(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) EP 1 035 330 A2

(12) # EUROPEAN PATENT APPLICATION

(43) Date of publication:
13.09.2000 Bulletin 2000/37

(51) Int. Cl.[7]: **F04D 29/38**, F04D 29/02

(21) Application number: **00104398.3**

(22) Date of filing: **02.03.2000**

(84) Designated Contracting States:
AT BE CH CY DE DK ES FI FR GB GR IE IT LI LU MC NL PT SE
Designated Extension States:
AL LT LV MK RO SI

(30) Priority: **08.03.1999 JP 5978899**

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(54) **Impeller for blower, its manufacturing method, and blower**

(57) An impeller having a large aperture is obtained easily. As a result, the blower is enhanced in performance. Having a hub and vanes projecting from the hub, the vanes have multiple layers, and at least one of the multiple layers has a foamed molded layer. This impeller is used in a blower. This blower is used in an outdoor unit of an air conditioner.

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Description

Technical Field of the Invention

[0001] The present invention relates to a blower, and more particularly to an impeller used in the blower, and a method of manufacturing the same.

Background of the Invention

[0002] Hitherto, the impeller used in the blower was manufactured by press forming of a metal. In particular, recently, the impeller used in the blower is manufactured by molding a resin, and resin-made impellers have come to be used widely. To improve the performance of this kind of blower, the sectional shape of vanes of the impeller is designed according to the theory of vanes, and the impeller having the shape designed by the vane theory is being proposed. For example, the impeller used in the outdoor unit of a household air conditioner measures 300 mm∅ in diameter and 15 mm in maximum wall thickness of vane.

[0003] However, when the impeller having such thickness is injection molded by using a resin, the vane surface may have asperities due to shrinkage or warp of resin by thermal shrinkage. When the impeller having such vanes with asperities is used in the air conditioner, disturbance occurs in the laminar flow along the vane surface, and the noise increases. On the other hand, to prevent such shrinkage or warp, it is attempted to cool gradually by extending the cooling time in injection molding. In such method, however, the molding cycle time is longer, and the productivity is lowered.

[0004] More recently, the hollow molding method and two-step multi-layer molding method are proposed. The hollow molding method of impeller comprise a step of injecting the resin into the die cavity, and a step of forming a hollow part inside of a plurality of vanes by injecting inert gas such as compressed nitrogen into the cavity. The multi-layer molding method of impeller has a process of molding the impeller by dividing into two steps.

[0005] However, since the impeller is a rotating body, the plurality of vanes are required to have a mutually balanced shape. In the hollow molding method, however, it is hard to obtain the wall thickness of the vane precisely at the specified thickness. That is, the hollow portion of the vane cannot be controlled due to the correlation of gas pressure and resin flow ability. It is hence hard to obtain vanes having a mutually balanced shape. In the hollow molding method, therefore, the same level of perfection as in injection molding method cannot be expected. In the general multi-layer molding method, meanwhile, only a member of medium thickness can be molded. For achieving high performance of air conditioner, an impeller of a large aperture is needed. For this purpose, when molding an impeller of a large aperture by multi-layer molding method, the maximum thickness of the thick portion becomes thicker. As a result, the weight of the impeller increases, and the starting torque and other loads increase in driving of the motor when rotating the impeller by the motor.

[0006] It is hence an object of the invention to present a impeller of light weight and high performance at high productivity.

Summary of the Invention

[0007] The impeller used in the blower of the invention comprises:

a hub, and
a vane projecting from the hub,
in which the vane has multiple layers, and at least one of the multiple layers has a foamed molded layer.

[0008] The manufacturing method of the impeller used in the blower of the invention comprises:

a first step of molding a hub and a first vane layer projecting from the hub, and
a second step of laminating a second vane layer having a foamed molded layer on the first vane layer.

[0009] The blower of the invention comprises:

a motor,
a hub connected to the motor, and
a vane projecting from the hub,
in which the vane has a rigid layer and a foamed molded layer laminated on the rigid layer, and
the vanes are rotatable along with driving of the motor.

[0010] The outdoor unit of the air conditioner of the invention comprises:

a heat exchanger, and
a blower installed near the heat exchanger,
in which the blower includes a motor, a hub connected to the motor, and a vane projecting from the hub, and
the vane has a rigid layer and a foamed molded layer laminated on the rigid layer, and
the vanes are rotatable along with driving of the motor.

[0011] In this constitution, an impeller having a necessary wall thickness, a necessary lightness of weight, a necessary large aperture, and a necessary shape is obtained. As a result, an impeller having an excellent blowing performance is obtained. Moreover, a blower having an excellent blowing performance is obtained. Further, an air conditioner having an excellent heat exchange function is obtained.

Brief Description of the Drawings

[0012]

Fig. 1 is a partial perspective exploded view of an outdoor unit of an air conditioner having a blower using an impeller of an embodiment of the invention.

Fig. 2 is a perspective outline view of an impeller for blower according to an embodiment of the invention.

Fig. 3 is a sectional view along line 6A-6B of the vanes of the impeller shown in Fig. 2.

Reference Numerals

[0013]

1	Outdoor unit main body
2	Impeller
3	Fan motor
4	Nut
5	Hub
6	Vane
7	Rigid layer, first vane layer
8	Foamed molded layer, second vane layer
10	Blower
12	Heat exchanger
15	Air receiving side
16	Air separating side
18	Skin layer

Detailed Description of the Invention

[0014] An impeller for blower in an embodiment of the invention includes a hub and vanes having multiple layers, and at least one layer of the multiple layers has a foamed molded layer, and at least one of other layers has a rigid layer. The foamed molded layer is a layer of a molded body which contains multiple pores, multiple foams, or multiple hollow parts. The foamed molded layer is formed, for example, by molding a molding material containing foaming agent or inflating agent. The rigid layer is a layer having a rigidity such as strong mechanical strength to withstand air pressure. The rigid layer is, for example, a plastic molded body having no cavities, a plastic molded body having rigidity, or a molded body containing reinforcing filler. Such rigid layer is manufactured, for example, by an ordinary injection molding method.

[0015] In this constitution, an impeller having a necessary thickness, necessary lightness of weight, necessary large aperture, and necessary shape is obtained.

[0016] Preferably, the vane has two layers, and one of the two layers is a foamed molded layer. In this constitution, an impeller having the same performance as above is obtained.

[0017] Preferably, the foamed molded layer is disposed at the side of the air separating in the rotating. In this constitution, the air receiving side has a stronger rigidity than the air separating side. Accordingly, when the impeller rotates at high speed, the wind pressure is received at the air receiving side having the rigidity, and high speed rotation is enabled, and an excellent blowing performance is obtained even at high speed. Moreover, the weight of the air separating side is lighter. As a result, on the whole, a lightweight impeller is obtained.

[0018] Preferably, the foamed molded layer has a greater thickness than other layers. In this constitution, a much lighter impeller is obtained.

[0019] A manufacturing method of impeller in an embodiment of the invention comprises a step of forming a rigid layer by injection molding, and a step of foaming and molding. In this constitution, the impeller can be completed in a continuous process.

[0020] Preferably, the foaming and molding is executed immediately after forming the rigid layer by injection molding.

[0021] Preferably, a first surface of the rigid layer has a surface roughness Ra in a range from about 50μm to 500μm. Foaming and molding is executed on the first surface side, and a foamed molded layer is bonded and disposed. Thus, since the surface roughness of the first surface of the rigid layer has an adequate roughness, the foamed molded layer is firmly bonded to the rigid layer. Therefore, the bonding strength of the foamed molded layer having a thick portion and the rigid layer is sufficiently maintained.

[0022] Preferably, the foaming factor of the foamed molded layer is about 1.5 times to 4 times. By such foaming factor, an impeller having no problem in practical use is obtained.

[0023] Exemplary embodiments of the invention are described in detail below while referring to the accompanying drawings.

Exemplary Embodiment 1

[0024] Fig. 1 is a perspective exploded view of an impeller used in a blower of an air conditioner according to an exemplary embodiment of the invention. Fig. 2 is a perspective view of the impeller in the exemplary embodiment of the invention. Fig. 3 is a sectional view along line 6A-6B of the vanes of the impeller shown in Fig. 2.

[0025] In Fig. 1, an outdoor unit main body 1 of the air conditioner includes a blower 10, and a heat exchanger 12 disposed near the blower 10. The blower 10 has a fan motor 3 and an impeller 2. The impeller 2 is fixed to the fan motor 3 with bolt and nut 4. By rotating the blower 10, air is transmitted from the air receiving side 15 to the air separating side 16. By the transmitted air, the heat exchanger is cooled or warmed.

[0026] In Fig. 2, the impeller 2 has a hub 5, and a plurality of vanes 6 projecting from the hub 5.

[0027] As shown in Fig. 3, the vane 6 has a rigid layer 7 as a first vane layer, and a foamed molded layer 8 as a second vane layer. In Fig. 3, as the impeller rotates, the vane 6 receives the air from the rigid layer 7 side, and sends in the direction of the foamed molded layer 8 side. The vanes 6 rotate centrifugally.

[0028] The hub 5 and rigid layer 7 were manufactured by injection molding, using an AES plastic material containing 20 wt.% of glass fiber. AES is a copolymer of acrylic compound, EPDM, and styrene. EPDM is ethylene propylene terpolymer. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The air separating side 16 of the rigid layer 7 has a surface roughness Ra of 50μm. The rigid layer 7 has a uniform wall thickness of 2 mm.

[0029] Immediately after molding the rigid layers 7, a foamed molded layer 8 was disposed on the surface of the rigid layer 7 by injection molding, using an AES plastic material containing 1 wt.% of microcapsule inflating agent having a thermal expansion property. In this case, the foamed molded layer 8 is bonded directly to the air separating side 16 of the rigid layer 7. The foamed molded layer 8 has a foamed molded body of foaming factor of 1.5 times. The foamed molded layer 8 that has been foamed and molded is directly bonded to the rigid layer 7. Thus, the foamed molded layer 8 having a great wall thickness was manufactured. The method of foaming and molding is as follows. In the condition of cylinder temperature of 230°C of the molding machine and die cavity temperature of 5°C the AES plastic material containing inflating agent was injected into the cavity. By slightly opening the die immediately after, the contact surfaces of the vanes and die were cooled suddenly. As a result, a skin layer 18 was formed, and the foamed state was stabilized when opening the die. The skin layer 18 formed at this time had a thickness of about 100μm. The foamed molded layer 8 had multiple foamed cells.

[0030] The size of the individual foamed cells of the foamed molded layer 8 was about 1 mm or less.

[0031] In this manner, the impeller 2 having the rigid layer 7 and foamed molded layer 8 was manufactured. The weight of the manufactured impeller was about 760 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

[0032] In Fig. 2, when the arrow direction is the rotating direction, the air separating side 16 corresponds to the upper side of the impeller 6.

Exemplary Embodiment 2

[0033] Using an AES plastic material containing 20 wt.% of glass fiber, the hub 5 and rigid layer 7 were manufactured by injection molding. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The air separating side 16 of the rigid layer 7 has a surface roughness Ra of 100μm. The rigid layer 7 has a uniform wall thickness of 2 mm.

[0034] Immediately after molding the rigid layer 7, a foamed molded layer 8 was disposed on the surface of the rigid layer 7 by injection molding, using an AES plastic material containing 2.5 wt.% of microcapsule inflating agent having a thermal expansion property. The foamed molded layer 8 has a foamed molded body of foaming factor of 2.0 times. The foamed molded layer 8 that has been foamed and molded is directly bonded to the rigid layer 7. Thus, the foamed molded layer 8 having a great wall thickness was manufactured. The method of foaming and molding was same as in embodiment 1.

[0035] In this manner, the impeller 2 having the rigid layer 7 and foamed molded layer 8 was manufactured. The weight of the manufactured impeller was about 670 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

Exemplary Embodiment 3

[0036] Using an AES plastic material containing 20 wt.% of glass fiber, the hub 5 and rigid layer 7 were manufactured by injection molding. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The air separating side 16 of the rigid layer 7 has a surface roughness Ra of 300μm. The rigid layer 7 has a uniform wall thickness of 2 mm.

[0037] Consequently, a foamed molded layer 8 was disposed on the surface of the rigid layer 7 by injection molding, using an AES plastic material containing 4 wt.% of microcapsule inflating agent having a thermal expansion property. The foamed molded layer 8 has a foamed molded body of foaming factor of 2.0. The foamed molded layer 8 that has been foamed and molded is directly bonded to the rigid layer 7. Thus, the foamed molded layer 8 having a great wall thickness was manufactured. The method of foaming and molding was same as in embodiment 1.

[0038] In this manner, the impeller 2 having the rigid layer 7 and foamed molded layer 8 was manufactured. The weight of the manufactured impeller was about 620 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

Exemplary Embodiment 4

[0039] Using an AES plastic material containing 20 wt.% of glass fiber, the hub 5 and rigid layer 7 were manufactured by injection molding. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The air separating side 16 of the rigid layer 7 has a surface roughness Ra of 500µm. The rigid layer 7 has a uniform wall thickness of 2 mm.

[0040] Consequently, a foamed molded layer 8 was disposed on the surface of the rigid layer 7 by injection molding, using an AES plastic material containing 6 wt.% of microcapsule inflating agent having a thermal expansion property. The foamed molded layer 8 has a foamed molded body of foaming factor of 2.0. The foamed molded layer 8 that has been foamed and molded is directly bonded to the rigid layer 7. Thus, the foamed molded layer 8 having a great wall thickness was manufactured. The method of foaming and molding was same as in embodiment 1.

[0041] In this manner, the impeller 2 having the rigid layer 7 and foamed molded layer 8 was manufactured. The weight of the manufactured impeller was about 580 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

Exemplary Embodiment 5

[0042] Using an AES plastic material containing 20 wt.% of glass fiber, the hub 5 and rigid layer 7 were manufactured by injection molding. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The air separating side 16 of the rigid layer 7 has a surface roughness Ra of 800µm. The rigid layer 7 has a uniform wall thickness of 2 mm.

[0043] Consequently, a foamed molded layer 8 was disposed on the surface of the rigid layer 7 by injection molding, using an AES plastic material containing 8 wt.% of microcapsule inflating agent having a thermal expansion property. The foamed molded layer 8 has a foamed molded body of foaming factor of 5.0. The foamed molded layer 8 that has been foamed and molded is directly bonded to the rigid layer 7. Thus, the foamed molded layer 8 having a great wall thickness was manufactured. The method of foaming and molding was same as in embodiment 1.

[0044] In this manner, the impeller 2 having the rigid layer 7 and foamed molded layer 8 was manufactured. The weight of the manufactured impeller was about 550 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

(Comparative Example 1)

[0045] Using an AES plastic material containing 20 wt.% of glass fiber, the hub 5 and rigid layer 7 were manufactured by injection molding. This AES plastic material containing 20 wt.% of glass fiber is the same material as used in embodiment 1. The molded body has the hub 5 positioned in the center, and three rigid layers 7 projecting from the hub 5. The rigid layer 7 has the same shape as the vane 6 manufactured in embodiment 1. That is, the vane 6 in this comparative example is composed only of the rigid layer 7.

[0046] The weight of the manufactured impeller was about 1150 g, and the thickness of the maximum wall thickness portion of the vanes 6 was 20 mm. The maximum outer diameter of the impeller 2 was 400 mm∅.

[0047] The impeller manufactured in this comparative example 1 is heavier than the impellers manufactured in embodiments 1 to 5.

[0048] In the foregoing embodiments, the surface roughness of the air separating side 16 of the rigid layer 7 is larger as the foaming factor of the formed molded body bonded to the rigid layer 7 is larger. In this constitution, when bonding the foamed molded layer 8 having a weak rigidity to the rigid layer 7, the bonding strength of the rigid layer 7 and the foamed molded layer 8 is enhanced.

[0049] In the impellers manufactured in embodiments 1 to 5, each one of the three vanes 6 had the shape and weight exactly as designed. Also, each one of the three vanes 6 had a mutual balance exactly as designed in the shape and weight.

[0050] When the impellers manufactured in embodiments 1 to 5 were used in the blower of the outdoor unit of the air conditioner, the blower having a required blowing capacity was obtained. Even in rotation at maximum speed, the noise level was low. The load torque when starting up the blower was small. By contrast, in the blower using the impeller manufactured in comparative example 1, a larger starting torque was required as compared with the impellers manufactured in the embodiments.

[0051] In the embodiments, the foaming factor of the foamed molded layer is preferred to be about 1.5 times to about 4.0 times. If the foaming factor is less than 1.5 times, enough effect is not expected for the purpose of reducing the weight of the impeller. If the foaming factor is more than 4 times, the individual foamed cells in the foamed body are large, fluctuations of foamed state increase, and the rotation balance of the blower tends to declines. Moreover, if the foaming factor exceeds 4 times, the mechanical strength of the impeller tends to decline.

[0052] In the embodiments, the vanes 6 having the maximum thickness of 20 mm and the impeller 2 having the maximum outer diameter of 400 mm∅ were manufactured, and the impeller having a larger shape can be also manufactured by the method of the invention. For example, it was confirmed possible to manufacture an impeller having rigid layer and foamed molded layer of 3 mm, vanes with maximum thickness of 30 mm, and maximum outer diameter of 700 mm∅.

[0053] The blower using the impeller of such large shape also exhibits the same excellent blowing performance and effect as mentioned above.

[0054] That is, in the impeller of the invention, the foamed molded layer has a larger volume than the rigid layer. The weight of the foamed molded layer is extremely lighter than the weight of the rigid layer. Therefore, when manufacturing an impeller having large vanes, if the shape of the foamed molded layer having a light weight is increased, the weight increment degree of the weight of the impeller is small. It is therefore possible to manufacture a blower having vanes of larger overall dimensions.

[0055] Instead of the AES plastic material used in the embodiments, other plastic materials may be used to manufacture the same impeller having the rigid layer 7 and foamed molded layer 8 as in embodiment 1. Other plastic materials are not particularly limited, and may include, for example, polypropylene resin, polycarbonate, polyamide resin, polyester resin, polyacetal resin, polyacrylic resin, polystyrene resin, ethylene propylene rubber, and their copolymers.

[0056] As the plastic material, in particular, a material having an excellent weather resistance is preferred. When the impeller molded by using such material having an excellent weather resistance is used in the blower of the outdoor unit of the air conditioner, it can be used for a long period in a stable performance.

[0057] In stead of the glass fiber used in the embodiments, a plastic material containing other filler may be used, and the impeller having the rigid layer 7 and foamed molded layer 8 same as in embodiment 1 can be manufactured. Other filler is not particularly limited, but inorganic powder, organic powder, or fibrous powder may be used. Such fillers have a function of enhancing the mechanical strength of the rigid layer.

[0058] The inflating agent or foaming agent is not particularly limited, but may include a material for generating gaseous substance when molding, and a material generating gaseous substance by heating when molding, among others.

[0059] In the embodiments, after forming the rigid layer by injection molding, by forming the foamed molded layer immediately, the rigid layer and foamed molded layer are bonded, but not limited to this method, other manufacturing method may be also employed. For example, using an adhesive or the like, the rigid layer and the foamed molded body formed separately may be bonded together.

[0060] Incidentally, the rigid layer and foamed molded layer may be manufactured also by other molding method such as compression molding and transfer molding method. However, the injection molding method is most excellent in mass producibility.

[0061] As clear from the foregoing embodiments, the foamed molded layer achieves the properties of both large thickness and light weight. Therefore, an impeller having a large aperture may be obtained easily. As a result, the blower is enhanced in performance

[0062] The blower of the embodiments is used in the outdoor unit of the air conditioner, but not limited to this, it may be also used in the cooling device for electronic appliance, air circulating device for circulating air, or blower for generating wind. However, the above effects are particularly enhanced when used in the blower requiring a large-sized impeller.

Claims

1. An impeller used in a blower comprising:

a hub (5), and
a vane (6) projecting from said hub,
wherein said vane includes multiple layers (7, 8), and
at least one of said multiple layers has a foamed molded layer (8).

2. The impeller of claim 1,
wherein said multiple layers (7, 8) have a two-layer structure of a first layer (8) and a second layer (7), and

said first layer has said foamed molded layer (8).

3. The impeller of claim 2,
wherein said foamed molded layer is disposed at an air separating side (16) in a rotating of said blower.

4. The impeller of claim 2 or 3,
wherein said foamed molded layer has a greater thickness than said second layer.

5. The impeller of claim 1,
wherein said multiple layers have a rigid layer (7), and said foamed molded layer (8) laminated on said rigid layer,

said rigid layer has a stronger mechanical strength than said foamed molded layer, and
said foamed molded layer has a smaller specific gravity than said rigid layer.

6. The impeller of claim 1,
wherein said multiple layers have a rigid layer (7), said foamed molded layer (8) laminated on said rigid layer, and a skin layer (18) formed on the surface of said foamed molded layer.

7. The impeller of claim 1,
wherein said vane has a plurality of vanes (6), and

said plurality of vanes are disposed symmetrically on a circumference of said hub.

8. The impeller of claim 1,
wherein said foamed molded layer has a foaming factor in a range from about 1.5 times to about 4 times.

9. The impeller of claim 1, wherein said multiple layers have a rigid layer, and said foamed molded layer laminated on said rigid layer,

said rigid layer has a plastic molded body, and said foamed molded layer has a plastic foamed molded body.

10. The impeller of claim 1, wherein a first surface of said rigid layer has a surface roughness in a range of Ra 50µm to Ra 500µm, and

said foamed molded layer is directly bonded to said first surface.

11. The impeller of claim 1, wherein said foamed molded layer has multiple foamed cells.

12. The impeller of claim 1, wherein said blower is used as an outdoor unit of an air conditioner.

13. A manufacturing method of an impeller used in a blower comprising:

a first step of molding a hub (5) and a first vane layer (7) projecting from said hub, and
a second step of laminating a second vane layer (8) having a foamed molded layer (8) on said first vane layer.

14. The manufacturing method of claim 13, wherein said first step includes a step of injection molding a plastic material.

15. The manufacturing method of claim 13 or 14, wherein said first step includes a step of molding said first vane layer so that a surface roughness of a first surface of said first vane layer may be in a range of Ra 50µm to Ra 500µm, and

said second step includes a step of bonding said foamed molded layer to said first surface.

16. The manufacturing method of claim 15, wherein said first surface is an air separating side 16 in a rotating direction of said blower.

17. The manufacturing method of any one of claims 13 to 15, wherein said second step includes a step of molding said second vane layer so that a foaming factor of said foamed molded layer may be about 1.5 to about 4 times.

18. The manufacturing method of any one of claims 13 to 17, wherein said second step further includes a step of forming a skin layer (18) on a surface of said foamed molded layer (8).

19. The manufacturing method of any one of claims 13 to 18, wherein said second step includes a step of injection molding a plastic material having at least one of foaming agent and inflating agent.

20. The manufacturing method of any one of claims 13 to 19, wherein said second step includes a step of molding so that said foamed molded layer may contain multiple foamed cells.

21. The manufacturing method of any one of claims 13 to 20, wherein said blower is used in an outdoor unit of an air conditioner.

22. A blower comprising:

a motor (3),
a hub (5) connected to said motor, and
a vane (6) projecting from said hub,
wherein said vane includes a rigid layer (7) and a foamed molded layer (8) laminated on said rigid layer, and
said vanes are rotatable along with driving of said motor.

23. The blower of claim 22, wherein said rigid layer has a plastic molded body, and

said foamed molded layer has a foamed plastic molded body having multiple foamed cells.

24. The blower of claim 22, wherein said foamed molded layer is disposed in an air separating side (16) in a rotating of said vane.

25. An outdoor unit of an air conditioner comprising:

a heat exchanger (12),
a blower (10) installed at a rear side of said heat exchanger,
wherein said blower includes:
a motor (3),
a hub (5) connected to said motor, and
a vane (6) projecting from said hub,
wherein said vane includes a rigid layer (7) and a foamed molded layer (8) laminated on said rigid layer, and
said vanes are rotatable along with driving of

said motor.

26. The outdoor unit of claim 25, wherein said rigid layer has a plastic molded body, and

said foamed molded layer has a foamed plastic molded body having multiple foamed cells.

27. The outdoor unit of claim 25, wherein said foamed molded layer is disposed in an air separating side in a rotating of said vane.

Fig. 1

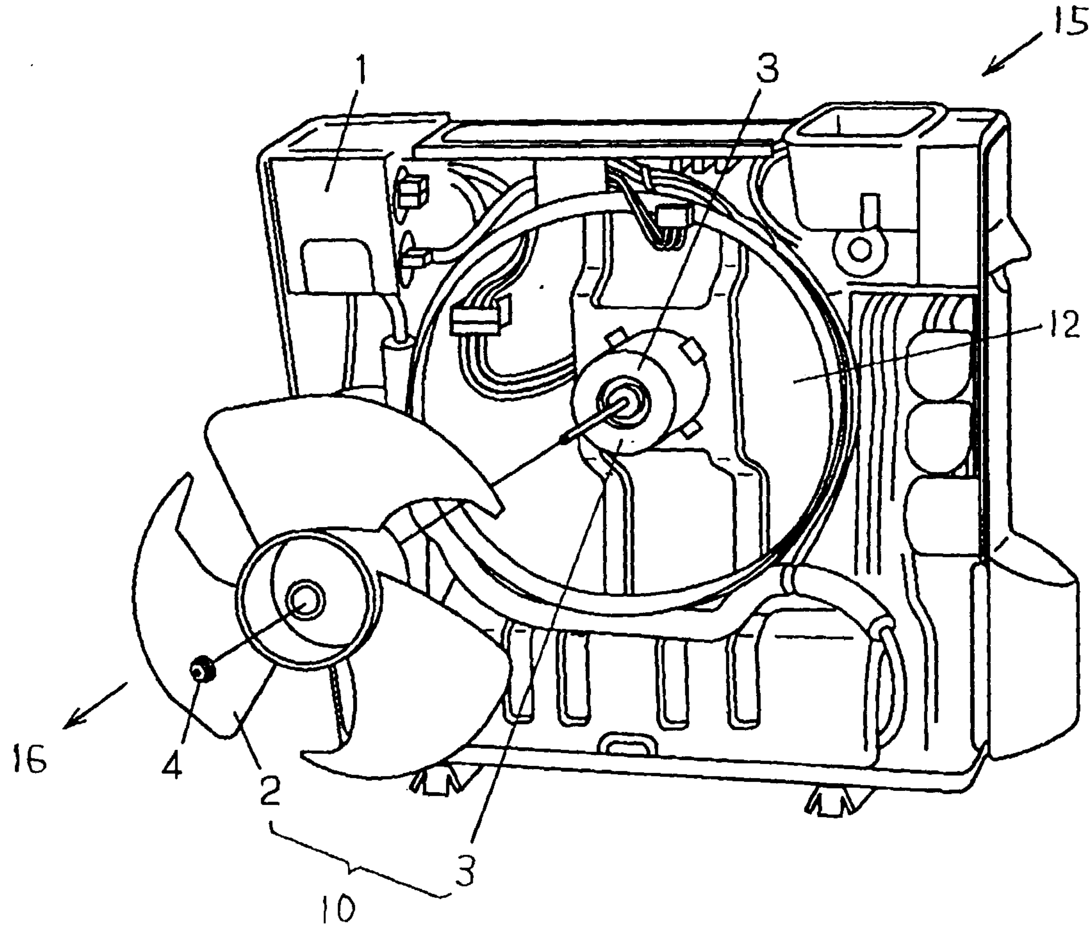

Fig. 2

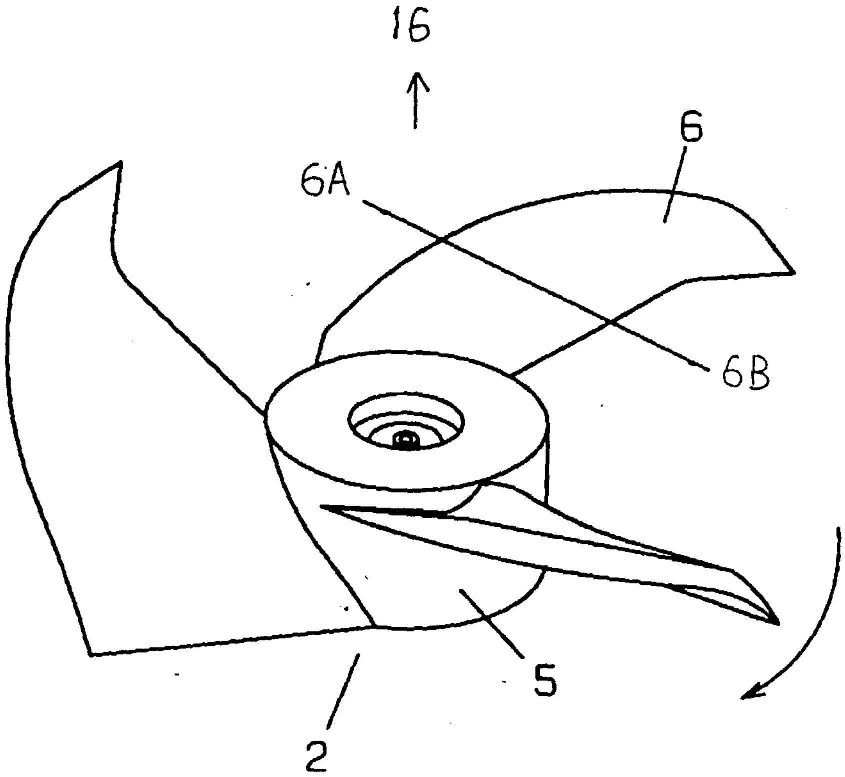

Fig. 3