(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 3 502 576 A1

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

(43) Date of publication:
26.06.2019 Bulletin 2019/26

(21) Application number: **17879851.8**

(22) Date of filing: **25.10.2017**

(51) Int Cl.:
F24F 1/30 *(2011.01)* ***F24F 1/10*** *(2011.01)*

(86) International application number:
PCT/JP2017/038586

(87) International publication number:
WO 2018/110103 (21.06.2018 Gazette 2018/25)

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME
Designated Validation States:
MA MD

(30) Priority: **13.12.2016 JP 2016241051**

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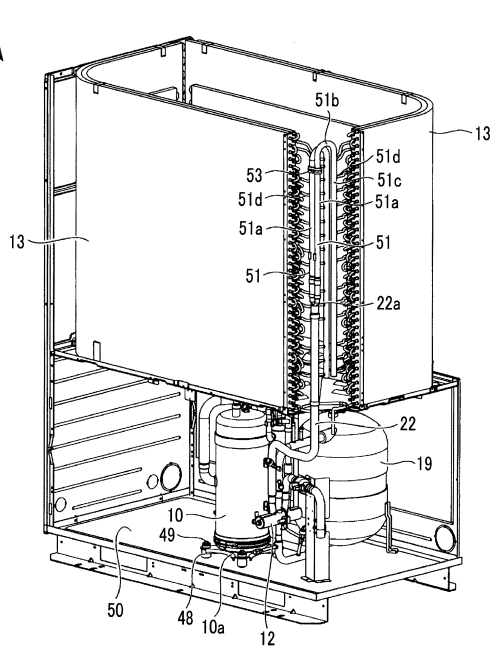
(54) COMPRESSOR UNIT AND OUTDOOR UNIT PROVIDED THEREWITH

(57) This compressor unit is provided with a compressor (10) which compresses a refrigerant, a refrigerant tube (22) which is connected to the compressor (10), multiple branch tubes (51) which branch in parallel from the refrigerant tube (22), and multiple outdoor heat exchangers (13) which are connected to the branch tubes (51). The branch tubes (51) include a rising part (51a) which branches from the refrigerant tube (22) and rise upwards, a fold-back part (51b) which is connected to the rising part (51a) and folds back downwards, a falling part (51c) which is connected to the fold-back part (51b) and falls downwards, and multiple branch pipes (51d) which connect the falling parts (51c) and the outdoor heat exchangers (13), and the branch tubes (51) have a fixing unit (53) which fixes together the rising parts (51a) of the branch tubes (51).

FIG. 2



EP 3 502 576 A1

Description

Technical Field

[0001] The present invention relates to a compressor unit that reduces stress concentration at a pipe, which is caused by vibration created from a compressor used in an air conditioner, 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 the compressed refrigerant is discharged. A refrigerant pipe is connected between the compressor and an outdoor heat exchanger.

[0003] A plurality of branch pipings are provided between the refrigerant pipe and the outdoor heat exchanger in some cases (refer to PTL 1).

Citation List

Patent Literature

[0004] [PTL 1] Japanese Unexamined Patent Application Publication No. 3-267637 (Fig. 6)

Summary of Invention

Technical Problem

[0005] Vibration from the compressor is transmitted to the branch pipings via the refrigerant pipe. There is a possibility that stress concentrates on a branching portion where the refrigerant pipe branches off into the respective branch pipings due to the vibration. In particular, as a result of examination made by the present inventor or the like, it is found that stress concentration at the branching portion, which is attributable to 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] The present invention is devised in view of such circumstances, and an object thereof is to provide a compressor unit that reduces stress concentration at branch pipings connected to heat exchangers and an outdoor unit including the compressor unit.

Solution to Problem

[0007] According to an aspect of the present invention, there is provided a compressor unit including a compressor that compresses a refrigerant, a refrigerant pipe connected to the compressor, and a plurality of branch pipings that are branched off in parallel from the refrigerant pipe and are each connected to a heat exchanger. Each of the branch pipings has a rising portion that is branched off from the refrigerant pipe and rises upwards from a lower side, a folded-back portion that is connected to the rising portion and is folded back downwards, a falling portion that is connected to the folded-back portion and falls downwards from an upper side, and a plurality of branch pipes that connect the falling portion to the heat exchanger. The compressor unit further includes a fixing unit that fixes the rising portions of the respective branch pipings to each other.

[0008] Each of the branch pipings connected to each heat exchanger is provided with the rising portion that is branched off from the refrigerant pipe and rises upwards from the lower side, the folded-back portion that is connected to the rising portion and is folded back downwards, and the falling portion that is connected to the folded-back portion and falls downwards from the upper side. That is because a liquid refrigerant stored in the heat exchangers passes the refrigerant pipe, and does not flow back (liquid backflow) to the compressor.

[0009] Vibration from the compressor is transmitted to the refrigerant pipe, and is further transmitted to the branch pipings. Due to the vibration, stress concentrates on a branching portion where the refrigerant pipe branches off into the respective branch pipings. In addition, upper sides of the rising portions of the branch pipings are greatly displaced due to the vibration. When the upper sides of the rising portions are greatly displaced, the displacement of the falling portions also becomes great, and the stress of the branch pipes connected to the heat exchangers becomes great.

[0010] By the fixing unit fixing the rising portions of the respective branch pipings to each other, the branch pipings can be integrated so as to suppress the individual vibration of the respective branch pipings. Accordingly, it is possible to reduce stress concentration at the branching portion where the refrigerant pipe branches off into the respective branch pipings and great displacement of the upper sides of the rising portions of the branch pipings.

[0011] A form in which rising pipes are fixed to each other by a material that has adiabaticity being wound around the rising pipes, a form in which the rising portions are fixed by being sandwiched in a metal bracket that is a sheet metal, or the like may be given as examples of the fixing unit.

[0012] According to another aspect of the present invention, there is provided a compressor unit including a compressor that compresses a refrigerant, a refrigerant pipe connected to the compressor, and a plurality of branch pipings that are branched off in parallel from the refrigerant pipe and are each connected to a heat exchanger. Each of the branch pipings has a rising portion that is branched off from the refrigerant pipe and rises upwards from a lower side, a folded-back portion that is connected to the rising portion and is folded back downwards, a falling portion that is connected to the folded-back portion and falls downwards from an upper side,

and a plurality of branch pipes that connect the falling portion to the heat exchanger. The rising portion of each of the branch pipings is fixed to the heat exchanger or a casing accommodating the heat exchanger.

[0013] Each of the branch pipings connected to each heat exchanger is provided with the rising portion that is branched off from the refrigerant pipe and rises upwards from the lower side, the folded-back portion that is connected to the rising portion and is folded back downwards, and the falling portion that is connected to the folded-back portion and falls downwards from the upper side. That is because a liquid refrigerant stored in the heat exchangers passes the refrigerant pipe, and does not flow back (liquid backflow) to the compressor.

[0014] Vibration from the compressor is transmitted to the refrigerant pipe, and is further transmitted to the branch pipings. Due to the vibration, stress concentrates at a branching position where the refrigerant pipe branches off into the respective branch pipings. In addition, upper sides of the rising portions of the branch pipings are greatly displaced due to the vibration. When the upper sides of the rising portions are greatly displaced, the displacement of the falling portions also becomes great, and the stress of the branch pipes connected to the heat exchangers becomes great.

[0015] By fixing the rising portions of the branch pipings to the heat exchangers or the casing accommodating the heat exchangers, the individual vibration of the respective branch pipings is suppressed. Accordingly, it is possible to reduce stress concentration at the branching position where the refrigerant pipe branches off into the respective branch pipings and great displacement of the upper sides of the rising portions of the branch pipings.

[0016] According to still another aspect of the present invention, there is provided an outdoor unit including the compressor unit, a plurality of heat exchangers, and a casing that accommodates the compressor unit and the respective heat exchangers.

Advantageous Effects of Invention

[0017] By fixing and integrating the rising portions of the respective branch pipings with each other, stress concentration at the branch pipings can be reduced.

[0018] By fixing the rising portions of the branch pipings to the heat exchangers or the casing accommodating the heat exchangers, stress concentration at the branch pipings can be reduced.

Brief Description of Drawings

[0019]

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 perspective view illustrating an outdoor unit accommodating a compressor unit according to the first embodiment.

Fig. 3 is a perspective view of the outdoor unit of Fig. 2 seen from another angle.

Fig. 4 is a perspective view of enlarged surroundings of a rising portion of a branch piping of Fig. 2.

Fig. 5 is a perspective view of enlarged surroundings of the rising portion of the branch piping of Fig. 4 seen from another angle.

Fig. 6 illustrates a modification example, and is a perspective view illustrating the enlarged rising portion of the branch piping of Fig. 2.

Fig. 7 is a perspective view of enlarged surroundings of the rising portion of the branch piping of Fig. 6 seen from another angle.

Fig. 8 illustrates a compressor unit according to a second embodiment, and is a perspective view illustrating an enlarged rising portion of a branch piping.

Description of Embodiments

[0020] Hereinafter, embodiments according to the present invention will be described with reference to the drawings.

[First Embodiment]

[0021] 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.

[0022] 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.

[0023] 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, outdoor heat exchangers 13 that cause heat exchange between a refrigerant and outside air, a supercooling coil 14 that is integrally configured with the outdoor heat exchangers 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.

[0024] 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 re-

frigerant from which the mist-like lubricant is separated out by the oil separator 26 is led to the four-way switching valve 12. The lubricant, which is separated out by the oil separator 26 and is stored inside the oil separator 26, returns to a low pressure side of the compressor 10 via an oil return pipe 27.

[0025] The oil return pipe 27 is provided with an electromagnetic valve 28 and a capillary portion 29. The opening and closing of the electromagnetic valve 28 is controlled by a control unit (not illustrated), and the electromagnetic valve adjusts the amount of oil to be flowed in the oil return pipe 27. The capillary portion 29 is used as a fixed aperture, and reduces the pressure of the lubricant which passes therethrough.

[0026] 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 exchangers 13.

[0027] 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.

[0028] 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.

[0029] In the multi-split air conditioning system 1, heating operation is performed as follows.

[0030] 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 exchangers 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.

[0031] 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.

[0032] 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.

[0033] 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.

[0034] On the other hand, heating operation is performed as follows.

[0035] 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.

[0036] 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.

[0037] 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 exchangers 13 via the supercooling coil 14.

[0038] In the outdoor heat exchangers 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 exchangers 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.

<Structure of Compressor Unit>

[0039] Figs. 2 and 3 illustrate a structure of the compressor unit including the compressor 10 and the outdoor heat exchangers 13 which are disposed inside the outdoor unit 2. In Figs. 2 and 3, the compressor 10, the outdoor heat exchangers 13, and a structure related to the compressor and the outdoor heat exchangers are illustrated, and illustration of other devices is omitted.

[0040] The compressor 10 is fixed on a bottom plate 50 inside a casing of the outdoor unit 2. 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. A leg portion 10a is provided in a bottom portion of the compressor 10, and is fixed to the bottom plate 50 via a vibration-proofing rubber 48 by means of a stud bolt 49.

[0041] The four-way switching valve 12 is positioned on a lateral lower portion of the compressor 10. The refrigerant pipe 22 extending upwards from the four-way switching valve 12 rises upwards along a corner of the outdoor unit 2. The reference sign 19 shown in Fig. 2 means the accumulator.

[0042] The refrigerant pipe 22 is connected to two branch pipings 51 at a branching portion 22a. The respective branch pipings 51 are provided in parallel from the branching portion 22a. Each of the branch pipings 51 has a rising portion 51a that rises upwards, a folded-back portion 51b that is connected to the rising portion 51a and is folded back in U-shape downwards, and a falling portion 51c that is connected to the folded-back portion 51b and falls downwards from an upper side. A plurality of branch pipes 51d connected to the outdoor heat exchanger 13 are provided on the falling portion 51c. The respective the branch pipes 51d are equidistantly provided in an up-and-down direction of the falling portion 51c.

[0043] The rising portion 51a, the folded-back portion 51b, and the falling portion 51c are shapes formed by bending the same pipe. After the height position of the folded-back portion 51b is made substantially the same position as an upper end of the outdoor heat exchanger 13, the rising portion 51a, the folded-back portion 51b, and the falling portion 51c are provided in an inverted U-shape. Accordingly, a liquid refrigerant stored in the outdoor heat exchangers 13 that are used as evaporators at the time of heating operation passes the refrigerant pipe 22, and does not flow back (liquid backflow) to the compressor 10.

[0044] The diameters of the rising portion 51a, the folded-back portion 51b, and the falling portion 51c are smaller than the diameter of the refrigerant pipe 22. The diameters of the branch pipes 51d are smaller than the diameters of the rising portion 51a, the folded-back portion 51b, and the falling portion 51c.

[0045] There are two outdoor heat exchangers 13, and each outdoor heat exchanger is bent in an L-shape in plan view. A refrigerant is supplied from the branch pipings 51 to the respectively corresponding two outdoor heat exchangers 13, and the refrigerant is led to each of the branch pipings 51.

[0046] A fixing unit 53 that integrally fixes the two rising portions 51a to each other is provided above the rising portions 51a of the branch pipings 51. Figs. 4 and 5 illustrate enlarged surroundings of the fixing unit 53.

[0047] The fixing unit 53 is configured by, for example, a material having adiabaticity, such as polyethylene foam, and is a band provided so as to be wound around the two rising portions 51a. The fixing unit 53 ensures that the rising portions 51a are not displaced independently of each other.

[0048] In the embodiment, the following operational effects are achieved.

[0049] Vibration from the compressor 10 is transmitted to the refrigerant pipe 22, and is further transmitted to the branch pipings 51. Due to the vibration, stress concentrates on the branching portion 22a where the refrigerant pipe 22 branches off into the respective branch pipings 51. In addition, the upper sides of the rising portions 51a of the branch pipings 51 are greatly displaced due to the vibration. When the upper sides of the rising portions 51a are greatly displaced, the displacement of the falling portions 51c also becomes great, and the stress of the branch pipes 51d connected to the outdoor heat exchangers 13 becomes great.

[0050] By the fixing unit 53 fixing the rising portions 51a of the respective branch pipings 51 to each other, the branch pipings 51 can be integrated so as to suppress the individual vibration of the respective branch pipings 51 in the embodiment. Accordingly, it is possible to reduce stress concentration at the branching portion 22a where the refrigerant pipe 22 branches off into the respective branch pipings 51 and great displacement of

the upper sides of the rising portions 51a of the branch pipings 51.

[0051] In the embodiment, deformation can take place as in Figs. 6 and 7.

[0052] As illustrated in Figs. 6 and 7, a fixing unit 53' may be configured by a metal bracket which is a sheet metal. The respective rising portions 51a are fixed by being sandwiched in the metal bracket. Accordingly, the fixing unit 53' can be configured at affordable costs.

[0053] Although the compressor 10 is described as a compressor that is rotatable at over 130 rps to 200 rps in the 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.

[0054] In addition, although a configuration where the refrigerant pipe branches off into the two branch pipings 51 is described, without being limited thereto, the present invention may have a configuration where the refrigerant pipe branches off into three or more pipes. In this case, at least two rising portions 51a positioned close to each other are fixed to each other by the fixing units 53 and 53'.

[Second Embodiment]

[0055] Hereinafter, a second embodiment of the present invention will be described. The embodiment is different from the first embodiment in terms of a configuration of fixing the rising portions 51a. Therefore, only differences from the first embodiment will be described hereinafter. Configurations common to the embodiments will be assigned with the same reference signs and description thereof will be omitted.

[0056] As illustrated in Fig. 8, a bracket for fixing 55 that fixes the upper side of the rising portion 51a to a side plate 13a on an end portion of the outdoor heat exchanger 13 is provided. The bracket for fixing 55 includes two metal plates curved in a predetermined shape, and the rising portion 51a is sandwiched between the metal plates. Although not illustrated in Fig. 8, also the rising portion 51a of the other branch piping 51 is fixed to the corresponding side plate 13a of the outdoor heat exchanger 13 via the bracket for fixing 55.

[0057] The vibration of the rising portions 51a can be suppressed by fixing the rising portions 51a to the outdoor heat exchangers 13 via the brackets for fixing 55. In addition, since the side plates 13a of the outdoor heat exchangers 13 are configured by a relatively strong material such as stainless steel, it is preferable to have the side plates as targets for fixing the brackets for fixing 55.

[0058] In addition, although a configuration where the refrigerant pipe branches off into the two branch pipings 51 is described, without being limited thereto, the present invention may have a configuration where the refrigerant pipe branches off into three or more pipes.

[0059] Instead of being fixed to the side plates 13a of the outdoor heat exchangers 13, the brackets for fixing 55 may be fixed to a casing accommodating the outdoor heat exchangers 13, that is, the casing of the outdoor unit 2. Specifically, the brackets for fixing may be fixed to a casing or a frame of the casing of the outdoor unit 2.

Reference Signs List

[0060]

1:	multi-split air conditioning system
2:	outdoor unit
3A, 3B:	indoor unit
10:	compressor
10a:	leg portion
13:	outdoor heat exchanger
19:	accumulator
22:	refrigerant pipe
22a:	branching portion
25:	discharge pipe
48:	vibration-proofing rubber
49:	stud bolt
50:	bottom plate
51:	branch piping
51a:	rising portion
51b:	folded-back portion
51c:	falling portion
51d:	branch pipe
53, 53':	fixing unit
55:	bracket for fixing

Claims

1. A compressor unit comprising:

a compressor that compresses a refrigerant;
a refrigerant pipe connected to the compressor; and
a plurality of branch pipings that are branched off in parallel from the refrigerant pipe and are each connected to a heat exchanger,
wherein each of the branch pipings has a rising portion that is branched off from the refrigerant pipe and rises upwards from a lower side, a folded-back portion that is connected to the rising portion and is folded back downwards, a falling portion that is connected to the folded-back portion and falls downwards from an upper side, and a plurality of branch pipes that connect the falling portion to the heat exchanger, and
the compressor unit further comprises a fixing unit that fixes the rising portions of the respective branch pipings to each other.

2. A compressor unit comprising:

a compressor that compresses a refrigerant;
a refrigerant pipe connected to the compressor; and

a plurality of branch pipings that are branched off in parallel from the refrigerant pipe and are each connected to a heat exchanger,
wherein each of the branch pipings has a rising portion that is branched off from the refrigerant pipe and rises upwards from a lower side, a folded-back portion that is connected to the rising portion and is folded back downwards, a falling portion that is connected to the folded-back portion and falls downwards from an upper side, and a plurality of branch pipes that connect the falling portion to the heat exchanger, and
the rising portion of each of the branch pipings is fixed to the heat exchanger or a casing accommodating the heat exchanger.

3. An outdoor unit comprising:

the compressor unit according to Claim 1 or 2;
a plurality of heat exchangers; and
a casing that accommodates the compressor unit and the respective heat exchangers.

FIG. 1

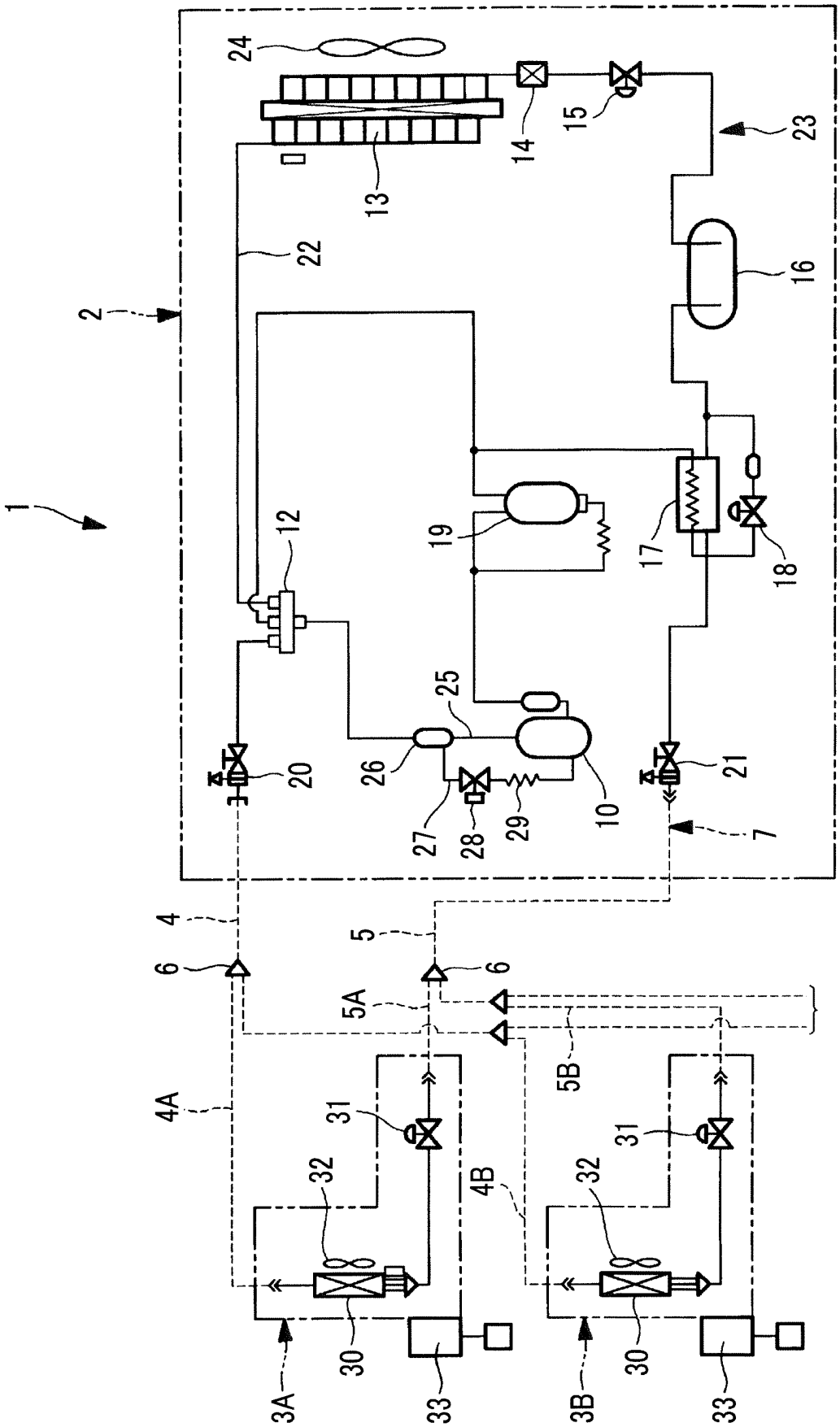

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FIG. 2

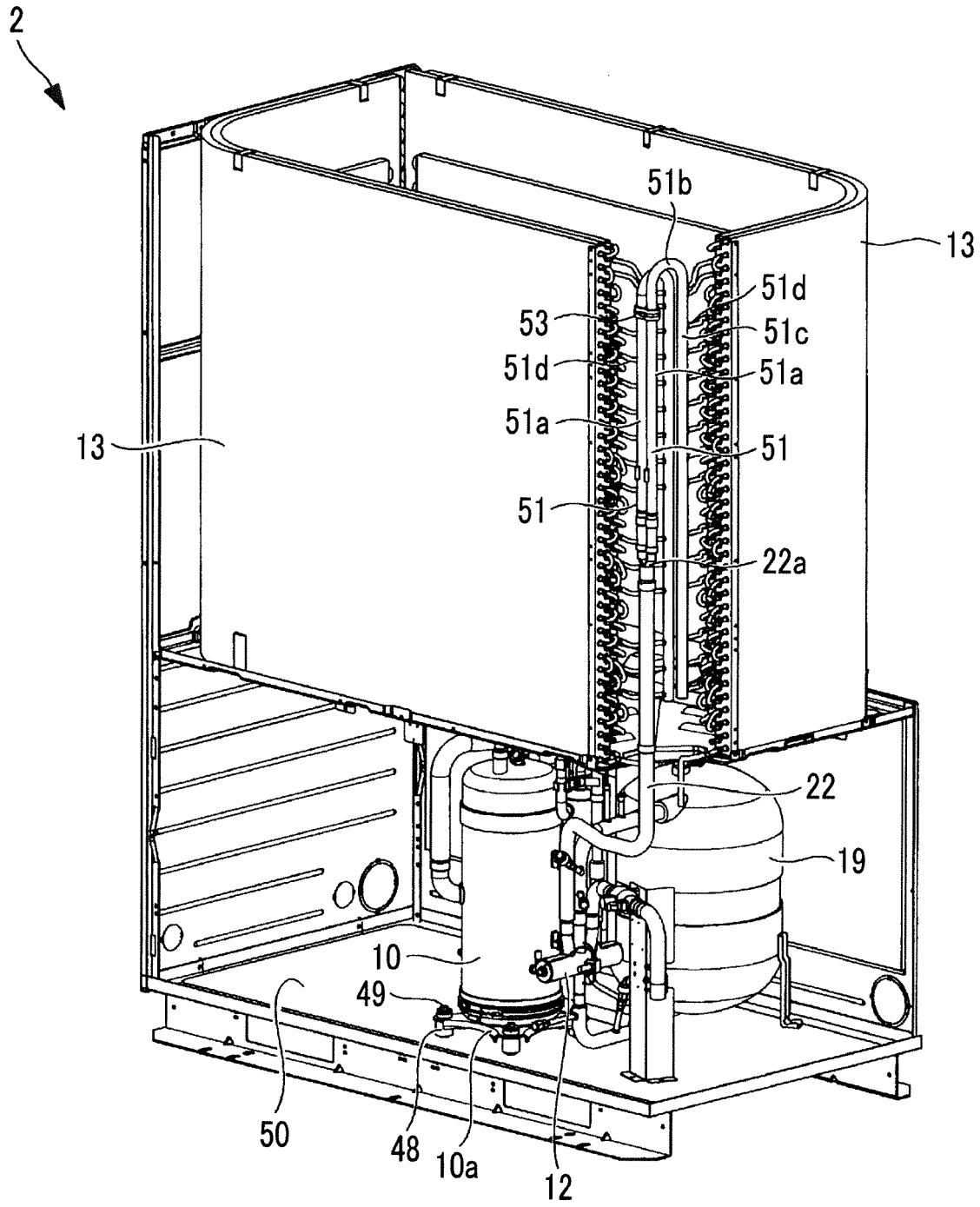


FIG. 3

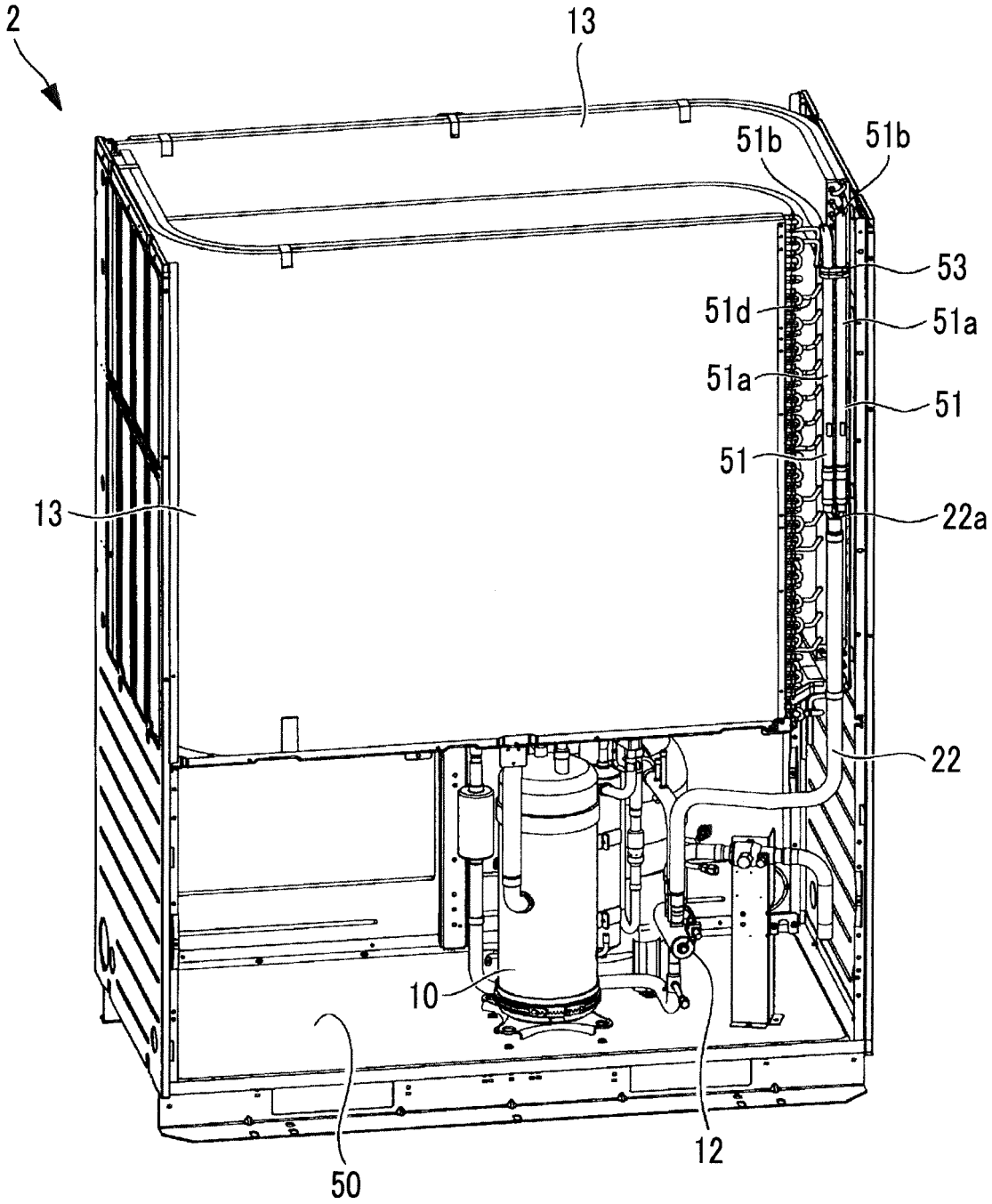


FIG. 4

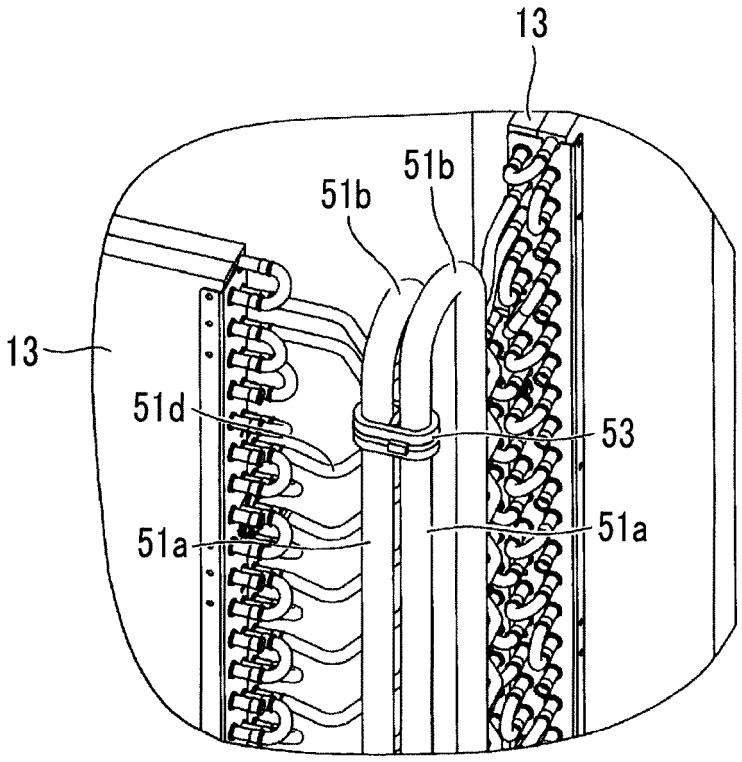


FIG. 5

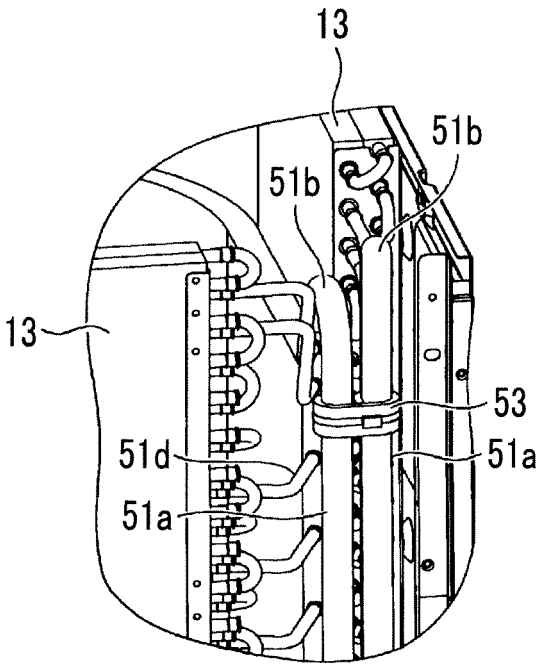


FIG. 6

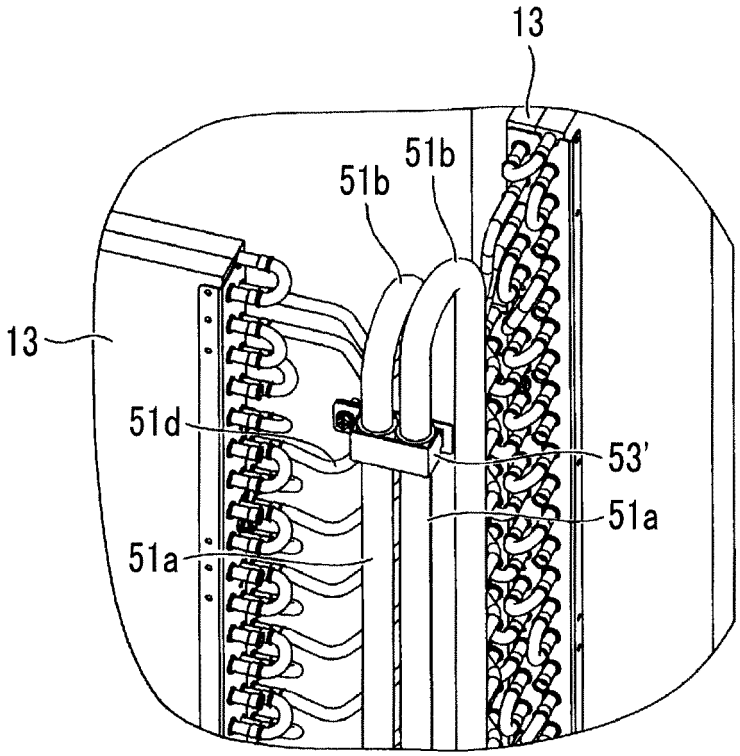


FIG. 7

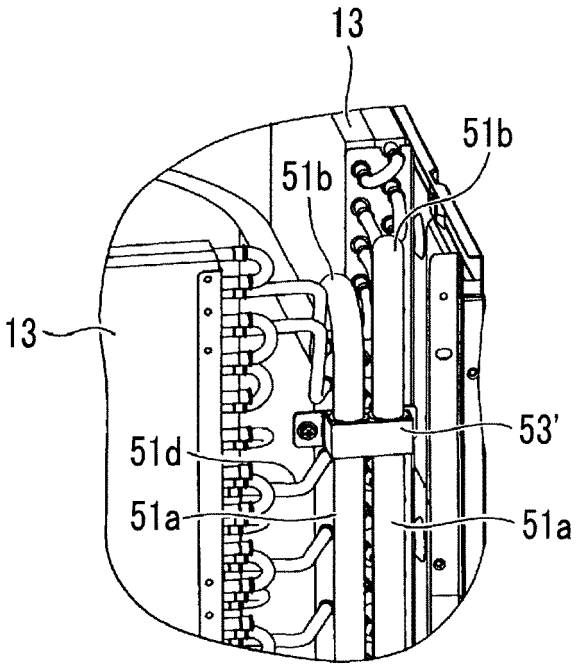
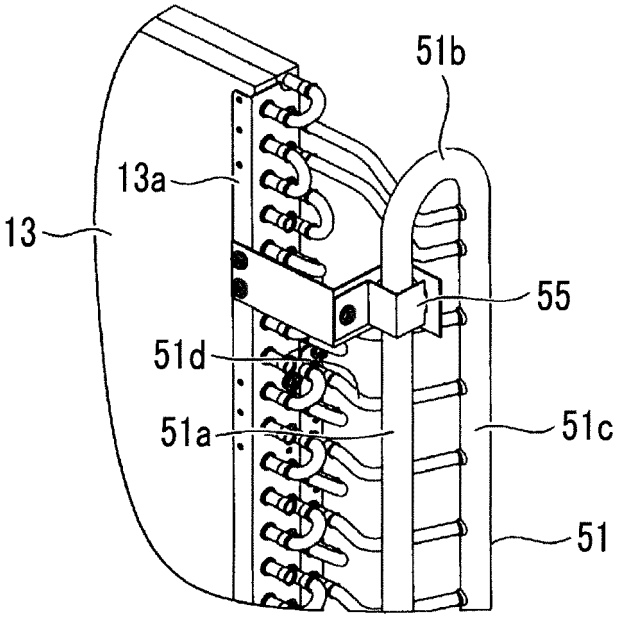


FIG. 8



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2017/038586

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl. F24F1/30(2011.01)i, F24F1/10(2011.01)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. F24F1/30, F24F1/10

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.
Y	JP 2015-87073 A (DAIKIN INDUSTRIES, LTD.) 07 May 2015, paragraphs [0032]-[0080], fig. 1-9 (Family: none)	1-3
Y	JP 2009-275990 A (DAIKIN INDUSTRIES, LTD.) 26 November 2009, paragraphs [0020]-[0029], fig. 1 (Family: none)	1-3
Y	JP 2004-324982 A (MATSUSHITA ELECTRIC INDUSTRIAL CO., LTD.) 18 November 2004, paragraphs [0011]-[0014], fig. 1-2 & CN 2706720 Y	2-3

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

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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
25 December 2017 (25.12.2017)	09 January 2018 (09.01.2018)

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

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

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

- JP 3267637 A **[0004]**