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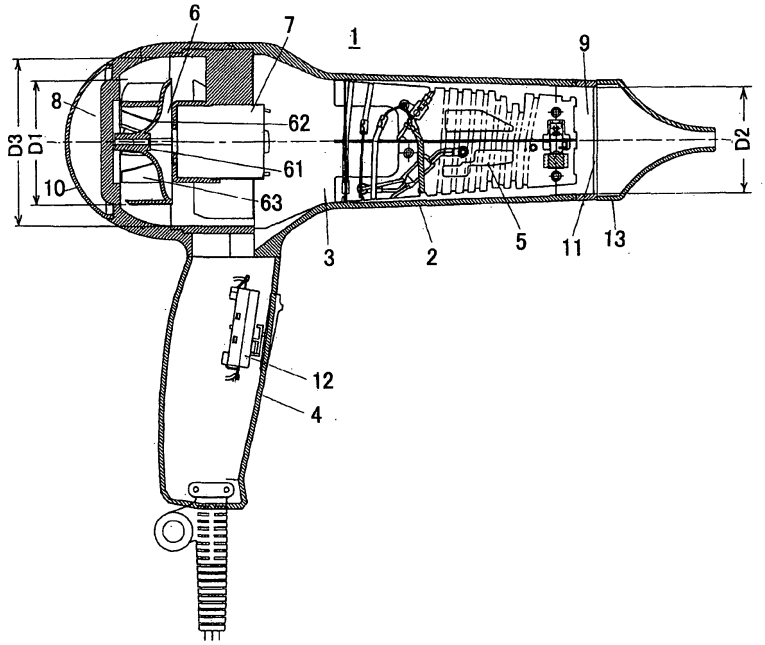
(54) Hair dryer

(57) A hair dryer (1) comprises a housing (2) having a substantially cylindrical air tunnel (3), a fan (6) provided in the air tunnel (3), a motor (7) for revolving the fan (6), and a heater (5). The fan (6) is a centrifugal fan having a revolution shaft (61), a circular disc (62) perpendicular to the revolution shaft (61), and a plurality of impeller blades (63) each provided substantially perpendicular to the circular disc (62) but curved with respect to a radial line passing the center axis of the revolution shaft (61). The outer diameter D1 of the fan (6) and the inner diameter D2 of the outlet (9) of airflow of the air tunnel (3) are selected so that the value D1/D2 in the region equal to or larger than 1.0 and equal to or smaller than 1.45, (1.0_D1/D2_1.45). Thereby, the hair dryer (1) can generate strong airflow with a constant volume without increasing rotation number of the motor (7) and without enlarging the outer diameter of the fan (6) by reducing the pressure loss due to the air tunnel.

FIG. 1



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Description

[0001] The present invention relates to configurations of a fan and an air tunnel of a hair dryer.

[0002] In hair dryers of high capacity such as hair dryers for professional use, it is desired to generate strong airflow by narrowing down a sectional area of an outlet of the airflow. However, when the sectional area of the outlet of the airflow is made narrower, pressure loss in the airflow path becomes larger, so that output power of a fan must be increased. Under such a condition of large pressure loss, centrifugal fans are generally used as disclosed in Japanese Laid-Open Patent Publication No. 2001-204537.

[0003] As mentioned above, when the sectional area of the outlet of the blow is made narrower, the pressure loss increases, so that it is necessary to increase revolution number of a motor or to enlarge an outer diameter of the fan. However, when the revolution number of the motor is increased, or the outer diameter of the fan is enlarged, it causes to increase a burden applied to the motor, and thereby there is a limit to increase the revolution number of the motor or to enlarge the outer diameter of the fan. Then, it is desired to design an air tunnel having low pressure loss so as to ensure a constant volume of airflow without increasing the burden to the motor.

[0004] A purpose of the present invention is to provide a hair dryer which can generate a constant volume of strong airflow without neither increasing revolution number of a motor nor enlarging an outer diameter of a fan by decreasing pressure loss in an air tunnel.

[0005] A hair dryer in accordance with an aspect of the present invention comprises a housing having a substantially cylindrical air tunnel, a fan provided in the air tunnel, a motor for revolving the fan and a heater. The fan is a centrifugal fan having a revolution shaft, a circular disc provided substantially perpendicular to a center axis of the revolution shaft, and a plurality of impeller blades each provided substantially perpendicular to the circular disc but curved with respect to a radial line passing the center axis of the revolution shaft. When an outer diameter of the fan is designated by a symbol D1 and an inner diameter of an outlet of airflow of the air tunnel of the housing is designated by a symbol D2, a value of D1/D2 is in a region equal to or larger than 1.0 and equal to or smaller than 1.45 (1.0_D1/D2_1.45).

[0006] Furthermore, it is preferable that when an inner diameter of the air tunnel surrounding the fan is designated by a symbol D3, a value of D1/D3 is in a range equal to or larger than 0.1 and equal to or smaller than 0.75 (0.6_D1/D3_0.75).

[0007] When the outer diameter D1 of the fan is enlarged (or a ratio D1/D2 is increased), a volume of air sucked by one revolution of the fan is increased, so that a volume of airflow is increased. However, a narrowing ratio of an airflow path in the air tunnel of the housing from a neighborhood of the fan to the outlet of the airflow becomes larger so that pressure loss in the air tunnel is increased. Thus, even though the outer diameter D1 of the fan is enlarged too much, it is not effective, so that it is preferable that the value D1/D2 is equal to or smaller than 1.45. Furthermore, when the outer diameter D1 of the fan is made smaller than the inner diameter D2 of the outlet of the airflow (that is, D1/D2<1.0), pressure loss due to expansion of airflow path in the air tunnel occurs. Therefore, it is preferable that the value D1/D2 is equal to or larger than 1.0. As mentioned above, by selecting the outer diameter D1 of the fan and the inner diameter D2 of the outlet of the airflow of the air tunnel of the housing so that the value D1/D2 in the region equal to or larger than 1.0 and equal to or smaller than 1.45, even when the same fan and motor as those of the conventional hair dryer are used, the volume of airflow of the hair dryer can be increased by reducing the pressure loss in the air tunnel.

[0008] When a clearance between the outer diameter D1 of the fan and the inner diameter D3 of the air tunnel surrounding the fan is increased, in other words, the value D1/D3 decreases, it is difficult to generate the airflow in a direction parallel to the revolution shaft of the fan. When the value of D1/D3 becomes smaller than 0.6, a value of the maximum efficiency of the fan suddenly falls. In contrast, when the clearance between the outer diameter D1 of the fan and the inner diameter D3 of the air tunnel surrounding the fan is decreased, in other words, the value D1/D3 increases, it is difficult to utilize the centrifugal force of the fan, so that the value of the maximum efficiency of the fan falls. When the value of D1/D3 becomes larger than 0.75, the value of the maximum efficiency of the fan suddenly falls. As mentioned above, by selecting the outer diameter D1 of the fan and the inner diameter D3 of the air tunnel of the housing surrounding the fan so that the value D1/D3 in the region equal to or larger than 0.6 and equal to or smaller than 0.75, even when the same fan and motor as those of the conventional hair dryer are used, the efficiency of the fan (output of the fan/ output of the motor) can be maximized.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009]

FIG. 1 is a sectional side view showing a configuration of a hair dryer in accordance with an embodiment of the present invention;

FIG. 2 is a front view showing a configuration of a fan of the above hair dryer;

FIG. 3 is a chart showing a relationship between a ratio D1/D2 of an outer diameter of the fan against an inner diameter D2 of an outlet of airflow of an air tunnel and pressure loss;

FIG. 4 is a chart showing definition of the pressure loss in the hair dryer; and

FIG. 5 is a chart showing a relationship between a ratio D1/D3 of the outside diameter D1 of the fan against an inner diameter D3 of the air tunnel surrounding the fan and a maximum efficiency of the fan.

DETAILED DESCRIPTION OF THE EMBODIMENT

[0010] A hair dryer in accordance with an embodiment of the present invention is described with reference to the figures. FIG. 1 shows a configuration of a hair dryer 1 in accordance with this embodiment. A housing 2 of the hair dryer 1 has an air tunnel 3 having substantially cylindrical shape and a grip 4 which is formed substantially perpendicular to the sir tunnel 3. The hair dryer 1 further comprises a heater 5, a fan 6 and a motor 7 for driving revolution of the fan 6 which are provided in an inside of the air tunnel 3, grids 10 and 11 which are attached to an inlet 8 and an outlet 9 of airflow of the air tunnel 3 for preventing foreign matter from getting into the air tunnel 3, an operation switch 12 provided on the grip 4, and a nozzle 13 detachably attached to the outlet 9 of airflow. The fan 6 is provided at a portion in the vicinity of the inlet 8 of airflow.

[0011] FIG. 2 shows a shape of the fan 6 observed from front. The fan 6 is a centrifugal fan which is generally used in a case that pressure loss is larger. The fan 6 has a revolution shaft 61, a circular disc 62 provided substantially perpendicular to a center axis of the revolution shaft 61 and a plurality of impeller blades 63 each of which is substantially perpendicular to the circular disc 62 and curved in a predetermined direction against a radial line passing the center axis of the revolution shaft 61. The circular disc 62 may be gently slanted toward a downstream side in an airflow path from the revolution axis 61 to outer periphery thereof, as shown in FIG. 1. When it is attended to neighboring two impeller blades 63, these two impeller blades 63 are formed so that a distance between them becomes gradually wider from inner portion near to the revolution axis 61 to outer periphery of the circular disc 62.

[0012] FIG. 3 shows a relationship between a ratio D1/D2 of an outer diameter of the fan 6 against an inner diameter D2 of the outlet 9 of airflow of the air tunnel 3 of the housing 2 and pressure loss of the hair dryer. In FIG. 3, abscissa shows value of the ratio D1/D2 of the outer diameter of the fan 6 against the inner diameter D2 of the outlet 9 of airflow, and ordinate shows value of the pressure loss of the hair dryer. The inner diameter D2 of the outlet 9 of airflow denotes not an inner diameter of a thing such as heater 5 contained in the housing 2 but an inner diameter of the housing 2 serving as the outlet 9 of airflow in a state that the nozzle 13 is not attached thereto. In addition, the outer diameter D1 of the fan denotes not the diameter of the circular disc 61 but a diameter at the most outside portion of the impeller blades 63.

[0013] As can be seen from FIG. 3, when the ratio D1/D2 takes a value between 1.0 and 1.45, the pressure loss of the hair dryer takes a minimum value, and when the value of the ratio D1/D2 becomes smaller than 1.0 or larger than 1.45, the pressure loss of the hair dryer shows a tendency to increase. Under an assumption that the revolution number of the motor 7 is constant, when the outer diameter D1 of the fan 6 is enlarged (or the ratio D1/D2 is increased), a volume of air sucked by one revolution of the fan 6 is increased, so that a volume of airflow is increased. However, a narrowing ratio of an airflow path in the air tunnel 3 of the housing 2 from a neighborhood of the fan 6 to the outlet 9 of airflow becomes too large so that pressure loss in the air tunnel 3 is increased. Thus, it is not effective even when the outer diameter D1 of the fan 6 is formed larger too much. In addition, when the outer diameter D1 of the fan 6 is made smaller than the inner diameter D2 of the outlet 9 of airflow (that is, D1/D2<1.0), pressure loss due to expansion of airflow path in the air tunnel 3 occurs. Thus, by selecting the outer diameter D1 of the fan 6 and the inner diameter D2 of the outlet 9 of airflow of the air tunnel 3 of the housing 2 so that the value D1/D2 in the region equal to or larger than 1.0 and equal to or smaller than 1.45, even when the same fan 6 and motor 7 as those of the conventional hair dryer are used, the volume of airflow of the hair dryer 1 can be increased by reducing the pressure loss in the air tunnel 3.

[0014] FIG. 4 shows definition of the pressure loss of the hair dryer. In FIG. 4, abscissa shows value of a volume of airflow generated by one revolution of the fan, and ordinate shows value of pressure of the airflow. A characteristic curve designated by a symbol PQ shows a PQ-characteristic of the fan which shows a performance of the fan. As can be seen from PQ-characteristic curve, the larger the volume of airflow becomes, the lower the pressure decreases. On the other hand, a characteristic curve designated by a symbol PL shows a pressure loss characteristic curve showing a relation between the volume of airflow and the pressure loss due to the air tunnel and the built-in objects contained therein. Generally, the larger the volume of airflow becomes, the larger the pressure loss increases. A cross point P of the PQ-characteristic curve and the pressure loss characteristic curve corresponds to the pressure loss of the hair dryer mentioned here. If the pressure loss due to the air tunnel and the built-in objects is decreased, the inclination of the pressure loss characteristic curve becomes gentle, so that the cross point P of the PQ-characteristic curve and the pressure loss characteristic curve shifts rightward in the figure, and thereby, the value of the pressure at the cross point P falls and the volume of airflow increases.

[0015] Subsequently, FIG. 5 shows a relation between the ratio D1/D3 of the outer diameter D1 of the fan 6 against the inner diameter D3 of the air tunnel 3 surrounding the fan 6 and the maximum efficiency of the fan. As can be seen from FIG. 5, the value of the ratio D1/D3 has a maximum value in the vicinity of the value 0.6, and the value of the maximum efficiency of the fan suddenly falls when the value of the ratio D1/D3 becomes smaller

than 0.6 or larger than 0.75. The cause of this phenomenon is considered as follows. When the clearance between the outer diameter D1 of the fan 6 and the inner diameter D3 of the air tunnel surrounding the fan 6 becomes larger, in other words, the value of the ratio D1/D3 decreases, it is hard to generate airflow in a direction parallel to the axis of the revolution shaft 61. Alternatively, when the clearance between the outer diameter D1 of the fan 6 and the inner diameter D3 of the air tunnel surrounding the fan 6 becomes smaller, in other words, the value of the ratio D1/D3 increases, centrifugal force of the fan 6 cannot be utilized sufficiently so that the efficiency of the fan falls. Thus, by selecting the outer diameter D1 of the fan 6 and the inner diameter D3 of the air tunnel 3 of the housing 2 surrounding the fan 6 so that the value D1/D3 in the region equal to or larger than 0.6 and equal to or smaller than 0.75, even when the same fan 6 and motor 7 as those of the conventional hair dryer are used, the efficiency of the fan (output of the fan/ output of the motor) can be maximized.

[0016] As mentioned above, when the outer diameter D1 of the fan 6 and the inner diameter D2 of the outlet 9 of airflow of the air tunnel 3 of the housing 2 are selected so that the value D1/D2 in the region equal to or larger than 1.0 and equal to or smaller than 1.45, it is possible to increase the volume of airflow generated by the hair dryer 1 due to reduction of the pressure loss in the air tunnel 3 although the same performance of the fan using the same fan 6 and motor 7 as those of the conventional hair dryer. Furthermore, when the outer diameter D1 of the fan 6 and the inner diameter D3 of the air tunnel 3 of the housing 2 surrounding the fan 6 are selected so that the value D1/D3 in the region equal to or larger than 0.6 and equal to or smaller than 0.75, it is possible to maximize the efficiency of the fan (output of the fan/ output of the motor) although the same performance of the fan using the same fan 6 and motor 7 as those of the conventional hair dryer. As a result, the hair dryer which generates strong airflow with a constant volume can be provided without increasing the rotation number of the motor and without enlarging the outer diameter of the fan by reducing the pressure loss due to the air tunnel.

Claims

1. A hair dryer (1) comprising a housing (2) having a substantially cylindrical air tunnel (3), a fan (6) provided in the air tunnel (3), a motor (7) for revolving the fan (6), and a heater (5), wherein
   the fan (6) is a centrifugal fan having a revolution shaft (61), a circular disc (62) provided substantially perpendicular to a center axis of the revolution shaft (61), and a plurality of impeller blades (63) each provided substantially perpendicular to the circular disc (62) but curved with respect to a radial line passing the center axis of the revolution shaft (61); and
   when an outer diameter of the fan (6) is designated by a symbol D1 and an inner diameter of an outlet (9) of airflow of the air tunnel (3) of the housing (2) is designated by a symbol D2, a value of D1/D2 is in a region equal to or larger than 1.0 and equal to or smaller than 1.45 (1.0_D1/D2_1.45).

2. The hair dryer in accordance with claim 1, wherein when an inner diameter of the air tunnel (3) surrounding the fan (6) is designated by a symbol D3, a value of D1/D3 is in a range equal to or larger than 0.1 and equal to or smaller than 0.75 (0.6_D1/D3_0.75).

3. The hair dryer in accordance with claim 1 or 2, wherein the circular disc (62) of the fan (6) is gently slanted toward a downstream side in an airflow path from the revolution axis to outer periphery thereof.

4. The hair dryer in accordance with one of claims 1 to 3, wherein
   neighboring two impeller blades (63) of the fan (6) are formed so that a distance between them becomes gradually wider from inner portion near to the revolution axis to outer periphery of the circular disc (62).

FIG. 1

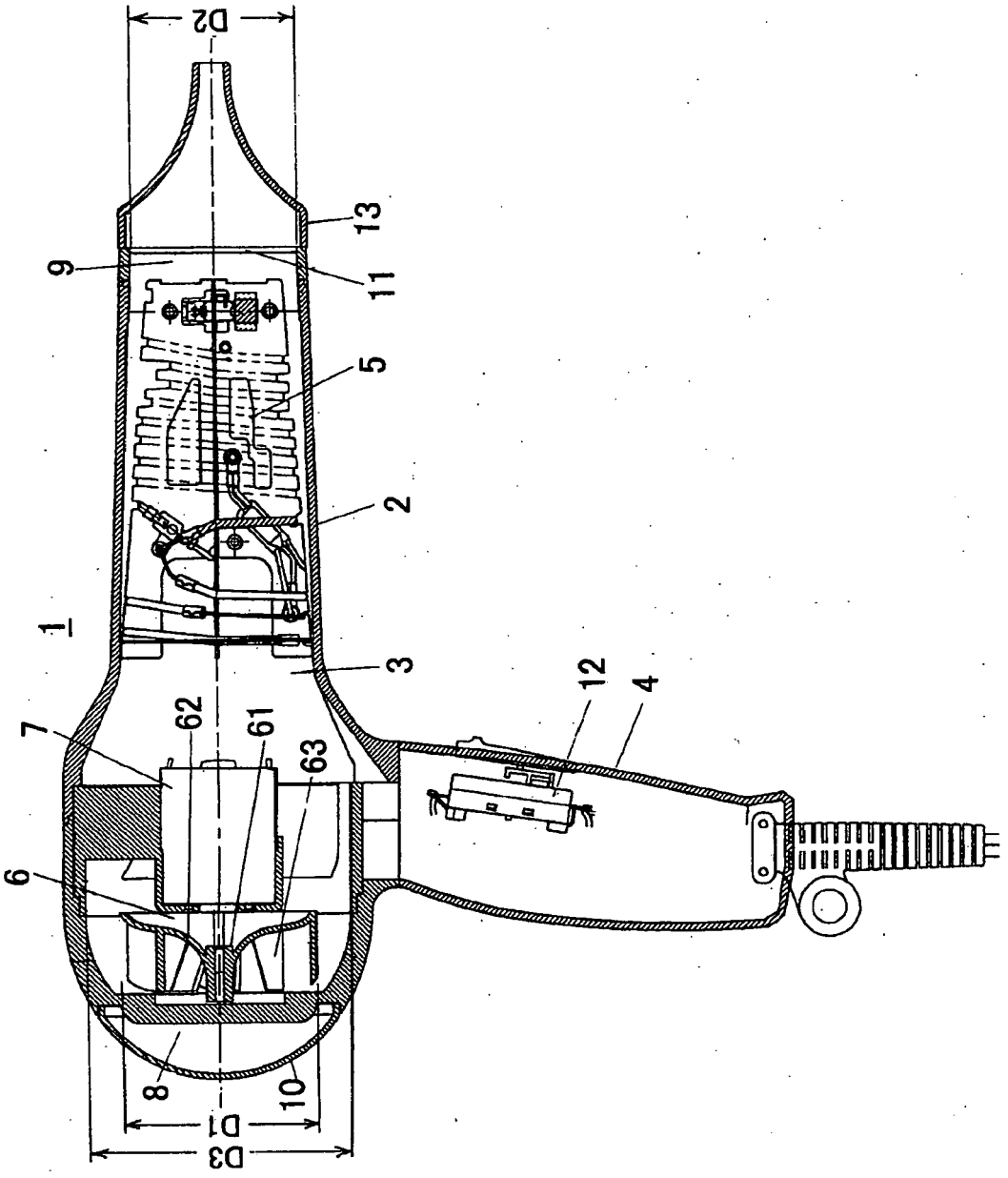


FIG. 2

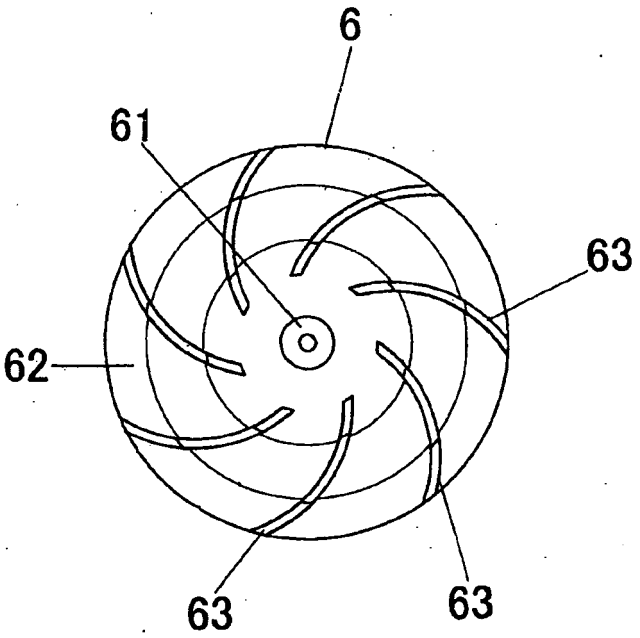


FIG. 3

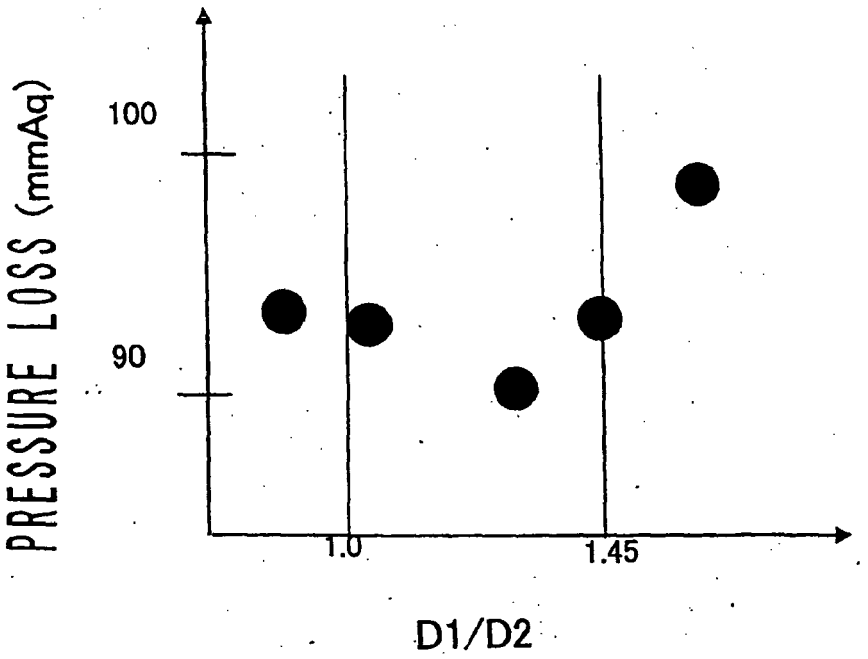


FIG. 4

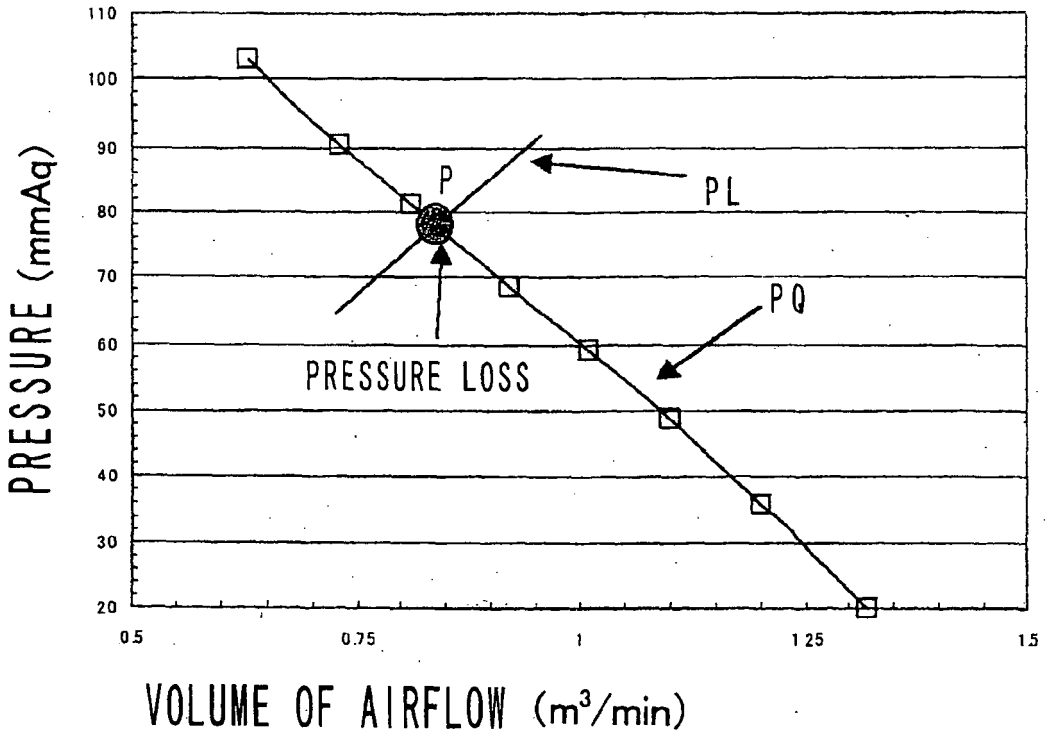
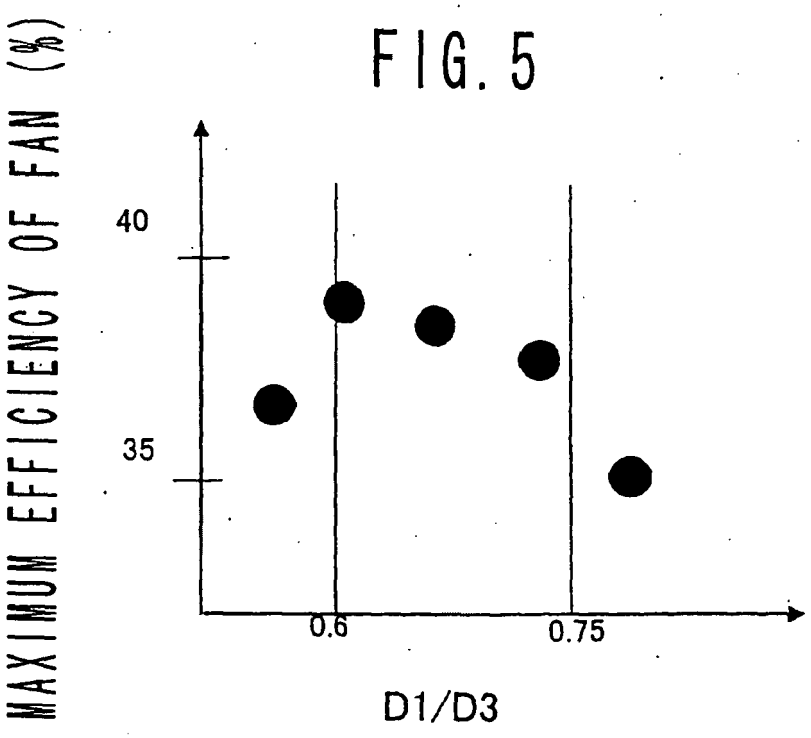

110
100
90
80
70
60
50
40
30
20
PRESSURE (mmAq)
P
PL
PQ
PRESSURE LOSS
0.5
0.75
1
1.25
1.5
VOLUME OF AIRFLOW (m³/min)

FIG. 5



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EUROPEAN SEARCH REPORT

Application Number
EP 06 00 6042

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
A	US 2002/174559 A1 (KAMADA KENJI ET AL) 28 November 2002 (2002-11-28) * paragraph [0023] * * page 2, lines 5-8 * * figures 2,3 *	1	INV. A45D20/12
A,D	PATENT ABSTRACTS OF JAPAN vol. 2000, no. 24, 11 May 2001 (2001-05-11) -& JP 2001 204537 A (MATSUSHITA ELECTRIC WORKS LTD), 31 July 2001 (2001-07-31) * abstract * * figures 1,2,9 *	1	
A	DE 195 00 994 A1 (BRAUN AKTIENGESELLSCHAFT, 60326 FRANKFURT, DE) 18 July 1996 (1996-07-18) * figures 1,2 *	3,4	

TECHNICAL FIELDS SEARCHED (IPC)

A45D

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
	26 July 2006	Witkowska-Piela, A

CATEGORY OF CITED DOCUMENTS

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26-07-2006

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

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Patent documents cited in the description

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