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(54) COMBUSTOR CONFIGURATIONS FOR A GAS TURBINE ENGINE

(57) The present disclosure relates to combustor configurations and components for a gas turbine engine (100). In one embodiment, a combustor (105) for a gas turbine engine includes a support structure and a plurality of panels (115) mounted to the structure. The plurality of panels define a combustion cavity (120) of the combustor. The plurality of panels include a first panel (126; 205; 305) having a leading (315) and trailing edge (135; 215), and a second panel (127; 210; 310) having a leading edge (140; 220; 320) and trailing edge (325), wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

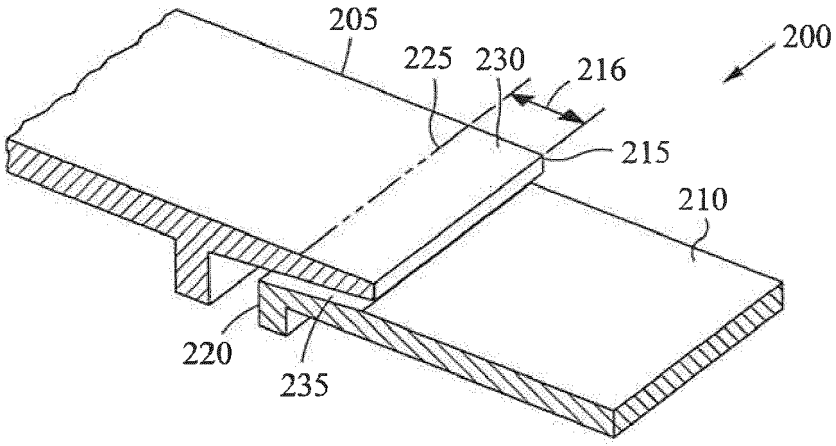


FIG. 2A

EP 3 076 078 A1

Description

FIELD

[0001] The present disclosure relates to combustors for gas turbine engines and, in particular, to combustor configurations and components for gas turbine engines.

BACKGROUND

[0002] Gas turbine engines are required to operate efficiently during operation and flight. Theses engines create a tremendous amount of force and generate high levels of heat. As such, components of these engines are subjected to high levels of stress, temperature and pressure. It is necessary to provide components that can withstand the demands of a gas turbine engine. It is also desirable to provide components with increased operating longevity.

[0003] Conventional gas turbine engine combustors can include a combustor shell. The conventional combustor shell and its typical arrangement provide air flow to a combustor cavity. However, the conventional arrangements may result in regions experiencing distress due to the hot gas environment of the engine. Accordingly, there is a desire to improve combustion cooling and provide a configuration that allows for improved cooling characteristics. There is also a desire to improve the configuration of gas turbine engines and combustors.

BRIEF SUMMARY OF THE EMBODIMENTS

[0004] Disclosed and claimed herein are combustor configurations and components for gas turbine engines. One embodiment is directed to a combustor for a gas turbine engine, the combustor including a support structure and a plurality of panels mounted to the structure, the plurality of panels defining a combustion cavity of the combustor. The plurality of panels include a first panel having a leading and trailing edge and a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

[0005] In one embodiment, the support structure is an annular structure including an inner diameter structure and outer diameter structure, and wherein the plurality of panels are mounted to at least one of the inner diameter structure and outer diameter structure.

[0006] In one embodiment, the plurality of panels are heat shield panels.

[0007] In one embodiment, an air gap between the trailing edge of the first panel and the leading edge of the second panel forms at least a portion of a circumferential air gap for the combustor.

[0008] In one embodiment, the trailing edge of the first panel extends beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein portion of the first panel associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

[0009] In one embodiment, the first panel extends over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

[0010] In one embodiment, the second panel includes effusion holes positioned along the leading edge of the second panel.

[0011] In one embodiment, the leading edge of the second panel is chamfered.

[0012] In one embodiment, the leading edge of the second panel includes one or more features to provide airflow when the trailing edge of the first panel contacts the leading edge of the second panel.

[0013] In one embodiment, the one or more features include groves in the leading edge of the second panel to provide said airflow.

[0014] Another embodiment is directed to a gas turbine engine including a combustor having a support structure and a plurality of panels mounted to the support structure. The plurality of panels define a combustion cavity of the combustor. The plurality of panels include a first panel having a leading and trailing edge, and a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

[0015] In one embodiment, the support structure is an annular structure including an inner diameter structure and outer diameter structure, and wherein the plurality of panels are mounted to at least one of the inner diameter structure and outer diameter structure.

[0016] In one embodiment, the plurality of panels are heat shield panels.

[0017] In one embodiment, an air gap between the trailing edge of the first panel and the leading edge of the second panel forms at least a portion of a circumferential air gap for the combustor.

[0018] In one embodiment, the trailing edge of the first panel extends beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein portion of the first panel associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

[0019] In one embodiment, the first panel extends over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

[0020] In one embodiment, the second panel includes effusion holes positioned along the leading edge of the second panel.

[0021] In one embodiment, leading edge of the second panel is chamfered.

[0022] In one embodiment, leading edge of the second panel includes one or more features to provide airflow when the trailing edge of the first panel contacts the lead-

ing edge of the second panel.

[0023] In one embodiment, the one or more features include groves in the leading edge of the second panel to provide said airflow.

[0024] The present disclosure provides a combustor for a gas turbine engine, the combustor comprising: a support structure; and a plurality of panels mounted to the structure, the plurality of panels defining a combustion cavity of the combustor, wherein the plurality of panels include a first panel having a leading and trailing edge, and a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

[0025] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the support structure may be an annular structure including an inner diameter structure and outer diameter structure, and the plurality of panels may be mounted to at least one of the inner diameter structure and outer diameter structure.

[0026] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of panels may be heat shield panels.

[0027] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, an air gap between the trailing edge of the first panel and the leading edge of the second panel may form at least a portion of a circumferential air gap for the combustor.

[0028] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the trailing edge of the first panel may extend beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein a portion of the first panel associated with the leading edge may be configured to prevent a gas path flow within the combustor to enter the air flow gap.

[0029] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the first panel may extend over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

[0030] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the second panel may include effusion holes positioned along the leading edge of the second panel.

[0031] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the leading edge of the second panel may be chamfered.

[0032] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the leading edge of the second panel may include one or more features to provide airflow when the trailing edge of the first panel contacts the leading edge of the second panel.

[0033] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the one or more features may include groves in the leading edge of the second panel to provide said airflow.

[0034] The present disclosure also provides a gas turbine engine comprising: a combustor having a support structure; and a plurality of panels mounted to the support structure, the plurality of panels defining a combustion cavity of the combustor, wherein the plurality of panels include a first panel having a leading and trailing edge, and a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

[0035] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the support structure may be an annular structure including an inner diameter structure and outer diameter structure, and the plurality of panels may be mounted to at least one of the inner diameter structure and outer diameter structure.

[0036] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of panels may be heat shield panels.

[0037] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, an air gap between the trailing edge of the first panel and the leading edge of the second panel forms at least a portion of a circumferential air gap for the combustor.

[0038] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the trailing edge of the first panel may extend beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein a portion of the first panel associated with the leading edge may be configured to prevent a gas path flow within the combustor to enter the air flow gap.

[0039] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the first panel may extend over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

[0040] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the second panel may include effusion holes positioned along the leading edge of the second panel.

[0041] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the leading edge of the second panel may

be chamfered.

[0042] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the leading edge of the second panel may include one or more features to provide airflow when the trailing edge of the first panel contacts the leading edge of the second panel.

[0043] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the one or more features may include groves in the leading edge of the second panel to provide said airflow.

[0044] Other aspects, features, and techniques will be apparent to one skilled in the relevant art in view of the following detailed description of the embodiments.

BRIEF DESCRIPTION OF THE DRAWINGS

[0045] The features, objects, and advantages of the present disclosure will become more apparent from the detailed description set forth below when taken in conjunction with the drawings in which like reference characters identify correspondingly throughout and wherein:

FIG. 1 depicts a graphical representation of a gas turbine engine and combustor configuration according to one or more embodiments;

FIGs. 2A-2B depict graphical representations of a panel configuration according to one or more embodiments; and

FIGs. 3A-3C depict graphical representations of combustor panels according to one or more embodiments.

DETAINED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Overview and Terminology

[0046] One aspect of this disclosure relates to configurations for combustors according to one or more embodiments. In one embodiment, a configuration is provided for a combustor to prevent hot air/gas path egress to one or more air gaps of the combustor. According to one embodiment, panels may be configured with an extended portion to allow for the trailing edge of panels to extend over the leading edge of adjacent and downstream panels. In addition, one or more features may be provided to account for thermal growth of the panel interface.

[0047] As used herein, the terms "a" or "an" shall mean one or more than one. The term "plurality" shall mean two or more than two. The term "another" is defined as a second or more. The terms "including" and/or "having" are open ended (e.g., comprising). The term "or" as used herein is to be interpreted as inclusive or meaning any one or any combination. Therefore, "A, B or C" means "any of the following: A; B; C; A and B; A and C; B and C; A, B and C". An exception to this definition will occur only when a combination of elements, functions, steps or acts are in some way inherently mutually exclusive.

[0048] Reference throughout this document to "one embodiment," "certain embodiments," "an embodiment," or similar term means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment. Thus, the appearances of such phrases in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner on one or more embodiments without limitation.

Exemplary Embodiments

[0049] FIG. 1 depicts a graphical representation of a gas turbine engine and combustor configuration according to one or more embodiments. FIG. 1 depicts a cross-sectional representation of a gas turbine engine **100** including a combustor **105** according to one or more embodiments. Combustor **105** includes a combustor structure **110** and a plurality of panel elements shown as **115.** According to one embodiment, combustor **105** employs combustor structure **110** to support the plurality of panel elements **115.** The plurality of panel elements **115** may be heat shield panels to form the combustion cavity **120** of combustor **105.** Combustor **105** may be an annular structure including outer diameter structure **112** and inner diameter structure **113** of combustor **105.** The plurality of panels **115** are mounted to at least one of the inner diameter structure **113** and outer diameter structure **112.** Combustion cavity **120** of combustor **105** may be positioned between outer diameter structure **112** and inner diameter structure **113.** Combustor **105** may interface with fuel injector **111.**

[0050] According to one embodiment, combustor **105** may include one or more air gaps between panels **115.** Air gaps between panels **115** may be associated with outer diameter structure **112** and/or inner diameter structure **113** of combustor **105.** Exemplary regions for including air gaps are shown as **124** and **125** associated with outer diameter structure **112** and inner diameter structure **113,** respectively. According to one embodiment, panels **115** associated with an air gap may include one or more features and configurations. FIG. 1 depicts an exploded view of region **125** associated with inner diameter structure **113.**

[0051] According to one embodiment, panels **115** may include a first panel **126** and a second panel **127** mounted to structure **110.** First and second panels **126** and **127** have leading and trailing edges. Second panel **127** is mounted to the support structure aft of the first panel **126.**

[0052] According to one embodiment, first panel **126** includes a trailing edge portion **135** which extends over

leading edge **140** of second panel **127.** The configuration of first panel **126** and a second panel **127** provides an air gap between the panels and allows for airflow **130** in the gap. Airflow **130** serves to both cool the extended lip of a trailing edge portion **135** of the first panel **126** (e.g., the upstream panel) and also lay a cooling film down on second panel **127** (e.g., the downstream panel). According to one embodiment, leading edge **140** of second panel 127 is chamfered.

[0053] According to one embodiment, first panel **126** is upstream (e.g., forward) from second panel **127.** Similarly, second panel **127** is downstream (e.g., aft) of first panel **126.** Although region **125** is shown and described as associated with inner diameter structure **113** it is equally appreciated that outer diameter **124** may include a similar configuration of a forward panel including a portion that overlaps an adjacent panel. It should also be appreciated that all panels along the circumferential gas path opening may include an overlapping configuration. As will be discussed in more detail below and according to another embodiment, an overlapping configuration may be employed to lateral portions (e.g., rails) of panel elements **115.**

[0054] FIGs. 2A-2B depict graphical representations of panel configurations for a combustor according to one or more embodiments. FIG. 2A depicts a graphical representation of a first panel **205** (e.g., first panel **126)** and a second panel **210** (e.g., a second panel **127).** First panel 205 includes trailing edge **215** which extends over a leading edge **220** of second panel **210** by a distance shown as **216.** The first panel **205** extends over the second panel **210** along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

[0055] The position of leading edge **220** is identified as **225** such that the portion **230** that extends over the first panel **205** is identified as **230.** According to one embodiment, second panel **210** includes chamfered region **235,** which is angled down to allow for portion **230** to extend over chamfered region **235.** An air gap between the trailing edge of the first panel **205** and the leading edge of the second panel **210** forms at least a portion of a circumferential air gap for the combustor. The trailing edge **215** of the first panel **205** extends beyond the leading edge **220** of the second panel **210** to provide an air flow gap between the first and second panels and wherein portion **230** of the first panel **205** associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

[0056] FIG. 2B depicts an exploded view of first panel **205** (e.g., upstream panel) and a second panel **210** (e.g., downstream panel). According to one embodiment, second panel **210** includes one or more features **240** in chamfered region **235.** Features **240** may provide air flow paths when the trailing edge of the first panel **205** contacts the leading edge of the second panel **210.** According to one embodiment, features **240** are grooves or indentations which may be perpendicular or substantially perpendicular to the leading edge **220** of second panel **210.** In certain embodiments, features **240** may be ridges or raised portions which may be perpendicular or substantially perpendicular to the leading edge **220** of second panel **210.** Features **240** may include effusion holes positioned along the leading edge of the second panel **210.**

[0057] FIGs. 3A-3C depict graphical representations of combustor panels according to one or more embodiments. FIG. 3A depicts combustor configuration **300** including panels **305** and **310.** The hot side (e.g., side facing combustor cavity **120)** of first panel **305** and **310** are shown. In FIG. 3A, combustor configuration **300** include a first panel **305** and a second panel **310** mounted to structure **110.** First and second panels **305** and **310** have leading and trailing edges, such that leading edge **315** of panel **305** extends over panel **310.** Leading edge of panel **310** is represented by segment **320.** Trailing edge of second panel **310** is shown as **325.** According to one embodiment, lateral or rail portions of panels **305** and **310** may include one or more features to provide lateral sealing between panels. Lateral portions **330** and **335** of first panel **305** may relate to overhanging or chamfered regions to interface with lateral portions of another panel, such as panel **350.** Panel **350** includes lateral regions **355** and **360.** According to one embodiment, lateral portion **335** of panel **305** may interface with lateral portion **355** of panel **350.** By way of example, FIG. 3B depicts an exemplary configuration **365** of panels **305** and **350.** Lateral portion **335** may overhang panel **310** and lateral portion **355** may be chamfered. Panel **305** includes base structure **366** to mount to support structure. Similarly, panel **350** includes base structure **367** to mount to support structure.

[0058] FIG. 3C depicts a representation of an inner diameter **371** of an annular structure **370,** such as a combustor inner diameter structure including panels **305** and **350.**

[0059] While this disclosure has been particularly shown and described with references to exemplary embodiments thereof, it will be understood by those skilled in the art that various changes in form and details may be made therein without departing from the scope of the claimed embodiments. The following clauses set out features of the present disclosure which may or may not presently be claimed but which may form basis for future amendments and/or a divisional application.

1. A combustor for a gas turbine engine, the combustor comprising:

a support structure; and

a plurality of panels mounted to the structure, the plurality of panels defining a combustion cavity of the combustor, wherein the plurality of panels include

a first panel having a leading and trailing edge, and

a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

2. The combustor of clause 1, wherein the support structure is an annular structure including an inner diameter structure and outer diameter structure, and wherein the plurality of panels are mounted to at least one of the inner diameter structure and outer diameter structure.

3. The combustor of clause 1, wherein the plurality of panels are heat shield panels.

4. The combustor of clause 1, wherein an air gap between the trailing edge of the first panel and the leading edge of the second panel forms at least a portion of a circumferential air gap for the combustor.

5. The combustor of clause 1, wherein the trailing edge of the first panel extends beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein portion of the first panel associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

6. The combustor of clause 1, wherein the first panel extends over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

7. The combustor of clause 1, wherein the second panel includes effusion holes positioned along the leading edge of the second panel.

8. The combustor of clause 1, wherein leading edge of the second panel is chamfered.

9. The combustor of clause 1, wherein leading edge of the second panel includes one or more features to provide airflow when the trailing edge of the first panel contacts the leading edge of the second panel.

10. The combustor of clause 9, wherein the one or more features include groves in the leading edge of the second panel to provide said airflow.

11. A gas turbine engine comprising:

a combustor having a support structure; and
a plurality of panels mounted to the support structure, the plurality of panels defining a combustion cavity of the combustor, wherein the plurality of panels include
a first panel having a leading and trailing edge, and
a second panel having a leading edge and trailing edge, wherein a trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

12. The gas turbine engine of clause 10, wherein the support structure is an annular structure including an inner diameter structure and outer diameter structure, and wherein the plurality of panels are mounted to at least one of the inner diameter structure and outer diameter structure.

13. The gas turbine engine of clause 10, wherein the plurality of panels are heat shield panels.

14. The gas turbine engine of clause 10, wherein an air gap between the trailing edge of the first panel and the leading edge of the second panel forms at least a portion of a circumferential air gap for the combustor.

15. The gas turbine engine of clause 10, wherein the trailing edge of the first panel extends beyond the leading edge of the second panel to provide an air flow gap between the first and second panels and wherein portion of the first panel associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

16. The gas turbine engine of clause 10, wherein the first panel extends over the second panel along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

17. The gas turbine engine of clause 10, wherein the second panel includes effusion holes positioned along the leading edge of the second panel.

18. The gas turbine engine of clause 10, wherein leading edge of the second panel is chamfered.

19. The gas turbine engine of clause 10, wherein leading edge of the second panel includes one or more features to provide airflow when the trailing edge of the first panel contacts the leading edge of the second panel.

20. The gas turbine engine of clause 19, wherein the one or more features include groves in the leading edge of the second panel to provide said airflow.

Claims

1. A combustor (105) for a gas turbine engine (100), the combustor comprising:

   a support structure; and
   a plurality of panels (115) mounted to the structure, the plurality of panels defining a combustion cavity (120) of the combustor, wherein the plurality of panels include

   a first panel (126; 205; 305) having a leading (315) and trailing edge (135; 215), and
   a second panel (127; 210; 310) having a leading edge (140; 220; 320) and trailing edge (325), wherein the trailing edge of the first panel extends beyond the leading edge of the second panel and wherein the second panel is mounted to the support structure aft of the first panel.

2. The combustor (105) of claim 1, wherein the support structure is an annular structure (370) including an inner diameter structure (113) and outer diameter structure (112), and wherein the plurality of panels (115) are mounted to at least one of the inner diameter structure and outer diameter structure.

3. The combustor (105) of claim 1 or 2, wherein the plurality of panels (115) are heat shield panels.

4. The combustor (105) of claim 1, 2 or 3, wherein an air gap between the trailing edge (135; 215) of the first panel (126; 205; 305) and the leading edge (140; 220; 320) of the second panel (127; 210; 310) forms at least a portion of a circumferential air gap for the combustor.

5. The combustor (105) of any preceding claim, wherein the trailing edge (215) of the first panel (205) extends beyond the leading edge (220) of the second panel (210) to provide an air flow gap between the first and second panels and wherein a portion of the first panel associated with the leading edge is configured to prevent a gas path flow within the combustor to enter the air flow gap.

6. The combustor (105) of any preceding claim, wherein the first panel (205) extends over the second panel (210) along the entire length of the first panel by an amount within the range of 0.5 cm to 2 cm.

7. The combustor (105) of any preceding claim, wherein the second panel (210) includes effusion holes positioned along the leading edge (220) of the second panel (210).

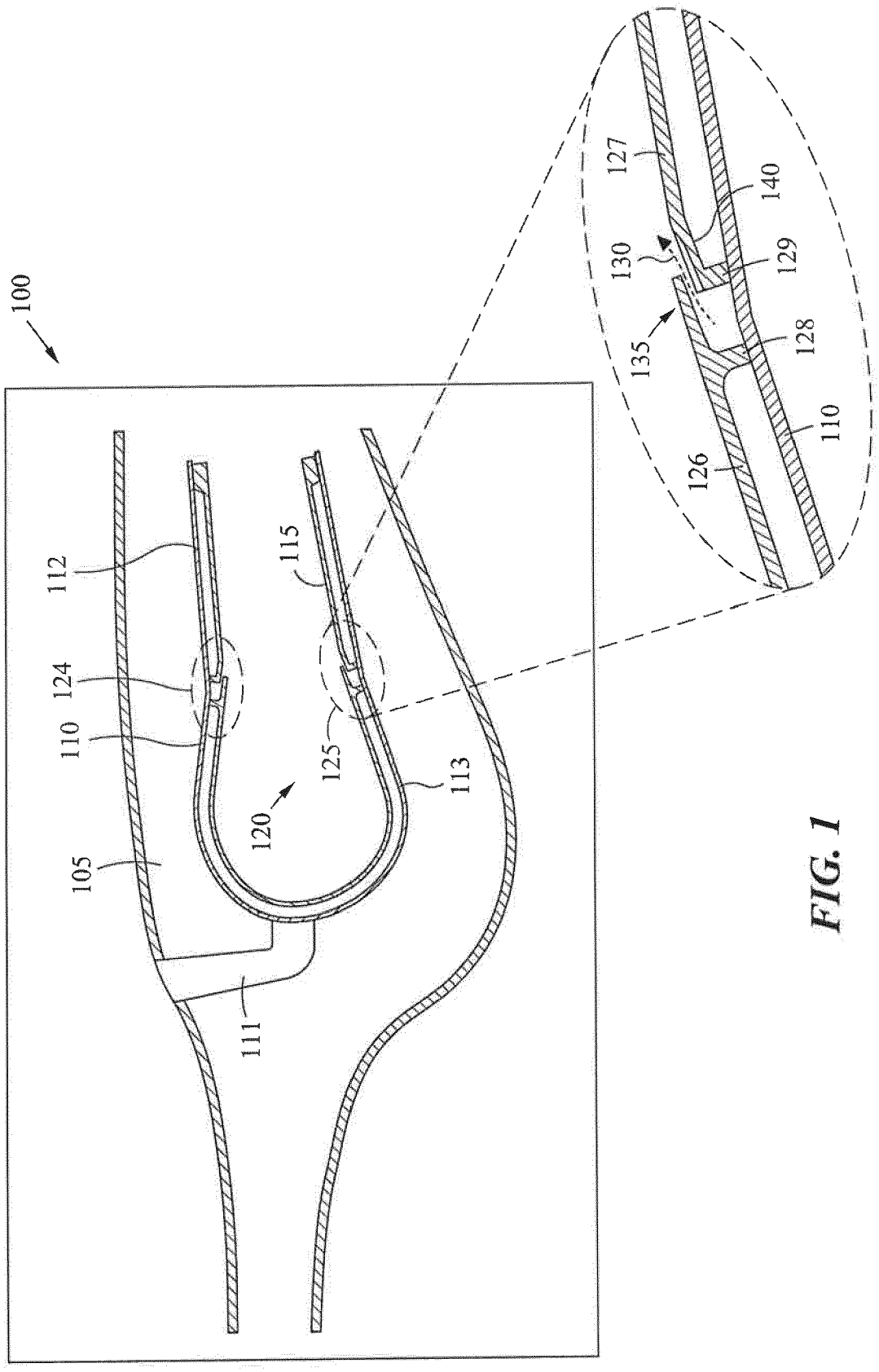
8. The combustor (105) of any preceding claim, wherein the leading edge (140; 220; 320) of the second panel (127; 210; 310) is chamfered.

9. The combustor (105) of any preceding claim, wherein the leading edge (140; 220; 320) of the second panel (127; 210; 310) includes one or more features (240) to provide airflow when the trailing edge (135; 215) of the first panel (126; 205; 305) contacts the leading edge of the second panel.

10. The combustor (105) of claim 9, wherein the one or more features (240) include grooves in the leading edge (140; 220; 320) of the second panel (127; 210; 310) to provide said airflow.

11. A gas turbine engine (100) comprising:

    a combustor (105) according to any preceding claim.


100
112
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105
111
120
125
115
113
127
140
130
129
135
128
110
126

FIG. 1

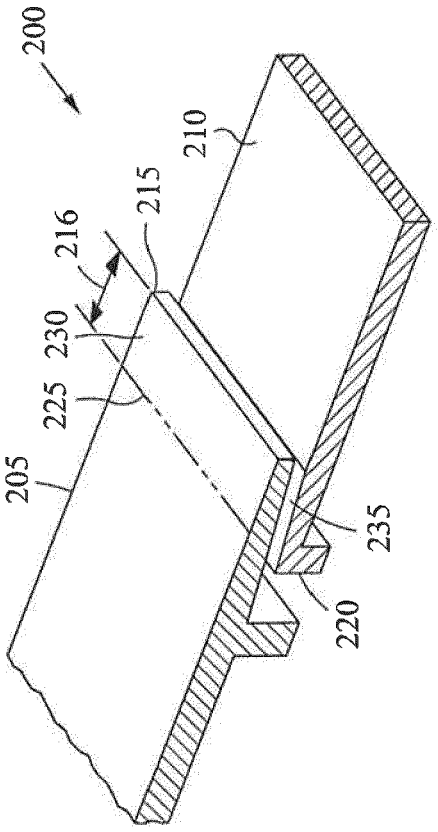
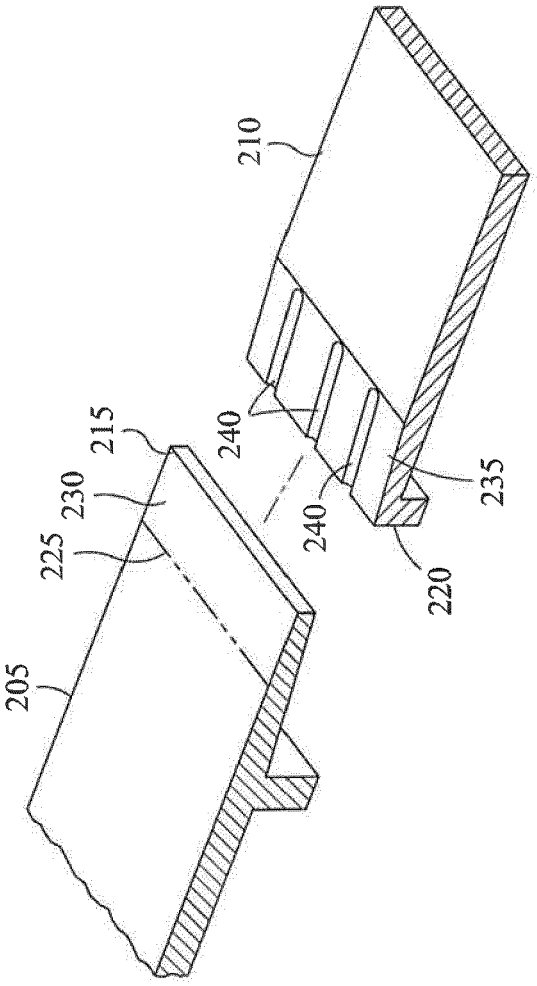

200
210
215
216
230
225
205
235
220

FIG. 2A


210
215
240
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205
240
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220

FIG. 2B

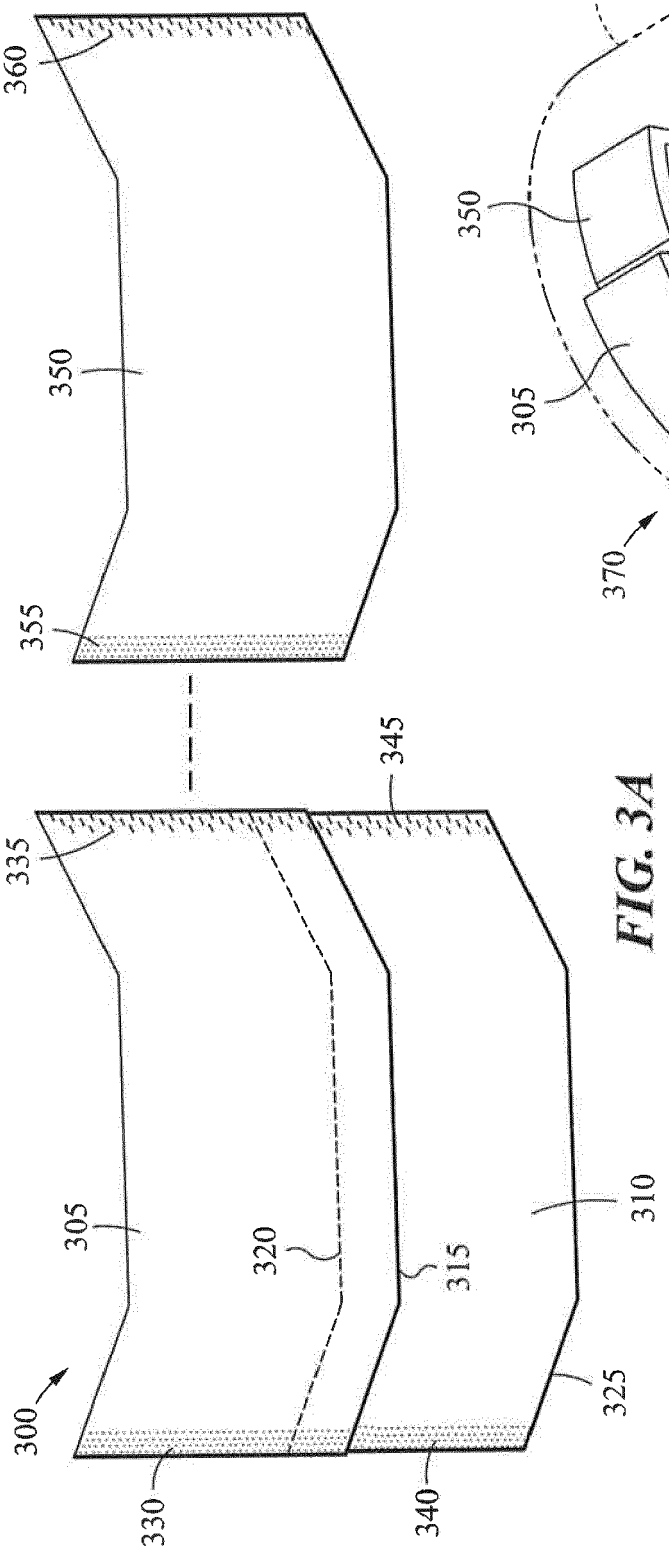

FIG. 3A

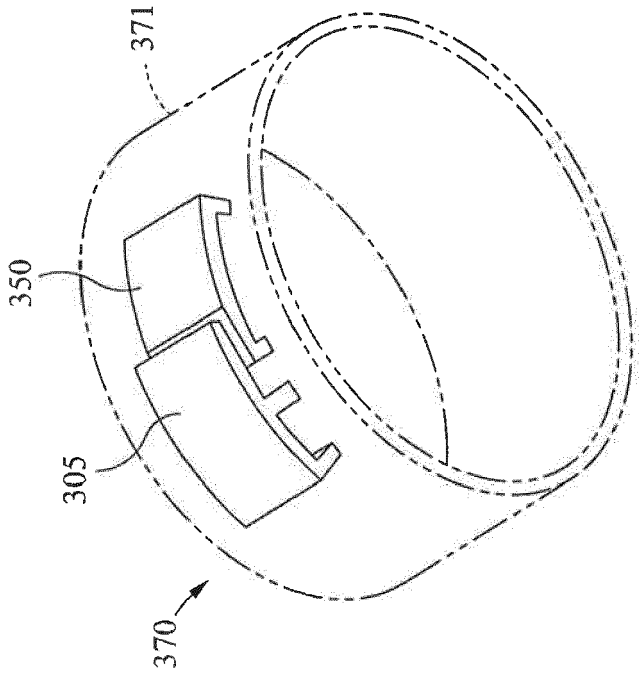

FIG. 3C

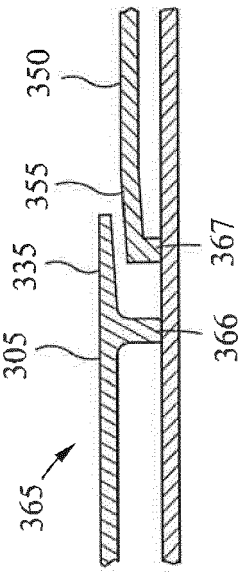

FIG. 3B

Europäisches Patentamt
European Patent Office
Office européen des brevets

EUROPEAN SEARCH REPORT

Application Number
EP 16 16 2430

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
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F23R

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 July 2016	Theis, Gilbert

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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D : document cited in the application
L : document cited for other reasons

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ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 16 16 2430

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