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(54) **COMPRESSOR UNIT AND OUTDOOR UNIT PROVIDED WITH SAME**

(57) The present invention is provided with: a compressor (10) that compresses a refrigerant; a discharge pipe (25) that discharges the refrigerant from the compressor (10); an oil separator (26) that separates a lubricating oil from the refrigerant drawn from the discharge pipe (25); and a capillary part (29) with a coil shape. The invention is further provided with an oil return pipe (27)

that returns the lubricating oil separated by the oil separator (26) to the compressor (10), and an upper bracket (54) and a lower bracket (55) which are fixed to the compressor (10) and which support an upper side and a lower side of the oil return pipe (27), respectively. The capillary part (29) is provided between the upper bracket (54) and the lower bracket (55).

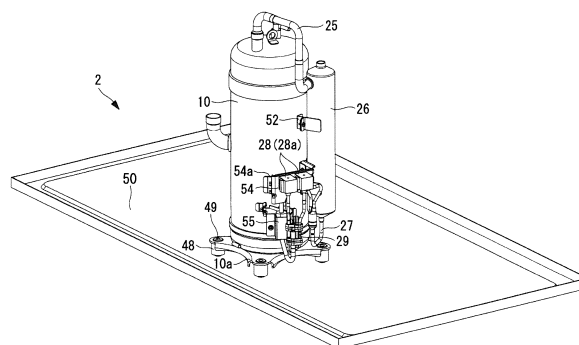


FIG. 2

Description

Technical Field

[0001] The disclosure relates to a compressor unit for suppressing vibrations generating from a compressor used in air conditioner, and an outdoor unit provided with the compressor unit.

Background Art

[0002] An outdoor unit of an air conditioner is provided with a compressor for compressing a refrigerant. In the compressor, a compression part such as a scroll part is driven by an electric motor to discharge the compressed refrigerant. The compressed refrigerant discharged from the compressor is drawn from a discharge pipe connected to the compressor to an oil separator.

[0003] The oil separator separates a mist-like lubricating oil from the compressed refrigerant. The lubricating oil separated by the oil separator is returned to a low-pressure side of the compressor via an oil return pipe.

[0004] The electric motor and pulsations of the discharged refrigerant in the compressor are vibration sources. To suppress transmission of vibrations from the compressor to the oil return pipe, Patent Document 1 discloses that both ends of a coil-shaped capillary part are configured of parts with an amount of play that allow vibrations, to absorb vibrations transmitted from the compressor.

Citation List

Patent Document

[0005] Patent Document 1: Japanese Unexamined Patent Application Publication No. 2008-202892

Summary of Invention

Problem to be Solved by the Invention

[0006] In Patent Document 1, a flexible pipe is provided between a discharge pipe and an oil separator, suppressing transmission of vibrations from the compressor to the oil separator.

[0007] However, in the case where vibration damping of the flexible pipe is insufficient, or the discharge pipe is not provided with the flexible pipe, vibrations are transmitted from the compressor to the oil separator, in turn, the oil return pipe. In particular, the Inventors found that vibrations from a compressor having a high rotational speed, for example, in the range from 130 rps to 200 rps were significantly large.

[0008] When vibrations are transmitted to the oil return pipe, the capillary part provided in the oil return pipe also vibrates. The capillary part is coil-shaped and has weight concentrated in certain areas and thus largely vibrates,

disadvantageously increasing a stress applied to the pipe around the capillary part.

[0009] The oil return pipe is also provided with a solenoid valve for controlling an oil return amount. The solenoid valve is a heavy object due to the weight of an electromagnet provided in a drive part. For this reason, disadvantageously, the solenoid valve is excited by the transmitted vibrations to become a large vibration source. Especially in the case of using a bottom plate-fixing bracket that fixes the solenoid valve to a bottom plate formed on a lower surface of the compressor, vibrations are transmitted to the bottom plate through the bottom plate-fixing bracket, possibly causing noise from the bottom plate.

[0010] In consideration of such circumstances, an object of the disclosure is to provide a compressor unit for reducing vibrations around a capillary part provided in an oil return part, and an outdoor unit provided with the compressor unit.

[0011] Another object of the disclosure is to provide a compressor unit for reducing vibration around a solenoid valve provided in an oil return pipe, and an outdoor unit provided with the compressor unit.

Solution to Problem

[0012] A compressor unit according to an aspect of the disclosure includes: a compressor configured to compress a refrigerant; a discharge pipe configured to discharge the refrigerant from the compressor; an oil separator configured to separate a lubricating oil from the refrigerant drawn from the discharge pipe; an oil return pipe including a capillary part with a coil shape and configured to return the lubricating oil separated by the oil separator to the compressor; and an upper bracket and a lower bracket configured to be fixed to the compressor, and to support an upper side and a lower side of the oil return pipe, respectively. The capillary part is provided between the upper bracket and the lower bracket.

[0013] Vibrations of the compressor are transmitted to the oil separator via the discharge pipe, thereby vibrating the oil separator as well. The vibrations of the oil separator are transmitted to the oil return pipe, thereby vibrating the capillary part as well. The capillary part is coil-shaped has weight concentrated in certain areas. Thus, a stress caused by vibrations may be generated onto the pipe around the capillary part.

[0014] The upper bracket and the lower bracket that are fixed to the compressor are disposed on either side of the capillary part and support the oil return pipe. This can suppress vibrations of the capillary part and reduce the stress generated on the oil return pipe around the capillary part.

[0015] The compressor unit according to an aspect of the disclosure further includes a solenoid valve provided on the oil return pipe, wherein the solenoid valve is fixed to the upper bracket.

[0016] The solenoid valve includes the electromagnet

and the like in the main body portion that functions as a drive part and thus, becomes a heavy object. The solenoid valve that is the heavy object can be fixed to the upper bracket, thereby suppressing vibrations of the solenoid valve and reducing the stress generated on the oil return pipe around the solenoid valve.

[0017] A compressor unit according to an aspect of the disclosure includes: a compressor configured to compress a refrigerant; a discharge pipe configured to discharge the refrigerant from the compressor; an oil separator configured to separate a lubricating oil from the refrigerant drawn from the discharge pipe; an oil return pipe configured to have a coil-shaped capillary part, and to return the lubricating oil separated by the oil separator to the compressor; an upper bracket configured to be fixed to the compressor and to support an upper side and a lower side of the oil return pipe; and a solenoid valve provided on the oil return pipe. The upper bracket includes an oil separator-side bracket fixed to the oil separator, and the solenoid valve is fixed to the upper bracket and the oil separator-side bracket.

[0018] Since the upper bracket has the oil separator-side upper bracket, the upper bracket is fixed to the compressor as well as the oil separator. In this manner, the individually vibrating compressor and oil separator can be fixed to each other to reduce vibrations.

[0019] The solenoid valve that is the heavy object can be fixed to the upper bracket, thereby suppressing vibrations of the solenoid valve and reducing the stress generated on the oil return pipe around the solenoid valve.

[0020] Further, since the solenoid valve can be directly fixed to the compressor and the oil separator via the upper bracket, it is not necessary to use a bottom plate-fixing bracket for fixing the solenoid valve that is the heavy object to the bottom plate provided on the lower surface of the compressor. This can prevent vibrations from being transmitted to the bottom plate via the bottom plate-fixing bracket, thereby suppressing a noise in the bottom plate.

[0021] An outdoor unit according to an aspect of the disclosure includes the compressor unit according to any one of the aspects; and a housing configured to store the compressor unit.

Advantageous Effects of Invention

[0022] The upper bracket and the lower bracket that are fixed to the compressor can support the oil return pipe via the capillary part, thereby suppressing vibrations of the capillary part and reducing the stress generated on the pipe around the capillary part.

[0023] The solenoid valve that is the heavy object can be fixed to the upper bracket, thereby suppressing vibrations of the solenoid valve and reducing the stress generated on the oil return pipe around the solenoid valve.

Brief Description of Drawings

[0024]

FIG. 1 is a view illustrating a refrigerant circuit of an air conditioner according to an embodiment of the disclosure.

FIG. 2 is a perspective view of a compressor unit according to the embodiment.

FIG. 3 is a perspective view of a side part the compressor unit in FIG. 2 when viewed from below.

FIG. 4 is a perspective view of the side part the compressor unit in FIG. 2 when viewed from above.

FIG. 5 is a perspective view of a side part the compressor unit in FIG. 2 when obliquely viewed from above.

FIG. 6 is a side view of a lower portion of the compressor in FIG. 2 with a lower bracket removed.

Description of Embodiment

[0025] An embodiment of the disclosure will be described below with reference to figures.

[0026] FIG. 1 illustrates a refrigerant circuit in a multi-type air conditioning system in which a plurality of indoor units are connected to one outdoor unit. A plurality of outdoor units may be provided.

[0027] As illustrated in FIG. 1, the multi-type air conditioning system 1 is configured such that a plurality of indoor units 3A, 3B are connected to one outdoor unit 2 in parallel. The plurality of indoor units 3A, 3B are connected to each other in parallel via branching devices 6 between a gas-side piping 4 and a liquid-side piping 5 connected to the outdoor unit 2.

[0028] The outdoor unit 2 includes an inverter-driven compressor 10 that compresses a refrigerant, a four-way selector valve 12 that switches a circulation direction of the refrigerant, an outdoor heat exchanger 13 for exchanging heat between the refrigerant and outside air, a sub-cooling coil 14 configured integrally with the outdoor heat exchanger 13, an outdoor expansion valve (EEVH) 15, a receiver 16 that stores a liquid refrigerant, a sub-cooling heat exchanger 17 that subcools the liquid refrigerant, an electronic expansion valve for sub-cooling (EEVSC) 18 that controls an amount of the refrigerant diverted to the sub-cooling heat exchanger 17, an accumulator 19 that separates a liquid portion from a refrigerant gas sucked into the compressor 10 and suctions only a gas portion into the compressor 10, a gas-side operation valve 20, and a liquid-side operation valve 21.

[0029] The compressor 10 can rotate at a rotational speed in a range from 130 rps to 200 rps. An oil separator 26 is connected to a discharge side of the compressor 10 via a discharge pipe 25. The oil separator 26 separates a mist-like lubricating oil from the compressed refrigerant. The refrigerant from which the mist-like lubricating oil is separated by the oil separator 26 is guided to the four-way selector valve 12. The lubricating oil that is separated by the oil separator 26 and stored in the oil separator 26 is returned to the low pressure-side of the compressor 10 via an oil return pipe 27.

[0030] The oil return pipe 27 is provided with a solenoid

valve 28 and a capillary part 29. The solenoid valve 28 is opened/closed under control of a control unit not illustrated to adjust the amount of the oil flowing in the oil return pipe 27. The capillary part 29 is used as a fixed aperture for decreasing the pressure of the flowing lubricating oil.

[0031] The above-described devices in the outdoor unit 2 are sequentially connected via a refrigerant piping 22, constituting a known outdoor coolant circuit 23. Further, an outdoor fan 24 that blows outside air to the outdoor heat exchanger 13 is provided to the outdoor unit 2.

[0032] A gas-side piping 4 and a liquid-side piping 5 are refrigerant pipes connected to the gas-side operation valve 20 and the liquid-side operation valve 21, respectively, of the outdoor unit 2. When mounting on site, the lengths of the pipes are appropriately set according to the distance between the outdoor unit 2 and the plurality of indoor units 3A, 3B connected thereto. A plurality of branching devices 6 are provided in the middle of the gas-side piping 4 and the liquid-side piping 5, and an appropriate number of indoor units 3A, 3B are connected to the piping via the branching devices 6. This constitutes one closed system of refrigeration cycle (refrigerant circuit) 7.

[0033] The indoor units 3A, 3B each include an indoor heat exchanger 30 for exchanging heat between inside air and the refrigerant for cooling or heating to condition indoor air, an indoor expansion valve (EEVC) 31, an indoor fan 32 that circulates inside air via the indoor heat exchanger 30, and an indoor controller 33. The indoor units 3A, 3B are connected to the branching devices 6 via branched gas-side piping 4A, 4B and branched liquid-side piping 5A, 5B on the indoor side.

[0034] In the above-described multi-type air conditioning system 1, cooling operation is performed as follows.

[0035] A high-temperature, high-pressure refrigerant gas, which is compressed by the compressor 10 and discharged therefrom, is circulated to the outdoor heat exchanger 13 by the four-way selector valve 12, and exchanges heat with outside air blown by the outdoor fan 24 in the outdoor heat exchanger 13 to be condensed and liquefied. The liquid refrigerant is further cooled by the sub-cooling coil 14 and then, passes through the outdoor expansion valve 15 and is temporarily stored in the receiver 16.

[0036] The liquid refrigerant with a circulation amount adjusted by the receiver 16 flows through the liquid refrigerant pipe via the sub-cooling heat exchanger 17. In the course of this process, the liquid refrigerant is partially diverted from the liquid refrigerant pipe, and exchanges heat with the refrigerant adiabatically expanded by the electronic expansion valve for sub-cooling 18 to be subjected to subcooling. The liquid refrigerant is guided from the outdoor unit 2 to the liquid-side operation valve 5 via the liquid-side operation valve 21 and then, is diverted to the branched liquid-side piping 5A, 5B of the indoor units 3A, 3B via the branching devices 6.

[0037] The liquid refrigerant diverted to the branched

liquid-side piping 5A, 5B flows into the indoor units 3A, 3B, is adiabatically expanded at the indoor expansion valve 31, and flows as a gas-liquid two-phase into the indoor heat exchanger 30. At the indoor heat exchanger 30, heat exchange occurs between the inside air circulated by the indoor fan 32 and the refrigerant, thereby cooling the inside air to cool the inside of the room. Meanwhile, the refrigerant is gasified, reaches the branching devices 6 via the branched gas-side piping 4A, 4B, and merges with a refrigerant gas from another indoor unit at the gas-side piping 4.

[0038] The refrigerant gas merged in the gas-side piping 4 returns to the outdoor unit 2 again, and merges with refrigerant gas from the sub-cooling heat exchanger 17 through the gas-side operation valve 20 and the four-way selector valve 12 and then, is introduced into the accumulator 19. In the accumulator 19, the liquid portion contained in the refrigerant gas is separated, and only the gas portion is suctioned into the compressor 10. This refrigerant is compressed by the compressor 10 again. The cooling operation is performed by repeating the cycle described above.

[0039] On the other hand, the heating operation is performed as follows.

[0040] The high-temperature, high-pressure compressed and discharged by the compressor 10 is circulated to the gas-side operation valve 20 via the four-way selector valve 12. The high-pressure gas refrigerant is drawn from the outdoor unit 2 through the gas-side operation valve 20 and the gas-side piping 4, and is introduced into the plurality of indoor units 3A, 3B through the branching device 6 and the indoor branched gas-side piping 4A, 4B.

[0041] The high-temperature, high-pressure refrigerant gas introduced into the indoor units 3A, 3B is subjected to heat exchange with the inside air circulated via the indoor fan 32 by the indoor heat exchanger 30, and the inside air thus heated is blown into a room and used for heating. Meanwhile, the refrigerant condensed and liquefied at the indoor heat exchanger 30 reaches the branching device 6 through the indoor expansion valve 31 and the branched liquid-side piping 5A, 5B, merges with the refrigerant from another indoor unit, and returns to the outdoor unit 2 through the liquid-side piping 5. During the heating operation, in the indoor units 3A, 3B, the degree of opening of the indoor expansion valve 31 is controlled by the indoor controller 33 such that the refrigerant outlet temperature or the refrigerant sub-cooling level of the indoor heat exchanger 30, which functions as the condenser, has a control target value.

[0042] The refrigerant returned to the outdoor unit 2 reaches the sub-cooling heat exchanger 17 through the liquid-side operation valve 21, and is subjected to sub-cooling as in the cooling operation. Then, the refrigerant flows into the receiver 16 and temporarily stored therein, adjusting the circulation amount. The liquid refrigerant is supplied to the outdoor expansion valve 15, and adiabatically expanded by the outdoor expansion valve 15 and

then, flows into the outdoor heat exchanger 13 through the sub-cooling coil 14.

[0043] At the outdoor heat exchanger 13, heat exchange occurs between the outside air blown from the outdoor fan 24 and the refrigerant. Then, the refrigerant absorbs heat from the outside air, and becomes evaporated gas. The refrigerant flows from the outdoor heat exchanger 13 through the four-way selector valve 12, merges with the refrigerant gas from the sub-cooling heat exchanger 17 and then, is introduced into the accumulator 19. In the accumulator 19, the liquid portion contained in the refrigerant gas is separated, and only the gas portion is suctioned into the compressor 10 and once again compressed in the compressor 10. The heating operation is performed by repeating the cycle described above.

Configuration of Compressor Unit

[0044] FIG. 2 illustrates a configuration of the compressor unit provided with the compressor 10, the oil separator 26, and the like. This figure illustrates the configuration of the compressor 10, the oil separator 26, and the related components, and does not illustrate other devices.

[0045] The compressor 10 is fixed to a bottom plate 50 in a housing of the outdoor unit 2. The compressor 10 has a substantially cylindrical shape having an axis extending in the vertical direction. The compressor 10 accommodates an electric motor (not illustrated) in a lower portion thereof, and a compression mechanism (not illustrated) such as a scroll part in an upper portion thereof. A leg 10a is provided on the bottom portion of the compressor 10, and is fixed to the bottom plate 50 using a stud bolt 49 via a rubber vibration isolator 48.

[0046] An upstream end of the discharge pipe 25 is connected to the top of the compressor 10.

[0047] The oil separator 26 is provided on the side of the compressor 10. An axis of the oil separator 26 is substantially parallel to the axis of the compressor 10. The discharge pipe 25 is connected to a side surface of the upper portion of the oil separator 26 so as to guide the compressed refrigerant from the compressor 10.

[0048] The oil separator 26 is fixed to the compressor 10 via an oil separator-fixing bracket 52. The oil separator-fixing bracket 52 is a sheet metal formed into a predetermined shape, and connects the oil separator 26 to the compressor 10 at their substantially intermediate positions in the height direction.

[0049] A discharge part is provided at the top of the oil separator 26, and the refrigerant with the mist-like lubricating oil removed is discharged from the discharge part toward the downstream four-way selector valve 12 (see FIG. 1).

[0050] The lubricating oil separated from the compressed refrigerant by the oil separator 26 is stored in the lower portion of the oil separator 26, and is taken from the oil return pipe 27 connected to the bottom portion of

the oil separator 26.

[0051] As illustrated in FIG. 3, the oil return pipe 27 extends downward from the bottom portion of the oil separator 26 and then, turns up and rises upward. Then, the oil return path is branched into two flow paths, and the branched flow paths are guided to respective solenoid valves 28.

[0052] A main body portion 28a of each solenoid valve 28, which stores an electromagnet and the like, is fixed to an upper bracket 54. Accordingly, the oil return pipe 27 is fixed using the upper bracket 54 via the solenoid valves 28.

[0053] As illustrated in FIG. 5, the upper bracket 54 is a sheet metal formed into a predetermined shape, and includes a compressor-side upper bracket 54a affixed to the compressor 10 at one end thereof, an oil separator-side upper bracket (oil separator-side bracket) 54b affixed to the oil separator 26 at one end thereof, and a connecting upper bracket 54c connecting the other end of the compressor-side upper bracket 54a to the other end of the oil separator-side upper bracket 54b. The main body portions 28a of the solenoid valves 28 are fixed to the connecting upper bracket 54c.

[0054] As illustrated in FIG. 3, the oil return pipe 27 is provided with the capillary part 29 downstream of the solenoid valves 28. The capillary part 29 has a coil shape formed by winding a thin tube having a smaller flow path cross-sectional area than the other portions of the oil return pipe 27 plural times. The capillary part 29 is bundled with a binding band 57.

[0055] As illustrated in FIG. 4, the oil return pipe 27 turns up and rises upward on the downstream side of the capillary part 29. At the rising portion, the oil return pipe 27 is fixed to the lower bracket 55.

[0056] As illustrated in FIG. 4, the lower bracket 55 is a sheet metal formed into a predetermined shape, and fixed to the compressor 10 at one end thereof. The height position of the lower bracket 55 is equivalent to the height position of the capillary part 29. The lower bracket 55 is affixed to only the compressor 10, and is not fixed to the oil separator 26.

[0057] As illustrated in FIG. 6, the oil return pipe 27 turns down above the lower bracket 55 and then, is connected to the side portion of the compressor 10 at a connection position 27a. In FIG. 6, for the sake of clarity, the lower bracket 55 is removed. In fact, the lower bracket 55 is present as illustrated in FIG. 4.

[0058] The present embodiment has following operational effects.

[0059] Vibrations of the compressor 10 are transmitted to the oil separator 26 via the discharge pipe 25, thereby vibrating the oil separator 26 as well. The vibrations of the oil separator 26 are transmitted to the oil return pipe 27, thereby vibrating the capillary part 29 as well. The capillary part 29 is coil-shaped and has weight concentrated in certain areas. Thus, a stress caused by vibrations may be applied onto the pipe around the capillary part 29. To address the stress, in the present embodi-

ment, the upper bracket 54 and the lower bracket 55 fixed to the compressor 10 support the oil return pipe 27 with the capillary part 29 disposed therebetween. This can suppress vibrations of the capillary part 29 and reduce the stress generated on the oil return pipe 27 around the capillary part 29.

[0060] The solenoid valves 28 each include the electromagnet and the like in the main body portion 28a that functions as a drive part and thus, are heavy objects. The main body portions 28a of the solenoid valves 28 that are the heavy objects can be fixed to the upper bracket 54, thereby suppressing vibrations of the solenoid valves 28 and reducing the stress generated on the oil return pipe 27 around the solenoid valves 28.

[0061] Since the upper bracket 54 has the compressor-side upper bracket 54a as well as the oil separator-side upper bracket 54b, the upper bracket 54 is fixed to the compressor 10 as well as the oil separator 26. In this manner, the individually vibrating compressor 10 and oil separator 26 can be affixed to each other to reduce vibrations.

[0062] Further, since the solenoid valves 28 can be directly fixed to the compressor 10 and the oil separator 26 via the upper bracket 54, it is not necessary to use a bottom plate-fixing bracket (not illustrated) for fixing the solenoid valves 28 that are the heavy objects to the bottom plate 50 provided on the lower surface of the compressor 10. This can prevent vibrations from being transmitted to the bottom plate 50 via the bottom plate-fixing bracket, thereby suppressing a noise in the bottom plate 50.

[0063] In the above-described embodiment, the compressor 10 can rotate at the rotational speed in the range from 130 rps to 200 rps. However, the disclosure is not limited to this, and the compressor may rotate at a rotational speed less than or equal to 130 rps, or at a rotational speed greater than 200 rps.

[0064] As illustrated in FIG. 6, the lower bracket 55 may be omitted. Even with such configuration, the above-described operational effect can be obtained by directly affixing the solenoid valves 28 to the compressor 10 and the oil separator 26 via the upper bracket 54.

Reference Signs List

[0065]

1	Multi-type air conditioning system
2	Outdoor unit
3A, 3B	Indoor unit
10	Compressor
10a	Leg
13	Outdoor heat exchanger
25	Discharge pipe
26	Oil separator
27	Oil return pipe
27a	Connection position
28	Solenoid valve

29	Capillary part
48	Rubber vibration isolator
49	Stud bolt
52	Oil separator-fixing bracket
54	Upper bracket
54a	Compressor-side upper bracket
54b	Oil separator-side upper bracket (oil separator-side bracket)
54c	Connecting upper bracket
55	Lower bracket
57	Binding band

Claims

1. A compressor unit comprising:

a compressor configured to compress a refrigerant;
a discharge pipe configured to discharge the refrigerant from the compressor;
an oil separator configured to separate a lubricating oil from the refrigerant drawn from the discharge pipe;
an oil return pipe including a capillary part with a coil shape and configured to return the lubricating oil separated by the oil separator to the compressor; and
an upper bracket and a lower bracket configured to be fixed to the compressor and to support an upper side and a lower side of the oil return pipe, respectively, wherein
the capillary part is provided between the upper bracket and the lower bracket.

2. The compressor unit according to claim 1 further comprising a solenoid valve provided on the oil return pipe, wherein the solenoid valve is fixed to the upper bracket.

3. A compressor unit comprising:

a compressor configured to compress a refrigerant;
a discharge pipe configured to discharge the refrigerant from the compressor;
an oil separator configured to separate a lubricating oil from the refrigerant drawn from the discharge pipe;
an oil return pipe configured to return the lubricating oil separated by the oil separator to the compressor;
an upper bracket configured to be fixed to the compressor and to support an upper side and a lower side of the oil return pipe; and
a solenoid valve provided on the oil return pipe, wherein
the upper bracket includes an oil separator-side

bracket fixed to the oil separator, and
the solenoid valve is fixed to the upper bracket
and the oil separator-side bracket.

4. An outdoor unit comprising:

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the compressor unit according to any one of
claims 1 to 3; and
a housing configured to store the compressor
unit.

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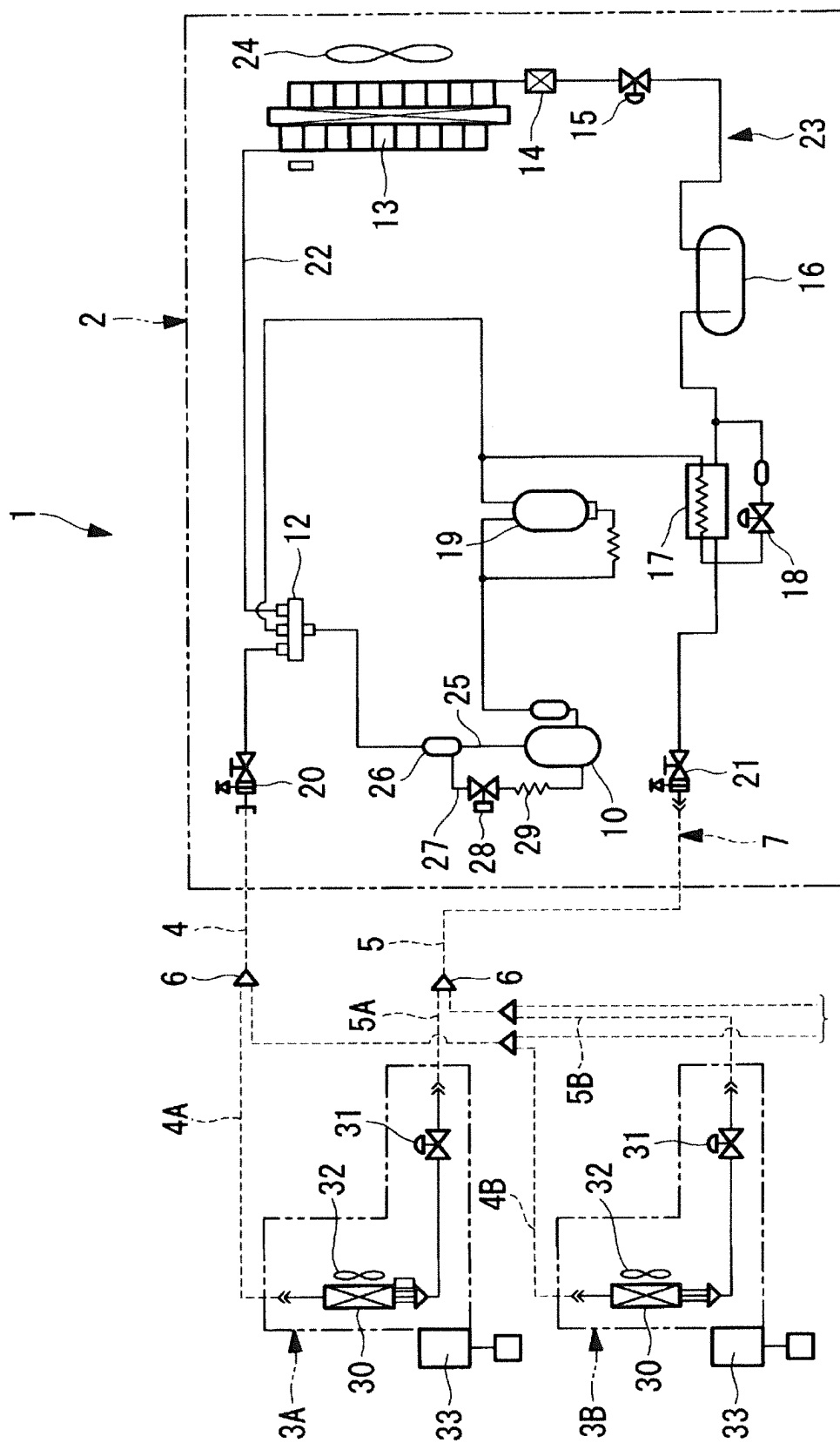
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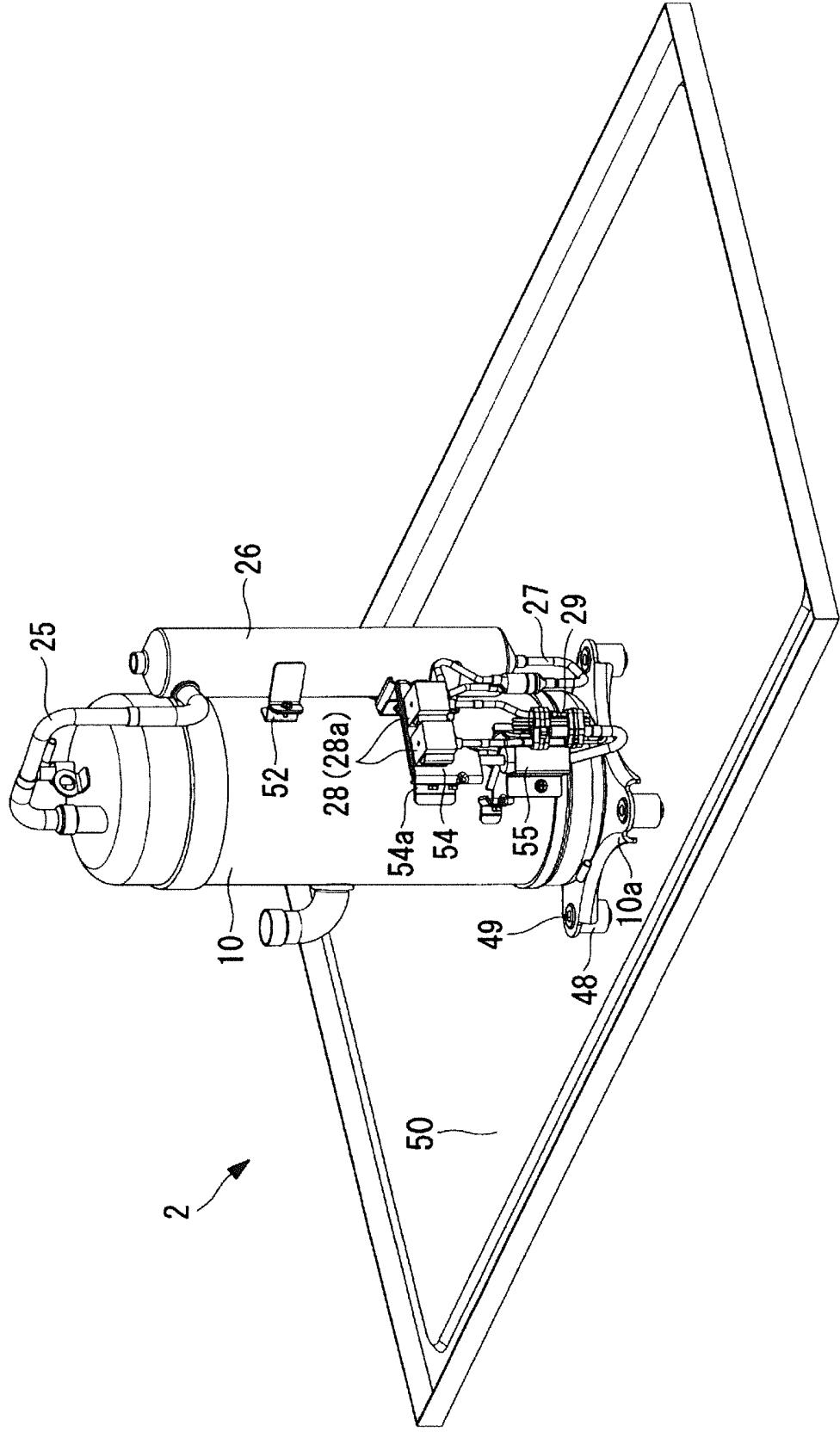


FIG. 2

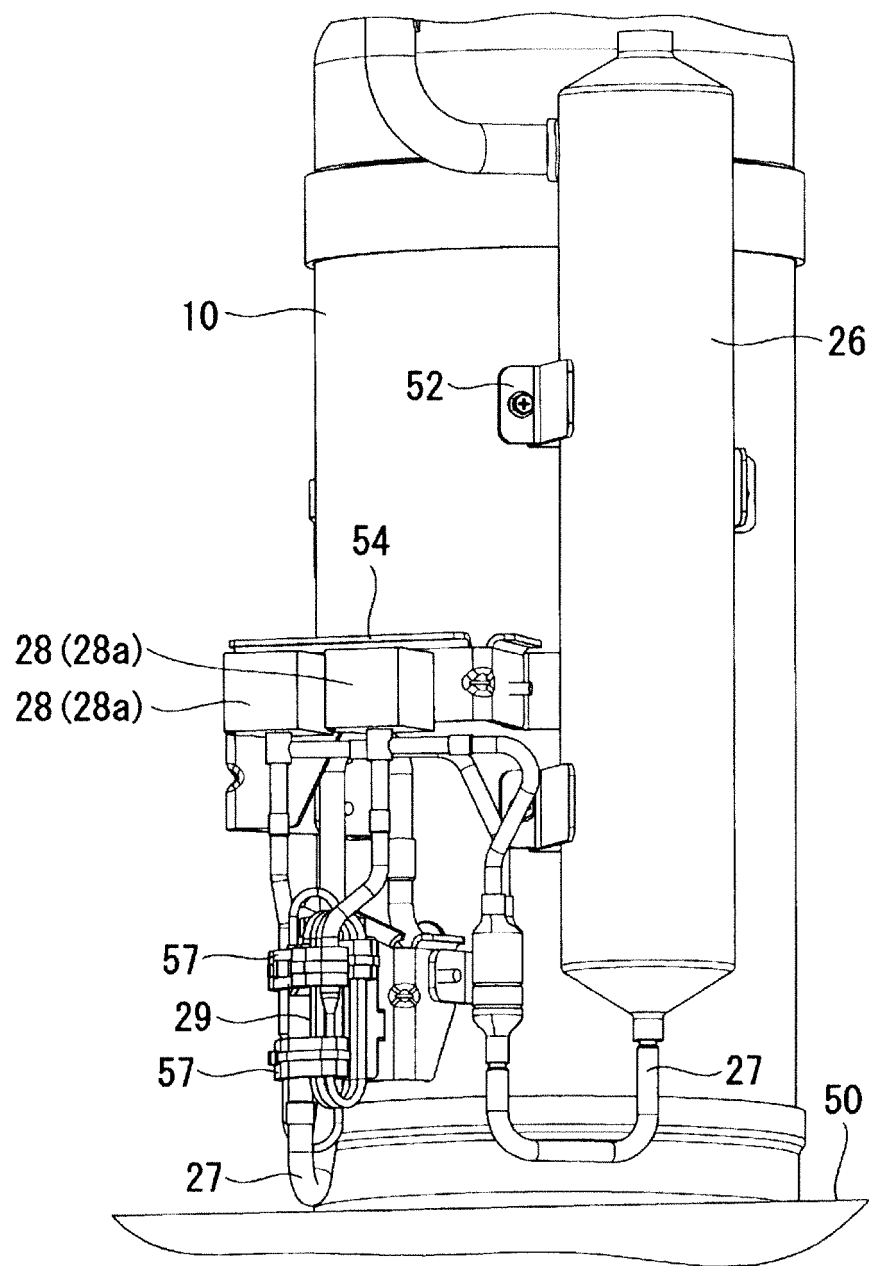


FIG. 3

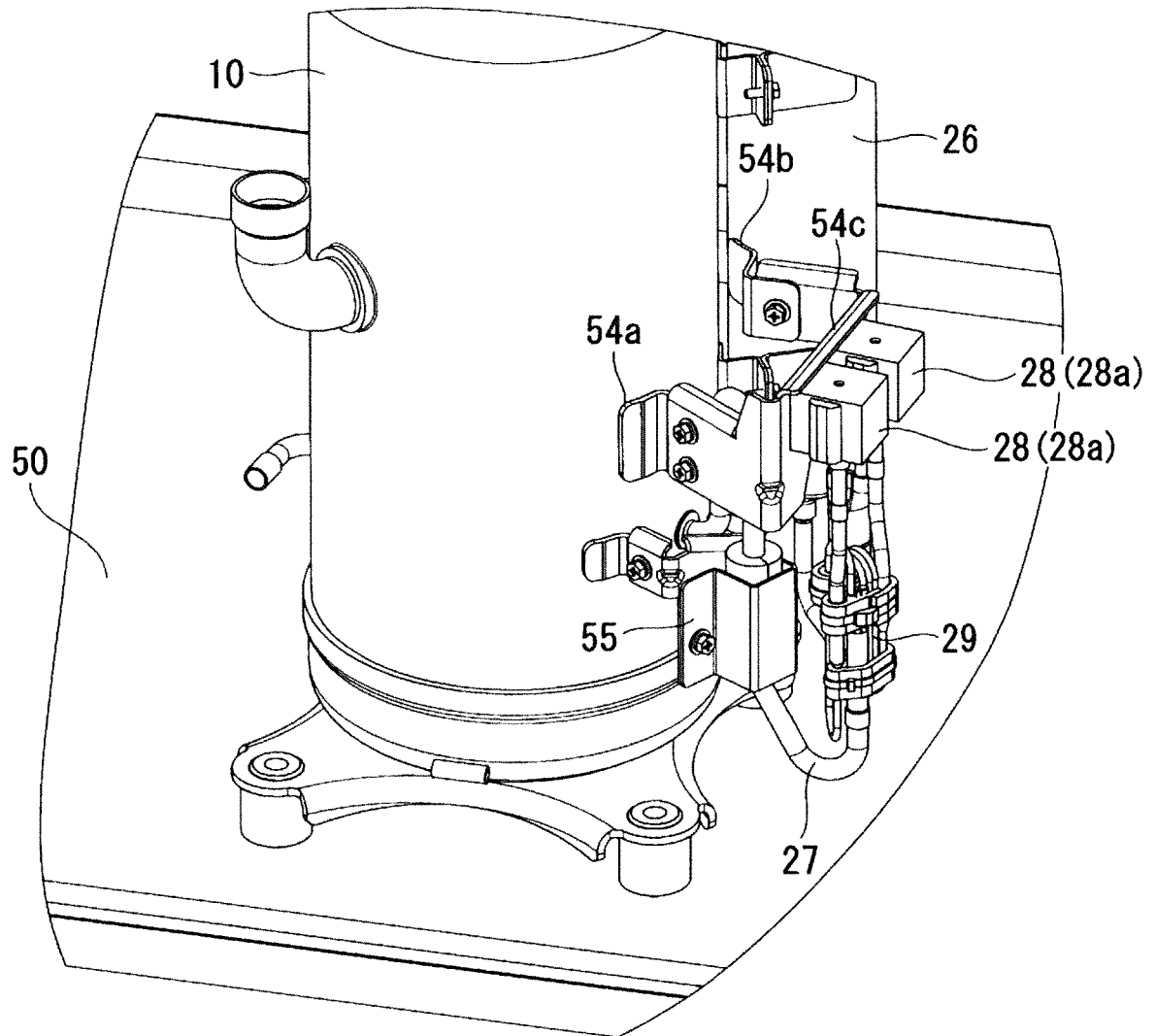


FIG. 4

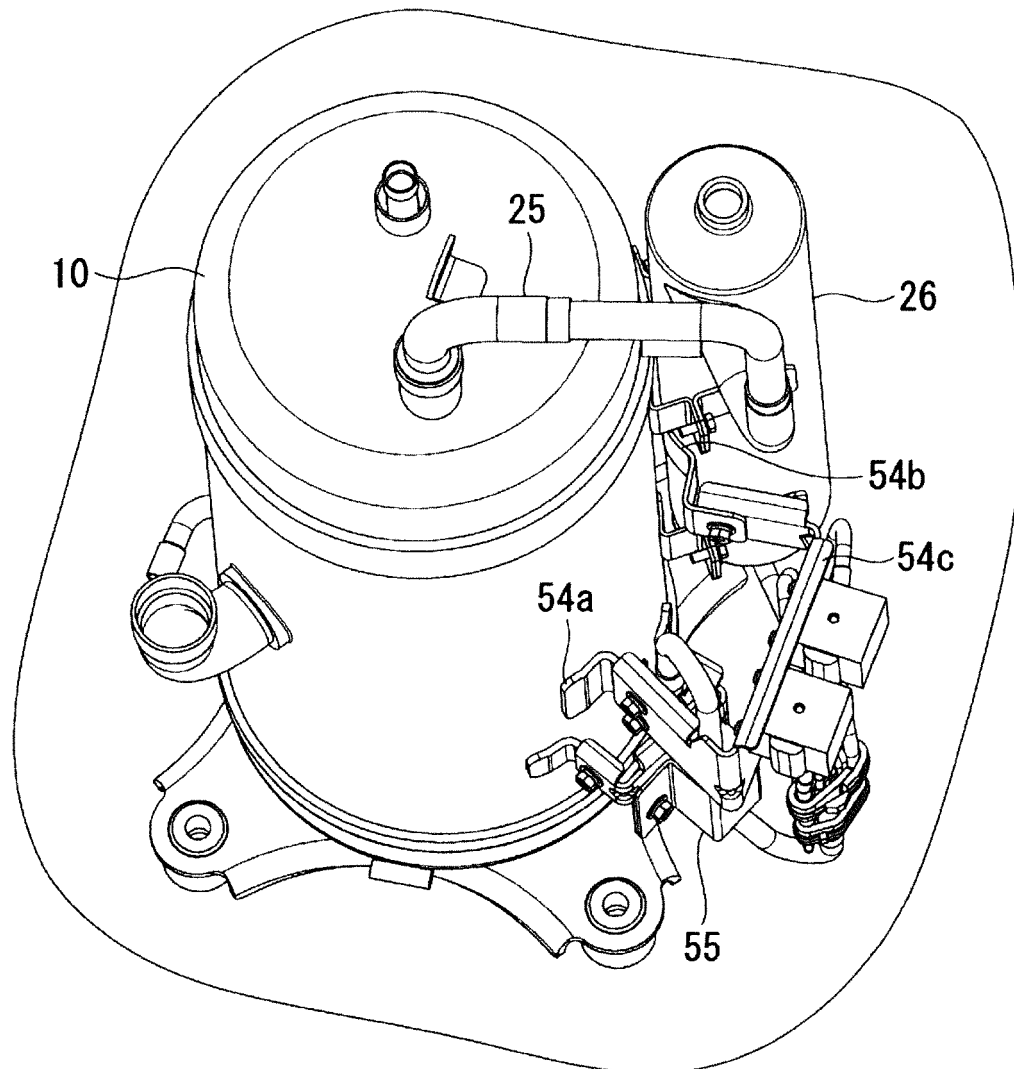


FIG. 5

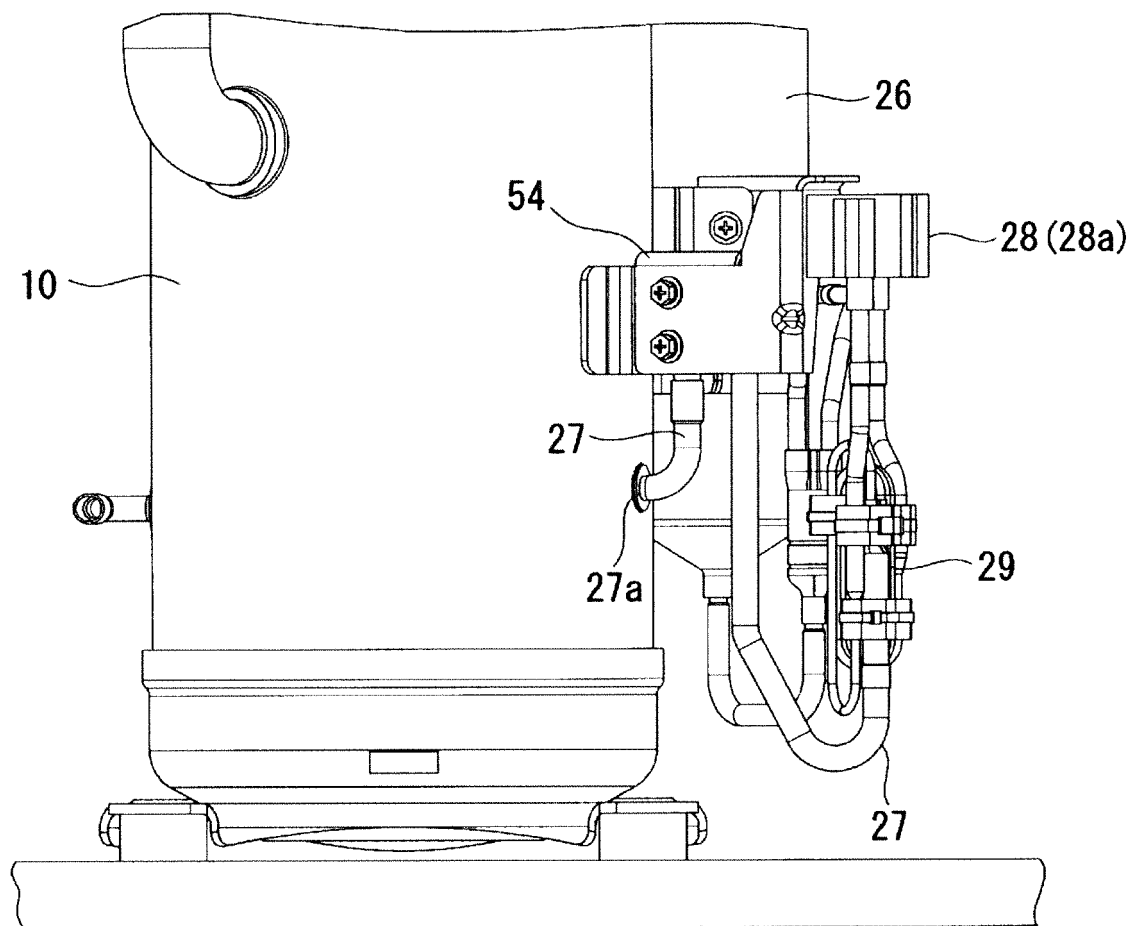


FIG. 6

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/038081

A. CLASSIFICATION OF SUBJECT MATTER

Int.Cl. F04B39/12(2006.01)i, F04B39/00(2006.01)i, F04B39/04(2006.01)i,
F04C29/02(2006.01)i, F04C29/12(2006.01)i, F25B1/00(2006.01)i,
F25B41/06(2006.01)i

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. F04B39/12, F04B39/00, F04B39/04, F04C29/02, F04C29/12, F25B1/00,
F25B41/06

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 1971-2017

Registered utility model specifications of Japan 1996-2017

Published registered utility model applications of Japan 1994-2017

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 2002-81799 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 22 March 2002, fig. 6 (Family: none)	1-4
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 34392/1976 (Laid-open No. 126349/1977) (SANYO ELECTRIC CO., LTD.) 26 September 1977, fig. 2 (Family: none)	1-4

☒ Further documents are listed in the continuation of Box C.

☐ See patent family annex.

* Special categories of cited documents:

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Date of the actual completion of the international search

20 December 2017

Date of mailing of the international search report

09 January 2018

Name and mailing address of the ISA/

Japan Patent Office

3-4-3, Kasumigaseki, Chiyoda-ku,

Tokyo 100-8915, Japan

Authorized officer

Telephone No.

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP2017/038081

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 172576/1984 (Laid-open No. 86683/1986) (TOSHIBA CORPORATION) 06 June 1986, fig. 2 (Family: none)	1-4
A	JP 2008-202892 A (YANMAR CO., LTD.) 04 September 2008, fig. 2 (Family: none)	1-4

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 2008202892 A [0005]