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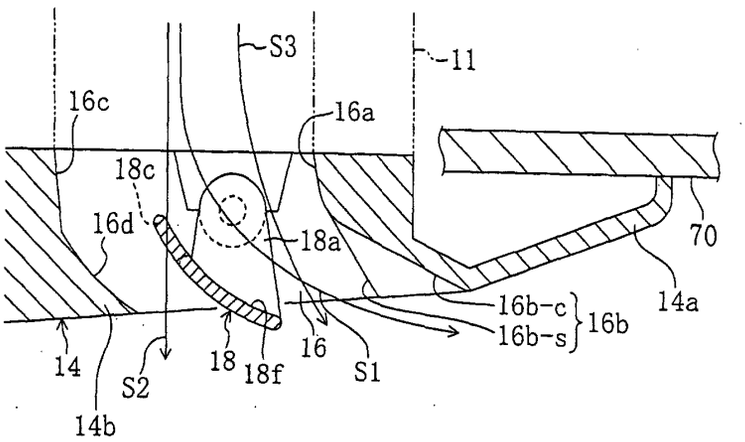
(54) DECORATIVE PANEL FOR AIR CONDITIONING SYSTEM, AIR OUTLET BLOW-OFF UNIT, AND AIR CONDITIONING SYSTEM

(57) The configuration of an airconditioner air vent **(16)** is improved so that horizontal emission by a horizontal vane **(18)** becomes possible and, at the same time, in order to prevent a ceiling surface **(70)** from becoming dirty when performing a horizontal emission operation, areas in the vicinity of both lengthwise ends of the air vent **(16)** are so configured that the direction in which conditioned air is emitted at lengthwise both ends of the air vent **(16)** is oriented more downwardly than the emission direction at a lengthwise middle portion of the air vent **(16)**.

Fig. 3



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Description

Technical Field

[0001] The present invention relates to airconditioner decorative panels, to airconditioner vent units, and to airconditioners. This invention relates particularly to configurations for an airconditioner air vent.

Background Art

[0002] In airconditioners of, for example, the ceiling flush mounting type or the duct type, horizontal vanes, capable of vertically changing the direction in which conditioned air is emitted, are conventionally mounted at air vents. During heating mode of operation, the emission direction of conditioned air is oriented relatively downward by the horizontal vanes and, on the other hand, during cooling mode of operation, the emission direction of conditioned air is oriented relatively upward so as to be as parallel as possible to a ceiling surface (so-called a "horizontal emission" operation), with a view to achieving a uniform distribution of room temperature during each mode of operation for the purpose of increasing the efficiency of air-conditioning.

[0003] However, in such a "horizontal emission" state, particulate dust contained in the emitted conditioned air and dust contained in indoor air are likely to deposit on ceiling surface areas. As a result, the ceiling surface becomes partially dirty. More specifically, a flow of air emitted from an air vent **(a)** in a state of "horizontal emission" forms a shape approximately similar to a V-shape along the flow, when viewing the airconditioner from a horizontal direction (see Figure **10**). Here, the velocity of a flow of air emitted at a lengthwise middle portion of the air vent **(a)** is rapid, so that negative pressure grows stronger, thereby preventing emitted air from reaching a ceiling surface **(b)** in the vicinity of the air vent.

[0004] On the other hand, since the velocity of a flow of air emitted at each end of the air vent **(a)** is slow, the air is drawn by negative pressure at the middle portion. As a result, the air reaches the ceiling surface **(b)** in the vicinity of the air vent **(a)**. At this time, dust contained in such a slow airflow emitted at each end of the air vent **(a)** (more specifically, dust contained in the slow airflow emitted at each end of the air vent **(a)** plus indoor dust involved by the slow airflow) will deposit on the ceiling surface **(b)**. Because of this, ceiling surface fouling is normally found in regions **(D)** in close proximity to both sides of the air vent **(a)** and in approximately a V shape, being directed toward the middle portion from the both ends of the air vent **(a)** as it leaves away from the air vent **(a)** (see Figure **2**).

[0005] With a view to circumventing such ceiling surface fouling, Japanese Patent Application *Kokai* Gazette No. H03-160266 proposed a technique in which an auxiliary fin operable to change the emission direction to orient in the direction of a ceiling surface is mounted detachably on a horizontal vane. And, the auxiliary fin is installed and removed, depending on the tendency that ceiling fouling occurs. In an airconditioner constructed in accordance with the gazette technique, such an auxiliary fin is removed and the horizontal vane is oriented downward, for example in an environment likely to cause ceiling fouling because of indoor air that contains dust in large amounts or in a place such as a hospital that requires high levels of contamination prevention. On the other hand, the auxiliary fin is installed so that a horizontal emission operation can be performed, for example in an environment unlikely to cause ceiling fouling or in a place that does not require high levels of contamination prevention.

[0006] However, even when an auxiliary fin is provided as in the aforementioned prior art example, the auxiliary fin must be removed in an environment likely to cause ceiling fouling. After all, conditioned air is continuously emitted downward from the air vent. This causes a drop in air-conditioning efficiency during cooling mode of operation in which a horizontal emission operation should basically be carried out. Besides, there is another problem that cold air falls directly on a person present in a room. This may cause uncomfortable feeling (so-called "draft feeling") to the person.

[0007] Bearing in mind the above-described problems, the invention was made. Accordingly, an object of the invention is to make it possible to perform a horizontal emission operation by a horizontal vane while preventing ceiling fouling by improvement in the configuration of an air vent.

DISCLOSURE OF THE INVENTION

[0008] The invention relates to improvements in the shape of an air vent, whereby conditioned air is emitted in a more downward direction at both lengthwise ends of the air vent than at a lengthwise middle portion of the air vent.

[0009] More specifically, the invention provides problem-solving means which are premised on a decorative panel for an airconditioner comprising an air vent **(16)** through which conditioned air is emitted from the direction of a ceiling surface **(70)** into an indoor space and a horizontal vane **(18)**, mounted at the air vent **(16)**, for adjusting the direction in which conditioned air is emitted, on a vent unit for an airconditioner comprising an air vent **(16)** through which conditioned air is emitted from the direction of a ceiling surface **(70)** into an indoor space and a horizontal vane **(18)**, mounted at the air vent **(16)**, for adjusting the direction in which conditioned air is emitted, on an airconditioner comprising the decorative panel **(14)** which is mounted along the ceiling surface, and on an airconditioner in which the vent unit **(51)** is mounted on a ceiling surface and is connected, through a fan duct **(52)**, to an airconditioner main body **(53)**.

[0010] The air vent **(16)** is so configured that condi-

tioned air is emitted in a more downward direction at, substantially, both lengthwise ends of the air vent **(16)** (i.e., at areas in the vicinity of the both lengthwise ends of the air vent **(16)**) than at a lengthwise middle portion of the air vent **(16)**. For example, in addition to the arrangement that the both ends of the vent **(16)** differs in the angle at which conditioned air is emitted from the middle portion of the vent **(16)**, when the angle of emission at the emission direction inside of the horizontal vane **(18)** is originally set more downward than the angle of emission at the emission direction outside, the volume of downward air emitted at the both ends of the air vent **(16)** may be increased.

[0011] In the above-described configuration, the air vent **(16)** may be provided, at the areas in the vicinity of the both lengthwise ends thereof, with guide surfaces **(16b-s)** which guide conditioned air to be emitted in a more downward direction at the areas than at the lengthwise middle portion.

[0012] Further, in the above-described configuration, it is possible to employ such a configuration that the guide surfaces **(16b-s)** of the air vent **(16)** are formed at areas in the vicinity of both lengthwise ends of either or both of sidewalls **(16a, 16b)** and **(16c**, **16d)** of the air vent **(16)** and the angle formed between the areas in the vicinity of the both lengthwise ends of the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)** and the ceiling surface **(70)** is greater than the angle formed between a lengthwise middle portion **(16b-c)** of the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)** and the ceiling surface **(70)**.

[0013] Further, in the above-described configuration, the guide surfaces **(16b-s)** of the air vent **(16)** may be formed in the sidewall **(16a, 16b)** corresponding to a side which becomes an upper surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission.

[0014] Furthermore, the guide surfaces of the air vent **(16)** may be composed of the sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission. In this case, in addition to the arrangement that the angle of the sidewall **(16c, 16d)** at the areas in the vicinity of the both lengthwise ends is made different from the angle of the sidewall **(16c, 16d)** at the lengthwise middle portion, the opening width of the air vent **(16)** at the both ends may be made greater than the opening width of the air vent **(16)** at the lengthwise middle portion so that the volume of downward air increases. In other words, when the guide surfaces, for guiding conditioned air to be emitted in a more downward direction at the areas in the vicinity of the both lengthwise ends of the air vent **(16)** than at the lengthwise middle portion of the air vent **(16)**, are composed of the sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of the horizontal vane **(18)** when the horizontal vane **(18)** placed in a state of horizontal emission, it is possible to increase the volume of downward air emitted at the both ends in the configuration that the opening width of the air vent **(16)** at the both ends is made greater than the opening width of the air vent **(16)** at the lengthwise middle portion because generally the angle of the sidewall **(16c, 16d)** with respect to the ceiling surface **(70)** is originally set relatively great.

[0015] By virtue of the above-described configuration, when conditioned air is emitted indoors through the air vent **(16)**, during cooling mode of operation conditioned air is guided in substantially a horizontal direction at the middle portion of the air vent **(16)** at which the emission velocity is relatively high while at the same time conditioned air is emitted in a more downward direction at the both lengthwise ends of the air vent **(16)** at which the emission velocity is relatively slow than at the lengthwise middle portion. Because of this, the flow rate of conditioned air, emitted at a low emission velocity at the both ends of the air vent **(16)** and flowing along the ceiling surface, will decrease. Further, during heating mode of operation the horizontal vane **(18)** is adjusted to be oriented downward, so that conditioned air is emitted indoors in a downward direction through the entire air vent **(16)**.

[0016] Especially, if the guide surfaces **(16b-s)** are formed at the areas in the vicinity of the both lengthwise ends of the air vent **(16)**, regulating the angle of the both ends of the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)**, this ensures downward emission at the both ends of the air vent **(16)** with a simple configuration.

[0017] Further, if the angle-regulation guide surfaces **(16b-s)** are formed in the sidewall **(16a, 16b)** corresponding to a side which becomes an upper surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission, this causes the guide surfaces **(16b-s)** to approach the horizontal vane **(18)** at the both ends of the air vent **(16)**. As a result, the distance between the horizontal vane **(18)** and the guide surfaces **(16b-s)** narrows, and conditioned air is definitely emitted in a more downward direction at the both ends than at the middle portion. Additionally, since the distance between the horizontal vane **(18)** and the guide surfaces **(16b-s)** is narrowed, this reduces the flow rate of air emitted at the both ends of the air vent **(16)**.

[0018] Conversely, if the angle-regulation guide surfaces **(16b-s)** are formed in the sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission, this widens the distance between the horizontal vane **(18)** and the guide surfaces of the sidewall **(16c, 16d)** at the both ends of the air vent **(16)**, thereby ensuring that conditioned air is emitted in a more downward direction at the both ends than at the middle portion.

[0019] Further, in the above-described construction, preferably the air vent **(16)** is so formed that, when the horizontal vane **(18)** is placed in a state of horizontal

emission, the lengthwise middle portion **(16b-c**) of the sidewall **(16a, 16b)(16c, 16d)** provided with the guide surfaces **(16b-s)** is inclined correspondingly to the inclination of the horizontal vane **(18)**. Further, the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)** provided with the guide surfaces **(16b-s)** may be configured so that the angle formed with respect to the ceiling surface **(70)** varies continuously from the lengthwise middle portion **(16b-c)** to the areas in the vicinity of the both ends **(16b-s)**.

[0020] As a result of the above-described arrangement, when the horizontal vane **(18)** is placed in a state of horizontal emission (for example during cooling mode of operation), conditioned air emitted indoors through the air vent **(16)** flows between the lengthwise middle portion **(16b-c)** of the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)** and the horizontal vane **(18)** and its flow direction is changed smoothly. The conditioned air is emitted in a direction substantially in parallel with the ceiling surface **(70)**. On the other hand, also at this time, conditioned air emitted at the both ends of the air vent **(16)** is delivered indoors in a downward direction.

[0021] In the above-described construction, preferably the horizontal vane **(18)** is so configured that conditioned air is allowed to pass through airflow upstream side end edges of the areas in the vicinity of the both lengthwise ends. For example, opening portions **(18c)** may be defined by notching parts of the horizontal vane **(18)**.

[0022] As a result of such arrangement, when the horizontal vane **(18)** is placed in a state of horizontal emission, air at the both ends of the air vent **(16)** passes through the opening portions **(18c)** of the horizontal vane **(18)** and so on. Because of this, air at the middle portion of the air vent **(16)** is emitted in a horizontal direction and, on the other hand, air at the both ends is emitted downward more definitely.

[0023] Further, when the air vent **(16)** is provided, at areas in the vicinity of its lengthwise ends, with extension portions **(16L)** so that the lengthwise opening length of the air vent **(16)** extends at areas facing an indoor space (see Figure **9**), the guide surfaces **(16b-s)** of the air vent **(16)** are desirably formed in regions substantially corresponding to the extension portions **(16L)**.

[0024] If the air vent **(16)** is provided with such extension portions **(16L)** when no guide surfaces **(16b-s)** are formed, this causes conditioned air flowing downward in the air circulation passageway **(W)** and striking the horizontal vane **(18)** to flow from the lengthwise middle portion side toward the extension portions **(16L)**. Thereafter, the conditioned air is emitted slowly in approximately a horizontal direction. However, if the guide surfaces **(16b-s)** are provided in regions substantially corresponding to the extension portions **(16L)**, conditioned air is emitted in a more downward direction at the both ends of the air vent **(16)** in comparison with the case where no guide surfaces **(16b-s)** are provided.

Effects

[0025] In accordance with the above-described problem-solving means, during cooling mode of operation which requires horizontal emission of conditioned air, air is emitted in a horizontal direction at the lengthwise middle portion of the air vent **(16)** while at the both lengthwise ends of the air vent **(16)** a part of air is emitted in a downward direction. As a result, the air emitted at the both lengthwise ends is unlikely to flow along the ceiling surface **(70)**. Therefore, fouling of the ceiling surface **(70)** is prevented and, in addition, horizontal emission is ensured in totality. Because of this, the occurrence of fouling of the ceiling surface **(70)** can be avoided while securing an emission direction according to the operating status of the airconditioner.

[0026] Further, if the guide surfaces **(16b-s)** of the areas in the vicinity of the both lengthwise ends of the air vent **(16)** are surfaces regulating the angle of the sidewall **(16a, 16b)(16c, 16d)** of the both ends of the air vent **(16**), this realizes a simplified construction while preventing ceiling fouling by ensuring that conditioned air is emitted downward at the both ends of the air vent **(16)**.

[0027] Furthermore, if the guide surfaces **(16b-s)** are formed in the sidewall **(16a, 16b)** corresponding to a side which becomes an upper surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission, this narrows the distance between the horizontal vane **(18)** and the guide surfaces **(16b-s)** at the both ends of the air vent **(16)**, thereby reducing the flow rate of air emitted at the both ends of the air vent **(16)**. As a result, air emitted at the both ends of the air vent **(16)** is unlikely to be involved by air emitted at the middle portion of the air vent **(16)**, thereby preventing ceiling fouling more definitely.

[0028] Conversely, even when the guide surfaces are formed in the sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission, conditioned air is emitted in a downward direction at the both ends of the air vent **(16)**, thereby preventing ceiling fouling.

[0029] Further, if the lengthwise middle portion **(16b-c)** of the sidewall **(16a, 16b)(16c, 16d)** is so constructed as to incline correspondingly to the inclination of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission, this makes it possible to achieve ceiling fouling prevention because conditioned air is emitted downward at the both ends of the air vent **(16)** while ensuring that conditioned air is emitted in a horizontal direction at the middle portion of the air vent **(16)**.

[0030] Furthermore, if the sidewall **(16a, 16b)(16c, 16d)** of the air vent **(16)** is so configured that the angle formed with respect to the ceiling surface **(70)** varies continuously from the lengthwise middle portion **(16b-c)** to the areas in the vicinity of the both ends **(16b-s)**, this allows the angle of the sidewall **(16b)** to vary

smoothly. This makes the air vent **(16)** superior in the aspect of design. Additionally, there are no parts that cause the emission angle of air to change abruptly, so that airflow turbulence is unlikely to occur.

[0031] Further, if opening portions **(18c)** or the like through which conditioned air is allowed to pass are formed at the airflow upstream side end edges of the areas in the vicinity of the both lengthwise ends of the horizontal vane **(18)**, air emitted at the both ends of the air vent **(16)** passes through the opening portions **(18c)** when the horizontal vane **(18)** is placed in a state of horizontal emission. As a result, the air emitted at the both ends of the air vent (**16)** is emitted in a downward direction more definitely while air emitted at the middle portion of the air vent **(16)** is delivered in a horizontal direction, thereby ensuring that ceiling fouling is prevented.

[0032] Furthermore, if, when the extension portions **(16L)** are defined at the areas in the vicinity of the both lengthwise ends of the air vent (16), the guide surfaces (16b-s) of the air vent **(16)** are formed in regions substantially corresponding to the extension portions **(16L)** of the air vent **(16)**, air flowing out at the both ends of the air vent **(16)** is likely to be emitted downward, thereby enhancing the effect of preventing ceiling fouling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0033]

Figure **1** is a schematic cross-sectional diagram of a ceiling flush type airconditioner according to an embodiment of the invention;

Figure **2** is a perspective view of the ceiling-mounted airconditioner when viewed from below;

Figure **3**, which is an enlarged configurational diagram of an air vent, illustrates a state in which the direction in which conditioned air is emitted is set to a state of "horizontal emission";

Figure **4** is a diagram which is similar to Figure **3** but illustrates a state in which the conditioned air emission direction is set to a state of "downward emission";

Figure **5** is a perspective view of the air vent when viewed from below;

Figure **6** is a perspective view of a horizontal vane;

Figure **7** is a schematic construction diagram of a duct type airconditioner;

Figure **8** is comprised of Figures **8A-8D** which are perspective views showing horizontal vanes having different opening portion shapes;

Figure **9** is a partial perspective view when extension portions are defined in the air vent; and

Figure **10** is an explanatory diagram illustrating a state of a flow of conditioned air from an air vent when viewed from at a side of a conventional airconditioner.

BEST MODE FOR CARRYING OUT THE INVENTION

[0034] Hereinafter, embodiments of the invention will be described in detail with reference to the Figures.

[0035] Figure **1** is a vertical section showing an arrangement of the ceiling flush type airconditioner **(1)** according to an embodiment of the invention. As shown in the Figure, the airconditioner **(1)** comprises a casing **(10)** in which are housed a fan **(20)** and a heat exchanger **(30)**. The airconditioner **(1)** is embedded in an installation opening **(71)** which opens in a ceiling board (ceiling surface) **(70)**. In this way, the airconditioner **(1)** is installed in an under-roof space.

[0036] The casing **(10)** is made up of a box-shaped main body casing **(11)** which opens downward and a decorative panel **(14)** with which a bottom opening portion of the main body casing **(11)** is covered. The main body casing **(11)** is fixedly suspended from an overlying beam or the like by the use of a hanging ring, which is not shown in the Figure. More specifically, the main body casing **(11)** is made up of an octagonally shaped top plate **(12)** formed by notching, in a chamfering manner, four corners of a square plate (not shown) and side plates **(13)** extending downward from outer edges of the top plate **(12)**. The decorative panel **(14)** is a plate having a substantially square shape and is attached to lower ends of the side plates **(13)** of the main body casing **(11)**. The decorative panel **(14)** is attached along the ceiling board **(70)** so that its periphery is brought into abutment with a lower surface of the ceiling board **(70)**.

[0037] Further, as shown also in Figure **2** which is a perspective view showing a state in which the airconditioner **(1)** is ceiling-installed, an air inlet **(15)** is formed in substantially a central portion of the decorative panel **(14)** so as to open squarely. Formed immediately outside the four sides of the air inlet **(15)** and in parallel therewith are four rectangular air vents **(16)**. And, the air inlet **(15)** is provided, all over its surface, with an air filter **(17)** for removal of suspended substances such as particulate dust contained in indoor air. The entire lower surface of the air filter **(17)** is supported by a lattice filter cover.

[0038] The air vent **(16)** of the decorative panel **(14)** is defined between an outside guide surface **(16a, 16b)** which is a sidewall on the panel outer peripheral side (on the righthand side in the Figures) of an air passageway and an inside guide surface **(16c, 16d)** which is a sidewall on the panel inner peripheral side (on the lefthand side in the Figures). Areas in the vicinity of both lengthwise ends of the air vent **(16)** are so configured that conditioned air is emitted in a more downward direction in comparison with a lengthwise middle portion of the air vent **(16)**. For this end, the air vent **(16)** is provided, at the areas in the vicinity of the both lengthwise ends thereof, with guide surfaces **(16b-s)** so that conditioned air is emitted in a more downward direction in comparison with the lengthwise middle portion. The guide surfaces **(16b-s)** of the air vent **(16)** are formed

by areas in the vicinity of both lengthwise ends of one of the sidewalls of the air vent **(16)**, i.e., the sidewall **(16a, 16b)**. It is arranged such that the angle formed between the areas in the vicinity of the both lengthwise ends **(16b-s)** of the sidewall **(16a, 16b)** and the ceiling surface **(70)** is greater than the angle formed between the lengthwise middle portion **(16b-c)** of the sidewall **(16a, 16b)** and the ceiling surface **(70)**.

[0039] More specifically, as shown in an enlarged manner in Figures 3 and 4, the outside guide surface **(16a, 16b)** is made up of a first outside guide surface **(16a)** extending substantially vertically downward and a second outside guide surface **(16b)** inclining, from the lower end of the first outside guide surface **(16a)** to the lower surface of the decorative panel **(14)**, obliquely in a downward direction toward the panel outer periphery. These outside guide surfaces **(16a, 16b)** are joined together smoothly.

[0040] The second outside guide surface **(16b)** comprises the middle portion **(16b-c)** and the both ends **(16b-s)**. The middle portion **(16b-c)** is located longitudinally centrally in the air vent **(16)** and its inclination with respect to the ceiling surface **(70)** is set relatively small (an angle of about 30 degrees). The both ends **(16b-s)** are located in the vicinity of the both lengthwise ends of the air vent **(16)** and their inclination to the ceiling surface **(70)** is set relatively large (an angle of about 60 degrees). These portions forming a greater angle with respect to the ceiling surface **(70)** are formed into the guide surfaces **(16b-s)**.

[0041] The inclination of the second outside guide surface **(16b)** varies gradually from the middle portion **(16b-c)** toward the both ends **(16b-s)** and the angle formed with respect to the ceiling surface **(70)** varies continuously. And, as shown in Figure 5 which is a perspective view of the air vent **(16)** when viewed from below, the second outside guide surface **(16b)** further comprises a lower end edge **(16b-e)** shaped like a circular arc.

[0042] On the other hand, as shown in Figures **3** and **4**, the inside guide surface **(16c, 16d)** is made up of a first inside guide surface **(16c)** which extends substantially vertically downward and a second inside guide surface **(16d)** which gently inclines obliquely downward toward the panel outer periphery from the lower end of the first inside guide surface **(16c)**. These inside guide surfaces **(16c, 16d)** are joined together smoothly.

[0043] The outside guide surface **(16a, 16b)** is formed in an outside member **(14a)** of the decorative panel **(14)**, whereas the inside guide surface **(16c, 16d)** is formed in an inside member **(14b)** of the decorative panel **(14)**. The air vent **(16)** is, as described above, defined between the outside guide surface **(16a, 16b)** and the inside guide surface **(16c, 16d)**. And, in the air vent **(16)**, the horizontal vane **(18)** capable of vertically adjustment of the direction in which conditioned air is emitted is disposed between the outside guide surface **(16a, 16b)** of the outside member **(14a)** and the inside guide surface **(16c, 16d)** of the inside member **(14b)**. In addition, the guide surfaces **(16b-s)** of the air vent **(16)** are located on a side of the horizontal vane **(18)** which becomes an upper surface of the horizontal vane **(18)** when the horizontal vane **(18)** is placed in a state of horizontal emission.

[0044] The horizontal vane **(18)** is, as depicted in Figure **6**, a long plate member and bends slightly throughout its width direction. Arms **(18a, 18a)** projecting from an inside surface of the horizontal vane **(18)** are formed integrally with the both lengthwise ends of the horizontal vane **(18)**, respectively. Formed at the end of each arm **(18a)** is a connecting pin **(18b)** that extends outward along the lengthwise direction of the horizontal vane **(18)**. The horizontal vane **(18)** is mounted at the air vent **(16)** in such a way that it can swivel about the connecting pins **(18b, 18b)**. More specifically, the horizontal vane **(18)** is swiveled about the connecting pins **(18b, 18b)** by a motor (not shown). In the above-described arrangement, the horizontal vane **(18)** is oriented downward when conditioned air is required to be emitted in the most downward direction, as shown in Figure **4**. On the other hand, in a so-called "horizontal emission" mode of operation, the horizontal vane **(18)** is so set as to be oriented upward, as shown in Figure **3**.

[0045] Notches **(18c)** as opening portions through which conditioned air is allowed to pass are defined at the airflow upstream side end edges of areas in the vicinity of the both lengthwise ends of the horizontal vane **(18)**. These notches **(18c)** are formed at the airflow upstream side end edges of the areas in the vicinity of the both lengthwise ends of the horizontal vane **(18)**, having a length of approximately a quarter of the lengthwise length of the horizontal vane **(18)**. Because of the provision of these notches **(18c)**, the horizontal vane **(18)** has such a shape that the both ends **(18e)** have a narrowed width about two thirds of that of the middle portion **(18d)**. Further, the horizontal vane **(18)** may have for example the following specific dimensions. The entire length of the horizontal vane **(18)** is about 480 mm. The width of the horizontal vane **(18)** (the width of the middle portion **(18d)**) is about 37 mm. The width of each end **(18e)** is about 25 mm. The length of each notch **(18c)** is about 120 mm.

[0046] The outside guide surface **(16a, 16b)** bends, at the middle portion thereof, substantially conformingly to the cross-sectional shape of the horizontal vane **(18)** (the shape is not limited to such a bent one and any shape may be used as long as it substantially conforms to the shape of the horizontal vane **(18)**). In other words, the air vent **(16)** is so configured that, when the horizontal vane **(18)** is placed in a state of horizontal emission, the sidewall **(16a, 16b-c)** of the lengthwise middle portion assumes an inclination corresponding to the horizontal vane **(18)**, in other words the entire inclination is substantially the same as that of the horizontal vane **(18)**. On the other hand, the inside guide surface **(16c, 16d)** is so formed as to extend, in totality, more vertically

downward than the outside guide surface **(16a, 16b)** of the outside member **(14a)**. In addition, the shape of the inside guide surface **(16c, 16d)** is a matter of choice.

[0047] And, these two wall surfaces (the outside guide surface **(16a, 16b)** and the inside guide surface **(16c, 16d)**) having the aforesaid shapes and lying face to face with each other, are formed so as to stretch the lengthwise length of the air vent **(16)** (i.e., in a direction normal to the paper surface of the Figure). The air passageway defined between the wall surface **(16a, 16b)** and the wall surface **(16c, 16d)** has a function of serving as an "approach way" for adjusting a flow of conditioned air while changing the direction of the conditioned air flow.

[0048] On the other hand, the fan **(20)** is located substantially centrally in the inside of the main body casing **(11)**. This fan is a so-called turbofan in which a blade (23) is held between a shroud **(21)** and a hub **(22)**. A drive shaft **(26)** of the fan motor **(25)** mounted on the top plate **(12)** of the main body casing **(11)** is fixedly inserted in the hub **(22)** of the fan **(20)**. The fan **(20)** is rotationally driven by driving force of the fan motor **(25)**, whereby air withdrawn from below the fan **(20)** is delivered radially laterally. Further, a bell-mouth **(27)** for guiding, to the fan **(20)**, air that has flowed into the inside of the casing **(10)** through the air inlet **(15)**, is provided underneath the fan **(20)**.

[0049] The heat exchanger **(30)** is a so-called cross fin heat exchanger made up of a large number of plate-like fins **(31)** which are arranged in parallel with each other and a heat transfer pipe **(32)** so arranged as to pass through the fins **(31)**. The heat exchanger **(30)** is formed into a rectangular cylinder, when viewed from top, so as to surround the periphery of the fan **(20)**. The heat exchanger **(30)** is connected, through a refrigerant pipe (not shown), to an outdoor unit. The heat exchanger **(30)** functions as an evaporator during cooling mode of operation, and as a condenser during heating mode of operation, for controlling the temperature state of air delivered from the fan **(20)**. And, a drain pan **(33)** for receiving drain water is disposed under the heat exchanger **(30)**.

[0050] By virtue of the above-described construction, an air circulation passageway **(W)** extending from the air inlet **(15)** of the decorative panel **(14)** to the air vent **(16)** by way of the air filter **(17)**, the bell-mouth **(27)**, the fan **(20)**, and the heat exchanger **(30)**, is defined in the inside of the main body casing **(11)** of the airconditioner **(1)**. And, when the fan **(20)** is driven during air-conditioning mode of operation, indoor air taken into the inside of the casing **(10)** from the air inlet **(15)** through the air filter **(17)** flows in the bell-mouth **(27)**, in the fan **(20)**, and in the heat exchanger **(30)** in that order in the air circulation passageway **(W)**. The indoor air exchanges heat with refrigerant in the heat exchanger **(30)** and is temperature controlled (cooled during cooling mode of operation and heated during heating mode of operation). Thereafter, the air is emitted, as conditioned air, into an indoor space. In this way, the indoor space is air-conditioned.

[0051] Here, when there is a demand for conditioned air to be emitted in a relatively downward direction, for example as in heating mode of operation or the like, the horizontal vane **(18)** is oriented substantially vertically downward (see Figure **4**) so that conditioned air is made to flow along the horizontal vane **(18)** between the panel outer peripheral side sidewall **(16a, 16b)** and the panel inner peripheral side sidewall **(16c, 16d)** of the air vent **(16)** and is emitted in a downward direction as indicted by Arrow S of the Figure.

[0052] On the other hand, during so-called "horizontal emission" mode of operation (for example during cooling mode of operation and so on), the horizontal vane **(18)** is turned in an upward direction (see Figure **3**) so that the upper surface **(18f)** of the horizontal vane **(18)** becomes substantially parallel with the middle portion **(16b-c)** of the second outside guide surface **(16b)** of the air vent **(16)**. As a result of this, conditioned air flows curvedly along the middle portion **(18d)** of the horizontal vane **(18)** at the middle portion of the air vent **(16)** and the direction of its line of flow varies greatly and smoothly. Then, as indicated by Arrow S1 of the Figure, the conditioned air passes between the second outside guide surface **(16b-c)** on the panel outer peripheral side of the air vent **(16)** and the horizontal vane **(18)**. Thereafter, the conditioned air is emitted through the air vent **(16)** at an emission angle as parallel as possible to the lower surface of the ceiling board **(70)** (for example, at angles of from 30 to 35 degrees with respect to the ceiling board's **(70)** lower surface).

[0053] Further, at the both ends of the air vent **(16)**, a part of conditioned air, which has flowed through the air circulation passageway **(W)** in a downward direction, flows in a more downward direction (i.e., in a direction indicated by Arrow S3) than the Arrow S1 direction, for the angle formed between the guide surfaces **(16b-s)** of the both ends of the air vent **(16)** and the ceiling surface **(70)** is great and the horizontal vane **(18)** approaches the guide surfaces **(16b-s)** to narrow the distance therebetween. Further, as described above, the distance between the horizontal vane **(18)** and the guide surfaces **(16b-s)** narrows at the both ends of the air vent **(16)** and, as a result, the flow rate of air flowing in the Arrow S3 direction decreases. Furthermore, at the both ends of the air vent **(16)**, the remaining part of the conditioned air which has flowed downward through the air circulation passageway **(W)** passes through the notches **(18c)** of the both ends **(18e)** of the horizontal vane **(18)** and is emitted in a downward direction as indicated by Arrow S2 of Figure **3.** Accordingly, air emitted at the both ends of the air vent **(16)** is unlikely to flow along the ceiling surface **(70)**.

[0054] In a conventional ceiling flush type airconditioner, a flow of air emitted at portions of low air emission velocity (at the both ends of the air vent **(16)**) is liable to reach the lower surface of the ceiling board **(70)**. If, during cooling mode of operation, the emission direction of

conditioned air is oriented relatively upward by the horizontal vane **(18)** so that the angle formed between the emission direction and the lower surface of the ceiling board **(70)** ranges between about 30 and about 35 degrees, this causes a flow of air to flow along the lower surface of the ceiling board **(70)**. As a result, ceiling fouling occurs in the regions (**D)** as indicated by virtual lines of Figure 2. In other words, ceiling fouling is distributed, substantially in a V-shape for each air vent. However, in accordance with the airconditioner **(1)** of the present embodiment, air emitted at the both ends of the air vent **(16)** is unlikely to flow along the lower surface of the ceiling board **(70)** during cooling mode of operation that especially requires a "horizontal emission" of conditioned air. Therefore, even when the emission direction of conditioned air emitted through the air vent **(16)** is varied by the horizontal vane **(18)** so that the angle formed between the conditioned air emission direction and the lower surface of the ceiling board **(70)** is made to come near to, for example, about 30 to about 35 degrees at the middle portion of the air vent, the occurrence of ceiling fouling can be prevented.

[0055] Therefore, in accordance with the airconditioner **(1)** of the present embodiment, ceiling fouling is prevented while making it possible to allow the emission direction of conditioned air to come closer to a horizontal direction than conventional, particularly during cooling mode of operation which requires horizontal emission of conditioned air. This prevents a resident present in the room from having uncomfortable feeling (draft feeling) while securing air-conditioning efficiency.

[0056] Further, in the present embodiment, each notch **(18c)** of the horizontal vane **(18)** is formed only in a region of each end **(18d)** of the horizontal vane **(18)** whose length is about a quarter of that of the horizontal vane **(18)**, which makes it possible to achieve, in totality, a satisfactory "horizontal emission" operation while at the same time preventing the occurrence of ceiling fouling.

[0057] Further, the invention is not limited to the above-mentioned embodiment. The invention includes other various embodiments.

[0058] For example, in the above-described embodiment the guide surfaces **(16b-s)** are formed only in the areas in the vicinity of the both ends of the outside guide surface **(16a, 16b)** of the air vent **(16)** and, in addition, the inclination of the sidewalls of the both end of the inside guide surface **(16c, 16d)** may be varied so that they are able to function as a guide surface. For example, the angle formed between the areas in the vicinity of the both ends of the inside guide surface **(16c, 16d)** of the air vent **(16)** and the ceiling surface is made greater than the angle formed between the middle portion of the inside guide surface **(16c, 16d)** and the ceiling surface, thereby making it possible for the areas in the vicinity of the inside guide surface **(16c, 16d)** to serve as a guide surface. Even such arrangement makes it possible to cause air to be emitted downward at the both ends of the air vent **(16)**, thereby preventing the occurrence of ceiling fouling.

[0059] Further, in the above-described embodiment it is arranged such that the angle of the outside guide surface **(16a, 16b)** of the air vent **(16)** continuously varies between the middle portion and the both ends. Alternatively, different embodiments may be possible. For example, it may be arranged such that the angle of the outside guide surface **(16a, 16b)** of the air vent **(16)** varies stepwise. In such a case, the lower end edge of the second outside guide surface **(16b)** and the lower end edge of the second inside guide surface **(16d)** may be shaped into other than a circular arc, e.g., into a trapezoidal shape.

[0060] Further, in addition to the arrangement that the both ends of the air vent **(16)** are made different in the angle at which conditioned air is emitted from the middle portion of the vent **(16)**, when, as in the above-described embodiment, the angle of emission at the emission direction inside (the side of the inside guide surface **(16c, 16d)**) of the horizontal vane **(18)** is originally set more downward than that at the emission direction outside (the side of the outside guide surface **(16a, 16b)**), the volume of downward air at the both ends of the air vent **(16)** may be increased. In other words, in addition to the arrangement that the areas in the vicinity of the both lengthwise ends are made different in the angle of the inside guide surface **(16c, 16d)** from the middle portion, the opening width of the air vent **(16)** at the both ends may be made greater than the opening width of the air vent **(16)** at the lengthwise middle portion, in order to increase the volume of downward air.

[0061] As has been described above, it is sufficient for the invention to have such a construction that conditioned air is emitted in a more downward direction at the areas in the vicinity of the both lengthwise ends of the air vent **(16)** than at the lengthwise middle portion of the air vent **(16)**. Further, any means other than the guide surface may be employed as far as the invention has such a construction.

[0062] Further, the invention is applied, in the above-described embodiment, to the airconditioner **(1)** of a so-called ceiling flush four-direction emission type which is provided with a turbofan and which emits conditioned air in four directions. However, the invention is not limited to such an application. For example, the invention is applicable to an airconditioner of a so-called ceiling flush two-direction emission type which emits conditioned air in two directions.

[0063] Furthermore, the invention is applicable not only to ceiling flush type airconditioners but also to duct type airconditioners. As shown in Figure **7**, the duct type airconditioner **(50)** is an airconditioner in which a vent unit **(51)** mounted on the ceiling board **(70)** is connected, through a fan duct **(52)**, to an airconditioner main body **(53)** mounted on a building roof or the like. Even for the vent unit **(51)** of the airconditioner **(50)**, the same effects as obtained in the above-described embodiment can be

obtained by regulating the direction of emission by, for example, provision of the guide surfaces **(16b-s)** at the areas in the vicinity of the both lengthwise ends of the air vent **(16)**.

[0064] Further, in the above-described embodiment the notches (18c) as opening portions are formed in the areas in the vicinity of the both ends (18e) of the horizontal vane **(18)**. However, the opening portions (**18c)** are not necessarily provided. Even in cases where opening portions are defined, through holes or the like may be formed in the horizontal vane **(18)** in place of the notches **(18c)**, and any construction may be employed as long as conditioned air is emitted in a downward direction at the both ends of the air vent **(16)** during "horizontal emission" mode of operation. In other words, preferably the horizontal vane **(18)** has airflow upstream side end edges which are formed into such a shape that the flow rate of air flowing on a negative pressure side of the horizontal vane **(18)** (a downward airflow (see S2 of Figure 3) on the backside of the horizontal vane **(18)** (on the side of the inside guide surfaces **(16c, 16d)** of the air vent **(16)**, i.e., on the emission direction inside)) is greater at the both ends than at the lengthwise middle portion. However, it should be noted that such arrangement is not necessarily made.

[0065] Furthermore, the shape and the dimensions of the horizontal vane **(18)** and the shape and the dimensions of the notch **(18c)** shown above are only examples and therefore can of course be altered properly according to the shape and the dimensions of a product embodied according to the invention.

[0066] When the opening portion **(18c)** is a notch, the notch **(18c)** may be formed into various shapes and Figures **8A-8C** show horizontal vanes **(18)** having different ends. Figure 8A illustrates an example of the notch **(18c)** in which airflow upstream side end edges of areas in the vicinity of both lengthwise ends of a horizontal vane **(18)** are shaped into a circular arc. Figure **8B** illustrates another example of the notch **(18c)** in which airflow upstream side end edges of areas in the vicinity of both lengthwise ends of a horizontal vane **(18)** are obliquely linearly shaped. Figure 8C illustrates still another example of the notch **(18c)** in which airflow upstream side end edges of areas in the vicinity of both lengthwise ends of a horizontal vane **(18)** are formed into a reversed circular arc with respect to the one shown in Figure **8A**.

[0067] Further, Figure **8D** shows a substitute for the opening portion **(18c)**. More specifically, each end of the horizontal vane **(18)** is formed into a three-dimensionally twisted shape so that the airflow upstream side end edges rise from the lengthwise middle portion toward the both ends of the horizontal vane **(18)**. In this case, since air is unlikely to separate at the ends of the horizontal vane **(18)**, the ends of the horizontal vane **(18)** are unlikely to involve surrounding warm air. This provides an advantage that condensation is unlikely to occur.

[0068] Further, for example in a ceiling flush type airconditioner, pipes and electrical component boxes are disposed at comers of the main body casing **(11)** and the decorative panel **(14)** is required to have four air vents of the same opening shape for the purpose of providing a better exterior appearance, which may produce a difference in the lengthwise opening length of the air passageway between the main body casing's **(11)** side and the decorative panel's **(14)** side, as shown in Figure 9. In order to cope with such a case, there are defined extension portions **(16L)** at the both lengthwise ends of the air vent **(16)** so that the opening length of the air passageway is extended, at areas facing an indoor space, in the lengthwise direction of the air vent **(16)**. In addition, the length of the extension portions **(16L)** varies from one air vent **(16)** to another depending upon the product embodied according to the invention.

[0069] Therefore, the guide surfaces **(16b-s)**, and the opening portions **(18c)** such as notches formed at the airflow upstream side end edges of areas in the vicinity of the both lengthwise ends of the horizontal vane **(18)** or portions equivalent to the opening portions **(18c)** are desirably defined in regions substantially corresponding to the extension portions **(16L)** of the air vent **(16)**. In the absence of the guide surfaces **(16b-s)** or the opening portions **(18c)** or when they are short, air emitted is likely to stay at the both ends of the horizontal vane **(18)** and is likely to be emitted in horizontal direction. However, if they are so formed as to substantially correspond to the extension portions **(16L)**, this makes it possible to reduce the volume of air lingering within the extension portions **(16L)** at the both lengthwise ends of the horizontal vane **(18)**. As a result, the occurrence of ceiling fouling can be prevented. The same applies to the duct type airconditioner **(50)**.

Claims

1. A decorative panel for an airconditioner comprising an air vent **(16)** through which conditioned air is emitted from the direction of a ceiling surface **(70)** into an indoor space and a horizontal vane **(18)**, mounted at said air vent **(16)**, for adjusting the direction in which conditioned air is emitted,

wherein:

said air vent **(16)** is so configured that conditioned air is emitted in a more downward direction at areas in the vicinity of both lengthwise ends of said air vent **(16)** than at a lengthwise middle portion of said air vent **(16**).

2. The airconditioner decorative panel of claim 1, wherein said air vent **(16)** is provided, at said areas in the vicinity of said both lengthwise ends thereof, with guide surfaces **(16b-s)** which guide conditioned air to be emitted in a more downward direction at said areas than at said lengthwise middle portion.

3. The airconditioner decorative panel of claim 2, wherein:

said guide surfaces **(16b-s)** of said air vent **(16)** are formed at areas in the vicinity of both lengthwise ends of either or both of sidewalls **(16a, 16b)** and **(16c, 16d)** of said air vent **(16)**, and
the angle formed between said areas in the vicinity of said both lengthwise ends **(16b-s)** of said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** and said ceiling surface **(70)** is greater than the angle formed between a lengthwise middle portion **(16b-c)** of said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** and said ceiling surface **(70)**.

4. The airconditioner decorative panel of claim 3, wherein said guide surfaces **(16b-s)** of said air vent **(16)** are composed of said sidewall **(16a, 16b)** corresponding to a side which becomes an upper surface of said horizontal vane **(18)** when said horizontal vane **(18)** is placed in a state of horizontal emission.

5. The airconditioner decorative panel of claim 3, wherein said guide surfaces of said air vent **(16)** are composed of said sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of said horizontal vane **(18)** when said horizontal vane **(18)** is placed in a state of horizontal emission.

6. The airconditioner decorative panel of any one of claims 2-5, wherein said air vent **(16)** is so formed that, when said horizontal vane **(18)** is placed in a state of horizontal emission, said lengthwise middle portion **(16b-c)** of said sidewall **(16a, 16b)(16c, 16d)** provided with said guide surfaces **(16b-s)** is inclined correspondingly to the inclination of said horizontal vane **(18)**.

7. The airconditioner decorative panel of any one of claims 3-6, wherein said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** provided with said guide surfaces **(16b-s)** is so configured that the angle formed with respect to said ceiling surface **(70)** varies continuously from said lengthwise middle portion **(16b-c)** to said areas in the vicinity of said both ends **(16b-s).**

8. The airconditioner decorative panel of any one of claims 2-7, wherein said horizontal vane **(18)** is so configured that conditioned air is allowed to pass through airflow upstream side end edges of said areas in the vicinity of said both lengthwise ends.

9. A vent unit for an airconditioner comprising an air vent **(16)** through which conditioned air is emitted from the direction of a ceiling surface **(70)** into an indoor space and a horizontal vane **(18)**, mounted at said air vent **(16)**, for adjusting the direction in which conditioned air is emitted,
wherein:

said air vent **(16)** is so configured that conditioned air is emitted in a more downward direction at areas in the vicinity of both lengthwise ends of said air vent **(16)** than at a lengthwise middle portion of said air vent **(16)**.

10. The airconditioner vent unit of claim 9, wherein said air vent **(16)** is provided, at said areas in the vicinity of said both lengthwise ends thereof, with guide surfaces **(16b-s)** which guide conditioned air to be emitted in a more downward direction at said areas than at said lengthwise middle portion.

11. The airconditioner vent unit of claim 10, wherein:

said guide surfaces **(16b-s)** of said air vent **(16)** are formed at areas in the vicinity of both lengthwise ends of either or both of sidewalls **(16a, 16b)** and **(16c, 16d)** of said air vent **(16)**, and
the angle formed between said areas in the vicinity of said both lengthwise ends **(16b-s)** of said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** and said ceiling surface **(70)** is greater than the angle formed between a lengthwise middle portion **(16b-c)** of said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** and said ceiling surface **(70)**.

12. The airconditioner vent unit of claim 11, wherein said guide surfaces **(16b-s)** of said air vent **(16)** are composed of said sidewall **(16a, 16b)** corresponding to a side which becomes an upper surface of said horizontal vane **(18)** when said horizontal vane **(18) i**s placed in a state of horizontal emission.

13. The airconditioner vent unit of claim 11, wherein said guide surfaces of said air vent **(16)** are composed of said sidewall **(16c, 16d)** corresponding to a side which becomes a lower surface of said horizontal vane **(18)** when said horizontal vane **(18)** is placed in a state of horizontal emission.

14. The airconditioner vent unit of any one of claims 10-13, wherein said air vent **(16)** is so formed that, when said horizontal vane **(18) i**s placed in a state of horizontal emission, said lengthwise middle portion **(16b-c)** of said sidewall **(16a, 16b)(16c, 16d)** provided with said guide surfaces **(16b-s)** is inclined correspondingly to the inclination of said horizontal vane **(18)**.

15. The airconditioner vent unit of any one of claims 10-14, wherein said sidewall **(16a, 16b)(16c, 16d)** of said air vent **(16)** provided with said guide surfaces **(16b-s)** is so configured that the angle formed with respect to said ceiling surface **(70)** varies continuously from said lengthwise middle portion **(16b-c)** to said areas in the vicinity of said both ends **(16b-s)**.

16. The airconditioner vent unit of any one of claims 10-15, wherein said horizontal vane **(18)** is so configured that conditioned air is allowed to pass through airflow upstream side end edges of said areas in the vicinity of said both lengthwise ends.

17. An airconditioner comprising a decorative panel **(14)** mounted along a ceiling surface,

wherein said decorative panel **(14)** is composed of a decorative panel according to any one of claims 1-8.

18. An airconditioner comprising a decorative panel **(14)** mounted along a ceiling surface,

wherein:

said decorative panel **(14)** is composed of a decorative panel according to any one of claims 2-8,
an air vent **(16)** of said decorative panel **(14)** has extension portions **(16L)** so that the lengthwise opening length of said air vent **(16)** extends at areas facing an indoor space, and
guide surfaces **(16b-s)** of said air vent **(16)** are formed in regions substantially corresponding to said extension portions **(16L)** of said air vent **(16)**.

19. An airconditioner in which a vent unit **(51)** mounted on a ceiling surface is connected, through a fan duct **(52)**, to an airconditioner main body **(53)**,

wherein said vent unit **(51)** is composed of a vent unit according to any one of claims 9-16.

20. An airconditioner in which a vent unit **(51)** mounted on a ceiling surface is connected, through a fan duct **(52)**, to an airconditioner main body **(53)**,

wherein:

said vent unit **(51)** is composed of a vent unit according to any one of claims 10-16,
an air vent **(16)** of said decorative panel **(14)** has extension portions **(16L)** so that the lengthwise opening length of said air vent **(16)** extends at areas facing an indoor space, and
guide surfaces **(16b-s)** of said air vent **(16)** are formed in regions substantially corresponding to said extension portions **(16L)** of said air vent **(16)**.

Fig. 1

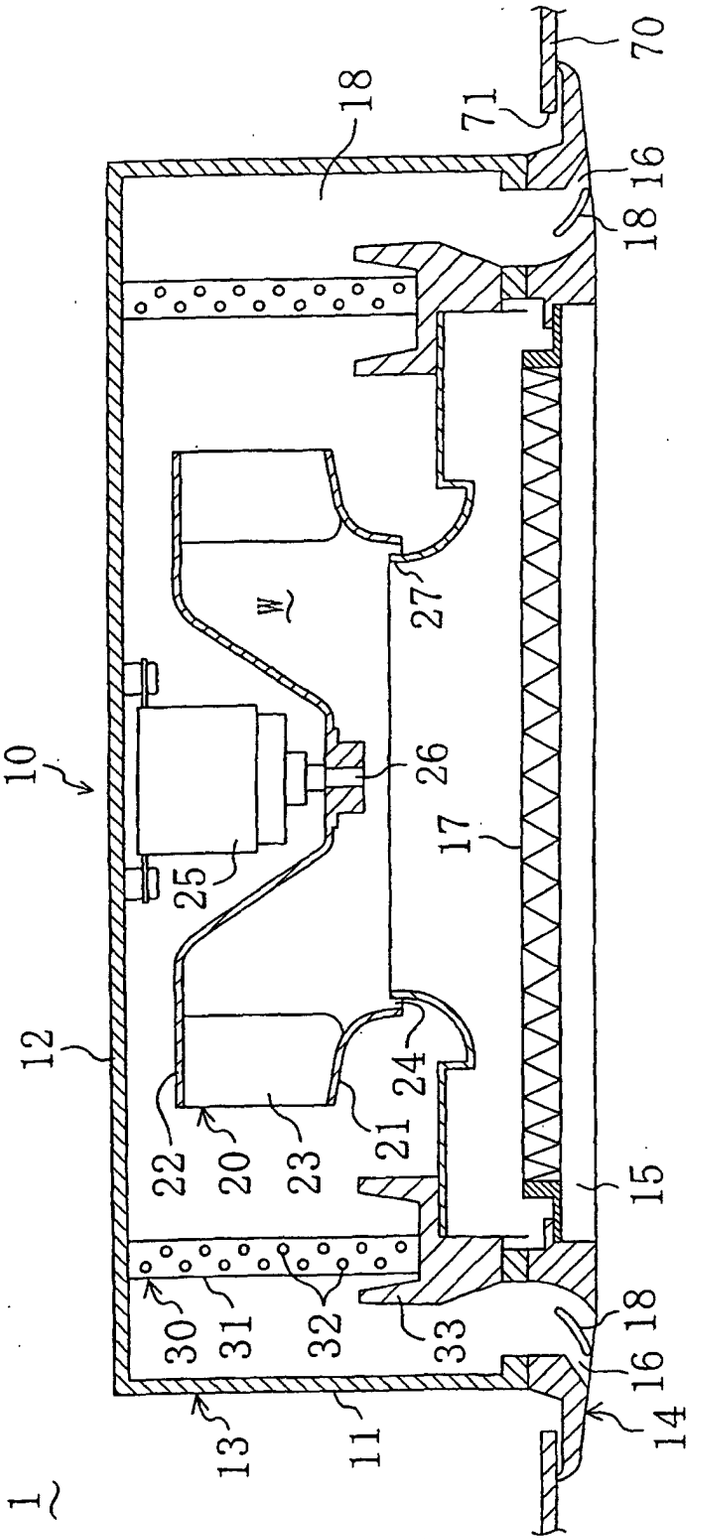


Fig. 2

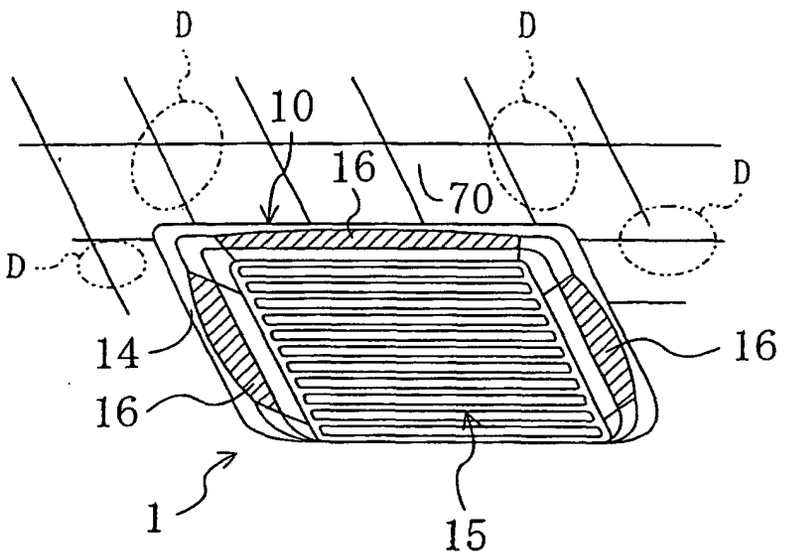


Fig. 3

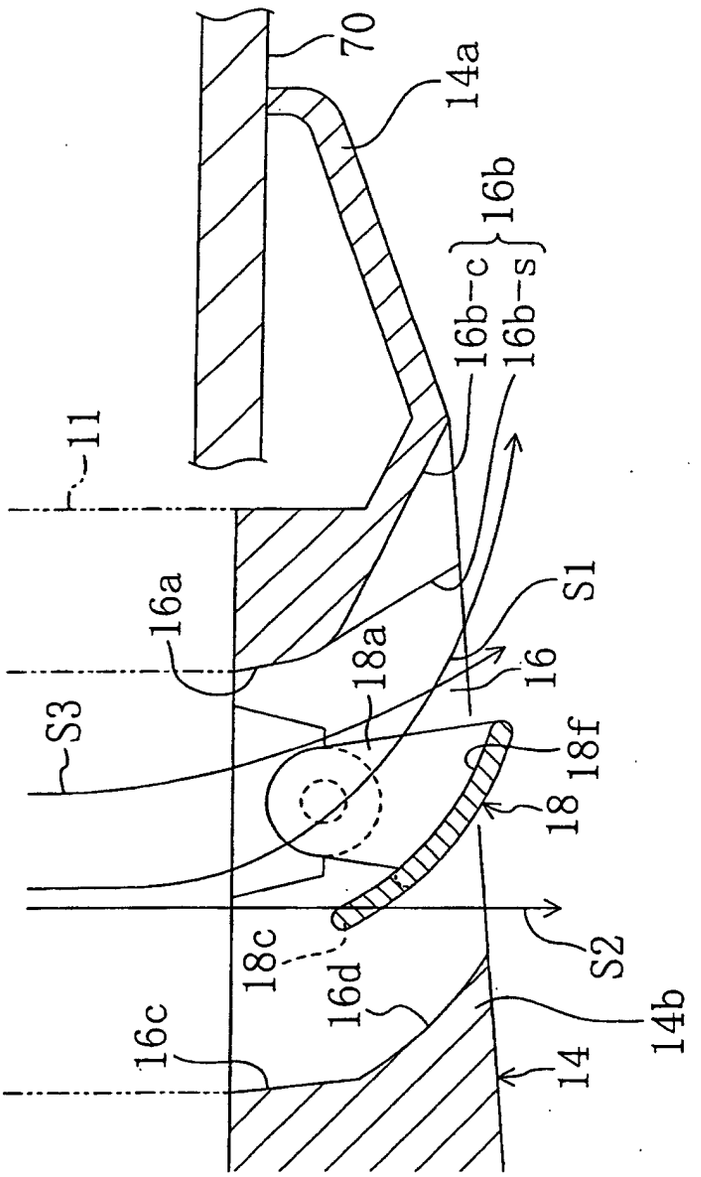

70
14a
16b
16b-c
16b-s
11
16a
S1
18a
16
S3
18f
18
18c
16d
S2
16c
14b
14

Fig. 4

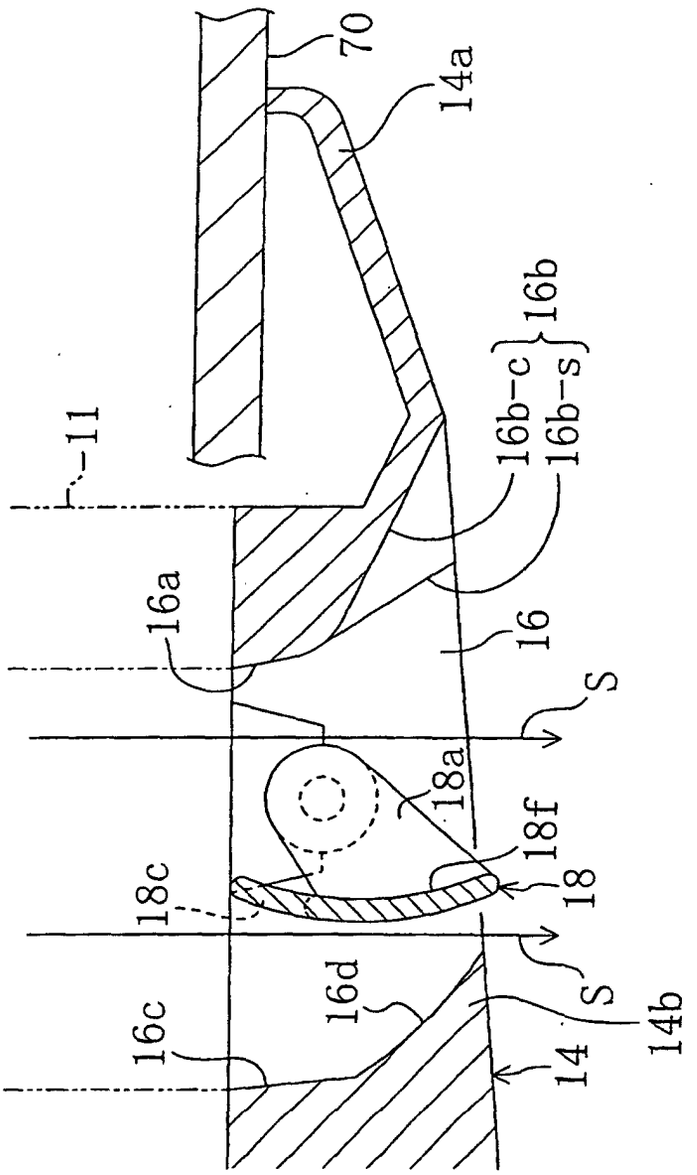


Fig. 5

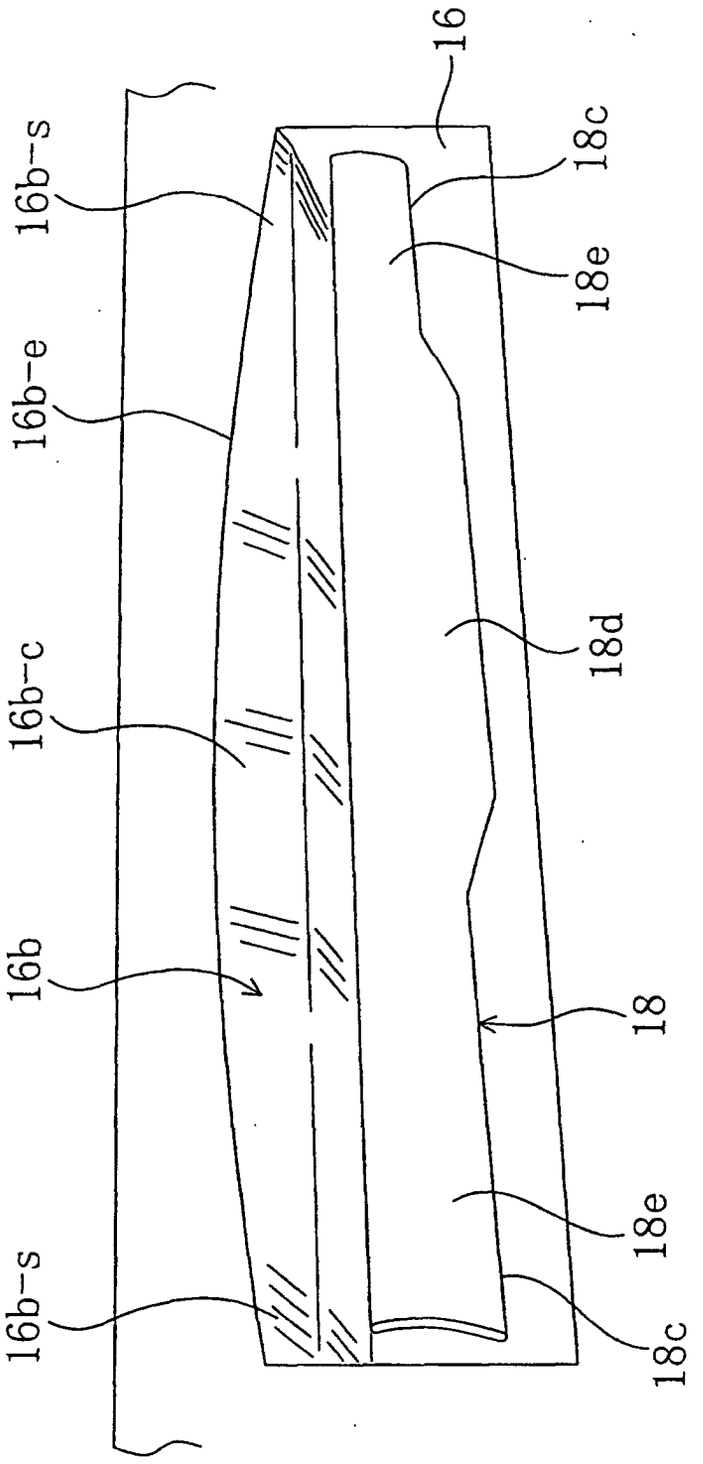


Fig. 6

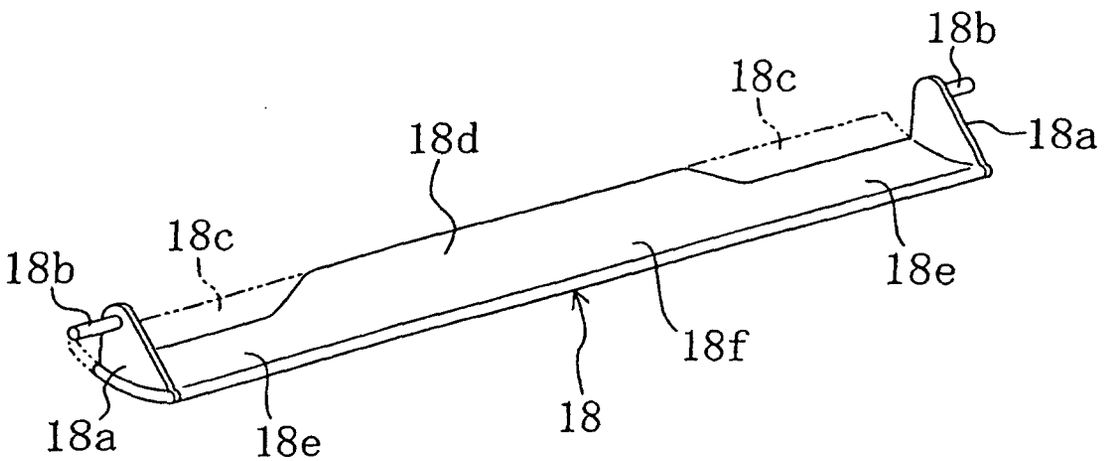


Fig. 7

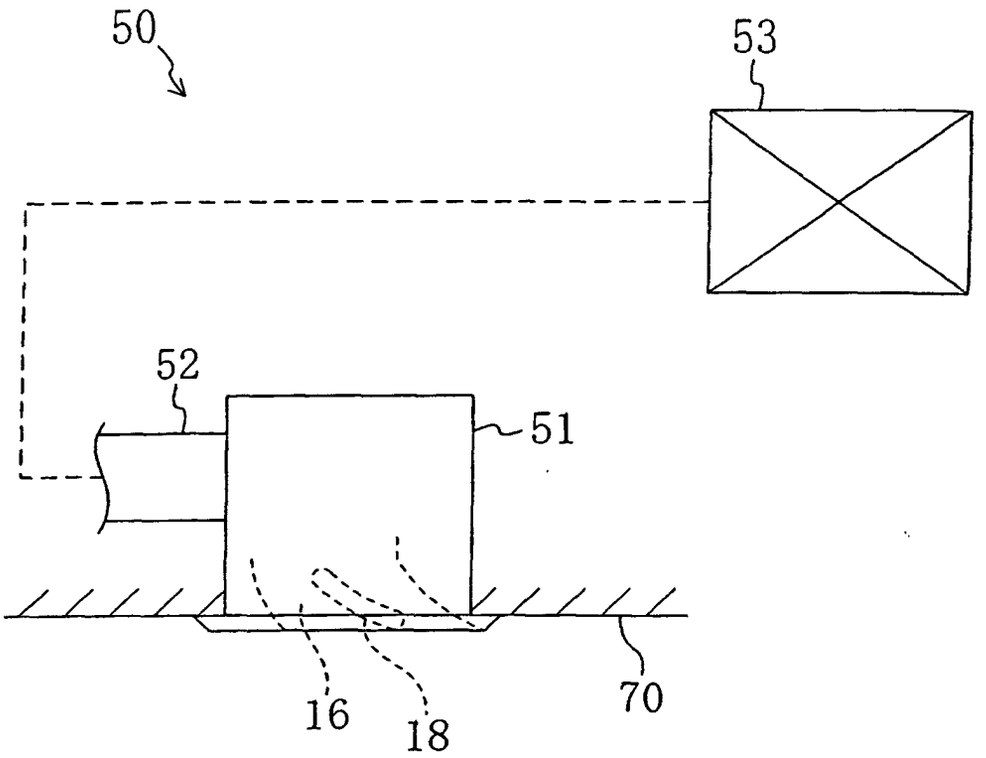


Fig. 8A

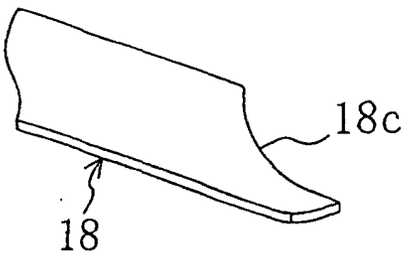


Fig. 8B

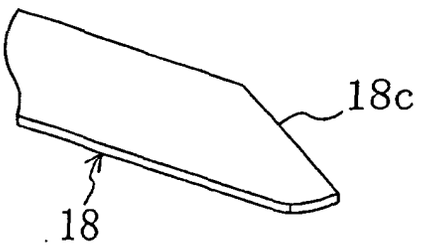


Fig. 8C

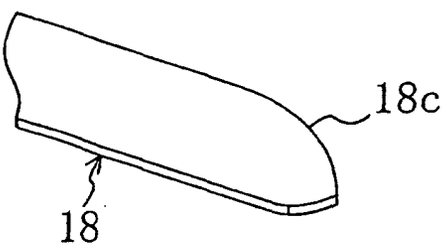


Fig. 8D

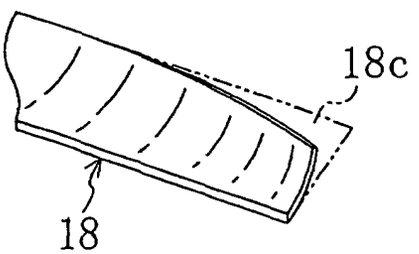


Fig. 9

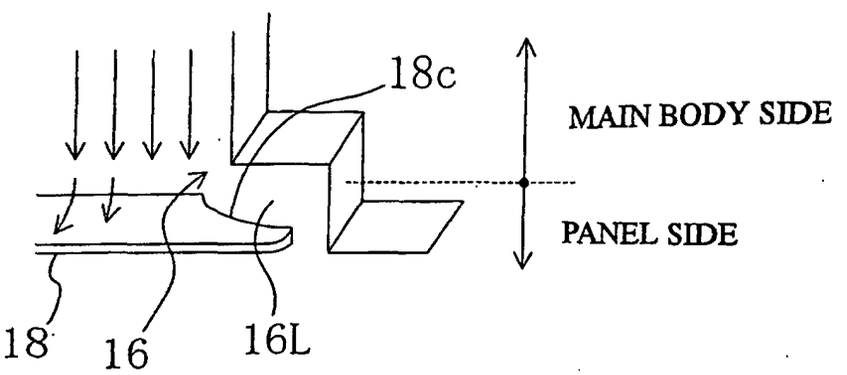
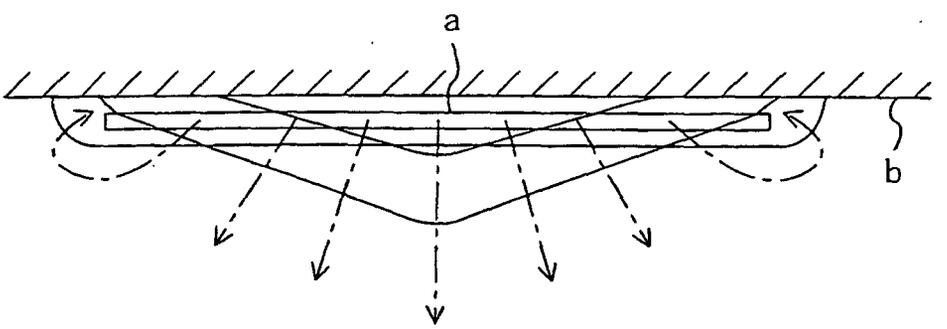


Fig. 10



INTERNATIONAL SEARCH REPORT

International application No.
PCT/JP01/07505

A. CLASSIFICATION OF SUBJECT MATTER
Int.Cl[7] F24F1/00, 13/14

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

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
Int.Cl[7] F24F1/00, 13/14

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Jitsuyo Shinan Koho 1926-1996 Toroku Jitsuyo Shinan Koho 1994-2001
Kokai Jitsuyo Shinan Koho 1971-2001 Jitsuyo Shinan Toroku Koho 1996-2001

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
E,X E,A	JP 2001-65911 A (Mitsubishi Heavy Industries, Ltd.), 16 March, 2001 (16.03.01), Full text; all drawings (Family: none)	1,2,6 3-5,7-20
A	JP 8-121857 A (Sanyo Electric Co., Ltd.), 17 May, 1996 (17.05.96), Full text; all drawings (Family: none)	1-20
A	JP 9-14742 A (Mitsubishi Heavy Industries, Ltd.), 17 January, 1997 (17.01.97), Full text; all drawings (Family: none)	1-20
A	JP 7-12398 A (Mitsubishi Electric Corporation), 17 January, 1995 (17.01.95), Full text; all drawings (Family: none)	1-20
A	JP 9-287766 A (Fujitsu General Limited), 04 November, 1997 (04.11.97), Full text; all drawings (Family: none)	1-20

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

* Special categories of cited documents:
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Date of the actual completion of the international search	Date of mailing of the international search report
23 October, 2001 (23.10.01)	30 October, 2001 (30.10.01)
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