

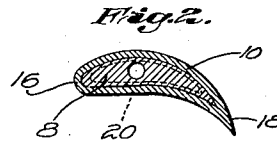
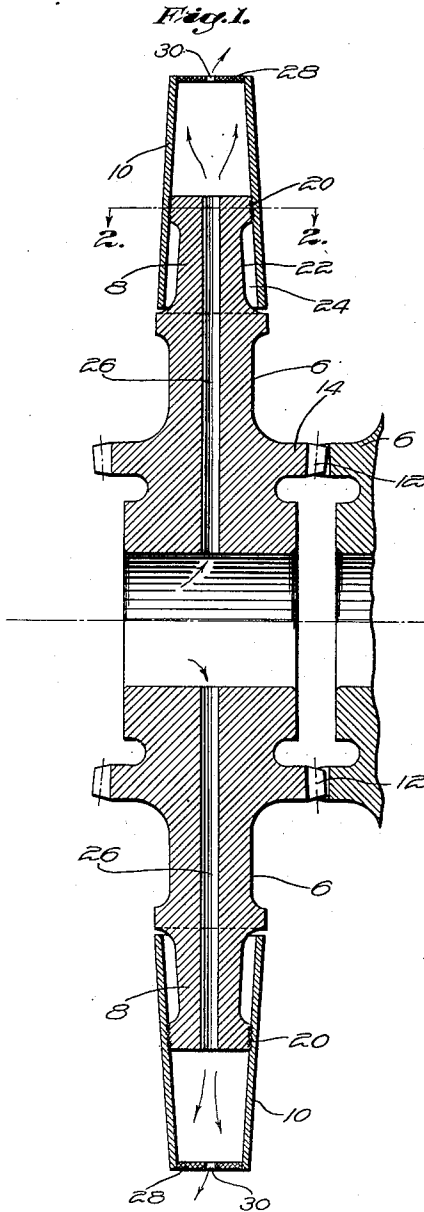
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TURBINE BLADE MOUNTING

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TURBINE BLADE MOUNTING

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The present invention relates to a turbine rotor construction and particularly to an arrangement for fastening a hollow, relatively thin blade to the rotor.

In the gas turbine field, the efficiency of the turbine increases rapidly with increases in temperature, but the maximum allowable temperature is limited by the temperature at which the rotor can operate without losing the blades by reason of the rapidly decreasing strength of the materials of the turbine as the temperature increases. An attempt to increase the safe operating temperature has been made by using hollow blades, but such blades have been difficult to mount satisfactorily on the rotor. A feature of this invention is a hollow blade supported by a substantially radially extending post which extends within and engages the hollow blade at a point spaced from the inner end of the blade, thereby reducing the tensile stresses in the blade resulting from the centrifugal force as the turbine rotates. Another feature of the invention is an arrangement for cooling the supporting post and also the hollow blade material.

At the high operating temperatures in the turbine, the thermal expansions in parts of the turbine become relatively large and the turbine must be designed to permit such expansions to take place without overstressing the members. A feature of this invention is an arrangement for mounting the hollow turbine blade so that it is free to expand radially and also in an axial direction independently of the supporting structure. Another feature is the support of the turbine blade between its ends by radial supporting posts positioned within but spaced from the blade except at the point of attachment.

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 section view of a turbine disc showing the method of mounting the turbine blade.

Fig. 2 is a sectional view along the line 2—2.

The turbine rotor, which may be adapted for a turbine with one or more turbine stages, includes a disc 6 having a number of radially extending posts 8 on its periphery with a hollow blade 10 mounted over each post. Each disc 6 may be aligned with the adjoining discs by means of face splines 12 on cylindrical flanges 14 on the sides of the discs. Each blade 10 is made of a heat-resistant material of substantially uniform thickness throughout. As shown in Fig. 2, the blade has substantially an airfoil shape having a

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rounded leading edge 16 and a pointed trailing edge 18.

The post 8 extends a substantial distance radially within the blade and adjacent its end is attached, as by a weld 20, to the blade. Between the weld and the inner end of the blade, the post is reduced in section as at 22 so that the surface of the post will be spaced from and out of contact with the blade to permit radial expansion of the blade without contact with the post, and to form an insulating space 24 to reduce the rate of heat transfer from the blade to the post. Since the weld 20 is spaced substantially from the inner end of the blade, the portion of the blade inwardly of the weld is not subjected to tensile stresses when the rotor is spinning and the only part of the blade under a substantial tensile load resulting from centrifugal force is that part of the blade between the weld 20 and the outer end of the blade. In this way the tensile stresses on the blade are substantially reduced as compared to a blade attached to the rotor at its inner end.

To prevent the overheating of the post 8, the disc 6 may have a number of radially extending passages 26, one of which extends substantially centrally through each post, as shown in Fig. 2, for the purpose of allowing a circulation of cooling air from within the rotor through the passage and into the part of the blade outwardly of the weld 20. In this way cooling air functions to cool the post and also to reduce the temperature of the part of the blade which is under tension. The outer end of the blade may be closed by a cap 28 having a small passage 30 for the escape of the cooling air.

By reason of the particular mounting of the blade at only one point radially of the blade, it will be apparent that the outer part of the blade is free to expand radially outwardly from the weld of the blade, and the inner part of the blade is free to expand radially inwardly from the weld, thereby reducing any thermal stresses that would result if the expansion of the blade were restricted. The blade is also free to expand at right angles to a radial line through the blade at all points except at the weld 20. Furthermore, the thin blade material will heat through rapidly as the turbine is started, thereby further reducing the thermal stresses in the blade.

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 turbine rotor, a disc having a number of radially-extending blade-supporting posts and a hollow blade positioned over and attached to each post, each of said blades being longer than the post, each blade being positively secured to the associated post adjacent its end and at a point on the blade spaced from the ends of the blade, the cross-sectional area of the post, between the point of attachment and the inner end of the blade, being maintained in such a manner as to be out of contact with the blade, and means for delivering cooling air through the post and into the blade between the end of the post and the outer end of the blade.

2. In a turbine rotor, a disc having a number of radially-extending blade-supporting posts and a hollow blade positioned over and attached to each post, each of said blades being longer than the post, each blade being positively secured to the associated post adjacent its end and at a point on the blade spaced from the ends of the blade, the cross-sectional area of the post, between the point of attachment and the inner end of the blade, being maintained in such a manner as to be out of contact with the blade, and means for delivering cooling air through the post and into the blade between the end of the post and the outer end of the blade, the outer

end of the blade having a cap for closing the end, said cap having a small hole for the escape of cooling air.

3. In a turbine rotor, a disc having a number of radially-extending blade-supporting posts and a hollow blade positioned over and attached to each post, each of said blades being longer than the post, each blade being positively secured to the associated post at a point adjacent the end of the post and at a point on the blade spaced from the ends of the blade, the cross-sectional area of the post, between the point of attachment and the inner end of the blade, being maintained in such a manner as to be out of contact with the blade whereby the blade is supported at one radial position only with the remainder of the blade out of contact with the post and free to move radially of the disc relative to the post.

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