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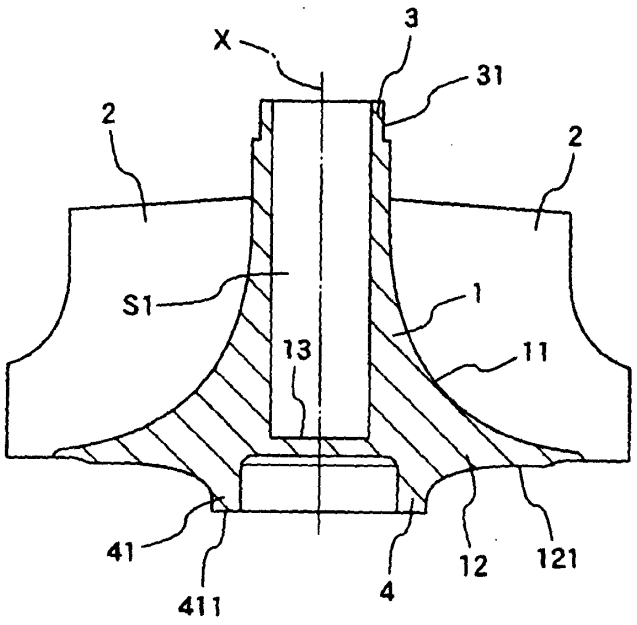
(54) Turbine wheel for a turbocharger

(57) A hot wheel of a turbocharger formed by precision casting, including a shaft-shaped hub part (1) disposed at a radially central portion thereof; a plurality of vane parts (2) formed on a periphery of the hub part (1); an wrench boss (3) formed at a top end of the hub part (1); and a boss portion (4) formed at a bottom end of the hub part (1). In the hot wheel having the above-described construction, with an outer configuration of a necessary portion of each of the hub part (1), the wrench boss (3), and the boss portion (4) maintained, a cavity (S1) open outward is formed with respect to an axis of said hub part (1) at at least one of said hub part (1), said wrench boss (3), and said boss portion (4).

Fig.1



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Description

BACKGROUND OF THE INVENTION

Field of the Invention

[0001] The present invention relates to a turbine wheel of a turbocharger. More particularly, the present invention relates to a turbine wheel for use in a high-temperature gas (hereinafter referred to as a hot wheel), which is manufactured by precision casting process. The present invention is intended to decrease the amount of wax in manufacturing the hot wheel model and decrease the weight of the hot wheel to improve the rotation response thereof.

Description of the Related Art

[0002] Fig. 10 is a vertical sectional view showing an example of a hot wheel formed by precision casting. The hot wheel is symmetrical with respect to an axis X thereof. A solid shaft-shaped hub part 1 is disposed at the center of the hot wheel. A vane part 2 is circumferentially formed at a plurality of positions of a peripheral surface 11 of the hub part 1 which draws a gentle curved surface in the shape of the foot of a mountain. The top portion of the hub part 1 is stepped to form an wrench boss 3 having a diameter smaller than the lower portion. The wrench boss 3 has a plurality of approximately triangular concavities and convexities alternately formed on a peripheral surface 31 thereof. A boss portion 4 having an annular wall 41 projected downward is formed at the center of a lower surface 121 of a base portion 12 of the hub part 1 which extends outwardly circularly in a plan view. One end of a shaft SH having a small diameter is inserted into an inner space of the annular wall 41. An end surface 411 of the annular wall 41 is welded to an end surface of the shaft SH having a large diameter. Because a heat-resistant alloy such as Inconel composing the hot wheel has a large density, the hot wheel is heavy and has a low rotation response.

[0003] To overcome this problem, in the hot wheel disclosed in Japanese Patent Application Laid-Open publication No. 9-53595, the central portion thereof is formed from a heat-resistant aluminum alloy by forging it, whereas the projected portion thereof is formed from a high-strength heat-resistant alloy by using a liquid quenching method. The central portion and the projected portion are joined with each other by di f fus ion bonding to make the hot wheel lightweight.

[0004] But the hot wheel described in the aforesaid publication has a problem that it has a complicated construction and thus much time and labor are required to manufacture it.

SUMMARY OF THE INVENTION

[0005] The present invention has been made in view of the above-described problems. Therefore it is an object of the present invention to provide a hot wheel, of a turbocharger, which can be easily manufactured by precision casting, has an improved rotation response by making it lightweight, and uses a decreased amount of wax when it is manufactured.

[0006] To solve the above-described problems, the present invention provides a hot wheel of a turbocharger formed by precision casting, including a shaft-shaped hub part (1) disposed at a radially central portion thereof; a plurality of vane parts (2) formed on a periphery of said hub part (1); an wrench boss (3) formed at a top end of said hub part (1); and a boss portion (4) formed at a bottom end of said hub part (1). In the hot wheel having the above-described construction, with an outer configuration of a necessary portion of each of the hub part (1), the wrench boss (3), and the boss portion (4) maintained, a cavity (S1, S2, S3, S4, S5, and S6) open outward is formed symmetrically with respect to an axis of the hub part (1) at at least one of the hub part (1), the wrench boss (3), and the boss portion (4). It is advantageous to form the cavities (S1, S3, S4 and S6) at the central portion of the hub part (1) in terms of the strength of the hot wheel.

[0007] In the present invention, with the outer configuration of the necessary portion of each of said hub part, said wrench boss, and said boss portion secured, the cavity open outward is formed symmetrically with respect to the axis of said hub part at at least one of said hub part, said wrench boss, and said boss portion. Therefore it is possible to manufacture the hot wheel easily by precision casting and improve the response capability thereof by making the hot wheel more lightweight than the conventional hot wheel with hardly deteriorating the strength thereof. Further the volume of the solid portion of the hot wheel is decreased owing to the formation of the cavity inside the hot wheel. Therefore it is possible to decrease the amount of wax which is used in manufacturing the hot wheel model and also decrease the amount of a metal material to be cast. Therefore it is possible to manufacture the hot wheel at a low cost. Furthermore because the entire hot wheel is lightweight, it is easy to adjust the rotation balance by grinding the wrench boss in a small amount.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008]

Fig. 1 is a vertical sectional view showing a hot wheel of a first embodiment of the present invention.
Fig. 2 is a vertical sectional view showing a hot wheel of a second embodiment of the present invention.
Fig. 3 is a vertical sectional view showing a hot wheel of a third embodiment of the present invention.
Fig. 4 is a vertical sectional view showing a hot wheel of a fourth embodiment of the present invention.
Fig. 5 is a vertical sectional view showing a hot wheel of a fifth embodiment of the present invention.

Fig. 6 is a vertical sectional view showing a hot wheel of a sixth embodiment of the present invention.
Fig. 7 is a vertical sectional view showing a hot wheel of a seventh embodiment of the present invention.
Fig. 8 is a vertical sectional view showing a hot wheel of an eighth embodiment of the present invention.
Fig. 9 is a vertical sectional view showing a hot wheel of a ninth embodiment of the present invention.
Fig. 10 is a vertical sectional view showing a conventional hot wheel.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

[0009] The hot wheel of each of the first through ninth embodiments of the present invention is made of a heat-resistant alloy such as Inconel by precision casting process. The same parts of the hot wheels of the embodiments as those of the above-described conventional hot wheel are denoted by the same reference numerals as those of the conventional hot wheel. The configurations of the following portions are the same as those of the conventional hot wheel: a necessary portion of a hub part 1, namely, a peripheral surface 11 thereof drawing a gentle curved surface in the shape of the base of a mountain, a necessary portion of an wrench boss 3, namely, a peripheral surface 31 thereof having a plurality of approximately triangular concavities and convexities formed thereon, and a necessary portion of a boss portion 4, namely, an end surface 411 of an annular wall 41 thereof. A vane part 2 is identical to that of the conventional hot wheel.

First Embodiment

[0010] In the first embodiment of the present invention, as shown in Fig. 1, a cavity S1 is formed at the radially central portion of the hub part 1 of the hot wheel with the cavity S1 extended in the longitudinal direction thereof. The cavity S1 is symmetrical with respect to an axis X of the hub part 1 and cross sectionally circular. The cavity S1 penetrates through the wrench boss 3 and is open at an upper portion thereof. A lower end of the cavity S1 reaches a partitioning wall 13 disposed at the boundary area to the boss portion 4. This construction makes the hot wheel more lightweight by about 20% than the conventional hot wheel with hardly deteriorating the strength thereof.

Second Embodiment

[0011] In the second embodiment of the present invention, as shown in Fig. 2, the partitioning wall 13 (see Fig. 1) of the first embodiment is eliminated to open a lower portion of the cavity S1 into the boss portion 4. This construction makes the hot wheel more lightweight by about 1% than the hot wheel of the first embodiment.

Third Embodiment

[0012] In the third embodiment of the present invention, as shown in Fig. 3, the configuration of the peripheral surface 11 of the hub part 1 is the same as that of the conventional hot wheel. A peripheral portion, of the bottom surface of the base portion 12 of the hub part 1, adjacent to the boss portion 4 is scooped deeply annularly and symmetrically with respect to the axis X of the hot wheel to form a cavity S2 which is approximately triangular in section and open downward. The peripheral surface of the cavity S2 is curved along the curved peripheral surface 11 of the hub part 1 to allow an outer wall 111 to have a predetermined thickness on the periphery of the base portion 12 of the hub part 1. This construction makes the hot wheel more lightweight by about 25% than the conventional hot wheel with hardly deteriorating the strength thereof.

Fourth Embodiment

[0013] In the fourth embodiment of the present invention, as shown in Fig. 4, a cavity S3 is formed at the radially central portion of the hub part 1 of the hot wheel with the cavity S3 extended in the longitudinal direction thereof. The cavity S3 is symmetrical with respect to the axis X of the hub part 1 and cross sectionally circular. The diameter of a circle of the cavity S3 becomes gradually larger downward along the curved peripheral surface 11 of the hub part 1. The cavity S3 penetrates through the wrench boss 3 and is open at an upper face thereof. A lower end of the cavity S3 reaches the partitioning wall 13 disposed at the boundry area to the boss portion 4. The peripheral surface of the cavity S3 is curved along the curved peripheral surface 11 of the hub part 1 to allow an outer wall 112 to have a predetermined thickness on the periphery of the wrench boss 3 and that of the hub part 1. This construction makes the hot wheel more lightweight by about 35% than the conventional hot wheel with hardly deteriorating the strength thereof.

Fifth Embodiment

[0014] In the fifth embodiment of the present invention, as shown in Fig. 5, a cavity S4 is formed at the radially central portion of the hub part 1 of the hot wheel with the cavity S4 extended in the longitudinal direction thereof. The cavity S4 is symmetrical with respect to the axis X of the hub part 1 and cross sectionally circular. An upper end of the cavity S4 reaches a partitioning wall 14 disposed at the boundary area to the wrench boss 3. A lower portion of the cavity S4 is open into the boss portion 4. As in the case of the third embodiment, the cavity S2 (see Fig. 3) is formed on the peripheral portion, of the bottom surface of the base portion 12 of the hub part 1, adj acent to the boss portion 4. This construction makes the hot wheelmore lightweight by about 40% than the conventional hot wheel with hardly deteriorating the

strength thereof.

Sixth embodiment

[0015] In the sixth embodiment of the present invention, as shown in Fig. 6, a cavity S1 (see Fig. 1) is formed at the radially central portion of the hub part 1 of the hot wheel with the cavity S1 extended in the longitudinal direction thereof and reaches the partitioning wall 13. As in the case of the third embodiment, the cavity S2 (see Fig. 3) is formed on the peripheral portion, of the bottom surface of the base portion 12 of the hub part 1, adjacent to the boss portion 4. This construction makes the hot wheel more lightweight by about 43% than the conventional hot wheel with hardly deteriorating the strength thereof.

Seventh Embodiment

[0016] In the seventh embodiment of the present invention, as shown in Fig. 7, the partitioning wall 13 (see Fig. 6) of the sixth embodiment is eliminated to open a lower portion of the cavity S1 into the boss portion 4. This construction makes the hot wheel more lightweight by about 1% than the hot wheel of the sixth embodiment.

Eighth Embodiment

[0017] In the eighth embodiment of the present invention, as shown in Fig. 8, the central portion of the hub part 1 of the hot wheel is solid. A region from the peripheral portion, of the bottom surface of the base portion 12 of the hub part 1, adjacent to the boss portion 4 to the peripheral portion of the main body of the hub part 1 is scooped deeply annularly and symmetrically with respect to the axis X of the hot wheel to form a cavity S5 open downward, with the peripheral surface 11 of the hub part 1 curved similarly to the conventional hot wheel. The peripheral surface of the cavity S5 is curved along the curved peripheral surface 11 of the hub part 1 to allow an outer wall 113 to have a predetermined thickness on the periphery of the hub part 1. This construction makes the hot wheel more lightweight by about 50% than the conventional hot wheel with hardly deteriorating the strength thereof.

Ninth Embodiment

[0018] In the ninth embodiment of the present invention, as shown in Fig. 9, a cavity S6 is formed at the radially central portion of the hub part 1 with the cavity S6 extended in the longitudinal direction thereof. The cavity S6 is symmetrical with respect to an axis X of the hub part 1 and cross sectionally circular. The diameter of a circle of the cavity S6 becomes gradually larger downward along the curved peripheral surface 11 of the hub part 1. As the base portion 12 becomes larger outward, the diameter of the cavity S6 becomes increasingly large outward and maximum at a portion of the base portion 12. A lower end of the cavity S6 is open into the boss portion 4 with an annular wall 41 formed similarly to the conventional hot wheel. In the construction of the hot wheel of the ninth embodiment, an outer wall 114 having a predetermined thickness is formed along the curved peripheral surface of the hot wheel symmetrical with respect to the axis thereof. Therefore it is possible to prevent a stress from concentrating at a portion of the hot wheel and decrease the weight thereof by about 20% than the conventional hot wheel with hardly deteriorating the strength thereof.

[0019] It is explicitly stated that all features disclosed in the description and/or the claims are intended to be disclosed separately and independently from each other for the purpose of original disclosure as well as for the purpose of restricting the claimed invention independent of the composition of the features in the embodiments and/or the claims. It is explicitly stated that all value ranges or indications of groups of entities disclose every possible intermediate value or intermediate entity for the purpose of original disclosure as well as for the purpose of restricting the claimed invention, in particular as limits of value ranges.

Claims

1. In a turbine wheel of a turbocharger formed by precision casting, comprising: a shaft-shaped hub part disposed at a radially central portion thereof; a plurality of vane parts formed on a periphery of said hub part; an wrench boss formed at a top end of said hub part; and a boss portion formed at a bottom end of said hub part,
said turbine wheel is **characterized in that** with an outer configuration of a necessary portion of each of said hub part, said wrench boss, and said boss portion maintained, a cavity open outward is formed symmetrically with respect to an axis of said hub part at at least one of said hub part, said wrench boss, and said boss portion.

2. A turbine wheel of a turbocharger according to claim 1, wherein said cavity is formed at a radially central portion of said hub part.

3. A turbine wheel of a turbocharger according to claim 2, wherein said cavity is symmetrical with respect to said axis of said hub part and cross sectionally circular; and a diameter of a circle of said cavity becomes gradually larger downward along a curved peripheral surface of said hub part.

4. A turbine wheel of a turbocharger according to claim 2 or 3, wherein said cavity penetrates through an wrench boss and is open outward.

5. A turbine wheel of a turbocharger according to any one of claims 2 through 4, wherein said cavity is open

into said boss portion.

6. A turbine wheel of a turbocharger according to claim 1, wherein a peripheral portion, of a bottom surface of a base portion of said hub part, adjacent to said boss portion is scooped annularly and symmetrically with respect to said axis of said hub part to form said cavity.

7. A turbine wheel of a turbocharger according to claim 6, wherein said cavity is reached to a peripheral portion of a main body of said hub part.

Fig.1

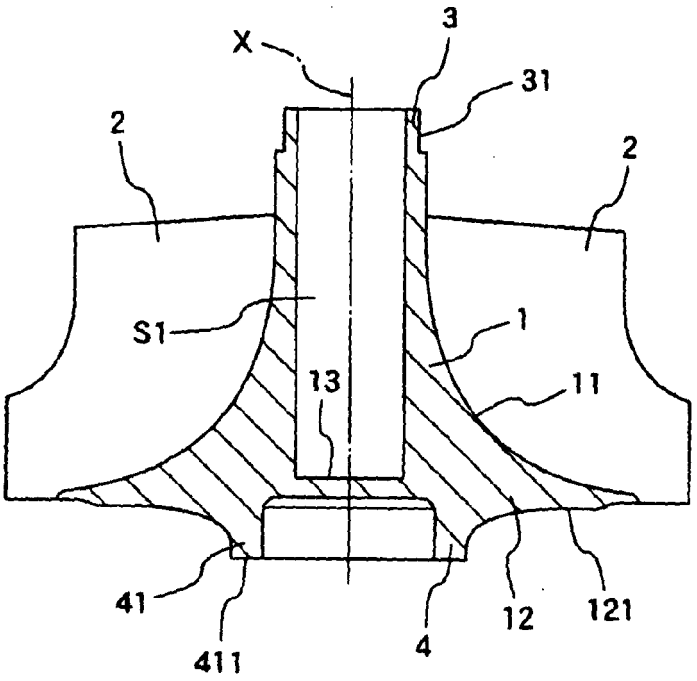


Fig.2

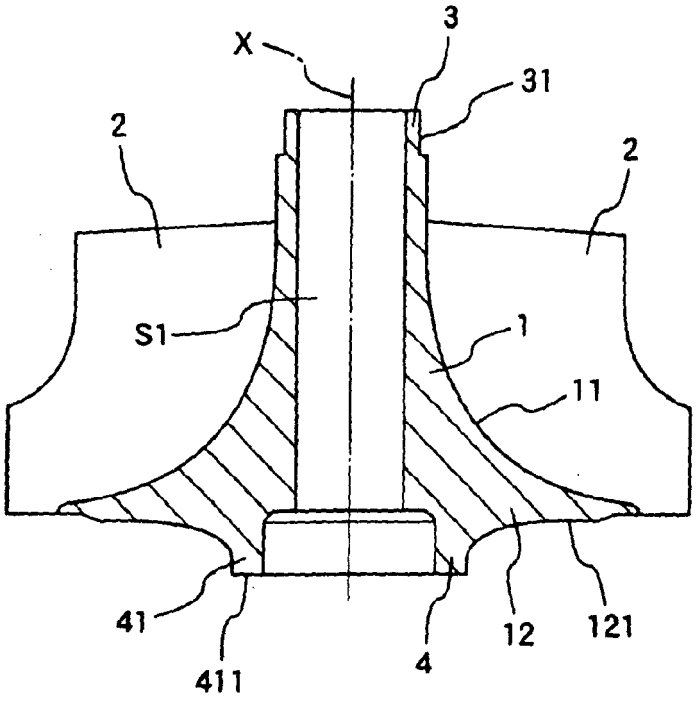


Fig.3

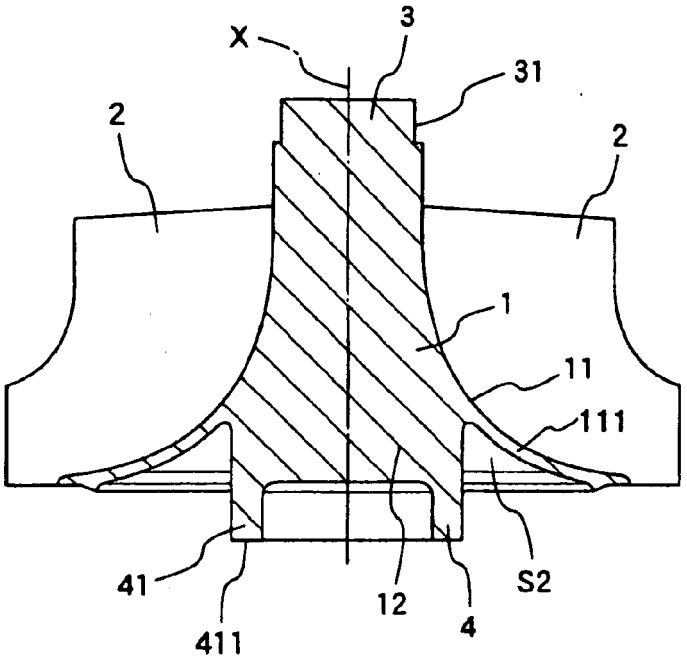


Fig.4

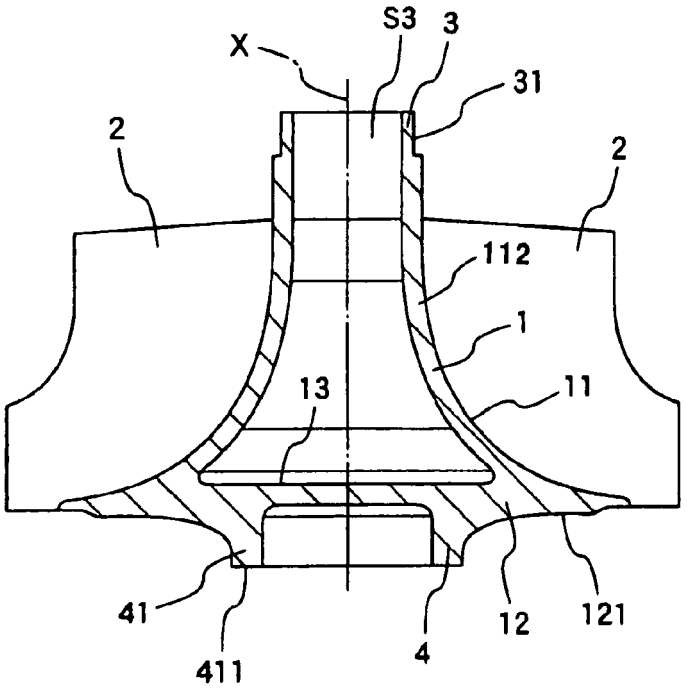


Fig.5

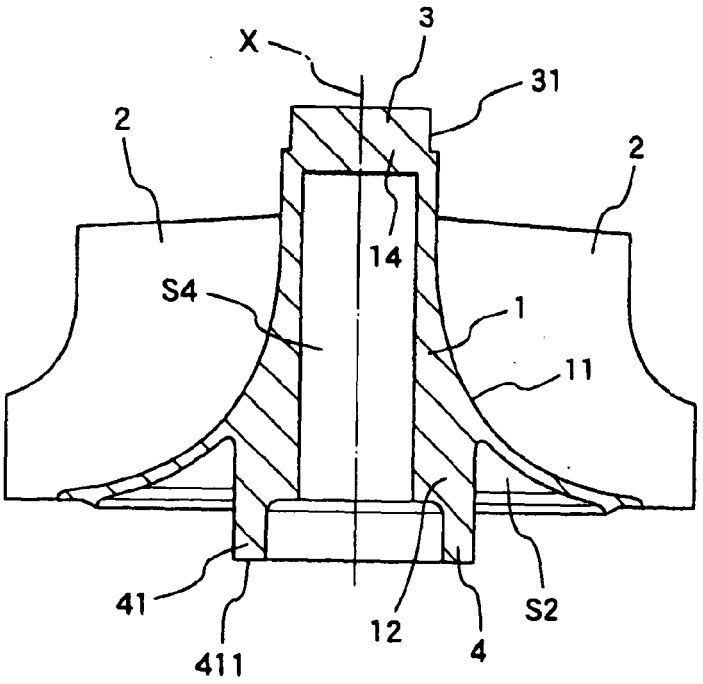


Fig.6

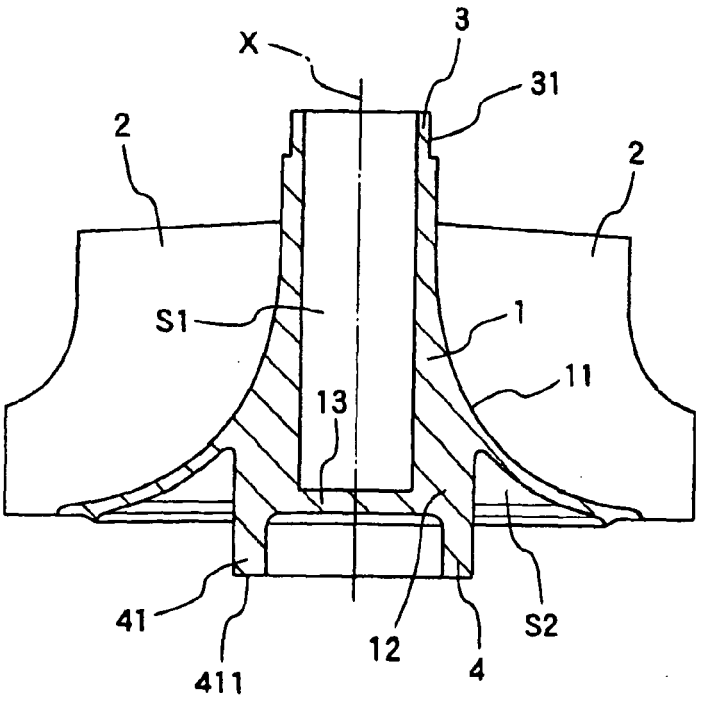


Fig.7

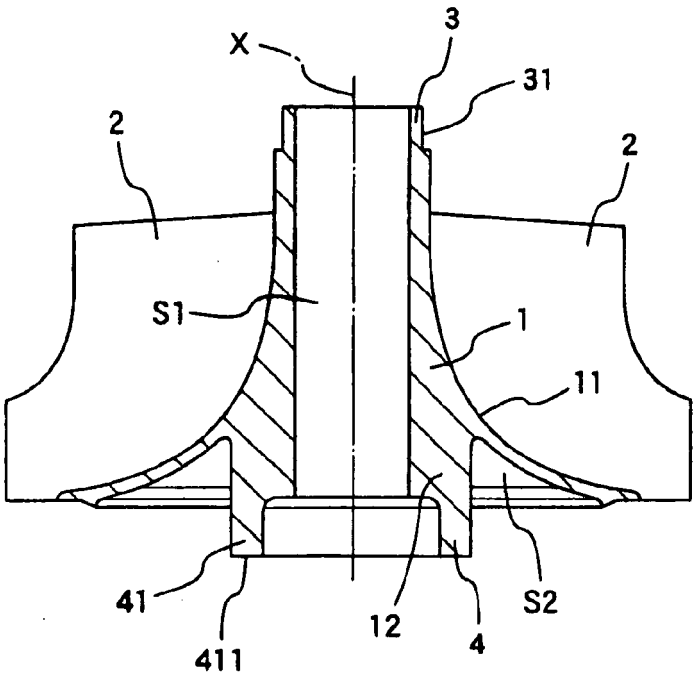


Fig.8

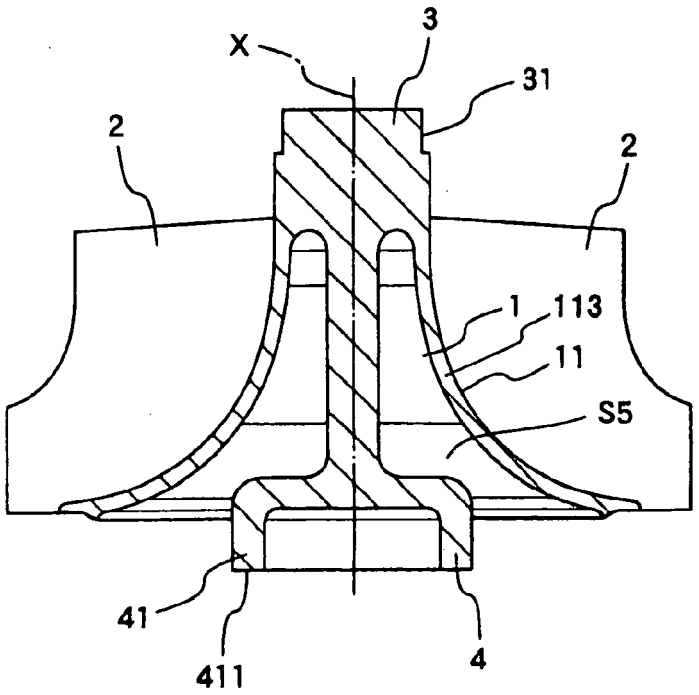


Fig.9

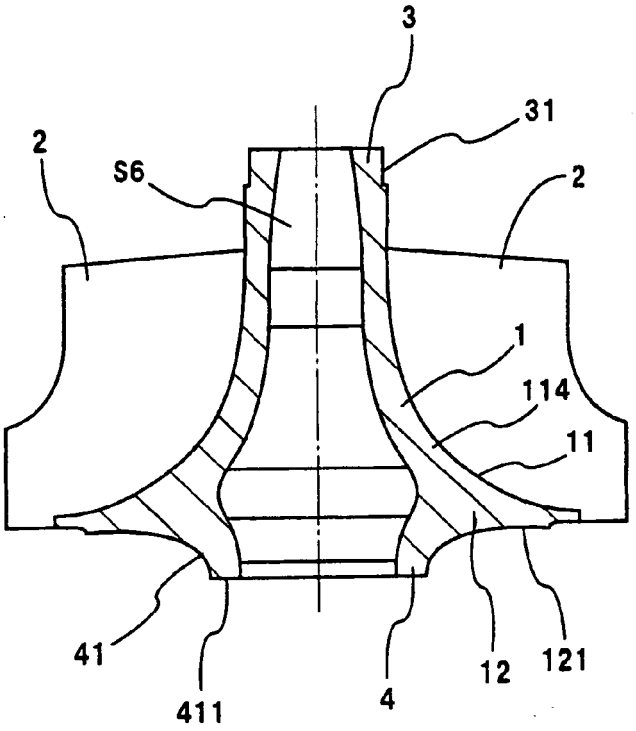
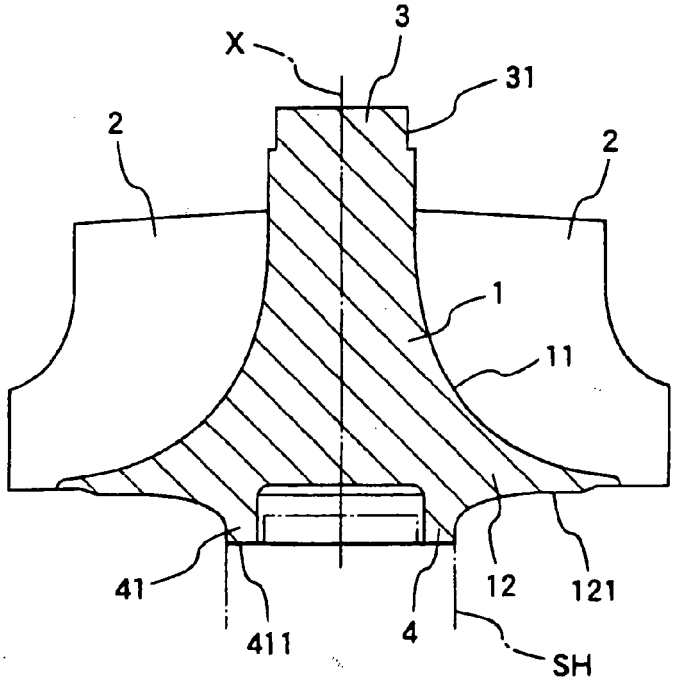


Fig.10

PRIOR ART



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EUROPEAN SEARCH REPORT

Application Number
EP 07 00 2943

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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Y	GB 1 515 296 A (PENNY TURBINES LTD N) 21 June 1978 (1978-06-21) * page 1, lines 10-48,78-92 * * page 2, lines 17-46 * * figures 1,2 *	1-7	
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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
The Hague	6 July 2007	Souris, Christophe

CATEGORY OF CITED DOCUMENTS

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REFERENCES CITED IN THE DESCRIPTION

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