Sept. 14, 1954 E. A. ODEGAARD 2,689,107

VIBRATION DAMPER FOR BLADES AND VANES

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Fig. 1.

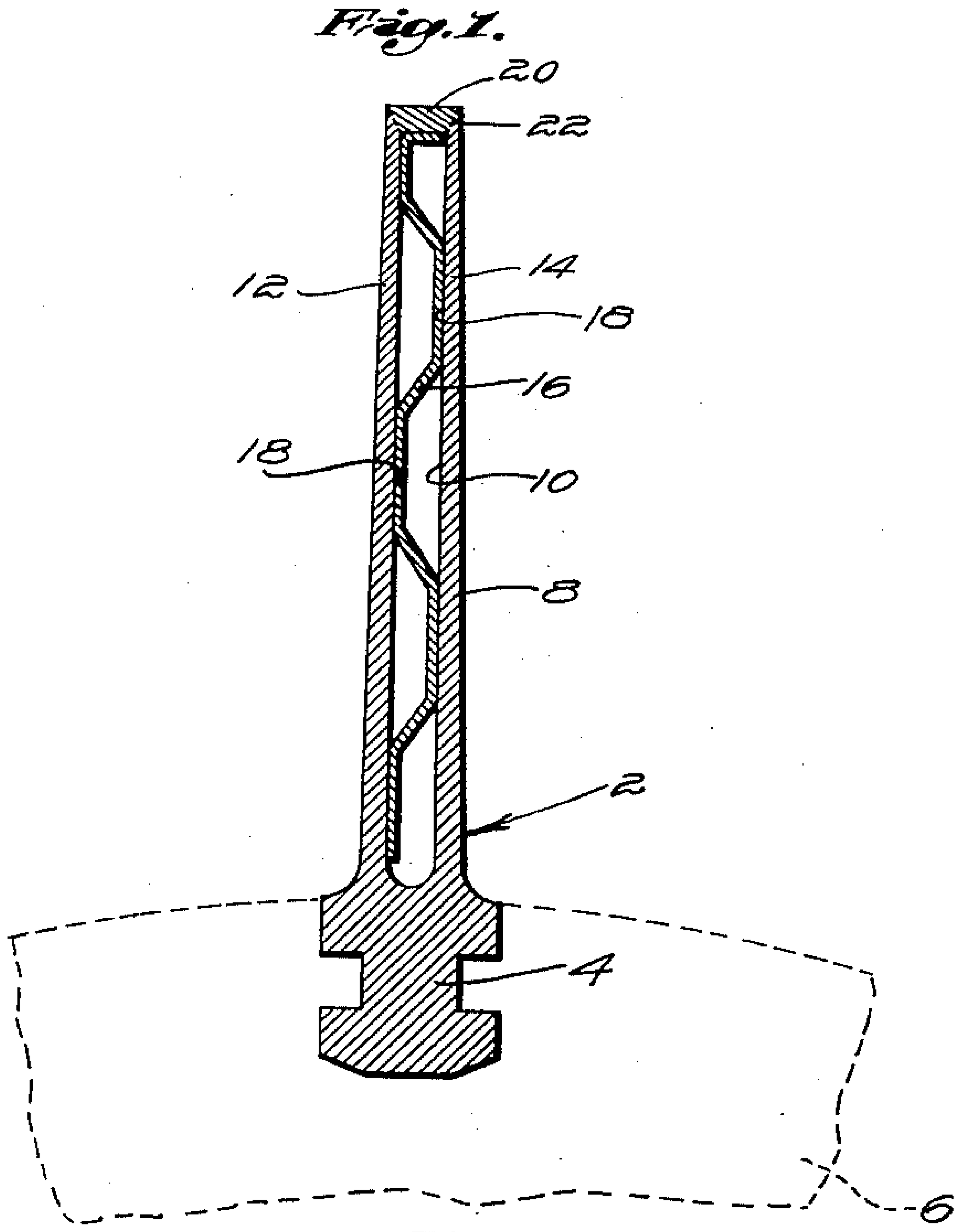


Fig. 2.

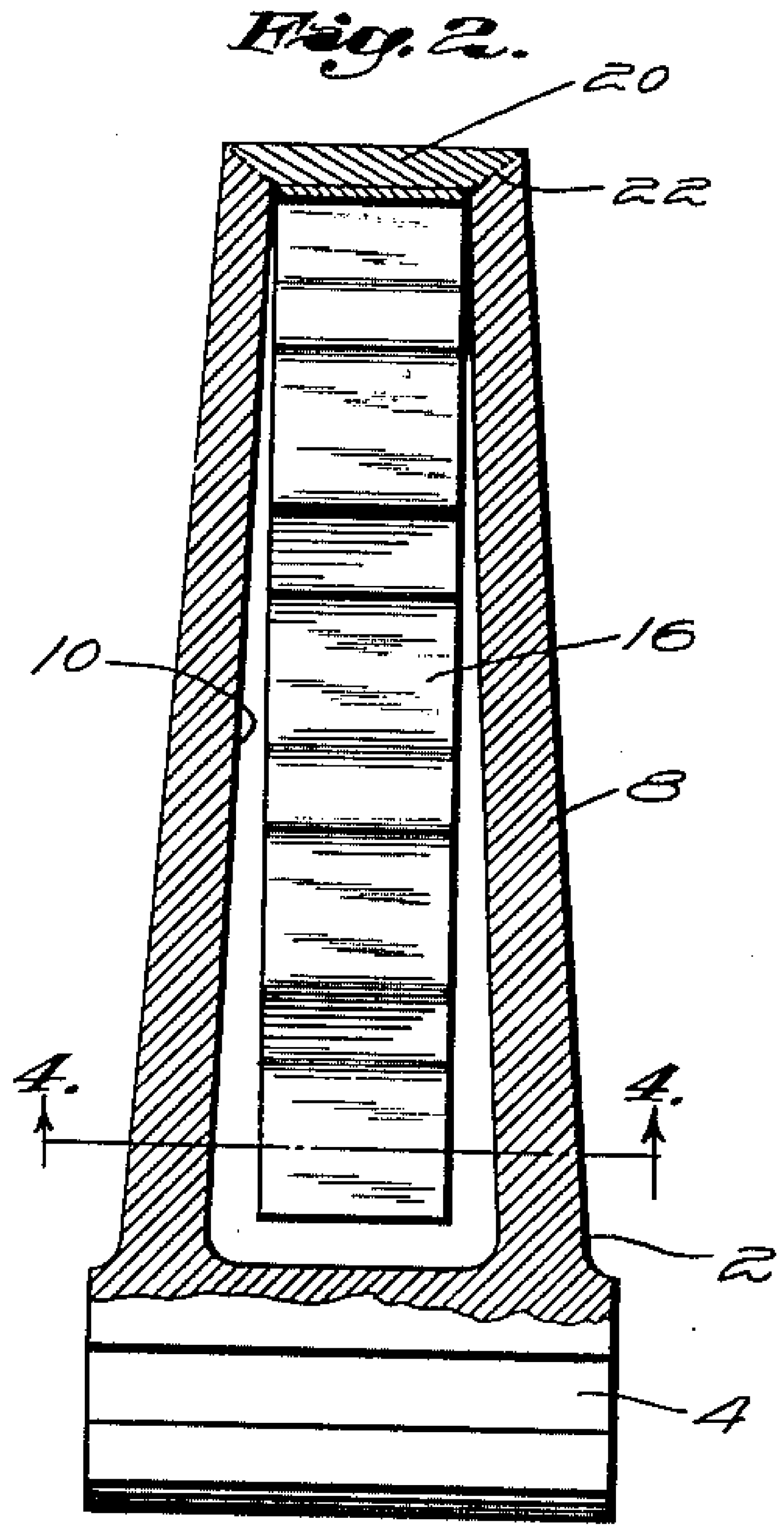


Fig. 3.

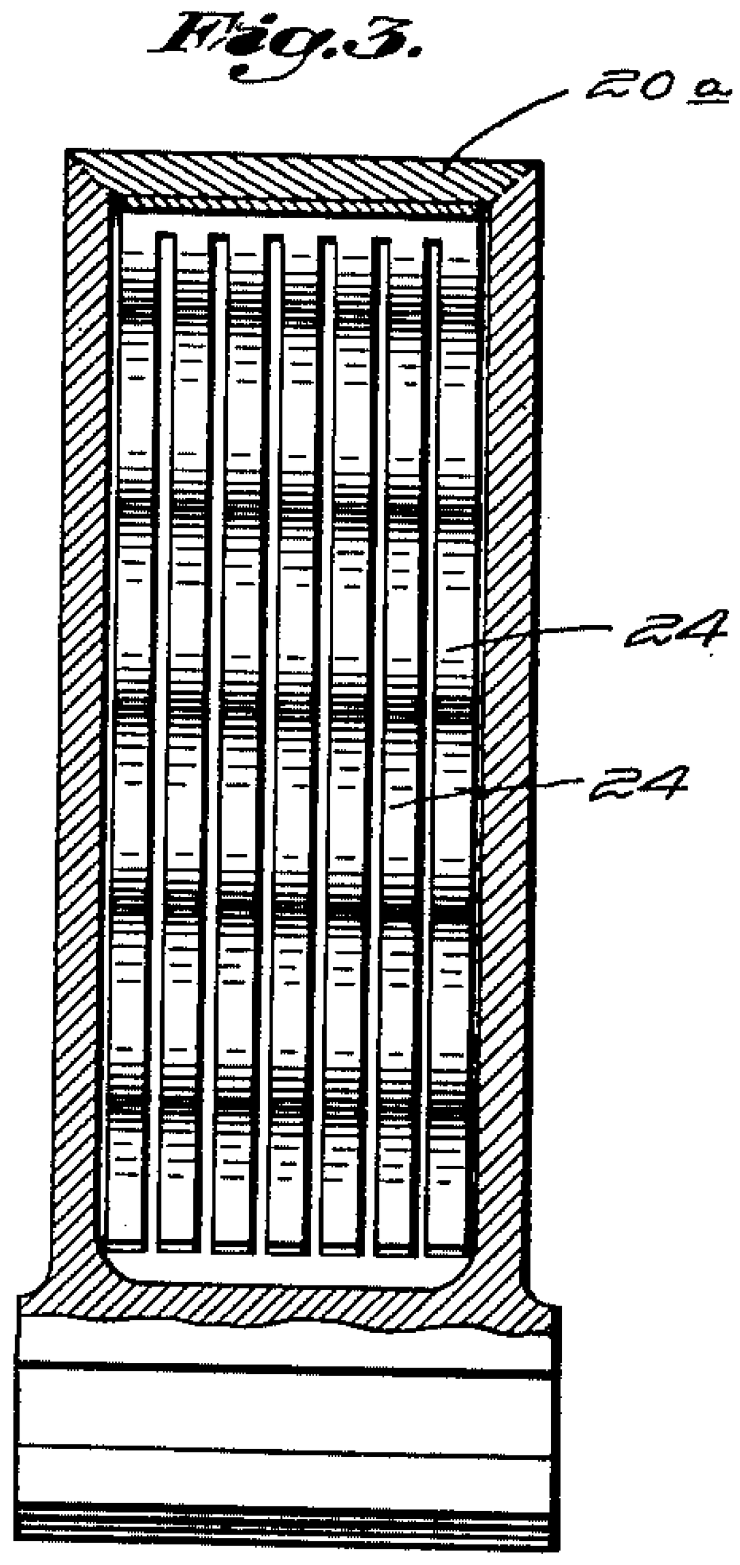
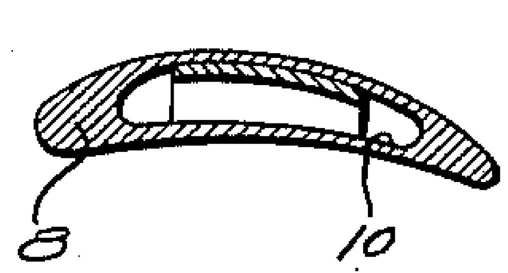


Fig. 4.



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2,689,107

VIBRATION DAMPER FOR BLADES AND VANES

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4 Claims. (Cl. 253—77)

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This invention relates to dampers for blades or vanes as used in compressors or turbines or other aerodynamic devices such as fans and propellers.

The damping of vibrations in blades or vanes, particularly in the moving vanes in high speed rotors in compressors and turbines, is frequently necessary to prevent excessive strains resulting from such vibrations. Inertia type dampers have been proposed for this purpose but the increase in weight is detrimental in many installations. A feature of this invention is a damper of the frictional type and particularly one which is effective without changing the external contours of the blade or vane.

Particularly in gas turbine power plants there is a trend toward hollow blades or vanes because of cooling problems as well as stress and weight problems. A feature of this invention is a damper adapted for use with many types of hollow blades or vanes without the necessity for modification of the vane structure. Another feature is a damper which will fit within a hollow blade or vane and in engagement with the side walls thereof for frictional damping. One feature is a frictional damper means for rotary devices so arranged that the damping effect is increased as the speed of the rotor carrying the vane increases.

Other objects and advantages will be apparent from the specification and claims, and from the accompanying drawing which illustrates an embodiment of the invention.

Fig. 1 is a transverse sectional view through a blade showing one form of the invention.

Fig. 2 is a sectional view at right angles to Fig. 1.

Fig. 3 is a sectional view similar to Fig. 2 showing a modification.

Fig. 4 is a sectional view substantially on the line 4—4 of Fig. 2.

With reference to the drawing, in which the invention is shown as applied to the blade of a rotor, the blade **2** has a root section **4** adapted to fit in a similarly shaped axial slot in a disc **6**. The effective blade section **8** of the turbine blade extends radially outward from the root and is hollow having a centrally located opening **10** extending from the outer end of the blade inwardly toward the root section. The blade section **8**, as shown in Fig. 4, is approximately airfoil in shape and the opening **10** may be approximately the same shape being defined between spaced substantially parallel walls **12** and **14** making up the inner and outer blade surfaces. In the arrangement shown, the opposite walls of the opening **10** are substantially parallel and the walls **12** and **14** may become thinner toward the tip of the turbine blade.

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In accordance with the invention, the opening **10** has inserted therein a sinuous or zig-zagged shaped resilient strip **16** having spaced lands **18** engaging with opposite side walls of the opening **10**. The strip **16** is supported adjacent to or at its tip end within the opening **10**, the arrangement shown for supporting this strip being a cap or shroud piece **20** for the tip of the turbine blade which is attached as by brazing or welding **22** to close the tip end of the opening **10** within the blade.

When the rotor is in operation, the blade may begin to vibrate in the plane of the disc **6** and such vibration is effectively damped by the frictional contact between the lands **18** of the resilient strip **16** and the cooperating surfaces of the opening **10**. As the rotor speed increases, the centrifugal force acting on the strip **16** tends to move the strip radially outward thereby increasing the contact pressure between the lands **18** and the associated blade structure so that the damper becomes more effective at higher speeds. It will be noted that no revision of the hollow blade structure is necessary for use of the blade damper since it can be inserted without modification of the blade and requires only the welding of the cap **20** to the tip of the blade to hold the damper in position.

The damper may be a single flexible strip as in Figs. 1 and 2 in which case the width of the strip is selected to give the required amount of damping. Instead of a single strip, the damping device may be made up of a series of relatively narrow strips **24**, as shown in Fig. 3, in which event the strips may all be integral at the tip end where they are attached to the cap **20A**. In either event, for most effective damping, it will be noted that the damper is preferably arranged to fill as nearly as possible the available space within the hollow blade. It will be understood that the particular blade configuration shown is merely by way of example and that many other types of hollow blades may have a damper of the type above described applied thereto.

It is to be understood that the invention is not limited to the specific embodiment herein illustrated and described, but may be used in other ways without departure from its spirit as defined by the following claims.

I claim:

1. In a vane construction, a hollow metallic vane of airfoil cross section having interior walls defining a longitudinally extending opening therein, the chordal dimension of the opening being less than the chordal dimension of the vane, at least one resilient metallic strip mounted within

said opening and extending longitudinally of the vane, said strip being of sinuous form and having longitudinally spaced lands extending in a chordal direction, said lands engaging opposite walls of said opening and being free of connection with said walls so as to be capable of longitudinal motion with respect to said vane, said strip providing friction damping when the vane vibrates.

2. In a vane construction, a hollow metallic vane of airfoil cross section, said vane having a root and a tip and interior walls defining a longitudinally extending opening therein, the chordal dimension of the opening being less than the chordal dimension of the vane, at least one resilient metallic strip mounted within said opening and extending longitudinally of the vane, said strip being of sinuous form and having longitudinally spaced lands extending in a chordal direction, said lands engaging opposite walls of said opening and being free of connection with said walls so as to be capable of longitudinal motion with respect to said vane, the root end of said strip being unrestrained against longitudinal movement, and means limiting longitudinal movement of the tip end of said strip away from said vane root, said strip providing friction damping when the vane vibrates.

3. In a vane construction, a hollow metallic vane of airfoil cross section having interior walls defining a longitudinally extending opening therein, the chordal dimension of the opening being less than the chordal dimension of the vane, a plurality of resilient metallic strips mounted in side-by-side relation within said opening and extending longitudinally of the vane, said strips being of sinuous form and having longitudinally spaced lands extending in a chordal direction, said lands engaging opposite walls of said opening and being free of connection with said walls so as to be capable of longitudinal motion with respect to said vane, and means joining the tip end of said strips to position said strips within said opening, said strips providing friction damping when the vane vibrates.

4. In a vane construction, a hollow metallic vane of airfoil cross section, said vane having a root and a tip and interior walls defining a longitudinally extending opening therein, the chordal dimension of the opening being less than the chordal dimension of the vane, a plurality of resilient metallic strips mounted within said opening and extending longitudinally of the vane, said strips being of sinuous form and having longitudinally spaced lands extending in a chordal direction, said lands engaging opposite walls of said opening and being free of connection with said walls so as to be capable of longitudinal motion with respect to said vane, the tip end of said strips being connected together, and means limiting longitudinal movement of the connected ends away from said vane root, said strips providing friction damping when the vane vibrates.

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