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(54) **FEATHER SEALS AND GAS TURBINE ENGINE SYSTEMS INVOLVING SUCH SEALS**

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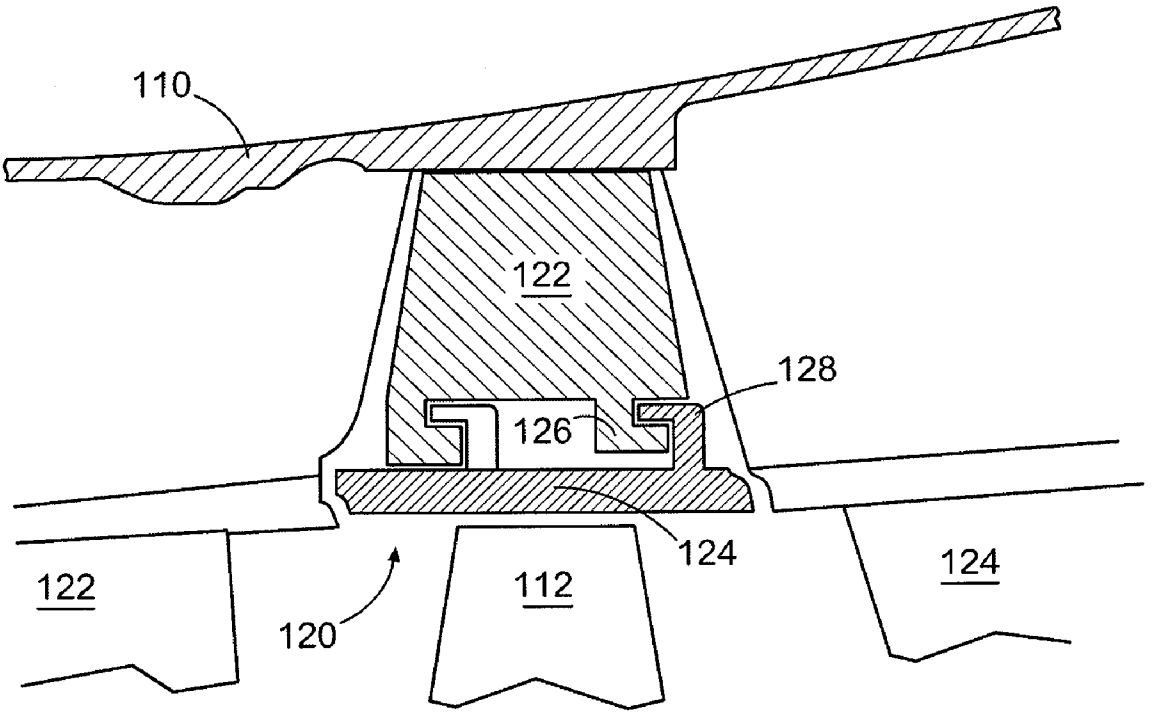
(57) **ABSTRACT**

Feather seals and gas turbine engine systems involving such seals are provided. In this regard, a representative feather seal for a gas turbine engine includes: an elongate body portion; and a locating tab extending longitudinally along the body portion and extending outwardly therefrom.



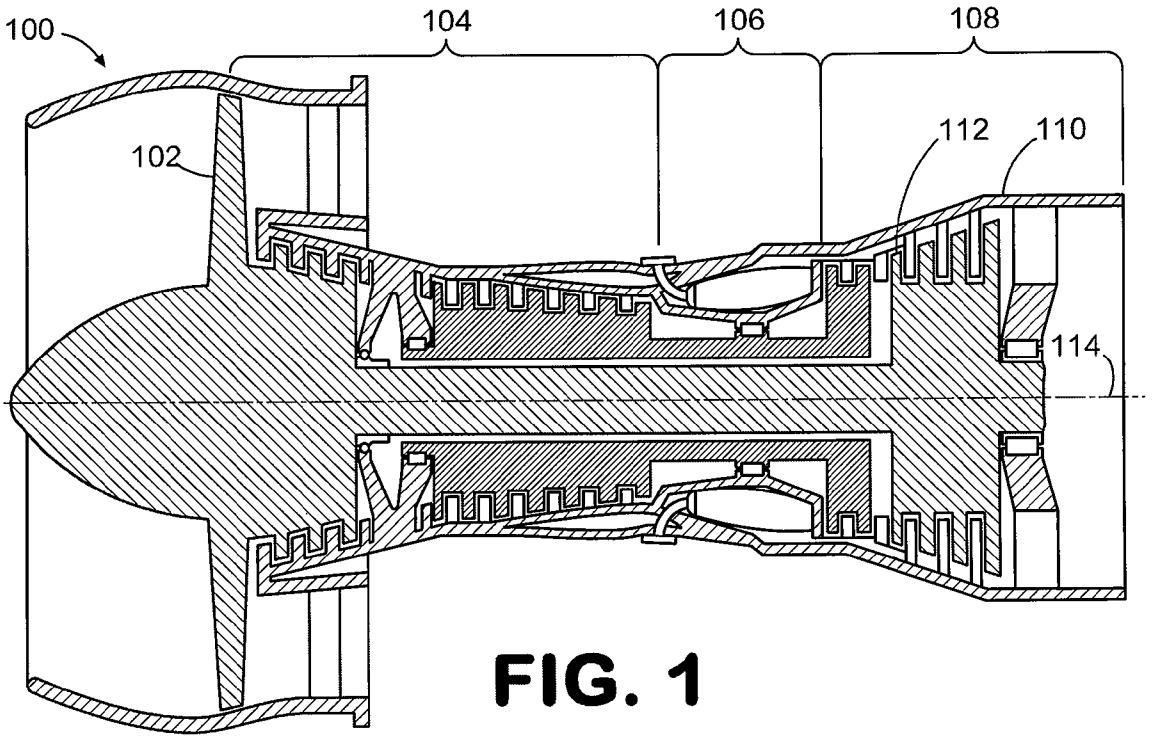

100
104
106
108
102
112
110
114

FIG. 1

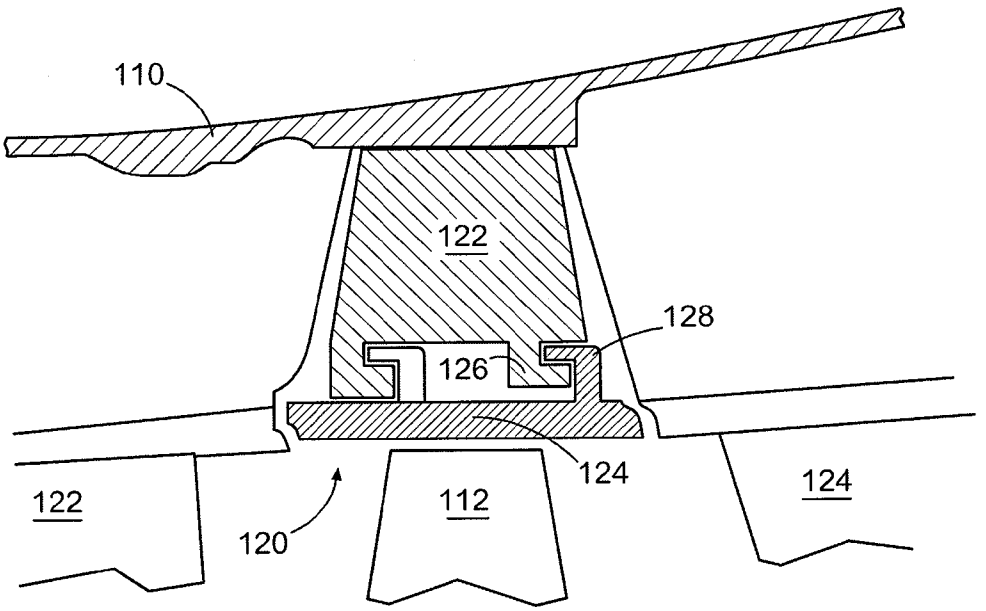

110
122
128
126
124
122
112
120
124

FIG. 2

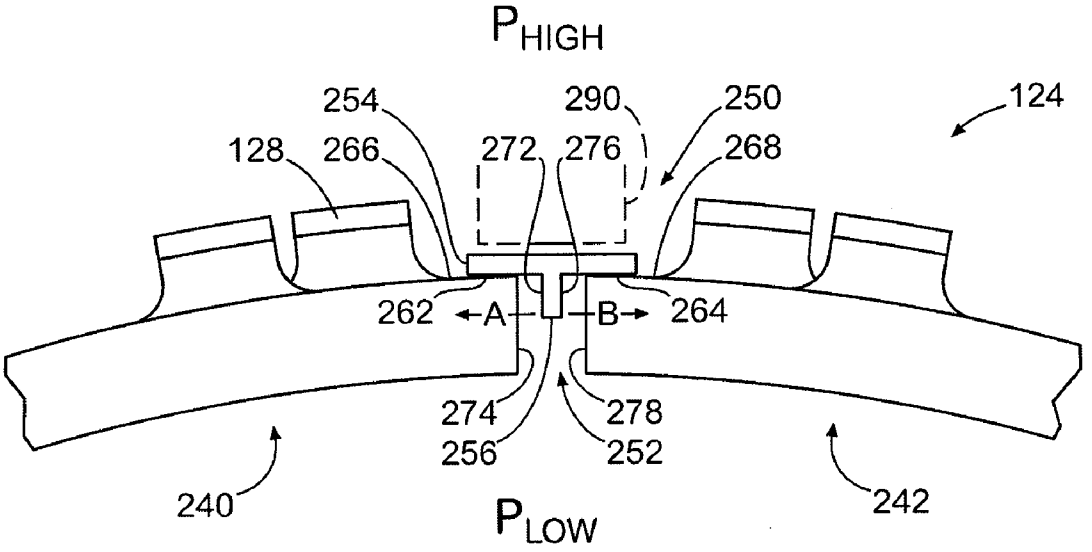

P HIGH
254
290
250
124
128
266
272
276
268
262
A
B
264
274
278
256
252
240
242
P LOW

FIG. 3

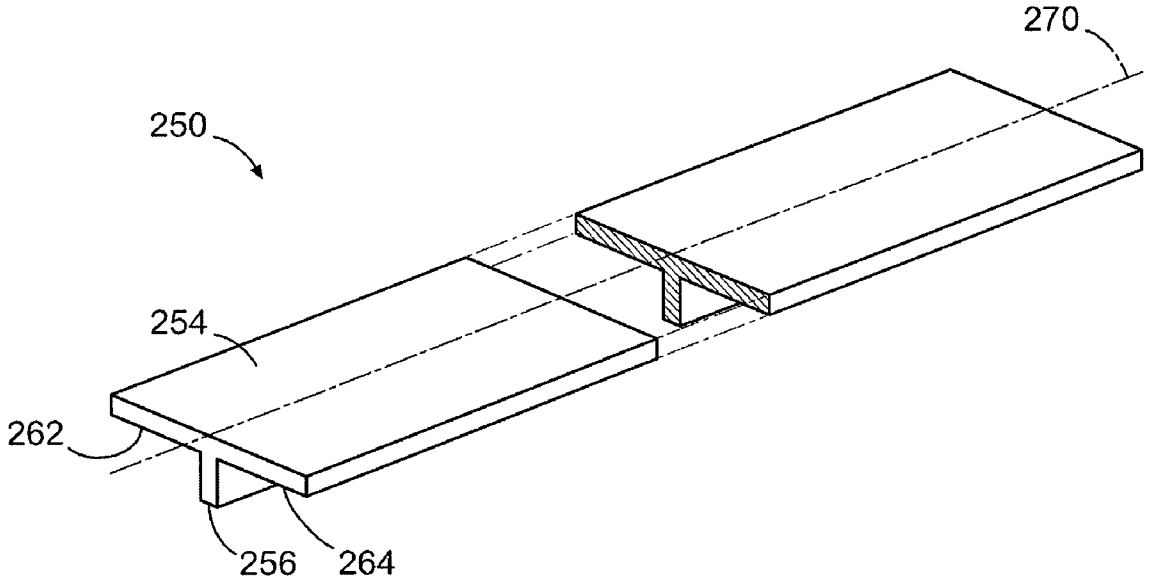

270
250
254
262
256
264

FIG. 4

FEATHER SEALS AND GAS TURBINE ENGINE SYSTEMS INVOLVING SUCH SEALS

STATEMENT REGARDING FEDERALLY SPONSORED RESEARCH AND DEVELOPMENT

[0001] The U.S. Government may have an interest in the subject matter of this disclosure as provided for by the terms of contract number F-33615-03-D-2354 (DO 0009) awarded by the United States Air Force.

BACKGROUND

[0002] 1. Technical Field

[0003] The disclosure generally relates to gas turbine engines.

[0004] 2. Description of the Related Art

[0005] A typical gas turbine engine incorporates a compressor section and a turbine section, each of which includes rotatable blades and stationary vanes. Within a surrounding engine casing, the radial outermost tips of the blades are positioned in close proximity to outer air seals. The seals are parts of shroud assemblies mounted within the engine casing.

[0006] Each outer air seal typically incorporates multiple segments that are annularly arranged within the engine casing. In order to reduce gas leakage between adjacent segments, feather seals commonly are used. Typically, feather seals are configured as elongated strips of metal that are mounted within corresponding recesses located along adjacent ends of the segments. Thus, a feather seal is typically positioned between each pair of ends of adjacent segments.

SUMMARY

[0007] Feather seals and gas turbine engine systems involving such seals are provided. In this regard, an exemplary embodiment of a feather seal for a gas turbine engine comprises: an elongate body portion; and a locating tab extending longitudinally along the body portion and extending outwardly therefrom.

[0008] An exemplary embodiment of an outer air seal assembly for a gas turbine engine comprises: a first outer air seal segment having a first sealing surface and a first end; a second outer air seal segment having a second sealing surface and a second end; the first outer air seal segment and the second outer air seal segment being oriented in an end-to-end annular arrangement such that the first end and the second end define a gap therebetween; and a feather seal having an elongate body portion and a locating tab extending outwardly from the body portion, the body portion having a first sealing surface and a second sealing surface, the locating tab being positioned between the first sealing surface and the second sealing surface such that, in an operative position in which the first sealing surface of the feather seal contacts the first sealing surface of the outer air seal and the second sealing surface of the feather seal contacts the second sealing surface of the outer air seal, the locating tab extends into the gap and between the first outer air seal segment and the second outer air seal segment.

[0009] An exemplary embodiment of a gas turbine engine comprises: a compressor; a combustion section; a turbine operative to drive the compressor responsive to energy imparted thereto by the combustion section, the turbine having a rotatable blade; and an outer air seal assembly annularly arranged about the turbine, at least a portion of the outer air seal being located radially outboard of the blade, the outer air seal assembly comprising: a first outer air seal segment; a second outer air seal segment; and a feather seal having an elongate body portion and a locating tab extending longitudinally along the body portion and extending outwardly therefrom; the first outer air seal segment and the second outer air seal segment being oriented in an end-to-end annular arrangement such that the first end and the second end define a gap therebetween, the locating tab extending into the gap.

[0010] Other systems, methods, features and/or advantages of this disclosure will be or may become apparent to one with skill in the art upon examination of the following drawings and detailed description. It is intended that all such additional systems, methods, features and/or advantages be included within this description and be within the scope of the present disclosure.

BRIEF DESCRIPTION OF THE DRAWINGS

[0011] Many aspects of the disclosure can be better understood with reference to the following drawings. The components in the drawings are not necessarily to scale. Moreover, in the drawings, like reference numerals designate corresponding parts throughout the several views.

[0012] FIG. **1** is a schematic diagram depicting an exemplary embodiment of a gas turbine engine.

[0013] FIG. **2** is a partially cut-away, schematic diagram depicting a portion of the embodiment of FIG. **1** in the vicinity of a turbine blade tip.

[0014] FIG. **3** is a partially cut-away, schematic diagram depicting a portion of the shroud assembly of the embodiment of FIGS. **1** and **2**.

[0015] FIG. **4** is a schematic diagram depicting an exemplary embodiment of a feather seal.

DETAILED DESCRIPTION

[0016] Feather seals and gas turbine engine systems involving such seals are provided, several exemplary embodiments of which will be described in detail. In this regard, the feather seals incorporate locating features that tend to position the seals between adjacent outer air seal segments. In some embodiments, the locating feature is oriented along a centerline of the seal, with the seal generally exhibiting a T-shape when viewed along an end view. Such a configuration potentially enables the width of the feather seal to be reduced, which can reduce component weight. This can also potentially alleviate the difficulty associated with cooling outer air seals that use wider feather seals. This is because the wider feather seals tend to cover more of the outer air seal segments and thereby limit the locations where cooling holes can be formed in those segments. In some embodiments, the locating feature can serve as a bumper that prevents part-to-part contact of adjacent outer air seal segments. Notably, such part-to-part contact is conventionally accommodated by machining bumpers into the segments themselves, which oftentimes requires the use of additional material and a corresponding machining step.

[0017] Referring now in more detail to the drawings, FIG. **1** is a schematic diagram depicting an exemplary embodiment of a gas turbine engine. As shown in FIG. **1**, engine **100** incorporates a fan **102**, a compressor section **104**, a combustion section **106** and a turbine section **108**. Various components of the engine are housed within an engine casing **110**, such as a blade **112** of the low-pressure turbine, that extends along a longitudinal axis **114**. Although engine **100** is con-

figured as a turbofan engine, there is no intention to limit the concepts described herein to use with turbofan engines as various other configurations of gas turbine engines can be used.

[0018] A portion of engine **100** is depicted in greater detail in the schematic diagram of FIG. **2**. In particular, FIG. **2** depicts a portion of blade **112** and a corresponding portion of a shroud assembly **120** that are located within engine casing **110**. Notably, blade **112** is positioned between vanes **122** and **124**, detail of which has been omitted from FIG. **2** for ease of illustration and description.

[0019] As shown in FIG. **2**, shroud assembly **120** is positioned between the rotating blades and the casing. The shroud assembly generally includes a annular mounting ring **122** and an annular outer air seal **124** attached to the mounting ring and positioned adjacent to the blades. Various other seals are provided both forward and aft of the shroud assembly. However, these various seals are not relevant to this discussion, as seals located between adjacent segments of the shroud will be described in detail.

[0020] Attachment of the outer air seal to the mounting ring in the embodiment of FIG. **2** is facilitated by interlocking flanges. Specifically, the mounting ring includes flanges (e.g., flange **126**) that engage corresponding flanges (e.g., flange **128**) of the outer air seal. Other attachment techniques may be used in other embodiments.

[0021] With respect to the annular configuration of the outer air seal, outer air seal **124** is formed of multiple arcuate segments, portions of two of which are depicted schematically in FIG. **3**. As shown in FIG. **3**, adjacent segments **240**, **242** of the outer air seal are oriented in an end-to-end relationship, with a feather seal **250** being provided to seal a gap **252** located between the segments. In this embodiment, the feather seal incorporates an elongate body portion **254** and a locating tab **256** that extends outwardly from the body portion. The body portion includes sealing surfaces **262**, **264**, with each of the sealing surfaces being located on a corresponding side of the locating tab.

[0022] In operation, relatively high pressure (P_{HIGH}) gas located radially outboard of feather seal **250** causes the sealing surfaces **262**, **264** to contact corresponding surfaces (e.g., surfaces **266**, **268**) of the outer air seal segments, thereby forming an air seal. Notably, locating tab **256** extends between the outer air seal segments.

[0023] In the embodiment of FIG. **3** (and as shown in greater detail in FIG. **4**), locating tab **256** is a central locating tab positioned along a longitudinal centerline **270** of the feather seal. In other embodiments, other positions may be used. Additionally, the locating tab extends from the sealing portion at an angle of approximately 90°; however, various angular deviations can be exhibited in other embodiments.

[0024] The locating tab functions as a stop that inhibits lateral movement of the feather seal. Specifically, movement of the feather seal is prevented in a direction A (FIG. **3**) beyond a location corresponding to contact between sidewall **272** of the locating tab and an end **274** of segment **240**. Similarly, movement of the feather seal is prevented in a direction B (FIG. **3**) beyond a location corresponding to contact between sidewall **276** of the locating tab and an end **278** of segment **242**. By limiting movement of the feather seal with respect to the gap **252**, width of the feather seal may be narrowed in contrast to the width of a conventional feather seal that does not include a locating tab. As mentioned above, such a configuration can potentially result in component weight reduction, and can also potentially alleviate difficulty associated with cooling outer air seal segments that use wider feather seals.

[0025] Additionally, a locating tab can function as a bumper that inhibits physical contact between adjacent out air seal segments in a vicinity of the locating tab. Without such a locating tab extending between adjacent segments, the gap between the segments may become too narrow, thereby preventing an adequate flow of cooling air from flowing through the gap.

[0026] In some embodiments (see FIG. **3**), an outboard retention component (e.g., component **290** depicted in dashed lines) can be used to restrict radial movement of a feather seal. By way of example, such a component could form a portion of the mounting ring.

[0027] It should be emphasized that the above-described embodiments are merely possible examples of implementations set forth for a clear understanding of the principles of this disclosure. Many variations and modifications may be made to the above-described embodiments without departing substantially from the spirit and principles of the disclosure. All such modifications and variations are intended to be included herein within the scope of this disclosure and protected by the accompanying claims.

1. An outer air seal assembly for a gas turbine engine comprising:

a first outer air seal segment having a first sealing surface and a first end;

a second outer air seal segment having a second sealing surface and a second end;

the first outer air seal segment and the second outer air seal segment being oriented in an end-to-end annular arrangement such that the first end and the second end define a gap therebetween; and

a feather seal having an elongate body portion and a locating tab extending outwardly from the body portion, the body portion having a first sealing surface and a second sealing surface, the locating tab being positioned between the first sealing surface and the second sealing surface such that, in an operative position in which the first sealing surface of the feather seal contacts the first sealing surface of the outer air seal and the second sealing surface of the feather seal contacts the second sealing surface of the outer air seal, the locating tab extends into the gap and between the first outer air seal segment and the second outer air seal segment.

2. The assembly of claim **1**, further comprising a mounting ring operative to mount the first outer air seal segment and the second outer air seal segment in an annular arrangement.

3. The assembly of claim **1**, wherein the locating tab extends outwardly from a longitudinal centerline of the body portion.

4. The assembly of claim **1**, wherein the first sealing surface of the first outer air seal segment is an outer diameter surface.

5. The assembly of claim **1**, further comprising a retention component located radially outboard of the feather seal, the retention component being operative to restrict radial movement of the feather seal.

6. The assembly of claim **5**, wherein:

the assembly further comprises a mounting ring operative to mount the first outer air seal segment and the second outer air seal segment in an annular arrangement; and

the retention component is associated with the mounting ring.

7. The assembly of claim **5**, wherein the retention component is not attached to either the first outer air seal segment or the second outer air seal segment.

8. The assembly of claim **1**, wherein the locating tab is operative to maintain at least a minimum spacing between the first outer air seal segment and the second outer air seal segment.

9. The assembly of claim **1**, wherein the locating tab extends the length of the body portion.

10. A feather seal for a gas turbine engine comprising:

an elongate body portion; and

a locating tab extending longitudinally along the body portion and extending outwardly therefrom.

11. The feather seal of claim **10**, wherein, as viewed in end view, the feather seal is T-shaped.

12. The feather seal of claim **10**, wherein the locating tab extends the length of the body portion.

13. The feather seal of claim **10**, wherein the body portion has a first sealing surface and a second sealing surface, the locating tab being positioned between the first sealing surface and the second sealing surface.

14. The feather seal of claim **10**, wherein the locating tab extends outwardly from a longitudinal centerline of the body portion.

15. A gas turbine engine comprising:

a compressor;

a combustion section;

a turbine operative to drive the compressor responsive to energy imparted thereto by the combustion section, the turbine having a rotatable blade; and

an outer air seal assembly annularly arranged about the turbine, at least a portion of the outer air seal being located radially outboard of the blade, the outer air seal assembly comprising:

a first outer air seal segment;

a second outer air seal segment; and

a feather seal having an elongate body portion and a locating tab extending longitudinally along the body portion and extending outwardly therefrom;

the first outer air seal segment and the second outer air seal segment being oriented in an end-to-end annular arrangement such that the first end and the second end define a gap therebetween, the locating tab extending into the gap.

16. The engine of claim **15**, further comprising a retention component located radially outboard of the feather seal, the retention component being operative to restrict radial movement of the feather seal.

17. The engine of claim **15**, wherein, as viewed in end view, the feather seal is T-shaped.

18. The engine of claim **15**, wherein the locating tab extends the length of the body portion.

19. The engine of claim **15**, wherein the body portion has a first sealing surface operative to contact the first outer air seal segment and a second sealing surface operative to contact the second outer air seal segment, the locating tab being positioned between the first sealing surface and the second sealing surface.

20. The engine of claim **15**, wherein the locating tab is operative to maintain at least a minimum spacing between the first outer air seal segment and the second outer air seal segment.

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