



BLOWER AND FAN, BLOWER AND FAN SYSTEM, AND METHOD
FOR SUPPLYING WIND USING THE BLOWER AND FAN SYSTEM

FIELD OF THE INVENTION

The present invention relates to a blower and fan applicable to technologies such as an air curtain which is disposed at an opened entrance door and performs heat insulation inside and outside a building principally in case of air conditioning state as well as to a technology in a blower and fan to which has been applied a propeller fan having improved aerodynamics-ambient noise characteristics, so that its blowoff wind velocity is very high, resulting in high air capacity.

BACKGROUND OF THE INVENTION

Such type of a conventional blower and fan as described above is called by the trade name of "Air Curtain" wherein a circular and axially long vane which is a transversal flow vane called by the name of line flow fan is employed, and air is delivered to a blowoff opening located at a position perpendicular to its suction opening.

In the accompanying drawings Fig. 39 is a cross-sectional view showing a condition of mounting a fan viewed from the direction of its revolving shaft wherein a conventional transversal flow vane is used and which has been disclosed in Japanese Patent Laid-Open No. 313603/1994 in which a fan main body 101 disposed on its indoor side of an upper wall surface 105 in the upper part of an opened



entrance door 106 of an accommodation unit is provided with a suction opening 103 on the side opposite to that 101a on which has been disposed the fan main body 101 and a blowoff opening 104 of the lower surface thereof. Furthermore, a transversal flow vane 113 for delivering air from the suction opening 103 to the blowoff opening 104 and a driving motor 114 for rotationally driving the transversal flow vane are disposed inside the fan main body 101, while a fan casing 115 for introducing a flow of air is disposed on the outer circumferential part of the transversal flow vane 113. Moreover, a plurality of wind direction adjusting plates 116 for adjusting a wind direction of blowoff air are rotatably supported at the blowoff opening 104 with their upper end sections thereof as the fulcrums, respectively. In the above described constitution, when the transversal flow vane 113 is rotated in accordance with rotation of the driving motor 114, air sucked through the suction opening 103 passes through the transversal flow vane 113, and delivered to the blowoff opening 104 in accordance with the fan casing 115, whereby an air curtain flow is formed from the upper part to the lower part of the opened entrance door 106. In a condition for mounting the fan shown in Fig. 39, while there is a suction space A110 between a ceiling surface 107 and an upper surface 101b of the fan main body being the surface opposite to the blowoff opening 104 of the fan main body 101, even when the upper surface 101b of the fan main body is closely secured to the ceiling surface 107 to define no suction space A110, the fan can be attached

without affecting adversely blowing action, since no suction opening 103 is blocked off.

In a transversal flow vane, the suction opening 103 is symmetrically positioned to the blowoff opening 104 in the fan casing with respect to the revolving shaft, so that both of a suction flow and a blowoff flow pass through the transversal flow vane 113. In other words, when the transversal flow vane is rotated by substantially 180° , the suction flow changes into the blowoff flow, and hence, transversal flow vane effects its work by only about $1/2$ the whole circumference thereof.

Accordingly, its fan efficiency is lower than that of a propeller fan, and in this respect an overall size of the main body 101 does not become so small, although a dimension of vane outside diameter of the transversal flow vane is smaller than that of a propeller fan, since the former fan involves a fan casing. The blowoff opening 104 in the fan casing has a small width dimension, because of blowoff for the transversal flow vane, but it has a longer contour in the axial direction thereof. As a result, its blowoff flow comes to be the one having high wind velocity, but low air capacity. Because of such flow of wind, if anyone stands right below the blowoff opening, he (or she) feels uncomfortable, while if it is intended to obtain a higher air capacity, resulting in a higher blowoff wind velocity, so that its wind velocity becomes high in even a floor area. Thus, there arise uncomfortable situations such as stirring-up of dust on the floor or blowing bounded wind upon any person other than the one who stands right below the blowoff

opening.

As a fan which can solve the above described problems, there is the one described in Japanese Patent Laid-Open No. 313603/1994 wherein a plurality of propeller fans are used, and a plurality of supplying wind sections are disposed in parallel with each other. Since the above described fan adopts the propeller fans, it has characteristics of low ambient noise and high fan efficiency, but its wind flow directions, i.e., its sucking and supplying directions are in the axial direction, so that the wind flow directions of the fan in question differ from that of a conventional transversal flow fan type the wind flow directions of which are in perpendicular directions.

Fig. 40 is a side sectional view showing a product structure of a conventional fan of propeller fan type wherein reference numeral 35 designates an outer casing for a fan 101, and 103 denotes a suction opening defined on the upper section of the outer casing into which is formed a resin molded article being a cylindrical bell-mouth 30 having a rounded upper end section 34. Reference numeral 36 is a leg for mounting a motor which secures a driving motor 1 a propeller fan 2 of which is fixed to its revolving shaft by means of a fan fastening nut 42 in such that the driving motor is positioned in between the above described bell-mouths 30. A plurality of wind supply sections each of which is composed of the driving motor 1, the propeller fan 2, and the bell-mouth 30 are placed in the outer casing 35 in parallel to each other. Reference numeral 104 denotes a blowoff opening defined in the lower section of the

outer casing 35 which has a constitution communicating with the above described suction opening 103 wherein a rounded lower end section 34 is folded inwards, the extreme end of the folded section is joined to an end of its blowoff section of the bell-mouth 30, so that a smooth air duct 31 is formed over the whole inner wall of the outer casing 35.

Reference numeral 33 designates a guide which is disposed at the center of the blowoff opening 104 of the outer casing 35, a guide section is formed into a substantially triangular configuration including the side of the suction opening as the apex and the side of the blowoff opening as the base, and respective portions 34 of the guide are rounded to define multilayer parallel nozzles 32 inside the blowoff opening 104.

In a conventional fan of propeller fan type, its wind flow direction is in the axial direction wherein wind blows from a upward direction to a downward direction, so that it is necessary for maintaining a suction space A110 between the suction opening 103 and a ceiling surface 107 of a building, and thus, the fan main body 101 cannot be closely mounted on a certain surface. The fan main body 101 is mounted by means of a part of a bracket 102 for mounting the main body on an upper wall surface 105 of an entrance door. In these circumstances, such fan cannot be mounted closely on the surface of a ceiling, wall, or floor.

Figs. 41(a) and (b) are side views each showing a mounting condition of a conventional fan of propeller fan type, and particularly a condition where external wind blows wherein Fig.

41(a) shows a case where a fan main body 101 is arranged in such that a direction of blowoff wind is made to be substantially right down, in other words, a case where the revolving shaft of the propeller fan is made to be vertical, while Fig. 41(b) shows a case where the fan main body 101 is obliquely inclined, whereby a direction of blowoff wind is inclined towards a direction outside the building, i.e., a side of the external wind. In the mounting condition shown in Fig. 41(a), blowoff wind is forced by external wind towards the room side (left side in the drawing), so that the external wind blows into the room. On the other hand, in the mounting condition shown in Fig. 41(b), since blowoff wind has been previously directed to a side outside the room (right side in the drawing), a degree of wind which blows into the room is moderated. In such a mounting condition of the fan, however, it is required to incline a direction of the fan main body 101 by means of a bracket 102 for mounting the main body, there is a case where the fan main body 101 must be mounted again with a required angle after removal thereof in the event where external wind blows. Besides, the mounting condition in the latter case is visibly unstable.

Fig. 42 is a side view showing a mounting condition of a conventional fan of propeller fan type, and showing particularly a condition where external wind is strong. In the figure, although a fan main body 101 has been mounted in an obliquely inclined manner, since force of external wind is stronger than that of blowoff wind of the fan, the blowoff wind

is unlike that shown in Fig. 41(b), wind blows into a room (left side in the drawing), so that external wind invades the room.

In case of a fan wherein a transversal flow vane is used as shown in Fig. 39, there has been such a problem that a sufficient draft amount cannot be assured, so that sealing effect is not sufficient. There have been such problems that this type of vane has a fan efficiency as low as around 30%, and that particularly discordant noise called by the name of "rotating sound" as to which frequency is determined by the number of revolution is remarkable. There have been also such problems that a vane is the one called by the name of multiblade fan composed of multiple small vanes (generally about twelve), so that dust adheres easily on the vanes, besides a length of each vane in the axial direction is long, and hence, it becomes unbalance, resulting in remarkable vibration. Moreover, operation for attaching and detaching vanes is complicated, so that cleaning has been heretofore difficult. Furthermore, in case of using propeller fan, as shown in Figs. 40 through 42, it is necessary for assuring a space in between the suction opening 103 and a building, there has been such a problem that a place where a fan is to be employed is limited in the case where such fan is used for an air curtain, because the fan cannot be closely mounted onto a ceiling.

On one hand, revolution components of blowoff flow being a characteristic feature of propeller fan cannot completely be removed, and its blowoff opening has a nozzle shape so that a blowoff area is smaller than its suction area, resulting in

pressure loss, and thus, such a situation where a static pressure involved in a fan is changed efficiently into blowoff dynamic pressure has not yet been achieved. There has been such a problem that wind velocity is hardly ensured, and performance such as heat insulation as an air curtain cannot be assured. While Japanese Patent Publication No. 35880/1994 has been known as a technique wherein air capacity and wind velocity is assured by propeller fan, there have been such problems that it is required to use a scroll casing for ensuring its performance and to incline the whole equipment so that its structure becomes complicated, whereby a size thereof increases, resulting in limitation of a place where such fan is to be mounted or suppression of its performance, and that since its blowoff wind expands so that it cannot be used for an air seal. In addition, since a plurality of propeller fans are employed, there has been such a problem that a number of motors having the highest manufacturing cost in a propeller fan must be employed.

SUMMARY OF THE INVENTION

According to a first aspect of the present invention, there is provided a blower and fan comprising:

a propeller fan, a fan casing, a first, thin plate-like,
5 air duct member, a second air duct member, a wall and a blowoff opening; wherein:

the propeller fan is driven rotatively by a driving means to supply wind;

the second air duct member is disposed around the
10 propeller fan to guide the supply wind produced by the propeller fan from the proximity of an end of the propeller in a radial direction, the second air duct member also being for separating a suction side of the propeller fan from a blowoff side of the propeller fan;

15 the fan casing is connected to the second air duct member, the fan casing being a substantially semicylindrical surface that is coaxial with the axis of the propeller fan;

the first air duct member is housed in the fan casing, disposed around the axis of the propeller fan with a
20 predetermined spacing between the first air duct member and the propeller fan so as to oppose the vanes of the propeller fan, and defining a diffuser air duct together with the second air duct member for guiding the supply wind away from the axis of the propeller fan;

25 the blowoff opening, defining an end of the diffuser air duct, is provided so as to blow off the supply wind in a direction perpendicular to the axis of the propeller fan; and

the wall is opposed to the first air duct member and on the opposite side of the first air duct member to the second
30 air duct member, the blowoff opening formed adjacent to the wall, and supply wind derived from the diffuser air duct is blown off from the blowoff opening through a space between the first air duct member and the wall.

BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be explained in more detail in conjunction with appended drawings, wherein:

Fig. 1 is a side sectional view showing a blower and fan according to a first embodiment of the present invention;

Fig. 2 is a front view showing the blower and fan according to the first embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 3 is a side sectional view showing a blower and fan according to a second embodiment of the present invention;

Fig. 4 is a side sectional view showing the blower and fan according to the second embodiment of the present

invention;

Fig. 5 is a side sectional view for explaining assembly of the blower and fan according to the second embodiment of the present invention;

Fig. 6 is an explanatory view for mounting a blower and fan according to a third embodiment of the present invention;

Fig. 7 is an explanatory view for mounting the blower and fan according to the third embodiment of the present invention;

Fig. 8 is an explanatory view for mounting the blower and fan according to the third embodiment of the present invention;

Fig. 9 is a front view showing the blower and fan according to a fourth embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 10 is a bottom view showing the blower and fan according to the fourth embodiment of the present invention;

Fig. 11 is an explanatory view for mounting a blower and fan according to a fifth embodiment of the present invention;

Fig. 12 is an explanatory view for mounting the blower and fan according to the fifth embodiment of the present invention;

Fig. 13 is a bottom view showing the blower and fan according to the fifth embodiment of the present invention;

Fig. 14 is an explanatory view showing the blower and fan according to the fifth embodiment of the present invention;

Fig. 15 is a side sectional view showing a blower and fan according to a sixth embodiment of the present invention;

Fig. 16 is a front view showing the blower and fan

according to the sixth embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 17 is a side sectional view showing the blower and fan according to the sixth embodiment of the present invention;

Fig. 18 is a front view showing the blower and fan according to the sixth embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 19 is a front view showing a state of a blower and fan from which have been extracted an internally driving motor and a first air duct member shown in Fig. 16;

Figs. 20(a), (b), and (c) are wind velocity distribution diagrams of supply wind derived from the sixth embodiment of the present invention wherein Fig. 20(a) shows a wind velocity distribution diagram according to the present invention, Fig. 20(b) shows a diagram according to a conventional fan of propeller fan type, and Fig. 20(c) shows a diagram according to a conventional fan of transversal flow vane type, respectively;

Fig. 21 is a front view showing a blower and fan according to a seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 22 is a front view showing the blower and fan according to the seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 23 is a front view showing the blower and fan according to the seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 24 is a front view showing the blower and fan according to the seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 25 is a front view showing the blower and fan according to the seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 26 is a front view showing the blower and fan according to the seventh embodiment of the present invention in a state where a decorative grille has been removed therefrom;

Fig. 27 is a side sectional view showing a blower and fan according to an eighth embodiment of the present invention;

Fig. 28 is a side sectional view showing the blower and fan according to the eighth embodiment of the present invention;

Fig. 29 is a side sectional view showing a blower and fan according to the eighth embodiment of the present invention;

Fig. 30 is a side sectional view showing a blower and fan according to the eighth embodiment of the present invention;

Fig. 31 is a front view showing a blower and fan according to a ninth embodiment of the present invention;

Fig. 32 is a vertical sectional view showing a blower and fan according to the ninth embodiment of the present invention;

Fig. 33 is a front view showing a blower and fan according to a tenth embodiment of the present invention;

Fig. 34 is a partially cutaway bottom view showing a blower and fan according to the tenth embodiment of the present invention;

Fig. 35 is an enlarged sectional view showing the blower and fan according to the tenth embodiment of the present invention;

Fig. 36 is a front view showing a nozzle frame of the blower and fan according to the tenth embodiment of the present invention;

Fig. 37 is a front view showing the nozzle frame of the blower and fan according to the tenth embodiment of the present invention;

Fig. 38 is a sectional view showing a holding portion of a protection member in the blower and fan according to the tenth embodiment of the present invention;

Fig. 39 is a side sectional view showing a conventional blower and fan;

Fig. 40 is a side sectional view showing a conventional blower and fan;

Fig. 41 is an explanatory view for mounting a conventional blower and fan; and

Fig. 42 is an explanatory view for mounting a conventional blower and fan.

BEST MODE FOR EMBODYING THE INVENTION

First Embodiment:

Fig. 1 is a side sectional view showing a product structure of a blower and fan according to the present invention, and Fig. 2 is a front view showing a state where a decorative grille has been removed therefrom wherein reference numeral 2

designates a propeller fan driven rotationally by a driving motor 1 to effect blowing-off operation, reference numeral 5 denotes a bell-mouth casing for introducing air into the propeller fan 2, reference numeral 4 denotes a second air duct member connected to an outlet end of the bell-mouth casing and for separating a suction side from a blowoff side, reference numeral 16 denotes a fan casing opposite a blowoff opening 104 in a direction intersecting perpendicularly the revolving shaft of the propeller fan 2 and the external shape of a section intersecting perpendicularly the revolving shaft being substantially a semicircular contour, reference numeral 3 denotes a disk-shaped first air duct member disposed in the fan casing 16 in such a manner that it is opposed to the propeller fan 2 with a predetermined spacing and functioning as a draft guide with a larger dimension than an outside diameter of the propeller fan, reference numeral 15 denotes a fan main body, reference numeral 103 denotes a suction opening a side of which is opened and the resulting opening corresponds thereto, reference numeral 15a denotes a back of the main body opposite to the suction opening, reference numeral 11 denotes a motor mounting plate for securing the driving motor 1 and the first air duct member 3 at a substantially central portion of the back 15a of the main body, reference numeral 22 denotes a fan holding nut for holding detachably the propeller fan 2 around the revolving shaft 1a of the driving motor 1, reference numeral 9 denotes diffuser air duct defined between the second air duct member 4 and the disk-shaped first air duct member

3 which is configured larger than a dimension of the outside diameter of the propeller fan 2 and mounted in substantially parallel thereto, and reference numeral 10 denotes a back space of a centrifugal diffuser air duct, respectively.

A fan casing 16 having a larger dimension than that of the first air duct member 3 is mounted on the outer circumference thereof in a semicircular configuration centering around the revolving shaft 1a, while the blowoff opening 104 of the fan is disposed on the side of the main body positioned opposite thereto. The whole of the fan casing is formed integrally into the main body 15 with the bell-mouth casing 5 being a draft guide of the propeller fan 2, the second air duct member 4 and the back 15a of the main body which constitute a side wall, the fan casing 16, and the suction opening 104. The fan casing includes further the decorative grille 14 to constitutes the main body 15. The decorative grille 14 is detachably attached to the suction opening 103 of the fan, while a plurality of vertically wind directing plates (current plates) 17 are attached to the blowoff opening 104 of the fan in a width direction of a scroll casing so as to partition its blowoff air duct along the width direction.

Air sucked by the propeller fan 2 through the decorative grille 14 and the fan suction opening 103 receives a force in the axial direction as well as the diametrical direction by means of rotation of the propeller fan. Furthermore, according to the present propeller fan, velocity energy of a flow from the axial direction to the diametrical direction can

be converted into static pressure by means of the bell-mouth casing 5, the second air duct member 4, and the first air duct member 3 without discarding uselessly the velocity energy of flow. In other words, according to the present propeller fan, a flow can be changed at 90° to elevate a pressure (static pressure) as compared with draft along the axial direction in a flow derived from a conventional propeller fan by means of the centrifugal air duct 9 wherein a flow in the axial direction is converted into the one in the diametrical direction in a blowoff space towards an outer circumferential direction extending from the bell-mouth casing to the first air duct member while maintaining characteristic features of high air capacity, low noise, and high efficiency involved in the propeller fan. More specifically, an amount of velocity energy which has been discarded uselessly in a conventional propeller fan is converted by the centrifugal diffuser air duct into static pressure, whereby characteristic property of the present propeller fan is elevated.

Air a flow direction of which has been changed from the centrifugal diffuser air duct 9 to the diametrical direction is guided to right and left sides of the fan main body 15, and blown off from the blowoff opening 104 of the fan in the under side of Fig. 2 as it stands. Namely, air is blown off with high air capacity of the propeller fan towards the lower direction as well as high wind velocity due to a pressure converted by the centrifugal diffuser air duct, whereby the air can be blown off to a distant place. In addition to the

above, wind supply towards the upper side collides with the fan casing 16, so that the flow changes its direction by about 180° to a side of the back space 10 of the centrifugal diffuser air duct defined between the back 15a of the main body and the first air duct member 3, i.e., onto the outer circumferential section of the first air duct member 3, and the air is supplied from the blowoff opening 104 through the centrifugal diffuser air duct back space 10. Furthermore, as shown in Fig. 2, wind supply towards a side direction collides also with the semicircular fan casing and a side wall of the main body 15, whereby the air flow changes its direction towards a side of the centrifugal diffuser air duct back space 10 defined between the main body back 15a and the first air duct member 3, in other words, the direction of air flow is changed at the outer circumference of the first air duct member 3, the air flow the direction of which has been thus changed is collected in the blowoff opening 104 which is opened extending over the whole lower part of the main body 15, so that the resulting air flow blows off in a constant direction with high air capacity and high wind velocity. More specifically, air sucked from the front of the decorative grille 14 changes its flow direction by 90° , and further air flow moving in the diametrical direction towards four surfaces of sides of a box-type main body is collected by means of the scroll casing 16 on one of the surfaces in sides of the box-type main body to blow off the same.

In a conventional scroll type casing wherein it is adapted in such that a volute tongue exists, and a vortex is expanded

towards a blowoff opening, whereby wind is made to flow smoothly, even if air capacity can be assured and noise can be reduced, it is difficult to delivery wind to a distant place, because diffused wind blew off from the expanded blowoff opening exhibits different wind velocity dependent upon a position of blowoff opening. On one hand, in a fan as in the present invention, a spacing wherein air is supplied in the axial direction from the centrifugal diffuser air duct defined between the semicircular fan casing and the first air duct member 3 to the centrifugal diffuser air duct back space 10, in other words, a spacing defined between the fan casing and the first air duct member 3 is the same in the upper half area, and further a spacing defined between a side wall of the main body and the first air duct member 3 is more broadened with much more invasion into the lower half area, so that blowoff wind in the propeller fan is concentrated downwards. As a result, wind is blown off while remaining air capacity and wind velocity as they are by such an arrangement that wind flow is concentrated in a constant direction without diffusing the wind flow after departing the same from the fan, so that it becomes possible to supply wind of a high air capacity to a distant place. Moreover, since the casing back space 27 is defined between the fan casing 16 and the main body 15, electrical parts such as capacitors and wiring components can be contained in the resulting casing back space.

Besides, since propeller fan is a kind of centrifugal fan so that its vane configuration is simple as compared with that

of other types of fan such as transversal flow fan, resulting in light weight, and no complicated fan casing is required. Thus, such simple structure brings about low vane load so that high-speed rotation becomes possible, whereby high air capacity can be obtained even if such fan comes to be constituted in a compact size. For instance, in comparison with a line flow fan of high air capacity, two times higher rotational speed can be achieved with respect to the same air capacity in propeller fan, and accordingly, much more downsizing is possible.

In Fig. 2, four horizontally wind directing plates 17 are disposed in such that a blowoff air duct is partitioned from side to side in its width direction, in other words, along a horizontal direction in the drawing. In order to carry the wind blown off from the blowoff opening 104 to a distant place, it is necessary for straightening the wind blown out from the blowoff opening 104, directing unidirectionally a blowoff direction of the wind, and further uniformizing blowoff wind velocity. Namely, if the wind blown off from the blowoff opening 104 has not yet been uniformized, they interfere with each other, so that such wind does not reach a distant place. In a prototype fan according to the present invention having $\phi 210$ vane outer diameter, $\square 300$ main body profile, and 300×75 mm blowoff opening dimension, when the wind directing plates 17 are disposed in the case where a propeller fan is rotatively driven at 2200 r/m rotational frequency, an advantage of about 30% elevated wind velocity was obtained. Although the above

described fan has been constituted in such that the propeller fan is disposed at a substantially central part of the main body profile, the fan casing 16 is disposed in the form wherein it is in contact with the main body, and further the first air duct member 3 is made of circular thin sheet-like material in Fig. 2 and which has a dimension larger than an outside diameter of the fan for forming the diffuser, while it is smaller than a diameter of the fan casing to hold a spacing for assuring a draft path in the axial direction, a lower half area of the air duct member 3 may be formed from a rectangular thin sheet-like material. In this case, however, an outside diameter of the propeller fan must be made larger as much as possible in comparison with a dimension of the main body, i.e., an outside diameter of the semicircular fan casing, if it is not arranged accordingly, insufficient wind velocity is obtained. In an example of the above described prototype fan, no wind velocity was obtained in case of $\phi 180$ vane outside diameter of the fan. This is because a pressure decreases in the main body, since an air duct from the fan to the blowoff opening becomes too long. Accordingly, it is desired to keep a fan diameter larger with respect to the main body so as to blow off wind while maintaining a high pressure. In other words, it is desired that a dimension of the main body is the one which assures to give the minimum diffuser air duct and passageway in the axial direction to a fan diameter.

Second Embodiment:

Figs. 3, 4, and 5 are side views each showing another product structure of a blower and fan according to the present invention wherein the same components as those in Figs. 1 and 2 are designated by the same reference numerals as those in Figs. 1 and 2, respectively. A unitary fan casing 19 is obtained by molding integrally the bell-mouth casing 5 and the second air duct member 4 in the constitution of Fig. 1 by the use of a heat insulating light-weight material such as foamed polystyrene. Furthermore, a unitary fan casing 20 is obtained by molding integrally the bell-mouth casing 5 and the second air duct member 4 in the constitution of Fig. 1 as well as a fan casing 16 by the use of a heat insulating light-weight material such as foamed polystyrene. In a blowoff opening 104, there are a total of two anteroposteriorly wind directing plates 18 other than a wind directing plate 17, i.e., one of which is disposed on the side of a centrifugal diffuser air duct 9 and the other is disposed on the side of a centrifugal diffuser air duct back space 10 to partition the blowoff air duct 104 in the axial direction. These anteroposteriorly wind directing plates 18 are rotatable in the axial direction, namely, wind directs vertically in Fig. 3, so that blowoff wind towards perpendicular direction with respect to the axial direction, i.e., the wind directs right down in the drawing. In Fig. 4, the anteroposteriorly wind directing plates are inclined with respect to the side of a main body back 15a, so that the blowoff wind does not direct right down, but inclines slightly towards the side of the main body back 15a which

indicates a condition for mounting a fan in the case where external wind blows. Since a unitary fan casing is integrally molded from a heat insulating light-weight material such as foamed polystyrene, integration and weight saving of parts can be realized simultaneously. In the case where a casing of the main body 5 has been manufactured from sheet steel, when a unitary fan casing is arranged so as to be closely contact the same with an inside surface of the main body, a strength of the main body can be improved. Accordingly, it becomes possible to obtain a thinner main body. In the above described case, rotation of the anteroposteriorly wind directing plate 18 can be manually made easily by a user around a fulcrum 18a of the anteroposteriorly wind directing plate as the point of support.

A sucking R section of the unitary fan casing 19 shown in Fig. 3 is an earthenware mortar-shaped area covering the outer circumferential part of the propeller fan, and hence all of a sucking section 19a, a blowoff section 19b, and an intermediate section of them have a circular contour, respectively. In the shape of the bell-mouth 5 shown in Fig. 1, air sucked from the suction opening 103 takes a circular shape in an area of the bell-mouth 5 although the original shape is square, since the opening surface of the main body 15 is square. In the circumstances, since a profile of the suction flow changes from square to circle, deflection appears in the flow, so that discordant noise called by the name of rotating sounds wherein frequency is determined by number of revolution

as in the case of a transversal flow fan generates easily due to a further reason where the propeller fan 2 rotates at high-speed. On the contrary, in the unitary fan casing 19, since the sucking R section is formed into an earthenware mortar-shape covering the outer circumferential part of the propeller fan, deflection appears hardly in the suction flow, so that rotating sounds generate hardly also.

In Figs. 1 and 2, a size of the fan casing in the width direction is made 1.4 to 1.5 times larger than an outside diameter of the propeller fan, and the fan casing is formed into a substantially semicircular shape centering around the revolving shaft of the fan. In a blower and fan wherein a conventional propeller fan is employed, a width W of a scroll casing is about two times larger than an outside diameter of a propeller fan as disclosed in Japanese Patent Publication No. 35880/1994. In the case where the scroll casing is made to be a spiral type as in a sirocco fan, when vanes are rotated in clockwise direction viewed from its air sucking side, a wind velocity of blowoff wind along the width direction of the blowoff opening 104 is faster on the right side, while slower on the left side. In order to smoothing a flow with respect to a vane outside diameter, a magnitude of scrolling is remarkable, for example, in case of standard scrolling scale of enlargement, if the vane outside diameter is $\phi 180$, its scroll outline comes to be $\square 300$, so that the scroll outline becomes 1.66 times larger than the vane outside diameter. In case of employing such flow as an air curtain, it is required

to uniformize blowoff wind velocity of a flow in a constant direction as mentioned above. In this respect, although an air capacity capable of processing somewhat decreases at the same rotational frequency, a constitution of the present invention is such that a fan casing is arranged to be concentric-shaped with respect to vanes so as to make the fan casing 1.4 to 1.5 times larger than a vane outside diameter. By such arrangement, it is possible to be around $\phi 210$ vane outside diameter with respect to $\square 300$ main body outline including the fan casing. Moreover, wind velocity in the width direction derived from the blowoff opening 104 can be uniformized. The reason why a fan casing is made to be 1.4 to 1.5 times larger than a vane outside diameter is based on such fact that 1.15 to 1.2 times larger first air duct member 3 than the vane outside diameter is optimum with taking a air duct defined on its outer circumferential part and extending from the centrifugal diffuser air duct 9 to the centrifugal diffuser air duct back space 10 into consideration. Fig. 5 is an explanatory view showing disassembled parts of a blower and fan containing a unitary fan casing wherein a front part to which has been attached a grille 14 may be disassembled successively from a main body 15 in order, while the rearmost part may be easily mounted to the main body and successively assembled further parts in order. Fig. 5 shows product structures of blower and fans shown in Figs. 3 and 4 as well as a case wherein the parts are assembled. First, a motor mounting plate 11 is fixed at a substantially central part of

a main body back 15a of a box type main body 15 a side of which is opened by means of spot welding, threaded fixation or the like. Then, a driving motor 1 is secured to the motor mounting plate 11 by motor fixing screws 23. In this occasion, a first air duct member 3 is also screwed together with the motor mounting plate 11. A unitary casing 20 is inserted into a fan suction opening 103. In the present case, the unitary fan casing 20 is obtained by molding integrally three parts of a bell-mouth casing 20a, a second air duct member 20b, and a fan casing member 20c by the use of foamed polystyrene and the like. Although the present explanation has been made with respect to the unitary fan casing 20, a unitary fan casing 19 is arranged in such that a fan casing 16 made from thin steel or the like was secured to the main body 15 before inserting the fan casing 19. In case of inserting the unitary fan casing 19, the main body 15 has been provided with, for example, a stopper or the like so as to hold a predetermined spacing between an end portion 19b on the blowoff side and the first air duct member 3. Through the fan suction opening 103, a propeller fan 2 is fixed to the revolving shaft 1a of the driving motor 1 by a vane fixing nut 22. Finally, a decorative grille is attached to an opened section of the main body.

In case of conducting maintenance such as removal of dust adhered to the propeller fan 2 of the blower and fan, first, the decorative grille attached to the suction opening 103 of the main body 15 is removed, then, the vane fixing nut 22 is removed, and finally, the propeller fan 2 is removed from the

revolving shaft 1a of the driving motor 1. As described above, in the constitution according to the present invention, it is possible to easily clean blower and fan under a mounting condition of the product. Moreover, dust adheres hardly to propeller fan as compared with transversal flow fan being multiblade fan, besides adhesion of dust is uniform on the front surface of a vane. As a result, there is not nonuniformity in amount of dust adhered in its axial direction unlike the case where transversal flow fan is employed, so that maintenance therefor is easy. In the case where the blower and fan is mounted to a building, as in the case of maintenance, first, the decorative grille 14 is removed, then, the propeller fan 2 is removed, under this condition, wall mounting members such as wood screws are inserted into mounting holes each of which does not adversely affect a condition of the blower and fan disposed on the first air duct member 3, and the blower and fan main body may be secured to a wall surface by utilizing openings for securing main body defined on the main body back 15a which correspond opposingly to the mounting holes. Alternatively, holes for securing main body through which ceiling mounting members such as wood screws can be fixed have been defined on a place where the bell-mouth casing 5 on a side 15b of the main body is not disposed, and a blower and fan may be directly secured to the ceiling surface 107 in a state where the decorative grille 14 has been removed. As described above, according to the present invention, a blower and fan main body can be directly secured to a wall surface or a ceiling surface

in a simple and positive manner, so that metal fittings and the like for mounting main body becomes unnecessary, whereby it is possible to mount a blower and fan main body in a inexpensive and light-weight manner.

Third Embodiment:

Fig. 6 is a side view showing a state wherein a plurality of blower and fans are disposed and mounted at distant positions in a room, respectively. The right side in the figure shows a usual mounting state for functioning blower and fans as an air curtain wherein a plurality of the blower and fans are arranged continuously in parallel to each other in which reference numeral 101 designates a fan main body, reference numeral 103 denotes a suction opening, reference numeral 104 denotes a blowoff opening, reference numeral 105 denotes an upper wall surface of entrance door, reference numeral 106 denotes an opened entrance door, reference numeral 107 denotes a ceiling, reference numeral 108 denotes a floor, and reference numeral 109 denotes a wall surface with no opening, respectively. In this arrangement, a direction of blowing wind is such that air is sucked from the suction opening 103 of a fan disposed in the lower part of the drawing, and the air thus sucked is supplied from the blowoff opening 104, more specifically, air is sucked by the fan disposed in the left lower part of the drawing, and a direction of the air to be supplied is changed into the one which is perpendicular to the direction of sucked air in this fan. The air thus supplied

is used as suction wind for another fan mounted on the ceiling 107. Blowoff wind from the fan on the ceiling is supplied to the fan for an air curtain disposed on the entrance door 106 as interior circulating wind. A mounting manner of the fan for an air curtain is such that a main body side a 101a opposite to the suction opening 103 of the fan main body 101 is disposed so as to face the same to the upper wall surface 105 of the entrance door, and the fan main body 101 may be mounted closely to the ceiling 107, because a side facing to the ceiling 107 of the building is a main body side b 101b opposite to the blowoff opening 104 of the fan main body 101. In the same figure, the fan on the left upper part is generally mounted for feeding air (circulator), and a situation where air in a ceiling part of a room is blown off from the left side to the right side is illustrated. In this case, the side of the suction opening 103 is free, the main body side b101b is faced to the wall side 109 of the building, and the main body side a101a is faced to the ceiling 107 of the building, so that the fan main body 101 can be closely mounted to both the wall surface 109 and the ceiling 107. In addition, since a dimension of vertical direction of a fan is determined by a dimension of a vane of its propeller fan along the axial direction, the fan in this embodiment may be constituted in a thin profile, whereby a dimension protruded from the ceiling can be suppressed, so that the resulting fan comes to be in a state where it fits suitably to the ceiling. In the same figure, a fan mounted usually as a circulator is illustrated in the left lower part

wherein the main body side b 101b is faced to the floor 108 of the building, and the main body side a 101a is faced to the wall 109 of the building, and thus, the fan main body 101 can be closely mounted to both the floor 108 and the wall 109, whereby the fan can be stably settled on the floor. While the above description has been made on a constitution wherein air is circulated along walls of a room, when such constitution is applied to an area defined between two rooms as a partition, a specified room can be thermally insulated by an air curtain. Further, although the constitution to be mounted to a ceiling has been described, it is also possible to apply such constitution to a huge space having a long vertical dimension. In such case, a space of the upper layer where no air-conditioning is required is partitioned by circulating supply wind, whereby energy efficiency can be improved. Even if an entrance door has not a flat configuration, but a complicated configuration, planes defined by two or three entrance doors can be sealed with continuously circulating supply wind in such a manner that an air curtain formed by such circulating supply wind is applied horizontally. Furthermore, such a complicated plane wherein an entrance door facing to the outside is indented towards the interior of a room can be also sealed with continuous flow of supply wind in accordance with the same manner as that described above.

Figs. 7(a) and (b) are side views each showing a state of mounting a blower and fan for air curtain use, and particularly showing a case where external wind blows. Fig. 7(a) illustrates

a case where a blowoff direction of wind in a fan main body 101 is allowed to direct substantially right below as in the case of Fig. 3, in other words, the figure illustrates either a case where a wind directing plate disposed in the blowoff opening is arranged vertically, or a case where no wind directing plate is disposed. Fig. 7(b) illustrates a case where the fan main body 101 is mounted in accordance with the quite same manner as that described above, but the wind directing plate is inclined towards the external direction of a building, i.e., the side of external wind. In a mounting state of the fan main body shown in Fig. 7(a), the blowoff wind is forcibly directed towards the inside of a room (left side in the drawing) by external wind, so that the external wind invades the room. On the other hand, in a mounting state of the fan main body shown in Fig. 7(b), since blowoff wind has been previously directed towards the outside of the room (right side in the drawing), a degree of invasion of external wind to the room decreases. In such a mounting state of the fan main body, a problem of invasion by external wind can be solved by such simple operation wherein a wind directing plate 21 disposed in the blowoff opening is merely inclined, so that it is sufficient to modify a direction of the wind directing plate by a user in the case where external wind blows after having been mounted the fan main body. Besides, a mounting state of a product is not constrained in this case. According to the present embodiment of the invention, a direction of blowoff air can be changed without requiring modification of a

direction for mounting the main body, so that countermeasures against external wind can be simply achieved. In Figs. 6 and 7, a plurality of fans are connected in parallel to each other so as to adjacent a suction opening of a propeller fan to a blowoff opening of another propeller fan to form an air curtain by blowoff wind flows delivered from a plurality of fans. In this arrangement, wind is supplied from the blowoff opening 104 in the whole bottom end section corresponding to a fan casing of the fan main body 101, and such blowoff openings are successively disposed, whereby the whole plane can be covered by a draft flow. Moreover, an air curtain serving a positive seal is formed by blowoff wind supplied from a fan casing having small gap with respect to the fan at a constant wind velocity while ensuring air capacity and wind velocity through the propeller fan to a centrifugal diffuser air duct.

Fig. 8 is a side view illustrating a state of mounting blower and fans in a combination thereof, and particularly showing the case where external wind blows intensively, or the case where an opening height in an entrance door is high. Both the backs 101a of two fan main bodies 101 are closely in contact with each other so as to be adjacent a blowoff opening 104 of the former fan main body to another blowoff opening 104 of the latter fan main body. Accordingly, a dimension of blowoff wind in the axial direction comes to be about two times larger, so that intensity of blowoff wind becomes about two times higher. In this situation, even if intensity of external wind is remarkable, a degree of invasion of blowoff wind due to external

wind into a room decreases. In this arrangement, a fan facing to the interior of the room sucks air from the room, while another fan facing to the exterior of the room sucks air from the outside of the room. Dependent upon opening height in entrance door, the fan main bodies 101, 101 are disposed in such that a main body side 101b opposite to the blowoff opening 104 in each of the fan main bodies faces the lower end surface of an upper wall 105 of the entrance door. Particularly, in this arrangement, a constitution of a series of fans is disposed on a ceiling, whereby the interior of a room may be partitioned by an air curtain to separate an area where air-conditioning is required from the other areas, or a smoking area may be established, and further an area where air-conditioning is generally operated may be divided into suitable sections without employing any bridgewall.

Fourth Embodiment:

Fig. 9 is a front view showing a state wherein a decorative grille is removed from another blower and fan according to the present invention; and Fig. 10 is a bottom view of the blower and fan shown in Fig. 9 viewed from the side of a blowoff opening 104 thereof wherein the same components as those shown in the preceding figures are represented by the same reference numerals in these preceding figures. Reference numeral 21 designates an endothermic-exothermic material disposed in the blowoff opening 104. Since the endothermic-exothermic material 21 is positioned in the place where wind velocity is

the highest, good heat exchange efficiency is attained. Besides, when, for example, an elongated rod-like sheath heater is used as such endothermic-exothermic material, effective heat exchange is achieved with respect to supply wind, and the blowoff wind is scarcely affected, because the endothermic-exothermic material has elongated rod-like profile. Furthermore, when a sheath heater is adapted to have U-shape so as to extend the same from a substantially central part of a centrifugal diffuser air duct 9 in its axial direction to a substantially central part of a centrifugal diffuser air duct back space 10 in its axial direction, the whole length becomes remarkably long. In such endothermic-exothermic material, when terminals 21a, 21a placed on opposite ends of the sheath heater are energized, it is possible to obtain a large capacity by the use of a single heater. In addition, since air capacity of wind passing through the outer circumference of the sheath heater is significant, heat exchange of high capacity becomes possible. When a part of a wind directing plate 17 is cut away in the vicinity of an area where the sheath heater exists, the wind directing plate is not affected adversely by heat. As a result, an air curtain with heater function having high heater capacity can be constituted, so that such air curtain can be effectively used as a supplementary heater in winter season.

Reference numeral 24 in Fig. 9 designates an openable second blowoff air duct without containing a scroll casing 16 of a box type main body 15 and disposed on the side adjacent

to the blowoff opening 104, reference numeral 25 an opening and closing damper disposed in the second blowoff air duct, and 26 a blowoff blocking section which is an opening for a blowoff opening of a plane of projection provided with the endothermic-exothermic material 21 and which blocks a part of the blowoff opening 104 adjacent to the second blowoff air duct 24, respectively. In this arrangement, a part of air supplied from the second blowoff air duct 24 is thermally exchanged.

According to the constitution as described above, the resulting single blower and fan may be used as a rotary fan, i.e., a cool wind fan in, for example, a rest room for a use application other than an air curtain, while in winter season, the same fan may be employed as a supplementary heater, and in this case, warm air supplied from the second blowoff air duct 24 may be used for defogging a mirror.

Fifth Embodiment:

Fig. 11 is a perspective view showing a product structure of a further blower and fan according to the invention wherein the same components as those of the preceding figures are represented by the same reference numerals as those of these figures. In Fig. 11, three blower and fans are connected in parallel to each other in such a manner that a suction opening 103 of a main body 15 is disposed adjacent to a blowoff opening 104 of another main body 15. As in a blower and fan disclosed in Japanese Patent Laid-Open No. 313603/1994, the number of blower and fans to be connected is determined by a dimension

of frontage of an opened entrance door 106 in a building. Dimensions of the blower and fan in this case is such that a width A is 300 mm, a height B is 300 mm, and a depth C is 180 mm with respect to vane outside diameter $\phi 210$. On one hand, in a conventional blower and fan of propeller fan type, a width A is 180 mm, a height B is 220 mm, and a depth C including a main body mounting bracket 102 is 245 mm wherein a dimension of the main body mounting bracket 102 is 35 mm. A ratio of air capacity in the case where a size of a fan is changed becomes a ratio of vane outside diameter to the third power, i.e., $(180/155)^3 = 1.6$ times larger, if its rotational frequency is not changed, so that the number of blower and fan comes to be $1/1.6$. Moreover, since a width A in a fan becomes about 1.5 times larger, three fan main bodies, i.e., three driving motors are required in a fan used for, e.g., 900 mm frontage. On the other hand, five fan main bodies, i.e., five driving motors are required in a conventional blower and fan. Due to the fact described herein, according to the blower and fan of the present example, the number of driving motor to be used which is the most expensive in manufactures' costs can be reduced, so that the manufactures' costs themselves can be also reduced.

When a volume wherein blower and fan is to be installed is compared, a suction space A110 is required to maintain in a conventional blower and fan of propeller fan type. In this respect, since a height of the suction space A110 is required to be 150 mm in Figs. 16 to 18, it results in 300 mm height x 180 mm depth in the present example, while it results in (220

+ 150) height x depth 245 mm, if a width is the same in both the cases. Consequently, a volume required for installing a fan in the present example is only 60% as compared with that of a conventional fan.

Fig. 12 is a perspective view showing a product structure obtained by combining blower and fans described in Fig. 8 wherein the same reference numerals as those of the preceding figures designate the same components as those of the preceding figures. In Fig. 8, a pair of fans are connected in such that a main body back 15 being the surface opposite to the suction opening 103 of a fan is superposed to that of another fan in such a direction where the suction openings 104 are aligned in the longitudinal direction (direction of revolving shaft). In Fig. 12, a set of three fans connected in parallel to each other in such a manner that a suction opening 103 of a fan is allowed to be adjacent to a blowoff opening 104 of another fan which corresponds to that shown in Fig. 8 is further connected in such a manner that each of backs opposite to the suction opening of a fan is superposed in a longitudinal direction where blowoff openings are aligned. Namely, a set is constituted in such that one pair each of fans shown in Fig. 11 is connected with each other so as to face closely a main body back 101a to another main body back 101a. As a result, a size of wind supplied from the blowoff opening 104 in the axial direction becomes two times larger, and a wind capacity becomes also two times larger. As mentioned above, such arrangement is effective for improving a capacity for blocking external wind

in case where external wind is particularly remarkable.

In the above description, a plane-like air seal with respect to an entrance door to the outside has been explained. In this connection, there are a tight building as well as a factory and a hospital which requires purity in the interior thereof in recent years. In such a situation, there are many cases where air partitions are required in a specified section in a room, a hall way and the like. In this case, useful is such an air supply system that when a propeller fan, which is driven rotatively by a motor being a driving means for fan, supplies overdraft delivered from the suction opening in the axial direction through a diffuser air duct towards the outer circumferential direction from a vicinity of an end of the propeller fan, whereby wind having a high air capacity and a high pressure can be supplied with low noise. When such wind is blown off from a blowoff opening defined on one end of fan casing of the fan containing the diffuser air duct along a direction in which blowoff wind of the propeller fan is in substantially perpendicular to the axial direction, it becomes possible to supply such wind to a distant place. In other words, when a supply air flow is formed from wind blown off from a set of plural fans obtained by such a manner that a plurality of fans are connected in parallel to each other in such that a suction opening of a propeller fan is allowed to be adjacent to a blowoff opening of another propeller fan, a forcible air curtain flow, i.e., air partition can be obtained. Apart from a set of plural fans with a certain distance, another set of

plural fans is arranged wherein another supply air flow is allowed to form in another direction from the latter set of plural fans. When much more combinations from these sets more than such two sets are prepared, a continuous plurality of planes can be formed from a circulating wind starting from a set of plural fans to another set of plural fans, and further a system wherein a certain angle is given to a suction air direction and a supply air direction can be obtained.

A closed space defined in a room or a hallway through which passage is possible, but which can lock the interior air may be established by only the above described system or a combination of the system and a wall surface. Moreover, when the system is combined with air-conditioning equipment for use in ventilating fan, cooler, air cleaning, a system for flow of supply wind which can comply with a variety of purposes such as locking contaminated air, exhausting such contaminated air, and keeping air clean can be achieved. Furthermore, a system having a more complicated constitution can also be achieved by such a manner that rotatable wind directing plates are disposed in a blowoff opening, an angle of each of the rotatable wind directing plates is changed, whereby a direction of supply wind blowing off towards a certain direction is changed from a perpendicular direction with respect to the axial direction.

As described above, in the present invention, it is arranged in such that a diameter of vane is made to be larger as much as possible in comparison with a size of a box profile of a blower and fan. This is because air capacity increases

by an outside diameter ratio of vane to third power, if a rotational frequency is the same in both cases. For this reason, a diffuser air duct and a semicircular fan casing are disposed in such that supply wind is allowed to be concentrated to blow off the same, whereby it becomes possible to supply wind to a distant place without decreasing air capacity and wind velocity. Due to a boss structure of a fan wherein a motor is contained in a vane of propeller fan, a thinner fan can be obtained. In addition, a structure of a fan along the axial direction is significantly reduced by a diffuser back space having a thickness of the same degree with that of a thin diffuser air duct. In a box profile, a shaft of a propeller fan is allowed to position at substantially the center with respect to a height of a blowoff direction, and a height of blowoff direction in a blowoff opening from a vane outside diameter is made to be around an intermediate dimension defined between a vane outside diameter on the opposite side and a fan casing. This is because a directivity with respect to wind direction has been obtained from the diffuser air duct and an air duct of the diffuser back space, so that there is no need to attach a long guide in the blowoff opening. Due to this fact, it is possible to suppress a dimension in a height direction. Accordingly, a blower and fan having a good space factor of small installation volume can be obtained based on a further advantage of no need of providing a space for suction between a ceiling and the fan main body.

A blower and fan according to the present invention

comprises a propeller fan driven rotatively by a motor to perform wind supply action; a bell-mouth casing for introducing air into the propeller fan; a fan casing connected to an outlet end of the bell-mouth casing, having a blowoff opening in a direction perpendicular to the revolving shaft of the propeller fan, and having a substantially semicircular contour of a section perpendicular to the revolving shaft; and a disk-shaped air duct disposed so as to oppose to the propeller fan with a predetermined distance. Furthermore, since a plurality of current plates being horizontally wind directing plates are disposed in a blowoff opening of the fan in a width direction of the fan casing, a compact, low noise, and a high efficient air curtain to which has been applied a novel propeller fan having improved aerodynamics-noise characteristics, so that there is little limitation for mounting, and a small volume for installation can be constituted by only a simple structural modification. As a result, an air curtain having high external wind shut-off capability can be attained. Accordingly, vanes can be detached by merely removing a decorative grille disposed on the front of vanes and removing vane fixing nuts, and hence cleaning of the vanes is easy. As compared with a conventional blower and fan wherein a plurality of propeller fans are employed, a propeller fan is made to be large-sized, the number of propeller fans to be used is reduced, whereby the manufacturing cost can be reduced. While a constitution wherein a light-weight material such as foamed polystyrene is

used, and assembling of parts can be simply carried out has been described in the explanation of the invention, when a thixotropic molding product of a magnesium alloy is employed for components including a rotating member such as vanes of a fan, it is effective from viewpoint of recycling. According to this modification, advantages of light weight as well as of good unit strength, besides further advantages of utilization of waste material in the course of manufacturing, and reuse of materials after discard of a product become easy and simple, so that there is no case where waste materials are discarded as refuse, whereby it brings about countermeasures against global environment problems.

Sixth Embodiment:

Fig. 15 is a side view illustrating a product structure of a blower and fan according to the present invention, Fig. 16 is a front view showing a state where a decorative grille has been removed, Fig. 17 is a side view illustrating a product structure wherein a contour of a blower and fan according to the present invention is modified, Fig. 18 is a front view of Fig. 17 wherein a decorative grille has been removed, and Fig. 19 is an explanatory view for explaining an air duct used in Fig. 15. In these figures, reference numeral 202 designates a propeller fan driven rotatively by a driving motor 201 to perform wind supplying action, reference numeral 205 denotes a bell-mouth casing for introducing air into the propeller fan 202, reference numeral 204 denotes a second air duct member

connected to an outlet end of the bell-mouth casing and for separating a suction side from a blowoff side, reference numeral 316 denotes a fan casing having a blowoff opening 404 in a direction perpendicular to the revolving shaft of the propeller fan 202, and having a semicircular profile of a section perpendicular to the revolving shaft, reference numeral 203 denotes a thin plate-like first air duct member provided in the fan casing 316 so as to oppose to the propeller fan 202 with a predetermined distance, and functioning as a draft guide, reference numeral 315 denotes a fan main body, reference numeral 403 denotes a suction opening of the fan defined as a result of opening a side thereof, reference numeral 315a denotes a main body back opposite to the fan suction opening 315, reference numeral 311 denotes a motor mounting plate for securing the driving motor 201 and the first air duct member 203 at a substantially central part of the main body back 315a, reference numeral 322 denotes a fan fixing nut for detachably fixing the propeller fan 202 to a revolving shaft 201a of the driving motor 201, reference numeral 209 denotes a diffuser air duct defined in relation to the disk-shaped first air duct member 203, constituted so as to have a larger size than an outside diameter of the propeller fan 202, and mounted substantially in parallel thereto, and reference numeral 310 denotes a centrifugal diffuser air duct back surface, respectively.

On the outer circumference of the first air duct member 203, the fan casing 316 having a larger size than that of the

former is mounted in the form of a semicircular configuration centering as the revolving shaft 201a, and the blowoff opening 404 is defined on a side of the main body positioned opposite thereto. The main body 315 is composed of the whole fan casing obtained by forming integrally the bell-mouth casing 205 being the duct guide of the propeller fan 202, the main body back 315a, the fan casing 316, and the blowoff opening 404 with the main body 315; and a decorative grille 314. The decorative grille 314 is detachably attached to the suction opening 403 of the fan, while a plurality of horizontally wind directing plates (current plates) 317 are attached to the blowoff opening 404 of the fan in a width direction of a scroll casing so as to partition a blowoff air duct along its width direction. As shown in Fig. 16, the suction opening 404 is opened over the whole width direction of the fan casing 316 in the main body 315.

Air sucked by the propeller fan 202 through the decorative grille 314 and the fan suction opening 403 receives force directing from the axial direction to diametrical direction by rotation of the propeller fan, and at the same time, the air can be supplied after being converted into static pressure by means of the bell-mouth casing 205 and the first air duct member 203 without losing uselessly speed energy from the axial direction to the diametrical direction. More specifically, a direction of a flow can be changed by 90° to elevate a pressure (static pressure) as compared with a draft in its axial direction corresponding to a flow of a conventional propeller fan by means

of the centrifugal diffuser air duct 209 wherein a flow in the axial direction is converted into that in the diametrical direction in a blowoff space towards the outer circumferential direction which extends from the bell-mouth casing to the first air duct member while maintaining characteristic features of high air capacity, low noise, and high efficiency belonging to the propeller fan. According to the present invention, speed energy which has been wastefully discarded in a conventional propeller fan can be converted into static pressure, whereby the characteristic feature thereof is improved.

The air a flow direction of which has been changed by the centrifugal diffuser air duct 209 into its diametrical direction is guided into the right and left sides of the fan main body 315 without any modification in the lower part of Fig. 16, and blown off from the blowoff opening 404 of the fan. Accordingly, since the air is blown off downwards by means of high air capacity of the propeller fan as well as of high wind velocity due to a pressure converted by the centrifugal diffuser air duct, the air can be supplied to a distant place. On the other hand, the supplying wind towards the upper part of the drawing collides with the fan casing 316 to change its direction to the side of the centrifugal diffuser air duct back space 310 defined between the main body back 315a and the first air duct member 203, i.e., the direction of the flow is changed by about 180° in the outer circumferential part of the first air duct member 203, and the resulting air is blown off from

the blowoff opening 404 through the centrifugal diffuser air duct back space 310. Further, as shown in Fig. 16, supplying wind towards side surfaces collides also with the semicircular fan casing and side walls of the main body 315, a direction of the flow is changed to a side of the centrifugal diffuser air duct back space 310 defined between the main body back 315a and the first air duct member 203, i.e., in the outer circumferential part of the first air duct member 203, the resulting air is collected in the blowoff opening 404 opened over the whole lower part of the main body 315 to be blown off towards a constant direction with high air capacity and high wind velocity. In brief, a flow direction of air sucked from a front of the decorative grille 314 is changed by 90°, and flows in diametrical directions towards four planes of box type main body sides are concentrated in one plane of the box type main body sides by the scroll casing 316 to be blown off.

In a conventional fan involving a scroll type casing wherein a volute tongue exists, and it is adapted to expand a vortex towards a blowoff opening, whereby wind is smoothly supplied, even if wind capacity can be assured and noise can be reduced, a wind velocity of diffused wind blown off from the expanded blowoff opening differs remarkably dependent upon a position of the blowoff opening, so that it is difficult to supply wind to a distant place. As shown in Figs. 17 and 18, a gap defined between the fan casing 316 and the air duct member 203 is the same in a closed side, i.e., a counter-supply side, and the gap broadens with closer to a blowoff side, so that

supply wind from the propeller fan concentrates on the blowoff side. Namely, a flow of wind is concentrated in a constant direction without diffusing the flow of wind after exiting the fan, so that the wind can be supplied to a distant place while maintaining its air capacity and its wind velocity. A casing back space 327 is defined between the fan casing 316 and the main body 315, and parts and wiring can be contained therein. Moreover, propeller fan belongs to a centrifugal fan, and a vane profile is simpler than that of other vanes in a transversal flow fan and the like. Accordingly, a propeller fan can be easily manufactured from a light metal, so that the resulting product has a high strength and light weight, whereby high-speed rotation becomes possible and a sufficient air capacity can be obtained in a compact size.

In such blower and fan, as shown in Figs. 17 and 18, a plate 203 being the first air duct member has a circular shape. In this respect, a plate having a similar shape is described in the previous embodiments wherein it is described that the optimum is 1.15 to 1.2 times larger size of the first air duct member 203 than that of its vane outside diameter. In this embodiment, however, a size of the first air duct member 203 could be more downsized without affecting adversely its wind supply performance. An extent of such downsizing extends over a range described hereinafter. In the constitution shown in Figs. 17 and 18, an air duct member is concentrically provided on the shaft center of a fan wherein an outside diameter of the air duct member is made to be 0.7 to 1.05 times smaller

than that of a vane of the propeller fan. With reference to Figs. 15 and 16, as a profile of the downsized first air duct member 203, it is considered that a rotational center of the propeller fan 202, which corresponds to the center of the driving motor 201, passes through this central position, and that a horizontal center line which is in a horizontal situation as well as a vertical center line which is in a vertical situation viewed in the front view as shown in Fig. 16. Under such condition as described above, a size of a half of the first air duct member 203 on a side under the horizontal center line, i.e., a side of a blowoff opening 404 is made to be 1.15 to 1.2 times larger than a vane outside diameter. As shown in Fig. 19, a size of a half of the rest on a side over the horizontal center line, i.e., a side of a closed space being a side of the scroll casing 316 is made to be larger than an outside diameter of the driving motor 201 in such that the driving motor 201 can be disposed on the vertical center line with both ends which correspond to two points determined by such condition that the first air duct member 203 on the lower side, i.e., a side of the blowoff opening intersects the horizontal center line. Thus, as shown in Fig. 16, a width of the main body 315 corresponding to a length of the blowoff opening can be remarkably reduced. In this case, an area on the upper side over the horizontal center line determined by the first air duct member 203 and the scroll casing 316 is formed to assure 60% or more of an area defined by the scroll casing 316 and the horizontal center line.

Figs. 20(a), (b), and (c) each shows a difference of a wind velocity distribution dependent upon a difference in a wind supplying manner in the case where wind is supplied by a fan of the same size in a main body structure constituted as, for example, an air curtain wherein (a) shows a wind velocity distribution in case of a fan of a propeller fan type provided with an air duct member forming a diffuser, (b) shows a wind velocity distribution in case of a fan of a conventional propeller fan type shown in Fig. 40, and (c) shows a wind velocity distribution in case of a fan of a conventional transversal flow vane type shown in Fig. 39, and in these cases, a standard setting height of each product is 3.5 m. In each of Figs. 20(a), (b), and (c), ordinate indicates a distance from a blowoff opening of a fan, i.e., a distance from a product, it means specifically a distance extending from 0 m to 3.5 m; abscissa indicates a breadth of a fan, i.e., a breadth of a product wherein numerals 1 and 10 mean both ends of a product, while numerals 5 and 6 mean a vicinity of a central part of the product; and further sorted regions with respect to a wind velocity of supply wind blown off from a blowoff opening of a product are represented, for example, by 7 to 10 m/s, and 1 to 4 m/s, respectively.

(a) In case of the present invention, there is no evenness in supply wind as the whole product. When a wind velocity at a height 3.5 m which is the top surface in the case where a fan is set at a standard setting height is determined, a value 3 m/s or higher is obtained in a sorted region of wind velocity

1 to 4 m/s. Accordingly, a sufficient shut-off effect being air seal effect can be expected in case of supplying air in order to shut off wind and the like which tries to invade the interior from the outside.

(b) In case of a fan of a conventional propeller fan type, although there is comparatively little unevenness in supplying wind as a product, it is understood that wind velocity is totally low in the vicinities of both ends of the product. For this reason, when air is supplied to shut off wind or the like, shut-off effect decreases in the vicinities of the both ends of the product as compared with a central portion thereof. When a wind velocity at a height 3.5 m which is the top surface in the case where a fan is set at a standard setting height is determined, a value of 3 m/s or higher can be maintained only in the vicinities of a central portion of a the product. Accordingly, even if air is supplied to shut off wind and the like, lower effect than that of the present invention is obtained.

(c) In case of a conventional fan of a transversal flow vane type, when a wind velocity at a height 3.5 m which is the top surface in the case where a fan is set at a standard setting height is determined, it is 3 m/s or higher. In the case when air is supplied to shut off wind and the like, although a similar shut-off effect to that of the present invention can be expected, air in a central part of the product cannot be supplied particularly in the vicinities of the blowoff opening, since a motor is disposed at a central part of the product as its

arrangement. Accordingly, even if air is supplied from the product in order to shut off wind and the like, regions wherein shut-off effect cannot be expected appear in the vicinities of a central portion of the product as well as main body ends. A shut-off effect involves thermally shutting off warm and cold heat produced by an air-conditioner in a room from the outside. In this case, if an air flow of a certain degree has been delivered, a zone can be separated by means of such air flow, and in this event, an effect is not necessarily improved by a wind velocity which is higher than that required. On the other hand, in case of shutting off external wind, when a wind velocity is insufficient for performing an air seal, its durability is weak against external wind.

In the above determination, power consumption in case of the above described (c) of a fan of a conventional transversal flow vane type was 500 W, while power consumption in case of (a) of a fan was 385 W. Although power consumption in case of a fan of a conventional propeller fan type was 246 W, its shut-off performance is inferior to that of (a) and (c) as a product as described above. Accordingly, there is a problem as an air curtain with respect to 3.5 m height. Moreover, as to noise performance, in an actual setting state, it was 72 dB in case of (c) of a fan in a conventional transversal flow vane type, while it was 68 dB in case of (a) in the present invention. It was also 68 dB in case of (b) in a fan of a conventional propeller fan type.

As described above, by such an arrangement wherein a

propeller fan which is compact and can maintain a considerable air capacity is used, and a direction of supplying wind is allowed to change at right angle while maintaining static characteristics by means of a diffuser, a wind velocity can be maintained, and the resulting air may be blown off. As a result, a suitable air capacity and wind velocity as well as low noise can be achieved. Hence, an effective air curtain can be obtained. On one hand, when such type of fan is downsized, even in this propeller fan of a diffuser type, an air duct area decreases, pressure loss increases to decrease amount of supplying wind, and noise increases. In this respect, according to the present invention, a breadth of an air duct member forming a diffuser is narrowed, and a profile of the air duct member is modified. When viewed an air curtain from a use application therefor, there are the air curtain of such type which is installed for 3.5 m opening height in a large-sized building, department store and the like, and an air curtain of a type which is installed for about 5 m opening height in a track yard and the like of a factory where tracks and the like come in and out. In the latter case, it is further required to increase an air capacity than that in case of Fig. 20(a). As described above, as a means for increasing air capacity, or in also the case where a situation of external wind circumstance is severe even in 3.5 m opening height, however, it is sufficient to use a fan wherein a breadth of an air duct member is made to be the same with an outside diameter or a smaller than that of a propeller fan as a means

for increasing a wind velocity as in the present invention.

By such an individual blower and fan provided with a fan which is rotatively driven by a driving means to supply wind, a fan casing which contains the fan and guides supply wind blown off from the fan, and the fan casing having a suction opening for sucking air from the outside and a blowoff opening for blowing off air to the outside; an amount of supplying air cannot be increased, because rotational frequency in the above blower and fan has an upper limit. Further, when a rotational frequency is allowed to increase over the most efficient value, input of electric current increases significantly, so that unnecessary energy is wasted. On the other hand, when a size of a vane is increased, the resulting fan has also an increased dimension, so that in the case where a plurality of fans are mounted so as to have a columnar blowoff opening to form an air curtain, the resulting product cannot be contained usually in an opening therefor which has been previously prepared, because a breadth for such opening is determined, for example, to be 1.2 m or so. Furthermore, even if a size of a vane is reduced and the number of parallel units is increased, an amount of supply wind in each unit decreases also dependent upon a diameter of a vane, so that it does not function as countermeasures. Therefore, as in the present invention, a unit itself is downsized while leaving a dimension of a vane in each unit as it is, in other words, leaving an amount of supply wind as before. In this case, a profile and a dimension of an air duct member is selected so as to maintain a pressure

and to ensure an air duct area without accompanying any deterioration of performance and increase in noise, even if an air duct area in a diffuser section is reduced. As a result of this downsizing, it is intended to increase the number of plural fans for forming air curtains with respect to an opening. An effective air seal ensuring a wind capacity and a wind velocity can be obtained in accordance with such a manner that columnar blowoff openings obtained by aligning a plurality of fans so as to be closely in contact with each other, and air sucked from such aligned openings is blown off. Thus, air which has been air-conditioned and retained in a room is not uselessly exchanged with the external air, whereby energy saving can be attained. On one hand, in the case where influences of external wind cannot be removed, because existing fans for air curtain involve a conventional transversal flow fan or a conventional propeller fan, a plurality of the fans forming an air curtain are replaced by those of the present invention. As a result, fresh air curtains are formed by a much more number of fans than that of the fans which had been employed before, i.e., they were the ones replaced by the fans of the present invention in accordance with such a manner that the fans of the invention each having a narrow breadth are closely disposed with each other, whereby effects for saving energy can be elevated.

Seventh Embodiment:

Figs. 21 through 26 are explanatory views each showing another example of the present embodiment according to the

present invention wherein the same reference numeral as that of the preceding figures designates the same component as that of the preceding figures, respectively. In Fig. 21, a breadth of a first air duct member 203 is downsized as compared with that of Fig. 16 in the above described sixth embodiment by cutting the same in parallel to a main body side at a position corresponding to 0.7 to 1.05 times larger dimension than an outside diameter of a propeller fan 202, and at the same time, a diameter of a fan casing 316 is also allowed to be 1.2 to 1.25 times larger than an outside diameter of the propeller fan 202. As a result, a breadth of a main body 315 reduces also.

When it is intended to restructure fans as constituted in an air curtain having, for example, 3.5 m standard setting height into another air curtain having 5 m standard setting height, increase in an air capacity of supply wind is usually studied as a product for delivery wind to a further distant place. As a means for increasing an air capacity, it may be considered to increase a vane outside diameter. In such a case, however, a breadth is determined in relation to a frontage of a place where a product is to be set in case of an air curtain. For this reason, when an outside diameter of a vane is increased, the number of fans employed must be reduced dependent upon a dimension of a product, so that an air capacity of the product decreases. On the contrary, even if the number of fans to be used is increased, a size of a vane must be reduced, so that the resulting product brings about small effect. When a

rotational frequency can be increased, an increased air capacity is obtained. In this respect, however, in case of the fans as shown in the sixth embodiment, an AC induction type motor is usually employed, and in such type of motor, there is an upper limit in rotational frequency dependent on a power source frequency, so that an air capacity cannot be increased over a certain limit. Because of this reason, a size of the fan casing 316 or a first air duct member 203 is downsized while maintaining supply wind performance, so that the resulting fan itself is downsized. Thus, the number of fans to be employed is increased as its product structure, otherwise an amount of air capacity cannot be increased as the product structure.

In Fig. 21, a side of the first air duct member 203 is cut in parallel to a main body side at a position corresponding to 0.7 to 1.05 times larger size of a vane diameter. Furthermore, a profile of the first air duct member 203 which is in the side over a horizontal center line is defined as in the case of the sixth embodiment by making larger than an outside diameter of a driving motor 201 in such that the driving motor 201 can be disposed on the horizontal center line with taking two points determined by intersection of the lower side of the first air duct member 203 with the horizontal center line as both ends. Besides, an area on the side over the horizontal center line defined by the first air duct member 203 and the scroll casing 316 is formed to ensure 60% or higher with respect to an area defined by the scroll casing 316 and the horizontal center line. In the case where the air duct

member 203 is integrally attached to a motor, it may be arranged in such that the air duct member is sandwiched between a motor fitting leg and the motor, and they are clamped together with a screw. In this case, a size of the fan main body can be downsized as compared with the above described sixth embodiment while maintaining substantially wind supplying performance such as air capacity and noise. Moreover, since it becomes possible to increase the number of fans which may be employed within a limited dimension of a product, an amount of supplying wind can be elevated in a product form as the whole air curtain.

Fig. 21 shows an example in which a fan is specifically downsized as described above wherein the upper part of the first air duct member 203 with respect to a diffuser air duct has an arch-like profile, a diameter of which being 1.15 to 1.2 times larger than a vane radius, the ends of both sides are on the extension of the vane center line, and they reach sides of the first air duct member 203. In this case, sides of the first air duct member 203 are cut in parallel to main body sides at a position corresponding to about 0.95 time larger size of a vane diameter. This time, an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to 70 to 75% of an air duct area defined by the vane center line and the diffuser air duct. In the present trial product, when the propeller fan 202 is driven at a rotational frequency of about 2730 r/m under the condition of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan

casing radius, a constant air capacity can be substantially maintained.

Fig. 22 shows another example in which a fan is downsized wherein the upper part of a first air duct member 203 with respect to a diffuser air duct is horizontally cut with reference to a blowoff opening in the vicinity of the vane center line except for fitting section to a motor. In this case, sides of the first air duct member 203 is cut in parallel to main body sides at a position corresponding to about 0.95 time larger size of a vane diameter. This time, an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to 75 to 80% of an air duct area defined by the vane center line and the diffuser air duct. In the present trial product, when the propeller fan 202 is driven at a rotational frequency of about 2720 r/m under the condition of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan casing radius, a constant air capacity can be substantially maintained. However, when compared with the fan having a profile shown in Fig. 16, a corner part exists in the upper half section, and the corner part might function as an edge, a noise value and a value of peak noise were increased in the former case where it was around 0.4 dB, while in the latter case where it was around 1.9 dB.

Fig. 23 shows another example in which a fan is downsized wherein the upper part of a first air duct member 203 to a diffuser air duct is cut horizontally with respect to a blowoff opening at a position where a fitting section to a motor remains,

whereby the air duct is somewhat reduced, and decrease in noise was studied. In this case, sides of the first air duct member 203 is cut in parallel to main body sides at a position corresponding to about 0.95 time larger than a vane diameter. This time, an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to about 65% of an air duct area defined by the vane center line and the diffuser air duct. In the present trial product, when the propeller fan 202 is driven at a rotational frequency of about 2750 r/m under the condition of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan casing radius, a constant air capacity can be substantially maintained. However, when compared with the fan having a profile shown in Fig. 16, a noise value and a value of peak noise were increased in the former case where it was around 0.4 dB, while in the latter case where it was around 1.7 dB, and such results are substantially the same as those of Fig. 22.

Fig. 24 shows another example in which a fan is downsized wherein the upper part of a first air duct member 203 to a diffuser air duct is cut horizontally with respect to a blowoff opening at a position where a fitting section to a motor remain as in the case of Fig. 23. This time, an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to about 60 to 65% of an air duct area defined by the vane center line and the diffuser air duct. In the present trial product, even when the propeller fan 202 is driven at a rotational frequency of about 2740 r/m under the condition

of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan casing radius, an air capacity is around 1% lower than the fan having the profile shown in Fig. 16. A noise value is not different, but a value of peak noise decreased by around 0.5 dB.

Fig. 25 shows another example in which a fan is downsized wherein the upper part of a first air duct member 203 to a diffuser air duct is in an arch-like shape having 0.7 to 0.8 time larger size than a vane radius, and both side ends reach sides of the first air duct member 203 on the extension of the vane center line. In this case, sides of the first air duct member 203 are also cut in parallel to main body sides at a position corresponding to 0.7 to 0.8 time larger size than a vane diameter. This time, an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to about 60 to 65% of an air duct area defined by the vane center line and the diffuser air duct. In this constitution, although an air duct area in the sides is allowed to increase, mixed flow effect deteriorates, and wind velocity decreases by an amount corresponding to that wherein a region of the air duct member 203 being larger than a vane diameter exhibiting mixed flow effect decreases. Namely, in the present invention, an even balance of mixed flow effect wherein a flow from a propeller fan is subjected to pressure recovery by a mixed flow plate, whereby a flow which withstands pressure loss and provides higher wind velocity with decrease in pressure loss due to assurance of an air duct area is studied. In the present

trial product, when the propeller fan 202 is driven at a rotational frequency of about 2770 r/m under the condition of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan casing radius, air capacity increases by around 1% as compared with that having the profile shown in Fig. 16. A noise value increases by around 0.6 dB, and a value of peak noise increases also by around 1.5 dB.

Fig. 26 shows another example in which a fan is downsized wherein the upper part of a first air duct member 203 to a diffuser air duct is in an arch-like shape having 0.95 time larger size than a vane radius, and both side ends reach sides of the first air duct member 203 on the extension of the vane center line. In this case, sides of the first air duct member 203 are also cut in parallel to main body sides at a position corresponding to 0.95 time larger size than a vane diameter. This time, an air duct area is allowed to be reduced, so that an air duct area defined by the first air duct member 203 and the diffuser air duct corresponds to about 35 to 40% of an air duct area defined by the vane center line and the diffuser air duct. In the present trial product, when the propeller fan 202 is driven at a rotational frequency of about 2730 r/m under the condition of 240 x 290 mm main body profile, 210 mm propeller fan outside diameter, and 130 mm fan casing radius, air capacity decreases by around 1.4% as compared with that having the profile shown in Fig. 16. A noise value is substantially the same, and a value of peak noise decreases merely by 0.8 dB. As described above, air duct members having a variety of

dimensions and profiles shown in Figs. 21 to 26 have been studied, and as a result, it has been found that all the modifications are within an applicable range as well as that a need such as reduction of noise may be selected on the basis of specifications of characteristics which are required by users.

Eighth Embodiment

Fig. 27 is a side view illustrating a blower and fan of another embodiment according to the present invention wherein the same reference numerals as that of Fig. 15 designate the same components as that of Fig. 15. In the same figure, reference numeral 318 designates an anteroposteriorly wind directing plate. In this arrangement, a first air duct member 203 is secured to a motor fitting plate 311 fitted to a substantially central part of a main body back 315a together with a driving motor 201. In this case, the air duct member 203 is positioned in a substantially central portion of a blowoff opening 404.

In Fig. 28, the first air duct member 203 of Fig. 27 is allowed to have access by 5% to a propeller fan 202 along a longitudinal direction of a blowoff opening 404. In other words, the air duct member is moved by 5 mm to the propeller fan in its axial direction in comparison with an arrangement in Fig. 27. In this case, both air capacity and noise value are substantially the same as those in Fig. 27.

Furthermore, in Fig. 29, the first air duct member 203 of Fig. 27 is allowed to have access by 10% to the propeller

fan 202 along the longitudinal direction of the blowoff opening 404. In other words, the air duct member is moved by 10 mm to the propeller fan in the axial direction in comparison with an arrangement in Fig. 27. In this case, both air capacity and noise value are substantially the same as those in Fig. 27.

In Fig. 30, the first air duct member 203 of Fig. 27 is allowed to have access by 15% to the propeller fan 202 along the longitudinal direction of the blowoff opening 404. In other words, the air duct member is moved by 15 mm to the propeller fan in the axial direction in comparison with an arrangement in Fig. 27. In this case, noise value is substantially the same as that in Fig. 27, but air capacity decreases by around 2%. As is apparent from the above description, characteristic properties which are desirably to be possessed can be maintained up to substantially such degree of modification as described above, i.e., so far as the modification is within a range wherein the first air duct is moved by around 15% from a substantially central portion of the blowoff opening. Accordingly, a position of the air duct member in the axial direction may be determined within an allowable range in which no characteristic properties are affected adversely with such a constitution wherein air is smoothly blown off in relation with an arrangement of the anteroposteriorly wind directing plate 318, or a constitution wherein the air duct member is moved dependent upon a manner for fitting the same.

Ninth Embodiment:

The present embodiment illustrated in Figs. 31 and 32 relates to a fan 502 suited for forming an air curtain wherein a propeller fan 501 having high fan efficiency is employed. The fan 502 is constituted in such that air stream produced by a propeller fan 1 in a direction intersecting the revolving shaft center of the propeller fan 501 built into a main body casing 503 at substantially right angles is blown off on a plane being substantially parallel to a rotating plane of the propeller fan 501. The main body casing 503 is constituted in a box of substantially hexahedron wherein the front of the main body casing is opened as a suction opening 504, the lower surface near to the back is also opened as a rectangular downwards opening extending over substantially the whole breadth direction, and all the other upper surface and both side surfaces including the back on which is disposed a fitting structure 5 are closed. On the front of the main body casing 503 is disposed a suction grille 507 provided with a protective member 506 capable of ventilation which is composed of a punching metal and the like.

The propeller fan 501 is rotated by a motor 509 mounted on the back in the main body casing 503 inside a bell-mouth 508 being an air channel and assembled from the suction opening 504 to the back side of the main body casing to produce air stream in the bell-mouth 508 in the axial direction. An outlet end of the bell-mouth 508 is provided with a blowoff opening 610 facing to the opening in the lower surface of the main body

casing 503 in a direction intersecting the revolving shaft center of the propeller fan 501 at substantially right angles, and to which is connected a plastic scroll casing 611 having a substantially semicircular sectional contour in a direction intersecting a revolving shaft center of the propeller fan 501 on a counter-blowoff opening side. A part intersecting the revolving shaft center of the propeller fan 501 on the counter-opening side of the scroll casing 611 at right angles is constituted into a smooth R-concave shape 612, and is smoothly continuous to the back of the main body casing 503. To a motor mounting member 613 for securing the motor 509 is attached an air duct member 614 opposed to the propeller fan 501 with a predetermined spacing in the scroll casing 611. The air duct member 614 is formed into a disk shape having a larger size than an outside diameter of the propeller fan 501, it is away from the back of the main body casing 503 to define a back space 615, and the air duct member is disposed with such a positional relationship wherein it divides the blowoff opening 610 into substantially two sections in front and in the rear. A centrifugal diffuser air duct 616 is defined between the outer circumferential part of the air duct member 614 and the scroll casing 611.

A rectangular nozzle frame 617 is fitted to the blowoff opening 610 by supporting the former with supporting pins 618, 618 functioning as rotation supporting sections at both ends thereof so as to be rotatable in a plane being substantially perpendicular to a rotational plane of the propeller fan 501,

and the nozzle frame 617 becomes a substantial blowoff opening for blowing off jet. The interior of the nozzle frame 617 has a lattice structure composed of a plurality of inclined wind directing plates 619 and a plurality of current plates 620 standing along its breadth direction. An externally hemispherical supporting structure 621 for supporting slidably the nozzle frame with abutting on edges of the blowoff opening 610 is disposed between the supporting pins 618. The supporting structure 621 is made from a soft material such as plastics and the like, and has suitable slide resistance with respect to the edges of the blowoff opening 610. A plurality of the inclined wind directing plates 619 are disposed at even intervals (65 mm distance in the present embodiment) in a direction intersecting the rotational plane of the propeller fan 501 at substantially right angles, and they are placed with such an inclination towards a reverse direction to the rotational direction of the propeller fan 501 (see Fig. 31). The inclination of the inclined wind directing plate 619 is determined in response to revolving components of blowoff air stream produced by rotation of the propeller fan 501 within a range extending from 1 to 5 degrees. Around 3 degrees of the inclination of the inclined wind directing plate 619 are suitable for forming an air curtain in a standard building having 3.5 m height of the opening. The current plates 620 are disposed along a direction in substantially parallel to the rotating plane of the propeller fan 501 in such a manner that a route extending from the rear end of the rotating plane

of the propeller fan 501 to the air duct member 614 is separated by the current plates with 10 mm each spacing.

In the fan 502, when the propeller fan 501 is rotated by the motor 509, air is sucked from the suction opening 504, and blown off from the outlet end of the bell-mouth 508 to the axial direction by the rotation of the propeller fan 501 while receiving forces directing to the axial direction and the radial direction. The air stream blown off from the outlet end of the bell-mouth 508 is allowed to flow after changing its direction from the axial direction to the radial direction by 180 degrees by means of the air duct member 614 and the scroll casing 611, and passes through the back space 615 defined between the air duct member 614 and the main body casing 503 to be blown off from the blowoff opening 610 through the nozzle frame 617 as jet.

A direction of flow may be changed by 90 degrees by the use of the centrifugal diffuser air duct 616 wherein a flow in axial direction is converted into that of radial direction while leaving characteristic features (high air capacity, low noise, and high efficiency) of the propeller fan 501 as they are, whereby static pressure can be elevated in comparison with a draft along axial direction corresponding to a flow in a conventional axial blower. The air stream flowing out from the centrifugal diffuser air duct 616 directs to the blowoff opening 610 along a portion of the smooth R concave 612 in the scroll casing 611 where there is a little pressure loss, so that loss in air capacity is scarce. In a trial product having

o 210 mm vane outside diameter, 300 mm x 900 mm x 238 mm outside dimension of the main body casing 503, and 900 mm x 85 mm opening area of the blowoff opening 610, the propeller fan 501 is rotated at 2200 r/m, and as a result, its air capacity increases by 3% as compared with a scroll casing containing no part of R concave 612.

Inclined wind directing plates 619 in the blowoff opening 610 function to correct revolving components contained in a blowing-off air stream produced by rotation of the propeller fan 501 by means of its inclination. In this arrangement, a straight jet which does not curve downwards to the blowoff opening 610 and has laterally uniform wind velocity can be blown off. This manner for correcting revolving components can be realized by a simple means of inclined wind directing plates. When an air curtain is established by a straight jet obtained after correcting revolving components, there is no case where a region wherein shielding function does not act upon an opened section of a building appears, so that such jet is suitable for forming an air curtain. Moreover, the current plates 620 arranged in such a fashion that a route extending from the rear end of a rotating plane of the propeller fan 501 to the air duct member 614 is separated thereby with 10 mm each of spacing, reduce vortices produced by differences of air flow in velocity in the blowoff opening 610, function to elevate blowoff wind velocity, and at the same time, prevent from touches by human fingers with respect to movable parts of the fan. As a result of measurement for the presence of the current plates 620 in

the trial product, it has been found that the trial product provided with the current plates 620 exhibits 20% improved result in wind velocity at a point which is 1 m apart from the blowoff opening 610 in comparison with a product with no current plate. Thus, the trial product is suitable for the fan 502 for forming an air curtain.

A direction of jet can be simply set by rotating suitably the nozzle frame 617 during a course extending from the front side to the back side. In this occasion, since the nozzle frame 617 is supported by the supporting structure 621 having a hemispherical external surface with an appropriate slide resistance, the rotation is smooth, and the nozzle frame may be simply stopped at a desired position.

Tenth Embodiment:

The present embodiment illustrated in Figs. 33 through 38 relates to a blower and fan system composed of a row 622 of the fans obtained by arranging a plurality of the fans illustrated in the ninth embodiment in a row wherein an individual constitution of each fan is essentially the same as that of the ninth embodiment, so that the same components as those of the ninth embodiment are represented by the same reference numerals as those of the ninth embodiment, and the explanation therefor is omitted.

The fan system of the present embodiment is constituted by such a manner that a plurality (three in an example shown in Fig. 33 and Fig. 34) of fans 502 illustrated in the ninth embodiment as a fan for forming an air curtain are arranged

in a row, and they are connected to each other to obtain the fan row 622. An essential structure of individual fan 502 is the same as that of the ninth embodiment as shown in Fig. 35, but there is no boundary structure between the blowoff openings in adjacent fans 502. In this respect, a nozzle frame 617 is constituted in a series of lengthy component extending over the blowoff openings 610 of the respective fans 502 as shown in Figs. 36 and 37. Several supporting structures 621 are disposed in the longitudinal direction with a suitable spacing (see Figs. 36 and 37).

A suction grille 507 is disposed also so as to cover the whole range over the fans in the block, and on the back thereof are disposed partition members 623 for partitioning a border between adjacent fans 502. The partition member 623 prevents from interference relating to mutual suction of the fans 502, functions to decrease pressure loss as to suction, and contributes to increase air capacity. As a result of measurement of the presence of the partition member 623 in the trial product shown in the ninth embodiment, it has been found that 3% improved air capacity is obtained in the product provided with the partition member 623 in comparison with the trial product with no partition member. Although a protective material 506 capable of ventilation disposed on the front of the suction grille 507 acts disadvantageously upon pressure loss relating to suction, it is indispensable part for preventing from invasion of foreign matters. For the sake of reducing pressure loss as much as possible, the protective

member 506 is made from a punching metal or the like having high permeability, but when such protective member is lengthy, it exhibits lack of rigidity so that there is a tendency of impairing aesthetic appearance in its mounting state. In order to eliminate such disadvantage, it is considered in the present embodiment that the protective member 506 is held by the partition member 623. More specifically, the partition member 623 is provided with opposed arm like parts 625 on the midway point of which is disposed a convex portion 624 as shown in Fig. 38. The protective member 506 is forcibly in contact with the convex portion 624 of the arm like parts 625, whereby rigidity of the protective member 506 is elevated. Besides, since dispersion in the profile of the suction grille 507 is absorbed by elastic deflection of the arm like parts 625, its assembling performance is improved. Functions other than that described above are those obtained by adding the functions involved in the ninth embodiment, so that the advantages of the fan system according to the present embodiment are essentially the same as those of the fan 502 in the ninth embodiment except that the fan system of the present embodiment is more suitable for forming an air curtain.

While a plurality of the embodiments have been described above, it is also possible by those skilled in the art to obtain a variety of blower and fans as well as of fan systems having respective characteristic features by combining suitably these embodiments within the scope of the present invention.

CLAIMS

1. A blower and fan comprising:

a propeller fan, a fan casing, a first, thin plate-like,
air duct member, a second air duct member, a wall and a
5 blowoff opening; wherein:

the propeller fan is driven rotatively by a driving means
to supply wind;

the second air duct member is disposed around the
propeller fan to guide the supply wind produced by the
10 propeller fan from the proximity of an end of the propeller
in a radial direction, the second air duct member also being
for separating a suction side of the propeller fan from a
blowoff side of the propeller fan;

the fan casing is connected to the second air duct member,
15 the fan casing being a substantially semicylindrical surface
that is coaxial with the axis of the propeller fan;

the first air duct member is housed in the fan casing,
disposed around the axis of the propeller fan with a
predetermined spacing between the first air duct member and
20 the propeller fan so as to oppose the vanes of the propeller
fan, and defining a diffuser air duct together with the
second air duct member for guiding the supply wind away from
the axis of the propeller fan;

the blowoff opening, defining an end of the diffuser air
25 duct, is provided so as to blow off the supply wind in a
direction perpendicular to the axis of the propeller fan; and

the wall is opposed to the first air duct member and on
the opposite side of the first air duct member to the second
air duct member, the blowoff opening formed adjacent to the
30 wall, and supply wind derived from the diffuser air duct is
blown off from the blowoff opening through a space between

the first air duct member and the wall.

2. A blower and fan according to claim 1, wherein a plurality of wind directing plates are disposed in the blowoff opening to supply wind in a desired direction.

5 3. A blower and fan according to claim 2, wherein the wind directing plates are disposed so as to change a revolving stream of the supply wind into a straight stream.

4. A blower and fan according to any one of claims 1 through 3, wherein a bell-mouth casing is disposed around the
10 propeller fan and connected to the second air duct member, the bell-mouth casing introducing air into the propeller fan.

5. A blower and fan according to any one of claims 1 through 4, wherein an outer edge of the first air duct member is over the outer radial edge of the propeller fan.

15 6. A blower and fan according to any one of claims 1 through 5 wherein a distance between the blowoff end of the blowoff opening and an outer radial edge of the propeller fan is substantially equal to a distance between the semicylindrical outer circumferential surface of the fan
20 casing and an outer radial edge of the propeller fan.

7. A blower and fan according to claim 1, 2, 3, 4 or 6 wherein the width of the first air duct member in a direction perpendicular to the axis of the propeller fan is approximately the same as or smaller than the radial edge
25 diameter of the propeller fan.

8. A blower and fan according to any one of claims 1 through 6 wherein the first air duct member has a different

shape at the blowoff opening side of the center of the propeller fan than on the side of the closed space opposite to the blowoff opening side, so that the surface area of the first air duct member on the closed space side of the propeller fan axis is smaller than that of the blowoff opening side.

9. A blower and fan according to claim 8, wherein a contour of the first air duct member is over an outer radial edge of the propeller fan at the blowoff opening side, and is over an outer edge of the driving means at the closed space side.

10. A blower and fan system comprising:

a plurality of fans each of which corresponds to that claimed in at least one of claims 1 through 9, the fans being connected and in contact with each other.

11. A blower and fan system according to claim 10, wherein the plurality of fans are connected in such a manner that backs opposed to suction openings of the fans are in contact with each other, and blowoff openings of the fans are in the same direction.

12. A blower and fan system according to claim 10, wherein the plurality of fans are disposed in such a manner that suction openings and blowoff openings of the fans are adjacent to each other respectively so that air in each fan is sucked in the same direction, and the air in each fan is blown off in the same direction.

13. A method for supplying wind using a plurality of blower and fan systems claimed in claim 12, wherein the plurality of systems are arranged so that supply wind from blowoff openings of one set of the systems flow toward suction

openings of the other set of the systems, and continuous supply wind is produced in a plurality of planes each having a different angle.

14. A method according to claim 13, wherein

5 rotatable wind directing plates are disposed in the blowoff openings, and angles of the wind directing plates are changed to modify a direction of the supply wind.

15. A blower and fan system constructed and arranged to operate substantially as hereinbefore described with
10 reference to and as illustrated in Figures 1 to 38 of the accompanying drawings.