Feb. 5, 1946. G. B. WARREN 2,394,124

BLADED BODY

Filed Feb. 13, 1943

Fig. 1.

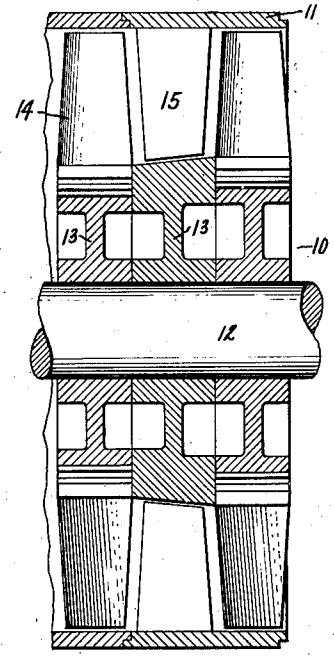


Fig. 2.

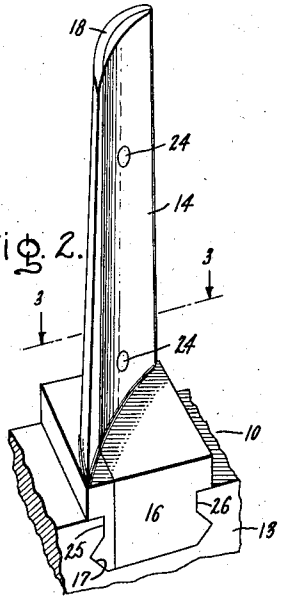


Fig. 3.

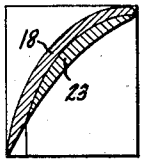
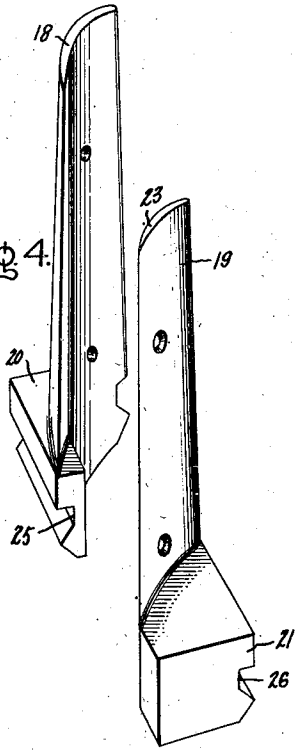


Fig. 4.



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2,394,124

BLADED BODY

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Application February 13, 1943, Serial No. 475,788

2 Claims. (Cl. 253—77)

The present invention relates to bladed bodies comprising a disk with a rim and a plurality of circumferentially spaced blades carried by the rim such as are used in elastic fluid turbines and compressors. During operation the blades are subject to considerable forces due to the high speed at which they are rotated and due to the flow of elastic fluid through the passages formed between them. In order to enable such blades or buckets to carry heavy loads it is important to dampen vibrations of the blades that may be set up during operation. In certain instances this has been heretofore accomplished by the provision of shroud bands or tie wires secured to outer portions of a group of blades. Often, especially with regard to axial flow compressor wheels, it is not desirable to connect a plurality of blades into groups by the provision of tie wires or shroud bands as this would reduce the compressor efficiency. In other instances, the vibration of blades has been dampened by the provision of vibration dampening elements located within bores formed in the blades. Such arrangements increase the manufacturing cost and, what is even more important, they weaken the blades by reducing their cross-sectional area thereby increasing the stresses per unit area of the blade cross-section.

The object of my invention is to provide an improved blade structure for compressors and turbines which does not have the drawbacks of the aforementioned designs and whereby vibrations set up during operation in turbines and compressors are effectively dampened.

For a consideration of what I believe to be novel and my invention, attention is directed to the following description and the claims appended thereto in connection with the accompanying drawing.

In the drawing:

Fig. 1 illustrates diagrammatically a section through an axial flow compressor embodying my invention; Fig. 2 is a perspective view of a bladed structure for impeller wheel of the compressor; Fig. 3 is a section along the line 3—3 of Fig. 2; and Fig. 4 is an exploded, perspective view of Fig. 2.

The compressor comprises a rotor 10 disposed within a casing 11. The rotor has a shaft 12 with a plurality of rings, disks or drums 13 fastened thereto. Alternate disks 13 carry a plurality of circumferentially spaced blades 14 to form impeller wheels or bladed bodies. During operation of the compressor elastic fluid impelled by the blades 14 of a wheel 10 is forced axially to a succeeding wheel 10. On its passage between succeeding wheels the fluid is guided by circumferentially spaced, stationary guide vanes 15 supported on the casing 11.

Each blade, as illustrated in Figs. 2 to 4, comprises a blade proper essentially crescent-shaped in section and with a cross-sectional area gradually decreasing in radial, outward direction towards the tip of the blade. The inner end of the blade proper is secured to or integrally united with a root or base 16 which is dovetail-shaped and held in a corresponding dovetailed recess 17 extending axially through the rim of the disk or ring 13. The structure so far described is typical of impeller wheels and bucket wheels used in many axial flow compressors and turbines respectively where it is not desirable to connect outer portions of the blades by means of shroud bands or tie ropes.

In order to dampen vibrations set up during operation in such blades I split the blades along their entire length to form two halves or parts engaging each other over the entire area of their adjacent faces. Thus, in the example illustrated, the blades 14 are split along their entire length, that is, made up of two parts 18 and 19, each having a root or base portion 20 and 21 respectively forming together the aforementioned root or base 16. Each part 18 and 19 has an essentially crescent-shaped blade portion. The part 18 has a large concave surface 22 facing a correspondingly large convex surface 23 of the blade portion 19. The two parts are secured together to effect frictional engagement of the surfaces 22 and 23 by means of their connection to the rim of the disk 13 and by additional means in the form of rivets 24. In most instances one or two rivets are sufficient to effect the desired frictional engagement between the surfaces 22, 23. The connecting means of the two parts of each blade, such as the aforementioned rivets, should bias the parts together without thereby preventing slight, relative movement between them. The frictional engagement of the two parts dampens vibrations of either part. In the present example the splitting of the blade extends radially along the entire length of the blade and axially from a point near the rear or trailing edge of the blade to the inlet edge thereof. This permits the formation of a sharp trailing edge by one of the parts of the blade. In the present example the trailing edge portion of the blade is formed entirely by the part 18.

The dovetailed root or base 16 has two axial grooves 25 and 26, of which the groove 25 is

formed completely in one part of the blade and the major part of the groove 26 is formed in the other part of the blade.

What I claim as new and desire to secure by Letters Patent of the United States, is:

1. A rotor for a high-speed turbo-machine including a disk with a circumferential row of buckets secured to the disk by dovetail joints, each bucket comprising a blade secured to a dovetail base, the bucket being divided into two portions of different cross section and mass so as to have unequal natural frequencies of vibration, the dividing surface extending the full length of the bucket including the dovetail base and extending across substantially the full width of the blade, said two bucket portions being secured together in tight frictional engagement with each other throughout the area of the dividing surface by rivet means permitting some slippage between the two portions throughout the bucket length when the blade portions bend due to vibration in operation.

2. In a high-speed turbo-machine, a rotor including a disk with a circumferential row of buckets secured to the disk by dovetail joints, said buckets being longitudinally divided throughout their length into two contacting bucket portions of different cross section and mass so as to have unequal natural frequencies of vibration, the curved dividing and contacting area extending across substantially the full width of said buckets, the two portions being held in direct frictional engagement with each other throughout said contact area by said dovetail joints and a small number of rivets interconnecting the two bucket portions and permitting slight relative longitudinal movement of the said portions.

GLENN B. WARREN.