

INDUCTION DEVICE

BACKGROUND OF THE INVENTION

1. Field of the Invention

[0001]

The present invention relates to an induction device used for air conditioning and ventilation in large space such as a logistics warehouse, a dome stadium, an exhibition hall, and semi-outdoor space. The induction device is connected to at least one of an air conditioner and a duct (for example, an air conditioning duct, a ventilation duct, or the like.) to mix conditioned air flowing in from the air conditioner or the like and air inducted from surrounding space, thereby blowing the mixed air out.

2. Description of the Related Art

[0002]

When air-conditioning or ventilating large space such as a logistics warehouse, a dome stadium, an exhibition hall, and semi-outdoor space should be performed, it is necessary to use large-scaled air-conditioning equipment (for example, an air handling unit, a duct system, or the like.) to process a large volume of air. However, air-conditioning or ventilating in large space not only consumes a lot of energy, but also increases costs for installation and/or running of the equipment.

[0003]

Considering the above problem, there is equipment (an induction device) including an induction mechanism for inducting air from surrounding space of a duct to mix the inducted air and conditioned air in prior art.

[0004]

For example, Reference 1 discloses an air conditioning device provided with a fan blowing air whose temperature has been adjusted by a temperature adjustment means from an outlet into an area to be air-conditioned. This air conditioning device includes an induction mixing means that inducts and inhales air within the area to be air-conditioned utilizing air flow blown out from the fan to mix the inducted and inhaled air and air blown out from the fan within an outlet air passage from the fan to the outlet.

[0005]

Reference 2 also discloses a grill-type induction outlet designed in order to prevent cold drafts and condensation.

[List of cited References]

[0006]

Reference 1: Japanese patent application Laid-Open No. H04-268130

Reference 2: Japanese patent application Laid-Open No. 2015-081721

OBJECTS AND SUMMARY OF THE INVENTION

[0007]

However, the air conditioning device disclosed in Reference 1 is concealed in a ceiling as shown in Fig. 1 to Fig. 3 of Reference 1. The air conditioning device also includes an intake chamber forming box 16 within arrangement of the induction mixing means 14 (See paragraph 0020.), and the induction portion is arranged within the box. For this reason, the internal air A2 is also inducted in only one direction (the vertical direction) with respect to fan-delivered air A1, and is also inducted from the internal air present within the box. Accordingly, it cannot be said that ambient air is efficiently

inducted, and the device is not suitable to be used in air conditioning and/or ventilation of large space such as a logistics warehouse.

[0008]

Furthermore, the grill-type induction outlet disclosed in Reference 2 uses the structure of the grill body 1 to induct ambient air and prevent condensation on the downstream side of the outlet, however, the structure thereof is so complicated (See Fig. 2.). The grill-type induction outlet is used as an air conditioning system that reduces the volume of air supplied from an air conditioner and supply thereof to space to be conditioned such as a room (See paragraphs 0002 to 0004.). For this reason, the volume of air that the grill-type induction outlet capable of being handled is limited, and large volume of air cannot be handled thereby. In this context, it is difficult to apply the outlet to air conditioning for large space. In this grill-type induction outlet, ambient air is taken into the main body 1 through the front outlet opening 11 and passes through the induction duct 3, and then the flow direction deflects in the opposite direction to the inflow direction to join the mixed outlet draft duct 4, thereby increasing the pressure loss within the grill-type induction outlet. Furthermore, since the outlet 2 of this grill-type inducted draft outlet has an area of about half of the grill front, the mixed air blown out from the outlet 2 naturally increases blowing airflow velocity. This feature may give a user an excessive draft feeling to reduce his/her comfort.

[0009]

In view of the above, an object of the present invention is to provide a more convenient air induction device that can increase the amount of air supplied from the outlet for processing a large amount of air and can suppress condensation within an outlet thereof.

[0010]

A first aspect of the present invention provides an induction device for mixing conditioned air flowing in from an upstream side directly or indirectly via a duct from an air conditioner and ambient air inducted from surrounding space to blow out mixed air into air-conditioned space in a downstream side, the induction device comprising: an upstream portion including a connection port connecting to at least one of the air conditioner and the duct toward the upstream side; and a downstream portion including an outlet in the downstream side, and the downstream portion mixing the conditioned air and the ambient air to blow out the mixed air from the outlet, wherein: the upstream portion includes: a contracting portion whose flow path cross-sectional area continuously decreases from the upstream side to the downstream side; and an opening provided with a trailing edge of the contracting portion, the conditioned air being blown out via the opening toward the downstream portion; and the downstream portion includes: an enlarged portion whose flow path cross-sectional area continuously increases from the upstream side to the downstream side; an induction port provided with the upstream side, the conditioned air being blown from the upstream portion flowing into the induction port; and an induction port provided with the downstream side, the ambient air being inducted via the induction port.

[0011]

With this arrangement,

(1-1) the conditioned air generated by the air conditioner flows into the upstream portion from the connection port of the upstream portion, directly from the air conditioner or indirectly via a duct, and then flow speed thereof increases due to the contracting portion, further promoting the induction of ambient air that flows in through the induction port of the downstream portion, the induction port being connected to the

downstream side of the upstream portion.

(1-2) In a case where the air conditioner operates in a cooling mode, the temperature of the air blown out from the outlet is about 10 °C, and the ambient air is warmer than this air (conditioned air). Since the ambient air is inducted via an induction port to be mixed with the conditioned air, the temperature of the mixed air becomes higher than the temperature of the incoming conditioned air (about 10 °C).

[0012]

Herein, it is preferable that the downstream portion is connected to the downstream side of the upstream portion by means of a connection unit at a position where the opening and the induction port face to each other.

[0013]

With this arrangement, since the opening and the induction port are connected by the connection unit at the position where the opening and the induction port face to each other, the conditioned air blown out from the opening is always blown out toward the induction port.

[0014]

Herein, it is preferable that the downstream portion (of the induction device) includes an airflow adjustment unit rectifying the mixed air blown out from the outlet, dividing the flow path within the downstream portion in the vertical direction (into an upper part and a lower part), and having a roughly sideways V-shape expanding toward the outlet in left side view. With this arrangement, the mixed air is evenly divided (in the vertical direction) into the upper part and the lower flow part (into an upper path and a lower flow path) within the downstream portion, and the divided air is blown out from the outlet. The respective air flow is supplied to the space to be air-conditioned while

diffusing after having been blown out.

[0015]

It is preferable that the airflow adjustment unit includes: an upper surface plate (an upper surface part) positioned at an upper side of the downstream portion, the upper surface plate extending from an upstream end toward the outlet; and a lower surface plate (a lower surface part) positioned at a lower side of the downstream portion, the lower surface plate extending from the upstream end toward the outlet; the downstream portion includes a plurality of guides provided so as to respectively extend from the downstream end of the upper surface plate (the upper surface part) and the downstream end of the lower surface plate (the lower surface part) within the airflow adjustment unit to the outlet, the plurality of guides dividing the outlet into three parts in a vertical direction in front view. This arrangement creates induction of ambient air toward the “central region” of the outlet. The “central region” is positioned between the plurality of guides, and is generated by dividing the outlet into the three parts in the vertical direction in front view. The induction causes the ambient air to flow from the “central region” of the outlet toward inside of the downstream portion.

[0016]

It is preferable that the plurality of guides are respectively provided so as to have gaps from the downstream end of the upper surface plate and the downstream end of the lower surface plate within the airflow adjustment unit. This arrangement causes induction of ambient air toward the “central region,” and the inducted air flows through the gaps between the airflow adjustment unit and one of the plurality of guides into the upper flow path and the lower flow path in the downstream portion.

[0017]

It is preferable that the downstream portion is movably connected to the upstream portion. With this arrangement, since the downstream portion is movably connected to the upstream portion, the downstream portion can be moved to form any angle.

[0018]

It is preferable that a nozzle is provided with the downstream portion so as to be positioned at the opening of the upstream portion. With this arrangement, the nozzle increases the airflow velocity of the conditioned air blown from the opening to the induction port of the downstream portion.

[0019]

In addition, it is preferable that the induction device further comprises a plurality of airflow adjustment vanes arranged along a longitudinal direction of the outlet to adjust an airflow direction of the mixed air blown out. With this arrangement, it is possible to change the direction wherein the mixed air is blown out from the outlet while taking conditions of the space to be air-conditioned into consideration.

Effect of Invention

[0020]

By means of the induction device according to the present invention, due to the above arrangement thereof,

(1-1) conditioned air generated by the air conditioner flows into the upstream portion from the upstream connection port, directly from the air conditioner or indirectly via the duct, and then flow speed thereof is increased by the contracting portion, further promoting the induction of ambient air that flows in through the

induction port of the downstream portion, which is connected to the downstream side of the upstream portion. By means of the induction device, ambient air with a volume of about “30 %” of the conditioned air can be inducted, and the volume of the mixed air supplied from the induction device can be increased by about “30 %” compared with the conditioned air. For example, if an air volume of “130” is required for the space to be air-conditioned it is necessary to generate conditioned air with the air volume of “130” according to a conventional air conditioner. By means of the induction device according to the present invention, the air conditioner can generate conditioned air with an air volume of “100” and induct ambient air with an air volume of about “30”, thereby making it possible to increase the amount of the mixed air blown out to be the value of “130”. In other words, it is, as a result, possible to reduce the output of the air conditioner and make the air conditioner smaller.

(1-2) Furthermore, when the air conditioner operates in a cooling mode, since the temperature of the mixed air blown out from the outlet is higher than the temperature of the conditioned air that flows in, condensation around the outlet can be suppressed.

[0021]

(2) Herein, since the downstream portion is connected to the downstream side of the upstream portion by means of the connection unit at a position where the opening and the induction port face with each other, the conditioned air blown out from the opening is always blown out toward the induction port. Accordingly, the conditioned air blown out from the upstream portion can efficiently flow into the downstream portion without loss.

[0022]

(3) Furthermore, with the arrangement including the airflow adjustment unit, the mixed air is split in the vertical direction (into the upper flow path and the lower flow path of the downstream portion) to be blown out from the outlet. After having been blown out, the respective split airflows are supplied to the air-conditioned space while diffusing well. For this reason, when the mixed air reaches to a position where a user exists, the airflow velocity thereof decreases to be a low level such that does not discomfort the user. On the other hand, if the induction device does not include the airflow adjustment unit, the mixed air becomes an airflow concentrated in the center of the outlet, and the airflows are not diffused enough at the outlet. So, the mixed air may hit the user while the airflow velocity dose not decrease enough compared with the above case wherein the airflow adjustment unit is included. This situation may cause to discomfort the user.

[0023]

(4) In particular, since the airflow adjustment unit includes the upper surface plate (the upper surface portion), the lower surface plate (the lower surface portion), and the plurality of guides, the mixed air is separated into the upper flow path and the lower flow path within the downstream portion by the plurality of guides to be guided more reliably to the outlet. As a result, the airflows blown out from the outlet does not tend to be centered in the vertical direction of the outlet, but are blown out separately with each other in the vertical direction from the upper region of the outlet and the lower region of the outlet.

[0024]

(5) Furthermore, since the plurality of guides are provided having gaps with the downstream end of the upper surface plate and the downstream end of the lower surface plate of within the airflow adjustment unit, ambient air is inducted to space between the

plurality of guides, that is, the “central region” among three parts to which the outlet is divided in the vertical direction in view from the front. The inducted air flows through the gaps between the airflow adjustment unit and the plurality of guides into the upper flow path and the lower flow path within the downstream portion. In this way, the volume of mixed air blown out from the “upper region” and “lower region” of the outlet can be further increased. In short, the “central region” of the outlet plays a role of an induction port for inducting ambient air near the front of the outlet, thereby further improving induction efficiency.

[0025]

(6) In addition, with the arrangement wherein the downstream portion is movably connected to the upstream portion, the downstream portion can be moved to form any angle. Accordingly, the direction in which the mixed air is blown into the air-conditioned space can be arbitrarily determined within a movable range thereof.

[0026]

(7) Furthermore, providing the nozzle within the downstream portion so as to be positioned at the opening in the upstream portion causes the nozzle to increase the airflow velocity of the conditioned air blown out from the opening toward the induction port in the downstream portion, thereby furthermore stabilizing an induction rate of the ambient air that flows in through the induction port in the downstream portion.

[0027]

(8) In addition, with the arrangement wherein the plurality of airflow adjustment vanes are provided, a user can freely change the direction and range of the mixed air blown out from the outlet of the induction device while taking conditions of the space to be air-conditioned into consideration.

BRIEF DESCRIPTION OF THE DRAWINGS

[0028]

Fig. 1 is a perspective schematic front, plan, and left side view showing an induction device in Embodiment 1 according to the present invention;

Fig. 2 (i) is a perspective schematic front, plan, and left-side view showing a first casing, and Fig. 2 (ii) is a perspective schematic front, plan, and left-side view of a second casing;

Fig. 3 is a perspective schematic front, bottom, and left side view of the induction device shown in Fig. 1;

Fig. 4, (i) is a rear view of the induction device shown in Fig. 1, and Fig. 4 (ii) is a front view of the same;

Fig. 5 (i) is a plan view of the induction device shown in Fig. 1, and Fig. 5 (ii) is a bottom view of the same;

Fig. 6 (i) is a right side view of the induction device shown in Fig. 1, Fig. 6 (ii) is a left side view of the same, and Fig. 6 (iii) is a cross-sectional view taken along the “A-A” line in Fig. 4(ii);

Fig. 7 is a perspective view wherein some parts are omitted of the cross section shown in Fig. 6 (iii);

Fig. 8 is a diagram for explaining a detailed arrangement based on the cross-sectional view shown in Fig. 6 (iii);

Fig. 9 is a diagram for explaining an airflow adjustment unit in another Embodiment based on the cross-sectional view shown in Fig. 6 (iii);

Fig. 10 is a perspective schematic front, plan, and left side view showing the induction device in Embodiment 1 of according to the present invention wherein the second casing is tilted downward;

Fig. 11 is a perspective schematic front, bottom, and left side view of the induction device shown in Fig. 10;

Fig. 12 (i) is a right side view of the induction device shown in Fig. 10, Fig. 12 (ii) is a left side view of the same, and Fig. 12 (iii) is a cross-sectional view of the second casing wherein the second casing is tilted downward;

Fig. 13 is a diagram for explaining operation of the induction device according to the present invention based on the cross-sectional view shown in Fig. 6 (iii);

Fig. 14 shows an image wherein mixed air is blown out from the induction device shown in Fig. 13;

Fig. 15 is a diagram for explaining operation of the induction device in a case wherein an airflow adjustment unit is not provided based on the cross-sectional view shown in Fig. 6 (iii);

Fig. 16 shows an image wherein mixed air is blown out from the induction device shown in Fig. 15;

Fig. 17 is a perspective schematic front, plan, and left side view showing an induction device in Embodiment 2 according to the present invention;

Fig. 18 (i) is a front view of the induction device shown in Fig. 17, and Fig. 18 (ii) is a plan view of the same;

Fig. 19 shows an image wherein mixed air is blown out from the induction device shown in Fig. 17;

Fig. 20 shows an image wherein mixed air is blown out from the induction device shown in Fig. 17;

Fig. 21 shows an image wherein mixed air is blown out from the induction device shown in Fig. 17; and

Fig. 22 is a cross-sectional view based on Fig. 6 (iii) showing an induction device in Embodiment 3 according to the present invention.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0029]

Hereinafter, Embodiments of the present invention will now be explained in detail, however the description of requirements disclosed below shows mere examples (representative examples) in the Embodiments according to the present invention. It must be understood that the present invention is not limited to the followings as long as the gist of the present invention is not changed.

[0030]

(INDUCTION DEVICE)

The induction device 10 mixes conditioned air SA that flows in from the upstream side directly from an air conditioner (not shown) or indirectly via a duct (not shown) and ambient air AA that is inducted from surrounding space to blow out the mixed air MA into downstream air-conditioned space (See Fig. 1 to Fig. 13.). The induction device 10 is composed of the upstream portion 100 and the downstream portion 200. The upstream portion 100 and the downstream portion 200 may be formed integrally, or may be formed separately from each other and connected. In this specification, the latter case will be explained. For this reason, for convenience in the

followings, the “upstream portion” will be called as the “first casing” and the “downstream portion” will be called as the “second casing.”

[0031]

In this specification, the direction where the connection port 101 of the induction device 10 exists is called as the rear (upstream side), and the direction where the outlet 202 exists is called as the front (downstream side). In addition, in this specification, the up-down direction and the left-right direction are defined based on the front-to-back direction (See Fig. 1.), and the front-to-back direction and the horizontal direction are synonymous, the up-to-down direction and the vertical direction are synonymous, and the left-to-right direction and the width direction are also synonymous.

[0032]

(FIRST CASING)

The first casing 100 includes the connection port 101 connecting an air conditioner or a duct for the upstream side. The first casing 100 also includes the contracting portion 110 whose cross-sectional area of the flow path continuously decreases from the upstream side to the downstream side. The opening 102 through which the conditioned air SA is blown out toward the second casing 200 is provided at the trailing edge 110e of the contracting portion 110 (See Fig. 2 (i)).

[0033]

The contracting portion 110 is formed by means of the side wall member 110s, and the upper wall member 110t and the lower wall member 110b. The upper wall member 110t and the lower wall member 110b are arranged facing to each other (See Fig. 2 (i)). The contracting degree of the contracting portion 110, that is, the angle

formed by the upper wall material 110t and the lower wall material 110b, can be changed as desired. In Embodiment 1, the angle A1 (See Fig. 6(ii).) is a value of “110°”.

[0034]

In addition, the connection port 101 is a short pipe with a rectangular shape, and the short pipe is inserted into the connection port of an air conditioner or the like (the connection port of an air conditioner or the like is also a short pipe). And, the circumference of the short pipe is fastened with screws, and then sealed with tape or the like to make the connection thereof. Alternatively, the connection port 101 may be flanged and connected to the air conditioner or the like by means of a bolt, a nut, a clip, or the like (not shown.).

[0035]

In addition, the nozzle 250 is provided with the opening 102 of the first casing 100 to increase the airflow velocity of the conditioned air SA blown out toward the induction port 201 of the second casing 200 (See Fig. 1 and Fig. 6(iii).). In Embodiment 1, the nozzle 250 is fixed to the second casing 200 (See Fig. 2.), and is provided so as to be movable with respect to the first casing 100 (See Fig. 6 (iii) and Fig. 12 (iii).). More specifically, since the second casing 200 includes partitions 240 (241, 242) as mentioned later, the nozzles 250 are also provided respectively in the areas divided by means of the partitions 240 (nozzles 251, 252, 253). Of course, the nozzle 250 is not limited to this form as long as it can increase the airflow velocity of the conditioned air SA blown out toward the induction port 201 of the second casing 200 and can be provided in the portion where the opening 102 of the first casing 100 exists.

[0036]

Furthermore, in Embodiment 1, the nozzle 250 has a curved inner surface (See

Fig. 6 (iii).). For this reason, even when the second casing 200 is tilted downward (See Fig. 12 (iii).), the conditioned air can be reliably guided in the tilted direction, and the airflow, which flows through the regions (the upper flow path 280 and the lower flow path 281) divided into upper and lower two parts by the airflow adjustment unit 220, can be generated more stably (See Fig. 6 (iii).). In this way, moving the nozzle 250 in conjunction with the movement of the second casing 200 causes the conditioned air whose speed has been increased by the nozzle to be made to flow efficiently into the downstream portion without loss.

[0037]

In Embodiment 1, iron plates (galvanized iron plates) are used for the respective members of the first casing 100. Also, heat insulating material (polyethylene foam) is attached to outer surfaces of members including: the upper wall material 110t; the lower wall material 110b; and the side wall material 110s of the first casing 100.

[0038]

(SECOND CASING)

On the other hand, the second casing 200 includes the outlet 202 at the downstream side, mixes the conditioned air SA and the ambient air AA to blow out the mixed air MA from the outlet 202. The second casing 200 includes the induction port 201 at the upstream side through which the conditioned air SA blown out from the first casing 100 (opening 102) flows in, and also includes the enlarged portion 210 whose flow path cross-sectional area continuously increases from the upstream side to the downstream side (See Fig. 2 (ii).). The second casing 200 includes the induction port 203 provided with the downstream side than the inlet 201 through which the ambient air AA is inducted.

[0039]

Similar to the contracting portion 110 of the first casing 100, the enlarged portion 210 of the second casing 200 is formed by means of the side wall material 210s and upper wall material and lower wall material facing to each other (See Fig. 2 (ii).) In Embodiment 1, the induction port 203 is provided over almost the entire of the upper side (the part where the upper wall material exists) and the lower side (the part where the lower wall material exists) of the second casing 200 (See Fig. 1, Fig. 3, or the like.). In Embodiment 1, the angle A2 (See Fig. 6 (ii).) formed between the upper wall material and the lower wall material is a value of “30°”.

[0040]

Moreover, the hanging tool 270 for suspending the second casing 200 is provided above the outlet 202. In Embodiment 1, the hanging tools 270 (271, 272) are provided on the left and right sides of the upper part of the outlet 202 (See Fig. 1, or the like.). The hanging tool 270 is suspended by means of a hanging bolt (not shown) and a nut (not shown) provided on a building frame (for example, a ceiling). In this way, the second casing 200 can be supported on the building frame (for example, a ceiling) via the hanging tool 270.

[0041]

The second casing 200 is connected to the downstream side of the first casing 100 at a position where the opening 102 and the induction port 201 face to each other. For example, if it is assumed that Fig. 2 (i) and Fig. 2(ii) show the first casing 100 and the second casing 200 before being connected to each other respectively, the first casing 100 and the second casing 200 are connected to each other at the position wherein the opening 102 and the induction port 201 face to each other to become the induction

device 10 as shown in Fig. 1. In Embodiment 1, a part (rear part) of the second casing 200 including the induction port 201, overlaps and is connected to the front part of the first casing 100 (See Fig. 6.).

[0042]

In addition, the second casing 200 is connected to the first casing 100 by means of the connection unit so as to be movable with respect to the first casing 100. In Embodiment 1, the first casing 100 and the second casing 200 are connected by means of the connection unit 260 such as screws and/or connecting rods (See Fig. 4 (i) and Fig. 6 (iii).). Accordingly, from a state wherein the first casing 100 and the second casing 200 are aligned in a horizontal line (See Fig. 1.), the second casing 200 can be tilted downward in the same manner as the induction device 11 (See Fig. 10 to Fig. 12.). Of course, the second casing 200 can also be tilted upward, and the tilting angle can be changed arbitrarily (for example, from “horizontal (0°)” to “30°”). And then, the second casing 200 can be fixed to the first casing 100 in the state wherein the second casing 200 is tilted.

[0043]

In Embodiment 1, iron plates (galvanized iron plates) are used for the respective members of the second casing 200, including: the airflow adjustment unit 220; the guide 230; the nozzle 250; and the like. In addition, insulating material (polyethylene foam) is attached to the outer surfaces of the second casing 200 and the outlet 202. More specifically, insulating material is attached to the side wall material 210s, the outer surfaces: of the nozzle 250; the upper surface plate 221b; the lower surface plate 222b; the plate-shaped member 223; and the guide 230 of the airflow adjustment unit 220 (See Fig. 6 (iii).). In particular, it is preferable to provide the insulating material on the surfaces of: the upper surface plate 221b; the lower surface

plate 222b; the plate-shaped member 223; and the guide 230 of the airflow adjustment unit 220, which come into contact with the ambient air AA inducted from the central region 310 as the ambient air AA passes through. It is also preferable to provide the insulating material on the surfaces of the nozzle 250, which comes into contact with the ambient air AA inducted from the induction port 203 as the ambient air AA passes through (See Fig. 6 and Fig. 13.).

[0044]

The horizontal length L1 (See Fig. 8.) of the induction device 10 of Embodiment 1 is 600 (mm). The horizontal length L2 of the second casing 200 (See Fig. 8.) is 500 (mm), and the length L3 from the enlarged portion 210 to the outlet 202 (See Fig. 6 (ii).) is 50 (mm). On the other hand, the length L4 (See Fig. 8.) in the height direction of the first casing 100 is 350 (mm) (370 (mm) when the heat insulating material is provided on the outer surface thereof). The second casing 200 has the height L5 (See Fig. 8.) of 400 (mm). The length L6 (See Fig. 5 (i).) of the second casing 200 in the width direction is 1,225 (mm) (1,245 (mm) when the heat insulating material is provided on the outer surface thereof).

[0045]

As mentioned above, the induction device 10 includes the first casing 100 and the second casing 200 that are composed of separate bodies respectively. As shown in Embodiment 1 (See Fig. 6.), a part including the induction port 201 of the second casing 200 overlaps and is connected to the front portion of the first casing 100. For this reason, by appropriately designing the sizes of the first casing 100 and the second casing 200 of the induction device 10, it is possible to fit the induction device 10 to the sizes of the duct or the air conditioner wherein the induction device 10 is installed.

[0046]

(AIRFLOW ADJUSTMENT UNIT)

The induction device 10 also includes within the second casing 200 thereof the airflow adjustment unit 220 rectifying the mixed air MA blown out from the outlet 202. The airflow adjustment unit 220 is a plate-shaped member that crosses the interior of the second casing 200 in the left-right direction. The airflow adjustment unit 220 has a roughly sideways V-shape expanding toward the outlet 202 in left side view, and divides the flow path within the second casing 200 into an upper part (the upper flow path 280) and a lower part (the lower flow path 281) (See Fig. 6(iii) and Fig. 7.).

[0047]

In Embodiment 1, the airflow adjustment unit 220 includes the upper surface plate (upper surface portion) 221 positioned at the upper side of the second casing 200, and further includes: the upper surface plate 221 extending from the upstream end 220t of the airflow adjustment unit 220 toward the outlet 202; the lower surface plate (lower surface portion) 222 positioned at the lower side of the second casing 200; the lower surface plate 222 extending from the upstream end 220t toward the outlet 202; and the plate-shaped member 223.

[0048]

In addition, in Embodiment 1, the upper surface plate 221 is composed of: the upper surface plate 221a extending from the upstream end 220t toward the outlet 202; and the upper surface plate 221b extending in a continuous line with the downstream end of the upper surface plate 221a. The lower surface plate 222 is composed of: the lower surface plate 222a extending from the upstream end 220t toward the outlet 202; and the lower surface plate 222b extending in a continuous line with the downstream

end of the lower surface plate 222a. In Embodiment 1, the downstream end of the upper surface plate 221b and the downstream end of the lower surface plate 222b are connected by means of the plate-shaped member 223 that crosses the interior of the second casing 200 in the left-right direction. Since the plate-shaped member 223 is provided as mentioned above, the ambient air AA inducted from the central region 310 of the outlet 202 collides with the plate-shaped member 223, and then flows along the inner surfaces of the upper surface plate 221b and the lower surface plate 222b. For this reason, the ambient air AA is easily guided toward the upper flow path 280 in the second casing and the lower flow path 281 in the second casing. However, even if the plate-shaped member 223 is not provided, the ambient air AA is sufficiently guided from the central region 310 of the outlet 202.

[0049]

In Embodiment 1, with the upstream end of 220t as the fulcrum, the upper panel 221a and the lower panel 222a are angled A3 (See Fig. 8.), and the angle is a value of “30°”. Furthermore, the upper surface plate 221b extends upward more than the first direction in which the upper surface plate 221a extends, and the lower surface plate 222b extends downward more than the second direction in which the lower surface plate 222a extends (See the dotted line in Fig. 6 (iii).). In Embodiment 1, the angle A4 (See Fig. 8.) between the upper plate 221b and the lower panel 222b is a value of “50°” as the fulcrum point wherein the extending upper plate 221b and the extending lower panel 222b (to the downstream side) intersect with each other.

[0050]

In Embodiment 1, the airflow adjustment unit 220 has a generally sideways V-shape in the left side view. The shape thereof is, however of course, not limited to this one as long as the airflow adjusting unit can achieve the effects disclosed in this

specification. For example, at least one of: the upper surface plate 221; the lower surface plate 222; and the guide 230 may be partially or entirely curved. Alternatively, the upper surface plate 221 and the lower surface plate 222 may extend to the outlet 202, and the blocking plate 234 may be provided between the downstream end of the upper surface plate 221 and the downstream end of the lower surface plate 222 (See Fig. 9.). In this case, the upper surface plate 221, the lower surface plate 222, and the blocking plate 234 create a closed space between the upper flow path 280 and the lower flow path 281 within the second casing 200. However, even with such arrangement, the mixed air MA blown out from the outlet 202 can be rectified and the flow paths within the second casing 200 can be divided into an upper part and a lower part (the upper flow path 280 and the lower flow path 281).

[0051]

(GUIDE)

In addition, the induction device 10 includes a plurality of guides 230 provided within the second casing 200 so as to extend from the downstream end of the upper surface plate 221 and the downstream end of the lower surface plate 222 of the airflow adjustment unit 220 to the outlet 202 (See Fig. 1, Fig. 4(ii), Fig. 6(iii), or the like.). In Embodiment 1, two guides 230 (the guides 231 and 232) are provided so as to divide the outlet 202 into three parts in the vertical direction in front view.

[0052]

For this reason, in Embodiment 1, the outlet 202 of the induction device 10 is divided into three regions by the guides 231 and 232. The three regions include: the upper region 300; the central region 310; and the lower region 320 (See Fig. 1, Fig. 4(ii), or the like.). In Embodiment 1, the ratio of the lengths of the upper region 300, the

central region 310, and the lower region 320 in the vertical direction (height direction) is approximately a ratio of “4:5:4.”

[0053]

In Embodiment 1, the guides 231 and 232 are provided closer to the center of the outlet 202 than the upper surface plate 221b and the lower surface plate 222b. Moreover, since the guides 231 and 232 are provided parallel to the upper surface plate 221b and the lower surface plate 222b respectively, the angle A5 (See Fig. 8.) formed between the guide 231 and the guide 232 is a value of “50°”. As mentioned above, the upper surface plate 221b extends upward more than the first direction in which the upper surface plate 221a extends, and the lower surface plate 222b extends downward more than the second direction in which the lower surface plate 222a extends, and the guides 231, 232 are provided closer to the center of the outlet 202 than the upper surface plate 221b and the lower surface plate 222b. Accordingly, a gap is created between the downstream end of the airflow adjustment unit 220 (the upper surface plate 221 and the lower surface plate 222) and the upstream end of the guide 230. This gap, which will be mentioned in detail later, plays a role as a passageway wherein the ambient air AA inducted from the central region 310 of the outlet 202 hits the inside of the airflow adjustment unit 220 and flows into the upper flow path 280 and the lower flow path 281 (See Fig. 6 (iii) and Fig. 13.).

[0054]

The airflow adjustment unit 220 and the guide 230 explained above are designed appropriately while taking various conditions into consideration. For example, dimensions of a triangular portion including: the upper surface plate 221; the lower surface plate 222; or the like of the airflow adjustment unit 220, and dimensions of the guide 230 are designed appropriately while taking an amount of inducted ambient air

SA, a shape of the outlet 202 blowing out the mixed air MA, or the like into consideration.

[0055]

(PARTITION)

The induction device 10 includes the partitions (partition plates) 240 provided within the second casing 200 so as to separate the air flow path flowing inside of the second casing 200 at regular intervals in the left-right direction (width direction) (See Fig. 1, Fig. 4(ii), or the like.). In other words, the inside of the second casing 200 is divided into a plurality of flow paths in the left-right direction by the partitions 240 that are arranged upright along the flow direction of the conditioned air SA (See Fig. 13.). By providing the partitions 240, the flow path of the air flowing inside the second casing 200 is divided at regular intervals in the width direction to be rectified, thereby preventing from increasing pressure loss within the second casing 200. In addition, since the airflow in the width direction of the second casing 200 is rectified, the air induction efficiency can also be improved. Furthermore, since the partitions 240 play a role of reinforcing material, the strength of the induction device 10 in the width direction can be also increased at the same time.

[0056]

In Embodiment 1, two partitions 240 are provided (the partitions 241 and 242), which are provided so as to divide the outlet 202 into three parts in the left-right direction in front view (See Fig. 1, or the like.). For this reason, in Embodiment 1, the outlet 202 of the induction device 10 is divided into six areas by the guides 231, 232 and the partitions 241, 242. The six areas include: the upper areas 301, 302, 303, the lower areas 310, 311, 312, and the lower areas 320, 321, 322 (See Fig. 1, Fig. 4(ii), or

the like.).

[0057]

(OPERATION OF INDUCTION DEVICE)

Referring to Fig. 1 to Fig. 13 as well as Fig. 14 to Fig. 16, the operation of the induction device 10 will now be explained as follows.

[0058]

First, the conditioned air SA flows into the induction device 10 from the connection port 101 of the first casing 100. The first casing 100 is connected to an air conditioner or the like (See Fig. 13.). When the conditioned air SA passes through the contracting portion 110 and flows toward the outlet 202 at the downstream side, the flow speed increases due to the portion of the contracting portion 110 whose flow path cross-sectional area continuously decreases toward the downstream side. For this reason, the induction of the ambient air AA flowing in through the induction port 203 provided in the second casing 200 connected to the downstream side of the contracting portion 110 is further promoted.

[0059]

The ambient air AA inducted through the induction port 203 is mixed with the conditioned air SA in the enlarged portion 210 of the second casing 200 and is blown out from the outlet 202 as the mixed air MA.

[0060]

In this way, the induction of ambient air AA is further promoted, and the air volume of the mixed air MA blown out from the induction device 10 is the “air volume of conditioned air SA supplied from the air conditioner to the induction device 10” plus

the “ambient air AA induced by the conditioned air SA,” which results in increasing approximately 30% over the air volume of the conditioned air SA itself.

[0061]

In addition, since the ambient air AA is induced through the induction port 203 and mixed within the second casing 200, when the air conditioner or the like operates in a cooling mode (when the temperature of the conditioned air SA is low), the temperature of the mixed air MA blown out from the outlet 202 becomes higher than the temperature of the conditioned air SA. For this reason, condensation within the outlet 202 can be suppressed. Herein, the insulating material is attached to the first outer surfaces of the first casing 100 and the second outer surfaces and the outlet of the second casing 200. Accordingly, the second casing 200 and the like are not cooled by the conditioned air SA, and condensation can be suppressed even when the ambient air AA comes into contact with the second casing 200 and/or around the outlet 202.

[0062]

In addition, with respect to the induction device 10, while the blowing direction of the mixed air MA into the air-conditioned space can be arbitrarily determined within the movable range, the opening 102 and the induction port 201 are connected at a position wherein the opening 102 and the induction port 201 face to each other. For this reason, the conditioned air SA blown out from the opening 102 is always blown out toward the induction port 201, so that no matter how the second casing 200 is moved (tilted), the conditioned air SA blown out from the first casing 100 can flow into the second casing 200 efficiently without loss.

[0063]

In addition, since the induction device 10 includes the airflow adjustment unit

220, the mixed air MA is split into an upper part and a lower part (into the upper flow path 280 and the lower flow path 281 within the second casing 200), and is blown out from the outlet 202 (See Fig. 6 (iii).). In other words, the mixed air MA is blown out from the upper region 300 and the lower region 320 of the outlet 202, and is blown out without an excessive increase in the airflow velocity compared with a case wherein the mixed air MA is blown out horizontally without being split into the upper part and the lower part. Accordingly, the mixed air MA blown out from the outlet 202 does not increase in the airflow velocity excessively, and is blown out while being well-diffused over a wide area (See Fig. 13.). For this reason, the induction device 10 can adjust the airflow velocity of the mixed air MA that is blown out such that the airflow velocity of the mixed air MA that blows a user staying in the air-conditioned space takes a desired value (See Fig. 14.).

[0064]

If the airflow adjustment unit 220 is not provided, the mixed air MA will not be sufficiently diffused from the outlet 202 differing from the induction device 20, and will be blown out horizontally while concentrating near the center of the outlet 202 in the height direction (See Fig. 15.). For this reason, this mixed air MA blows the user staying in the air-conditioned space without being attenuated, which may cause discomfort the user (See Fig. 16.).

[0065]

The outlet 202 of the induction device 10 is divided into three parts of: the upper region 300; the central region 310; and the lower region 320 by the guides 231 and 232. Accordingly, the ambient air AA is caused to be inducted to the central region 310, and the ambient air AA flows from the central region 310 of the outlet 202 to inside of the second casing 200.

[0066]

For this reason, the airflow flowing inside the second casing 200 is divided by the guide 230 into the upper flow path 280 and the lower flow path 281 within the second casing to be more reliably guided to the outlet 202, so that the air does not become concentrated in the center in the vertical direction (height direction) of the outlet 202. And then, the air is blown out from the upper region 300 and the lower region 320 of the outlet 202 while being diffused in the vertical direction (See Fig. 13.). According to the induction device 10, the airflow velocity of the blown mixed air MA can be adjusted to take any desired value regardless of a airflow velocity and/or a point (See Fig. 14.).

[0067]

In addition as mentioned above, the guide 230 inducts the ambient air AA toward the central region 310 of the outlet 202, and the inducted ambient air AA hits inside of the airflow adjustment unit 220 (particularly the plate-shaped member 223) and flows into the upper flow path 280 and the lower flow path 281 (See Fig. 6 (iii).) through the gap between the guide 230 (231, 232) and the airflow adjustment unit 220 (221, 222). And then, the air is mixed within the second casing 200 and is blown out as the mixed air MA from the upper region 300 and the lower region 320 (See Fig. 13.).

[0068]

In short, by providing the guide 230, the induction device 10 can also induct the ambient air AA into the second casing 200 from a part of the outlet 202, thereby further promoting the induction of the ambient air AA. In this way, the volume of the mixed air MA supplied by the induction device 10 can be further increased.

[0069]

(EMBODIMENT 2 other than the above)

Next, the induction device in Embodiment 2 other than the above according to the present invention will now be explained. The same components as those of the induction device 10 are attached with the same reference numerals in Figs., and detailed explanations thereof will be omitted.

[0070]

The induction device 30 is composed in a manner such that the first casing 100 and the second casing 200 are aligned in a horizontal line (so that the mixed air MA blown out from the induction device 30 is also horizontal), and a plurality of airflow adjustment vanes 400 are provided near the outlet 202 of the second casing 200 (See Fig. 17 and Fig. 18.). In Embodiment 2, the plurality of plate-shaped airflow adjustment vanes 400 are provided with the upper region 300 and the lower region 320 in a state of being aligned in the horizontal direction. The airflow adjustment vanes 400 can be formed by bending a metal plate from a cut provided in the plate, and a black painted steel plate is used for the same in Embodiment 2. By using the black painted steel plate, the airflow adjustment vanes 400 become less noticeable to be capable of improving the appearance thereof. Of course, the number, size, thickness, material, or the like of the airflow adjustment vanes 400 can be changed as needed, and for example, aluminum plates or other materials can be used for the purpose of reducing weight thereof.

[0071]

The airflow adjusting vanes 400 are composed of vertical blades that can be tilted left and right in a plan view, and adjusts the blowing direction of the mixed air MA blown out from the outlet 202 in the left and right direction in plan view (See Fig. 17.). Herein, Fig. 19 (i) to Fig. 21 (i) show a partially omitted plan view of the induction

device 30 enlarged so that the inclination of the airflow adjustment vanes 400 can be clearly seen (the airflow adjustment vanes 400 are shown in solid lines), and Fig. 19 (ii) to Fig. 21 (ii) show images of the mixed air MA being blown out.

[0072]

When the airflow adjustment vanes 400 face straight ahead (when the airflow adjustment vanes 400 are not tilted), the mixed air MA is blown out in a straight direction from the outlet 202 (See Fig. 17 and Fig. 19.). In this case, the reach distance of the straight-line airflow can be ensured. For this reason, a user can set the device to this state when he/she wants to ensure the reach distance (when he/she wants the airflow to reach a point that is somewhat far away) or when he/she does not need to change the direction of the wind.

[0073]

In addition, when the airflow adjustment vanes 400 provided with the upper region 301 and the lower region 321 are tilted approximately “30°” to the left, and the airflow adjustment vanes 400 provided with the upper region 303 and the lower region 323 are tilted approximately “30°” to the right, and the airflow adjustment vanes 400 provided with the upper region 302 and the lower region 322 are facing straight ahead (when the airflow adjustment vanes 400 are not tilted), the mixed air MA is blown out from the outlet 202 while being diffused in the left and right direction (See Fig. 17 and Fig. 20.). In this case, the reach distance is reduced compared with a case shown in Fig. 19, but the airflow can be well-diffused over a wide area in the left and right direction. For this reason, the user can select this situation when he/she wants to diffuse the airflow over a wider area rather than ensuring the reach distance, or when an area to be air-conditioned is relatively close to the induction device 30.

[0074]

When all of the airflow adjustment vanes 400 are tilted to the left by about a value of “30°”, the mixed air MA is blown out from the outlet 202 while being deflected to the left (See Fig. 21.). Spot use is available in this case. The user can select this situation, if he/she wants the airflow to reach only a specific area (if he/she doesn't want to supply air to an unnecessary area or if he/she wants to avoid an area with an obstacle). Since the inclination of the plurality of airflow adjusting vanes 400 can be set arbitrarily and respectively, the blowing direction of the blown mixed air MA can be adjusted more precisely.

[0075]

As mentioned above, the user can arbitrarily change the inclination of the airflow adjustment vanes 400 to change the blowing direction and blowing range of the mixed air MA blown out from the outlet 202 of the induction device 30 according to the conditions of the space to be air-conditioned. In addition, similar to the induction device 10, the induction device 30 can tilt the second casing 200 downward or upward, so the blowing direction of the mixed air MA can be also adjusted more precisely in the up, down, left, and right directions.

[0076]

(EMBODIMENT 3 other than the above)

Some parts of the induction device 40 are extruded (See Fig. 22.). In Embodiment 3, the airflow adjustment unit 220, the guide 230, the nozzle 250, the upper panel member 290, the lower panel member 291 (See Fig. 7.), or the like are made of aluminum extrusions formed by extruding aluminum alloy. In the induction device 10, the upper surface plate 221b of the airflow adjustment unit 220 is integrated

with the upper surface plate 221a, and the lower surface plate 222b is integrated with the lower surface plate 222a. On the other hand, the upper surface plate 221b and the lower surface plate 222b of the airflow adjustment unit 220 of the induction device 40 are made of extruded members with the same shape as that of the guide 230 (231, 232) and are used (shared) as separate members from each other. The upper surface plate 221a and the lower surface plate 222a of the airflow adjustment unit 220 are integrated with the plate-shaped member 223 to form a hollow triangular extrusion. In the induction device 40, by replacing the sheet metal member with an aluminum extrusion instead of iron plates for example, it is possible to reduce the number of manufacturing steps. This shaping method is particularly effective for components with a complicated shape, as it eliminates the need for curved surface processing and bending processes that are troublesome when using the iron plates. In addition, by using aluminum to form the extrusion, the product can be made lighter compared with a case wherein the iron plates are used. In addition, if the extruded portion is in a movable side of the induction device 40 (the second casing 200's side), the movable side becomes lighter, reducing the effort required to switch the induction device 40 between horizontal blowing and diagonally downward blowing, or the like, thereby making it easier to operate the device.

[0077]

In addition, the induction device 40 includes C-shaped protrusions (screw holes BH) on the extruded guide 230 and the extruded nozzle 250, and these screw holes BH are used to screw into other members (for example, iron plates). Providing the screw holes BH also causes to reinforce the guide 230, thereby particularly increasing the strength of the guide 230 (a flat plate-shaped member) in the longitudinal direction. In this case, it is possible to eliminate the partition 240 (See Fig. 1.) provided as a reinforcing member in the width direction of the induction device 10, thereby reducing

the number of parts, reducing costs, and simplifying manufacturing thereof. With regard to simplifying manufacturing the device, increasing the strength of steel plate components requires additional bending processes, which increases the number of processing steps.

[0078]

Also, in the induction device 40, similar to the induction device 10, heat insulating material is provided on the outer surfaces of the first casing 100, the second casing 200, the guide 230, the nozzle 250, or the like of the airflow adjustment unit 220. (See the hatched areas in Fig. 22.).

[0079]

In order to reduce the weight of the components constituting the induction devices 10 to 40, non-combustible lightweight materials (for example, non-combustible cardboards with aluminum foil attached to both sides thereof) can also be used. In this case, the induction device is manufactured from non-combustible cardboards, which makes material processing easier and simplifies manufacturing, and also makes the induction device itself lighter, thereby making installation and operation thereof easier.

[0080]

The induction device 10 explained above are mere examples of the induction device according to the present invention. The configuration of the present invention is not limited to the examples provided without departing from the gist of the present invention. For example, in Embodiment 3, the induction device 10 is disclosed as being configured such that the divided first casing 100 and the divided second casing 200 are connected by the connection unit 260 such as screws and/or connecting rods. The present invention is not limited to this example. More specifically, the first casing 100

and the second casing 200 may be integrally formed (one casing is constricted approximately in the center, with the upstream side of the constricted part being the upstream portion 100 and the downstream side being the downstream portion 200). Furthermore, the first casing 100 and the second casing 200 may be connected and integrated with each other by a connecting member such as a bellows as the connection unit.

[0081]

In addition, the number of partitions 240 may be increased in order to increase strength thereof, and the length of the airflow adjustment unit 220 and the guide 230 in the horizontal direction may also be modified appropriately. Furthermore, the upper surface plate 221b, the lower surface plate 222b, and the plate-shaped member 223 may be integrally formed.

INDUSTRIAL APPLICABILITY

[0082]

The induction device according to the present invention is industrially useful because it can be widely used by being connected to an air conditioner and/or a duct used for air conditioning and ventilation in large space such as a logistics warehouse, a dome stadium, an exhibition hall, and semi-outdoor space.

BRIEF DESCRIPTION OF SYMBOLS

[0083]

10: Induction device

11: Induction device with downstream portion (Second casing) tilted downward

20: Induction device without airflow adjustment unit and guide

30, 40: Induction device in other Embodiments

100: Upstream portion (First casing)

101: Connection port

102: Opening

110: Contracting portion

110e: Trailing edge of contracting portion

110t: Upper wall material of contracting portion

110b: Lower wall material of contracting portion

110s: Side wall material of contracting portion

200: Downstream portion (Second casing)

201: Induction port

202: Outlet

203, 203a, 203b, 203c, 203d, 203e, 203f: Induction port

210: Enlarged portion

210s: Side wall material of enlarged portion

220: Airflow adjustment unit

220t: Upstream end of the airflow adjustment unit

221, 221a, 221b: Upper surface plate (upper surface portion) of the airflow adjustment unit

222, 222a, 222b: Lower surface plate (lower surface portion) of the airflow adjustment unit

unit

223: Plate-shaped member

230, 231, 232: Guide

234: Blocking plate

240, 241, 242: Partition (partition plate)

250, 251, 252, 253: Nozzle

260: Connection unit

270, 271, 272: Hanging tool

280: Upper flow path in downstream portion (Second casing)

281: Lower flow path in downstream portion (Second casing)

290: Upper panel member

291: Lower panel member

300, 301, 302, 303: Upper region

310, 311, 312, 313: Central Region

320, 321, 322, 323: Lower Region

400: Airflow Control Vanes

L1: Horizontal Length of Induction Device

L2: Horizontal Length of Downstream Section (Second Casing)

L3: Length from Enlarged portion to Outlet

L4: Height of Upstream Section (First Casing)

L5: Height of Downstream Section (Second Casing)

L6: Width of Downstream Section (Second Casing)

A1: Angle between the Upper and Lower Wall Materials of Contracting portion

A2: Angle between the Upper and Lower Wall Materials of Enlarged portion

A3: Angle between the Upper and Lower Panels 221a and 222a of Airflow adjustment unit

A4: Angle between the Upper and Lower Panels 221b and 222b of Airflow adjustment unit

A5: Angle between Guide 231 and Guide 232

BH: Screw Hole

SA: Conditioned Air

AA: Ambient air

MA: Mixed air

What is claimed is:

1. An induction device for mixing conditioned air flowing in from an upstream side directly or indirectly via a duct from an air conditioner and ambient air inducted from surrounding space to blow out mixed air into air-conditioned space in a downstream side, the induction device comprising:

an upstream portion including a connection port connecting to at least one of the air conditioner and the duct toward the upstream side; and

a downstream portion including an outlet in the downstream side, and the downstream portion mixing the conditioned air and the ambient air to blow out the mixed air from the outlet,

wherein:

the upstream portion includes:

a contracting portion whose flow path cross-sectional area continuously decreases from the upstream side to the downstream side; and

an opening provided with a trailing edge of the contracting portion, the conditioned air being blown out via the opening toward the downstream portion; and

the downstream portion includes:

an enlarged portion whose flow path cross-sectional area continuously increases from the upstream side to the downstream side;

an induction port provided with the upstream side, the conditioned air being blown from the upstream portion flowing into the induction port; and

an induction port provided with the downstream side, the ambient air being inducted via the induction port.

2. The induction device as defined in claim 1, wherein the downstream portion is connected to the downstream side of the upstream portion by means of a connection unit at a position where the opening and the induction port face to each other.

3. The induction device as defined in claim 1 or 2, wherein the downstream portion includes an airflow adjustment unit rectifying the mixed air blown out from the outlet, dividing the flow path within the downstream portion into an upper part and a lower part, and having a roughly sideways V-shape expanding toward the outlet in left side view.

4. The induction device as defined in claim 3, wherein:

the airflow adjustment unit includes:

an upper surface plate positioned at an upper side of the downstream portion, the upper surface plate extending from an upstream end toward the outlet; and

a lower surface plate positioned at a lower side of the downstream portion, the lower surface plate extending from the upstream end toward the outlet;

the downstream portion includes a plurality of guides provided so as to respectively extend from the downstream end of the upper surface plate and the downstream end of the lower surface plate within the airflow adjustment unit to the outlet, the plurality of guides dividing the outlet into three parts in a vertical direction in

front view.

5. The induction device as defined in claim 4, wherein the plurality of guides are respectively provided so as to have gaps from the downstream end of the upper surface plate and the downstream end of the lower surface plate within the airflow adjustment unit.

6. The induction device as defined in claim 1 or 2, wherein the downstream portion is movably connected to the upstream portion.

7. The induction device as defined in claim 6, wherein a nozzle is provided with the downstream portion so as to be positioned at the opening of the upstream portion.

8. The induction device as defined in claim 1, further comprising:

a plurality of airflow adjustment vanes arranged along a longitudinal direction of the outlet to adjust an airflow direction of the mixed air blown out.