Abstract: A connection between an annular sleeve (52) on a gas turbine engine first rotor component (34) includes an annular tapered conical slot (53) extending axially inwardly into the sleeve from an annular opening and tapers axially into the sleeve from the opening. An annular rim (64) of a second rotor component (12) is received within the conical slot and includes a rim inner conical surface (70) mating with and contacting a sleeve inner conical surface (56) in part bounding the conical slot. A sleeve cylindrical outer surface (60) in part bounds the conical slot in the sleeve and a rim outer cylindrical surface (72) on the annular rim contacts the sleeve cylindrical outer surface. An annular lip (80) may extend radially inwardly from the sleeve and sleeve inner conical surface a the annular opening to the conical slot. The connection may be used between a first stage disk and an interstage seal (12).
TAPERED COLLET CONNECTION OF ROTOR COMPONENTS

BACKGROUND OF THE INVENTION

FIELD OF THE INVENTION

[0001] This invention relates to connecting aircraft gas turbine engine rotor components.

DISCUSSION OF THE BACKGROUND ART

[0002] Gas turbine engines frequently have multi-stage turbine rotors having adjacent co-rotating components such as interstage seals located between adjacent first and second stage turbine disks. The interstage seal may be connected to the first stage disk and the second stage disk by boltless connections, thereby, eliminating the time-consuming task of properly torquing the bolts and eliminating the stress concentration problems associated with bolted connections. An example of such a connection is disclosed in United States Patent No. 5,320,488, titled "Turbine Disk Interstage Seal Anti-rotation System", by Meade et al., and issued June 14, 1994.

[0003] Aircraft engine rotors carry large torque loads and separate torque loads applied to separate components must be carried through the interfaces or connections connecting the components to avoid component slipping. If components slip at the connecting or mating interfaces hardware may be damage and is subject to fretting.

[0004] Anti rotation or torque and slip countering features such as keys, tabs, or splines to carry torque are well known in art. Boltless connections also incorporate rabbets and their interface load with friction to avoid slipping. These features are costly three dimensional features and splines and tabs are also highly stressed.

[0005] Accordingly, there is a need for a turbine engine rotor boltless connection between rotor components that
provides improved anti rotation or torque and slip effectiveness and more robust in countering rotation and associated rotational slippage than rabbets. There is also a need for boltless connections that are less expensive and less complicated than three dimensional features such as splines and tabs.

SUMMARY OF THE INVENTION

[0006] A gas turbine engine rotor assembly includes a first rotor component connected to a second rotor component by a connection. The connection includes an annular sleeve on the first rotor component, an annular tapered conical slot extending axially inwardly into the sleeve from an annular opening of the slot, the tapered conical slot tapering axially into the sleeve from the opening, and a sleeve inner conical surface in part bounding the conical slot. The second rotor component includes an annular rim received within the conical slot the annular rim and a rim inner conical surface mating with and pressing against the sleeve inner conical surface.

[0007] The assembly may further includes a sleeve cylindrical outer surface in part bounding the conical slot in the sleeve and a rim outer cylindrical surface on the annular rim. The annular rim outer cylindrical surface mates with and contacts the sleeve cylindrical outer surface.

[0008] An annular lip extending radially inwardly from the sleeve and sleeve inner conical surface at the annular opening to the conical slot may be incorporated.

[0009] The connection may be used in a gas turbine engine rotor assembly including an interstage seal axially disposed between and connected to first and second stage disks circumscribed about a centerline axis. The annular sleeve may be on the first stage disk and the interstage seal and the annular rim on the interstage seal.

[0010] The annular rim may be on a forward arm extending
axially from an annular outer shell of the interstage seal towards the first stage disk. The sleeve may be on an aft boltless blade retainer mounted on the first stage disk.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] The novel features believed characteristic of the present invention are set forth and differentiated in the claims. The invention, together with further objects and advantages thereof, is more particularly described in conjunction with the accompanying drawings in which:

[0012] FIG. 1 is a cross-sectional view illustration of a gas turbine engine with first and second high pressure turbine stages and an interstage seal therebetween connected to the first stage turbine with a tapered collet boltless connection.

[0013] FIG. 2 is an enlarged cross-sectional view illustration of the interstage seal illustrated in FIG. 1.

[0014] FIG. 3 is an enlarged cross-sectional view illustration of the boltless connection illustrated in FIG. 2.

[0015] FIG. 4 is an enlarged cross-sectional view illustration of a rim of the interstage seal received in the tapered collet illustrated in FIG. 3.

DETAILED DESCRIPTION

[0016] Illustrated in FIG. 1 is an exemplary embodiment of a collet boltless connection 8 for gas turbine engine rotor components. A gas turbine engine rotor assembly 10 circumscribed about a centerline axis 11 of a gas turbine engine includes an interstage seal 12 axially disposed between and connected to first and second stage disks 14, 16. First and second webs 18, 20 of the first and second stage disks 14, 16 extend radially outward from first and second bores 22, 24, respectively. The first and second webs 18, 20 each terminate in an outer periphery having a plurality of first and second turbine blades 23, 25 received
in first and second slots 26, 28 in first and second disk rims 27, 29 of the first and second stage disks 14, 16 respectively.

[0017] Referring to FIGS. 2 and 3, forward and aft boltless blade retainers 32, 34 mounted on the first disk rim 27 retains the first turbine blades 23 in the first slots 26. The forward and aft boltless blade retainers 32, 34 include forward and aft recesses 33, 35 respectively for containing wire seals 36. A first rotor component 40 is exemplified by a first stage disk assembly 41 including the first stage disk 14 and its blades and boltless blade retainers. A second rotor component 42 is exemplified by the interstage seal 12. The collet boltless connection 8 connects the first and second rotor components 40, 42. A rabbet connection 45 is used to connect the interstage seal 12 to the second stage disk 16.

[0018] Referring to FIGS. 1, 2, and 3, the interstage seal 12 includes an outer shell 38 and a seal disk 46 having a seal web 47 and a seal bore 48. A forward arm 49 extends axially forwardly from the outer shell 38 towards the first stage disk 14 and is connected to the aft boltless blade retainer 34 on the first stage disk 14 by the collet boltless connection 8. An aft arm 50 extends axially aftwardly from the outer shell 38 towards the second stage disk 16 and is connected to the second disk rim 29 of the second stage disk 16 by the rabbet connection 45.

[0019] The shell 38 is generally cylindrical in shape, and the forward and aft arms 49, 50 each have an inwardly convex shape. More specifically, the forward and aft arms 49, 50 each have a catenary curve 51 which extends from the shell 38 to the respective first and second stage disks 14, 16.

[0020] Referring to FIGS. 3 and 4, the collet boltless connection 8 includes an annular sleeve 52 on the aft boltless blade retainer 34. The annular sleeve 52 includes a tapered conical slot 53 extending axially inwardly into
the sleeve from an annular opening 54. The conical slot 53 tapers axially into the sleeve 52 from the opening 54. The sleeve 52 includes a sleeve radially inner conical surface 56 in part bounding the conical slot 53. The embodiment of sleeve 52 illustrated herein further includes a sleeve cylindrical outer surface 60 juxtaposed to the sleeve inner conical surface 56. The sleeve cylindrical outer surface 60 in part bounds the conical slot 53 in the sleeve 52.

[0021] The collet boltless connection 8 further includes an annular rim 64 on a forward end 66 of the forward arm 49. The rim 64 is received within the conical slot 53 in the sleeve 52. The rim 64 includes a rim inner conical surface 70 and a rim outer cylindrical surface 72. The rim inner conical surface 70 mates with, contacts, and presses against the sleeve inner conical surface 56.

[0022] The rim inner conical surface 70 and the sleeve inner conical surface 56 have substantially the same conical angle AC with respect to the centerline axis 11. There may be a small difference between the conical angles of the rim inner conical surface 70 and the sleeve inner conical surface 56 to accommodate radial deflection. The rim outer cylindrical surface 72 mates with and contacts the sleeve cylindrical outer surface 60. The connection 8 locks or secures the annular rim 64 on the forward arm 49 of the interstage seal 12 within the conical slot 53 in the sleeve 52 of the first stage disk assembly 41 thus preventing or resisting circumferential slipping between and related fretting of the mating surfaces.

[0023] An annular lip 80 extends radially inwardly from the sleeve 52 and sleeve inner conical surface 56 at the annular opening 54 to the conical slot 53. The annular lip 80 is provided to allow a tool to be used to disassemble and separate the first and second rotor components 40, 42 and more particularly the rim 64 from the sleeve 52.

[0024] While there have been described herein, what are considered to be preferred and exemplary embodiments of the
present invention, other modifications of the invention shall be apparent to those skilled in the art from the teachings herein and, it is, therefore, desired to be secured in the appended claims all such modifications as fall within the true spirit and scope of the invention.

[0025] Accordingly, what is desired to be secured by Letters Patent of the United States is the invention as defined and differentiated in the following claims:
CLAIMS

What is claimed is:

1. A gas turbine engine rotor assembly comprising:
   first and second rotor components circumscribing a centerline axis,
   the first rotor component including an annular sleeve on the first rotor component,
   an annular tapered conical slot extending axially inwardly into the sleeve from an annular opening of the slot,
   the tapered conical slot tapering axially into the sleeve from the opening,
   the sleeve including a sleeve inner conical surface in part bounding the conical slot,
   the second rotor component including an annular rim received within the conical slot, and
   the annular rim including a rim inner conical surface mating with and pressing against the sleeve inner conical surface.

2. An assembly as claimed in claim 1, further comprising:
   a sleeve cylindrical outer surface in part bounding the conical slot in the sleeve,
   a rim outer cylindrical surface on the annular rim, and
   the annular rim outer cylindrical surface mating with and contacting the sleeve cylindrical outer surface.

3. An assembly as claimed in claim 2, further comprising an annular lip extending radially inwardly from the sleeve and sleeve inner conical surface at the annular opening to the conical slot.

4. A gas turbine engine rotor assembly comprising:
an interstage seal axially disposed between and connected to first and second stage disks circumscribed about a centerline axis,
an annular sleeve on the first stage disk,
an annular tapered conical slot extending axially inwardly into the sleeve from an annular opening of the slot,
the tapered conical slot tapering axially into the sleeve from the opening,
the sleeve including a sleeve inner conical surface in part bounding the conical slot,
the interstage seal including an annular rim received within the conical slot, and
the annular rim including a rim inner conical surface mating with and pressing against the sleeve inner conical surface.

5. An assembly as claimed in claim 4, further comprising:
a sleeve cylindrical outer surface in part bounding the conical slot in the sleeve,
a rim outer cylindrical surface on the annular rim, and the annular rim outer cylindrical surface mating with and contacting the sleeve cylindrical outer surface.

6. An assembly as claimed in claim 5, further comprising an annular lip extending radially inwardly from the sleeve and sleeve inner conical surface at the annular opening to the conical slot.

7. An assembly as claimed in claim 4, further comprising the annular rim on a forward arm extending axially from an annular outer shell of the interstage seal towards the first stage disk.

8. An assembly as claimed in claim 7, further
comprising an aft boltless blade retainer mounted on the
first stage disk and the blade retainer including the
sleeve.

9. An assembly as claimed in claim 8, further
comprising:
a sleeve cylindrical outer surface in part bounding the
conical slot in the sleeve,
a rim outer cylindrical surface on the annular rim, and
the annular rim outer cylindrical surface mating with
and contacting the sleeve cylindrical outer surface.

10. An assembly as claimed in claim 9, further
comprising an annular lip extending radially inwardly from
the sleeve and sleeve inner conical surface at the annular
opening to the conical slot.

11. A gas turbine engine turbine disk annular blade
retainer comprising:
the blade retainer circumscribing a centerline axis,
an annular sleeve on the blade retainer,
an annular tapered conical slot extending axially
inwardly into the sleeve from an annular opening of the
slot,
the tapered conical slot tapering axially into the
sleeve from the opening, and
the sleeve including a sleeve inner conical surface in
part bounding the conical slot.

12. A blade retainer as claimed in claim 11, further
comprising a sleeve cylindrical outer surface in part
bounding the conical slot in the sleeve.

13. A blade retainer as claimed in claim 11, further
comprising an annular lip extending radially inwardly from
the sleeve and sleeve inner conical surface at the annular
opening to the conical slot.

14. An interstage seal comprising:
the interstage seal circumscribing a centerline axis,
a forward arm extending axially from an annular outer
shell of the interstage seal,
the forward arm including an annular rim, and
the annular rim including a rim inner conical surface.

15. An interstage seal as claimed in claim 14, further
comprising a rim outer cylindrical surface on the annular
rim.
**INTERNATIONAL SEARCH REPORT**

**A. CLASSIFICATION OF SUBJECT MATTER**

INV. F01D5/06 F01D5/30 FOIDII/00

According to International Patent Classification (IPC) or to both national classification and IPC

**B. FIELDS SEARCHED**

Minimum documentation searched (classification system followed by classification symbols)

F01D F16D

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

**C. DOCUMENTS CONSIDERED TO BE RELEVANT**

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<tr>
<th>Category</th>
<th>Citation of document, with indication, where appropriate, of the relevant passages</th>
<th>Relevant to claim No.</th>
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<td>X</td>
<td>EP 1 273 815 A2 (ROLLS ROYCE PLC [GB]) 8 January 2003 (2003-01-08) paragraphs [0040], [0037], [0028], [0029], [0023], [0024], [0010], [0003], [0005]; figure 2</td>
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<td>EP 0 801 208 A2 (UNITED TECHNOLOGIES CORP [US]) 15 October 1997 (1997-10-15) figure 1</td>
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<td>A</td>
<td>US 5 318 405 A (MEADE ROBERT J [US] ET AL) 7 June 1994 (1994-06-07) figure 1 col umn 1, line 5 - col umn 2, line 34 col umn 4, line 45 - col umn 4, line 53</td>
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X Further documents are listed in the continuation of Box C. X See patent family annex.

* Special categories of cited documents:

- "A" document defining the general state of the art which is not considered to be of particular relevance
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- "S" document member of the same patent family

**Date of the actual completion of the international search**

29 September 2011

**Date of mailing of the international search report**

07/10/2011

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**Authorized officer**

Herbi et, J
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