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CA 2423731 A1 2002/05/16

(21) 2 423 731

(12) DEMANDE DE BREVET CANADIEN
CANADIAN PATENT APPLICATION

(13) A1

(86) Date de dépôt PCT/PCT Filing Date: 2001/09/25
(87) Date publication PCT/PCT Publication Date: 2002/05/16
(85) Entrée phase nationale/National Entry: 2003/03/26
(86) N° demande PCT/PCT Application No.: SE 2001/002061
(87) N° publication PCT/PCT Publication No.: 2002/038330
(30) Priorité/Priority: 2000/11/09 (0004138-4) SE

(51) Cl.Int.^{7}/Int.Cl.^{7} B23P 15/02, B23H 9/00

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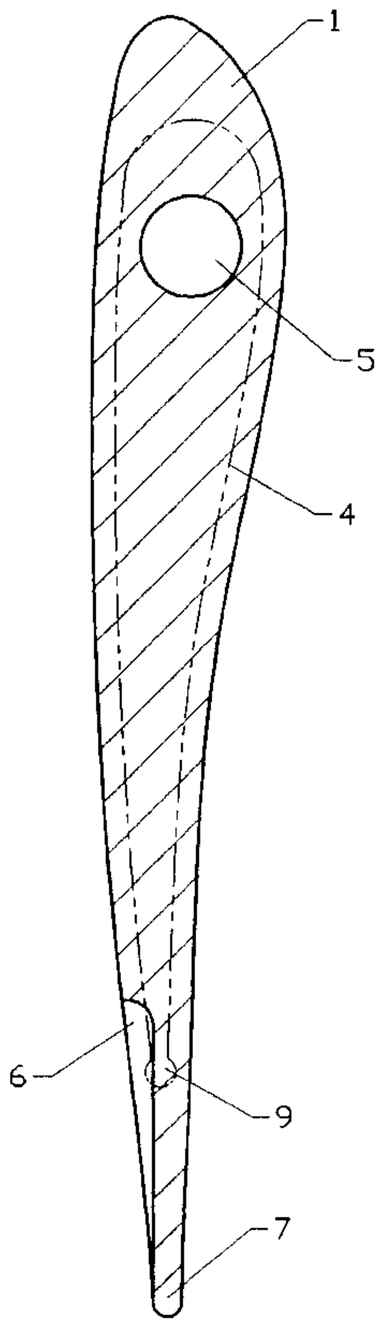
(54) Titre : PROCEDE DE FABRICATION D'AUBE DE COMPOSANT DE TURBINE A GAZ ET PROCEDE DE FABRICATION DE COMPOSANT DE TURBINE A GAZ

(54) Title: A METHOD FOR MANUFACTURING A VANE TO A GAS TURBINE COMPONENT AND A METHOD FOR MANUFACTURING A GAS TURBINE COMPONENT



(57) Abrégé/Abstract:
The invention relates to a method for manufacturing a vane (1) to a gas turbine component, which vane is intended for guiding a gas flow, the vane (1) being produced by casting. An internal hole (3) for coolant is then cut out of the cast vane (1). The vane (1) is provided with a starter hole (5), either during casting or once casting is completed, following which the internal hole (3) for

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(57) Abrégé(suite)/Abstract(continued):
coolant is cut out of the vane, proceeding from the starter hole. The invention also relates to a method for manufacturing a gas turbine component comprising a plurality of vanes (1) for guiding a gas flow. The gas turbine component is cast in such a way that it comprises said vanes and an internal hole (3) for coolant is then cut out of each of the vanes in the manner stated above.

(12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(19) World Intellectual Property Organization
International Bureau

(43) International Publication Date
16 May 2002 (16.05.2002)

PCT

(10) International Publication Number
WO 02/38330 A1

(51) International Patent Classification[7]: B23P 15/02, B23H 9/00

(21) International Application Number: PCT/SE01/02061

(22) International Filing Date:
25 September 2001 (25.09.2001)

(25) Filing Language: Swedish

(26) Publication Language: English

(30) Priority Data:
0004138-4 9 November 2000 (09.11.2000) SE

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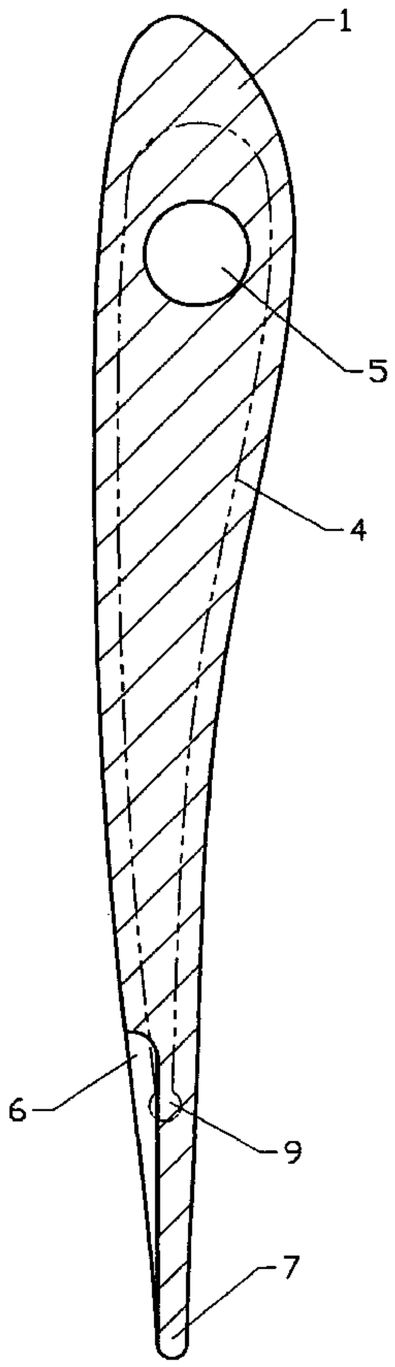
(81) Designated States *(national)*: AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, PH, PL, PT, RO, RU, SD, SE, SG, SI, SK, SL, TJ, TM, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZW.

(84) Designated States *(regional)*: ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European

[Continued on next page]

(54) Title: A METHOD FOR MANUFACTURING A VANE TO A GAS TURBINE COMPONENT AND A METHOD FOR MANUFACTURING A GAS TURBINE COMPONENT



(57) Abstract: The invention relates to a method for manufacturing a vane (1) to a gas turbine component, which vane is intended for guiding a gas flow, the vane (1) being produced by casting. An internal hole (3) for coolant is then cut out of the cast vane (1). The vane (1) is provided with a starter hole (5), either during casting or once casting is completed, following which the internal hole (3) for coolant is cut out of the vane, proceeding from the starter hole. The invention also relates to a method for manufacturing a gas turbine component comprising a plurality of vanes (1) for guiding a gas flow. The gas turbine component is cast in such a way that it comprises said vanes and an internal hole (3) for coolant is then cut out of each of the vanes in the manner stated above.

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patent (AT, BE, CH, CY, DE, DK, ES, FI, FR, GB, GR, IE, IT, LU, MC, NL, PT, SE, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

Published:

— *with international search report*

A method for manufacturing a vane to a gas turbine component and a method for manufacturing a gas turbine component

BACKGROUND OF THE INVENTION

The present invention relates to a method for manufacturing a vane to a gas turbine component, which vane is intended for guiding a gas flow, the vane being made by casting. The invention also relates to a method for manufacturing a gas turbine component.

The term gas turbine is intended to mean a unit, which comprises at least one turbine and a compressor driven by the former, together with a combustion chamber. Gas turbines are used, for example as engines for vehicles and aircraft, as prime movers for vessels and in power stations for producing electricity.

The term gas turbine component is intended to mean a stator or a rotor. The gas turbine component may consist of both a radial and axial stator or rotor.

A gas turbine comprises a compressor turbine, the stator of which is that part of the gas turbine that is exposed to the highest temperature in operation of the gas turbine. In order to obtain a high efficiency, the highest possible compressor turbine inlet temperature is desirable. One method of achieving this is to cool the stator vanes, particularly in the rear area of the vanes.

DESCRIPTION OF THE PRIOR ART

One casting method commonly used for the manufacture of a vane for a gas turbine component is the lost wax casting method. According to this method, a wax pattern is manufactured. A ceramic core is used in

order to produce an internal cooling duct in the vane. The core is held in place in the tool that forms the wax pattern. Once the wax pattern has been made, a liquid ceramic mass is applied around the wax pattern by immersion in order to build up a shell. The wax pattern is then removed by melting out. This leaves the shell with the ceramic core inside. Molten metal is then poured down into the shell and made to solidify around the core. The shell is then broken up leaving a metal vane with a remaining ceramic core. The ceramic core is removed by chemical treatment. More specifically, the vane is lowered into a vessel containing a liquid that attacks the core, thereby dissolving the latter.

Disadvantages to this method include the fact that it is difficult to hold the core with any high degree of accuracy in the intended position in the molding tool that forms the wax pattern and in the mold during casting. This problem is especially pronounced where the vane is of smaller dimension. This problem leads to a relatively large scrap rate for vanes that are manufactured in this way.

SUMMARY OF THE INVENTION

A first object of the invention is to provide a method for the manufacture of vanes for a gas turbine component, which creates the prerequisites for greater accuracy in the location and shape of the coolant hole than in the state of the art.

This object is achieved in that an internal hole for coolant is cut out of the cast vane. Very accurate methods are now available for cutting out a hole in bodies.

According to a preferred embodiment the vane is provided with a starter hole, and the internal hole for coolant is cut out of the vane proceeding from the starter hole. More specifically, the starter hole is located inside the intended boundary line of the ultimate coolant hole and the coolant hole is then cut out, proceeding from the starter hole. To this purpose the starter hole is smaller than the ultimate coolant hole and the precision in locating the former need not be as high as the precision in locating the coolant hole.

According to a preferred embodiment the starter hole is cast into the vane. A core is used during casting, which defines the shape of the starter hole. In an alternative to use of the said core for the starter hole, the starter hole is machined into the vane after casting, for example by drilling. The latter solution eliminates the need for a core in order to define the shape of the coolant hole during casting, which results in a cost-effective casting process.

According to a further development of the preceding embodiments, the coolant hole is cut out by wire electrodischarge machining (EDM). This is a cutting process which creates the prerequisites for producing cutouts with very high accuracy.

A second object of the invention is to manufacture a gas turbine component comprising a plurality of vanes for guiding a gas flow by a method more cost-effective than the state of the art.

This is achieved in that a vane holder structure is manufactured and the said vanes manufactured in the manner stated above are fitted in the vane holder

structure. The vane holder structure is preferably manufactured by casting.

A third object of the invention is to provide a method for the manufacture of a gas turbine component comprising a plurality of vanes for guiding a gas flow, which creates the prerequisites for greater accuracy in the location and shape of the coolant hole than in the state of the art.

This object is achieved in that the gas turbine component is cast in such a way it comprises the said vanes and that an internal hole for coolant is cut out of each of the vanes after casting.

Other preferred embodiments and advantages of the invention are set out in the description and claims below.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be described in more detail below with reference to the embodiments shown in the drawings attached.

Figure 1 shows a cross-sectional view of a vane for a stator of radial type after casting.

Figure 2 shows a section of a stator of radial type having a plurality of vanes fitted.

Figure 3 shows a perspective view of a radial stator manufactured by the method according to the invention.

Figure 4 shows a cross-sectional view of a vane for a stator of radial type after casting. More specifically, the figure shows an alternative embodiment of a coolant hole.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS OF THE INVENTION

In the method of manufacture according to the invention a vane 1 for a radial stator 2 is cast in a first manufacturing stage. In a second manufacturing stage an internal hole 3 for coolant is cut out of the vane 1, see figures 1 and 2. The coolant may be air, for example. The intended shape of the coolant hole 3 is illustrated by a dashed line 4 in figure 1.

According to a first preferred embodiment a core is used to define a starter hole 5 during the casting stage. In the second manufacturing stage the internal hole 3 for coolant is cut out of the vane 1 proceeding from the starter hole 5. In order to achieve optimum cooling of the vane, this has a small wall thickness. The coolant hole 3 also has a cross-sectional shape essentially corresponding to the cross-sectional shape of the vane 1. The coolant hole 3 has a rounded shape, a so-called keyhole shape, in the end 9 of the hole facing the rear end 7 of the vane 1, with the aim of reducing the risk of incipient fracture.

The cutting out of the coolant hole 3 is performed by means of so-called wire electrodischarge machining. After casting, a wire is introduced through the starter hole 5 and arranged in a wire electrodischarge machining tool (not shown) on both sides of the vane 1. The coolant hole 3 is then cut out of the vane 1 by means of the wire along the dashed line 4.

According to a second preferred embodiment the starter hole 5 is drilled through the vane 1 after casting is completed. The internal hole 3 for coolant is then cut out of the vane 1, proceeding from the starter hole 5 in the manner stated above.

The vane 1 shown in figure 1 furthermore has a plurality of recesses 6 in proximity to its rear end 7. The recesses 6 are provided at the rear end 7 of the vane 1 during casting and are distributed along the width of the vane. The said recesses 6 are intended to be connected to the internal hole 3 for coolant with the object of producing strong cooling of the vane 1 at its rear end 7. More specifically, the recesses 6 are connected to the internal hole 3 for coolant during cutting out of the latter.

The invention furthermore relates to the manufacture of a gas turbine component, here in the form of a radial stator 2. According to a first example, in a first stage a vane holder structure 8 is manufactured by casting. In this, the vane holder structure is cast so as to form sections, or seats, for receiving the vanes 1. The vanes 1, which are manufactured according to any of the preceding embodiments, are then fitted in the vane holder structure 8.

According to a second example of the manufacture of a gas turbine component, here in the form of a radial stator 2, the component including the vanes 1 is cast in a first casting stage. According to a first alternative, a core is used to define the starting hole 5 in each of the vanes 1 during the casting stage. In the second manufacturing stage, the internal hole 3 for coolant is cut out of each of the vanes 1, proceeding from the starter hole 5. The cutting out is done by the above-mentioned wire electrodischarge machining method.

According to a second alternative, in a first stage the gas turbine component 2 is cast without any starter hole 5. After the casting stage, the starter hole 5 is drilled into each of the vanes 1. The coolant hole 3

is then cut out of each of the vanes 1 by means of the said wire electrodischarge machining.

In the same way as stated above for manufacturing the vanes, each vane 1 in the turbine component 2 is provided during casting with a plurality of recesses 6 in proximity to its rear end.

Figure 3 illustrates a perspective view of the radial stator 2 manufactured by the method according to the invention.

Figure 4 illustrates an alternative embodiment of the coolant hole 3. What distinguishes this embodiment from that shown in figure 1 is that the surface of the vane 1 that defines the coolant hole 3 has, at least in part, an area 10 with alternating elevations and depressions. In this way an enlarged cooling surface is obtained in the hole. The elevations form so-called cooling fins, which extend in the transverse direction of the vanes.

The gas turbine may be of both single-shaft and twin-shaft type. The term single-shaft gas turbine means that the compressor (or the compressors) is connected to the drive turbine by way of a shaft, the drive turbine being connected to an output shaft. The combustion chamber is here situated between the compressor (s) and the drive turbine. The term twin-shaft gas turbine means that the compressor (or compressors) is connected to a compressor turbine by way of a shaft. The drive turbine is not mechanically connected to the compressor turbine but is situated downstream of the compressor turbine in the direction of flow of the gas and connected to an output shaft. The combustion chamber is here situated between the compressor and the compressor turbine.

The method of processing by cutting described above encompasses both direct action on the material with a tool or a cutting element, such as the said wire, and action by means of a beam or the like, such as a laser beam.

The lost wax casting method is suitably used as casting method, but other casting methods with high dimensional accuracy are also included in the term casting. Methods using a ceramic core are primarily intended.

The invention must not be regarded as being confined to the embodiments of the invention described above, a number of modifications being conceivable without departing from the scope of the patent protection.

According to one alternative to the wire electrodischarge machining described above, the coolant hole may be cut out by conventional electrodischarge machining. In a further alternative for cutting out the coolant hole, laser cutting is used. In this case no starter hole is required for the machining. According to a further alternative, electrochemical processing is used for cutting out the coolant hole.

CLAIMS

1. A method for manufacturing a vane (1) to a gas turbine component (2), which vane is intended for guiding a gas flow, the vane (1) being made by casting, **characterized in that** an internal hole (3) for coolant is cut out of the cast vane (1).

2. The method as claimed in claim 1, **characterized in that** the vane (1) is provided with a starter hole (5), and that the internal hole (3) for coolant is cut out of the vane proceeding from the starter hole.

3. The method as claimed in claim 2, **characterized in that** the starter hole (5) is cast into the vane (1).

4. The method as claimed in claim 2, **characterized in that** the starter hole (5) is machined into the vane (1) after casting.

5. The method as claimed in any of claims 2 to 4, **characterized in that** the cutting out of the coolant hole (3) is performed by means of wire electrodischarge machining.

6. The method as claimed in any of the preceding claims, **characterized in that** the cutting out is performed in such a way that the surface of the vane (1) that defines the coolant hole (3) has, at least in part, an area (10) with alternating elevations and depressions.

7. The method as claimed in any of the preceding claims,
characterized in that
the vane (1) is provided with at least one recess (6) in proximity to its rear end (7), and that this is connected to the internal hole (3) for coolant.

8. The method as claimed in claim 7,
characterized in that
the recess (6) is connected to the internal hole (3) for coolant during cutting out of the latter.

9. The method as claimed in claim 7 or 8,
characterized in that
the recess (6) is provided at the rear end of the vane (1) during casting.

10. A method for manufacturing a gas turbine component (2) comprising a plurality of vanes (1) for guiding a gas flow,
characterized in that
a vane holder structure (8) is manufactured and said vanes (1) manufactured according to any of the preceding claims are fitted in the vane holder structure.

11. The method as claimed in claim 10,
characterized in that
the vane holder structure (8) is manufactured by casting.

12. A method for manufacturing a gas turbine component (2) comprising a plurality of vanes (1) for guiding a gas flow,
characterized in that the gas turbine component is cast in such a way that it comprises said vanes and that an

internal hole (3) for coolant is cut out of each of the vanes after casting.

13. The method as claimed in claim 12,
characterized in that
each of the vanes (1) is provided with a starter hole (5), and that the internal hole (3) for coolant is cut out of the vane proceeding from the starter hole.

14. The method as claimed in claim 13,
characterized in that
the starter hole (5) is cast into each of the vanes (1).

15. The method as claimed in claim 13,
characterized in that
the starter hole (5) is machined into each of the vanes (1) after casting.

16. The method as claimed in any of claims 13 to 15,
characterized in that
the cutting out of the coolant hole (3) is performed by means of wire electrodischarge machining.

17. The method as claimed in any of claims 12 to 16,
characterized in that
the cutting out is performed in such a way that the surface of each of the vanes (1) that defines the coolant hole (3) has, at least in part, an area (10) with alternating elevations and depressions.

18. The method as claimed in any of claims 12 to 17,
characterized in that
each of the vanes (1) is provided with at least one recess (6) in proximity to its rear end (7), and that this is connected to the internal hole (3) for coolant.

19. The method as claimed in claim 18,
characterized in that
the recess (6) is connected to the internal hole (3) for coolant during cutting out of the latter.

20. The method as claimed in claim 18 or 19,
characterized in that
the recess (6) is provided at the rear end of each of the vanes (1) during casting.

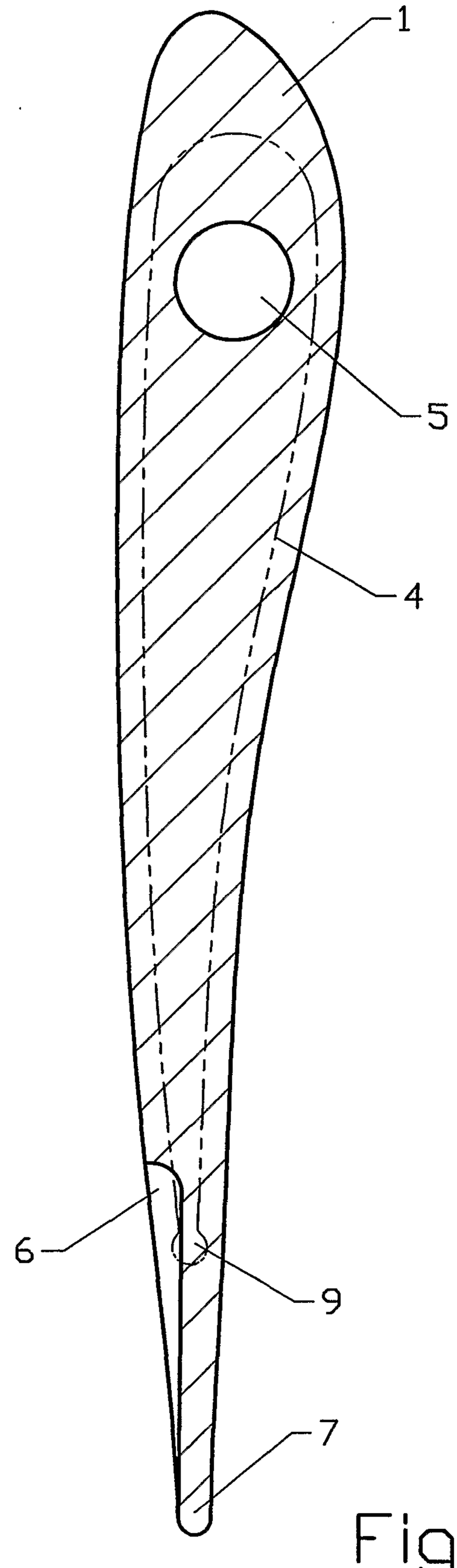


Fig.1

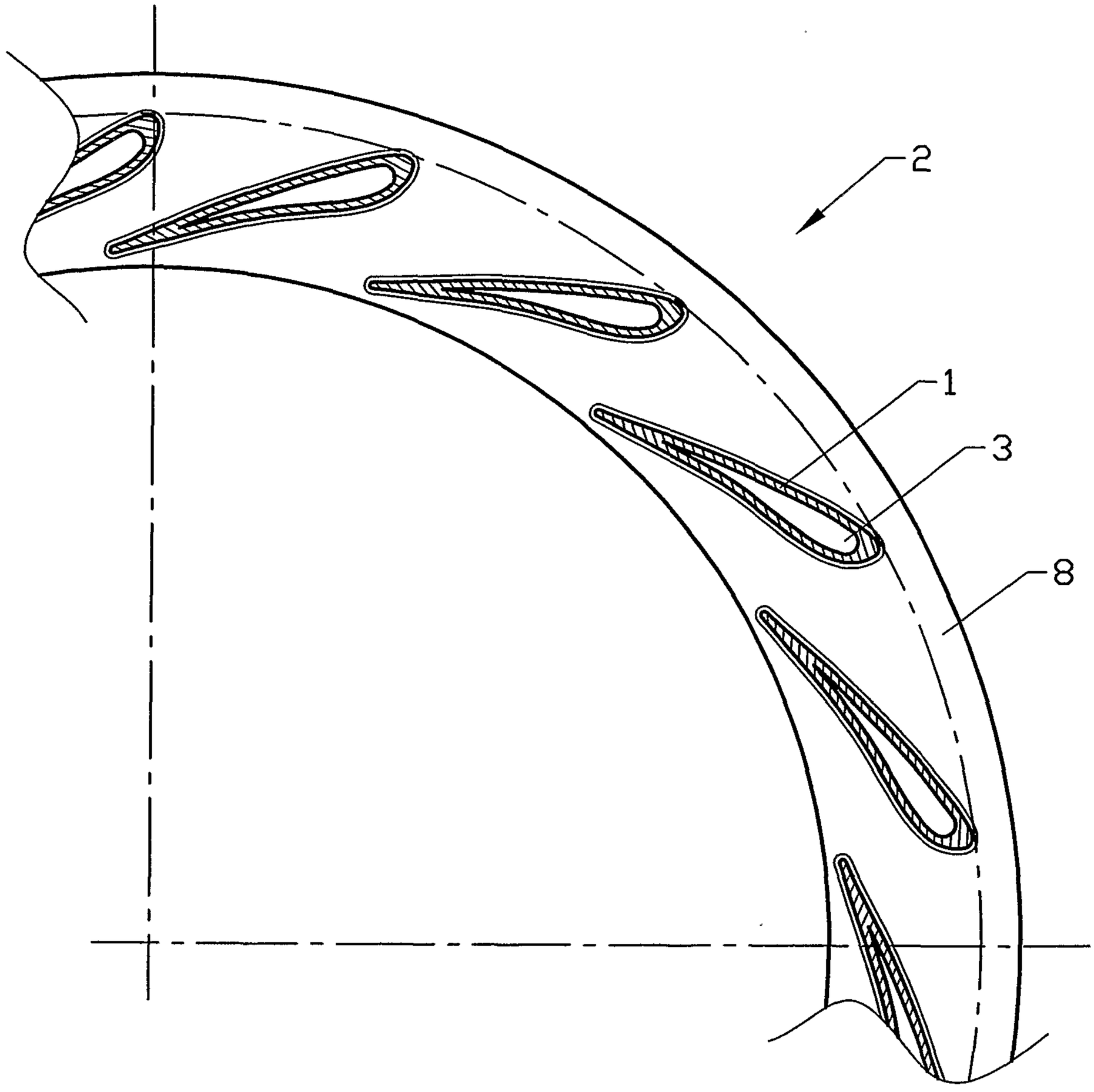


Fig.2

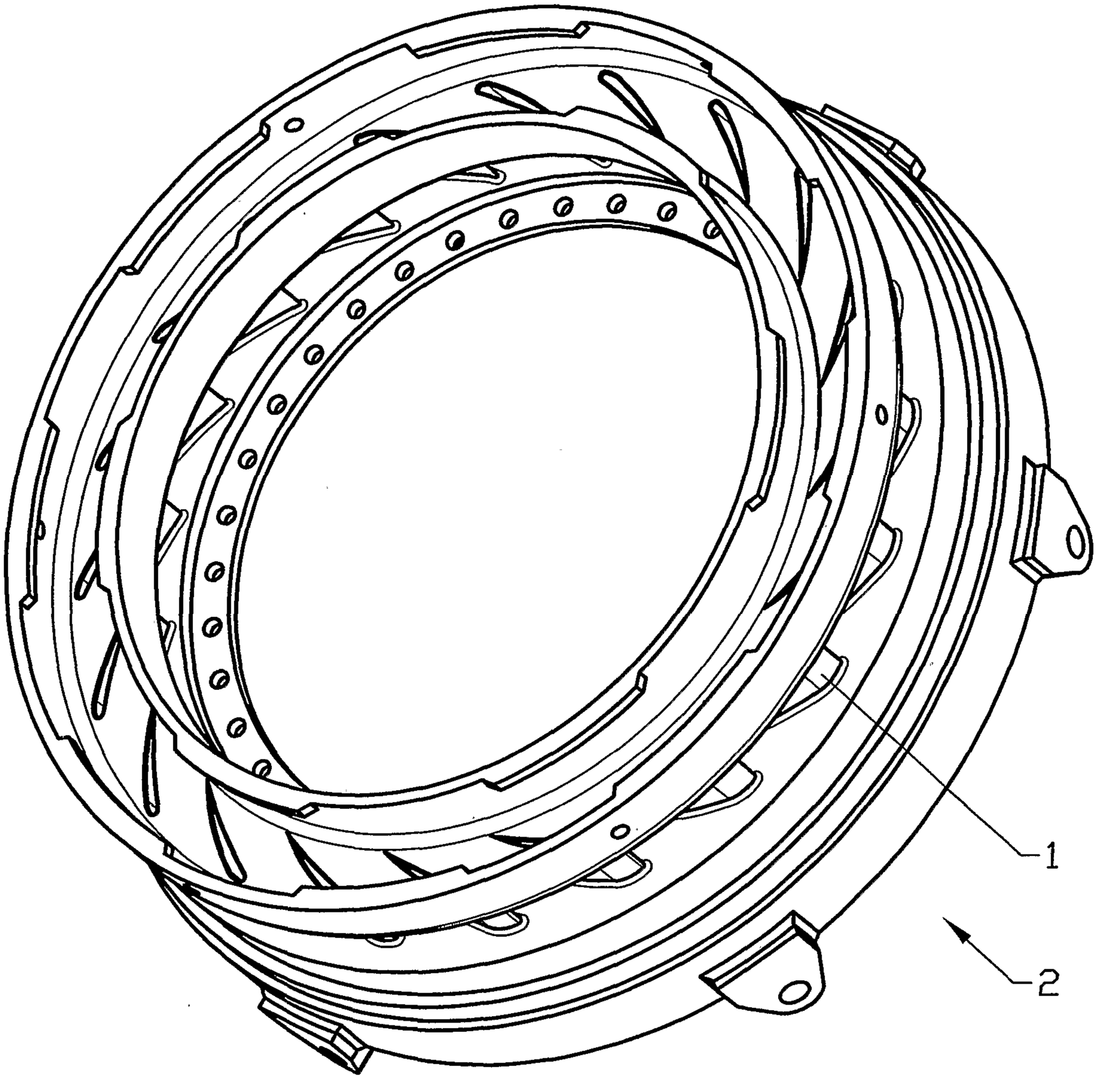


Fig.3

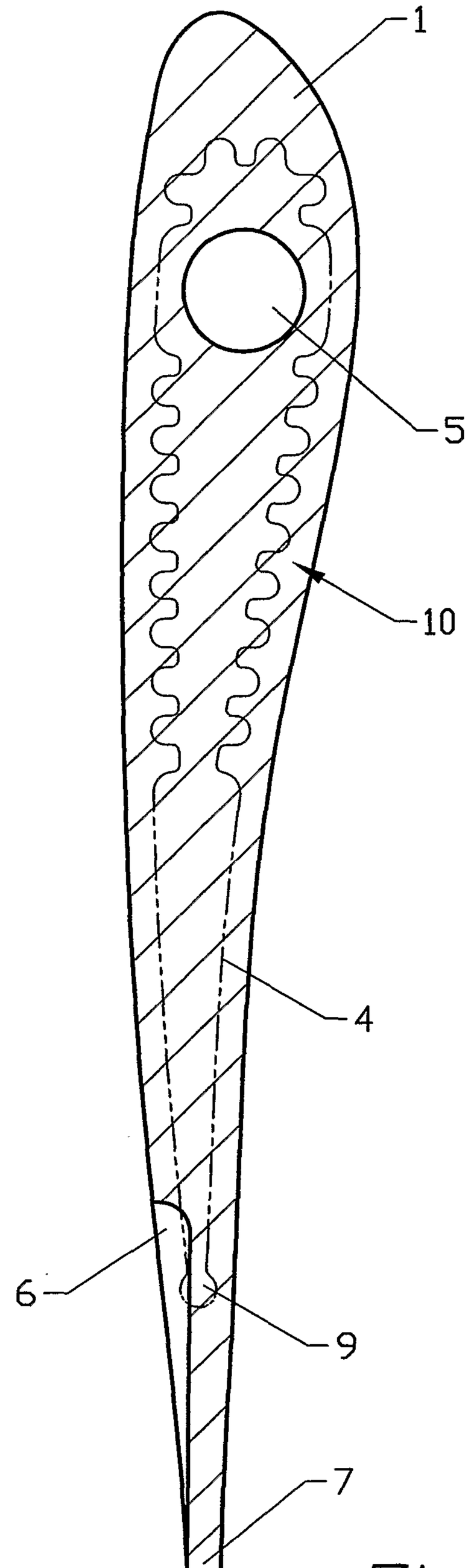
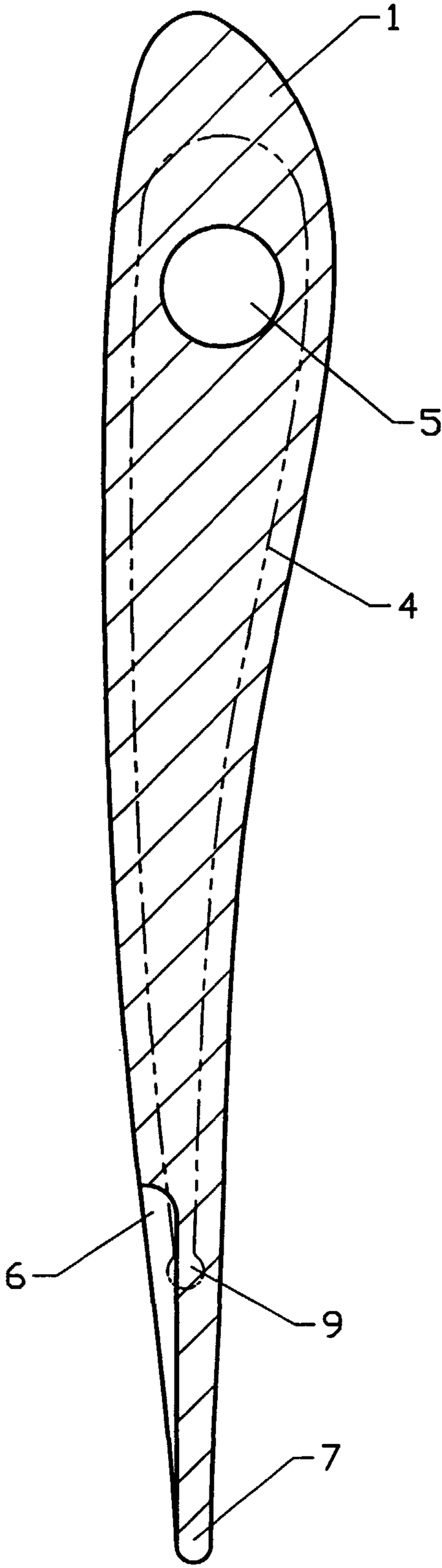


Fig.4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