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(54) **Method for manufacturing a component having a damping structure**

(57) A method for manufacturing a component (1) having an internal damping structure (2) is disclosed. The method comprising the following steps:
a) providing core parts (3, 3'), made of a first material with a melting point higher than the manufacturing process temperature,
b) arranging the core parts (3,3') in a cast mould in a pattern for receiving a desired internal damping structure (2),
c) providing and melting a base material (4), the base material (4) having different physical properties, at least a lower melting point then the first material, then
d) casting the component (1) by using the molten base material (4), the base material surrounding the core parts (3,3'), then
e) solidification of the base material (4), then
f) removing the cast mould, then
g) optionally removing a part (3) of the core parts.

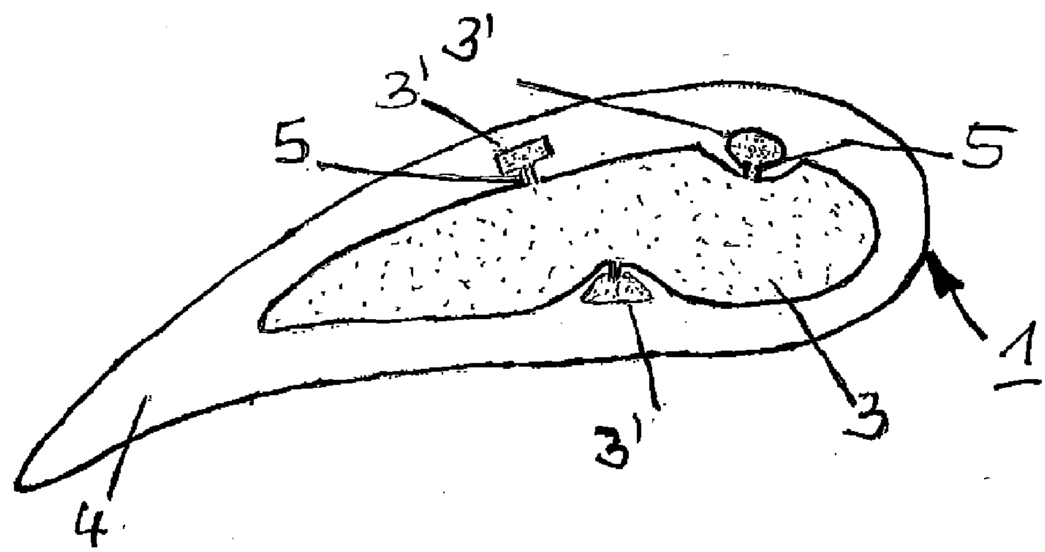

Fig.1a

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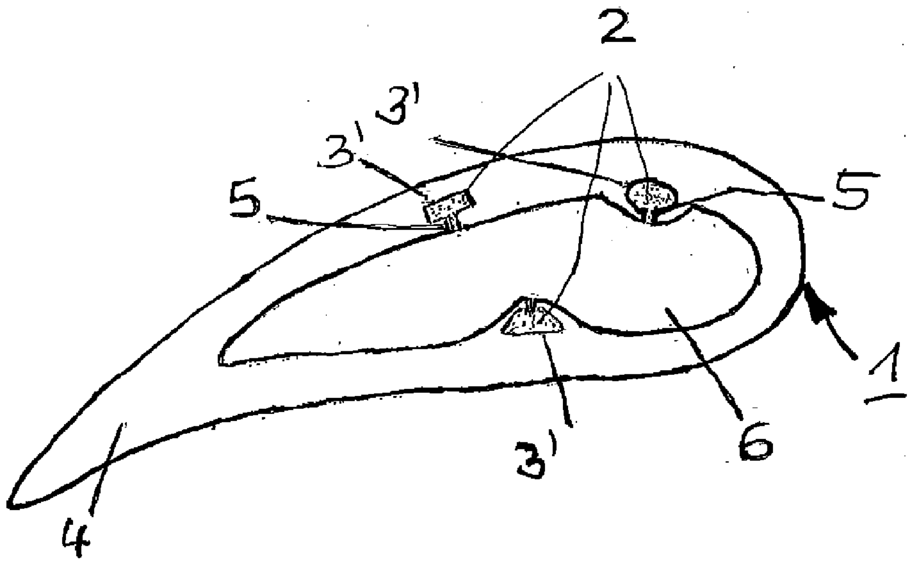

Fig. 1b

Description

TECHNICAL FIELD

[0001] The present disclosure relates to a method for manufacturing a component having a damping structure.

[0002] The component can be a part of a large machine such as a gas or steam turbine, for example a blade, a vane, a casing or also parts thereof, or parts of a large electric generator such as a hydro generator or a turbo generator, but in different application the component can also be a part of a different device that requires damping to improve service lifetime. In the following particular reference to a blade or vane of a turbine such as a gas turbine will be made, the scope of the disclosure is anyhow not limited to such an application.

BACKGROUND

[0003] The blade length of the last turbine stage has a major impact on engine performance. In particular, by increasing the last turbine blade length, the engine efficiency can be increased. As longer the blade is as lower is the Ma number and in turn flow losses decrease.

[0004] However, longer blades suffer vibration problems (e.g. flutter) and thus require damping elements to reduce vibration stresses (e. g. shroud, snubber).

[0005] State of the art of damping elements include for example under-platform dampers, but these under-platform dampers do not provide enough damping for very long blades and they can be used only for the vibration modes with significant relative movement at the platforms.

[0006] Other damping elements are the so called impact dampers (described in US 6,827,551) or particle dampers (described in US 6,224,341).

[0007] Particle dampers include a cavity in the component whose vibrations need to be damped; the cavity is fully or partly filled with particle material. Particle dampers proved to be quite effective in damping vibrations, but their manufacturing is not easy. For example, the cavities must be cast and after casting the cavities have to be filled with particle material. Finally the cavities must be closed e.g. by a threaded plug. However, the requirements for the location, size and geometry of the cavities must accept compromises (e.g. in design or use of non-optimal solutions). In addition, filling the cavities after they have been realised can be troublesome and costly, because of the need to handle an already casted component that shall not be damaged and to introduce the particle material in the cavities that can be small or whose opening are small or difficult to access.

[0008] The applicant has filed a so far unpublished application in which a method for manufacturing components having a damping structure is disclosed that allows great flexibility for the location, size and geometry of the cavities and at the same time, counteracts the drawbacks caused by needs of introducing particle material into the cavities.

[0009] The method according to clam 1 of that mentioned application can be used preferably for manufacturing components having a thin thickness. The method comprising the following steps:

a) providing a substrate base, then
b) providing a layer of particle material on the substrate base, then
c) welding and/or sintering at least a part of the particle material of the layer of particle material according to a defined pattern, then
d) providing an additional layer of particle material on top of the layer of particle material whose particle material has already been welded and/or sintered, then
e) welding and/or sintering at least a part of the particle material of the additional layer of particle material according to a defined pattern, then
f) repeating steps d) and e) and define the component, and wherein

defining at least one cavity in the component (during step f), and
closing the at least one cavity without removing at least a part of the particle material from it. Preferably, the particle material is metallic material and the welding and/or sintering include laser or electron beam welding and/or sintering.

[0010] Although this method has the above mentioned advantages it has the disadvantage that it is time consuming because of the layer wise built up of the component.

SUMMARY

[0011] An aspect of the disclosure includes providing a method for manufacturing components having a damping structure that allows great flexibility for the location, size and geometry of the damping structures, at the same time, counteracts the drawbacks of the known state of the art solutions.

[0012] These and further aspects are attained by providing a method in accordance with the accompanying claims.

[0013] The component according to the invention is cast in a known usual way, but using cores, made of ceramic or of other high melting materials, for example high melting metallic alloys using as damping means. Those additional cores are not removed after casting.

[0014] Damping into a part can be introduced by having one material fully confined by another material, if the two materials have got reasonable different physical properties, e.g. Young's modulus and/or thermal expansion. Due to the differences in properties relative movement during service and especially during vibrational excitation between the contact surfaces are induced. Those cause dissipation of energy due to friction effects. Thus, vibrational response of the part is reduced.

[0015] For example the method can be used to manufacture blades or vanes of turbines, compressors, etc, but also other structure for power generation, automotive, small appliances or devices such as PCs, fans, etc requiring damping to improve service lifetime.

BRIEF DESCRIPTION OF THE DRAWINGS

[0016] Further characteristics and advantages will be more apparent from the description of a preferred but non-exclusive embodiment of the method, illustrated by way of non-limiting example in the accompanying drawings, in which:

Fig. 1a,1b shows each a cross section of a schematic airfoil of a turbine blade according to an embodiment of the invention, wherein Fig. 1 a shows the cross section after step f) and Fig. 1b shows the cross section after step g) of the disclosed method according to claim 1; and

Fig. 2 shows a part of a component, for example an insert for a gas turbine blade.

DETAILED DESCRIPTION OF EXEMPLARY EMBODIMENTS

[0017] With reference to the figures the invention is now described in detail.

[0018] According to claim 1 the method for manufacturing a component 1 having an internal damping structure 2 comprising the following steps:

a) providing core parts 3, 3', made of a first material with a melting point higher than the manufacturing process temperature,

b) arranging said core parts 3, 3' in a cast mould (not shown) in a pattern for receiving a desired internal damping structure 2,

c) providing and melting a base material 4, the base material 4 having different physical properties, at least a lower melting point then the first material, then

d) casting the component 1 by using the molten base material 4, the base material surrounding the core parts 3,3', then

e) solidification of the base material 4, then

f) removing the cast mould, then

g) optionally removing a part 3 of the core parts for building an internal cavity (6).

[0019] The component can be any kind of component that requires damping.

[0020] Preferably, said first material is a ceramic material or a high melting metallic material. It is essential that the first material (for the core parts) and the second material (base material) have got reasonable for present application different physical properties, at least different melting points. The base material 4 is preferable a metallic material, for example a Nickel base superalloy or a Co base superalloy or a high temperature resistant steel. The melting point of the base material is lower than the melting point of the core part material.

[0021] Fig. 1a, 1 b shows a cross section of a schematic airfoil of a gas turbine blade according to one embodiment of the invention.

[0022] The component 1 can be a blade or a vane of a turbo machine. The cross section in Fig. 1 a is done after step f) of the described method. The main inner core 3 is connected via webs 5 with the additional core parts 3'. There can be a plurality of webs 5 located on the core parts 3, 3' over the entire height to give a good stability. The cores parts 3, 3' are made of a first material, for example of ceramic material or of a high melting metallic material. The core parts 3, 3' can also be made of different material dependent on the desired damping requirements. The core parts 3, 3' are surrounded by a base material, for example a Nickel base superalloy.

[0023] After finishing the casting (after step f)) the inner core 3 is then removed in this embodiment, so that according to Fig. 1 b an internal cavity 6 is located in the component 1, which is here used as a cooling channel for guiding a cooling medium during operation of the turbo machine. The additional core parts 3' are not removed, they build the desired damping structure 2 in the airfoil 1.

[0024] Fig. 2 shows a second embodiment. The component 1 is an insert to be connected to a complex element. The component 1 (insert) has damping structures 2 with several core parts 3'. The core parts 3' have different shape and location to better counteract the oscillations. The insert can for example be used for manufacturing new turbine part or for repairing or reconditioning of already used parts in service.

[0025] The method can be used to manufacture components that are:

- an whole complex element, such as a whole blade or vane, including a root and an airfoil extending from the root, or
- a part of a more complex element, such as an airfoil of a blade having an airfoil connected to a root; or
- an insert to be connected to a complex element.

[0026] For example the method can be used to manufacture blades or vanes of turbines, compressors, etc, but also other structure for power generation, automotive, small appliances or devices such as PCs, fans, etc requiring damping to improve service lifetime.

REFERENCE NUMBERS

1	component
2	damping structure
3, 3'	core parts
4	base material
5	web
6	internal cavity

Claims

1. A method for manufacturing a component (1) having an internal damping structure (2), the method comprising

    a) providing core parts (3, 3'), made of a first material with a melting point higher than the manufacturing process temperature,
    b) arranging the core parts (3,3') in a cast mould in a pattern for receiving a desired internal damping structure (2),
    c) providing and melting a base material (4), the base material (4) having different physical properties, at least a lower melting point then the first material, then
    d) casting the component (1) by using the molten base material (4), the base material surrounding the core parts (3,3'), then
    e) solidification of the base material (4), then
    f) removing the cast mould, then
    g) optionally removing a part (3) of the core parts.

2. The method according to claim 1, **characterized in that** said first material is ceramic or a high melting metallic material.

3. The method according to claim 1, **characterized in that** said core parts (3, 3') are connected via at least one web (5).

4. The method according to claim 3, **characterized in that** there is a plurality of webs (5) located on the core parts (3, 3').

5. The method according to claim 1, **characterized in that** said base material is metallic material, preferable a Nickel base superalloy.

6. The method according to one of claims 1 to 5, **characterized in that** said component (1) is a blade or a vane of a turbo machine and that the main inner core (3) is removed after casting for cooling purposes of the component (1).

7. The method according to one of claims 1 to 5, **characterized in that** said component (1) is an insert to be connected to a complex element.

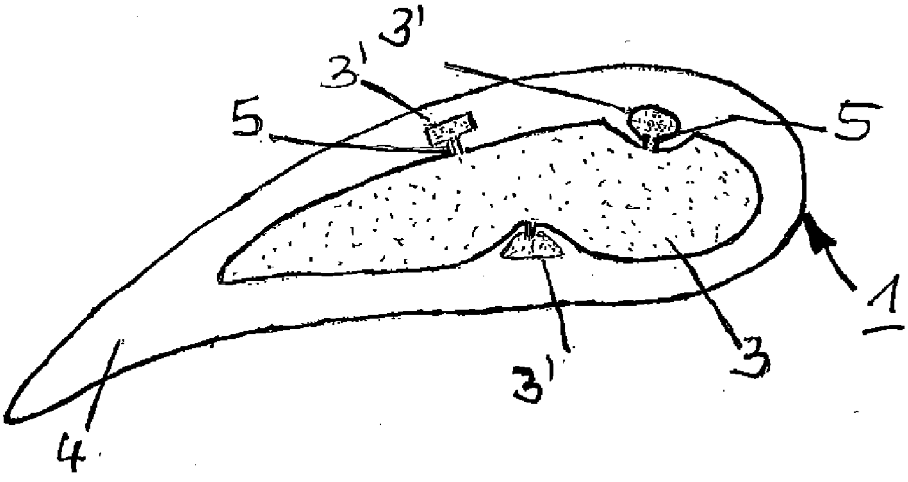

Fig. 1a

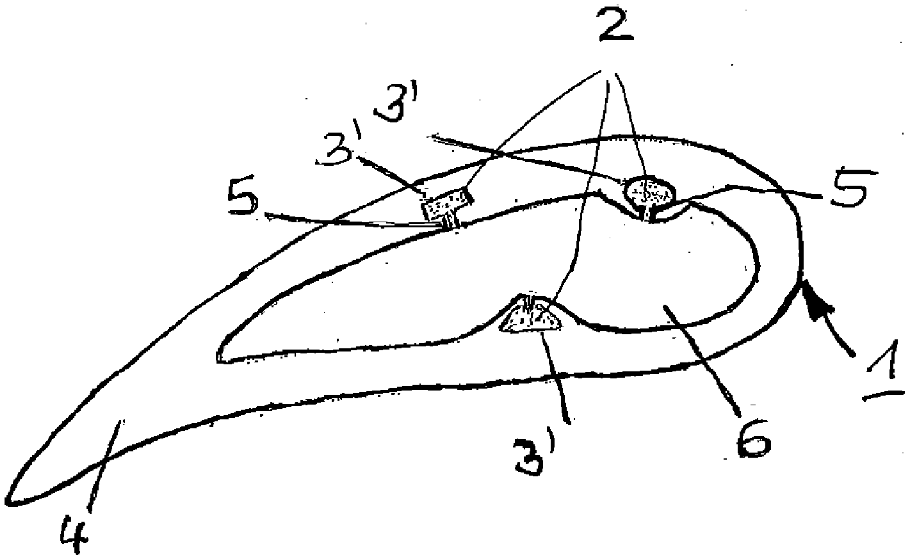

Fig. 1b

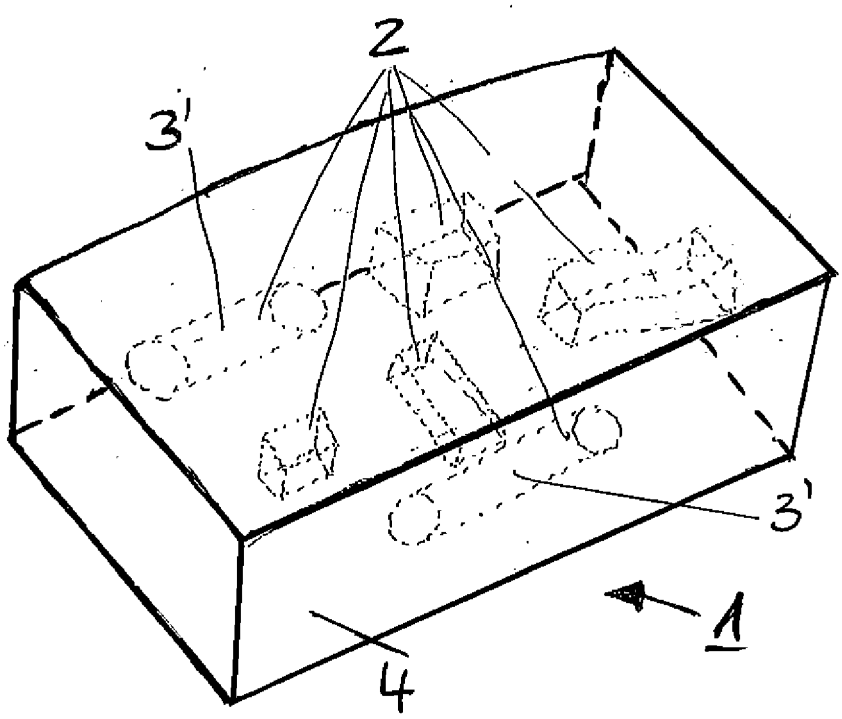

Fig. 2

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EUROPEAN SEARCH REPORT

Application Number
EP 13 16 4577

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	EP 2 441 542 A1 (SIEMENS AG [DE]) 18 April 2012 (2012-04-18) * paragraph [0001] - paragraph [0044] * * figures 1-8,12 *	1-7	INV. B22D19/04 B22C9/10 F01D5/18
X	US 2009/020256 A1 (HANNA MICHAEL D [US] ET AL) 22 January 2009 (2009-01-22) * paragraph [0004] - paragraph [0062] * * figures 1-20 *	1,2,5,7	
A	US 5 915 452 A (CONROY PATRICK L [US] ET AL) 29 June 1999 (1999-06-29) * figures 1-3 * * column 1, line 51 - column 6, line 27 *	6	
A	EP 2 161 411 A1 (SIEMENS AG [DE]) 10 March 2010 (2010-03-10) * the whole document *	1-7	
			TECHNICAL FIELDS SEARCHED (IPC)
			B22D B22C F01D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
Munich	2 September 2013	Zimmermann, Frank

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
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T : theory or principle underlying the invention
E : earlier patent document, but published on, or after the filing date
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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 13 16 4577

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For more details about this annex : see Official Journal of the European Patent Office, No. 12/82

REFERENCES CITED IN THE DESCRIPTION

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- US 6224341 B **[0006]**