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(71) Applicant: **MITSUBISHI HEAVY INDUSTRIES THERMAL SYSTEMS, LTD.**
Tokyo 100-8332 (JP)

(72) Inventors:
- **SHIMAYA, Hirofumi**
  Tokyo 100-8332 (JP)
- **ESAKI, Ikuo**
  Tokyo 100-8332 (JP)

(74) Representative: **Cabinet Beau de Loménie**
158, rue de l'Université
75340 Paris Cedex 07 (FR)

(54) ROTARY COMPRESSOR

(57) To provide a rotary compressor that can reduce vibration during driving. The compressor includes a housing (2) including a tubular portion (21) extending in a height direction along a center axis (CL2), a rotary compression unit (6) that is accommodated in the housing (2) and fixed to the tubular portion (21) by a plurality of welded portions (70) formed in a circumferential direction about the center axis (CL2), the compression unit (6) being configured to compress a refrigerant, an electric motor accommodated in the housing (2) and being configured to drive the rotary compression unit (6), and a plurality of leg portions (7) provided on an outside surface (21b) of the tubular portion (21) and being configured to fix the housing (2) to an installation surface. Positions of the leg portions (7) correspond to positions of the welded portions (70) in the circumferential direction, respectively.

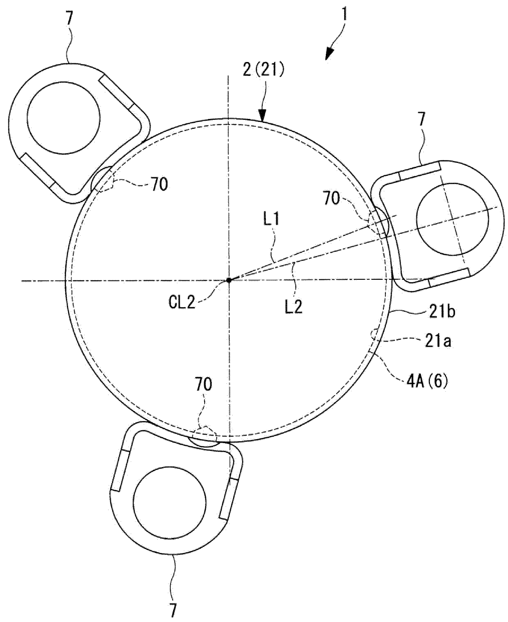

FIG. 2

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Description

Technical Field

[0001] The present disclosure relates to a rotary compressor.

Background Art

[0002] A rotary compressor is one type of compressor used in devices such as refrigeration devices and air-conditioning devices (e.g., Patent Document 1).

[0003] In a related-art rotary compressor having a relatively large weight, the weight of the rotary compressor tends to suppress vibration caused by driving a compression unit (e.g., piston rotor rotation). However, as rotary compressors have become lighter, problems related to vibration have become more apparent.

Citation List

Patent Literature

[0004] Patent Document 1: JP 58-131392 A

Summary of Invention

Technical Problem

[0005] When vibration occurs, ease of mounting the compressor to a product may be impaired.

[0006] If the vibration causes a refrigerant pipe to break, the refrigerant inside the pipe may leak to the outside. In particular, when a flammable refrigerant (A2L or A3 as an example of the class) is used as the refrigerant, there is a higher need to help prevent the refrigerant from leaking.

[0007] The present disclosure has been made in view of such circumstances, and it is an object of the present disclosure to provide a rotary compressor that can reduce vibration during driving.

Solution to Problem

[0008] To solve the above problem, the present disclosure provides a rotary compressor including a housing including a tubular portion extending in a height direction along an axis, a compression unit that is accommodated in the housing and fixed to the tubular portion by a plurality of welded portions formed in a circumferential direction about the axis, the compression unit being configured to compress a refrigerant, a drive unit accommodated in the housing and being configured to drive the compression unit, and a plurality of leg portions provided on an outside surface of the tubular portion and being configured to fix the housing to an installation surface, in which positions of the leg portions correspond to positions of the welded portions in the circumferential direction, respectively.

Advantageous Effects of Invention

[0009] According to the rotary compressor of the present disclosure, it is possible to reduce vibration during driving.

Brief Description of Drawings

[0010]

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

FIG. 2 is a plan view illustrating the rotary compressor according to the embodiment of the present disclosure.

FIG. 3 is a side view illustrating a state in which the rotary compressor of FIG. 1 is provided on an installation surface.

FIG. 4 is a partially enlarged view of a portion A illustrated in FIG. 1.

FIG. 5 is a plan view illustrating a modification example of the rotary compressor according to the embodiment of the present disclosure.

Description of Embodiments

[0011] An embodiment according to the present disclosure will be described below with reference to the drawings.

[0012] 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 has a weight of 6.5 kg or less and 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.

Basic Configuration of Compressor

[0013] The compressor main body 10 includes a housing 2 having a substantially cylindrical shape, a rotor shaft body 3, an electric motor (drive unit) 5, and a rotary compression unit (compression unit) 6.

[0014] An axis of rotation CL1 of the rotor shaft body 3 coincides with a center axis CL2 of the housing 2.

[0015] The rotor shaft body 3 is disposed extending in an up-down direction and rotates about the axis of rotation CL1 in the housing 2.

[0016] The housing 2 is hermetically sealed and extends in the up-down direction. The up-down direction coincides with, for example, a height direction of the housing 2 when the compressor 1 is installed on an installation surface FL (see FIG. 3).

[0017] The housing 2 includes a tubular portion 21 extending in the height direction along the center axis CL2, and an upper lid portion 22 and a lower lid portion 23 that close upper and lower openings of the tubular portion 21, respectively. The outer diameter of the tubular portion 21 is, for example, 95 mm or less.

[0018] A plurality of leg portions 7 are fixed to an outside surface 21b of the tubular portion 21 at a lower portion.

[0019] As illustrated FIG. 2, the leg portions 7 are disposed in the circumferential direction at predetermined angular intervals. In FIG. 2, three leg portions 7 are disposed at intervals of about 120 degrees in the circumferential direction.

[0020] Note that, in FIG. 2, some components (e.g., detailed portions of the accumulator 12, the upper lid portion 22, the rotor shaft body 3, and an upper bearing 4A) are not illustrated to simplify the description.

[0021] As illustrated in FIG. 3, the compressor 1 is installed by each leg portion 7 being fixed to the installation surface FL via vibration-proof rubber 8.

[0022] As illustrated in FIG. 1, an opening 24 is formed in a lower portion of the side wall of the housing 2 at a position facing the outside surface of a cylinder 60. In the cylinder 60, a suction port 25 that communicates with a predetermined position in the cylinder is formed at a position facing the opening 24.

[0023] An oil sump for storing lubricating oil is formed at a bottom portion of the housing 2. The liquid level in the oil sump when the oil sump is initially sealed is located above the rotary compression unit 6. Thus, the rotary compression unit 6 is driven in the oil sump.

[0024] The upper lid portion 22 is provided with a discharge tube 13 and a terminal block 30. The discharge tube 13 extends through the upper lid portion 22 in a 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 alternating electric power is supplied to the power supply terminals 31 from an inverter device (not illustrated).

[0025] The accumulator 12 is used to separate a refrigerant into gas and liquid before the refrigerant is supplied to the compressor main body 10. The accumulator 12 has a substantially cylindrical shape and is fixed to the housing 2 (the outside surface 21b of the tubular portion 21) via a bracket 14. An inlet tube 15 for introducing the 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 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.

[0026] The electric motor 5 is accommodated at a central portion of the housing 2 in the up-down direction. The electric motor 5 includes a rotor 51 and a stator 52.

[0027] The rotor 51 is fixed to the outside surface of the rotor shaft body 3 and is disposed above the rotary compression unit 6.

[0028] The stator 52 is disposed surrounding the outside surface of the rotor 51 and is fixed (e.g., shrink fitted) to an inside surface 21a of the tubular portion 21 of the housing 2. Electric power is supplied to the stator 52 from each power supply terminal 31 through a wiring line 32.

[0029] The electric motor 5 is configured such that the rotor 51 rotates by the electric power supplied from the power supply terminal 31. When the rotor 51 rotates, the rotor shaft body 3 is rotationally driven about the axis of rotation CL1. At this time, the rotation of the electric motor 5 is vector-controlled.

[0030] The rotary compression unit 6 includes a cylinder 60 and an upper bearing 4A and a lower bearing 4B. The rotary compression unit 6 is disposed at a lower portion (bottom portion) in the up-down direction in the housing 2 with the cylinder 60 sandwiched between the upper bearing 4A and the lower bearing 4B from above and below.

[0031] The upper bearing 4A and the lower bearing 4B are each made of a metal material and are fixed by the cylinder 60 and a bolt 61.

[0032] The rotor shaft body 3 is rotatably supported by the upper bearing 4A and the lower bearing 4B about the axis of rotation CL1.

[0033] The rotary compression unit 6 further includes an eccentric shaft portion 62 and a piston rotor 63 provided around the eccentric shaft portion 62.

[0034] The eccentric shaft portion 62 is formed at a lower portion of the rotor shaft body 3 and is provided in a space formed by the inside surface of the piston rotor 63 in a state of being offset in a direction orthogonal to the axis of rotation CL1 of the rotor shaft body 3.

[0035] The piston rotor 63 has a cylindrical shape having an outside diameter smaller than the inside diameter of the cylinder 60. The piston rotor 63 is disposed in a space formed by the inside surface of the cylinder 60 and is fixed in a state of being mounted at the outside surface of the eccentric shaft portion 62.

[0036] The piston rotor 63 eccentrically rotates about the axis of rotation CL1 along with the rotation of the rotor shaft body 3.

[0037] A compression chamber 60A, a suction hole 60B, and a discharge hole (not illustrated) are formed in the rotary compression unit 6.

[0038] The space formed by the inside surface of the cylinder 60 is sandwiched between the upper bearing 4A and the lower bearing 4B to define the compression chamber 60A. The piston rotor 63 is accommodated in the compression chamber 60A.

[0039] The suction hole 60B is a hole for guiding the refrigerant to the compression chamber 60A from the outside of the cylinder 60 and is formed in the cylinder 60 along a direction orthogonal to the axis of rotation CL1.

[0040] The rotary compression unit 6 configured as described above is fixed to the housing 2. Specifically, as illustrated in FIGS. 1 and 2, for example, the upper bearing 4A is fixed by being plug-welded at a plurality of locations in the circumferential direction of the tubular portion 21.

[0041] As illustrated in FIG. 4, the upper bearing 4A is fixed to the housing 2 by a welded portion 70 formed extending from the outside surface 21b of the tubular portion 21 to the upper bearing 4A through the tubular portion 21. Thus, the welded portion 70 is a fixing portion between the housing 2 and the rotary compression unit 6, and is also an excitation position (excitation source) that transmits vibration and mechanical reaction force from the rotary compression unit 6 to the housing 2.

[0042] As illustrated in FIG. 2, the positions of the welded portions 70 are preferably disposed at equal angular intervals in the circumferential direction from the viewpoint of force balance. In FIG. 2, three welded portions 70 are formed at intervals of about 120 degrees in the circumferential direction.

[0043] Note that the number of welded portions 70 is not limited to three and may be four or more, for example.

[0044] The welded portion 70 may be formed in the cylinder 60 instead of the upper bearing 4A. That is, the cylinder 60 may be plug-welded to the tubular portion 21.

[0045] The compressor 1 configured as described above operates as follows. A refrigerant guided from the evaporator (not illustrated) is taken into the accumulator 12 through the inlet tube 15.

[0046] 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.

[0047] Then, eccentric rotation of the piston rotor 63 gradually decreases the volume of the compression chamber 60A and compresses the refrigerant.

[0048] The refrigerant after compression is guided into a space formed between a discharge cover 65 and the upper bearing 4A through a discharge hole (not illustrated) formed in the cylinder 60 and then discharged into the space inside the housing 2.

[0049] The refrigerant discharged into the space inside the housing 2 is guided to a condenser (not illustrated) through the discharge tube 13 provided at the upper portion of the housing 2.

Positions of Leg Portions

[0050] As illustrated in FIG. 2, when the compressor 1 is viewed in plan view from a direction along the center axis CL2, the positions of the leg portions 7 correspond to the positions of the welded portions 70 in the circumferential direction with respect to the center axis CL2.

[0051] With this configuration, it is possible to bring the leg portions 7 close to the welded portions 70, which are the excitation positions of the housing 2.

[0052] Here, "correspond" means that the leg portions 7 overlap the welded portions 70 in the circumferential direction. In other words, as illustrated in FIGS. 1 and 2, the welded portions 70 are positioned directly above the leg portions 7.

[0053] Specifically, in a plan view as illustrated in FIG. 2, when a line passing through the center axis CL2 and the center position of the welded portion 70 is defined as a line L1 and a line passing through the center axis CL2 and the center position of the leg portion 7 is defined as a line L2, the leg portion 7 is disposed such that the line L2 falls within a range of $\pm$ 10 degrees with respect to the line L1 as a reference, with the center axis CL2 as the center of the angle.

[0054] It is preferable that the leg portion 7 is disposed such that the line L2 coincides with the line L1.

[0055] Additionally, as illustrated in FIG. 1, when the compressor 1 is viewed from the side in a direction orthogonal to the center axis CL2, the position of the leg portion 7 preferably corresponds to the position of the rotary compression unit 6 in the height direction of the tubular portion 21.

[0056] As a result, it is possible to bring the leg portion 7 further closer to the welded portion 70, which is the excitation position of the housing 2.

[0057] Here, "corresponds" means that the leg portion 7 overlaps any component constituting the rotary compression unit 6 in the height direction. In FIG. 1, the leg portion 7 overlaps the lower bearing 4B constituting the rotary compression unit 6 in the height direction.

[0058] The operational effects of the present embodiment described above are as follows.

[0059] Since the position of the leg portion 7 corresponds to the position of the welded portion 70 in the circumferential direction, reaction force generated at the welded portion 70 is more likely to be received at the leg portion 7 when the welded portion 70 serving as the excitation position and the leg portion 7 are brought close to each other. Accordingly, vibration of the compressor 1 caused by the reaction force can be reduced. Therefore, it is possible to reduce the size and weight of the compressor 1 and reduce material costs by reducing the thickness of the housing 2, for example.

[0060] When the electric motor 5 is used as the drive unit for driving the rotary compression unit 6 and the rotation of the electric motor 5 is vector-controlled, the reaction force at the welded portion 70 is received by the leg portion 7. Thus, the torsion of the tubular portion 21 (housing 2) can be reduced and a decrease in controllability due to the relative phase shift between the stator 52 and the rotor 51 can be suppressed.

[0061] Twisting of the tubular portion 21 occurs in the following manner.

[0062] A force in the circumferential direction originating from the reaction force at the welded portion 70 acts on the tubular portion 21 by driving the rotary compression unit 6. A force in the circumferential direction originating from the torque reaction force received by the stator 52 due to the rotation of the electric motor 5 acts on the tubular portion 21 to which the stator 52 is fixed.

[0063] By combining these two forces, torsional displacement that causes oscillation in the circumferential direction is generated in the tubular portion 21 while driving the rotary compression unit 6. When the tubular portion 21 oscillates due to twisting, the stator 52 fixed to the inside surface 21a of the tubular portion 21 also oscillates in the circumferential direction. In this case, a relative phase shift occurs between the stator 52 and the rotor 51.

[0064] When the position of the leg portion 7 corresponds to the position of the rotary compression unit 6 in the height direction, the leg portion 7 can be brought further closer to the welded portion 70 being the excitation position. Accordingly, the reaction force at the welded portion 70 is more likely to be received at the leg portion 7.

[0065] When the center position of the leg portion 7 in the circumferential direction coincides with the center position of the welded portion 70 in the circumferential direction, the leg portion 7 can be brought closest to the welded portion 70 being the excitation position. Accordingly, the reaction force at the welded portion 70 is more likely to be received at the leg portion 7.

[0066] When the welded portions 70 and the leg portions 7 are disposed at substantially equal angular intervals in the circumferential direction, the reaction force at the welded portions 70 can be processed in a well-balanced manner.

Modified Example

[0067] As illustrated in FIG. 5, a support leg portion 9 may be provided between one leg portion 7 corresponding to the position of the welded portion 70 and the leg portion 7 adjacent thereto (preferably at an intermediate position).

[0068] Similarly to the leg portions 7, the support leg portions 9 are provided at predetermined angular intervals in the circumferential direction on the outside surface 21b at the lower portion of the tubular portion 21. The support leg portion 9 is provided at the same height position as the leg portion 7. Similarly to the leg portion 7, the support leg portion 9 is fixed to the installation surface FL via the vibration-proof rubber 8.

[0069] With this configuration, the reaction force at the welded portion 70 can be received not only by the leg portion 7 but also by the support leg portion 9. As a result, vibration of the compressor 1 and torsion of the tubular portion 21 (housing 2) can be further reduced.

[0070] Note that, although the support leg portions 9 are provided between all the leg portions 7 in FIG. 5, it is not always necessary to provide the support leg portions 9 between all the leg portions 7.

[0071] The rotary compressor (1) described in each embodiment as above is understood as follows, for example.

[0072] A rotary compressor according to a first aspect of the present disclosure includes a housing (2) including a tubular portion (21) extending in a height direction along an axis (CL2), a compression unit (6) that is accommodated in the housing and fixed to the tubular portion by a plurality of welded portions (70) formed in a circumferential direction about the axis, the compression unit being configured to compress a refrigerant, a drive unit (5) accommodated in the housing and being configured to drive the compression unit, and a plurality of leg portions (7) provided on an outside surface (21b) of the tubular portion and being configured to fix the housing to an installation surface (FL), in which positions of the leg portions correspond to positions of the welded portions in the circumferential direction, respectively.

[0073] The rotary compressor according to the present aspect includes a housing including a tubular portion extending in a height direction along an axis, a compression unit that is accommodated in the housing and fixed to the tubular portion by a plurality of welded portions formed in a circumferential direction about the axis, the compression unit being configured to compress a refrigerant, a drive unit accommodated in the housing and being configured to drive the compression unit, and a plurality of leg portions provided on an outside surface of the tubular portion and being configured to fix the housing to an installation surface. Positions of the leg portions correspond to positions of the welded portions in the circumferential direction, respectively. By bringing the welded portions which are connecting locations with the compression unit and excitation positions for the tubular portion (housing) close to the leg portions, reaction force at the welded portions is easily received by the leg portions. Accordingly, vibration of the rotary compressor caused by the reaction force can be reduced. Therefore, it is possible to reduce the size and weight of the compressor and reduce material costs by reducing the thickness of the housing, for example.

[0074] Additionally, since the leg portions receive the reaction force, torsion of the tubular portion (housing) caused by the reaction force can be reduced. Therefore, it is possible to help prevent failure of the drive unit caused by the torsion of the tubular portion (housing) (e.g., a decrease in controllability caused by a relative phase shift between the stator and the rotor when the drive unit is an electric motor).

[0075] A rotary compressor according to a second aspect of the present disclosure is the rotary compressor according to the first aspect, in which the drive unit is an electric motor (5) including a stator (52) fixed to the housing and a rotor (51) connected to the compression unit.

[0076] According to the rotary compressor of the present aspect, since the drive unit is an electric motor including the stator fixed to the housing and the rotor connected to the compression unit, the reaction force at the welded portion as a connecting location with the compression unit is received by the leg portions. Thus, torsion of the tubular portion (housing) caused by the reaction force at the welded portion and the torque reaction force received by the stator can be reduced and a decrease in controllability due to the relative phase shift between the stator and the rotor can be suppressed.

[0077] A rotary compressor according to a third aspect of the present disclosure is the rotary compressor according to the first aspect or the second aspect, in which the position of each of the leg portions corresponds to a position of the compression unit in the height direction.

[0078] According to the rotary compressor of the present aspect, since the position of the leg portion corresponds to the position of the compression unit in the height direction, the leg portion can be brought further closer to the welded portion being the excitation position. Accordingly, the reaction force at the welded portion is more likely to be received at the leg portion.

[0079] A rotary compressor according to a fourth aspect of the present disclosure is the rotary compressor according to any one of the first to third aspects, in which center positions of the leg portions in the circumferential direction coincide with center positions of the welded portions in the circumferential direction, respectively.

[0080] According to the rotary compressor of the present aspect, since the center position of the leg portion in the circumferential direction coincides with the center position of the welded portion in the circumferential direction, the leg portion can be brought closest to the welded portion being the excitation position. Accordingly, the reaction force at the welded portion is more likely to be received at the leg portion.

[0081] A rotary compressor according to a fifth aspect of the present disclosure is the rotary compressor according to any one of the first to fourth aspects, in which the welded portions and the leg portions are disposed at substantially equal angular intervals in the circumferential direction.

[0082] According to the rotary compressor of the present aspect, since the welded portions and the leg portions are disposed at substantially equal angular intervals in the circumferential direction, it is possible to process the reaction force in the welded portions in a well-balanced manner.

[0083] A rotary compressor according to a sixth aspect of the present disclosure is the rotary compressor according to any one of the first to fifth aspects, further including a support leg portion (9) provided on the outside surface of the tubular portion between one leg portion of the leg portions and another leg portion of the leg portions adjacent to the one leg portion.

[0084] According to the rotary compressor of the present aspect, the support leg portion is provided on the outside surface of the tubular portion between one leg portion of the leg portions and another leg portion of the leg portions adjacent to the one leg portion. Thus, the reaction force at the welded portion being the excitation position can be received not only at the leg portion but also at the support leg portion. As a result, vibration of the rotary compressor and torsion of the tubular portion (housing) can be further reduced.

Reference Signs List

[0085]

1 Compressor (rotary compressor)
2 Housing
3 Rotor shaft body
4A Upper bearing
4B Lower bearing
5 Electric motor (drive unit)
6 Rotary compression unit
7 Leg portion
8 Vibration-proof rubber
9 Support leg portion
10 Compressor main body
11 Suction tube
12 Accumulator
13 Discharge tube
14 Bracket
15 Inlet tube
21 Tubular portion
21a Inside surface
21b Outside surface
22 Upper lid portion
23 Lower lid portion
24 Opening
25 Suction port
30 Terminal block
31 Power supply terminal
32 Wiring line
51 Rotor
52 Stator
60 Cylinder
60A Compression chamber
60B Suction hole
61 Bolt
62 Eccentric shaft portion
63 Piston rotor
65 Discharge cover
70 Welded portion
CL1 Axis of rotation
CL2 Center axis
FL Installation surface

Claims

1. A rotary compressor comprising:

a housing including a tubular portion extending in a height direction along an axis;
a compression unit that is accommodated in the housing and fixed to the tubular portion by a plurality of welded portions formed in a circumfer-

ential direction about the axis, the compression unit being configured to compress a refrigerant;
a drive unit accommodated in the housing and being configured to drive the compression unit; and
a plurality of leg portions provided on an outside surface of the tubular portion and being configured to fix the housing to an installation surface, wherein
positions of the leg portions correspond to positions of the welded portions in the circumferential direction, respectively.

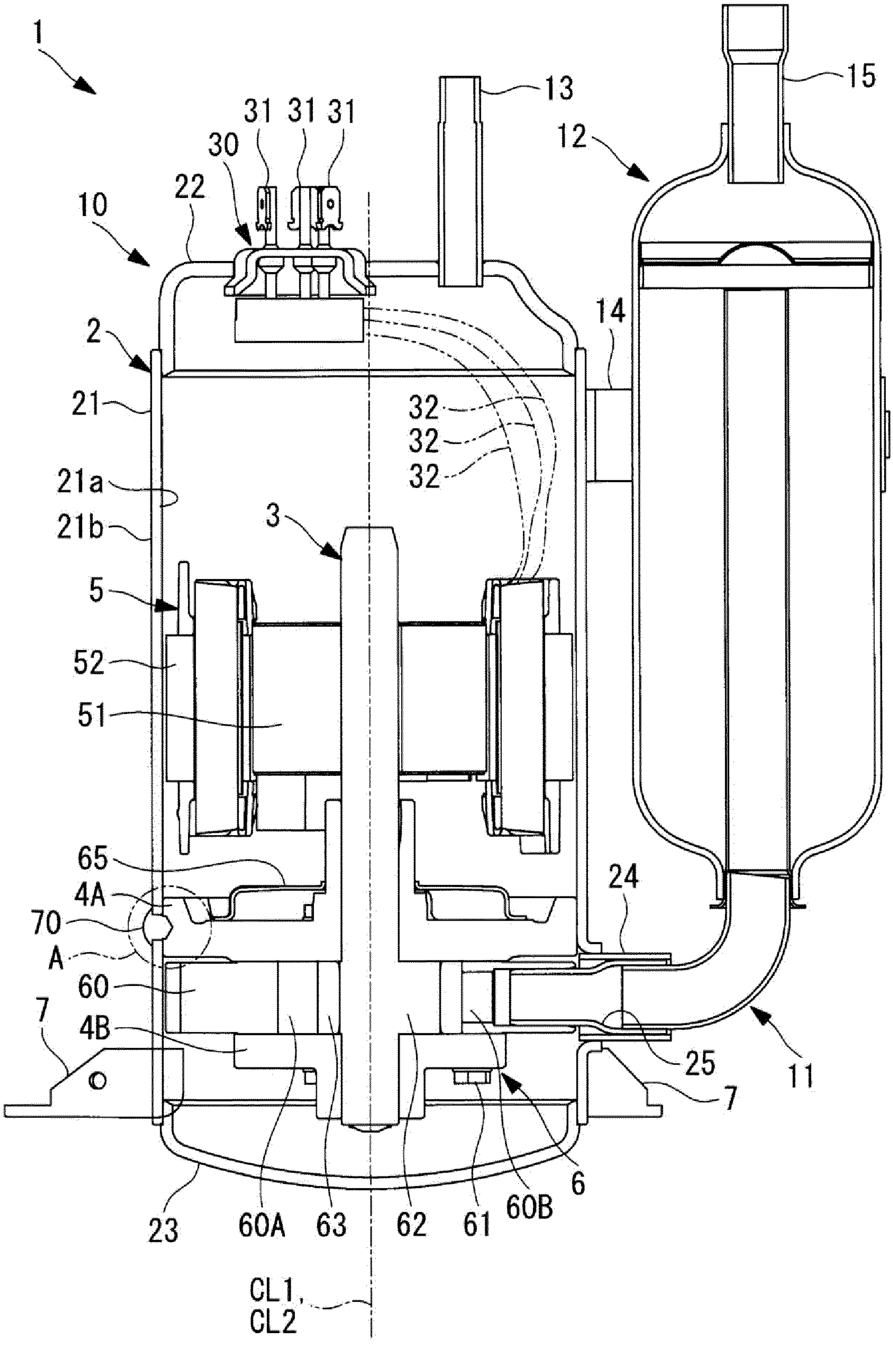
2. The rotary compressor according to claim 1, wherein the drive unit is an electric motor including a stator fixed to the housing and a rotor connected to the compression unit.

3. The rotary compressor according to claim 1 or 2, wherein the position of each of the leg portions corresponds to a position of the compression unit in the height direction.

4. The rotary compressor according to claim 1 or 2, wherein center positions of the leg portions in the circumferential direction coincide with center positions of the welded portions in the circumferential direction, respectively.

5. The rotary compressor according to claim 1 or 2, wherein the welded portions and the leg portions are disposed at substantially equal angular intervals in the circumferential direction.

6. The rotary compressor according to claim 1 or 2, further comprising a support leg portion provided on the outside surface of the tubular portion between one leg portion of the leg portions and another leg portion of the leg portions adjacent to the one leg portion.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60B
CL1,
CL2

FIG. 1

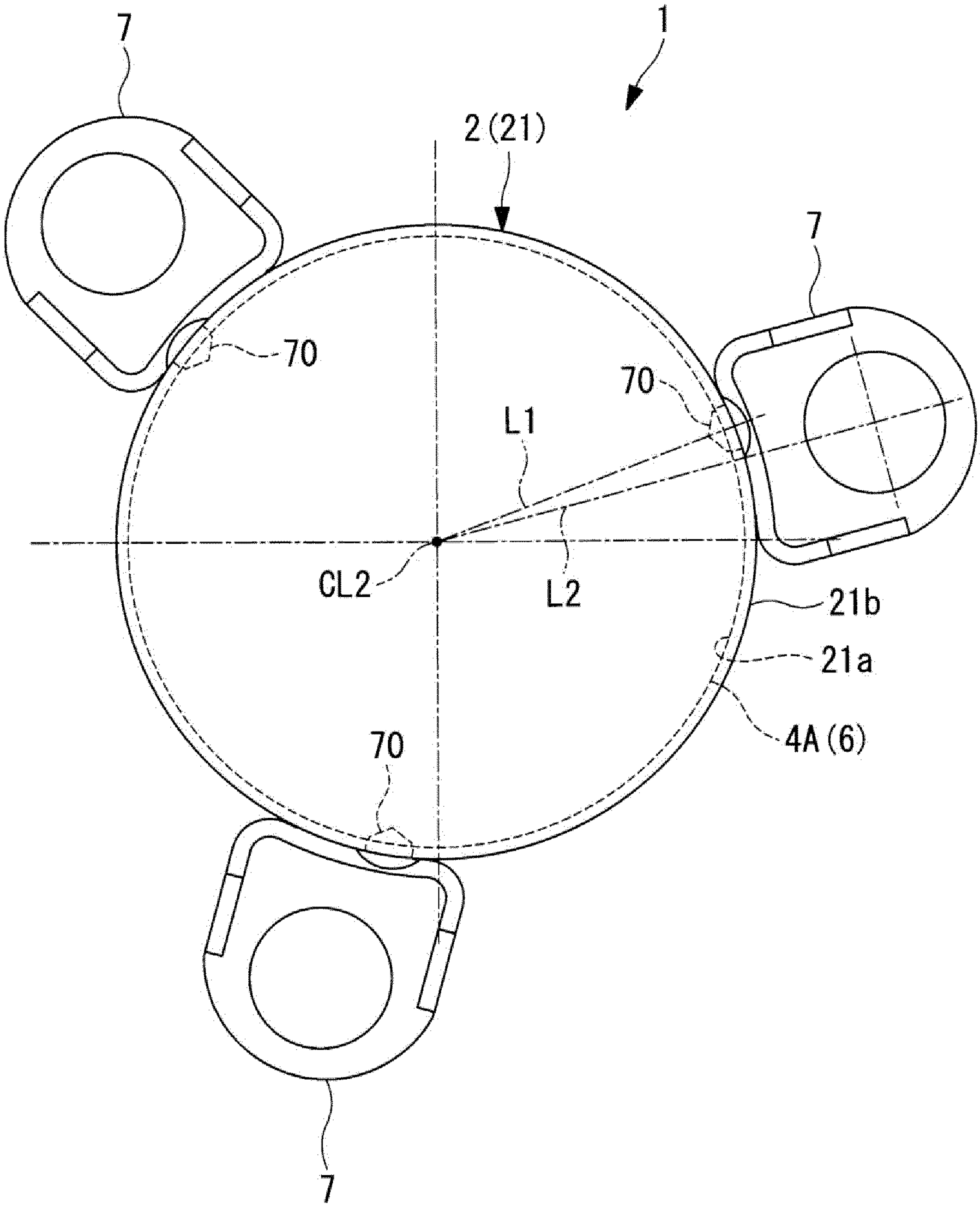

FIG. 2

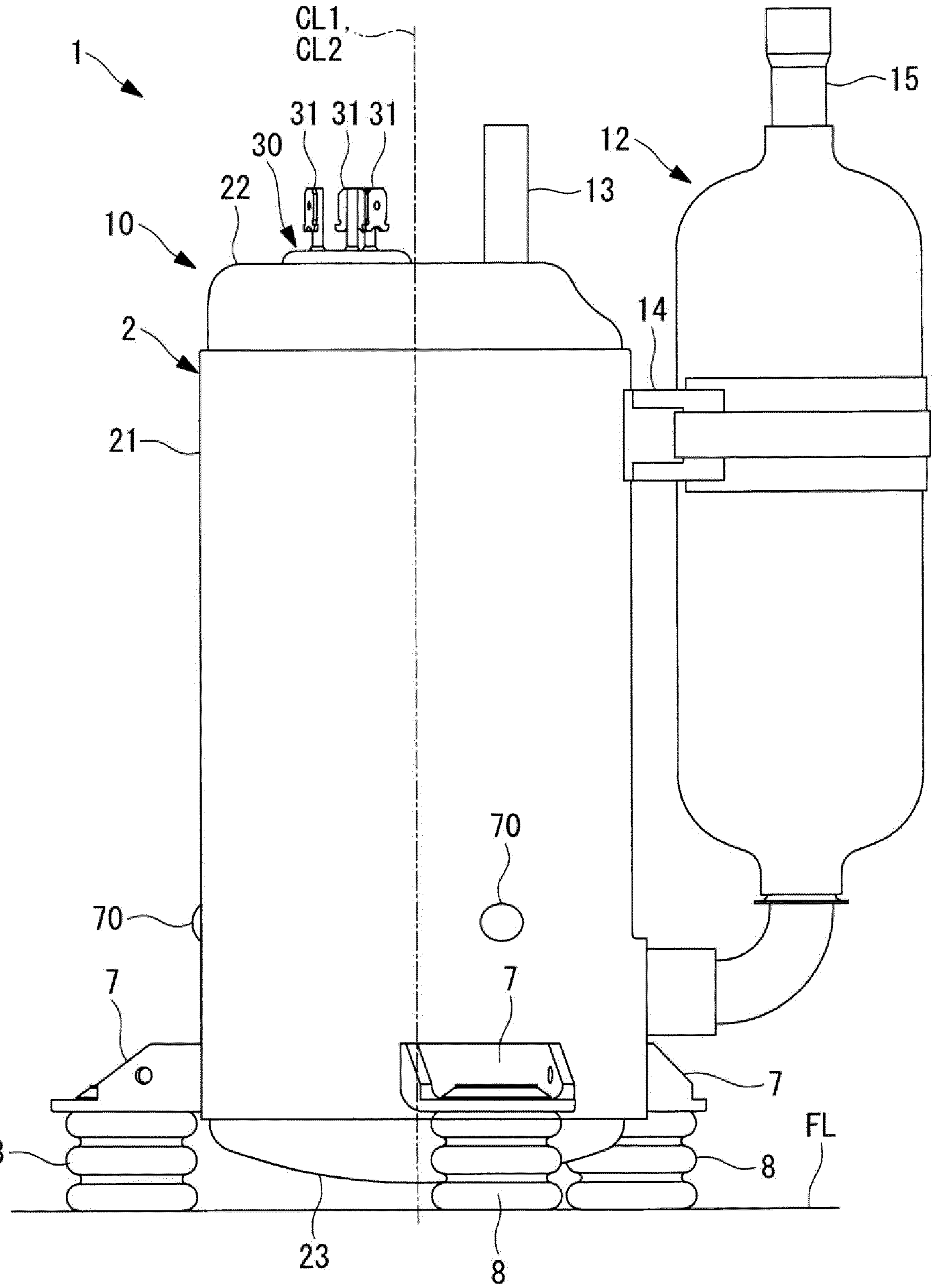

FIG. 3

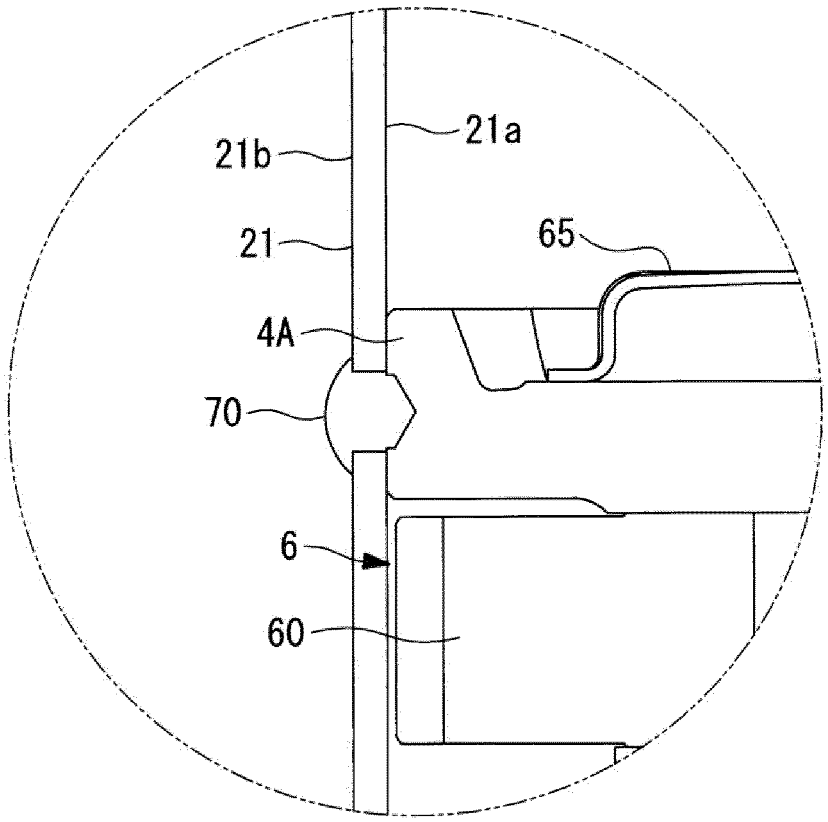

FIG. 4

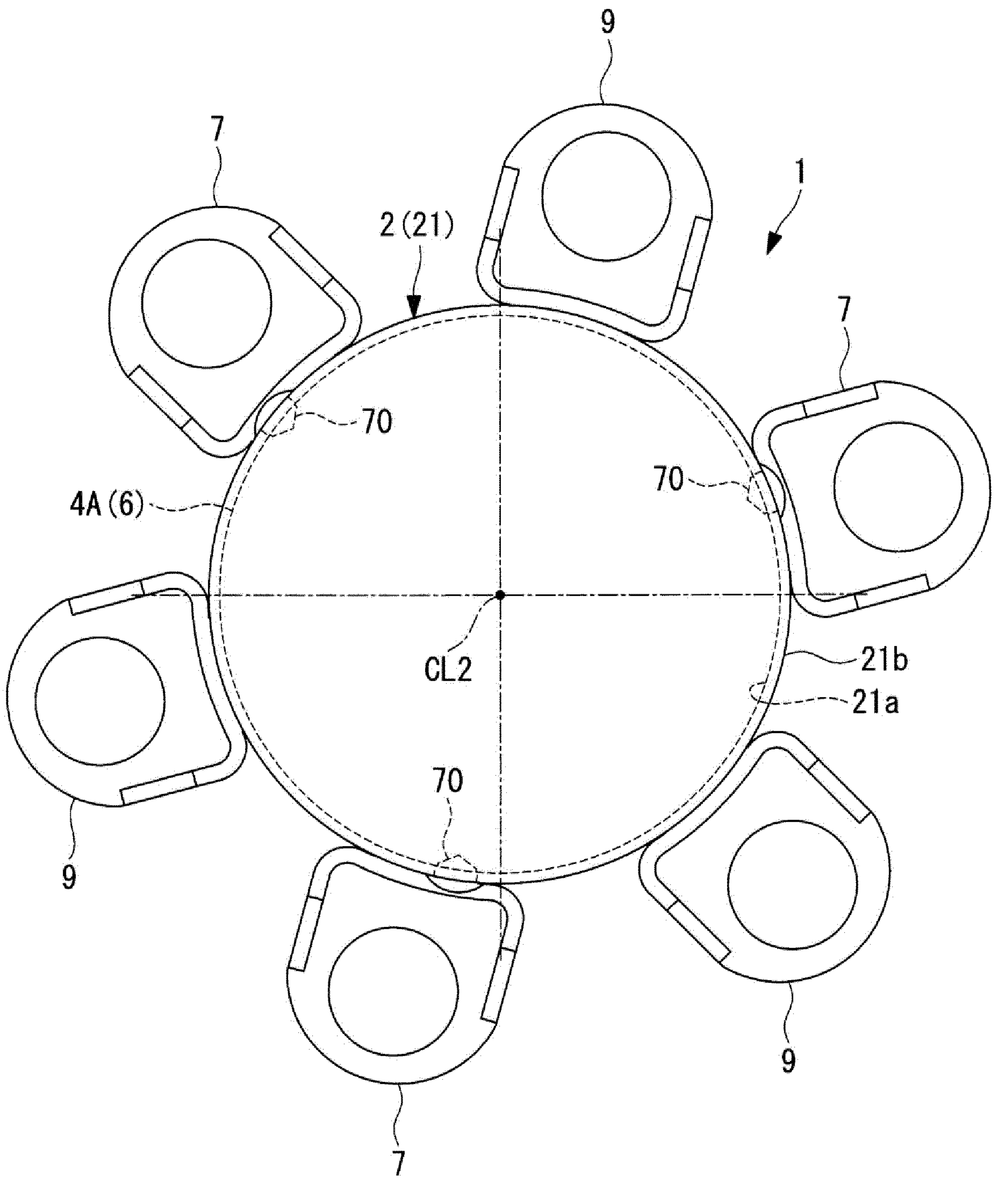

FIG. 5

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2023/018613

A. CLASSIFICATION OF SUBJECT MATTER

F04C 29/00(2006.01)i
FI: F04C29/00 S; F04C29/00 B

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)

F04C29/00

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 2001-132674 A (MATSUSHITA ELECTRIC IND CO LTD) 18 May 2001 (2001-05-18) paragraphs [0020]-[0025], fig. 1-2	1-6
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 140483/1977 (Laid-open No. 65410/1979) (MATSUSHITA REFRIGERATION COMPANY) 09 May 1979 (1979-05-09), specification, p. 2, line 12 to p. 3, line 14, fig. 1-2	1-6

☐ 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
"P" document published prior to the international filing date but later than the priority date claimed
"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
"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
"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
18 July 2023	**01 August 2023**

Name and mailing address of the ISA/JP	Authorized officer
Japan Patent Office (ISA/JP) **3-4-3 Kasumigaseki, Chiyoda-ku, Tokyo 100-8915** **Japan**	Telephone No.

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INTERNATIONAL SEARCH REPORT
Information on patent family members

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