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(54) **OUTDOOR UNIT FOR A HEAT PUMP SYSTEM**

(57) The present invention relates to an outdoor unit for a heat pump system. The outdoor unit comprises a refrigerant circuit comprising a compressor, a heat source heat exchanger, an expansion valve, and a re-

frigerant side of a plate heat exchanger. The heat medium circuit comprises on a side of the plate heat exchanger, and an internal gas liquid separator.

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Description

FIELD OF THE INVENTION

[0001] The present invention relates to an outdoor unit for a heat pump system.

BACKGROUND

[0002] In and air conditioning, and in particular, in heat pump systems, it is common to have combined refrigerant and heat medium circuits capable of changing heat between each other. For such thermal exchanges to take place, it is common to use heat exchangers. These heat exchangers are typically complex, usually metal constructions. As the system ages, such heat exchangers occasionally develop leakages which may pass unnoticed to the user but which leakages can cause the transfer of substantial amounts of refrigerant to the heat medium circuit of said systems. As such, a gas-liquid separator is an essential part of an air conditioning and/or heat pump in order to prevent high concentrations of refrigerant in indoor areas, should a leakage come to develop. Should refrigerant build up inside the gas-liquid separator, said refrigerant must be evacuated. EP3967943 discloses an air conditioning outside unit comprising a gas-liquid separator at the highest part of the heat medium circuit. Said gas-liquid separator comprises a top outlet in fluid connection with an outlet disposed to the front plate, and above the ventilation element of said unit. The benefits of disposing of the refrigerant gas near the ventilation element of an outdoor unit, in particular above the center of said unit, should be obvious to one skilled in the art. However, the refrigerant gas is usually heavier than air, causing it to sink. This makes it difficult for the refrigerant to even reach the refrigerant outlet without having refrigerant flowing back into the gas liquid separator and/or dwelling between the outlet and the gas-liquid separator.

[0003] The present invention aims to provide a device which resolves the disadvantage mentioned above. The present invention relates to an outdoor unit having an improved refrigerant evacuation.

SUMMARY OF THE INVENTION

[0004] The present invention and embodiments thereof serve to provide a solution to one or more of above-mentioned disadvantages. To this end, the present invention relates to an outdoor unit for a heat pump system according to the first aspect of the invention. The outdoor unit for a heat pump system comprises a refrigerant circuit comprising a compressor, a heat source heat exchanger, an expansion valve, and a refrigerant side of a plate heat exchanger.

[0005] The outdoor unit further comprises a heat medium circuit comprising a heat medium side of the plate heat exchanger and a gas-liquid separator with a first inlet

port and a first outlet port. The plate heat exchanger has a first lateral face and a second lateral face that is oppositely positioned to the first lateral face, and a second inlet port and a second outlet port, wherein the second inlet port and the second outlet port are arranged on the first lateral face. The heat medium circuit and the refrigerant circuit advantageously permits containing the refrigerant circuit to the outdoor unit, thus minimizing the risk of refrigerant leaking into any indoor space.

[0006] The outdoor unit further comprises a housing comprising a front plate, a first side plate, a second side plate, a rear plate, top plate and a bottom plate, the housing accommodating the compressor, the heat source heat exchanger, the expansion valve, the plate heat exchanger and the gas-liquid separator, and a third inlet port and a third outlet port. The third inlet port and the third outlet port are arranged on the rear panel. The first lateral face faces the rear plate and the first inlet port is connected to the second outlet port with a first straight pipe and the first outlet port is connected to the third outlet port with a second straight pipe, said first and second straight pipes extending substantially parallel to the bottom plate. Since the plate heat exchanger and gas-liquid separator, and the gas-liquid separator and the third outlet port are each connected by straight pipes, the heat medium can be flowed into a short pipe, and the effect of pressure loss of the heat medium can be reduced.

[0007] In an embodiment, the gas-liquid separator is a centrifugal gas-liquid separator comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port and the first outlet port are disposed on the cylindrical body. This positioning of the first inlet port and first outlet port of the gas-liquid separator permits an easier and more convenient positioning inside the outdoor unit which facilitates installation of the outdoor unit.

[0008] In an embodiment, the first inlet port and the first outlet port are positioned so that they are positioned on opposite sides of the cylindrical body. This permits increasing the time the heat medium dwells inside the separator, thus giving any leaked refrigerant gas more time to separate from the heat medium.

[0009] In an embodiment the gas-liquid separator is a centrifugal gas-liquid separator, comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port is connected to the cylindrical body and the first outlet port comprises an L-shape bent pipe that is connected to an outlet opening formed on the bottom surface. This permits to take advantage of the difference in density between the refrigerant gas and the heat medium.

[0010] In an embodiment refrigerant pipe connection ports are arranged on the second lateral face for supplying the refrigerant to the plate heat exchanger from the compressor. This permits shortening the path between the compressor and the refrigerant ports of the heat exchanger, allowing for a more compact outdoor unit.

[0011] In an embodiment the plate heat exchanger is located at a predetermined distance from the rear plate,

said predetermined distance being at most half of the distance between the front plate and the rear plate. In this way, sufficient space is made available for the gas-liquid separator, allowing said separator to be advantageously fitted inside the outdoor unit. This permits maintaining the outside envelope of the outdoor unit and to protect the gas-liquid separator from damage.

DESCRIPTION OF FIGURES

[0012] The following description of the figures of specific embodiments of the invention is merely exemplary in nature and is not intended to limit the present teachings, their application or uses. Throughout the drawings, corresponding reference numerals indicate like or corresponding parts and features.

Figure 1 schematically presents outdoor unit (1) with a gas-liquid separator (3).

Figure 2 schematically presents outdoor unit (1) with a gas-liquid separator (3) having an L-shaped pipe.

DETAILED DESCRIPTION OF THE INVENTION

[0013] The invention is further described by the following non-limiting examples which further illustrate the invention, and are not intended to, nor should they be interpreted to, limit the scope of the invention.

[0014] The present invention concerns an outdoor unit for a heat pump, said unit is provided with a gas-liquid separator disposed on the heat medium circuit and inside of the housing. The outdoor unit according to the present invention advantageously comprises an internal gas-liquid separator placed adjacent to a plate heat exchanger. This advantageously permits including all the elements of the outdoor unit inside the housing of said unit, maintaining the same unit envelope while protecting the gas-liquid separator from damage.

[0015] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, term definitions are included to better appreciate the teaching of the present invention.

[0016] As used herein, the following terms have the following meanings:

"A", "an", and "the" as used herein refers to both singular and plural referents unless the context clearly dictates otherwise. By way of example, "a compartment" refers to one or more than one compartment.

[0017] "Comprise", "comprising", and "comprises" and "comprised of" as used herein are synonymous with "include", "including", "includes" or "contain", "containing", "contains" and are inclusive or open-ended terms that specifies the presence of what follows e.g. component and do not exclude or preclude the presence of

additional, non-recited components, features, element, members, steps, known in the art or disclosed therein.

[0018] Furthermore, the terms first, second, third and the like in the description and in the claims, are used for distinguishing between similar elements and not necessarily for describing a sequential or chronological order, unless specified. It is to be understood that the terms so used are interchangeable under appropriate circumstances and that the embodiments of the invention described herein are capable of operation in other sequences than described or illustrated herein.

[0019] The recitation of numerical ranges by endpoints includes all numbers and fractions subsumed within that range, as well as the recited endpoints.

[0020] Whereas the terms "one or more" or "at least one", such as one or more or at least one member(s) of a group of members, is clear *per se*, by means of further exemplification, the term encompasses *inter alia* a reference to any one of said members, or to any two or more of said members, such as, e.g., any ≥ 3 , ≥ 4 , ≥ 5 , ≥ 6 or ≥ 7 etc. of said members, and up to all said members.

[0021] Unless otherwise defined, all terms used in disclosing the invention, including technical and scientific terms, have the meaning as commonly understood by one of ordinary skill in the art to which this invention belongs. By means of further guidance, definitions for the terms used in the description are included to better appreciate the teaching of the present invention. The terms or definitions used herein are provided solely to aid in the understanding of the invention.

[0022] Reference throughout this specification to "one embodiment" or "an embodiment" means that a particular feature, structure or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, appearances of the phrases "in one embodiment" or "in an embodiment" in various places throughout this specification are not necessarily all referring to the same embodiment, but may. Furthermore, the particular features, structures or characteristics may be combined in any suitable manner, as would be apparent to a person skilled in the art from this disclosure, in one or more embodiments. Furthermore, while some embodiments described herein include some but not other features included in other embodiments, combinations of features of different embodiments are meant to be within the scope of the invention, and form different embodiments, as would be understood by those in the art. For example, in the following claims, any of the claimed embodiments can be used in any combination.

[0023] With as a goal illustrating better the properties of the invention the following presents, as an example and limiting in no way other potential applications, a description of a number of preferred embodiments of the outdoor unit according to the invention, wherein:

FIG. 1 schematically presents outdoor unit (1) with a gas-liquid separator (3). The outdoor unit for a heat pump system comprises a refrigerant circuit (4 not shown)

comprising a compressor (5 not shown), a heat source heat exchanger (6 not shown), an expansion valve (7 not shown), and a refrigerant side of a plate heat exchanger (2).

[0024] The outdoor unit (1) further comprises a heat medium circuit (8) comprising a heat medium side of the plate heat exchanger (2) and the gas-liquid separator (3) with a first inlet port (9) and a first outlet port (10). The plate heat exchanger (2) has a first lateral (11) face and a second lateral face (12) that is oppositely positioned to the first lateral face (11), and a second inlet port (13) and a second outlet port (14), wherein the second inlet port (13) and the second outlet (14) port are arranged on the first lateral face (11). The heat medium circuit (8) and the refrigerant circuit (4) advantageously permits containing the refrigerant circuit (4) to the outdoor unit (1), thus minimizing the risk of refrigerant leaking into any indoor space.

[0025] The outdoor unit (1) further comprises a housing (15) comprising a front plate (16), a first side plate (17), a second side plate (18), a rear plate (19), top plate (20) and a bottom plate (21), the housing (15) accommodating the compressor, the heat source heat exchanger (6), the expansion valve (7), the plate heat exchanger (2) and the gas-liquid separator (3), and a third inlet port (22) and a third outlet port (23). The third inlet port (22) and the third outlet port (23) are arranged on the rear panel (19). The first lateral face (11) faces the rear plate (19) and the first inlet port (9) is connected to the second outlet port (14) with a first straight pipe (24) and the first outlet port (10) is connected to the third outlet port (23) with a second straight pipe (25), said first and second straight pipes (24, 25) extending substantially parallel to the bottom plate (21). Since the plate heat exchanger (2) and gas-liquid separator (3), and the gas-liquid separator (3) and the third outlet port (23) are each connected by straight pipes (24, 25), the heat medium can be flowed into a short pipe, and the effect of pressure loss of the heat medium can be reduced.

[0026] The gas-liquid separator (3) shown in FIG. 1 is a centrifugal gas-liquid separator comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port (9) and the first outlet port (10) are disposed on the cylindrical body. This positioning of the inlet port (9) and outlet port (10) of the separator (3) permits an easier and more convenient positioning inside the outdoor unit (1) which facilitates installation of the outdoor unit (1). The first inlet port and the first outlet ports (9, 10) are positioned so that they are positioned on opposite sides of the cylindrical body. This permits increasing the time the heat medium dwells inside the separator (3), thus giving any leaked refrigerant gas more time to separate from the heat medium. The refrigerant pipe connection ports (27, 28) are arranged on the second lateral face (12) for supplying the refrigerant to the plate heat exchanger (2) from the compressor (5). This permits shortening the path between the compressor (5) and the refrigerant ports of the heat exchanger (27, 28), allowing for a more

compact outdoor unit (1). The plate heat exchanger (2) is shown advantageously distanced from the rear plate (19) less than half of the distance between the front plate (16) and the rear plate (19). In this way, sufficient space is made available for the gas-liquid separator (3), allowing said separator (3) to be advantageously fitted inside the outdoor unit (1). This permits maintaining the outside envelope of the outdoor unit (1) compact and to protect the gas-liquid separator (3) from damage. In this embodiment, the first inlet port (9) is connected to the cylindrical body and the first outlet port (10) is advantageously located below the inlet port (9).

[0027] In an embodiment the plate heat exchanger (2) is located at a predetermined distance from the rear plate (19), said predetermined distance being at most half of the distance between the front plate (16) and the rear plate (19). In this way, sufficient space is made available for the gas-liquid separator (3), allowing said separator (3) to be advantageously fitted inside the outdoor unit (1). This permits maintaining the outside envelope of the outdoor unit (1) and to protect the gas-liquid separator (3) from damage.

[0028] FIG. 2 schematically presents outdoor unit (1) with a gas-liquid separator (3) having an L-shaped pipe (26). In this embodiment, the gas-liquid separator (3) is a centrifugal gas-liquid separator, comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port (9) is connected to the cylindrical body and the first outlet port (10) comprises an L-shape bent pipe (26) that is connected to an outlet opening formed on the bottom surface. This permits to take advantage of the difference in density between the refrigerant gas and the heat medium and allow the buoyancy of the refrigerant cause it to rise inside the gas-liquid separator, while the heat medium is evacuated through the outlet (10) at the bottom.

[0029] The present invention is in no way limited to the embodiments described in the examples and/or shown in the figures. On the contrary, methods according to the present invention may be realized in many different ways without departing from the scope of the invention.

List of numbered items:

[0030]

- 1 outdoor unit
- 2 plate heat exchanger
- 3 gas-liquid separator
- 4 refrigerant circuit
- 5 compressor
- 6 heat source heat exchanger
- 7 expansion valve
- 8 heat medium circuit
- 9 first inlet port
- 10 first outlet port
- 11 first lateral face
- 12 second lateral face

13 second inlet port
 14 second outlet port
 15 housing
 16 front plate
 17 first side plate
 18 second side plate
 19 rear plate
 20 top plate
 21 bottom plate
 22 third inlet port
 23 third outlet port
 24 first straight pipe
 25 second straight pipe
 26 L-shaped pipe
 27 first refrigerant pipe connection port
 28 second refrigerant pipe connection port

Claims

1. An outdoor unit for a heat pump system comprising:
 - a refrigerant circuit comprising a compressor, a heat source heat exchanger, an expansion valve, and a refrigerant side of a plate heat exchanger;
 - a heat medium circuit comprising a heat medium side of the plate heat exchanger and a gas-liquid separator with a first inlet port and a first outlet port, wherein the plate heat exchanger has a first lateral face and a second lateral face that is oppositely positioned to the first lateral face, and a second inlet port and a second outlet port, wherein the second inlet port and the second outlet port are arranged on the first lateral face;
 - a housing comprising a front plate, a first side plate, a second side plate, a rear plate, top plate and a bottom plate, the housing accommodating the compressor, the heat source heat exchanger, the expansion valve, the plate heat exchanger and the gas-liquid separator, and a third inlet port and a third outlet port, wherein the third inlet port and the third outlet port are arranged on the rear panel;
 - wherein the first lateral face faces the rear plate and the first inlet port is connected to the second outlet port with a first straight pipe and the first outlet port is connected to the third outlet port with a second straight pipe, said first and second straight pipes extending substantially parallel to the bottom plate.
2. The outdoor unit for a heat pump system according to the claim 1, wherein the gas-liquid separator is a centrifugal gas-liquid separator comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port and the first outlet port are disposed on the cylindrical body.

3. The outdoor unit for a heat pump system according to the claim 2, wherein the first inlet port and the first outlet port are positioned so that they are positioned on opposite sides of the cylindrical body.
4. The outdoor unit for a heat pump system according to the claim 1, wherein the gas-liquid separator is a centrifugal gas-liquid separator, comprising a cylindrical body, a bottom surface, and a top surface, wherein the first inlet port is connected to the cylindrical body and the first outlet port comprises an L-shape bent pipe that is connected to an outlet opening formed on the bottom surface.
5. The outdoor unit for a heat pump system according to any one of the claims 1 to 4, wherein refrigerant pipe connection ports are arranged on the second lateral face for supplying the refrigerant to the plate heat exchanger from the compressor.
6. The outdoor unit for a heat pump system according to any one of the claims 1 to 5, wherein the plate heat exchanger is located at a predetermined distance from the rear plate, said predetermined distance being at most half of the distance between the front plate and the rear plate.

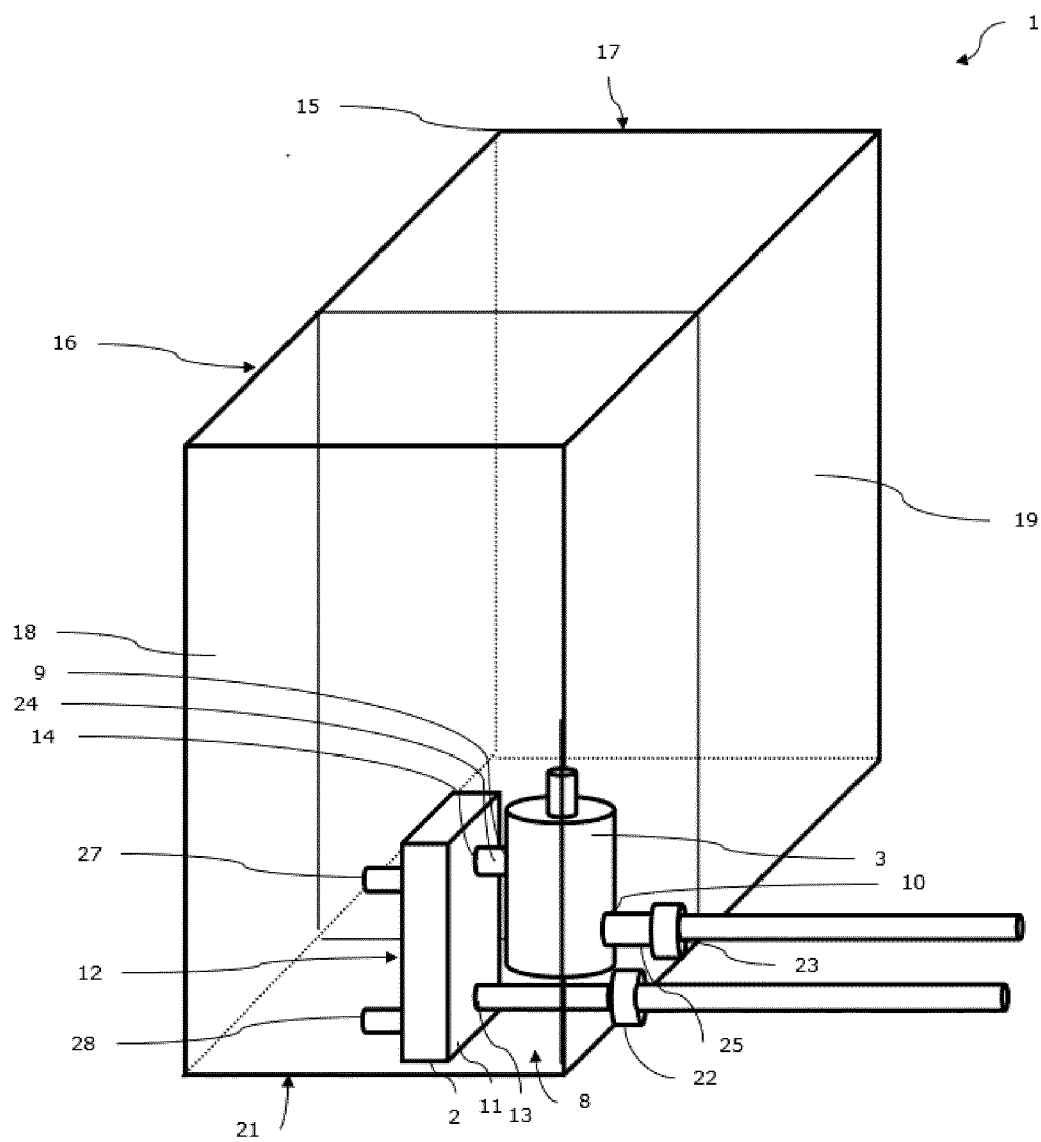


FIG. 1

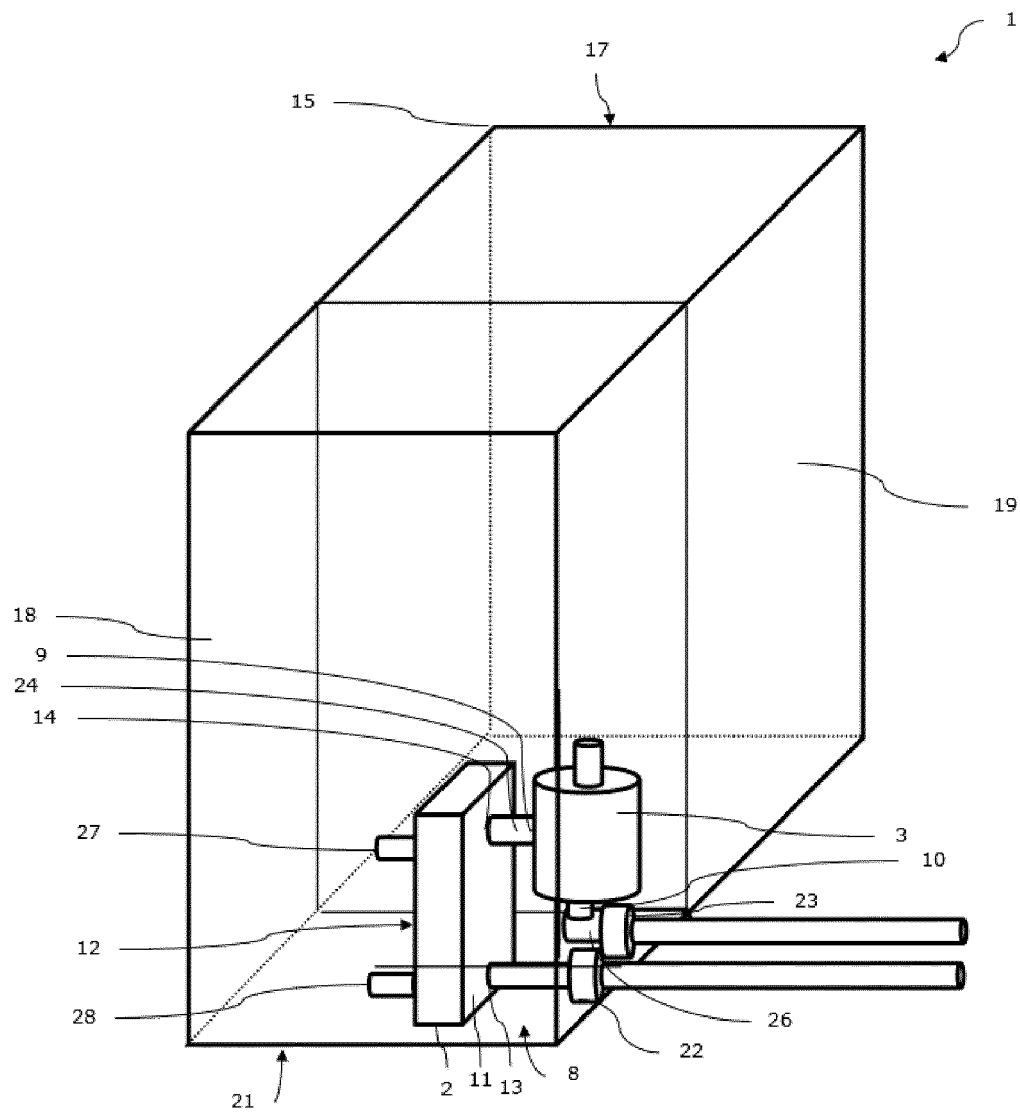


FIG. 2



EUROPEAN SEARCH REPORT

Application Number

EP 23 21 1368

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	EP 4 075 074 A1 (PANASONIC IP MAN CO LTD [JP]) 19 October 2022 (2022-10-19) * the whole document *	1-6	INV. F24F1/16 F24F1/46 F24F5/00 F25B13/00
A	EP 3 967 943 A1 (PANASONIC IP MAN CO LTD [JP]) 16 March 2022 (2022-03-16) * figure 1 *	1	
A	EP 4 047 288 A1 (PANASONIC IP MAN CO LTD [JP]) 24 August 2022 (2022-08-24) * figures 1,4 *	1	
			TECHNICAL FIELDS SEARCHED (IPC)
			F24F F25B
The present search report has been drawn up for all claims			
Place of search		Date of completion of the search	Examiner
Munich		16 April 2024	Blot, Pierre-Edouard
CATEGORY OF CITED DOCUMENTS			
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO.

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This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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16-04-2024

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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