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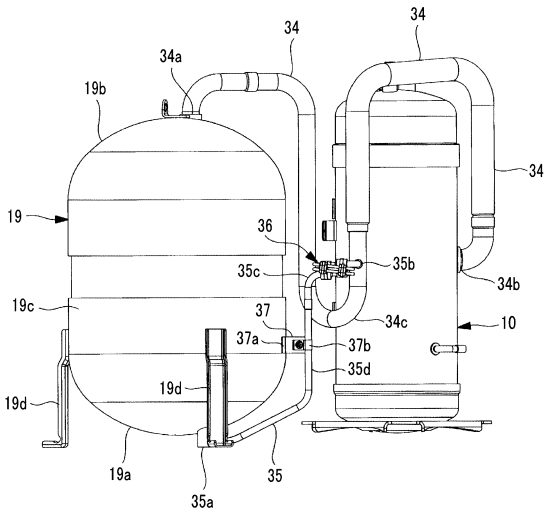
(54) **COMPRESSOR UNIT AND OUTDOOR UNIT PROVIDED THEREWITH**

(57) This compressor unit is provided with a compressor (10) which compresses a refrigerant, an accumulator (19) which performs gas-liquid separation on a refrigerant guided to the compressor (10), a suction tube (34) which is provided between the compressor (10) and the accumulator (19) and which guides gas refrigerant separated in the accumulator (19) into the compressor (10), an oil return tube (35) which is connected between the bottom of the accumulator (19) and the suction tube (34), a capillary unit (36) formed in a winding shape and provided in an intermediate position of the oil return tube, and a fixing bracket (37) which fixes the oil return tube (35) below the capillary unit (36) to the accumulator (19).

FIG. 2



EP 3 495 746 A1

Description

Technical Field

[0001] The present invention relates to a compressor unit including an accumulator and an outdoor unit including the compressor unit.

Background Art

[0002] An outdoor unit of an air conditioner is provided with a compressor that compresses a refrigerant. In the compressor, a compression portion such as a scroll part is driven by an electric motor, and a refrigerant sucked from a suction pipe is compressed.

[0003] An accumulator for separating a refrigerant returning to the compressor into a gas refrigerant and a liquid refrigerant is connected to the suction pipe. The gas refrigerant separated out by the accumulator passes the suction pipe and is led to the compressor. An oil return pipe that returns a lubricant with the liquid refrigerant, which is separated out and is stored, to the compressor is provided on a bottom portion of the accumulator (refer to PTL 1).

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Utility Model Registration Application Publication No. 60-182678 (Fig. 1)

Summary of Invention

Technical Problem

[0005] The compressor is a vibration source since the electric motor is provided. Therefore, vibration from the compressor is transmitted to the oil return pipe connected between the accumulator and a compressor side. In particular, as a result of examination made by the present inventor or the like, it is found that vibration from a compressor, for example, a compressor having a high rotation speed which reaches over 130 rps to 200 rps, is not negligible.

[0006] When vibration is transmitted to the oil return pipe, stress caused in the oil return pipe becomes great. In a case where the oil return pipe is provided with a capillary portion having a winding shape, the vibration of the oil return pipe further becomes great since the weight concentrates on the capillary portion. Thus, there is a problem of an increase in the stress of the pipe around the capillary portion.

[0007] The present invention is devised in view of such circumstances, and an object thereof is to provide a compressor unit that reduces the stress of an oil return pipe connecting an accumulator to the compressor and an outdoor unit including the compressor unit.

Solution to Problem

[0008] To solve the problems, the compressor unit and the outdoor unit including the compressor unit of the present invention adopt the following means.

[0009] According to an aspect of the present invention, there is provided a compressor unit including a compressor that compresses a refrigerant, an accumulator that separates the refrigerant to be led to the compressor into a gas refrigerant and a liquid refrigerant, a suction pipe that is provided between the compressor and the accumulator and leads the gas refrigerant separated out by the accumulator to the compressor, an oil return pipe that is connected between a bottom portion of the accumulator and the suction pipe, a capillary portion that is provided at a position in a middle of the oil return pipe and has a winding shape, and a fixing bracket that fixes the oil return pipe below the capillary portion to the accumulator.

[0010] The liquid refrigerant separated out by the accumulator passes the oil return pipe with a lubricant so as to be led to the suction pipe, and returns to the compressor.

[0011] The vibration of the compressor is transmitted to the oil return pipe via the suction pipe. Since the oil return pipe is provided with the capillary portion having a winding shape, there is a possibility that the capillary portion, which is heavy, greatly vibrates and increases the stress of the pipe around the capillary portion.

[0012] Thus, the fixing bracket that fixes the oil return pipe below the capillary portion to the accumulator is provided. Accordingly, the vibration of the capillary portion can be suppressed, and the stress of the oil return pipe can be reduced.

[0013] In the compressor unit according to the aspect of the present invention, a bent portion is formed in the oil return pipe below the capillary portion, and the fixing bracket is provided below the bent portion.

[0014] In a case where the bent portion is formed in the oil return pipe below the capillary portion, stress concentrates on the bent portion. By providing the fixing bracket below the bent portion, vibration to be caused in the bent portion is suppressed, and thus the stress of the pipe can be reduced.

[0015] In the compressor unit according to the aspect of the present invention, the accumulator includes the bottom portion having a substantially hemispherical shape and a cylindrical portion connected to a portion above the bottom portion, and the fixing bracket is fixed to a lower end of the cylindrical portion.

[0016] The accumulator includes the substantially hemispherical bottom portion and the cylindrical portion connected to the bottom portion. In a case where the fixing bracket is fixed to the accumulator by welding or the like, construction is difficult since the bottom portion has a substantially hemispherical shape. Thus, the fixing

bracket is fixed to the cylindrical portion.

[0017] In addition, the oil return pipe can be fixed at a position separated downwards from the capillary portion by fixing the fixing bracket to the lower end of the cylindrical portion. Accordingly, the stress of the pipe around the capillary portion can be reduced.

[0018] In the compressor unit according to the aspect of the present invention, an oil return pipe side fixing position where one end of the fixing bracket is fixed to the oil return pipe is lower than an accumulator side fixing position where the other end of the fixing bracket is fixed to the accumulator.

[0019] The oil return pipe side fixing position where one end of the fixing bracket is fixed to the oil return pipe is lower than the accumulator side fixing position where the other end of the fixing bracket is fixed to the accumulator. Accordingly, stress to be caused in the oil return pipe below the capillary portion can be further reduced by making a distance from the capillary portion to the oil return pipe side fixing position long.

[0020] According to another aspect of the present invention, there is provided an outdoor unit including the compressor unit and a casing that accommodates the compressor unit. Advantageous Effects of Invention

[0021] The stress of the pipe can be reduced by the fixing bracket suppressing the vibration of the oil return pipe that connects the accumulator to the compressor.

Brief Description of Drawings

[0022]

Fig. 1 is a diagram showing a refrigerant circuit of an air conditioner according to a first embodiment of the present invention.

Fig. 2 is a side view of a compressor unit according to the first embodiment.

Fig. 3 is a side view of a compressor unit according to a second embodiment.

Description of Embodiments

[0023] Hereinafter, embodiments according to the present invention will be described with reference to the drawings.

[First Embodiment]

[0024] Fig. 1 is a refrigerant circuit diagram of a multi-split air conditioning system in which a plurality of indoor units are connected to one outdoor unit. There may be a plurality of outdoor units.

[0025] As shown in Fig. 1, in the multi-split air conditioning system 1, a plurality of indoor units 3A and 3B are connected in parallel to one outdoor unit 2. The plurality of indoor units 3A and 3B are connected to each other in parallel via splitters 6 between a gas side pipe 4 and a liquid side pipe 5, which are connected to the outdoor unit 2.

[0026] The outdoor unit 2 includes an inverter-driven compressor 10 that compresses a refrigerant, a four-way switching valve 12 that switches between refrigerant circulation directions, an outdoor heat exchanger 13 that causes heat exchange between a refrigerant and outside air, a supercooling coil 14 that is integrally configured with the outdoor heat exchanger 13, an outdoor expansion valve (EEVH) 15, a receiver 16 that stores a liquid refrigerant, a supercooling heat exchanger 17 that supercools a liquid refrigerant, an expansion valve for supercooling (EEVSC) 18 that controls a refrigerant amount to be divided for the supercooling heat exchanger 17, an accumulator 19 that separates a liquid out from a refrigerant gas to be sucked by the compressor 10 and sucks only a gas into a compressor 10 side, a gas side operating valve 20, and a liquid side operating valve 21.

[0027] The compressor 10 is rotatable at over 130 rps to 200 rps. An oil separator 26 is connected to a discharge side of the compressor 10 via a discharge pipe 25. In the oil separator 26, a mist-like lubricant (oil) in a compressed refrigerant is separated out from the refrigerant. The refrigerant from which the mist-like lubricant is separated out by the oil separator 26 is led to the four-way switching valve 12.

[0028] The accumulator 19 is provided with an oil return pipe 35 that returns a liquid refrigerant separated by the accumulator 19 to a suction pipe 34 with a lubricant. The oil return pipe 35 is provided with a capillary portion 36. The capillary portion 36 is used as a fixed aperture, and reduces the pressures of the liquid refrigerant and the lubricant which pass therethrough.

[0029] The respective devices on an outdoor unit 2 side are connected in turn via a refrigerant pipe 22, and configure a known outdoor side refrigerant circuit 23. In addition, the outdoor unit 2 is provided with an outdoor fan 24 that blows outside air with respect to the outdoor heat exchanger 13.

[0030] The gas side pipe 4 and the liquid side pipe 5 are refrigerant pipes which are respectively connected to the gas side operating valve 20 and the liquid side operating valve 21 of the outdoor unit 2. At the time of mounting in the field, the lengths of the pipes are set as appropriate according to a distance between the outdoor unit 2 and the plurality of indoor units 3A and 3B connected thereto. The plurality of splitters 6 are provided in the middle of the gas side pipe 4 and the liquid side pipe 5, and an appropriate number of indoor units 3A and 3B are connected via the splitters 6. Accordingly, one closed refrigerating cycle (refrigerant circuit) 7 is configured.

[0031] The indoor units 3A and 3B each include an indoor heat exchanger 30 that cools or heats indoor air by causing heat exchange with a refrigerant and contributes to indoor air conditioning, an indoor expansion valve (EEVC) 31, an indoor fan 32 that circulates indoor air via the indoor heat exchanger 30, and an indoor controller 33. The indoor units are connected to the splitters 6 via gas side branch pipes 4A and 4B and liquid side branch

pipes 5A and 5B on an indoor side.

[0032] In the multi-split air conditioning system 1, heating operation is performed as follows.

[0033] A high-temperature and high-pressure refrigerant gas, which is compressed and discharged by the compressor 10, circulates to an outdoor heat exchanger 13 side by means of the four-way switching valve 12, and exchanges heat with outside air blown to the outdoor heat exchanger 13 by the outdoor fan 24 so as to be condensed and liquefied. After being further cooled by the supercooling coil 14, the liquid refrigerant passes through the outdoor expansion valve 15 and is temporarily stored inside the receiver 16.

[0034] In the process of flowing to a liquid refrigerant pipe side via the supercooling heat exchanger 17, the refrigerant of which a circulation amount is adjusted by the receiver 16 is partially divided from a liquid refrigerant pipe, and exchanges heat with a refrigerant adiabatically expanded by the expansion valve for supercooling 18 to be given with a degree of supercooling. The liquid refrigerant is led from the outdoor unit 2 to the liquid side pipe 5 via the liquid side operating valve 21, and is divided into the liquid side branch pipes 5A and 5B of the indoor units 3A and 3B respectively via the splitter 6.

[0035] The liquid refrigerant divided into the liquid side branch pipes 5A and 5B flows into the indoor units 3A and 3B respectively, is adiabatically expanded by the indoor expansion valves 31, and forms a gas-liquid two-phase flow to flow into the indoor heat exchangers 30. Indoor air which is being circulated by the indoor fan 32 exchanges heat with a refrigerant in the indoor heat exchanger 30, and the indoor air is cooled and contributes to indoor cooling. Meanwhile, the refrigerant becomes a gas, reaches the splitters 6 via the gas side branch pipes 4A and 4B, and joins a refrigerant from the other indoor unit in the gas side pipe 4.

[0036] After the refrigerant gas which has joined in the gas side pipe 4 returns to the outdoor unit 2 again and joins a refrigerant gas from the supercooling heat exchanger 17 via the gas side operating valve 20 and the four-way switching valve 12, the refrigerant is introduced into the accumulator 19. In the accumulator 19, a liquid is separated out from the refrigerant gas, and only a gas is sucked into the compressor 10. The refrigerant is again compressed by the compressor 10, and cooling operation is performed by repeating such cycle. The liquid refrigerant separated out by the accumulator 19 is stored in a bottom portion of the accumulator 19, and is led to the suction pipe 34 via the oil return pipe 35 with a lubricant.

[0037] On the other hand, heating operation is performed as follows.

[0038] A high-temperature and high-pressure refrigerant gas which is compressed and discharged by the compressor 10 circulates to a gas side operating valve 20 side via the four-way switching valve 12. The high-pressure gas refrigerant is led out from the outdoor unit 2 via the gas side operating valve 20 and the gas side pipe 4, and is introduced into the plurality of indoor units 3A and 3B via the splitters 6 and the gas side branch pipes 4A and 4B on the indoor side.

[0039] The high-temperature and high-pressure refrigerant gas introduced in the indoor units 3A and 3B exchanges heat with indoor air circulating in the indoor heat exchangers 30 via the indoor fans 32, and accordingly the heated indoor air is blown out indoors and contributes to heating. On the other hand, a refrigerant which is condensed and liquefied by the indoor heat exchangers 30 reaches the splitters 6 via the indoor expansion valves 31 and the liquid side branch pipes 5A and 5B, joins a refrigerant from the other indoor unit, and returns to the outdoor unit 2 via the liquid side pipe 5. At the time of heating, in the indoor units 3A and 3B, the opening degree of each of the indoor expansion valves 31 is controlled via the indoor controller 33 such that a refrigerant outlet temperature or a degree of refrigerant supercooling of the indoor heat exchanger 30, which functions as a condenser, becomes a control target value.

[0040] After the refrigerant which has returned to the outdoor unit 2 reaches the supercooling heat exchanger 17 via the liquid side operating valve 21 and is supercooled as in the case of cooling, the refrigerant flows into the receiver 16 and a circulation amount thereof is adjusted by being temporarily stored in the receiver. After being supplied to the outdoor expansion valve 15 and being adiabatically expanded, the liquid refrigerant flows into the outdoor heat exchanger 13 via the supercooling coil 14.

[0041] In the outdoor heat exchanger 13, outside air blown from the outdoor fan 24 exchanges heat with the refrigerant, and the refrigerant absorbs heat from the outside air to evaporate and become a gas. After joining a refrigerant gas from the supercooling heat exchanger 17 via the four-way switching valve 12 from the outdoor heat exchanger 13, the refrigerant is introduced into the accumulator 19. In the accumulator 19, a liquid is separated out from the refrigerant gas and only a gas is sucked into the compressor 10. The gas is again compressed by the compressor 10. Heating operation is performed by repeating such cycle. The liquid refrigerant separated out by the accumulator 19 is stored in a bottom portion of the accumulator 19, and is led to the suction pipe 34 via the oil return pipe 35 with a lubricant.

<Structure of Compressor Unit>

[0042] Fig. 2 illustrates a structure of the compressor unit including the compressor 10 and the accumulator 19 which are provided inside a casing of the outdoor unit 2.

[0043] The compressor 10 has a substantially cylindrical shape having an axis extending in a vertical direction. An electric motor (not illustrated) is accommodated in a lower portion of the compressor 10, and a compression mechanism (not illustrated) such as a scroll part is accommodated in an upper portion of the compressor.

[0044] The accumulator 19 having an axis in the ver-

tical direction is erected, and has a cocoon shape formed with a substantially hemispherical bottom portion 19a, a substantially hemispherical upper portion 19b, and a cylindrical portion 19c sandwiched between the bottom portion 19a and the upper portion 19b. The accumulator 19 is fixed to a bottom plate (not illustrated) via leg portions 19d.

[0045] An upstream end 34a of the suction pipe 34 is connected to a top portion of the accumulator 19. A downstream end 34b of the suction pipe 34 is connected to the compressor 10. After rising upwards from the top portion of the accumulator 19, the suction pipe 34 extends sideways and bends downwards. After being folded back in a U-shape at a folded-back portion 34c below, the suction pipe again rises upwards. Then, after rising upwards, the suction pipe 34 extends sideways, again falls downwards, and is connected to a side portion of the compressor 10 in the end.

[0046] The oil return pipe 35 is provided between the accumulator 19 and the suction pipe 34, and is a pipe made of a metal such as stainless steel and a copper alloy. An upstream end 35a of the oil return pipe 35 is connected to a lower end of the bottom portion 19a of the accumulator 19. A downstream end 35b of the oil return pipe 35 is connected at a vertically middle position of the compressor 10 in the vicinity of the folded-back portion 34c at a lower portion of the suction pipe 34.

[0047] The capillary portion 36 is provided at a position in the middle of the oil return pipe 35, and has a winding shape which is obtained by winding a plurality of capillaries each having a diameter smaller than the diameter of the oil return pipe 35. The capillary portion 36 is provided in the vicinity of the downstream end 35b of the oil return pipe 35 at a height position substantially the same as the downstream end 35b.

[0048] The oil return pipe 35 connected to an upstream side (the left in Fig. 2) of the capillary portion 36 has a vertical portion 35d that extends downwards in the substantially vertical direction after being bent in a substantially L-shape at a bent portion 35c. A fixing bracket 37 is fixed to the vertical portion 35d.

[0049] The fixing bracket 37 is a sheet metal formed in a predetermined shape. An accumulator side fixing position 37a of the fixing bracket 37 is provided by welding with respect to a side portion of a lower end of the cylindrical portion 19c of the accumulator 19. The fixing bracket extends from the accumulator side fixing position 37a in a horizontal direction. Therefore, an oil return pipe side fixing position 37b of the fixing bracket 37 is the same height position as the accumulator side fixing position 37a, and is provided below the capillary portion 36 and the bent portion 35c.

[0050] In the embodiment, the following operational effects are achieved.

[0051] The vibration of the compressor 10 is transmitted to the oil return pipe 35 via the suction pipe 34. Since the oil return pipe 35 is provided with the capillary portion 36 having a winding shape, there is a possibility that the capillary portion 36, which is heavy, greatly vibrates and increases the stress of the pipe around the capillary portion 36. On this respect, the fixing bracket 37 that fixes the vertical portion 35d of the oil return pipe 35 below the capillary portion 36 to the accumulator 19 is provided in the embodiment. Accordingly, the vibration of the capillary portion 36 can be suppressed, and the stress of the oil return pipe 35 can be reduced.

[0052] Since the bent portion 35c is formed in the oil return pipe 35 below the capillary portion 36, stress concentrates on the bent portion 35c. By providing the fixing bracket 37 below the bent portion 35c, vibration to be caused in the bent portion 35c is suppressed, and thus the stress of the pipe can be reduced.

[0053] In a case where the fixing bracket is fixed to the bottom portion 19a of the accumulator 19 by welding or the like, construction is difficult since the bottom portion 19a has a substantially hemispherical shape. Thus, the fixing bracket 37 is fixed to the cylindrical portion 19c of the accumulator 19 in the embodiment.

[0054] In addition, the oil return pipe 35 can be fixed at the oil return pipe side fixing position 37b separated downwards from the capillary portion 36 by fixing the fixing bracket 37 to the lower end of the cylindrical portion 19c. Accordingly, stress caused in the pipe around the capillary portion 36 can be reduced.

[Second Embodiment]

[0055] Next, a second embodiment of the present invention will be described with reference to Fig. 3. The embodiment has a different fixing bracket configuration from that of the first embodiment, and other configurations are the same. Therefore, configurations that are the same as the first embodiment will be assigned with the same reference signs and description thereof will be omitted. Only differences will be described.

[0056] A fixing bracket 38 has a shape that is curved in an up-and-down direction such that the heights of fixing positions of both ends are different from each other. That is, while an accumulator side fixing position 38a of the fixing bracket 38 is provided on the lower end of the cylindrical portion 19c of the accumulator 19 as in the first embodiment, an oil return pipe side fixing position 38b of the fixing bracket 38 is provided below the accumulator side fixing position 38a. Accordingly, stress to be caused in the oil return pipe 35 below the capillary portion 36 can be further reduced by making a distance from the capillary portion 36 to the oil return pipe side fixing position 38b long.

[0057] Although the compressor 10 is described as a compressor that is rotatable at over 130 rps to 200 rps in the respective embodiments described above, the present invention is not limited thereto. The compressor may be rotatable at a compressor rotation speed of 130 rps or lower, or at a compressor rotation speed of over 200 rps.

Reference Signs List

[0058]

1: multi-split air conditioning system
2: outdoor unit
3A, 3B: indoor unit
10: compressor
13: outdoor heat exchanger
19: accumulator
19a: bottom portion
19b: upper portion
19c: cylindrical portion
19d: leg portion
34: suction pipe
34a: upstream end
34b: downstream end
34c: folded-back portion
35: oil return pipe
35a: upstream end
35b: downstream end
35c: bent portion
35d: vertical portion
36: capillary portion
37: fixing bracket
37a: accumulator side fixing position
37b: oil return pipe side fixing position
38: fixing bracket
38a: accumulator side fixing position
38b: oil return pipe side fixing position

Claims

1. A compressor unit comprising:

a compressor that compresses a refrigerant;
an accumulator that separates the refrigerant to be led to the compressor into a gas refrigerant and a liquid refrigerant;
a suction pipe that is provided between the compressor and the accumulator and leads the gas refrigerant separated out by the accumulator to the compressor;
an oil return pipe that is connected between a bottom portion of the accumulator and the suction pipe;
a capillary portion that is provided at a position in a middle of the oil return pipe and has a winding shape; and
a fixing bracket that fixes the oil return pipe below the capillary portion to the accumulator.

2. The compressor unit according to Claim 1,
wherein a bent portion is formed in the oil return pipe below the capillary portion, and
the fixing bracket is provided below the bent portion.

3. The compressor unit according to Claim 1 or 2,
wherein the accumulator includes the bottom portion having a substantially hemispherical shape and a cylindrical portion connected to a portion above the bottom portion, and
the fixing bracket is fixed to a lower end of the cylindrical portion.

4. The compressor unit according to any one of Claims 1 to 3, wherein an oil return pipe side fixing position where one end of the fixing bracket is fixed to the oil return pipe is lower than an accumulator side fixing position where the other end of the fixing bracket is fixed to the accumulator.

5. An outdoor unit comprising:

the compressor unit according to any one of Claims 1 to 4; and
a casing that accommodates the compressor unit.

FIG. 1

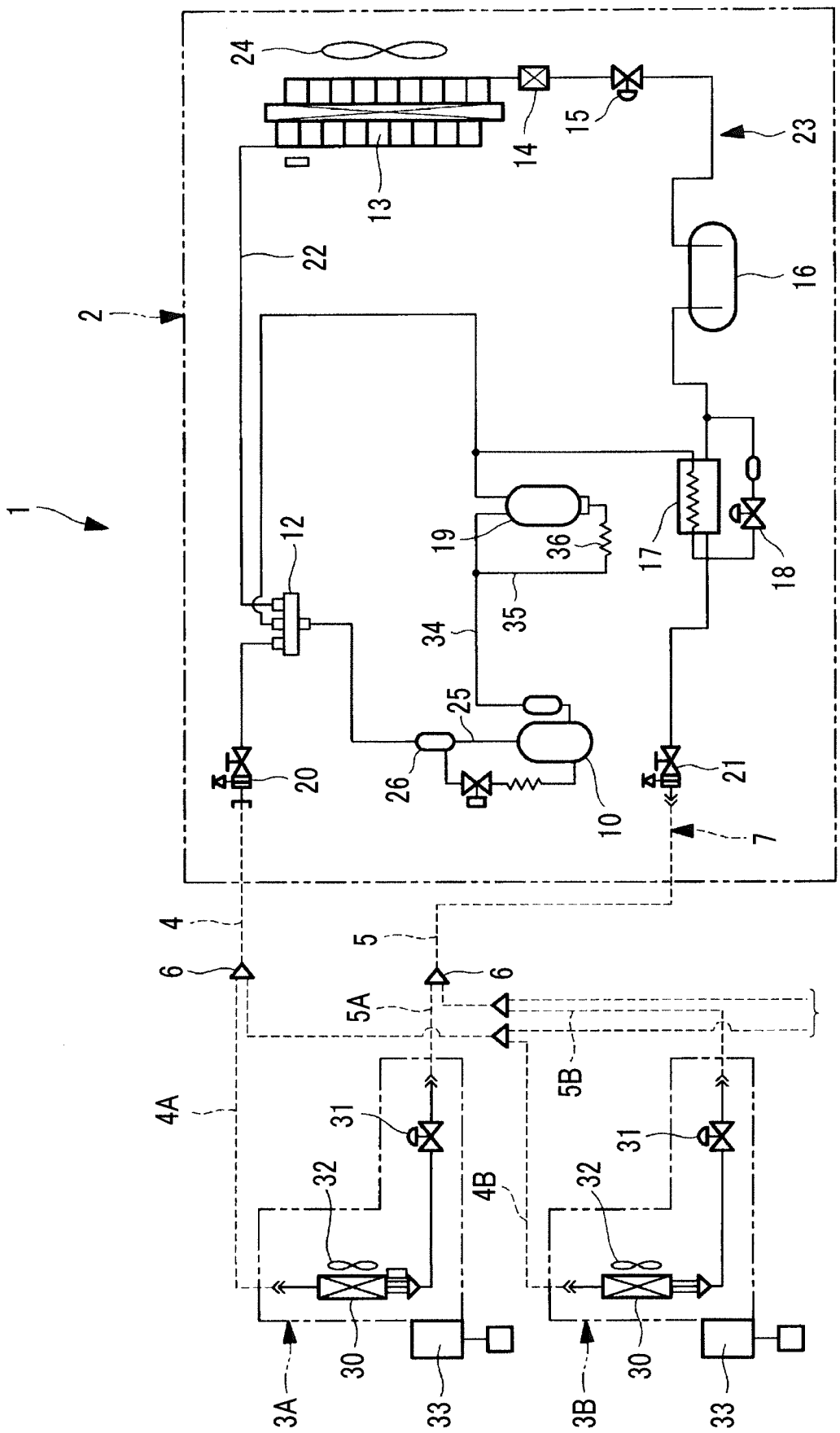

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FIG. 2

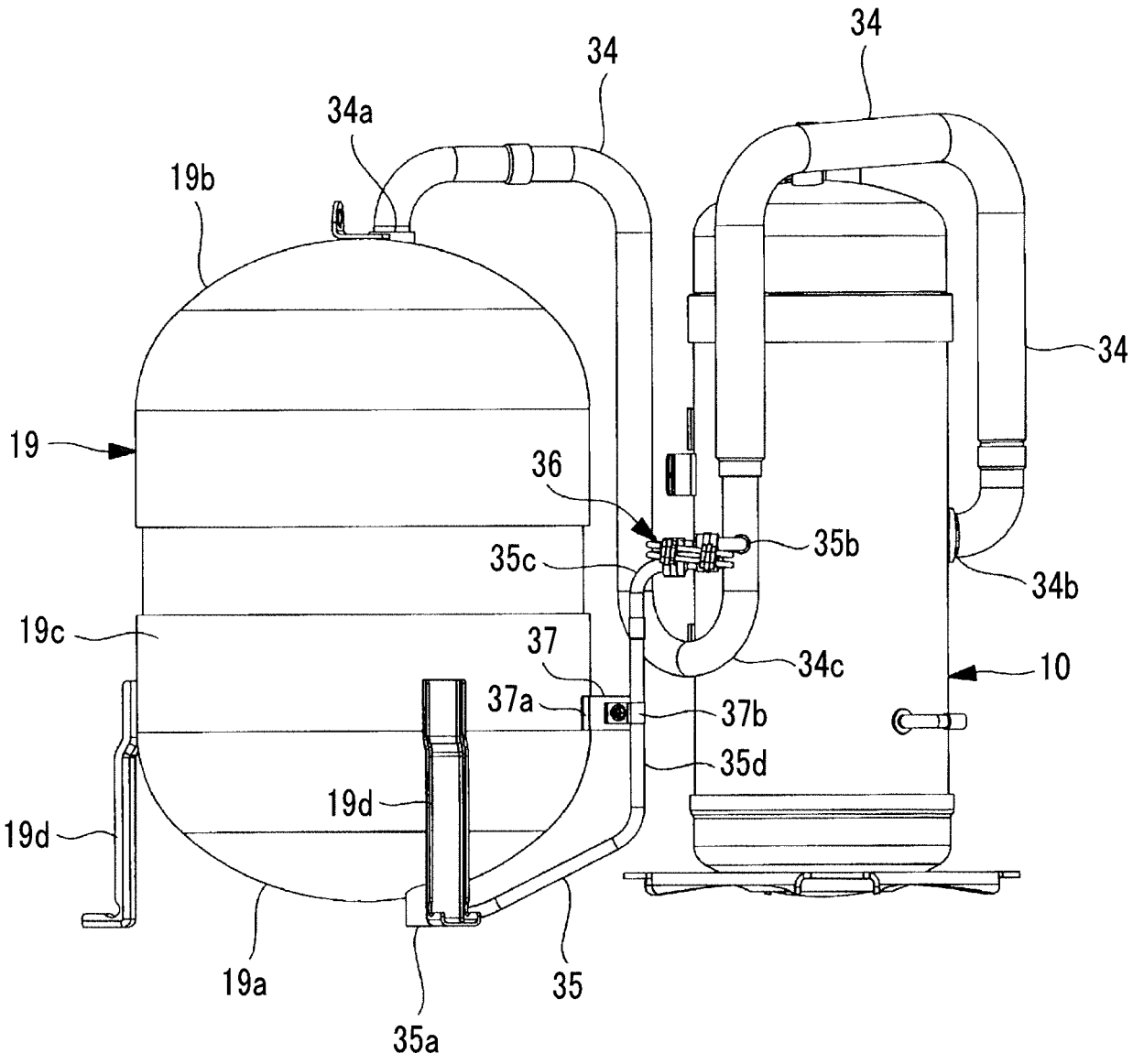
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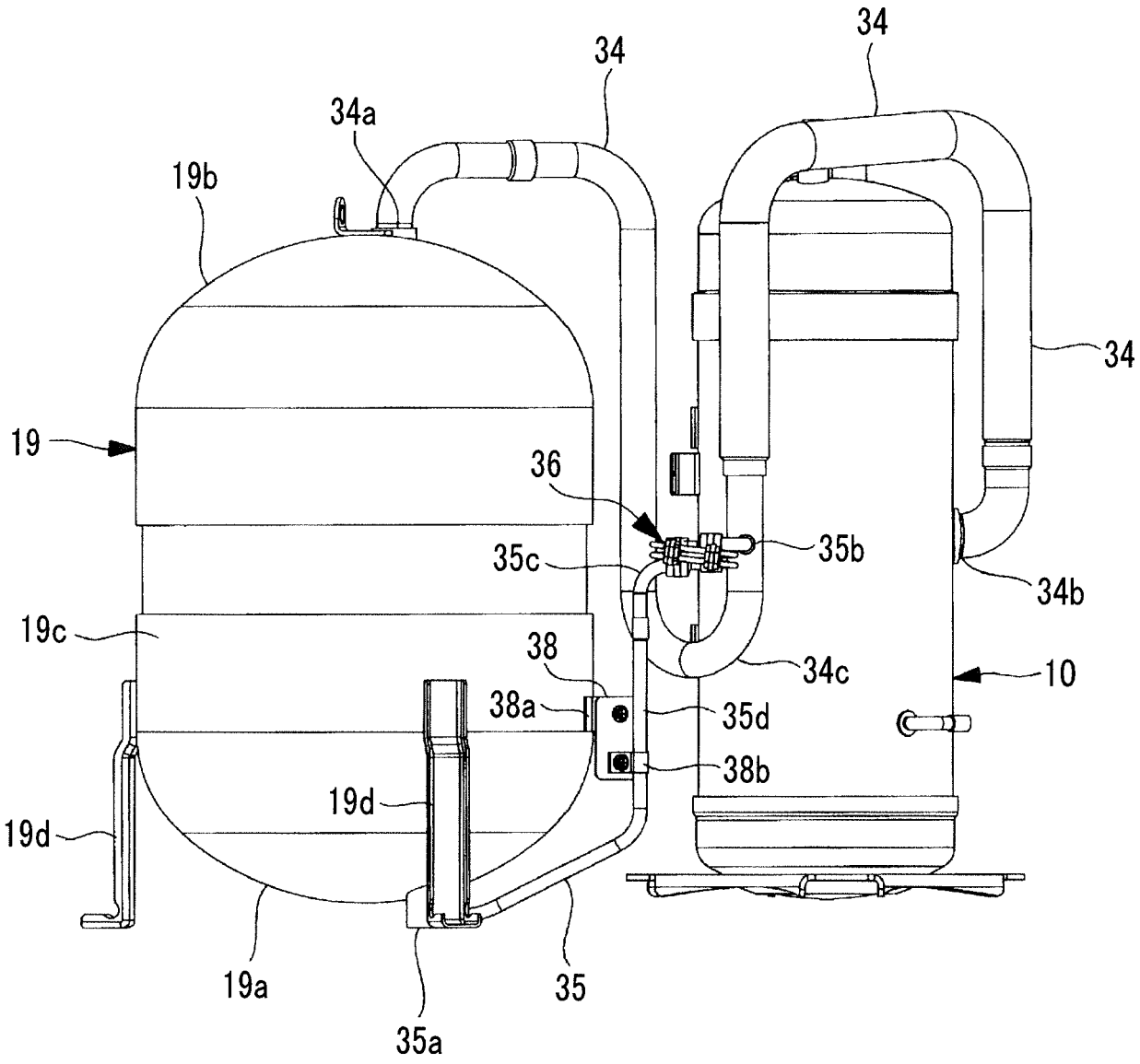
FIG. 3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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/043384

A. CLASSIFICATION OF SUBJECT MATTER
F24F1/30(2011.01)i, F25B43/02(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)
F24F1/30, F25B43/02

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Published examined utility model applications of Japan	1922-1996
Published unexamined utility model applications of Japan	1971-2018
Registered utility model specifications of Japan	1996-2018
Published registered utility model applications of Japan	1994-2018

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

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y A	JP 2011-33211 A (SANYO ELECTRIC CO., LTD.) 17 February 2011, paragraphs [0022]-[0058], fig. 1-4 (Family: none)	1, 3, 5 2, 4
Y	JP 8-189732 A (MITSUBISHI HEAVY INDUSTRIES, LTD.) 23 July 1996, paragraphs [0019]-[0022], fig. 1 (Family: none)	1, 3, 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
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
Name and mailing address of the ISA/ Japan Patent Office 3-4-3, Kasumigaseki, Chiyoda-ku, Tokyo 100-8915, Japan	Authorized officer Telephone No.

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

INTERNATIONAL SEARCH REPORT

International application No.
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C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	JP 2010-48241 A (TOSHIBA CARRIER CORP.) 04 March 2010, paragraphs [0044]-[0045], fig. 3 (Family: none)	1, 3, 5
A	US 2008/0314068 A1 (JANG, Seok Hoon) 25 December 2008, entire text, all drawings & EP 2037187 A2 & KR 2009-0028064 A & CN 101387427 A	1-5

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REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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