United States Patent [19]

Jonas

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[54] **HIGH DAMPING BLADES**

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[52] **U.S. Cl.** **416/224,** 416/229, 416/241, 416/500

[51] **Int. Cl.** **F01d 5/16**

[58] **Field of Search** 416/229, 230, 500, 224, 416/241

[56] **References Cited**

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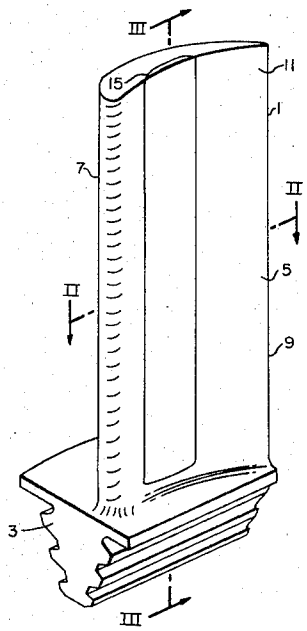
[57] **ABSTRACT**

A rotating turbine blade having an elongated depression disposed lengthwise along a concave surface forming an airfoil shaped portion of the blade and a high damping material disposed in the depression to produce a high strength blade with good damping characteristics.

5 Claims, 3 Drawing Figures



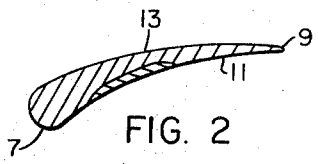


FIG. 2

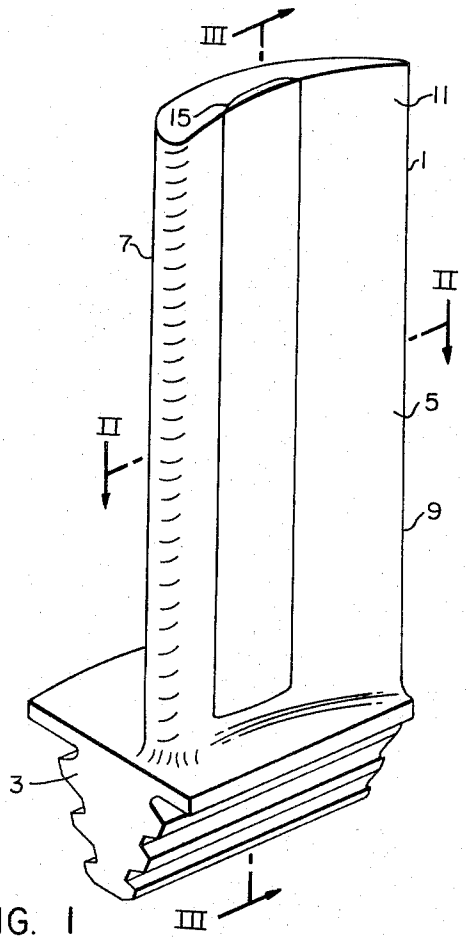


FIG. 1

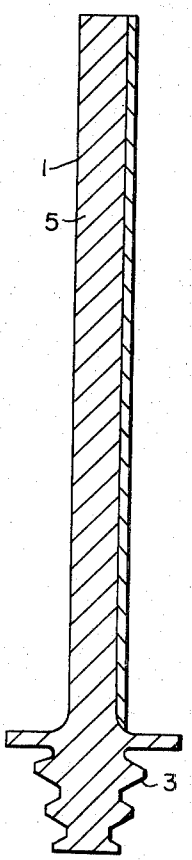


FIG. 3

HIGH DAMPING BLADES

BACKGROUND OF THE INVENTION

This invention relates to turbine blades and more particularly to vibration damping blades.

During the operation of a turbine the rotating blades are subjected to centrifugal forces and repetitive forces produced by the impinging steam and by other sources which cause the blades to vibrate, producing varying forces and stresses which result in fatigue cracks appearing on the surface of the blades and progressing inwardly until the blades must be removed or they will fracture, causing extensive damage to the turbine. The life of the blades decreases with increasing amplitude of the vibrational stresses, so that reducing the amplitude of the vibrational stresses, retards the formation of the fatigue cracks and extends the life of the blades.

Unfortunately, high strength materials with good fatique resistant qualities, that are required because of the stresses involved in rotating the blades at high speeds, have poor damping characteristics and materials having good damping characteristics, normally have low fatigue strength, therefore blades combining several materials have been suggested. Reference may be made to the Heymann U.S. Pat. No. 2,984,453, which is assigned to the same assignee, for additional information on such blades.

SUMMARY OF THE INVENTION

In general, a rotatable blade for an elastic fluid machine, when made in accordance with this invention, is formed from a high strength material and has an elongated depression disposed lengthwise therein and a high dampening material is disposed in the depression, whereby the vibration of the blade is dampened, while the strength of the blade is not materially altered.

BRIEF DESCRIPTION OF THE DRAWINGS

The objects and advantages of this invention will become more apparent from reading the following detailed description in connection with the accompanying drawings, in which:

FIG. 1 is an isometric view of a turbine blade made in accordance with this invention;

FIG. 2 is a sectional view taken on lines II—II of FIG. 1; and

FIG. 3 is a sectional view taken on line III—III of FIG. 1.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring now to the drawings in detail, FIG. 1 shows a rotatable blade 1 for an elastic fluid machine such as a steam turbine. The blade 1 comprises a root portion 3 having a fir tree configuration, which slidably engages a groove in a rotor (not shown) having generally the same configuration as the root of the blade. Extending upwardly from the root portion 3 is a blade portion 5 having an airfoil shaped cross section, which is shown best in FIG. 2. The blade portion 5 has a rounded leading edge 7 and a relatively sharp trailing edge 9 with

smooth rounded or arcuate surfaces 11 and 13 disposed between the edges 7 and 9. One of the rounded surfaces 11 is concave and the other rounded surface 13 is convex.

The concave surface 11 has an elongated depression or groove 15 formed therein. The depression is disposed to extend lengthwise of the blade 1, extends from adjacent the root portion to the tip of the blade, and is filled with a material having high damping characteristics such as a copper manganese alloy or a ferric nickel chrome alloy. The material having high damping characteristics may be deposited in the depression by a plasma spray process, an electrolysis process or by other means.

The blade 1 may be from a high strength material such as an alloy steel, i.e., 12 percent chrome steel or 17–4 PH steel, or a titanium alloy may be utilized in manufacturing the blades.

The outer surface of the damping material is shaped to provide the blade with a smooth curved surface to form the airfoil shaped cross section well known in the art.

The lower end of the depression 15 adjacent the root 3 has a radius 19, which generally reduces in depth as it approaches the root 3, to eliminate stress concentrations resulting from forming the depression in the blade.

The blade, hereinbefore described, advantageously forms a composite structure, which is easy to manufacture, has good damping characteristics, and yet is sufficiently strong to withstand the high stresses associated with rotating blades at high speeds and has good fatigue strength.

What is claimed is:

1. A rotatable blade for an elastic fluid machine having a rotor, said blade being formed of a high strength material and comprising a root portion which fastens to said rotor, and a airfoil shaped portion which extends radially from said rotor portion and has a concave and convex portion; said concave portion having an elongated depression disposed lengthwise therein, said depression terminating radially outwardly from the root portion, said depression having a high damping material disposed therein, whereby the vibration of the blade is dampened, while the strength of the blade is not materially altered.

2. A rotatable blade as set forth in claim 1, wherein the high damping material is so disposed in the depression to provide a continuous concave surface.

3. A blade as set forth in claim 1, wherein the root end of the depression gradually reduces in depth as it approaches the root, thereby eliminating stress concentrations resulting from the formation of the depression in the blade.

4. A blade as set forth in claim 1, wherein the blade is formed from an alloy steel and the damping material is a magnesium copper alloy.

5. A blade as set forth in claim 1, wherein the damping material is a nickel chrome iron alloy.

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