

(19)



Europäisches
Patentamt
European
Patent Office
Office européen
des brevets



(11)

EP 2 706 195 A1

(12)

EUROPEAN PATENT APPLICATION

(43) Date of publication:

12.03.2014 Bulletin 2014/11

(51) Int Cl.:

F01D 5/18 (2006.01)(21) Application number: **12183096.2**(22) Date of filing: **05.09.2012**

(84) Designated Contracting States:

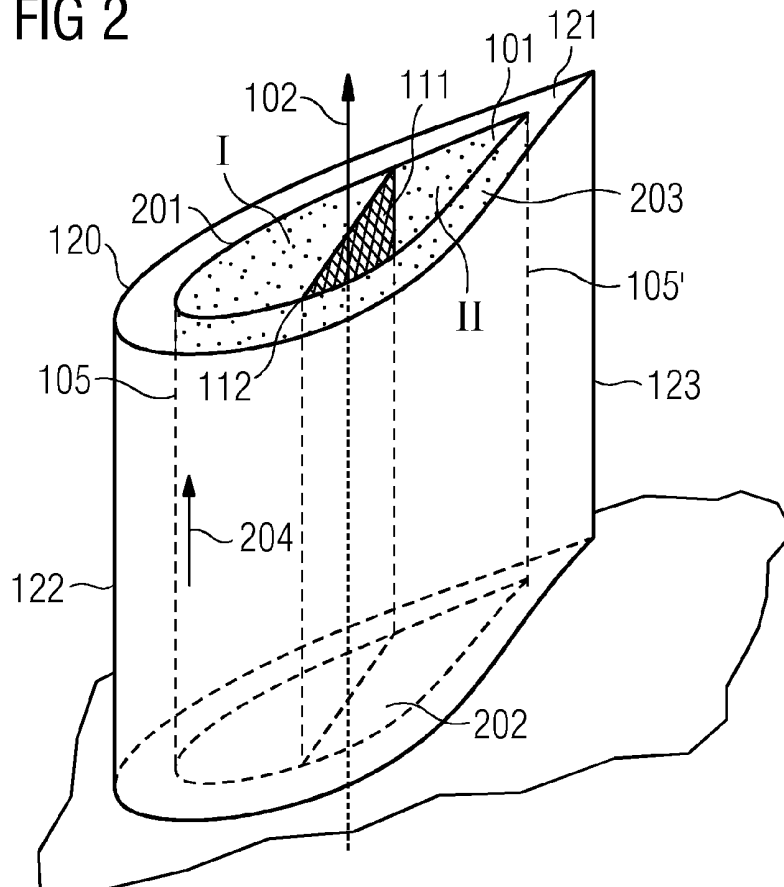
**AL AT BE BG CH CY CZ DE DK EE ES FI FR GB
GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO
PL PT RO RS SE SI SK SM TR**

Designated Extension States:

BA ME(71) Applicant: **Siemens Aktiengesellschaft
80333 München (DE)**(72) Inventor: **Bluck, Richard****Welton, Lincolnshire, LN2 3FQ (GB)**(54) **Impingement tube for gas turbine vane with a partition wall**

(57) The present invention relates to a tube (100) for being installed into a guide vane (120) of a turbine. The tube (100) comprises a tube wall (101) for forming a fluid channel and a dividing wall (110) which is arranged inside the fluid channel. The dividing wall (110) comprises a first edge (111) and a second edge (112) which is spaced

apart from the first edge (111). The first edge (111) is fixed to a first surface section of the tube wall (101). The dividing wall (110) is formed in such a way that the second edge (112) resiliently abuts in a detachable manner against a second surface section of the tube wall (101) such that the dividing wall (110) divides the fluid channel in a first channel (I) and a second channel (II).

FIG 2**EP 2 706 195 A1**

Description

Field of invention

[0001] The present invention relates to a tube for being installed into a guide vane of a turbine, a guide vane device of a turbine and a method of manufacturing a tube for a guide vane of a turbine.

Art Background

[0002] A turbine nozzle guide vane may comprise an internal impingement cooling system into which cooling air is fed through a tube which is mounted in a vane body of the guide vane. The tube comprises holes to direct discrete flows of cooling air against an internal wall of the guide vane. The tube is typically fixed in a close-fit manner within the body of the guide vane in order to restrict radial leakage flows of the cooling air. In order to achieve the close-fit fixation of the tube within the guide vane, the tube may be partially flexible in order to provide a good manufacturing variability.

[0003] Furthermore, it is known to split the tube into separate chambers along a tube's length, whereby each chamber is fed separately with cooling air from different sources within the turbine. Such a configuration may enable a selection of cooling air to optimize the cooling effectiveness over the vane airfoil surface. In order to generate these separate chambers, dividers or bulk head features are incorporated into the tube. The dividers affect the stiffness of the tube, such that the stiffness of the tube is increased by the dividers. The increased stiffness of the tube leads to a difficult assembly due to fouling or generating the close-fit between the tube and the guide vane body.

[0004] The divider may be brazed to the surfaces of the tube. Hence, during assembly of the tube, the higher stiffness of the tube due to the divider may cause a fracture of the brazing connection between the divider and the tube surface.

[0005] US 4,252,501 discloses a hollow cooled vane for a gas turbine engine which comprises at least two apertured members each mounted spaced from a separate part of a vane interior surface. The first of these members is provided with the supply of cooling air which passes through the apertures in the form of jets to impingement cool the respective first surface. Furthermore, an interconnecting passage is provided to take the cooling air to a second apertured member where an impingement cools the respective second surface.

[0006] US 5,516,260 A discloses a bonded turbine airfoil with floating wall cooling insert. The airfoil comprises an internal cavity which is split by a forward wall and by an after wall.

[0007] US 5,259,730 A discloses an impingement cooled airfoil with a bonding foil insert. Inside an inner cavity of the airfoil ribs are inserted in order to provide several cavities inside an inner volume of the guide vane.

[0008] US 2,873,944 comprises a turbine blade cooling. Inside an inner volume of a blade metal sheets are fixed in order to form passages for the cooling fluid inside the inner volume of the blade.

Summary of the Invention

[0009] It may be an objective of the present invention to provide a guide vane for a turbine which is robust and simple to manufacture.

[0010] This objective may be solved by a tube for being installed into a guide vane of a turbine, by a guide vane device of a turbine and by a method of manufacturing a tube for a guide vane of a turbine according to the independent claims.

[0011] According to a first aspect of the present invention, a tube for being installed into a guide vane of a turbine is presented. The tube comprises a tube wall for forming a fluid channel and a dividing wall which is arranged inside the fluid channel. The dividing wall comprises a first edge and a second edge which is spaced apart from the first edge. The first edge is fixed to a first surface section of the tube wall. The dividing wall is formed in such a way that the second edge resiliently abuts in a detachable manner against a second surface section of the tube wall such that the dividing wall divides the fluid channel into a first channel and a second channel.

[0012] Furthermore, according to a further aspect of the present invention, a guide vane device of a turbine is presented. The guide vane device comprises the above-described tube and the guide vane which comprises an inner volume. The tube is arranged inside the inner volume.

[0013] Furthermore, according to a further aspect of the present invention, a method of manufacturing a tube for a guide vane of a turbine is presented. According to a method, a tube which comprises a tube wall for forming a fluid channel is provided. A first edge of a dividing wall is fixed to a first surface section of the tube wall. A second edge of the dividing wall, which second edge is spaced from the first edge, is resiliently abutted in a detachable manner against the tube wall such that the dividing wall divides the fluid channel into a first channel and a second channel.

[0014] The guide vane comprises an aerodynamic profile and guides a hot working gas of the turbine in a desired direction. The guide vane is mounted to a turbine housing, and in particular to a guide vane carrier. The guide vane comprises a centre axis (e.g. the symmetry axis) which runs generally along the length of the guide vane and particularly along a radial direction to a rotary axis of a turbine shaft of the turbine. The guide vane comprises an inner volume into which the tube is mountable.

[0015] The tube comprises the fluid channel, through which cooling fluid (e.g. cooling air) flows. Hence, the tube wall of the tube is cooled by the cooling air such that

also the guide vane is cooled by the cooling air. Additionally, the tube wall may comprise holes through which the cooling fluid may flow from the fluid channel to an inner surface of the guide vane for cooling purposes.

[0016] The tube and in particular the fluid channel comprises a centre axis which runs along the length of the tube and generally parallel to the centre axis of the guide vane. The fluid channel comprises a fluid inlet and a fluid outlet, wherein the fluid outlet is located at an opposite end of the tube along the central axis with respect to the fluid inlet. In particular, the fluid inlet and the fluid outlet are arranged at opposite ends of the tube in such a way that the cooling fluid flows through the fluid channel along a radial direction with respect to the rotary axis of the turbine shaft.

[0017] The guide vane comprises a leading edge against which the hot working gas of the turbine streams and a trailing edge, where the hot working gas streams away from the guide vane. Hence, the hot working gas heats the section of the guide vane in the vicinity of the leading edge more than the section of the guide vane in the vicinity of the trailing edge. Hence, in order to provide a more efficient cooling of the guide vane, it is desired to provide a cooler cooling fluid or a higher mass flow of the cooling fluid in the vicinity of the leading edge than in the vicinity of the trailing edge.

[0018] For this reason the fluid channel of the tube is divided by the dividing wall into a first channel and a second channel. The first channel and the second channel are divided by the dividing wall in such a way that through the first channel a cooling fluid with different parameters (temperature, mass flow, pressure) in comparison to parameters of a cooling fluid which flows through the second channel is provided.

[0019] Alternatively, also two or a plurality of dividing walls may be arranged inside the fluid channel in order to provide a respective plurality of further channels inside the fluid channel.

[0020] The dividing wall may be a sheet metal and a metal plate, respectively, which divides the fluid channel into the first channel and the second channel. The dividing wall runs generally along the length of the tube. According to the present invention, the dividing wall is fixed with a first edge to a first surface section of the tube wall and abuts with a second edge against a second surface section of the tube wall.

[0021] The first edge and the second edge may be for example parallel edges of the dividing wall, wherein the first edge and the second edge are opposite located edges of the dividing wall. The first edge is a free end of the plate. The first edge has a longitudinal extension and is in other words a free end of one side of the dividing wall. Accordingly, the second edge has a similar longitudinal extension and is in other words a free end of another side of the dividing wall, i.e. opposite with respect to the first edge. The dividing wall may have a rectangular shape, wherein the edges and thus the dividing wall run along the length and the centre axis of the tube, respectively.

Alternatively, the dividing wall may also comprise a curved shape. In particular, the dividing wall may run from a first fluid opening of the fluid channel to a second fluid opening of the fluid channel. Accordingly, each of the first channel and the second channel, which are formed by the dividing wall, may have a respective first fluid opening and a respective second fluid inlet. Through each of the respective first and second channels, fluid with different parameters may be injected.

[0022] The term "resiliently abuts in a detachable manner" means that the second edge is not fixed to the second surface section by any fixation means (such as welding, brazing or gluing means) but only (i.e. sealingly) contacts the second surface section. In particular, the contour of the second edge in comparison to the second surface section is formed and adapted in such a way that a sealing between the first channel and the second channel is achievable. Furthermore, the contact of the second edge to the tube wall (i.e. the second surface section) is strong enough, such that the sealing between the first channel and the second channel is provided. The dividing wall may be a metal plate and hence elastically deformable and hence comprises resilient properties.

[0023] Hence, if the first channel is located more upstream with respect to a flow direction of the hot working gas of the turbine and hence in the vicinity of the leading edge of the guide vane, more cooling fluid or a cooler cooling fluid may be injected such that the cooling efficiency of the cooling fluid in the first channel is higher than a cooling fluid which is injected through the second channel, wherein the second channel is located closer to the vicinity of the trailing edge of the guide vane.

[0024] By the present invention, the dividing wall is (only) fixed with the first edge to the tube wall of the tube. The opposite second edge only resiliently abuts in a detachable manner against a second surface section of the tube wall. Hence, if the tube is compressed during the inserting of the tube into the inner volume of the guide vane, the second edge may slide along the second surface section. Thus, the stiffness of the dividing wall is reduced and an easier manufacturing and installation of the tube inside the guide vane is achieved. Furthermore, if the tube is fitted into the inner volume of the guide vane, the tube may expand elastically again, such that the second edge slides along the second surface section into its initial position. However, during the compression and expansion of the tube, the second edge stays in contact and is kept abutted against the second surface such that a sealing between the first channel and the second channel is provided.

[0025] Hence, by the present invention, a compressible and expendable tube for a guide vane is generated without complex manufacturing methods. In order to provide the above-described inventive tube with the first channel and the second channel, only one fixing fabricating step for fixing the dividing wall to the tube wall is necessary, namely the fixing of the first edge to the first surface section of the tube wall.

[0026] According to a further exemplary embodiment, the first edge is brazed, welded or glued to the first surface section of the tube wall.

[0027] According to a further exemplary embodiment, the dividing wall is arranged inside the fluid channel in such a way that, if a first fluid pressure in the first channel is higher than a second fluid pressure in the second channel, the second edge is pressed against the tube wall by the fluid pressure and in particular by the differential pressure between the first fluid pressure and the second fluid pressure.

[0028] According to a further exemplary embodiment, the first surface section has a first normal, wherein the dividing wall comprises a further first surface section which has a further first normal and which comprise the first edge. An angle between the normal of the first surface section and the further normal of the further first surface section differs to 90° . In particular, the dividing wall runs from the first edge not perpendicular with respect to the first normal of first surface section of the tube wall. Hence, if a force acting parallel to the first normal of the first surface section (e.g. due to compressing of the tube), the force presses the dividing wall aside such that the second edge slides along the second surface section and the dividing wall does not prevent the compressing of the tube.

[0029] The further first surface section may define the complete surface of the dividing wall or may only be a part of the overall surface of the dividing wall. For example, the dividing wall may form an L-shaped cross-section or a U-shaped cross-section, wherein the further first surface section defines the section comprising the first edge.

[0030] Accordingly, according to a further exemplary embodiment of the present invention, the second surface section has a second normal, wherein the dividing wall comprises a further second surface section which comprises a second edge, wherein the further second surface section has a further second normal. The dividing wall is formed such that a further angle between the second normal of the second surface section and the further second normal of the further second surface section differs from 90° .

[0031] In particular, the dividing wall runs from the second edge not perpendicular with respect to the second normal of second surface section of the tube wall. Hence, if a force acting parallel to the second normal of the first surface section (e.g. due to compressing of the tube), the force presses the dividing wall aside such that the second edge slides along the second surface section and the dividing wall does not prevent the compressing of the tube.

[0032] According to a further exemplary embodiment of the present invention, the tube has the above-described centre axis which runs between a first tube end and a second tube end. The tube is divided along a dividing direction into a first tube part, i.e. a first tube half, and a second tube part, i.e. a second tube half. The dividing direction comprises at least a component which is

parallel to the centre axis. Specifically, a dividing line between the first tube part and the second tube part runs along the length of the tube and parallel to the centre axis of the tube, respectively.

[0033] Hence, the first tube part and the second tube part may be fabricated independently from each other, wherein after fixing the first tube part with the second tube part, the tube and respectively the fluid channel are formed.

[0034] Furthermore, according to a further exemplary embodiment, the first tube part and the second tube part are welded, brazed, glued together or joined together by adding material.

[0035] According to a further exemplary embodiment, the first edge of the dividing wall is fixed to the first tube part and wherein the dividing wall is formed in such a way that the second edge resiliently abuts in a detachable manner against the second tube part such that the dividing wall divides the fluid channel into the first channel and the second channel. The first edge is fixed to the first tube part in particular before the first tube part and the second tube part are fixed together.

[0036] Accordingly, according to a further exemplary embodiment of the method, the first edge of the dividing wall is fixed to the first tube part, wherein the first tube part is fixed to the second tube part after the first edge has been fixed to the first tube part. The second edge abuts against the second tube part.

[0037] Hence, before the first tube part and the second tube part are fixed together, the dividing wall is fixed with its first edge to the first tube part. Before the first tube part and the second tube part are fixed together, the fixation of the first edge to the first tube part is easy because the first surface section is easily accessible. By the present invention, it is not necessary to apply fixation steps to the dividing wall after the first tube part is fixed to the second tube part, because a second edge of the dividing wall only resiliently abuts in a detachable manner against the second surface section. That is, that further fixation steps to the dividing wall are not necessary after the first tube part is fixed to the second tube part. Hence, it is not necessary to apply fixation steps to locations of the tube which are only hardly accessible, such as the second surface section after the first tube part is fixed to the second tube part.

[0038] Hence, a simplified and easy manufacturing of the above-described tube is achieved.

[0039] Summarizing, by the present invention, a dividing wall is arranged inside the fluid channel of the tube, wherein only one first edge is (non-detachably) fixed, e.g. by welding, to a first surface section of the tube wall. Due to the abutting of the second edge of the dividing wall at the second surface section a fluid channel is dividable into the first channel and the second channel although only the first edge is (rigidly) fixed to the first section of the tube wall.

[0040] In particular, the dividing wall, and in particular a further surface section comprising the first edge and/or

a further surface section comprising the second edge, is angled relatively to the respective first and second surface section of the tube wall and are thus non-perpendicular. The dividing wall is only welded to one surface of the tube inside the fluid channel, in particular along the tubes length (i.e. along the centre axis) prior to the welding of the second tube part to the first tube part.

[0041] By the present invention, the size of the dividing wall is set and predetermined in such a way, that a width of the dividing wall between the first surface section and the second surface section of the tube is large enough such that the second edge resiliently abuts permanently against the second surface section during operation of the turbine, so that a reliable separation of the first channel to the second channel by the dividing wall is achieved.

[0042] In particular, the second edge of the turbine is located more upstream i.e. closer to the leading edge of the guide vane in comparison to the first edge.

[0043] By the above-described tube a simplified manufacturing method for the tube is achieved. The manufacturing method enables the dividing wall to be attached using a stronger welded joint (as compared to brazing). By angling the dividing wall with respect to the respective first and second normals of the respective first and second surface sections of the tube wall and by allowing the second edge to remain free from any permanently fixing means, this will achieve flexibility of the tube to enable reduced installation forces during installation of the tube into the guide vane. By setting the length and the size of the dividing wall and by welding the first edge at a more downstream location in comparison to the second edge, the dividing wall will ensure a seal between the first channel and the second channel. Furthermore, a pressure difference between fluid in the first channel and the second channel will assist to close and to press the dividing wall against the tube wall.

[0044] It has to be noted that embodiments of the invention have been described with reference to different subject matters. In particular, some embodiments have been described with reference to apparatus type claims whereas other embodiments have been described with reference to method type claims. However, a person skilled in the art will gather from the above and the following description that, unless other notified, in addition to any combination of features belonging to one type of subject matter also any combination between features relating to different subject matters, in particular between features of the apparatus type claims and features of the method type claims is considered as to be disclosed with this application.

Brief Description of the Drawings

[0045] The aspects defined above and further aspects of the present invention are apparent from the examples of embodiment to be described hereinafter and are explained with reference to the examples of embodiment. The invention will be described in more detail hereinafter

with reference to examples of embodiment but to which the invention is not limited.

Fig. 1 shows a schematical view of a cross-section of the guide vane device according to an exemplary embodiment of the present invention;

Fig. 2 shows a perspective view of a guide vane device according to an exemplary embodiment of the present invention as shown in Fig. 1; and

Fig. 3 shows a schematical view of a tube comprising a first tube part and a second tube part according to an exemplary embodiment of the present invention.

Detailed Description

[0046] The illustrations in the drawings are schematically. It is noted that in different figures, similar or identical elements are provided with the same reference signs.

[0047] Fig. 1 shows a guide vane device (i.e. a dual chamber impingement guide vane device) for a turbine, wherein the guide vane device comprises a guide vane 120 and a tube 100. The tube 100 is arranged inside the inner volume 121 of the guide vane 120. The guide vane device may be particularly of a turbine section of a gas turbine, which will be in contact with a hot working fluid from the outside and particularly also in contact with a cooling fluid guided to the interior of the guide vane device.

[0048] The tube 100 may be installed into the inner volume 121 of the guide vane 120 by a press-fit connection for example. Therefore, the (elastically compressible) tube 100 may be compressed during installation into the inner volume 121 and released after placing the tube 100 into the inner volume 121, such that the tube 100 extends again into its initial position and such that the press-fit connection between the tube 100 and the guide vane 120 is achieved. Therefore, the tube 100 has to provide a low stiffness on the one side but has also to be robust enough on the other side.

[0049] The tube 100 comprises a dividing wall 110 which is arranged inside the fluid channel which is housed and surrounded by a tube wall 101 of the tube 100. The dividing wall 110 comprises a first edge 111 and a second edge 112 which is spaced apart from the first edge 111.

[0050] The first edge 111 is fixed to the first surface section of the tube wall 101, e.g. by welding.

[0051] The dividing wall 110 is formed in such a way that the second edge 112 abuts resiliently against a second surface section of the tube wall 101 such that the dividing wall 110 divides the fluid channel into a first channel I and a second channel II.

[0052] Specifically, the dividing wall 110 comprises a length between the first edge 111 and the second edge 112, wherein the length is adapted such that the second edge 112 is in contact with the second surface section

(and hence abuts against the second surface section) when the first edge is fixed with the first surface section. Furthermore, the dividing wall 110 is angled relative to the respective first surface section of the tube wall 101 and/or to the second surface section of the tube wall 101, respectively. In other words, the dividing wall 110 runs between the first edge 111 and the second edge 112 non-parallel with respect to a first normal n_1 of the first surface section and/or with respect to a second normal n_2 of the second surface section, respectively. Hence, the dividing wall 110 runs angled relative to the respective surface sections of the inner surface of the tube wall 101.

[0053] In other words, the dividing wall 110 comprises a further first surface section which comprises the first edge 111, wherein an angle α between the first normal n_1 of the first surface section and the further first normal fn_1 of the further first surface section differs to 90° .

[0054] Accordingly, the dividing wall 110 may comprise a further second surface section which comprises the second edge 112, wherein the dividing wall 110 is formed such that a further angle β between the second normal n_2 of the second surface section and a further second normal fn_2 of the further second surface section differs from 90° .

[0055] Hence, if the tube 100 is compressed during installation into the inner volume 121 of the guide vane 120, the second edge 112 slides in particular along the second surface section in an upstream direction with respect to the flow direction 124 of the working gas of the turbine.

[0056] Further, the dividing wall 110 as shown in Fig. 1 is arranged inside the fluid channel in such a way, that if a first fluid pressure p_1 in the first channel I is higher than a second fluid pressure p_2 in the second channel II, the second edge 112 is pressed against the tube wall 101 by the first fluid pressure p_1 , i.e. by the pressure difference between the first fluid pressure p_1 and the second fluid pressure p_2 .

[0057] In particular, the second edge 112 of the dividing wall 110 is located closer to a leading edge 122 of the guide vane 120 and hence more upstream with respect to the flow direction 124 of the working gas of the turbine than the first edge 111 of the dividing wall 110. Generally, in the first channel I, which is located closer to the leading edge 122 of the guide vane 120, a higher cooling efficiency is desired and hence a higher fluid pressure p_1 is generated in comparison to the second channel II, which is located more downstream with respect to the flow direction 124 of the working gas and closer to the trailing edge 123, respectively. Hence, because the first fluid pressure p_1 is higher than the second fluid pressure p_2 and because the second edge 112, which abuts against the second surface section, is located more upstream with respect to the first edge 111, which is fixed to the first surface section, the pressure surplus in the first channel I with respect to the second pressure p_2 forces and presses the second edge 112 against the second surface section of the tube wall 101.

[0058] The fluid channel and in particular the first channel I and the second channel II comprise a respective fluid inlet and a respective fluid outlet, such that separated cooling fluids with separated cooling fluid parameters may be injected in each of the channels I, II. In particular, the respective fluid inlets and outlets are located at opposite ends of the tube 100 with respect to a centre axis 102 of the tube 100. The centre axis 102 runs generally along a radial direction with respect to a turbine shaft of the turbine.

[0059] Furthermore, the tube 100 may comprise a first turbine section 103 (i.e. a first turbine half) and a second tube part 104 (second tube half). The first tube part 103 and the second tube part 104 are divided along a dividing line 105, wherein the dividing line runs approximately parallel to the centre axis 102 and along the length of the tube, respectively. Alternatively, the dividing line 105 may only have one component which is parallel to the centre axis 102. In particular, the dividing line 105, 105' runs from one free end to an oppositely located free end with respect to the centre axis 102.

[0060] Fig. 2 shows the exemplary embodiment shown in Fig. 1 and hence comprises similar features as already explained above for Fig. 1.

[0061] Moreover, in Fig. 2, the first tube end 201 and the second tube end 202 is shown. Furthermore, it is shown that the tube wall 101 comprises a plurality of holes 203. The cooling fluid may stream from the first channel I and the second channel II into the inner volume 121. Specifically, the cooling fluid streams through the holes 203 and impinges against the inner surface of the inner wall of the guide vane 120. Hence, an impingement cooling is provided.

[0062] Furthermore, a dividing direction 204 is shown, along which the tube 100 is divided into the first tube part 103 and the second tube part 104.

[0063] Fig. 3 shows the tube 100, wherein the tube 100 comprises the first tube part 103 and the second tube part 104. Fig. 3 shows the tube before the first tube part 103 and the second tube part 104 are fixed together. As can be taken from Fig. 3, before the first tube part 103 is fixed to the second tube part 104, the dividing wall 110 may already be fixed (e.g. by welding) with its first edge 111 to the first surface section of the tube wall 101 and respectively of the first tube part 103. The dividing wall 110 is formed in such a way (with respect to its size and extension) that after the first tube part 103 is fixed (e.g. by welding) to the second tube part 104, the second edge 112 of the dividing wall 110 resiliently abuts against the second surface section of the second tube part 104.

[0064] Hence, an easy manufacturing method is achieved, because before the first tube part 103 is fixed to the second tube part 104, the dividing wall 110 can already be fixed with its first edge 111 and after the first tube part 103 is fixed to the second tube part 104 no further fixing steps are necessary.

[0065] It should be noted that the term "comprising" does not exclude other elements or steps and "a" or "an"

does not exclude a plurality. Also elements described in association with different embodiments may be combined. It should also be noted that reference signs in the claims should not be construed as limiting the scope of the claims.

Claims

1. Tube (100) for being installed into a guide vane (120) of a turbine, the tube (100) comprising a tube wall (101) for forming a fluid channel, and a dividing wall (110) which is arranged inside the fluid channel, wherein the dividing wall (110) comprises a first edge (111) and a second edge (112) which is spaced apart from the first edge (111), wherein the first edge (111) is fixed to a first surface section of the tube wall (101), and wherein the dividing wall (110) is formed in such a way that the second edge (112) resiliently abuts in a detachable manner against a second surface section of the tube wall (101) such that the dividing wall (110) divides the fluid channel in a first channel (I) and a second channel (II). 10
2. Tube (100) according to claim 1, wherein the first edge (111) is welded to the first surface section of the tube wall (101). 15
3. Tube (100) according to claim 1 or 2, wherein the dividing wall (110) is arranged inside the fluid channel in such a way that, if a first fluid pressure (p_1) in the first channel (I) is higher than a second fluid pressure (p_2) in the second channel (II), the second edge (112) is pressed against the tube wall (101) by the first fluid pressure (p_1). 20
4. Tube (100) according to one of the claims 1 to 3, wherein the first surface section has a first normal (n_1), wherein the dividing wall (110) comprises a further first surface section which has a further first normal (fn_1) and which comprises the first edge (111), wherein an angle (α) between the first normal (n_1) of the first surface section and the further first normal (fn_1) of the further first surface section differs from 90° . 25
5. Tube (100) according to one of the claims 1 to 4, wherein the second surface section has a second normal (n_2), wherein the dividing wall (110) comprises a further second surface section which has a further second normal (fn_2) and which comprises the second edge (112), wherein the dividing wall (110) is formed such that a further angle (β) between the second normal (n_2) of the second surface section and the further second normal (fn_2) of the further second surface section 30
6. Tube (100) according to one of the claims 1 to 5, wherein a centre axis (102) runs between a first tube end (201) and a second tube end (202), wherein the tube (100) is divided along a dividing direction (204) into a first tube part (103) and a second tube part (104), and wherein the dividing direction (204) comprises at least a component which is parallel to the centre axis (102). 35
7. Tube device according to claim 6, wherein the first tube part (103) and the second tube part (104) are connected to each other by means of a welding connection. 40
8. Tube device according to claim 6 or 7, wherein the first edge (111) of the dividing wall (111) is fixed to the first tube part (103), wherein the first tube part (103) comprises the first surface section, and wherein the second tube part (104) comprises the second surface section. 45
9. Tube (100) according to one of the claims 1 to 8, wherein the tube wall (101) comprises holes (203) for guiding a fluid between the fluid channel and the environment of the tube (100). 50
10. Guide vane device for a turbine, the guide vane device comprising a guide vane (120) which comprises an inner volume (121), and a tube (100) according to one of the claims 1 to 9, wherein the tube (100) is arranged inside the inner volume (121). 55
11. Method of manufacturing a tube (100) for a guide vane (120) for a turbine, the method comprising providing a tube (100) which comprises a tube wall (101) for forming a fluid channel, fixing a first edge (111) of a dividing wall (110) to a first surface section of the tube wall (101), and abutting a second edge (112) of the dividing wall (110), which second edge (112) is spaced from the first edge (111), against the tube wall (101) such that the dividing wall (110) divides the fluid channel into a first channel (I) and a second channel (II).
12. Method according to claim 11, wherein the tube (100) has a centre axis (102) which runs between a first tube end (201) and a second tube end (202), and wherein the tube (100) is divided along a dividing direction (204) into a first tube part (103) and a second tube part (104), wherein the dividing direction (204) comprises at least a component which is parallel to the centre axis

(102), wherein the fixing comprises
fixing the first edge (111) to the first tube part (103),
wherein the first tube part (103) is fixed to the second
tube part (104) after the first edge (111) is fixed to
the first tube part (103), and
wherein the abutting comprises
resiliently abuts in a detachable manner the second
edge (112) against the second tube part (104).

5

10

15

20

25

30

35

40

45

50

55

FIG 1

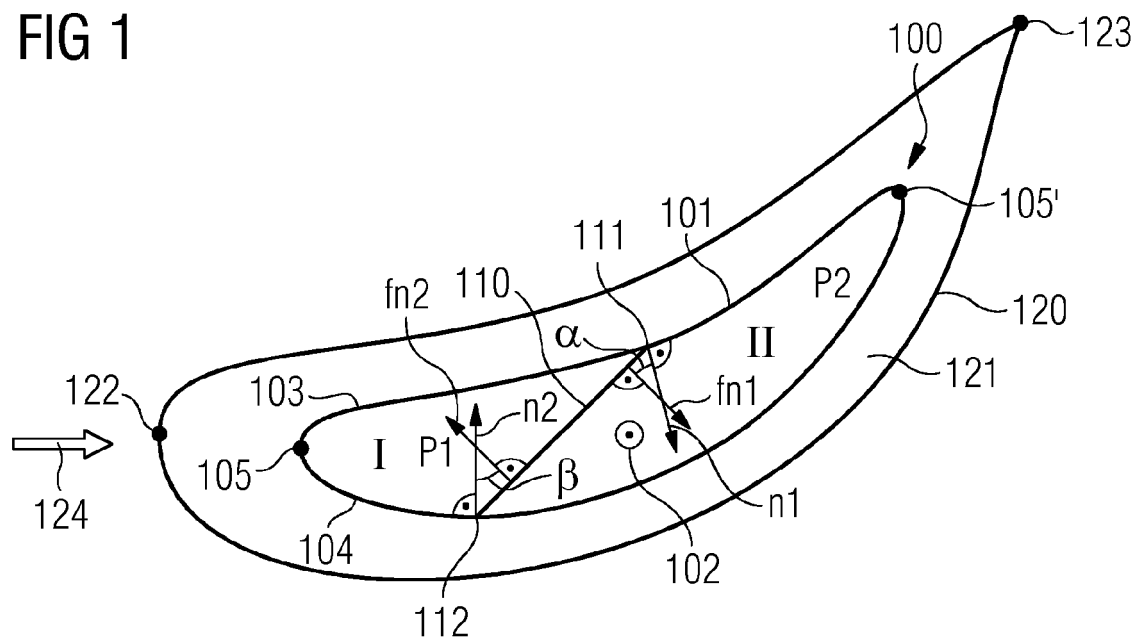


FIG 2

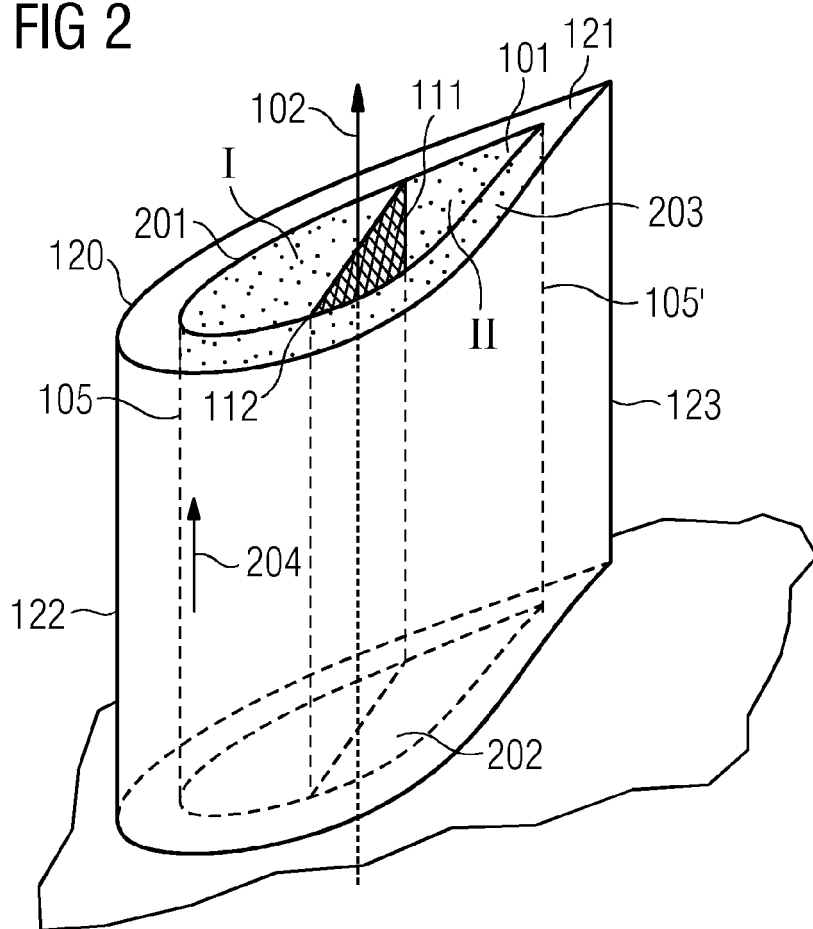
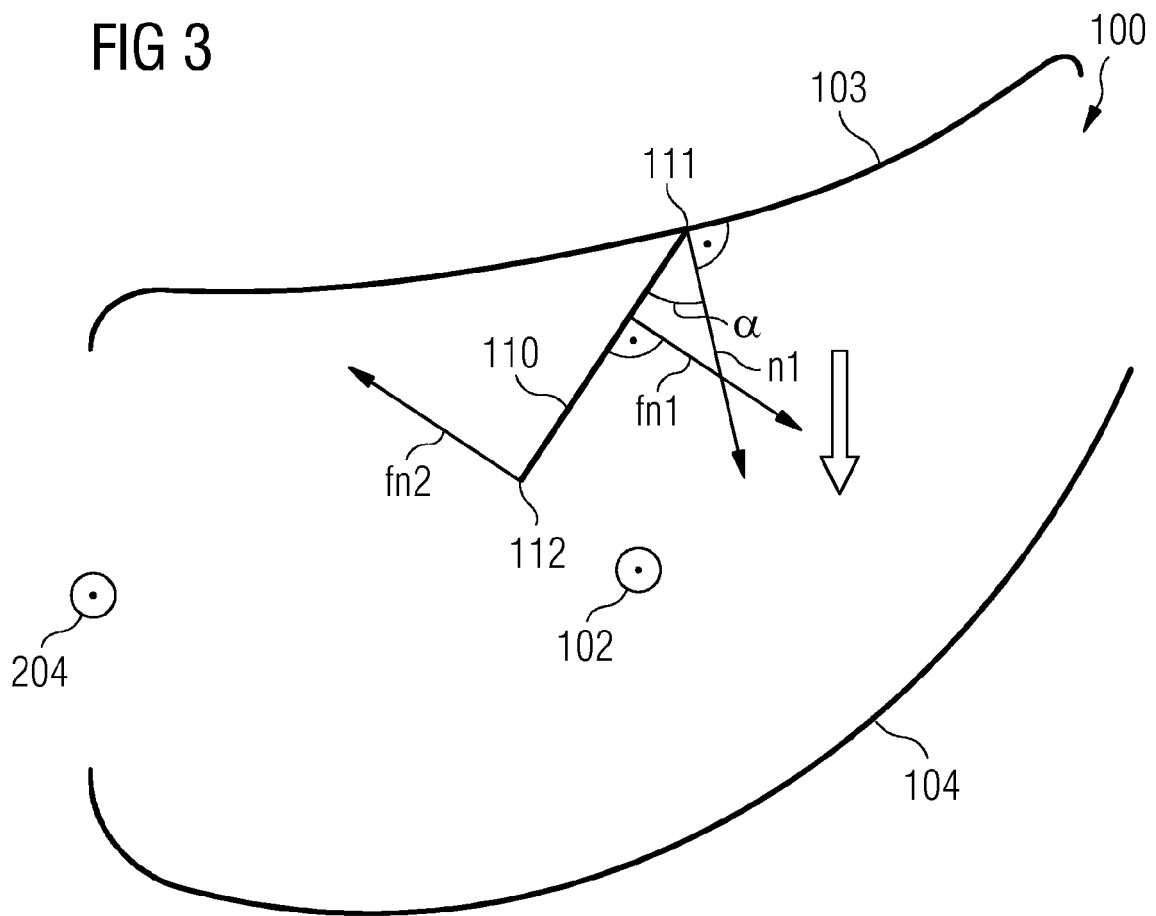


FIG 3





EUROPEAN SEARCH REPORT

Application Number
EP 12 18 3096

DOCUMENTS CONSIDERED TO BE RELEVANT			
Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
X	US 5 207 556 A (FREDERICK ROBERT A [US] ET AL) 4 May 1993 (1993-05-04)	11	INV. F01D5/18
A	* column 4, line 46 - column 5, line 46 * * column 9, lines 48-54 * * figure 2 *	1-10,12	
X	EP 0 182 588 A1 (WESTINGHOUSE ELECTRIC CORP [US]) 28 May 1986 (1986-05-28)	11	
A	* the whole document *	1-10,12	
X	EP 1 674 660 A2 (UNITED TECHNOLOGIES CORP [US]) 28 June 2006 (2006-06-28)	11	
A	* paragraph [0026] * * figure 4 *	1-10,12	
A	EP 2 492 442 A2 (ROLLS ROYCE PLC [GB]) 29 August 2012 (2012-08-29) * paragraphs [0029] - [0032] * * figures 8-10 *	1-12	
			TECHNICAL FIELDS SEARCHED (IPC)
			F01D
The present search report has been drawn up for all claims			
Place of search The Hague		Date of completion of the search 8 February 2013	Examiner de la Loma, Andrés
CATEGORY OF CITED DOCUMENTS X : particularly relevant if taken alone Y : particularly relevant if combined with another document of the same category A : technological background O : non-written disclosure P : intermediate document T : theory or principle underlying the invention E : earlier patent document, but published on, or after the filing date D : document cited in the application L : document cited for other reasons & : member of the same patent family, corresponding document			

1
EPO FORM 1503 03.82 (P04C01)

**ANNEX TO THE EUROPEAN SEARCH REPORT
ON EUROPEAN PATENT APPLICATION NO.**

EP 12 18 3096

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report.
The members are as contained in the European Patent Office EDP file on
The European Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

08-02-2013

Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US 5207556 A	04-05-1993	EP 0568226 A1	03-11-1993
		JP 6010704 A	18-01-1994
		JP 7003162 B	18-01-1995
		US 5207556 A	04-05-1993

EP 0182588 A1	28-05-1986	CA 1221915 A1	19-05-1987
		CN 85108282 A	27-08-1986
		DE 3565298 D1	03-11-1988
		EP 0182588 A1	28-05-1986
		IN 163070 A1	06-08-1988
		IT 1186049 B	18-11-1987
		JP 3079522 B	19-12-1991
		JP 61126302 A	13-06-1986
		MX 161444 A	27-09-1990

EP 1674660 A2	28-06-2006	CN 1793616 A	28-06-2006
		EP 1674660 A2	28-06-2006
		JP 2006177340 A	06-07-2006
		KR 20060071301 A	26-06-2006
		SG 123662 A1	26-07-2006
		TW 1279487 B	21-04-2007
		US 2006133923 A1	22-06-2006

EP 2492442 A2	29-08-2012	EP 2492442 A2	29-08-2012
		US 2012219402 A1	30-08-2012

REFERENCES CITED IN THE DESCRIPTION

This list of references cited by the applicant is for the reader's convenience only. It does not form part of the European patent document. Even though great care has been taken in compiling the references, errors or omissions cannot be excluded and the EPO disclaims all liability in this regard.

Patent documents cited in the description

- US 4252501 A [0005]
- US 5516260 A [0006]
- US 5259730 A [0007]
- US 2873944 A [0008]