

Description

BACKGROUND

[0001] This application relates to a rotor that is provided with a stiffening element.

[0002] Gas turbine engines are known, and typically include a fan delivering air into a compressor section. The air is compressed in the compressor section and delivered downstream into a combustion section where it is mixed with fuel and ignited. Products of this combustion pass downstream over turbine rotors, driving the turbine rotors to rotate. The turbine rotors in turn rotate the fan and compressor sections.

[0003] Typically the compressor sections are formed of a plurality of rotor stages, with each of the rotor stages carrying compressor blades. The compressor rotors may have removal blades, or may be formed integrally with their blades.

[0004] The compressor rotors and blades are subject to a number of stresses, and must have sufficient stiffness to address those stresses.

[0005] Typically, to provide required stiffness, the prior art has made the rotors thicker. Often, the rotors are formed of titanium. The use of the additional thickness to provide additional stiffness increases the weight and expense of the rotor.

SUMMARY

[0006] An embodiment provides a rotor, including a hub at a radially outer location, with a leg extending from an inner ring at a radially inner location to the hub. The hub has an inner bore at a location spaced from the leg. A stiffening ring is forced to fit into the inner bore of the hub.

[0007] In a particular embodiment, the leg extends from the inner ring to the hub in a direction having an axial component and a radial component such that its axial component extends along the direction that will be downstream when the rotor is mounted in a gas turbine engine. The stiffening ring is positioned in the inner bore at a location that will be upstream of the location where the leg connects into the hub but when the rotor is mounted in a gas turbine engine.

[0008] In another embodiment of either of the foregoing embodiments, an axial location of the stiffening ring is such that a plane defined perpendicularly to a central axis of the rotor and passing through the stiffening ring, will also pass through a portion of the leg.

[0009] In another embodiment of any of the foregoing embodiments, the stiffening ring is formed of a distinct material from the hub. The hub material may contain titanium and the stiffening ring may be formed of nickel. Alternatively the hub material may contain titanium and the stiffening ring may be formed of aluminum.

[0010] In yet another embodiment of any of the foregoing embodiments, the inner bore has a surface which

receives the stiffening ring, and a ledge extends radially inwardly of a portion of the inner bore to provide a stop for the stiffening ring. The ledge may have a radially innermost extent, with the stiffening ring extending radially inwardly of the radially innermost extent of the ledge.

[0011] The rotor may be a compressor rotor.

[0012] In yet another embodiment, a gas turbine engine includes a compressor section, a combustor section and a turbine section, with the turbine section driving a shaft to drive the compressor section. The compressor section and the turbine section include at least one rotor. The rotor of at least one of the compressor and turbine sections includes a hub at a radially outer location and a leg extending to an inner ring at a radially inner location.

The hub has an inner bore at a location spaced from the leg, and a stiffening ring is force-fit into the inner bore.

[0013] These and other features can be best understood from the following specification and drawings, the following of which is a brief description.

BRIEF DESCRIPTION OF THE DRAWINGS

[0014]

Figure 1 shows a schematic view of a gas turbine engine.

Figure 2A is a cross-sectional view through a compressor rotor.

Figure 2B is a view along line 2B-2B of Figure 2A, extended for 360°.

DETAILED DESCRIPTION

[0015] A gas turbine engine 10, such as a turbofan gas turbine engine, circumferentially disposed about an engine centerline 11, is shown in Figure 1. The engine 10 includes a fan 18, a compressor 12, a combustion section 14 and turbine sections 16. As is well known in the art, air compressed in the compressor 12 is mixed with fuel which is burned in the combustion section 14 and expanded across turbine sections 16. The turbine sections 16 include rotors that rotate in response to the expansion, driving the compressor 12 and fan 18. A compressor rotor 24 is shown schematically, and would typically have a rotor and blade. The blades may or may not be removable. This structure is shown somewhat schematically in Figure 1. While one example gas turbine engine is illustrated, it should be understood this invention extends to any other type gas turbine engine for any application. As one example, the gas turbine engine could have a third spool. A compressor stage 40 is illustrated in Figure 2A. The compressor stage 40 carries a number of blades 42 in a rotor 44. While the drawings illustrate a removable blade, the teachings of this application would extend to integrally bladed rotors also. As shown, the rotor 44 extends to a radially inner base 46 which is mounted on a shaft 47. As known, the shaft is driven by a turbine section. From the base 46, a leg 48 extends in a downstream

direction to an outer hub 144 which actually mounts the blades 42. The leg 48 extends from inner ring 46 to hub 144 in a direction having an axial component and a radial component, such that its axial component extends along a direction that will be downstream when the compressor rotor is mounted in a gas turbine engine. An inner bore 50 of the rotor 44, which is axially aligned with portions of the leg 48 is subject to a number of stresses, and must have sufficient stiffness.

[0016] To provide additional stiffness, a ring 56 is force fit into an inner bore or internal surface 52. In this embodiment, an axial end of the ring 56 abuts a ledge 54 on the hub 144. As shown, a radially inner end 58 of the ledge is spaced radially outwardly of a radially inner end 60 of the ring 56.

[0017] The stiffening ring 56 is positioned in inner bore 52 at a location that will be upstream of a location where leg 48 connects into hub 144 when the rotor is mounted in a gas turbine engine. An axial location of ring 56 is such that a plane defined perpendicularly to a central axis 11 of rotor 44 and passing through ring 56 would also pass through a portion of leg 48.

[0018] The ring 56 is selected to provide stiffening properties, and is typically formed of a distinct material from the rotor 44. On the other hand, in some embodiments, the stiffening ring may be formed of the same material as the rotor.

[0019] As one example, the rotor 44 may be formed of titanium or a titanium alloy, while the ring 56 may be formed of aluminum. An aluminum stiffening ring may be selected if bending stiffness is most important. In such a situation, thickness of the ring is more important than the material properties.

[0020] On the other hand, if hoop stiffness is desired, and design space is limited, nickel may be best suited for the stiffening ring.

[0021] The use of the force fit between the outer periphery of the ring and the inner periphery of the hub also provides preload which will increase the stiffness.

[0022] Figure 2B shows that both the ring 56 and the hub 44 extend 360° about a central axis 11. The size of the components is not dimensionally to scale in Figure 2B. Rather, Figure 2A is more representative of scale.

[0023] While this application discloses a compressor rotor, its teachings extend to other gas turbine engine rotors, such as a turbine rotor.

[0024] While an embodiment has been disclosed, a worker of ordinary skill in this art would recognize that certain modification would come within the scope of this invention. For that reason, the following claims should be studied to determine the true scope and content.

Claims

1. A rotor (44) comprising:

a hub (144) at a radially outer location, and a leg

(48) extending from an inner ring (46) at a radially inner location to said hub (144), said hub (144) having an inner bore (52) at a location spaced from said leg (48); and
a stiffening ring (56) force fit into said inner bore (52) of said hub (144).

2. The rotor as set forth in claim 1, wherein said leg (48) extends from said inner ring (46) to said hub (144) in a direction having an axial component and a radial component, such that its axial component extends along a direction that will be downstream when the rotor is mounted in a gas turbine engine, and said stiffening ring (56) positioned in said inner bore (52) at a location that will be upstream of a location where said leg (48) connects into said hub (144) when the rotor (44) is mounted in a gas turbine engine.

3. The rotor as set forth in claim 2, wherein an axial location of said stiffening ring (56) is such that a plane defined perpendicularly to a central axis of said rotor (44), and passing through said stiffening ring (56), also passes through a portion of said leg (48).

4. The rotor as set forth in any preceding claim, wherein said stiffening ring (56) is formed of a distinct material from a material forming said hub (144).

5. The rotor as set forth in claim 4, wherein said hub material contains titanium, and said stiffening ring (56) is formed of nickel.

6. The rotor as set forth in claim 4, wherein said hub material contains titanium, and said stiffening ring (56) is formed of aluminum.

7. The rotor as set forth in any preceding claim, wherein said inner bore (52) has a surface which receives said stiffening ring (56), and a ledge (54) extending radially inwardly of a portion of said inner bore (52) to provide a stop for said stiffening ring (56).

8. The rotor as set forth in claim 7, wherein said ledge (54) has a radially innermost extent, and said stiffening ring (56) extending radially inwardly of said radially innermost extent of said ledge (54).

9. The rotor as set forth in any preceding claim, wherein said rotor (44) is a compressor rotor.

10. A compressor section (12) for a gas turbine section comprising:

at least one rotor (44) as set forth in any preceding claim, said rotor (44) receiving a plurality of blades (42).

11. A gas turbine engine (10) compressing:

a compressor section (12), a combustor section (14) and a turbine section (16), said turbine section (16) driving a shaft to in turn drive said compressor section (12), said compressor section (12) and said turbine section (16) including at least one rotor (44); and
wherein said rotor (44) of at least one of said compressor and turbine sections is a rotor (44) as set forth in any of claims 1 to 9.

12. The engine as set forth in claim 11, wherein said at least one rotor (44) is in said compressor section (12).

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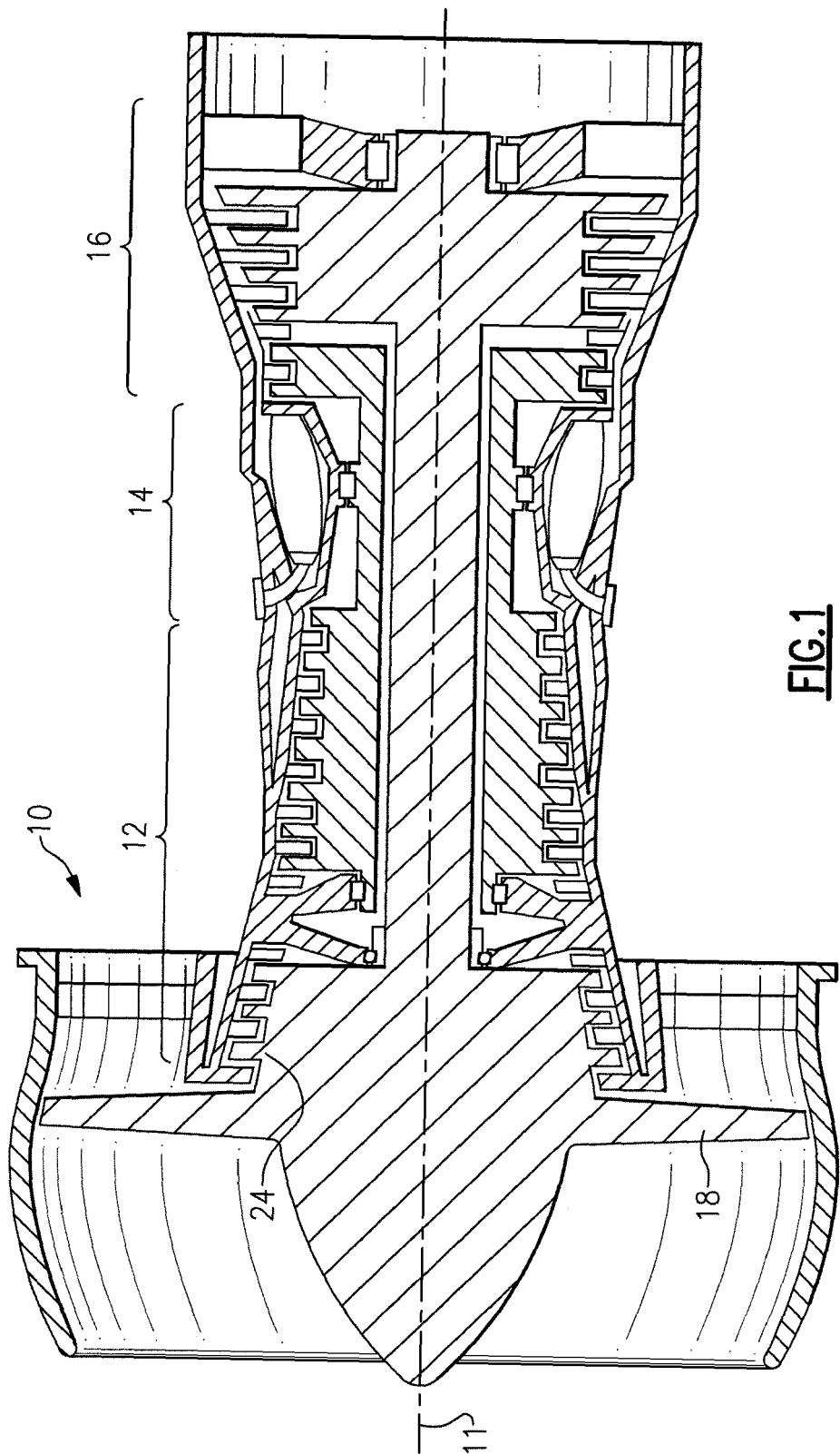


FIG. 1

