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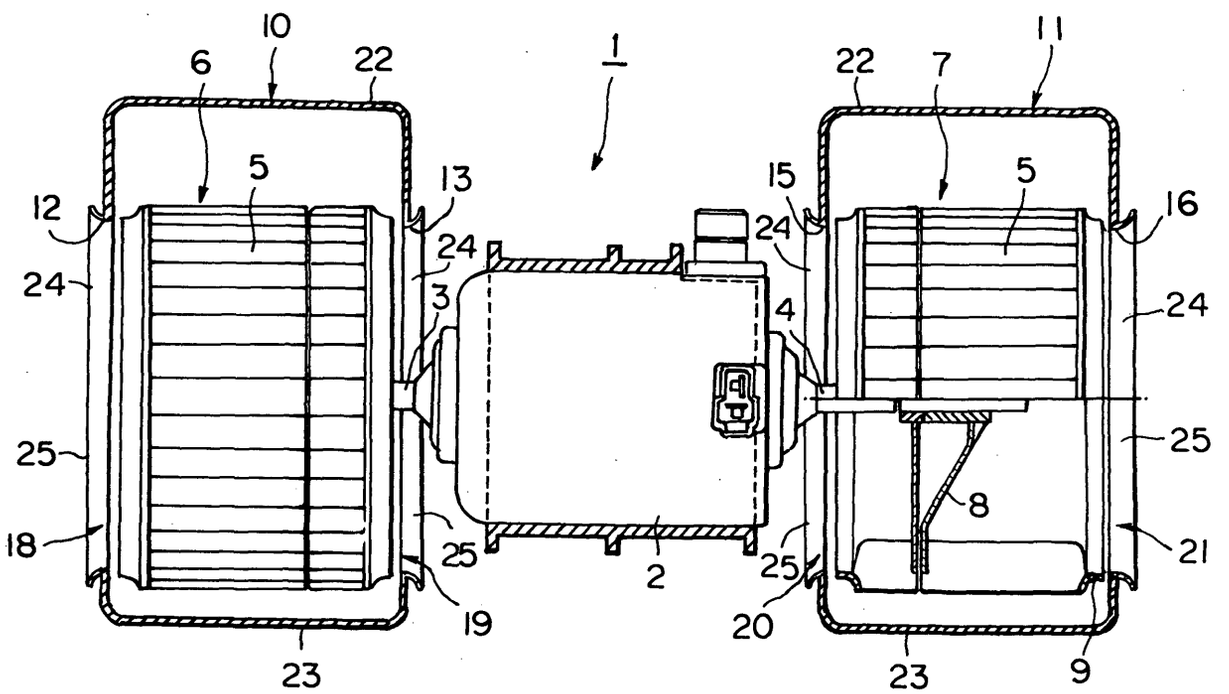
(54) Centrifugal blower

(57) A centrifugal blower (1) comprises a multiblade fan (6, 7) having a plurality of blades (5) disposed around a rotary shaft (3, 4) in the circumferential direction, and a casing (10, 11) containing the multiblade fan (6, 7), wherein air sucked through an air intake port (12, 13, 15, 16) opened on the casing (10, 11) is sucked from a radial inside to a radial outside through a portion between adjacent blades (5). In the blower (1), a bellmouth (18, 19, 20, 21) having a diameter increasing toward an outside of the casing (10, 11) is provided to the air intake port (12, 13, 15, 16). The bellmouth (18, 19, 20, 21) can be easily provided without using a complicated mold and without increase of number of parts. By the bellmouth (18, 19, 20, 21), the blast performance of the blower may be improved, and the generation of noise from the blower may be suppressed.

FIG. 1



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Description

[0001] The present invention relates to a centrifugal blower, and, more specifically, to a centrifugal blower suitable particularly for an air conditioning system for vehicles, in which a bellmouth is provided to an air intake port of a casing.

[0002] A conventional centrifugal blower used in an air conditioning system for vehicles is constructed, for example, as shown in Figs. 7 and 8 (for example, JP-A-8-109897). In Fig. 7, a centrifugal blower 100 has a motor 101, and multiblade fans 104 and 105 are provided on the ends of rotary shafts 102 and 103 connected to the motor 101. Fans 104 and 105 are contained in casings 106 and 107, respectively. Air intake ports 108 and 109 are provided on both sides of casing 106, and air intake ports 111 and 112 are provided on both sides of casing 107. Air sucked through air intake ports 108 and 109 is discharged from the radial inside of fan 104 to the radial outside of the fan 104, and sent to a heater unit (not shown) of an air conditioning system through a flow path 110 formed in casing 106. Similarly, air sucked through air intake ports 111 and 112 is discharged from the radial inside of fan 105 to the radial outside of the fan 105, and sent to the heater unit of the air conditioning system through a flow path 113 formed in casing 107. Each of casings 106 and 107 are formed from two casing forming members 114 and 115 capable of being divided into each other in the arrow directions (in the radial direction of the multiblade fan) shown in Fig. 8.

[0003] In a centrifugal blower, generally it is considered that, if a bellmouth is provided to each air intake port, because residence or back flow of air near the air intake port is prevented and the air flow may be stabilized, reduction of blast performance and generation of noise at the time of air suction may be prevented. In the above-described centrifugal blower, however, if a bellmouth is provided to each of casings 106 and 107 integrally with the casing, the structure of a mold for molding the casing may become complicated. Therefore, at least in a double-axis type centrifugal blower as described above, a centrifugal blower having a bellmouth on each air intake port integrally with the air intake port has not been known as long as the inventor of the present invention has investigated. In a single-axis type centrifugal blower, although a structure as shown in Fig.9, where a bellmouth 116 having a diameter decreasing toward the inside of casing 117 is provided to an air intake port 118 integrally with the air intake port, is known (for example, JP-A-3-100399), this bellmouth 116 extends toward the inside of casing 117, and therefore, the mold for molding the casing also may become complicated and a sliding mechanism for divided molds may be required for setting and removing of the molds. Further, particularly to a double-axis type centrifugal blower, application of such a structure of bellmouth 116 requiring complicated molds may be difficult.

[0004] On the other hand, even if it is intended to form such a bellmouth separately and attach it to an air intake port after assembly, particularly in a double-axis type centrifugal blower as described above, because axes 102 and 103 and motor 101 exist, it may be difficult to attach a bellmouth 116 to each of air intake ports 109 and 112. Further, the number of parts increases, and the cost for manufacturing the blower may increase.

[0005] It would be desirable to provide a centrifugal blower which can easily provide a bellmouth to each air intake port without use of a complicated mold for molding a casing forming member and without increase of number of parts, thereby effectively preventing reduction of the blast performance of the blower and generation of noise from the blower.

[0006] A centrifugal blower according to the present invention comprises a multiblade fan having a plurality of blades disposed around a rotary shaft in the circumferential direction, and a casing containing the multiblade fan, and air sucked through an air intake port opened on the casing is sucked from a radial inside to a radial outside through a portion between adjacent blades. The centrifugal blower is characterized in that a bellmouth having a diameter increasing toward an outside of the casing is provided to the air intake port.

[0007] In the centrifugal blower according to the present invention, the casing may be made of a resin. Further, the bellmouth may be formed integrally with the casing. In the structure where the bellmouth is formed integrally with the casing, the number of parts is reduced as compared with a case where the bellmouth is formed separately from the casing. Further, when the casing is molded (for example, injection molding), it becomes possible to mold the casing and the bellmouth simultaneously. Therefore, the cost for manufacturing the casing, ultimately, the whole of the blower, may be reduced.

[0008] Further, the casing may be formed from a plurality of casing forming members capable of being divided into each other in a radial direction of the multiblade fan. For example, it is preferred that the casing is formed from two casing forming members capable of being divided into each other in the radial direction of the multiblade fan. By forming the casing from a plurality of casing forming members, when the bellmouth is molded integrally with the casing, each casing forming member having a bellmouth forming portion with a complicated shape may be easily molded with a simple mold which does not have a complicated structure such as a slide structure. Therefore, the cost of the mold may be reduced. Further, by making the structure of the mold simple without using a slide structure and the like, the durability and the reliability of the mold may be increased, and the quality of the casing forming members may be improved.

[0009] The present invention may be applied to both of a single-axis type centrifugal blower, in which a multiblade fan is provided on one side of a rotary shaft, and a double-axis type centrifugal blower, in which the multiblade fan is provided on each end of the rotary shaft to

form a double-axis type fan structure. In particular, the advantage according to the present invention is great in a case where the present invention is applied to a double-axis type centrifugal blower.

[0010] In the above-described centrifugal blower according to the present invention, since the bellmouth having a diameter increasing toward the outside of the casing is provided to the air intake port opened on the casing, residence and back flow of air near the air intake port may be prevented, and the air flow may be stabilized. Therefore, decrease of the blast performance ascribed to reduction of the amount of sucked air and generation of noise at the time of air suction may be effectively prevented. Since this bellmouth extends toward the outside of the casing, when the casing forming member is molded, the bellmouth portion may be easily molded integrally with the casing forming member by a simple mold without a complicated slide structure and the like. Further, increase of the number parts may be prevented by forming the bellmouth portion integrally with the casing forming member. Especially, the bellmouth may be easily formed by forming the casing from a plurality of casing forming members capable of being divided into each other in the radial direction of the multiblade fan.

[0011] Thus, in the present invention, a desirable bellmouth may be formed on each air intake port easily and inexpensively without using a complicated mold structure. In particular, by applying the present invention to a double-axis type centrifugal blower, a centrifugal blower having a desirable property may be manufactured easily and inexpensively.

[0012] Further features and advantages of the present invention will be understood from the following detailed description of the preferred embodiment of the present invention with reference to the accompanying figures, of which:

Fig. 1 is a vertical sectional view of a centrifugal blower according to an embodiment of the present invention.

Fig. 2 is a side view of the centrifugal blower depicted in Fig. 1.

Fig. 3 is an enlarged partial sectional view of a portion of an air intake port of the centrifugal blower depicted in Fig. 1.

Fig. 4 is an enlarged side view of a multiblade fan of the centrifugal blower depicted in Fig. 1.

Fig. 5 is a graph showing the relationship between a flow rate coefficient and a pressure coefficient in the centrifugal blower depicted in Fig. 1 and in a conventional centrifugal blower having no bellmouth.

Fig. 6 is a graph showing the relationship between an air amount and a static pressure in the centrifugal blower depicted in Fig. 1 and in a conventional centrifugal blower having no bellmouth.

Fig. 7 is a vertical sectional view of a conventional centrifugal blower.

Fig. 8 is a side view of the centrifugal blower depicted in Fig. 7.

Fig. 9 is an enlarged partial sectional view of a portion of an air intake port of another conventional centrifugal blower.

[0013] Figs. 1 to 4 show a centrifugal blower according to an embodiment of the present invention. In this embodiment, a centrifugal blower 1 is constructed as a blower used in an air conditioning system for vehicles. Centrifugal blower 1 has a motor 2, and it is constructed as a double-axis type centrifugal blower. Multiblade fans 6 and 7 each having a plurality of blades 5 are provided at the ends of rotary shafts 3 and 4 of motor 2. The plurality of blades 5 are disposed around each of rotary shafts 3 and 4 in the circumferential direction, as shown in Fig. 4. Each of rotary shafts 3 and 4 are connected to the plurality of blades 5 via a drive plate 8 formed as a disc-like plate, and the drive plates 8 and blades 5 are rotated accompanying with the rotation of rotary shafts 3 and 4 in a predetermined direction as shown by the arrow in Fig. 4. A connection ring 9 is provided on blades 5 of each of multiblade fans 6 and 7 for connecting the blades 5 to each other and reinforcing and maintaining the connection formation.

[0014] Multiblade fans 6 and 7 are contained in scroll-type casings 10 and 11, respectively. Air intake ports 12 and 13 are opened on casing 10, and air sucked through air intake ports 12 and 13 is discharged from the radial inside of multiblade fan 6 to the radial outside of the multiblade fan 6. The discharged air is sent to a heater unit (not shown) of an air conditioning system through a flow path 14. Similarly, air intake ports 15 and 16 are opened on casing 11, and air sucked through air intake ports 15 and 16 is discharged from the radial inside of multiblade fan 7 to the radial outside of the multiblade fan 7.

[0015] The discharged air is sent to the heater unit of the air conditioning system through a flow path 17.

[0016] Bellmouths 18, 19, 20 and 21 are provided to respective air intake ports 12, 13, 15 and 16. Each of bellmouths 18, 19, 20 and 21 extends from each of air intake ports 12, 13, 15 and 16 toward the outside of casing 10 or 11, and the diameter of each bellmouth increases toward the outside of the casing. Further, each of bellmouths 18, 19, 20 and 21 is formed integrally with casing 10 or 11. Each casing with each bellmouth is formed from, for example, a resin.

[0017] As shown in Figs. 1 and 2, each of casings 10 and 11 is formed from two casing forming members 22 and 23 capable of being divided into each other in the radial direction of multiblade fan 6 or 7. On each casing forming member 22 or 23, a semi-circular bellmouth forming portion 24 or 25 is provided.

[0018] Divided casing forming members 22 and 23 forms casing 10 or 11 by being connected to each other, and each bellmouth having a circular shape is formed

by connection of bellmouth forming portions 24 and 25 at the time of the formation of casing 10 or 11.

[0019] Further, in this embodiment, casing forming members 22 and 23 are formed so as to be divided in the arrow directions shown in Fig. 2. Therefore, by designing the parting lines of molds for molding casing forming members 22 and 23 so as to meet with the division lines shown in Fig. 2, bellmouth forming portions 24 and 25 may be easily molded integrally with casing forming members 22 and 23 without using a complicated structure such as a slide mechanism and the like.

[0020] In the centrifugal blower 1 thus constructed, since bellmouths 18, 19, 20 and 21 each having a diameter increasing toward the outside of each casing are provided to respective air intake ports 12, 13, 15 and 16 of respective casings 10 and 11, residence and back flow of air near each air intake port may be appropriately prevented, the air flow from each air intake port to the inside of each casing may be stabilized, and the pressure loss may be reduced. Therefore, because the variation of the amount of sent air ascribed to the variation of the amount of sucked air may be suppressed, the blast performance may be stabilized and improved and a desirable blast performance may be maintained. Further, because residence of air is prevented, noise generated at the time of air suction may be suppressed, and a quiet blower may be realized.

[0021] The relationship between the flow rate coefficient and the pressure coefficient in the above-described centrifugal blower 1 and in the conventional centrifugal blower 100 having no bellmouth shown in Fig. 7 is shown in Fig. 5. Further, the relationship between the air amount (amount of blown air) and the static pressure in the above-described centrifugal blower 1 and in the conventional centrifugal blower 100 having no bellmouth shown in Fig. 7 is shown in Fig. 6. As is evident from Fig. 5, in the centrifugal blower 1 of this embodiment, even if the flow rate (the flow rate coefficient) is increased, the pressure loss is suppressed small (the pressure coefficient is maintained to be high), as compared with those in the conventional centrifugal blower 100. Further, as is evident from Fig. 6, in the centrifugal blower 1 of this embodiment, a usage range for an air conditioning system, which exists between the resistance curve at the time of minimum load and the resistance curve at the time of maximum load, is enlarged as compared with that in the conventional centrifugal blower 100, and the advantage for improving the blast performance is exhibited.

[0022] Thus, the above-described centrifugal blower 1 having the respective bellmouths exhibits an excellent performance. Further, in this embodiment, since bellmouths 18 and 19 are formed integrally with casing 10 and bellmouths 20 and 21 are formed integrally with casing 11, the number of parts does not increase, and the cost up due to increase of the number of parts may be prevented. Furthermore, since casing forming members 22 and 23 and bellmouth forming portions 24 and 25 extending toward the outside of the casing forming members can be simultaneously molded by using a simple mold without employing a complicated structure such as a slide mechanism, the cost for the molding and the cost for manufacturing the mold may be greatly reduced.

[0023] Although the above-described centrifugal blower 1 is explained as to a double-axis type centrifugal blower, the present invention may be applied to a single-axis type centrifugal blower.

Claims

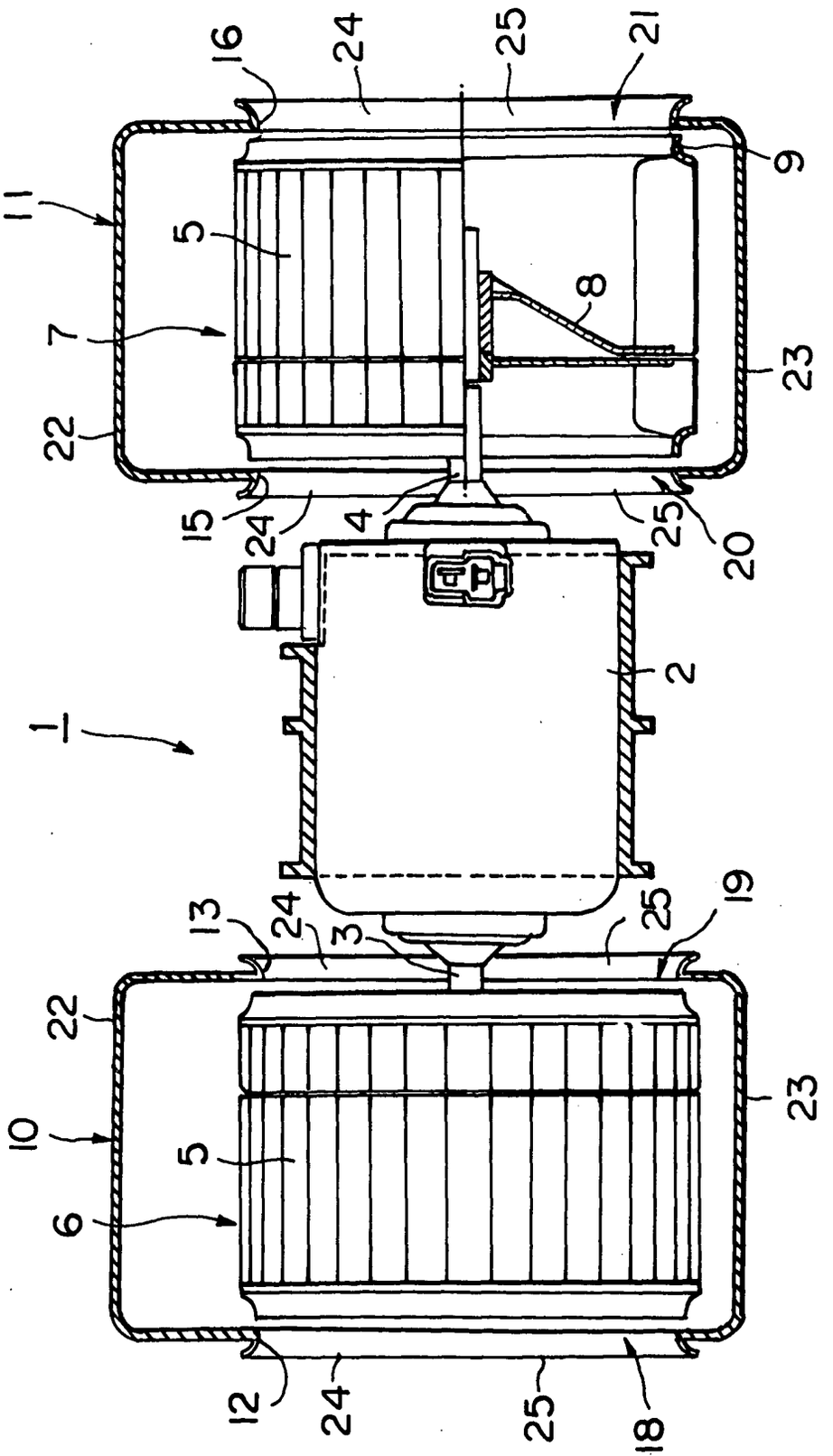
1. A centrifugal blower comprising a multiblade fan having a plurality of blades disposed around a rotary shaft in the circumferential direction, and a casing containing said multiblade fan, wherein air sucked through an air intake port opened on said casing is sucked from a radial inside to a radial outside through a portion between adjacent blades, **characterized in that** a bellmouth having a diameter increasing toward an outside of said casing is provided to said air intake port.

2. The centrifugal blower according to claim 1, wherein said bellmouth is formed integrally with said casing.

3. The centrifugal blower according to claim 1 or 2, wherein said casing is formed from a plurality of casing forming members capable of being divided into each other in a radial direction of said multiblade fan.

4. The centrifugal blower according to any of claims 1 to 3, wherein said multiblade fan is provided on each end of said rotary shaft to form a double-axis type fan.

FIG. 1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18

FIG. 2

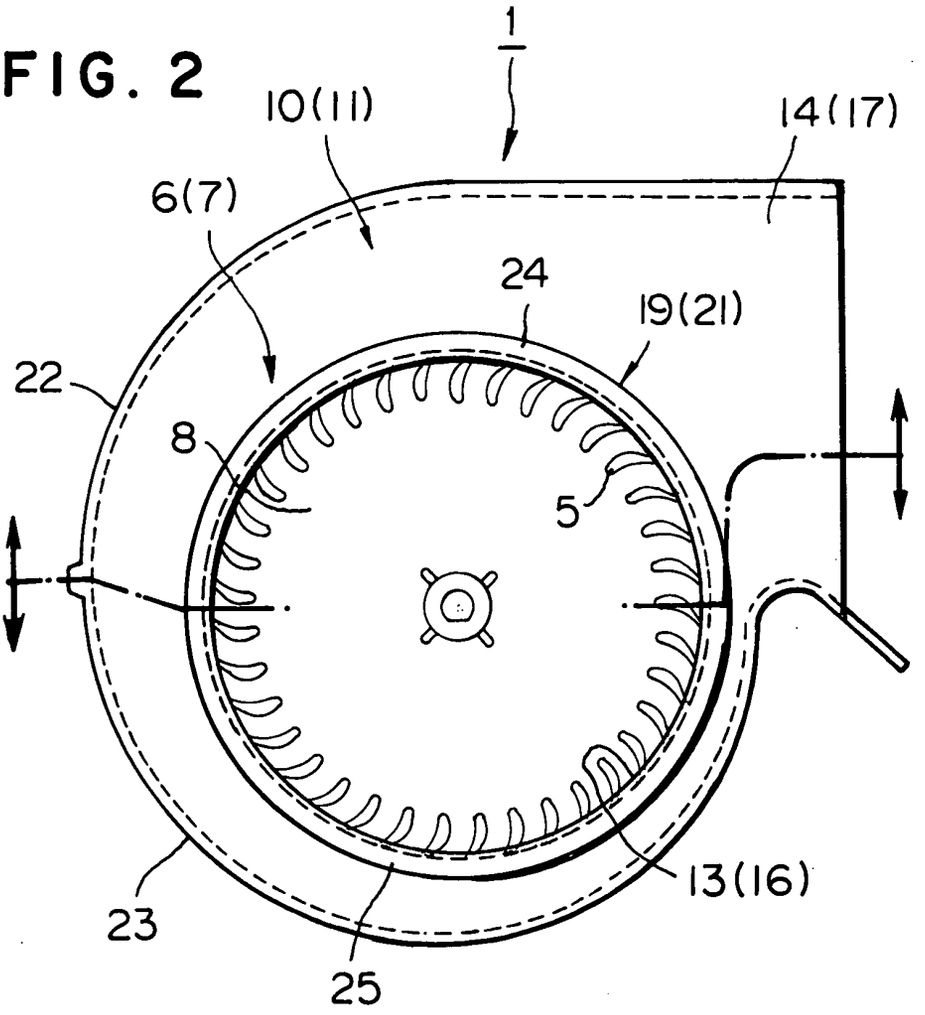


FIG. 3

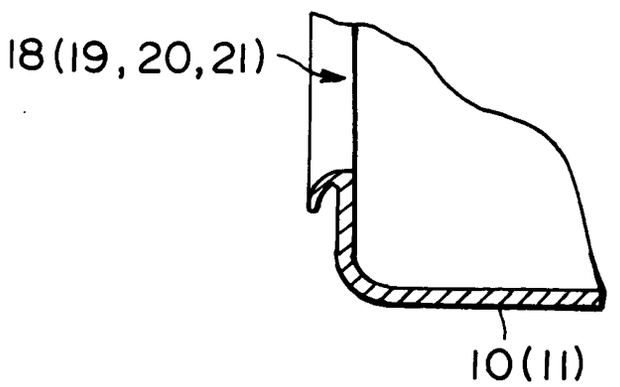


FIG. 4

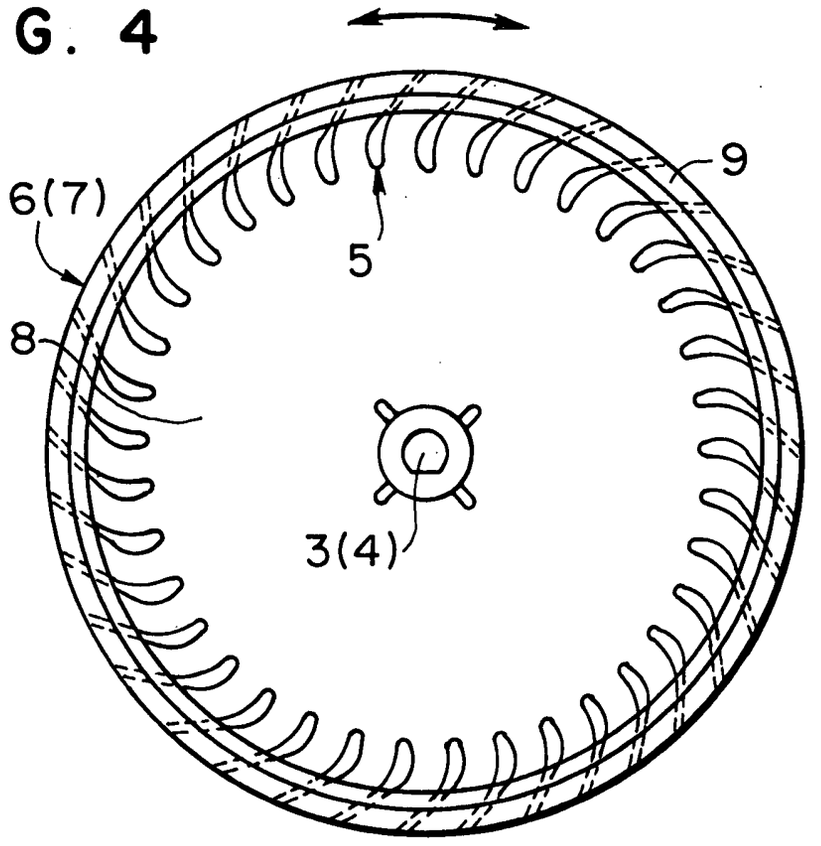

6(7)
8
5
9
3(4)

FIG. 5

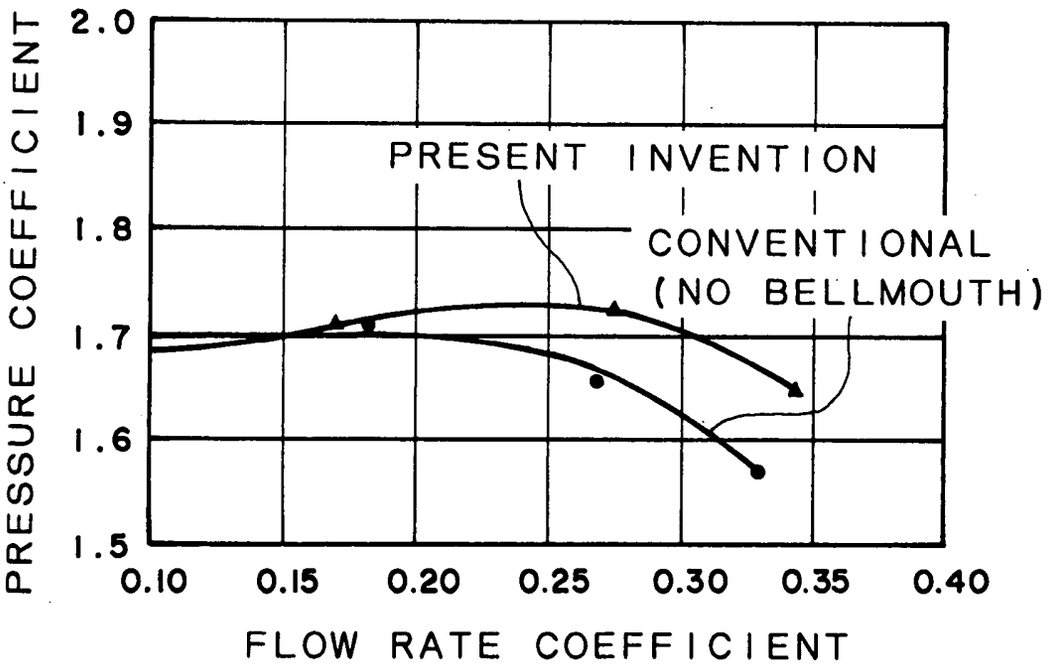

PRESSURE COEFFICIENT
2.0
1.9
1.8
1.7
1.6
1.5
PRESENT INVENTION
CONVENTIONAL
(NO BELLMOUTH)
0.10
0.15
0.20
0.25
0.30
0.35
0.40
FLOW RATE COEFFICIENT

FIG. 6

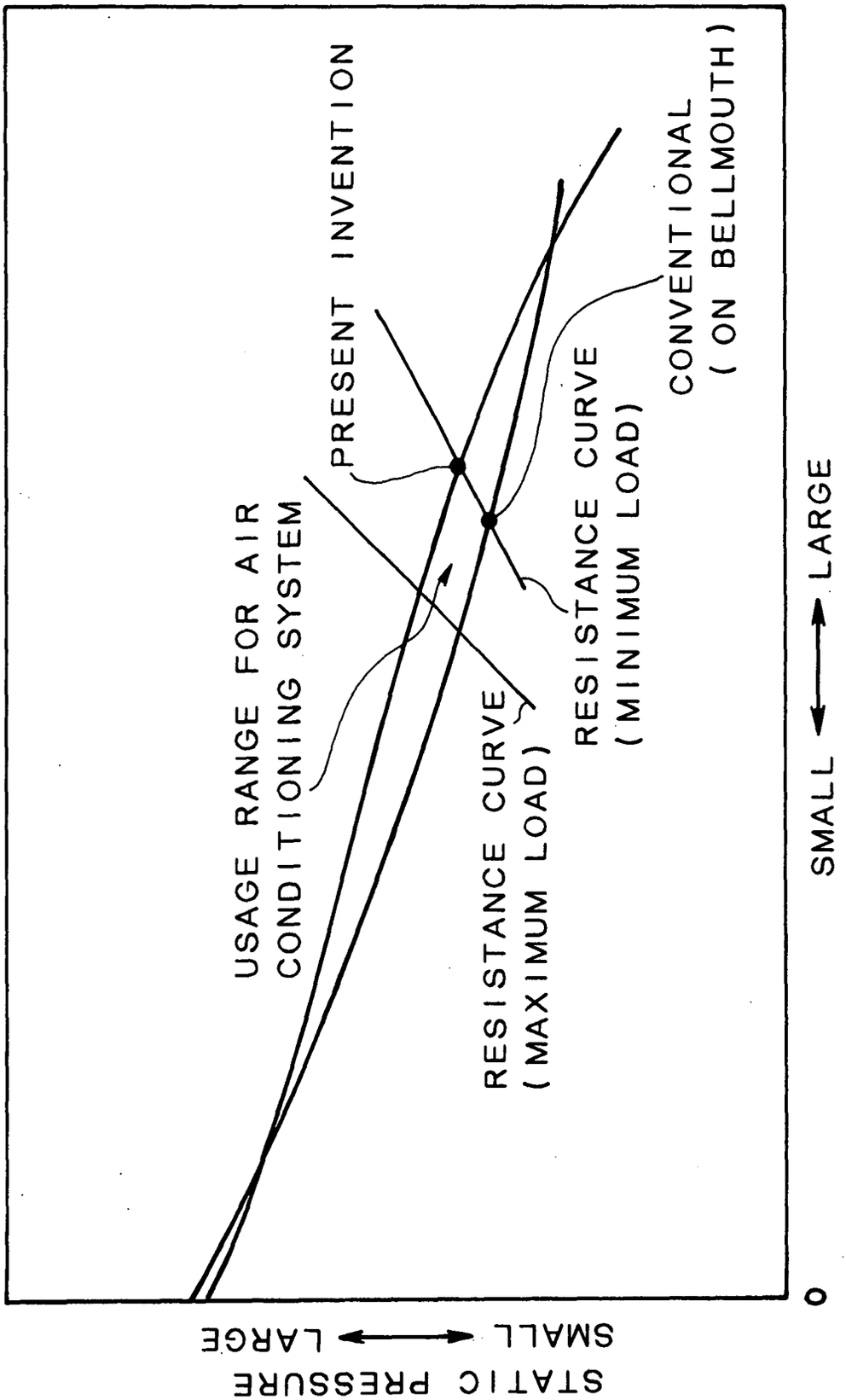

STATIC PRESSURE
SMALL ⟷ LARGE
0
SMALL ⟷ LARGE
AIR AMOUNT
USAGE RANGE FOR AIR CONDITIONING SYSTEM
PRESENT INVENTION
RESISTANCE CURVE (MAXIMUM LOAD)
RESISTANCE CURVE (MINIMUM LOAD)
CONVENTIONAL (ON BELLMOUTH)

FIG. 7

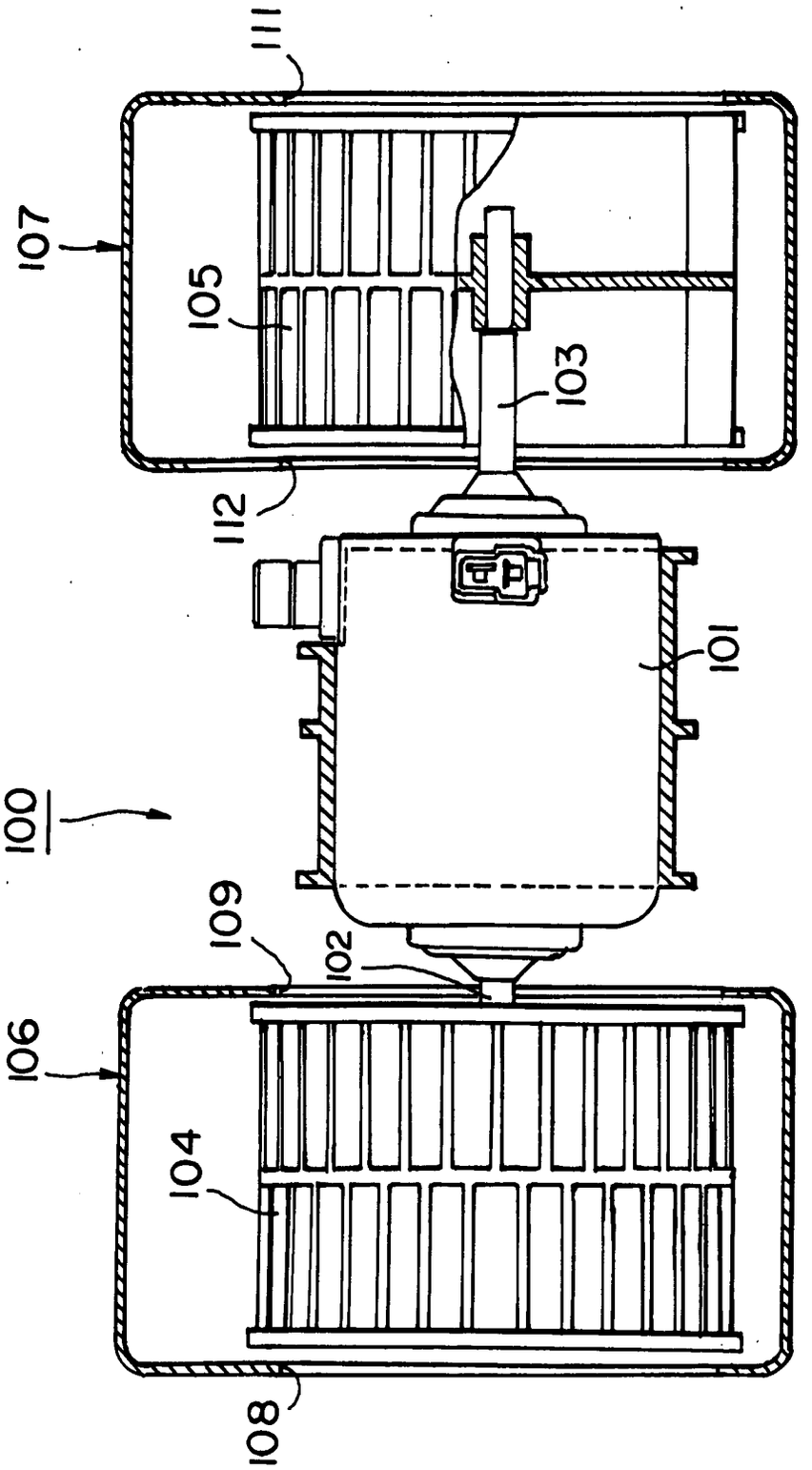


FIG. 8

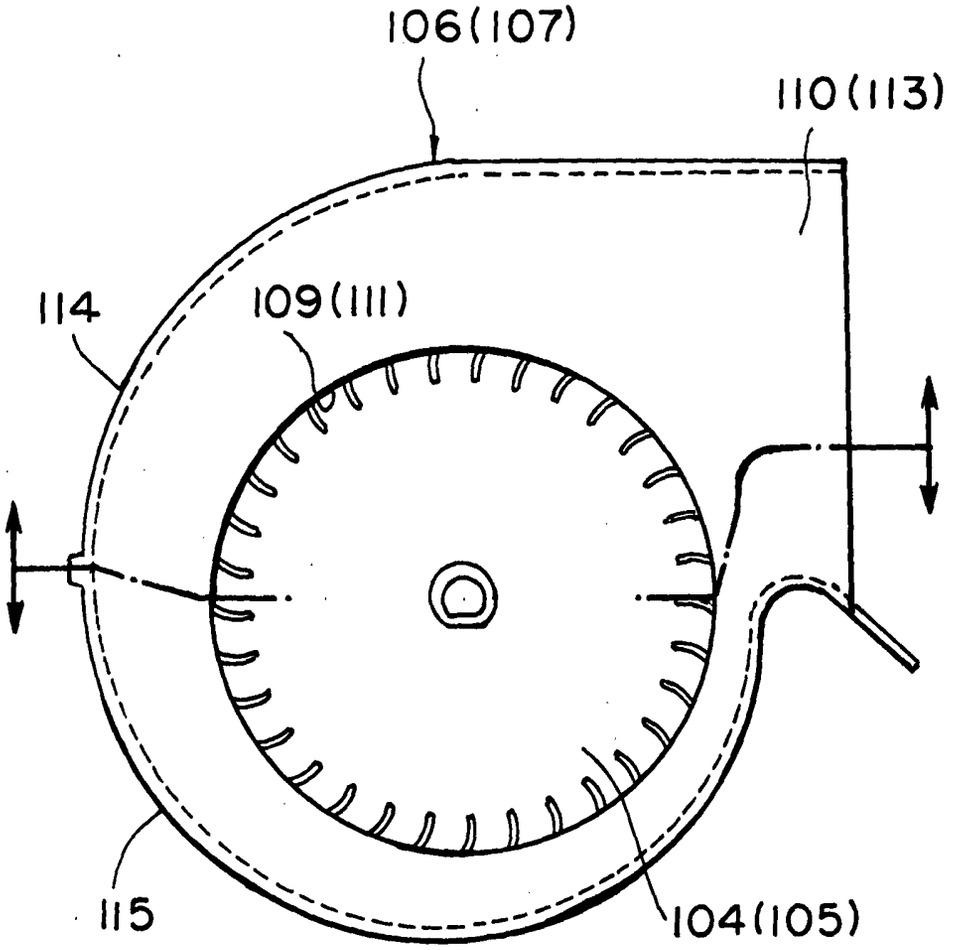
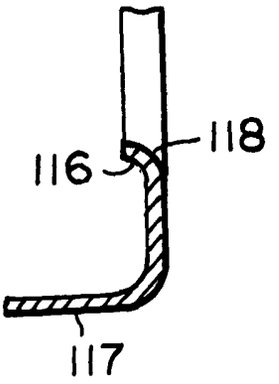


FIG. 9



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EUROPEAN SEARCH REPORT

Application Number
EP 03 25 7081

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X	US 6 206 633 B1 (KANDA HIROSHI ET AL) 27 March 2001 (2001-03-27) * the whole document *	1,2	
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X	EP 0 837 246 A (PM LUFT) 22 April 1998 (1998-04-22) * column 2, line 15-30 * * figure 2 *	1	
X	US 1 875 881 A (MORSE CLARK T) 6 September 1932 (1932-09-06) * page 1, line 39-47 * * figures 2,3 *	1	
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The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
MUNICH	20 January 2004	Giorgini, G

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