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(54) **TURBINE BLADE ASSEMBLY**

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(57) **ABSTRACT**

A blade assembly for a rotor includes an attachment section operably connectable to a rotor, and an airfoil section. At least one retainer extends in a substantially tangential direction at least partially through the airfoil section and the attachment section to secure the airfoil section to the attachment section. A method of assembling a rotor assembly includes inserting at least one retainer in a substantially tangential direction at least partially through an attachment section of a blade assembly and an airfoil section of the blade assembly, thereby securing the airfoil section to the attachment section. The blade assembly is then secured to a rotor.

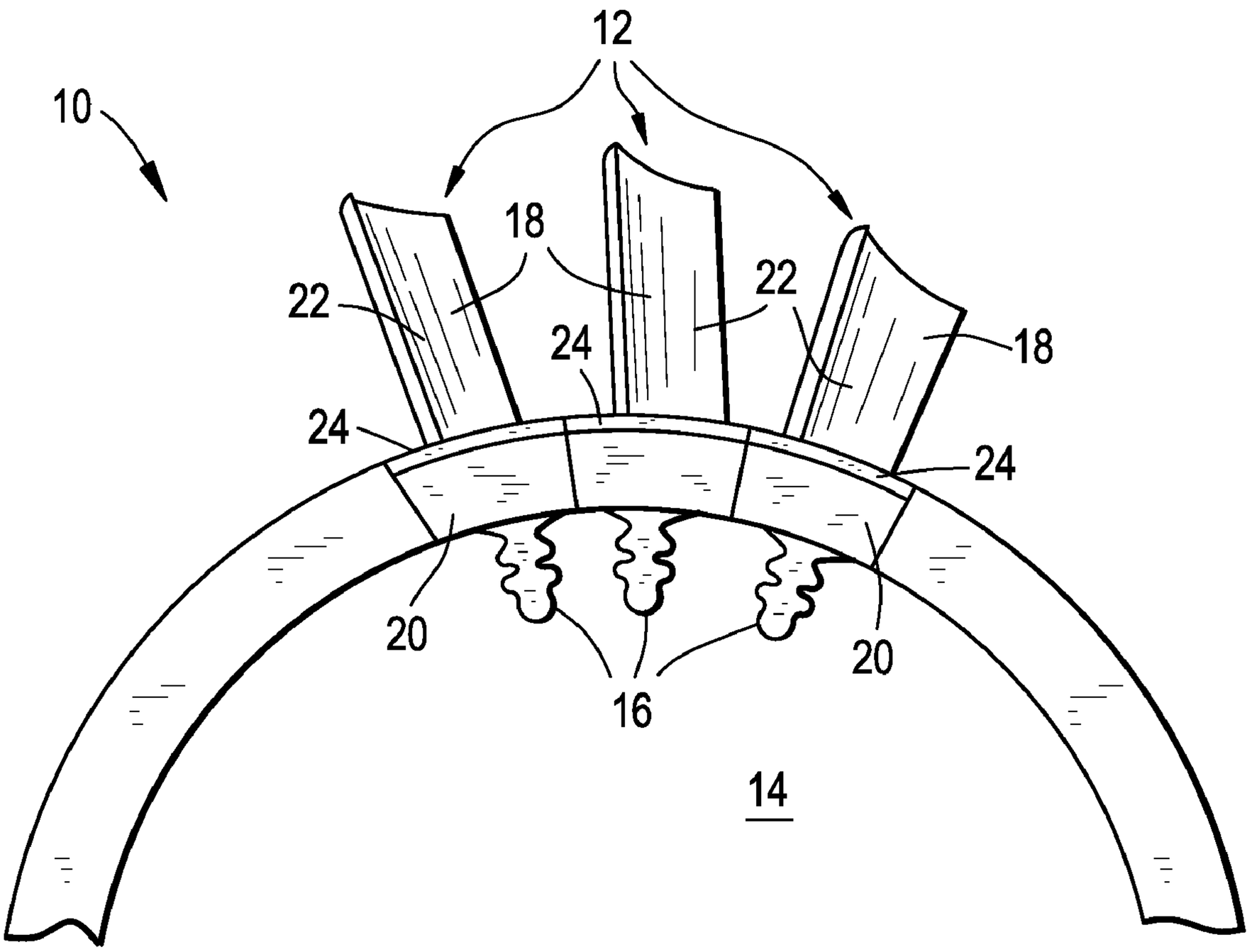


FIG. 1

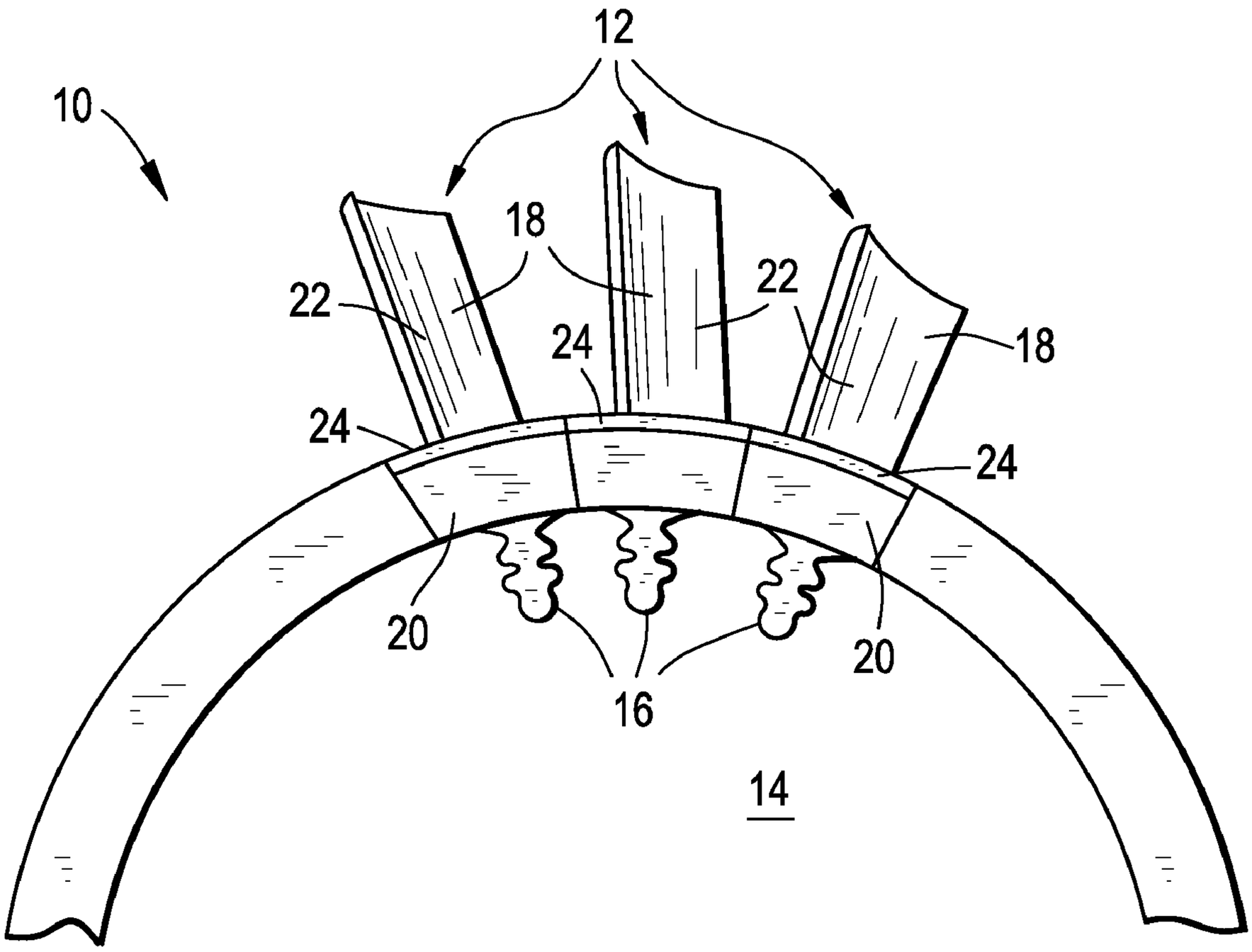


FIG. 2

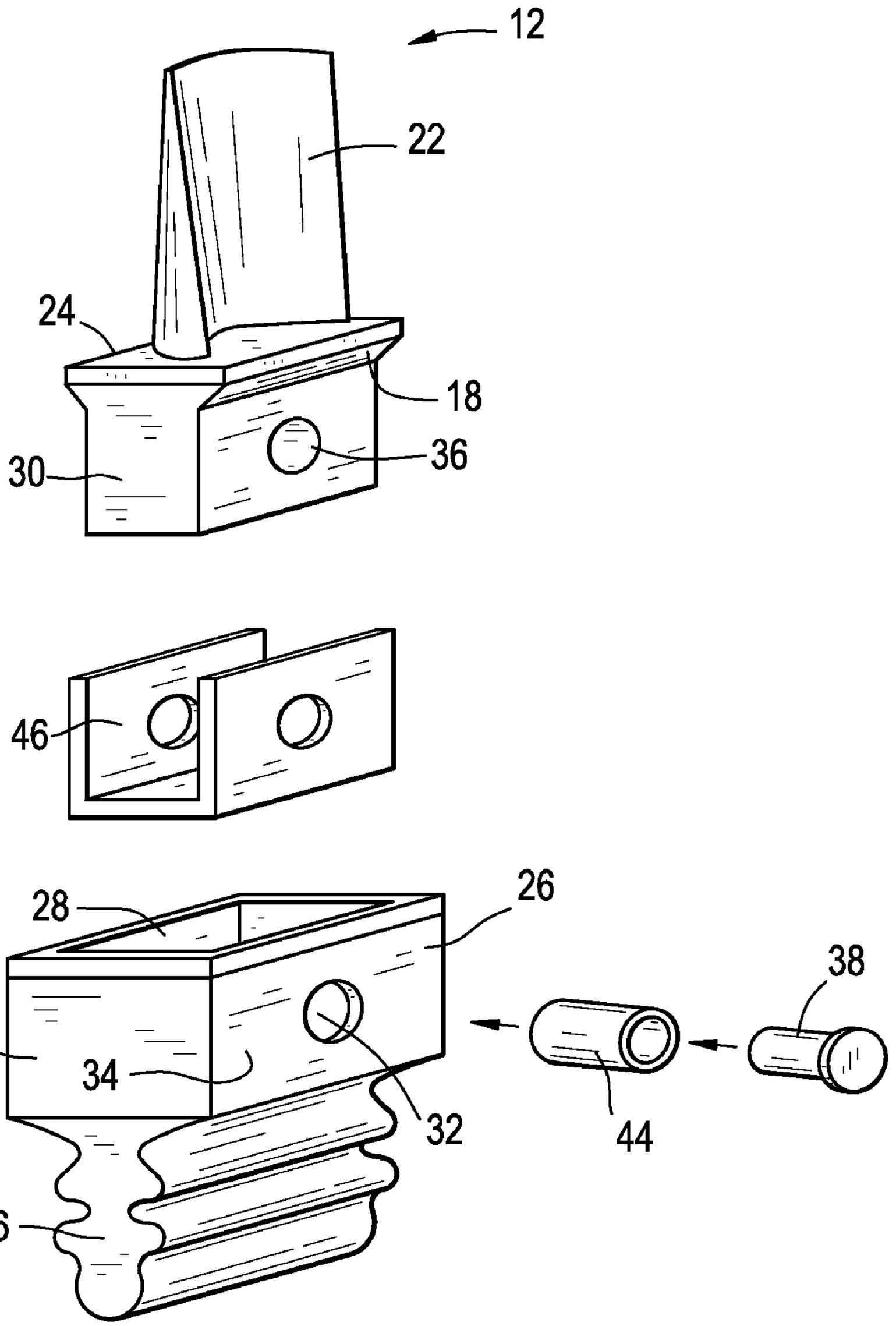
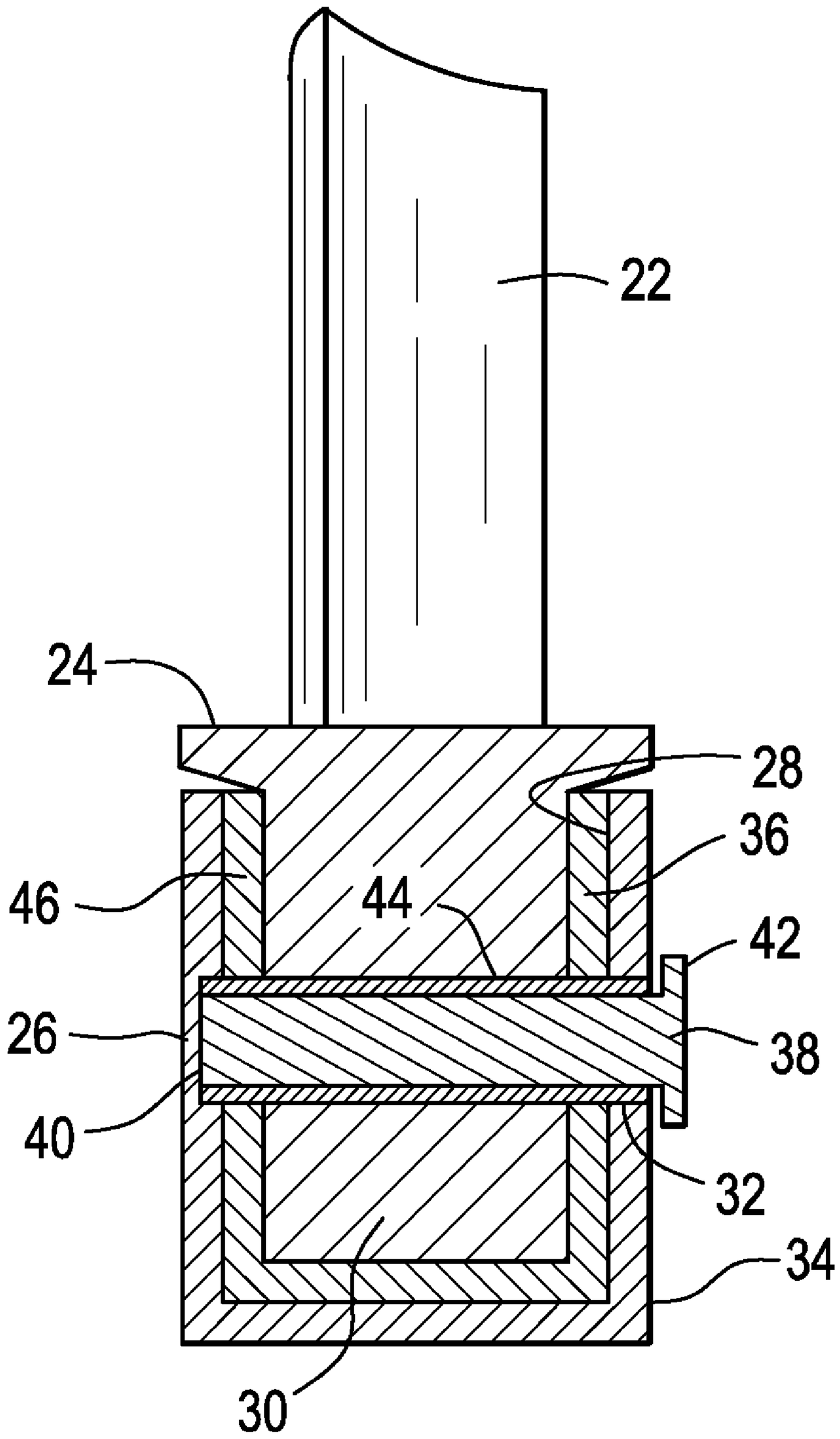


FIG. 3



TURBINE BLADE ASSEMBLY

[0001] The subject invention was conceived under United States Government contract DE-FC26-05NT42643-DOE. The Federal Government may have certain rights to this invention.

BACKGROUND OF THE INVENTION

[0002] The subject matter disclosed herein relates to turbomachines. More specifically, the subject disclosure relates to turbine blade assemblies for turbomachines.

[0003] Turbine assemblies include a number of blades secured to a rotor. In some turbines, it is desirable for the blade to include an airfoil portion and a platform portion into which the airfoil portion is inserted, often in order to allow the airfoil portion and the platform portion to be formed from different materials. The combined airfoil/platform blade assembly is secured to the rotor via, for example, a conventional dovetail attachment.

[0004] Blade assemblies where the airfoil portion and the platform portion are of differing materials having differing mechanical and thermal characteristics that introduce thermal matching problems as well as issues regarding the mechanical integrity of the assembly. In such assemblies the airfoil portions are typically secured to the platform portions also via dovetails, often in an axial direction. This introduces leakage paths through the turbomachine, for which additional sealing structures must be introduced to control the leakage. As such, the part count and therefore cost of the turbomachine increases. The art would well receive a turbine blade assembly that is cost effective and does not greatly negatively impact leakage through the turbomachine.

BRIEF DESCRIPTION OF THE INVENTION

[0005] According to one aspect of the invention, a blade assembly for a rotor includes an attachment section operably connectable to a rotor, and an airfoil section. At least one retainer extends in a substantially tangential direction at least partially through the airfoil section and the attachment section to secure the airfoil section to the attachment section.

[0006] According to another aspect of the invention, a method of assembling a rotor assembly includes inserting at least one retainer in a substantially tangential direction at least partially through an attachment section of a blade assembly and an airfoil section of the blade assembly, thereby securing the airfoil section to the attachment section. The blade assembly is then secured to a rotor.

[0007] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0009] FIG. **1** is a partial plan view of an embodiment of a rotor assembly;

[0010] FIG. **2** is an exploded view of an embodiment of a blade assembly for a rotor assembly; and

[0011] FIG. **3** is a cross-sectional view of an embodiment of a blade assembly for a rotor assembly.

[0012] The detailed description explains embodiments of the invention, together with advantages and features, by way of example with reference to the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Shown in FIG. **1** is an embodiment of a rotor assembly **10** for, for example, a turbine of a turbomachine. The rotor assembly **10** includes a plurality of blade assemblies **12** secured to a rotor **14** at a periphery of the rotor **14** via, for example, a plurality of dovetail attachments **16**.

[0014] Referring to the exploded view of FIG. **2**, a blade assembly **12** includes an airfoil section **18** and an attachment section **20**. The airfoil section **18** includes an airfoil **22** and, in some embodiments, a platform **24** which defines an annular flowpath of the rotor **14**. The airfoil section **18** may be formed from a variety of materials, which are well suited to the high temperature environment in which many rotors **14** operate. For example, the airfoil section **18** may be formed from a ceramic matrix composite (CMC), or a single crystal alloy. The attachment section **20** is formed separately from the airfoil section **18** and may be formed from a material different than that utilized in the airfoil section **18**. Since the environment of the attachment section **20** is not as high temperature as that of the airfoil section **18**, lower cost metallic materials such as nickel alloys may be used. The attachment section **20** includes an attachment feature to secure the blade assembly to the rotor **14**, which in some embodiments is the dovetail **16**.

[0015] The attachment section **20** includes a web portion **26**, which in some embodiments, extends in a substantially axial direction along the attachment section **20**. The web portion **26** includes a pocket **28** into which a tab **30** of the airfoil section **18** is inserted. The pocket **28** includes one or more pocket holes **32** through at least one wall of the pocket **28**. As shown in FIG. **2**, in some embodiments the pocket hole **32** extends through an axially-extending sidewall **34** of the pocket **28**. Although the embodiment of FIG. **2** includes one pocket hole **32**, it is to be appreciated that two or more pocket holes **32** may be included. The tab **30** includes at least one tab hole **36** extending therethrough and substantially aligned with the one or more pocket holes **32**. While the tab hole **36** and the pocket hole **32** shown in FIG. **2** are round, it is to be appreciated that the tab hole **36** and/or the pocket hole **32** may be other shapes, for example oval or angular.

[0016] One or more retainers, for example, blade pins **38** are included to secure the airfoil section **18** to the attachment section **20**. Each blade pin **38** extends tangentially through the pocket hole **32** and at least partially through the tab hole **36**. Referring now to FIG. **3**, the blade pin **38** extends through the pocket hole **32** at a first sidewall **34** of the pocket **28** and through the tab hole **36**. In this embodiment, a second sidewall **34** of the pocket is without a pocket hole **32** so that a tip **40** of the blade pin **38** does not pass entirely through the pocket **28**. To prevent the blade pin **38** from being inadvertently removed, when the adjacent blade assembly **12** is installed in the rotor **14**, the sidewall **34** of the adjacent blade assembly **12** may substantially abut a head **42** of the blade pin **38** to retain the blade pin **38** in the blade assembly **12**. In other embodiments, the blade pin may be retained in the blade assembly **12** via a process such as welding, or other retention means. Further, the blade pin **38** may be assembled to the blade assembly **12** via a press fit. Even though a blade pin **38** is utilized in the illustrated embodiment of FIG. **3**, it is to be

appreciated that other means for securing the airfoil section **18** to the attachment section **20**, including mechanical threaded fasteners, wedges, welding, and/or adhesives.

[0017] Referring again to FIG. **2**, in some embodiments, the blade assembly **12** includes a bushing **44** installed into the pocket holes **32** and tab holes **36** prior to installing the blade pin **38**. Use of the bushing **44** reduces hertz stresses on the blade assembly **12** in the area of the blade pin **38**. As shown in FIGS. **2** and **3**, a sleeve **46**, comprising for example, a relatively soft material, is disposed between the tab **30** and the pocket **28**. The sleeve **46** is utilized to reduce stresses and wear on the tab **30** and the pocket **28** at the interfaces between the tab **30** and the pocket **28**.

[0018] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

1. A blade assembly for a rotor comprising:
an attachment section operably connectable to a rotor;
an airfoil section; and
at least one retainer extending in a substantially tangential direction at least partially through the airfoil section and the attachment section to secure the airfoil section to the attachment section.

2. The blade assembly of claim **1**, wherein the at least one retainer is at least one pin.

3. The blade assembly of claim **2**, wherein the at least one pin is secured in the blade assembly via welding.

4. The blade assembly of claim **1**, wherein the attachment section comprises a pocket into which the airfoil section is inserted.

5. The blade assembly of claim **4**, wherein the pocket includes at least one pocket hole into which the at least one retainer is inserted.

6. The blade assembly of claim **5**, wherein the at least one pocket hole is disposed at one tangential surface of the pocket.

7. The blade assembly of claim **1**, further comprising a bushing disposed between the retainer and the airfoil section.

8. The blade assembly of claim **1**, further comprising a sleeve disposed between the airfoil section and the attachment section.

9. The blade assembly of claim **1**, wherein the airfoil section and the attachment section are formed of different materials.

10. The blade assembly of claim **1** wherein the airfoil section is formed of a ceramic matrix composite and/or a single crystal alloy.

11. The blade assembly of claim **1**, wherein the attachment section is formed of a nickel alloy.

12. The blade assembly of claim **1**, wherein the attachment section is operably connectable to the rotor via an axially-extending dovetail.

13. A method of assembling a rotor assembly comprising:
inserting at least one retainer in a substantially tangential direction at least partially through an attachment section of a blade assembly and an airfoil section of the blade assembly, thereby securing the airfoil section to the attachment section; and
securing the blade assembly to a rotor.

14. The method of claim **13**, further comprising inserting the airfoil section into a pocket of the attachment section.

15. The method of claim **13**, further comprising disposing a bushing between the at least one retainer and the airfoil section.

16. The method of claim **13**, further comprising disposing a sleeve between the airfoil section and the attachment section.

17. The method of claim **13**, wherein the at least one retainer is at least one pin.

18. The method of claim **17**, further comprising securing the at least one pin in the blade assembly via welding.

19. The method of claim **13**, further comprising securing additional blade assemblies to the rotor.

20. The method of claim **19**, further comprising retaining the at least one retainer in the blade assembly via contact of the at least one retainer with an adjacent blade assembly.

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