AXIAL RETENTION DEVICE FOR TURBINE SYSTEM

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ABSTRACT

An axial retention device for a turbine system is disclosed. The axial retention device includes a pocket defined in a mating surface of one of a turbine component and a support structure. The pocket includes a first axial load surface. The axial retention device further includes a latch comprising a base member and a pivotal member. The base member is associated with a mating surface of the other of the turbine component and the support structure. The pivotal member is configured to engage the pocket and includes a first mating axial load surface. Engagement of the pivotal member and the pocket allows the first axial load surface and the first mating axial load surface to interact, preventing axial movement of the turbine component with respect to the support structure in the at least one direction.
AXIAL RETENTION DEVICE FOR TURBINE SYSTEM

FIELD OF THE INVENTION

[0001] The subject matter disclosed herein relates generally to turbine systems, and more particularly to axial retention devices for retaining components within turbine systems.

BACKGROUND OF THE INVENTION

[0002] Turbine systems are widely utilized in fields such as power generation. For example, a conventional gas turbine system includes a compressor, a combustor, and a turbine. Further, a conventional gas turbine includes a rotor with various components, such as a turbine blade and a rotor disk.

[0003] Many times, the blades disposed in the rotor disks may shift, slide, or become disengaged with respect to the rotor disks during operation of the system, which potentially allows air or fluid flow leakage or other damage to the system. Thus, devices for retaining the blades with respect to the rotor disks may be desired.

[0004] One prior art method for axially retaining blades in rotor disks involves staking. Staking creates an interference fit between two components, such as between a blade and a rotor disk. The blade and rotor disk are connected, and the apparatus connecting the blade and rotor disk is deformed to create the interference fit. However, the use of staking for retaining blades in rotor disks has many disadvantages. For example, blades must be replaced after certain periods of use due to, for example, wear or damage. Each time a blade is replaced, the blade must be staked to the rotor disk at a different location. Utilizing staking to retain a replacement blade in the rotor disk is a time-consuming process.

[0005] Thus, an improved retention device for retaining blades and other suitable components in a rotor disk and other suitable support structures would be desirable. For example, an axial retention device that prevents axial movement of blades and other components with respect to the rotor disks and other support structures would be advantageous. Further, a retention device that provides for efficient and cost-effective replacement of the blades and other components, and that reduces or eliminates the need to replace the rotor disks and other support structures, would be desired.

BRIEF DESCRIPTION OF THE DRAWINGS

[0009] A full and enabling disclosure of the present invention, including the best mode thereof, directed to one of ordinary skill in the art, is set forth in the specification, which makes reference to the appended figures, in which:

[0010] FIG. 1 is a schematic illustration of a turbine system;

[0011] FIG. 2 is a sectional side view of the compressor of a turbine system according to one embodiment of the present disclosure;

[0012] FIG. 3 is an exploded perspective view of a support structure and turbine component according to one embodiment of the present disclosure;

[0013] FIG. 4 is an exploded cross-sectional view of an axial retention device according to one embodiment of the present disclosure;

[0014] FIG. 5 is a cross-sectional view of an axial retention device in a first position during assembly according to one embodiment of the present disclosure;

[0015] FIG. 6 is a cross-sectional view of an axial retention device in a second position according to one embodiment of the present disclosure; and

[0016] FIG. 7 is a cross-sectional view of an axial retention device in a first position during disassembly according to one embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0017] Reference now will be made in detail to embodiments of the invention, one or more examples of which are illustrated in the drawings. Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that various modifications and variations can be made in the present invention without departing from the scope or spirit of the invention. For instance, features illustrated or described as part of one embodiment can be used with another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0018] FIG. 1 is a schematic diagram of a turbine system. While the turbine system described herein may generally be a gas turbine system, it should be understood that the turbine system of the present disclosure is not limited to gas turbine systems, and that any suitable turbine system, including but not limited to a steam turbine system, is within the scope and spirit of the present disclosure.
Thus, the system may include a compressor 12, a combustor 14, and a turbine 16. The compressor 12 and turbine 16 may be coupled by a shaft 18. The shaft 18 may be a single shaft or a plurality of shaft segments coupled together to form shaft 18.

Various components of the compressor 12 of a turbine system 10 are shown in FIG. 2. For example, a rotor 20 of the compressor 12 may include a plurality of rotor disks 22. A plurality of blades 24 may be disposed in an annular array about each rotor disk 22, and may be attached to the rotor disk 22 as discussed below. As discussed below, each of the blades 24 may be attached to a rotor disk 22 by sliding the blade 24 in a generally axial direction such that an appendage of the blade 24 engages a cavity of the rotor disk 22. For the blade 24 to be securely attached to the rotor disk 22, and to prevent axial movement of the blade 24 with respect to the rotor disk 22, an axial retention device may be provided to prevent such axial movement.

It should be understood, however, that the present disclosure is not limited to axial retention devices for blades 24 in rotor disks 22 in the compressor 12 of a turbine system 10. Rather, the axial retention device according to the present disclosure may be utilized in conjunction with any suitable support structure 32 to retain any suitable turbine component 34 in any section of the turbine system 10. The support structure 32 and turbine component 34 may, in exemplary embodiments, be a rotor disk 22 and blade 24, respectively, in the compressor 12. Alternatively, however, the support structure 32 and turbine component 34 may be a rotor disk and blade in the turbine 16, or a sealing device and spacer rim structure in the compressor 12 or turbine 16, or any other suitable support structure 32 and turbine component 34 in the turbine system 10.

As shown in FIG. 3, the turbine components 34 and support structures 32 may include mating appendages 40 and cavities 42 for mating the turbine components 34 and support structures 32 together. For example, in some embodiments, the appendages 40 may be dovetails, and the cavities 42 may be shaped and sized to receive the dovetails therein. Generally, the turbine components 34 are mated to the support structures 32 by sliding the appendages 40 into the cavities 42 along a generally axial axis 44, as shown in FIG. 3. Mating of the appendages 40 in the cavities 42 prevents movement of the turbine components 34 with respect to the support structures 32 in the generally radial and tangential directions, but may not prevent movement of the turbine components 34 with respect to the support structures 32 in a generally axial direction. For example, when the appendages 40 are mated with the cavities 42, the appendages are free to move along the axial axis 44 in direction 46 or direction 48.

Thus as shown in FIGS. 3 through 7, an axial retention device 50 is provided for axially retaining a turbine component 34 in a support structure 32. The axial retention device 50 includes a pocket 52 and a latch 54. The latch 54 according to the present disclosure includes a base member 56 and a pivoting member 58. In general, the pocket 52 may be defined in one of the turbine component 34 and the support structure 32, and the base member 56 may be associated with the other of the turbine component 34 and the support structure 32. For example, in exemplary embodiments as illustrated in FIGS. 3 through 7, the pocket 52 may be associated with the support structure 32 and the base member 56 may be defined in the turbine component 34. In alternative embodiments, the pocket 52 may be associated with the turbine component 34 and the base member 56 may be defined in the support structure 32.

The turbine component 34 may define a mating surface 62, and the support structure 32 may define a mating surface 64. The mating surfaces 62, 64 may be defined on the appendage 40 and in the cavity 42, respectively, as shown in FIGS. 3 through 7. For example, in exemplary embodiments, the mating surface 62 of the turbine component 34 may be the bottom surface of the appendage 40, and the mating surface 64 of the support structure 32 may be the surface within the cavity 42 configured to mate with the bottom surface of the appendage 40. In alternative embodiments, the mating surface 62 may be any side or other surface of the appendage 40, and the mating surface 64 may be the surface within the cavity 42 configured to mate with that surface of the appendage 40. In further alternative embodiments, the mating surfaces 62, 64 may be defined adjacent the appendage 40 and cavity 42. For example, the mating surface 64 may be the rim of the support structure 32, and the mating surface 62 of the turbine component 34 may be the surface configured to mate with that surface of the support structure 32. The mating surfaces 62, 64, generally mate together when the turbine component 34 and support structure 32 are mated together. The pocket 52 may be defined in the mating surface 62 or 64 of the turbine component 34 or support structure 32, and the base member 56 may be associated with the other of the mating surface 62 or 64 of the turbine component 34 or support structure 32. For example, in exemplary embodiments as shown in FIGS. 3 through 7, the pocket 52 may be defined in the mating surface 64 of the support structure 32 and the base member 56 may be associated with the mating surface 62 of the turbine component 34.

As discussed, the base member 56 may be associated with the mating surface 62 or 64. In some embodiments, the base member 56 may be, for example, mounted to the mating surface 62 or 64. In these embodiments, the base member 56 may be mounted utilizing, for example, a suitable adhesive, mechanical fastener, or other suitable mounting device or method. In other embodiments, the base member 56, or a portion thereof, may be integral with the mating surface 62 or 64. In other exemplary embodiments, as shown in FIGS. 3 through 7, the mating surface 62 or 64 that is associated with the base member 56 may define a second pocket 72 therein. The base member 56 may be configured to engage the second pocket 72. In general, engagement of the base member 56 and the second pocket 72 prevents axial movement along the axial axis 44 of the base member 56 with respect to the second pocket 72 in at least one direction. For example, as shown, the base member 56 may be disposed in the second pocket 72. In some embodiments, the base member 56 may be mounted in the second pocket 72 utilizing, for example, a suitable adhesive, mechanical fastener, or other suitable mounting device or method, and thus may engage the second pocket 72. In other exemplary embodiments, the base member 56 may not be mounted or otherwise attached to the second pocket 72, and may simply be positioned in the second pocket 72. In these embodiments, the second pocket 72 may include a first axial load surface 74 and, optionally, a second axial load surface 76. Further, the base member 56 may include a first mating axial load surface 82 and, optionally, a second mating axial load surface 84. When the base member 56 is positioned in the second pocket 72, the first axial load surface 74 and the first mating axial load surface 82 may interact, preventing axial movement of the base member 56 in one direction, such as in direction 46. Further, in exemplary embodiments, the second axial load surface 76 and the second mating axial load surface 84 may interact, preventing axial movement of the base member 56 in a second opposite direc-
In exemplary embodiments, the base member 56 may be removable from the second pocket 72. Alternatively, however, the base member 56 may be permanently mounted in the second pocket 72.

As shown in FIGS. 3 though 7, the pivotal member 58 may be configured to engage the pocket 52. In general, engagement of the pivotal member 58 and the pocket 52 prevents axial movement along the axial axis 44 of the pivotal member 58 with respect to the pocket 52 in at least one direction. For example, to engage the pocket 52 as shown in FIG. 6, the pivotal member 58 may be disposed in the pocket 52. The pocket 52 may include a first axial load surface 94 and, optionally, a second mating axial load surface 104. Further, the pivotal member 58 may include a first mating axial load surface 102 and, optionally, a second mating axial load surface 104. When the pivotal member 58 is disposed in the pocket 52, the first axial load surface 94 and the first mating axial load surface 102 may interact, preventing axial movement of the pivotal member 58 in one direction, such as in direction 48, and thus preventing axial movement of the turbine component 34 with respect to the support structure 32 in that direction. Further, in exemplary embodiments, the second axial load surface 96 and the second mating axial load surface 104 may interact, preventing axial movement of the pivotal member 58 in a second opposite direction, such as in direction 48, and thus preventing axial movement of the turbine component 34 with respect to the support structure 32 in that direction. Thus, the pivotal member 58 in these embodiments may engage the pocket 52.

As mentioned, the pivotal member 58 may be configured to engage the pocket 52. For example, the pivotal member 58 may be pivotal with respect to the base member 56. The pivotal member 58 may pivot about a pivot point 110. The pivot point 110 may be located adjacent an end of the base member 56, as shown in FIGS. 3 through 7, or may be located adjacent the base member 56 at any point along the base member 56. The pivot point 110 may generally connect the pivotal member 58 to the base member 56.

In exemplary embodiments, the pivotal member 58 may pivot between a first position, as shown in FIGS. 5 and 7, and a second position, as shown in FIGS. 4 and 6. In the first position, the pivotal member 58 may be disengaged from the pocket 52. When disengaged, the first axial load surface 94 and the first mating axial load surface 102 may not interact. Thus, the pivotal member 58 may be allowed to move axially with respect to the pocket 52 in at least one direction, such as in direction 46. Further, the turbine component 34 may be allowed to move axially with respect to the support structure 32 in at least one direction, such as in direction 46. In the second position, the pivotal member 58 may be engaged with the pocket 52. When engaged, the first axial load surface 94 and the first mating axial load surface 102 may interact. Thus, the pivotal member 58 may be prevented from moving axially with respect to the pocket 52 in at least one direction, such as in direction 46. Further, the turbine component 34 may be prevented from moving axially with respect to the support structure 32 in at least one direction, such as in direction 46.

In some embodiments, the pivotal member 58 may be biased towards the second position. For example, the latch 54 may include a spring member (not shown) or other suitable biasing device therein. The spring member or other biasing device may exert a force on the pivotal member 58, such as a tensile or compressive force, to bias the pivotal member 58 towards the second position. In alternative embodiments, however, the pivotal member 58 may be biased towards the first position, may have no bias, or may have any other suitable bias.

In some embodiments, the pivotal member 58 may include a disassembly feature 120. The disassembly feature 120 may be configured to pivot the pivotal member 58 from the second position to the first position. For example, in some embodiments, the disassembly feature 120 may be a tab, handle or other protrusion. The disassembly feature 120 in these embodiments may be engaged by a pivoting device, such as a lever, or by a person, to pivot the pivotal member 58 from the second position to the first position. In other embodiments, the disassembly feature 120 may be a groove 122 (see FIG. 3) defined in the pivotal member 58. The groove 122 may be engaged by a pivoting device to pivot the pivotal member 58 from the second position to the first position.

In some embodiments, as shown in FIG. 7, the axial retention device 50 may further include a pivoting device, such as a lever 124. The lever 124 may be configured to engage the disassembly feature 120, such as the groove 122 in exemplary embodiments, and pivot the pivotal member 58 from the second position to the first position.

The disassembly feature 120 and the pivoting device, such as the lever 124, may pivot the pivotal member 58 from the second position to the first position. As discussed above, the turbine component 34 in the first position may be allowed to move axially with respect to the support structure 32 in at least one direction. Thus, pivoting of the pivotal member 58 from the second position to the first position may allow for the turbine component 34 to be disassembled from the support structure 32.

Thus, the axial retention device 50 of the present disclosure may allow for efficient, cost-effective, and repeatable assembly, retention, and disassembly of turbine components 34 in support structures 32. For example, as shown in FIG. 5 and discussed above, the pivotal member 58 of the axial retention device 50 may, in the first position, allow a turbine component 34 to be assembled in a support structure 32. After the turbine component 34 is moved axially with respect to the support structure 32 to a desired position in the support structure 32, the pivotal member 58 may pivot to a second position, as shown in FIG. 6. In the second position, the axial retention device 50 may retain the turbine component 34 within the support structure 32, thus preventing axial movement of the turbine component 34 with respect to the support structure 32 in at least one direction. To disassemble the turbine component 34 from the support structure 32, as shown in FIG. 7, the pivotal member 58 may be pivoted from the second position to the first position. In the first position, the axial retention device 50 may again allow axial movement of the turbine component 34 within the support structure 32 in at least one direction.

Beneficially, the axial retention device 50 of the present disclosure may prevent axial movement of turbine components 34 with respect to support structures 32 in one or more directions. This prevention of axial movement may advantageously prevent or reduce the potential leakage of high temperature flow and/or escape of cooling medium between the turbine component 34 and support structure 32. Further, the use of an axial retention device 50 as discussed herein may provide for efficient and cost-effective assembly and disassembly of turbine components 34 in support structures 32. Further, the axial retention device 50 may provide for repeated assembly and disassembly of turbine components 34 in support structures 32 without requiring frequent replacement of the support structures 32. Additionally, existing turbine components 34 and support structures 32 may be
retrofitted to accommodate axial retention devices 50, thus reducing the time and cost previously associated with assembly and disassembly of these turbine components 34 and support structures 32.

[0036] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal languages of the claims.

What is claimed is:

1. An axial retention device for a turbine system, the axial retention device comprising:
   a pocket defined in a mating surface of one of a turbine component and a support structure, the pocket including a first axial load surface; and
   a latch comprising a base member and a pivotal member, the base member associated with a mating surface of the other of the turbine component and the support structure, the pivotal member configured to engage the pocket and including a first mating axial load surface, wherein engagement of the pivotal member and the pocket allows the first axial load surface and the first mating axial load surface to interact, preventing axial movement of the turbine component with respect to the support structure in at least one direction.

2. The axial retention device of claim 1, wherein in a first position, the pivotal member is disengaged from the pocket and allows axial movement of the turbine component with respect to the support structure in the at least one direction, and in a second position, the pivotal member is engaged with the pocket and prevents axial movement of the turbine component with respect to the support structure in the at least one direction.

3. The axial retention device of claim 2, wherein the pivotal member is biased towards the second position.

4. The axial retention device of claim 2, the pivotal member further comprising a disassembly feature, the disassembly feature configured to pivot the pivotal member from the second position to the first position.

5. The axial retention device of claim 4, wherein the disassembly feature is a groove defined in the pivotal member.

6. The axial retention device of claim 4, further comprising a lever configured to engage the disassembly feature and pivot the pivotal member from the second position to the first position.

7. The axial retention device of claim 1, the pocket further including a second axial load surface, the pivotal member further including a second mating axial load surface, and wherein interaction of the second axial load surface and the second mating axial load surface prevents axial movement of the turbine component with respect to the support structure in a second opposite direction.

8. The axial retention device of claim 1, wherein the pocket is defined in a mating surface of the support structure.

9. The axial retention device of claim 1, the mating surface of the other of the turbine component and the support structure defining a second pocket, and wherein the base member is configured to engage the second pocket.

10. The axial retention device of claim 1, wherein the turbine component is a blade and the support structure is a rotor disk.

11. A turbine system, comprising:
   a support structure, the support structure having a mating surface;
   a turbine component, the turbine component having a mating surface;
   a pocket defined in a mating surface of one of the turbine component and the support structure, the pocket including a first axial load surface; and
   a latch comprising a base member and a pivotal member, the base member associated with a mating surface of the other of the turbine component and the support structure, the pivotal member configured to engage the pocket and including a first mating axial load surface, wherein engagement of the pivotal member and the pocket allows the first axial load surface and the first mating axial load surface to interact, preventing axial movement of the turbine component with respect to the support structure in at least one direction.

12. The turbine system of claim 11, wherein in a first position, the pivotal member is disengaged from the pocket and allows axial movement of the turbine component with respect to the support structure in the at least one direction, and in a second position, the pivotal member is engaged with the pocket and prevents axial movement of the turbine component with respect to the support structure in the at least one direction.

13. The turbine system of claim 12, wherein the pivotal member is biased towards the second position.

14. The turbine system of claim 12, the pivotal member further comprising a disassembly feature, the disassembly feature configured to pivot the pivotal member from the second position to the first position.

15. The turbine system of claim 14, wherein the disassembly feature is a groove defined in the pivotal member.

16. The turbine system of claim 14, further comprising a lever configured to engage the disassembly feature and pivot the pivotal member from the second position to the first position.

17. The turbine system of claim 11, the pocket further including a second axial load surface, the pivotal member further including a second mating axial load surface, and wherein interaction of the second axial load surface and the second mating axial load surface prevents axial movement of the turbine component with respect to the support structure in a second opposite direction.

18. The turbine system of claim 11, wherein the pocket is defined in a mating surface of the support structure.

19. The turbine system of claim 11, the mating surface of the other of the turbine component and the support structure defining a second pocket, and wherein the base member is configured to engage the second pocket.

20. The turbine system of claim 11, wherein the turbine component is a blade and the support structure is a rotor disk.