DESCRIPTION

AIR-CONDITIONING INDOOR UNIT

TECHNICAL FIELD

The present invention relates to an air conditioning indoor unit that can utilize the Coanda effect to guide a flow of outlet air in a predetermined direction.

BACKGROUND ART

Conventionally, there have been air conditioning indoor units that can utilize the Coanda effect to guide a flow of outlet air in a predetermined direction.

For example, in the air conditioner disclosed in patent document 1 (JP-A No. 2003-232531), a horizontal louver is disposed in the neighborhood of an air outlet and in the traveling path of outlet air. In this air conditioner, the outlet air becomes an upward Coanda airflow along the horizontal louver because of the Coanda effect and is guided toward a ceiling in a room.

SUMMARY OF INVENTION

<Technical Problem>

In this connection, the present inventor investigated, in relation to an air conditioning indoor unit in which a Coanda blade and a horizontal blade cooperate with one another to utilize the Coanda effect to change outlet air to a Coanda airflow along an undersurface of the Coanda blade, the relationship between the Coanda airflow and the relative angle between the Coanda blade and the horizontal blade, and in doing so the present inventor discovered that as angular ranges of the relative angle between the Coanda blade and the horizontal blade, there exist an angular range in which the Coanda airflow is produced on substantially the entire region of the undersurface of the Coanda blade and an angular range in which the Coanda airflow is not produced and which is larger than the angular range in which the Coanda airflow is produced on substantially the entire region of the undersurface of the Coanda blade.

~~Therefore, it is an object~~ Embodiments of the present invention ~~to~~ produce, in an air conditioning indoor unit in which a Coanda blade and a horizontal blade cooperate with one another to change outlet air to a Coanda airflow along an undersurface of the Coanda blade, a stable airflow in both an airflow state utilizing the Coanda airflow and an airflow state not utilizing the Coanda airflow by adjusting the relative angle between the Coanda blade and the horizontal blade.

<Solution to Problem>

~~An air conditioning indoor unit pertaining to a first aspect of the present invention is~~

~~equipped with a casing, a horizontal blade, a Coanda blade, and a control unit. An air outlet from which outlet air is blown out is formed in the casing. The horizontal blade changes an up and down direction flow of the outlet air. The Coanda blade cooperates with the horizontal blade to utilize the Coanda effect to change the outlet air to a Coanda airflow along an undersurface of the Coanda blade. The control unit can adjust a relative angle between the Coanda blade and the horizontal blade in such a way as to selectively use either of a first airflow state and a second airflow state. The first airflow state is a state in which the control unit adjusts the relative angle to a predetermined angle in a first angular range to produce the Coanda airflow on substantially the entire region of the undersurface of the Coanda blade. The second airflow state is a state in which the control unit adjusts the relative angle to a predetermined angle in a second angular range larger than the first angular range to not produce the Coanda airflow.~~

According to an aspect of the present invention, there is provided an air conditioning indoor unit comprising: a casing in which is formed an air outlet from which outlet air is blown out; a horizontal blade that changes an up and down direction flow of the outlet air; a Coanda blade that utilizes the Coanda effect, which is phenomenon in which the outlet air tends to flow in a direction along an undersurface positioned in a direction out of and different from the flow direction of the outlet air, to change the outlet air of which air direction has been changed by rhte horizontal blade to a Coanda airflow along the undersurface; and a control unit that can adjust a relative angle between the Coanda blade and the horizontal blade in such a way as to selectively use either of a first airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a first angular range to produce the Coanda airflow on substantially the entire region of the undersurface of the Coanda blade, and a second airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a second angular range larger than the first angular range to not produce the Coanda airflow.

The present inventor investigated, in relation to an air conditioning indoor unit in which a Coanda blade and a horizontal blade cooperate with one another to utilize the Coanda effect to change outlet air into a Coanda airflow along an undersurface of the Coanda blade, the relationship between the Coanda airflow and the relative angle between the Coanda blade and the horizontal blade, and in doing so the present inventor discovered that as angular ranges of the relative angle between the Coanda blade and the horizontal blade, there exist a first angular range that results in a first airflow state in which the Coanda airflow is produced on substantially the

entire region of the undersurface of the Coanda blade and a second angular range that is larger than the first angular range and results in a second airflow state in which the Coanda airflow is not produced.

Therefore, in the air conditioning indoor unit ~~pertaining to the first aspect~~ as per an embodiment of the present invention, in the case of using the first airflow state, the relative angle between the Coanda blade and the horizontal blade is adjusted to a predetermined angle in the first angular range. Furthermore, in the case of using the second airflow state, the relative angle between the Coanda blade and the horizontal blade is adjusted to a predetermined angle in the second angular range. In this way, in this air conditioning indoor unit, by adjusting the relative angle between the Coanda blade and the horizontal blade to the predetermined angle in the first angular range or the second angular range, either of the first airflow state and the second airflow state can be selectively used.

Because of this, a stable airflow can be produced in both the first airflow state utilizing the Coanda airflow and the second airflow state not utilizing the Coanda airflow.

~~An~~In an air conditioning indoor unit ~~pertaining to a second aspect~~as per an embodiment of the present invention

~~is the air conditioning indoor unit of the first aspect, wherein,~~ when the relative angle is adjusted to a predetermined angle in a third angular range, this results in a third airflow state in which the Coanda airflow is produced on part of the undersurface of the Coanda blade. Furthermore, the first angular range and the second angular range are set in such a way as to exclude the third angular range.

The present inventor discovered that as an angular range of the relative angle between the Coanda blade and the horizontal blade, there is a third angular range that results in an unstable third airflow state in which the Coanda airflow is produced on part of the undersurface of the Coanda blade.

Therefore, in the air conditioning indoor unit ~~pertaining to the second aspect~~ as per an embodiment of the present invention, the first angular range and the second angular range are set in such a way as to exclude the third angular range that results in the third airflow state. For this reason, when the first airflow state and the second airflow state are used, the concern that this will result in an unstable airflow can be reduced.

Because of this, a stable airflow can be produced in both the first airflow state and the second airflow state.

~~An~~In an air conditioning indoor unit ~~pertaining to a third aspect~~ as per an embodiment of the present invention ~~is the air conditioning indoor unit of the second aspect, wherein,~~ an upper limit angle of the first angular range is set to an angle equal to or less than an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range. In this air conditioning indoor unit, the upper limit angle of the first angular range is set to an angle equal to or less than an angle at which there is a transition from the third airflow state to the first airflow state, so in a case where the first airflow state is used, the concern that this will result in an unstable airflow can be reduced, and as a result, a stable Coanda airflow can be produced.

~~An~~In an air conditioning indoor unit ~~pertaining to a fourth aspect~~as per an embodiment of the present invention ~~is the air conditioning indoor unit of the second aspect or the third aspect, wherein,~~ a lower limit angle of the second angular range is set to an angle equal to or greater than an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range. In this air conditioning indoor unit, the lower limit angle of the second angular range is set to an angle equal to or greater than an angle at which there is a transition from the third airflow state to the second airflow state, so in a case where the second airflow state is used,

the concern that this will result in an unstable airflow can be reduced, and as a result, the concern that the Coanda airflow will be produced can be reduced.

~~An~~In an air conditioning indoor unit ~~pertaining to a fifth aspect~~as per an embodiment of the present invention ~~is the air conditioning indoor unit of any of the second aspect to the fourth aspect, wherein,~~ an angle at which there is a transition from the first airflow state to the third airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range and an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the third angular range are different. In this air conditioning indoor unit, the third angular range includes an angular range between the angle at which there is a transition from the first airflow state to the third airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range and the angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the third angular range. Additionally, because the first angular range is set in such a way as to exclude the third angular range, the angular range included in the third angular range is also excluded from the first angular range. Because of this, when the first airflow state is used, the concern that this will result in an unstable Coanda airflow can be reduced.

~~An~~In an air conditioning indoor unit ~~pertaining to a sixth aspect~~ as per an embodiment of the present invention ~~is the air conditioning indoor unit of any of the second aspect to the fifth aspect, wherein,~~ an angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range are different. In this air conditioning indoor unit, the third angular range includes an angular range between the angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and the angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range. Additionally, because the second angular range is set in such a way as to exclude the third angular range, the angular range included in the third angular range is also excluded from the second angular range. Because of this, when the second airflow state is used, the concern that this will result in an unstable Coanda airflow can be

reduced.

~~An air conditioning indoor unit pertaining to a seventh aspect of the present invention is~~In an embodiment, the above air conditioning indoor unit ~~of any of the first aspect to the sixth aspect and~~ is further equipped with a fan that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet. Furthermore, the Coanda airflow is produced as a result of the outlet air being regulated by a regulating surface of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade. Moreover, the casing includes a scroll surface that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path for the outlet air. Additionally, in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.

In an air conditioning indoor unit having a configuration that uses the regulating surface of the horizontal blade to regulate the outlet air and thereafter channel the outlet air toward the undersurface of the Coanda blade to change the outlet air to a Coanda airflow along the undersurface of the Coanda blade, in a case where the regulating surface of the horizontal blade is positioned on the lower side of the imaginary extension plane of the scroll surface, depending on the structure of the scroll surface, sometimes the outlet air cannot be regulated toward the undersurface of the Coanda blade.

Therefore, in the air conditioning indoor unit ~~pertaining to the seventh aspect~~ as per an embodiment of the present invention, in a case where the first airflow state is used, by setting the position of the regulating surface of the horizontal blade on the upper side of the imaginary extension plane of the scroll surface, the outlet air can be regulated by the regulating surface of the horizontal blade toward the undersurface of the Coanda blade. For this reason, in a case where the first airflow state is used, the concern that the Coanda airflow will not be produced can be reduced.

<Advantageous Effects of Invention>

In the air conditioning indoor unit pertaining to the ~~first~~above aspect of the present invention, by adjusting the relative angle between the Coanda blade and the horizontal blade to a predetermined angle in the first angular range or the second angular range, a stable airflow can be produced in both the first airflow state utilizing the Coanda airflow and the second airflow state not utilizing the Coanda airflow.

In the air conditioning indoor unit ~~pertaining to the second aspect~~as per an embodiment of the present invention, the first angular range and the second angular range are set in such a way as to exclude the third angular range, so a stable airflow can be produced in both the first airflow

state and the second airflow state.

In the air conditioning indoor unit ~~pertaining to the third aspect~~ as per an embodiment of the present invention, the upper limit angle of the first angular range is set to an angle equal to or less than the angle at which there is a transition from the third airflow state to the first airflow state, so in a case where the first airflow state is used, a stable Coanda airflow can be produced.

In the air conditioning indoor unit ~~pertaining to the fourth aspect~~ as per an embodiment of the present invention, the lower limit angle of the second angular range is set to an angle equal to or greater than the angle at which there is a transition from the third airflow state to the second airflow state, so in a case where the second airflow state is used, the concern that the Coanda airflow will be produced can be reduced.

In the air conditioning indoor unit ~~pertaining to the fifth aspect~~ as per an embodiment of the present invention, the angular range included in the third angular range is excluded from the first angular range, so when the first airflow state is being used, the concern that this will result in an unstable Coanda airflow can be reduced.

In the air conditioning indoor unit ~~pertaining to the sixth aspect~~ as per an embodiment of the present invention, the angular range included in the third angular range is excluded from the second angular range, so when the second airflow state is being used, the concern that this will result in an unstable Coanda airflow can be reduced.

In the air conditioning indoor unit ~~pertaining to the seventh aspect~~ as per an embodiment of the present invention, in a case where the first airflow state is used, the position of the regulating surface of the horizontal blade is set on the upper side of the imaginary extension plane of the scroll surface, so that when the first airflow state is used, the concern that the Coanda airflow will not be produced can be reduced.

BRIEF DESCRIPTION OF DRAWINGS

FIG. 1 is a cross-sectional view of an air conditioning indoor unit pertaining to an embodiment of the present invention when operation is stopped;

FIG. 2 is a cross-sectional view of the air conditioning indoor unit during operation;

FIG. 3 is a cross-sectional view of the air conditioning indoor unit during operation;

FIG. 4A is a partial cross-sectional view of the neighborhood of an air outlet during normal forward blowing of the outlet air;

FIG. 4B is a partial cross-sectional view of the neighborhood of the air outlet during normal forward and downward blowing of the outlet air;

FIG. 4C is a partial cross-sectional view of the neighborhood of the air outlet during

CLAIMS

1. An air conditioning indoor unit (10) comprising:

a casing (11) in which is formed an air outlet (15) from which outlet air is blown out;

a horizontal blade (31) that changes an up and down direction flow of the outlet air;

a Coanda blade (32) that cooperates with the horizontal blade to utilize the Coanda effect to change the outlet air to a Coanda airflow along an undersurface (32a); and

a control unit (40) that can adjust a relative angle between the Coanda blade and the horizontal blade in such a way as to selectively use either of a first airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a first angular range to produce the Coanda airflow on substantially the entire region of the undersurface of the Coanda blade, and a second airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a second angular range larger than the first angular range to not produce the Coanda airflow.

2. The air conditioning indoor unit according to claim 1, wherein

when the relative angle is adjusted to a predetermined angle in a third angular range, this results in a third airflow state in which the Coanda airflow is produced on part of the undersurface of the Coanda blade, and

the first angular range and the second angular range are set in such a way as to exclude the third angular range.

3. The air conditioning indoor unit according to claim 2, wherein an upper limit angle of the first angular range is set to an angle equal to or less than an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range.

4. The air conditioning indoor unit according to claim 2 or 3, wherein a lower limit angle of the second angular range is set to an angle equal to or greater than an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range.

5. The air conditioning indoor unit according to any one of claims 2 to 4, wherein an angle at which there is a transition from the first airflow state to the third airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range and an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the third angular range are different.

6. The air conditioning indoor unit according to any one of claims 2 to 5, wherein an angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range are different.

7. The air conditioning indoor unit according to any one of claims 1 to 6, further comprising a fan (14) that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet, wherein

the Coanda airflow is produced as a result of the outlet air being regulated by a regulating surface (31b) of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade.

the casing includes a scroll surface (17) that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path (18) for the outlet air, and

in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.

CLAIMS

1. An air conditioning indoor unit (10) comprising:

a casing (11) in which is formed an air outlet (15) from which outlet air is blown out;

a horizontal blade (31) that changes an up and down direction flow of the outlet air;

a Coanda blade (32) that utilizes the Coanda effect, which is a phenomenon in which the outlet air tends to flow in a direction along an undersurface (32a) positioned in a direction out of and different from the flow direction of the outlet air, to change the outlet air of which air direction has been changed by the horizontal blade to a Coanda airflow along the undersurface; and

a control unit (40) that can adjust a relative angle between the Coanda blade and the horizontal blade in such a way as to selectively use either of a first airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a first angular range to produce the Coanda airflow on substantially the entire region of the undersurface of the Coanda blade, and a second airflow state, in which the control unit adjusts the relative angle to a predetermined angle in a second angular range larger than the first angular range to not produce the Coanda airflow.

2. The air conditioning indoor unit according to claim 1, wherein

when the relative angle is adjusted to a predetermined angle in a third angular range, this results in a third airflow state in which the Coanda airflow is produced on part of the undersurface of the Coanda blade, and

the first angular range and the second angular range are set in such a way as to exclude the third angular range.

3. The air conditioning indoor unit according to claim 2, wherein an upper limit angle of the first angular range is set to an angle equal to or less than an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range.

4. The air conditioning indoor unit according to claim 2 or 3, wherein a lower limit angle of the second angular range is set to an angle equal to or greater than an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular

range.

5. The air conditioning indoor unit according to claim 2 or 3, wherein an angle at which there is a transition from the first airflow state to the third airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range and an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the third angular range are different.

6. The air conditioning indoor unit according to claim 2 or 3, wherein an angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range are different.

7. The air conditioning indoor unit according to any one of claims 1 to 3, further comprising a fan (14) that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet, wherein

the Coanda airflow is produced as a result of the outlet air being regulated by a regulating surface (31b) of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade,

the casing includes a scroll surface (17) that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path (18) for the outlet air, and

in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.

8. The air conditioning indoor unit according to claim 4, wherein an angle at which there is a transition from the first airflow state to the third airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the first angular range and an angle at which there is a transition from the third airflow state to the first airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the third angular range are different.

9. The air conditioning indoor unit according to claim 4, wherein an angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and an angle at which there is a transition from the third airflow state to the second

airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range are different.

10. The air conditioning indoor unit according to claim 5, wherein an angle at which there is a transition from the second airflow state to the third airflow state in a case where the relative angle has been gradually decreased from a predetermined angle in the second angular range and an angle at which there is a transition from the third airflow state to the second airflow state in a case where the relative angle has been gradually increased from a predetermined angle in the third angular range are different.

11. The air conditioning indoor unit according to claim 4, further comprising a fan (14) that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet, wherein

the Coanda airflow is produced as a result of the outlet air being regulated by a regulating surface (31b) of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade,

the casing includes a scroll surface (17) that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path (18) for the outlet air, and

in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.

12. The air conditioning indoor unit according to claim 5, further comprising a fan (14) that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet, wherein

the Coanda airflow is produced as a result of the outlet air being regulated by a regulating surface (31b) of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade,

the casing includes a scroll surface (17) that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path (18) for the outlet air, and
in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.

13. The air conditioning indoor unit according to claim 6, further comprising a fan (14) that is disposed inside the casing and forms an airflow in which air taken into the casing is channeled toward the air outlet, wherein

the Coanda airflow is produced as a result of the outlet air being regulated by a

regulating surface (31b) of the horizontal blade and thereafter flowing along the undersurface of the Coanda blade,

the casing includes a scroll surface (17) that ranges from a back side of the fan to the air outlet and forms a lower portion of a flow path (18) for the outlet air, and

in a case where the first airflow state is used, the regulating surface of the horizontal blade is set in such a way as to be in a position on an upper side of an imaginary extension plane of the scroll surface.