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(54) A system for cooling a hot gas path component, corresponding gas turbine combustor and cooling method

(57) A system for cooling a hot gas path component for a combustor generally includes an impingement sleeve 74 that circumferentially surrounds an outer surface of the hot gas path component. A first cooling chamber is defined between the impingement sleeve 74 and a first portion of the outer surface 82 of the hot gas path component. A second cooling chamber is disposed downstream from the first cooling chamber. The second cooling chamber is defined between the impingement sleeve 74 and a second portion of the outer surface 90 of hot gas path component. An inlet 96 extends through the impingement sleeve 75 so as to define a first flow path into the first cooling chamber. An outlet 104 defines a second flow path between the first cooling chamber and the second cooling chamber. Corresponding gas turbine combustor and cooling method are also provided.

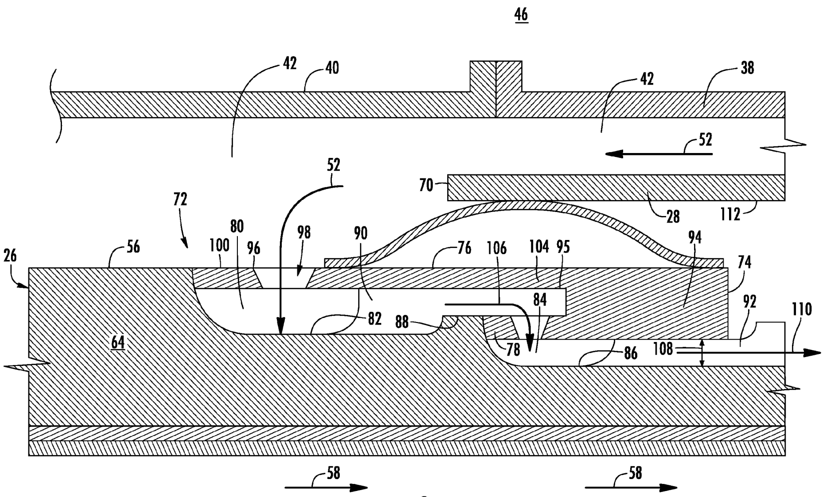

FIG. 3

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Description

FIELD OF THE INVENTION

[0001] The present invention generally relates to a hot gas path component disposed within a combustor of a gas turbine. More particularly, this invention relates to impingement cooling a portion of the hot gas component.

BACKGROUND OF THE INVENTION

[0002] Gas turbines are widely used in industrial and power generation operations. A typical gas turbine includes a compressor section, a combustion section downstream from the compressor section, and a turbine section downstream from the combustor. The combustion section generally includes a combustor having various annular shaped hot gas path components such as a combustion liner and/or a transition duct that at least partially define a hot gas path that extends between the combustion section and the turbine section. Each of the hot gas path components generally includes an inner surface and an outer surface. Typically, the combustion section further includes a casing that surrounds the hot gas path components and defines a plenum that is in fluid communication with the compressor section.

[0003] In operation, a compressed working fluid such as ambient air is routed from the compressor section into the plenum of the combustion section. A portion of the compressed working fluid is mixed with a fuel to form a combustible mixture in a combustion chamber that is typically defined within the combustion liner. The combustible mixture is burned to produce a high temperature and high velocity hot gas that flows through the hot gas path and into the turbine section. A portion of the compressed working fluid is used as a cooling medium to cool the outer surfaces and other hot segments of the various hot gas path components. For example, the cooling medium may be directed across the outer surfaces of the various hot gas path components so as to convectively and/or conductively cool those surfaces.

[0004] Certain areas of the hot gas path components such as an aft end of the combustion liner or an aft end of the transition duct may be particularly sensitive to thermal stress. As a result, those areas gain significant benefit from focusing a jet of the cooling medium onto the outer surface of the hot gas path component, thereby significantly increasing the rate of heat transfer or cooling effectiveness between the cooling medium and the hot gas path component. This method of cooling is known in the industry as impingement or jet impingement cooling.

[0005] In current impingement cooling configurations, the cooling medium is routed through one or more cooling passages that are configured to impinge/focus the compressed working fluid onto a particular area of the outer surface of one of the hot gas path components. Generally, the cooling medium impinges on the outer surface of one of the hot gas path components and is then routed directly into the hot gas path and/or it is reintroduced back into the stream of the compressed working fluid where it may be mixed with the fuel for combustion.

[0006] Although this cooling method is generally effective at cooling the specific area in which the cooling air is impinged, a substantial amount of cooling capability of the cooling air is not utilized. For example, further cooling of the hot gas component could be realized using the same cooling medium. Accordingly, an improved hot gas path component and an improved method for cooling the hot gas path component would be useful in the art.

BRIEF DESCRIPTION OF THE INVENTION

[0007] Aspects and advantages of the invention are set forth below in the following description, or may be obvious from the description, or may be learned through practice of the invention.

[0008] One embodiment of the present invention is a system for cooling a hot gas path component for a combustor. The system generally includes an impingement sleeve that circumferentially surrounds an outer surface of the hot gas path component. A first cooling chamber is defined between the impingement sleeve and a first portion of the outer surface of the hot gas path component. A second cooling chamber is disposed downstream from the first cooling chamber. The second cooling chamber is defined between the impingement sleeve and a second portion of the outer surface of hot gas path component. An inlet extends through the impingement sleeve so as to define a first flow path into the first cooling chamber. An outlet defines a second flow path between the first cooling chamber and the second cooling chamber.

[0009] Another embodiment of the present invention is a combustor for a gas turbine having an outer casing and an annular hot gas path component circumferentially surrounded by the casing. The hot gas path component is radially separated from the casing so as to at least partially define a flow passage therebetween. The hot gas path component includes a main body that defines a first cooling chamber and a second cooling chamber along an outer surface of the main body. The second cooling chamber being downstream from the first cooling chamber. An impingement sleeve circumferentially surrounds the first and the second cooling chambers. An inlet extends through the impingement sleeve. The inlet defines a first flow path between the flow passage and the first cooling chamber. An outlet extends through the impingement sleeve downstream from the inlet. The outlet defines a second flow path between the first cooling chamber and the second cooling chamber.

[0010] Another embodiment of the present invention includes a method for cooling a portion of an outer surface of a hot gas path component disposed within a combustor of a gas turbine. The method includes routing a cooling medium through an inlet that extends through an impingement sleeve. The cooling medium is impinged onto a first portion of the outer surface of the hot gas path component. The cooling medium is routed through an outlet that extends through the impingement sleeve. The cooling medium is re-impinged onto a second portion of the outer surface of the hot gas path component.

[0011] Those of ordinary skill in the art will better appreciate the features and aspects of such embodiments, and others, upon review of the specification.

BRIEF DESCRIPTION OF THE DRAWINGS

[0012] A full and enabling disclosure of the present invention, including the best mode thereof to one skilled in the art, is set forth more particularly in the remainder of the specification, including reference to the accompanying figures, in which:

Fig. 1 is a simplified cross-section view of an exemplary combustor within the scope of various embodiments of the present disclosure;

Fig. 2 is a perspective, partial cut-away view of a portion of the combustor shown in Fig. 1;

Fig. 3 is an enlarged cross section of a system for cooling an aft end portion of a hot gas path component as shown in Fig. 2, according to one embodiment of the present disclosure;

Fig. 4 is an enlarged cross section perspective view of an impingement sleeve portion of the system for cooling the hot gas path component, as shown in Fig. 3;

Fig. 5 is an enlarged cross section perspective view of an aft end of a combustion liner as shown in Fig. 3, according to at least one embodiment of the present invention; and

Fig. 6 is an enlarged cross section of the system for cooling an aft end portion of a hot gas path component as shown in Fig. 3, according to one embodiment of the present disclosure.

DETAILED DESCRIPTION OF THE INVENTION

[0013] Reference will now be made in detail to present embodiments of the invention, one or more examples of which are illustrated in the accompanying drawings. The detailed description uses numerical and letter designations to refer to features in the drawings. Like or similar designations in the drawings and description have been used to refer to like or similar parts of the invention. As used herein, the terms "first", "second", and "third" may be used interchangeably to distinguish one component from another and are not intended to signify location or importance of the individual components. In addition, the terms "upstream" and "downstream" refer to the relative location of components in a fluid pathway. For example, component A is upstream from component B if a fluid flows from component A to component B. Conversely, component B is downstream from component A if component B receives a fluid flow from component A.

[0014] Each example is provided by way of explanation of the invention, not limitation of the invention. In fact, it will be apparent to those skilled in the art that modifications and variations can be made in the present invention without departing from the scope or spirit thereof. For instance, features illustrated or described as part of one embodiment may be used on another embodiment to yield a still further embodiment. Thus, it is intended that the present invention covers such modifications and variations as come within the scope of the appended claims and their equivalents.

[0015] Various embodiments of the present disclosure include a system for cooling a portion of a combustor hot gas path component such as a combustion liner or a transition duct. The system generally includes an impingement sleeve that circumferentially surrounds the hot gas component. A first cooling chamber is positioned upstream from a second cooling chamber. The first and the second cooling chambers are surrounded by the impingement plate. A cooling medium flows through an inlet into the first cooling chamber and is impinged onto a portion of an outer surface of the hot gas path component. The cooling medium is then routed through an outlet that extends through the impingement plate. The cooling medium is re-focused and impinged onto a second portion of the outer surface of the hot gas path component, thereby further utilizing the cooling medium for cooling the hot gas path component.

[0016] Referring now to the drawings, Fig. 1 provides a simplified cross-section of an exemplary combustion section 10, such as may be included in a gas turbine, and Fig. 2 provides a perspective, partial cut-away view of a portion of a combustor 12 of the combustion section as shown in Fig. 1. As shown in Fig. 1, the combustion section 10 generally includes a casing 14 that surrounds the combustor 12. An end cover 16 is connected to a portion of the casing 14 at one end of the combustor 12. At least one fuel nozzle 18 extends axially downstream from the end cover 16. The at least one fuel nozzle 18 extends through a cap assembly 20 that extends radially within the casing 14.

[0017] Various hot gas path components 22 extend downstream from the cap assembly 20 so as to define a hot gas path 24 through the combustor 12. The hot gas path components 22 generally include an annular combustion liner 26 and an annular transition duct 28. The combustion liner 26 extends downstream from the cap assembly 20. A combustion chamber 30 is at least partially defined within the combustion liner 26 downstream from the at least one fuel nozzle 18. The transition duct 28 extends downstream from the combustion liner 26 and terminates adjacent to a first stage nozzle 32 that is disposed adjacent to an inlet 34 of a turbine 36.

[0018] A first flow sleeve 38 at least partially surrounds the transition duct 28, and a second flow sleeve 40 at least partially surrounds the combustion liner 26. An annular flow passage 42 is defined between the first flow sleeve 38 and the transition duct 28, and the second flow sleeve 40 and the combustion liner 26. The first flow sleeve 38 generally includes a plurality of cooling passages 44 that define a flow path between a plenum 46 defined within the combustion section casing 14 and the annular flow passage 42. In addition, the second flow sleeve 40 may include one or more cooling passages 48 that define a flow path between the plenum 46 and the annular flow passage 42.

[0019] In operation, a working fluid such as compressed air 50 is routed into the plenum 46 of the combustion section 10 from a compressor (not shown) such as an axial compressor positioned upstream from the combustion section 10. As shown in Fig. 1, a primary portion of the compressed air 50 is routed through the cooling passages 44, 48 into the annular flow passage. In this manner, the compressed air 50 is used as a cooling medium 52 to provide impingement, convective, and/or conductive cooling to an outer surface 54 (Fig. 2) of the transition duct 28 and/or to an outer surface 56 (Fig. 2) of the combustion liner 26.

[0020] As shown in Fig. 1, the cooling medium 52 travels along the annular flow passage 42 before reversing direction at the end cover 16. The cooling medium 52 then flows past the one or more fuel nozzles 18 and through the end cap 20 where it is mixed with a fuel and burned in the combustion chamber 30, thereby producing a hot gas 58 that flows through the hot gas path 24, across the first stage nozzle 32 and into the inlet 34 of the turbine 36. The hot gas 58 results in high thermal stresses on the combustion liner 26 and/or the transition duct 28, thereby limiting the mechanical life of those hot gas path components 22. More specifically, as shown in Fig. 2, an aft end 60 of the combustion liner 26 and/or an aft end 62 of the transition duct 28 may be particularly sensitive to the high thermal stresses produced by the hot gas 58.

[0021] As shown in Fig. 2, the combustion liner 26 generally includes an annular main body 64 and a forward end 66 that is axially separated from the aft end 60. The outer surface 56 of the combustion liner generally extends between the forward and aft ends 66, 60. The transition duct 28 generally includes an annular main body 68 and a forward end 70 that is upstream from the aft end 62. As shown in Fig. 2, the aft end 60 of the combustion liner 26 is generally seated within the forward end 70 of the transition duct 28.

[0022] Fig. 3 illustrates a cross section side view of a system for cooling the various hot gas path components 72, herein referred to as "the system 72", according to one embodiment of the present disclosure. Fig. 4 illustrates a cross section perspective view of an impingement sleeve 74 portion of the system 72 as shown in Fig. 3, and Fig. 5 illustrates a cross section perspective view of a portion of the aft end 60 of the combustion liner 26 as shown in Fig. 2, according to one embodiment of the present disclosure. As shown in Fig. 2, the system 72 may be deployed at the aft end 60 of the combustion liner and/or on the transition duct 28.

[0023] In one embodiment, as shown in Fig. 3, the system 72 is deployed at the aft end 60 of the combustion liner 26. As shown, the system 72 generally includes an impingement sleeve 74 having an upper portion 76 and a lower portion 78. The impingement sleeve 74 at least partially circumferentially surrounds the outer surface 56 of the combustion liner 26. A first cooling chamber 80 is defined between the upper portion 76 of the impingement sleeve 74 and a first portion 82 of the outer surface 56 of the combustion liner 26. A second cooling chamber 84 is defined downstream from the first cooling chamber 80 between the lower portion 78 of the impingement sleeve 74 and a second portion 86 of the outer surface 56 of the combustion liner 26. The second cooling chamber 84 is disposed generally adjacent to the aft end 60 of the combustion liner 26.

[0024] In particular embodiments, as shown in Figs. 3 and 5, the annular main body 64 of the combustion liner 26 at least partially defines at least one of the first cooling chamber 80 or the second cooling chamber 84. For example, at least one of the first or the second cooling chambers 80, 84 may be cast and/or machined into the main body 64 of the combustion liner 26. In alternate embodiments, the system 72 may comprise of separate components such as a liner extension that at least partially defines at least one of the first or the second cooling chambers 80, 84. The separate components may be welded or otherwise joined to the aft end 60 of the combustion liner 26.

[0025] In particular embodiments, as shown in Figs. 3 and 5, a transversely extending rail member 88 at least partially separates the first cooling chamber 80 from the second cooling chamber 84. The rail member 88 may at least partially provide a seating surface for supporting and/or joining the impingement sleeve 74 to the main body 64 of the combustion liner 26.

[0026] In various embodiments, as shown in Fig. 3, a first radially extending support member 90 extends between the first portion 80 of the outer surface 56 and the upper portion 76 of the impingement sleeve 74. The first support member 90 provides radial separation between the upper portion 76 of the impingement sleeve 74 and the rail member 88. The first support member 90 may at least partially define a seating surface for supporting and/or joining the impingement sleeve 74 to the main body 64 of the combustion liner 26. A second radially extending support member 92 extends between the second portion 86 of the outer surface 56 of the combustion liner 26 and an end portion 94 of the impingement sleeve 74. As shown in Fig. 3, the second support member 92 may provide radial separation between the lower portion 78 and/or the end portion 94 of the impingement sleeve 74 and the second portion 86 of the outer surface 56. The second support member 92 may at least partially provide a seating surface for supporting and/or joining the impingement sleeve 74 to the combustion liner 26.

[0027] As shown in Figs. 3 and 4, the lower portion 78 of the impingement sleeve 74 is radially separated from the upper portion 76 of the impingement sleeve 74. In particular embodiments, as shown in Fig. 3, the lower portion 78 extends substantially axially downstream from the rail member 88 and is generally parallel to the upper portion 76 of the impingement sleeve 74. A flow channel 95 is at least partially defined between the upper portion 76 and the lower portion 78 of the impingement sleeve 74.

[0028] As shown in Figs. 3 and 4, an inlet or cooling passage 96 extends through the upper portion 76 of the impingement sleeve 74. As shown in Fig. 3, the inlet 96 defines a cooling flow path 98 between the annular flow passage 42 and the first cooling chamber 80. In operation, the annular flow passage 42 is generally held at a higher pressure than the first cooling chamber 80. As a result, the cooling medium 52 flows along the cooling flow path 98 and into the first cooling chamber 80. In particular embodiments, as shown in Figs. 3 and 4, the inlet is configured to focus or impinge the cooling medium 52 onto a small area of the first portion 82 of the outer surface 56 of the combustion liner 26 at a high velocity, thereby increasing the heat transfer rate of the cooling medium 52. For example, as shown in Fig. 3, the inlet 96 may be tapered, chamfered or concaved from a top surface 100 of the upper portion 76 of the impingement sleeve 74. In this manner, the cooling medium 52 may be concentrated into a cooling jet to more effectively cool the first portion 82 of the outer surface 56 within the first cooling chamber 80.

[0029] In alternate embodiments, as shown in Fig. 4, a scoop or other flow catching device 102 may extend radially outward from and at least partially surround the inlet 96. The scoop 102 generally faces the direction of flow of the cooling medium 52 flowing through the annular flow passage 42 (Fig. 3). As the cooling medium 52 flows through the annular passage 42, friction reduces the velocity of a portion of the cooling medium 52 flowing closest to the outer surfaces 54, 56 of the transition duct 28 and/or the combustion liner 26. The scoop 102 captures a portion of the cooling medium 52 that is radially separated from those surfaces 54, 56, thereby increasing the velocity of the cooling medium 52 flowing into the first cooling chamber 80 (Fig. 3). As a result, the heat transfer rate of the cooling medium 52 is increased, thereby providing improved cooling to the first portion 82 of the outer surface 56 of the combustion liner 26 disposed within the first cooling chamber 80.

[0030] As shown in Figs. 3 and 4, an outlet or cooling passage 104 extends through the lower portion 78 of the impingement sleeve 74. As shown in Fig. 3, the outlet 104 defines a cooling flow path 106 that extends between the first cooling chamber 80 and the second cooling chamber 84. In operation, the first cooling chamber 80 is generally at a higher pressure than the second cooling chamber 84. As a result, the cooling medium 52 flows from the first cooling chamber 80 along the cooling flow path 106 and into the second cooling chamber 84.

[0031] In particular embodiments, as shown in Figs. 3 and 5, the outlet 104 is configured to focus or impinge the cooling medium 52 from the first cooling chamber 80 onto a small or concentrated area of the second portion 86 of the outer surface 56 of combustion liner 26, thereby increasing the heat transfer rate of the cooling medium 52. For example, as shown in Fig. 3 the outlet 104 may be tapered, chamfered or concaved radially inward from an outer surface 107 (Fig. 4) of the lower portion 78 of the impingement sleeve 74. In this manner, the cooling medium 52 may be concentrated into a cooling jet and re-impinged on the second portion 86 of the outer surface 56 within the second cooling chamber 84 so as to further utilize the cooling capability of the cooling medium 52 routed from the first cooling chamber 80.

[0032] As shown in Fig. 3, an exhaust outlet 108 is at least partially defined between the end portion 94 and/or the lower portion 78 of the impingement sleeve 74 and the second portion 86 of the outer surface 56 of the combustion liner 26. In particular embodiments, the exhaust outlet 108 defines a flow path 110 between the second cooling chamber 84 and the transition duct 28. In this manner, the cooling medium 52 is routed from the exhaust passage 110 along an inner surface 112 of the transition duct 28 so as to provide film cooling to the transition duct 28 inner surface 112.

[0033] In alternate embodiments, wherein the system 72 is deployed at the aft end of the transition duct, the exhaust outlet 108 routes the cooling medium 52 from the second cooling chamber 84 to the first stage of stationary vanes 32 (Fig. 1) disposed at the aft end 62 of the transition duct 28. In this manner, the cooling medium 52 may provide film cooling to the first stage of stationary nozzles 32 (Fig. 1).

[0034] In operation, as shown in Fig. 6, the cooling medium 52 flows from the annular flow passage 42 along the flow path 98 through the inlet 98 that extends through the upper portion 76 of the impingement sleeve 74. The cooling medium 52 is impinged onto the first portion 82 of the outer surface 56 of the combustion liner 26 and heat is transferred from the first portion 82 of the outer surface 56 to the cooling medium 52. The cooling medium 52 is then routed from the first cooling chamber 80 along the flow path 106 that extends between the first cooling chamber 80 and the second cooling chamber 84. As the cooling medium 52 flows through the outlet 104 of the lower portion 78 of the impingement sleeve 74 and into the second cooling chamber 84, the cooling medium 52 is focused so that it is re-impinged onto the second portion 86 of the outer surface 56 of the combustion liner 26. In this manner, heat is transferred from the second portion 86 of the outer surface 56 to the cooling medium 52. The cooling medium 52 is then routed through the exhaust passage 108 and into the hot gas path 24 and/or along the inner surface 112 of the transition duct 28, thereby providing a cooling film that flows along the inner surface 112 of the transition duct 28.

[0035] The various embodiments presented in Figs. 3 through 6 also provide a method for cooling an aft portion of various hot gas path components 22 such as the combustion liner 26 and/or the transition duct 28. The method generally includes routing the cooling medium 52 through the inlet 96 extending through the impingement sleeve 74 and into the first cooling chamber 80. The cooling medium 52 is then impinged onto the first portion 82 of the outer surface 56 of the hot gas path component 22. The cooling medium 52 is then routed from the first cooling chamber and through the outlet 104 that extends through the impingement sleeve 74. The cooling medium 52 is then impinged onto the second portion 86 of the outer surface 56 of the hot gas path component 22 disposed within the second cooling chamber 84. The method may further include routing the cooling medium 52 through the exhaust passage 108 and filming the cooling medium 52 onto an inner surface of a second hot gas path component 22. The method may further include routing the cooling medium 52 from the second cooling chamber 84 through the exhaust passage 108 and into the hot gas path 24.

[0036] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to practice the invention, including making and using any devices or systems and performing any incorporated methods. The patentable scope of the invention is defined by the claims, and may include other examples that occur to those skilled in the art. Such other and examples are intended to be within the scope of the claims if they include structural elements that do not differ from the literal language of the claims, or if they include equivalent structural elements with insubstantial differences from the literal language of the claims.

[0037] Various aspects and embodiments of the present invention are defined by the following numbered clauses:

1. A system for cooling a hot gas path component for a combustor, comprising:

a. an impingement sleeve that circumferentially surrounds an outer surface of the hot gas path component;

b. a first cooling chamber defined between the impingement sleeve and a first portion of the outer surface of the hot gas path component;

c. a second cooling chamber downstream from the first cooling chamber, the second cooling chamber being defined between the impingement sleeve and a second portion of the outer surface of hot gas path component; and

d. an inlet that extends through the impingement sleeve to define a first flow path into the first cooling chamber, and an outlet that defines a second flow path between the first cooling chamber and the second cooling chamber.

2. The system as in clause 1, wherein the hot gas path component is one of a combustion liner or a transition duct.

3. The system as in clause 1 or clause 2, wherein the inlet is configured to impinge a cooling medium onto the first portion of the outer surface of the hot gas path component.

4. The system as in any preceding clause, wherein the outlet is configured to re-impinge the cooling medium from the first cooling chamber onto the second portion of the outer surface of the hot gas path component.

5. The system as in any preceding clause, wherein the impingement sleeve includes an upper portion radially separated from a lower portion.

6. The system as in any preceding clause, further comprising a cooling channel defined between the upper and the lower portions of the impingement sleeve.

7. The system as in any preceding clause, wherein the inlet extends through the upper portion of the impingement sleeve and the outlet extends through the lower portion of the impingement sleeve.

8. The system as in any preceding clause, further comprising a transversely extending rail member disposed along the outer surface of the hot gas path component, the rail member at least partially separating the first cooling chamber from the second cooling chamber.

9. The system as in any preceding clause, further comprising an exhaust passage downstream from the outlet, the exhaust passage being defined between the impingement sleeve and the second portion of the outer surface of the hot gas path component.

10. A combustor for a gas turbine, comprising:

a. an outer casing; and

b. an annular hot gas path component circumferentially surrounded by the casing, the hot gas path component being radially separated from the casing so as to define a flow passage therebetween, the hot gas path component comprising:

i. a main body defining a first cooling chamber and a second cooling chamber along an outer surface of the main body, the second cooling chamber being downstream from the first cooling chamber;

ii. an impingement sleeve circumferentially surrounding the first and the second cooling chambers;

iii. an inlet extending through the impingement sleeve, the inlet defining a first flow path between the flow passage and the first cooling chamber; and

iv. an outlet extending through the impingement sleeve downstream from the inlet, the outlet defining a second flow path between the first cooling chamber and the second cooling chamber.

11. The combustor as in any preceding clause, wherein the hot gas component is one of a combustion liner or a transition duct.

12. The combustor as in any preceding clause, wherein the inlet is configured to impinge a cooling medium from the flow passage of the combustor onto a first portion of the outer surface of the main body.

13. The combustor as in any preceding clause, wherein the outlet is configured to impinge the cooling medium from the first cooling chamber onto a second portion of the outer surface of the main body.

14. The combustor as in any preceding clause, further comprising a transversely extending rail member disposed along an outer surface of the main body of the hot gas path component, the rail member at least partially separating the first cooling chamber from the second cooling chamber.

15. The combustor as in any preceding clause, further comprising an exhaust flow path defined between the impingement sleeve and the second cooling chamber, the exhaust flow path being downstream from the second cooling passage of the impingement sleeve.

16. The combustor as in any preceding clause, wherein the impingement sleeve includes an upper portion radially separated from a lower portion, and a cooling channel defined therebetween.

17. The combustor as in any preceding clause, wherein the inlet extends through the upper portion of the impingement sleeve and the outlet extends through the second portion of the impingement sleeve.

18. A method for cooling a portion of an outer surface of a hot gas path component disposed within a combustor of a gas turbine, the method comprising:

a. routing a cooling medium through an inlet extending through an impingement sleeve;

b. impinging the cooling medium onto a first portion of the outer surface of the hot gas path component;

c. routing the cooling medium through an outlet that extends through the impingement sleeve; and

d. re-impinging the cooling medium onto a second portion of the outer surface of the hot gas path component.

19. The method as in any preceding clause, further comprising routing the cooling medium through an exhaust passage of the hot gas path component onto an inner surface of a second hot gas path component.

20. The method as in any preceding clause, further comprising routing the cooling medium from the second portion of the outer surface of the hot gas path component into a hot gas path defined within the combustor.

Claims

1. A system for cooling a hot gas path component for a combustor (12), comprising:

a. an impingement sleeve (74) that circumferentially surrounds an outer surface of the hot gas path component;
b. a first cooling chamber defined between the impingement sleeve (74) and a first portion of the outer surface (82) of the hot gas path component;
c. a second cooling chamber downstream from the first cooling chamber, the second cooling chamber being defined between the impingement sleeve (74) and a second portion of the outer surface (90) of hot gas path component; and
d. an inlet (96) that extends through the impingement sleeve (74) to define a first flow path into the first cooling chamber, and an outlet (104) that defines a second flow path between the first cooling chamber and the second cooling chamber.

2. The system as in claim 1, wherein the hot gas path component is one of a combustion liner or a transition duct.

3. The system as in claim 1 or claim 2, wherein the inlet is configured to impinge a cooling medium onto the first portion of the outer surface of the hot gas path component.

4. The system as in any preceding claim, wherein the outlet is configured to re-impinge the cooling medium from the first cooling chamber onto the second portion of the outer surface of the hot gas path component.

5. The system as in any preceding claim, wherein the impingement sleeve includes an upper portion radially separated from a lower portion.

6. The system as in any preceding claim, further comprising a cooling channel defined between the upper and the lower portions of the impingement sleeve.

7. The system as in any preceding claim, wherein the inlet extends through the upper portion of the impingement sleeve and the outlet extends through the lower portion of the impingement sleeve.

8. The system as in any preceding claim, further comprising a transversely extending rail member disposed along the outer surface of the hot gas path component, the rail member at least partially separating the first cooling chamber from the second cooling chamber.

9. The system as in any preceding claim, further comprising an exhaust passage downstream from the outlet, the exhaust passage being defined between the impingement sleeve and the second portion of the outer surface of the hot gas path component.

10. A combustor for a gas turbine, comprising:

a. an outer casing; and
b. an annular hot gas path component circumferentially surrounded by the casing, the hot gas path component being radially separated from the casing so as to define a flow passage therebetween, the hot gas path component comprising:

i. a main body defining a first cooling chamber and a second cooling chamber along an outer surface of the main body, the second cooling chamber being downstream from the first cooling chamber;
ii. an impingement sleeve circumferentially surrounding the first and the second cooling chambers;
iii. an inlet extending through the impingement sleeve, the inlet defining a first flow path between the flow passage and the first cooling chamber; and
iv. an outlet extending through the impingement sleeve downstream from the inlet, the outlet defining a second flow path between the first cooling chamber and the second cooling chamber.

11. The combustor as in claim 10, wherein the hot gas component is one of a combustion liner or a transition duct.

12. The combustor as in claim 10 or claim 11, wherein the inlet is configured to impinge a cooling medium from the flow passage of the combustor onto a first portion of the outer surface of the main body.

13. A method for cooling a portion of an outer surface of a hot gas path component disposed within a combustor of a gas turbine, the method comprising:

a. routing a cooling medium through an inlet extending through an impingement sleeve;
b. impinging the cooling medium onto a first portion of the outer surface of the hot gas path component;
c. routing the cooling medium through an outlet that extends through the impingement sleeve; and
d. re-impinging the cooling medium onto a second portion of the outer surface of the hot gas path component.

14. The method as in claim 13, further comprising routing the cooling medium through an exhaust passage of the hot gas path component onto an inner surface of a second hot gas path component.

15. The method as in claim 13 or claim 14, further comprising routing the cooling medium from the second portion of the outer surface of the hot gas path component into a hot gas path defined within the combustor.

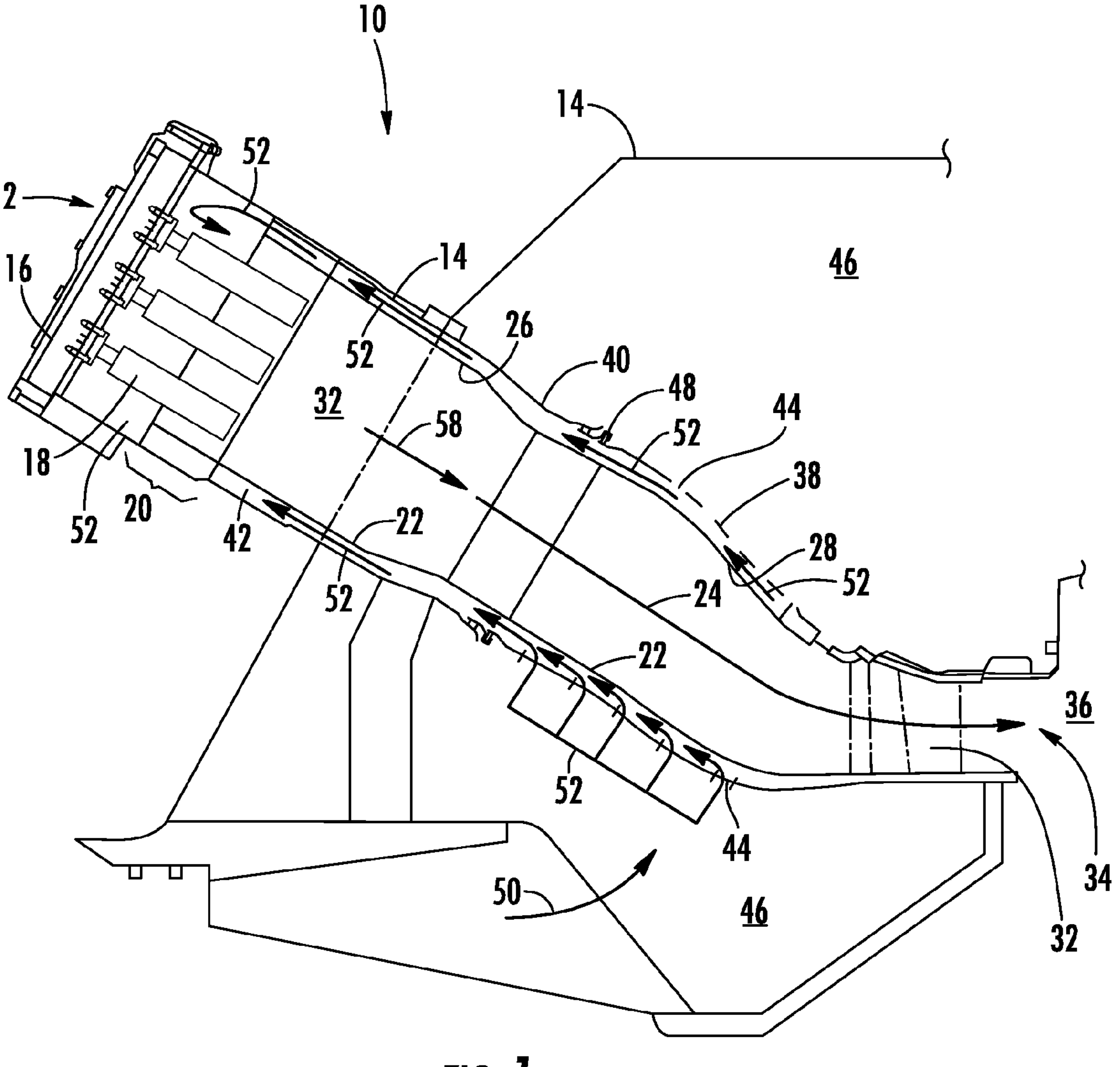
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FIG. 1

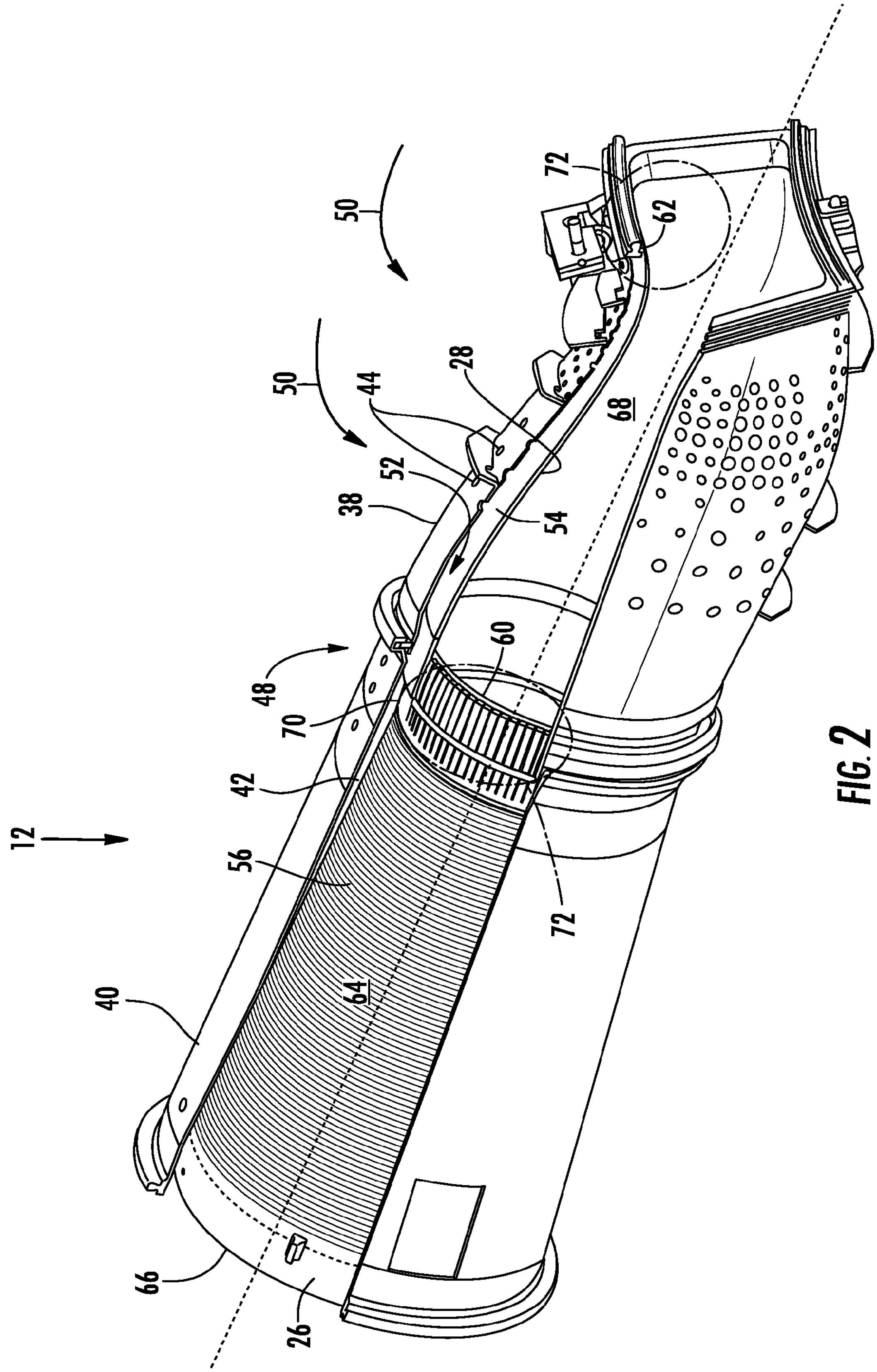

FIG. 2

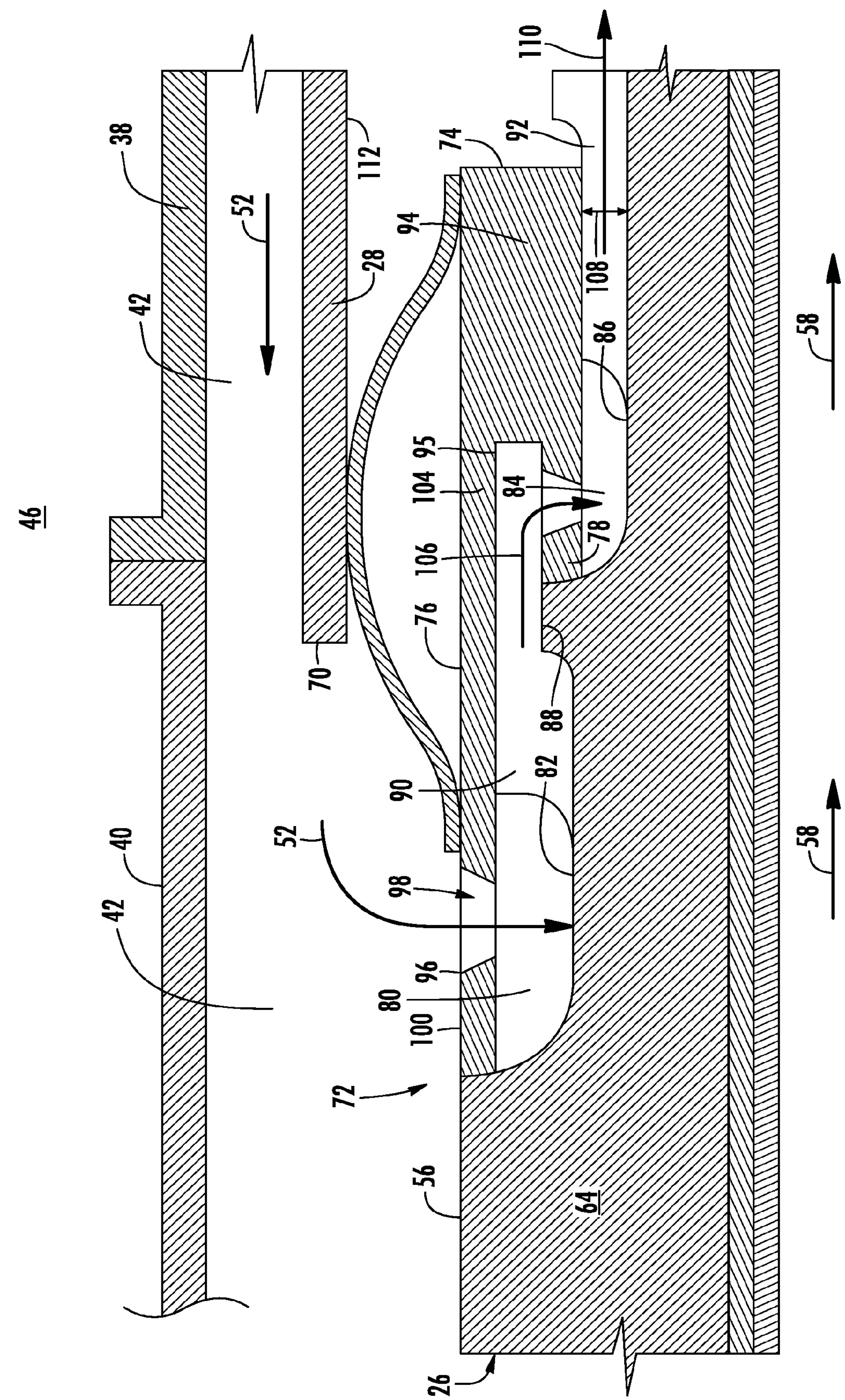
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FIG. 3

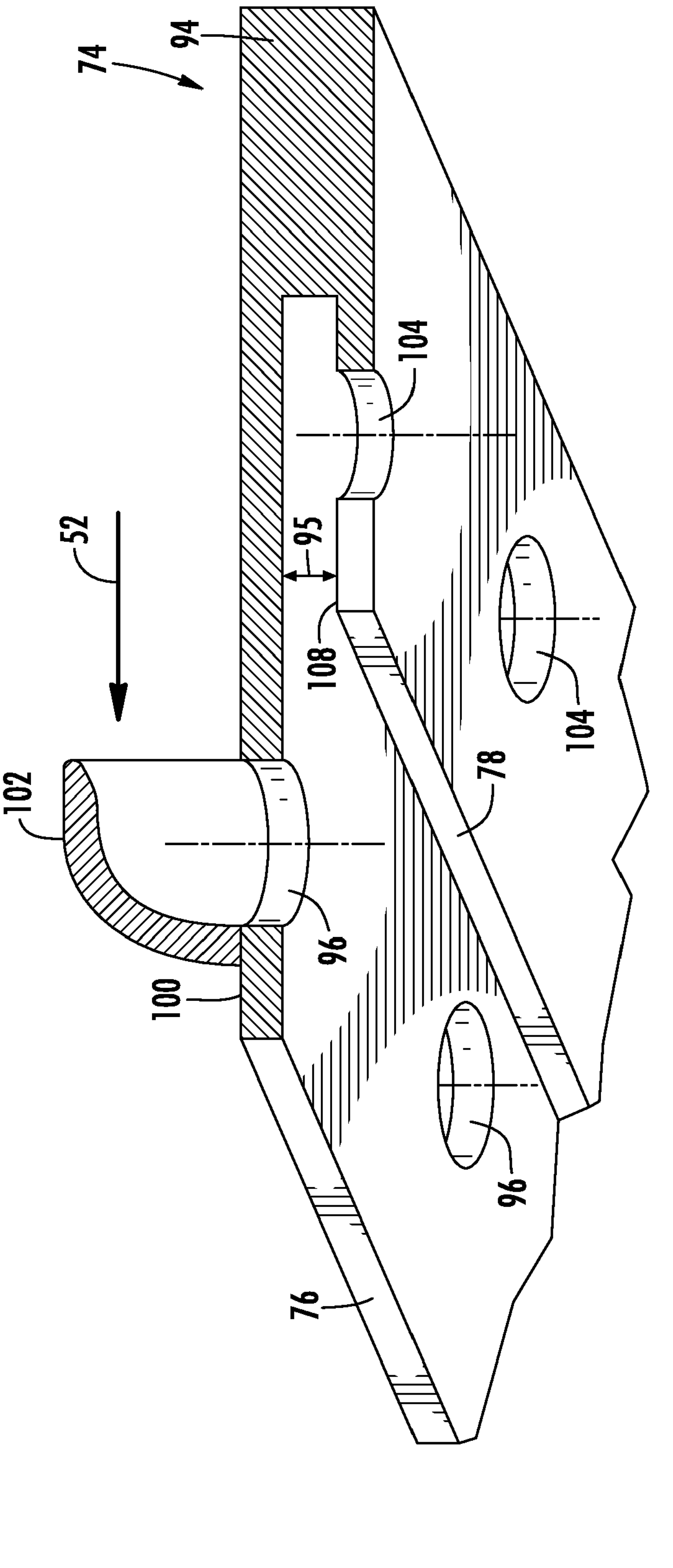

FIG. 4

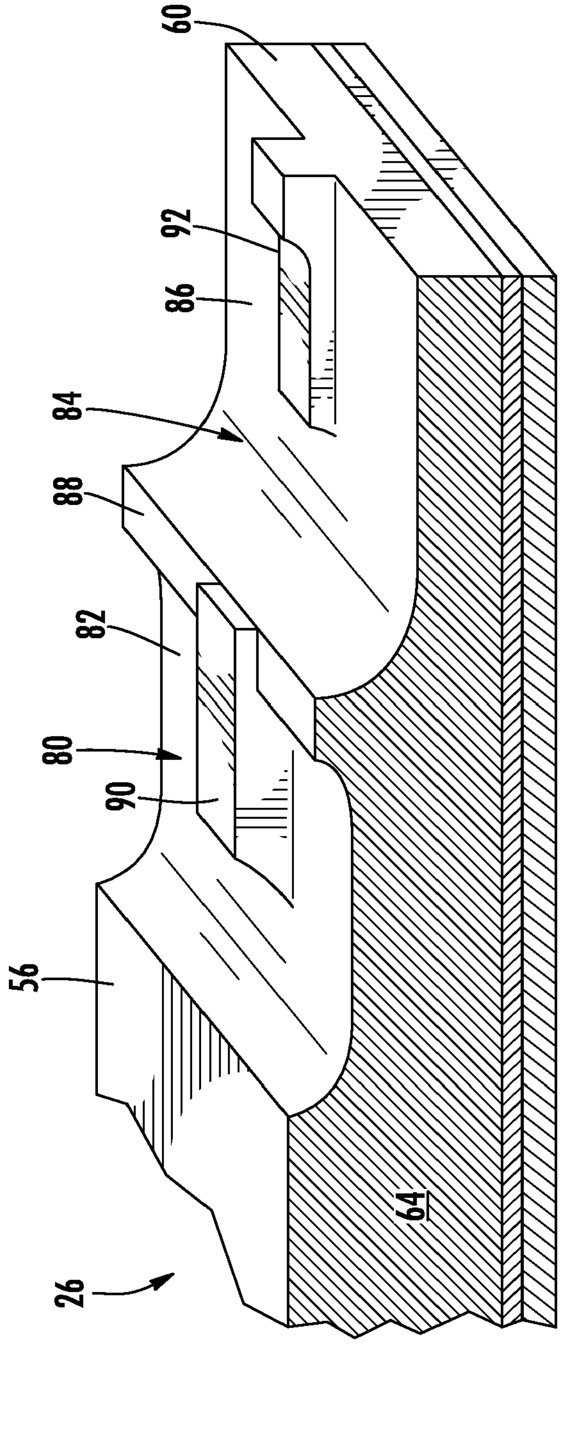

FIG. 5

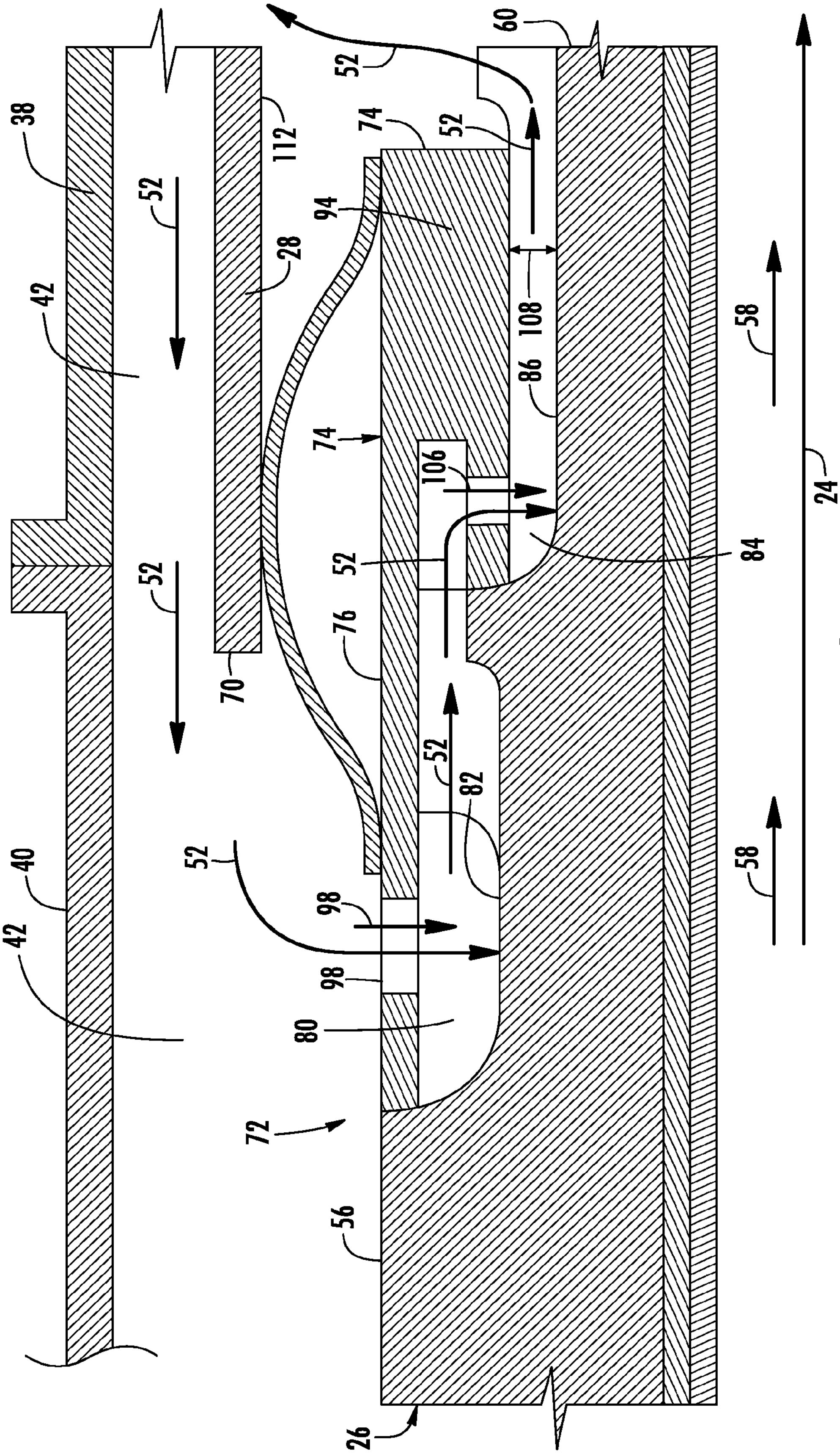
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FIG. 6