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

(11) EP 3 048 375 A1

(12) # EUROPEAN PATENT APPLICATION

published in accordance with Art. 153(4) EPC

(43) Date of publication:
27.07.2016 Bulletin 2016/30

(21) Application number: **13893750.3**

(22) Date of filing: **17.09.2013**

(51) Int Cl.:
F24F 1/00 (2011.01) ***F24F 13/32*** (2006.01)

(86) International application number:
PCT/JP2013/075016

(87) International publication number:
WO 2015/040668 (26.03.2015 Gazette 2015/12)

(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

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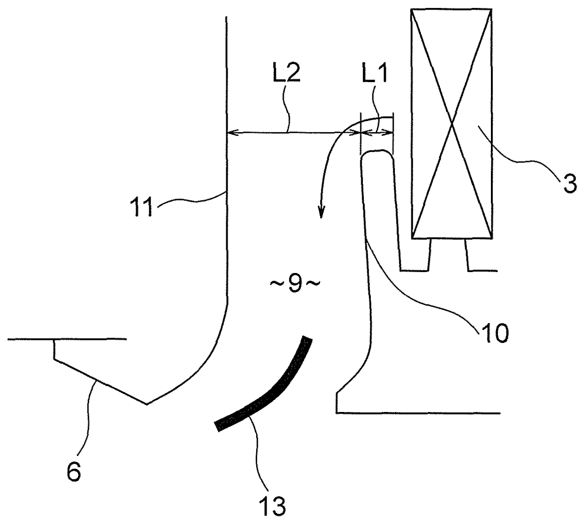
(54) **AIR CONDITIONER**

(57) Provided is an air conditioning apparatus, including: a main body (20) having at least one air inlet and at least one air outlet (9) each being formed at a lower part of the main body; and a heat exchanger (3) housed inside the main body and arranged in a flow passage of air to be sucked into the main body through the air inlet and blown out to a target space through the air outlet. The air outlet is formed between a heat exchanger outlet-side air duct wall (10) and an opposing air duct wall (11), which is opposed to the heat exchanger outlet-side air duct wall. A thickness (L1) of the heat exchanger outlet-side air duct wall is 0.15L2 to 0.25L2, where L2 represents an inlet width of the air outlet.

FIG. 2



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Description

Technical Field

[0001] The present invention relates to an air conditioning apparatus.

Background Art

[0002] As a ceiling-concealed air conditioning apparatus of the related art, for example, an air conditioning apparatus disclosed in Patent Literature 1 is known. In this air conditioning apparatus, an airflow direction adjusting member having a flattened lower surface is arranged at an air outlet, and a convex surface is formed at an air blower-side upper end of an air duct wall that defines an air outlet channel at an upstream side of the air outlet.

Citation List

Patent Literature

[0003] [PTL 1] JP 2012-251676 A (FIG. 1)

Summary of Invention

Technical Problem

[0004] In the ceiling-concealed air conditioning apparatus of the related art, however, there is a problem in that the airflow rate may be insufficient and noise may be generated due to the airflow resistance caused at the air outlet. As one factor of this problem, for example, the air current may be separated at an inlet portion of the air outlet when the air passing through a heat exchanger is caused to flow into the air outlet. That is, when the air current is separated, the airflow resistance is increased, thereby causing decrease in airflow rate and increase in noise.

[0005] Further, to address such a problem, in the above-mentioned air conditioning apparatus disclosed in Patent Literature 1, the shape of the air duct wall is merely devised, but no further consideration is given so as to secure the airflow rate and reduce the noise.

[0006] The present invention has been made in view of the above-mentioned circumstances, and it is therefore an object of the present invention to provide an air conditioning apparatus capable of suppressing increase in airflow resistance, thereby being capable of securing a sufficient airflow rate and reducing noise.

Solution to Problem

[0007] In order to achieve the above-mentioned object, according to one embodiment of the present invention, there is provided an air conditioning apparatus, including: a main body having at least one air inlet and at least one air outlet each being formed at a lower part of the main body; and a heat exchanger housed inside the main body and arranged in a flow passage of air to be sucked into the main body through the air inlet and blown out to a target space through the air outlet, in which the air outlet is formed between a heat exchanger outlet-side air duct wall and an opposing air duct wall, which is opposed to the heat exchanger outlet-side air duct wall, and in which a thickness L1 of the heat exchanger outlet-side air duct wall is 0.15L2 to 0.25L2, where L2 represents an inlet width of the air outlet.

[0008] An upper end of the heat exchanger outlet-side air duct wall may include, in an air outlet-side region thereof, a curved surface portion formed of a curved surface, which is convex toward an air duct side. A range L3 of the curved surface portion in a thickness direction may be equal to or larger than 0.4L1.

[0009] An upper end of the heat exchanger outlet-side air duct wall may include a curved surface portion and a flat surface portion. The curved surface portion may be formed of a curved surface, which is convex toward an air duct side, and be positioned at the upper end of the heat exchanger outlet-side air duct wall, which is close to a center portion of the air outlet. The flat surface portion may be positioned at the upper end of the heat exchanger outlet-side air duct wall, which is closer to the heat exchanger than the curved surface portion.

[0010] The heat exchanger outlet-side air duct wall may include a curved surface portion and a flat surface port ion . The curved surf ace portion may be formed of a curved surface, which is convex toward an air duct side, and be positioned at an upper end of the heat exchanger outlet-side air duct wall. The flat surface portion may be positioned closer to a center portion of the air outlet than the curved surface portion, and be positioned at an end of an upstream side of the heat exchanger outlet-side air duct wall in a region opposed to the opposing air duct wall.

[0011] A part of the curved surface portion, which is positioned at each end portion of the heat exchanger outlet-side air duct wall in a longitudinal direction, may be larger than a part of the curved surface portion, which is positioned at a center portion of the heat exchanger outlet-side air duct wall in the longitudinal direction.

[0012] The heat exchanger outlet-side air duct wall may include a stepped portion. The stepped portion may be positioned at the heat exchanger outlet-side air duct wall in a region opposed to the opposing air duct wall. A region below the stepped portion of the heat exchanger outlet-side air duct wall may be concave away from the opposing air duct wall.

[0013] A distance L5 between the heat exchanger outlet-side air duct wall and the heat exchanger may be smaller than the thickness L1 of the heat exchanger outlet-side air duct wall.

[0014] A thickness L1' of the heat exchanger outlet-side air duct wall at the each end portion in the longitudinal direction may be larger than the thickness L1 of the heat exchanger outlet-side air duct wall at the center portion in the longitudinal direction.

Advantageous Effects of Invention

[0015] According to the one embodiment of the present invention, it is possible to suppress increase in airflow resistance, to thereby secure a sufficient airflow rate and reduce noise.

Brief Description of Drawings

[0016]

FIG. 1 is a side view illustrating an internal structure of an air conditioning apparatus according to a first embodiment of the present invention.
FIG. 2 is a side view illustrating an air outlet of the air conditioning apparatus according to the first embodiment.
FIG. 3 is a graph showing characteristics of a change in airflow rate with respect to L1/L2 in the air conditioning apparatus according to the first embodiment.
FIG. 4 is a view illustrating a second embodiment of the present invention in the same manner as that of FIG. 2.
FIG. 5 is a graph showing characteristics of a change in airflow rate with respect to L3/L1 in an air conditioning apparatus according to the second embodiment.
FIG. 6 is a view illustrating a third embodiment of the present invention in the same manner as that of FIG. 2.
FIG. 7 is a view illustrating a fourth embodiment of the present invention in the same manner as that of FIG. 2.
FIG. 8 is a view illustrating a fifth embodiment of the present invention in the same manner as that of FIG. 2.
FIG. 9 is a view illustrating a sixth embodiment of the present invention in the same manner as that of FIG. 2.
FIG. 10 is a top view illustrating an air outlet of an air conditioning apparatus according to a seventh embodiment of the present invention.

Description of Embodiments

[0017] Now, an air conditioning apparatus according to embodiments of the present invention is described with reference to the accompanying drawings. Note that, in the drawings, the same reference symbols represent the same or corresponding parts.

First Embodiment

[0018] FIG. 1 is a schematic side view illustrating an internal structure of an air conditioning apparatus according to a first embodiment of the present invention. More specifically, the air conditioning apparatus according to the first embodiment corresponds to an indoor unit of a so-called package air conditioner. FIG. 1 illustrates a state in which a principal part of a main body of the air conditioning apparatus is embedded in a ceiling of a room and a lower part of the main body faces the inside of the room.

[0019] The ceiling-concealed air conditioning apparatus includes a main body 20 and a heat exchanger 3. The main body 20 of the air conditioning apparatus is embedded at a back side of a ceiling surface 15 of the room (opposite side to the room) being a target space.

[0020] As one example, in the first embodiment, the main body 20 includes a main-body top panel 5 having a rectangular shape in plan view, and four main-body side panels 4 extending downward from four sides of the main-body top panel 5. In other words, the main body 20 is such a casing that an upper end surface of a rectangular tube body defined by the four main-body side panels 4 is closed by the main-body top panel 5.

[0021] At the lower part of the main body, namely, at an opened lower end surface of the above-mentioned casing, a decorative panel 6 is mounted on the main body in a freely removable manner. As illustrated in FIG. 1, the main-body top panel 5 is positioned above the ceiling surface 15, whereas the decorative panel 6 is positioned substantially flush with the ceiling surface 15.

[0022] Further, the main body 20 of the air conditioning apparatus has at least one air inlet and at least one air outlet 9. In the vicinity of a center of the decorative panel 6, a suction grille 7 is provided as the inlet of air into the main body. A filter 8 for removing dust in the air passing through the suction grille 7 is provided at an inner side of the suction grille 7.

[0023] As one example, in the first embodiment, the decorative panel 6 and the suction grille 7 each have a rectangular outer edge in plan view.

[0024] In a region between the outer edge of the decorative panel 6 and the outer edge of the suction grille 7, a plurality of air outlets 9 are formed as the outlets of the air. In the first embodiment, four air outlets 9 are formed in accordance with the structure in which the decorative panel 15 and the suction grille 7 each have the outer edge along four sides thereof, and the respective air outlets 9 are arranged so as to extend along the corresponding sides of the decorative panel 6 and the suction grille 7. Further, the four air outlets 9 are positioned so as to surround the suction grille 7. An airflow direction flap 13 for adjusting a direction of the air to be blown out is provided at each air outlet 9.

[0025] A fan motor 2 is arranged at a center portion of the inside of the main body. The fan motor 2 is supported by a lower surface of the main-body top panel 5 (at an inner space side of the main body). A turbofan 1 serving as an air blowing section is fixed to a rotational shaft of the fan motor 2 , which extends downward. Further, a bellmouth 14 that defines a suction air duct extending from the suction grille 7 toward the turbofan 1 is provided between the turbofan 1 and the suction grille 7. The turbofan 1 sucks the air into the main body through the suction grille 7, and causes the air to flow out to an inside 17 of the room being the target space through the air outlet 9.

[0026] The heat exchanger 3 is arranged at a radially outer side of the turbofan 1. In other words, the heat exchanger 3 is housed inside the main body 20, in particular, arranged in a flow passage of the air to be sucked into the main body 20 through the air inlet (suction grille 7) and blown out to the target space through the air outlet 9, to thereby exchange heat between the air and a refrigerant.

[0027] The heat exchanger 3 includes a plurality of fins arranged at predetermined intervals in a horizontal direction, and heat transfer pipes passing through the fins. The heat transfer pipes are connected to a known outdoor unit (not shown) through a connection pipe so that a cooled or heated refrigerant is supplied to the heat exchanger 3. Note that, the structures and shapes of the turbofan 1, the bellmouth 14, and the heat exchanger 3 are not particularly limited, but known structures and shapes are employed in the first embodiment.

[0028] In this structure, when the turbofan 1 is rotated, the air in the inside 17 of the room is sucked into the suction grille 7 of the decorative panel 6. Then, the air from which the dust is removed by the filter 8 is guided by the bellmouth 14 that defines the air inlet of the main body, and is then sucked into the turbofan 1. Further, the air sucked into the turbofan 1 from bottom to top is blown out in a horizontal and radially outward direction. When the air thus blown out passes through the heat exchanger 3, the heat is exchanged and the humidity is adjusted. After that, the air is blown out to the inside 17 of the room through each air outlet 9 with the flow direction switched to a downward direction.

[0029] Next, details of the air outlet 9 are described with reference to FIGS. 1 to 3. FIG. 2 is a view illustrating a vertical section of one air outlet 9 according to the first embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in a longitudinal direction (direction orthogonal to both of a vertical direction and a width direction: lengthwise direction).

[0030] As illustrated in FIG. 1, the air outlet 9 is formed between the heat exchanger 3 and the main-body side panel 4 in plan view. More specifically, as illustrated in FIG. 2, the air outlet 9 is formed between a heat exchanger outlet-side air duct wall 10 and an opposing air duct wall 11, which is opposed to the heat exchanger outlet-side air duct wall 10. A part of the air outlet 9 at the center side of the main body (heat exchanger side or air blower side) is defined by the heat exchanger outlet-side air duct wall 10, whereas a part of the air outlet 9 at the outer edge side of the decorative panel 6 is defined by the opposing air duct wall 11 formed at the main-body side panel side. Both ends of the heat exchanger outlet-side air duct wall 10 and both ends of the opposing air duct wall 11 are connected to each other by a pair of side walls (wall portions represented by reference symbol 12 in FIG. 10). The air current passing through the heat exchanger 3 is caused to flow into the air outlet 9 from the heat exchanger outlet-side air duct wall 10 side.

[0031] In the first embodiment, assuming that the thickness of the heat exchanger outlet-side air duct wall 10 of the air outlet 9 is defined as L1 and the inlet width of the air outlet 9 is defined as L2, L1 is set within a range of from 0.15L2 to 0.25L2. FIG. 3 shows a relationship between L1/L2 and the airflow rate. As shown in FIG. 3, in a case where the thickness L1 of the heat exchanger outlet-side air duct wall 10 is smaller than 0.15L2, the air current is significantly separated at the inlet portion of the air outlet 9 when the air current is caused to flow into the air outlet 9, and hence the airflow resistance is increased, thereby causing decrease in airflow rate. In a case where the thickness L1 of the heat exchanger outlet-side air duct wall 10 is larger than 0.25L2, on the other hand, the air duct width is decreased, and hence the airflow resistance is increased, thereby causing the decrease in airflow rate. In contrast, when L1 falls within the range of from 0.15L2 to 0.25L2 as in the first embodiment, a sufficient airflow rate is secured.

[0032] According to the air conditioning apparatus of the first embodiment, which is constructed as described above, the thickness L1 of the heat exchanger outlet-side air duct wall 10 is set within the range of from 0.15L2 to 0.25L2, thereby being capable of suppressing the increase in airflow resistance, which may be caused by the separation of the air current, and also suppressing the increase in airflow resistance, which may be caused by the decrease in size of the air outlet. Thus, it is possible to secure a sufficient airflow rate, reduce noise, and to achieve a highpower saving rate. Further, decrease in air velocity can be suppressed through the suppression of the separation of the air current, with the result that dew condensation on the airflow direction flap, which may be caused by undesired intake of the air from the inside of the room, can be prevented.

Second Embodiment

[0033] Next, a second embodiment of the present invention is described with reference to FIGS. 4 and 5. FIG. 4 is a view illustrating a vertical section of one air outlet 9 according to the second embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in a longitudinal direction. Note that, an air conditioning apparatus of the second embodiment is similar to the air conditioning apparatus of the first embodiment except for the parts described below.

[0034] In the second embodiment, a curved surface portion 121 is formed in an air outlet-side region of an upper end of a heat exchanger outlet-side air duct wall 110 that defines the air outlet 9 (at a downstream side of the air current flowing out of the heat exchanger down along the air outlet). The curved surface portion 121 is formed of a curved surface that is convex upward (toward the outer side of the air duct wall or the air duct side instead of the inner side of the air duct wall). A range L3 of the curved surface portion 121 in a thickness direction is equal to or larger than 0.4L1. For example, the curved surface portion 121 may be formed with at least one curvature radius, or may be formed of a curved surface having a radius that continuously changes. Note that, L3 equals L1 at a maximum ($L3 \leq L1$).

[0035] FIG. 5 shows a relationship between L3/L1 and the airflow rate. As shown in FIG. 5, in a case of $L3/L1<0.4$, the airflow rate is increased as L3 is larger. In a case of $L3/L1 \geq 0.4$, on the other hand, the airflow rate is substantially constant irrespective of L3. Thus, in the second embodiment, the range L3 of the curved surface portion 121 in the thickness direction is set equal to or larger than 0.4L1 so that a substantially constant and high airflow rate may be maintained.

[0036] Also in the air conditioning apparatus of the second embodiment, which is constructed as described above, similar advantages to the advantages of the first embodiment described above are attained. In addition, in the second embodiment, the upper end of the heat exchanger outlet-side air duct wall 110 is formed into the curved surface shape, and thus the separation of the air current can be suppressed, thereby being capable of suppressing the increase in airflow resistance. Thus, it is possible to further enhance the power saving rate, reduce the air blowing noise, and to prevent the dew condensation, which may be caused by undesired intake of the air from the inside of the room.

Third Embodiment

[0037] Next, a third embodiment of the present invention is described with reference to FIG. 6. FIG. 6 is a view illustrating a vertical section of one air outlet 9 according to the third embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in the longitudinal direction. Note that, an air conditioning apparatus of the third embodiment is similar to the air conditioning apparatus of the first or second embodiment except for the parts described below.

[0038] In the air conditioning apparatus of the third embodiment, a curved surface portion 221 and a flat surface portion 223 are formed at an upper end of a heat exchanger outlet-side air duct wall 210. The curved surface portion 221 is positioned at the upper end of the heat exchanger outlet-side air duct wall 210, which is close to a center portion of the air outlet 9, whereas the flat surface portion 223 is positioned at the upper end of the heat exchanger outlet-side air duct wall 210, which is closer to the heat exchanger 3 than the curved surface portion 221 (which is spaced away from the center portion of the air outlet 9), namely, positioned at an upstream side of the air current flowing out of the heat exchanger 3 down along the air outlet 9. The curved surface portion 221 is formed of a curved surface that is convex upward. The flat surface portion 223 is formed continuous with the curved surface portion 221. It is desired that a range L4 of the flat surface portion 223 in the thickness direction be equal to or larger than 1 mm.

[0039] Also in the air conditioning apparatus of the third embodiment, which is constructed as described above, similar advantages to the advantages of the first or second embodiment described above are attained. Inaddition, in the third embodiment, the flat surface portion 223 is formed at the upstream side of the curved surface portion 221 of the upper end of the heat exchanger outlet-side air duct wall 210, and thus the air current before flowing toward the curved surface portion 221 easily adheres to the wall surface of the heat exchanger outlet-side air duct wall 210, thereby being capable of further suppressing the separation of the air current at the curved surface portion 221. Thus, it is possible to further enhance the power saving rate, reduce the air blowing noise, and to prevent the dew condensation, which may be caused by undesired intake of the air from the inside of the room.

Fourth Embodiment

[0040] Next, a fourth embodiment of the present invention is described with reference to FIG. 7. FIG. 7 is a view illustrating a vertical section of one air outlet 9 according to the fourth embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in the longitudinal direction. Note that, an air conditioning apparatus of the fourth embodiment is similar to the air conditioning apparatus of any one of the first to third embodiments except for the parts described below.

[0041] A heat exchanger outlet-side air duct wall 310 of the air conditioning apparatus of the fourth embodiment has a curved surface portion 321 and a flat surface portion 325. The curved surface portion 321 is positioned at an upper end of the heat exchanger outlet-side air duct wall 310. The curved surface portion 321 is formed of a curved surface that is convex upward. The flat surface portion 325 is positioned closer to the center portion of the air outlet 9 than the curved surface portion 321, namely, positioned at the downstream side of the air current flowing out of the heat exchanger 3 down along the air outlet 9. In addition, the flat surface portion 325 is positioned in an immediately downstream region of the upper end of the heat exchanger outlet-side air duct wall 310, namely, positioned at the end of the upstream side of the heat exchanger outlet-side air duct wall 310 in a region opposed to the opposing air duct wall 11. The flat surface portion 325 is formed continuous with the curved surface portion 321.

[0042] Also in the air conditioning apparatus of the fourth embodiment, which is constructed as described above, similar advantages to the advantages of any one of the corresponding first to third embodiments described above are attained. In addition, in the fourth embodiment, the flat surface portion 325 is formed at the downstream side of the curved surface portion 321 of the upper end of the heat exchanger outlet-side air duct wall 310, and thus, even when the air current is separated at the curved surface portion 321, re-adhesion of the air current can be promoted. Thus, it is possible to further enhance the power saving rate, reduce the air blowing noise, and to prevent the dew condensation, which may be caused by undesired intake of the air from the inside of the room.

Fifth Embodiment

[0043] Next, a fifth embodiment of the present invention is described with reference to FIG. 8. FIG. 8 is a view illustrating a vertical section of one air outlet 9 according to the fifth embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in the longitudinal direction. Note that, an air conditioning apparatus of the fifth embodiment is similar to the air conditioning apparatus of any one of the first to fourth embodiments except for the parts described below.

[0044] A heat exchanger outlet-side air duct wall 410 of the air conditioning apparatus of the fifth embodiment has a stepped portion 427 formed thereon. The stepped portion 427 is positioned at the heat exchanger outlet-side air duct wall 410 in a region opposed to the opposing air duct wall 11. A region below the stepped portion 427 of the heat exchanger outlet-side air duct wall 410 (at the downstream side of the air current flowing out of the heat exchanger 3 down along the air outlet 9) is concave away from the opposing air duct wall 11.

[0045] Also in the air conditioning apparatus of the fifth embodiment, which is constructed as described above, similar advantages to the advantages of any one of the corresponding first to fourth embodiments described above are attained. In addition, in the fifth embodiment, even when the air current is separated over a range of from an upper end of the heat exchanger outlet-side air duct wall 410 to the region opposed to the opposing air duct wall 11 and a vortex is generated in the region in which the air current is separated, the vortex can be suppressed by the stepped portion 427. Also in this case, it is possible to enhance the power saving rate, reduce the air blowing noise, and to prevent the dew condensation, which may be caused by undesired intake of the air from the inside of the room.

Sixth Embodiment

[0046] Next, a sixth embodiment of the present invention is described with reference to FIG. 9. FIG. 9 is a view illustrating a vertical section of one air outlet 9 according to the sixth embodiment. Further, in this embodiment, it is assumed that a heat exchanger outlet-side air duct wall has the same vertical section maintained in the longitudinal direction. Note that, an air conditioning apparatus of the sixth embodiment is similar to the air conditioning apparatus of any one of the first to fifth embodiments except for the parts described below. Further, FIG. 9 only illustrates an example, which is a structure obtained by combining the fifth embodiment with the fourth embodiment described above.

[0047] In the air conditioning apparatus of the sixth embodiment, a distance L5 between a heat exchanger outlet-side air duct wall 510 and the heat exchanger 3 is set smaller than a thickness L1 of the heat exchanger outlet-side air duct wall 510.

[0048] Also in the air conditioning apparatus of the sixth embodiment, which is constructed as described above, similar advantages to the advantages of any one of the corresponding first to fifth embodiments described above are attained. In addition, in the sixth embodiment, the distance L5 between the heat exchanger outlet-side air duct wall 510 and the heat exchanger 3 is smaller than the thickness L1 of the heat exchanger outlet-side air duct wall 10, and thus the amount of air current passing through the heat exchanger 3 at a position lower than an upper end of the heat exchanger outlet-side air duct wall 510 can be reduced, thereby being capable of suppressing the separation of the air current when the air current flows over the heat exchanger outlet-side air duct wall 510. Thus, it is possible to further enhance the power saving rate, reduce the air blowing noise, andtopreventthedewcondensation, which may be caused by undesired intake of the air from the inside of the room.

Seventh Embodiment

[0049] Next, a seventh embodiment of the present invention is described with reference to FIG. 10. FIG. 10 is a top view illustrating one air outlet 9 according to the seventh embodiment of the present invention. Note that, an air conditioning apparatus of the seventh embodiment is similar to the air conditioning apparatus of any one of the first to sixth embodiments except for the parts described below. Further, it is assumed that the features of the first to sixth embodiments are applied to a center portion of the heat exchanger outlet-side air duct wall in the longitudinal direction.

[0050] As illustrated in FIG. 10, the air outlet 9 is defined, in plan view, by a heat exchanger outlet-side air duct wall 610, the opposing air duct wall 11, and the pair of side walls 12 connecting both ends of the heat exchanger outlet-side air duct wall 610 and both ends of the opposing air duct wall 11 to each other. In the seventh embodiment, a thickness L1' of the heat exchanger outlet-side air duct wall 610 at each end portion in the longitudinal direction is set larger than a thickness L1 of the heat exchanger outlet-side air duct wall 610 at the center portion in the longitudinal direction.

[0051] Also in the air conditioning apparatus of the seventh embodiment, which is constructed as described above, similar advantages to the advantages of any one of the corresponding first to sixth embodiments described above are attained. In addition, in the seventh embodiment, the following advantages are attained as well. That is, considering the flow of the air current at the entire air outlet 9, at both end portions of the air outlet 9 in the longitudinal direction, the air is caused to flow not only from the side of the heat exchanger outlet-side air duct wall 610 but also from the side of the pair of side walls 12. Therefore, at both end portions of the air outlet 9 in the longitudinal direction, the air current is more liable to be separated than at the center portion of the air outlet 9 in the longitudinal direction. In contrast, in the seventh embodiment, the thickness L1' of the heat exchanger outlet-side air duct wall 610 at each end portion in the longitudinal direction is set larger than the thickness L1 of the heat exchanger outlet-side air duct wall 610 at the center portion in the longitudinal direction, and thus the amount of air current flowing into the air outlet 9 at each end portion in the longitudinal direction can be reduced, thereby being capable of suppressing the separation of the air current in the entire region in the longitudinal direction. Thus, it is possible to further enhance the power saving rate, reduce the air blowing noise, andtopreventthedewcondensation, which may be caused by undesired intake of the air from the inside of the room.

Eighth Embodiment

[0052] Next, an eighth embodiment of the present invention is described. Note that, an air conditioning apparatus of the eighth embodiment is similar to the air conditioning apparatus of any one of the first to seventh embodiments except for the parts described below. Further, it is assumed that the features of the first to seventh embodiments are applied to a center portion of the heat exchanger outlet-side air duct wall in the longitudinal direction.

[0053] The eighth embodiment has a feature in that, in the curved surface portion formed at the upper end of the heat exchanger outlet-side air duct wall of the air outlet 9 according to any one of the first to seventh embodiments, a part of the curved surface portion, which is positioned at each end portion of the heat exchanger outlet-side air duct wall in the longitudinal direction, is larger than a part of the curved surface portion, which is positioned at the center portion of the heat exchanger outlet-side air duct wall in the longitudinal direction. The size of the curved surf ace portion is determined based on comparison in any one of the size of the convex portion that defines the curved surface portion, the width of the heat exchanger outlet-side air duct wall in the region including the curved surface portion, the range of formation of the curved surface portion of the heat exchanger outlet-side air duct wall in the vertical direction, and the range of occupation of the curved surface portion in side view (in the view of FIG. 2). Note that, in this respect, FIG. 10 also illustrates one aspect of the eighth embodiment in the case of comparison in the width of the heat exchanger outlet-side air duct wall in the region including the curved surface portion.

[0054] Also in the air conditioning apparatus of the eighth embodiment, which is constructed as described above, similar advantages to the advantages of any one of the corresponding first to seventh embodiments described above are attained. Further, also in the eighth embodiment, similar advantages to the advantages unique to the seventh embodiment described above are attained in terms of the curved surface portion of the heat exchanger outlet-side air duct wall. Thus, it is possible to enhance the power saving rate, reduce the air blowing noise, and to prevent the dew condensation, which may be caused by undesired intake of the air from the inside of the room.

Industrial Applicability

[0055] As examples of application of the present invention, the present invention is widely applicable to an indoor unit that constructs a refrigeration cycle system, such as an indoor unit of an air conditioning apparatus, or various other apparatus and facilities in which an air blower is installed.

[0056] Although the details of the present invention are specifically described above with reference to the preferred embodiments, it is apparent that persons skilled in the art may adopt various modifications based on the basic technical concepts and teachings of the present invention.

Reference Signs List

[0057] 3 heat exchanger, 9 air outlet, 10, 110, 210, 310, 410, 510, 610 heat exchanger outlet-side air duct wall, 11 opposing air duct wall, 121, 221, 321 curved surf ace portion, 223, 325 flat surface portion, 427 stepped portion

Claims

1. An air conditioning apparatus, comprising:

a main body having at least one air inlet and at least one air outlet each being formed at a lower part of the main body; and

a heat exchanger housed inside the main body and arranged in a flow passage of air to be sucked into the main body through the air inlet and blown out to a target space through the air outlet,

wherein the air outlet is formed between a heat exchanger outlet-side air duct wall and an opposing air duct wall, which is opposed to the heat exchanger outlet-side air duct wall, and

wherein a thickness L1 of the heat exchanger outlet-side air duct wall is 0.15L2 to 0.25L2, where L2 represents an inlet width of the air outlet.

2. An air conditioning apparatus according to claim 1, wherein an upper end of the heat exchanger outlet-side air duct wall comprises, in an air outlet-side region thereof, a curved surface portion formed of a curved surface, which is convex toward an air duct side, and
wherein a range L3 of the curved surface portion in a thickness direction is equal to or larger than 0.4L1.

3. An air conditioning apparatus according to claim 1, wherein an upper end of the heat exchanger outlet-side air duct wall comprises a curved surface portion and a flat surface portion,
wherein the curved surface portion is formed of a curved surface, which is convex toward an air duct side, and is positioned at the upper end of the heat exchanger outlet-side air duct wall, which is close to a center portion of the air outlet, and
wherein the flat surface portion is positioned at the upper end of the heat exchanger outlet-side air duct wall, which is closer to the heat exchanger than the curved surface portion.

4. An air conditioning apparatus according to claim 1, wherein the heat exchanger outlet-side air duct wall comprises a curved surface portion and a flat surface portion,
wherein the curved surface portion is formed of a curved surface, which is convex toward an air duct side, and is positioned at an upper end of the heat exchanger outlet-side air duct wall, and
wherein the flat surface portion is positioned closer to a center portion of the air outlet than the curved surface portion, and is positioned at an end of an upstream side of the heat exchanger outlet-side air duct wall in a region opposed to the opposing air duct wall.

5. An air conditioning apparatus according to any one of claims 2 to 4, wherein a part of the curved surface portion, which is positioned at each end portion of the heat exchanger outlet-side air duct wall in a longitudinal direction, is larger than a part of the curved surface portion, which is positioned at a center portion of the heat exchanger outlet-side air duct wall in the longitudinal direction.

6. An air conditioning apparatus according to any one of claims 1 to 5,
wherein the heat exchanger outlet-side air duct wall comprises a stepped portion,
wherein the stepped portion is positioned at the heat exchanger outlet-side air duct wall in a region opposed to the opposing air duct wall, and
wherein a region below the steppedportion of the heat exchanger outlet-side air duct wall is concave away from the opposing air duct wall.

7. An air conditioning apparatus according to any one of claims 1 to 6, wherein a distance L5 between the heat exchanger outlet-side air duct wall and the heat exchanger is smaller than the thickness L1 of the heat exchanger outlet-side air duct wall.

8. An air conditioning apparatus according to any one of claims 1 to 7, wherein a thickness L1' of the heat exchanger outlet-side air duct wall at the each end portion in the longitudinal direction is larger than the thickness L1 of the heat exchanger outlet-side air duct wall at the center portion in the longitudinal direction.

FIG. 1

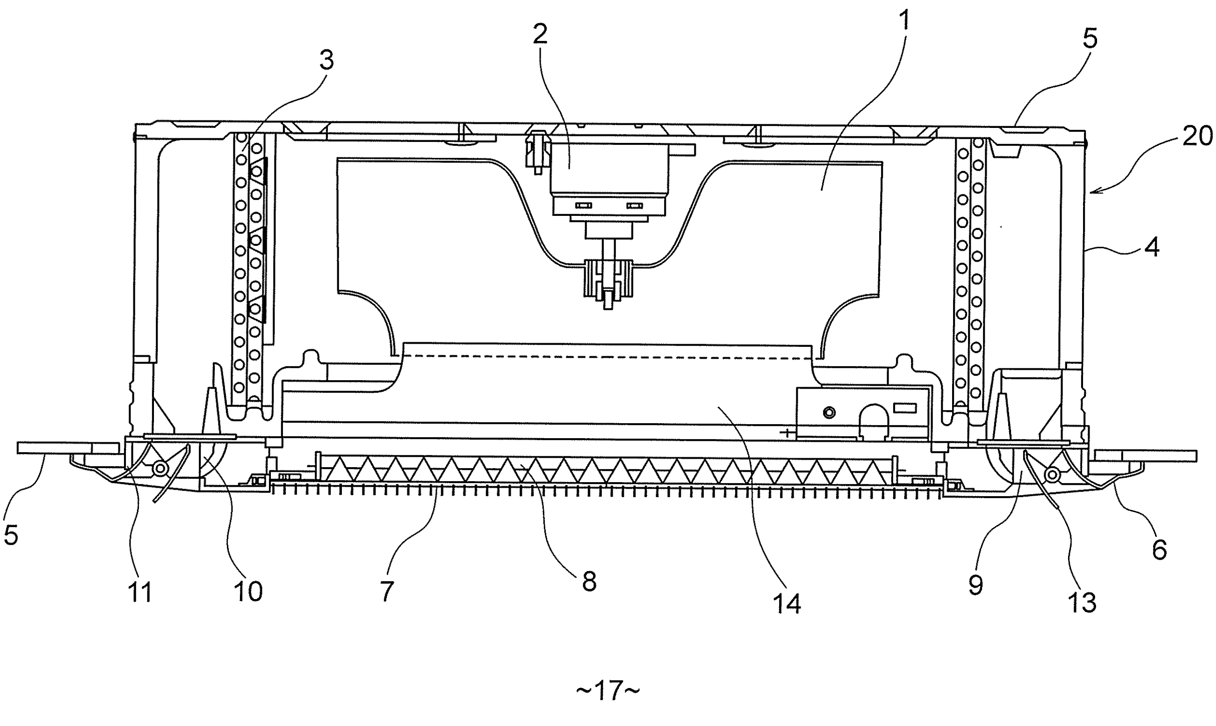


FIG. 2

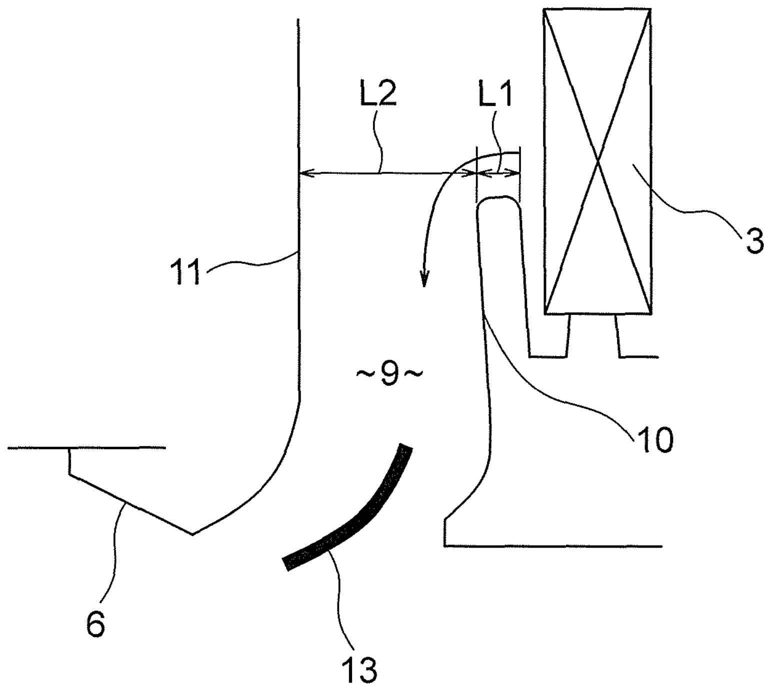

L2
L1
3
11
~9~
10
6
13

FIG. 3

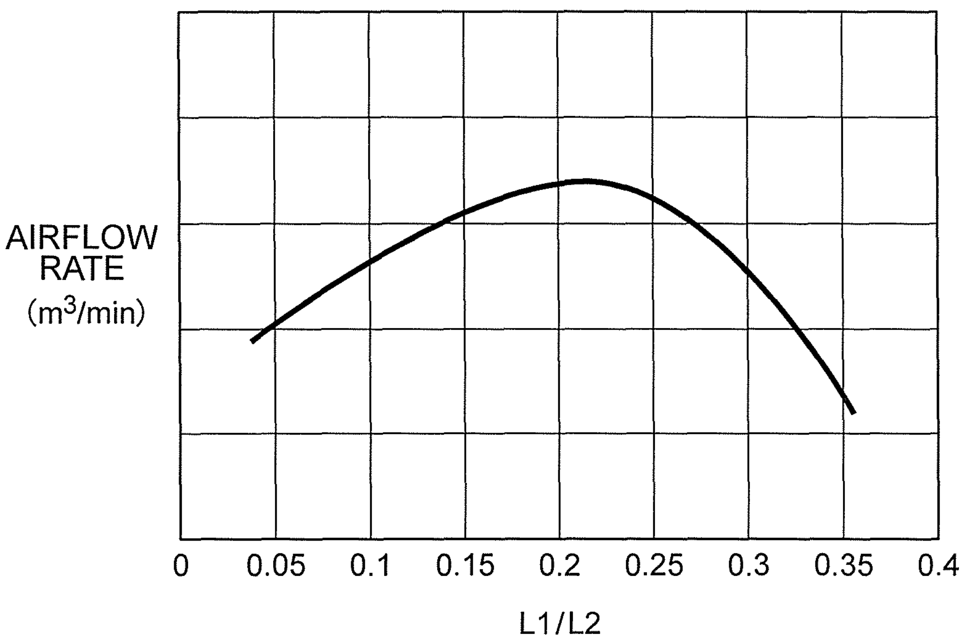

AIRFLOW RATE (m3/min)
0
0.05
0.1
0.15
0.2
0.25
0.3
0.35
0.4
L1/L2

FIG. 4

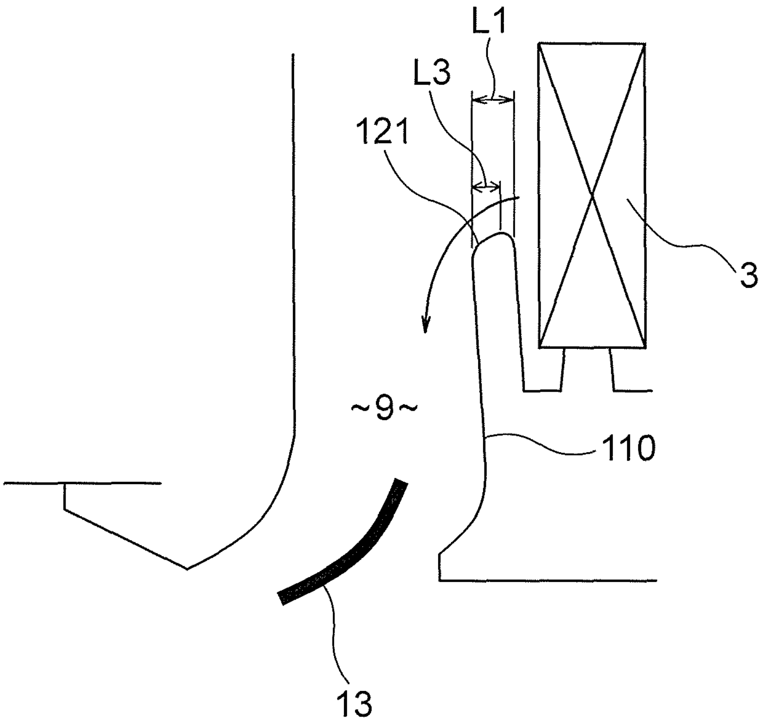

L1
L3
121
3
9
110
13

FIG. 5

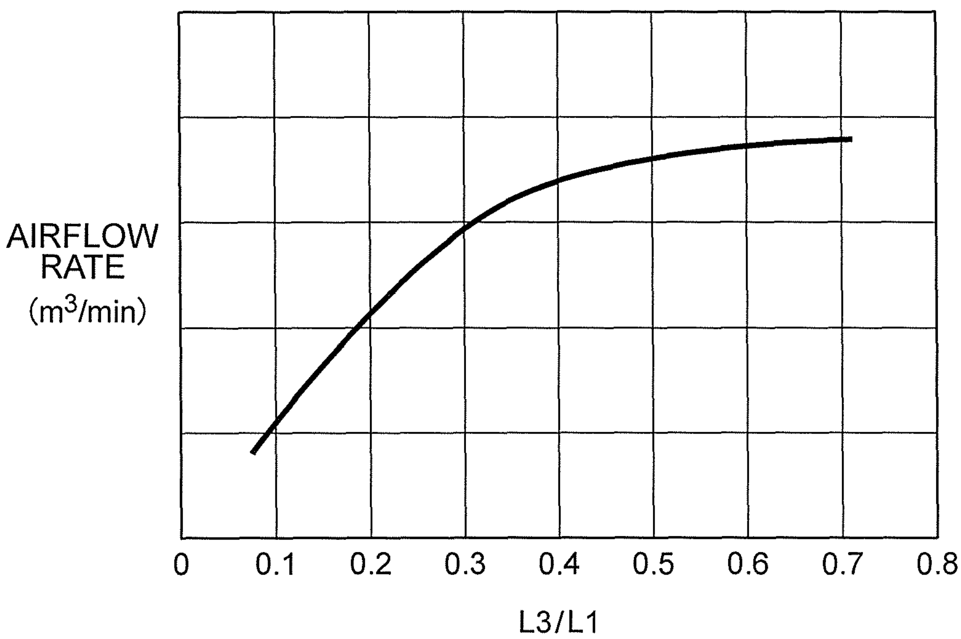

AIRFLOW RATE (m3/min)
0
0.1
0.2
0.3
0.4
0.5
0.6
0.7
0.8
L3/L1

FIG. 6

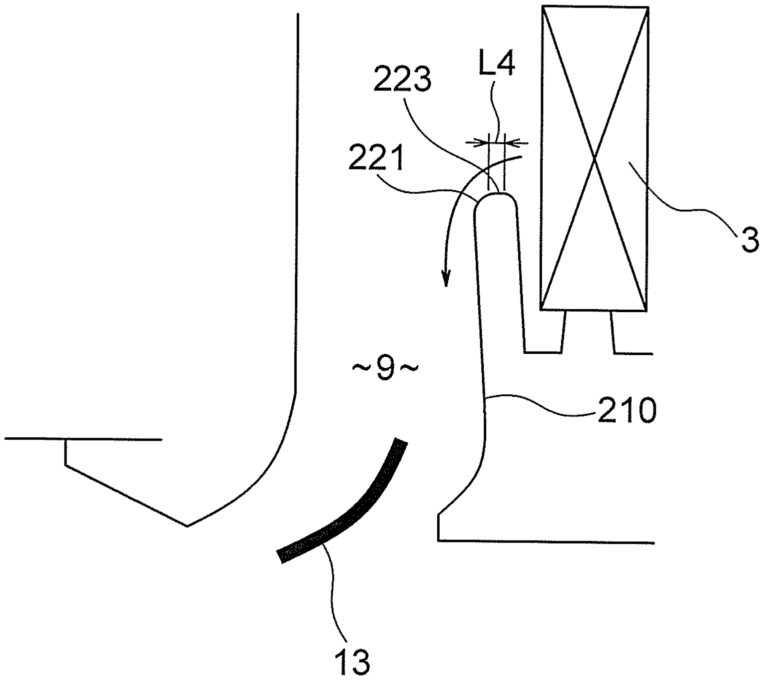


FIG. 7

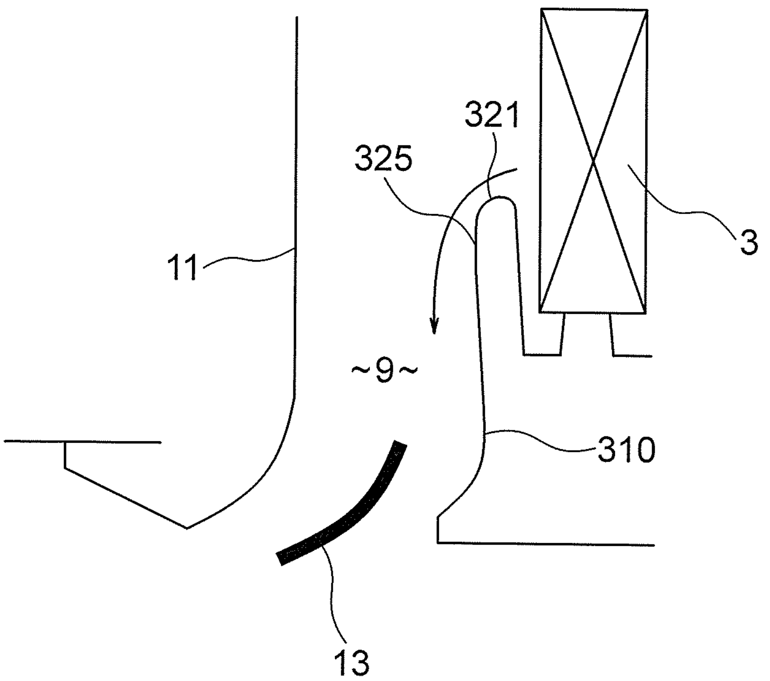


FIG. 8

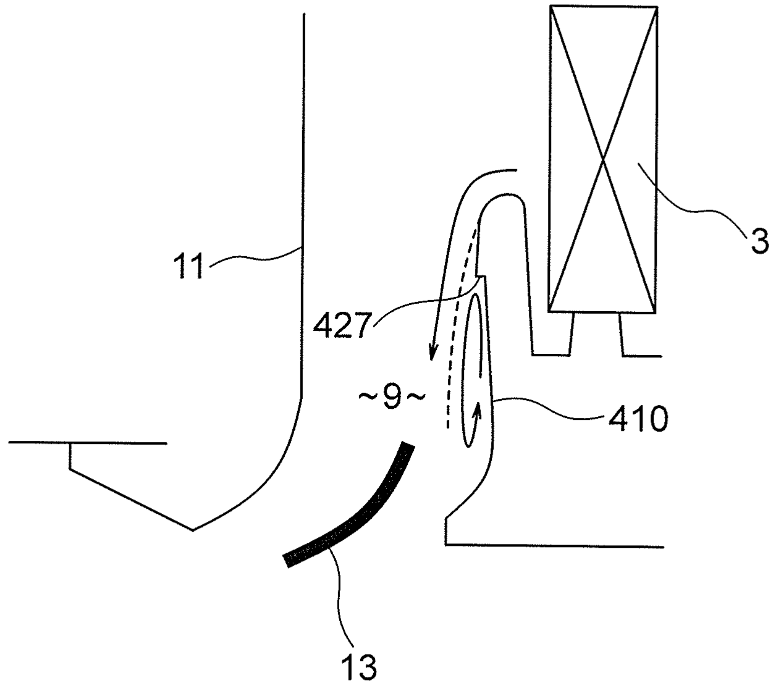


FIG. 9

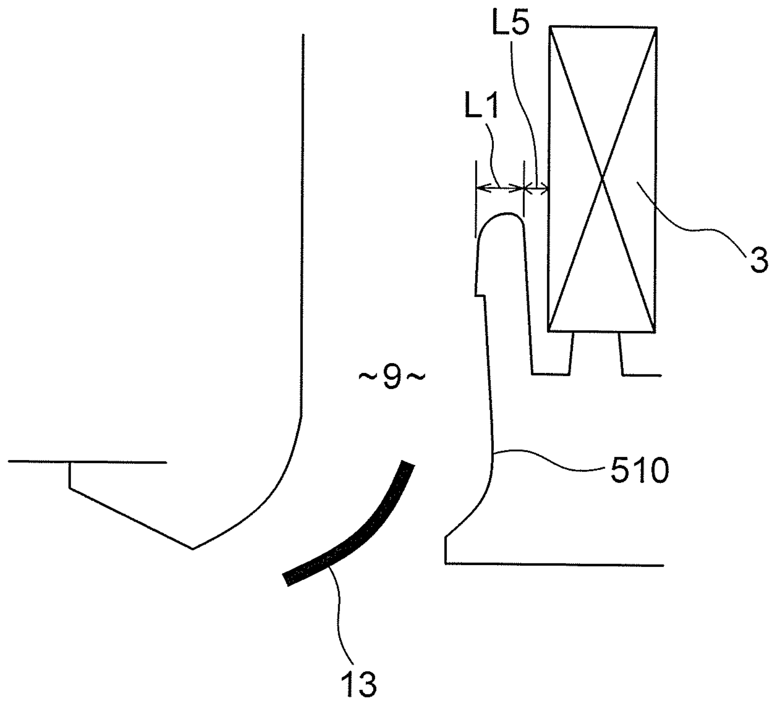
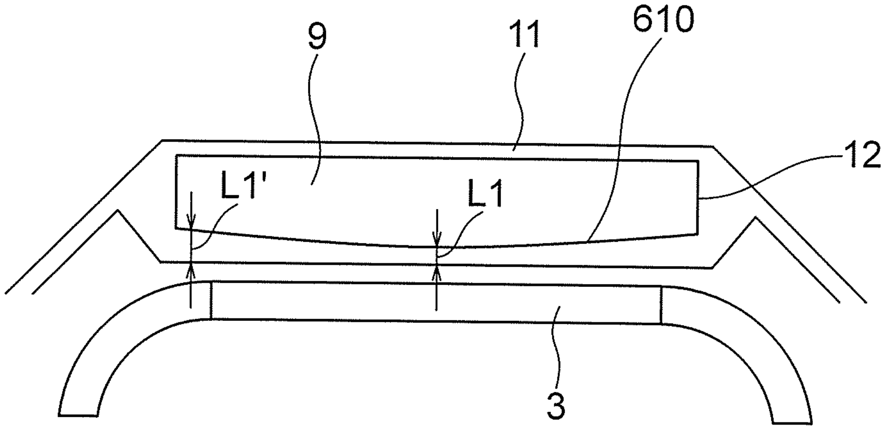


FIG. 10



INTERNATIONAL SEARCH REPORT

International application No. PCT/JP2013/075016

A. CLASSIFICATION OF SUBJECT MATTER

F24F1/00(2011.01)i, *F24F13/32*(2006.01)i

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F24F1/00, F24F13/32

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	1996-2013
Kokai Jitsuyo Shinan Koho	1971-2013	Toroku Jitsuyo Shinan Koho	1994-2013

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 A	JP 8-178335 A (Daikin Industries, Ltd.), 12 July 1996 (12.07.1996), paragraphs [0014] to [0023]; fig. 1 to 3 (Family: none)	1 2-4,6-7 5,8
Y	CD-ROM of the specification and drawings annexed to the request of Japanese Utility Model Application No. 6618/1993(Laid-open No. 59722/1994) (Zexel Corp.), 19 August 1994 (19.08.1994), paragraphs [0010] to [0013]; fig. 2 (Family: none)	2-3,6-7

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

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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed
- "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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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 November, 2013 (25.11.13)	03 December, 2013 (03.12.13)

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/JP2013/075016

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 11-101483 A (Matsushita Electric Industrial Co., Ltd.), 13 April 1999 (13.04.1999), paragraphs [0030] to [0033]; fig. 3 to 6 (Family: none)	4,6-7
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 13844/1984(Laid-open No. 125429/1985) (Yazaki Corp.), 23 August 1985 (23.08.1985), page 3, line 13 to page 5, line 3; fig. 5 (Family: none)	6-7

Form PCT/ISA/210 (continuation of second sheet) (July 2009)

REFERENCES CITED IN THE DESCRIPTION

Patent documents cited in the description

- JP 2012251676 A **[0003]**