April 6, 1943. A. H. REDDING 2,315,655

TURBINE BLADE SHROUD FASTENING

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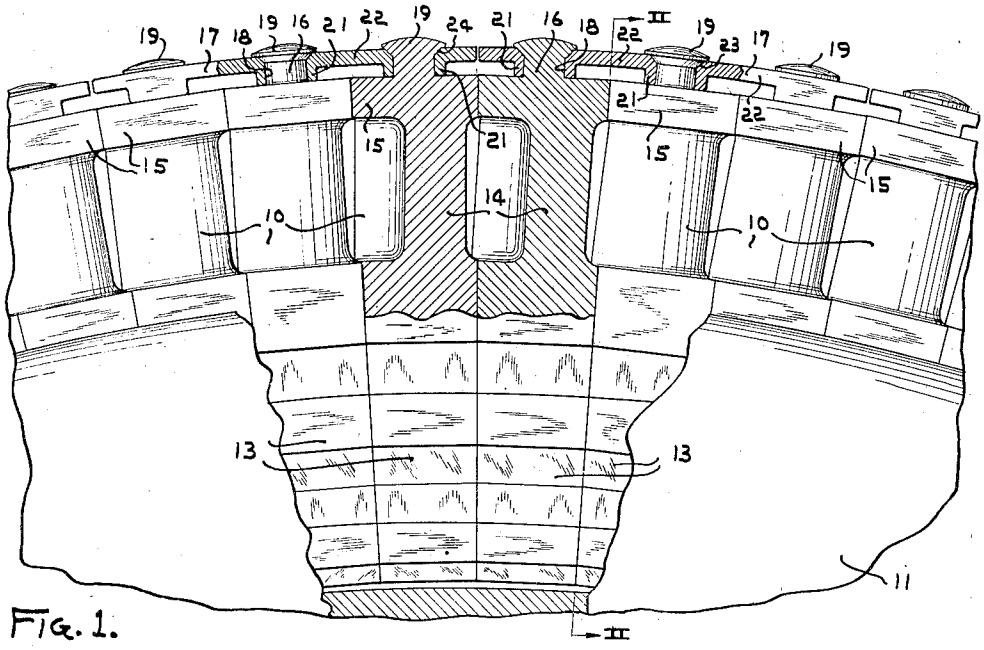


FIG. 1.

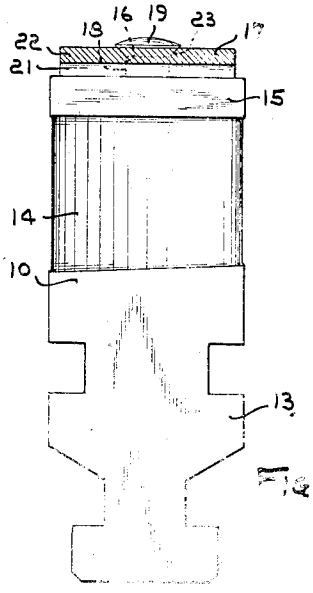


FIG. 2.

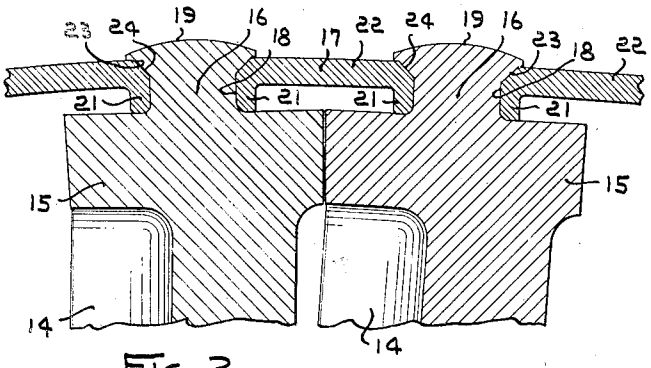


FIG. 3.

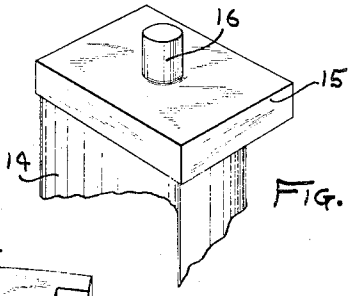
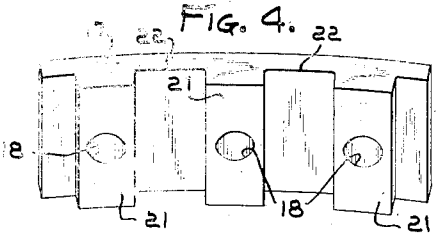


FIG. 5.

FIG. 4.



WITNESSE

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TURBINE BLADE SHROUD FASTENING

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2 Claims. (Cl. 253—77)

The invention relates to a row of relatively short and stiff turbine blades having individual shroud elements disposed circumferentially in end-to-end relation together with tie bands cooperating with tenons formed on the blades for connecting the latter circumferentially in groups, and it has for an object to provide a tie band constructed and arranged to give adequate flexibility between adjacent tenons while at the same time providing for connection thereof with the tenons in such a manner that looseness and consequent opportunity of the blades to move tangentially with respect thereto are avoided.

With blade tenons extending through plain cylindrical openings formed in a relatively thin and flexible tie band and riveted to form button heads fitting the outer surface of the band tightly, tangential movement of the blades relative to the band may occur to the extent of looseness of the tenons with respect to the openings. To avoid this difficulty, a conical or chamfered connection is provided between each tenon and the tie band so that centrifugal force acting on the band will be effective to move the latter out to maintain a taper-tight fit between the tenon and the blade, thereby avoiding any tangential looseness and consequent freedom of the blade to move tangentially with respect to the band. The achievement of this objective inherently requires a minimum thickness of band, but the necessary minimum thickness for this purpose is in excess of that required for the desired flexibility of the band between tenons. Therefore, in accordance with the present invention, each tie band of sufficient thinness for the required flexibility is provided with thickened portions for the tenons, and each thickened portion, extending circumferentially to the extent required by the tenon, has a conical chamfered or countersunk opening which serves to form the outer end of the tenon with a conical portion fitting therein incident to riveting or heading the tenon. If there should be any tangential looseness in a connection, such looseness is overcome when the blading is rotated, centrifugal force acting on the tie band causing the chamfered portion of the openings to engage tightly the conical portions of the tenons.

A further object of the invention is to provide a segmental tie band and associated blades provided with connections having these advantageous features of construction and of operation.

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

Fig. 1 is a fragmentary view, partly in section and showing a portion of a row of turbine blades;

Fig. 2 is an elevational view of a turbine blade having the improved tie band applied thereto;

Fig. 3 is a fragmentary detail sectional view of a plurality of blades and a tie band;

Fig. 4 is an isometric view of a tie band; and,

Fig. 5 is a fragmentary isometric view showing the outer end portion of a blade.

In the drawing, there is shown a row of blades 10 attached to a rotor 11.

Each blade 10 comprises a root element 13, a blade element 14, a shroud element 15, and a tenon 16 extending outwardly from the shroud element.

With the blades 10 assembled to provide a row, the root and shroud elements 13 and 15 of successive blades are in end-to-end relation circumferentially so as to provide inner and outer boundaries for the blade passages.

The blades 10 are connected in circumferential groups by means of tie bands having openings 18 through which the tenons 16 extend, and the tenons have riveted or headed portions 19 overlapping the tie bands so as to connect the latter to the blades.

As shown, each tie band 17 is formed with transversely-extending portions 21 for the tenons joined by the relatively thinner and more flexible portions 22. Preferably, the thickened portions are provided by transversely-extending ribs formed internally of the bands.

The tenon openings 18 are disposed centrally of the ribs or thickened portions 21 and the latter extend only far enough circumferentially to provide adequate bearing for the riveted or headed portion 19. The thickened portions 21 provide for tenon openings 18 having conical chamfered portions 23. Heading or riveting of the tenons results in expansion of the latter to form conical or tapered portions 24 fitting the chamfers.

By restricting the circumferential width or extent of the thickened portion or rib to the transverse zone of the tenon head, each portion of the tie band rigidly connected to a blade is correspondingly reduced in a circumferential direction and, therefore, the bending moment and the stress in the shroud band are kept at a minimum. The relatively thinner spanning portions 22 afford adequate flexibility so that the tie band may accommodate itself to deflection of the blades due to centrifugal and vibratory effects. Fur-

thermore, as the flexible portions 22 are clear of contiguous outer corners of the shroud elements, assembly is facilitated and initial shroud band stresses are avoided if these corners do not aline circumferentially, as is very likely to be the case because of inevitable small variations in blade manufacture. In addition, bending forces tending to loosen the riveted connection between the tenons and the tie bands, or tending to break the tenons, are reduced.

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, and it is desired, therefore, that only such limitations shall be placed thereupon as are specifically set forth in the appended claims.

What is claimed is:

1. In an elastic-fluid turbine, a row of blades; each blade having a shroud element and a tenon extending outwardly from the latter and the shroud elements being disposed circumferentially in end-to-end relation; and means for connecting the blades in groups comprising a plurality of tie bands having openings through which all of the tenons extend and the latter having riveted or headed portions for fastening the tie bands to the blades; each tie band having transversely-extending thickened portions through which the tenon openings extend and which are joined by thinner and more flexible portions spaced from and extending over adjacent contiguous ends of the shroud elements and each thickened portion having its tenon opening formed with an outer conical or chamfered portion and the cooperating tenon having a conical portion for said outer portion.

2. The combination as claimed in claim 1, wherein the thickened portions are provided by internal ribs formed on the tie bands.

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