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DAMPENED BLADE STRUCTURE

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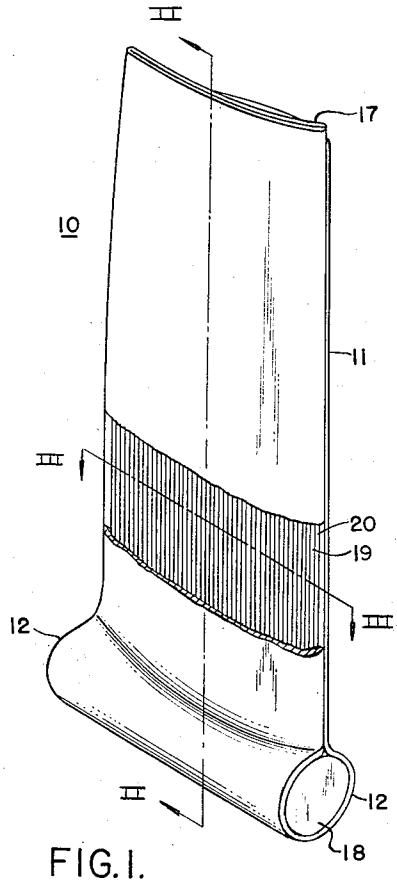


FIG. 1.

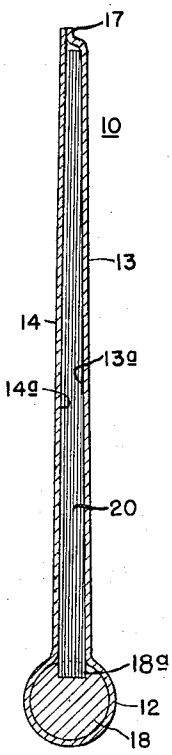


FIG. 2.

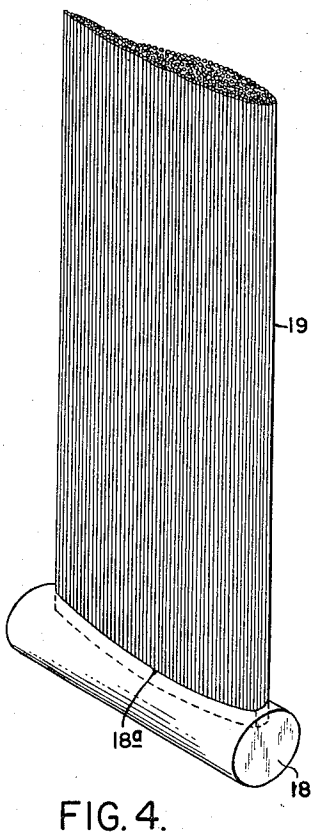


FIG. 4.

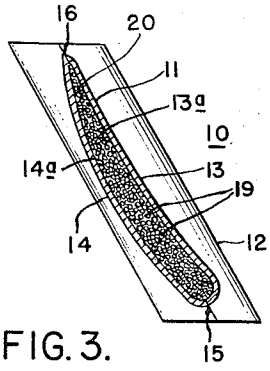


FIG. 3.

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DAMPENED BLADE STRUCTURE

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This invention relates to blading for axial flow elastic fluid machines such as axial flow compressors and turbines and has for an object to provide a blade having improved operating characteristics.

A further object of the invention is to provide a blade of the above type in which blade vibration is minimized.

Another object is to provide a damped blade of the above type which is simple to manufacture, does not involve damping components machined to critical dimensions, has a prolonged useful life, and maintains its damping characteristics in extreme conditions of service for the life of the blade.

A more specific object is to provide a blade damping structure which may be readily incorporated in a fabricated blade prior to completion of the blade.

In accordance with the invention, a group of fine strands of wire are placed or inserted in the longitudinal opening of a hollow blade. The strands are sufficiently numerous to occupy from about 60% to 80% of the cross-sectional area of the opening (although the above percentages are not critical and may vary) and are disposed at random in intimate side-by-side relation, so that they are in contact with each other and in contact with the walls of the opening. Hence any vibration induced in the blade during operation is transmitted through the walls of the opening to the wire strands which absorb or otherwise dissipate the vibrational energy to effectively suppress the vibrational tendencies of the blade.

The wire strands preferably extend the full length of the vane portion of the blade and, when employed in a rotor blade, are anchored at the base of the blade by brazing or other desirable fastening means. The wire strands may be made of any suitable metal having good wearing properties and when utilized in turbine blading must be formed of metal capable of withstanding high temperatures without fusing. Applicants have found that stainless steel and copper are highly satisfactory materials, however numerous other materials may be employed with similarly advantageous results.

The above and other objects are effected by the invention as will be apparent from the following description taken in connection with the accompanying drawings, forming a part of this application, in which:

Fig. 1 is a perspective view of an axial flow compressor rotor blade with a portion cut away from clarity;

Fig. 2 is a longitudinal sectional view taken on line II—II of Fig. 1 and looking in the direction of the arrows;

Fig. 3 is a cross-sectional view taken on line III—III of Fig. 1 and looking in the direction of the arrows; and

Fig. 4 is a perspective view of the damping structure removed from the blade.

Referring to Fig. 1 of the drawing, there is illustrated a blade **10** designed for the rotor of an axial flow compressor of the class adapted for use in an aviation gas turbine power plant (not shown). The blade **10** may be of conventional outward form, comprising a vane portion **11** of suitably warped airfoil contour, and an enlarged

base or root portion **12** which is adapted to be slidably engaged and suitably anchored in a mounting groove of the above mentioned rotor.

According to the invention, as best shown in Figs. 1, 2 and 3, the blade **10** has an envelope or casing including curved envelope walls **13** and **14** having complementary edges or abutting margins which are adapted to be brazed or otherwise suitably secured together to form leading and trailing edge joints **15** and **16** and an offset tip portion **17** for wearing in purposes.

The base or root portion **12** is formed by the central portion of the envelope and is of tubular shape with its central axis extending transversely of the longitudinal axis of the vane portion **11** and having openings at opposite ends. Within the base portion **12** there is provided a solid core member **18** having attached thereto, by brazing or the like, a group of fine strands of wire **19** extending therefrom into the cavity **20** provided in the vane portion **11** by the complementary walls **13** and **14**. The wire strands **19** are disposed at random and in intimate rubbing or frictional contact with each other and with the inner wall surfaces **13***a* and **14***a* of the vane portion **11**. The strands of wire preferably extend the full length of the vane portion **11**, as best shown in Fig. 2, and may be formed of any suitable metal having good wearing properties, so that the coefficient of friction between the strands does not change appreciably with wear, and capable of withstanding temperatures to which the blade is subjected in use.

Although the blade **10** may be manufactured in any desirable manner, the core member **18** is preferably formed with a longitudinal recess **18***a* in its periphery and the ends of the strands of wire **19** are inserted in the recess **18***a*, and firmly anchored therein by means of brazing or the like to prevent detachment therefrom during rotation of the blade. The blade envelope in a preformed state is then placed around the structure shown in Fig. 4 and brazed at the leading edge **15**, the trailing edge **16**, and the tip **17**. Subsequently thereto or simultaneously therewith the core member **18** is brazed within the base **12**, thereby providing a rigid unitary structure of simple yet effective configuration.

The diameter of the strands **19** may be selected as desired depending upon the material of the envelope and the proportions of the vane **11**. However, in any event the diameter of the strands is of a very small order and the number of strands is of a relatively large order occupying about 60% to 80% of the total cross-sectional area of the cavity **20**.

In operation, any vibration induced in the vane portion **11** is transmitted through the interior wall surfaces **13***a* and **14***a* of the vane portion **11** to the wire strands **19** and then transmitted from strand to strand thereby absorbing or otherwise dissipating the vibrational energy of the envelope and effectively damping the vibrational tendencies of the blade.

It will be seen that the invention provides a damped blade of relatively simple design and easy to manufacture, in which the dampening structure is formed of readily available material.

Also, it will be apparent that the invention provides a dampening structure which is not limited to any specific type of material for attaining the desired dampening and that stainless steel or copper strands may be utilized with equal effectiveness.

Although the invention has been described in conjunction with a blade adapted to be mounted on a rotor, it will be understood that the invention is not so limited and may be utilized in conjunction with stationary blades as well. Also, since in stationary blading rotational forces are absent, it will be understood that the strands need not

be anchored and other strand materials may be utilized when the invention is applied to stationary blading.

While the invention has been shown in but one form, it will be obvious to those skilled in the art that it is not so limited, but is susceptible of various changes and modifications without departing from the spirit thereof.

What is claimed is:

1. A fabricated blade for a rotor of an axial flow machine comprising a sheet metal envelope providing a hollow vane portion of air foil shape and a base portion adjacent one end of said vane portion, said base portion being of tubular shape and defining a passage open at both ends, said vane portion having interior wall surfaces defining a longitudinal opening therein communicating with the passage in said base portion, a group of fine strands of wire disposed at random and in closely packed side-by-side relation within said vane opening, said group of strands extending lengthwise in said opening and contacting said interior wall surfaces, means received within said base portion for anchoring said group of strands, said anchoring means comprising an elongated member having a longitudinal recess in its periphery and the terminal portions of said strands being firmly imbedded in said recess.

2. The structure recited in claim 1 in which the group of strands extends substantially to the tip portion of the vane.

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