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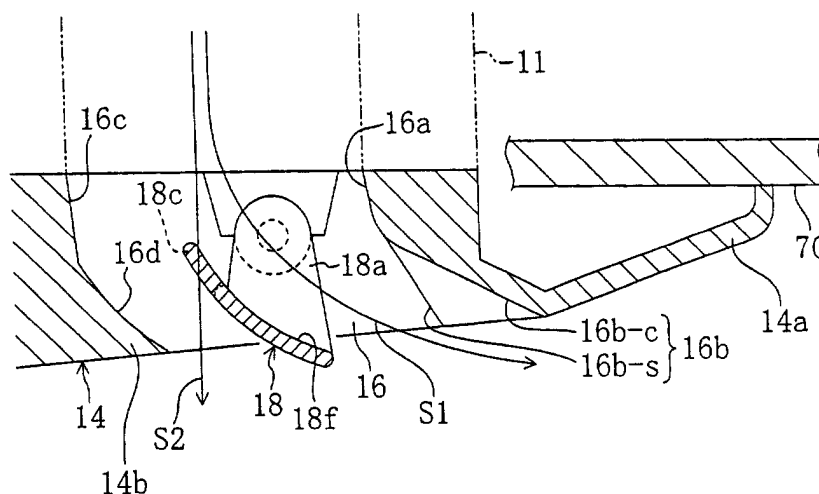
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(54) **DECORATIVE PANEL AND DIFFUSER UNIT OF AIR CONDITIONER, AND AIR CONDITIONER**

(57) In cases where a horizontal vane (18) which controls the direction in which conditioned air is emitted is provided at an air vent (16) of an air conditioner, airflow upstream side end edges of both lengthwise ends of the

horizontal vane (18) are notched to form opening portions (18c) through which air is allowed to pass, for preventing fouling of a ceiling surface (70) during "horizontal emission" mode of operation.

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Description

Technical Field

[0001] The present invention relates to airconditioner decorative panels, to airconditioner vent units, and to airconditioners. More specifically, the invention relates to structures for a horizontal vane, mounted at an air vent, for controlling the direction in which conditioned air is emitted.

Background Art

[0002] Horizontal vanes, capable of vertically changing the direction in which conditioned air is emitted, are conventionally mounted at an air vent of an airconditioner of the ceiling flush mounting type or the duct type. 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 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 a state of "horizontal emission", particulate dust contained in the emitted conditioned air is likely to deposit on a ceiling surface. 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 no air reaches 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] In order to circumvent 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 toward 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 in accordance with the gazette, the 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 fouling 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 an air vent. This causes a drop in air-conditioning efficiency during cooling mode of operation in which 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 set an adequate emission direction according to the operating status of an airconditioner while preventing ceiling fouling by making improvements in the shape of a horizontal vane mounted at an air vent.

DISCLOSURE OF THE INVENTION

[0008] In the invention, the shape of a horizontal vane is improved in such a way that the emission direction of conditioned air from both lengthwise side portions of an air vent is more downwardly oriented than that 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 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 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 a 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 horizontal vane (18) has, at airflow up-

stream side end edges of both lengthwise ends thereof, opening portions (18c) through which conditioned air is allowed to pass.

[0011] In this construction, the opening portions (18c) may be notches formed at the airflow upstream side end edges of the both lengthwise ends of the horizontal vane (18).

[0012] Further, portions equivalent to the opening portions (18c) may be provided at the both ends of the horizontal vane (18) by forming the horizontal vane (18) into a three-dimensionally twisted shape so that the airflow upstream side end edges gradually rise from the lengthwise middle portion toward the both ends.

[0013] Furthermore, portions equivalent to the opening portions (18c) may be provided by forming the airflow upstream side end edges of the horizontal vane (18) in such a way that the flow rate of air flowing on the side of a negative pressure surface of the horizontal vane (18) is greater at the both ends than at the lengthwise middle portion of the horizontal vane (18).

[0014] With the above-described construction, when conditioned air is emitted indoors through the air vent (16), the conditioned air is guided in an approximately horizontal direction at the middle portion of the air vent (16) of a relatively high emission velocity during cooling mode of operation whereas, at the both lengthwise ends of the air vent (16) of a relatively low emission velocity, a part of the conditioned air, after passing through the opening portions (18c) and so on, of the both ends of the horizontal vane (18), is emitted in a more downward direction than at the middle portion. As a result, the flow rate of air flowing on the side of the negative pressure surface of the horizontal vane (18) increases at the both ends of the horizontal vane (18), so that the flow rate of conditioned air of low emission initial velocity flowing along a ceiling surface decreases at the both ends of the air vent (16). On the other hand, during heating mode of operation, conditioned air is emitted downward into a room from the entire air vent (16) by adjusting the orientation of the horizontal vane (18) in a downward direction.

[0015] Further, in the above-described construction, it is preferable that the horizontal vane (18) is formed into a shape (i.e., a downwardly projecting shape) which bends, from an upstream side to a downstream side of a flow of air emitted, toward a wall surface of the air vent (16) on one of crosswise sides thereof and the one crosswise side wall surface of the air vent (16) bends in the same direction that the horizontal vane (18) does. Further, the shape of the one crosswise side wall surface is not necessarily limited to a bent shape. Any shape may be used as long as it is formed along the horizontal vane (18). Furthermore, the other crosswise side wall surface may be formed into a more gently bent shape than the one crosswise side wall surface or may be formed into a straight shape.

[0016] The above-described construction, coupled with the arrangement that the horizontal vane (18) is so

constructed that the flow rate of air flowing on the negative pressure side of the horizontal vane (18) (a downward airflow flowing on the back side (airflow upstream side end edges)) increases at the both ends of the horizontal vane (18), enables "horizontal emission" to be definitely carried out at the middle portion of the horizontal vane (18) and further enables air to be definitely emitted in a downward direction at the both ends of the horizontal vane (18).

[0017] Further, in the air conditioner of the invention, in cases where the air vent (16) has extension portions (16L) (see Figure 9) so that the lengthwise opening length of the air vent (16) extends at areas facing an indoor space, it may be arranged such that the opening portions (18c) of the horizontal vane (18) are formed in regions corresponding to the extension portions (16L) of the air vent (16). This can be applied to cases where the airflow upstream side end edges gradually rise from the lengthwise middle portion side toward the both ends of the horizontal vane (18) as well as to cases where the airflow upstream side end edges of the horizontal vane (18) are so formed that the flow rate of air flowing on the negative pressure surface side of the horizontal vane (18) increases. In each case, it may be arranged such that these portions are formed in regions corresponding to the extension portions (16L) of the air vent (16).

[0018] In cases where there are extension portions (16L) at the air vent (16) as described above when the opening portions (18c) or portions equivalent to the opening portions (18c) are not provided, air emitted is likely to stay at the both ends of the horizontal vane (18). However, if the opening portions (18c) in the form of for example notches are so formed that they have a length corresponding to that of the extension portions (16L) of the air vent (16), this causes a flow of air flowing along the horizontal vane (18) to be directed in a downward direction at its both lengthwise ends, thereby reducing the volume of air staying at the side of an inner surface of the horizontal vane (18).

Effects

[0019] In accordance with the above-mentioned problem-solving means, during cooling mode of operation which requires a "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 downward. As a result, the air from the both lengthwise ends is unlikely to flow along the ceiling. Therefore, ceiling surface fouling is prevented. Besides, "horizontal emission" is secured in totality. Because of this, the occurrence of ceiling surface fouling can be avoided while at the same time securing an emission direction according to the operating status of an air conditioner.

[0020] Further, if the opening portions (18c) at the both lengthwise ends of the horizontal vane (18) are notches or if the horizontal vane (18) is so formed that

its airflow upstream end edges gradually rise from the lengthwise middle portion toward the both ends, this makes it possible to prevent ceiling fouling with a simple structure. Furthermore, if the dimensions of the opening portions (18c) and so on are set to adequate values, this makes it possible to allow conditioned air to be emitted at the both ends of the air vent (16) at an adequate ratio in a downward direction. This easily realizes a construction capable of providing "horizontal emission" as a whole while preventing ceiling fouling without fail.

[0021] Furthermore, for the case of using a conventional horizontal vane, airflow burble is likely to occur at the ends of the horizontal vane, as a result of which condensation may occur to the horizontal vane by involvement of surrounding warm air. However, if the horizontal vane (18) is so formed that its airflow upstream end edges gradually rise from the lengthwise middle portion toward the both ends, the direction in which air flowing downward in the air vent (16) advances substantially agrees with the direction of the both ends of the horizontal vane (18), thereby making airflow burble unlikely to occur. As a result, condensation is also unlikely to occur.

[0022] Finally, if, in cases where there are extension portions (16L) at the lengthwise ends of the air vent (16), the opening portions (18c) of the horizontal vane (18) or the like are formed in regions corresponding to the extension portions (16L), this reduces the volume of air staying at the side of an inner surface of the horizontal vane (18) at the both lengthwise ends of the horizontal vane (18), thereby realizing a construction capable of providing "horizontal emission" while at the same time preventing ceiling fouling.

BRIEF DESCRIPTION OF THE DRAWINGS

[0023]

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 a ceiling-mounted airconditioner when viewed from below;

Figure 3, which is an enlarged structural 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 an air vent when viewed from below;

Figure 6 is a perspective view of a horizontal vane;

Figure 7 is comprised of Figures 7A-7D which are perspective views showing different opening portion shapes for a horizontal vane;

Figure 8 is a schematic construction diagram of a

duct type airconditioner;

Figure 9 is a partial perspective view when extension portions are defined at 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

[0024] Hereinafter, embodiments of the invention will be described in detail with reference to the Figures.

[0025] 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.

[0026] 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 the outer edges of the top plate (12). The decorative panel (14) has a plate having a substantially square shape and is attached to the 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).

[0027] 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 a substantially central part 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.

[0028] Further, a horizontal vane (18) capable of vertical adjustment of the direction in which conditioned air is emitted is disposed at the air vent (16). More specifically, as shown enlargedly in Figures 3 and 4, an outside guide surface of the decorative panel (14) which is a side wall on the panel outer peripheral side (on the right-hand side in the Figures) of an air passageway in communication with the air vent (16), 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.

[0029] The second outside guide surface (16b) comprises a middle portion (16b-c) located longitudinally centrally in the air vent (16) and both ends (16b-s) located at both lengthwise ends of the air vent (16). The inclination of the middle portion (16b-c) is set at relatively large values (an angle of about 60 degrees), whereas the inclination of the both ends (16b-s) is set at relatively small values (an angle of about 30 degrees). The inclination of the second outside guide surface (16b) varies gradually from the middle portion (16b-c) toward the both ends (16b-s). 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.

[0030] On the other hand, as shown in Figures 3 and 4, an inside guide surface of the decorative panel (14) which is a side wall on the panel inner peripheral side (on the lefthand side in the Figures) of an air passageway in communication with the air vent (16), is made up of a first inside guide surface (16c) extending substantially vertically downward and a second inside guide surface (16d) gently inclining 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.

[0031] The outside guide surfaces (16a, 16b) are formed in an outside member (14a) of the decorative panel (14), whereas the inside guide surfaces (16c, 16d) are formed in an inside member (14b) of the decorative panel (14). Further, the outside guide surfaces (16a, 16b) of the outside member (14a) located on the airflow downstream side of the horizontal vane (18) bend 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 that of the horizontal vane (18)). On the other hand, the inside guide surfaces (16c, 16d) of the inside member (14b) located on the airflow upstream side of the horizontal vane (18) are so formed as to extend more vertically downward than the outside guide surfaces (16a, 16b) of the outside member (14a). The air vent (16) is defined between the outside guide surfaces (16a, 16b) and the inside guide surfaces (16c, 16d). The shape of the inside guide surfaces (16c, 16d) is a matter of choice.

[0032] And, these two wall surfaces (the outside guide surfaces (16a, 16b) and the inside guide surfaces (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 conditioned air flow while changing the direction of the conditioned air flow.

[0033] 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) can swivel 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.

[0034] The present embodiment is characterized in that notches (18c) as opening portions through which conditioned air is allowed to pass are defined at airflow upstream side end edges of both lengthwise ends of the horizontal vane (18). The length of each notch (18c) is approximately a quarter of the lengthwise length of the horizontal vane (18). These notches (18c) are formed at the airflow upstream side end edges of the both lengthwise ends of the horizontal vane (18), respectively. Because of the provision of the 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). 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 middle portion ((18)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.

[0035] On the other hand, the fan (20) is located substantially centrally in the inside of the main body casing (11). The fan (20) 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).

[0036] 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 constructed 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).

[0037] By 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 air conditioner (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.

[0038] 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 discharged in a downward direction as indicated by Arrow S of the Figure.

[0039] On the other hand, during so-called "horizontal emission" mode of operation (for example during cooling mode of operation), the horizontal vane (18) is turned in an upward direction (see Figure 3) so that the inside 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) 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 such 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 ceil-

ing board's (70) lower surface).

[0040] Further, at the both ends of the air vent (16), a part of conditioned air flowing through the air circulation passageway (W) in a downward direction 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. Because of this, at the both ends of the air vent (16), the flow rate of air flowing in a direction indicated by Arrow S1 decreases, so that air is unlikely to flow along the ceiling surface. Further, since the both ends (16b-s) of the second outside guide surface (16b) have a more raised shape (i.e., a less inclined shape) than the middle portion (16b-c), air emitted at the both ends of the air vent (16) is more unlikely to flow in the S 1 direction.

[0041] In a conventional ceiling flush type air conditioner, at portions of low air emission velocity (at the both ends of the air vent (16)), a flow of air 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 air conditioner (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.

[0042] Furthermore, 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.

[0043] Accordingly, in accordance with the air conditioner (1) of the present embodiment, the occurrence of 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 uncom-

fortable feeling (draft feeling) while securing air-conditioning efficiency.

[0044] Further, the invention is not limited to the above-mentioned embodiment. The invention includes other various embodiments.

[0045] For example, in the above-mentioned embodiment, the notches **(18c)** as opening portions are formed at the both ends **(18e)** of the horizontal vane **(18)**. Alternatively, through holes may be formed in the horizontal vane **(18)** in place of the notches **(18c)**. In other words, any construction, capable of causing air to be emitted in a downward direction at the both ends of the air vent **(16)** during "horizontal emission" mode of operation, can be employed.

[0046] 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.

[0047] When the opening portion **(18c)** is a notch, the notch **(18c)** may be formed into various shapes (Figures **7A-7C** shows one ends of different horizontal vanes **(18)**). Figure **7A** illustrates an example of the notch **(18c)** in which airflow upstream side end edges of both lengthwise ends of a horizontal vane **(18)** are shaped into a circular arc. Figure **7B** illustrates another example of the notch **(18c)** in which airflow upstream side end edges of both lengthwise ends of a horizontal vane **(18)** are obliquely linearly shaped. Figure **7C** illustrates still another example of the notch **(18c)** in which airflow upstream side end edges of both lengthwise ends of a horizontal vane **(18)** are formed into a reversed circular arc with respect to the one shown in Figure **7A**.

[0048] Further, Figure **7D** shows a substitute for the opening portion **(18c)**. More specifically, each end of a 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.

[0049] As has been described above, it is sufficient in the invention that 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.

[0050] Further, in the present embodiment, the invention is applied to the air conditioner **(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 air conditioner of a so-called ceiling flush two-direction emission type which emits conditioned air in two directions.

[0051] Furthermore, the invention is applicable not only to ceiling flush type air conditioners but also to duct type air conditioners. As shown in Figure **8**, the duct type air conditioner **(50)** is an air conditioner in which a vent unit **(51)** mounted on the ceiling board **(70)** is connected, through a fan duct **(52)**, to an air conditioner main body **(53)** mounted on a building roof or the like. Even for the vent unit **(51)** of the air conditioner **(50)**, the same effects as obtained in the above-described embodiment can be obtained by provision of any one of the opening portions **(18c)** shown in Figures **7A-7D** at each lengthwise end of the horizontal vane **(18)**.

[0052] Further, for example in a ceiling flush type air conditioner, pipes and electrical component boxes are conventionally disposed at corners of the main body casing **(11)**, as shown in Figure **9**. Since 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, this may create a difference in the lengthwise opening length of an air passageway between the main body casing **(11)** side and the decorative panel **(14)** side. In such a case, there is defined an extension portion **(16L)** at each lengthwise end 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)**. Further, the length of the extension portion **(16L)** varies from one air vent to another.

[0053] It is therefore advisable that opening portions **(18c)** such as notches formed at airflow upstream side end edges of both lengthwise ends of a horizontal vane **(18)** or portions equivalent to the opening portions **(18c)** have a length corresponding to that of the extension portions **(16L)** of the air vent **(16)**. In the absence of the opening portions **(18c)** or the like or when the length of the opening portions **(18c)** is short, air emitted is likely to stay at the both ends of the horizontal vane **(18)**. However, if made corresponding to the extension portions **(16L)**, a flow of air flowing along the horizontal vane **(18)** is directed downward at the both lengthwise ends thereof, thereby making it possible to reduce the volume of air staying on the inner surface side of the horizontal vane **(18)** as well as to prevent the occurrence of ceiling fouling while at the same time performing a "horizontal emission" operation. The same applies to the duct type air conditioner **(50)**.

[0054] Further, in the above-described embodiment, the inclination of the second outside guide surface **(16b)** of the air vent **(16)** is set in such a way that the both ends **(16b-s)** are inclined at an angle nearer to a vertical than the middle portion **(16b-c)**. However, such arrangement is not necessarily made. The second outside guide surface **(16b)** may be inclined, for example throughout

the air vent (16), correspondingly to the inclination of the middle portion (16b-c) of the above-described embodiment.

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 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 horizontal vane (18) has, at air-flow upstream side end edges of both lengthwise ends thereof, opening portions (18c) through which conditioned air is allowed to pass.
2. The airconditioner decorative panel of claim 1, wherein said opening portions (18c) are notches formed at airflow upstream side end edges of both lengthwise ends of said horizontal vane (18).
3. A decorative panel for an airconditioner comprising an air vent (16) through which conditioned air is emitted from the direction of a ceiling surface 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 horizontal vane (18) is formed in such a way that airflow upstream side end edges of said horizontal vane (18) gradually rise from a lengthwise middle portion toward both ends of said horizontal vane (18).
4. A decorative panel for an airconditioner comprising an air vent (16) through which conditioned air is emitted from the direction of a ceiling surface 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 airflow upstream side end edges of said horizontal vane (18) are formed in such a way that the flow rate of air flowing on the side of a negative pressure surface of said horizontal vane (18) is greater at both ends than at a lengthwise middle portion of said horizontal vane (18).
5. The airconditioner decorative panel of any one of claims 1-4, wherein said horizontal vane (18) bends, from an upstream side to a downstream side of a flow of air emitted, in the direction of one of crosswise sides of said air vent (16) and wherein a wall surface of said air vent (16) on said one traversal side bends in the same direction that said horizontal vane (18) bends.
6. A vent unit for an airconditioner comprising an air vent (16) through which conditioned air is emitted from the direction of a ceiling surface 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 horizontal vane (18) has, at air-flow upstream side end edges of both lengthwise ends thereof, opening portions (18c) through which conditioned air is allowed to pass.
7. The airconditioner vent unit of claim 6, wherein said opening portions (18c) are notches formed at air-flow upstream side end edges of both lengthwise ends of said horizontal vane (18).
8. A vent unit for an airconditioner comprising an air vent (16) through which conditioned air is emitted from the direction of a ceiling surface 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 horizontal vane (18) is formed in such a way that airflow upstream side end edges of said horizontal vane (18) gradually rise from a lengthwise middle portion toward both ends of said horizontal vane (18).
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 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 airflow upstream side end edges of said horizontal vane (18) are formed in such a way that the flow rate of air flowing on the side of a negative pressure surface of said horizontal vane (18) is greater at both ends than at a lengthwise middle portion of said horizontal vane (18).
10. The airconditioner vent unit of any one of claims 6-9, wherein said horizontal vane (18) bends, from an upstream side to a downstream side of a flow of air emitted, in the direction of one of crosswise sides of said air vent (16) and wherein a wall surface of said air vent (16) on said one traversal side bends in the same direction that said horizontal vane (18) bends.
11. An airconditioner comprising a decorative panel (14) which is mounted along a ceiling surface,
 wherein said decorative panel (14) is composed of a decorative panel according to any one of claims 1-5.
12. An airconditioner comprising a decorative panel (14) which is mounted along a ceiling surface,
 wherein:

said decorative panel (14) is composed of a decorative panel according to claim 2, an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and opening portions (18c) of a horizontal vane (18) are formed in regions corresponding to said extension portions (16L) of said air vent (16).

13. An airconditioner comprising a decorative panel (14) which is mounted along a ceiling surface, wherein:

said decorative panel (14) is composed of a decorative panel according to claim 3, an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and said horizontal vane (18) is formed in such a way that, in regions corresponding to said extension portions (16L) of said air vent (16), air-flow upstream side edges of said horizontal vane (18) gradually rise from a lengthwise middle portion side toward both ends of said horizontal vane (18).

14. An airconditioner comprising a decorative panel (14) which is mounted along a ceiling surface, wherein:

said decorative panel (14) is composed of a decorative panel according to claim 4, an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and airflow upstream side end edges of said horizontal vane (18) are formed in such a way that the flow rate of air flowing on the side of a negative pressure surface of said horizontal vane (18) increases in regions corresponding to said extension portions (16L) of said air vent (16).

15. 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 6-10.

16. 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 claim 7,

an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and

opening portions (18c) of a horizontal vane (18) are formed in regions corresponding to said extension portions (16L) of said air vent (16).

17. 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 claim 8,

an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and

said horizontal vane (18) is formed in such a way that, in regions corresponding to said extension portions (16L) of said air vent (16), air-flow upstream side edges of said horizontal vane (18) gradually rise from a lengthwise middle portion side toward both ends of said horizontal vane (18).

18. 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 claim 9,

an air vent (16) has extension portions (16L) so that the lengthwise opening length of said air vent (16) extends at areas facing an indoor space, and

airflow upstream side end edges of said horizontal vane (18) are formed in such a way that the flow rate of air flowing on the side of a negative pressure surface of said horizontal vane (18) increases in regions corresponding to said extension portions (16L) of said air vent (16).

Fig. 1

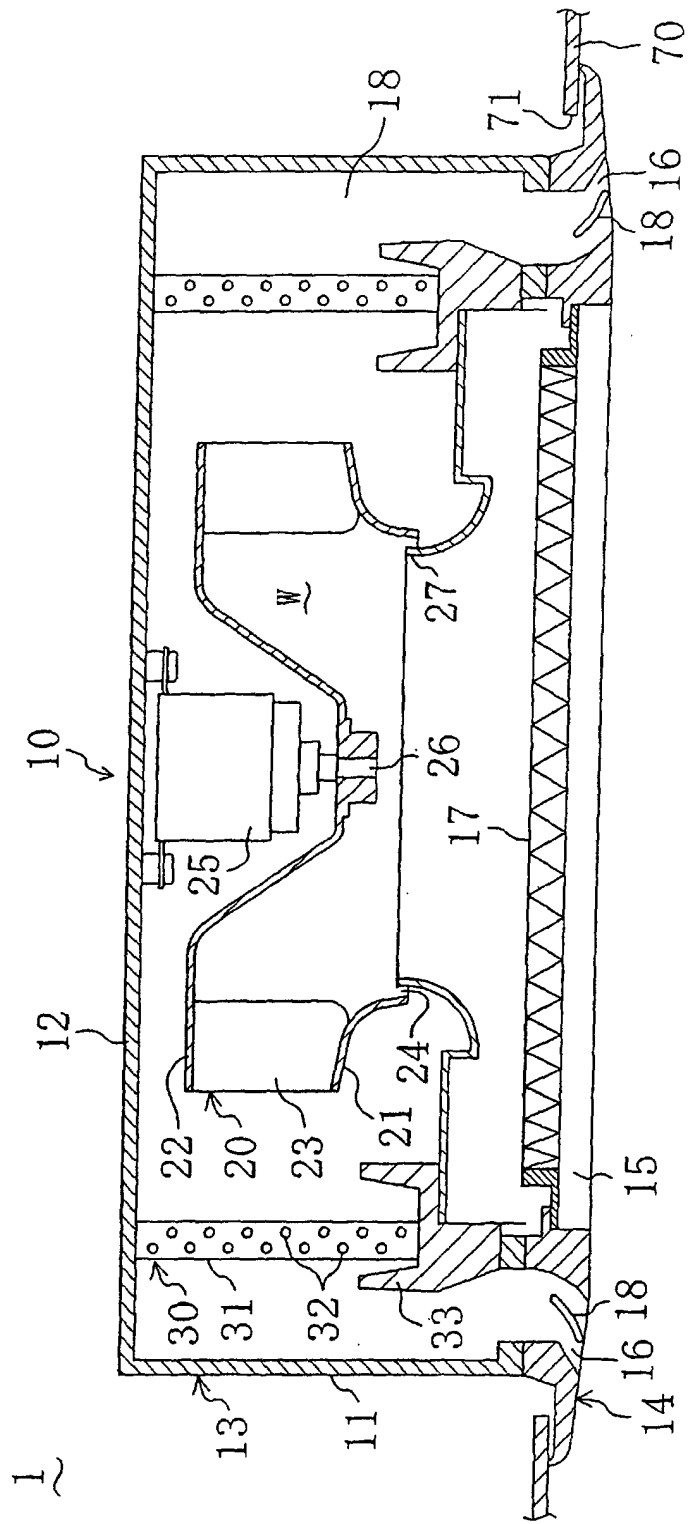


Fig. 2

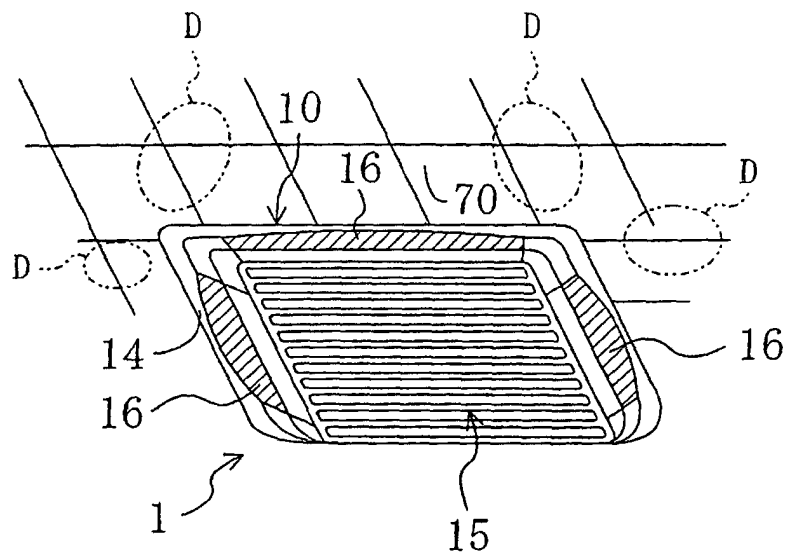


Fig. 4

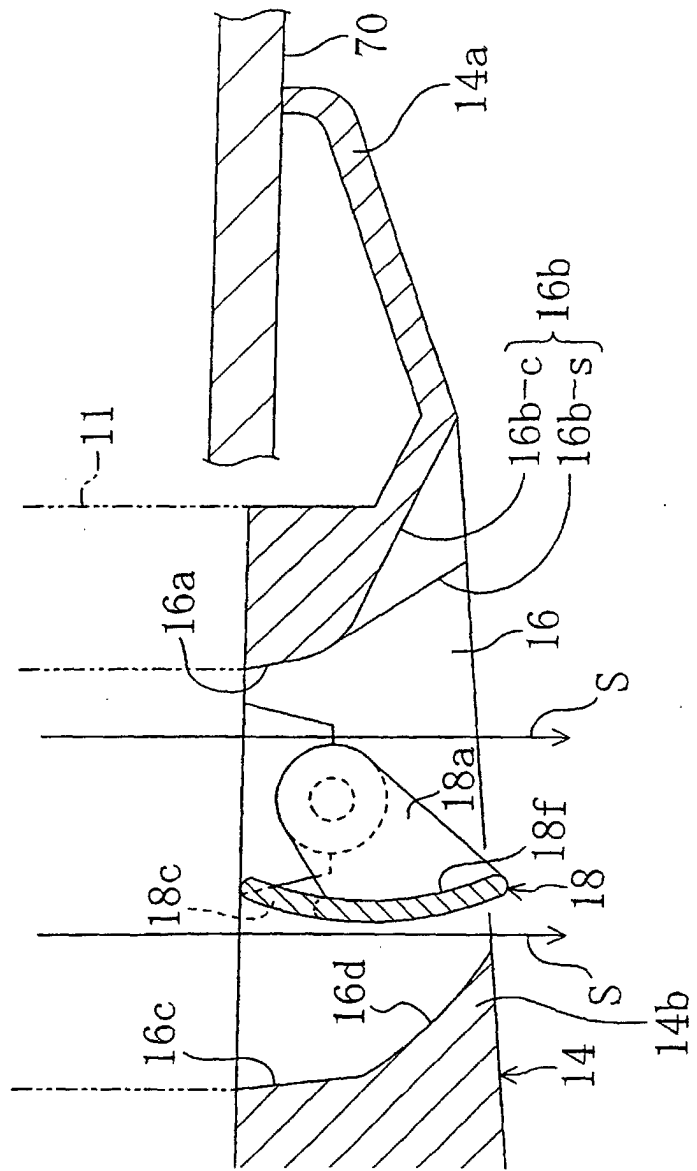


Fig. 5

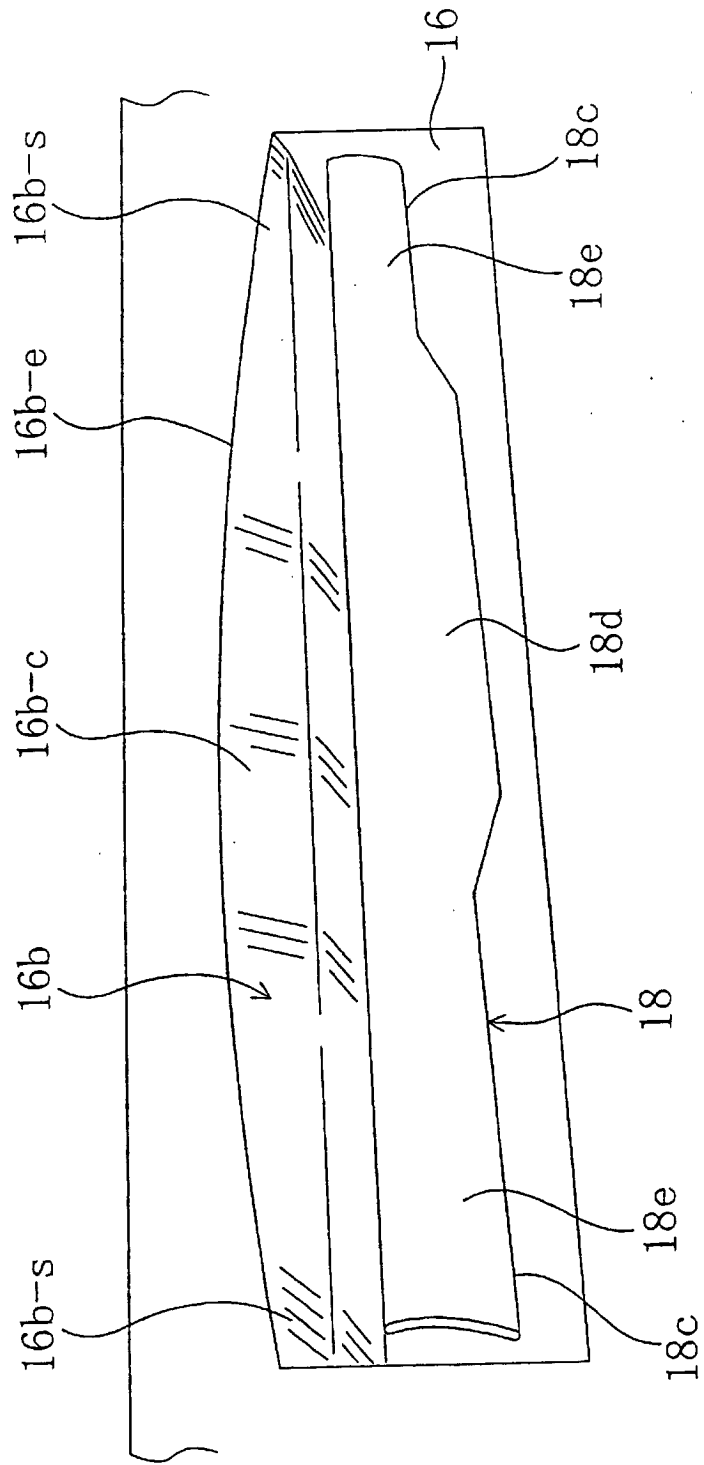


Fig. 6

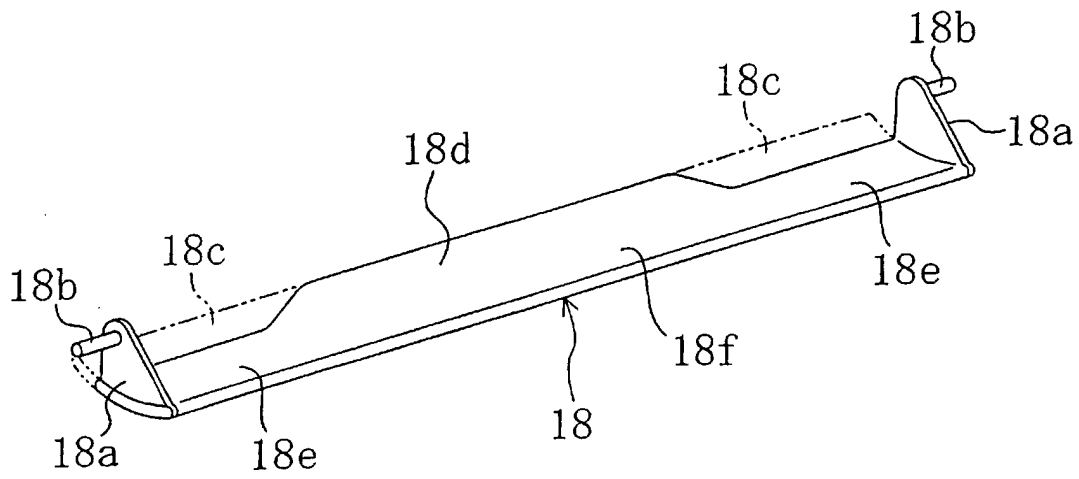


Fig. 7 A

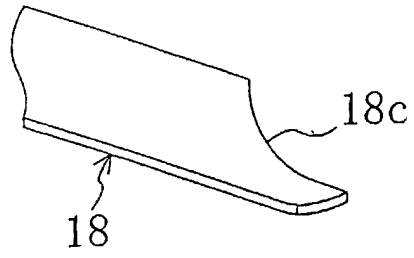


Fig. 7 B

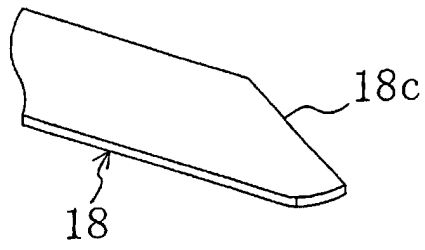


Fig. 7 C

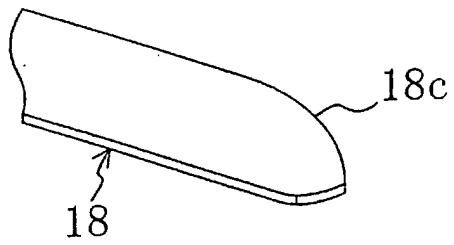


Fig. 7 D

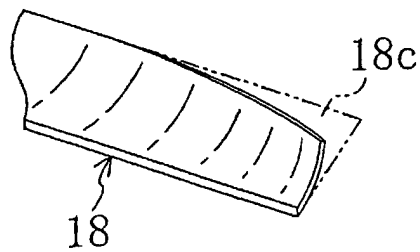


Fig. 8

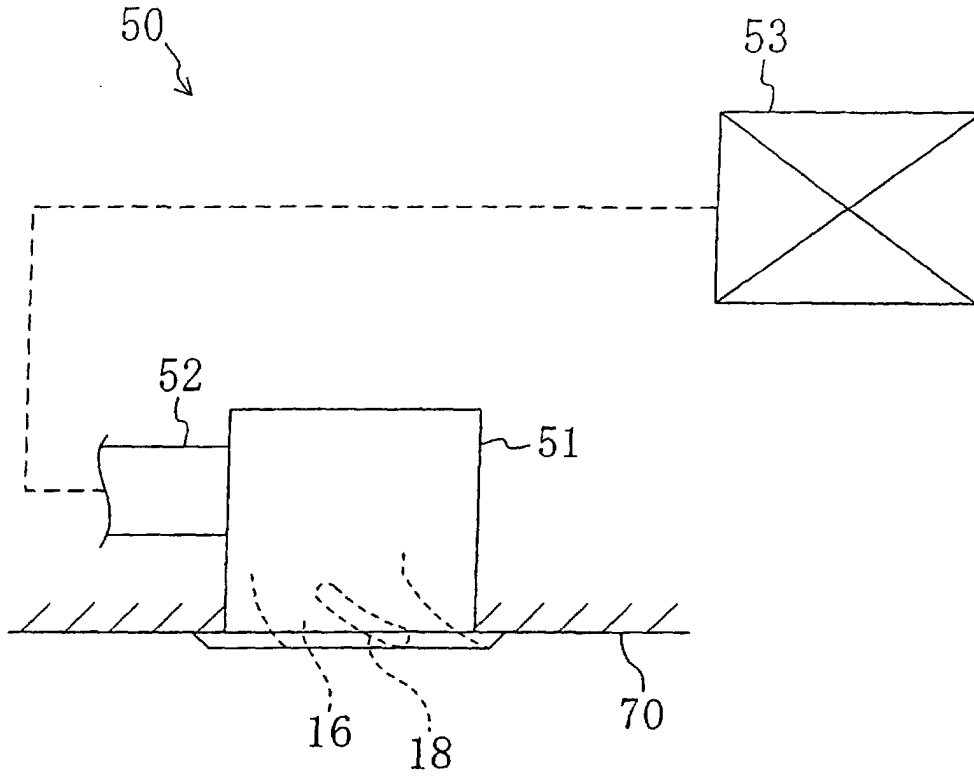
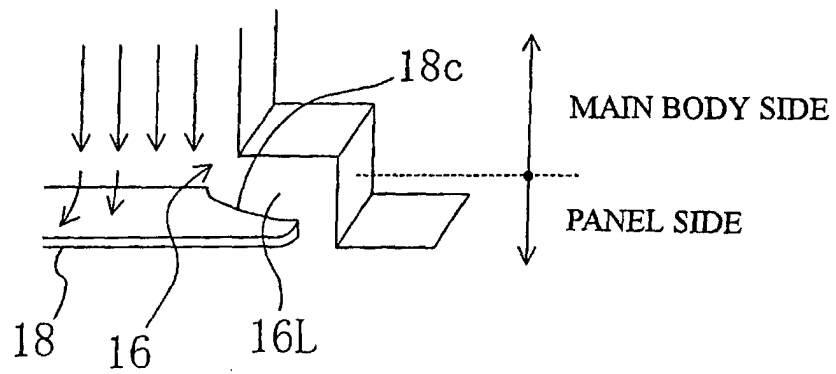
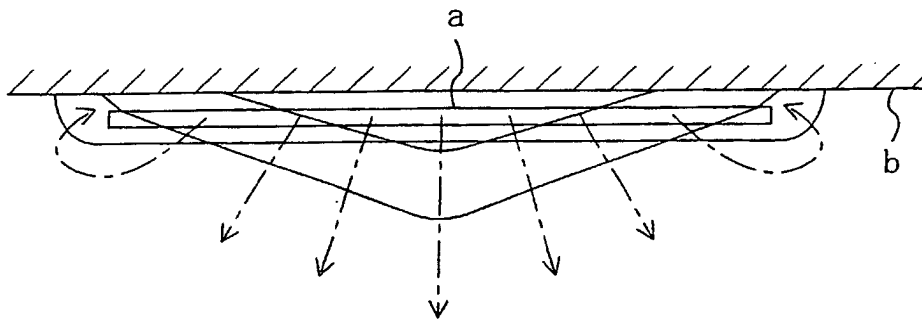


Fig. 9



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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/06516

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.
X	JP 7-324802 A (Daikin Ind., Ltd.), 12 December, 1995 (12.12.95), Full text; all drawings	1-3, 5, 11
Y	(Family: none)	4, 6-10, 12-18
Y	JP 7-12398 A (Mitsubishi Electric Corporation), 17 January, 1995 (17.01.95), Full text; all drawings (Family: none)	6-10, 15-18
Y	JP 9-14742 A (Mitsubishi Heavy Ind., Ltd.), 17 January, 1997 (17.01.97), Full text; all drawings (Family: none)	12-14, 16-18
E,A	JP 2001-65911 A (Mitsubishi Heavy Ind., Ltd.), 16 March, 2001 (16.03.01), Full text; all drawings (Family: none)	1-18
<input checked="" type="checkbox"/> Further documents are listed in the continuation of Box C. <input type="checkbox"/> See patent family annex.		
* Special categories of cited documents:		
"A"	document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention
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"O"	document referring to an oral disclosure, use, exhibition or other means	"&" document member of the same patent family
"P"	document published prior to the international filing date but later than the priority date claimed	
Date of the actual completion of the international search 23 October, 2001 (23.10.01)	Date of mailing of the international search report 30 October, 2001 (30.10.01)	
Name and mailing address of the ISA/ Japanese Patent Office	Authorized officer	
Facsimile No.	Telephone No.	

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INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP01/06516

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	JP 9-287766 A (Fujitsu General Ltd.), 04 November, 1997 (04.11.97), Full text; all drawings (Family: none)	1-18
A	JP 8-121857 A (Sanyo Electric Co., Ltd.), 17 May, 1996 (17.05.96), Full text; all drawings (Family: none)	1-18
A	US 5577958 A (Mitsubishi Denki Kabushiki Kaisha), 26 November, 1996 (26.11.96), Full text; all drawings & AU 3284295 A & HK 1009347 A & IT 95840761 A & ES 2125774 A & GB 2293447 A & JP 8-94160 A & CN 1125313 A & BE 1010103 A & KR 155607 B	1-18
A	JP 10-205795 A (Daikin Ind., Ltd.), 04 August, 1998 (04.08.98), Full text; all drawings (Family: none)	1-18

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7A.