

US010385712B2

(12) **United States Patent**
Jenkins et al.

(10) **Patent No.:** **US 10,385,712 B2**
(45) **Date of Patent:** **Aug. 20, 2019**

(54) **SUPPORT ASSEMBLY FOR A GAS TURBINE ENGINE**

(56) **References Cited**

(71) Applicant: **United Technologies Corporation**,
Hartford, CT (US)
(72) Inventors: **Decari S. Jenkins**, Manchester, CT
(US); **Andrew S. Miller**, Marlborough,
CT (US)
(73) Assignee: **UNITED TECHNOLOGIES**
CORPORATION, Farmington, CT
(US)
(*) Notice: Subject to any disclaimer, the term of this
patent is extended or adjusted under 35
U.S.C. 154(b) by 772 days.

U.S. PATENT DOCUMENTS

5,125,796 A 6/1992 Cromer
5,211,535 A 5/1993 Martin et al.
5,813,674 A * 9/1998 Dickie F16J 15/38
277/390
6,170,831 B1 1/2001 Bouchard
7,717,671 B2 5/2010 Addis
7,926,784 B2 * 4/2011 Fleming F16K 47/08
251/282
8,661,828 B2 3/2014 Pieussergues et al.
8,769,963 B2 7/2014 Ryan
8,800,133 B2 8/2014 Caprario et al.
8,834,106 B2 9/2014 Luczak
(Continued)

FOREIGN PATENT DOCUMENTS

(21) Appl. No.: **14/719,569**
(22) Filed: **May 22, 2015**

EP 0921277 6/1999
EP 1323893 7/2003
(Continued)

(65) **Prior Publication Data**
US 2016/0341055 A1 Nov. 24, 2016

OTHER PUBLICATIONS

Extended European Search Report for European Application No.
16170808.6 dated Nov. 8, 2016.

(51) **Int. Cl.**
F01D 11/00 (2006.01)
F01D 5/02 (2006.01)
F01D 9/04 (2006.01)
F16J 15/10 (2006.01)
(52) **U.S. Cl.**
CPC **F01D 11/001** (2013.01); **F01D 5/02**
(2013.01); **F01D 9/041** (2013.01); **F01D**
11/005 (2013.01); **F16J 15/104** (2013.01);
F05D 2220/32 (2013.01); **F05D 2230/60**
(2013.01); **F05D 2240/11** (2013.01); **F05D**
2260/52 (2013.01)

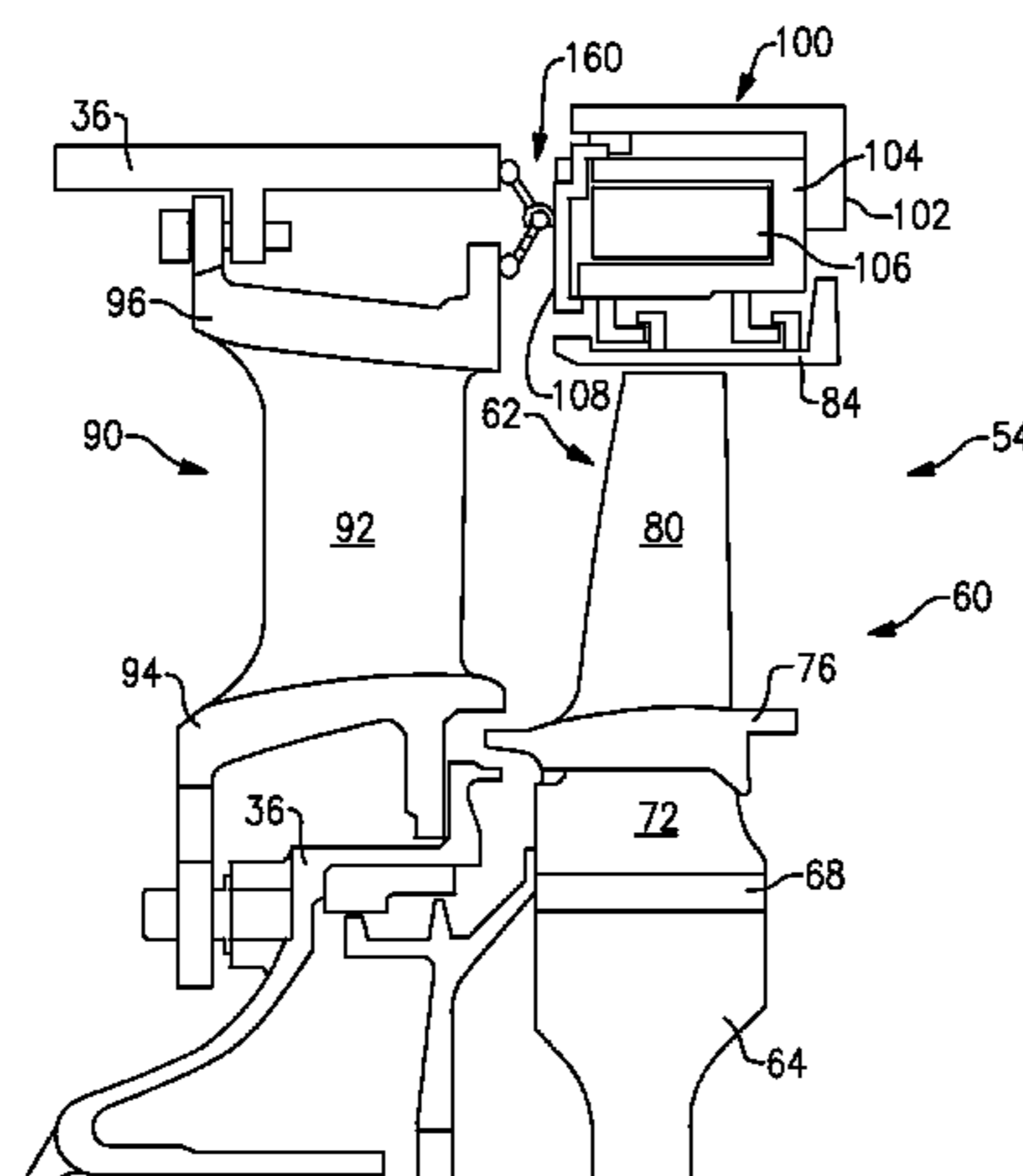
Primary Examiner — Richard A Edgar
Assistant Examiner — Michael L Sehn
(74) *Attorney, Agent, or Firm* — Carlson, Gaskey & Olds,
P.C.

(57) **ABSTRACT**

A seal assembly for a gas turbine engine includes a first member including a first seal land for contacting a first structure. A second member includes a second seal land for contacting a second structure and a third seal land for contacting a third structure. The first member and the second member form a pivotable connection.

(58) **Field of Classification Search**
CPC . F02C 7/28; F01D 11/001; F01D 5/24; F01D
9/041; F01D 11/005; F05D 2240/11
See application file for complete search history.

19 Claims, 4 Drawing Sheets



(56)

References Cited

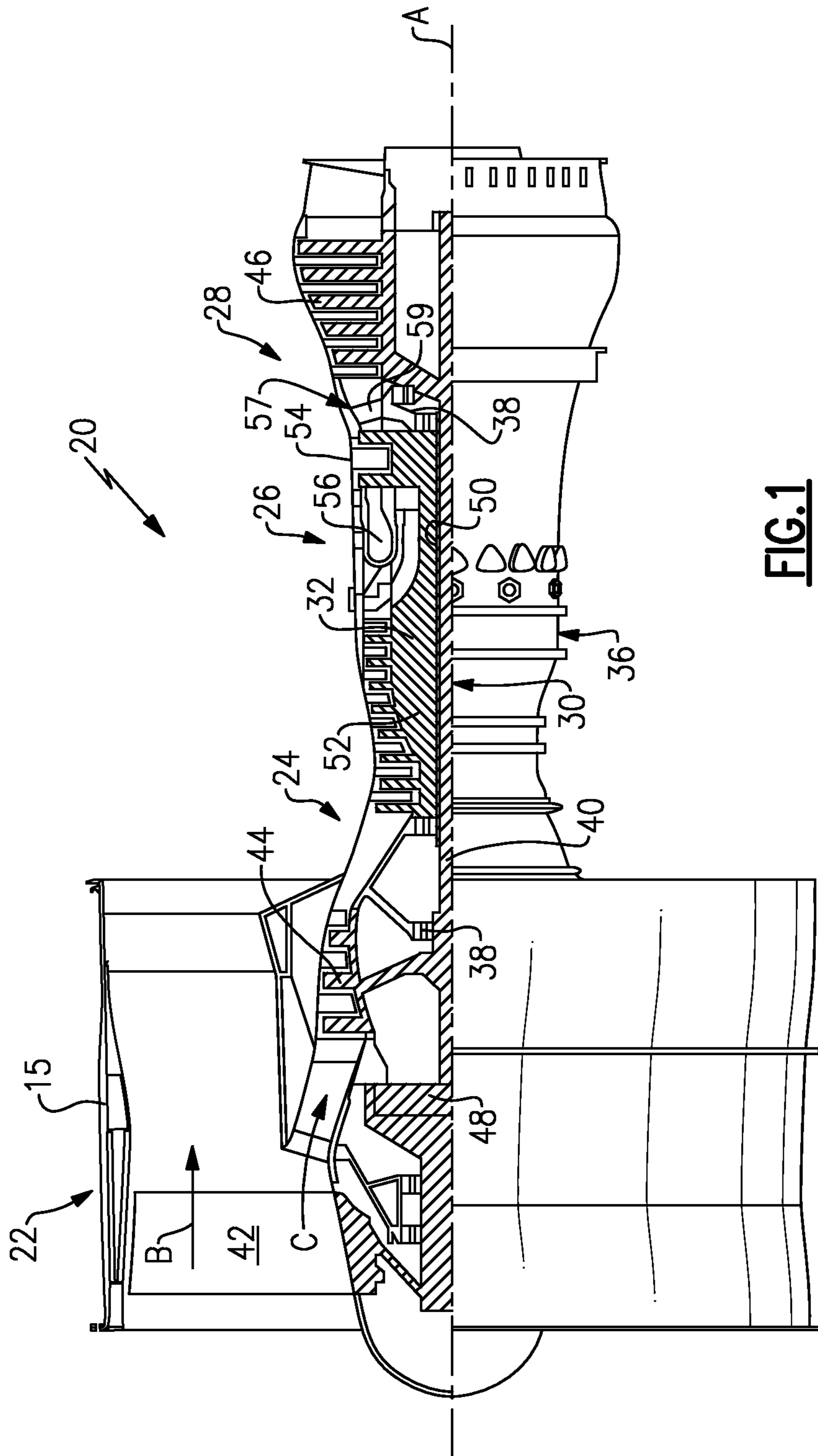
U.S. PATENT DOCUMENTS

2009/0142180 A1 6/2009 Munson
2013/0048749 A1 2/2013 McMahon et al.
2013/0149143 A1 6/2013 Gibson
2013/0183150 A1* 7/2013 Batt F01D 11/003
415/214.1
2013/0323046 A1 12/2013 Gordon et al.
2014/0186163 A1* 7/2014 Clouse F01D 11/005
415/173.1

FOREIGN PATENT DOCUMENTS

EP 2562363 2/2013
EP 2746625 6/2014
GB 2027818 2/1980
WO WO 2013189883 A1* 12/2013 F01D 11/005

* cited by examiner



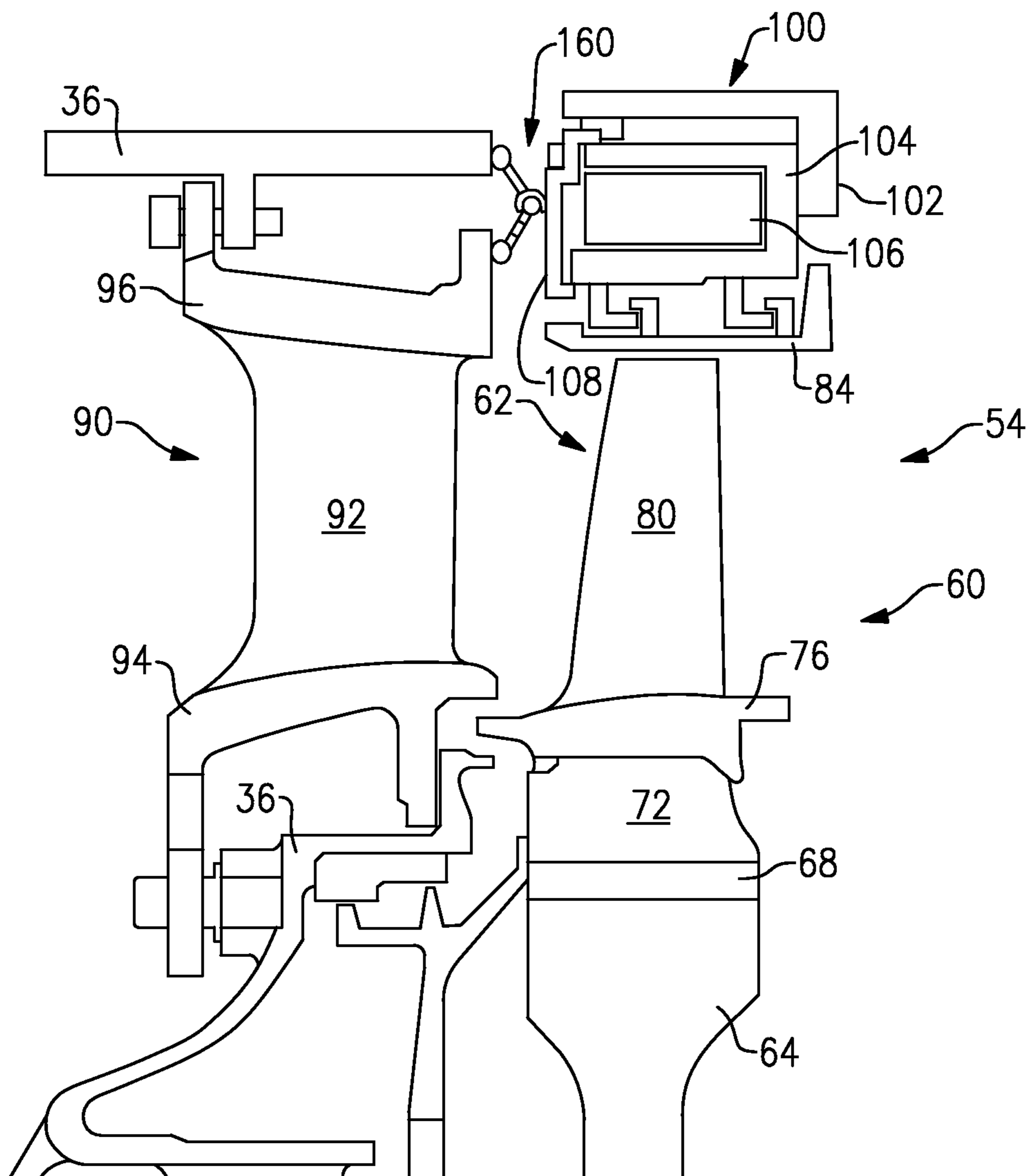


FIG.2

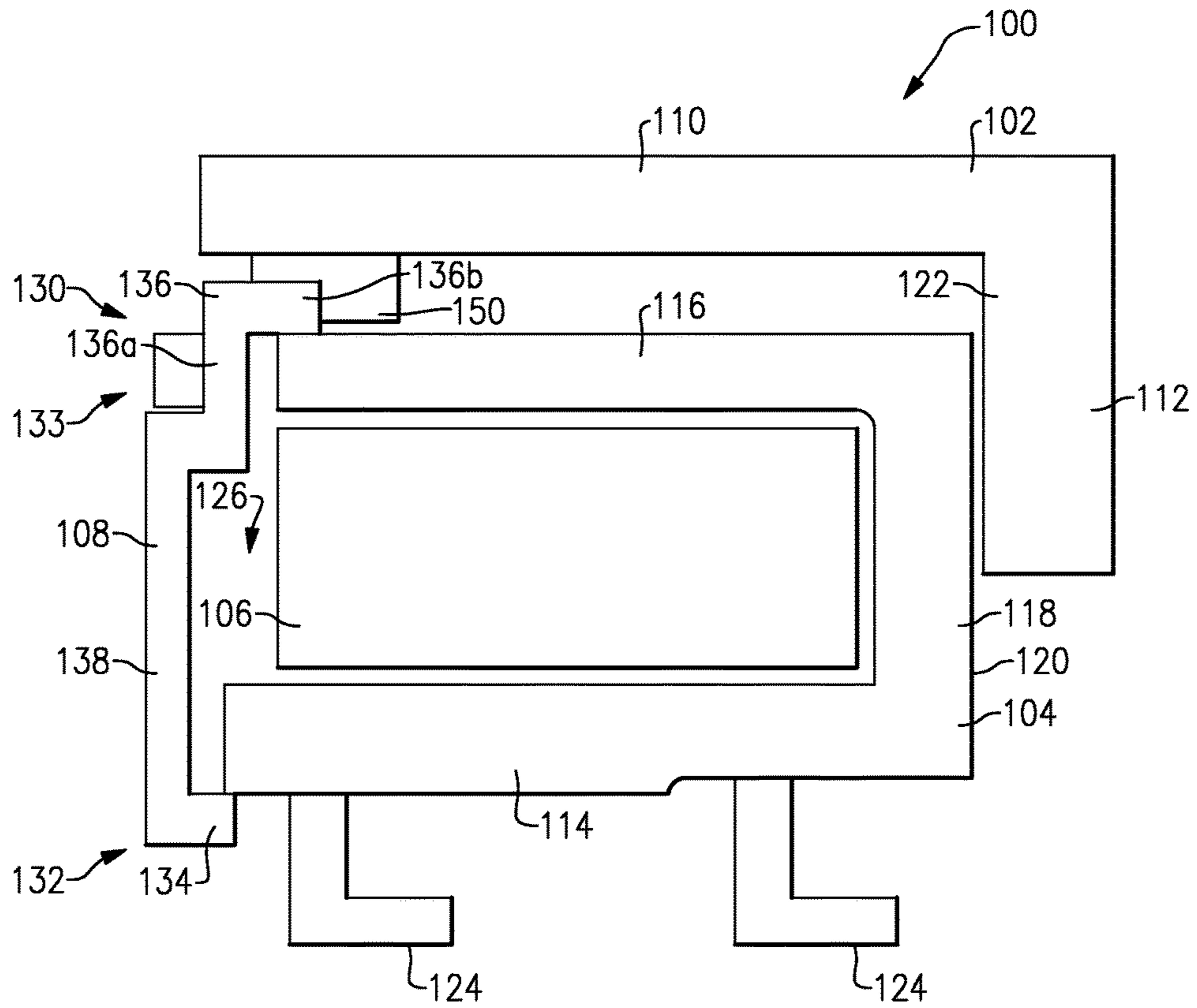


FIG.3

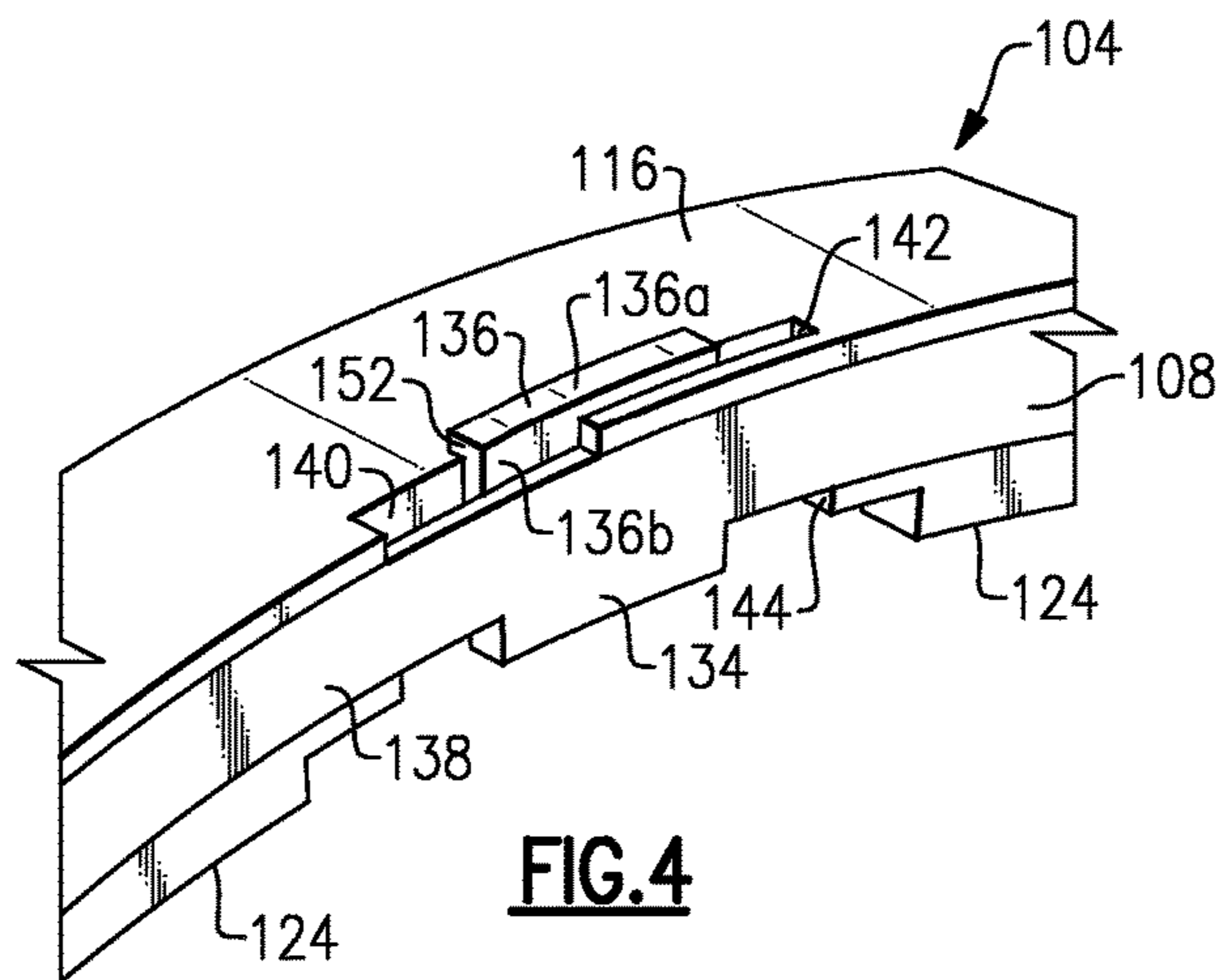
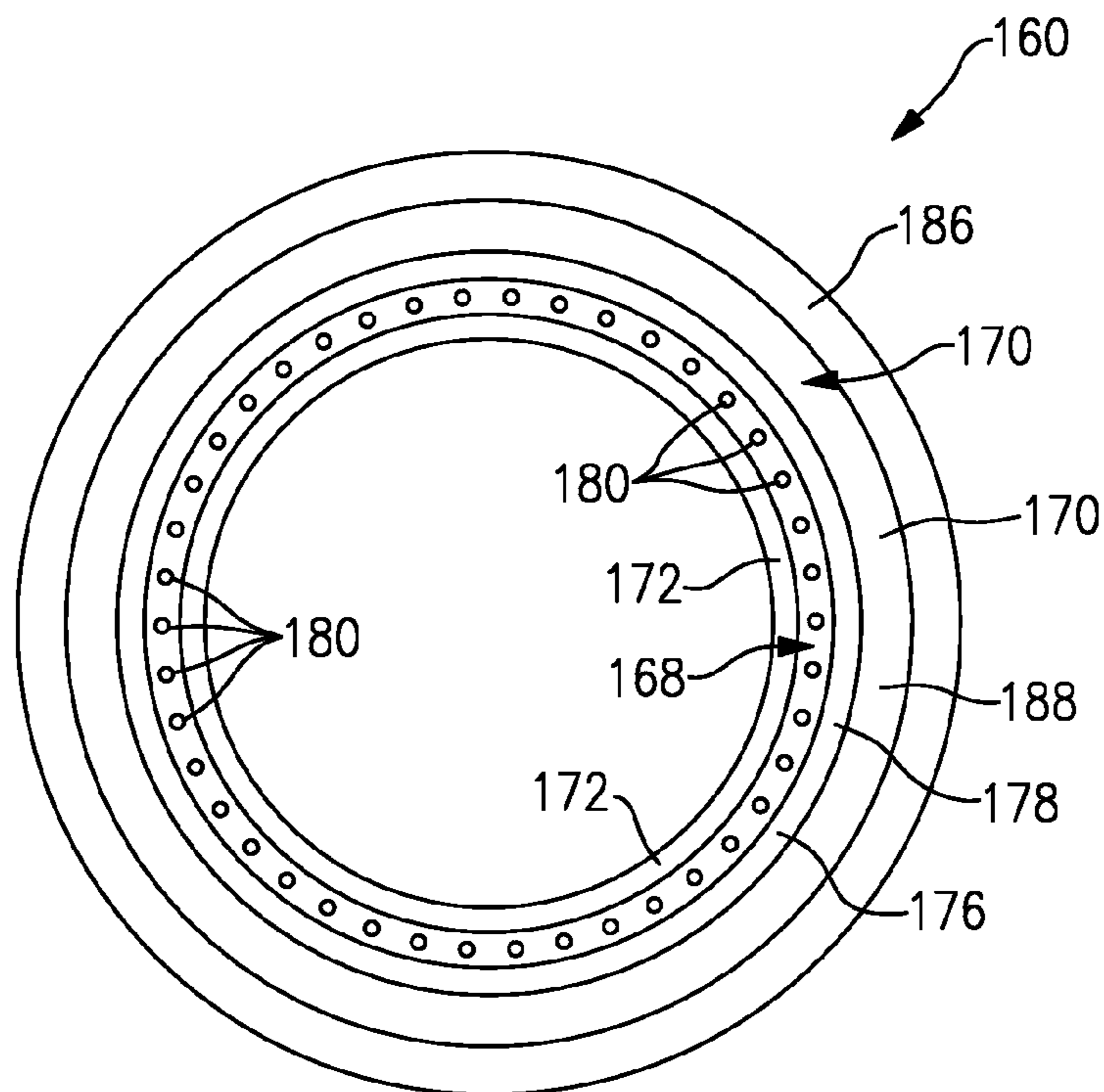
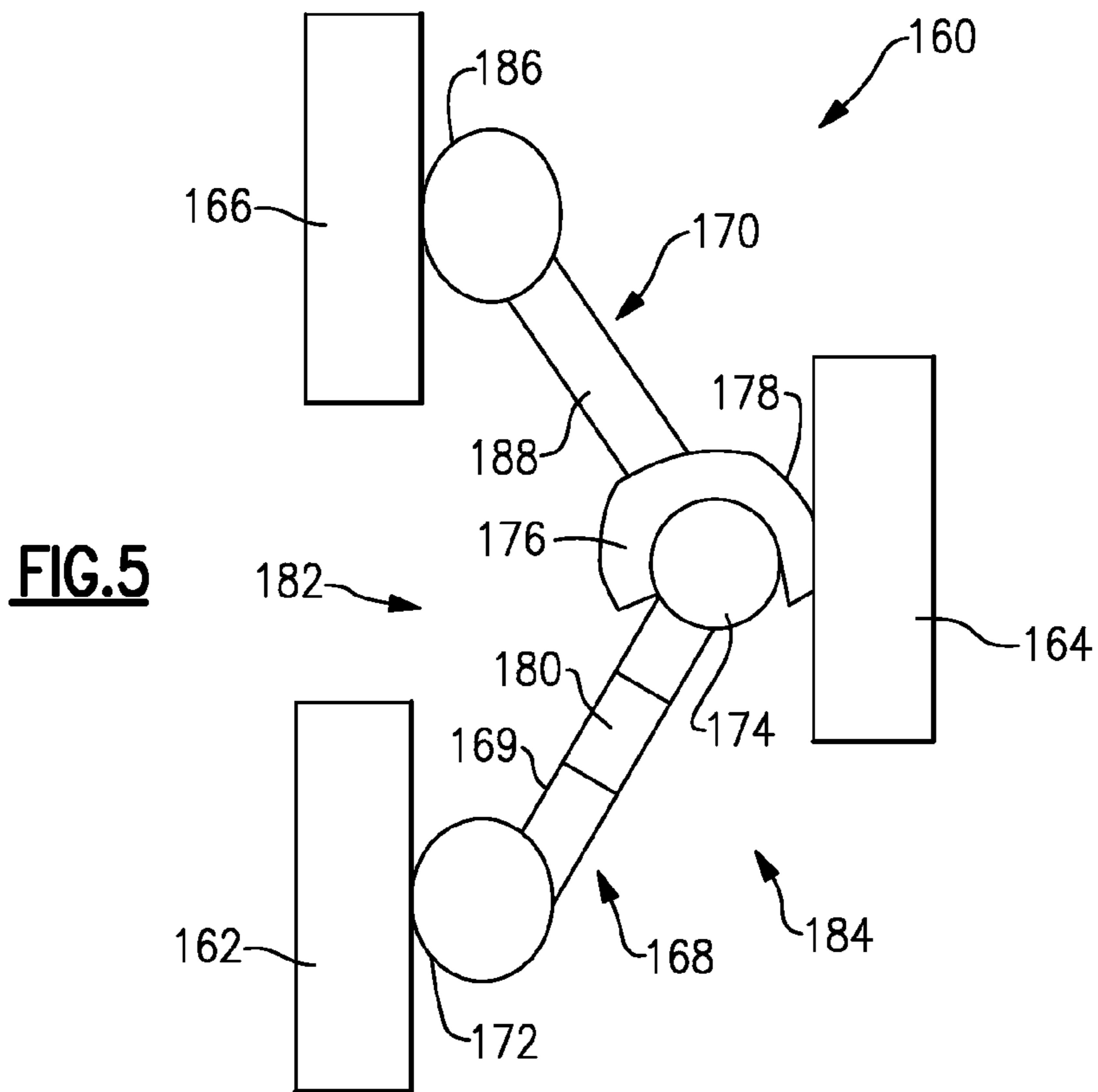


FIG.4



1**SUPPORT ASSEMBLY FOR A GAS TURBINE
ENGINE**STATEMENT REGARDING FEDERALLY
SPONSORED RESEARCH OR DEVELOPMENT

This invention was made with government support under Contract No. FA-8650-09-D-2923-0021 awarded by the United States Air Force. The Government has certain rights in this invention.

BACKGROUND

Gas turbine engines typically include a fan delivering air into a compressor. The air is compressed in the compressor and delivered into a combustion section where it is mixed with fuel and ignited. Products of this combustion pass downstream over turbine blades, driving them to rotate. Turbine rotors, in turn, drive the compressor and fan rotors.

The efficiency of the engine is impacted by ensuring that the products of combustion pass in as high a percentage as possible across the turbine blades. Leakage around the blades reduces efficiency.

Thus, a blade outer air seal is provided radially outward of the blades to prevent leakage radially outwardly of the blades. The blade outer air seal may be held radially outward from the rotating blade via connections on the case or a blade outer air seal support structure. The clearance between the blade outer air seal and a radially outer part of the blade is referred to as a tip clearance.

Since the rotating blade and blade outer air seal may respond radially at different rates due to loads, the tip clearance may be reduced and the blade may rub on the blade outer air seal, which is undesirable. Therefore, there is a need to control the clearance between the blade and the blade outer air seal in order to increase the efficiency of the gas turbine engine.

SUMMARY

In one exemplary embodiment, a seal assembly for a gas turbine engine includes a first member including a first seal land for contacting a first structure. A second member includes a second seal land for contacting a second structure and a third seal land for contacting a third structure. The first member and the second member form a pivotable connection.

In a further embodiment of the above, at least one of the first member and the second member includes at least one passage that extends through a body portion.

In a further embodiment of any of the above, the first member and the second member each form a circumferential ring.

In a further embodiment of any of the above, the first seal land is located on a first end of the first member and the second seal land and the third seal land are located on opposite ends of the second member.

In a further embodiment of any of the above, the pivotable connection includes a male portion on one of the first member and the second member received within a female portion on the other of the first member and the second member.

In a further embodiment of any of the above, the pivotable connection is spring loaded.

In a further embodiment of any of the above, the first seal land and the third seal land are on a first side of the seal and the second seal land is on a second opposite side of the seal.

2

In another exemplary embodiment, a gas turbine engine includes a first structure. A second structure is spaced from the first structure. A third structure is aligned with the first structure. A seal includes a first member which includes a first seal land for contacting a first structure. A second member includes a second seal land for contacting a second structure and a third seal land for contacting a third structure. The first member and the second member form a pivotable connection.

In a further embodiment of any of the above, the first structure, the second structure, and the third include one of a vane, blade outer air seal, engine static structure, engine case, or cover plate.

In a further embodiment of any of the above, at least one of the first member and the second member includes at least one passage that extends through a body portion.

In a further embodiment of any of the above, the first member and the second member each form a circumferential ring.

In a further embodiment of any of the above, the first seal land is located on a distal end of the first member and the second seal land and the third seal land are located on opposite ends of the second member.

In a further embodiment of any of the above, the pivotable connection includes a male portion on the first member received within a female portion on the second member.

In a further embodiment of any of the above, the pivotable connection is spring loaded for providing a biasing force between the first structure, the second structure, and the third structure.

In a further embodiment of any of the above, the first structure is axially aligned with the third structure and the second structure is axially downstream of the first structure and the second structure.

In another exemplary embodiment, a method of sealing gas turbine engine components includes engaging a first structure with a first seal land on a first member of a seal. A second structure is engaged with a second seal land on a second member of the seal. A third structure is engaged with a third seal land on the second member of the seal. The first member is attached to the second member with a pivotable connection.

In a further embodiment of any of the above, the method includes applying a biasing force between the first structure, the second structure, and the third structure with the pivotable connection.

In a further embodiment of any of the above, the method includes directing cooling fluid through passages in at least one of the first member and the second member.

In a further embodiment of any of the above, the method includes pivoting the first member relative to the second member.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a schematic view of an example gas turbine engine.

FIG. 2 is a cross-sectional view of a turbine section of the example gas turbine engine of FIG. 1.

FIG. 3 is a cross-sectional view of an example support assembly for a blade outer air seal.

FIG. 4 is a perspective view of a portion of the support assembly of FIG. 3.

FIG. 5 is a cross-sectional view of an example seal.
FIG. 6 is an axial view of the example seal of FIG. 5.

DETAILED DESCRIPTION

FIG. 1 schematically illustrates a gas turbine engine 20. The gas turbine engine 20 is disclosed herein as a two-spool turbofan that generally incorporates a fan section 22, a compressor section 24, a combustor section 26 and a turbine section 28. Alternative engines might include an augmentor section (not shown) among other systems or features. The fan section 22 drives air along a bypass flow path B in a bypass duct defined within a nacelle 15, while the compressor section 24 drives air along a core flow path C for compression and communication into the combustor section 26 then expansion through the turbine section 28. Although depicted as a two-spool turbofan gas turbine engine in the disclosed non-limiting embodiment, it should be understood that the concepts described herein are not limited to use with two-spool turbofans as the teachings may be applied to other types of turbine engines including three-spool architectures.

The exemplary engine 20 generally includes a low speed spool 30 and a high speed spool 32 mounted for rotation about an engine central longitudinal axis A relative to an engine static structure 36 via several bearing systems 38. It should be understood that various bearing systems 38 at various locations may alternatively or additionally be provided, and the location of bearing systems 38 may be varied as appropriate to the application.

The low speed spool 30 generally includes an inner shaft 40 that interconnects a fan 42, a first (or low) pressure compressor 44 and a first (or low) pressure turbine 46. The inner shaft 40 is connected to the fan 42 through a speed change mechanism, which in exemplary gas turbine engine 20 is illustrated as a geared architecture 48 to drive the fan 42 at a lower speed than the low speed spool 30. The high speed spool 32 includes an outer shaft 50 that interconnects a second (or high) pressure compressor 52 and a second (or high) pressure turbine 54. A combustor 56 is arranged in exemplary gas turbine 20 between the high pressure compressor 52 and the high pressure turbine 54. A mid-turbine frame 57 of the engine static structure 36 is arranged generally between the high pressure turbine 54 and the low pressure turbine 46. The mid-turbine frame 57 further supports bearing systems 38 in the turbine section 28. The inner shaft 40 and the outer shaft 50 are concentric and rotate via bearing systems 38 about the engine central longitudinal axis A which is collinear with their longitudinal axes.

The core airflow is compressed by the low pressure compressor 44 then the high pressure compressor 52, mixed and burned with fuel in the combustor 56, then expanded over the high pressure turbine 54 and low pressure turbine 46. The mid-turbine frame 57 includes airfoils 59 which are in the core airflow path C. The turbines 46, 54 rotationally drive the respective low speed spool 30 and high speed spool 32 in response to the expansion. It will be appreciated that each of the positions of the fan section 22, compressor section 24, combustor section 26, turbine section 28, and fan drive gear system 48 may be varied. For example, gear system 48 may be located aft of combustor section 26 or even aft of turbine section 28, and fan section 22 may be positioned forward or aft of the location of gear system 48.

The engine 20 in one example is a high-bypass geared aircraft engine. In a further example, the engine 20 bypass ratio is greater than about six (6), with an example embodiment being greater than about ten (10), the geared architecture 48 is an epicyclic gear train, such as a planetary gear

system or other gear system, with a gear reduction ratio of greater than about 2.3 and the low pressure turbine 46 has a pressure ratio that is greater than about five. In one disclosed embodiment, the engine 20 bypass ratio is greater than about ten (10:1), the fan diameter is significantly larger than that of the low pressure compressor 44, and the low pressure turbine 46 has a pressure ratio that is greater than about five 5:1. Low pressure turbine 46 pressure ratio is pressure measured prior to inlet of low pressure turbine 46 as related to the pressure at the outlet of the low pressure turbine 46 prior to an exhaust nozzle. The geared architecture 48 may be an epicycle gear train, such as a planetary gear system or other gear system, with a gear reduction ratio of greater than about 2.3:1. It should be understood, however, that the above parameters are only exemplary of one embodiment of a geared architecture engine and that the present invention is applicable to other gas turbine engines including direct drive turbofans.

A significant amount of thrust is provided by the bypass flow B due to the high bypass ratio. The fan section 22 of the engine 20 is designed for a particular flight condition—typically cruise at about 0.8 Mach and about 35,000 feet. The flight condition of 0.8 Mach and 35,000 ft (10,668 meters), with the engine at its best fuel consumption—also known as “bucket cruise Thrust Specific Fuel Consumption (‘TSFC’)”—is the industry standard parameter of 1 bm of fuel being burned divided by 1 bf of thrust the engine produces at that minimum point. “Low fan pressure ratio” is the pressure ratio across the fan blade alone, without a Fan Exit Guide Vane (“FEGV”) system. The low fan pressure ratio as disclosed herein according to one non-limiting embodiment is less than about 1.45. “Low corrected fan tip speed” is the actual fan tip speed in ft/sec divided by an industry standard temperature correction of $[(T_{\text{ram}} \text{ } ^\circ \text{R}) / (518.7^\circ \text{R})]^{0.5}$. The “Low corrected fan tip speed” as disclosed herein according to one non-limiting embodiment is less than about 1150 ft/second (350.5 meters/second).

The example gas turbine engine includes fan 42 that comprises in one non-limiting embodiment less than about twenty-six (26) fan blades. In another non-limiting embodiment, fan section 22 includes less than about twenty (20) fan blades. Moreover, in one disclosed embodiment low pressure turbine 46 includes no more than about six (6) turbine rotors schematically indicated at 34. In another non-limiting example embodiment low pressure turbine 46 includes about three (3) turbine rotors. A ratio between number of fan blades 42 and the number of low pressure turbine rotors is between about 3.3 and about 8.6. The example low pressure turbine 46 provides the driving power to rotate fan section 22 and therefore the relationship between the number of turbine rotors 34 in low pressure turbine 46 and number of blades 42 in fan section 22 disclose an example gas turbine engine 20 with increased power transfer efficiency.

Although the gas turbine engine 20 shown is a high bypass gas turbine engine, other types of gas turbine engines could be used, such as a turbojet engine.

FIG. 2 illustrates an enlarged schematic view of the high pressure turbine 54, however, other sections of the gas turbine engine 20 could benefit from this disclosure, such as the compressor section 24 or the low pressure turbine 46. In the illustrated example, the high pressure turbine 54 includes a one-stage turbine section with a first rotor assembly 60. In another example, the high pressure turbine 54 could include a two or more stage high pressure turbine section.

The first rotor assembly 60 includes a first array of rotor blades 62 circumferentially spaced around a first disk 64. Each of the first array of rotor blades 62 includes a first root

portion 72, a first platform 76, and a first airfoil 80. Each of the first root portions 72 is received within a respective first rim 68 of the first disk 64. The first airfoil 80 extends radially outward toward a first blade outer air seal (BOAS) assembly 84. The BOAS 84 is supported by a support assembly 100.

The first array of rotor blades 62 are disposed in the core flow path that is pressurized in the compressor section 24 then heated to a working temperature in the combustor section 26. The first platform 76 separates a gas path side inclusive of the first airfoils 80 and a non-gas path side inclusive of the first root portion 72.

An array of vanes 90 are located axially upstream of the first array of rotor blades 62. Each of the array of vanes 90 include at least one airfoil 92 that extend between a respective vane inner platform 94 and an vane outer platform 96. In another example, each of the array of vanes 90 include at least two airfoils 92 forming a vane double. The vane outer platform 96 of the vane 90 may at least partially engage the BOAS 84.

As shown in FIGS. 2 and 3, the support assembly 100 includes an outer support 102, an inner support 104, a control ring 106, and a cover plate 108. The outer support 102 forms a complete unitary hoop and includes an axially extending flange 110 and a radially extending flange 112. The axially extending flange 110 engages a case or a portion of the engine static structure 36 when installed in the gas turbine engine 20. The radially extending portion of the outer support 102 extends radially inward from the axially extending flange 110. In this disclosure, radial or radially extending is in relation to the engine axis A of the gas turbine engine 20 unless stated otherwise.

In the illustrated example, the inner support 104 includes a C-shaped cross section with an opening of the C-shaped cross section facing an axially upstream or forward direction. In another example, the opening of the C-shaped cross section faces in an axially downstream or rearward direction. The C-shaped cross section is formed by a radially inner flange 114 connected to a radially outer flange 116 by a radially extending flange 118. The radially extending flange 118 includes an axial surface 120 that contacts or is in close proximity to an axial surface 122 on the radially extending flange 112 on the outer support 102 to prevent the inner support 104 from moving axially downstream past the radially extending flange 112.

The radially outer flange 116 is spaced radially inward from the axially extending flange 110 on the outer support 102 such that a clearance between the axially extending flange 110 and the radially outer flange 116 is maintained during operation of the gas turbine engine 20. By maintaining the clearance between the axially extending flange 110 and the radially outer flange 116, the inner support 104 is allowed to grow radially outward when exposed to elevated operating temperatures during operation of the gas turbine engine 20 without transferring a load to the outer support 102.

In the illustrated example, the radially inner flange 114 includes attachment members 124 that extend radially inward from a radially inner surface of the radially inner flange 114 to support the BOAS 84 as shown in FIGS. 1 and 2. Although the attachment members 124 are shown as a pair of hooks with distal ends pointing axially downstream in the illustrated example, the attachment members 124 could include hooks pointing in opposite directions or more than or less than two hooks.

In the illustrated example, the cover plate 108 is attached to an axially forward end of the inner support 104 to form a cavity 126 that surrounds the control ring 106. Both the

inner support 104 and the cover plate 108 are made of corresponding segments that fit together to form a circumferential ring.

In one example, the cover plate 108 and the inner support 104 are made of the same material. By making the cover plate 108 and the inner support 104 of the same material, the thermal growth of the cover plate 108 will closely match the thermal growth of the inner support 104 to ensure that the axial ends of the inner support 104 grow at a similar rate in the radial direction. In another example, the cover plate 108 and the inner support 104 are made of dissimilar material to control positioning of the support assembly 100.

As shown in FIGS. 2 and 3, the cover plate 108 and the inner support 104 are attached to each other with a first retention member 130 and a second retention member 132. In the illustrated example, the first retention member 130 includes a bayonet attachment portion 133 on a radially outer edge of the cover plate 108 and the second retention member 132 includes a tab 134 on a radially inner edge of the cover plate 108. The tab 134 extends in an axially downstream direction. The first retention member 130 and the second retention member 132 allow for axial movement between the cover plate 108 and the inner support 104.

The bayonet attachment portion 133 includes a hook portion 136 having a radially extending portion 136a that is axially offset from a body portion 138 of the cover plate 108. The radially outer flange 116 of the inner support 104 includes a recess 140 for accepting the hook portion 136 and a groove 142 at least partially axially aligned with the recessed 140 and circumferentially offset such that the cover plate 108 can be rotated in a circumferential direction to move the hook portion 136 from the recessed 140 into the groove 142. The radially extending portion 136a of the hook portion 136 engages axial faces of the groove 142 and an axially extending portion 136b of the hook portion 136 engages a radially outer surface of the radially outer flange 116.

The tab 134, which forms the second retention member 132, is located on a radially inner edge of the cover plate 108. The tab 134 engages a radially inner surface of the radially inner flange 114 on the inner support 104 such that the bayonet attachment portion 133 and the tab 134 surround the inner support 104.

Opposing ends of the cover plate 108, which are circumferentially spaced from the first retention member 130 and the second retention member 132, fit within the inner support 104. As shown in FIG. 3, the opposing ends of the cover plate 108 contact a radially inner surface of the radially outer flange 116 and a radially inner edge of the cover plate 108 contacts a radially outer surface of the radially inner flange 114.

As shown in FIG. 5, a seal 160 is formed between a first structure 162, a second structure 164, and a third structure 166. In the illustrated example shown in FIG. 2, the first structure 162 is the outer platform 96 on the airfoil 92, the second structure 164 is the cover plate 108, and the third structure 166 is the engine static structure 36. In one example, the first structure 162 is axially aligned on the same side with the third structure 166 and spaced radially inward from the third structure 166. In another example, the first structure 162 could be axially offset from third structure 166. The second structure 164 is also spaced axially downstream of the first structure 162 and the third structure 166.

Although the outer platform 96, the cover plate 108, and the engine static structure 36 represent the first, second, and third structure 162, 164, and 166, respectively, the seal 160 could contact other structures of the gas turbine engine 20,

such as the BOAS **84** or the engine case. Additionally, the seal **160** could be located in other parts of the gas turbine engine **20**, such as the compressor section **24**.

As shown in FIGS. **5** and **6**, the seal **160** includes a first member **168** and a second member **170**. The first member **168** includes a first seal land **172** at a first radially inner end and a male connector **174** on a second radially outer end. The first seal land **172** may engage the first structure **162** with a frictional contact that allows the rounded portion of the first seal land **172** to rotate or pivot on the first structure **162**. Alternatively, the first seal land **172** could be rigidly attached to the first structure **162** such that the first seal land **172** does not move in the circumferential or radial direction relative to the first structure **162**. The first seal land **172** and the male connector **174** extend in a circumferential direction and form a complete hoop. In another example, the first seal land **172** and the male connector **174** are divided into more than one segment to form a circumferential loop.

The first member **168** includes a body portion **169** that extends between and connects the first seal land **172** to the male connector **174**. As shown in FIGS. **5** and **6**, a plurality of cooling passages **180** extend through the first member **168** to allow fluid to travel between a first cavity **182** at a higher pressure to a second cavity **184** at a lower pressure.

The second member **170** includes a female connector **176** on a first radially inner end and a third seal land **186** on a second radially outer end. The female connector **176** receives the male connector **174** and includes a second seal land **178** that engages the second structure **164**. The second seal land **178** may engage the second structure **164** with a frictional contact that allows the rounded portion of the second seal land **178** to rotate or pivot on the second structure **164**. Alternatively, the second seal land **178** could be rigidly attached to the second structure **164** such that the second seal land **178** does not move in the circumferential or radial direction relative to the second structure **164**. The female connector **176** including both the second seal land **178** and the third seal land **186** extend in a circumferential direction and form a complete hoop.

The second member **170** includes a body portion **188** that extends between and connects the third seal land **186** and the female connector **176**. Although the illustrated example shows the plurality of cooling passages **180** in the first member **168**, the plurality of cooling passages **180** could also be located in the body portion **188** of the second member **170**. The cooling passages **180** located in the body portion **188** of the second member could be in addition to or in place of the cooling passages **180** in the first member **168** depending on the desired amount and direction of flow required.

Depending on a desired amount of relative movement between the first, second, and third structures **162**, **164**, **166**, a stiffness of the first member **168** and a stiffness of the second member **170** could vary. For example, the first member **168** could have stiffness greater than, equal to, or less than a stiffness of the second member **170**.

In order to provide resistance to deflections in the first, second, and third structures **162**, **164**, **166**, a pivotable connection between the male connector **174** and the female connector **176** is spring loaded to resist the deflection between the first, second, and third structures **162**, **164**, **166**.

During assembly of the support assembly **100**, the plurality of inner supports **104** are arranged in a circumferential ring surrounding the control ring **106** with the control ring **106** located in the cavity **126**. Each of the corresponding plurality of cover plates **108** is placed on the inner support **104** such that the hook portion **136** on each of the plurality

of cover plates **108** is located within the corresponding recess **140** in each of the plurality of inner supports **104**.

When the plurality of cover plates **108** are located on the inner supports **104**, the plurality of cover plates **108** are rotated in unison such that the hook portion **136** on each of the plurality of cover plates **108** moves into the corresponding grooves **142** on each of the inner supports **104**. When each of the plurality of cover plates **108** is initially placed in the grooves **142** of the inner support **104**, one of the circumferential ends of each of the plurality of cover plates **108** will overlap an adjacent inner support **104**. As the plurality of cover plates **108** rotate, each of the plurality of cover plates **108** will circumferentially align with a corresponding one of the inner supports **104**. The plurality of cover plates **108** are prevented from rotating further by a stop **144** on the inner support **104** that engages the tab **134**.

The inner supports **104**, the control ring **106**, and the plurality of cover plates **108** are then placed within the outer support **102** such that the axial surface **120** on the inner support **104** contacts or is in close proximity to the axial surface **122** on the outer support **102**. A plurality of cover plate tabs **150** extend from a radially inner surface of the axially extending flange **110** of the outer support **102** and engage an edge **152** on each of the hook portions **136** to prevent each of the cover plates **108** from rotating out of the groove **142** after being installed into the outer support **102**.

When the support assembly **100** is placed within the gas turbine engine **20**, the seal **160** is placed adjacent the cover plate **108**. The first member **168** and the second member **170** provide a stabilizing force that vertically aligns the axial surface **120** with the axial surface **122**. A spring force creates the stability and prevents a range of tilting of the inner support **104**.

The preceding description is exemplary rather than limiting in nature. Variations and modifications to the disclosed examples may become apparent to those skilled in the art that do not necessarily depart from the essence of this disclosure. The scope of legal protection given to this disclosure can only be determined by studying the following claims.

What is claimed is:

1. A seal assembly for a gas turbine engine comprising:
 - a first member including a first seal land for contacting a first structure; and
 - a second member including a second seal land for contacting a second structure and a third seal land for contacting a third structure, wherein the first member and the second member form a pivotable connection, wherein the pivotable connection includes a male portion on one of the first member and the second member received within a female portion on the other of the first member and the second member and wherein the pivotable connection is spring loaded.
2. The assembly of claim **1**, wherein at least one of the first member and the second member includes at least one passage extending through a body portion.
3. The assembly of claim **1**, wherein the first member and the second member each form a circumferential ring, the first seal land is located on a first radial side of the second seal land and the third seal land is located on a second radial side of the second seal land opposite the first radial side.
4. The assembly of claim **1**, wherein the first seal land is located on a first end of the first member and the second seal land and the third seal land are located on opposite ends of the second member and the first seal land and the third seal land face a common axial direction.

5. The assembly of claim 1, wherein the first member and the second member each form a circumferential ring extending about a central longitudinal axis and the first seal land and the third seal land are on a first axial side of the seal assembly and the second seal land is on a second opposite axial side of the seal assembly.

6. The assembly of claim 1, wherein the second seal land is located on the female portion of the pivotable connection.

7. A gas turbine engine comprising:

a first structure;

a second structure spaced from the first structure;

a third structure aligned on the same side as the first structure with the first structure; and

a seal including:

a first member including a first seal land for contacting a first structure; and

a second member including a second seal land for contacting a second structure and a third seal land for contacting a third structure, wherein the first member and the second member form a pivotable connection.

8. The gas turbine engine of claim 7, wherein the first structure, the second structure, and the third structure include one of a vane, a blade outer air seal, a gas turbine engine static structure, a gas turbine engine case, or a cover plate for a control ring for a gas turbine engine and the first member is spaced from the third structure.

9. The gas turbine engine of claim 8, wherein the pivotable connection includes a male portion on the first member received within a female portion on the second member and the second seal land is located on the female portion.

10. The gas turbine engine of claim 9, wherein the pivotable connection is spring loaded for providing a biasing force between the first structure, the second structure, and the third structure.

11. The gas turbine engine of claim 7, wherein at least one of the first member and the second member includes at least one passage extending through a body portion.

12. The gas turbine engine of claim 7, wherein the first member and the second member each form a circumferential ring, the first seal land is located on a first radial side of the second seal land and the third seal land is located on a second radial side of the second seal land opposite the first radial side.

13. The gas turbine engine of claim 7, wherein the first seal land is located on a distal end of the first member and the second seal land and the third seal land are located on opposite ends of the second member, the first structure includes a first seal land contact surface contacting the first seal land, the third structure includes a third seal land contact surface and the first seal land contact surface and the third seal land contact surface face a common axial direction.

14. The gas turbine engine of claim 7, wherein the first structure is axially aligned with the third structure on a upstream side of the seal relative to a central longitudinal axis of the gas turbine engine, the second structure is downstream of the seal relative to the central longitudinal axis of the gas turbine engine, and first structure and the third structure, the first structure includes a first seal land contact surface contacting the first seal land, the third structure includes a third seal land contact surface and the first seal land contact surface and the third seal land contact surface face a common axial direction.

15. The gas turbine engine of claim 7, wherein the first member and the second member each form a circumferential ring extending about a central longitudinal axis of the gas turbine engine and the first seal land and the third seal land are on a first axial side of the seal relative to the central longitudinal axis of the gas turbine engine and the second seal land is on a second opposite axial side of the seal relative to the central longitudinal axis of the gas turbine engine, and the first seal land is located on a first radial side of the second seal land and the third seal land is located on a second radially side of the second seal land opposite the first radial side, and the first structure includes a first seal land contact surface contacting the first seal land, the third structure includes a third seal land contact surface and the first seal land contact surface and the third seal land contact surface face a common axial direction.

16. A method of sealing and/or stabilizing gas turbine engine components comprising:

engaging a first structure with a first seal land on a first member of a seal;

engaging a second structure with a second seal land on a second member of the seal;

engaging a third structure with a third seal land on the second member of the seal, wherein the first member is attached to the second member with a pivotable connection.

17. The method of claim 16, further comprising applying a biasing force between the first structure, the second structure, and the third structure with the pivotable connection and the first member is spaced from the third structure.

18. The method of claim 16, further comprising directing cooling fluid through passages in at least one of the first member and the second member.

19. The method of claim 16, further comprising pivoting the first member relative to the second member and the pivotable connection includes a male portion on the first member received within a female portion on the second member and the second seal land is located on the female portion.

* * * * *