A vaned rotor of the type comprising a central metal hub or rotor body carrying a plurality of rotor blades made of a ceramic material, in which the blades are simply located on the rotor body and held in place by a coil of carbon fibres or ceramic fibres which surrounds the blades. To form a support surface for the coil each blade has a transverse part at the radially outer end thereof, which is partly cylindrical and which together with the transverse parts of the other blades, forms a substantially cylindrical support surface for the coil.

6 Claims, 2 Drawing Figures
VANED ROTOR FOR GAS TURBINES

This invention relates to vaned rotors for gas turbines, and particularly to rotors of the type having a metal body and a number of ceramic vanes attached at the root thereof to the rotor body. Such rotors are particularly suited to operate in gases at a very high temperature.

Although ceramic materials used for such vanes (silicon nitride, silicon carbide, alumina, etc.) have much better physical properties at high temperatures (i.e., over 1,100°C) than any metal alloy, especially if undergoing compression loads, they are nevertheless very difficult to couple to metal parts because of their relative fragility, lack of ductility, and their low coefficient of expansion.

Because of the lack of ductility of ceramic materials, the driving forces exerted during operation of the rotor give rise to a concentration of the load in parts of the coupling areas between the ceramic vanes and the metal body of the rotor. This frequently causes breakages in these parts. The various systems presently in use for attaching a ceramic blade by the root to a metal rotor body for a gas turbine are generally inadequate because these systems, including dovetail fixings having both straight and curved sides, do not take sufficient account of the rigidity and relative fragility of the ceramic vanes.

This problem is exacerbated by the fact that present manufacturing techniques for ceramic materials are still not able to provide a complete homogeneity of composition and structure of the material, so that adjacent areas of ceramic material can vary by up to 200% in tensile strength. For this reason the known types of coupling between a support disc forming a rotor body and rotor vanes of ceramic material, which rely on a wedging action, are not satisfactory.

The present invention seeks to provide a vaned rotor for a gas turbine, of the type having a metal rotor body and ceramic vanes, in which the above mentioned inconveniences are overcome.

According to the present invention, there is provided a vaned rotor for a gas turbine, of the type comprising a rotor having a metal rotor body and a plurality of ceramic vanes attached to the periphery of the metal body, in which each vane has a transverse part at the radially outer end thereof, the said transverse parts of the vanes together forming a support surface around which is wound a coil of substantially inextensible filaments, the coil acting to absorb the radial forces exerted on the vanes of the rotor during use.

One embodiment of the invention will now be more particularly described, by way of example only, with reference to the accompanying drawings, in which:

FIG. 1 is a view in axial section of part of a rotor for a gas turbine, formed as an embodiment of this invention; and

FIG. 2 is a partial face view of the rotor illustrated in FIG. 1.

Referring now to the drawings there is shown a metal body 10 in the shape of a disc having a central hub. The periphery 12 of the disc 10 has a number of grooves 20 which extend parallel to the axis of the disc, in which the roots 16 of a number of vanes 18 are located. The shape of the grooves 20 is not important as far as this invention is concerned and can be any suitable shape instead of that shown; for example they could have a part circular profile, or have a truncated V-shape. The grooves 20 are provided to ensure the correct relative positioning of the vanes 18 and to transmit from the vanes 18 to the disc 10 the tangential forces due to the action of the gas on the aerodynamically profiled surfaces of the vanes. The axial location of the vanes 18 is determined by a second, deeper, series of grooves 14, which are orthogonal to the grooves 20.

The vanes 18 are made of a ceramic material and at the radially outer end each has a transverse portion 22, formed as a part-cylindrical surface coaxial with the disc 10. Each transverse portion 22 is integral with the vane 18 on which it is formed, and is provided with axially spaced, circumferentially extending lateral shoulders or borders 24 and 26. The combined transverse portions 22 of all the vanes 18 forms an effectively continuous cylindrical surface around which is wound a coil 28 formed by filaments of ceramic fibres or carbon fibres having a high modulus of elasticity. The coil of filaments acts to hold the vanes 18 on the disc 10 and to maintain them in position during operation of the turbine without relying on any form of coupling at the roots of the vanes. The particular feature of ceramic or carbon fibres with a high modulus of elasticity is their very high tensile strength and this is exploited in the construction of the present invention. The forces applied to the vanes are therefore, for the most part, compression forces, and only minimum flexure of the vanes can take place as the tangential forces derived from the action of the gas are very small.

If the fibres used are sensitive to oxidation they can be protected, during winding of the coil onto the cylindrical surface formed by the transverse parts of the vanes, with a thin layer of liquid ceramic, which after baking will encapsulate the fibres isolating them from the oxidising agents; alternatively metalization before or after the winding operation may be effected.

Claim:

1. In a vaned rotor for a gas turbine, of the type comprising:
   - a rotor having a metal rotor body,
   - a plurality of ceramic vanes, and
   - means for locating the vanes on the periphery of the metal body,
   - the improvement wherein,
   - each vane has a transverse part at the radially outer end thereof, said transverse parts of said vanes together forming a support surface, and
   - a coil of substantially inextensible filaments, wound around said support surface, said coil acting to absorb all the radial forces exerted on said vanes of said rotor during use.

2. The vaned rotor of claim 1, wherein said coil wound on said support surface formed by said transverse parts of said vanes, comprises a plurality of filaments of a material with a high modulus of elasticity.

3. The vaned rotor of claim 2, wherein said filaments are fibres of a ceramic material.

4. The vaned rotor of claim 2, wherein said filaments are carbon fibres.

5. The vaned rotor of claim 1, wherein the radially outer surface of said transverse parts of each said vane is a partly cylindrical surface, said partly cylindrical surfaces together forming a substantially continuous cylindrical support surface, two lateral shoulders on said radially outer surface of each said transverse part, said shoulders being axially spaced and extending sub-
stantially circumferentially of said cylindrical surface, to define therebetween a circumferential channel for said fibres.

6. The vaned rotor of claim 1 wherein said means for locating the vanes on the periphery of the metal body comprise a plurality of grooves in the circumference of said rotor body extending parallel to the axis of rotation of said body and a circumferential groove deeper than said plurality of grooves and intercepting said grooves.