



(11)

EP 4 417 814 A1

(12)

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

(43) Date of publication:

21.08.2024 Bulletin 2024/34

(51) International Patent Classification (IPC):

F04C 29/06 ^(2006.01) **F04B 39/00** ^(2006.01)
F04C 29/12 ^(2006.01)

(21) Application number: **23819691.9**

(52) Cooperative Patent Classification (CPC):

F04B 39/00; F04C 29/06; F04C 29/12

(22) Date of filing: **26.05.2023**

(86) International application number:

PCT/JP2023/019761

(87) International publication number:

WO 2023/238709 (14.12.2023 Gazette 2023/50)

(84) Designated Contracting States:

**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC ME MK MT NL
NO PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA

Designated Validation States:

KH MA MD TN

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(30) Priority: **09.06.2022 JP 2022093807**

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(54) **COMPRESSOR AND DESIGN METHOD FOR SAME**

(57) Provided is a compressor capable of reducing vibration even when a compressor main body is miniaturized. A compressor includes a compressor main body (10) including, in a tubular housing (2), a compression unit (6) compressing a refrigerant, and a tubular accumulator (12) coupled to a refrigerant suction portion of the compressor main body, in which $3 \leq (m1/D1)/(m2/D2) \leq 7$, where m1 is a mass of the compressor main body (10), m2 is a mass of the accumulator (12), D1 is an outside diameter of the compressor main body (10), and D2 is an outside diameter of the accumulator (12).

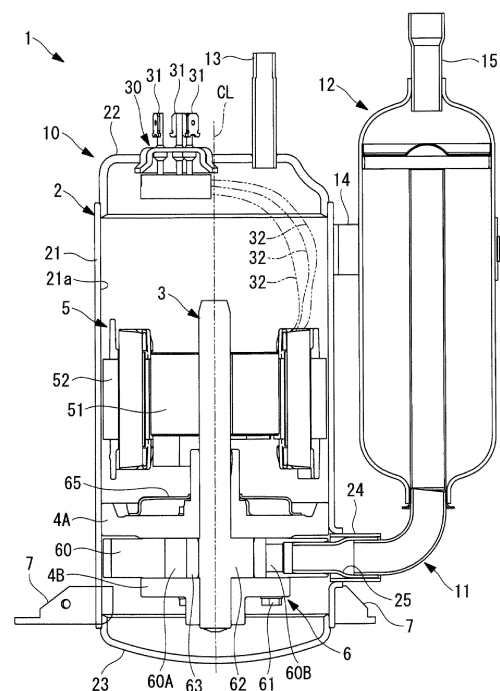


FIG. 1

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Description

Technical Field

5 **[0001]** The present disclosure relates to a compressor and a method for designing the compressor.

Background Art

10 **[0002]** A rotary compressor is known as one of compressors used in refrigeration devices, air-conditioning devices, and the like.

[0003] As described in Patent Document 1, propagation of vibration of a rotary compressor to an inlet tube of an accumulator is problematic. When a refrigerant pipe is broken due to the vibration propagated to the inlet tube of the accumulator, a refrigerant inside the pipe may leak to the outside. In particular, when a flammable refrigerant (as an example of a flammability class, a mildly flammable refrigerant (A2L), a flammable refrigerant (A2), or a strongly flammable refrigerant (A3)) is used as the refrigerant, it is more necessary to avoid leakage of the refrigerant.

15 **[0004]** In addition, when the rotary compressor vibrates, mountability to a product can be deteriorated.

Citation List

20 Patent Literature

[0005] Patent Document 1: JP 2011-185123 A

Summary of Invention

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Technical Problem

30 **[0006]** In a related-art rotary compressor having a relatively large weight, the moment of inertia of a static system is large, and thus vibration caused by driving of a rotary compression unit (for example, rotation of a piston rotor), which is a rotating system, tends to be suppressed. However, due to miniaturization of the rotary compressor, the moment of inertia of the static system may decrease and a problem related to vibration may become apparent.

[0007] The present disclosure has been made in view of such circumstances, and an object thereof is to provide a compressor capable of reducing vibration even when a compressor main body is miniaturized and a method for designing the compressor.

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Solution to Problem

40 **[0008]** A compressor (1) according to an aspect of the present disclosure is a compressor including a compressor main body (10) including, in a tubular housing (2), a compression unit (6) compressing a refrigerant, and a tubular accumulator (12) coupled to a refrigerant suction portion of the compressor main body, in which $3 \leq (m1/D1)/(m2/D2) \leq 7$, where m1 is a mass of the compressor main body, m2 is a mass of the accumulator, D1 is an outside diameter of the compressor main body, and D2 is an outside diameter of the accumulator.

45 **[0009]** A method for designing a compressor according to another aspect of the present disclosure is a method for designing a compressor, the compressor including a compressor main body including, in a tubular housing, a compression unit compressing a refrigerant, and a tubular accumulator coupled to a refrigerant suction portion of the compressor main body, in which $3 \leq (m1/D1)/(m2/D2) \leq 7$, where m1 is a mass of the compressor main body, m2 is a mass of the accumulator, D1 is an outside diameter of the compressor main body, and D2 is an outside diameter of the accumulator.

Advantageous Effects of Invention

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[0010] It is possible to reduce vibration even when a compressor is miniaturized.

Brief Description of Drawings

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[0011]

FIG. 1 is a vertical cross-sectional view illustrating a rotary compressor according to an embodiment of the present disclosure.

FIG. 2 is a side view illustrating a state in which the rotary compressor of FIG. 1 is provided at an installation surface.
 FIG. 3 is a graph showing a vibration reduction effect when the compressor of the present disclosure is miniaturized.
 FIG. 4A is a graph of a comparative example of FIG. 3 when the horizontal axis is $D1/m2$.
 FIG. 4B is a graph of a comparative example of FIG. 3 when the horizontal axis is $m1/m2$.

Description of Embodiments

[0012] An embodiment according to the present disclosure will be described below with reference to the drawings.

[0013] As illustrated in FIG. 1, a rotary compressor (hereinafter simply referred to as a "compressor") 1 according to the present embodiment is a hermetically sealed electric rotary compressor used in, for example, an air conditioner or a refrigeration device. The compressor 1 includes a compressor main body 10 and an accumulator 12. The accumulator 12 is coupled to the compressor main body 10 via a suction tube 11.

[0014] The compressor main body 10 includes a housing 2 having a substantially cylindrical shape, a rotor shaft body 3, an electric motor 5, and a rotary compression unit 6. An axis of rotation CL of the rotor shaft body 3 coincides with the center axis of the housing 2. The rotor shaft body 3 is disposed so as to extend in the vertical direction and rotates about the axis of rotation CL in the housing 2.

[0015] The housing 2 is hermetically sealed and extends in the vertical direction. The housing 2 includes a cylindrical main body portion 21, and an upper lid portion 22 and a lower lid portion 23 that close upper and lower openings of the main body portion 21.

[0016] A plurality of leg portions 7 are fixed to a lower portion of the main body portion 21. The leg portions 7 are disposed in the circumferential direction of the main body portion 21 at predetermined angular intervals. As illustrated in FIG. 2, each leg portion 7 is fixed to an installation surface FL via a vibration-proof rubber 8.

[0017] An opening 24 is formed at a position facing the outside surface of a cylinder 60 in a lower portion of the side wall of the housing 2. In the cylinder 60, a suction port 25 that communicates to a predetermined position in the cylinder is formed at a position facing the opening 24.

[0018] An oil sump for storing lubricating oil is formed at a bottom portion of the housing 2. The liquid level of the oil sump when the oil is initially sealed is located above the rotary compression unit 6. Thus, the rotary compression unit 6 is driven in the oil sump.

[0019] The upper lid portion 22 is provided with a discharge tube 13 and a terminal block 30. The discharge tube 13 penetrates the upper lid portion 22 in the thickness direction and includes a lower portion disposed inside the housing 2 and an upper portion disposed outside the housing 2. The discharge tube 13 discharges a compressed refrigerant to the outside of the housing 2. The terminal block 30 is provided with three power supply terminals 31 for supplying electric power to the electric motor 5. Three-phase electric power is supplied to the power supply terminals 31 from an inverter device (not illustrated).

[0020] The accumulator 12 is used to separate a refrigerant into gas and liquid before supplying the refrigerant to the compressor main body 10. The accumulator 12 has a substantially cylindrical shape and is fixed to the outside surface of the housing 2 via a bracket 14. An inlet tube 15 for introducing a refrigerant guided from an evaporator (not illustrated) is provided at an upper portion of the accumulator 12. The suction tube 11 for causing the refrigerant inside the accumulator 12 to be sucked into the compressor main body 10 is coupled to a lower portion of the accumulator 12. The suction tube 11 is coupled to the suction port 25 through the opening 24 of the housing 2. The accumulator 12 supplies the gas-phase refrigerant to the rotary compression unit 6 through the suction tube 11.

[0021] As the refrigerant, a flammable refrigerant, that is, a refrigerant in a flammability class of a mildly flammable refrigerant (A2L), a flammable refrigerant (A2), or a strongly flammable refrigerant (A3) such as propane, is used.

[0022] The electric motor 5 is accommodated at a central portion of the housing 2 in the vertical direction. The electric motor 5 includes a rotor 51 and a stator 52. The rotor 51 is fixed to the outside surface of the rotor shaft body 3 and is disposed above the rotary compression unit 6. The stator 52 is disposed so as to surround the outside surface of the rotor 51 and is fixed to an inner surface 21a of the main body portion 21 of the housing 2.

[0023] Electric power is supplied to the stator 52 from each power supply terminal 31 through a wiring line 32. The electric motor 5 rotates the rotor shaft body 3 by electric power supplied from each power supply terminal 31.

[0024] The rotary compression unit 6 is disposed in a state of being vertically interposed between an upper bearing 4A and a lower bearing 4B. The upper bearing 4A and the lower bearing 4B are each formed of a metal material and are fixed to the cylinder 60 constituting the rotary compression unit 6 with a bolt 61.

[0025] The rotor shaft body 3 is supported by the upper bearing 4A and the lower bearing 4B in a rotatable manner about the axis of rotation CL.

[0026] The rotary compression unit 6 is disposed at a bottom portion in the housing 2 below the electric motor 5. The rotary compression unit 6 includes the cylinder 60, an eccentric shaft portion 62, and a piston rotor 63.

[0027] A compression chamber 60A, a suction hole 60B, and a discharge hole (not illustrated) are formed in the cylinder 60. The compression chamber 60A is formed inside the cylinder 60. The piston rotor 63 is accommodated in

the compression chamber 60A.

[0028] The rotary compression unit 6 is fixed to the inner surface 21a of the main body portion 21 of the housing 2. Specifically, the upper bearing 4A sandwiching the cylinder 60 is fixed to the inner surface 21a of the main body portion 21 of the housing 2. The upper bearing 4A is fixed by plug-welding at a plurality of positions in the circumferential direction of the housing 2. Note that instead of plug welding, shrink fitting, cold fitting, or the like may be performed.

[0029] The eccentric shaft portion 62 is provided at a lower end portion of the rotor shaft body 3 and is provided inside the piston rotor 63 in a state of being offset in an orthogonal direction from the central axis of the rotor shaft body 3.

[0030] The piston rotor 63 has a cylindrical shape having an outside diameter smaller than the inside diameter of the cylinder 60, is disposed inside the cylinder 60, and is fixed in a state of being mounted at the outside periphery of the eccentric shaft portion 62. The piston rotor 63 eccentrically rotates about the axis of rotation CL along with the rotation of the rotor shaft body 3.

[0031] The suction hole 60B is a hole for guiding the refrigerant to the inside of the cylinder 60 and is formed in a direction orthogonal to the axis of rotation CL.

[0032] The high-pressure refrigerant discharged from the discharge hole (not illustrated) formed in the cylinder 60 is guided into a space formed between a discharge cover 65 and the upper bearing 4A and then guided into the internal space of the housing 2.

[0033] The above-described compressor 1 operates as follows.

[0034] A refrigerant guided from the evaporator (not illustrated) is taken into the accumulator 12 through the inlet tube 15. The refrigerant is separated into gas and liquid in the accumulator 12, and the gas-phase refrigerant is guided to the rotary compression unit 6 through the suction tube 11. In the rotary compression unit 6, the refrigerant is guided to the compression chamber 60A through the suction hole 60B. Then, eccentric rotation of the piston rotor 63 gradually decreases the volume of the compression chamber 60A and compresses the refrigerant. The compressed refrigerant passes through the space inside the discharge cover 65 through the discharge hole and is then guided to the internal space of the housing 2. The refrigerant discharged into the internal space of the housing 2 is guided to a condenser (not illustrated) through the discharge tube 13 provided at the upper portion of the housing 2.

[0035] Next, vibration when the compressor 1 operates will be described.

[0036] Vibration caused by the operation of the compressor 1 is generated from a drive unit of a rotating system such as the piston rotor 63 and propagated from the compressor main body 10 to the accumulator 12.

[0037] The specifications used for vibration calculation are as follows.

Mass of the compressor main body 10: m_1 [kg]

Mass of the accumulator 12: m_2 [kg]

Outside diameter of the compressor main body 10: D_1 (see FIG. 2) [m]

Outside diameter of the accumulator 12: D_2 (see FIG. 2) [m]

Distance between the axis of rotation CL and a center axis CL2 of the inlet tube 15: R_g (see FIG. 2) [m]

Displacement amount of the rotary compression unit 6: V [cc/rev]

Mass of the refrigeration oil: m_0 [kg]:

Mass of the rotating system: m_r [kg]

[0038] Here, the rotating system refers to rotating members, that is, the rotor shaft body 3, the rotor 51, and the piston rotor 63. Thus, the static system refers to a configuration other than the rotating system, that is, the compressor main body 10 and the accumulator 12 exclusive of the rotating system.

[0039] The numerical values of m_1 , m_2 , D_1 and D_2 are in the following ranges.

$$4 \text{ kg} \leq m_1 \leq 6 \text{ kg}$$

$$0.3 \text{ kg} \leq m_2 \leq 0.7 \text{ kg}$$

$$80 \text{ mm} \leq D_1 \leq 95 \text{ mm}$$

$$50 \text{ mm} \leq D_2 \leq 75 \text{ mm}$$

[0040] The moment of inertia of the static system and the moment of inertia of the rotating system are as follows.

Static System

Moment of inertia (compressor main body):

$$J_c = \{(m_1 - m_r - m_0) \times D_1^2\}/8 \text{ [kg} \cdot \text{m}^2\}$$

Moment of inertia (accumulator):

$$J_a = (m_2 \times D_2^2)/8 \text{ [kg} \cdot \text{m}^2\text{]}$$

Moment of inertia (total):

$$J_s = J_c + J_a + m_2 \times R_g^2 \text{ [kg} \cdot \text{m}^2\text{]}$$

Rotating system

Moment of inertia: J_r [kg·m²]

[0041] When vibration of an inlet tube 15 of an accumulator 12 of a reference compressor (related-art compressor) at a time of design is A [m], vibration A' [m] of the inlet tube 15 of the compressor 1 of the present embodiment in comparison with the reference compressor is simply represented by the following equations.

$$A' = \alpha A \text{ [m]}$$

$$\alpha = (V/V') \times (J_r'/J_r) \times (J_s'/J_s) \times (R_g/R_g')$$

[0042] The terms of the above equation of α have the following physical meanings:

Excitation force (proportional to the displacement amount): (V/V') times

Rotation speed variation (proportional to J_r^{-1}): (J_r'/J_r) times

Angular speed of the rotary compression unit 6 (proportional to J_s^{-1}): (J_s'/J_s) times

Rotational direction acceleration of the inlet tube 15 (proportional to R_g): (R_g/R_g') times

[0043] FIG. 3 shows a graph obtained by plotting results of the above calculations.

[0044] In the figure, the vertical axis represents the moment of inertia J_s of the static system (total), and the horizontal axis represents $(m_1/D_1)/(m_2/D_2)$.

[0045] A larger moment of inertia J_s of the static system on the vertical axis means smaller vibration.

[0046] As can be seen from FIG. 3, by designing the range of $(m_1/D_1)/(m_2/D_2)$ to be equal to or more than 3 and equal to or less than 7, the moment of inertia J_s of the static system is smaller than that of a related-art machine (reference compressor) (the maximum moment of inertia J_s of the static system is 0.011 [kg·m²], which is in an allowable range of a vibration reduction effect). In addition, it is possible to obtain the moment of inertia J_s of the static system equal to or more than a predetermined value (0.006 [kg·m²]), which is allowable as a value for vibration reduction.

[0047] Further, as can be seen from the figure, by using the parameter $(m_1/D_1)/(m_2/D_2)$, the compressor 1 can be evaluated in distinction from the related-art machine (reference compressor). This serves as an effective indicator for evaluating miniaturization of the compressor main body 10.

[0048] For example, when parameters are set as in respective comparative examples described below, the compressor 1 cannot be distinguished from the related-art machine, and miniaturization and vibration reduction cannot be evaluated at the same time.

[0049] In FIG. 4A, D_1/m_2 , that is, a value obtained by dividing the outside diameter D_1 of the compressor main body 10 by the mass m_2 of the accumulator 12 is used as a parameter of the horizontal axis. As can be seen from the figure, plotted points of the present embodiment are overlapped with values of the related-art machine (reference compressor) on the horizontal axis, and they cannot be distinguished from each other.

[0050] In FIG. 4B, m_1/m_2 , that is, a value obtained by dividing the mass m_1 of the compressor main body 10 by the mass m_2 of the accumulator 12 is used as a parameter of the horizontal axis. As can be seen from the figure, plotted points of the present embodiment are overlapped with values of the related-art machine (reference compressor) on the horizontal axis, and they cannot be distinguished from each other.

[0051] As can be understood with reference to FIGS. 3, 4A and 4B, by appropriately selecting a parameter as illustrated in FIG. 3, it is possible to evaluate the compressor in distinction from the related-art machine (reference compressor).

[0052] The operational effects of the present embodiment described above are as follows.

[0053] Miniaturization of the compressor main body 10 decreases the mass. Thus, the moment of inertia of the static system decreases and vibration during operation tends to increase. On the other hand, as a result of studies conducted by the present inventors and the like, it has been found that there is a range in which vibration can be reduced in terms of the relationship between the mass m_1 and the outside diameter D_1 of the compressor main body 10 and the mass

m_2 and the outside diameter D_2 of the accumulator 12.

[0054] That is, even when the compressor main body 10 is miniaturized, the vibration can be reduced in the range of $3 \leq (m_1/D_1)/(m_2/D_2) \leq 7$.

[0055] Even when a mildly flammable refrigerant (A2L), a flammable refrigerant (A2), or a strongly flammable refrigerant (A3) is used as the refrigerant, since the compressor 1 with less vibration during operation is provided, it is possible to reduce the possibility that the refrigerant leaks due to breakage of a pipe coupled to the inlet tube 15 as much as possible.

[0056] A weight adding member may be attached to the accumulator 12 so as to adjust the mass m_2 of the accumulator 12. The weight adding member is mainly used to increase the mass m_2 of the accumulator 12 and is irrelevant to the essential function of the accumulator 12. For example, rubber (particularly, butyl rubber having a high specific weight) is used. When rubber is used, the rubber is attached to the outside surface of the accumulator 12, for example.

[0057] The compressor and the design method therefor described in the above-described embodiment can be understood, for example, as follows.

[0058] A compressor (1) according to a first aspect of the present disclosure is a compressor including a compressor main body (10) including, in a tubular housing (2), a compression unit (6) compressing a refrigerant, and a tubular accumulator (12) coupled to a refrigerant suction portion of the compressor main body, in which $3 \leq (m_1/D_1)/(m_2/D_2) \leq 7$, where m_1 is a mass of the compressor main body, m_2 is a mass of the accumulator, D_1 is an outside diameter of the compressor main body, and D_2 is an outside diameter of the accumulator.

[0059] Miniaturization of the compressor main body decreases the mass. Thus, the moment of inertia of the static system decrease and vibration during operation tends to increase. On the other hand, as a result of studies conducted by the present inventors and the like, it has been found that there is a range in which vibration can be reduced in terms of the relationship between the mass and the outside diameter of the compressor main body and the mass and the outside diameter of the accumulator. That is, even when the compressor main body is miniaturized, vibration can be reduced in the range of $3 \leq (m_1/D_1)/(m_2/D_2) \leq 7$, where m_1 is the mass of the compressor main body, m_2 is the mass of the accumulator, D_1 is the outside diameter of the compressor main body, and D_2 is the outside diameter of the accumulator.

[0060] A compressor according to a second aspect of the present disclosure is the compressor according to the first aspect, in which

$$\begin{aligned} 4 \text{ kg} &\leq m_1 \leq 6 \text{ kg}, \\ 0.3 \text{ kg} &\leq m_2 \leq 0.7 \text{ kg}, \\ 80 \text{ mm} &\leq D_1 \leq 95 \text{ mm}, \text{ and} \\ 50 \text{ mm} &\leq D_2 \leq 75 \text{ mm}. \end{aligned}$$

[0061] When the masses and the outside diameters are within the above-described ranges, a miniaturized compressor can be achieved.

[0062] A compressor according to a third aspect of the present disclosure is the compressor according to the first aspect or the second aspect, in which a mildly flammable refrigerant, a flammable refrigerant, or a strongly flammable refrigerant is used as the refrigerant.

[0063] Even when the mildly flammable refrigerant (A2L), the flammable refrigerant (A2), or the strongly flammable refrigerant (A3) is used, since the compressor with less vibration during operation is provided, it is possible to reduce the possibility that the refrigerant leaks due to breakage of a pipe or the like.

[0064] A compressor according to a fourth aspect of the present disclosure is the compressor according to any of the first aspect to the third aspect, in which a weight adding member adjusting the m_2 is attached to the accumulator.

[0065] The above relationship for achieving vibration reduction may be satisfied by adjusting the mass m_2 of the accumulator. The weight adding member is mainly used to increase the weight of the accumulator and is irrelevant to the essential function of the accumulator. For example, rubber (specifically, butyl rubber having a large specific gravity) is used. When rubber is used, the rubber is attached to the outside surface of the accumulator, for example.

[0066] A method for designing a compressor according to a fifth aspect of the present disclosure is a method for designing a compressor, the compressor including a compressor main body including, in a tubular housing, a compression unit compressing a refrigerant, and a tubular accumulator coupled to a refrigerant suction portion of the compressor main body, in which $3 \leq (m_1/D_1)/(m_2/D_2) \leq 7$, where m_1 is a mass of the compressor main body, m_2 is a mass of the accumulator, D_1 is an outside diameter of the compressor main body, and D_2 is an outside diameter of the accumulator.

Reference Signs List

[0067]

1 Compressor (rotary compressor)

	2 Housing
	3 Rotor shaft body
	4A Upper bearing
	4B Lower bearing
5	5 Electric motor
	6 Rotary compression unit (compression unit)
	7 Leg portion
	8 Vibration-proof rubber
	10 Compressor main body
10	11 Suction tube
	12 Accumulator
	13 Discharge tube
	14 Bracket
	15 Inlet tube
15	21 Main body portion
	21a Inner surface
	22 Upper lid portion
	23 Lower lid portion
	24 Opening
20	25 Suction port
	30 Terminal block
	31 Power supply terminal
	32 Wiring line
	51 Rotor
25	52 Stator
	60 Cylinder
	60A Compression chamber
	60B Suction hole
	61 Bolt
30	62 Eccentric shaft portion
	63 Piston rotor
	65 Discharge cover
	CL Axis of rotation
	CL2 Center axis of the inlet tube
35	FL Installation surface

Claims

- 40 **1.** A compressor comprising:
- a compressor main body including, in a tubular housing, a compression unit configured to compress a refrigerant;
and
a tubular accumulator coupled to a refrigerant suction portion of the compressor main body, wherein
- 45 $3 \leq (m1/D1)/(m2/D2) \leq 7$, where m1 is a mass of the compressor main body, m2 is a mass of the accumulator, D1 is an outside diameter of the compressor main body, and D2 is an outside diameter of the accumulator.
- 2.** The compressor according to claim 1, wherein
- 50 $4 \text{ kg} \leq m1 \leq 6 \text{ kg}$,
 $0.3 \text{ kg} \leq m2 \leq 0.7 \text{ kg}$,
 $80 \text{ mm} \leq D1 \leq 95 \text{ mm}$, and
 $50 \text{ mm} \leq D2 \leq 75 \text{ mm}$.
- 55 **3.** The compressor according to claim 1 or 2, wherein a mildly flammable refrigerant, a flammable refrigerant, or a strongly flammable refrigerant is used as the refrigerant.
- 4.** The compressor according to claim 1 or 2, wherein

a weight adding member configured to adjust the m2 is attached to the accumulator.

- 5 5. A method for designing a compressor, the compressor including a compressor main body including, in a tubular housing, a compression unit configured to compress a refrigerant, and a tubular accumulator coupled to a refrigerant suction portion of the compressor main body, wherein

$3 \leq (m1/D1)/(m2/D2) \leq 7$, where m1 is a mass of the compressor main body, m2 is a mass of the accumulator, D1 is an outside diameter of the compressor main body, and D2 is an outside diameter of the accumulator.

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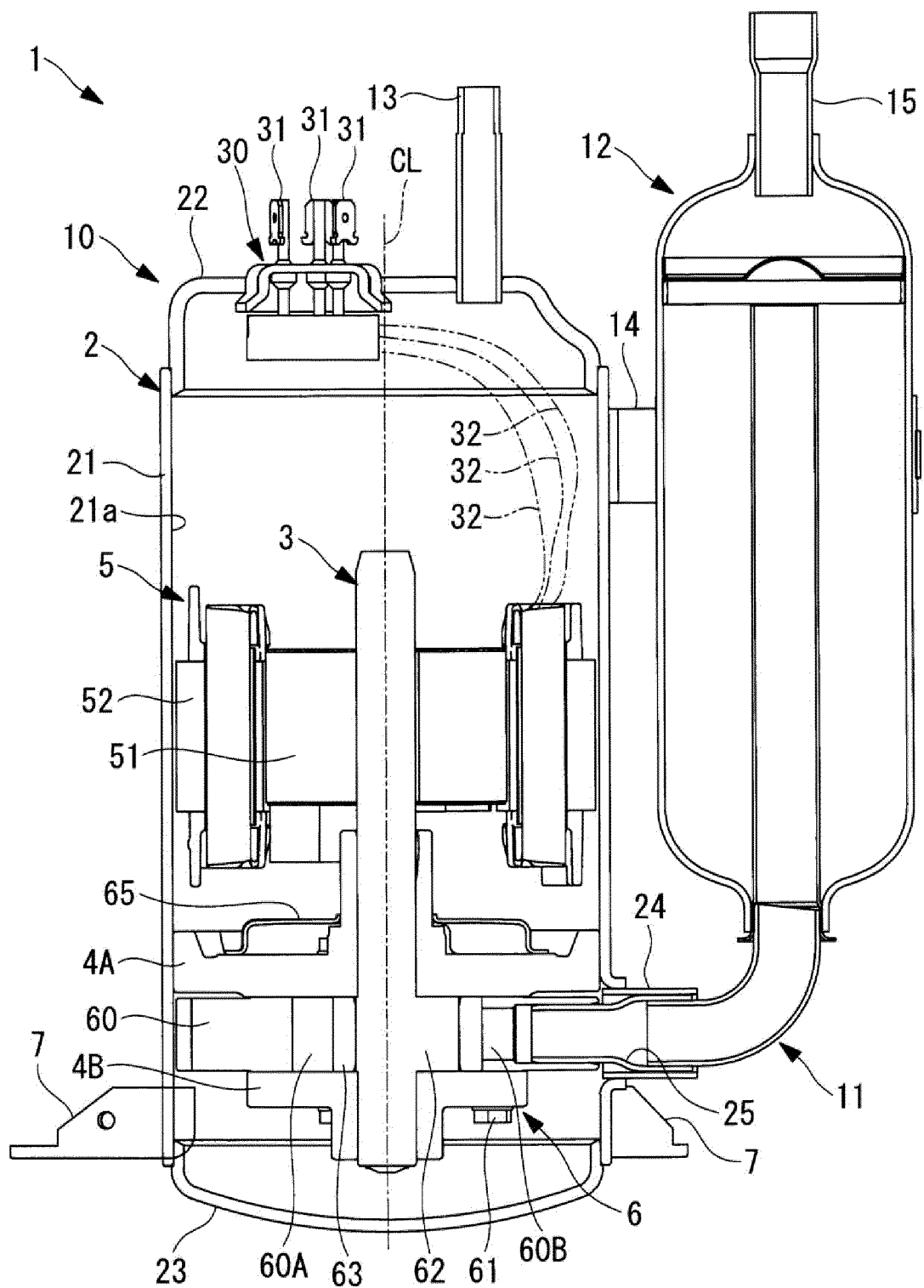


FIG. 1

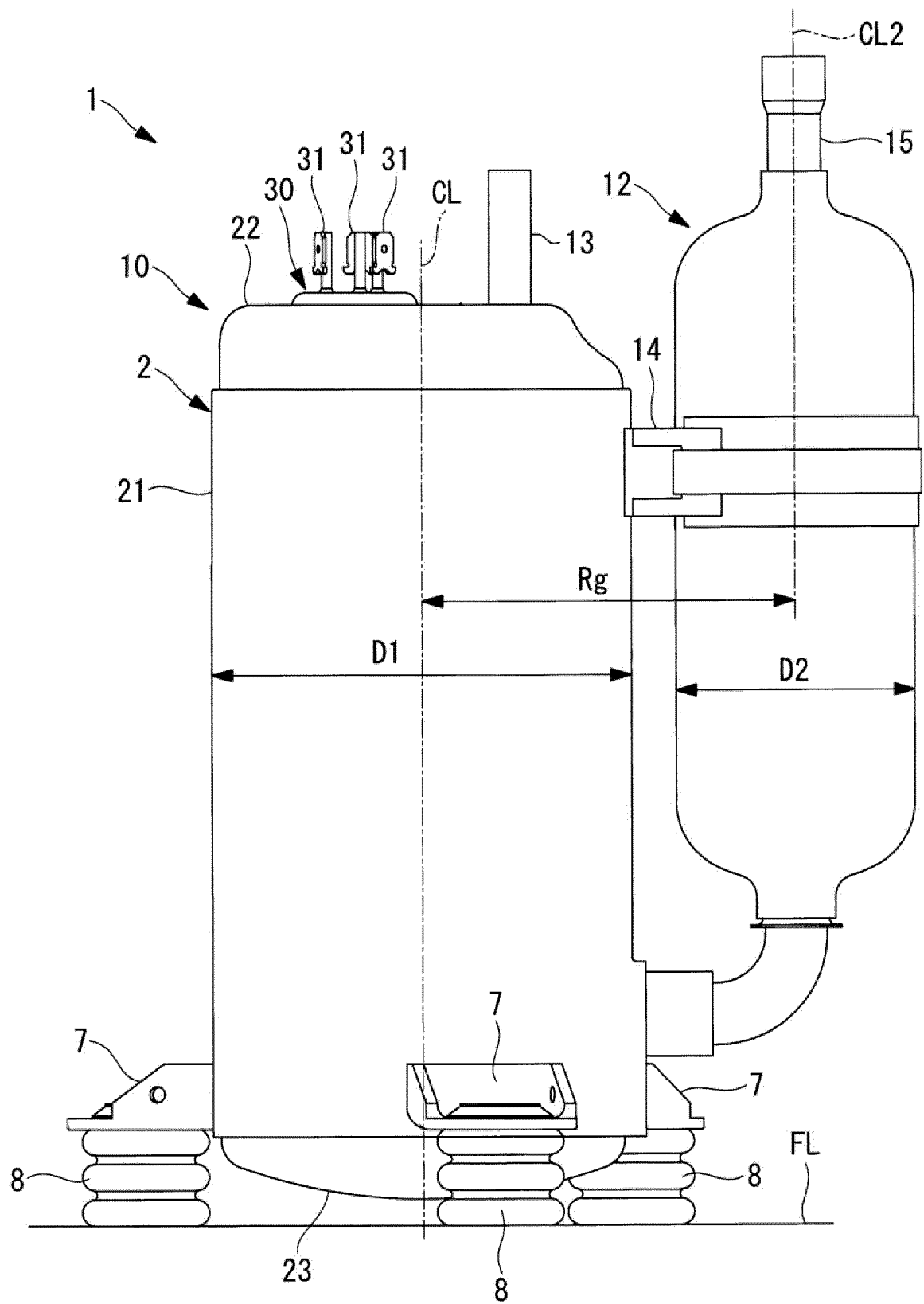


FIG. 2

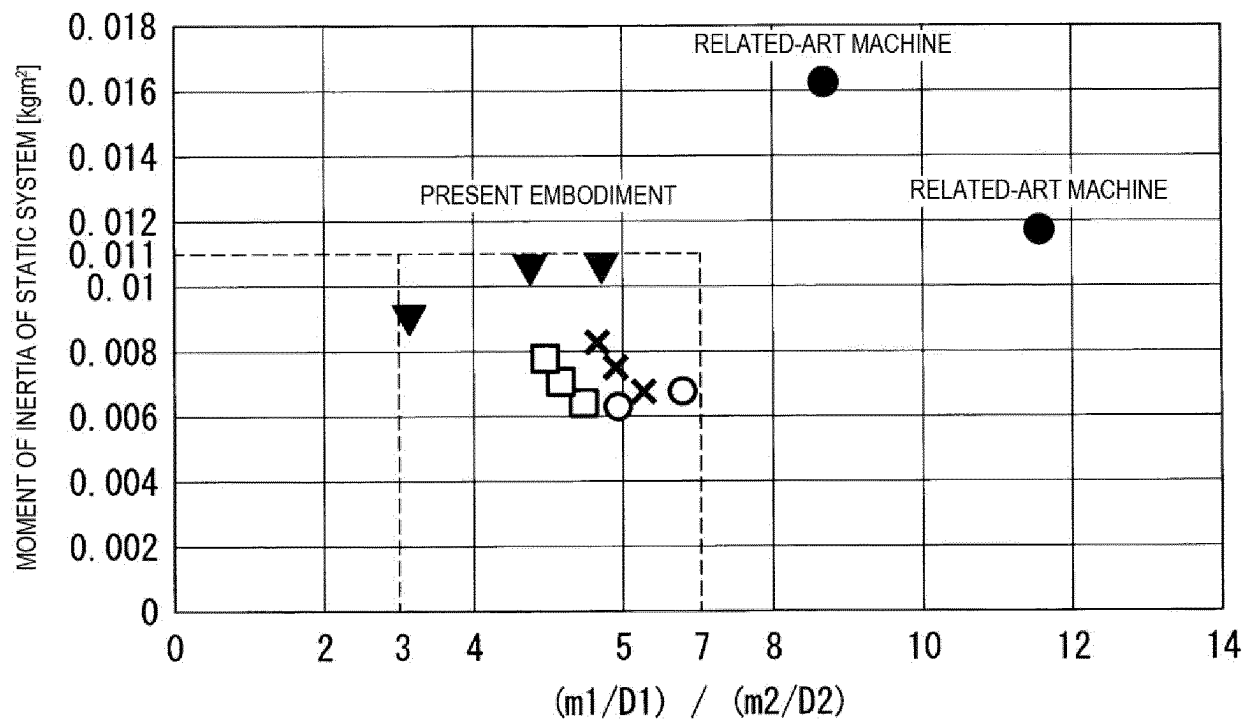


FIG. 3

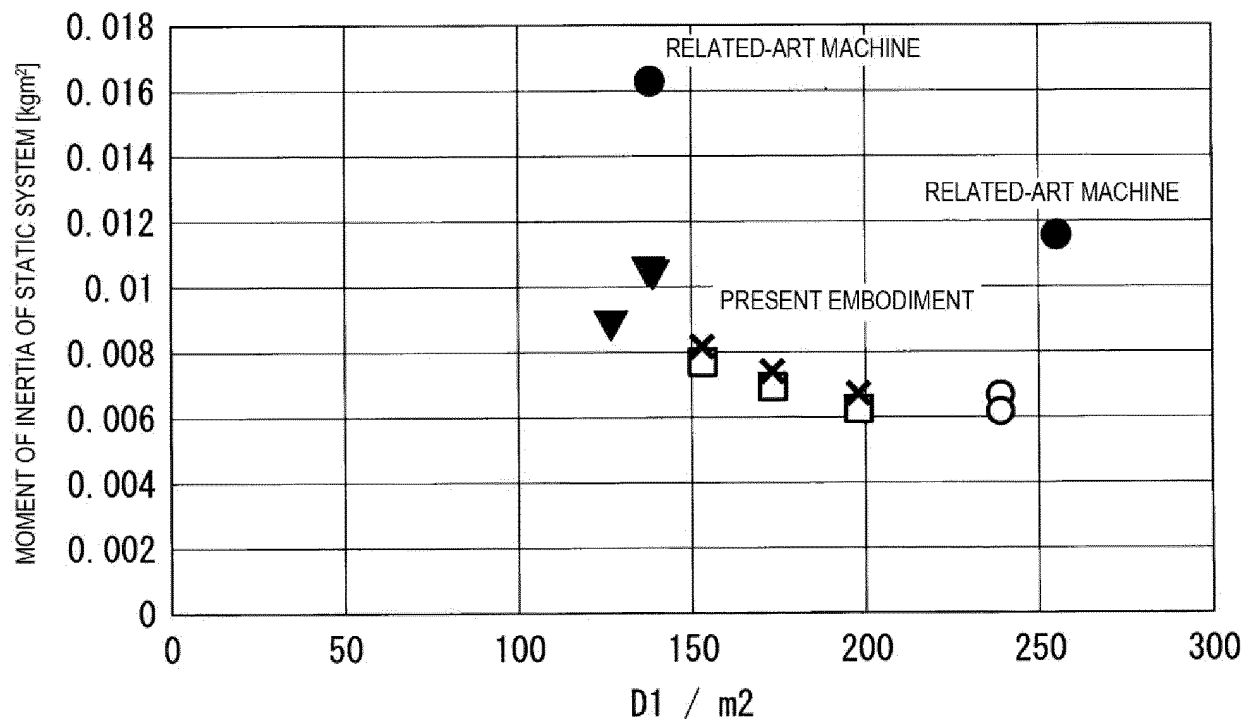


FIG. 4A

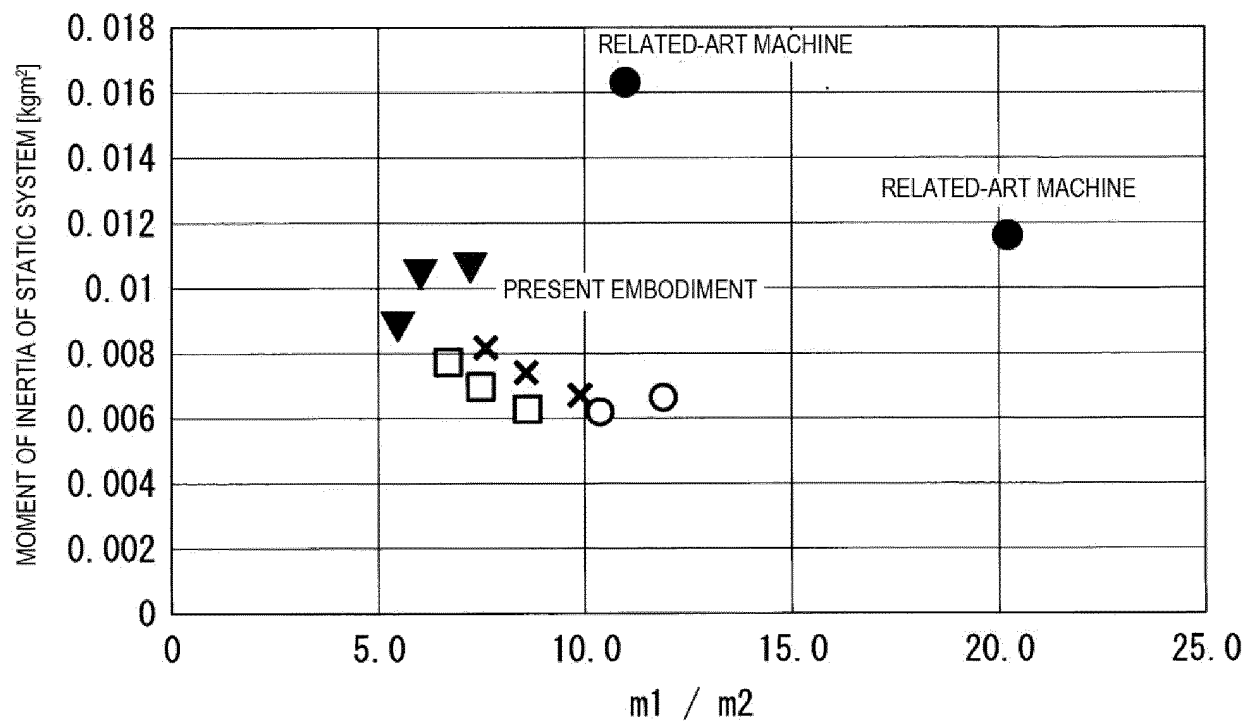


FIG. 4B

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2023/019761

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/06(2006.01)i; **F04B 39/00**(2006.01)i; **F04C 29/12**(2006.01)i
 FI: F04C29/06 D; F04B39/00 102Z; F04C29/12 C

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)
 F04C29/06; F04B39/00; F04C29/12

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 1971-2023
 Registered utility model specifications of Japan 1996-2023
 Published registered utility model applications of Japan 1994-2023

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 2014-92078 A (DAIKIN IND., LTD.) 19 May 2014 (2014-05-19) paragraphs [0001]-[0005], fig. 5, 6	1-5
A	JP 2009-97394 A (PANASONIC CORP.) 07 May 2009 (2009-05-07) paragraphs [0003]-[0007]	1-5

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

* Special categories of cited documents:

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

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

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

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

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

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

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Date of the actual completion of the international search

19 July 2023

Date of mailing of the international search report

01 August 2023

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Form PCT/ISA/210 (second sheet) (January 2015)

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/JP2023/019761

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REFERENCES CITED IN THE DESCRIPTION

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