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(54) ANNULAR FLOW CONDITIONING MEMBER FOR GAS TURBOMACHINE COMBUSTOR ASSEMBLY

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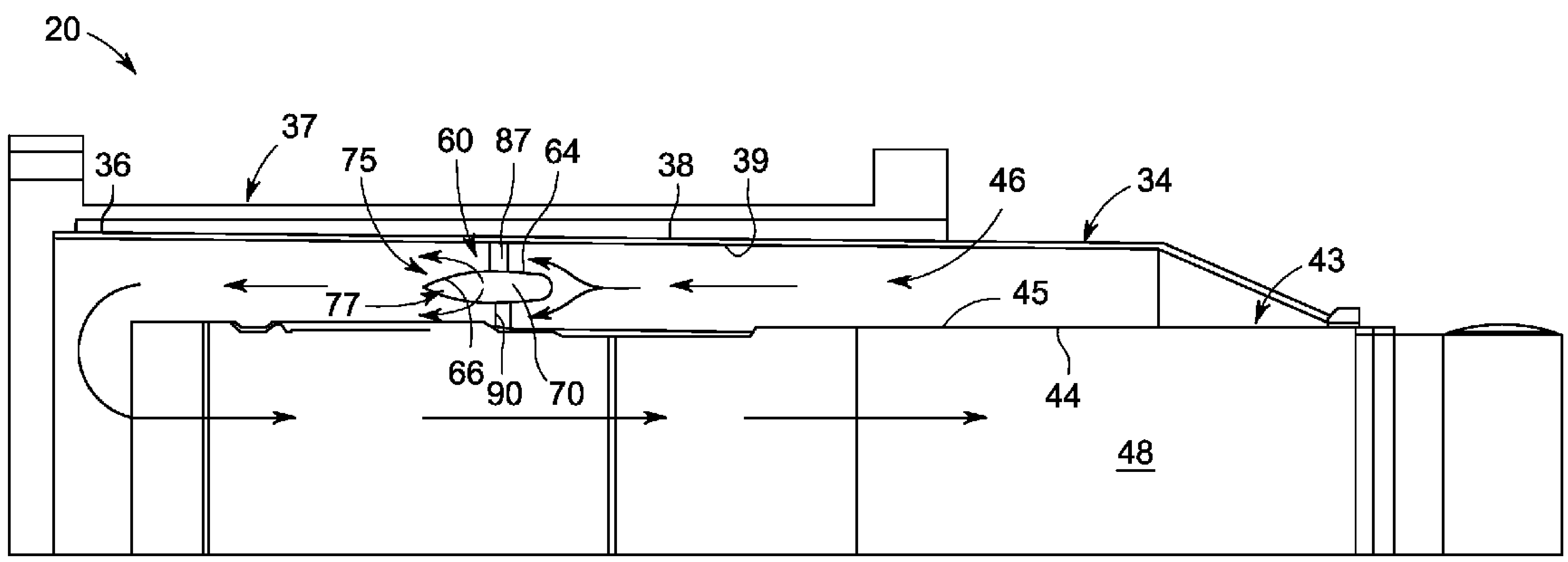
(57) ABSTRACT

A turbomachine combustor assembly includes a combustor body, a combustor liner arranged within the combustor body and defining a combustion chamber, a fluid passage defined between the combustor body and the combustor liner, and an annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.



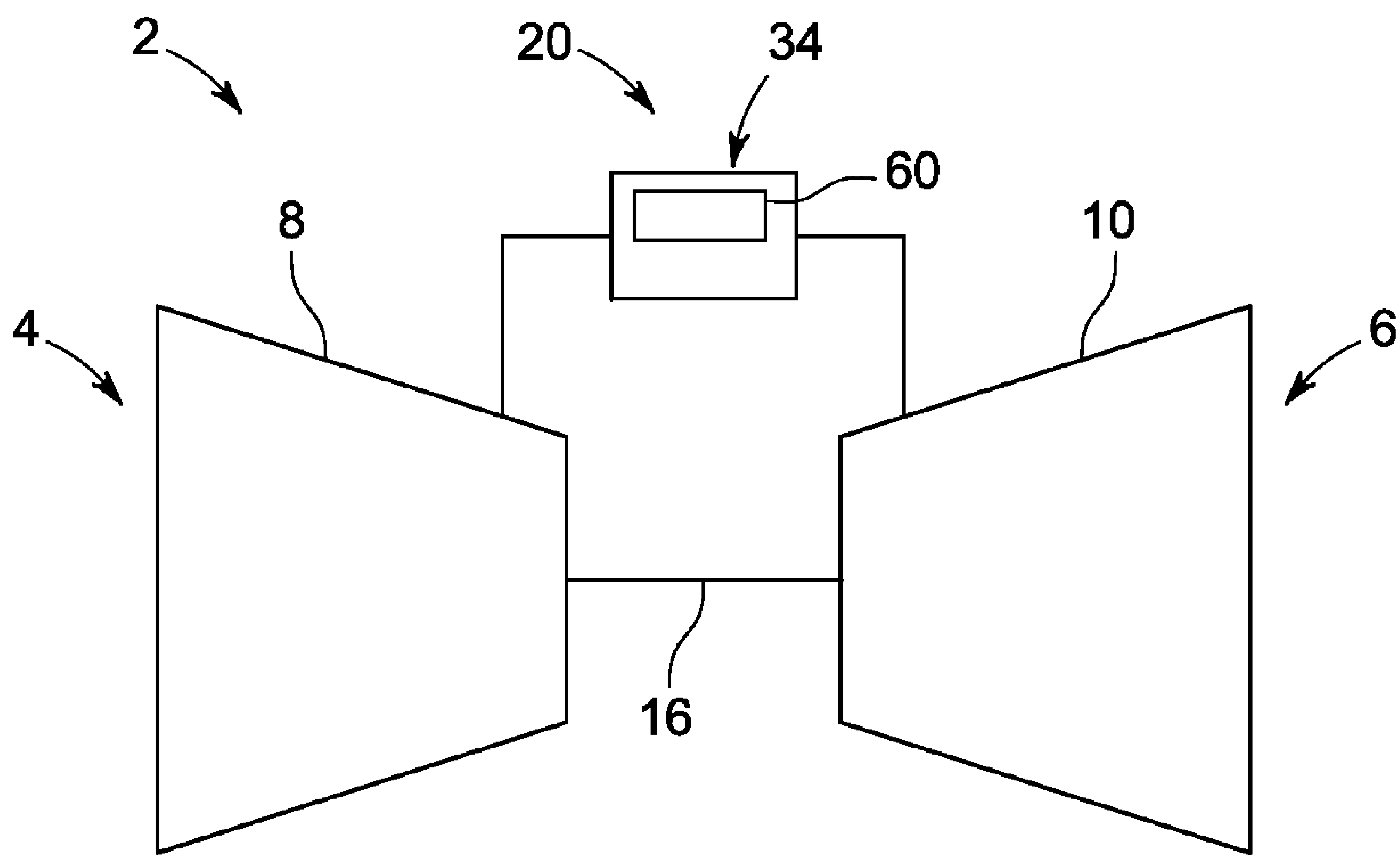


FIG. 1

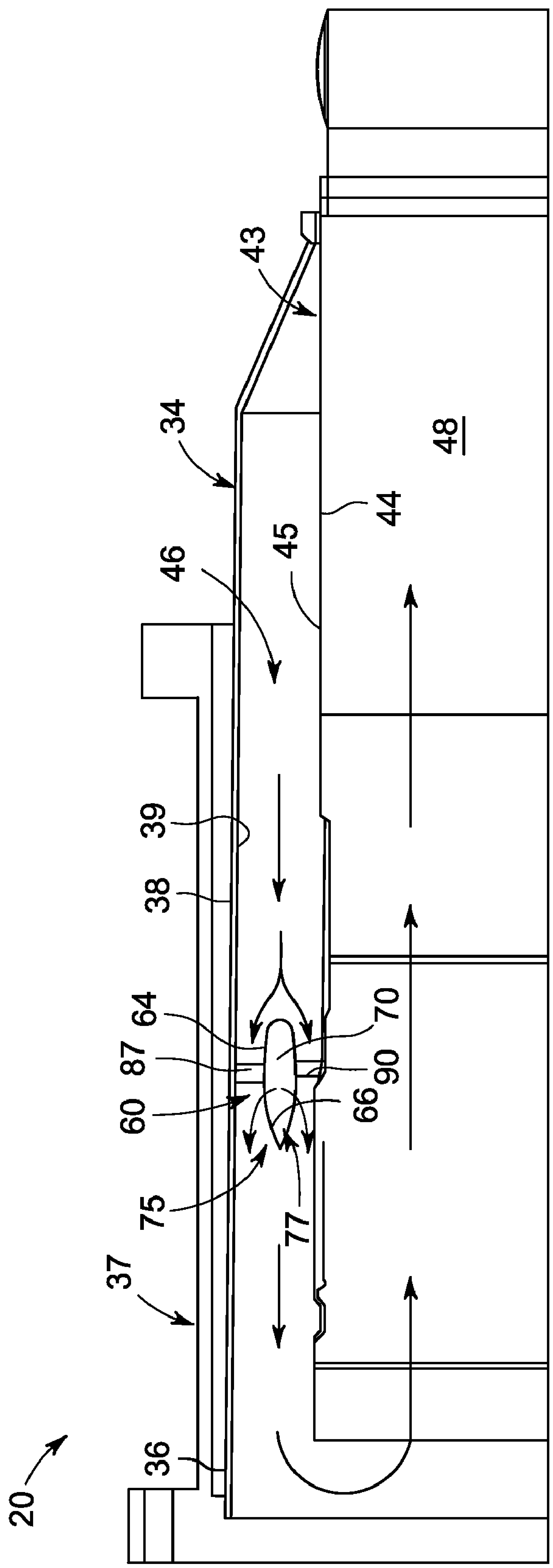


FIG. 2

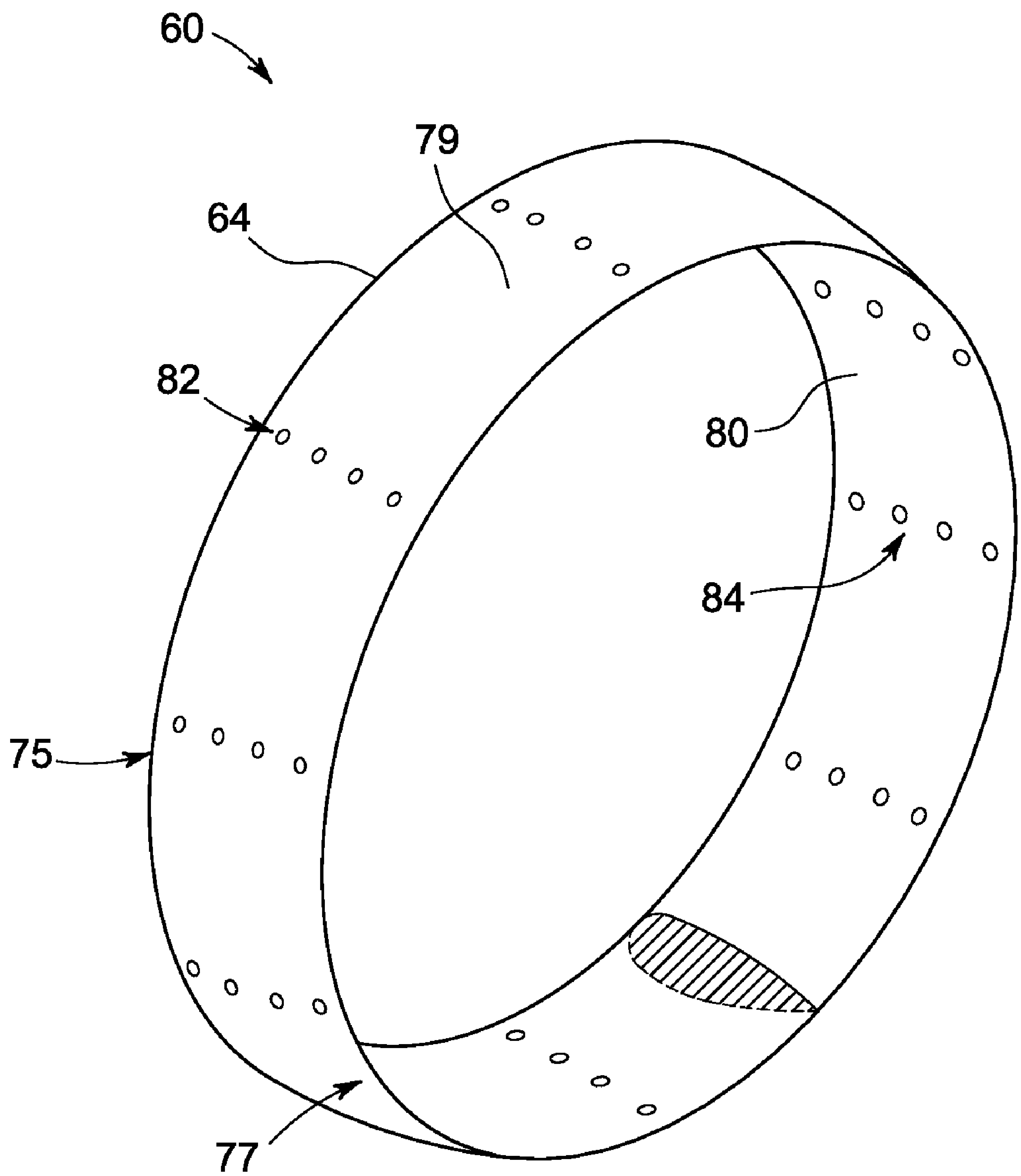


FIG. 3

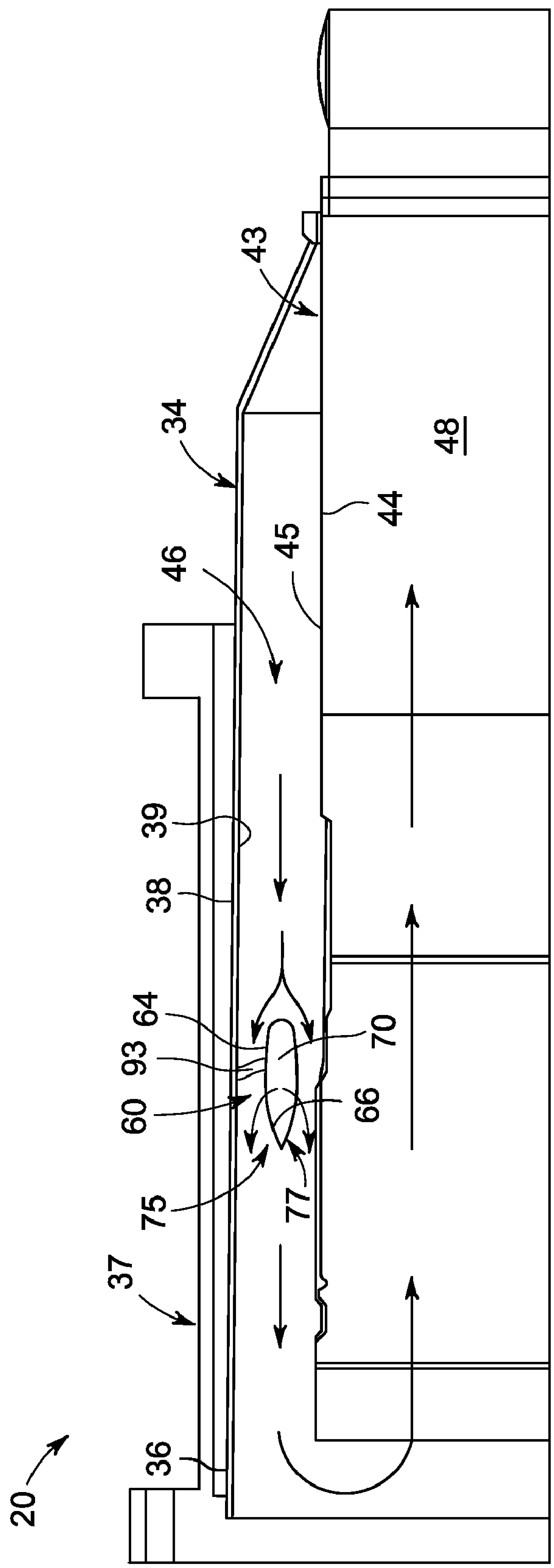


FIG. 4

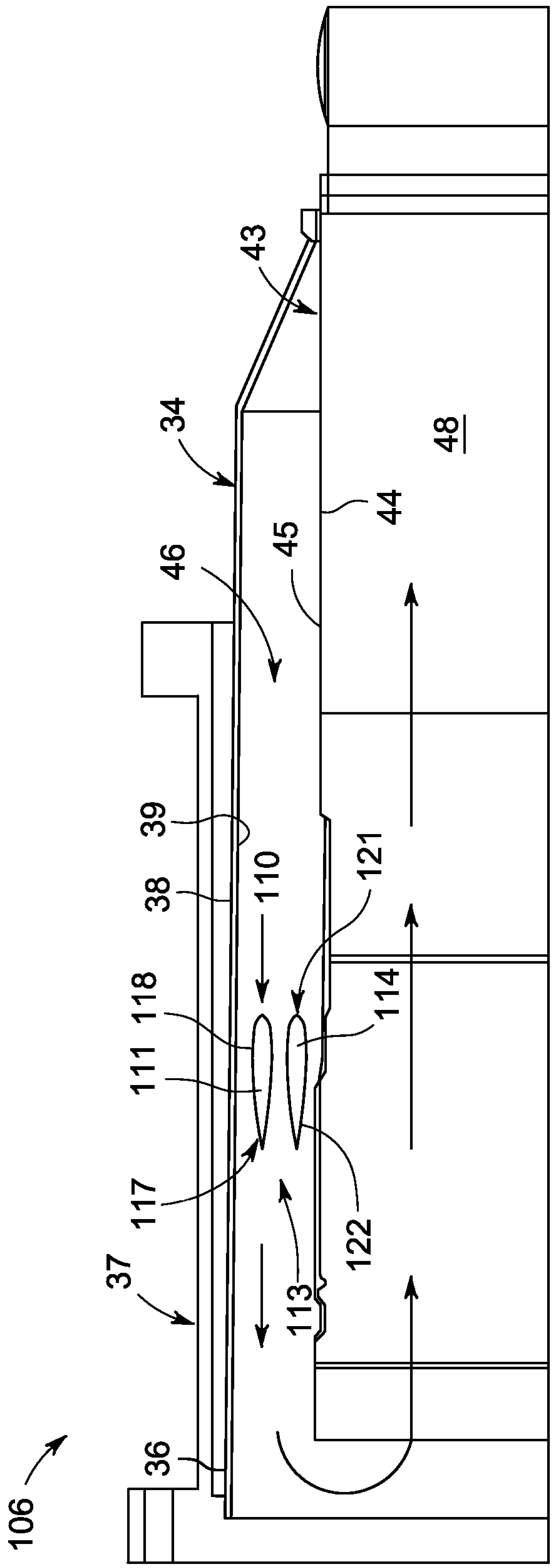


FIG. 5

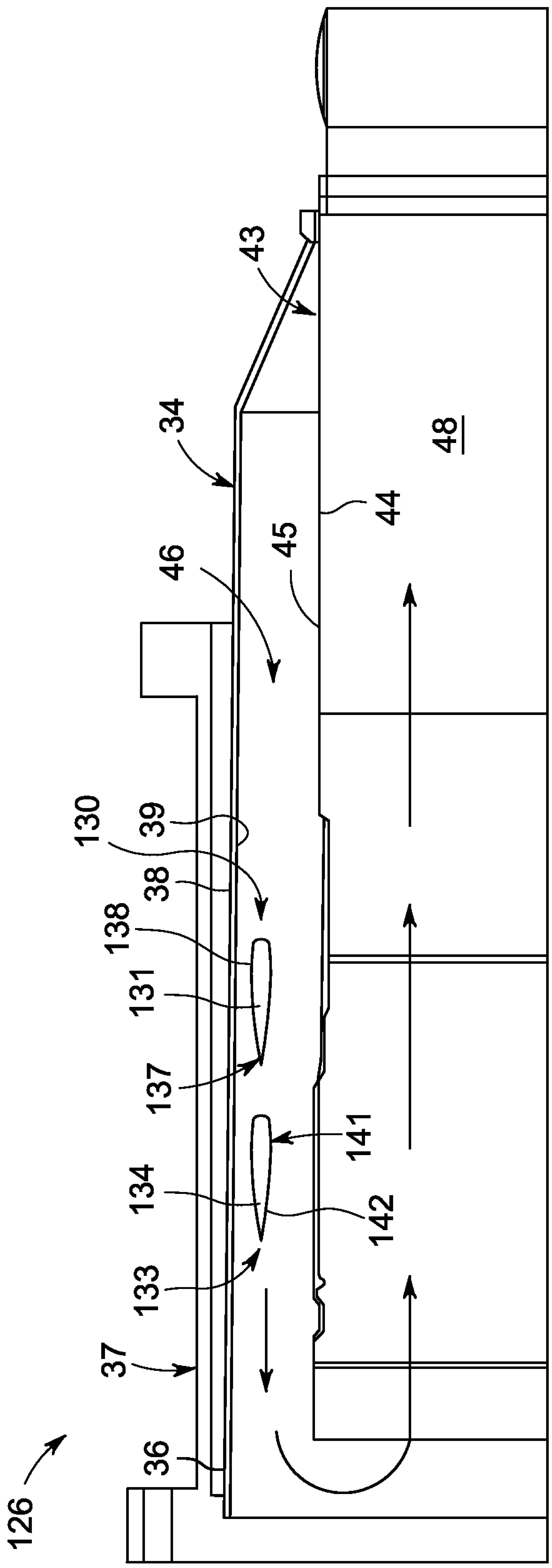


FIG. 6

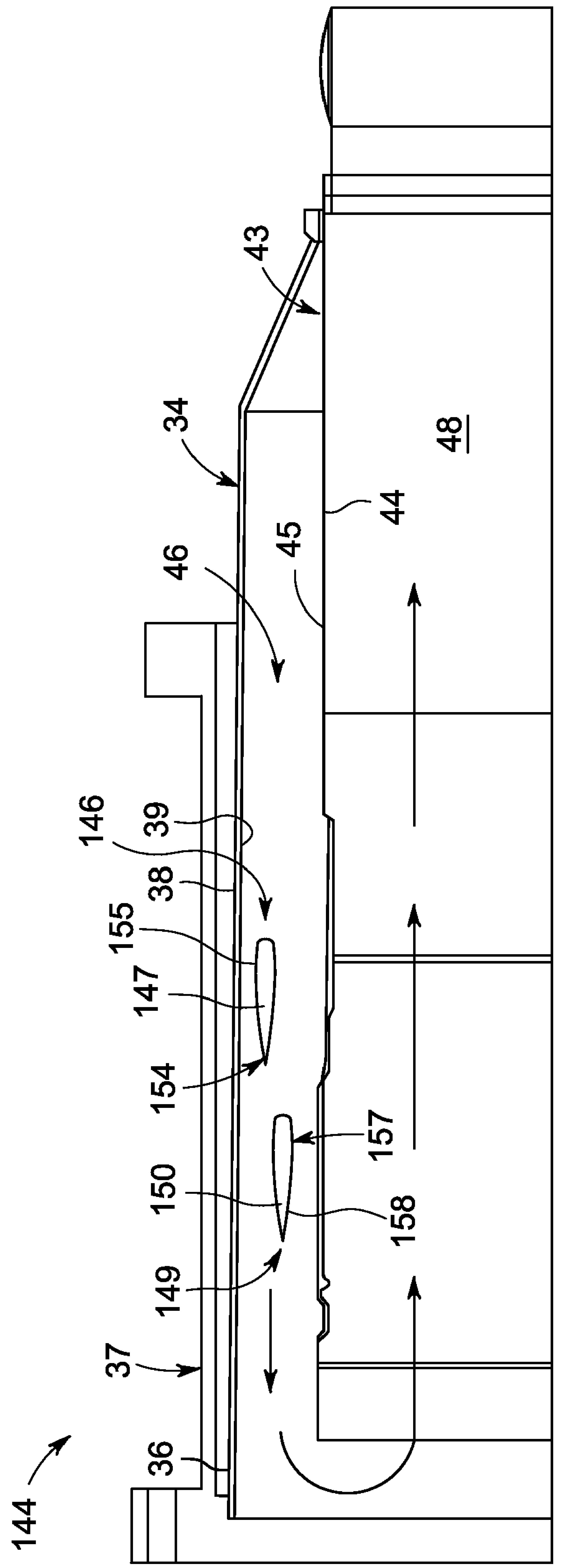


FIG. 7

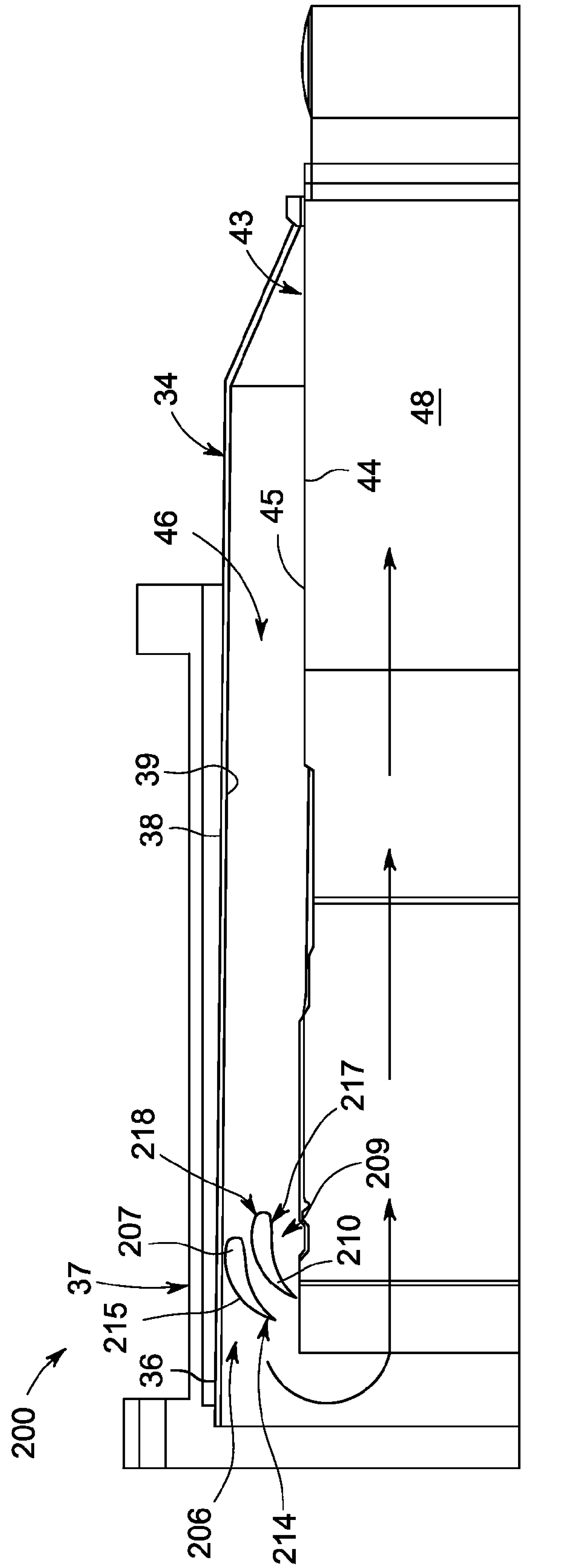


FIG. 8

ANNULAR FLOW CONDITIONING MEMBER FOR GAS TURBOMACHINE COMBUSTOR ASSEMBLY

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to the art of turbomachines and, more particularly, to an annular flow conditioning member for a gas turbomachine combustor assembly.

[0002] In general, gas turbine engines combust a fuel/air mixture that releases heat energy to form a high temperature gas stream. The high temperature gas stream is channeled to a turbine via a hot gas path. The turbine converts thermal energy from the high temperature gas stream to mechanical energy that rotates a turbine shaft. The turbine may be used in a variety of applications, such as for providing power to a pump or an electrical generator.

[0003] Many gas turbines include an annular combustor within which are formed the combustion gases that create the high temperature gas stream. Other turbomachines employ a plurality of combustors arranged in a can-annular array. In such a turbomachine, the combustion gases are formed in each of the plurality of combustors, combusted in a combustion chamber defined by a combustor body, and delivered to the turbine through a transition piece. Often times, compressor discharge air is passed into the combustor to cool various surfaces and aid in forming the fuel/air mixture. In certain arrangements, compressor discharge air is often channeled along a combustor liner toward a venturi.

[0004] A portion of the compressor discharge air is directed onto internal surfaces of the venturi for cooling. The compressor discharge air passes from the venturi into a passage formed between the combustor body and the combustor liner. In certain arrangements, a plurality of turbulator members is arranged in the passage. The turbulator members create flow vortices that enhance heat transfer in the combustor body. The compressor discharge air exits the passage into the combustion chamber to mix with the combustion gases.

BRIEF DESCRIPTION OF THE INVENTION

[0005] According to one aspect of the exemplary embodiment, a turbomachine combustor assembly includes a combustor body, a combustor liner arranged within the combustor body and defining a combustion chamber, a fluid passage defined between the combustor body and the combustor liner, and an annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

[0006] According to another aspect of the exemplary embodiment, a gas turbomachine system including a compressor portion, a turbine portion operatively coupled to the compressor portion, and a combustor assembly fluidly connecting the compressor portion and the turbine portion. The combustor assembly includes a combustor body, a combustor liner arranged within the combustor body and defining a combustion chamber, a fluid passage defined between the combustor body and the combustor liner, and an annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

[0007] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0008] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0009] FIG. **1** is a schematic diagram of a gas turbomachine system including a combustor assembly having a flow conditioning member in accordance with an exemplary embodiment;

[0010] FIG. **2** is a partial cross-sectional view of the combustor assembly of FIG. **1** illustrating a flow conditioning member in accordance with an exemplary embodiment;

[0011] FIG. **3** is a perspective view of a flow conditioning member in accordance with an exemplary embodiment;

[0012] FIG. **4** is a partial cross-sectional view of the combustor assembly of FIG. **2** illustrating the flow conditioning member in accordance with an exemplary embodiment;

[0013] FIG. **5** is a partial cross-sectional view of the combustor assembly of FIG. **1** illustrating first and second flow conditioning members in accordance with an exemplary embodiment;

[0014] FIG. **6** is a partial cross-sectional view of the combustor assembly of FIG. **1** illustrating first and second flow conditioning members in accordance with another aspect of the exemplary embodiment;

[0015] FIG. **7** is a partial cross-sectional view of the combustor assembly of FIG. **1** illustrating first and second flow conditioning members in accordance with yet another exemplary embodiment; and

[0016] FIG. **8** is a partial cross-sectional view of the combustor assembly of FIG. **1** illustrating first and second flow conditioning members in accordance with still yet another exemplary embodiment.

[0017] The detailed description explains embodiments of the invention, together with advantages and features, by way of example with reference to the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0018] With reference to FIG. **1**, a turbomachine constructed in accordance with an exemplary embodiment is indicated generally at **2**. Turbomachine **2** includes a compressor portion **4** and a turbine portion **6**. Compressor portion **4** includes a compressor housing **8** and turbine portion **6** includes a turbine housing **10**. Compressor portion **4** is linked to turbine portion **6** through a common compressor/turbine shaft or rotor **16**. Compressor portion **4** is also linked to turbine portion **6** through a plurality of circumferentially spaced combustor assemblies, one of which is indicated at **20**.

[0019] As best shown in FIG. **2**, combustor assembly **20** includes a combustor body **34** having a forward end **36** to which is mounted an injector nozzle housing **37**. Combustor body **34** includes an outer surface **38** and an inner surface **39**. In the exemplary embodiment shown, combustor assembly **20** includes a combustor liner **43** arranged within combustor body **34**. Combustor liner **43** includes an inner surface **44** and an outer surface **45**. Outer surface **45** is spaced from an inner surface **39** of combustor body **34** thereby forming a fluid flow passage **46** that transmits compressor discharge air from compressor portion **4** toward injector nozzle housing **37**. Inner surface **44** of combustor liner **43** defines a combustion chamber **48**. In further accordance with the exemplary embodiment shown, combustor assembly **20** includes an annular flow conditioning member **60**. As will become more fully evident below, flow conditioning member **60** is arranged within fluid flow passage **46** and extends about combustor liner **43**.

[0020] Annular flow conditioning member **60** includes an external surface **64** and an internal surface **66** that defines an annular fuel plenum **70**. External surface **64** of flow conditioning member **60** includes an aerodynamic profile **75** that defines an airfoil **77**. As best shown in FIG. **3**, annular flow conditioning member **60** includes a first airfoil surface **79** and a second airfoil surface **80**. First airfoil surface **79** includes a plurality of openings **82** and second airfoil surface **80** includes a second plurality of openings **84**. Openings **82** and **84** extend into annular fuel plenum **70**. With this arrangement, fuel flowing into annular fuel plenum **70** exits through first and second plurality of openings **82** and **84** to mix with air flowing through fluid flow passage **46** prior to entering an injection nozzle (not shown) and being combusted in combustion chamber **48**. The particular profile of annular flow conditioning member **60** enhances air/fuel mixing. In addition, the positioning of annular flow conditioning member **60** within fluid flow passage **46** leads to more consistent flow velocities particularly in axial and tangential directions. Furthermore, by supporting annular flow conditioning member **60** within fluid flow passage **46** flow separations are reduced.

[0021] In further accordance with the exemplary embodiment, annular flow conditioning member **60** is supported within fluid flow passage **46** by first and second support members **87** and **90**. First support member **87** extends between inner surface **39** of combustor body **34** and first airfoil surface **79**. Second support member **90** extends between second airfoil surface **80** and combustor liner **43**. The number and location of support members **87** and **89** can vary. That is, while shown with two support members **87** and **90**, annular flow conditioning member **60** could be supported within flow passage **46** through a single support member that extends from combustor body **34** or combustor liner **43**. In addition to first and second support members **87** and **89**, annular flow conditioning member **60** is coupled to a fuel delivery passage **93** (FIG. **4**). In accordance with one aspect of the exemplary embodiment first and second support members **87** and **89** are designed with an airfoil shape so as to reduce downstream flow separation. Fuel delivery passage **93** fluidly couples annular fuel plenum **70** and a source of fuel (not shown). Fuel delivery passage **93** may take on a variety of forms that include rigid and flexibly connections.

[0022] Reference will now be made to FIG. **5**, wherein like reference numbers represent corresponding parts in the respective views, in describing a combustor assembly **106** in accordance with another aspect of the exemplary embodiment. Combustor assembly **106** includes a first annular flow conditioning member **110** having a first annular fuel plenum **111** and a second annular flow conditioning member **113** having a second annular fuel plenum **114**. First annular flow conditioning member **110** includes a first aerodynamic profile **117** that defines a first airfoil **118**. Similarly, second annular flow conditioning member **113** includes a second aerodynamic profile **121** that defines a second airfoil **122**. In the exemplary aspect shown, first annular flow conditioning member **110** extends about second annular flow conditioning member **113** within fluid flow passage **46**. The number and radial location of annular flow conditioning members **110** and **113** can vary. The particular orientation of flow conditioning members **110** and **113** allows for enhanced fuel/air mixing while also leading to more consistent flow velocities and reduced air/fuel separation within fluid flow passage **46**.

[0023] Reference will now be made to FIG. **6**, wherein like reference numbers represent corresponding parts in the respective views, in describing a combustor assembly **126** in accordance with another aspect of the exemplary embodiment. Combustor assembly **126** includes a first annular flow conditioning member **130** having a first annular fuel plenum **131** and a second annular flow conditioning member **133** having a second annular fuel plenum **134**. First annular flow conditioning member **130** includes a first aerodynamic profile **137** that defines a first airfoil **138**. Similarly, second annular flow conditioning member **133** includes a second aerodynamic profile **141** that defines a second airfoil **142**. In the exemplary aspect shown, second annular flow conditioning member **133** is positioned downstream from first annular flow conditioning member **130** within fluid flow passage **46**. The number and axial location of annular flow conditioning members **130** and **133** can vary. In a manner similar to that described above, the particular orientation of flow conditioning members **133** and **130** allows for enhanced fuel/air mixing while also leading to more consistent flow velocities and reduced air/fuel separation within fluid flow passage **46**.

[0024] Reference will now be made to FIG. **7**, wherein like reference numbers represent corresponding parts in the respective views, in describing a combustor assembly **144** in accordance with another aspect of the exemplary embodiment. Combustor assembly **144** includes a first annular flow conditioning member **146** having a first annular fuel plenum **147** and a second annular flow conditioning member **149** having a second annular fuel plenum **150**. First annular flow conditioning member **146** includes a first aerodynamic profile **154** that defines a first airfoil **155**. Similarly, second annular flow conditioning member **149** includes a second aerodynamic profile **157** that defines a second airfoil **158**. In the exemplary aspect shown, second annular flow conditioning member **149** is positioned downstream from, and is axially off-set relative to first annular flow conditioning member **146** within fluid flow passage **46**. The number and location of annular flow conditioning members **146** and **149** can vary. In a manner also similar to that described above, the particular orientation of flow conditioning members **146** and **149** allows for enhanced fuel/air mixing while also leading to more consistent flow velocities and reduced air/fuel separation within fluid flow passage **46**.

[0025] Reference will now be made to FIG. **8**, wherein like reference numbers represent corresponding parts in the respective views, in describing a combustor assembly **200** in accordance with another aspect of the exemplary embodiment. Combustor assembly **200** includes a first annular flow conditioning member **206** having a first annular fuel plenum **207** and a second annular flow conditioning member **209** having a second annular fuel plenum **210**. First annular flow conditioning member **206** includes a first aerodynamic profile **214** that defines a first airfoil **215**. Similarly, second annular flow conditioning member **209** includes a second aerodynamic profile **217** that defines a second airfoil **218**. In the exemplary aspect shown, first and second annular flow conditioning members **206** and **209** are curved so as to form respective pressure and suction sides (not separately labeled). In this manner, first and second flow conditioning members **206** and **209** assist in turning fluid flow from fluid flow passage **46** into the respective combustor (not separately labeled) without developing flow separations in the fluid flow.

[0026] At this point it should be appreciated that the exemplary embodiments describe an annular flow conditioning member(s) that is suspended within a flow passage of a turbomachine combustor assembly. The aerodynamic profile and the positioning of the annular flow conditioning member enhances air/fuel mixing and also leads to more consistent flow velocities particularly in axial and tangential directions. Furthermore, by supporting annular flow conditioning member **60** within fluid flow passage **46** separation of fluid flow is reduced. It should also be understood that fuel may be passed to the fuel plenum defined by the annular flow conditioning member either through the support member instead of or as a supplement to the fuel passage.

[0027] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

1. A turbomachine combustor assembly comprising:
a combustor body;
a combustor liner arranged within the combustor body and defining a combustion chamber;
a fluid passage defined between the combustor body and the combustor liner; and
an annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

2. The turbomachine combustor assembly according to claim **1**, wherein the annular flow conditioning member includes an external surface and an internal surface that defines an annular fuel plenum.

3. The turbomachine combustor assembly according to claim **2**, wherein the external surface of the annular flow conditioning member includes an aerodynamic profile.

4. The turbomachine combustor assembly according to claim **3**, wherein the aerodynamic profile defines an airfoil.

5. The turbomachine combustor assembly according to claim **2**, wherein the annular flow conditioning member includes a plurality of openings extending through the external and internals surfaces, the plurality of openings fluidly connecting the annular fuel plenum and the fluid passage.

6. The turbomachine combustor assembly according to claim **2**, further comprising: a fuel delivery passage fluidly connected to the annular fuel plenum.

7. The turbomachine combustor assembly according to claim **1**, further comprising: a support member extending between the combustor body and the annular flow conditioning member.

8. The turbomachine combustor assembly according to claim **7**, further comprising: another between the combustor liner and the annular flow conditioning member.

9. The turbomachine combustor assembly according to claim **1**, further comprising: another annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

10. The turbomachine combustor assembly according to claim **9**, wherein the another annular flow conditioning member extends about the annular flow conditioning member.

11. The turbomachine combustor assembly according to claim **9**, wherein the another annular flow conditioning member is arranged downstream relative to the annular flow conditioning member.

12. The turbomachine combustor assembly according to claim **11**, wherein the another annular flow conditioning member is arranged substantially co-planar relative to the annular flow conditioning member.

13. The turbomachine combustor assembly according to claim **11**, wherein the another annular flow conditioning member is axially off-set relative to the annular flow conditioning member.

14. A gas turbomachine system comprising:
a compressor portion;
a turbine portion operatively coupled to the compressor portion; and
a combustor assembly fluidly connecting the compressor portion and the turbine portion, the combustor assembly comprising:
a combustor body;
a combustor liner arranged within the combustor body and defining a combustion chamber;
a fluid passage defined between the combustor body and the combustor liner; and
an annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

15. The gas turbomachine system according to claim **14**, wherein the annular flow conditioning member includes an external surface that defines an aerodynamic profile and an internal surface that defines an annular fuel plenum.

16. The gas turbomachine system according to claim **14**, further comprising: another annular flow conditioning member arranged in the fluid passage and extending about the combustor liner.

17. The gas turbomachine system according to claim **16**, wherein the another annular flow conditioning member extends about the annular flow conditioning member.

18. The gas turbomachine system according to claim **16**, wherein the another annular flow conditioning member is arranged downstream relative to the annular flow conditioning member.

19. The gas turbomachine system according to claim **18**, wherein the another annular flow conditioning member is arranged substantially co-planar relative to the annular flow conditioning member.

20. The gas turbomachine system according to claim **18**, wherein the another annular flow conditioning member is axially off-set relative to the annular flow conditioning member.

* * * * *