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(71) Applicants:
- **Cunha, Frank J.**
Avon, CT 06001 (US)
- **Kostka, Stanislav**
Shrewsbury, MA 01545 (US)

(72) Inventors:
- **CUNHA, Frank J.**
Avon, CT Connecticut 06001 (US)
- **KOSTKA, Stanislav**
Shrewsbury, MA Massachusetts 01545 (US)

(74) Representative: **Hall, Matthew Benjamin**
Dehns
St Bride's House
10 Salisbury Square
London EC4Y 8JD (GB)

(54) **GAS TURBINE ENGINE COMPONENTS AND COOLING CAVITIES**

(57) The present disclosure relates to gas turbine engine components (115; 200; 201) including cooling cavities. One embodiment is directed to a component including a forward surface (220; 301), an aft surface (240; 302), at least one inlet (210; 310; 311) on the forward surface and a cavity (205; 206) between the forward surface and the aft surface. The cavity is configured to receive airflow from at least one inlet to provide cooling flow for the component. The cavity includes a plurality of structures (250; 255; 256) within the cavity. The component also includes at least one exit (211; 212) between the forward surface and the aft surface. The plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit. The component having a cavity may be employed by a combustor (105) of a gas turbine engine (100).

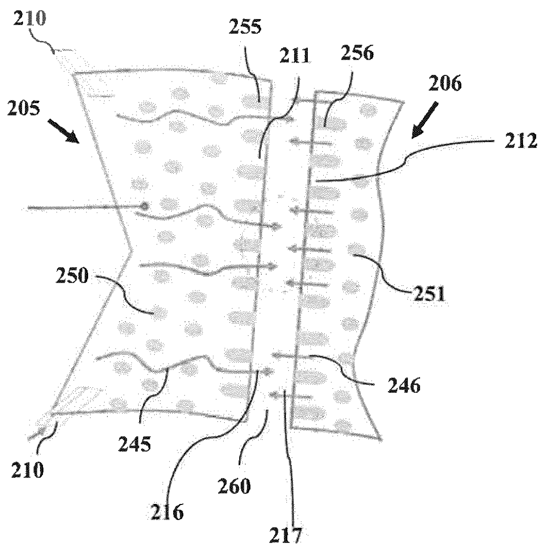

FIG. 2C

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Description

FIELD

[0001] The present disclosure relates to components of a gas turbine engine and, in particular, a component having a cooling cavity.

BACKGROUND

[0002] Gas turbine engine combustors are required to operate efficiently during engine operation and flight. Combustors are locations of tremendous amounts of heat. Combustors also experienced a high degree of heat and distress. High heat exposure to the combustor may cause loss of protective thermal barrier coating which leads to exposure to a hot gas environment. This, in turn, leads to deformities of the combustor which have an adverse effect on cooling airflow and back side heat transfer coefficients. Film cooling alone may not remedy this situation and may worsen the condition due to the addition of more air (and oxygen) which could increase combustion temperature.

[0003] Accordingly, it is desirable to provide components which minimize or limit heat exposure causing deformities and maximizing cooling airflow within a gas turbine engine.

BRIEF SUMMARY OF THE EMBODIMENTS

[0004] Disclosed and claimed herein are components for a gas turbine engine. One embodiment is directed to a component including a cooling cavity. The component includes a forward surface, an aft surface, and at least one inlet on the forward surface, the at least one inlet configured to receive air flow. The component includes a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity. The component includes at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity, wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

[0005] In one embodiment, the forward surface is a cold side of a combustor bulkhead, and the aft surface is the hot side of the combustor bulkhead.

[0006] In one embodiment, the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

[0007] In one embodiment, the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

[0008] In one embodiment, the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

[0009] In one embodiment, the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

[0010] In one embodiment, the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

[0011] In one embodiment, the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

[0012] In one embodiment, component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

[0013] In one embodiment, at least a first portion of the plurality of structures are configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

[0014] Another embodiment is directed to a combustor of a gas turbine engine. The combustor includes a combustor shell, wherein the shell is configured to engage bulkhead and a bulkhead. The bulkhead includes a plurality of bulkhead panels. Each bulkhead panel includes a forward surface, an aft surface, and at least one inlet on the forward surface, the at least one inlet configured to receive air flow. Each bulkhead panel includes a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity. Each bulkhead panel includes at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity, wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

[0015] In one embodiment, the forward surface is a cold side of a bulkhead panel, and the aft surface is the hot side of said bulkhead panel.

[0016] In one embodiment, the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

[0017] In one embodiment, the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

[0018] In one embodiment, the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

[0019] In one embodiment, the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

[0020] In one embodiment, the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

[0021] In one embodiment, the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

[0022] In one embodiment, component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

[0023] In one embodiment, at least a first portion of the plurality of structures are configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

[0024] In one embodiment, a gas turbine engine component including a cooling cavity is provided. The component having: a forward surface; an aft surface; at least one inlet on the forward surface, the at least one inlet configured to receive air flow; a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity; and at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity, wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

[0025] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the forward surface is a cold side of a combustor bulkhead, and the aft surface is the hot side of the combustor bulkhead.

[0026] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

[0027] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

[0028] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

[0029] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

[0030] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

[0031] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

[0032] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

[0033] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, at least a first portion of the plurality of structures is configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

[0034] In yet another embodiment, a combustor of a gas turbine engine is provided. The combustor having: a combustor shell, wherein the shell is configured to engage bulkhead; and a bulkhead including: a plurality of bulkhead panels, wherein each bulkhead panel includes a forward surface; an aft surface; at least one inlet on the forward surface, the at least one inlet configured to receive air flow; a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity; and at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity, wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

[0035] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the forward surface is a cold side of a bulkhead panel, and the aft surface is the hot side of said bulkhead panel.

[0036] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

[0037] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

[0038] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

[0039] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

[0040] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

[0041] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

[0042] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, the component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

[0043] In addition to one or more of the features described above, or as an alternative to any of the foregoing embodiments, at least a first portion of the plurality of structures are configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

[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 according to one or more exemplary embodiments;

FIGs. 2A-2C depict graphical representations of a component according to one or more exemplary embodiments;

FIGs. 2D-2E depict structures of a component according to one or more exemplary embodiments; and

FIGs. 3A-3B depict graphical representations of a bulkhead according to one or more exemplary embodiments.

DETAILED DESCRIPTION OF THE EXEMPLARY EMBODIMENTS

Overview and Therminology

[0046] One aspect of this disclosure relates to components of a gas turbine engine, and in particular components with cooling cavities. One or more structural configurations are provided for components to allow for cooling with a cavity or plenum of the component. The cavity position and structures may allow for particular areas within a gas turbine engine or high temperature environment to receive cooling flow. According to another exemplary embodiment, configurations are provided to meter airflow and maintain cooling efficiency within a cavity of a component, such as a bulkhead.

[0047] According to another exemplary embodiment, configurations are provided for components, such as combustors of gas turbine engines. By way of example, a combustor including a combustor shell may include one or more cavities in the bulkhead or bulkhead panels of the combustor. Although components are described as bulkhead components, it should be appreciated that the principles may apply to other components.

[0048] A cavity as used herein related to an area or plenum within a structural component. In the context of a bulkhead, the cavity is in between the forward and aft surfaces of the bulkhead.

[0049] 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.

[0050] 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

[0051] Referring now to the figures, FIG. 1 depicts a graphical representation of a gas turbine engine 100 according to one or more embodiments. A cross-sectional representation is provided for components of gas turbine engine **100**. Gas turbine engine **100** includes a combustor **105** which may include one or more combustor shells, such as combustor shell **110**. Components of a gas turbine engine, such as combustor **105** combustor shell **110**, and gas turbine engine components in general, may be configured to include one or more features to allow for cooling. According to one embodiment, structural configurations are provided for cavities to allow for cooling, and in particular, providing components with a cavity including one or more structural elements within the cavity to meter air flow within the cavity. According to an exemplary embodiment, and as described herein, a cooling cavity may be employed by components of a hot section of gas turbine engine **100**, such as combustor **105**. It should be appreciated though, that a cooling cavity, and components including a cavity with structural elements as described herein, may be employed with other types of components and non-gas turbine engine components in general.

[0052] Combustor **105** of FIG. 1 includes combustor shell **110**. Combustor **105** may include a plurality of combustion chambers or shells, such as combustor shell **110**. Combustor shell **110** receives fuel injector **120** and provides an area for combustion of fuel and gases within the shell. Accordingly, portions of combustor shell **110** are exposed to high temperatures which can lead to distress. Film cooling may be applied to portions of combustor shell **110**, however, portions of the combustor shell may experience more stress than others. By way of example, bulkhead **115** of combustor shell **110** may experience distress and possibly wear due to inadequate film cooling. Configurations including a cavity as described herein may provide additional cooling to one or more regions of a component that experience higher levels of distress and wear.

[0053] Bulkhead **115** is depicted as a an annular component including an outer circumferential surface, such as outer rail **116**, inner circumferential surface, such as inner rail **117** and opening **118**. Bulkhead **115** may be the bulkhead for combustor shell **110**.

[0054] Gas turbine engine **100** may include a plurality of combustors and/or combustor shells **110**. Gas turbine engine **100** may direct airflow, shown as airflow **125** towards combustor **105** and in particular combustor shell **110**. Output airflow of combustor shell **110** is shown as airflow **130**. According to one embodiment, a component of a gas turbine engine, such as bulkhead **115** may include one or more inlets to received airflow, such as air flow **125**. According to one embodiment, the inlets may be on a forward surface, shown as **135**, of bulkhead **115**. The component may have an aft surface, shown as **140**. The component, such as bulkhead **115** may include a cavity between forward surface **135** (cold side) and aft surface **140** (hot side).

[0055] Referring now to FIGs. 2A-2E, FIGs. 2A-2C depict graphical representations of a component according to one or more embodiments. FIGs. 2D-2E depict structures of the component according to one or more embodiments.

[0056] FIG. 2A depicts a representation of a component **200**. According to one embodiment, component **200** may be a component of a gas turbine engine (e.g., gas turbine engine **100**), such as a bulkhead (e.g., bulkhead **115**). As such, component **200** may relate to a section or panel of a bulkhead, such as a bulkhead panel or the bulkhead itself. In certain embodiments, component **200** may be part of an annular component, such as an annular bulkhead, and annular components in general.

[0057] According to one embodiment, component **200** includes a cavity **205** which may be a cooling cavity for component **200**. Component **200** includes one or more inlets for cavity **205**, such as inlets **210** configured to receive airflow **215** (e.g., airflow **125**). Cavity **205** provides a passageway for air flow **215** to cool the component, including the forward and aft surfaces of the component, in the area associated with the cavity. Cavity **205** also allows airflow within the cavity to exit as shown by **216** via one or more of exits **211**. Cavity **205** may occupy a portion of the component **200**. Components may include multiple cavities per component.

[0058] Component **200** includes forward surface **220** which can include at least one inlet **210**. Component also includes an aft surface (represented as **240**). Air directed to and/or flowing toward forward surface **220**, such as airflow directed to a combustor of a gas turbine engine, may be received by inlets **210**. Component **200** includes at least one exit **211** between the forward surface **220** and the aft surface **240**. The at least one exit **211** may be configured to allow airflow within the cavity **205** to exit the cavity. According to one embodiment, exits **211** are offset or displaced from inlets **210**. Exits **211** may be cavity exits and may be positioned along the edge of component **200** and such that exits **211** are displaced from the at least one inlet **210**.

[0059] The position of cavity **205** may be based on areas of component **200** that need additional cooling. In the context of a gas turbine engine component and in particular a bulkhead, cavity **205** may be associated with positions of a bulkhead or bulkhead panel that need additional cooling. Component **200** may be a structure including one or more edges, and cavity **205** may be positioned proximate to an edge of the component. Component **200** may optionally include opening **225** (e.g., opening **118**) such as a fuel injector opening. In certain embodiments, cavity **205** may be positioned relative to opening **225**. By way of example, opening **225** may be an opening for fuel injector, such that distress in the component **200** due to combustion from the fuel injector may be modeled and/or determined. Cavity **205** may be associated with locations of distress for component **200**. According to another embodiment, cavity **205** may be position between rails **230** (e.g., outer circumferential edge) and rail **235** (e.g., inner circumferential edge) of the component **200**.

[0060] Cavity **205** may be provided between the forward surface **220** and the aft surface **240**. Cavity **205** may be configured to receive airflow **215** from the at least one inlet **210** to provide cooling flow for the component **200** and wherein the cavity **205** includes a plurality of structures within the cavity. As will be described in more detail below, component **200** may include one or more structures internal to the cavity **205**. In certain embodiments, cavity **205** may be formed by a refractory metal core, such that structures are formed within the cavity during a casting or manufacturing process of component **200**. Cavity **205** may be a plenum, such as a plenum cooling space formed by a refractory metal core during a casting or formation process.

[0061] According to certain embodiments, component **200** may interface with one or more similar components (e.g., panels). FIG. 2B depicts a configuration of component **200** with cavity **205** relative to component **201** with cavity **206**. Component **200** is configured to interface with a second component, component **201**, and a plurality of structures associated with the exit of the component **200** may be offset from a plurality of structures associated with an exit of the second component **201**. Components **200** and **201** may be bulkhead panels, for example. According to one embodiment, components **200** and **201** may include cavities **205** and **206**, respectively to provide cooling. Airflow exits of components **200** and **201** are shown as **216** and **217**, respectively. According to one embodiment, structures within cavities **205** and **206** may be arranged to allow for airflows **216** and **217** to efficiently exit. For example, structures within cavities **205** and **206** may be configured to stagger the exit points of airflows **216** and **217**.

[0062] FIG. 2C depicts structures of cavities **205** and **206** according to one or more embodiments. Each cavity may include a plurality of structures. FIG. 2C depicts an exemplary representation (cut-away view) of structures for each of cavities **205** and **206**.

[0063] Cavity **205** includes a plurality of structures, shown as structures **250** and **255** configured to meter airflow within cavity **205**. Cavity **205** may receive airflow from inlets **210**. Airflow within cavity **205** is shown as **245**. Airflow **245** then exits cavity **205** and is shown as **216** relative to exits **211**. Structures **250** and **255** of cavity **205** may be cylindrical pillars position in order to meter flow. Structures **250** are configured to meter air flow by directing airflow within cavity **205** based on one or more of structure spacing, structure size, structure shape, and structure pattern. Structures **255** operate similar to structures **250**. Structures **255** are at least one of a cylindrical and oblong shape. Structures **255** are positioned near an exit area of cavity **205**. According to one embodiment structures **255** may be shaped to control airflow **216** that exits cavity **205**.

[0064] Cavity **206** includes a plurality of structures, shown as structures **251** and **256** configured to meter airflow within cavity **206**. Structures **251** and **256** of cavity **206** may operate similarly to structures of cavity **205**. Cavity **206** may receive airflow from inlets **210** and airflow within cavity **206** is shown as **246**. Airflow **246** then exits cavity **206** and is shown as **217** relative to exits **212** of cavity **206**. Structures **251** and **256** of cavity **206** may be cylindrical pillars position in order to meter flow. According to another embodiment structures **255** of cavity **205** may be positioned in an alternating location with structures **256** of cavity **206**.

[0065] FIG. 2D depicts a representation of structures within a cavity according to one or more embodiments. Structures **250** may be configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit. Cooling flow **265** may be based on airflow received by inlets for a cavity. One embodiment is directed to providing an arrangement of structures to maintain the ability of cooling flow **265** within a cavity such that air flow **267** exiting cavity may cool the component. According to one embodiment, structures **250** may be arranged in sections. Structures **250** may also be arranged in rows or formations. FIG. 2D depicts an exemplary division **266** separating structures into first portion **268** and second portion **269**. By arranging structures to maintain cooling efficiency, cooling flow **270** near the exit of the cavity may retain the ability to provide cooling effectiveness for the component. In that fashion, structures **250** are configured to meter airflow within a cavity and to provide a cooling effectiveness that increases towards a rail or exit of the cavity, such that cooling effectiveness is the capacity to cool a portion of component.

[0066] FIG. 2E depicts a graphical representation of structures **250** within a cavity of a component. According to one embodiment and regarding cooling provided by structures, a portion of the structures may be associated with providing high efficiency cooling, and a portion of the structures within the cavity may be configured to provide high effectiveness. Structures **250** maintain cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity. Structures may also be configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity. For example, a first portion of structures may be configured to provide higher cooling efficiency and a second portion of the plurality of structures may be configured to provide a higher cooling effectiveness.

[0067] Structures **250** may be arranged such that a portion of the structures (e.g., rows 1-3) provide cooling with higher efficiency, shown as **280**. According to another embodiment, Structures **250** may be arranged such that a portion of the structures (e.g., rows 4-6) provide cooling with higher effectiveness, shown as **285**. Structures **250** associated with section **280** may be populated more densely, compared to the arrangement of structures in section **285** to provide effective and efficient heat transfer. In that fashion, the air flow may be controlled within a cavity.

[0068] FIGs. 3A-3B depict graphical representations of a bulkhead according to one or more embodiments. According to one embodiment, bulkhead 300 may include one or more cavities to provide cooling. FIG. 3A depicts a forward surface **301** of bulkhead **300**. Bulkhead **300** may be an annular structure. Bulkhead **300** may include a plurality of bulkhead panels $\mathbf{305_{1\text{-}n}}$. Bulkhead **300** may be associated with the bulkhead of a combustor shell of a gas turbine engine (e.g., gas turbine engine **100**). Bulkhead **300** is represented as an annular bulkhead including a plurality of combustor panels $\mathbf{305_{1\text{-}n}}$. Bulkhead **300** and panels $\mathbf{305_{1\text{-}n}}$ may be arranged around a rotating axial shaft in opening **316** of gas turbine engine.

[0069] FIG. 3A depicts inlets **310** which may be configured to receive air flow for a cavity within a panel of bulkhead **300**. Inlets **310** are shown near the edge of bulkhead **300**. The position of inlets **310** may be associated with the position of cavities within panels $\mathbf{305_{1\text{-}n}}$. The position of inlets **310** may be exemplary. Inlets of bulkhead **300** may be positioned in other portions of panels **305**. Exemplary inlet positions, which are optional, for bulkhead **300** are shown as **311**. Surface **301** may be a forward surface of the bulkhead **300**. Bulkhead **300** is shown with openings **320** for fuel injectors, with inner circumferential rail **315**, panel rail **325** between bulkhead panels, opening **316**, and outer circumferential rail **330**.

[0070] FIG. 3B depicts an aft or back surface **302** of bulkhead **300**. Bulkhead **300** may include one or more cavities between forward surface **301** and aft surface **302**. Exemplary positions for cavities are shown as **335** and **340** for bulkhead **300**. These locations may be areas that may be susceptible to distress and/or wear within a combustor shell. However, it should be appreciated that these areas are exemplary, and that cavities may be position in other locations of bulkhead **300**. Positions **335** relate to positions along an outer circumferential rail **330**. Positions **340** relate to positions between panels and associated with panel rails **325**. When cavities are associated with positions between panels, such as panel rails **325**, the structural elements of adjoining panels may be offset within the cavities to allow for alternating exits paths of airflow.

[0071] 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.

[0072] 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 gas turbine engine component including a cooling cavity, the component comprising:

   a forward surface;
   an aft surface;
   at least one inlet on the forward surface, the at least one inlet configured to receive air flow;
   a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity; and
   at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity,
   wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

2. The component of clause 1, wherein the forward surface is a cold side of a combustor bulkhead, and the aft surface is the hot side of the combustor bulkhead.

3. The component of clause 1, wherein the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

4. The component of clause 1, wherein the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

5. The component of clause 4, wherein the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

6. The component of clause 1, wherein the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

7. The component of clause 1, wherein the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

8. The component of clause 1, wherein the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

9. The component of clause 1, wherein component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

10. The component of clause 1, wherein at least a first portion of the plurality of structures are configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

11. A combustor of a gas turbine engine comprising:

a combustor shell, wherein the shell is configured to engage bulkhead; and
a bulkhead including:

a plurality of bulkhead panels, wherein each bulkhead panel includes a forward surface;
an aft surface;
at least one inlet on the forward surface, the at least one inlet configured to receive air flow;
a cavity between the forward surface and the aft surface, wherein the cavity is configured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures within the cavity; and
at least one exit between the forward surface and the aft surface, the at least one exit configured to allow airflow to exit the cavity, wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

12. The combustor of clause 11, wherein the forward surface is a cold side of a bulkhead panel, and the aft surface is the hot side of said bulkhead panel.

13. The combustor of clause 11, wherein the at least one inlet is configured to receive airflow directed to a combustor of a gas turbine engine.

14. The combustor of clause 11, wherein the component is a structure including one or more edges, and wherein the cavity is positioned proximate to an edge of the component.

15. The combustor of clause 14, wherein the at least one exit is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet.

16. The combustor of clause 11, wherein the plurality of structures are configured to meter air flow by directing airflow within the cavity based on one or more of structure spacing, structure size, structure shape, and structure pattern.

17. The combustor of clause 11, wherein the plurality of structures maintains cooling effectiveness of airflow by allowing greater flow within a first portion of the cavity and reduced flow in a second portion of the cavity, wherein the second portion of the cavity is associated with the at least one exit of the cavity.

18. The combustor of clause 11, wherein the plurality of structures are configured to provide a cooling efficiency that increases as the airflow traverses the cavity, wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

19. The combustor of clause 11, wherein component is configured to interface with a second component, and a plurality of structures associated with the exit of the component are offset from a plurality of structures associated with an exit of the second component.

20. The combustor of clause 11, wherein at least a first portion of the plurality of structures are configured to provide higher cooling efficiency and a second portion of the plurality of structures are configured to provide a higher cooling effectiveness.

Claims

1. A gas turbine engine component (115; 200; 201) including a cooling cavity, the component comprising:

a forward surface (220; 301);
an aft surface (240; 302);
at least one inlet (210; 310; 311) on the forward surface, the at least one inlet configured to receive air flow (215);
a cavity (205; 206) between the forward surface and the aft surface, wherein the cavity is config-

ured to receive airflow from the at least one inlet to provide cooling flow for the component and wherein the cavity includes a plurality of structures (250; 255; 256) within the cavity; and
at least one exit (211; 212) between the forward surface and the aft surface, the at least one exit configured to allow airflow (216; 217; 245; 246) to exit the cavity,

wherein the plurality of structures are configured to meter air flow within the cavity and to maintain the cooling effectiveness of air flow within the cavity from the at least one inlet to the at least one exit.

2. The component (115; 200; 201) of claim 1, wherein the forward surface (220; 301) is a cold side of a combustor bulkhead (115), and the aft surface (240; 302) is the hot side of the combustor bulkhead.

3. The component (115; 200; 201) of claim 1 or 2, wherein the at least one inlet (210; 310; 311) is configured to receive airflow directed to a combustor (105) of a gas turbine engine (100).

4. The component (115; 200; 201) of any preceding claim, wherein the component is a structure including one or more edges, and wherein the cavity (205; 206) is positioned proximate to an edge of the component.

5. The component (115; 200; 201) of claim 4, wherein the at least one exit (211; 212) is a cavity exit, and wherein the at least one exit is positioned along the edge of the component and displaced from the at least one inlet (210; 310; 311).

6. The component (115; 200; 201) of any preceding claim, wherein the plurality of structures (250; 255; 256) are configured to meter air flow by directing airflow within the cavity (205; 206) based on one or more of structure spacing, structure size, structure shape, and structure pattern.

7. The component (115; 200; 201) of any preceding claim, wherein the plurality of structures (250; 255; 256) maintains cooling effectiveness of airflow by allowing greater flow within a first portion (268) of the cavity (205; 206) and reduced flow in a second portion (269) of the cavity, wherein the second portion of the cavity is associated with the at least one exit (211; 212) of the cavity.

8. The component (115; 200; 201) of any preceding claim, wherein the plurality of structures (250; 255; 256) are configured to provide a cooling efficiency that increases as the airflow traverses the cavity (205; 206), wherein cooling efficiency is a measure of heat pickup by airflow within the cavity.

9. The component (115; 200; 201) of any preceding claim, wherein the component (200) is configured to interface with a second component (201), and a plurality of structures (255) associated with the exit (211) of the component are offset from a plurality of structures (256) associated with an exit (212) of the second component.

10. The component (115; 200; 201) of any preceding claim, wherein at least a first portion (268) of the plurality of structures (250; 255; 256) are configured to provide higher cooling efficiency and a second portion (269) of the plurality of structures are configured to provide a higher cooling effectiveness.

11. A combustor (105) of a gas turbine engine (100) comprising:

a combustor shell (110), wherein the shell is configured to engage a bulkhead (115); and
a bulkhead including:

a plurality of components (115; 200; 201) according to claim 1, 3, 4, 5, 6, 7, 8, 9 or 10, wherein each component is a bulkhead panel (305).

12. The combustor (105) of claim 11, wherein the forward surface (301) is a cold side of a bulkhead panel, and the aft surface (302) is the hot side of said bulkhead panel (305).

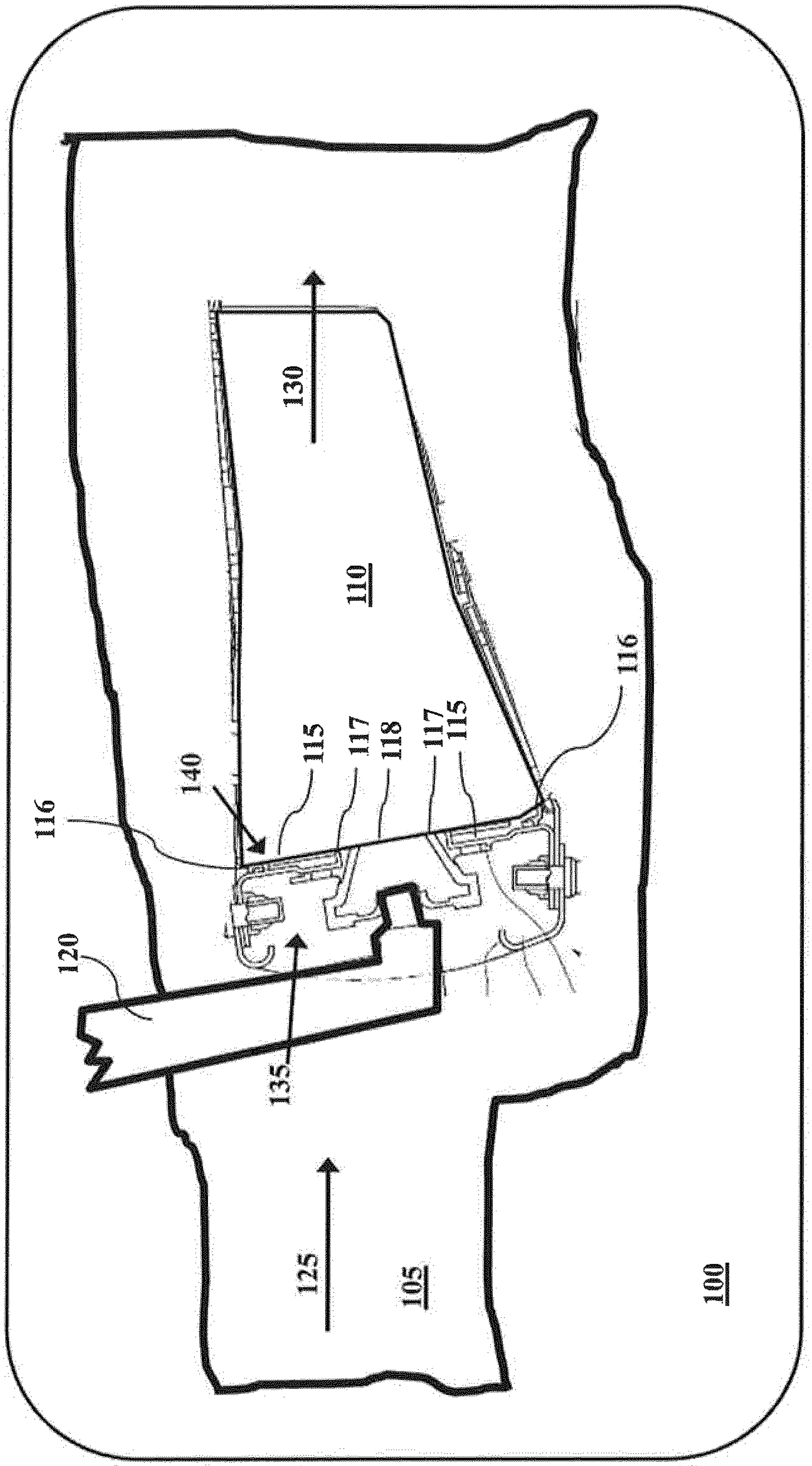
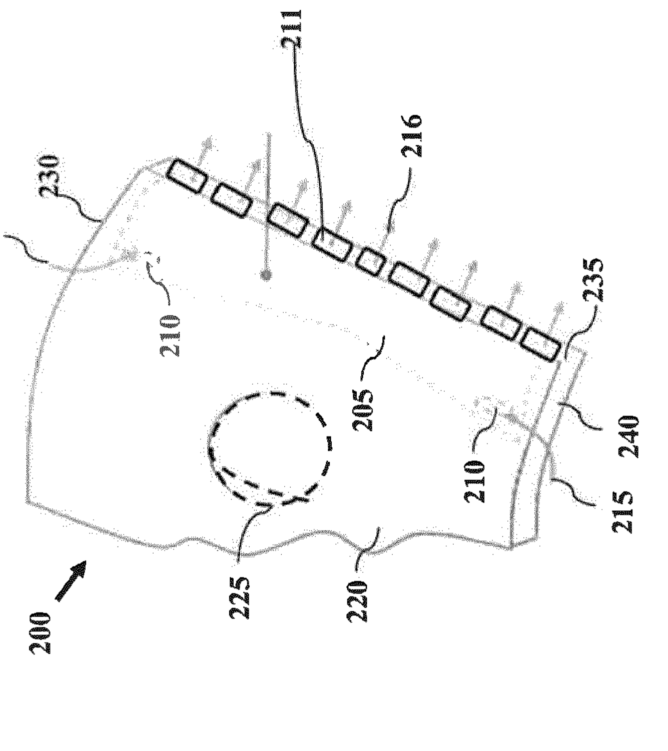


FIG. 1


200
215
230
210
211
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205
225
220
210
215
240
235

FIG. 2A

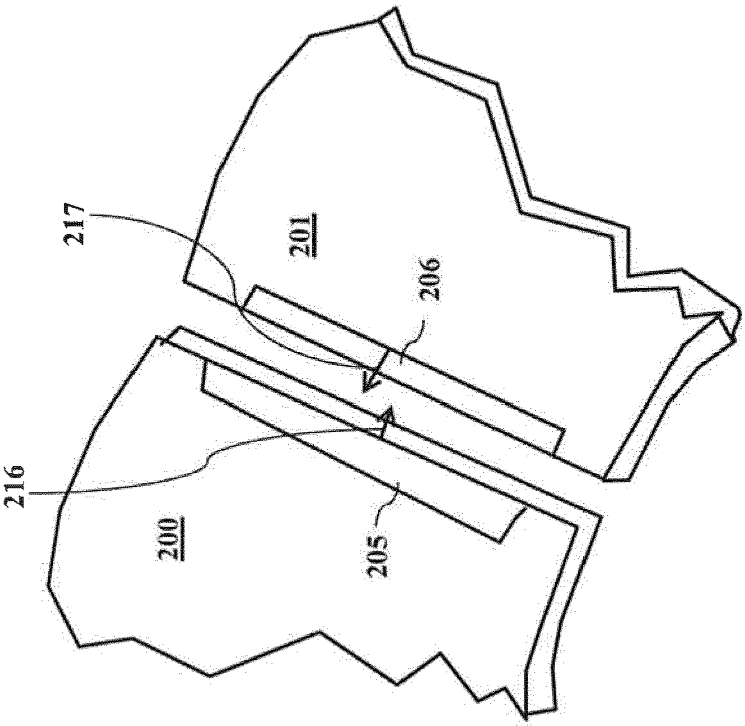
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FIG. 2B

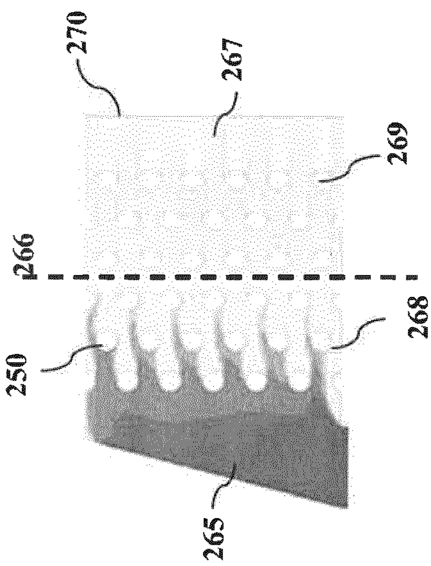


FIG. 2D

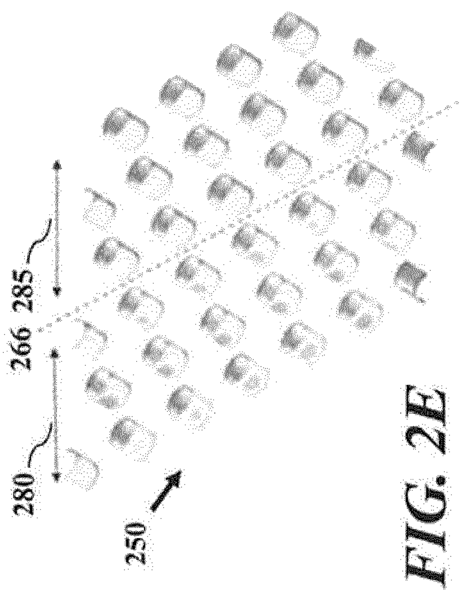


FIG. 2E

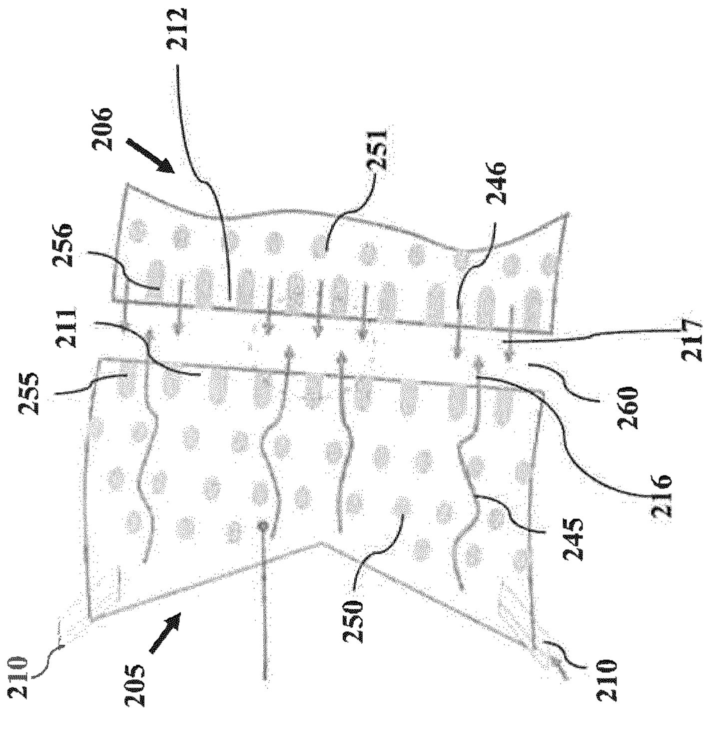
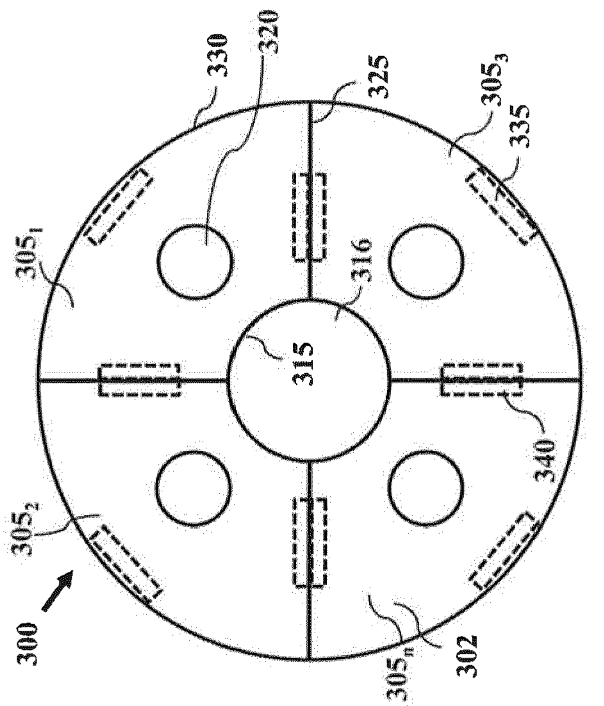


FIG. 2C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320
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305_3
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316
315
340
305_n
302

FIG. 3B

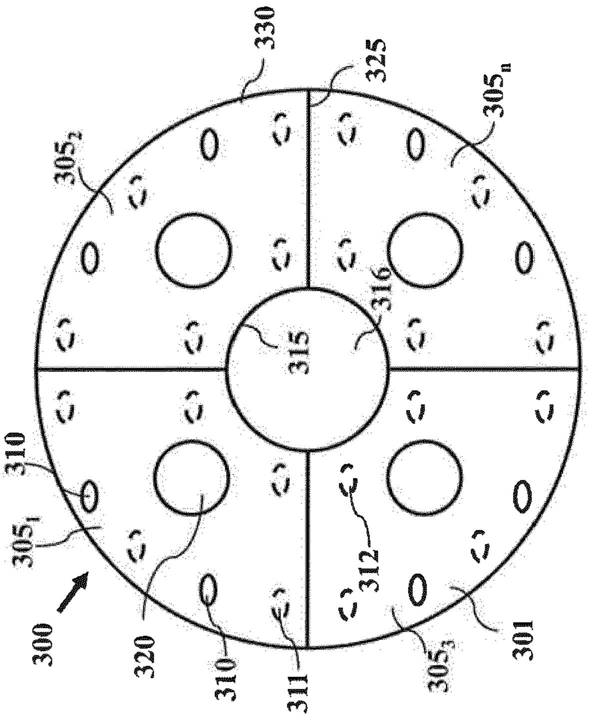
300
305_1
310
305_2
330
325
305_n
320
310
311
315
316
312
305_3
301

FIG. 3A

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EUROPEAN SEARCH REPORT

Application Number
EP 15 20 1744

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 F01D

The present search report has been drawn up for all claims

1

Place of search	Date of completion of the search	Examiner
The Hague	18 April 2016	Munteh, Louis

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18-04-2016

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