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BLOWER

BACKGROUND OF THE INVENTION

The present invention relates to a blower, installed at the entrance and/or exit of a building, for thermally insulating the inside of the building from the outside mainly when the building is air-cooled or heated.

Figs. 38 and 39 show a conventional blower disclosed in Published Unexamined Japanese Patent Application No. Hei. 5-106898. This machine will be described hereinafter.

10 A box-like blower body 5 is installed on the inner wall 4 (in the interior 3 of a room) of a house 1. The blower body 5 includes an air inlet port 6 at a side opposite to the installation side and an air outlet port 7 at a lower side. Within the blower body 5, a motor 9 is mounted. The motor 9
15 with a single traverse vane 8 secured thereto receives air from the inlet port 6 and forcefully blowing the air to the outlet port 7. A plural number of flow-direction control plates 7a for controlling the direction of a stream of the discharged air are mounted at the outlet port 7. These vanes are swingable on
20 the upper ends thereof as fulcra.

In the blower thus constructed, the vane 8 is rotated by the motor 9 to suck air through the inlet port 6 and to blow the air through the outlet port 7, thereby forming an air curtain hanging down in the entrance/exit 2 of the house 1.





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In the blower, a single traverse vane 8 is used for the air blowing. As a stream of air discharged from the outlet port 7 proceeds, it pulls in surrounding air and expands as shown in Fig. 39. In the air curtain formed by the expanded
5 air stream, the thermal isolating capability is reduced, and the effective thermal-isolating height or length of the air curtain at the entrance/exit 2 of the house 1 as well is restricted.

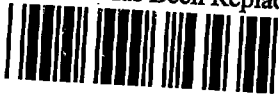
Also, to increase the effective thermal-isolating
10 length of the air curtain, a large vane must be used for the vane 8. The result is to install the large and heavy, or cumbersome vane, on the wall 4.

Also, since the width of the air curtain is determined by the length of the vane 8, in order that the air curtain is
15 formed so as to fit for various sizes of the entrance/exit 2, the respective blower with the vane 8 of different length must be provided.

Also, when the traverse vane 8 is used, noise inherent to the vane 8, such as a whistling sound, is large.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above circumstances and has an object to improve the thermal insulating capability of a blower by minimizing the expansion of the air stream in the form of a curtain, and to secure a
25 sufficiently long thermal-isolating length of the air curtain



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without increasing the size of the machine. Another object of the present invention is to provide a blower of low noise which can selectively set the width of the air curtain at a desired value of width for an arbitrary opening of the entrance/exit of a building without using different traverse vanes.

To achieve the above objects, there is provided an blower having a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within the housing, for sucking air through the inlet port and forcefully blowing the sucked air through the outlet port, wherein the inlet port is shaped like a bellmouth in which the vane wheel is disposed, and the lower end portion of the housing is uniformly narrowed toward the center of the housing, thereby forming the outlet port.

Also, in the blower, mounting members, formed on the outer surface of the housing, rotatably supports the housing.

Also, a movable louver is disposed within the outlet port.

Also, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and is bifurcated to have an X-shape.

Also, a blower comprises blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within the housing, for sucking air through the inlet port and forcefully blowing the sucked air through the outlet port, and



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a guide is disposed within the outlet port, thereby forming a parallel multi-nozzle.

Also, the guide is a tubular member substantially triangle

5 in cross section having the base at the blowing side, the corners of the guide being rounded, and the lower end of the housing is folded inward to form a round circumferential edge of the outlet port.

Also, the guide is rotatable within the outlet port.

10 Also, the vane wheel of the blowing means is an axial vane wheel, and a plural number of blowing means are disposed side by side within the housing.

Also, a first air flow rectifying plate located at almost the center of the vane wheel and between the blowing
15 means and the outlet port, and a second air flow rectifying plate partitioning the adjacent blowing means are disposed within the housing.

Also, a heater or a lighting means, covered with a cover, is provided within the guide.

20 In the construction of the invention, the inlet port within which a vane wheel is disposed is shaped like a bellmouth. The outlet port is formed by uniformly bending the lower end portion of the wall of the housing toward the center thereof. Accordingly, when the motor is driven and the vane
25 wheel turns, air is blown from the inlet port to the outlet port, thereby forming an air curtain.



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Also, the mounting members, formed on the outer surface of the housing, rotatably supports the housing. With the provision of the mounting member, the housing can be swung as desired.

5 Also, the movable louver is disposed within the outlet port. Thus, the direction of the air stream discharged through the outlet port can be arbitrarily changed by the movable louver.

10 Also, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and by bifurcating the lower end to have an x-shape. Thus, two outlet ports are obtained and two air streams can be output from the outlet ports.

15 Also, the guide is disposed within the outlet port, thereby forming a parallel multi-nozzle. A plural number of parallel air streams are discharged through the outlet port. A negative pressure is created between the adjacent air jet streams. Under the negative pressure, the jet streams proceeds and are inwardly bent to meet into one jet stream.

20 Also, the guide is a tubular member substantially triangle in cross section. The guide and the outlet port are rounded at the corners. The parallel multi-nozzle is formed in the outlet port so that a plurality of parallel air streams are discharged from the outlet port. The round parts of the guide
25 and the outlet port greatly attenuate the turbulence in the air streams when they are discharged from the outlet port.



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Also, the guide can be movable at the outlet port. Accordingly, the direction of a flow pattern of the air stream can flexibly be changed as desired.

Also, the vane wheel is the axial vane wheel. With the use of the axial vane wheel, the flow coefficient is large. In an operating state free from a static pressure, the highest efficiency is obtained. As a result, noise caused by the drive power source and the turning of the vanes is reduced. Further, provision of the plural number of blowing means enables one to adjust, as intentionally, the width of the air curtain formed.

Also, the air curtain stream containing turning components, generated by the axial vane wheel, is converted into a linear air curtain stream by the air flow rectifying plate.

Also, the heater or the lighting means, contained in the guide to be covered with the cover, provides an illuminating light beam or a hot stream in parallel with the air stream.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is a side and plan view of an blower according to an embodiment 1 of the present invention,

Fig. 2 is a sectional view showing the blower of the embodiment 1,

Fig. 3 is a view showing an example of the installation of the blower of the embodiment 1 in a house,



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Fig. 4 is a view showing a profile of a jet stream of air discharged from the blower of the embodiment 1,

Fig. 5 is a view showing the installation according to embodiment 2,

5 Fig. 6 is a side view showing an blower according to an embodiment 3 of the present invention,

Fig. 7 is another side view showing an blower according to the embodiment 3 of the present invention,

10 Fig. 8 is a view showing an example of the installation of the blower of the embodiment 3 in a house,

Fig. 9 is a view showing another example of the installation of the blower of the embodiment 3 in a house,

Fig. 10 is a side and plan view of an blower according to an embodiment 4 of the present invention,

15 Fig. 11 is a front and side sectional view showing the blower of the embodiment 4,

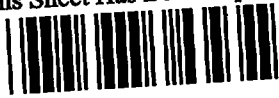
Fig. 12 is a view showing an example of the installation of the blower of the embodiment 4,

20 Fig. 13 is a view showing another example of the installation of the blower of the embodiment 4,

Fig. 14 is a side and plan view of an blower according to an embodiment 5 of the present invention,

Fig. 15 is a sectional view showing the blower of the embodiment 5,

25 Fig. 16 is a view showing an example of the installation of the blower of the embodiment 5,



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Fig. 17 is a view showing another example of the installation of the blower of the embodiment 5,

Fig. 18 is a side and plan view of an blower according to an embodiment 6 of the present invention,

5 Fig. 19 is a sectional view taken on line A - A in Fig. 18.

Fig. 20 is a diagram showing the profile of the air stream formed by the blower of the embodiment 6,

10 Fig. 21 is a side view showing an outlet port in the machine of the embodiment 6,

Fig. 22 is a cross sectional view showing the outlet port in the machine of the embodiment 6,

Figs. 23(a) to 23(c) are diagrams showing flow patterns of the air stream blown from the blower of the embodiment 6,

15 Figs. 24(a) to 24(c) are additional flow patterns of the air stream blown from the blower of the embodiment 6,

Figs. 25(a) and 25(b) are cross sectional views showing an outlet port of an blower according to an embodiment 7 of the present invention,

20 Figs. 26(a) and 26(b) are cross sectional views showing another outlet port of an blower according to the embodiment 7 of the present invention,

Fig. 27 is a perspective view showing an blower according to an embodiment 8 of the present invention,

25 Fig. 28 is a side and plan view of an blower according to an embodiment 9 of the present invention,



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Fig. 29 is a cross sectional view taken on line A - A
in Fig. 28,

Fig. 30 is a cross sectional view taken on line B - B
in Fig. 29,

5 Fig. 31 is a side and plan view of an blower according
to an embodiment 10 of the present invention,

Fig. 32 is a sectional view showing the blower of the
embodiment 10,

10 Fig. 33 is a view showing an example of the
installation of the blower of the embodiment 10 in a house.

Fig. 34 is a side and plan view of an blower according
to an embodiment 11 of the present invention,

Fig. 35 is a sectional view showing the blower of the
embodiment 11,

15 Fig. 36 is a view showing an example of the
installation of the blower of the embodiment 11 in a house,

Fig. 37 is a view showing another example of the
installation of the blower of the embodiment 11 in a house,

20 Fig. 38 is a cross sectional view showing a structure
where a conventional blower is installed, and

Fig. 39 is a diagram showing a model of a stream of air
forcefully discharged from the conventional blower.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

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Figs. 1 to 4 shows an embodiment 1 of the present invention. In the figures, reference numeral 10 designates a blower and numeral 11 designates a housing of the blower. The housing 11 is provided with an inlet port 12 at the upper portion and an outlet port at the opposite lower portion. The details of the outlet port will be described later. A plural number of bellmouths 13, to be inserted into the inlet port 12, are formed in a plate 14 covering the inlet port 12 of the housing 11 in a state that the bellmouths are equidistantly arrayed as shown. The plate 14 has a number of legs 15 standing upright thereon. The plate 14 is secured to the housing 11 by means of the legs and screws 16. An outlet port 17 is formed by uniformly narrowing the lower part of the housing 11 toward the center L of the housing 11 to be shaped like a sector in cross section, and includes a small outlet port 18 at the apex.

A plural number of motors 19, equal in number to the bellmouths 13, are secured to the inside of the housing 11 by means of mounting legs, not shown. A vane wheel 20 with the axial vanes is mounted on the rotary shaft 20a of each motor. The vane wheels 20 are disposed within the bellmouths 13, respectively when assembled. A fitting flange 21 is attached to the wall of the housing 11. Reference numeral 22 indicates a house; 23, an entrance of the house; 24, the interior of a room; 25, the outside of the house; A, the outer diameter of the small outlet port 18; B, an angle of the spread of an air

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stream discharged from the small outlet port 18; H, the distance the air stream reaches; and W, the width of the air stream at a location where the air stream reaches.

The blower thus constructed is mounted on the wall above the entrance 23 of the house 22 as shown in Fig. 3 by means of the fitting flange 21. Each vane wheel 20 is turned by its associated motor 19 to suck air through the inlet port 12 to impel the air outside through the outlet port 17. In the air stream blown out from the small outlet port 18, the center velocity of the air stream is little reduced and the initial velocity of the air stream is high, since the outlet port 17 is formed into a narrowed-shape. In the experiment conducted by the inventors, the small outlet port 18 of the diameter A of 50 mm could form an air curtain specified: $B = 20^\circ$, $H = 1500$ mm, and $W = 660$ mm. The air curtain formed was longer and wider than the conventional one. Thus, the air curtain of a high wind velocity and a long thermal-insulating length can be formed.

Embodiment 2

In the embodiment 2, the blower 10 is mounted at the ceiling 26 of the house 22, as shown in Fig. 5, while it is mounted on the wall above the entrance 23 in the embodiment 1. The blower 10 thus mounted circulates air in a room, thereby providing a uniform distribution of temperature in the room. In heating the room, the temperature difference between the ceiling and the floor is generally 7°C to 10°C . The



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embodiment 2 succeeds in eliminating this temperature difference.

Embodiment 3

Figs. 6 through 9 show an embodiment 3 of the present invention. In the figure, a U-shaped mounting member 30 with legs 31 is mounted on the housing 11 in a swingable manner. Specifically, bearings (not shown) are formed in the leg 31 of the bent end portions, respectively. Support shafts (not shown) protruded from the housing 11 are inserted into the bearings, respectively. The combinations of the support shafts and the bearings form supports 29. The housing 11 is swung about the supports 29. Pitch holes 32 formed in the outer wall of the housing 11, are semicircularly arrayed with the center of the support at given pitches. Positioning holes 33 are formed in the legs 31 of the mounting member 30, which are to be aligned with the pitch holes 32. Set screws 34 are screwed into the positioning holes 33 and the pitch holes 32 when those are aligned with each other.

The blower thus constructed is installed on the wall of the room above the entrance 23 of the house 22, like the blower of the embodiment 1. In installing the blower, the angle of the blower is set to a desired value of angle, and the housing 11 is secured to the mounting member 30 by means of the set screws 34. Accordingly, the blower can be installed in a state that the outlet port 17 is set in a desired direction. The blower thus set at the direction is driven by the motors 19 to



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blow air. The blower may be installed on the floor 27 or the ceiling 26 of the room, as shown in Fig. 9. The blower set on the floor 27 blows up air on the floor toward the ceiling to circulate the air in the room. In cooling the room, for example, it blows up the cooled air staying in the lower portion of the room, thereby uniformizing temperature in the room. The blower set on the ceiling 26 blows down air in the upper portion of the room toward the floor 27. Particularly, in heating the room, the machine blows hot air staying in the upper portion of the room toward the floor 27, thereby providing a temperature uniformity in the room.

Embodiment 4

In Figs. 10 to 13 showing an embodiment 4 of the present invention, a louver motor 40 is located under the motor 19 disposed at the side of the outlet port 17 of the housing 11. The louver motor 40 forwardly and reversely turns a rotary shaft 41. A crank 42 is coupled with the rotary shaft. A louver 43 is rotatably supported at one end by a support 44 provided at the small outlet port 18. The other end is coupled with the crank 42. When the louver motor 40 operates, the louver 43 is horizontally swung about the support 44 to change the direction of the air stream discharged from the small outlet port 18.

The blower of the embodiment 4 is installed as in the embodiment 1. By driving the motors 19 and the louver motor 40, the direction of the air stream from the outlet port 17 can

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be changed as desired. A more effective circulation of the air is secured. When set as shown in Fig. 13, the blower functions also as an electric fan.

Embodiment 5

5 In Figs. 14 through 17 showing a blower according to an embodiment 5 of the present invention, the outlet port 17 is gradually and uniformly narrowed toward the center L of the housing 11 and is bifurcated to have x-shaped outlet ports 50.

10 The blower thus constructed is installed as in the embodiment 1. When driven by the motors 19, the blower sucks air and blows twin air streams through the bifurcated x-shaped outlet ports 50. Accordingly, when the blower is used for the thermal isolating purposes, the air curtain is double and wide, and isolates the interior of the house from the outside,
15 thereby providing improved thermal isolating effects. When the blower is installed on the ceiling 26 as shown in Fig. 17, the air stream blown from one of the x-shaped outlet ports 50 strikes the ceiling and flows forward. Accordingly, hot air of the highest temperature in the space about 10 cm below the
20 ceiling is forcibly moved to circulate in the room. This results in excellent air conditioning.

Embodiment 6

In Figs. 18 through 24 showing a blower according to an embodiment 6 of the present invention, reference numeral 55 is
25 representative of a housing, and numeral 56 designates inlet ports formed in the top of the housing 55. The upper end of



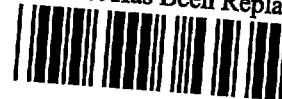
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the housing is folded at the round part 57 toward the inside of the housing 55, thereby to form a bellmouth 13. Mounting members 58 hold each motor 19 therebetween, with the shape of band. The respective ends of the mounting members 58 are
5 secured to the inner wall of the housing 55. A vane wheel 20 with axial vanes 59 is secured to the rotary shaft 20a in a state that it is located within the bellmouth 13.

A plural number of blower means 54 each including the motor 19, the vane wheel 20, and the bellmouth 13 are mounted
10 on the housing 55 while being equidistantly spaced from one another. An outlet port 60 is provided at the lower portion of the housing 55, and is communicated with the inlet port 56. The lower end of the housing is folded at the round part 57 toward the inside of the housing and reaches the bottom edge of
15 the folded portion of the inlet port 56. Those folded portions are jointed together to form the smooth inner wall of the housing 55, which defines a smooth wind path 61 ranging from the inlet port 56 to the outlet port 60.

A guide 62, located near at the center of the outlet
20 port 60, is shaped like a triangle in cross section of which the vertex is located at the side of the inlet port 56 and the base is located at the side of the outlet port 60. The corners of the triangle are curved as indicated by reference numeral 57. The outlet port 60 including the guide 62 thus located
25 therein functions as a parallel multi-nozzle 63. The guide 62 is an elongated and tubular member with the ends having





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threaded holes. The guide 62 is mounted on the housing 55 in a state that both ends of the guide are brought into contact with the opposed inner walls of the housing 55 and fastened to the latter by means of adjust screws 64. A T-groove 65 is formed in the portion of the outer wall of the housing 55, which corresponds to the portion with which each end of the guide 62 contacts. Each adjust screw 64 is inserted into and slidably guided by the T-groove 65. In Fig. 20, H indicates the cut height of the air curtain; W, the width of the air curtain at the cut height H; h, the length of the air curtain before it expands in the profile; and Z, a jet stream of air discharged from the outlet port 60.

In the thus constructed blower of the embodiment 6, the guide 62 is placed within the outlet port 60 and fastened to a desired position on the inner wall of the housing 55 by means of the adjust screws 64 that is inserted through the T-groove 65. The axial vane wheels 59 are turned by the motors 19 to suck air through the inlet port 56 and to emit jet streams of air through the outlet port 60. More exactly, two parallel jet streams Z are discharged through the parallel multi-nozzle 63 parted by the guide 62 located within the outlet port 60, as shown in Fig. 20.

A negative pressure is created in the space between the two jet streams discharged from the two nozzle openings since the inducing action takes place therein. Under the negative pressure, the two jet streams proceed and are inwardly bent to

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meet into one jet stream Z. Accordingly, the jet stream Z starts to expand at a location distanced h from the outlet port 60. Thus, the expansion of the width W of the air curtain at the cut height H can be reduced, and the center velocity of the jet stream is little reduced. That is, the air curtain formed by a multiple of nozzles with the small nozzle width is more effective than that by a single nozzle with a large nozzle width. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional one, with a more reduced velocity of the jet stream Z. Such a jet stream is less sensed bodily by a passenger.

The round parts 57 of the guide 62 and the outlet port 60 greatly attenuate the turbulence in the air stream Z when it is discharged from the outlet port 60, effectively holding down the expansion of the jet stream Z.

In a case where the wide width of the jet stream of air rather than the high velocity thereof is required, the guide 62 is moved, guided by the T-groove 65, to a location lower than the level of the outlet port 60, as shown in Figs. 23(a) to 23(c). When the guide 62 is moved downward, the jet stream Z is widened. The direction of the jet stream Z can be turned to the right or left as shown in Fig. 24. When the guide 62 is moved through the T-groove 65 to the right, the jet stream is turned to the right by an angle θ , as shown in Fig. 24(a). When the guide 62 is moved through the T-groove 65 to the left,



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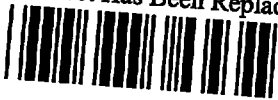
the jet stream is turned to the left by an angle θ , as shown in Fig. 24(c). Thus, the jet stream can be flexibly set in a desired direction since the guide 62 is horizontally and vertically movable at the outlet port 60. This can be realized with a simple structure without using the louver or the like.

A series of blower means 54 each including the axial vane wheel 59 are contained in the blower 10. With the plural number of blow means 54, the flow coefficient is large. When comparing with the use of the traverse vanes, the highest efficiency is obtained in an operating state free from a static pressure, that is, in the state of the maximum air flow. The result is reduction of noise generated when the blower 10 operates. Further, the width of the air curtain can be adjusted by properly selecting the number of blower means 54.

Embodiment 7

Figs. 25 through 26 show a blower according to an embodiment 7 of the present invention. In this embodiment, the guide 62 is automatically moved at the outlet port 60 while in the embodiment 6, it is manually moved by the combination of the adjust screws 64 and the T-grooves 65. As shown, servo motors 70 are mounted on the inner walls of both ends of the housing 55. A pinion 72 is fastened to the rotary shaft 71 of each servo motor 70. A rack 73 to be in mesh with the pinion 72 is vertically or horizontally disposed within the guide 62.

When the servo motors 70 are driven by operating a switch, not shown, the guide 62 is vertically or horizontally



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5 moved in the outlet port 60 through the engagement of the rack 73 and the pinion 72. In this embodiment, in addition to the effects as in the embodiment 7, the direction of the air jet stream can be remotely adjusted by means of the operation switch so that the operation property is further improved.

Embodiment 8

10 In Fig. 27 showing a blower according to an embodiment 8 of the invention, a blower 81 is constructed with a housing 80 containing a single blower means 54. An optional number of blowers 81 are coupled, by means of a coupling member 82, into a single unit. A blower unit of $L \times n$ long can simply be formed by coupling an n number of blowers 81 each of L long by means of the coupling member 82 of the corresponding length. Accordingly, the blower unit may be constructed according to 15 the width of the entrance of a building. The coupling member 82 may also serve as a dressed panel.

Embodiment 9

20 Figs. 28 through 30 show a blower according to an embodiment 9 of the present invention. In the figure, reference numeral 90 designates a first air flow rectifying plate made of a plate located just under the center of the axial vane wheel 59, which is under each motor 19 in the housing 55. The first air flow rectifying plate 90 consists of paired partition plates 92. One end of the partition plate is 25 jointed to the inner wall of the outlet port 60, and the other end thereof is jointed to the side face 91 of the guide 62. A

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second air flow rectifying plate 93 as a single plate partitions the adjacent blower means 54 in the housing 55. The upper end of each second air flow rectifying plate 93 and the inner wall of the inlet port 56 are jointed together, while the portion of the lower end thereof corresponding to the guide 62 is cut and the lower end is jointed with the inner wall of the outlet port 60 and the side face 91 of the guide 62.

In the blower thus constructed, the blower means 54 are operated to suck air through the inlet port 56 and forcefully send the air through the outlet port 60. The jet stream containing turning components, caused by the axial vane wheel 59, is converted into a linear stream of air by the combination of the first and second air flow rectifying plates 90 and 93. Accordingly, this greatly contributes to the formation of the air curtain used in the present invention which is directed to reduce the spread of the jet stream of air, and the width of the jet stream of air can reliably be reduced.

Embodiment 10

Figs. 31 to 33 show a blower of an embodiment 7 of the present invention. In the embodiments 6, 8 and 9, the guide 62 is a tubular member substantially triangle in cross section. In the embodiment 10, the guide 62 is opened in the bottom located in the outlet port 60, as shown in Fig. 32. Reference numeral 95 designates a lighting means such as a fluorescent lamp, which is disposed in the guide 62.

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The blower of the embodiment 10 is installed as in the embodiment 1. When the motors 19 and the lighting means 95 are turned on, the blower forms an air curtain in the entrance 23 while lighting there. This embodiment has the lighting function in addition to the thermal isolation function so that the operation property is further improved.

Embodiment 11

Figs. 34 through 37 show a blower according to an embodiment 11 of the present invention. In the figure, reference numeral 96 designates a heater, for example, an electrical heater shaped like a bar. The heater 96 is disposed within the guide 62. A heater cover 97 for covering the heater 96, is semicircular in shape, and serves also as a reflector.

The blower of the embodiment 11 is installed as in the embodiment 11. When the motors 19 and the heater 96 are turned on, a hot air curtain is formed, eliminating a sense of coolness at the entrance 23. When the blower is provided with a support 97, and set upright as shown in Fig. 37, it can be used as a motor fan in summer and as a heater in winter. The blower can be used multifunctionally.

The present invention thus constructed has the following useful effects.

In the construction of the blower according to a first aspect of the present invention, the inlet port within which a vane wheel is disposed is shaped like a bellmouth, and outlet port is formed by uniformly bending the wall of the housing



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toward the center thereof. The resultant air curtain is high in velocity and long in its length.

In the construction of the blower according to a second aspect of the present invention, the mounting members, formed on the outer surface of the housing, rotatably supports the housing. With the provision of the mounting member, the air stream discharged from the blower can be set in a desired direction. Thus, the flexible use of the blower is secured.

In the construction of the blower according to a third aspect of the present invention, a movable louver is disposed within the outlet port. With this, the air can be blown in a wide range. Thus, the product performances are further improved.

In the construction of the blower according to a fourth aspect of the present invention, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and is bifurcated to have an x-shape. The resultant air curtain is double and wide, and isolates the interior of the house from the outside.

In the construction of the blower according to a fifth aspect of the present invention, the guide is disposed within the outlet port, thereby forming a parallel multi-nozzle. Thus, the expansion of the width of the air curtain can be suppressed, and the thermal isolating capability is improved. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional



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one, with a more reduced velocity of the jet stream. Such a jet stream is less sensed bodily by a passanger. The blower is small in size, light in wieght and excellent in power saving.

In the construction of the blower according to a sixth aspect of the present invention, the parallel multi-nozzle is formed in the outlet port. Further, the round parts of the guide and the outlet port greatly attenuate the turbulence in the air stream when it is discharged from the outlet port. As a result, the expansion of the jet stream can be effectively held down and the capacity of thermal insulation is improved.

In the construction of the blower according to a seventh aspect of the present invention, the flow pattern of the air stream blown from the blower can flexibly be changed as desired. Accordingly, the air curtain can be formed as desired.

In the construction of the blower according to a eighth aspect of the present invention, use of the axial vane wheel reduces noise generated. With the feature of a plural number of blowing means arrayed side by side into the blower unit, the size of the blower unit may be constructed according to the size of the location where the blower unit is installed.

In the construction of the blower according to a ninth aspect of the present invention, the air stream within the housing is converted into a linear air stream by the air flow rectifying plate. This results in holding down the expansion of the air stream.



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In the construction of the blower according to a tenth aspect of the present invention, the guide contains a heater or a lighting means. Thus, a multi-functional blower is realized.





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WHAT IS CLAIMED IS:

1 1. A blower comprising a housing with an air inlet
2 port at one end and an air outlet port at the other end; and a
3 vane wheel and a motor, located within said housing, for
4 sucking air through said inlet port and forcefully blowing the
5 sucked air through said outlet port, wherein said inlet port is
6 shaped like a bellmouth in which said vane wheel is disposed,
7 and a lower end portion of said housing is uniformly narrowed
8 toward the center of said housing, thereby forming said outlet
9 port.

1 2. The blower according to claim 1, further
2 comprising mounting members for rotatably supporting said
3 housing, said mounting members being disposed on an outer
4 surface of said housing.

1 3. The blower according to claim 1, further
2 comprising a movable louver disposed in said outlet port.

1 4. The blower according to claim 1, wherein said
2 outlet port has an x-shaped end formed by gradually and
3 uniformly narrowing the lower end portion of said housing
4 toward the center of said housing and by bifurcating the lower
5 end portion.

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1 5. A blower comprising blowing means including a
2 housing with an air inlet port at one end and an air outlet
3 port at the other end, and a vane wheel and a motor, located
4 within said housing, for sucking air through said inlet port
5 and forcefully blowing the sucked air through said outlet port;
6 and a guide, being disposed within said outlet port, for
7 forming a parallel multi-nozzle.

1 6. The blower according to claim 5, wherein said
2 guide is a tubular member substantially triangle in cross
3 section with a base at a side of said outlet port, corners of
4 said guide are rounded, and the lower end of said housing is
5 folded inward to have a round bent portion.

1 7. The blower according to claim 5, wherein said
2 guide is movable within said outlet port.

1 8. The blower according to claim 5, wherein said
2 vane wheel of said blowing means is an axial vane wheel, and a
3 plural number of blowing means are disposed side by side within
4 said housing.

1 9. The blower according to claim 5, further
2 comprising a first air flow rectifying plate located at almost
3 the center of said vane wheel and between said blowing means
4 and said outlet port, and a second air flow rectifying plate





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5 partitioning the adjacent blowing means and disposed within
6 said housing.

1 10. The blower according to claim 5, further
2 comprising a heater or a lighting means, covered with a cover,
3 within said guide.

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ABSTRACT OF THE DISCLOSURE

5 In a housing with an inlet port (12) opened upward and an outlet port (17) opened downward, a plate having a plural number of bellmouths (13) is mounted on the side of each housing having the inlet port (12). The outlet port (17) is narrowed toward the center of the housing (11), thereby forming a small outlet port (18). A motor (19) with a vane wheel (20) is located within the housing (11).

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FIG. 1

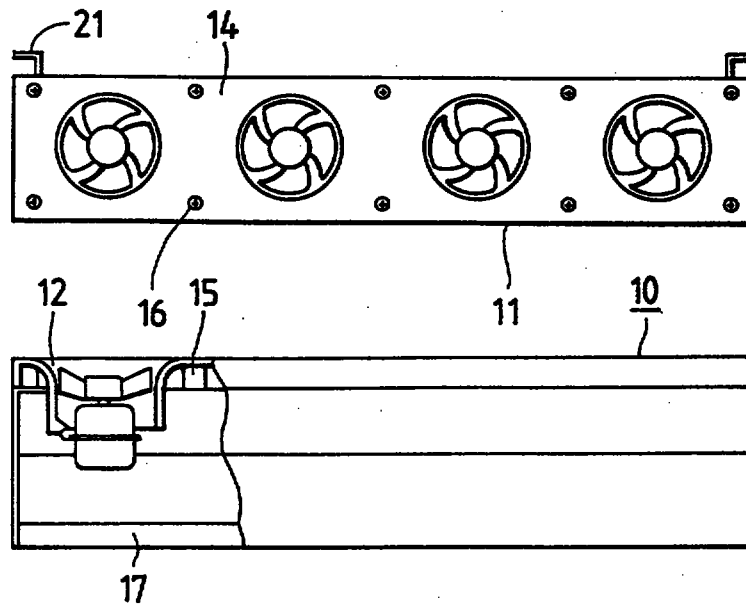
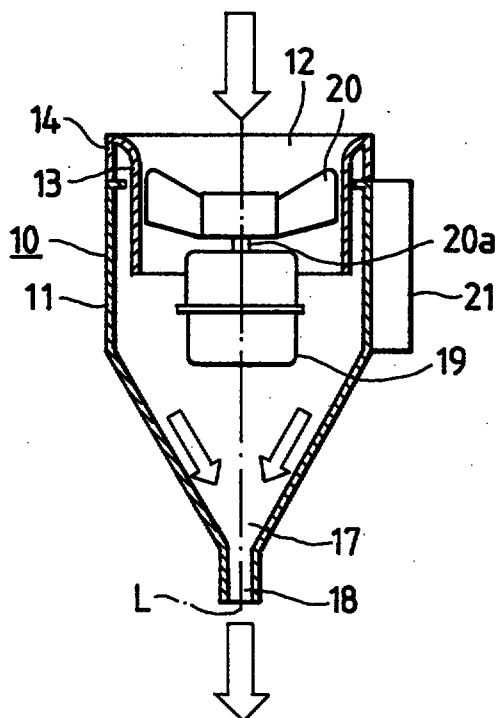


FIG. 2

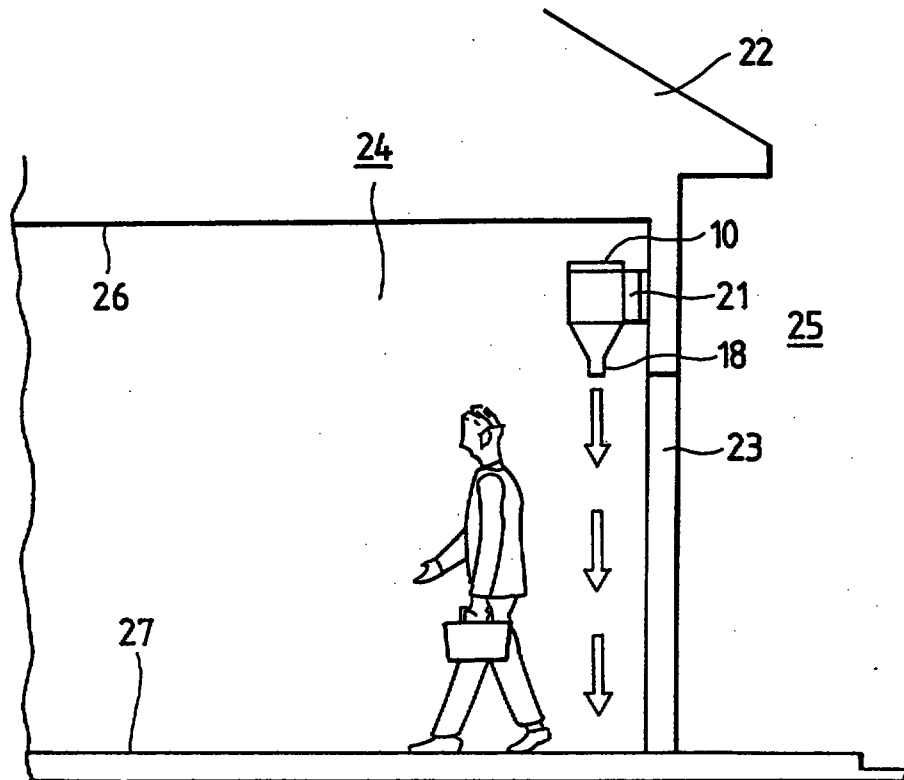


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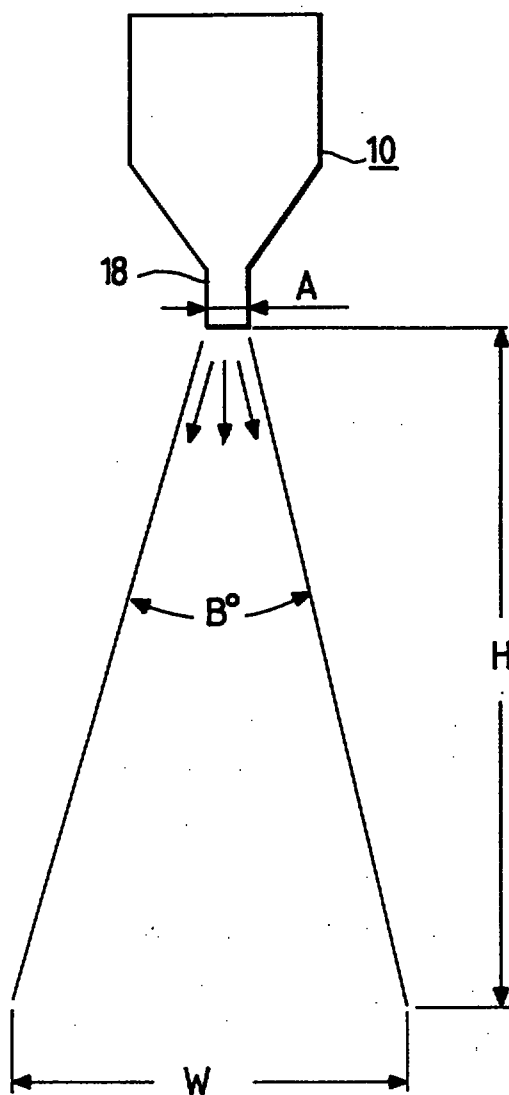
FIG. 3



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FIG. 4



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FIG. 5

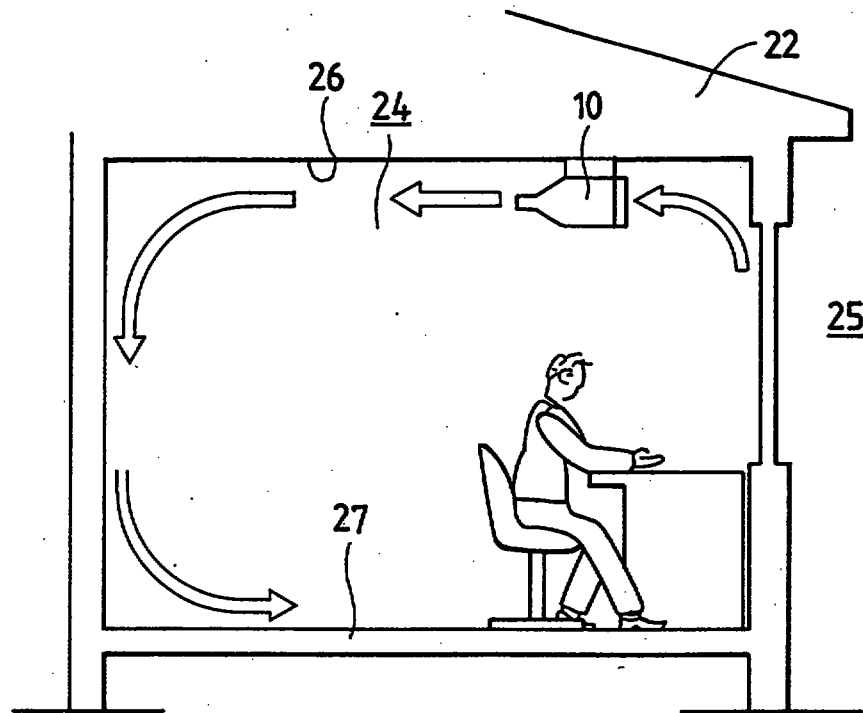
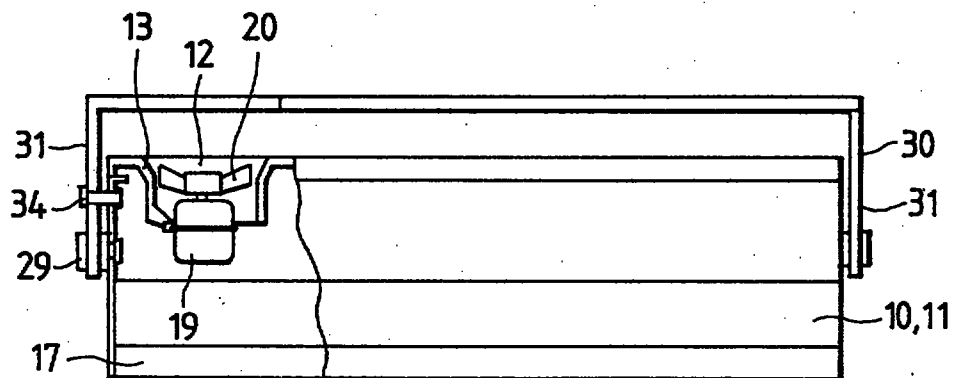


FIG. 6



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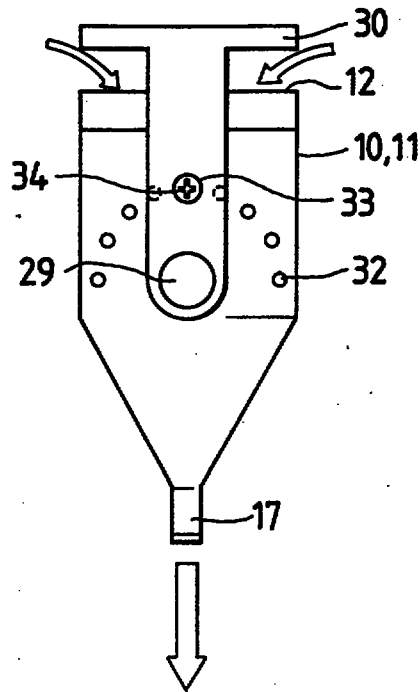


FIG. 7

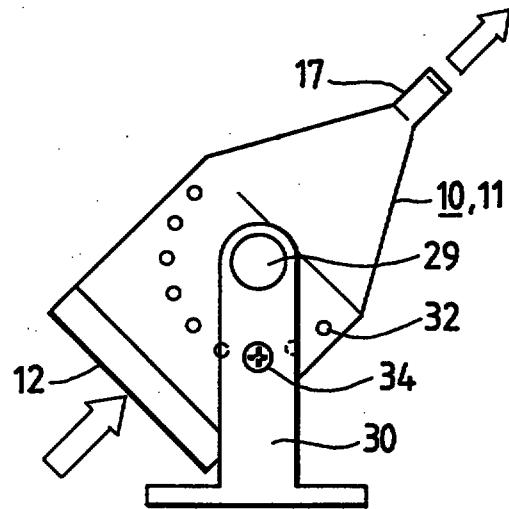
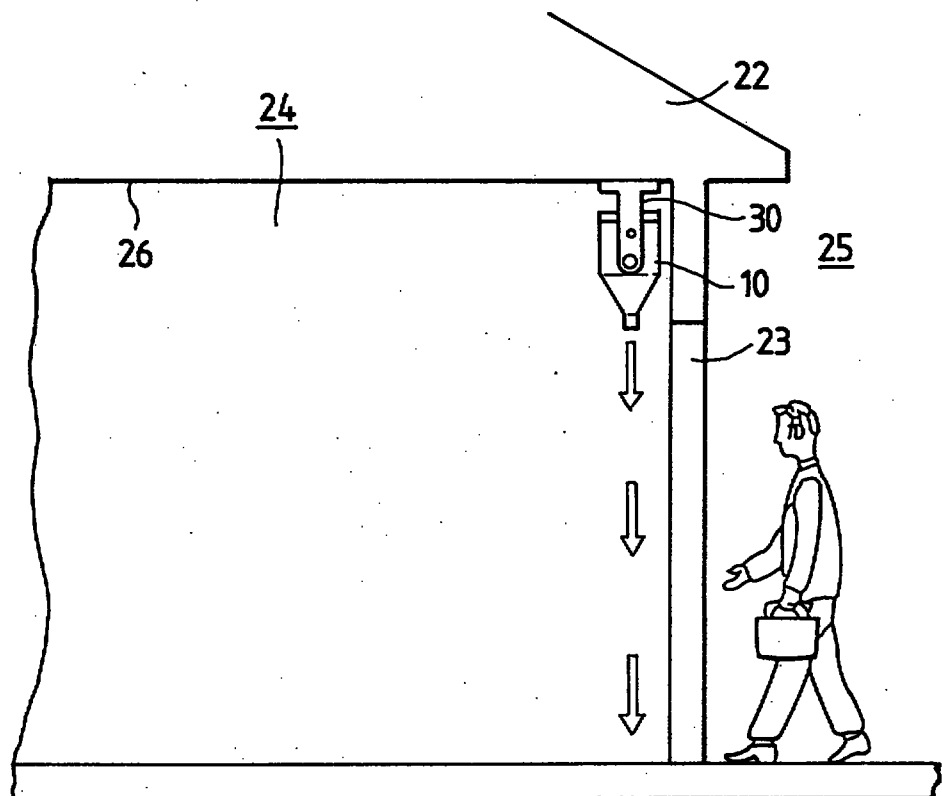


FIG. 8



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FIG. 9

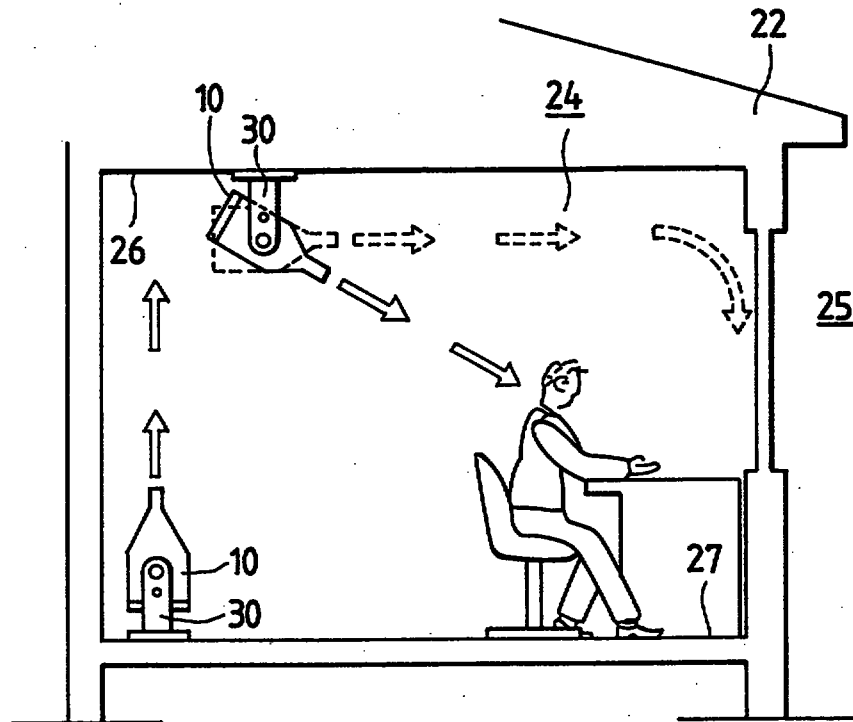
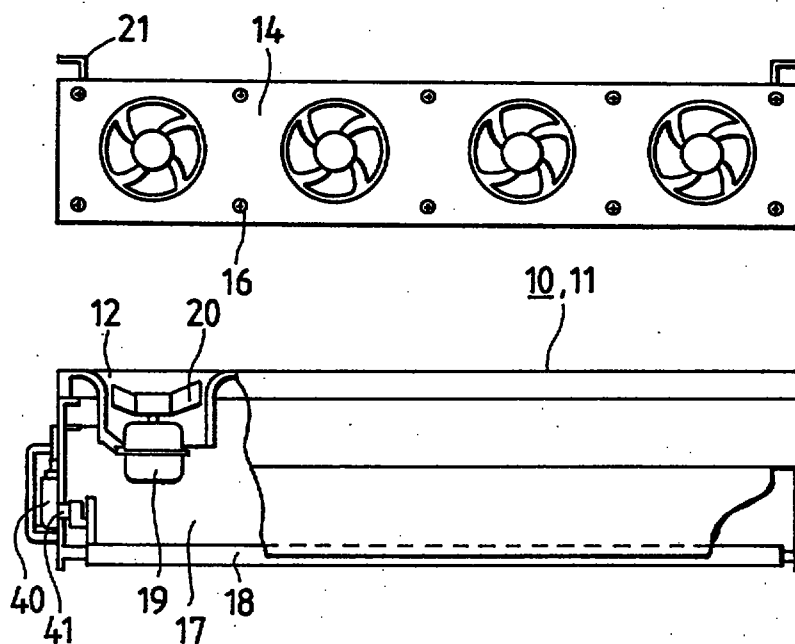
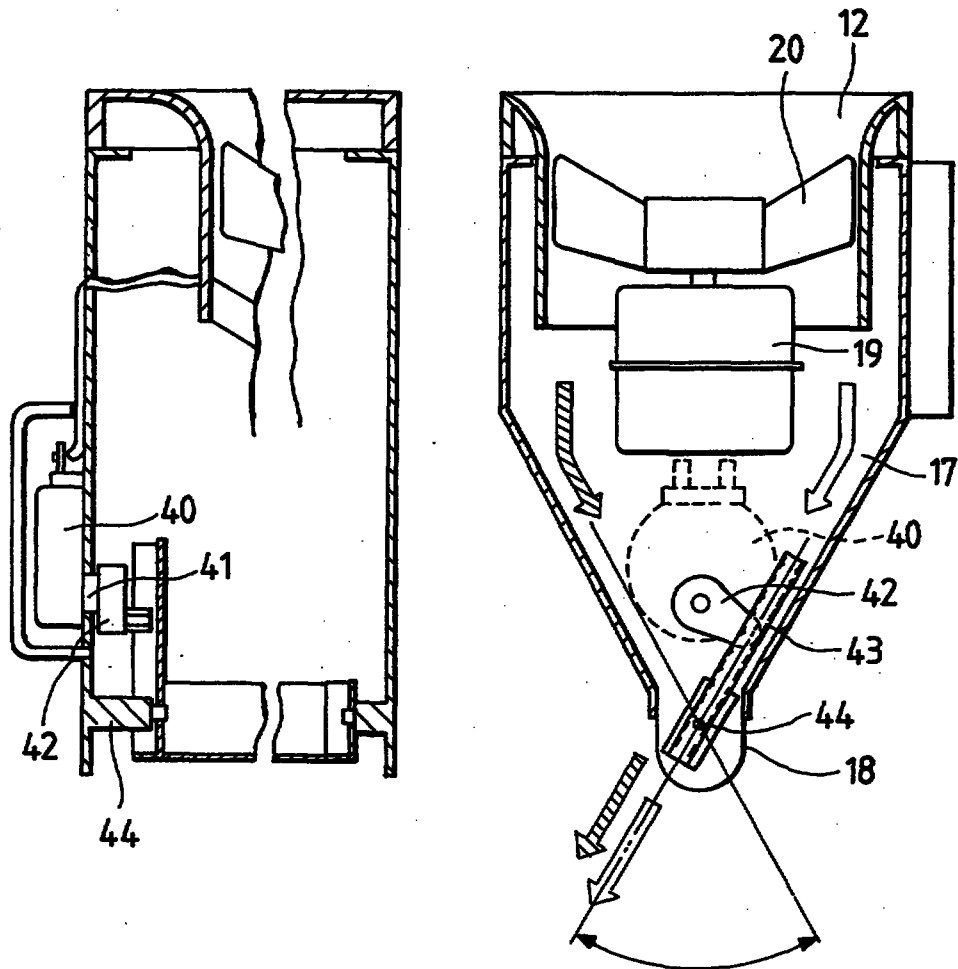


FIG. 10



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FIG. 11



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FIG. 12

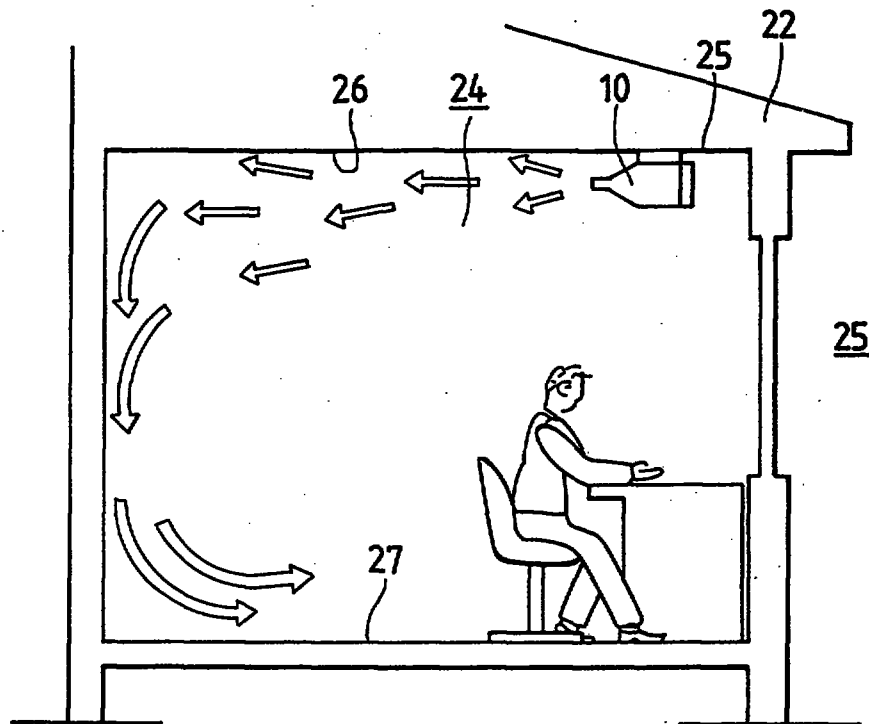
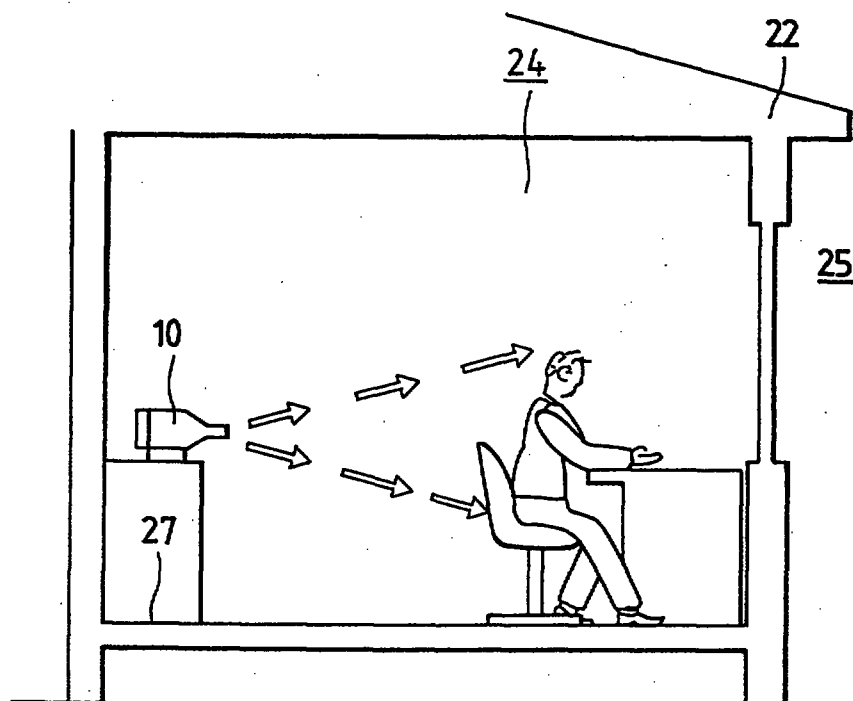


FIG. 13



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FIG. 14

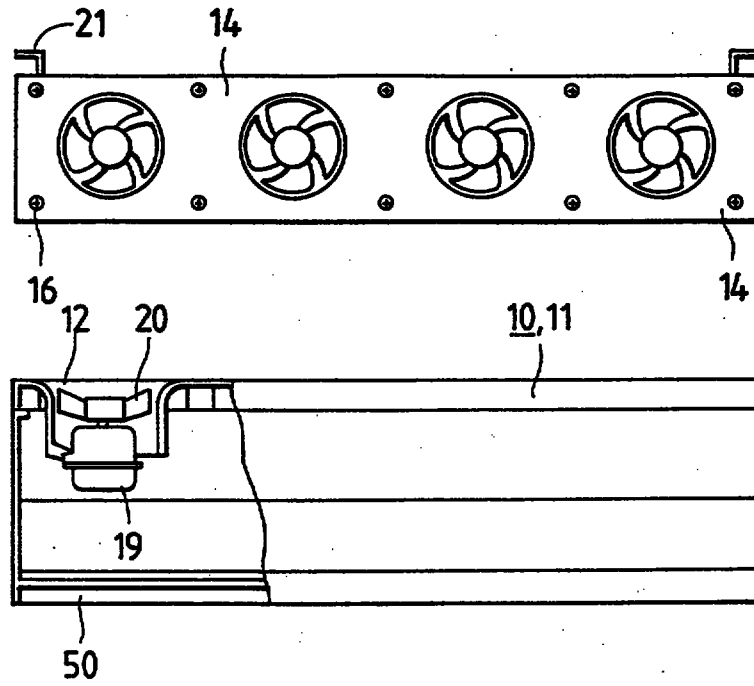
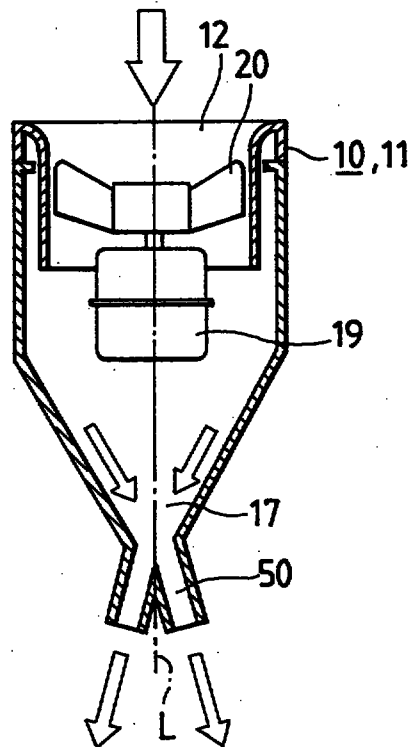


FIG. 15



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FIG. 16

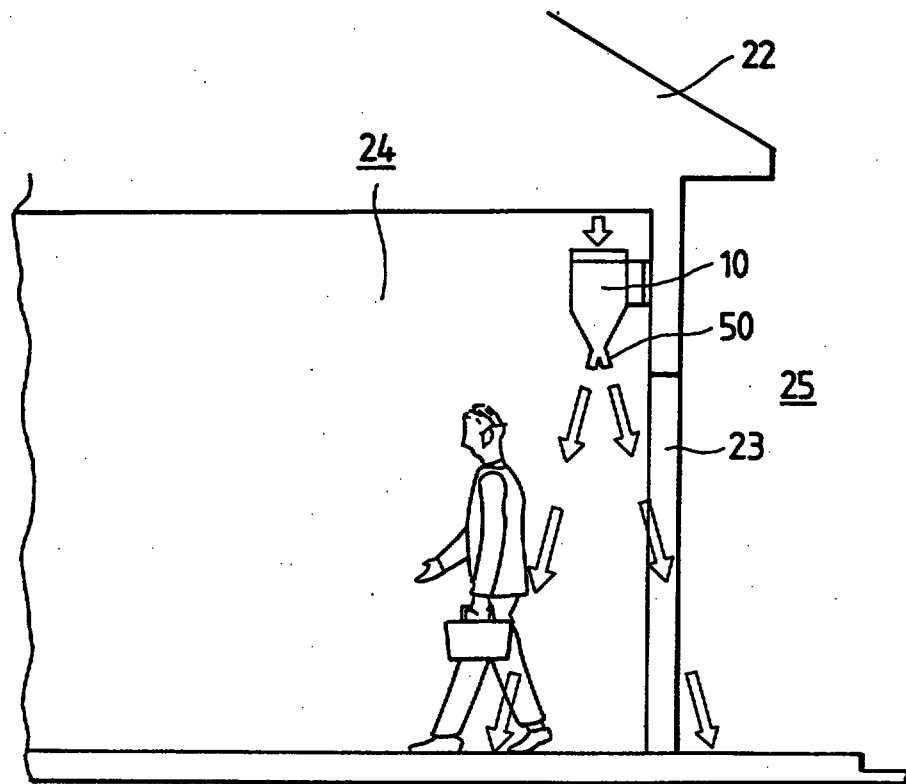


FIG. 17

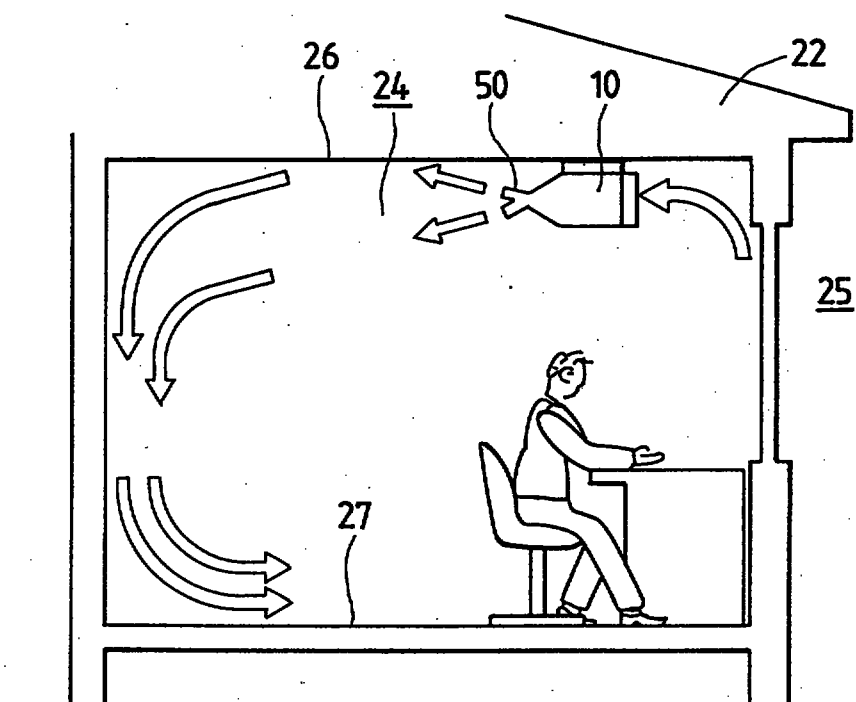


FIG. 18

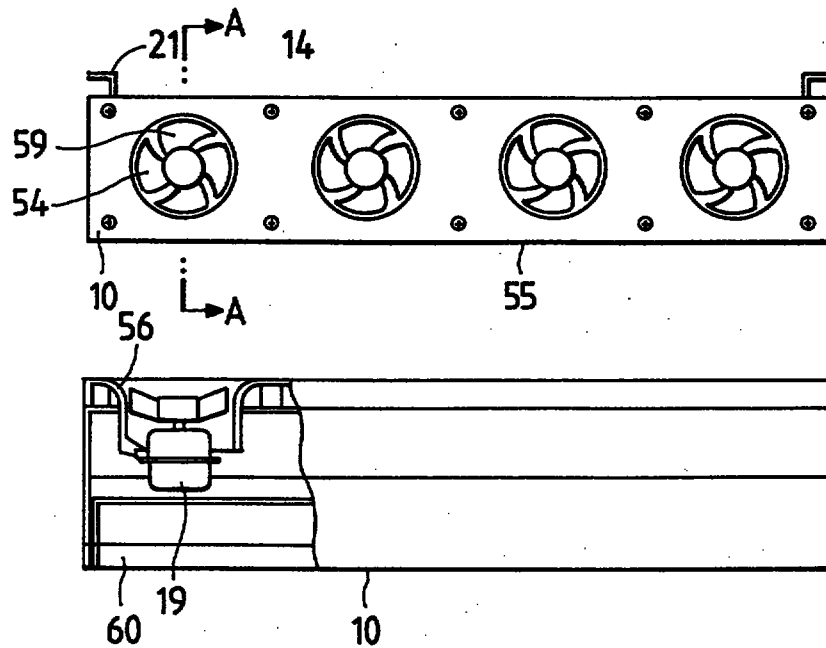
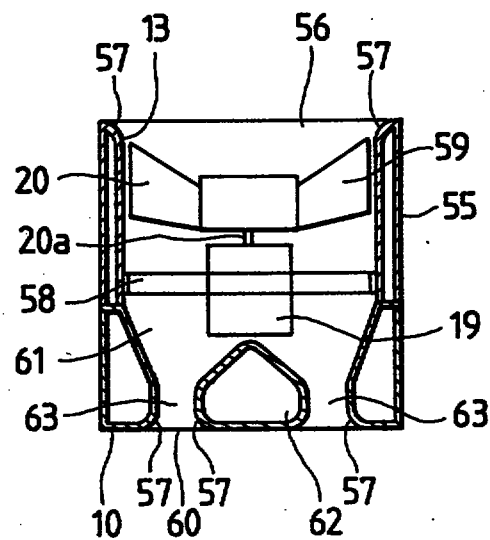


FIG. 19



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FIG. 20

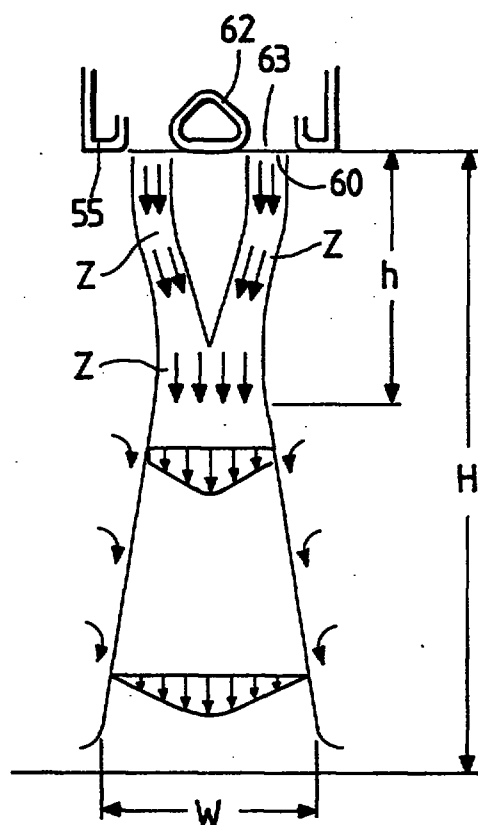


FIG. 21

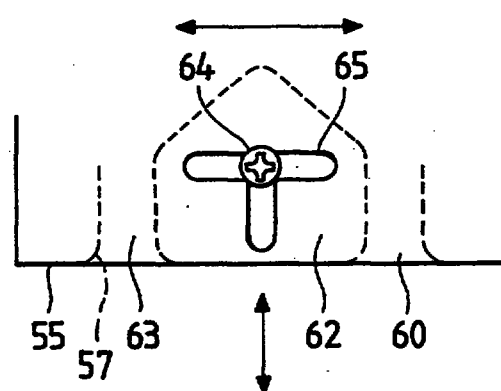


FIG. 22

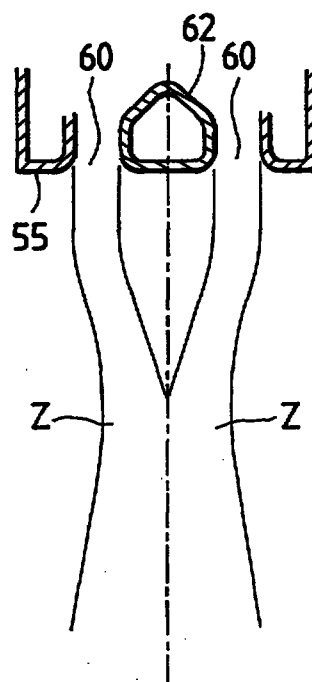


FIG. 23(a)

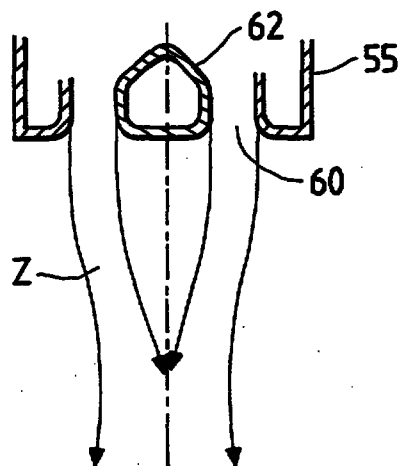


FIG. 23(b)

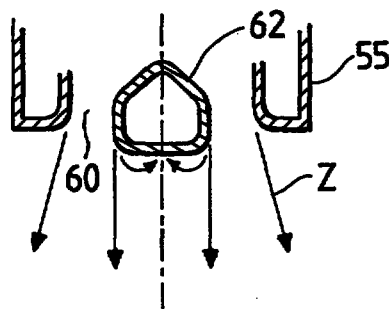
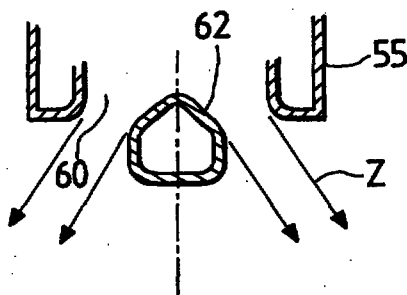
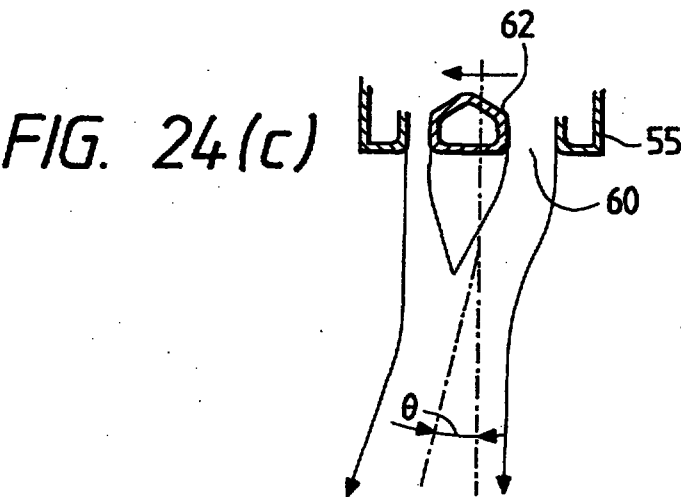
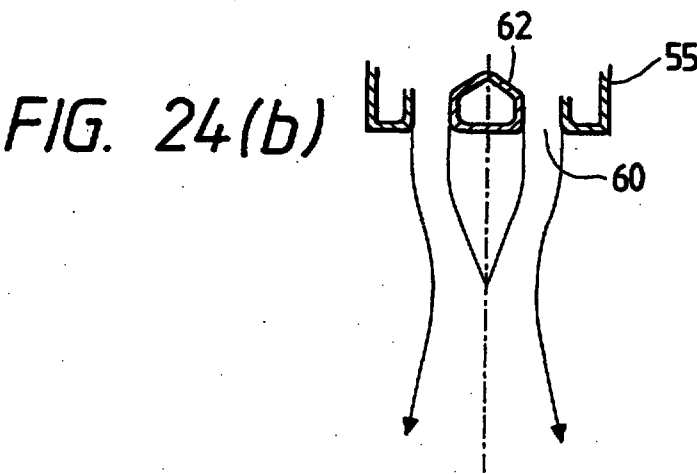
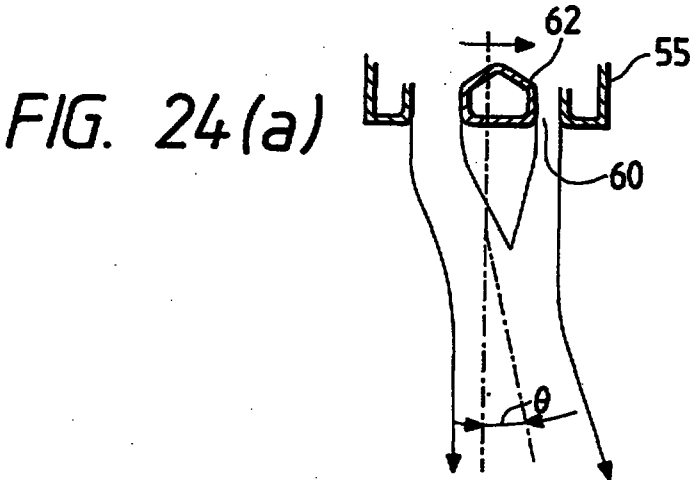


FIG. 23(c)



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FIG. 25(a)

FIG. 25(b)

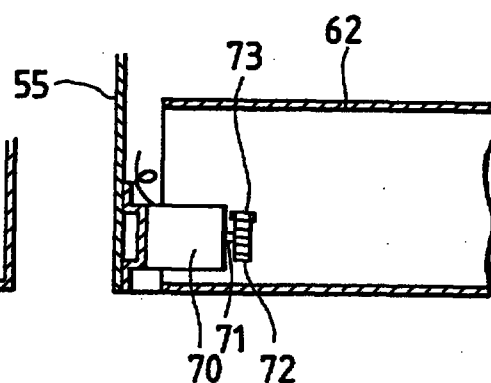
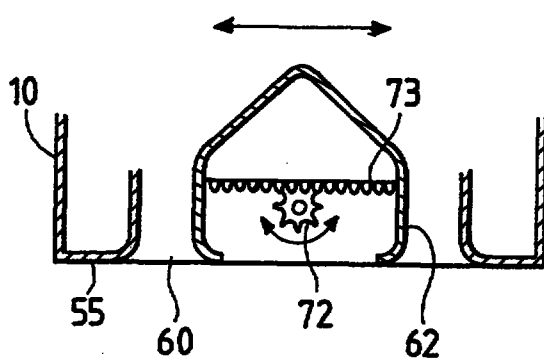
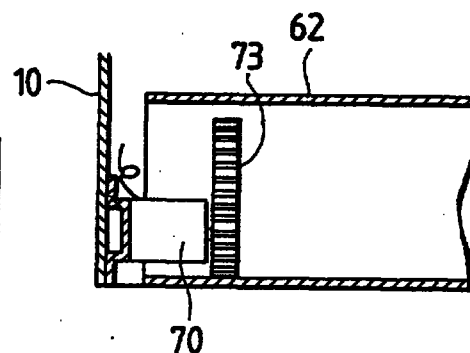
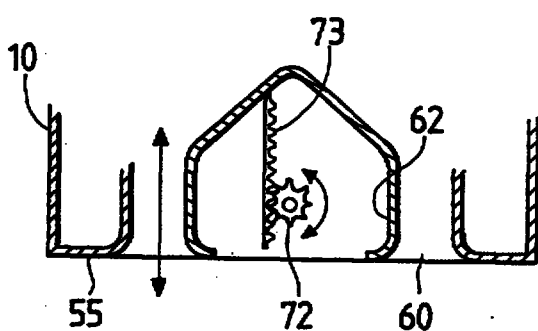


FIG. 26(a)

FIG. 26(b)



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FIG. 27

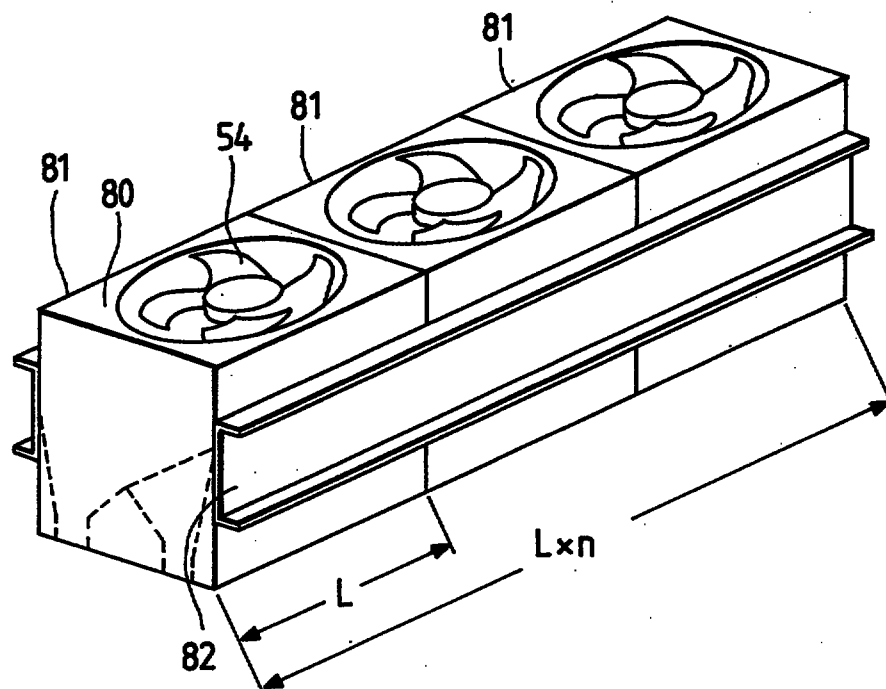
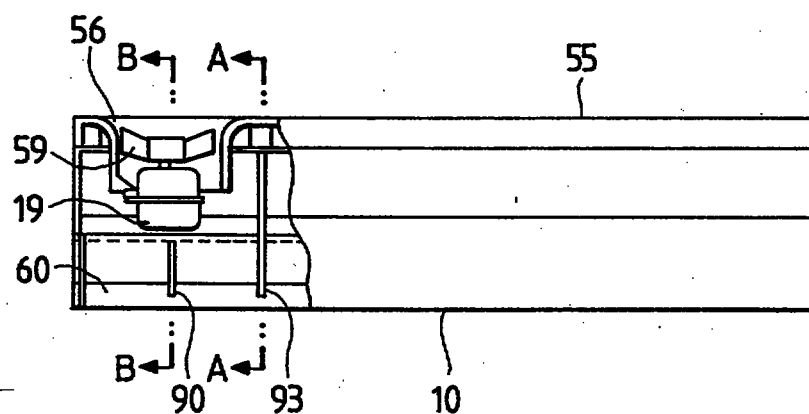
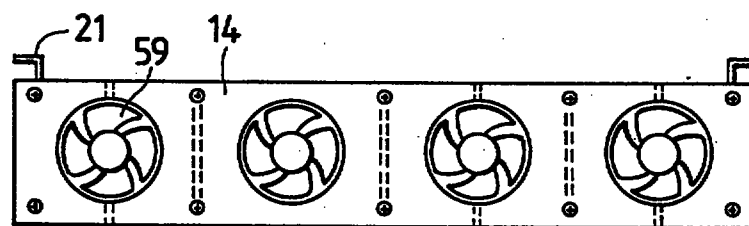


FIG. 28



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FIG. 29

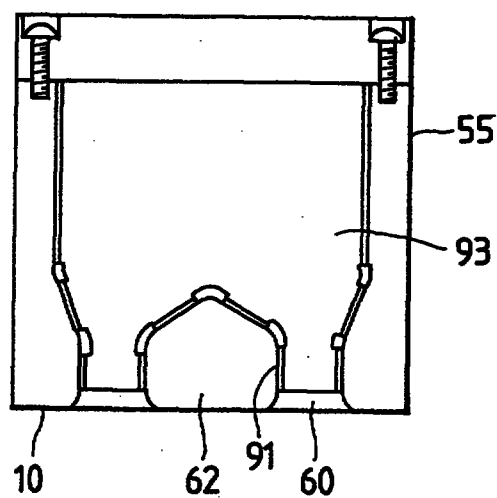
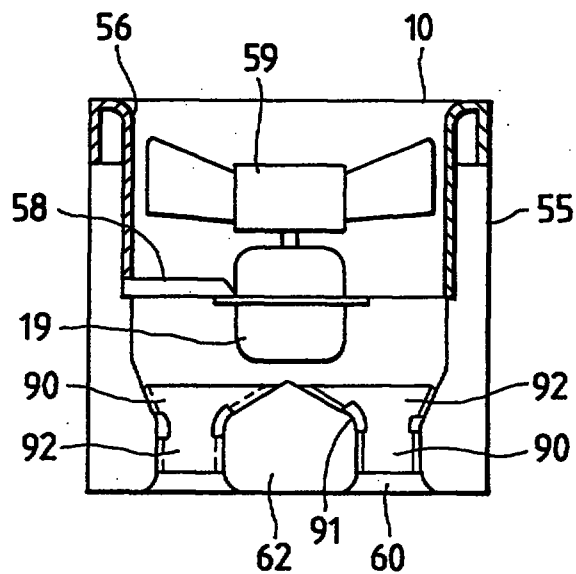


FIG. 30



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FIG. 31

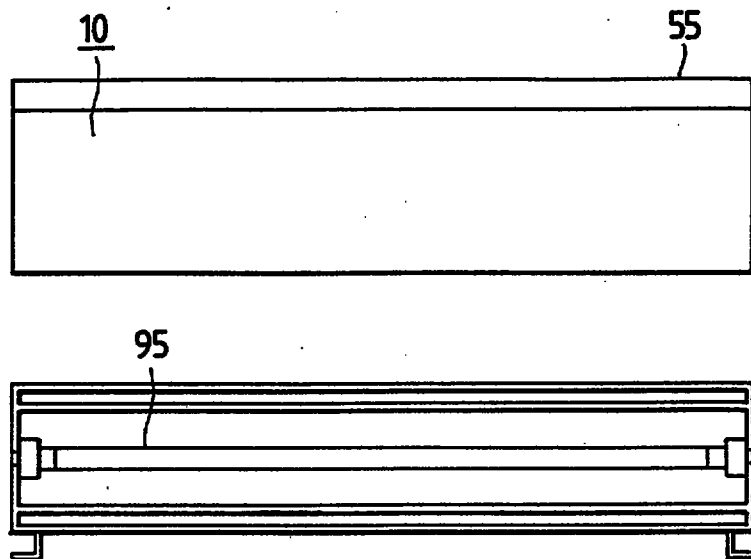
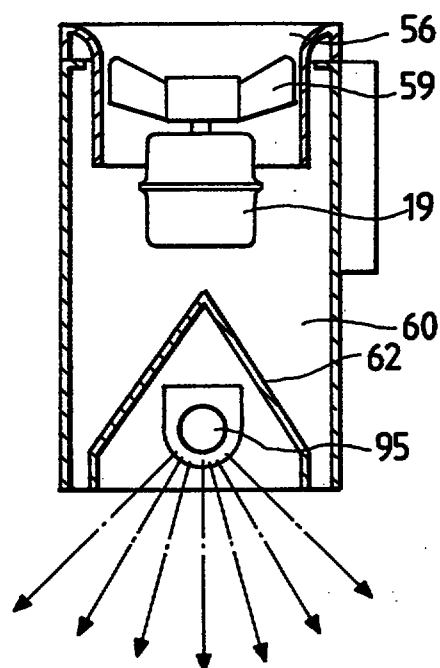


FIG. 32



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FIG. 33

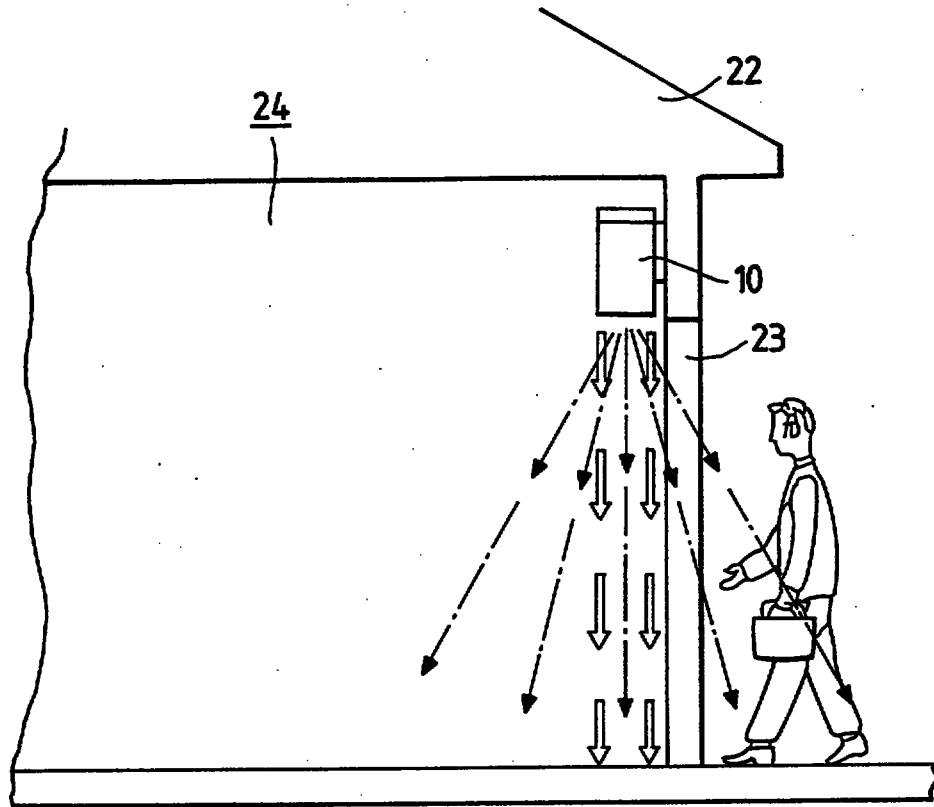
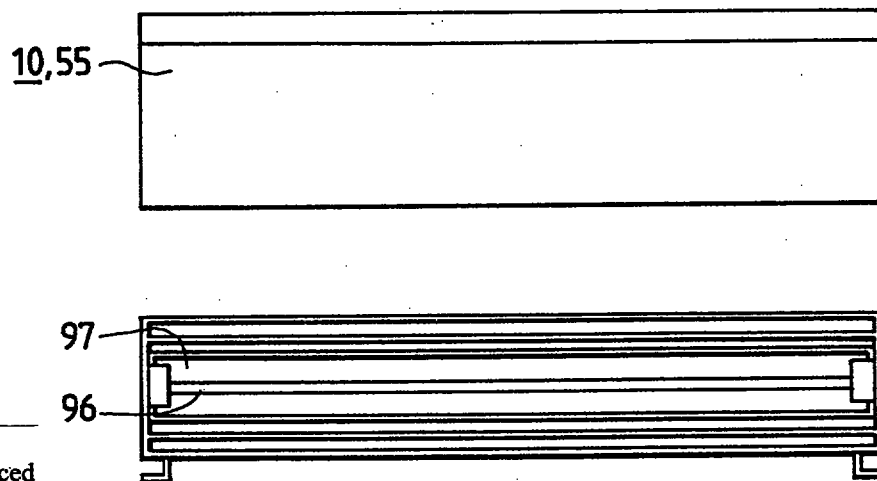


FIG. 34





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FIG. 35

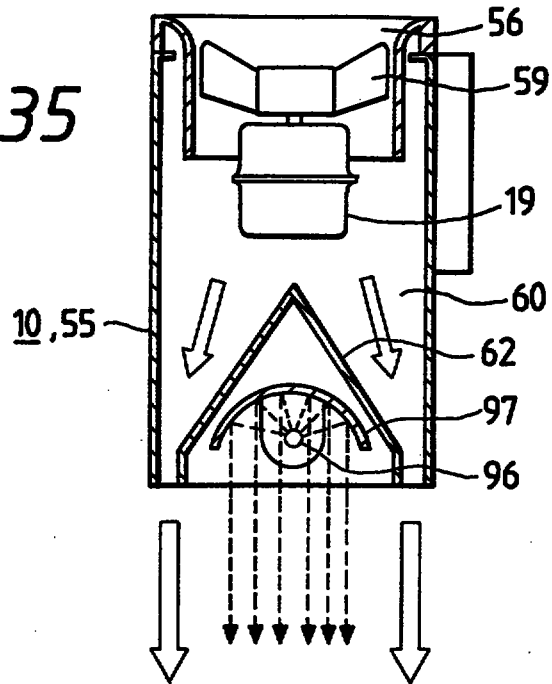
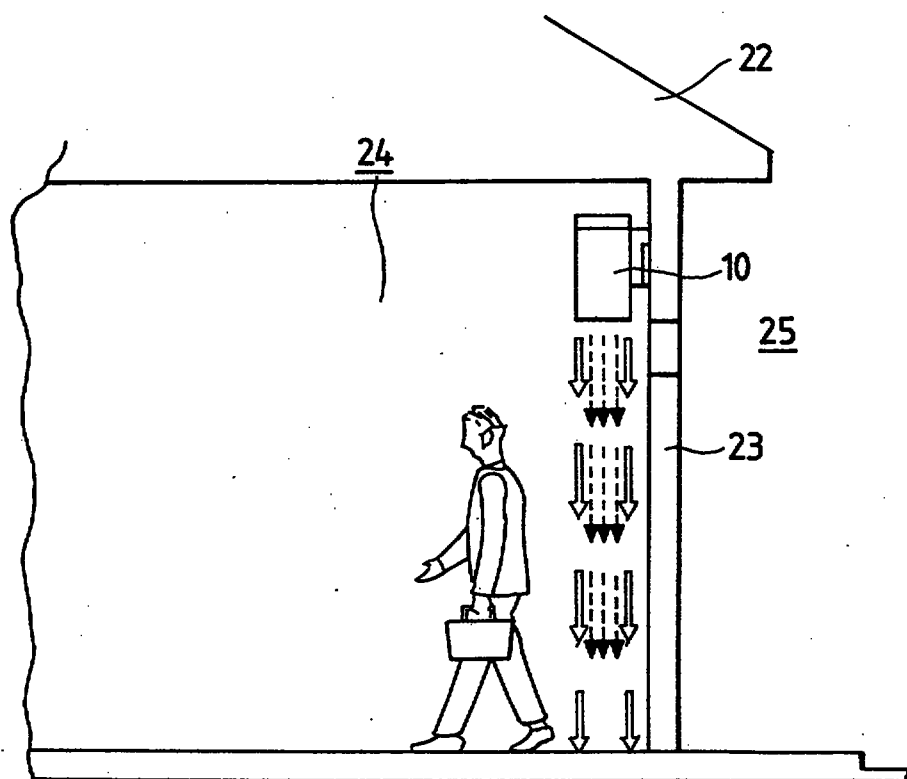


FIG. 36



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FIG. 37

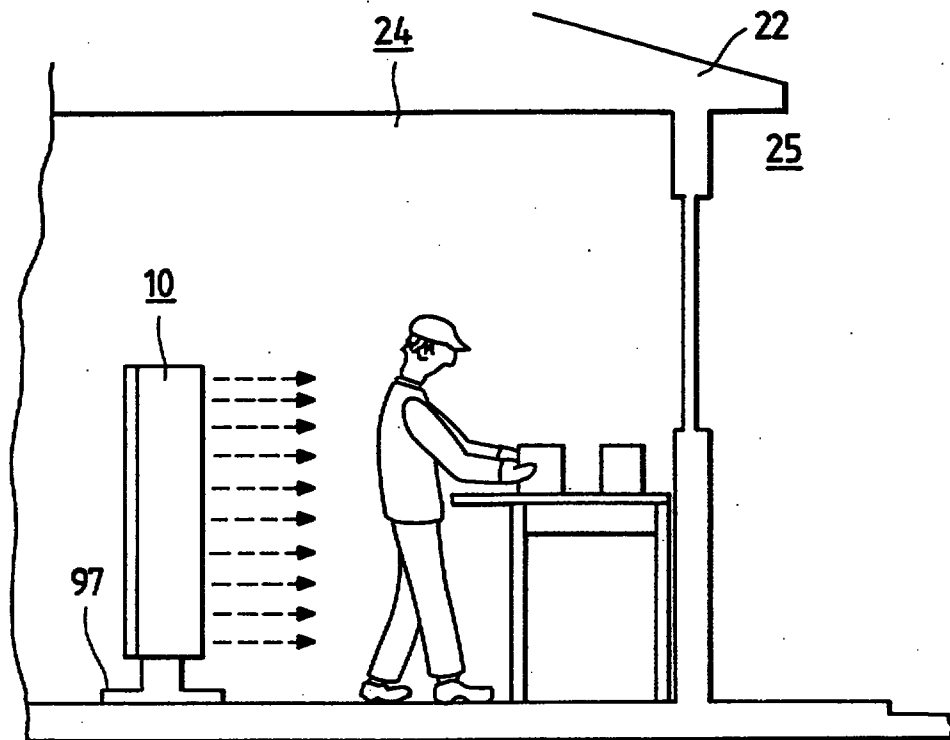
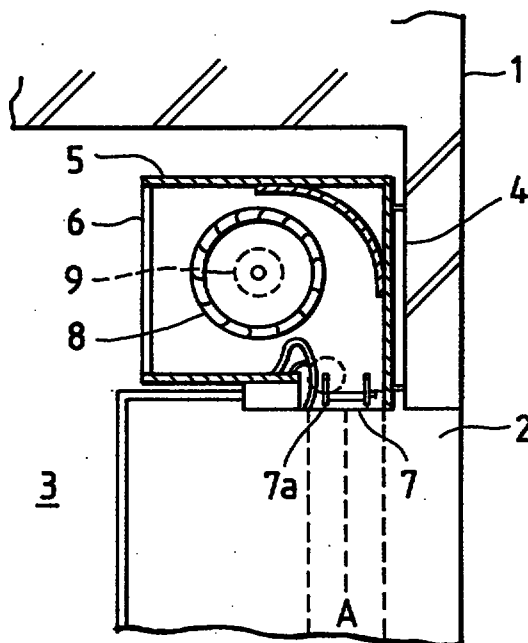
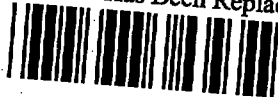
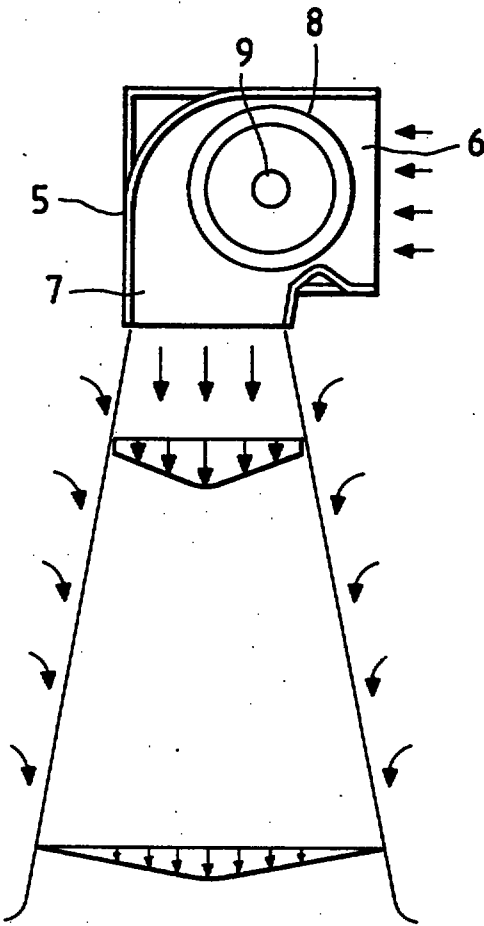


FIG. 38



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FIG. 39



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BLOWER

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BACKGROUND OF THE INVENTION

The present invention relates to a blower, installed at the entrance and/or exit of a building, for thermally insulating the inside of the building from the outside mainly when the building is air-cooled or heated.

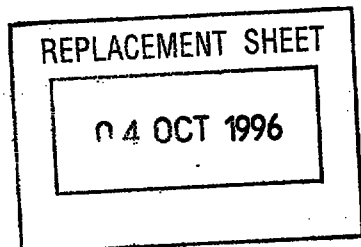
Figs. 38 and 39 show a conventional blower disclosed in Published Unexamined Japanese Patent Application No. Hei. 5-106898. This machine will be described hereinafter.

A box-like blower body 5 is installed on the inner wall 4 (in the interior 3 of a room) of a house 1. The blower body 5 includes an air inlet port 6 at a side opposite to the installation side and an air outlet port 7 at a lower side. Within the blower body 5, a motor 9 is mounted. The motor 9 with a single traverse vane 8 secured thereto receives air from the inlet port 6 and forcefully blowing the air to the outlet port 7. A plural number of flow-direction control plates 7a for controlling the direction of a stream of the discharged air are mounted at the outlet port 7. These vanes are swingable on the upper ends thereof as fulcra.

In the blower thus constructed, the vane 8 is rotated by the motor 9 to suck air through the inlet port 6 and to blow the air through the outlet port 7, thereby forming an air curtain hanging down in the entrance/exit 2 of the house 1.

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In the blower, a single traverse vane 8 is used for the air blowing. As a stream of air discharged from the outlet port 7 proceeds, it pulls in surrounding air and expands as shown in Fig. 39. In the air curtain formed by the expanded air stream, the thermal isolating capability is reduced, and the effective thermal-isolating height or length of the air curtain at the entrance/exit 2 of the house 1 as well is restricted.

Also, to increase the effective thermal-isolating length of the air curtain, a large vane must be used for the vane 8. The result is to install the large and heavy, or cumbersome vane, on the wall 4.

Also, since the width of the air curtain is determined by the length of the vane 8, in order that the air curtain is formed so as to fit for various sizes of the entrance/exit 2, the respective blower with the vane 8 of different length must be provided.

Also, when the traverse vane 8 is used, noise inherent to the vane 8, such as a whistling sound, is large.

SUMMARY OF THE INVENTION

The present invention has been made in view of the above circumstances and has an object to improve the thermal insulating capability of a blower by minimizing the expansion of the air stream in the form of a curtain, and to secure a sufficiently long thermal-isolating length of the air curtain

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without increasing the size of the machine. Another object of the present invention is to provide a blower of low noise which can selectively set the width of the air curtain at a desired value of width for an arbitrary opening of the entrance/exit of a building without using different traverse vanes.

To achieve the above objects, there is provided an blower having a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within the housing, for sucking air through the inlet port and forcefully blowing the sucked air through the outlet port, wherein the inlet port is shaped like a bellmouth in which the vane wheel is disposed, and the lower end portion of the housing is uniformly narrowed toward the center of the housing, thereby forming the outlet port.

Also, in the blower, mounting members, formed on the outer surface of the housing, rotatably supports the housing.

Also, a movable louver is disposed within the outlet port.

Also, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and is bifurcated to have an X-shape.

Also, a blower comprises blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within the housing, for sucking air through the inlet port and forcefully blowing the sucked air through the outlet port, and

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a guide is disposed within the outlet port, thereby forming a parallel multi-nozzle.

Also, the guide is a tubular member substantially triangle

in cross section having the base at the blowing side, the corners of the guide being rounded, and the lower end of the housing is folded inward to form a round circumferential edge of the outlet port.

Also, the guide is rotatable within the outlet port.

Also, the vane wheel of the blowing means is an axial vane wheel, and a plural number of blowing means are disposed side by side within the housing.

Also, a first air flow rectifying plate located at almost the center of the vane wheel and between the blowing means and the outlet port, and a second air flow rectifying plate partitioning the adjacent blowing means are disposed within the housing.

Also, a heater or a lighting means, covered with a cover, is provided within the guide.

In the construction of the invention, the inlet port within which a vane wheel is disposed is shaped like a bellmouth. The outlet port is formed by uniformly bending the lower end portion of the wall of the housing toward the center thereof. Accordingly, when the motor is driven and the vane wheel turns, air is blown from the inlet port to the outlet port, thereby forming an air curtain.

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Also, the mounting members, formed on the outer surface of the housing, rotatably supports the housing. With the provision of the mounting member, the housing can be swung as desired.

Also, the movable louver is disposed within the outlet port. Thus, the direction of the air stream discharged through the outlet port can be arbitrarily changed by the movable louver.

Also, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and by bifurcating the lower end to have an x-shape. Thus, two outlet ports are obtained and two air streams can be output from the outlet ports.

Also, the guide is disposed within the outlet port, thereby forming a parallel multi-nozzle. A plural number of parallel air streams are discharged through the outlet port. A negative pressure is created between the adjacent air jet streams. Under the negative pressure, the jet streams proceeds and are inwardly bent to meet into one jet stream.

Also, the guide is a tubular member substantially triangle in cross section. The guide and the outlet port are rounded at the corners. The parallel multi-nozzle is formed in the outlet port so that a plurality of parallel air streams are discharged from the outlet port. The round parts of the guide and the outlet port greatly attenuate the turbulence in the air streams when they are discharged from the outlet port.

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Also, the guide can be movable at the outlet port. Accordingly, the direction of a flow pattern of the air stream can flexibly be changed as desired.

Also, the vane wheel is the axial vane wheel. With the use of the axial vane wheel, the flow coefficient is large. In an operating state free from a static pressure, the highest efficiency is obtained. As a result, noise caused by the drive power source and the turning of the vanes is reduced. Further, provision of the plural number of blowing means enables one to adjust, as intentionally, the width of the air curtain formed.

Also, the air curtain stream containing turning components, generated by the axial vane wheel, is converted into a linear air curtain stream by the air flow rectifying plate.

Also, the heater or the lighting means, contained in the guide to be covered with the cover, provides an illuminating light beam or a hot stream in parallel with the air stream.

BRIEF DESCRIPTION OF THE DRAWINGS

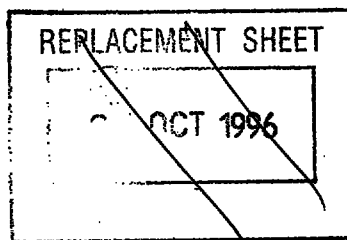
Fig. 1 is a side and plan view of an blower according to an embodiment 1 of the present invention,

Fig. 2 is a sectional view showing the blower of the embodiment 1,

Fig. 3 is a view showing an example of the installation of the blower of the embodiment 1 in a house,

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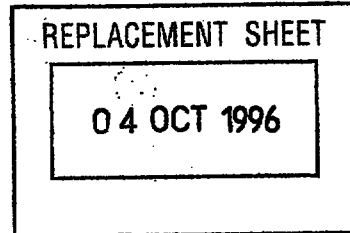


Fig. 4 is a view showing a profile of a jet stream of air discharged from the blower of the embodiment 1,

Fig. 5 is a view showing the installation according to embodiment 2,

Fig. 6 is a side view showing an blower according to an embodiment 3 of the present invention,

Fig. 7 is another side view showing an blower according to the embodiment 3 of the present invention,

Fig. 8 is a view showing an example of the installation of the blower of the embodiment 3 in a house,

Fig. 9 is a view showing another example of the installation of the blower of the embodiment 3 in a house,

Fig. 10 is a side and plan view of an blower according to an embodiment 4 of the present invention,

Fig. 11 is a front and side sectional view showing the blower of the embodiment 4,

Fig. 12 is a view showing an example of the installation of the blower of the embodiment 4,

Fig. 13 is a view showing another example of the installation of the blower of the embodiment 4,

Fig. 14 is a side and plan view of an blower according to an embodiment 5 of the present invention,

Fig. 15 is a sectional view showing the blower of the embodiment 5,

Fig. 16 is a view showing an example of the installation of the blower of the embodiment 5,

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Fig. 17 is a view showing another example of the installation of the blower of the embodiment 5,

Fig. 18 is a side and plan view of an blower according to an embodiment 6 of the present invention,

Fig. 19 is a sectional view taken on line A - A in Fig. 18.

Fig. 20 is a diagram showing the profile of the air stream formed by the blower of the embodiment 6,

Fig. 21 is a side view showing an outlet port in the machine of the embodiment 6,

Fig. 22 is a cross sectional view showing the outlet port in the machine of the embodiment 6,

Figs. 23(a) to 23(c) are diagrams showing flow patterns of the air stream blown from the blower of the embodiment 6,

Figs. 24(a) to 24(c) are additional flow patterns of the air stream blown from the blower of the embodiment 6,

Figs. 25(a) and 25(b) are cross sectional views showing an outlet port of an blower according to an embodiment 7 of the present invention,

Figs. 26(a) and 26(b) are cross sectional views showing another outlet port of an blower according to the embodiment 7 of the present invention,

Fig. 27 is a perspective view showing an blower according to an embodiment 8 of the present invention,

Fig. 28 is a side and plan view of an blower according to an embodiment 9 of the present invention,



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Fig. 29 is a cross sectional view taken on line A - A in Fig. 28,

Fig. 30 is a cross sectional view taken on line B - B in Fig. 29,

Fig. 31 is a side and plan view of an blower according to an embodiment 10 of the present invention,

Fig. 32 is a sectional view showing the blower of the embodiment 10,

Fig. 33 is a view showing an example of the installation of the blower of the embodiment 10 in a house.

Fig. 34 is a side and plan view of an blower according to an embodiment 11 of the present invention,

Fig. 35 is a sectional view showing the blower of the embodiment 11,

Fig. 36 is a view showing an example of the installation of the blower of the embodiment 11 in a house,

Fig. 37 is a view showing another example of the installation of the blower of the embodiment 11 in a house,

Fig. 38 is a cross sectional view showing a structure where a conventional blower is installed, and

Fig. 39 is a diagram showing a model of a stream of air forcefully discharged from the conventional blower.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

Embodiment 1

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Figs. 1 to 4 shows an embodiment 1 of the present invention. In the figures, reference numeral 10 designates a blower and numeral 11 designates a housing of the blower. The housing 11 is provided with an inlet port 12 at the upper portion and an outlet port at the opposite lower portion. The details of the outlet port will be described later. A plural number of bellmouths 13, to be inserted into the inlet port 12, are formed in a plate 14 covering the inlet port 12 of the housing 11 in a state that the bellmouths are equidistantly arrayed as shown. The plate 14 has a number of legs 15 standing upright thereon. The plate 14 is secured to the housing 11 by means of the legs and screws 16. An outlet port 17 is formed by uniformly narrowing the lower part of the housing 11 toward the center L of the housing 11 to be shaped like a sector in cross section, and includes a small outlet port 18 at the apex.

A plural number of motors 19, equal in number to the bellmouths 13, are secured to the inside of the housing 11 by means of mounting legs, not shown. A vane wheel 20 with the axial vanes is mounted on the rotary shaft 20a of each motor. The vane wheels 20 are disposed within the bellmouths 13, respectively when assembled. A fitting flange 21 is attached to the wall of the housing 11. Reference numeral 22 indicates a house; 23, an entrance of the house; 24, the interior of a room; 25, the outside of the house; A, the outer diameter of the small outlet port 18; B, an angle of the spread of an air

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stream discharged from the small outlet port 18; H, the distance the air stream reaches; and W, the width of the air stream at a location where the air stream reaches.

The blower thus constructed is mounted on the wall above the entrance 23 of the house 22 as shown in Fig. 3 by means of the fitting flange 21. Each vane wheel 20 is turned by its associated motor 19 to suck air through the inlet port 12 to impel the air outside through the outlet port 17. In the air stream blown out from the small outlet port 18, the center velocity of the air stream is little reduced and the initial velocity of the air stream is high, since the outlet port 17 is formed into a narrowed-shape. In the experiment conducted by the inventors, the small outlet port 18 of the diameter A of 50 mm could form an air curtain specified: $B = 20^\circ$, $H = 1500$ mm, and $W = 660$ mm. The air curtain formed was longer and wider than the conventional one. Thus, the air curtain of a high wind velocity and a long thermal-insulating length can be formed.

Embodiment 2

In the embodiment 2, the blower 10 is mounted at the ceiling 26 of the house 22, as shown in Fig. 5, while it is mounted on the wall above the entrance 23 in the embodiment 1. The blower 10 thus mounted circulates air in a room, thereby providing a uniform distribution of temperature in the room. In heating the room, the temperature difference between the ceiling and the floor is generally 7°C to 10°C . The

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embodiment 2 succeeds in eliminating this temperature difference.

Embodiment 3

Figs. 6 through 9 show an embodiment 3 of the present invention. In the figure, a U-shaped mounting member 30 with legs 31 is mounted on the housing 11 in a swingable manner. Specifically, bearings (not shown) are formed in the leg 31 of the bent end portions, respectively. Support shafts (not shown) protruded from the housing 11 are inserted into the bearings, respectively. The combinations of the support shafts and the bearings form supports 29. The housing 11 is swung about the supports 29. Pitch holes 32 formed in the outer wall of the housing 11, are semicircularly arrayed with the center of the support at given pitches. Positioning holes 33 are formed in the legs 31 of the mounting member 30, which are to be aligned with the pitch holes 32. Set screws 34 are screwed into the positioning holes 33 and the pitch holes 32 when those are aligned with each other.

The blower thus constructed is installed on the wall of the room above the entrance 23 of the house 22, like the blower of the embodiment 1. In installing the blower, the angle of the blower is set to a desired value of angle, and the housing 11 is secured to the mounting member 30 by means of the set screws 34. Accordingly, the blower can be installed in a state that the outlet port 17 is set in a desired direction. The blower thus set at the direction is driven by the motors 19 to

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blow air. The blower may be installed on the floor 27 or the ceiling 26 of the room, as shown in Fig. 9. The blower set on the floor 27 blows up air on the floor toward the ceiling to circulate the air in the room. In cooling the room, for example, it blows up the cooled air staying in the lower portion of the room, thereby uniformizing temperature in the room. The blower set on the ceiling 26 blows down air in the upper portion of the room toward the floor 27. Particularly, in heating the room, the machine blows hot air staying in the upper portion of the room toward the floor 27, thereby providing a temperature uniformity in the room.

Embodiment 4

In Figs. 10 to 13 showing an embodiment 4 of the present invention, a louver motor 40 is located under the motor 19 disposed at the side of the outlet port 17 of the housing 11. The louver motor 40 forwardly and reversely turns a rotary shaft 41. A crank 42 is coupled with the rotary shaft. A louver 43 is rotatably supported at one end by a support 44 provided at the small outlet port 18. The other end is coupled with the crank 42. When the louver motor 40 operates, the louver 43 is horizontally swung about the support 44 to change the direction of the air stream discharged from the small outlet port 18.

The blower of the embodiment 4 is installed as in the embodiment 1. By driving the motors 19 and the louver motor 40, the direction of the air stream from the outlet port 17 can

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be changed as desired. A more effective circulation of the air is secured. When set as shown in Fig. 13, the blower functions also as an electric fan.

Embodiment 5

In Figs. 14 through 17 showing a blower according to an embodiment 5 of the present invention, the outlet port 17 is gradually and uniformly narrowed toward the center L of the housing 11 and is bifurcated to have x-shaped outlet ports 50.

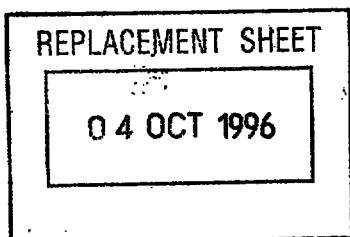
The blower thus constructed is installed as in the embodiment 1. When driven by the motors 19, the blower sucks air and blows twin air streams through the bifurcated x-shaped outlet ports 50. Accordingly, when the blower is used for the thermal isolating purposes, the air curtain is double and wide, and isolates the interior of the house from the outside, thereby providing improved thermal isolating effects. When the blower is installed on the ceiling 26 as shown in Fig. 17, the air stream blown from one of the x-shaped outlet ports 50 strikes the ceiling and flows forward. Accordingly, hot air of the highest temperature in the space about 10 cm below the ceiling is forcibly moved to circulate in the room. This results in excellent air conditioning.

Embodiment 6

In Figs. 18 through 24 showing a blower according to an embodiment 6 of the present invention, reference numeral 55 is representative of a housing, and numeral 56 designates inlet ports formed in the top of the housing 55. The upper end of

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the housing is folded at the round part 57 toward the inside of the housing 55, thereby to form a bellmouth 13. Mounting members 58 hold each motor 19 therebetween, with the shape of band. The respective ends of the mounting members 58 are secured to the inner wall of the housing 55. A vane wheel 20 with axial vanes 59 is secured to the rotary shaft 20a in a state that it is located within the bellmouth 13.

A plural number of blower means 54 each including the motor 19, the vane wheel 20, and the bellmouth 13 are mounted on the housing 55 while being equidistantly spaced from one another. An outlet port 60 is provided at the lower portion of the housing 55, and is communicated with the inlet port 56. The lower end of the housing is folded at the round part 57 toward the inside of the housing and reaches the bottom edge of the folded portion of the inlet port 56. Those folded portions are jointed together to form the smooth inner wall of the housing 55, which defines a smooth wind path 61 ranging from the inlet port 56 to the outlet port 60.

A guide 62, located near at the center of the outlet port 60, is shaped like a triangle in cross section of which the vertex is located at the side of the inlet port 56 and the base is located at the side of the outlet port 60. The corners of the triangle are curved as indicated by reference numeral 57. The outlet port 60 including the guide 62 thus located therein functions as a parallel multi-nozzle 63. The guide 62 is an elongated and tubular member with the ends having



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threaded holes. The guide 62 is mounted on the housing 55 in a state that both ends of the guide are brought into contact with the opposed inner walls of the housing 55 and fastened to the latter by means of adjust screws 64. A T-groove 65 is formed in the portion of the outer wall of the housing 55, which corresponds to the portion with which each end of the guide 62 contacts. Each adjust screw 64 is inserted into and slidably guided by the T-groove 65. In Fig. 20, H indicates the cut height of the air curtain; W, the width of the air curtain at the cut height H; h, the length of the air curtain before it expands in the profile; and Z, a jet stream of air discharged from the outlet port 60.

In the thus constructed blower of the embodiment 6, the guide 62 is placed within the outlet port 60 and fastened to a desired position on the inner wall of the housing 55 by means of the adjust screws 64 that is inserted through the T-groove 65. The axial vane wheels 59 are turned by the motors 19 to suck air through the inlet port 56 and to emit jet streams of air through the outlet port 60. More exactly, two parallel jet streams Z are discharged through the parallel multi-nozzle 63 parted by the guide 62 located within the outlet port 60, as shown in Fig. 20.

A negative pressure is created in the space between the two jet streams discharged from the two nozzle openings since the inducing action takes place therein. Under the negative pressure, the two jet streams proceed and are inwardly bent to

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meet into one jet stream Z. Accordingly, the jet stream Z starts to expand at a location distanced h from the outlet port 60. Thus, the expansion of the width W of the air curtain at the cut height H can be reduced, and the center velocity of the jet stream is little reduced. That is, the air curtain formed by a multiple of nozzles with the small nozzle width is more effective than that by a single nozzle with a large nozzle width. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional one, with a more reduced velocity of the jet stream Z. Such a jet stream is less sensed bodily by a passenger.

The round parts 57 of the guide 62 and the outlet port 60 greatly attenuate the turbulence in the air stream Z when it is discharged from the outlet port 60, effectively holding down the expansion of the jet stream Z.

In a case where the wide width of the jet stream of air rather than the high velocity thereof is required, the guide 62 is moved, guided by the T-groove 65, to a location lower than the level of the outlet port 60, as shown in Figs. 23(a) to 23(c). When the guide 62 is moved downward, the jet stream Z is widened. The direction of the jet stream Z can be turned to the right or left as shown in Fig. 24. When the guide 62 is moved through the T-groove 65 to the right, the jet stream is turned to the right by an angle θ , as shown in Fig. 24(a). When the guide 62 is moved through the T-groove 65 to the left,

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the jet stream is turned to the left by an angle θ , as shown in Fig. 24(c). Thus, the jet stream can be flexibly set in a desired direction since the guide 62 is horizontally and vertically movable at the outlet port 60. This can be realized with a simple structure without using the louver or the like.

A series of blower means 54 each including the axial vane wheel 59 are contained in the blower 10. With the plural number of blow means 54, the flow coefficient is large. When comparing with the use of the traverse vanes, the highest efficiency is obtained in an operating state free from a static pressure, that is, in the state of the maximum air flow. The result is reduction of noise generated when the blower 10 operates. Further, the width of the air curtain can be adjusted by properly selecting the number of blower means 54.

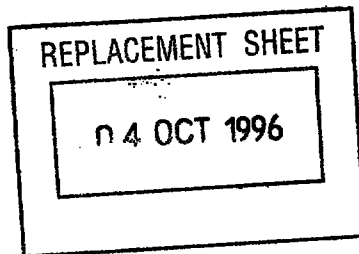
Embodiment 7

Figs. 25 through 26 show a blower according to an embodiment 7 of the present invention. In this embodiment, the guide 62 is automatically moved at the outlet port 60 while in the embodiment 6, it is manually moved by the combination of the adjust screws 64 and the T-grooves 65. As shown, servo motors 70 are mounted on the inner walls of both ends of the housing 55. A pinion 72 is fastened to the rotary shaft 71 of each servo motor 70. A rack 73 to be in mesh with the pinion 72 is vertically or horizontally disposed within the guide 62.

When the servo motors 70 are driven by operating a switch, not shown, the guide 62 is vertically or horizontally

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moved in the outlet port 60 through the engagement of the rack 73 and the pinion 72. In this embodiment, in addition to the effects as in the embodiment 7, the direction of the air jet stream can be remotely adjusted by means of the operation switch so that the operation property is further improved.

Embodiment 8

In Fig. 27 showing a blower according to an embodiment 8 of the invention, a blower 81 is constructed with a housing 80 containing a single blower means 54. An optional number of blowers 81 are coupled, by means of a coupling member 82, into a single unit. A blower unit of $L \times n$ long can simply be formed by coupling an n number of blowers 81 each of L long by means of the coupling member 82 of the corresponding length. Accordingly, the blower unit may be constructed according to the width of the entrance of a building. The coupling member 82 may also serve as a dressed panel.

Embodiment 9

Figs. 28 through 30 show a blower according to an embodiment 9 of the present invention. In the figure, reference numeral 90 designates a first air flow rectifying plate made of a plate located just under the center of the axial vane wheel 59, which is under each motor 19 in the housing 55. The first air flow rectifying plate 90 consists of paired partition plates 92. One end of the partition plate is jointed to the inner wall of the outlet port 60, and the other end thereof is jointed to the side face 91 of the guide 62. A



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second air flow rectifying plate 93 as a single plate partitions the adjacent blower means 54 in the housing 55. The upper end of each second air flow rectifying plate 93 and the inner wall of the inlet port 56 are jointed together, while the portion of the lower end thereof corresponding to the guide 62 is cut and the lower end is jointed with the inner wall of the outlet port 60 and the side face 91 of the guide 62.

In the blower thus constructed, the blower means 54 are operated to suck air through the inlet port 56 and forcefully send the air through the outlet port 60. The jet stream containing turning components, caused by the axial vane wheel 59, is converted into a linear stream of air by the combination of the first and second air flow rectifying plates 90 and 93. Accordingly, this greatly contributes to the formation of the air curtain used in the present invention which is directed to reduce the spread of the jet stream of air, and the width of the jet stream of air can reliably be reduced.

Embodiment 10

Figs. 31 to 33 show a blower of an embodiment 7 of the present invention. In the embodiments 6, 8 and 9, the guide 62 is a tubular member substantially triangle in cross section. In the embodiment 10, the guide 62 is opened in the bottom located in the outlet port 60, as shown in Fig. 32. Reference numeral 95 designates a lighting means such as a fluorescent lamp, which is disposed in the guide 62.

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The blower of the embodiment 10 is installed as in the embodiment 1. When the motors 19 and the lighting means 95 are turned on, the blower forms an air curtain in the entrance 23 while lighting there. This embodiment has the lighting function in addition to the thermal isolation function so that the operation property is further improved.

Embodiment 11

Figs. 34 through 37 show a blower according to an embodiment 11 of the present invention. In the figure, reference numeral 96 designates a heater, for example, an electrical heater shaped like a bar. The heater 96 is disposed within the guide 62. A heater cover 97 for covering the heater 96, is semicircular in shape, and serves also as a reflector.

The blower of the embodiment 11 is installed as in the embodiment 11. When the motors 19 and the heater 96 are turned on, a hot air curtain is formed, eliminating a sense of coolness at the entrance 23. When the blower is provided with a support 97, and set upright as shown in Fig. 37, it can be used as a motor fan in summer and as a heater in winter. The blower can be used multifunctionally.

The present invention thus constructed has the following useful effects.

In the construction of the blower according to a first aspect of the present invention, the inlet port within which a vane wheel is disposed is shaped like a bellmouth, and outlet port is formed by uniformly bending the wall of the housing



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toward the center thereof. The resultant air curtain is high in velocity and long in its length.

In the construction of the blower according to a second aspect of the presnet invention, the mounting members, formed on the outer surface of the housing, rotatably supports the housing. With the provision of the mounting member, the air stream discharged from the blower can be set in a desired direction. Thus, the flexible use of the blower is secured.

In the construction of the blower according to a third aspect of the present invention, a movable louver is disposed within the outlet port. With this, the air can be blown in a wide range. Thus, the product performances are further improved.

In the construction of the blower according to a fourth aspect of the presnet invention, the outlet port is formed by gradually and uniformly narrowing the lower end portion of the housing toward the center of the housing and is bifurcated to have an x-shape. The resultant air curtain is double and wide, and isolates the interior of the house from the outside.

In the construction of the blower according to a fifth aspect of the present invention, the guide is disposed within the outlet port, thereby forming a parallel multi-nozzle. Thus, the expansion of the width of the air curtain can be suppressed, and the thermal isolating capability is improved. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional



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one, with a more reduced velocity of the jet stream. Such a jet stream is less sensed bodily by a passenger. The blower is small in size, light in weight and excellent in power saving.

In the construction of the blower according to a sixth aspect of the present invention, the parallel multi-nozzle is formed in the outlet port. Further, the round parts of the guide and the outlet port greatly attenuate the turbulence in the air stream when it is discharged from the outlet port. As a result, the expansion of the jet stream can be effectively held down and the capacity of thermal insulation is improved.

In the construction of the blower according to a seventh aspect of the present invention, the flow pattern of the air stream blown from the blower can flexibly be changed as desired. Accordingly, the air curtain can be formed as desired.

In the construction of the blower according to a eighth aspect of the present invention, use of the axial vane wheel reduces noise generated. With the feature of a plural number of blowing means arrayed side by side into the blower unit, the size of the blower unit may be constructed according to the size of the location where the blower unit is installed.

In the construction of the blower according to a ninth aspect of the present invention, the air stream within the housing is converted into a linear air stream by the air flow rectifying plate. This results in holding down the expansion of the air stream.

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In the construction of the blower according to a tenth aspect of the present invention, the guide contains a heater or a lighting means. Thus, a multi-functional blower is realized.

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1. A blower comprising a housing with an air inlet port at one end and an air outlet port at the other end; and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and forcefully blowing the sucked air through said outlet port, wherein said inlet port is shaped like a bellmouth in which said vane wheel is disposed, and a lower end portion of said housing is uniformly narrowed toward the center of said housing, thereby forming said outlet port.

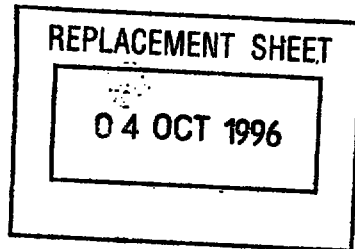
2. The blower according to claim 1, further comprising mounting members for rotatably supporting said housing, said mounting members being disposed on an outer surface of said housing.

3. The blower according to claim 1, further comprising a movable louver disposed in said outlet port.

4. The blower according to claim 1, wherein said outlet port has an x-shaped end formed by gradually and uniformly narrowing the lower end portion of said housing toward the center of said housing and by bifurcating the lower end portion.

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5. A blower comprising blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and forcefully blowing the sucked air through said outlet port; and a guide, being disposed within said outlet port, for forming a parallel multi-nozzle.

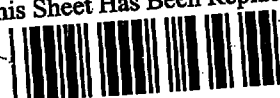
6. The blower according to claim 5, wherein said guide is a tubular member substantially triangle in cross section with a base at a side of said outlet port, corners of said guide are rounded, and the lower end of said housing is folded inward to have a round bent portion.

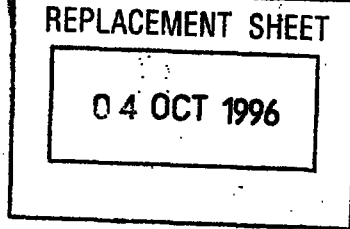
7. The blower according to claim 5, wherein said guide is movable within said outlet port.

8. The blower according to claim 5, wherein said vane wheel of said blowing means is an axial vane wheel, and a plural number of blowing means are disposed side by side within said housing.

9. The blower according to claim 5, further comprising a first air flow rectifying plate located at almost the center of said vane wheel and between said blowing means and said outlet port, and a second air flow rectifying plate

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partitioning the adjacent blowing means and disposed within said housing.

10. The blower according to claim 5, further comprising a heater or a lighting means, covered with a cover, within said guide.

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ABSTRACT OF THE DISCLOSURE

In a housing with an inlet port (12) opened upward and an outlet port (17) opened downward, a plate having a plural number of bellmouths (13) is mounted on the side of each housing having the inlet port (12). The outlet port (17) is narrowed toward the center of the housing (11), thereby forming a small outlet port (18). A motor (19) with a vane wheel (20) is located within the housing (11).

FIGURE 3

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FIG. 1

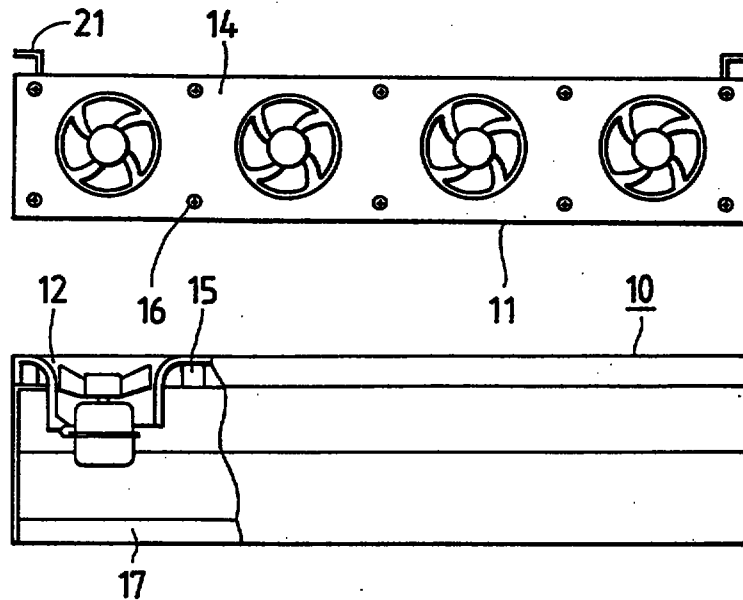
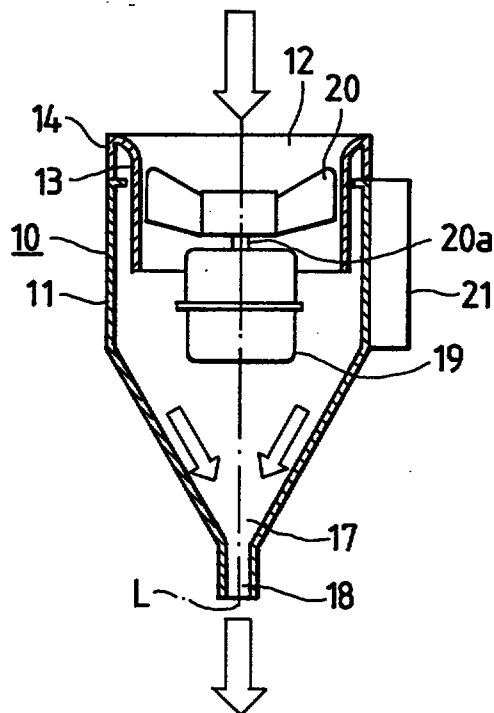


FIG. 2



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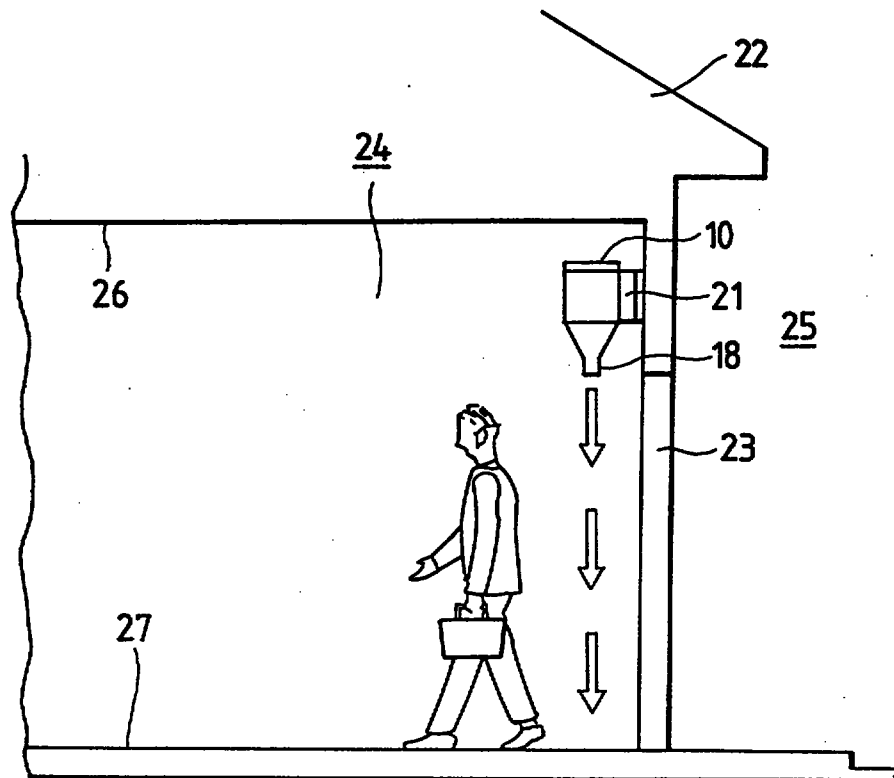
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FIG. 3



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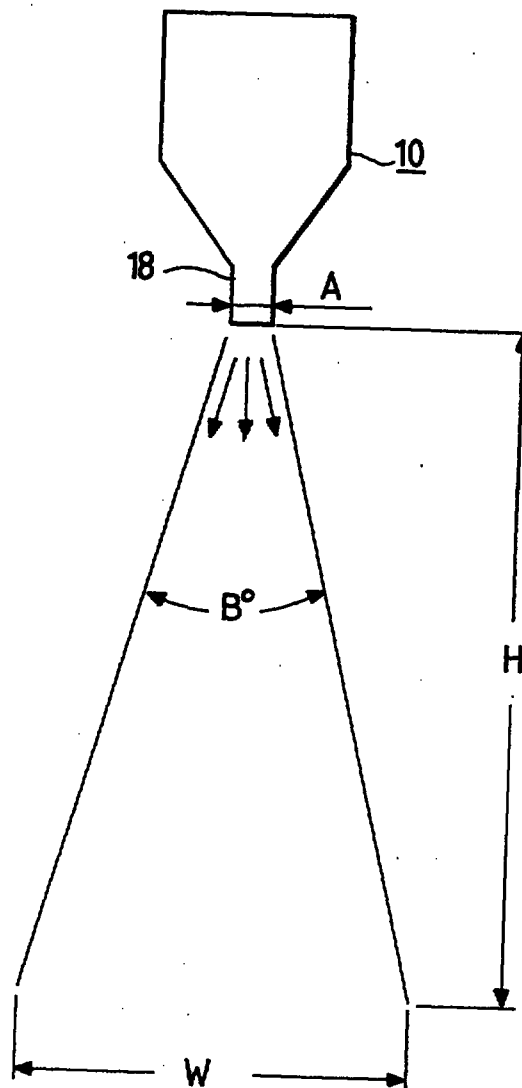
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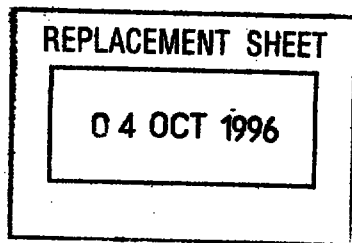
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FIG. 4



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FIG. 5

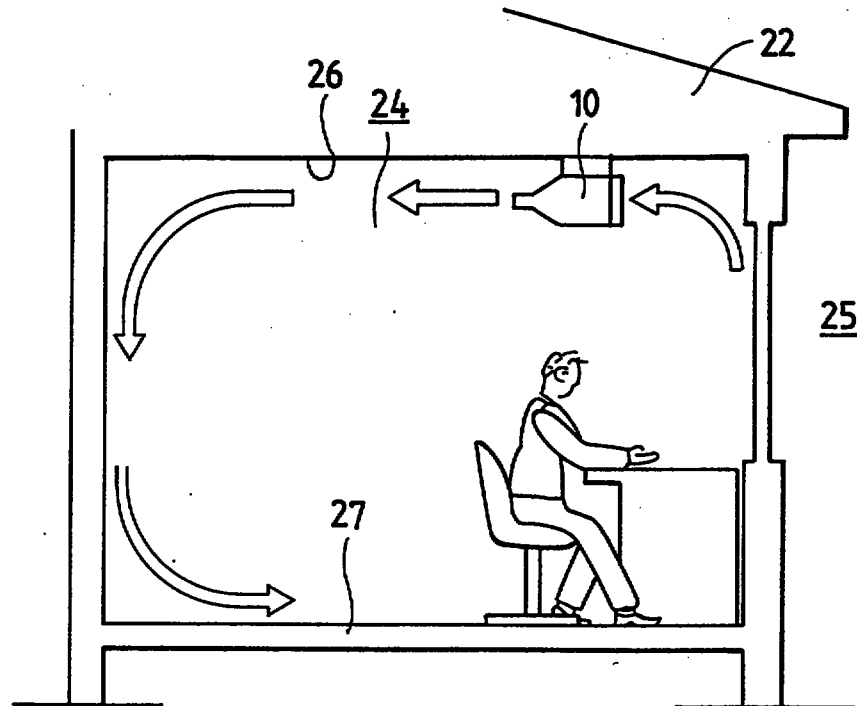
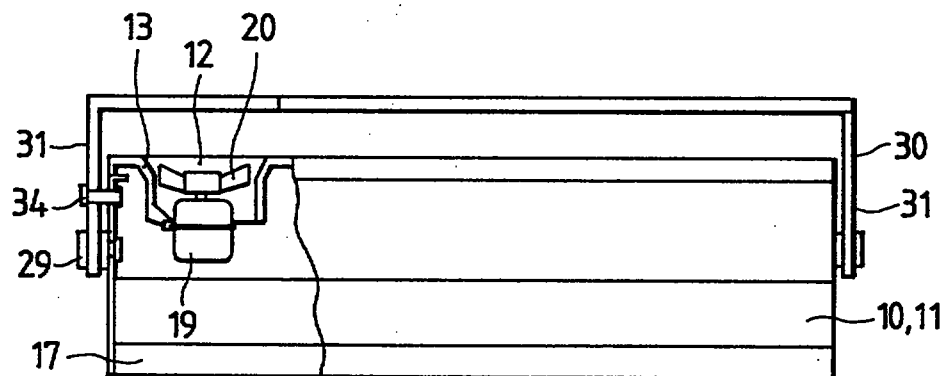


FIG. 6



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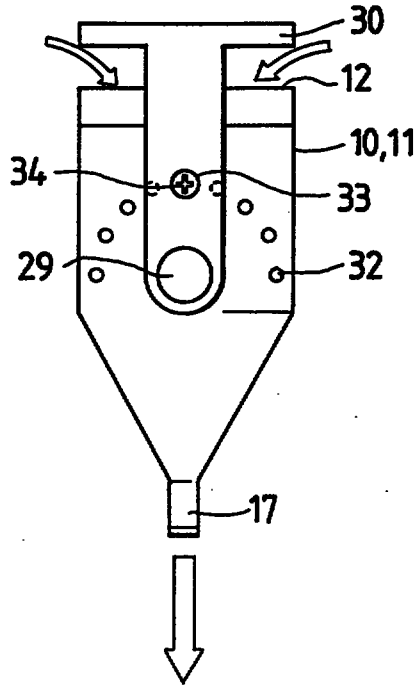


FIG. 7

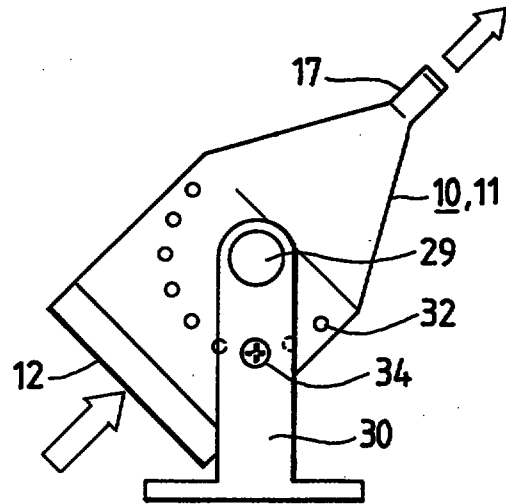
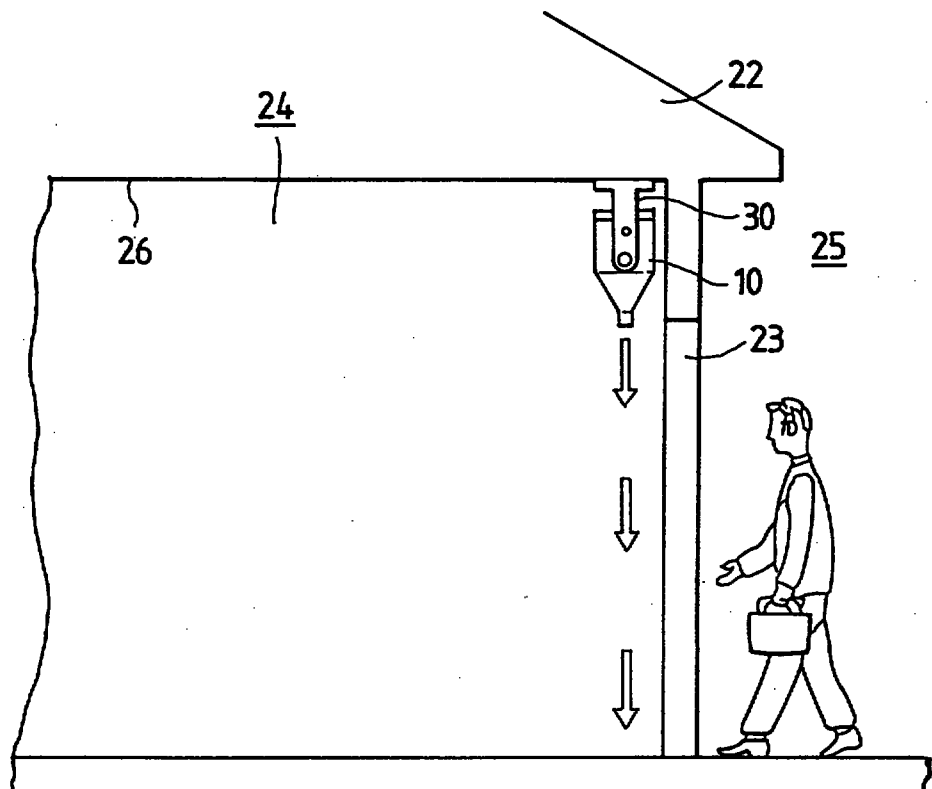


FIG. 8



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FIG. 9

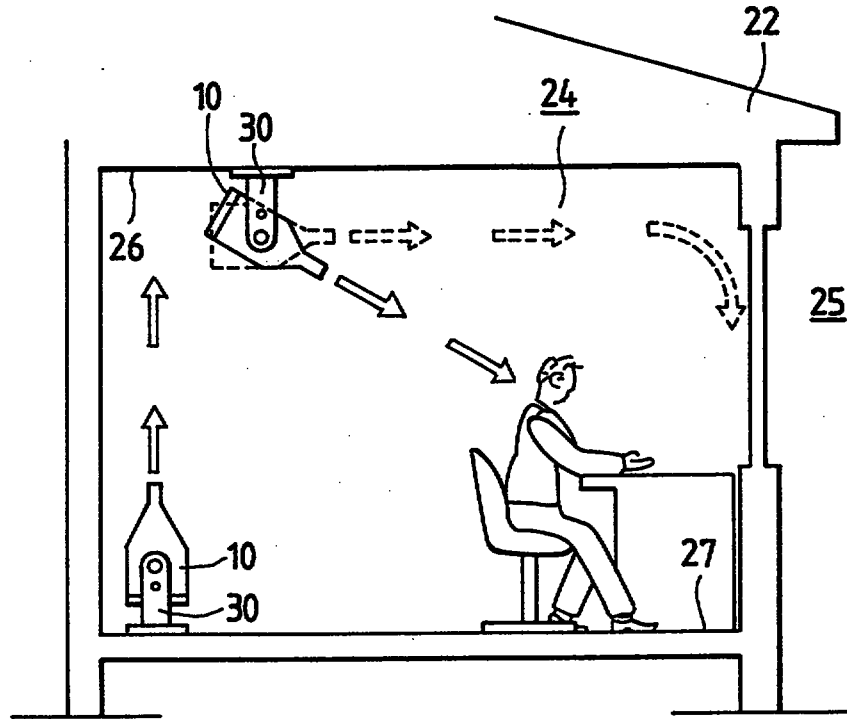
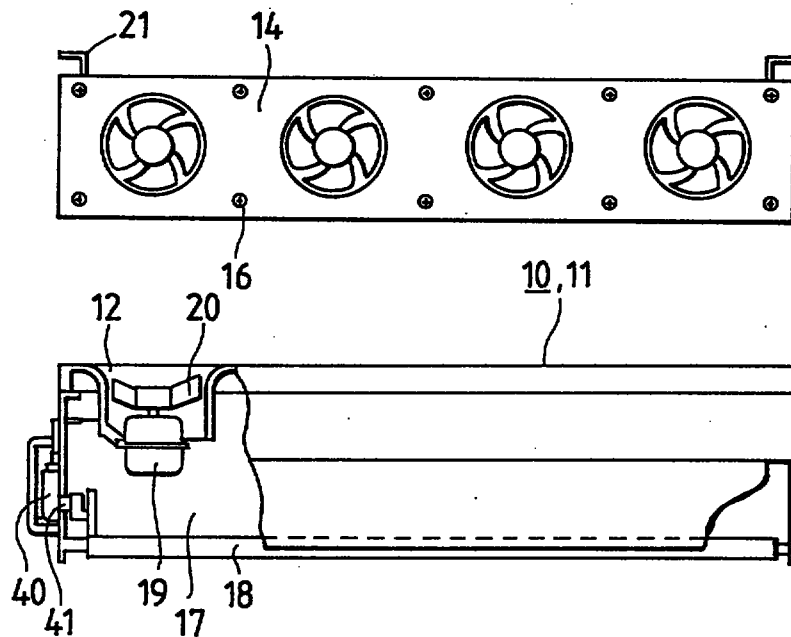


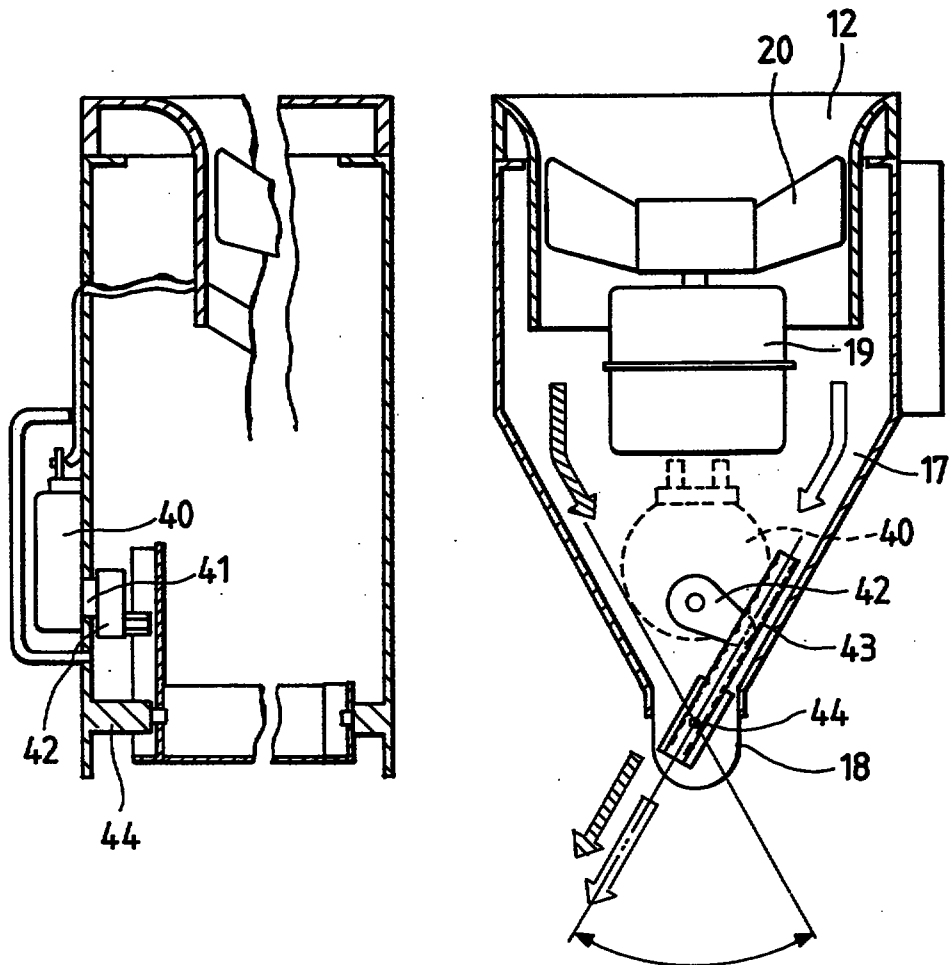
FIG. 10



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FIG. 11



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FIG. 12

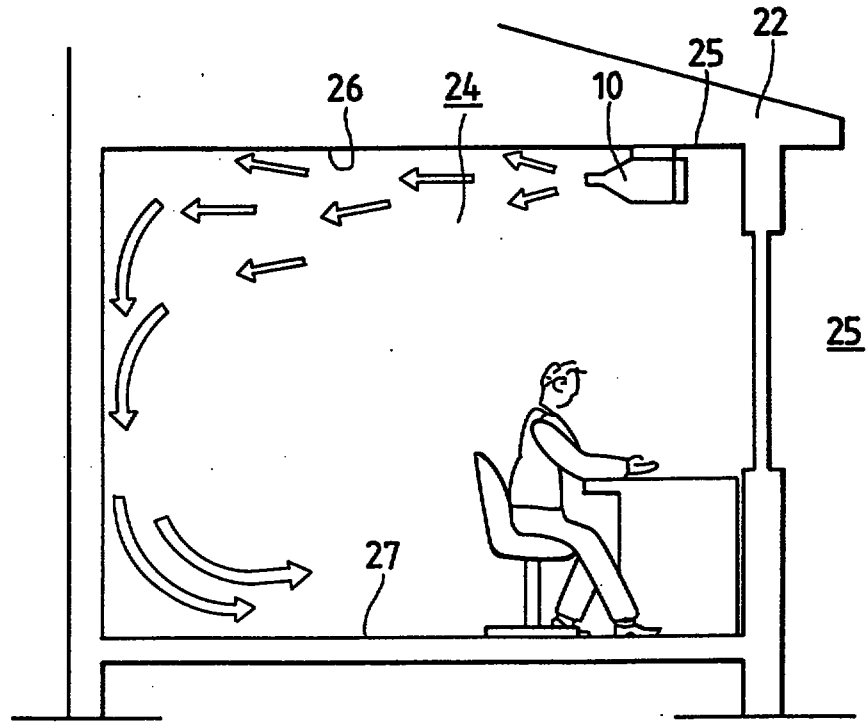
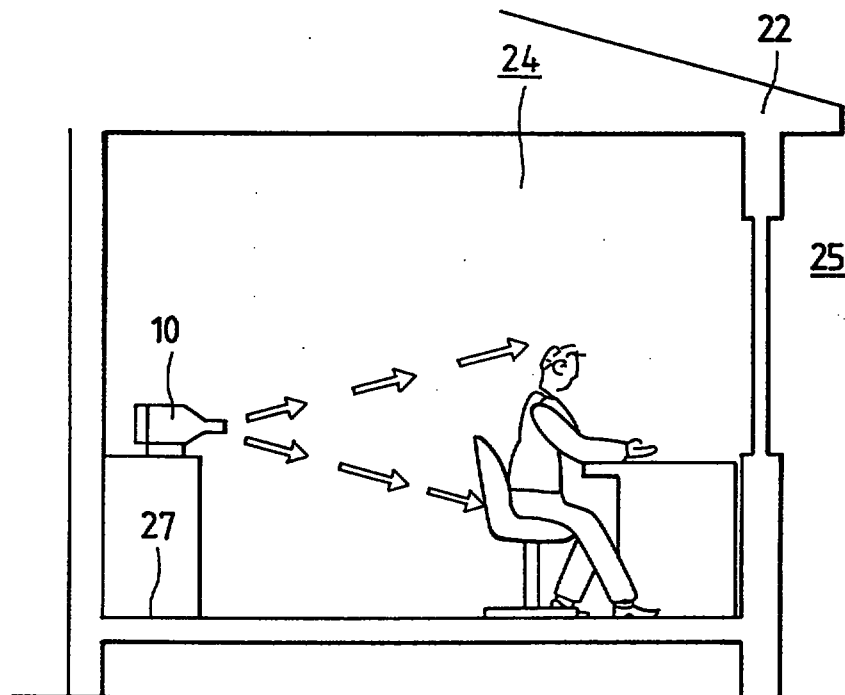


FIG. 13



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FIG. 14

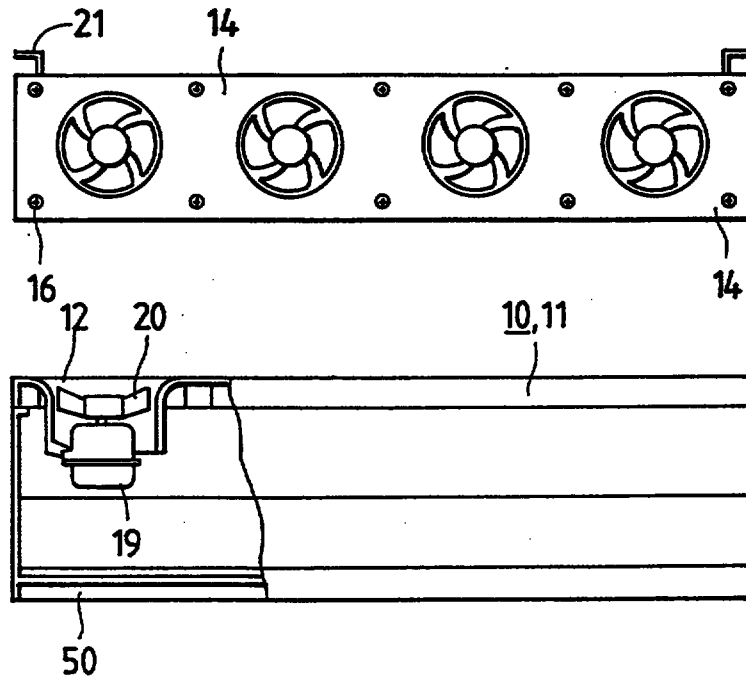
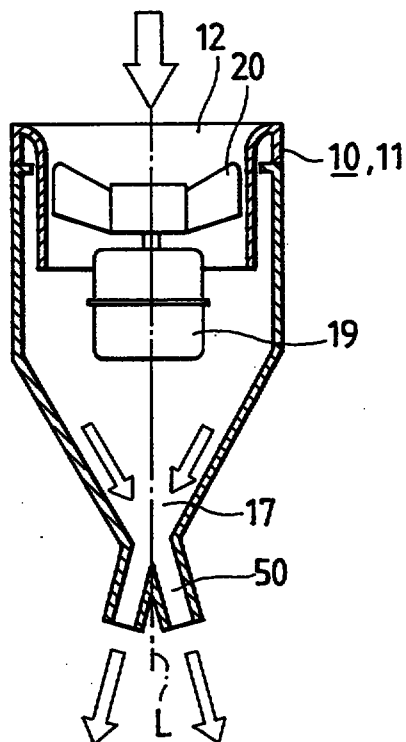


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FIG. 16

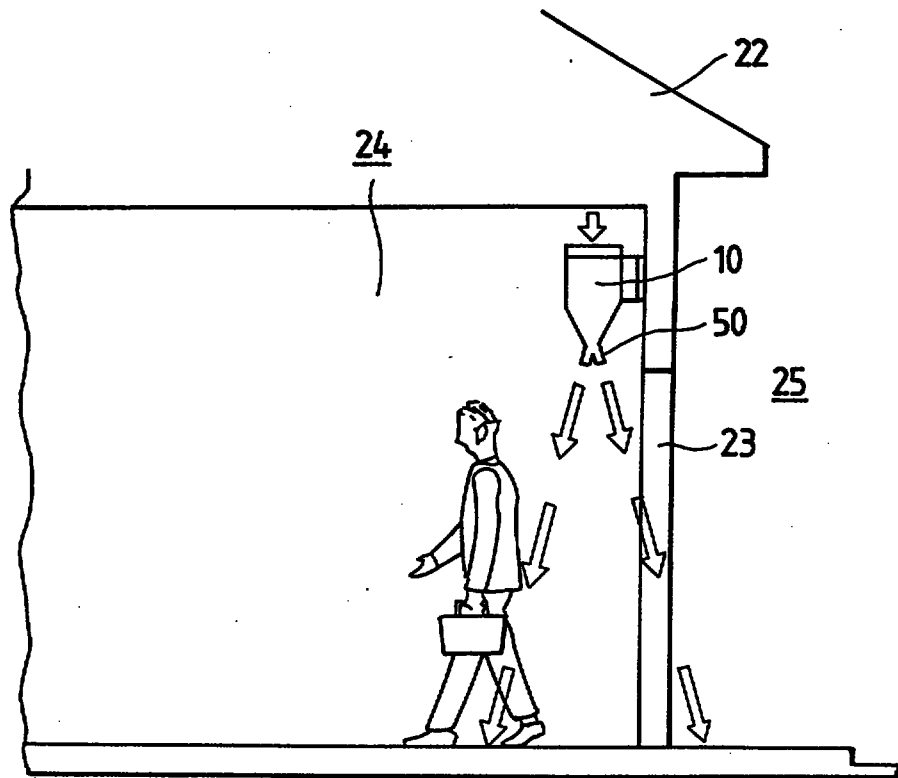
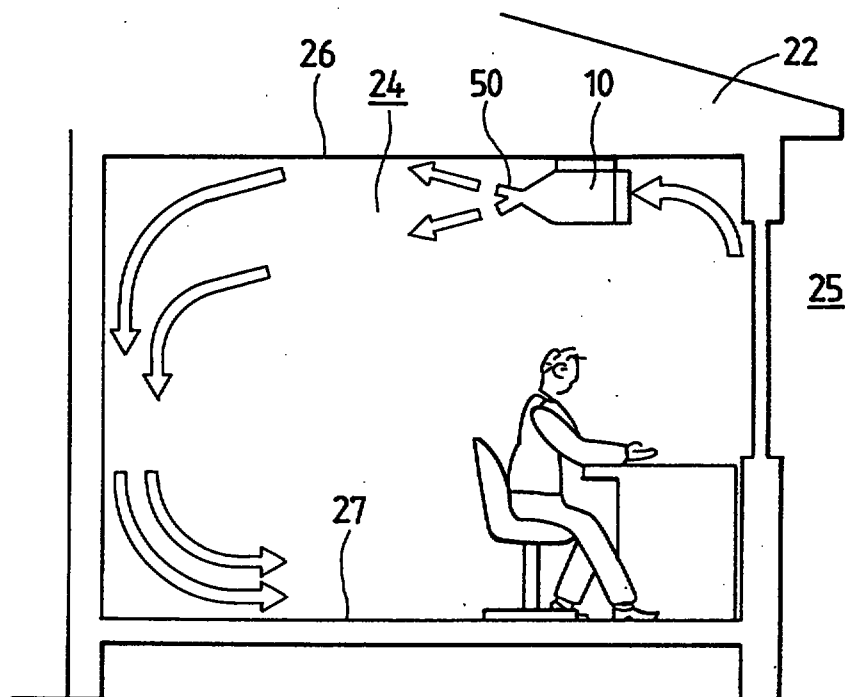
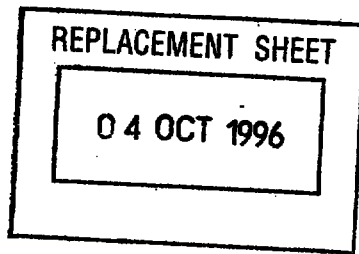


FIG. 17



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FIG. 18

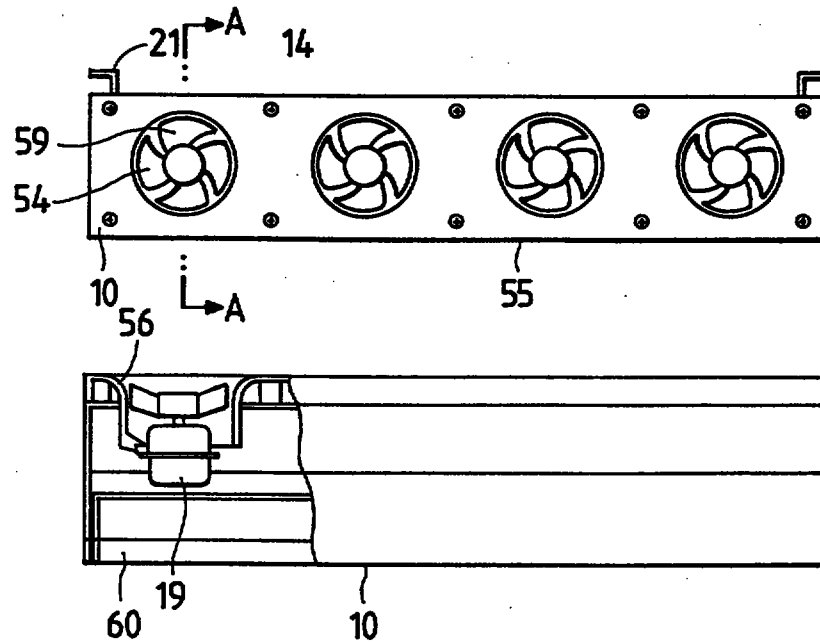
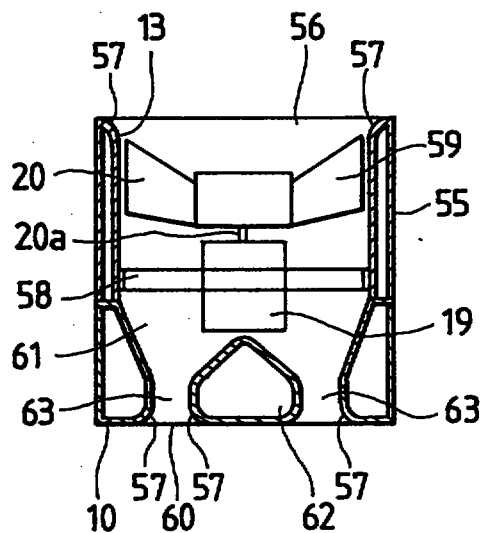


FIG. 19



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FIG. 20

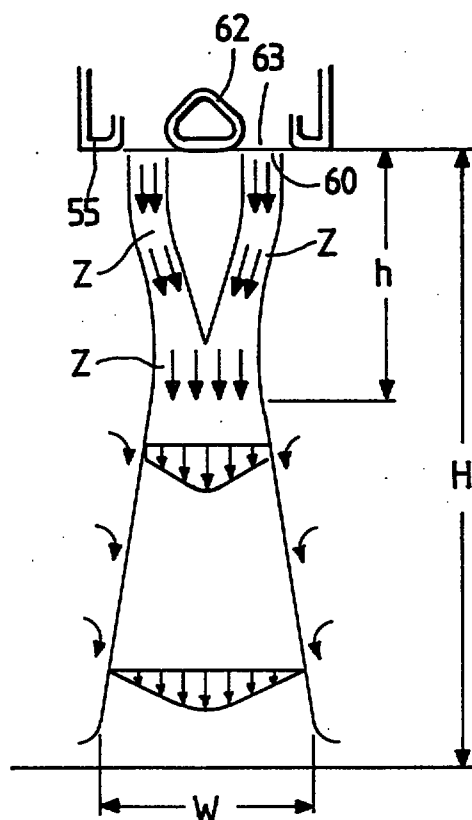


FIG. 21

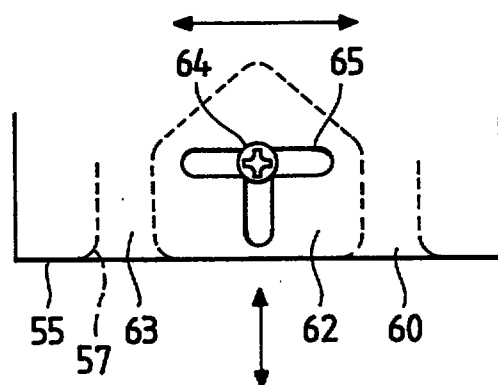
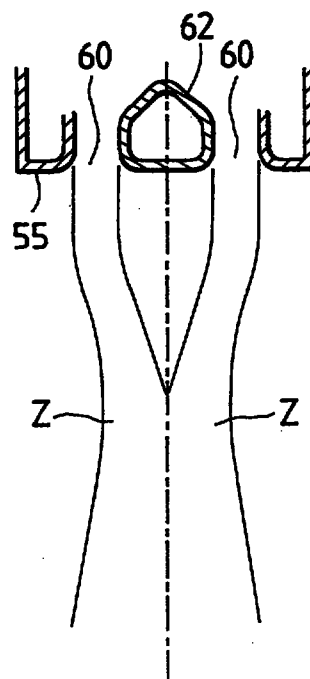


FIG. 22



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FIG. 23 a

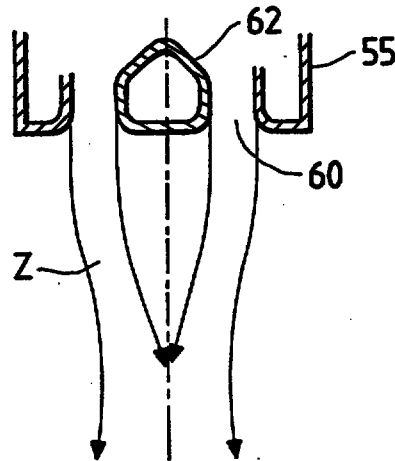


FIG. 23 b

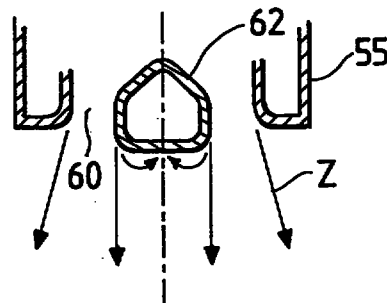
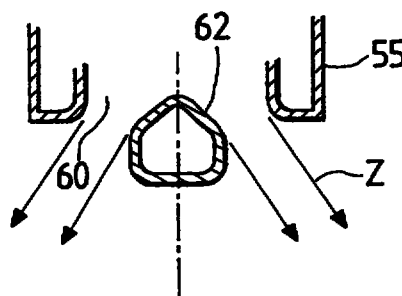
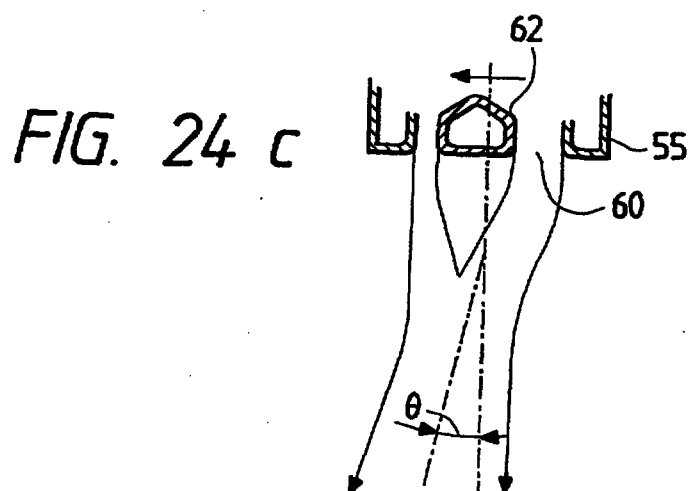
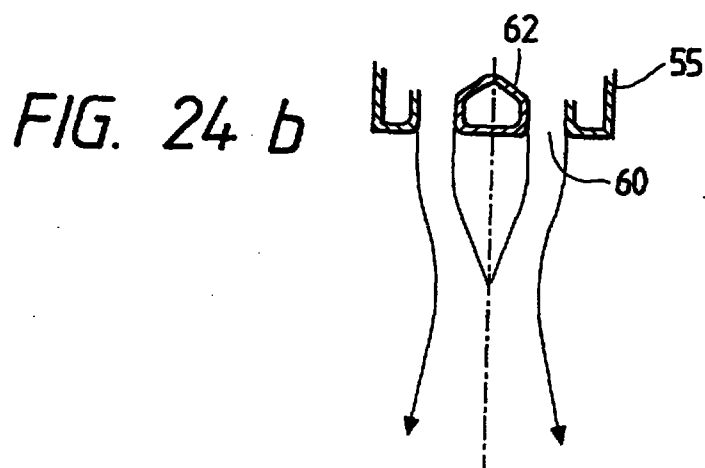
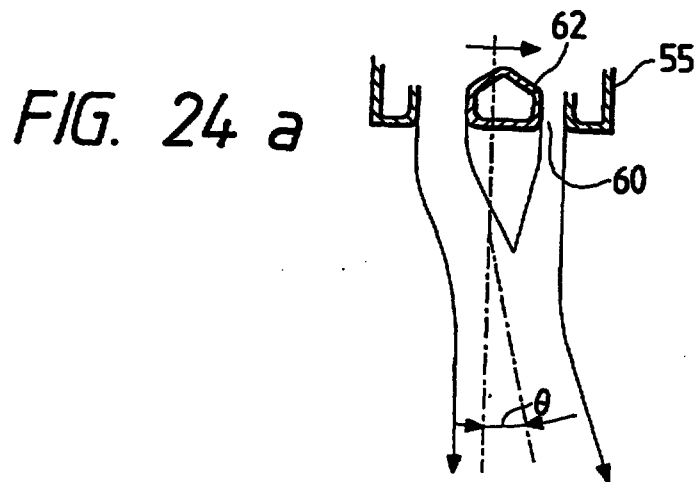


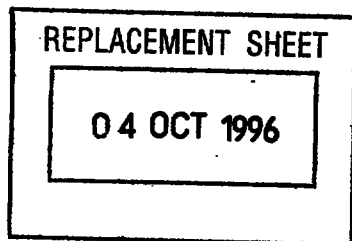
FIG. 23 c



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FIG. 25 a

FIG. 25 b

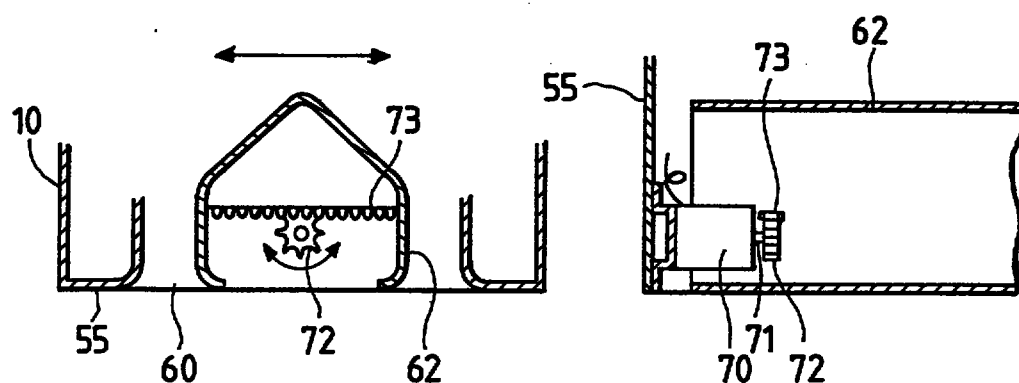
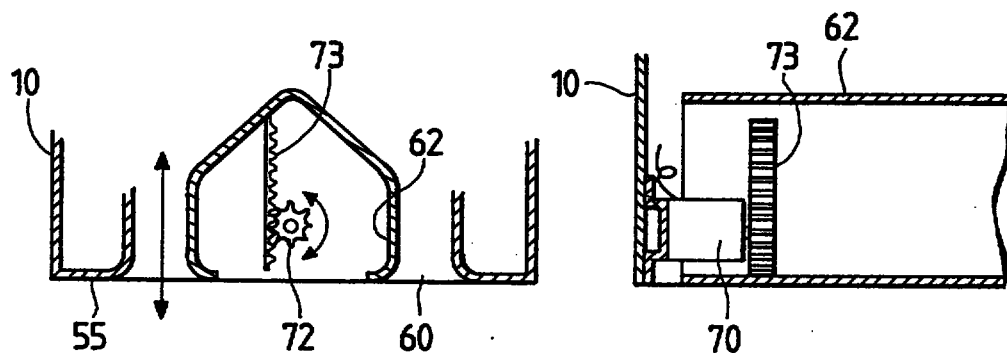


FIG. 26 a

FIG. 26 b



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FIG. 27

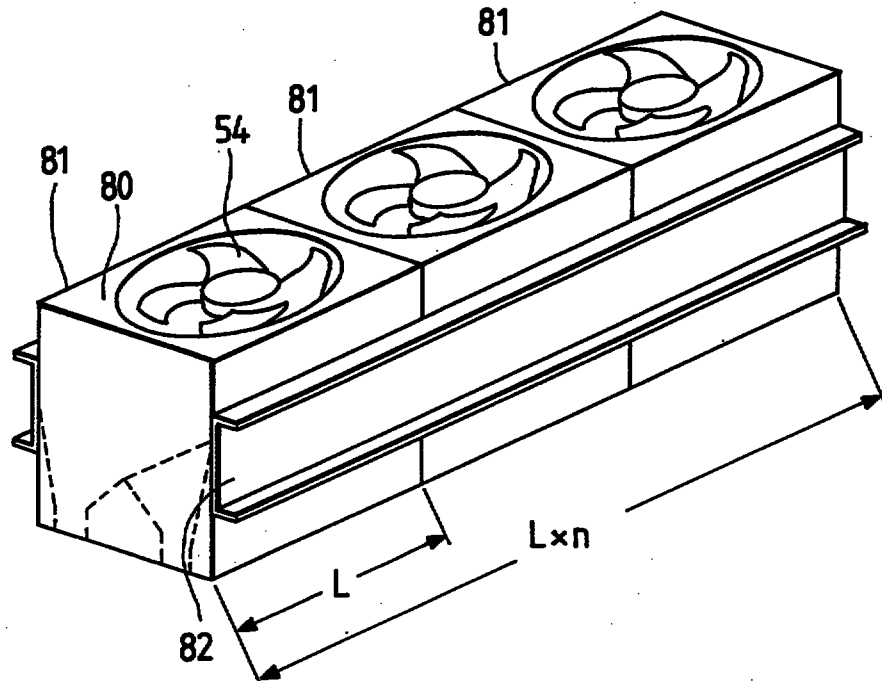
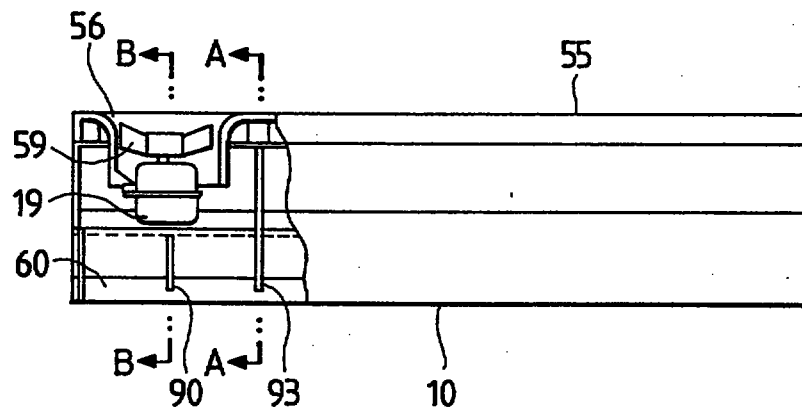
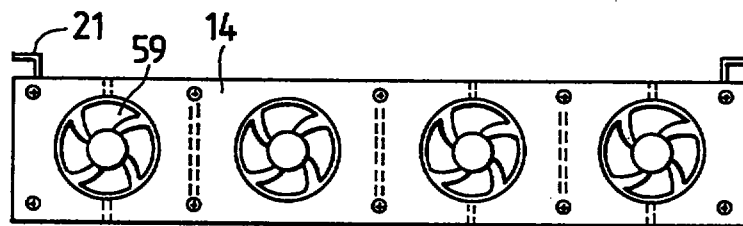


FIG. 28



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FIG. 29

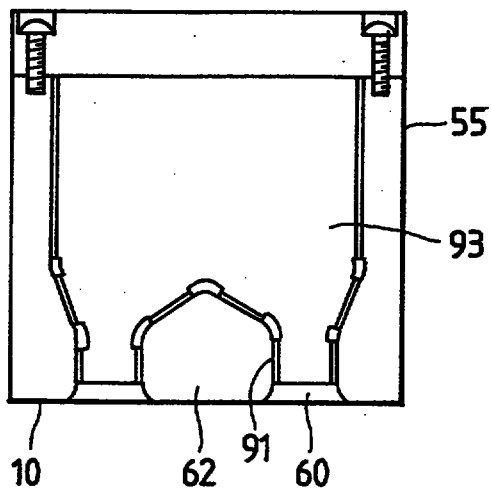
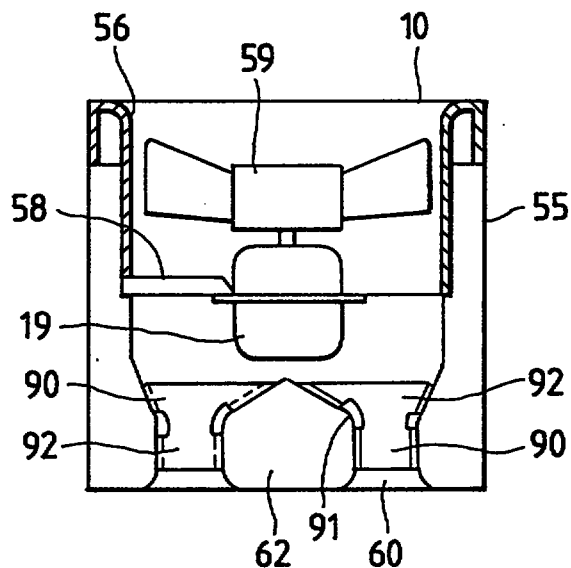
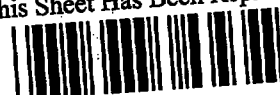


FIG. 30



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FIG. 31

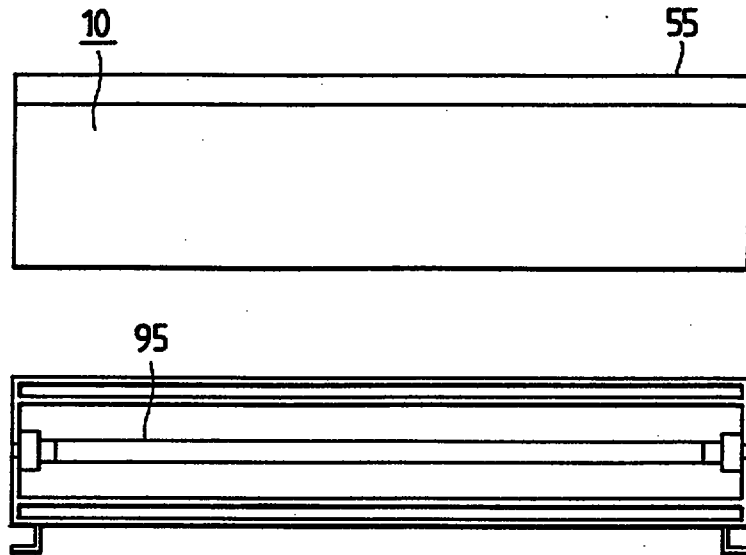
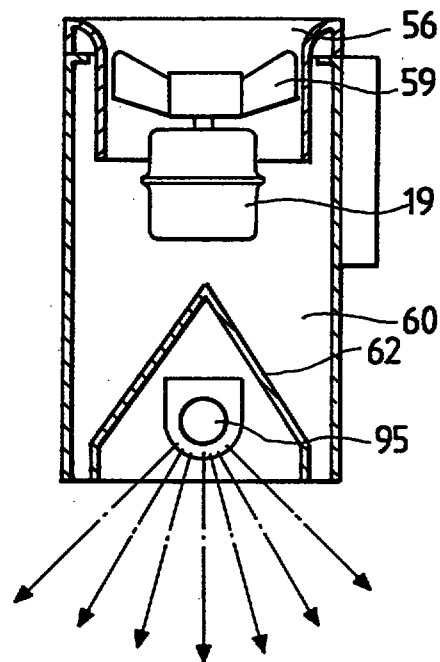


FIG. 32



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FIG. 33

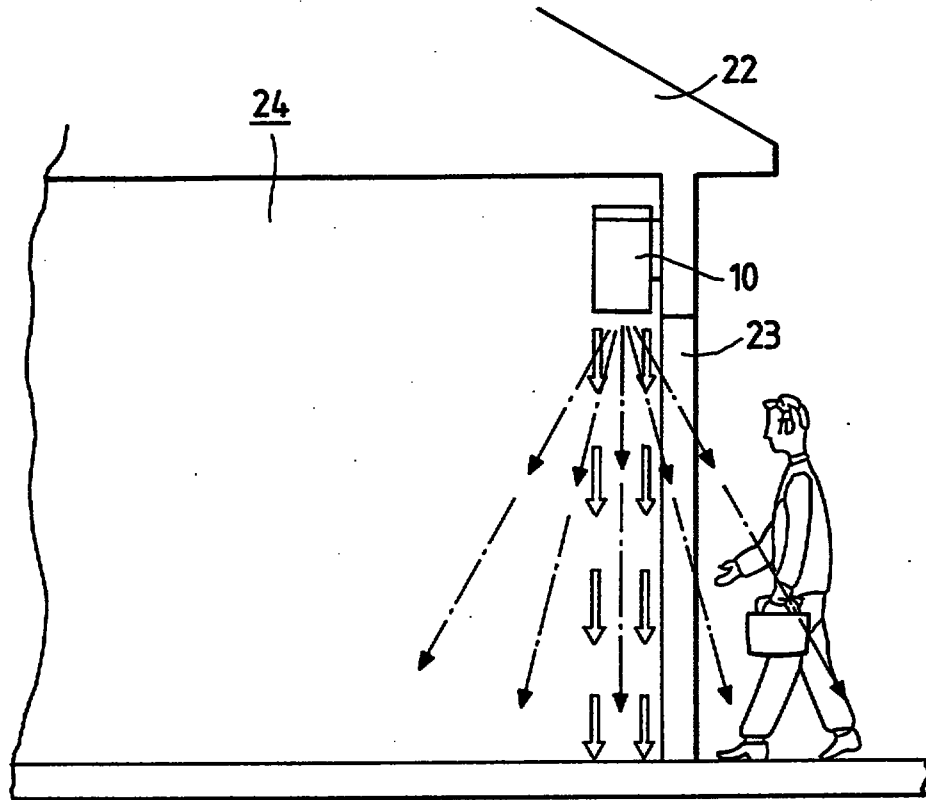
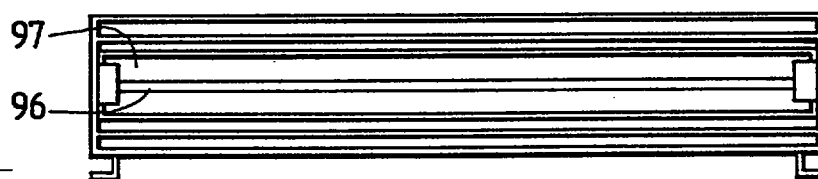
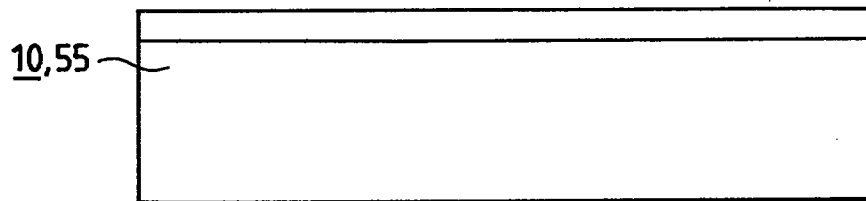


FIG. 34



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FIG. 35

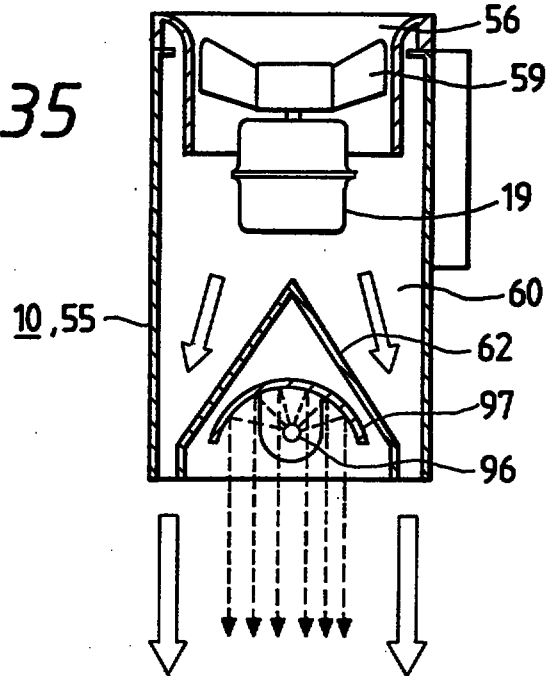
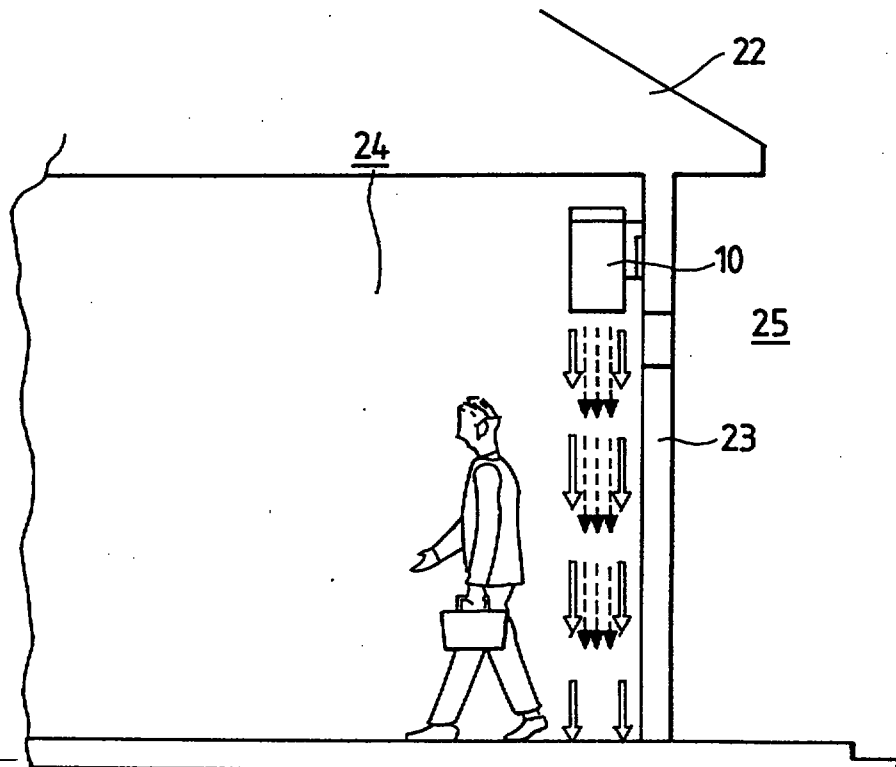


FIG. 36



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FIG. 37

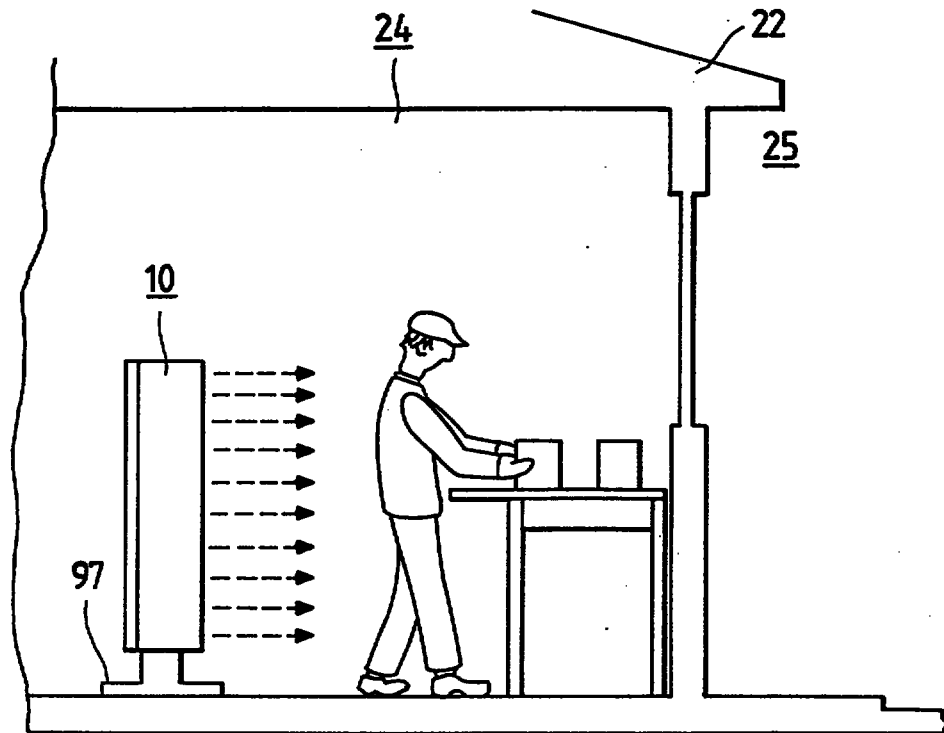
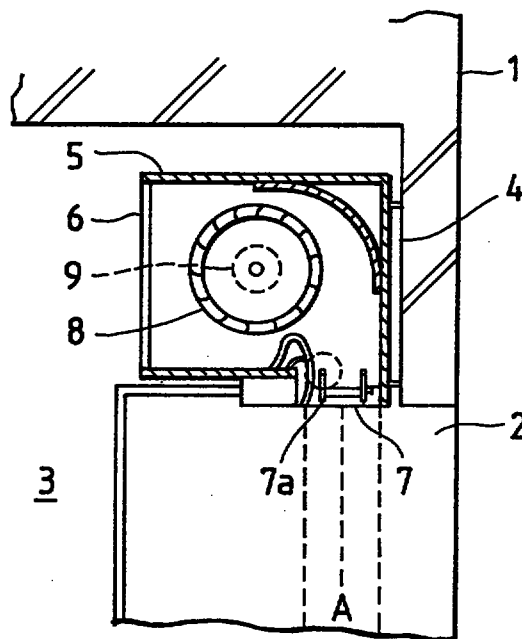


FIG. 38



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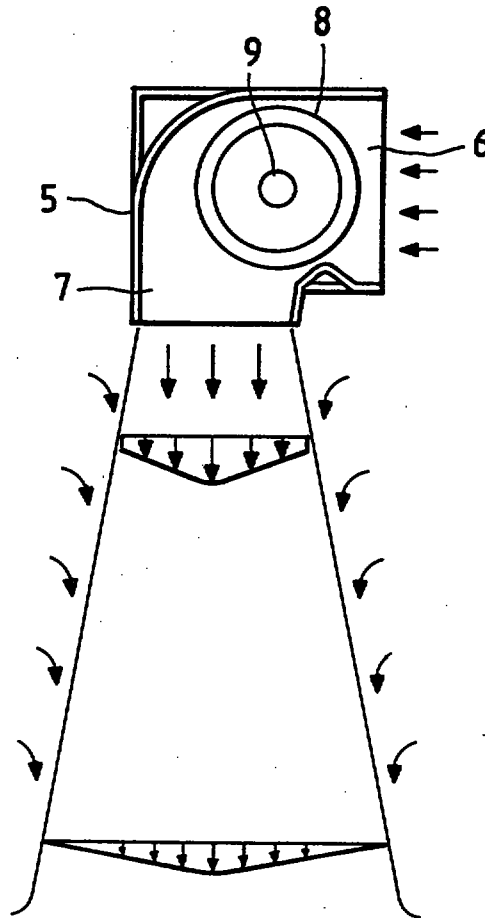


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FIG. 39



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"BLOWER"

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The present invention relates to a blower, installed at the entrance and/or exit of a building, for thermally insulating the inside of the building from the outside mainly when the building is air-cooled or heated.

In the accompanying drawings, Figures 11 and 12 show a conventional blower disclosed in Published Unexamined Japanese Patent Application No Hei 5-106898. This machine will be described later.

A box-like blower body 5 is installed on the inner wall 4 (in the interior 3 of a room) of a house 1. The blower body 5 includes an air inlet port 6 at a side opposite to the installation side and an air outlet port 7 at a lower side. Within the blower body 5, a motor 9 is mounted. The motor 9 with a single traverse vane 8 secured thereto receives air from the inlet port 6 and forcefully blows the air to the outlet port 7. A plural number of flow-direction control plates 7a for controlling the direction of a stream of the discharged air are mounted at the outlet port 7. These vanes are swingable on the upper ends thereof as fulcra.

In the blower thus constructed, the vane 8 is rotated by the motor 9 to suck air through the inlet port 6 and to blow the air through the outlet port 7, thereby forming an air curtain hanging down in the entrance/exit 2 of the house 1.

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In the blower, a single traverse vane 8 is used for the air blowing. As a stream of air discharged from the outlet port 7 proceeds, it pulls in surrounding air and expands as shown in Fig. 12. In the air curtain formed by the expanded air stream, the thermal isolating capability is reduced, and the effective thermal-isolating height or length of the air curtain at the entrance/exit 2 of the house 1 as well is restricted.

Also, to increase the effective thermal-isolating length of the air curtain, a large vane must be used for the vane 8. The result is installation of a large and heavy, or cumbersome vane, on the wall 4.

Also, since the width of the air curtain is determined by the length of the vane-8, in order that the air curtain is formed so as to fit for various sizes of the entrance/exit 2, respective blowers with the vanes 8 of different lengths must be provided.

Also, when the traverse vane 8 is used, noise inherent to the vane 8, such as a whistling sound, is large.

The present invention has been made in view of the above circumstances and has an object to improve the thermal insulating capability of a blower by minimizing the expansion of the air stream in the form of a curtain, and to secure a sufficiently long thermal-isolating length of the air curtain

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without increasing the size of the machine. Another object of the present invention is to provide a blower of low noise which can selectively set the width of the air curtain at a desired value of width for an arbitrary opening of the entrance/exit of a building without using different transverse vanes.

According to the present invention there is provided a blower comprising blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port; and a guide disposed within said outlet port for dividing it into a parallel multi-nozzle, the guide being a tubular member substantially triangular in cross section oriented with its base on the outlet port side, and wherein corners of said guide are rounded, and the lower end of said housing is bent inwards to round the edges of the outlet port.

The guide may be rotatable within the outlet port to change as desired the flow pattern of the air stream.

The vane wheel of the blowing means may be an axial fan, and a plural number of the blowing means may be disposed side by side within the housing. With the use of the axial fan, the flow coefficient is large. In an operating state free from a static pressure, the highest efficiency is obtained. As a result, noise caused by the drive power source and the turning of the vanes is reduced.



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Further, provision of the plural number of blowing means enables one to adjust, as intentionally, the width of the air curtain formed.

The apparatus may also include a first air flow rectifying plate located at almost the center of the vane wheel and between the blowing means and the outlet port, and a second air flow rectifying plate partitioning the adjacent blowing means disposed within the housing. Thus, the air curtain stream containing turning components, generated by the axial fan, is converted into a linear air curtain stream by the air flow rectifying plate.

A heater or a lighting means, covered with a cover, may be provided within the guide to provide illumination or hot air in parallel with the air stream.

With the invention parallel air streams are discharged through the outlet port and negative pressure is created between the adjacent air jet streams which bends them inwardly to meet into one jet stream. The round parts of the guide and the outlet port greatly attenuate the turbulence in the air streams when they are discharged from the outlet port.

The invention will be further described by way of non-limitative example, with reference to the accompanying drawings, in which:-

Fig. 1 is a side and plan view of a blower according to an embodiment 1 of the present invention,

Fig. 2 is a sectional view taken on line A - A in Fig.





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Fig. 3 is a diagram showing the profile of the air stream formed by the blower of the embodiment 1,

Fig. 4 is a side view showing an outlet port in the machine of the embodiment 1,

Fig. 5 is a cross sectional view showing the outlet port in the machine of the embodiment 1,

Fig. 6(a) to 6(c) are diagrams showing flow patterns of the air stream blown from the blower of the embodiment 1,

Fig. 7(a) to 7(c) are additional flow patterns of the air stream blown from the blower of the embodiment 1,

Fig. 8(a) and 8(b) are cross sectional views showing an outlet port of an blower according to an embodiment 2 of the present invention,

Fig. 9(a) and 9(b) are cross sectional views showing another outlet port of an blower according to the embodiment 2 of the present invention,

Fig. 10 is a perspective view showing an blower according to the embodiment 3 of the present invention,

Fig. 11 is a side and plan view of an blower according to an embodiment 4 of the present invention,

Fig. 12 is a cross sectional view taken on line A - A in Fig. 11,

Fig. 13 is a cross sectional view taken on line B - B in Fig. 11,

Fig. 14 is a side and plan view of an blower according

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to an embodiment 5 of the present invention,

Fig. 15 is a sectional view showing the blower of the embodiment 5,

Fig. 16 is a view showing an example of the installation of the blower of the embodiment 5 in a house.

Fig. 17 is a side and plan view of a blower according to an embodiment 6 of the present invention,

Fig. 18 is a sectional view showing the blower of the embodiment 6,

Fig. 19 is a view showing an example of the installation of the blower of the embodiment 6 in a house,

Fig. 20 is a view showing another example of the installation of the blower of the embodiment 6 in a house,

Fig. 21 is a cross sectional view showing a structure where a conventional blower is installed, and

Fig. 22 is a diagram showing a model of a stream of air forcefully discharged from the conventional blower.

Embodiment 1

In Figs. 1 through 7 showing a blower according to an embodiment 1 of the present invention, reference numeral 55 is representative of a housing, and numeral 56 designates inlet ports formed in the top of the housing 55. The upper end of

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the housing is folded at the round part 57 toward the inside of the housing 55, thereby to form a bellmouth 13. Mounting members 58 hold each motor 19 therebetween, with the shape of band. The respective ends of the mounting members 58 are secured to the inner wall of the housing 55. A vane wheel 20 with axial vanes 59 is secured to the rotary shaft 20a in a state that it is located within the bellmouth 13.

A plural number of blower means 54 each including the motor 19, the vane wheel 20, and the bellmouth 13 are mounted on the housing 55 while being equidistantly spaced from one another. An outlet port 60 is provided at the lower portion of the housing 55, and is communicated with the inlet port 56. The lower end of the housing is folded at the round part 57 toward the inside of the housing and reaches the bottom edge of the folded portion of the inlet port 56. Those folded portions are jointed together to form the smooth inner wall of the housing 55, which defines a smooth wind path 61 ranging from the inlet port 56 to the outlet port 60.

A guide 62, located near at the center of the outlet port 60, is shaped like a triangle in cross section of which the vertex is located at the side of the inlet port 56 and the base is located at the side of the outlet port 60. The corners of the triangle are curved as indicated by reference numeral 57. The outlet port 60 including the guide 62 thus located therein functions as a parallel multi-nozzle 63. The guide 62 is an elongated and tubular member with the ends having

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threaded holes. The guide 62 is mounted on the housing 55 in a state that both ends of the guide are brought into contact with the opposed inner walls of the housing 55 and fastened to the latter by means of adjust screws 64. A T-groove 65 is formed in the portion of the outer wall of the housing 55, which corresponds to the portion with which each end of the guide 62 contacts. Each adjust screw 64 is inserted into and slidably guided by the T-groove 65. In Fig. 3, H indicates the cut height of the air curtain; W, the width of the air curtain at the cut height H; h, the length of the air curtain before it expands in the profile; and Z, a jet stream of air discharged from the outlet port 60.

In the thus constructed blower of the embodiment 1, the guide 62 is placed within the outlet port 60 and fastened to a desired position on the inner wall of the housing 55 by means of the adjust screws 64 that is inserted through the T-groove 65. The axial vane wheels 59 are turned by the motors 19 to suck air through the inlet port 56 and to emit jet streams of air through the outlet port 60. More exactly, two parallel jet streams Z are discharged through the parallel multi-nozzle 63 parted by the guide 62 located within the outlet port 60, as shown in Fig. 3.

A negative pressure is created in the space between the two jet streams discharged from the two nozzle openings since the inducing action takes place therein. Under the negative pressure, the two jet streams proceed and are inwardly bent to

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meet into one jet stream 2. Accordingly, the jet stream 2 starts to expand at a location distanced h from the outlet port 60. Thus, the expansion of the width W of the air curtain at the cut height H can be reduced, and the center velocity of the jet stream is little reduced. That is, the air curtain formed by a multiple of nozzles with the small nozzle width is more effective than that by a single nozzle with a large nozzle width. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional one, with a more reduced velocity of the jet stream 2. Such a jet stream is less sensed bodily by a passenger.

The round parts 57 of the guide 62 and the outlet port 60 greatly attenuate the turbulence in the air stream 2 when it is discharged from the outlet port 60, effectively holding down the expansion of the jet stream 2.

In a case where the wide width of the jet stream of air rather than the high velocity thereof is required, the guide 62 is moved, guided by the T-groove 65, to a location lower than the level of the outlet port 60, as shown in Figs. 6 (a) to 6 (c). When the guide 62 is moved downward, the jet stream 2 is widened. The direction of the jet stream 2 can be turned to the right or left as shown in Fig. 7. When the guide 62 is moved through the T-groove 65 to the right, the jet stream is turned to the right by an angle θ , as shown in Fig. 7 (a). When the guide 62 is moved through the T-groove 65 to the left,



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the jet stream is turned to the left by an angle θ , as shown in Fig. 7 (c). Thus, the jet stream can be flexibly set in a desired direction since the guide 62 is horizontally and vertically movable at the outlet port 60. This can be realized with a simple structure without using the louver or the like.

A series of blower means 54 each including the axial vane wheel 59 are contained in the blower 10. With the plural number of blower means 54, the flow coefficient is large. When comparing with the use of the traverse vanes, the highest efficiency is obtained in an operating state free from a static pressure, that is, in the state of the maximum air flow. The result is reduction of noise generated when the blower 10 operates. Further, the width of the air curtain can be adjusted by properly selecting the number of blower means 54.

Embodiment 2

Figs. 8 through 9 show a blower according to an embodiment 2 of the present invention. In this embodiment, the guide 62 is automatically moved at the outlet port 60 while in the embodiment 6, it is manually moved by the combination of the adjust screws 64 and the T-grooves 65. As shown, servo motors 70 are mounted on the inner walls of both ends of the housing 55. A pinion 72 is fastened to the rotary shaft 71 of each servo motor 70. A rack 73 to be in mesh with the pinion 72 is vertically or horizontally disposed within the guide 62.

When the servo motors 70 are driven by operating a switch, not shown, the guide 62 is vertically or horizontally



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moved in the outlet port 60 through the engagement of the rack 73 and the pinion 72. In this embodiment, in addition to the effects as in the embodiment 2, the direction of the air jet stream can be remotely adjusted by means of the operation switch so that the operation property is further improved.

Embodiment 3

In Fig. 10 showing a blower according to an embodiment 3 of the invention, a blower 81 is constructed with a housing 80 containing a single blower means 54. An optional number of blowers 81 are coupled, by means of a coupling member 82, into a single unit. A blower unit of $L \times n$ long can simply be formed by coupling an n number of blowers 81 each of L long by means of the coupling member 82 of the corresponding length. Accordingly, the blower unit may be constructed according to the width of the entrance of a building. The coupling member 82 may also serve as a dressed panel.

Embodiment 4

Figs. 11 through 13 show a blower according to an embodiment 4 of the present invention. In the figure, reference numeral 90 designates a first air flow rectifying plate made of a plate located just under the center of the axial vane wheel 59, which is under each motor 19 in the housing 55. The first air flow rectifying plate 90 consists of paired partition plates 92. One end of the partition plate is jointed to the inner wall of the outlet port 60, and the other end thereof is jointed to the side face 91 of the guide 62. A



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second air flow rectifying plate 93 as a single plate partitions the adjacent blower means 54 in the housing 55. The upper end of each second air flow rectifying plate 93 and the inner wall of the inlet port 56 are jointed together, while the portion of the lower end thereof corresponding to the guide 62 is cut and the lower end is jointed with the inner wall of the outlet port 60 and the side face 91 of the guide 62.

In the blower thus constructed, the blower means 54 are operated to suck air through the inlet port 56 and forcefully send the air through the outlet port 60. The jet stream containing turning components, caused by the axial vane wheel 59, is converted into a linear stream of air by the combination of the first and second air flow rectifying plates 90 and 93. Accordingly, this greatly contributes to the formation of the air curtain used in the present invention which is directed to reduce the spread of the jet stream of air, and the width of the jet stream of air can reliably be reduced.

Embodiment 5

Figs. 14 to 16 show a blower of an embodiment⁵ of the present invention. In the embodiments 1, 2 and 3, the guide 62 is a tubular member substantially triangle in cross section. In the embodiment 5, the guide 62 is opened in the bottom located in the outlet port 60, as shown in Fig. 15. Reference numeral 95 designates a lighting means such as a fluorescent lamp, which is disposed in the guide 62.



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The blower of the embodiment 5 can be installed above a doorway. When the motors 19 and the lighting means 95 are turned on, the blower forms an air curtain in the entrance 23 while lighting there. This embodiment has the lighting function in addition to the thermal isolation function so that the operation property is further improved.

Embodiment 6

Figs. 17 through 20 show a blower according to an embodiment 6 of the present invention. In the figure, reference numeral 96 designates a heater, for example, an electrical heater shaped like a bar. The heater 96 is disposed with the guide 62. A heater cover 97 for covering the heater 96, is semicircular in shape, and serves also as a reflector.

The blower of the embodiment 11 may be installed above a doorway. When the motors 19 and the heater 96 are turned on, a hot air curtain is formed, eliminating a sense of coolness at the entrance 23. When the blower is provided with a support 97, and set upright as shown in Fig. 20, it can be used as a motor fan in summer and as a heater in winter. The blower can be used multifunctionally.

With the present invention, the guide is disposed within the outlet port, thereby forming a parallel multi-nozzle. Thus, the expansion of the width of the air curtain can be suppressed, and the thermal isolating capability is improved. Therefore, the blower of the



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invention can attain the thermal isolating capability with that of the conventional one, with a more reduced velocity of the jet stream. Such a jet stream is less sensed bodily by a passenger. The blower is small in size, light in weight and excellent in power saving. Further, the round parts of the guide and the outlet port greatly attenuate the turbulence in the air stream when it is discharged from the outlet port. As a result, the expansion of the jet stream can be effectively held down and the capacity of thermal insulation is improved.

The air flow rectifying plate can convert the air stream within the housing into a linear air stream. This results in holding down the expansion of the air stream.

Attention is drawn to copending application number 97 which was divided from this application and which claims:

a blower comprising a housing with an air inlet port at one end and an air outlet port at the other end; and a plurality of vane wheels and motors, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port, wherein said inlet port is covered by a plate formed with a plurality of circular mouths each surrounding a respective one of said vane wheels and converging curvedly inwardly towards the respective vane wheel, and wherein a lower end portion of said housing is uniformly narrowed toward the center of said housing, thereby forming said outlet port.

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CLAIMS

1. A blower comprising blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port; and a guide disposed within said outlet port for dividing it into a parallel multi-nozzle, the guide being a tubular member substantially triangular in cross section oriented with its base on the outlet port side, and wherein corners of said guide are rounded, and the lower end of said housing is bent inwards to round the edges of the outlet port.

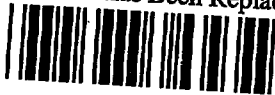
2. The blower according to claim 1, wherein said guide is movable within said outlet port.

3. The blower according to claim 1 or 2, wherein said vane wheel of said blowing means is an axial fan, and plural inlet and outlet ports, vane wheels and motors are disposed side by side within said housing.

4. The blower according to claim 3, further comprising a first air flow rectifying plate located substantially diametrically of said vane wheel between said vane wheel and said outlet port, and a second air flow



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rectifying plate partitioning adjacent blowing means and disposed within said housing.

5. The blower according to claims 1, 2, 3 or 4, further comprising a heater or a lighting means, covered with a cover and disposed within said guide.

6. A blower constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 20 of the accompanying drawings.



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FIG. 1

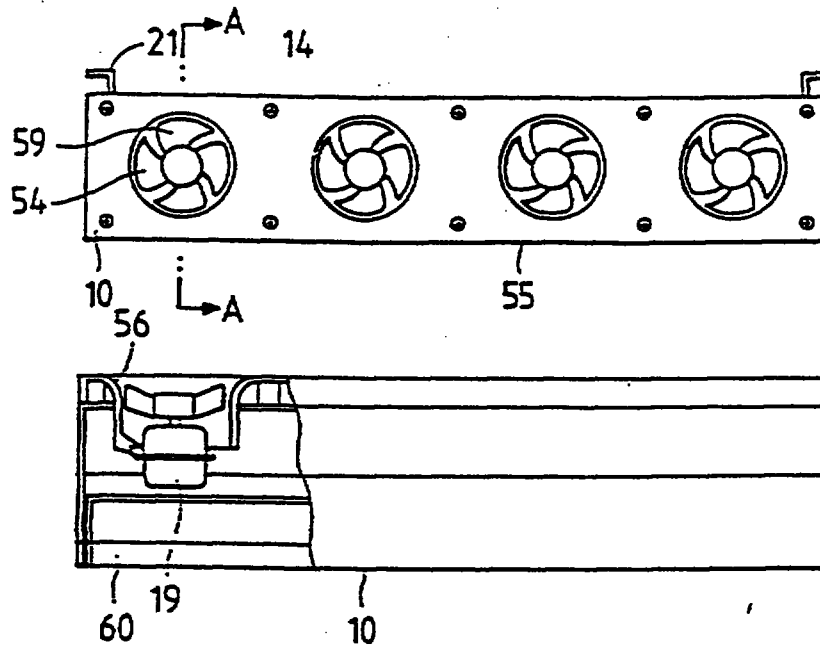
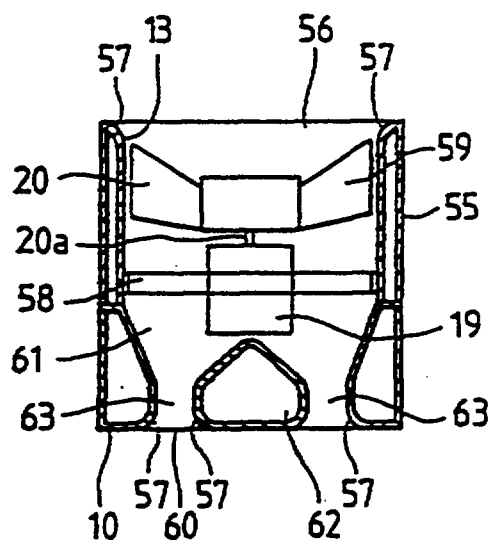


FIG. 2



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FIG. 3

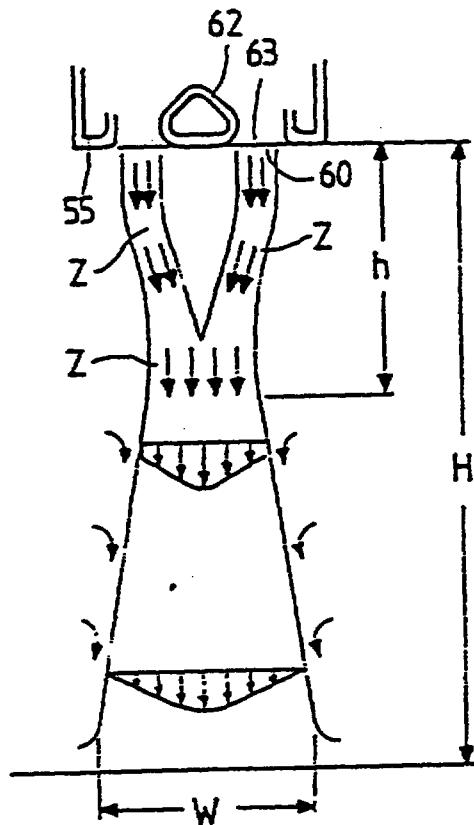


FIG. 4

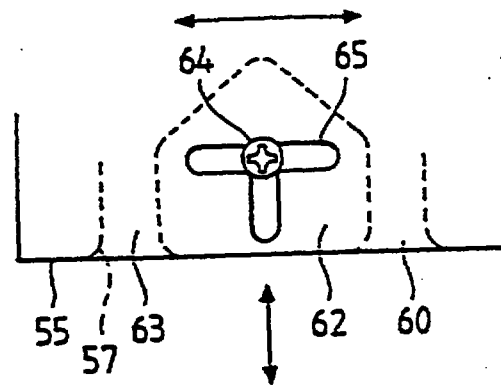
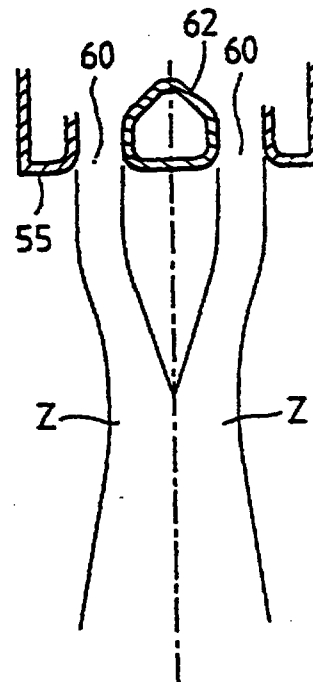


FIG. 5



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FIG. 6(a)

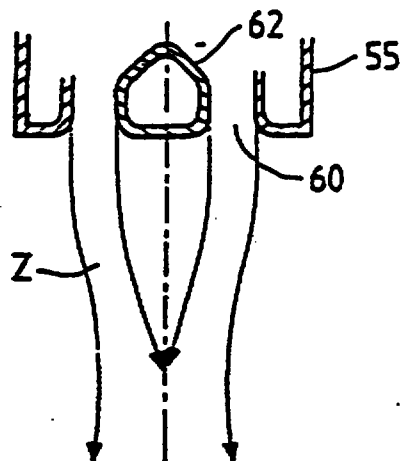


FIG. 6(b)

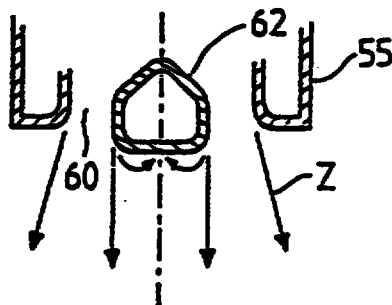
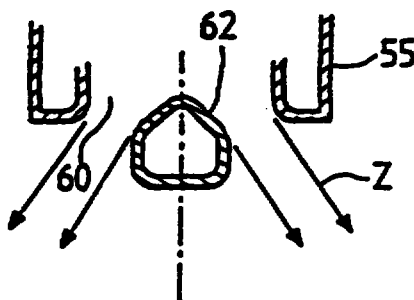
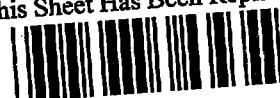


FIG. 6(c)



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FIG. 7(a)

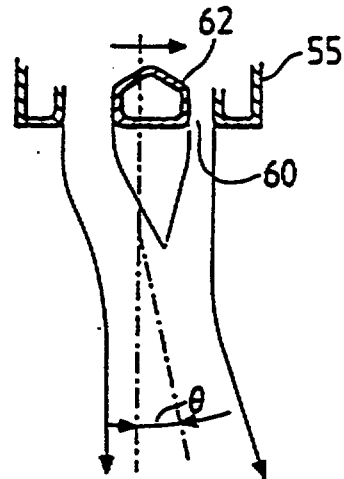


FIG. 7(b)

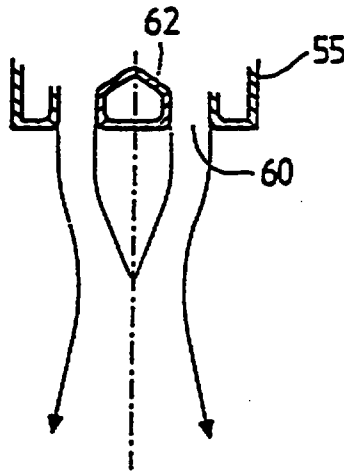
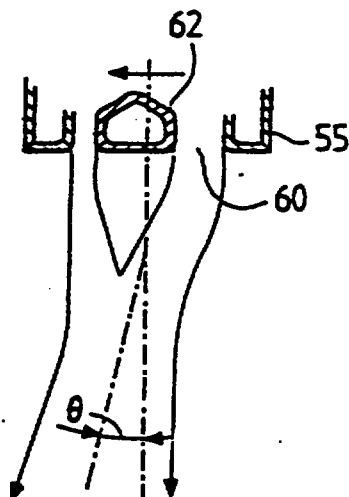


FIG. 7(c)



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FIG. 8(a)

FIG. 8(b)

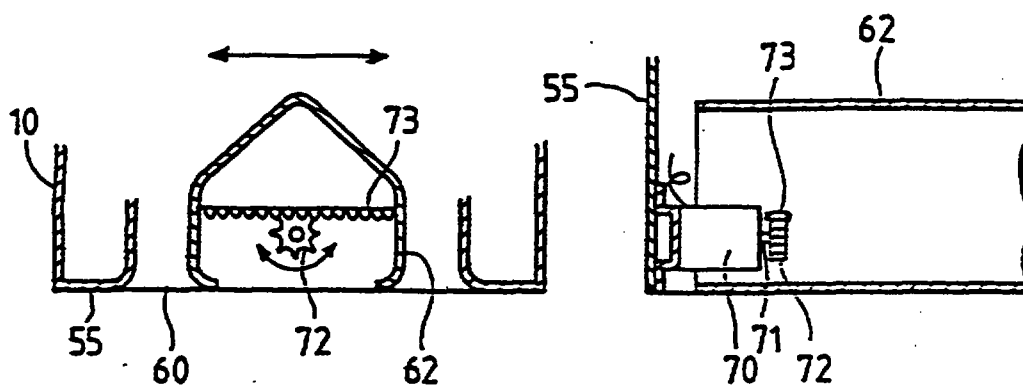
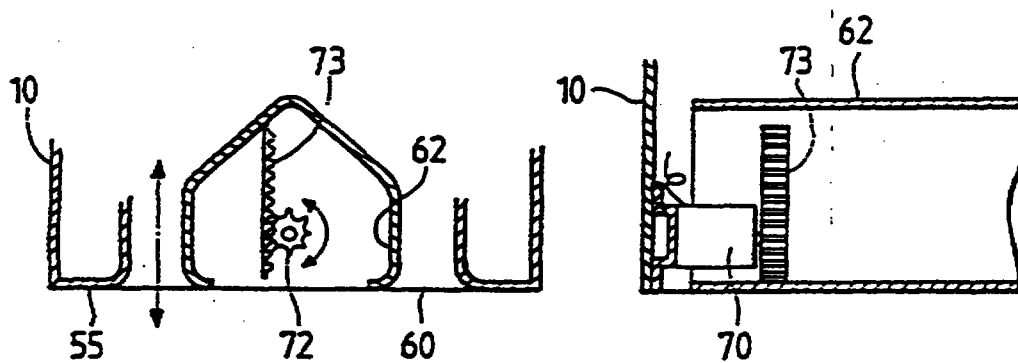


FIG. 9(a)

FIG. 9(b)



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FIG. 10

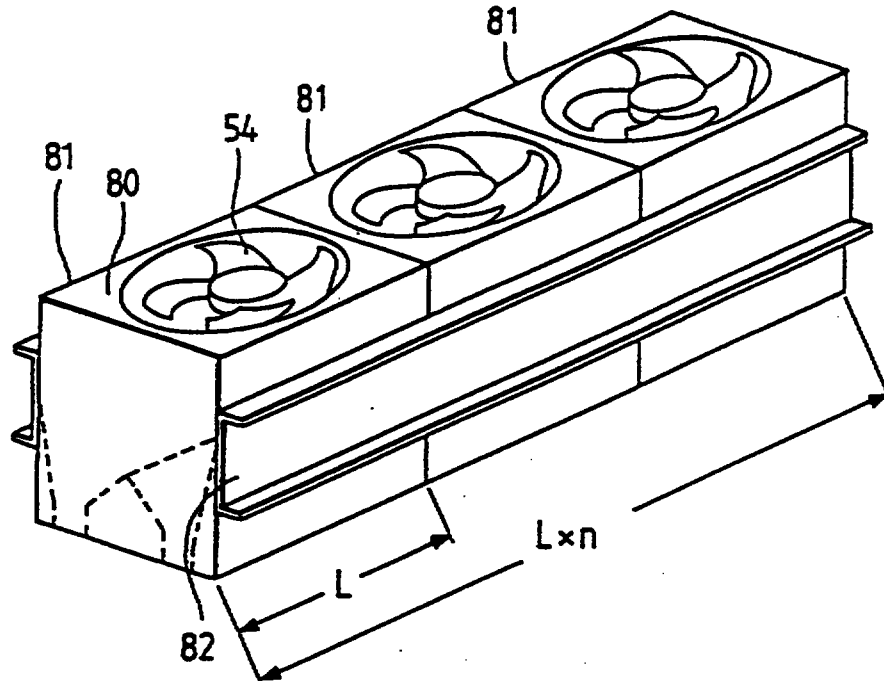
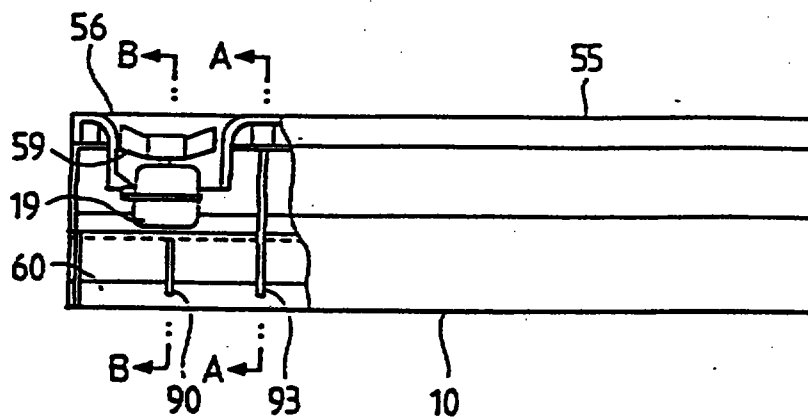
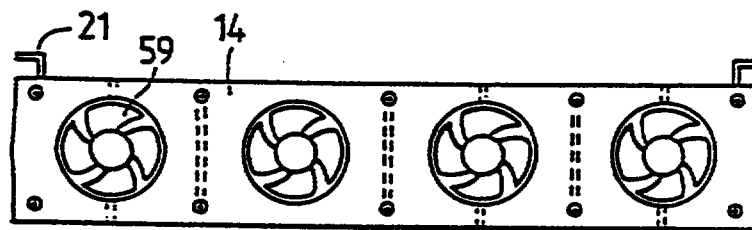


FIG. 11



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FIG. 12

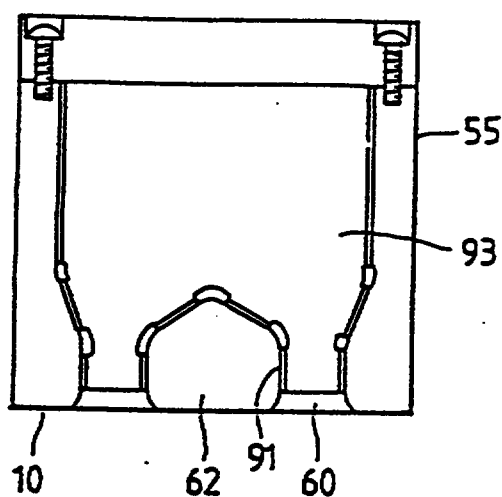
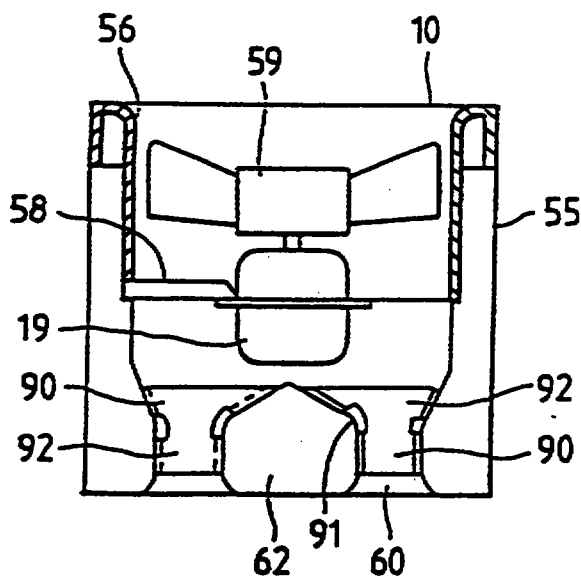


FIG. 13



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FIG. 14

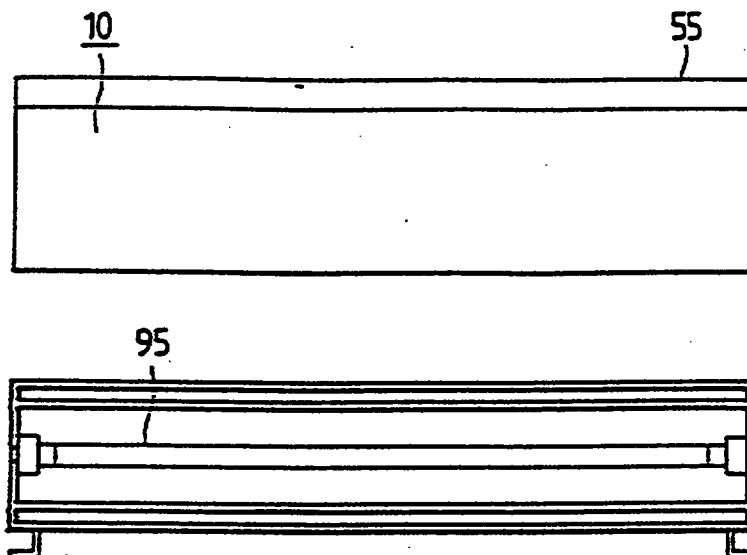
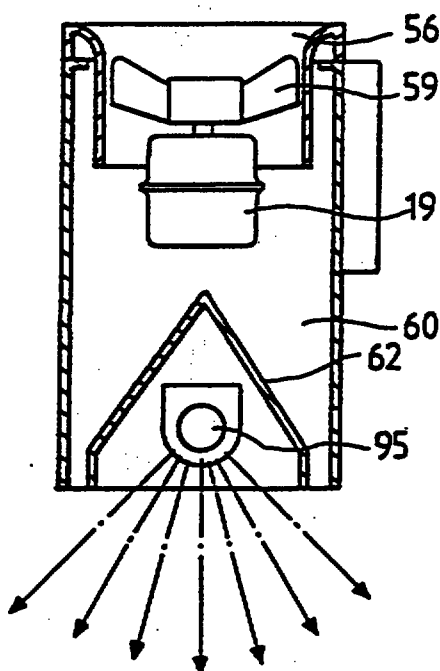


FIG. 15



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FIG. 16

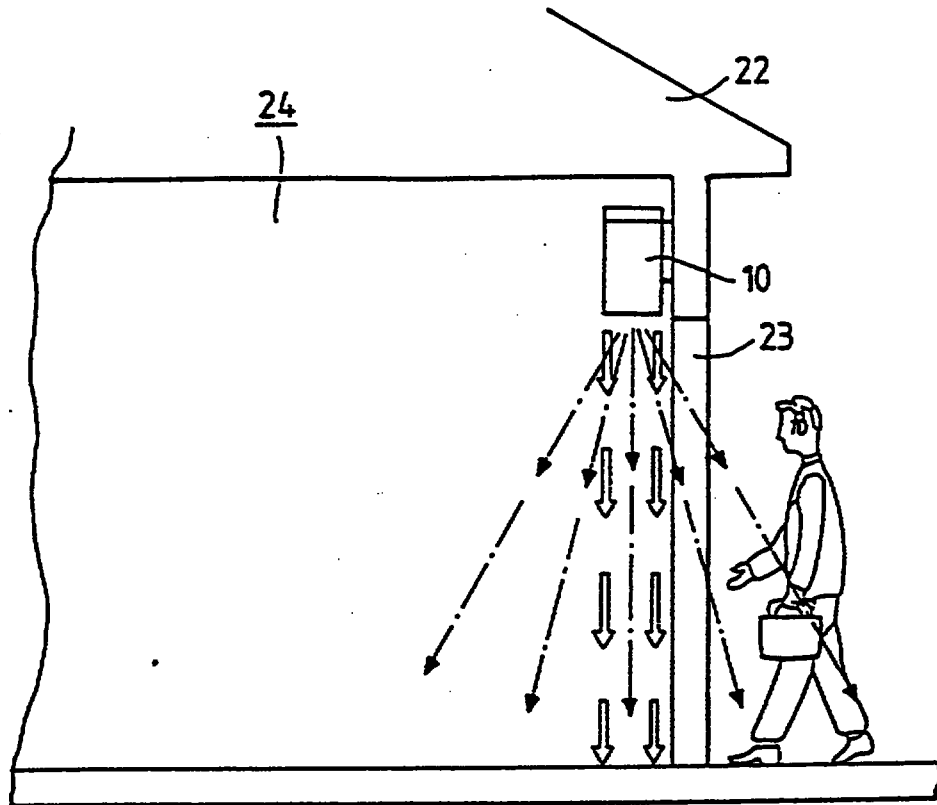
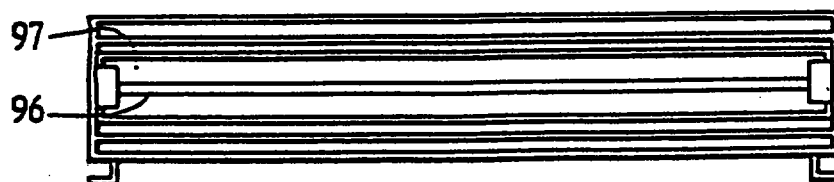
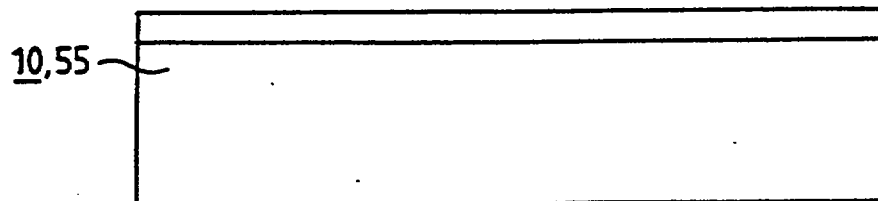


FIG. 17



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FIG. 18.

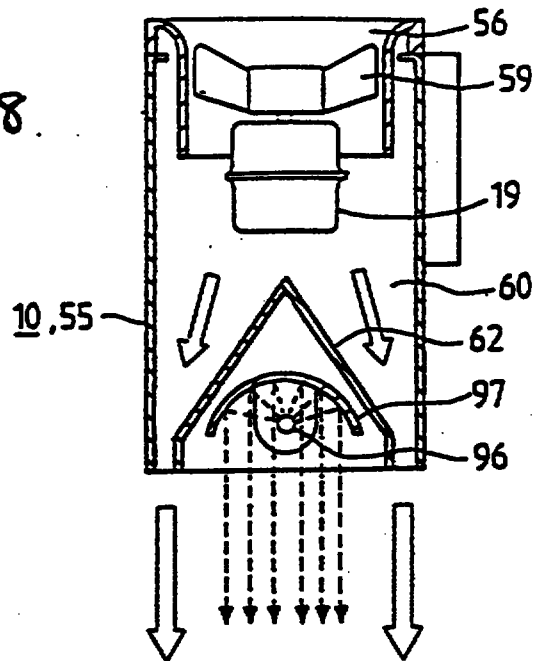
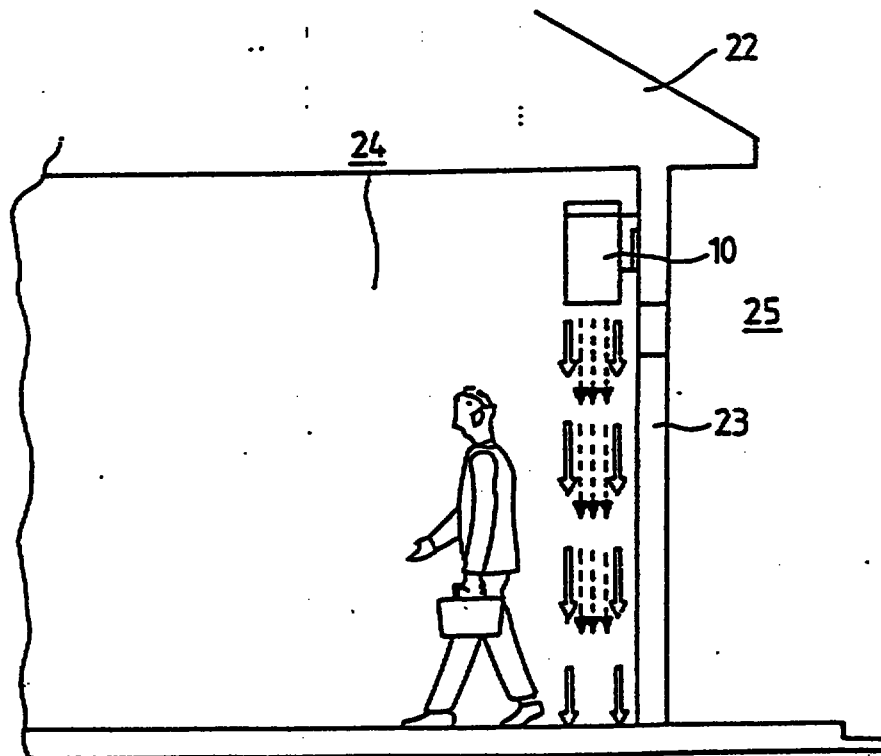


FIG. 19



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FIG. 20

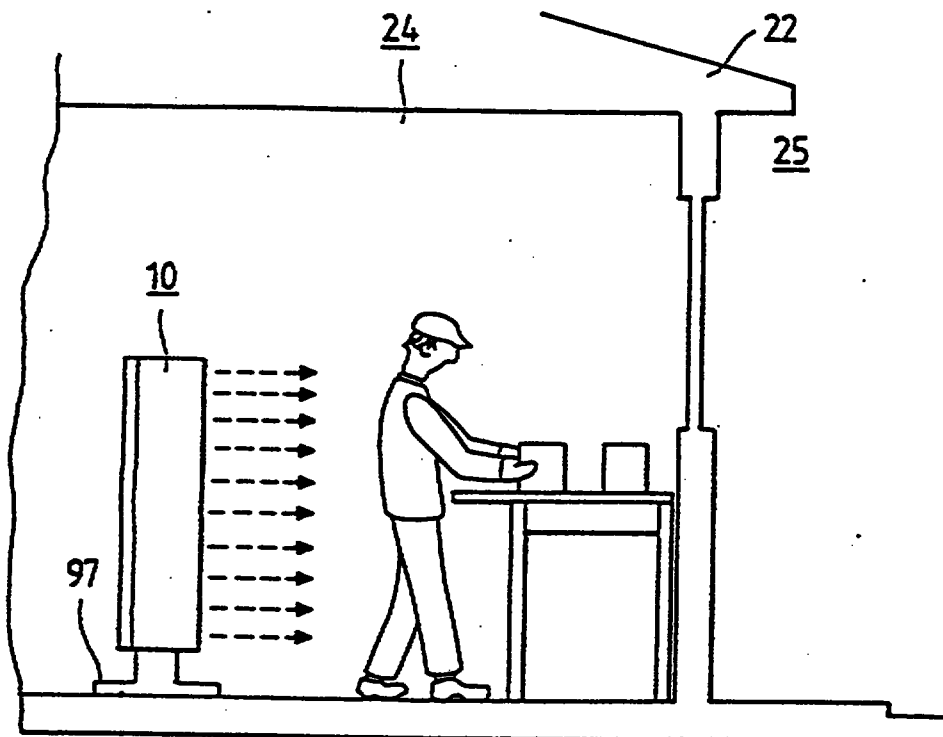
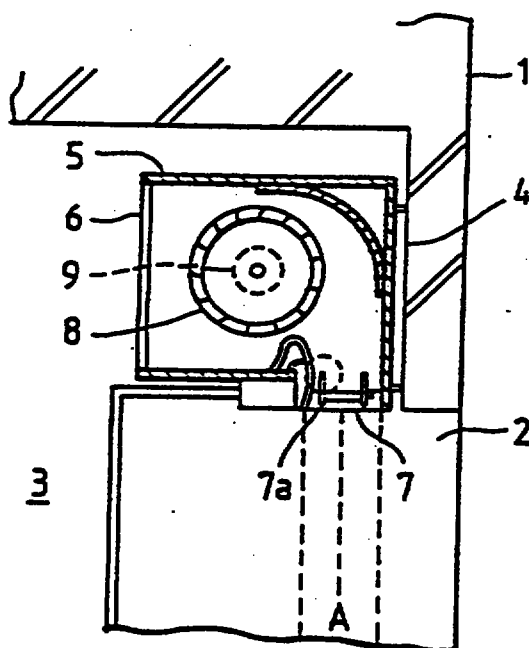


FIG. 21



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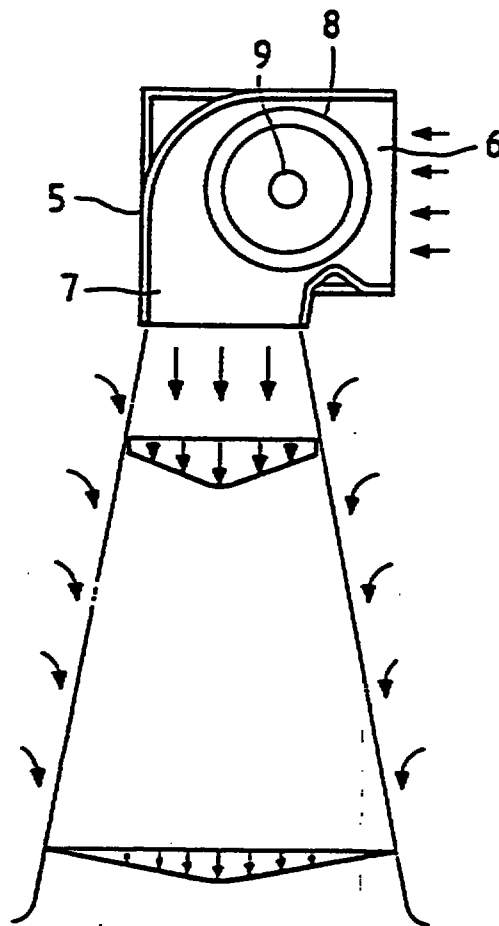


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FIG. 22.



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"BLOWER"

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The present invention relates to a blower, installed at the entrance and/or exit of a building, for thermally insulating the inside of the building from the outside mainly when the building is air-cooled or heated.

In the accompanying drawings, Figures 14 and 15 show a conventional blower disclosed in Published Unexamined Japanese Patent Application No Hei 5-106898. This machine will be described later.

A box-like blower body 5 is installed on the inner wall 4 (in the interior 3 of a room) of a house 1. The blower body 5 includes an air inlet port 6 at a side opposite to the installation side and an air outlet port 7 at a lower side. Within the blower body 5, a motor 9 is mounted. The motor 9 with a single traverse vane 8 secured thereto receives air from the inlet port 6 and forcefully blows the air to the outlet port 7. A plural number of flow-direction control plates 7a for controlling the direction of a stream of the discharged air are mounted at the outlet port 7. These vanes are swingable on the upper ends thereof as fulcra.

In the blower thus constructed, the vane 8 is rotated by the motor 9 to suck air through the inlet port 6 and to blow the air through the outlet port 7, thereby forming an air curtain hanging down in the entrance/exit 2 of the house 1.

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In the blower, a single transverse vane 8 is used for the air blowing. As a stream of air discharged from the outlet port 7 proceeds, it pulls in surrounding air and expands as shown in Fig. 15. In the air curtain formed by the expanded air stream, the thermal isolating capability is reduced, and the effective thermal-isolating height or length of the air curtain at the entrance/exit 2 of the house 1 as well is restricted.

Also, to increase the effective thermal-isolating length of the air curtain, a large vane must be used for the vane 8. The result is installation of a large and heavy, to cumbersome vane, on the wall 4.

Also, since the width of the air curtain is determined by the length of the vane 8, in order that the air curtain is formed so as to fit for various sizes of the entrance/exit 2, respective blowers with the vanes 8 of different lengths must be provided.

Also, when the transverse vane 8 is used, noise inherent to the vane 8, such as a whistling sound, is large.

The present invention has been made in view of the above circumstances and has an object to improve the thermal insulating capability of a blower by minimizing the expansion of the air stream in the form of a curtain, and to secure a sufficiently long thermal-isolating length of the air curtain

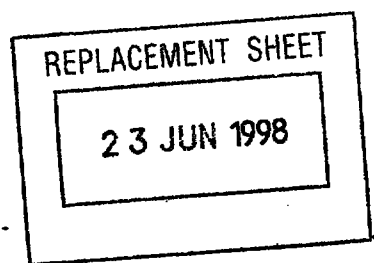
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without increasing the size of the machine. Another object of the present invention is to provide a blower of low noise which can selectively set the width of the air curtain at a desired value of width for an arbitrary opening of the entrance/exit of a building without using different transverse vanes.

According to the present invention there is provided a blower comprising blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port; and a guide disposed within said outlet port for dividing it into a parallel multi-nozzle, the guide being a tubular member substantially triangular in cross section oriented with its base on the outlet port side, and wherein corners of said guide are rounded, and the lower end of said housing is bent inwards to round the edges of the outlet port.

The guide may be rotatable within the outlet port to change as desired the flow pattern of the air stream.

The vane wheel of the blowing means may be an axial fan, and a plural number of the blowing means may be disposed side by side within the housing. With the use of the axial fan, the flow coefficient is large. In an operating state free from a static pressure, the highest efficiency is obtained. As a result, noise caused by the drive power source and the turning of the vanes is reduced.



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Further, provision of the plural number of blowing means enables one to adjust, as intentionally, the width of the air curtain formed.

The apparatus may also include a first air flow rectifying plate located at almost the center of the vane wheel and between the blowing means and the outlet port, and a second air flow rectifying plate partitioning the adjacent blowing means disposed within the housing. Thus, the air curtain stream containing turning components, generated by the axial fan, is converted into a linear air curtain stream by the air flow rectifying plate.

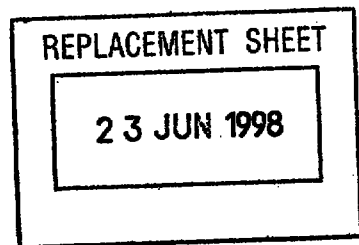
A heater or a lighting means, covered with a cover, may be provided within the guide to provide illumination or hot air in parallel with the air stream.

With the invention parallel air streams are discharged through the outlet port and negative pressure is created between the adjacent air jet streams which bends them inwardly to meet into one jet stream. The round parts of the guide and the outlet port greatly attenuate the turbulence in the air streams when they are discharged from the outlet port.

The invention will be further described by way of non-limitative example, with reference to the accompanying drawings, in which:-

Fig. 1 is a side and plan view of a blower according to an embodiment 1 of the present invention,

Fig. 2 is a sectional view taken on line A - A in Fig.



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1.

Fig. 3 is a diagram showing the profile of the air stream formed by the blower of the embodiment 1,

Fig. 4 is a side view showing an outlet port in the machine of the embodiment 1,

Fig. 5 is a cross sectional view showing the outlet port in the machine of the embodiment 1,

Fig. 6(a) to 6(c) are diagrams showing flow patterns of the air stream blown from the blower of the embodiment 1,

Fig. 7(a) to 7(c) are additional flow patterns of the air stream blown from the blower of the embodiment 1,

Fig. 8(a) and 8(b) are cross sectional views showing an outlet port of a blower according to an embodiment 2 of the present invention,

Fig. 9(a) and 9(b) are cross sectional views showing another outlet port of a blower according to the embodiment 2 of the present invention,

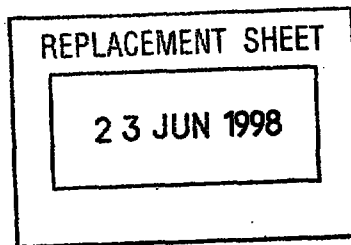
Fig. 10 is a perspective view showing a blower according to the embodiment 3 of the present invention,

Fig. 11 is a side and plan view of a blower according to an embodiment 4 of the present invention,

Fig. 12 is a cross sectional view taken on line A - A in Fig. 11,

Fig. 13 is a cross sectional view taken on line B - B in Fig. 11,

Fig. 14 is a cross sectional view showing a structure



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where a conventional blower is installed, and

Fig. 15 is a diagram showing a model of a stream of air forcefully discharged from the conventional blower.

Embodiment 1

In Figs. 1 through 7 showing a blower according to an embodiment 1 of the present invention, reference numeral 55 is representative of a housing, and numeral 56 designates inlet ports formed in the top of the housing 55. The upper end of

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the housing is folded at the round part 57 toward the inside of the housing 55, thereby to form a bellmouth 13. Mounting members 58 hold each motor 19 therebetween, with the shape of band. The respective ends of the mounting members 58 are secured to the inner wall of the housing 55. A vane wheel 20 with axial vanes 59 is secured to the rotary shaft 20a in a state that it is located within the bellmouth 13.

A plural number of blower means 54 each including the motor 19, the vane wheel 20, and the bellmouth 13 are mounted on the housing 55 while being equidistantly spaced from one another. An outlet port 60 is provided at the lower portion of the housing 55, and is communicated with the inlet port 56. The lower end of the housing is folded at the round part 57 toward the inside of the housing and reaches the bottom edge of the folded portion of the inlet port 56. Those folded portions are jointed together to form the smooth inner wall of the housing 55, which defines a smooth wind path 61 ranging from the inlet port 56 to the outlet port 60.

A guide 62, located near at the center of the outlet port 60, is shaped like a triangle in cross section of which the vertex is located at the side of the inlet port 56 and the base is located at the side of the outlet port 60. The corners of the triangle are curved as indicated by reference numeral 57. The outlet port 60 including the guide 62 thus located therein functions as a parallel multi-nozzle 63. The guide 62 is an elongated and tubular member with the ends having

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threaded holes. The guide 62 is mounted on the housing 55 in a state that both ends of the guide are brought into contact with the opposed inner walls of the housing 55 and fastened to the latter by means of adjust screws 64. A T-groove 65 is formed in the portion of the outer wall of the housing 55, which corresponds to the portion with which each end of the guide 62 contacts. Each adjust screw 64 is inserted into and slidably guided by the T-groove 65. In Fig. 3, H indicates the cut height of the air curtain; W, the width of the air curtain at the cut height H; h, the length of the air curtain before it expands in the profile; and Z, a jet stream of air discharged from the outlet port 60.

In the thus constructed blower of the embodiment 1, the guide 62 is placed within the outlet port 60 and fastened to a desired position on the inner wall of the housing 55 by means of the adjust screws 64 that is inserted through the T-groove 65. The axial vane wheels 59 are turned by the motors 19 to suck air through the inlet port 56 and to emit jet streams of air through the outlet port 60. More exactly, two parallel jet streams Z are discharged through the parallel multi-nozzle 63 parted by the guide 62 located within the outlet port 60, as shown in Fig. 3.

A negative pressure is created in the space between the two jet streams discharged from the two nozzle openings since the inducing action takes place therein. Under the negative pressure, the two jet streams proceed and are inwardly bent to

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meet into one jet stream Z. Accordingly, the jet stream Z starts to expand at a location distanced h from the outlet port 60. Thus, the expansion of the width W of the air curtain at the cut height H can be reduced, and the center velocity of the jet stream is little reduced. That is, the air curtain formed by a multiple of nozzles with the small nozzle width is more effective than that by a single nozzle with a large nozzle width. Therefore, the blower of the invention can attain the thermal isolating capability comparable with that of the conventional one, with a more reduced velocity of the jet stream Z. Such a jet stream is less sensed bodily by a passenger.

The round parts 57 of the guide 62 and the outlet port 60 greatly attenuate the turbulence in the air stream Z when it is discharged from the outlet port 60, effectively holding down the expansion of the jet stream Z.

In a case where the wide width of the jet stream of air rather than the high velocity thereof is required, the guide 62 is moved, guided by the T-groove 65, to a location lower than the level of the outlet port 60, as shown in Figs. 6 (a) to 6 (c). When the guide 62 is moved downward, the jet stream Z is widened. The direction of the jet stream Z can be turned to the right or left as shown in Fig. 7. When the guide 62 is moved through the T-groove 65 to the right, the jet stream is turned to the right by an angle θ , as shown in Fig. 7 (a). When the guide 62 is moved through the T-groove 65 to the left,

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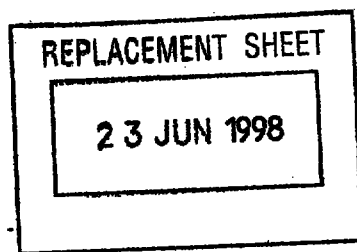
the jet stream is turned to the left by an angle θ , as shown in Fig. 7 (c). Thus, the jet stream can be flexibly set in a desired direction since the guide 62 is horizontally and vertically movable at the outlet port 60. This can be realized with a simple structure without using the louver or the like.

A series of blower means 54 each including the axial vane wheel 59 are contained in the blower 10. With the plural number of blower means 54, the flow coefficient is large. When comparing with the use of the traverse vanes, the highest efficiency is obtained in an operating state free from a static pressure, that is, in the state of the maximum air flow. The result is reduction of noise generated when the blower 10 operates. Further, the width of the air curtain can be adjusted by properly selecting the number of blower means 54.

Embodiment 2

Figs. 8 through 9 show a blower according to an embodiment 2 of the present invention. In this embodiment, the guide 62 is automatically moved at the outlet port 60 while in the embodiment 1, it is manually moved by the combination of the adjust screws 64 and the T-grooves 65. As shown, servo motors 70 are mounted on the inner walls of both ends of the housing 55. A pinion 72 is fastened to the rotary shaft 71 of each servo motor 70. A rack 73 to be in mesh with the pinion 72 is vertically or horizontally disposed within the guide 62.

When the servo motors 70 are driven by operating a switch, not shown, the guide 62 is vertically or horizontally



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moved in the outlet port 60 through the engagement of the rack 73 and the pinion 72. In this embodiment, in addition to the effects as in the embodiment 2, the direction of the air jet stream can be remotely adjusted by means of the operation switch so that the operation property is further improved.

Embodiment 3

In Fig. 10 showing a blower according to an embodiment 3 of the invention, a blower 81 is constructed with a housing 80 containing a single blower means 54. An optional number of blowers 81 are coupled, by means of a coupling member 82, into a single unit. A blower unit of $L \times n$ long can simply be formed by coupling an n number of blowers 81 each of L long by means of the coupling member 82 of the corresponding length. Accordingly, the blower unit may be constructed according to the width of the entrance of a building. The coupling member 82 may also serve as a dressed panel.

Embodiment 4

Figs. 11 through 13 show a blower according to an embodiment 4 of the present invention. In the figure, reference numeral 90 designates a first air flow rectifying plate made of a plate located just under the center of the axial vane wheel 59, which is under each motor 19 in the housing 55. The first air flow rectifying plate 90 consists of paired partition plates 92. One end of the partition plate is jointed to the inner wall of the outlet port 60, and the other end thereof is jointed to the side face 91 of the guide 62. A

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second air flow rectifying plate 93 as a single plate partitions the adjacent blower means 54 in the housing 55. The upper end of each second air flow rectifying plate 93 and the inner wall of the inlet port 56 are jointed together, while the portion of the lower end thereof corresponding to the guide 62 is cut and the lower end is jointed with the inner wall of the outlet port 60 and the side face 91 of the guide 62.

In the blower thus constructed, the blower means 54 are operated to suck air through the inlet port 56 and forcefully send the air through the outlet port 60. The jet stream containing turning components, caused by the axial vane wheel 59, is converted into a linear stream of air by the combination of the first and second air flow rectifying plates 90 and 93. Accordingly, this greatly contributes to the formation of the air curtain used in the present invention which is directed to reduce the spread of the jet stream of air, and the width of the jet stream of air can reliably be reduced.

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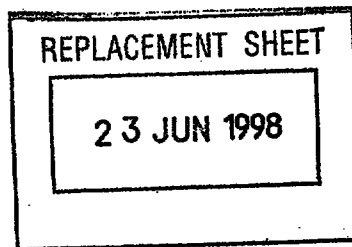
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Attention is drawn to copending application number 9720966.2 which was divided from this application and which claims:

a blower comprising a housing with an air inlet port at one end and an air outlet port at the other end; and a plurality of vane wheels and motors, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port, wherein said inlet port is covered by a plate formed with a plurality of circular mouths each surrounding a respective one of said vane wheels and converging curvedly inwardly towards the respective vane wheel, and wherein a lower portion of said housing is uniformly narrowed toward the center of said housing, thereby forming said outlet port.



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CLAIMS

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1. A blower comprising blowing means including a housing with an air inlet port at one end and an air outlet port at the other end, and a vane wheel and a motor, located within said housing, for sucking air through said inlet port and blowing the sucked air through said outlet port; and a guide disposed within said outlet port for dividing it into a parallel multi-nozzle, the guide being a tubular member substantially triangular in cross section oriented with its base on the outlet port side, and wherein corners of said guide are rounded, and the lower end of said housing is bent inwards to round the edges of the outlet port.

2. The blower according to claim 1, wherein said guide is movable within said outlet port.

3. The blower according to claim 1 or 2, wherein said vane wheel of said blowing means is an axial fan, and plural inlet and outlet ports, vane wheels and motors are disposed side by side within said housing.

4. The blower according to claim 3, further comprising a first air flow rectifying plate located substantially diametrically of said vane wheel between said vane wheel and said outlet port, and a second air flow



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rectifying plate partitioning adjacent blowing means and disposed within said housing.

5. The blower according to claims 1, 2, 3 or 4, further comprising a heater or a lighting means, covered with a cover and disposed within said guide.

6. A blower constructed and arranged to operate substantially as hereinbefore described with reference to and as illustrated in Figures 1 to 20 of the accompanying drawings.

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FIG. 1

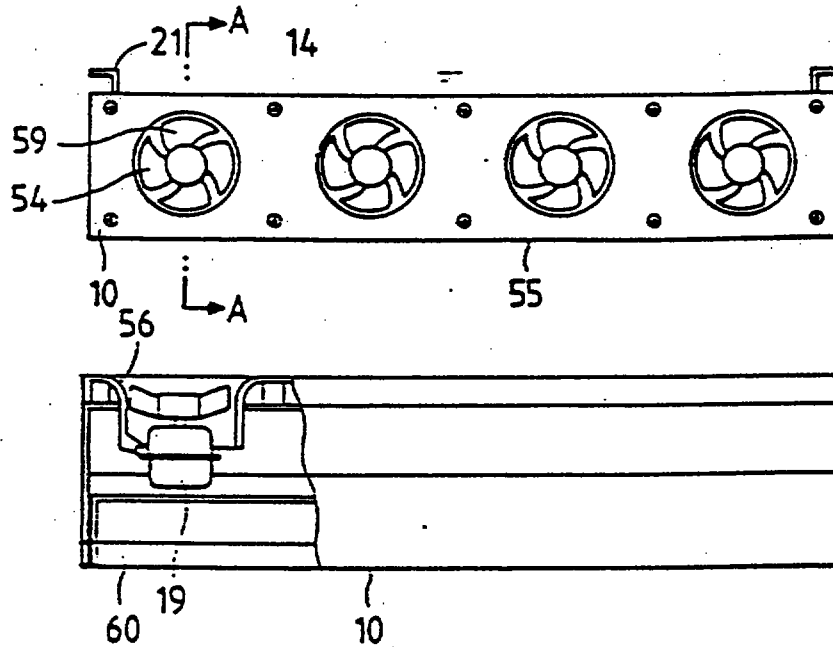
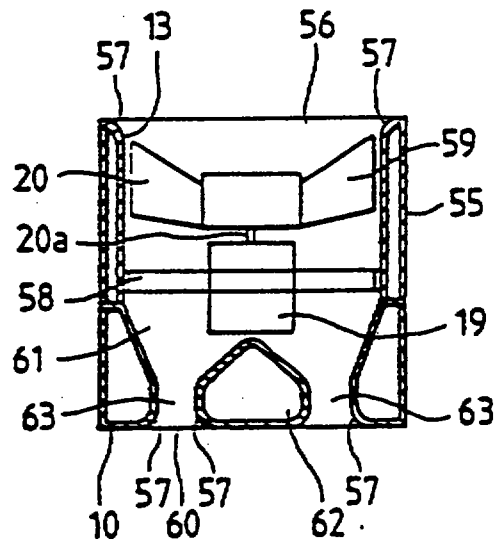


FIG. 2



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FIG. 3

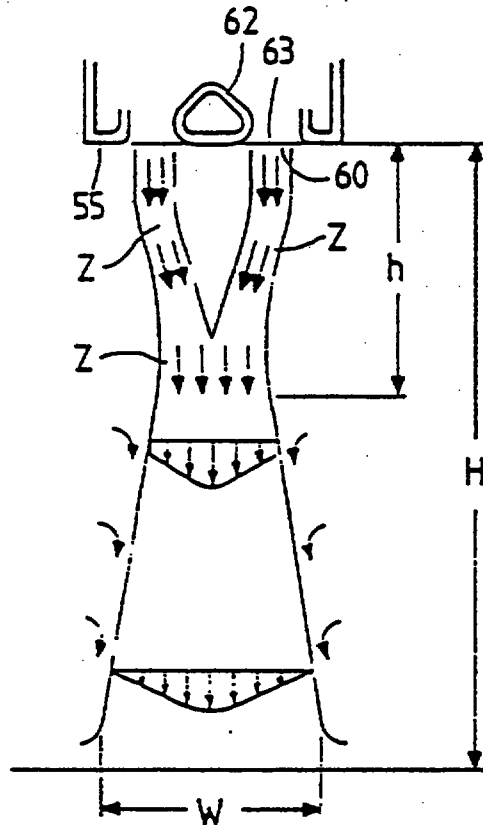


FIG. 4

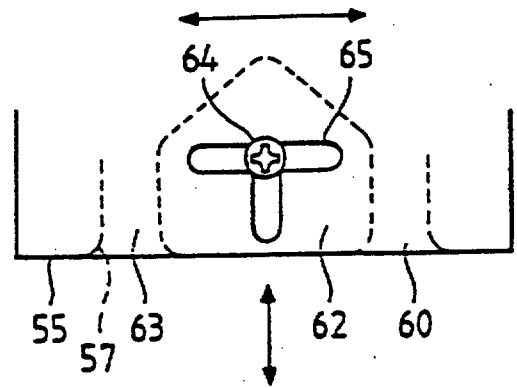
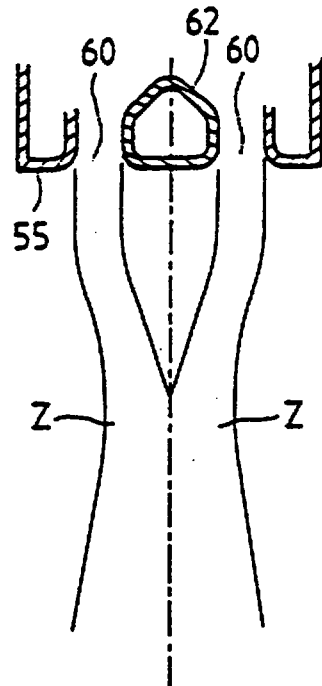


FIG. 5



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REPLACEMENT SHEET

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FIG. 6(a)

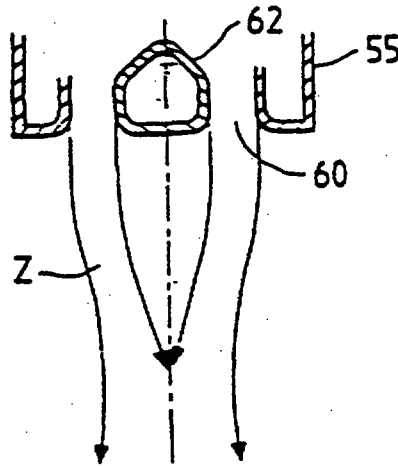


FIG. 6(b)

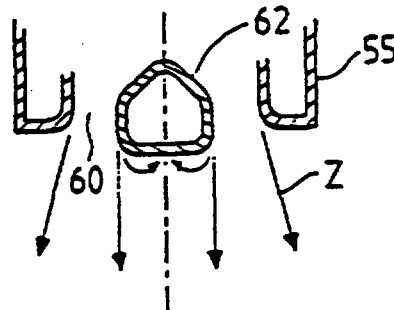
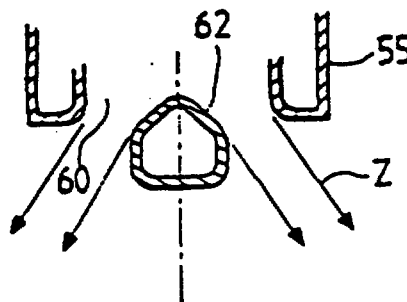
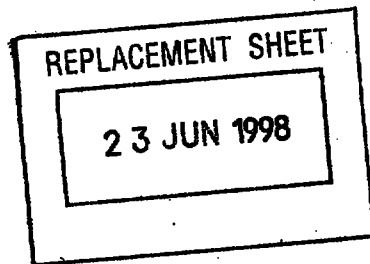


FIG. 6(c)



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REPLACEMENT SHEET

FIG. 7(a)

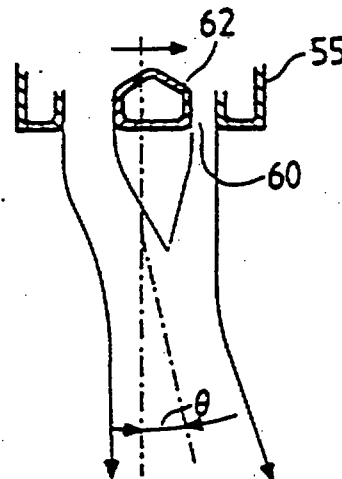


FIG. 7(b)

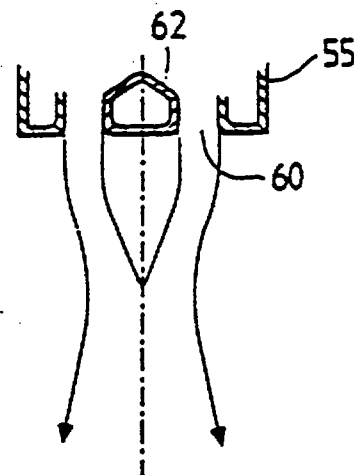
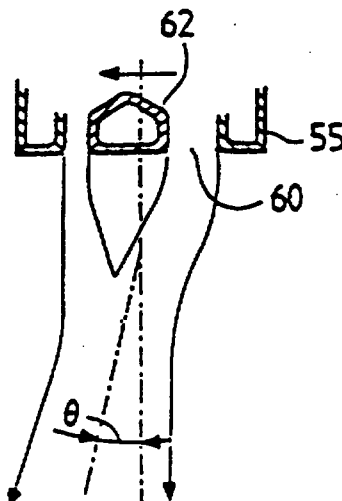
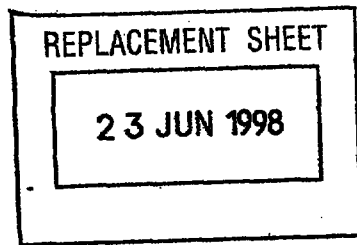


FIG. 7(c)



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REPLACEMENT SHEET

FIG. 8(a)

FIG. 8(b)

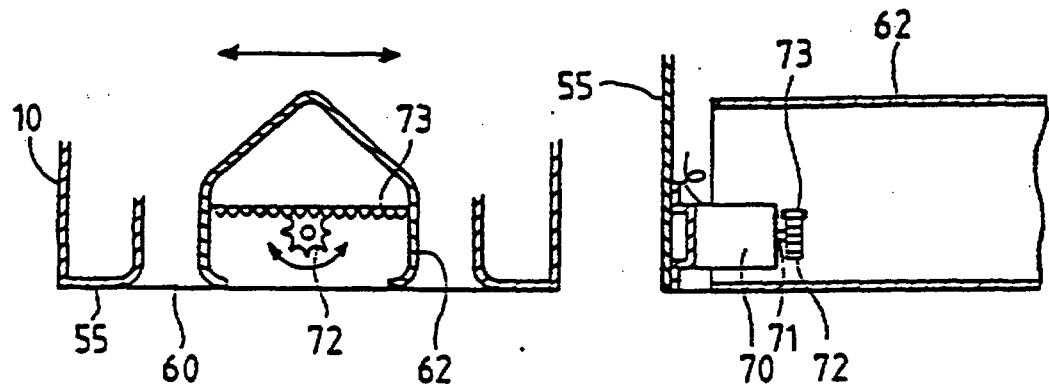
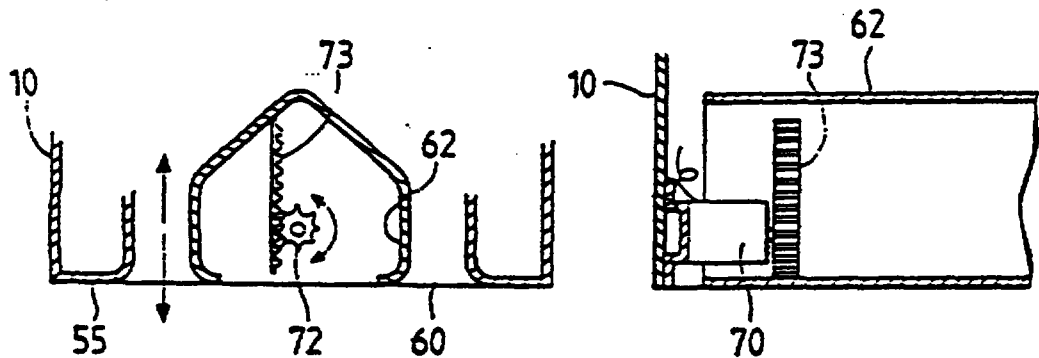


FIG. 9(a)

FIG. 9(b)



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FIG. 10

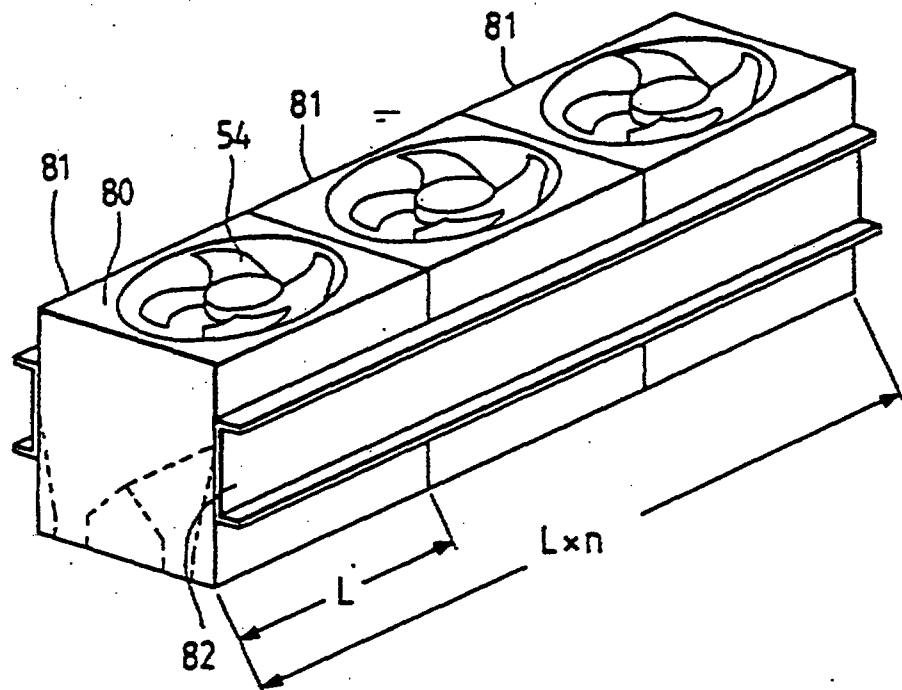
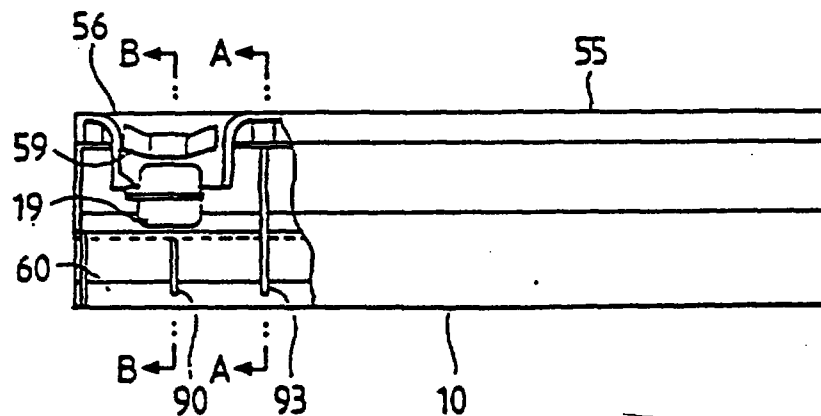
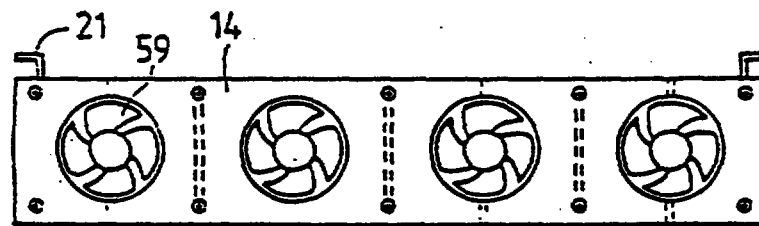
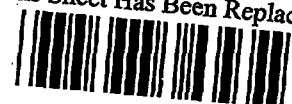


FIG. 11



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REPLACEMENT SHEET

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REPLACEMENT SHEET

FIG. 12

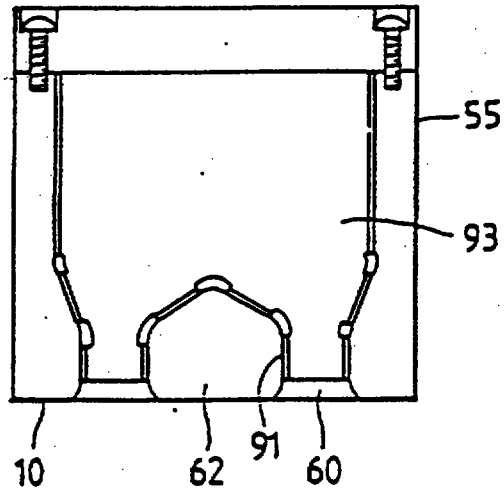
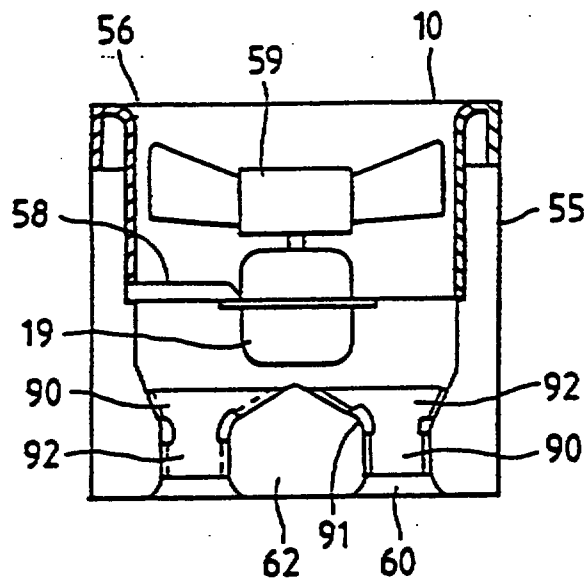
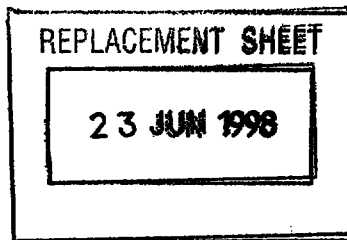


FIG. 13



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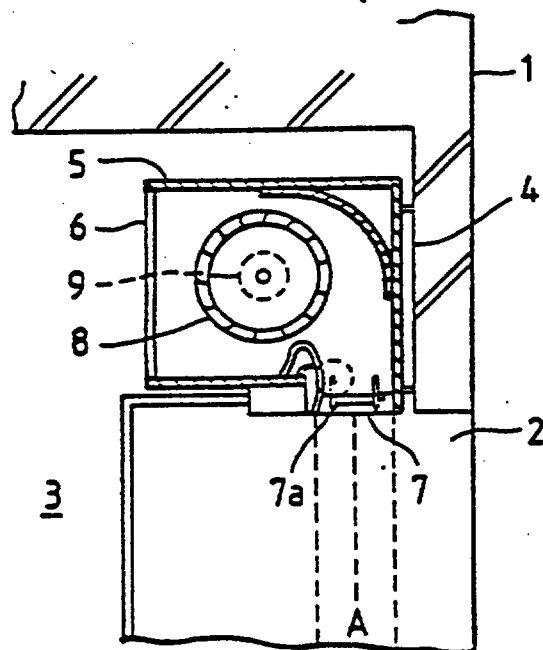


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REPLACEMENT SHEET

FIG. 14



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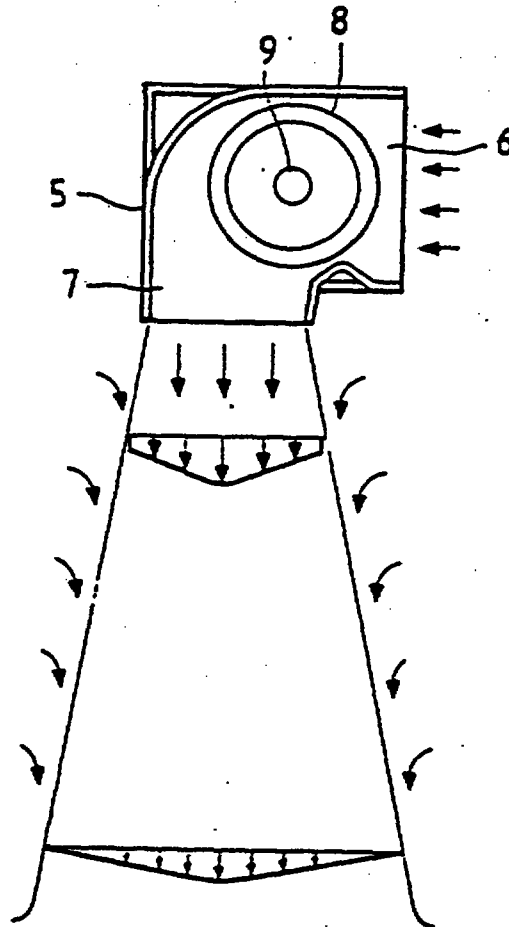
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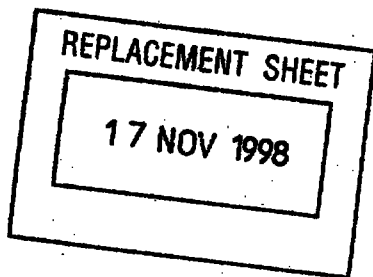
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FIG. 15



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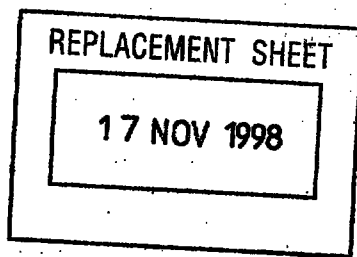


REPLACEMENT SHEET

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rectifying plate partitioning adjacent blowing means and disposed within said housing.

5. The blower according to claims 1, 2, 3 or 4, further comprising a heater or a lighting means, covered with a cover and disposed within said guide.



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BLOWER

REPLACEMENT SHEET

ABSTRACT OF THE DISCLOSURE

In a housing with an inlet port (12) opened upward and an outlet port (17) opened downward, a plate having a plural number of bellmouths (13) is mounted on the side of each housing having the inlet port (12). The outlet port (17) is narrowed toward the center of the housing (11), thereby forming a small outlet port (18). A motor (19) with a vane wheel (20) is located within the housing (11).

FIGURE 2

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FIG. 3

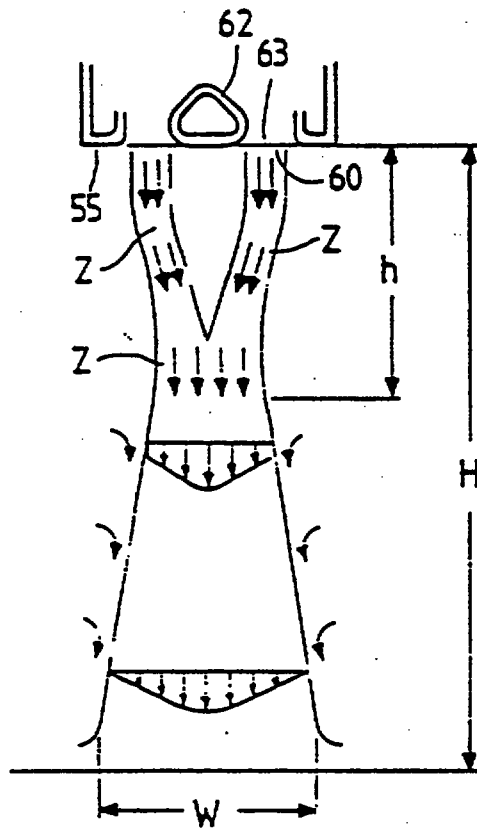


FIG. 4

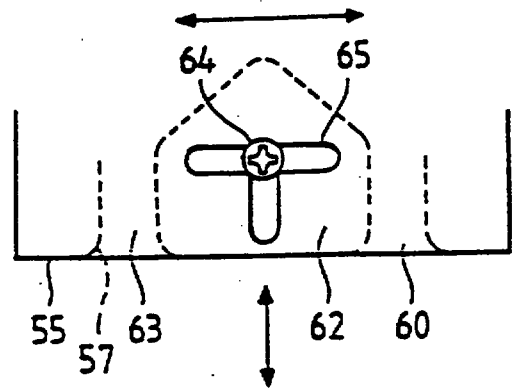
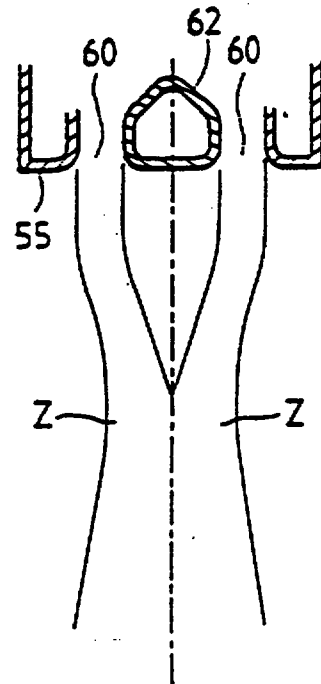


FIG. 5



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FIG. 6a

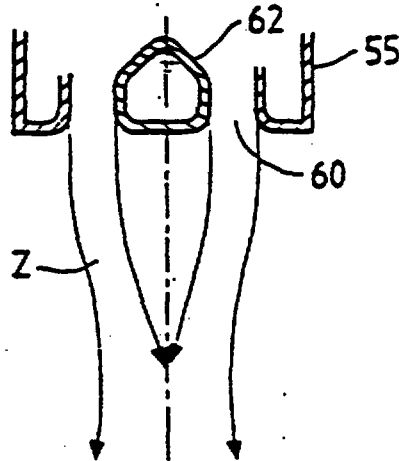


FIG. 6b

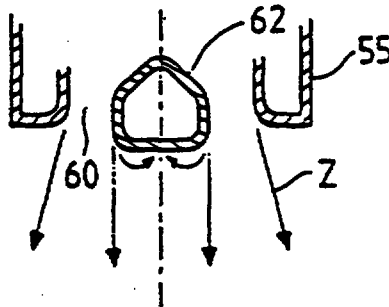


FIG. 6c

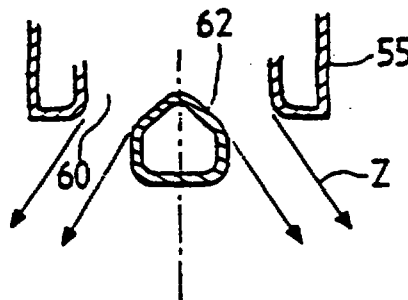


FIG. 7a

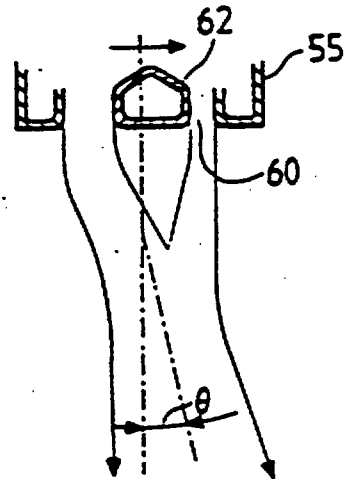


FIG. 7b

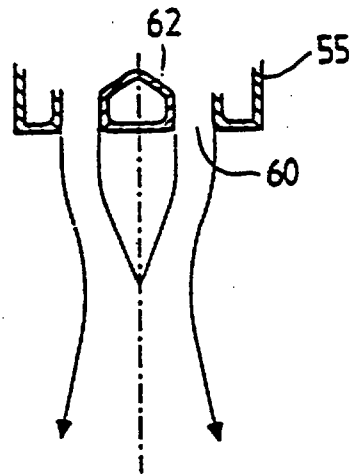
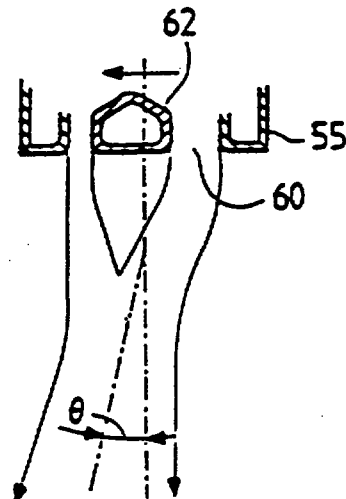
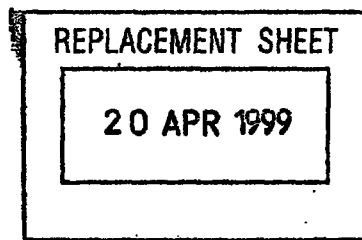


FIG. 7c





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REPLACEMENT SHEET

FIG. 8a

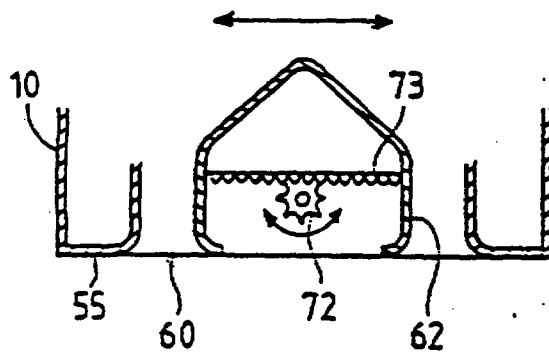


FIG. 8b

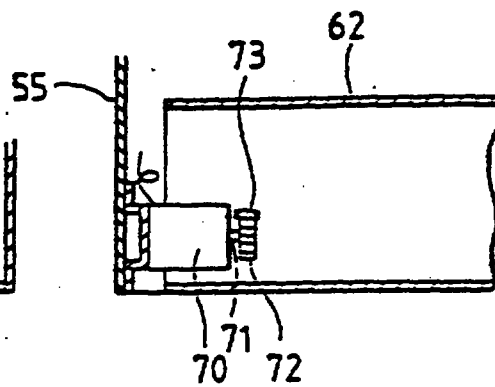


FIG. 9a

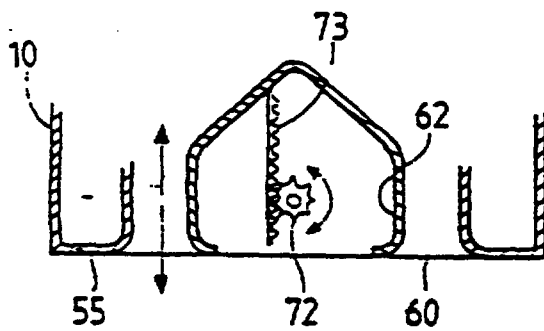
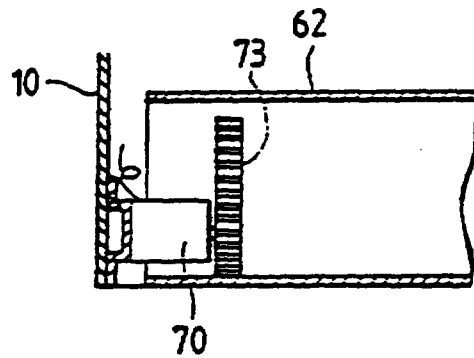


FIG. 9b



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FIG. 10

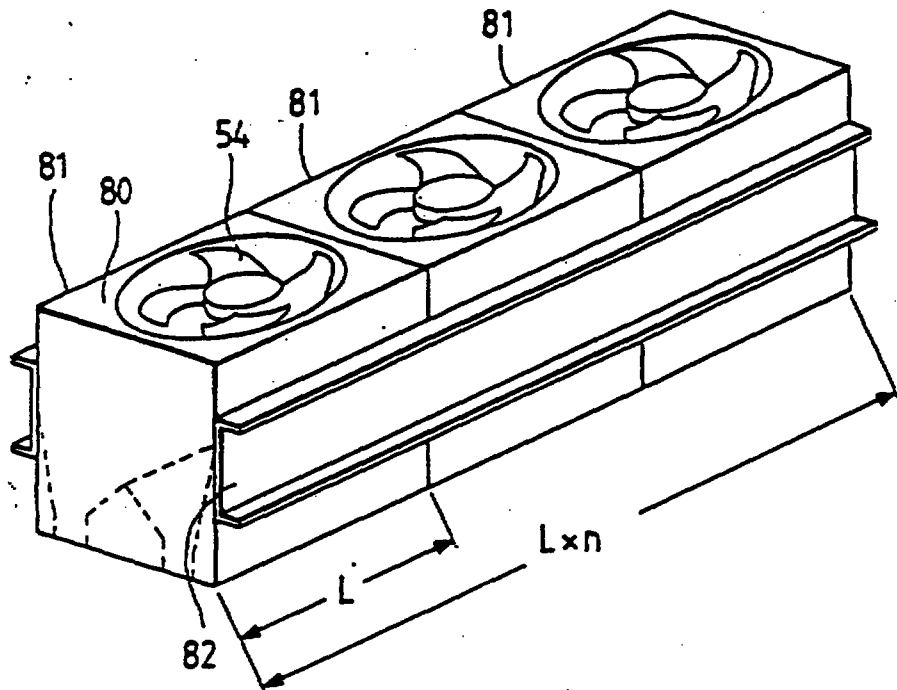


FIG. 11

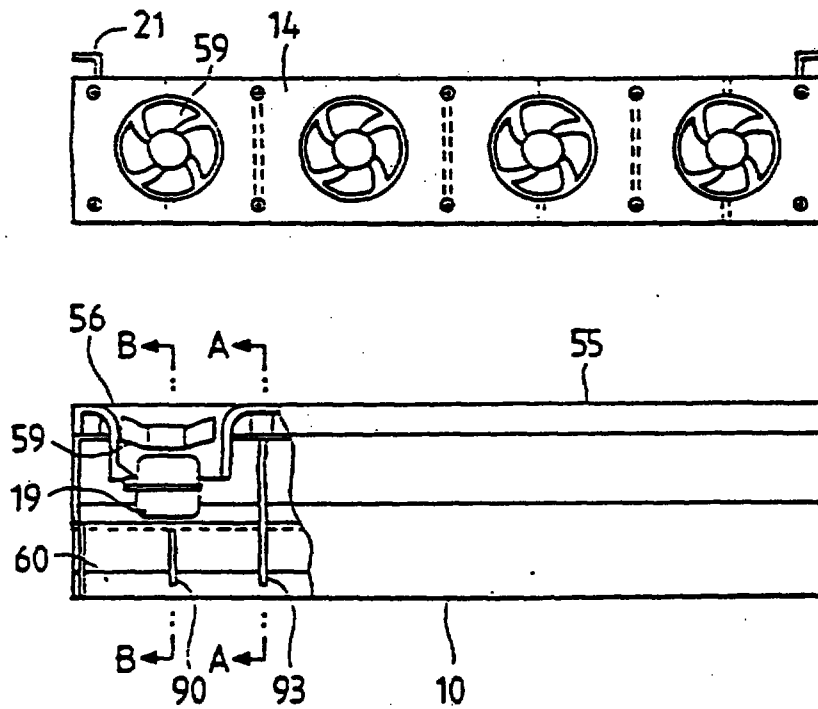


FIG. 12

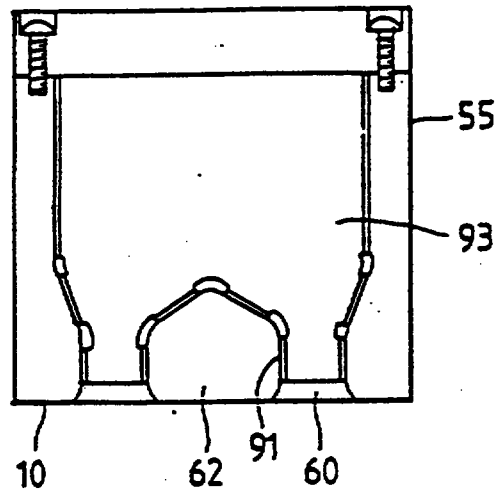
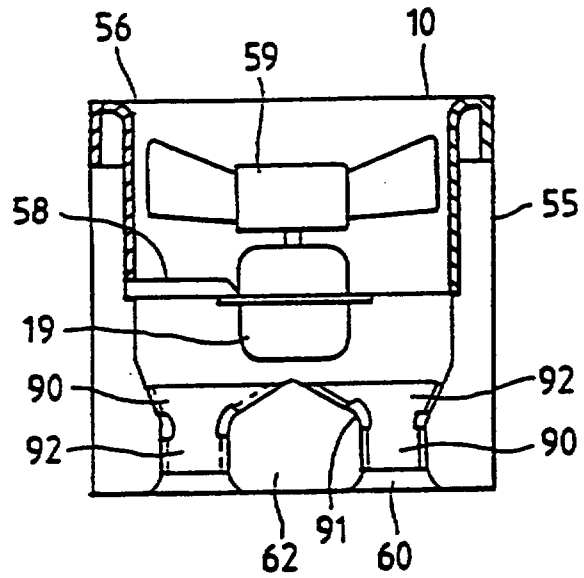


FIG. 13



REPLACEMENT SHEET

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REPLACEMENT SHEET

FIG. 14

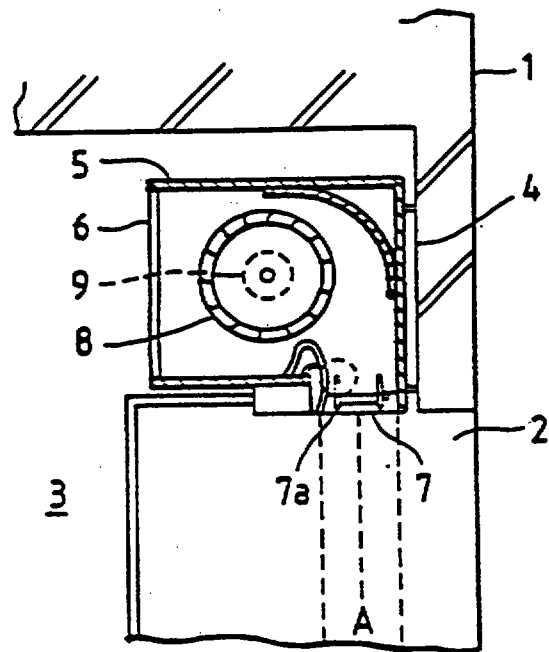


FIG. 15

