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

(11) EP 3 081 875 A1

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

(43) Date of publication:
19.10.2016 Bulletin 2016/42

(21) Application number: **14869264.3**

(22) Date of filing: **06.10.2014**

(51) Int Cl.:
F24F 13/06 *(2006.01)* ***F24F 11/02*** *(2006.01)*
F24F 13/20 *(2006.01)*

(86) International application number:
PCT/JP2014/076657

(87) International publication number:
WO 2015/087606 (18.06.2015 Gazette 2015/24)

(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

(30) Priority: **13.12.2013 JP 2013257951**

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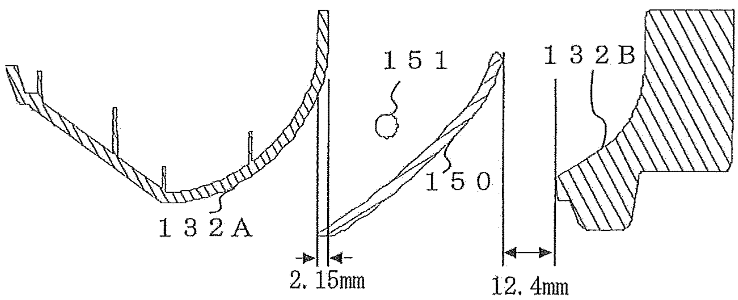
(54) INDOOR UNIT AND AIR CONDITIONING DEVICE

(57) An indoor unit 100 includes at least one air outlet 132 including an inner air-passage wall 132B and an outer air-passage wall 132A located outwardly of the inner air-passage wall 132B, and at least one outlet vane 150 disposed in the air outlet 132. The outlet vane 150 is rotated about a rotation axis 151 and deflects air blown from the air outlet 132 at an angle of rotation. While the indoor unit 100 is in an operating state, the outer air-passage wall 132A and the outlet vane 150 define therebetween an outer air passage through which the blown air passes, and the inner air-passage wall 132B and the outlet vane 150 define therebetween an inner air passage through which the blown air passes. The outlet vane 150 is rotatable to an upward position at which the outer air passage between the outer air-passage wall 132A and the outlet vane 150 is narrowed to have a higher air flow resistance than the inner air passage.

FIG. 2



Printed by Jouve, 75001 PARIS (FR)

Description

Technical Field

[0001] The present invention relates to, for example, an indoor unit included in, for example, an air-conditioning apparatus, and in particular, relates to air blowing (diffusing).

Background Art

[0002] A known indoor unit included in, for example, an air-conditioning apparatus, has a function of enabling outlet vanes (air flow direction louvers) of the indoor unit to be positioned at an angle beyond, for example, a normal position so that air (blown air) from the indoor unit is not directly blown to a human (see, for example, Patent Literature 1). At the angle beyond the normal position, end part of each outlet vane on a downstream side in an air flow direction (downstream end part) is located at a higher level or position (or closer to a ceiling) than at the normal position. In such a state, the blown air tends to flow more horizontally than a normal air flow direction.

Citation List

Patent Literature

[0003] Patent Literature 1: Japanese Unexamined Patent Application Publication No. 2011-075168 (Fig. 9, for example)

Summary of Invention

Technical Problem

[0004] As in the above-described related-art indoor unit of the air-conditioning apparatus, simply orienting the outlet vane upward relative to the normal position facilitates horizontal flowing of blown air. However, since the blown air flows along the ceiling, continued blowing at the orientation tends to cause smudging or staining of the ceiling.

[0005] The present invention has been made to overcome the above-described disadvantage and is directed to, for example, an indoor unit capable of reducing smudging, for example, if an outlet vane is moved to an upward position so that blown air is not directly applied to a human.

Solution to Problem

[0006] The present invention provides an indoor unit comprising: at least one air outlet having formed therein an inner air-passage wall and an outer air-passage wall located at outside of the inner air-passage wall; and at least one air flow direction louver disposed in the air outlet, the air flow direction louver being rotatable about a rotation axis and configured to deflect air blown from the air outlet by an angular position thereof in rotation, wherein while the indoor unit is in an operating state, the outer air-passage wall and the air flow direction louver define therebetween an outer air passage through which the blown air passes, and the inner air-passage wall and the air flow direction louver define therebetween an inner air passage through which the blown air passes, and the air flow direction louver is rotatable to an upward position, being the angular position, at which the outer air passage between the outer air-passage wall and the air flow direction louver is narrowed to have a higher air flow resistance than the inner air passage.

Advantageous Effects of Invention

[0007] The indoor unit according to the present invention allows the air flow direction louver to be moved to the upward position to achieve a comfortable operation such that air is not directly blown to a human. At the upward position, the outer air passage between the air flow direction louver and the outer air-passage wall is narrowed to have a higher air flow resistance than the inner air passage. This reduces the flow velocity and flow rate of the blown air flowing along a room wall, thus reducing smudging.

Brief Description of Drawings

[0008]

[Fig. 1] Fig. 1 is a vertical sectional view of an indoor unit 100 according to Embodiment 1 of the present invention.

[Fig. 2] Fig. 2 is a first sectional view illustrating the positional relationship between an air outlet 132 and an outlet vane 150 in Embodiment 1 of the present invention.

[Fig. 3] Fig. 3 is a second sectional view illustrating the positional relationship between the air outlet 132 and the outlet vane 150 in Embodiment 1 of the present invention.

[Fig. 4] Fig. 4 is a third sectional view illustrating the positional relationship between the air outlet 132 and the outlet vane 150 in Embodiment 1 of the present invention.

[Fig. 5] Fig. 5 shows an exterior of an indoor unit 100 according to Embodiment 2 of the present invention.

[Fig. 6] Fig. 6 is a diagram illustrating an exemplary configuration of an air-conditioning apparatus according to Embodiment 4 of the present invention.

Description of Embodiments

[0009] Heat exchangers according to Embodiments of the present invention will be described with reference to the drawings. Note that components designated by the same reference numerals in the drawings are the same components or equivalents. This applies to the entire description of following Embodiments. Furthermore, note that the forms of components described in the specification are intended to be illustrative only and are not intended to be limited to the descriptions. In particular, combination patterns of the components are not intended to be limited to those in Embodiments. A component in one Embodiment can be applied to another Embodiment. As used herein, the term "upward" or "upper" refers to the upward direction or upper part or level or side in the drawings and the term "downward" or "lower" refers to the downward direction or lower part or level in the drawings. Furthermore, note that the dimensional relationship among components in the drawings may differ from the actual one.

Embodiment 1

[0010] Fig. 1 is a vertical sectional view of an indoor unit 100 according to Embodiment 1 of the present invention. The indoor unit 100 according to Embodiment 1 has a ceiling-embedding structure that can be embedded or concealed in the ceiling of a room, and is also of a four-way cassette type having air outlets in four directions. The indoor unit 100 will now be described. The indoor unit 100 is connected to an outdoor unit by refrigerant pipes to form a refrigerant circuit through which refrigerant is circulated for, for example, refrigeration or air conditioning.

[0011] As illustrated in Fig. 1, the indoor unit 100 includes a casing 120 that includes a top panel 121 and a side panel 122. The indoor unit 100 is concealed in the ceiling of a room and is installed such that the top panel 121 is located at an upper side. The casing 120 itself opens to the room (or opens downward). Furthermore, a decorative panel 130, which is substantially rectangular in plan view, is attached to lower part of the indoor unit 100 such that the decorative panel 130 faces the room. The decorative panel 130 includes a grille 131 and a filter 140 at substantially center part of the decorative panel 130. The grille 131 serves as an air inlet through which air is taken into the indoor unit 100. The filter 140 removes dust from air passed through the grille 131.

[0012] The indoor unit 100 has a main-body air inlet 123, through which air is allowed to flow into the main body of the indoor unit 100, located at central part of a lower surface of the indoor unit 100. The indoor unit 100 further has a main-body air outlet 124, through which air is allowed to flow out of the main body, located around the main-body air inlet 123. The grille 131, the main-body air inlet 123, the main-body air outlet 124, and air outlets 132 communicate with one another, thus defining an air passage in the indoor unit 100.

[0013] The indoor unit 100 includes in the main body a turbo fan 170, a bell mouth 160, a fan motor 180, and an indoor heat exchanger 110. The turbo fan 170 is a centrifugal blower device having its rotation axis extending vertically. The turbo fan 170 blows air, sucked through the grille 131, laterally (lateral direction in Fig. 1) to produce a flow of air. Although the turbo fan 170 is used as an blower device in Embodiment 1, any other blower device, such as a sirocco fan or a radial fan, may be used in the present invention. Furthermore, the bell mouth 160 defines an inlet air passage for the turbo fan 170 and rectifies an air flow. The fan motor 180 rotates and drives the turbo fan 170.

[0014] The indoor heat exchanger 110 of, for example, a finned tube type is disposed downstream of the turbo fan 170 such that the indoor heat exchanger 110 surrounds the turbo fan 170. Assuming that the indoor unit 100 according to Embodiment 1 is included in, for example, an air-conditioning apparatus, the indoor heat exchanger 110 functions as an evaporator in a cooling operation and functions as a condenser in a heating operation.

[0015] The air outlets 132 are arranged at respective sides of the decorative panel 130 such that each of the air outlets 132 extends along the corresponding side. The indoor unit 100 according to Embodiment 1 has four air outlets 132. The indoor unit 100 further includes an outlet vane (flap) 150 disposed in each of the air outlets 132. The outlet vane 150 serves as an air flow direction louver that changes an air flow direction. Each outlet vane 150 is rotated or moved about a rotation axis 151 by driving of a motor (not illustrated), so that the outlet vane 150 is positioned.

[0016] The indoor unit 100 further includes a controller 190 configured to control operations of the components of the indoor unit 100. In Embodiment 1, the controller 190 drives and controls the motors connected to the outlet vanes 150 to position each of the outlet vanes 150.

[0017] Figs. 2 to 4 are sectional views illustrating the positional relationship between the air outlet 132 and the outlet vane 150 in Embodiment 1 of the present invention. Fig. 2 illustrates the positional relationship in a normal mode. Fig. 3 illustrates the positional relationship in a direct air-blowing avoidance mode in which an air flow (blown air) is not directly blown to a human. Fig. 4 illustrates the positional relationship in a non-operating state. The air outlet 132 includes an inner air-passage wall 132B adjacent to the grille 131 (or closer to the center of the indoor unit 100) and an outer air-passage wall 132A adjacent to an outer frame of the decorative panel 130 (or farther from the center of the indoor unit 100). The inner air-passage wall 132B and the outlet vane 150 define therebetween an inner air passage through which the blown air passes. The outer air-passage wall 132A and the outlet vane 150 define therebetween an outer air passage through which the blown air passes.

[0018] The indoor unit 100 according to Embodiment 1 is configured such that end part (downstream end part) of the outlet vane 150 located on a downstream side in a flow direction of the blown air overlaps the outer air-passage wall 132A when the indoor unit 100 is viewed from below. For example, when operation of the indoor unit 100 is stopped and the outlet vane 150 is turned to a substantially horizontal position, the outlet vane 150 does not completely close the air outlet 132 such that the outlet vane 150 and the inner air-passage wall 132B form a clearance therebetween. For example, in Fig. 4, a clearance of approximately 8.73 mm is left between the outlet vane 150 and the inner air-passage wall 132B. In contrast to the rotation axis in the related-art indoor unit, the rotation axis 151 of the outlet vane 150 is accordingly located closer to the outer air-passage wall 132A.

[0019] Referring to Fig. 2, the outlet vane 150 overlaps the outer air-passage wall 132A by a small extent (for example, approximately 2.15 mm) in the positional relationship between the air outlet 132 and the outlet vane 150 in the normal mode. In addition, the clearance between the outlet vane 150 and the inner air-passage wall 132B is the largest (for example, approximately 12.4 mm). This results in a low air flow resistance, thus facilitating flowing of the blown air.

[0020] Referring to Fig. 3, when the outlet vane 150 overlaps the outer air-passage wall 132A by a large extent (for example, approximately 8.28 mm), the outer air passage between the outlet vane 150 and the outer air-passage wall 132A is narrowed, thus increasing the air flow resistance. This reduces the flow velocity of the blown air flowing along the ceiling. On the other hand, the inner air passage between the outlet vane 150 and the inner air-passage wall 132B is left (by approximately 9.22 mm, for example) without being closed, thus allowing the blown air to flow through the inner air passage.

[0021] An operation for direct air-blowing avoidance in the indoor unit 100 according to Embodiment 1 will now be described. For example, when receiving a signal indicative of a direct air-blowing avoidance instruction from a remote control or other similar devices, the controller 190 determines, based on instruction information contained in the signal, which outlet vane 150 of the outlet vanes 150 included in the indoor unit 100 is to be moved. The controller 190 then permits the determined outlet vane 150 to be moved to a position (at which direct air-blowing avoidance is achieved; hereinafter, referred to as an "upward position") at a predetermined angle at which air flows substantially horizontally (upwardly) as compared with the air flow direction provided by the outlet vane 150 in the normal mode. In this process, an edge (outer edge) of the outlet vane 150 is moved upward relative to that in the normal mode, so that the outer edge comes close to the outer air-passage wall 132A.

[0022] Consequently, part of the outlet vane 150 overlapping the outer air-passage wall 132A is increased, and the outer air passage is accordingly narrowed. Thus, the flow velocity and flow rate of the blown air through the outer air passage between the outlet vane 150 and the outer air-passage wall 132A are reduced, so that the blown air is less likely to flow along the ceiling and the air flow is reduced. This results in a reduction in area of the air flow along the ceiling. Since the inner air passage is defined between the outlet vane 150 and the inner air-passage wall 132B in Embodiment 1, the blown air is further less likely to flow through the outer air passage between the outlet vane 150 and the outer air-passage wall 132A. Consequently, smudging can be reduced.

[0023] The blown air passing through the inner air passage between the outlet vane 150 and the inner air-passage wall 132B also flows in the vicinity of a design surface (facing the room) of the outlet vane 150. Assuming that the air-conditioning apparatus is performing the cooling operation, therefore, room air warmer than the blown air will not contact the outlet vane 150. Consequently, the room air can be prevented from being cooled by the outlet vane 150 (in particular, the design surface thereof) upon coming into contact with the outlet vane 150, thus preventing condensation on the outlet vane 150. Furthermore, part of the blown air passing through the inner air passage between the outlet vane 150 and the inner air-passage wall 132B flows through the grille 131 into the indoor unit 100. Consequently, the blown air is not directly blown to a human, thus achieving comfort.

[0024] As described above, when the outlet vane 150 is at the upward position, the air flow resistance in the air outlet 132 increases. If the turbo fan 170 (fan motor 180) is continuously driven with a high air flow resistance, a load would increase. In Embodiment 1, therefore, the indoor unit 100 inhibits all of the (four in Embodiment 1) outlet vanes 150 from being at the upward position at the same time. When the controller 190 determines that direct air-blowing avoidance instructions are given in association with more than a predetermined number of outlet vanes 150, the controller 190 allows a display unit included in, for example, the remote control to display a message indicative of failed direct air-blowing avoidance.

[0025] Being at the upward position of the outlet vane 150 reduces the flow rate of blown air, resulting in a reduction in temperature of the blown air. This makes condensation more likely to form. The indoor unit 100, therefore, may inhibit all of the outlet vanes 150 from being simultaneously located at the upward position.

[0026] As described above, when the outlet vane 150 is at the upward position, the air flow resistance in the air outlet 132 increases. When the controller 190 receives a signal indicative of a direct air-blowing avoidance instruction, for example, the controller 190 may reduce the rotation speed of the turbo fan 170 (fan motor 180) to regulate the air flow rate. If, for example, an instruction can be given to a compressor included in an outdoor unit, for example, the controller 190 may reduce the rotation speed of the compressor in the refrigerant circuit to regulate a supply capacity.

[0027] As described above, the indoor unit 100 according to Embodiment 1 allows a designated outlet vane 150 to be at the upward position, thus achieving a comfortable operation in which air is not directly blown to a human. At the upward position, part of the outlet vane 150 overlapping the outer air-passage wall 132A is increased, and the outer air passage is accordingly narrowed. The flow velocity and flow rate of the blown air through the outer air passage between the outlet vane 150 and the outer air-passage wall 132A are reduced, so that the flow of the blown air is reduced. This results in a reduction in area of the blown air flow along the ceiling. In addition, a large amount of blown air flows through the inner air passage defined between the outlet vane 150 and the inner air-passage wall 132B. Thus, smudging can be reduced. Additionally, since the blown air through the inner air passage between the outlet vane 150 and the inner air-passage wall 132B flows in the vicinity of the design surface of the outlet vane 150, the room air does not come into contact with the outlet vane 150. This can prevent condensation from forming on the outlet vane 150.

[0028] In addition, inhibiting more than a predetermined number of outlet vanes 150 of the indoor unit 100 from being simultaneously located at the upward position can eliminate, for example, an increase in load on the turbo fan 170 (fan motor 180). This can prevent damage to the turbo fan 170 (fan motor 180), thus increasing reliability.

Embodiment 2

[0029] Fig. 5 is a perspective view of an indoor unit 100 according to Embodiment 2 of the present invention. In Fig. 5, components designated by the same reference numerals as those in Figs. 1 to 4 operate or act in a manner similar to those described in Embodiment 1. In Fig. 5, a human presence sensor 191 is a sensor (detector) detecting the presence or absence of an occupant or human in, for example, a room.

[0030] The controller 190 controls the components in the indoor unit 100. In Embodiment 2, the controller 190 determines, based on a signal transmitted from the human presence sensor 191, the presence or absence of a human. When determining the presence of a human, the controller 190 determines the position of the human. The controller 190 determines, based on the determined position, an outlet vane 150 to be moved, adjusts the angle of the outlet vane 150, and permits the outlet vane 150 to be moved (rotated) to the upward position.

[0031] In Embodiment 1 described above, a designated outlet vane 150 of the four outlet vanes 150 of the indoor unit 100 is moved to the upward position in accordance with a signal indicative of a direct air-blowing avoidance instruction transmitted from the remote control. The indoor unit 100 according to Embodiment 2 includes the human presence sensor 191. The controller 190 automatically determines an outlet vane 150 to be moved to the upward position in accordance with a result of detection by the human presence sensor 191, and controls the position of the outlet vane 150 to avoid direct air application.

[0032] Data associated with each of the outlet vanes 150 and indicative of a defined area where air blown through the outlet vane 150 is directly applied to a human is stored in a storage unit (not illustrated) included in, for example, the controller 190. The controller 190 determines the position of a human in accordance with a result of detection by the human presence sensor 191. When determining that the human is located in an area where blown air is directly applied to the human, the controller 190 permits the outlet vane 150 corresponding to the area to be moved to the upward position.

[0033] As described in Embodiment 1, if the number of outlet vanes 150 at the upward position exceeds the predetermined number by moving the corresponding outlet vane 150 to the upward position, the corresponding outlet vane 150 is inhibited from moving to the upward position.

[0034] As described above, the indoor unit 100 according to Embodiment 2 includes the human presence sensor 191, and the controller 190 permits an outlet vane 150 determined in accordance with a result of detection by the human presence sensor 191 to be moved to the upward position. Thus, direct air-blowing avoidance can be automatically accomplished. A comfortable space can be achieved without, for example, making a human aware of direct air-blowing avoidance.

Embodiment 3

[0035] In Embodiments 1 and 2, any of the outlet vanes 150 is moved to avoid direct air application. This movement is not limited to that for direct air-blowing avoidance. For example, in the four-way cassette type indoor unit 100, air blown from a certain air outlet 132 may interfere with air blown from a neighboring air outlet 132. This interference may cause, for example, uneven room temperature distribution. The outlet vane 150 in one of these air outlets 132 can be moved to eliminate the interference between blown air flows.

Embodiment 4

[0036] Fig. 6 is a diagram illustrating an exemplary configuration of an air-conditioning apparatus according to Embodiment 4 of the present invention. Fig. 6 illustrates the air-conditioning apparatus as an example of a refrigeration cycle apparatus. In Fig. 6, the components described with reference to, for example, Fig. 1 operate or function in a manner similar to those described above. The air-conditioning apparatus of Fig. 6 includes an outdoor unit 200 and an indoor unit 100 connected by a gas refrigerant pipe 300 and a liquid refrigerant pipe 400. The outdoor unit 200 includes a compressor 210, a four-way valve 220, an outdoor heat exchanger 230, and an expansion valve 240.

[0037] The compressor 210 compresses sucked refrigerant and discharges the refrigerant. The compressor 210 may be, but not limited to, capable of changing its operation frequency to any value by using, for example, an inverter circuit, to change the capacity (amount of refrigerant sent per unit time) of the compressor 210. The four-way valve 220 is a valve switching between, for example, a refrigerant flow direction in the cooling operation and a refrigerant flow direction in the heating operation.

[0038] The outdoor heat exchanger 230 in Embodiment 4 exchanges heat between the refrigerant and air (outdoor air). For example, the outdoor heat exchanger 230 functions as an evaporator in the heating operation to evaporate and gasify the refrigerant, and functions as a condenser in the cooling operation to condense and gasify the refrigerant.

[0039] The expansion valve 240, such as an expansion device (flow control device), reduces the pressure of the refrigerant to expand the refrigerant. For example, when the expansion valve 240 is an electronic expansion valve, the opening degree of the expansion valve 240 is controlled in accordance with an instruction from, for example, the above-described controller 190. The indoor heat exchanger 110 exchanges heat between the refrigerant and, for example, air to be conditioned. The indoor heat exchanger 110 functions as a condenser in the heating operation to condense and liquefy the refrigerant, and functions as an evaporator in the cooling operation to evaporate and gasify the refrigerant.

[0040] First, a refrigerant flow in the cooling operation in the refrigeration cycle apparatus will be described. In the cooling operation, the four-way valve 220 is switched to provide a connection indicated by full lines. High temperature, high pressure gas refrigerant, compressed and discharged by the compressor 210, passes through the four-way valve 220 and flows into the outdoor heat exchanger 230. While passing through the outdoor heat exchanger 230, the refrigerant exchanges heat with outdoor air, and thus condenses and liquefies. The condensed and liquefied refrigerant (liquid refrigerant) flows into the expansion valve 240. The pressure of the refrigerant is reduced by the expansion valve 240, so that the refrigerant turns into two-phase gas-liquid refrigerant. The refrigerant then flows out of the outdoor unit 200.

[0041] The two-phase gas-liquid refrigerant that has flowed out of the outdoor unit 200 passes through the liquid refrigerant pipe 400 and flows into the indoor unit 100. The refrigerant is distributed by a distributor and flow control capillary tubes (not illustrated) and then flows into the indoor heat exchanger 110. As described above, while passing through the indoor heat exchanger 110, the refrigerant exchanges heat with, for example, air to be conditioned, and thus evaporates and gasifies. The evaporated and gasified refrigerant (gas refrigerant) then flows out of the indoor unit 100.

[0042] The gas refrigerant that has flowed out of the indoor unit 100 passes through the gas refrigerant pipe 300 and flows into the outdoor unit 200. The refrigerant passes through the four-way valve 220 and is again sucked into the compressor 210. The refrigerant is circulated through the air-conditioning apparatus in the above-described manner, thus achieving air conditioning (cooling).

[0043] Next, a refrigerant flow in the heating operation will be described. In the heating operation, the four-way valve 220 is switched to provide a connection indicated by dotted lines. High temperature, high pressure gas refrigerant, compressed and discharged by the compressor 210, passes through the four-way valve 220 and flows out of the outdoor unit 200. The gas refrigerant that has flowed out of the outdoor unit 200 passes through the gas refrigerant pipe 300 and flows into the indoor unit 100.

[0044] While passing through the indoor heat exchanger 110, the refrigerant exchanges heat with, for example, air to be conditioned, and thus condenses and liquefies. The refrigerant passes through the distributor and the flow control capillary tubes (not illustrated) and then flows out of the indoor unit 100.

[0045] The refrigerant that has flowed out of the indoor unit 100 passes through the liquid refrigerant pipe 400 and flows into the outdoor unit 200. The pressure of the refrigerant is reduced by the expansion valve 240, so that the refrigerant turns into two-phase gas-liquid refrigerant. The refrigerant then flows into the outdoor heat exchanger 230. While passing through the outdoor heat exchanger 230, the refrigerant exchanges heat with outdoor air, and thus evaporates and gasifies. The evaporated and gasified (liquid refrigerant) passes through the four-way valve 220 and is again sucked into the compressor 210. The refrigerant is circulated through the air-conditioning apparatus in the above-described manner, thus achieving air conditioning (heating).

[0046] As described above, the air-conditioning apparatus (refrigeration cycle apparatus) according to Embodiment 4 includes the above-described indoor unit 100, and can accordingly achieve direct air-blowing avoidance and reduce smudging.

Industrial Applicability

[0047] In Embodiments 1 to 4 described above, the indoor unit 100 has the four air outlets 132 and the four outlet vanes 150, namely, it is of the four-way cassette type that blows air in four ways. In addition, the present invention can be applied to any other ceiling concealed indoor unit for producing, for example, two-way or three-way air flows. In addition to the ceiling concealed indoor units, the present invention can be applied to any other type of indoor unit. In addition to smudging on a ceiling, therefore, smudging on any indoor wall other than the ceiling can be reduced by appropriately installing the indoor unit. Furthermore, any number of air outlets 132 and any number of outlet vanes 150 may be arranged.

[0048] In Embodiments 1 to 4 described above, the air-conditioning apparatus has been described as an example of a refrigeration cycle apparatus. In addition, the present invention can be applied to any other refrigeration cycle apparatus, such as a refrigerator or a freezer. In addition to the refrigeration cycle apparatus, the present invention can be applied to, for example, an blower device and a ventilating device.

Reference Signs List

[0049] 100: indoor unit; 110: indoor heat exchanger; 120: housing; 121: top panel; 122: side plate; 123: main-body air inlet; 124: main-body air outlet; 130: decorative panel; 131: grille; 132: air outlet; 132A: outer air-passage wall; 132B: inner air-passage wall; 140: filter; 150: outlet vane; 151: rotation axis; 160: bell mouth; 170: turbo fan; 180: fan motor; 190: controller; 191: human presence sensor; 200: outdoor unit; 210: compressor; 220: four-way valve; 230: outdoor heat exchanger; 240: expansion valve; 300: gas refrigerant pipe; and 400: liquid refrigerant pipe.

Claims

1. An indoor unit comprising:

   at least one air outlet having formed therein an inner air-passage wall and an outer air-passage wall located at outside of the inner air-passage wall; and
   at least one air flow direction louver disposed in the air outlet, the air flow direction louver being rotatable about a rotation axis and configured to deflect air blown from the air outlet by an angular position thereof in rotation, wherein
   while the indoor unit is in an operating state, the outer air-passage wall and the air flow direction louver define therebetween an outer air passage through which the blown air passes, and the inner air-passage wall and the air flow direction louver define therebetween an inner air passage through which the blown air passes, and
   the air flow direction louver is rotatable to an upward position, being the angular position, at which the outer air passage between the outer air-passage wall and the air flow direction louver is narrowed to have a higher air flow resistance than the inner air passage.

2. The indoor unit of claim 1, wherein
   the at least one air outlet includes a plurality of air outlets and the at least one air flow direction louver includes a plurality of air flow direction louvers,
   the indoor unit being configured to limit a number of the air flow direction louvers being at the upward position at a same time.

3. The indoor unit of claim 1 or 2, wherein while the indoor unit is in a non-operating state, the air flow direction louver and the inner air-passage wall form a clearance therebetween.

4. The indoor unit of any one of claims 1 to 3, wherein the at least one air outlet includes a plurality of air outlets and the at least one air flow direction louver includes a plurality of air flow direction louvers, and the indoor unit further includes

   a human presence sensor configured to detect a presence or absence of a human, and when detecting the presence of a human, detecting a position of the human, and
   a controller configured to determine at least one air flow direction louver to be at the upward position of the air flow direction louvers in accordance with a result of detection by the human presence sensor.

5. The indoor unit of any one of claims 1 to 4, wherein the indoor unit has a ceiling-embedding structure configured to be concealed and installed in a ceiling of a room.

6. An air-conditioning apparatus comprising:

   the indoor unit of any one of claims 1 to 5;
   an outdoor unit, and
   a refrigerant circuit including

   a compressor configured to compress and discharge refrigerant and included in the outdoor unit,
   a condenser configured to cause the refrigerant to condense by heat exchange,
   an expansion device configured to reduce a pressure of the condensed refrigerant, and
   an evaporator configured to exchange heat between the pressure-reduced refrigerant and air to cause the refrigerant to evaporate,
   the compressor, the condenser, the expansion device and the evaporator being connected by pipes and provided to the indoor unit or the outdoor unit.

FIG. 1

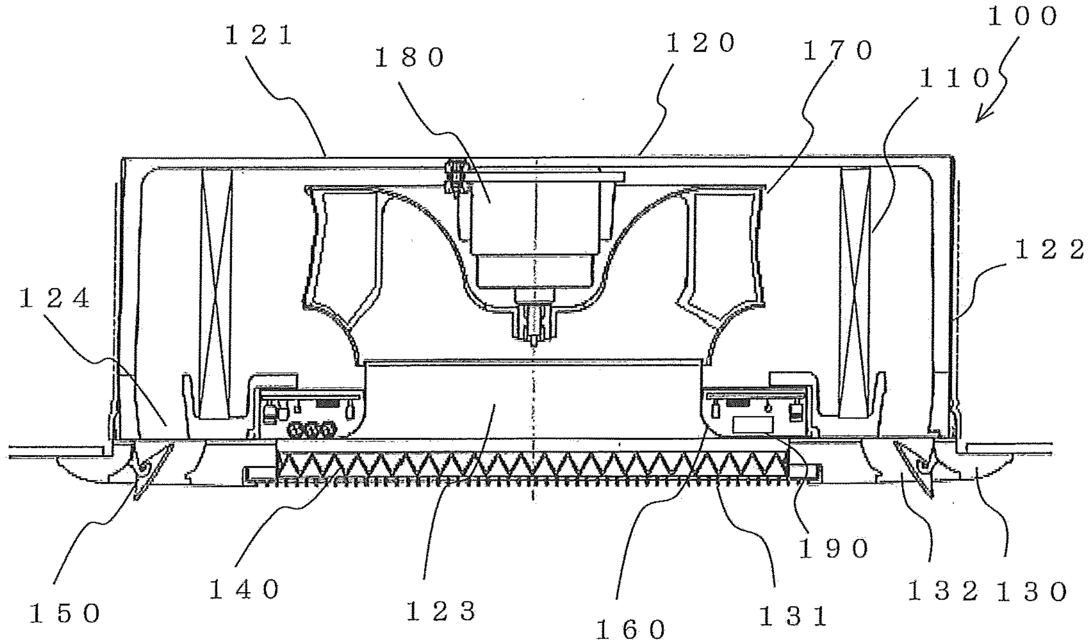

100
121
180
120
170
110
122
124
150
140
123
160
131
190
132
130

FIG. 2

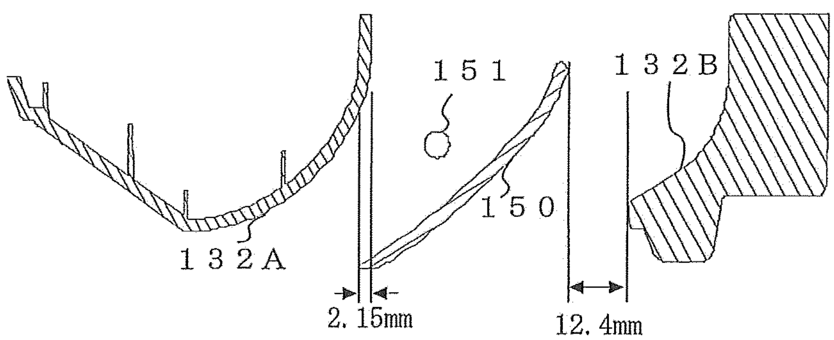

151
132B
150
132A
2.15mm
12.4mm

FIG. 3

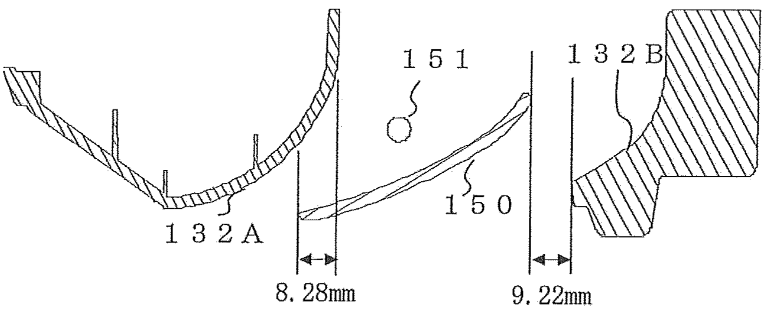


FIG. 4

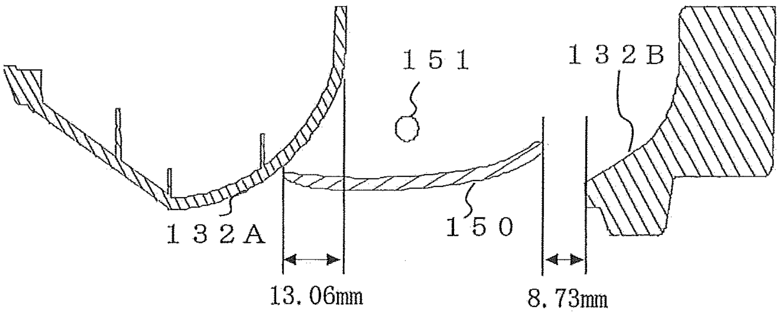


FIG. 5

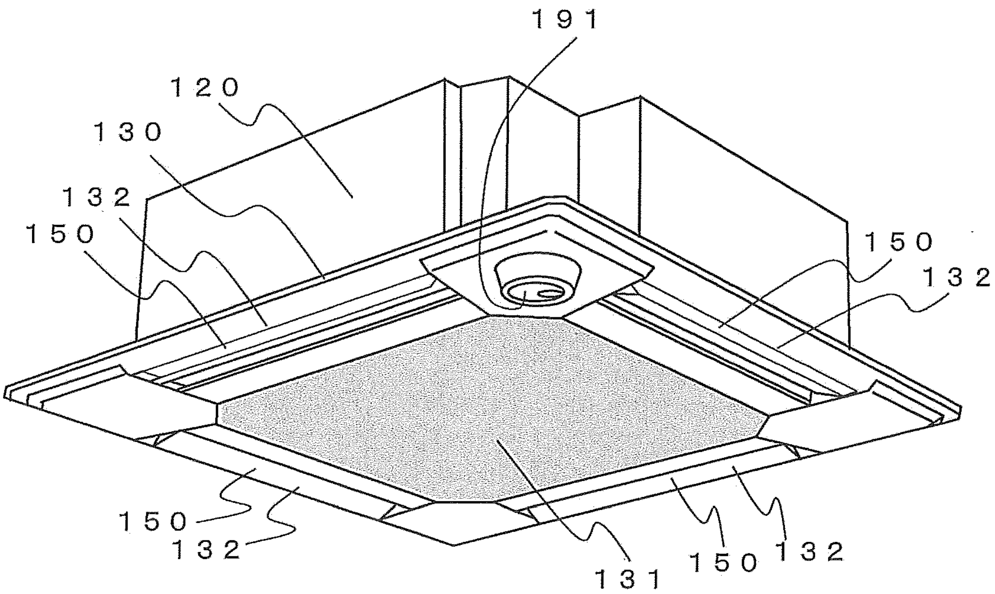
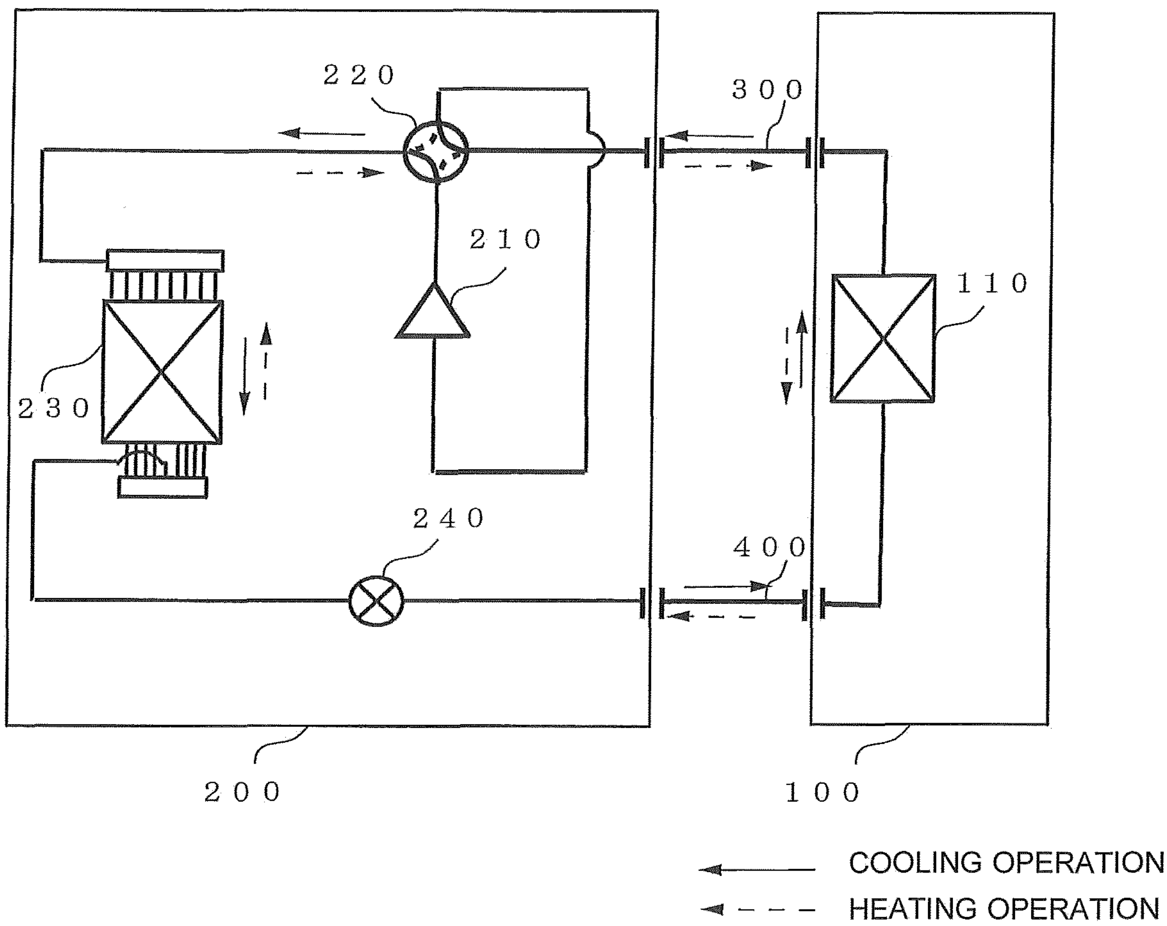


FIG. 6


2 2 0
3 0 0
2 1 0
1 1 0
2 3 0
2 4 0
4 0 0
2 0 0
1 0 0
COOLING OPERATION
HEATING OPERATION

INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/076657

A. CLASSIFICATION OF SUBJECT MATTER
F24F13/06(2006.01)i, *F24F11/02*(2006.01)i, *F24F13/20*(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)
F24F13/06, F24F11/02, F24F13/20

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

Jitsuyo Shinan Koho	1922-1996	Jitsuyo Shinan Toroku Koho	1996-2014
Kokai Jitsuyo Shinan Koho	1971-2014	Toroku Jitsuyo Shinan Koho	1994-2014

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.
X Y	JP 10-325595 A (Hitachi, Ltd.), 08 December 1998 (08.12.1998), paragraphs [0012] to [0027]; fig. 1 to 5 (Family: none)	1,5-6 2-4
X Y	JP 08-313042 A (Daikin Industries, Ltd.), 29 November 1996 (29.11.1996), paragraphs [0030] to [0046]; fig. 1 to 7 (Family: none)	1,5-6 2-4
Y	JP 2011-080686 A (Panasonic Corp.), 21 April 2011 (21.04.2011), claims; fig. 1 & WO 2011/043038 A1 & CN 102575866 A & KR 10-2012-0093201 A	2-4

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

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Date of the actual completion of the international search	Date of mailing of the international search report
12 December, 2014 (12.12.14)	22 December, 2014 (22.12.14)

Name and mailing address of the ISA/	Authorized officer
Japanese Patent Office	
Facsimile No.	Telephone No.

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP2014/076657

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 11-237076 A (Fujitsu General Ltd.), 31 August 1999 (31.08.1999), paragraph [0020]; fig. 4 (Family: none)	3
Y	JP 2013-104599 A (Sharp Corp.), 30 May 2013 (30.05.2013), paragraph [0052]; fig. 7 (Family: none)	3
A	JP 11-325573 A (Mitsubishi Heavy Industries, Ltd.), 26 November 1999 (26.11.1999), entire text; all drawings (Family: none)	1

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REFERENCES CITED IN THE DESCRIPTION

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- JP 2011075168 A **[0003]**