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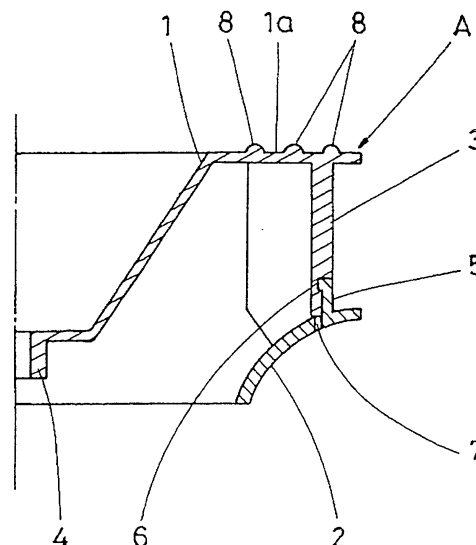
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(54) **CENTRIFUGAL FAN ROTOR AND METHOD OF MANUFACTURING THE FAN ROTOR**

(57) In a method of manufacturing a centrifugal fan rotor comprising a main plate (1), a shroud (2), and a plurality of blades (3, 3, ...) disposed between an outer peripheral part (1a) of the main plate (1) and the shroud (2), a rotor half-finished product (A) comprising the main plate (1) and the blades (3, 3, ...) is formed as an integral molding of synthetic resin and, in addition, the shroud (2) is formed as an integral molding of synthetic resin separately from the rotor half-finished product (A). Thereafter, an engaging claw (5) formed integrally with the shroud (2) is engaged into an engaging part (6) formed in each blade (3) so that the rotor half-finished product (A) and the shroud (2) are united together. As a result, it becomes possible to use inexpensive polypropylene as a material and the reduction in manufacturing costs and the improvement in recycling efficiency are achieved, without having to employ a conventionally-used welding means.

FIG. 2



Description

TECHNICAL FIELD

[0001] The present invention relates to a centrifugal fan rotor and to a manufacturing method thereof.

BACKGROUND ART

[0002] Referring to Figure 1, there is illustrated a turbo fan rotor as an example of centrifugal fan rotors. The turbo fan rotor has a main plate 1, a shroud 2, and a plurality of blades 3, 3, ... which are disposed between an outer peripheral part 1a of the main plate 1 and the shroud 2. Each blade 3 is shaped like a swept-back wing inclined in a direction opposite to the rotational direction. Reference numeral 4 indicates a boss to which a motor rotational shaft is rotatably fastened.

[0003] It is difficult to form such a turbo fan rotor as an integral molding of synthetic resin because it has a three-dimensional shape which complicates the drawing-out of a molding.

[0004] With a view to coping with this difficulty, the following conventional techniques have been proposed. For example, there is a technique known in the art in which a main plate 1 is formed integrally with blades 3, 3, ..., and leading ends of the blades 3, 3, ... are welded to an interior surface of a shroud 2 made of synthetic resin. In addition, there is another conventional technique in which a main plate 1 is formed integrally with first half portions of blades 3, 3, ... while on the other hand a shroud 2 is formed integrally with second half portions of the blades 3, 3, Thereafter, the first half portions and the second half portions are welded together.

Problem To Be Solved

[0005] The above-described conventional techniques, however, require a welding process step of a higher level of accuracy, therefore producing a problem of increased manufacturing costs.

[0006] In addition, there is another problem that polypropylene (PP), which does not suit for welding but has advantages of being inexpensive and recycle-friendly, cannot be used as a material.

[0007] Furthermore, there is the possibility that during the operation centrifugal forces cause a welded junction to come loose if deteriorated with age.

[0008] Bearing in mind the above-described drawbacks, the present invention was made. Accordingly, an object of the present invention is to make it possible to manufacture a fan rotor which is inexpensive and rich in recycling efficiency. More specifically, a rotor fan of the present invention is assembled not by a welding means but by an engaging means.

DISCLOSURE OF INVENTION

[0009] A first invention is directed to a centrifugal fan rotor comprising a main plate 1, a shroud 2, and a plurality of blades 3, 3, ... disposed between an outer peripheral part 1a of the main plate 1 and the shroud 2. And, a rotor half-finished product A which is formed as an integral molding of synthetic resin comprising the main plate 1 and the blades 3, 3, ..., and the shroud 2 which is formed as an integral molding of synthetic resin are manufactured separately. Furthermore, an engaging claw is formed integrally with the shroud 2 or with each blade 3, while on the other hand an engaging part for engaging with the engaging claw is formed in each blade 3 or in the shroud 2. In addition, the rotor half-finished product A and the shroud 2 are united together by establishing engagement between the engaging claw and the engaging part.

[0010] A second invention according to the first invention is characterized in that the engaging claw and the engaging part are constructed so that the direction of engagement of the engaging claw and the engaging part becomes a direction in which the force of engagement of the engaging claw and the engaging part increases when a centrifugal force is exerted on each blade 3.

[0011] A third invention according to the second invention is characterized in that the engaging claw is an inward claw piece 5 which is provided projectingly and formed integrally with an interior surface of the shroud 2, and is further characterized in that the engaging part is an engaging concave part 6 which is formed in an external surface of each blade 3.

[0012] A fourth invention according to the second invention is characterized in that the engaging claw is an outward claw piece 9 which is provided projectingly and formed integrally with a leading end of the each blade 3, and is further characterized in that the engaging part is an engaging hole 10 which is formed in the shroud 2.

[0013] A fifth invention according to the first invention is characterized in that a rib 8 is formed integrally with a rear surface of the outer peripheral part 1a of the main plate 1.

[0014] A sixth invention is directed to a method of manufacturing a centrifugal fan rotor comprising a main plate 1, a shroud 2, and a plurality of blades 3, 3, ... disposed between an outer peripheral part 1a of the main plate 1 and the shroud 2. And, a rotor half-finished product A comprising the main plate 1 and the blades 3, 3, ... is formed as an integral molding of synthetic resin, and the shroud 2 is formed as an integral molding of synthetic resin separately from the rotor half-finished product A. Thereafter, an engaging claw which is formed integrally with the shroud 2 or with each blade 3 and an engaging part which is formed in each blade 3 or in the shroud 2 are brought into engagement with each other so that the rotor half-finished product A and the shroud 2 are united together.

[0015] A seventh invention according to the sixth in-

vention is characterized in that the direction of engagement of the engaging claw and the engaging part becomes a direction in which the force of engagement of the engaging claw and the engaging part increases when a centrifugal force is exerted on each blade 3.

[0016] An eighth invention according to the seventh invention is characterized in that the engaging claw is an inward claw piece 5 provided projectingly and formed integrally with an interior surface of the shroud 2, and is further characterized in that the engaging part is an engaging concave part 6 formed in an external surface of each blade 3.

[0017] A ninth invention according to the seventh invention is characterized in that the engaging claw is an outward claw piece 9 provided projectingly and formed integrally with a leading end of the each blade 3, and is further characterized in that the engaging part is an engaging hole 10 formed in the shroud 2.

[0018] Finally, a tenth invention according to the sixth invention is characterized in that a rib 8 is formed integrally with a rear surface of the outer peripheral part 1a of the main plate 1 at the time of molding of the rotor half-finished product A.

[0019] In the first and sixth inventions, after integral molding of the rotor half-finished product A made up of the main plate 1 and the blades 3, 3, ... by the use of a synthetic resin, the engaging claw formed integrally with the shroud 2 or with each blade 3 and the engaging portion formed in each blade 3 or in said shroud 2 are brought into engagement with each other to assemble a fan rotor. Accordingly, it is no longer necessary to employ a conventionally-required welding means. It therefore becomes possible to employ polypropylene which is inexpensive as a material, thereby achieving the reduction in manufacturing costs and the improvement in recycling efficiency.

[0020] In the second and seventh inventions, even when a centrifugal force acts on the blade 3 during the operation, the engagement between the engaging claw and the engaging part will not come loose. As the result of this, durability is improved significantly and no chatter sound is produced in the engaging part during the operation.

[0021] In the third and eighth inventions, it is possible to firmly unite together each blade 3 and the shroud 2 by a simple means such as the engaging of the claw piece 5 and the engaging concave part 6.

[0022] In the fourth and ninth inventions, it is possible to firmly unite together each blade 3 and the shroud 2 by a simple means such as the engaging of the claw piece 9 and the engaging hole 10.

[0023] In the fifth and tenth inventions, the main plate outer peripheral part 1a in the rotor half-finished product A takes the same shape as that of the forming die (i.e., a horizontal shape) at the time immediately after the integral moulding. After being cooled, the main plate outer peripheral part 1a is bent slightly toward the side on which the rib 8 is formed (i.e., toward the rear surface).

In other words, the main plate outer peripheral part 1a is deformed in the same direction that the blade 3 is deformed by centrifugal force. Accordingly, if assembled to the shroud 2 immediately after the integral moulding of the rotor half-finished product A, this facilitates assembly work. Furthermore, the force of engagement increases after the assembly work. As a result, assembly workability is improved and, in addition, the engagement will not come loose during the operation.

Effects of Invention

[0024] In the first and sixth inventions, in manufacturing a centrifugal fan rotor comprising a main plate 1, a shroud 2, and a plurality of blades 3, 3, ... disposed between an outer peripheral part 1a of the main plate 1 and the shroud 2, a rotor half-finished product A composed of the main plate 1 and the blades 3, 3, ... is formed as an integral molding of synthetic resin and the shroud 2 is formed as an integral molding of synthetic resin separately from the rotor half-finished product A. And, an engaging claw integrally formed with the shroud 2 or with each blade 3 and an engaging part integrally formed with each blade 3 or with the shroud 2 are engaged with each other so that the rotor half-finished product A and the shroud 2 are united together. Accordingly, in accordance with these inventions, it is no longer necessary to employ a conventionally-required welding means. It therefore becomes possible to employ polypropylene which is inexpensive as a material, thereby achieving the reduction in manufacturing costs and the improvement in recycling efficiency.

[0025] In the second and seventh inventions, it is arranged such that the direction of engagement of the engaging claw and the engaging part becomes a direction in which the force of engagement of the engaging claw and the engaging part increases when a centrifugal force is exerted on the blades 3, 3, Accordingly, in accordance with these inventions, even when a centrifugal force acts on the blade 3 during the operation, the engagement between the engaging claw and the engaging part will not come loose. As the result of this, durability is improved significantly and no chatter sound is produced in the engaging part during the operation.

[0026] In the third and eighth inventions, it is arranged such that the engaging claw is an inward claw piece 5 provided in a projecting manner and formed integrally with an interior surface of the shroud 2, and that the engaging part is an engaging concave part 6 formed in an external surface of each blade 3. Accordingly, in accordance with these inventions, it is possible to firmly unite together each blade 3 and the shroud 2 by a simple means such as the engaging of the claw piece 5 and the engaging concave part 6.

[0027] In the fourth and ninth inventions, it is arranged such that the engaging claw is an outward claw piece 9 provided in a projecting manner and formed integrally with a leading end of the each blade 3, and that the en-

gaging part is an engaging hole **10** formed in the shroud **2**. Accordingly, in accordance with these inventions, it is possible to firmly unite together each blade **3** and the shroud **2** by a simple means such as the engaging of the claw piece **9** and the engaging hole **10**.

[0028] Finally, in the fifth and tenth inventions, it is arranged such that a rib **8** is formed integrally with a rear surface of the outer peripheral part **1a** of the main plate **1** at the time of molding of the rotor half-finished product **A**. Accordingly, in accordance with these inventions, the main plate outer peripheral part **1a** in the rotor half-finished product **A** takes the same shape as that of the forming die (i.e., a horizontal shape) at the time immediately after the integral moulding; however, after being cooled, the main plate outer peripheral part **1a** is bent slightly toward the side on which the rib **8** is formed (i.e., toward the rear surface). In other words, the main plate outer peripheral part **1a** is deformed in the same direction that the blade **3** is deformed by centrifugal force. Accordingly, if assembled to the shroud **2** immediately after the integral moulding of the rotor half-finished product **A**, this facilitates assembly work. As the result of this, the force of engagement increases after the assembly work. Consequently, assembly workability is improved and, in addition, the engagement will not come loose during the operation.

BRIEF DESCRIPTION OF DRAWINGS

[0029]

Figure **1** is a perspective illustration depicting a turbo fan rotor which is an example of commonly-used centrifugal fan rotors;

Figure **2** is a half cross-sectional view of a centrifugal fan rotor according to a first embodiment of the present invention;

Figure **3** is a half cross-sectional view showing two states of a rotor half-finished product for the centrifugal fan rotor according to the first embodiment of the present invention, i.e., a state immediately after being molded and a state after being cooled;

Figure **4** is an enlarged top plan view of relevant parts of a main plate of the centrifugal fan rotor according to the first embodiment of the present invention; and

Figure **5** is a half cross-sectional view of a centrifugal fan rotor according to a second embodiment of the present invention.

BEST MODE FOR CARRYING OUT INVENTION

[0030] Hereinbelow, several preferred embodiments of the present invention will be described in detail with reference to the accompanying drawings.

[0031] A centrifugal fan rotor (i.e., a turbo fan rotor) which is manufactured in accordance with each of the embodiments is similar in structure to the one previously

described in terms of the Background Art (see Figure **1**). This turbo fan rotor comprises a main plate **1**, a shroud **2**, and a plurality of blades **3**, **3**, ... installed between an outer peripheral part **1a** of the main plate **1** and the shroud **2**. Each blade **3** is shaped like a swept-back wing which is inclined in a direction opposite to the rotational direction. Reference numeral **4** indicates a boss to which a motor rotational shaft is rotatably fastened.

Embodiment 1

[0032] Referring to Figures **2** and **4**, there is shown a centrifugal fan rotor according to a first embodiment of the present invention.

[0033] In the centrifugal fan rotor (i.e., the turbo fan rotor), as shown in Figure **2**, an inward claw piece **5** serving as an engaging claw is formed, in a projecting manner, integrally with an internal surface of the shroud **2**. On the other hand, an engaging concave part **6** serving as an engaging part is formed on the side of an external surface of each blade **3**. And, by bringing the claw piece **5** into engagement with the engaging concave parts **6**, each blade **3** and the shroud **2** are united together. Reference numeral **7** indicates a cavity for use in integral molding of the claw piece **5** at the time of moulding of the shroud **2**.

[0034] The turbo fan rotor of the present embodiment is manufactured as follows. In the first place, a rotor half-finished product **A** comprising a main plate **1** and blades **3**, **3**, ... is formed as an integral molding of synthetic resin (for example, polypropylene). On the other hand, together with a claw piece **5**, a shroud **2** is formed as an integral molding of synthetic resin (for example, polypropylene). Thereafter, the claw piece **5** of the shroud **2** is engaged into an engaging concave part **6** of the blade **3** so that the rotor half-finished product **A** and the shroud **2** are united together integrally.

[0035] As a result of such arrangement, the blade **3** and the shroud **2** are firmly united together by a simple means such as engagement of the claw piece **5** and the engaging concave part **6**. Accordingly, unlike the conventional techniques, it is no longer necessary to use a welding means.

[0036] Consequently, it becomes possible to use inexpensive polypropylene as a material and the reduction in manufacturing costs and the improvement in recycling efficiency are achieved.

[0037] Besides, the shroud **2** and the blade **3** are united together by engagement between the inward claw piece **5** and the engaging concave part **6** formed in the outer peripheral surface of the blade **3**. As the result of this, the direction of engagement of the claw piece **5** and the engagement concave part **6** becomes a direction in which the force of engagement increases when a centrifugal force acts on the blade **3**.

[0038] Accordingly, even when a centrifugal force is exerted on the blade **3** during operation, the engage-

ment between the claw piece **5** and the engaging concave part **6** will not come loose. As the result of this, durability is improved significantly and no chatter sound is produced in the engaging part during operation.

[0039] Ribs **8, 8, ...** are formed integrally with a rear surface of the outer peripheral part **1a** of the main plate **1** at the time of moulding of the rotor half-finished product **A** in the present embodiment. Because of the provision of the ribs **8, 8, ...**, the main plate outer peripheral part **1a** becomes warped in the direction of the rear surface at the time of cooling after the molding. In other words, during the cooling, the surface of each rib **8** is first solidified when cooled and then is shrunk. As a result, the main plate outer peripheral part **1a** becomes warped in the direction of the rear surface on which the ribs **8, 8, ...** are formed. As shown in Figure 4, the ribs **8, 8, ...** are shaped like a mound and are arranged radially, circumferentially, and in a direction of interconnecting them.

[0040] As a result of such arrangement, the main plate outer peripheral part **1a** in the rotor half-finished product **A** takes the same shape as that of its forming die (i.e., a horizontal shape) immediately after the integral moulding, as indicated by chain double-dashed line of Figure 3; however, after being cooled the main plate outer peripheral part **1a** becomes warped slightly in the direction of the side on which the ribs **8, 8, ...** are formed (i.e., in the direction of the rear surface) as indicated by solid line of Figure 3. In other words, the main plate outer peripheral part **1a** deforms in the same direction that the blades **3, 3, ...** deform by centrifugal force. Accordingly, if assembled to the shroud **2** immediately after integral moulding of the rotor half-finished product **A**, this facilitates assembly work and the force of engagement increases after the assembly work. As a result, assembly workability is improved and, in addition, the engagement will not come loose.

Embodiment 2

[0041] Referring to Figure 5, there is shown a centrifugal fan rotor according to a second embodiment of the present invention.

[0042] In the centrifugal fan rotor (i.e., the turbo fan rotor) of the present embodiment, an outward claw piece **9** serving as an engaging claw is provided projectingly and formed integrally with an leading end of the blade **3**. On the other hand, the shroud **2** is provided with an engaging hole **10** serving as an engaging part. And, by engaging the claw piece **9** into the engaging hole **10**, the blade **3** and the shroud **2** are united together.

[0043] This turbo fan rotor is manufactured as follows. In the first place, a rotor half-finished product **A** comprising a main plate **1** and a plurality of blades **3, 3, ...** is formed as an integral molding of synthetic resin (for example, polypropylene), together with a claw piece **9**. On the other hand, a shroud **2** is formed as an integral molding of synthetic resin (for example, polypropylene).

Thereafter, the claw piece **9** of the blade **3** is engaged into the engaging hole **10** of the shroud **2**, whereby the rotor half-finished product **A** and the shroud **2** are united together integrally.

[0044] As a result of such arrangement, the blade **3** and the shroud **2** are firmly joined together by a simple means such as engagement of the claw piece **9** into the engaging hole **10**. Accordingly, unlike the conventional techniques, it is no longer necessary to use a welding means.

[0045] Consequently, it becomes possible to use inexpensive polypropylene as a material and the reduction in manufacturing costs and the improvement in recycling efficiency are achieved.

[0046] Besides, the rotor half-finished product **A** and the shroud **2** are united together by engagement of the outward claw piece **9** into the engaging hole **10** formed in the shroud **2**. As the result of this, the direction of engagement of the claw piece **9** and the engaging hole **10** becomes a direction in which the force of engagement increases when a centrifugal force acts on the blade **3**.

[0047] Accordingly, even when centrifugal forces act on the blade **3** during operation, the engagement between the claw piece **9** and the engaging hole **10** will not come loose. As the result of this, durability is improved significantly and no chatter sound is produced in the engaging part during operation.

[0048] In addition, also in the case of the present embodiment, ribs **8, 8, ...** are formed integrally with the rear surface of the outer peripheral part **1a** of the main plate **1** at the time of molding of the rotor half-finished product **A**, as in the first embodiment. Accordingly, the same working effects as the first embodiment are obtained.

[0049] It is needless to say that the present invention is applicable to centrifugal fan rotors other than the turbo fan rotor.

INDUSTRIAL APPLICABILITY

[0050] As has been described above, the present invention provides a centrifugal fan rotor and a method of manufacturing a centrifugal fan rotor useful for manufacture of turbo fan rotors and especially suitable for molding of turbo fan rotors from synthetic resin.

Claims

1. A centrifugal fan rotor comprising a main plate (**1**), a shroud (**2**), and a plurality of blades (**3, 3, ...**) disposed between an outer peripheral part (**1a**) of said main plate (**1**) and said shroud (**2**),

wherein a rotor half-finished product (**A**) formed as an integral molding of synthetic resin comprising said main plate (**1**) and said blades (**3, 3, ...**), and said shroud (**2**) formed as an integral molding of synthetic resin are manufactured separately,

wherein an engaging claw is formed integrally with said shroud (2) or with each said blade (3), and wherein an engaging part for engaging with said engaging claw is formed in each said blade (3) or in said shroud (2), and

wherein said rotor half-finished product (A) and said shroud (2) are united together by establishing engagement between said engaging claw and said engaging part.

2. The centrifugal fan rotor of claim 1, wherein said engaging claw and said engaging part are constructed so that the direction of engagement of said engaging claw and said engaging part becomes a direction in which the force of engagement of said engaging claw and said engaging part increases when a centrifugal force is exerted on each said blade (3).

3. The centrifugal fan rotor of claim 2, wherein said engaging claw is an inward claw piece (5) provided projectingly and formed integrally with an interior surface of said shroud (2), wherein said engaging part is an engaging concave part (6) formed in an external surface of each said blade (3).

4. The centrifugal fan rotor of claim 2, wherein said engaging claw is an outward claw piece (9) provided projectingly and formed integrally with a leading end of said each blade (3), wherein said engaging part is an engaging hole (10) formed in said shroud (2).

5. The centrifugal fan rotor of claim 1, wherein a rib (8) is formed integrally with a rear surface of said outer peripheral part (1a) of said main plate (1).

6. A method of manufacturing a centrifugal fan rotor comprising a main plate (1), a shroud (2), and a plurality of blades (3, 3, ...) disposed between an outer peripheral part (1a) of said main plate (1) and said shroud (2), said method comprising the steps of:

providing a rotor half-finished product (A) formed as an integral molding of synthetic resin comprising said main plate (1) and said blades (3, 3, ...), and providing said shroud (2) formed as an integral molding of synthetic resin separately from said rotor half-finished product (A), establishing engagement between an engaging claw which is formed integrally with said shroud (2) or with each said blade (3) and an engaging part which is formed in each said blade (3) or in said shroud (2) so that said rotor half-finished product (A) and said shroud (2) are united together.

7. The centrifugal fan rotor manufacturing method of claim 6, wherein the direction of engagement of said engaging claw and said engaging part becomes a direction in which the force of engagement of said engaging claw and said engaging part increases when a centrifugal force is exerted on each said blade (3).

8. The centrifugal fan rotor manufacturing method of claim 7, wherein said engaging claw is an inward claw piece (5) provided projectingly and formed integrally with an interior surface of said shroud (2), and wherein said engaging part is an engaging concave part (6) formed in an external surface of each said blade (3).

9. The centrifugal fan rotor manufacturing method of claim 7, wherein said engaging claw is an outward claw piece (9) provided projectingly and formed integrally with a leading end of said each blade (3), and wherein said engaging part is an engaging hole (10) formed in said shroud (2).

10. The centrifugal fan rotor manufacturing method of claim 6, wherein a rib (8) is formed integrally with a rear surface of said outer peripheral part (1a) of said main plate (1) at the time of molding of said rotor half-finished product (A).

FIG. 1

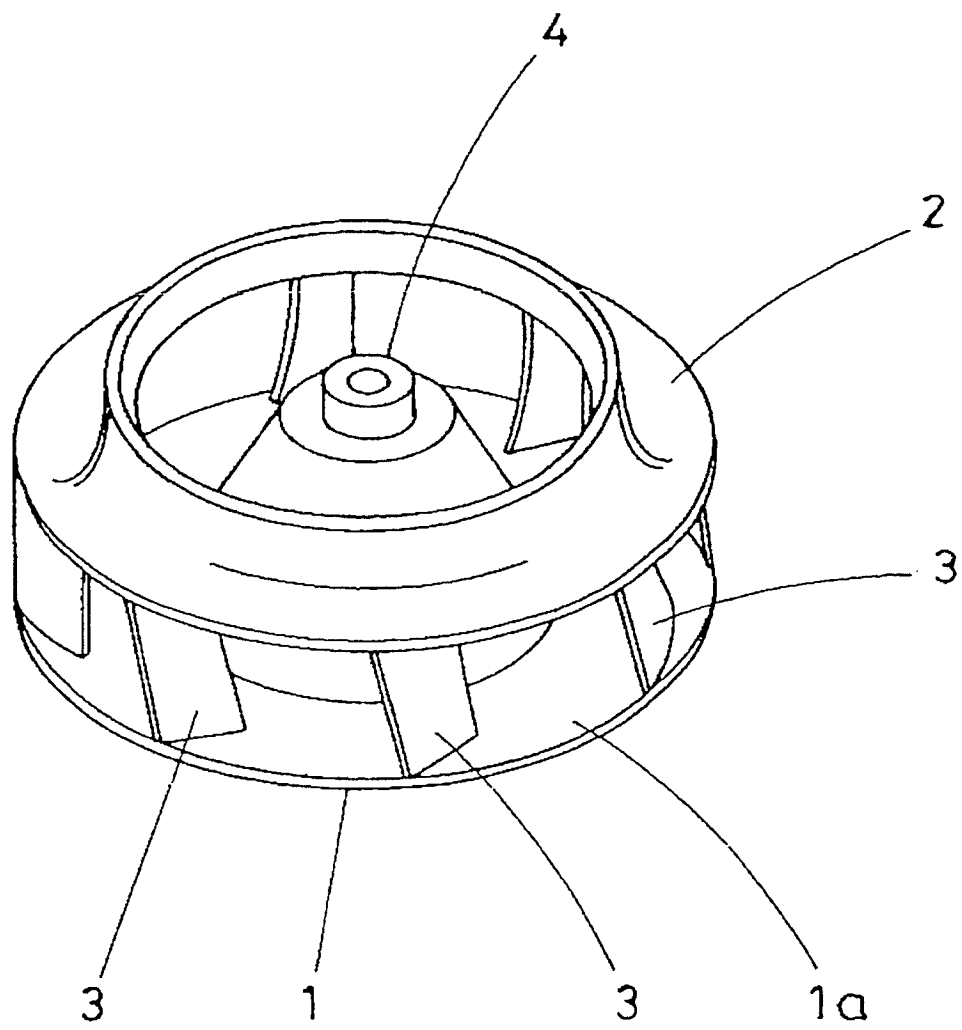


FIG. 2

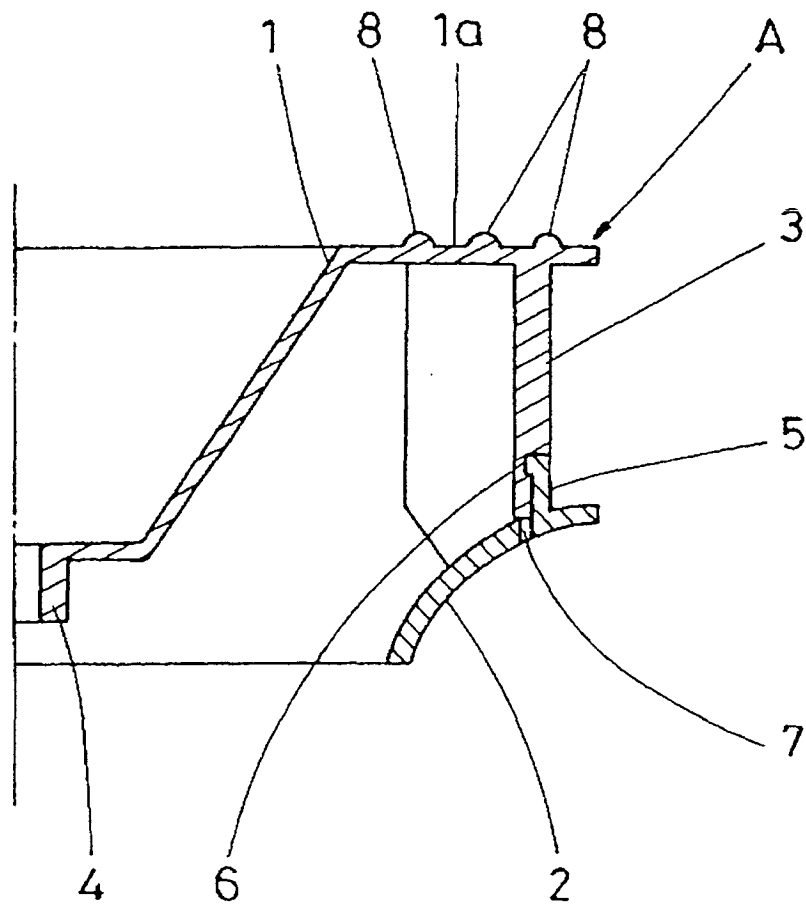


FIG. 3

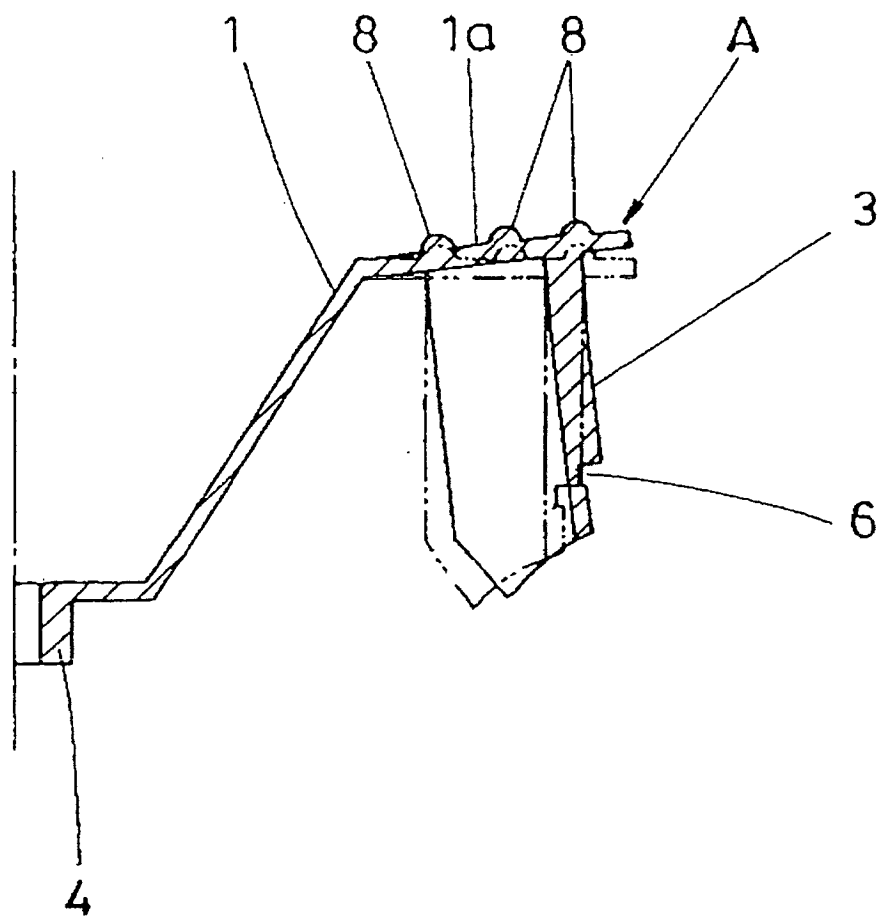


FIG. 4

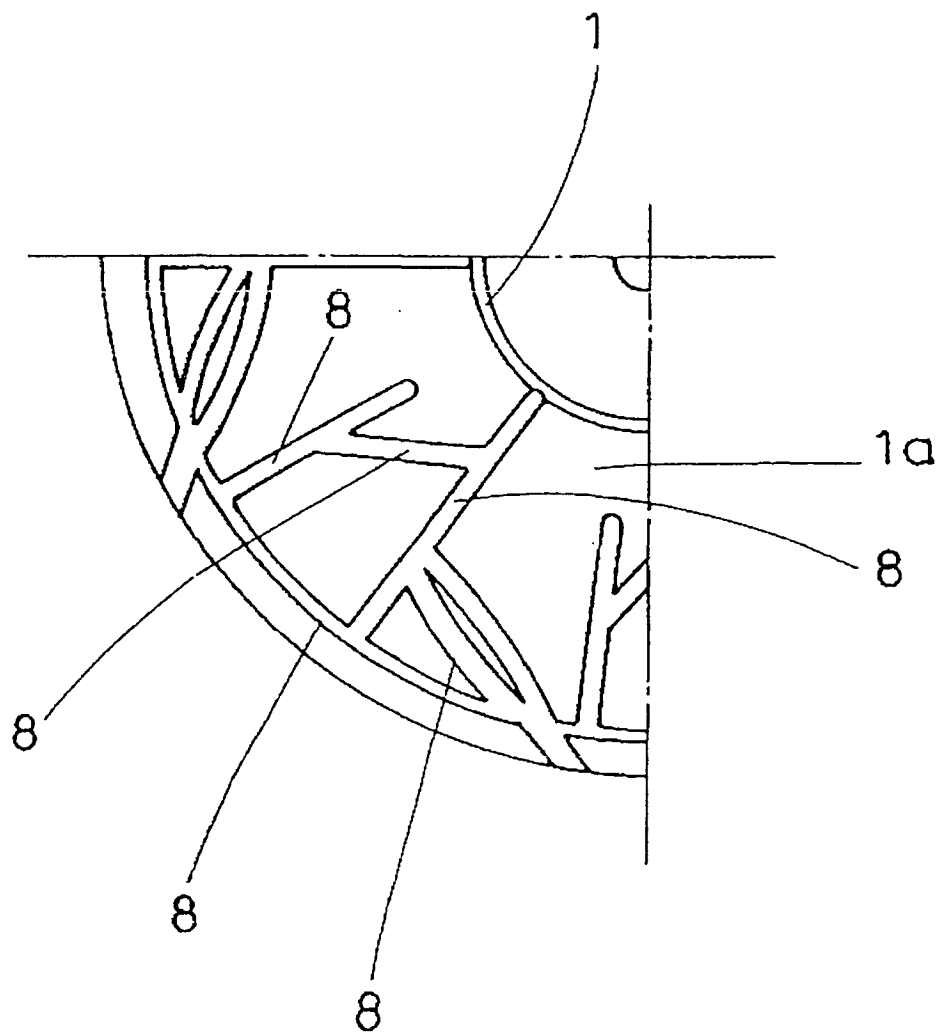
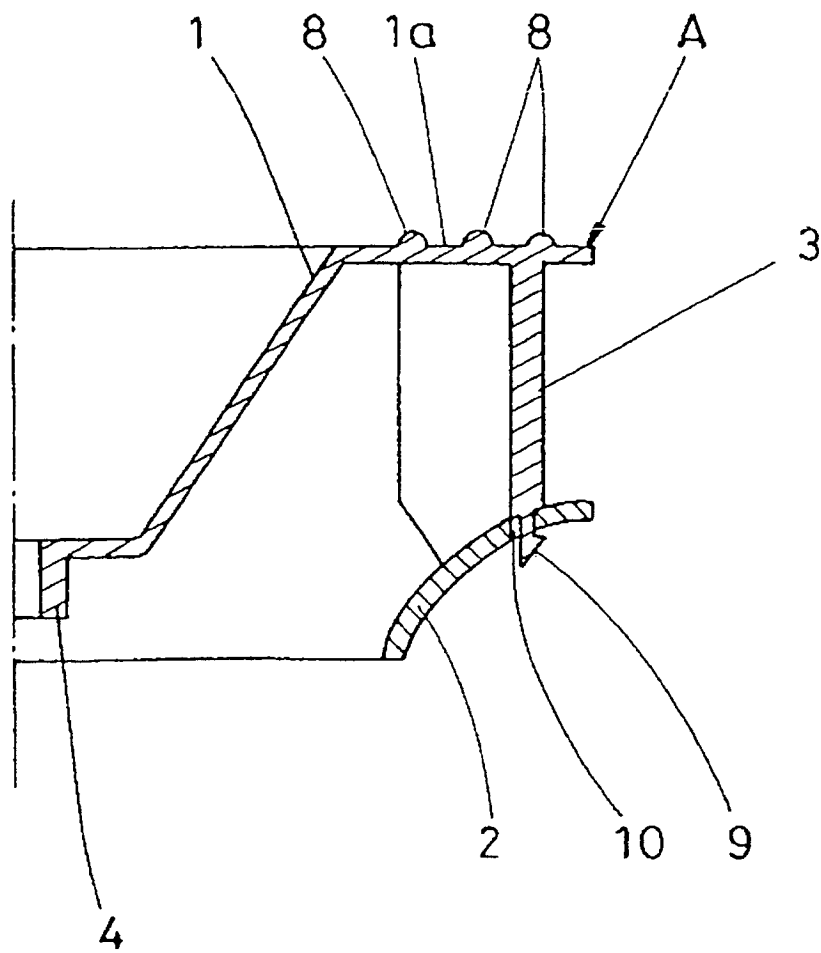


FIG. 5



INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/04244

A. CLASSIFICATION OF SUBJECT MATTER Int.Cl ⁷ F04D29/28		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) Int.Cl ⁷ F04D29/28		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched Jitsuyo Shinan Koho 1922-1996 Toroku Jitsuyo Shinan Koho 1994-2003 Kokai Jitsuyo Shinan Koho 1971-2003 Jitsuyo Shinan Toroku Koho 1996-2003		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X Y A	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 68232/1980 (Laid-open No. 169497/1981) (Komatsu Zenoah Co.), 15 December, 1981 (15.12.81), Full text; Figs. 1 to 6 (Family: none)	1, 2, 6, 7 4, 5, 9, 10 3, 8
Y	JP 47-19776 Y1 (Kabushiki Kaisha Marunaka Seisakusho), 05 July, 1972 (05.07.72), Full text; Figs. 1 to 3 (Family: none)	4, 9
☒ Further documents are listed in the continuation of Box C. ☐ See patent family annex.		
* Special categories of cited documents: "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed "T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art "&" document member of the same patent family		
Date of the actual completion of the international search 01 July, 2003 (01.07.03)		Date of mailing of the international search report 15 July, 2003 (15.07.03)
Name and mailing address of the ISA/ Japanese Patent Office		Authorized officer
Facsimile No.		Telephone No.

Form PCT/ISA/210 (second sheet) (July 1998)

INTERNATIONAL SEARCH REPORT

International application No.

PCT/JP03/04244

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Y	Microfilm of the specification and drawings annexed to the request of Japanese Utility Model Application No. 40431/1989 (Laid-open No. 131099/1990) (Arimitsu Industry Co., Ltd.), 30 October, 1990 (30.10.90), Full text; Figs. 1 to 5 (Family: none)	5, 10

Form PCT/ISA/210 (continuation of second sheet) (July 1998)