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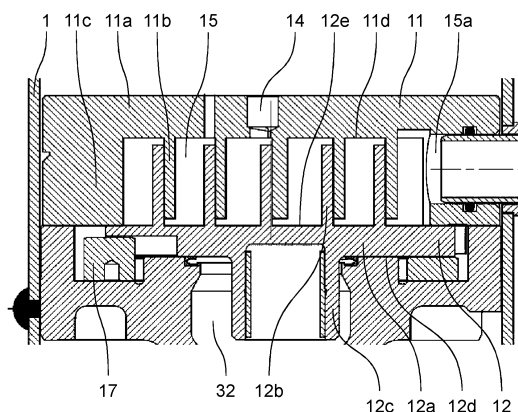
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(54) **SCROLL COMPRESSOR**

(57) A scroll compressor has an axial gap between fixed spiral wrap (11b) and orbiting scroll bottom surface (12e) and between orbiting spiral wrap (12b) and fixed scroll bottom surface (11d), and is configured such that orbiting scroll end plate (12a) is pressed against outer

peripheral wall (11c) of fixed scroll (11) in a region with angle of rotation larger than maximum involute angle of fixed scroll (11), and one of fixed scroll (11) and orbiting scroll (12) has a higher hardness than the other.

FIG. 2



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Description

TECHNICAL FIELD

[0001] The present disclosure relates to a scroll compressor used for, in particular, an air conditioner, a water heater, or a freezing machine of a refrigerator or the like.

BACKGROUND ART

[0002] PTL 1 and PTL 2 disclose scroll compressors used in air conditioners and the like. In these scroll compressors, a fixed spiral wrap of a fixed scroll and an orbiting spiral wrap of an orbiting scroll are engaged with each other and the orbiting scroll is made to orbit to compress a refrigerant. When a same kind of metals are used for the fixed scroll and the orbiting scroll, surface treatment such as anodization coating treatment or plating treatment is performed on a surface of either one of the fixed scroll and the orbiting scroll to prevent seizing between the fixed scroll and the orbiting scroll. For example, in PTL 1, an alloy containing aluminum as a main component is used for the fixed scroll and the orbiting scroll. The orbiting scroll is subjected to alumite treatment and then the surface of the orbiting scroll is smoothed by pressure treatment. In PTL 2, aluminum is used for the fixed scroll and the orbiting scroll. The coating on one of the fixed scroll and the orbiting scroll is of hard oxidized alumite, and the coating on the other is of semihard oxidized alumite.

Citation List

Patent Literature

[0003]

PTL 1: Unexamined Japanese Patent Publication No. 2007-132297

PTL 2: Unexamined Japanese Utility Model Publication No. S63-171681

SUMMARY OF THE INVENTION

[0004] The present disclosure provides a scroll compressor that prevents seizing between a fixed scroll and an orbiting scroll and has further improved efficiency and reliability.

[0005] In the scroll compressor of the present disclosure, both the fixed scroll and orbiting scroll are made of light metal, an axial gap is formed between an orbiting spiral wrap of the orbiting scroll and a fixed scroll bottom surface on the wrap surface side of the fixed scroll and between a fixed spiral wrap of the fixed scroll and an orbiting scroll bottom surface on the wrap surface side of the orbiting scroll, and an orbiting scroll end plate is pressed against an outer peripheral wall of the fixed scroll in a region with angle of rotation larger than outer wall

maximum involute angle of the fixed scroll. One or both of the fixed scroll and the orbiting scroll are subjected to a surface treatment, and one of the fixed scroll and the orbiting scroll has a higher hardness than the other.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

Fig. 1 is a longitudinal sectional view of a scroll compressor according to a first exemplary embodiment. Fig. 2 is an enlarged sectional view illustrating a meshed configuration of a fixed scroll and an orbiting scroll of a compression mechanism unit of the scroll compressor.

Fig. 3 is a plan view of the fixed scroll of the scroll compressor.

Fig. 4 is an explanatory view illustrating an axial gap between the fixed scroll and the orbiting scroll of the scroll compressor.

DESCRIPTION OF EMBODIMENTS

(Knowledge and the like underlying the present disclosure)

[0007] At the time when the inventors have arrived at the present disclosure, as described in PTL 1 or PTL 2, seizing between a fixed scroll and an orbiting scroll of a scroll compressor is prevented by surface treatment performed on a surface of one of the fixed scroll and the orbiting scroll. In an assumed case where an orbiting scroll is hardened by surface treatment, with a fixed scroll and the orbiting scroll always sliding against each other, a fixed scroll bottom surface of the fixed scroll, which is soft, wears by sliding of the scrolls against each other. A spiral wrap of the orbiting scroll is sandwiched between the rapidly wearing fixed scroll bottom surface of the fixed scroll and an orbiting scroll bottom surface of the orbiting scroll, which increases the resistance against sliding and causes seizing. In addition, sliding of the orbiting scroll bottom surface of the orbiting scroll against the distal end of the spiral wrap of the fixed scroll increases the rotational moment acting on the orbiting scroll, which might turn the orbiting scroll. There is still room for further improvement regarding the risk of a decrease in efficiency and a decrease in reliability of the scroll compressor.

[0008] The inventors have found these problems and have made the subject matter of the present disclosure to solve the problems.

[0009] The present disclosure provides a scroll compressor that has improved efficiency and reliability by suppressing an increase in the resistance against sliding between a fixed scroll and an orbiting scroll, an increase in rotational moment, and the like.

[0010] Hereinafter, an exemplary embodiment will be described in detail with reference to the accompanying drawings. Unnecessary detailed description may be

omitted. For example, detailed description of already well-known matters and repeated description of substantially the same configuration may be omitted. This is to avoid an unnecessary redundancy in the following description and to facilitate understanding of a person skilled in the art.

[0011] Note that, the accompanying drawings and the following description are merely presented to help those skilled in the art fully understand the present disclosure, and are not intended to limit the subject matters described in the claims.

(First exemplary embodiment)

[0012] A first exemplary embodiment will be described below with reference to Figs. 1 to 4.

[1 -1. Configuration]

[0013] As illustrated in Fig. 1, scroll compressor 100 includes compression mechanism unit 10 that compresses a refrigerant and motor mechanism unit 20 that drives compression mechanism unit 10, compression mechanism unit 10 and motor mechanism unit 20 being disposed in hermetic container 1.

[0014] Hermetic container 1 includes barrel 1a having a cylindrical shape extending in the up-down direction, lower lid 1b closing a lower opening of barrel 1a, and upper lid 1c closing an upper opening of barrel 1a.

[0015] Hermetic container 1 is provided with refrigerant suction pipe 2 for introducing the refrigerant into compression mechanism unit 10, and refrigerant discharge pipe 3 for discharging the refrigerant compressed by compression mechanism unit 10 to the outside of hermetic container 1.

[0016] Compression mechanism unit 10 includes fixed scroll 11, orbiting scroll 12, and rotary shaft 13 for driving orbiting scroll 12 to orbit.

[0017] Motor mechanism unit 20 includes stator 21 fixed to hermetic container 1, and rotor 22 disposed inside stator 21. Rotary shaft 13 is fixed to rotor 22.

[0018] Eccentric shaft 13a is provided at an upper end of rotary shaft 13 to be eccentric to rotary shaft 13. On eccentric shaft 13a, an oil reservoir which is a recess opened to an upper surface of eccentric shaft 13a is provided.

[0019] Main bearing 30 that supports fixed scroll 11 and orbiting scroll 12 is provided below fixed scroll 11 and orbiting scroll 12.

[0020] Main bearing 30 includes bearing 31 that rotatably supports rotary shaft 13, and boss housing 32. Main bearing 30 is fixed to hermetic container 1 by welding, shrink fit, or the like. Lower end 13b of rotary shaft 13 is rotatably supported by sub-bearing 18 disposed at the lower portion of hermetic container 1.

[0021] Fixed scroll 11 includes fixed scroll end plate 11a having a disk shape, fixed spiral wrap 11b having a spiral shape and erecting from fixed scroll end plate 11a,

and outer peripheral wall portion 11c erecting so as to surround the circumference of fixed spiral wrap 11b. Discharge port 14 is provided substantially at a center portion of fixed scroll end plate 11a.

[0022] Orbiting scroll 12 includes orbiting scroll end plate 12a having a disk shape, an orbiting spiral wrap 12b erecting from a wrap side end surface of orbiting scroll end plate 12a, and cylindrical boss portion 12c formed on an anti-wrap side end surface of orbiting scroll end plate 12a (a surface opposite to the wrap side end surface of orbiting scroll end plate 12a).

[0023] Fixed spiral wrap 11b of fixed scroll 11 and orbiting spiral wrap 12b of orbiting scroll 12 mesh with each other, and a plurality of compression chambers 15 is formed between fixed spiral wrap 11b and orbiting spiral wrap 12b.

[0024] Boss portion 12c is formed substantially at the center of orbiting scroll end plate 12a. Eccentric shaft 13a is inserted in boss portion 12c, and boss portion 12c is accommodated in boss housing 32.

[0025] Fixed scroll 11 is fixed to main bearing 30 by outer peripheral wall 11c using a plurality of bolts (not shown). Meanwhile, orbiting scroll 12 is supported by fixed scroll 11 via spin-restraining member 17 such as an Oldham ring. Spin-restraining member 17 that restrains spinning of orbiting scroll 12 is provided between fixed scroll 11 and main bearing 30. Accordingly, orbiting scroll 12 makes an orbit motion without spinning with respect to fixed scroll 11.

[0026] Oil storage part 4 that stores lubricating oil is formed at the bottom of hermetic container 1. Oil pump 5 of a displacement type is provided at the lower end of rotary shaft 13. Oil pump 5 is disposed so as a suction port of oil pump 5 to be in oil storage part 4. Oil pump 5 is driven by rotary shaft 13 and reliably sucks up lubricating oil in oil storage part 4 provided at the bottom of hermetic container 1 at any pressure condition and operating speed, which eliminates concern about loss of oil.

[0027] Rotary shaft oil supply hole 13c extending from lower end 13b of rotary shaft 13 to eccentric shaft 13a is formed in rotary shaft 13.

[0028] The lubricating oil sucked up by oil pump 5 is supplied to a bearing of sub-bearing 18, bearing 31, and into boss portion 12c through rotary shaft oil supply hole 13c formed in rotary shaft 13.

[0029] The refrigerant sucked through refrigerant suction pipe 2 is guided from suction port 15a to compression chamber 15. Compression chamber 15 moves from the outer peripheral side toward the central portion while reducing its volume. The refrigerant that has reached a predetermined pressure in compression chamber 15 is discharged to discharge chamber 6 from discharge port 14 provided at the central portion of fixed scroll 11. Discharge port 14 is provided with a discharge reed valve (not shown). The refrigerant that has reached a predetermined pressure in compression chamber 15 pushes open the discharge reed valve and is discharged to discharge chamber 6. The refrigerant discharged to dis-

charge chamber 6 is led out to an upper portion in hermetic container 1, and is discharged from refrigerant discharge pipe 3.

[0030] Fig. 2 illustrates a meshed configuration of fixed scroll 11 and orbiting scroll 12 of scroll compressor 100 according to the present exemplary embodiment. An axial gap is formed between the distal end surface of fixed spiral wrap 11b and orbiting scroll bottom surface 12e and between fixed scroll bottom surface 11d and the distal end surface of orbiting spiral wrap 12b.

[0031] In fixed scroll 11 illustrated in Fig. 3, a region with angle of rotation larger than outer wall maximum involute angle of fixed scroll 11 is hatched. The hatched region is a portion of fixed scroll 11 existing in the outer side of the involute curve extending to the maximum involute angle of fixed scroll 11 in a plan view of fixed scroll 11, and corresponds to outer peripheral wall 11c. By applying pressure to a back surface of orbiting scroll end plate 12d of orbiting scroll 12, an outer peripheral portion of orbiting scroll end plate 12a is pressed against outer peripheral wall 11c of fixed scroll 11 in the hatched region in Fig. 3.

[0032] In scroll compressor 100 according to the present exemplary embodiment, one or both of fixed scroll 11 and orbiting scroll 12 are subjected to surface treatment. This makes the hardness of one of fixed scroll 11 and orbiting scroll 12 higher than the hardness of the other. As a method of surface treatment, for example, anodization coating (alumite) treatment is known.

[1 -2. Operation]

[0033] Operations and advantageous effects of scroll compressor 100 configured as described above will be described below.

[0034] In scroll compressor 100 having the above configuration, the difference between the hardness of fixed scroll 11 and the hardness of orbiting scroll 12 causes the scroll having the lower hardness, among fixed scroll 11 and orbiting scroll 12, to wear by a proper amount. In the present exemplary embodiment, an axial gap is formed between the distal end surface of fixed spiral wrap 11b of fixed scroll 11 and orbiting scroll bottom surface 12e of orbiting scroll 12 and between fixed scroll bottom surface 11d and the distal end surface of orbiting spiral wrap 12b. This avoids, even when the scroll having a low hardness wears by a proper amount, sandwiching of orbiting spiral wrap 12b of orbiting scroll 12 between fixed scroll bottom surface 11d and orbiting scroll bottom surface 12e. Accordingly, seizing between fixed scroll 11 and orbiting scroll 12 resulting from sliding of orbiting scroll 12 can be prevented, and thereby reliability improves. Furthermore, since the increase in rotational moment acting on orbiting scroll 12 is avoided, turning of orbiting scroll 12 can also be suppressed.

[0035] Furthermore, since sandwiching of orbiting spiral wrap 12b of orbiting scroll 12 between fixed scroll bottom surface 11d and orbiting scroll bottom surface

12e is avoided even when the scroll having a low hardness wears by a proper amount as described above, orbiting scroll 12 can be pressed against fixed scroll 11. This reduces leakage of the refrigerant from compression chamber 15 to suction port 15a, and leakage loss can be reduced.

[0036] In scroll compressor 100 of the present exemplary embodiment, region with angle of rotation larger than outer wall maximum involute angle 11e (hatched portion in Fig. 3) of fixed scroll 11 is made to slide against the outer peripheral portion of orbiting scroll end plate 12a to reduce the turning moment of orbiting scroll 12 and improve the resistance against turning of orbiting scroll 12. Therefore, gas leakage due to turning of orbiting scroll 12 can be suppressed. Accordingly, the efficiency of the compressor can be further improved by a combination with the above-described effect of reducing the leakage loss of the refrigerant. Note that turning refers to a state in which orbiting scroll 12 separates from fixed scroll 11 by a push back force from compression chamber 15.

[0037] Fig. 4 is a sectional view illustrating a relationship between axial gap Hf between fixed spiral wrap 11b and orbiting scroll bottom surface 12e and axial gap Ho between orbiting spiral wrap 12b and fixed scroll bottom surface 11d.

[0038] Axial gap Hf between fixed spiral wrap 11b and orbiting scroll bottom surface 12e and axial gap Ho between orbiting spiral wrap 12b and fixed scroll bottom surface 11d are set to satisfy $H_f \leq H_o$ in the present exemplary embodiment. In the present exemplary embodiment, the hardness of fixed scroll 11 is higher than the hardness of orbiting scroll 12.

[0039] With axial gap Ho between orbiting spiral wrap 12b and fixed scroll bottom surface 11d made larger than axial gap Hf between fixed spiral wrap 11b and orbiting scroll bottom surface 12e as described above, the distal end surface of orbiting spiral wrap 12b does not slide against fixed scroll bottom surface 11d, which enhances the resistance against turning.

[0040] Furthermore, by making the hardness of fixed scroll 11 higher than the hardness of orbiting scroll 12 and letting fixed spiral wrap 11b of fixed scroll 11 having a high hardness slide against orbiting scroll bottom surface 12e even in a transition period between operational states and an abnormal state of the compressor, friction between fixed spiral wrap 11b and orbiting spiral wrap 12b can be suppressed, so that reliability of scroll compressor 100 can be secured. In an assumed case where the relationship between gap Hf and gap Ho is reversed ($H_f > H_o$), for instance, the wrap distal end of a scroll having a high hardness receives a load, and this might cause a decrease in reliability of scroll compressor 100.

[0041] In the present exemplary embodiment, the case where anodization coating (alumite) treatment is performed as the surface treatment is described. However, the method of surface treatment is not limited to the anodization coating treatment. For example, a plating treat-

ment can raise the hardness of a member such as a fixed scroll and an orbiting scroll, and thus can obtain a similar effect as that of the present disclosure.

[1 -3. Effects and the like]

[0042] As described above, in the scroll compressor according to the present exemplary embodiment, both the fixed scroll and orbiting scroll are made of light metal, and an axial gap is formed between the orbiting spiral wrap of the orbiting scroll and the fixed scroll bottom surface on the wrap surface side of the fixed scroll and between the fixed spiral wrap of the fixed scroll and the orbiting scroll bottom surface on the wrap surface side of the orbiting scroll. In addition, the end plate of the orbiting scroll is pressed against the region with angle of rotation larger than outer wall maximum involute angle of the fixed scroll, and one or both of the fixed scroll and the orbiting scroll are subjected to surface treatment so that either one has a higher hardness than the other.

[0043] This prevents seizing caused by the fixed scroll and the orbiting scroll sliding against each other, and thus the reliability can be improved. Furthermore, by reducing the turning moment of the orbiting scroll to reduce gas leakage due to turning or the like of the orbiting scroll or gas leakage from the compression chamber to the suction port, the efficiency of the scroll compressor can be improved.

[0044] The scroll compressor is configured such that axial gap H_f between the fixed spiral wrap of the fixed scroll and the orbiting scroll bottom surface and axial gap H_o between the orbiting spiral wrap of the orbiting scroll and the fixed scroll bottom surface satisfy the relationship of $H_f \leq H_o$. The hardness of the fixed scroll is made higher than the hardness of the orbiting scroll.

[0045] Accordingly, the resistance against turning of the orbiting scroll can be further reliably improved, and the friction between the fixed spiral wrap and the orbiting spiral wrap is suppressed even in a transition period between operating states and an abnormal state of the compressor, so that the reliability of the scroll compressor can be improved.

[0046] The present disclosure has been described using the exemplary embodiment described above. Since the exemplary embodiment is for illustrating the technology in the present disclosure, various modifications, replacements, additions, omissions, or the like, can be made within the scope of the claims or equivalents thereof.

[0047] As the refrigerant of the scroll compressor of the present disclosure, R32, carbon dioxide, or a refrigerant having a double bond between carbons can be used.

INDUSTRIAL APPLICABILITY

[0048] The scroll compressor according to the present disclosure can improve reliability and efficiency, and is

thus useful for a hot water heating device, an air conditioning device, a water heater, or a refrigeration cycle device such as a freezing machine.

5 REFERENCE MARKS IN THE DRAWINGS

[0049]

	1	hermetic container
10	1a	barrel
	1b	lower lid
	1c	upper lid
	2	refrigerant suction pipe
	3	refrigerant discharge pipe
15	4	oil storage part
	5	oil pump
	6	discharge chamber
	10	compression mechanism unit
	11	fixed scroll
20	11a	fixed scroll end plate
	11b	fixed spiral wrap
	11c	outer peripheral wall
	11d	fixed scroll bottom surface
	11e	region with angle of rotation larger than outer wall
25		maximum involute angle
	12	orbiting scroll
	12a	orbiting scroll end plate
	12b	orbiting spiral wrap
	12c	boss portion
30	12d	back surface of orbiting scroll end plate
	12e	orbiting scroll bottom surface
	13	rotary shaft
	13a	eccentric shaft
	13b	lower end
35	13c	rotary shaft oil supply hole
	14	discharge port
	15	compression chamber
	15a	suction port
	17	spin-restraining member
40	18	sub-bearing
	20	motor mechanism unit
	21	stator
	22	rotor
	30	main bearing
45	31	bearing
	32	boss housing
	100	scroll compressor

50 Claims

1. A scroll compressor comprising:

a compression mechanism unit that compresses a refrigerant, and includes a fixed scroll, an orbiting scroll, and a rotary shaft that drives and makes the orbiting scroll orbit;
a motor mechanism unit that drives the com-

pression mechanism unit; and
 a hermetic container that accommodates the
 compression mechanism unit and the motor
 mechanism unit, and includes an oil storage part
 that stores lubricating oil in a bottom portion, 5
 wherein the fixed scroll includes a fixed scroll
 end plate having a disk shape, a fixed spiral wrap
 erecting from the fixed scroll end plate, and an
 outer peripheral wall disposed around the fixed
 spiral wrap, 10
 the orbiting scroll includes an orbiting scroll end
 plate having a disk shape, and an orbiting spiral
 wrap erecting from the orbiting scroll end plate,
 the fixed scroll and the orbiting scroll contain a
 light metal, 15
 the fixed scroll and the orbiting scroll are dis-
 posed so as to have an axial gap H_o between
 the orbiting spiral wrap and the fixed scroll end
 plate and an axial gap H_f between the fixed spiral
 wrap and the orbiting scroll end plate, 20
 the orbiting scroll end plate is pressed against
 the outer peripheral wall of the fixed scroll in a
 region with angle of rotation larger than maxi-
 mum involute angle of the fixed scroll,
 at least one of the fixed scroll and the orbiting 25
 scroll is subjected to surface treatment, and
 a hardness of the fixed scroll and a hardness of
 the orbiting scroll differ from each other.

2. The scroll compressor according to Claim 1, wherein 30

the axial gap H_f and the axial gap H_o have a
 relationship of $H_f \leq H_o$, and
 the hardness of the fixed scroll is higher than
 the hardness of the orbiting scroll. 35

3. The scroll compressor according to Claim 1 or 2,
 wherein at least one of the fixed scroll and the orbiting
 scroll is subjected to surface treatment of anodiza-
 tion coating treatment or plating treatment. 40

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FIG. 1

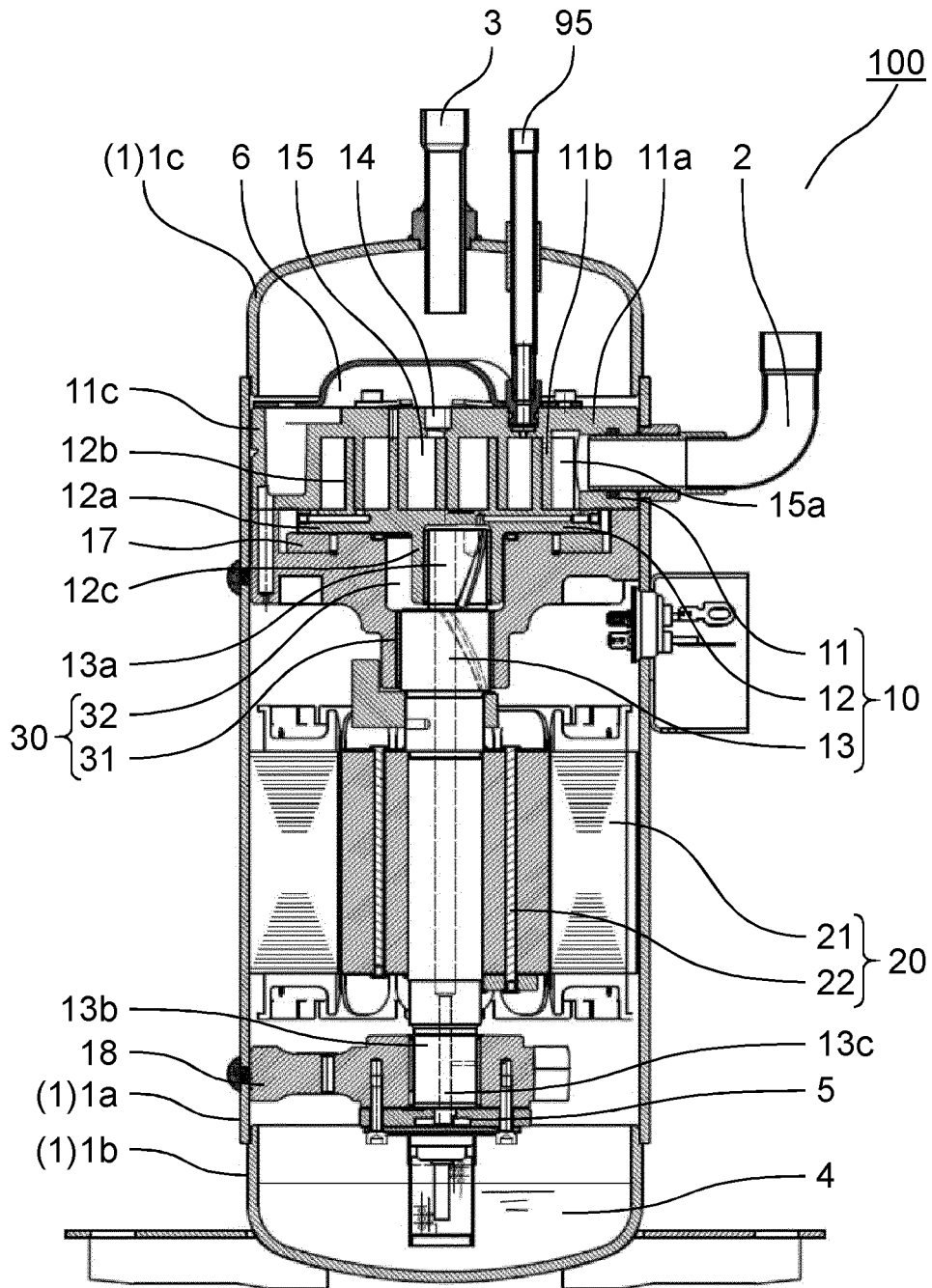


FIG. 2

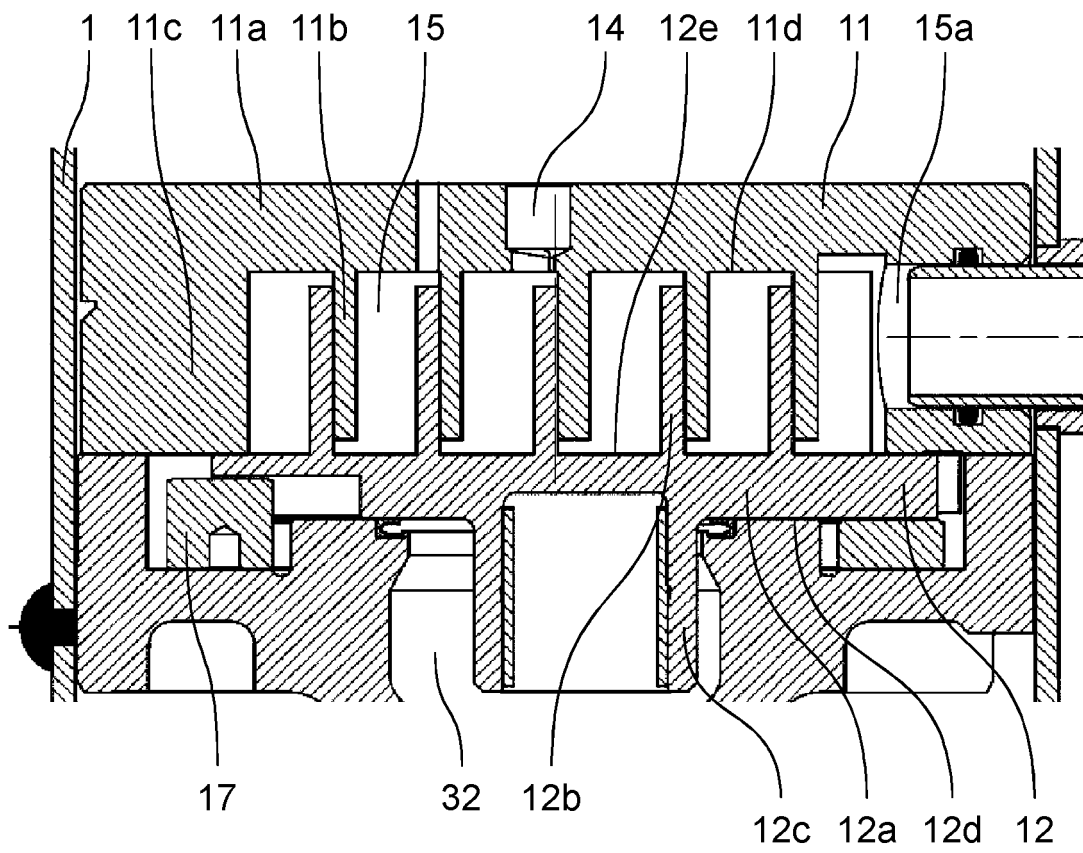


FIG. 3

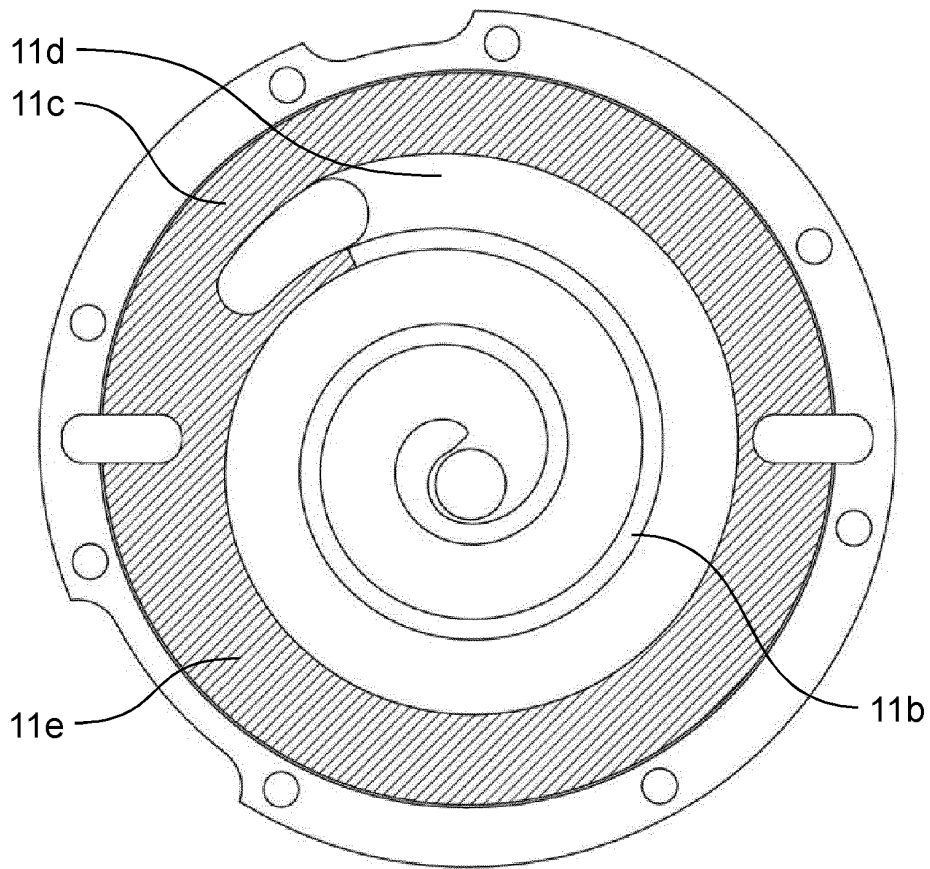
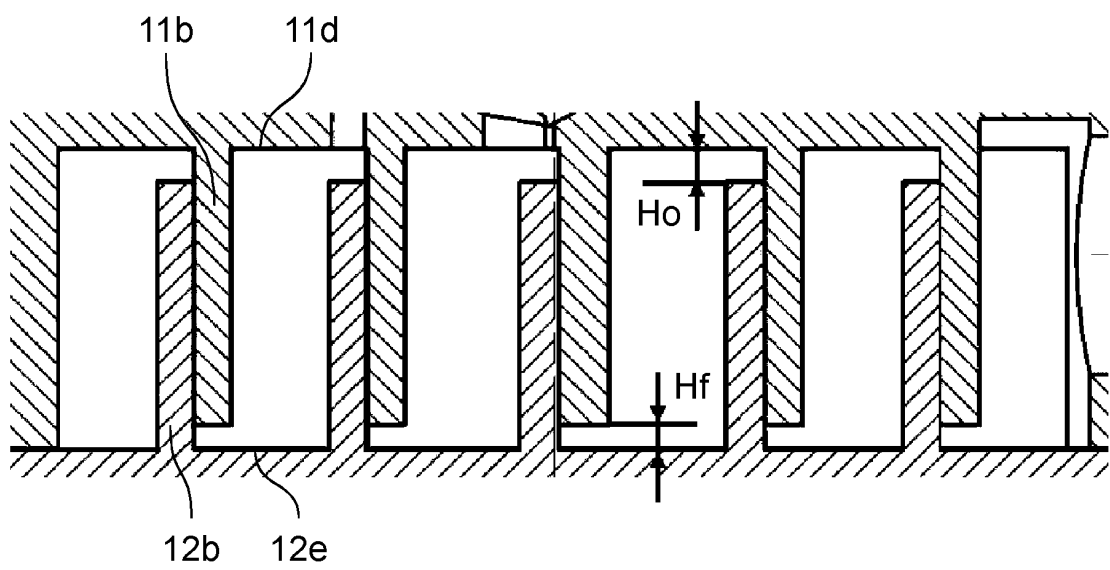


FIG. 4



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2020/047805

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl. F04C18/02 (2006.01) i FI: F04C18/02311Q, F04C18/02311R, F04C18/02311S		
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) Int.Cl. F04C18/02		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Published examined utility model applications of Japan 1922-1996 Published unexamined utility model applications of Japan 1971-2021 Registered utility model specifications of Japan 1996-2021 Published registered utility model applications of Japan 1994-2021		
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 2009-8006 A (PANASONIC CORPORATION) 15 January 2009 (2009-01-15), paragraphs [0031]-[0055], fig. 1-4	1-3
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 64122/1987 (Laid-open No. 171681/1988) (TOSHIBA CORPORATION) 08 November 1988 (1988-11-08), specification, page 4, line 9 to page 5, line 16, fig. 1	1-3
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<input type="checkbox"/> Further documents are listed in the continuation of Box C.		<input checked="" type="checkbox"/> See patent family annex.
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Date of the actual completion of the international search 03 February 2021	Date of mailing of the international search report 16 February 2021	
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INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2020/047805

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JP 2009-8006 A	15 January 2009	(Family: none)
JP 63-171681 U1	08 November 1988	(Family: none)
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REFERENCES CITED IN THE DESCRIPTION

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