US 20050000674A1

(19) United States

(12) Patent Application Publication (10) Pub. No.: US 2005/0000674 A1

Beddard et al. (43) Pub. Date: Jan. 6, 2005

(54) PERIMETER-COOLED STAGE 1 BUCKET CORE STABILIZING DEVICE AND RELATED METHOD

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(21) Appl. No.: **10/604,220**

(22) Filed: **Jul. 1, 2003**

Publication Classification

(51) **Int. Cl.**[7] **B22C 9/10**; B22D 27/04

(52) **U.S. Cl.** **164/122.1**; 164/361; 164/369

(57) **ABSTRACT**

A core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above the elongated slot but spaced from an upper edge of the upper body portion.

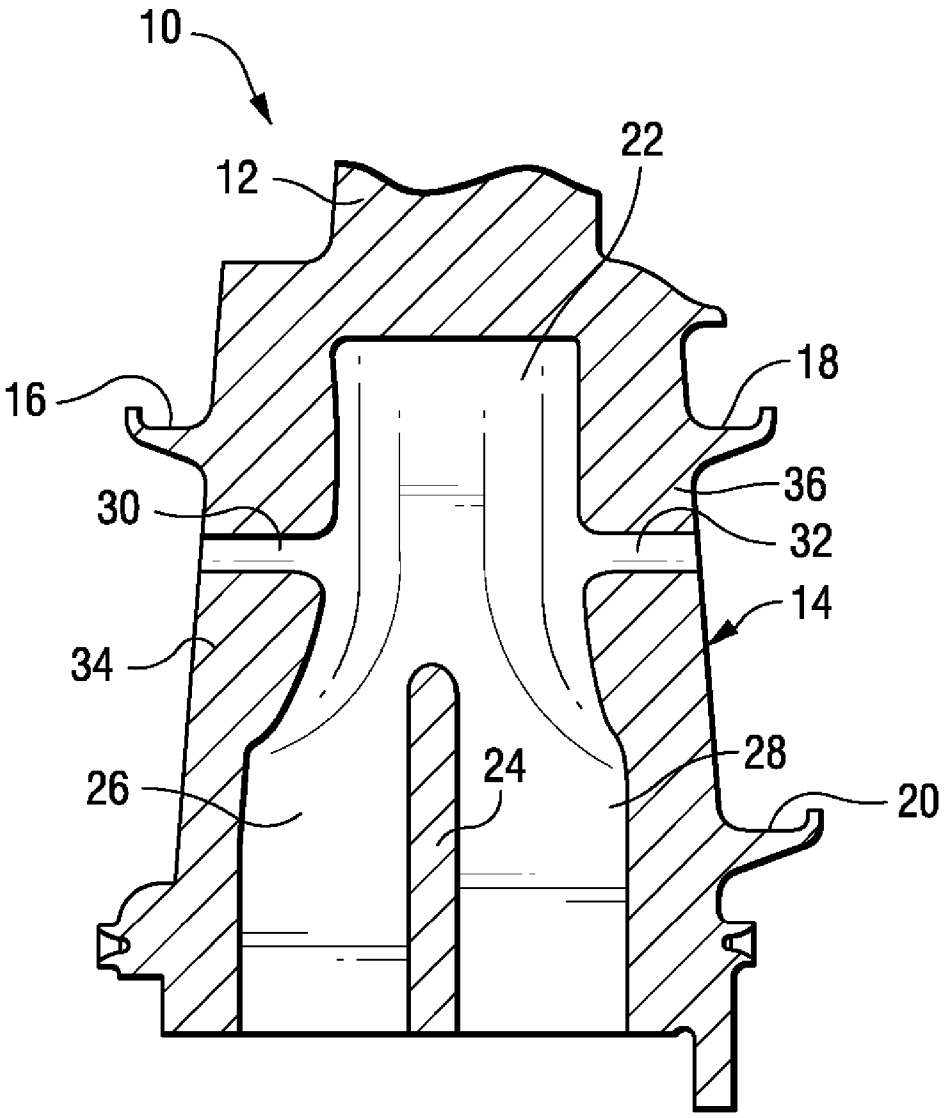
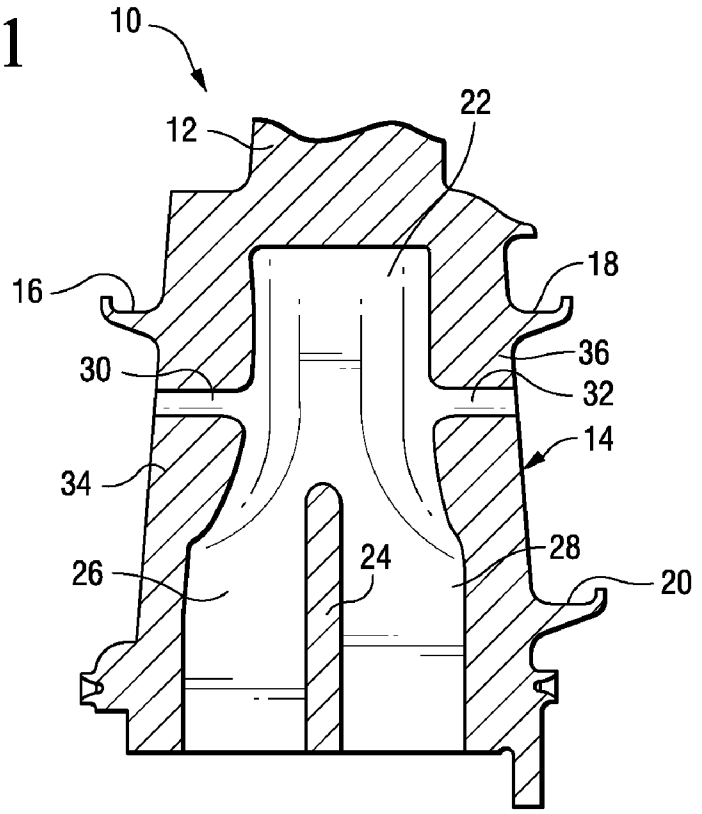


Fig. 1



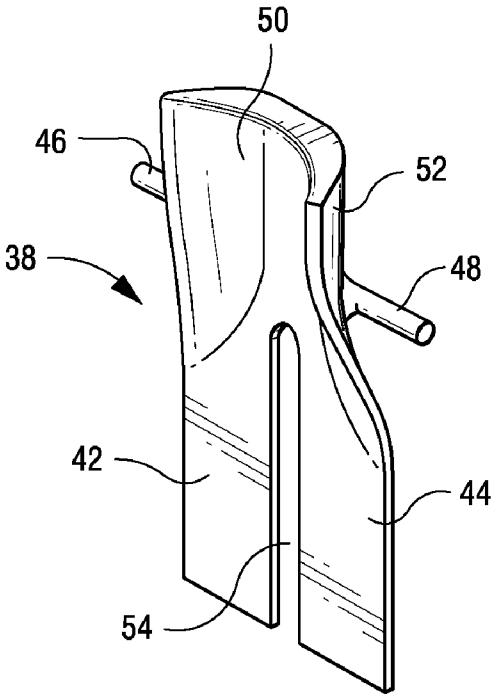


Fig. 2

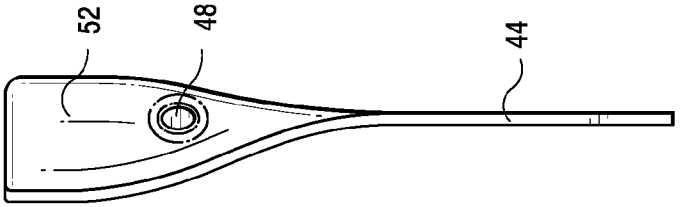


Fig. 5

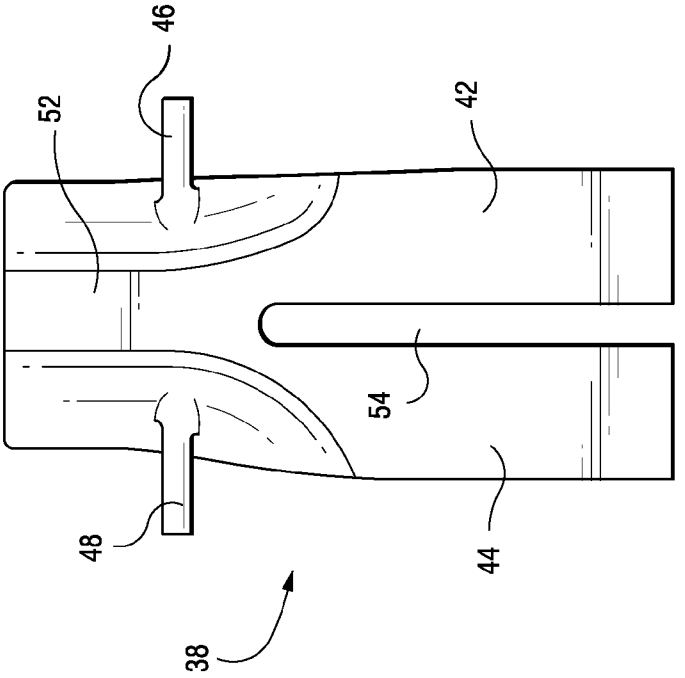


Fig. 4

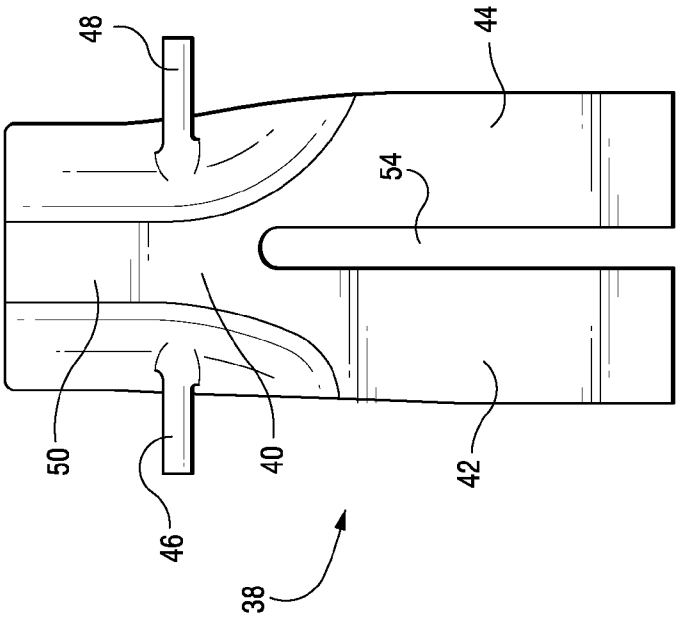


Fig. 3

PERIMETER-COOLED STAGE 1 BUCKET CORE STABILIZING DEVICE AND RELATED METHOD

BACKGROUND OF INVENTION

[0001] This invention relates generally to the casting of perimeter-cooled buckets for a gas turbine and, more specifically, to a stabilization device for an internal core used in the bucket casting process.

[0002] In an effort to improve the cooling scheme of a stage 1 gas turbine bucket, a "pants-leg" shaped core has been used in the bucket shank portion of the shell die to form a pair of cooling passages in place of a previous design utilized to form a plurality of radial cooling holes. In the casting process, however, the core tended to drift significantly, resulting in wall thicknesses in the shank portion of the bucket being out of tolerance.

[0003] Core stabilizing devices or "printouts" for improving the yield of a bucket casting process have been previously used in stage 2 buckets, but with a different core design and in a different location relative to the so-called angel wings on the exterior of the shank portion of the bucket. Because of the different design of the stage 1 and stage 2 buckets, it was not possible to simply scale up the stage 2 bucket core for use in the stage 1 bucket casting process.

SUMMARY OF INVENTION

[0004] This invention provides stabilization devices on the core used for casting stage 1 gas turbine buckets. Because of the interior configuration of the shank portion of the bucket, and in light of the desire to have the stabilizing devices laterally aligned, it was necessary to move the stabilizing devices or printouts radially downwardly in the shell die so as to be located below the external angel wings of the cast bucket.

[0005] It is also a feature of the present invention that the cross sectional shape of the stabilization devices or printouts is of elliptical rather than the oblong or rounded rectangular shape used with the printouts for the casting of stage 2 buckets. By making the printouts elliptical in cross-sectional shape, the flat surfaces of the prior design have been eliminated, and stresses, particularly at the intersection of the printouts and the core, have been reduced.

[0006] Accordingly, in one aspect, the present invention relates to a core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above the elongated slot but spaced from an upper edge of the upper body portion.

[0007] In another aspect, the invention relates to a core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above the elongated slot but spaced from an upper edge of the upper body portion, and wherein the pegs are elliptical in cross section.

[0008] In still another aspect, the invention relates to a method of controlling wall thickness in the shank portion of a turbine bucket during casting comprising: a) providing a core comprising a solid upper body portion and a pair of legs extending downwardly from the solid upper body portion, the legs separated by an elongated slot; b) supporting the core within a shell die by a pair of laterally aligned pegs extending from opposite ends of the solid upper body portion, the pegs located above the slot and below an upper edge of the upper body portion.

[0009] The invention will now be described in connection with the drawings identified below.

BRIEF DESCRIPTION OF DRAWINGS

[0010] **FIG. 1** is a partial cross section of a shank portion of a stage 1 bucket cast n accordance with the invention;

[0011] **FIG. 2** is a perspective view of a core used in casting the bucket shown in **FIG. 1**;

[0012] **FIG. 3** is a front elevation of the core shown in **FIG. 2**;

[0013] **FIG. 4** is a rear elevation of the core shown in **FIG. 1**;

[0014] **FIG. 5** is a side elevation of the core shown in **FIGS. 2-4**.

DETAILED DESCRIPTION

[0015] With reference to **FIG. 1**, a stage 1 turbine bucket **10** includes an airfoil portion **12** and a shank portion or shank **14**. The shank includes a plurality of so-called angel wings **16**, **18** and **20** that serve as seals vis-a-vis adjacent buckets when installed on the rotor wheel of a gas turbine. The interior of the shank portion includes a hollow space **22**, with a central divider **24** that establishes side-by-side cooling passages **26** and **28**. Elliptical holes **30** and **32** are cast in the fore and aft shank walls **34** and **36**, respectively, as a byproduct of having the core supported in the shell die during casting.

[0016] Turning to **FIGS. 2-5**, the core **38** has a generally "pants-leg" shape with a solid upper body portion **40** and a pair of radially inwardly extending legs **42** and **44** in accordance with an exemplary embodiment of the invention. A pair of stabilizing pegs or printouts **46**, **48** extend axially from opposite sides of the core while an elongated radially extending slot **54** separates the pants-leg portions **42** and **44**. Notice that the core is curved in its solid upper portion so as to provide convex and concave surfaces (**50**, **52**), respectively.

[0017] It will be appreciated that in the casting process, the reinforcing pegs or printouts **46**, **48** will be supported within aligned holes in the shell die, thus forming holes **30**, **32** in the fore and aft walls of the shank portion of the cast bucket. At the same time, the slot **50** will create the center partition **24**.

[0018] By locating the stabilizing pegs or printouts **46**, **48** radially below the angel wings **16**, **18**, sufficient room is provided so that the printouts **46**, **48** may be directly across from one another, i.e., aligned both axially and radially. After the casting process is completed, and the core removed, holes **30**, **32** remain in the bucket and must be

plugged. By laterally aligning the holes **30**, **32**, plugs can be inserted and press fit simultaneously in the holes **30**, **32** from opposite directions, without creating any asymmetrical stresses on the bucket.

[**0019**] It is also a feature of this invention, as best seen in **FIG. 5**, that the stabilizing pegs or printouts **46**, **48** have a cross sectional shape that is elliptical. The elliptical cross-sectional shape reduces stress at the intersection of the printouts and respective ends of the core by eliminating flat surfaces. When the casting process has been completed, the elliptical holes may be redrilled to a round shape and plugged with cylindrical plugs.

[**0020**] While the invention has been described in connection with what is presently considered to be the most practical and preferred embodiment, it is to be understood that the invention is not to be limited to the disclosed embodiment, but on the contrary, is intended to cover various modifications and equivalent arrangements included within the spirit and scope of the appended claims.

1. A core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from said solid upper body portion, said pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above said elongated slot but spaced from an upper edge of said upper body portion.

2. The core of claim 1 wherein said solid upper body portion is curved, forming opposite concave and convex surfaces, and said legs are substantially planar, said pegs extending from the convex surface of said solid upper body portion.

3. The core of claim 1 wherein said pegs are elliptical in cross section.

4. The core of claim 2 wherein said pegs are elliptical in cross section.

5. The core of claim 1 wherein said solid upper body portion has an upper edge, and further wherein, in a radial direction, said pegs are closer to said elongated slot than to said upper edge.

6. The core of claim 1 wherein said pegs are laterally aligned.

7. A core for use in casting a gas turbine bucket, the core comprising a solid upper body portion and a pair of legs extending downwardly from said solid upper body portion, said pair of legs separated by an elongated slot, and a pair of pegs projecting axially from opposite sides of the upper body portion, above said elongated slot but spaced from an upper edge of said upper body portion; and wherein said pegs are elliptical in cross section.

8. The core of claim 7 wherein said solid upper body portion is curved, forming opposite concave and convex surfaces, and said legs are substantially planar, said pegs extending from the convex surface of said solid upper body portion.

9. The core of claim 6 wherein said pegs are substantially laterally aligned.

10. A method of controlling wall thickness in the shank portion of a turbine bucket during casting comprising:

a) providing a core comprising a solid upper body portion and a pair of legs extending downwardly from said solid upper body portion, said legs separated by an elongated slot;

b) supporting the core within a shell die by a pair of laterally aligned pegs extending from opposite ends of the solid upper body portion, said pegs located above said slot and below an upper edge of said upper body portion.

11. The method of claim 10 wherein said solid upper body portion is curved, forming opposite concave and convex surfaces, and said legs are substantially planar, said pegs extending from the convex surface of said solid upper body portion.

12. The method of claim 10 wherein said pegs are elliptical in cross section.

13. The method of claim 11 wherein said pegs are elliptical in cross section.

14. The method of claim 10 wherein said solid upper body portion has an upper edge, and further wherein, in a radial direction, said pegs are closer to said elongated slot than to said upper edge.

15. The method of claim 10 wherein said pegs are laterally aligned.

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