bearing	15		(13).
26	Seal portion			
27	Bearing		2.	The compressor (10, 10B, 10C) according to claim
28	Pulley			1, wherein
29	Electromagnetic clutch			
30	Armature plate	20		the housing (13) has a fixing portion (15) for at-
31	Electromagnet			taching the housing main body (14) to an attach-
32	O-ring			ment target (2) such that the side wall (17) of
33	Crank pin			the housing main body (14) is along an attach-
34	Orbiting scroll			ment surface (7) of the attachment target (2),
35	Fixed scroll	25		and
36	Compression chamber			the second bolts (42) include a bolt (42N) closest
37	Discharge port			to the attachment surface (7) and a bolt (42F)
39	Driven crank mechanism			farthest from the attachment surface (7) among
40	O-ring			the plurality of bolts disposed in annular shape
41	First bolt	30		by being spaced apart in the circumferential di-
42	Second bolt			rection.
43	Third bolt			
44	Bolt insertion hole		3.	The compressor (10, 10B, 10C) according to claim
45	Check valve			1 or 2, wherein the plurality of bolts (41, 42, 43) are
46	Retainer	35		disposed at equal intervals in the circumferential di-
A	Axis			rection.
Da	Axial direction			
S1	Suction chamber		4.	The compressor (10B) according to any one of
S2	Discharge chamber			claims 1 to 3, wherein the plurality of bolts (41, 42,
W	Width direction	40		43) have a third bolt (43) and a shaft portion of the
				third bolt (43) is smaller in diameter than the shaft
				portions of the plurality of first bolts (41) and larger
				in diameter than the shaft portions of the second bolts
				(42).

Claims

1. A compressor (10, 10B, 10C) comprising:
 - a compression mechanism (11) having a rotat-
ing shaft (12);
 - a housing (13) accommodating the compression
mechanism (11) and having a housing main
body (14) having a tubular side wall (17) extend-
ing along an axial direction (Da) of the rotating
shaft (12) and a bottom portion (18) connected
to one end of the side wall (17) in the axial di-
rection (Da), an other end of the side wall (17)
in the axial direction (Da) being a first end sur-
face (19) formed in a plane and extending in a
circumferential direction of an axis (A);
2. The compressor (10, 10B, 10C) according to claim
1, wherein
 - the housing (13) has a fixing portion (15) for at-
taching the housing main body (14) to an attach-
ment target (2) such that the side wall (17) of
the housing main body (14) is along an attach-
ment surface (7) of the attachment target (2),
and
 - the second bolts (42) include a bolt (42N) closest
to the attachment surface (7) and a bolt (42F)
farthest from the attachment surface (7) among
the plurality of bolts disposed in annular shape
by being spaced apart in the circumferential di-
rection.
3. The compressor (10, 10B, 10C) according to claim
1 or 2, wherein the plurality of bolts (41, 42, 43) are
disposed at equal intervals in the circumferential di-
rection.
4. The compressor (10B) according to any one of
claims 1 to 3, wherein the plurality of bolts (41, 42,
43) have a third bolt (43) and a shaft portion of the
third bolt (43) is smaller in diameter than the shaft
portions of the plurality of first bolts (41) and larger
in diameter than the shaft portions of the second bolts
(42).
5. A compressor system (1, 1B) comprising:
 - a bracket (2);
 - a drive source (3) fixed to the bracket (2); and
 - the compressor (10, 10B) according to any one
of claims 1 to 4 fixed to the bracket (2) and driven
by the drive source (3).
6. A compressor system (1C) comprising:
 - a drive source (3C); and
 - the compressor (10C) according to any one of
claims 1 to 4 fixed to the drive source (3C) and

driven by the drive source (3C).

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FIG. 1

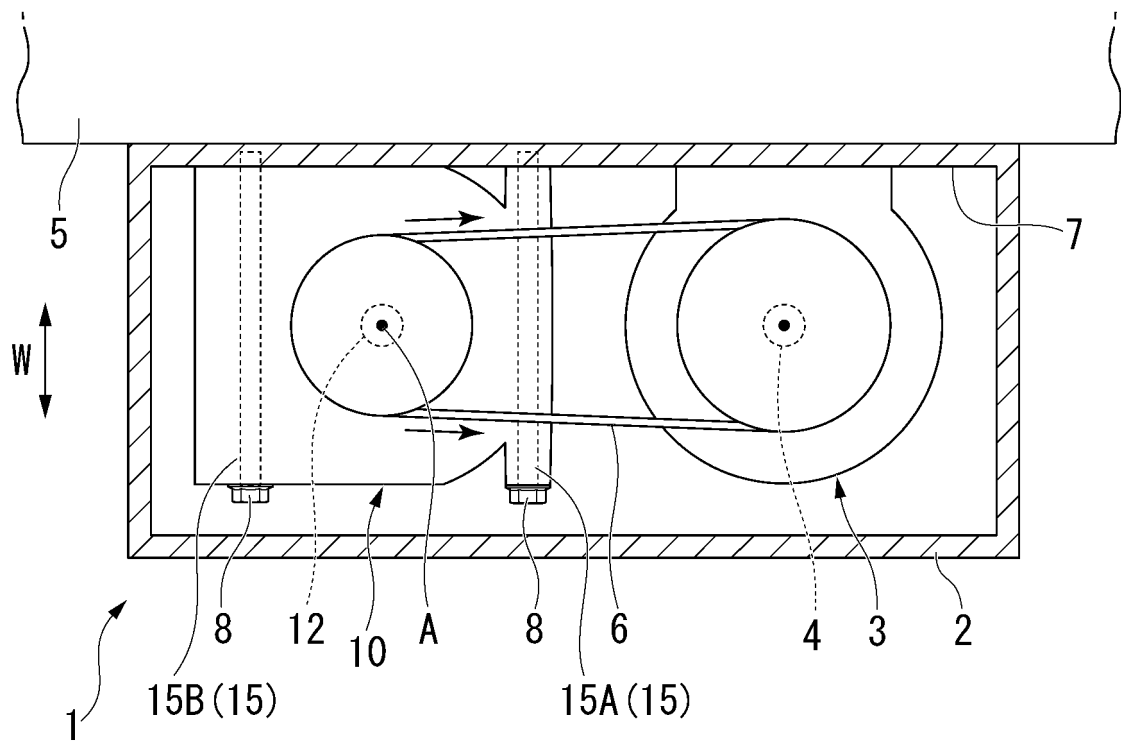


FIG. 2

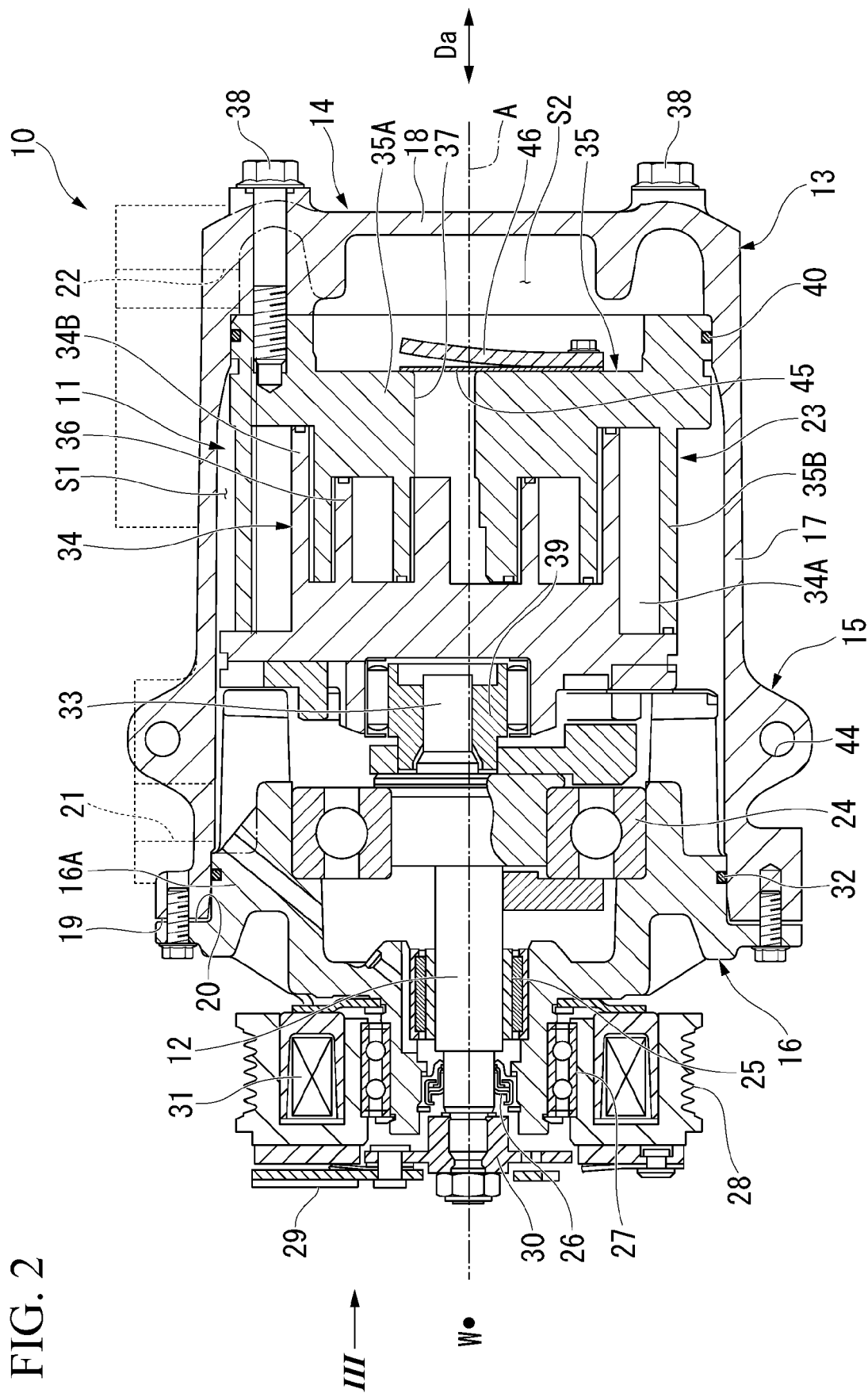


FIG. 3

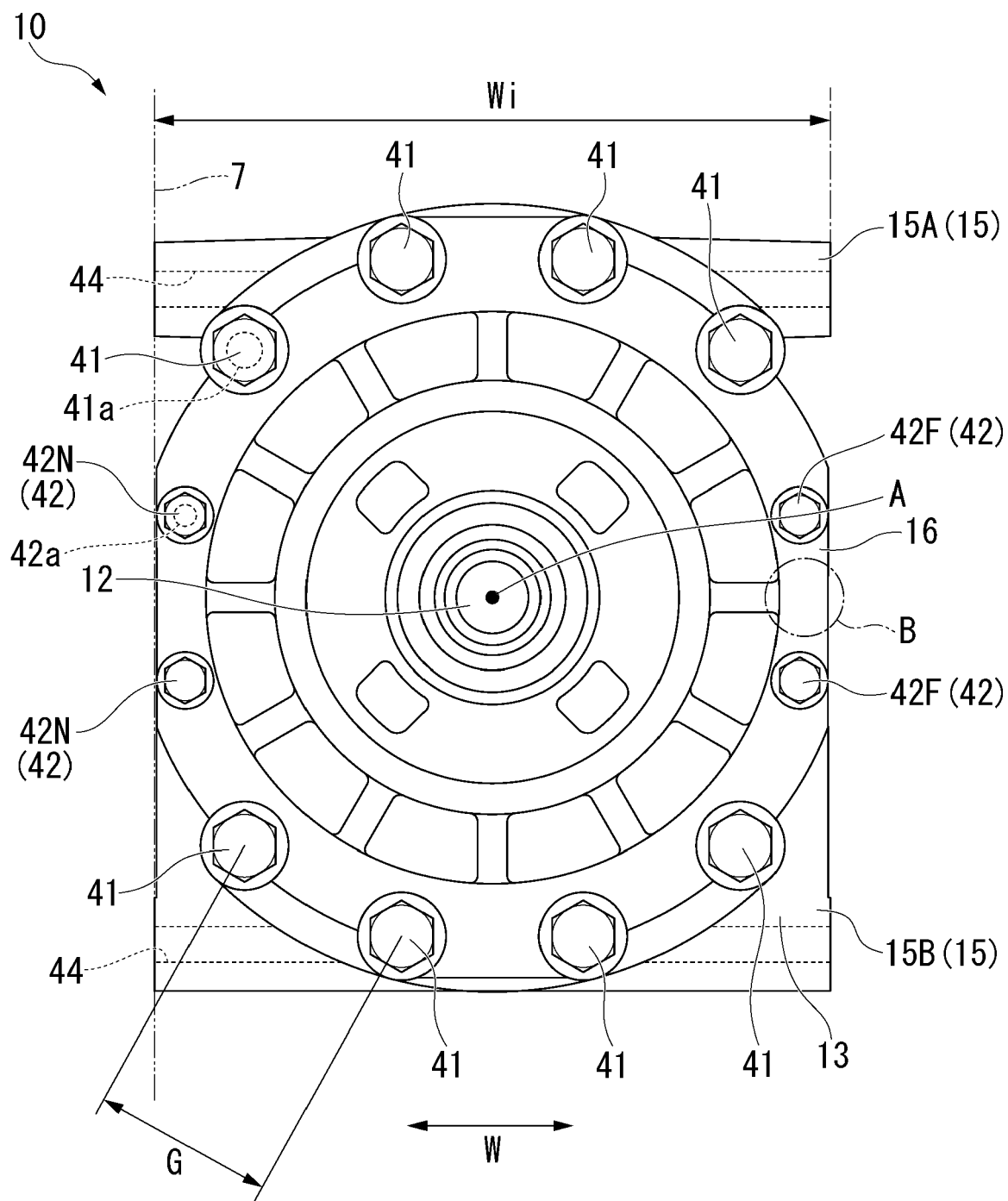


FIG. 4

10B

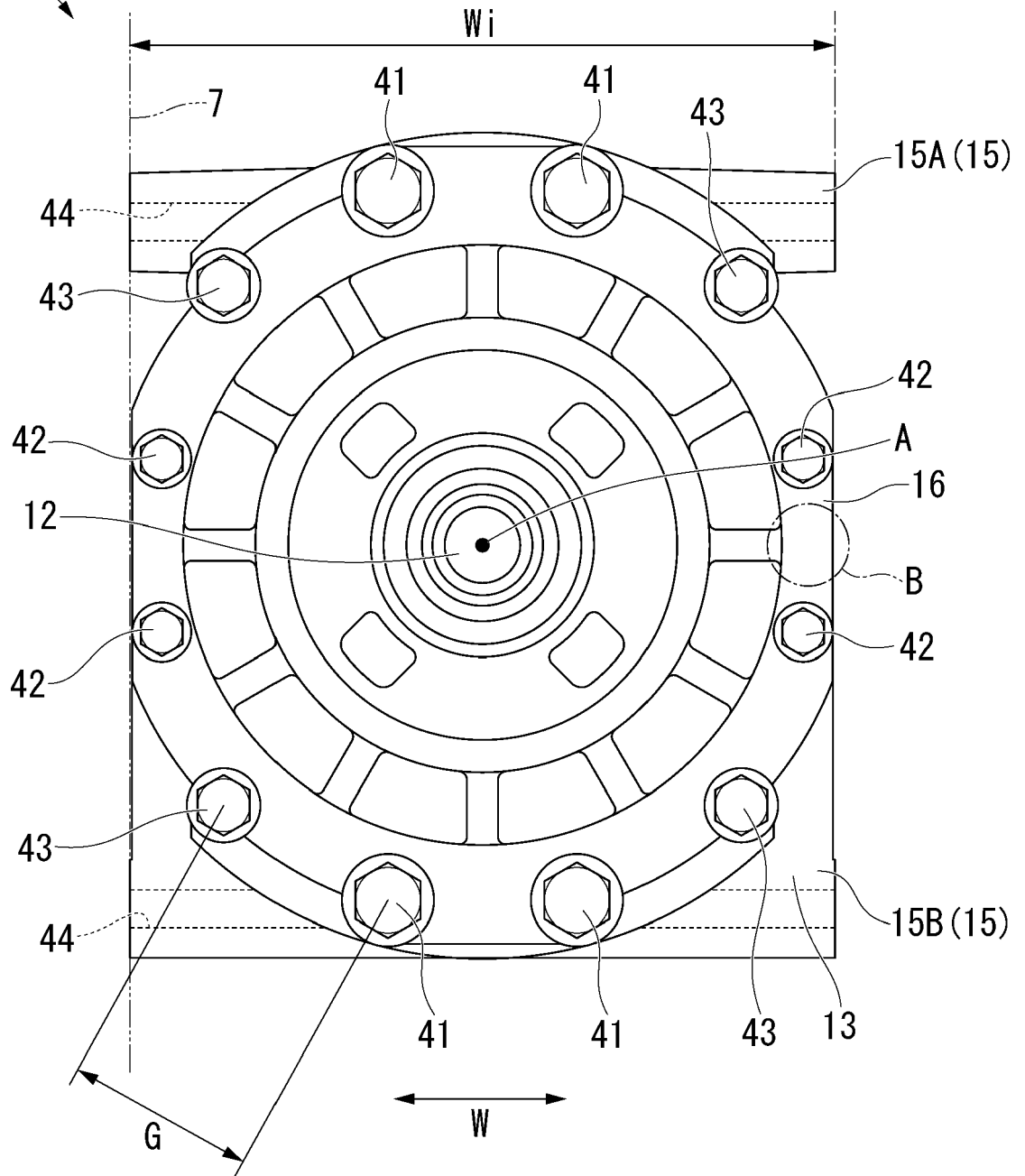
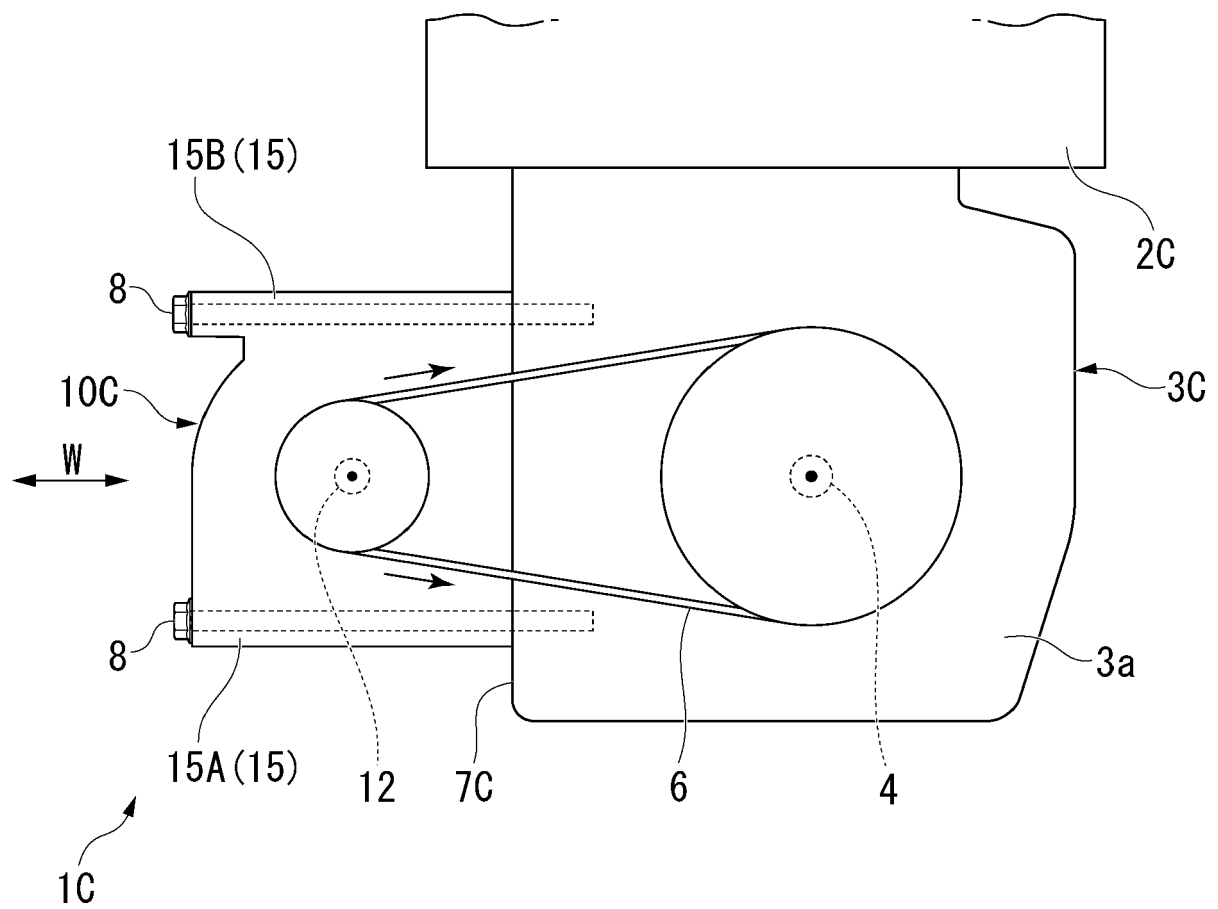


FIG. 5





EUROPEAN SEARCH REPORT

Application Number
EP 19 18 7098

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DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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The present search report has been drawn up for all claims			
Place of search Munich		Date of completion of the search 28 November 2019	Examiner Lange, Christian
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document		T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document	

EPO FORM 1503 03/82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
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