



(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
12.12.2012 Bulletin 2012/50

(51) Int Cl.:
F23D 14/70 (2006.01) F23R 3/16 (2006.01)

(21) Application number: **12169988.8**

(22) Date of filing: **30.05.2012**

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

- **Melton, Patrick Benedict**
Greenville, SC South Carolina 29615 (US)
- **Kim, Kwanwoo**
Cincinnati, OH Ohio 45215 (US)
- **Berry, Jonathan Dwight**
Greenville, SC South Carolina 29615 (US)

(30) Priority: **06.06.2011 US 201113153506**

(74) Representative: **Cleary, Fidelma**
GE International Inc.
Global Patent Operation-Europe
15 John Adam Street
London WC2N 6LU (GB)

(71) Applicant: **General Electric Company**
Schenectady, NY 12345 (US)

(72) Inventors:
• **Flamand, Luis Manuel**
Greenville, SC South Carolina 29615 (US)

(54) **System for conditioning flow through a nozzle**

(57) A system for conditioning flow through a plurality of nozzles (12) arranged in a combustor (10) includes a shield circumferentially surrounding at least a portion of

the plurality of nozzles (12) and a plurality of baffles (40) disposed circumferentially around the shield. Each baffle (40) is circumferentially disposed between adjacent nozzles (12).

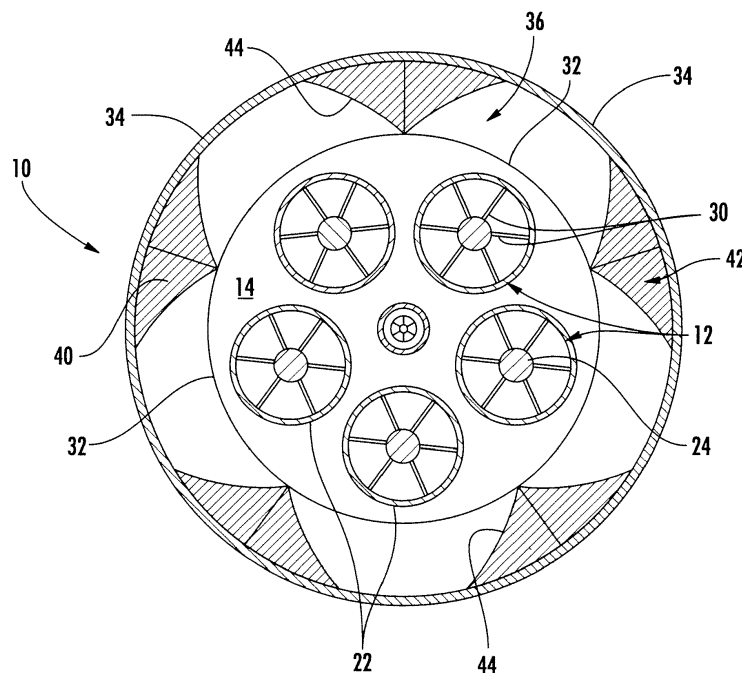


FIG. 2

Description

FIELD OF THE INVENTION

[0001] The present invention generally involves a system for conditioning flow through a nozzle. In particular embodiments of the present invention, a plurality of baffles may circumferentially surround a plurality of nozzles arranged in a combustor to enhance the distribution of a compressed working fluid through the nozzles.

BACKGROUND OF THE INVENTION

[0002] Combustors are commonly used in industrial and power generation operations to ignite fuel to produce combustion gases having a high temperature and pressure. For example, gas turbines typically include one or more combustors to generate power or thrust. A typical gas turbine used to generate electrical power includes an axial compressor at the front, one or more combustors around the middle, and a turbine at the rear. Ambient air may be supplied to the compressor, and rotating blades and stationary vanes in the compressor progressively impart kinetic energy to the working fluid (air) to produce a compressed working fluid at a highly energized state. The compressed working fluid exits the compressor and flows through one or more nozzles into a combustion chamber in each combustor where the compressed working fluid mixes with fuel and ignites to generate combustion gases having a high temperature and pressure. The combustion gases expand in the turbine to produce work. For example, expansion of the combustion gases in the turbine may rotate a shaft connected to a generator to produce electricity.

[0003] During normal combustor operations, a combustion flame exists downstream from the nozzles, typically in the combustion chamber at the exit of the nozzles. Occasionally, however, "flame holding" may occur in which a combustion flame exists upstream of the combustion chamber inside one or more nozzles. For example, conditions may exist in which a combustion flame exists near a fuel port in the nozzles or near an area of low flow in the nozzles. Nozzles are typically not designed to withstand the high temperatures created by a flame holding event which may therefore cause severe damage to a nozzle in a relatively short amount of time.

[0004] Various methods are known in the art for preventing or reducing the occurrence of flame holding. For example, the tortuous flow path of the compressed working fluid through the combustor may produce excessive pressure loss and/or create regions of uneven flow through the combustor and/or nozzles. Each of these effects reduces the efficiency of the combustor and increases the chance of flame holding occurring at the low flow regions. Therefore, a system for conditioning the flow of the compressed working fluid through the combustor and/or nozzles that reduces the pressure loss across the combustor and/or the regions of uneven flow

through the combustor and/or nozzles would be useful.

BRIEF DESCRIPTION OF THE INVENTION

[0005] 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.

[0006] The present invention resides in a system for conditioning flow through a plurality of nozzles arranged in a combustor. The system includes a shield circumferentially surrounding at least a portion of the plurality of nozzles and a plurality of baffles disposed circumferentially around the shield. Each baffle is circumferentially disposed between adjacent nozzles.

[0007] 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

[0008] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

Fig. 1 is a simplified cross-section of a portion of a combustor according to one embodiment of the present invention;

Fig. 2 is an downstream axial view of the combustor shown in Fig. 1 taken along line A-A;

Fig. 3 is a perspective view of the baffle shown in Figs. 1 and 2 according to one embodiment of the present invention;

Fig. 4 is a simplified cross-section of a portion of a combustor according to a second embodiment of the present invention;

Fig. 5 is a downstream axial view of the combustor shown in Fig. 4 taken along line B-B; and

Fig. 6 is a perspective view of the baffle shown in Figs. 4 and 5 according to an alternate embodiment of the present invention.

DETAILED DESCRIPTION OF THE INVENTION

[0009] 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.

[0010] 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.

[0011] Various embodiments of the present invention include a system for conditioning flow through a nozzle. In particular embodiments, a plurality of baffles may be circumferentially arranged around and/or between a plurality of nozzles, and the baffles may divide and/or distribute a compressed working fluid flowing through the nozzles to produce a more uniform volumetric and/or velocity profile through the nozzles. Although exemplary embodiments of the present invention will be described generally in the context of a combustor incorporated into a gas turbine for purposes of illustration, one of ordinary skill in the art will readily appreciate that embodiments of the present invention may be applied to any combustor and are not limited to a gas turbine combustor unless specifically recited in the claims.

[0012] Fig. 1 provides a simplified cross-section of a portion of a combustor, such as may be included in a gas turbine, according to one embodiment of the present invention. The combustor 10 may include one or more nozzles 12 radially arranged between a cap 14 and an end cover 16. The cap 14 and a liner 18 generally surround and define a combustion chamber 20 located downstream from the nozzles 12. As used herein, 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.

[0013] Each nozzle 12 may generally include a shroud 22 that circumferentially surrounds at least a portion of a center body 24 to define an annular passage 26 between the shroud 22 and the center body 24. The center body 24 generally extends axially from the end cover 16 toward the cap 14 to provide fluid communication for fuel to flow from the end cover 16, through the center body 20, and into the combustion chamber 20. The shroud 22 may include a bellmouth opening 28 to enhance the radial distribution of the compressed working fluid flowing through the annular passage 26 between the shroud 22 and the center body 24. In addition, one or more vanes 30 extending radially between the center body 24 and the shroud 22 may impart a tangential swirl to the compressed working fluid to enhance mixing between the compressed working fluid and the fuel prior to combustion.

[0014] As shown in Fig. 1, a cap shield 32 may circumferentially surround the nozzles 12 between the cap 14 and the end cover 16, and a casing 34 may surround the

liner 18 and cap shield 32 to define an axis-symmetric annular passage 36 that circumferentially surrounds the combustion chamber 20 and nozzles 12. The compressed working fluid may flow through the annular passage 36 to provide impingement and/or convective cooling to the liner 18 and/or cap shield 32. When the compressed working fluid reaches the end cover 16, the compressed working fluid reverses direction to flow through the one or more nozzles 12 where it mixes with fuel before igniting in the combustion chamber 20 to produce combustion gases having a high temperature and pressure.

[0015] Fig. 2 provides an downstream axial view of the combustor 10 shown in Fig. 1 taken along line A-A. As shown in Figs. 1 and 2, the combustor 10 may include a plurality of baffles 40 disposed circumferentially around the cap shield 32. In the embodiment shown in Figs. 1 and 2, each baffle 40 extends radially inside the annular passage 36 between the casing 34 and the cap shield 32, while in other particular embodiments, a portion or all of each baffle 40 may extend radially inward from the cap shield 32. As shown most clearly in Fig. 2, each baffle 40 may be circumferentially disposed between adjacent nozzles 12 and fixedly connected to at least one of the casing 34 or the cap shield 32. In this manner, the baffles 40 divide and distribute the compressed working fluid flowing through the annular passage 36 to reduce pressure losses across the combustor 10 and/or reduce low flow regions in the vicinity of the nozzles 12. Specifically, the compressed working fluid flowing through the annular passage 36 is redirected, guided, or curved circumferentially and/or radially inward by the baffles 40 to more evenly distribute the compressed working fluid into the bellmouth opening 28 of each nozzle 12.

[0016] Fig. 3 provides a perspective view of an exemplary baffle 40 shown in Figs. 1 and 2 according to one embodiment of the present invention. As shown, each baffle 40 may comprise one or more substantially triangular surfaces 42 and/or concave surfaces 44 to reduce the flow resistance, and thus the pressure drop, of the compressed working fluid flowing over the baffles 40. One of ordinary skill in the art can readily determine other suitable shapes and curvatures for the baffles 40 to complement the particular arrangement and geometry of the nozzles 12 radially arranged in the combustor 10, and the particular shape and/or curvature of the baffles 40 is not a limitation of the present invention unless specifically recited in the claims.

[0017] Figs. 4 and 5 provides simplified cross-section and axial views of the combustor 10 according to a second embodiment of the present invention. The combustor 10 again includes one or more nozzles 12 radially arranged between the cap 14 and end cover 16 and the other general components as previously described with respect to the embodiment shown in Fig. 1. The combustor 10 again includes the plurality of baffles 40 radially disposed around the cap shield 32, with each baffle 40 again circumferentially disposed between the adjacent nozzles 12. However, as shown most clearly in Fig. 5, in

this particular embodiment, each baffle 40 is radially disposed completely inward of the cap shield 32. In this manner, the baffles 40 again divide and distribute the compressed working fluid into the bellmouth openings 28 of the adjacent nozzles to reduce pressure losses across the combustor 10 and/or reduce low flow regions in the vicinity of the nozzles 12. Specifically, the compressed working fluid flowing through the annular passage 36 reverses direction as it reaches the end cover 16, and the baffles 40 redirect, guide, or curve the compressed working fluid circumferentially and/or radially inward to more evenly distribute the compressed working fluid into the bellmouth opening 28 of each nozzle 12.

[0018] Fig. 6 provides a perspective view of an exemplary baffle 40 shown in Figs. 4 and 5 according to an alternate embodiment of the present invention. As shown, each baffle 40 may again comprise a substantially triangular surface 42 to allow each baffle 40 to fit circumferentially between adjacent nozzles 12. In this particular embodiment, each baffle further includes a convex surface 46 to reduce the flow resistance, and thus the pressure drop, of the compressed working fluid flowing over the baffles 40 and into the adjacent nozzles 12. One of ordinary skill in the art can readily determine other suitable shapes and curvatures for the baffles 40 to complement the particular arrangement and geometry of the nozzles 12 radially arranged in the combustor 10, and the particular shape and/or curvature of the baffles 40 is not a limitation of the present invention unless specifically recited in the claims.

[0019] The various shapes and locations of the baffles 40 described and illustrated in the various embodiment shown in Figs. 1-6 thus reduce the pressure losses and low flow regions associated with the flow path of the compressed working fluid. As a result, it is anticipated that each nozzle 12 will receive a more uniform distribution of compressed working fluid, by volume and velocity, which in turn enhances the efficiency and flame holding margin for each nozzle 12.

[0020] 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 languages of the claims.

Claims

1. A system for conditioning flow through a plurality of nozzles (12) arranged in a combustor (10), compris-

ing:

- a. a shield (32) circumferentially surrounding at least a portion of the plurality of nozzles (12); and
- b. a plurality of baffles (40) disposed circumferentially around said shield (32), wherein each baffle (40) is circumferentially disposed between adjacent nozzles (12).

2. The system as in claim 1, wherein each baffle (40) comprises a substantially triangular surface (42).
3. The system as in claim 1 or 2, wherein each baffle (40) comprises at least one concave surface (44).
4. The system as in any of claims, 1 to 3 wherein at least a portion of each baffle (40) extends radially inward from said shield (32).
5. The system as in any of claims 1 to 4, wherein each baffle (40) is radially disposed completely inward of said shield (32).
6. The system as in any preceding claim, further comprising a casing (34) circumferentially surrounding at least a portion of said shield (32).
7. The system as in claim 6, wherein each baffle (40) is fixedly connected to at least one of said shield (32) or said casing (34).
8. The system as in any of claims 6 to 7, wherein each baffle (40) extends radially between said shield (32) and said casing (34).

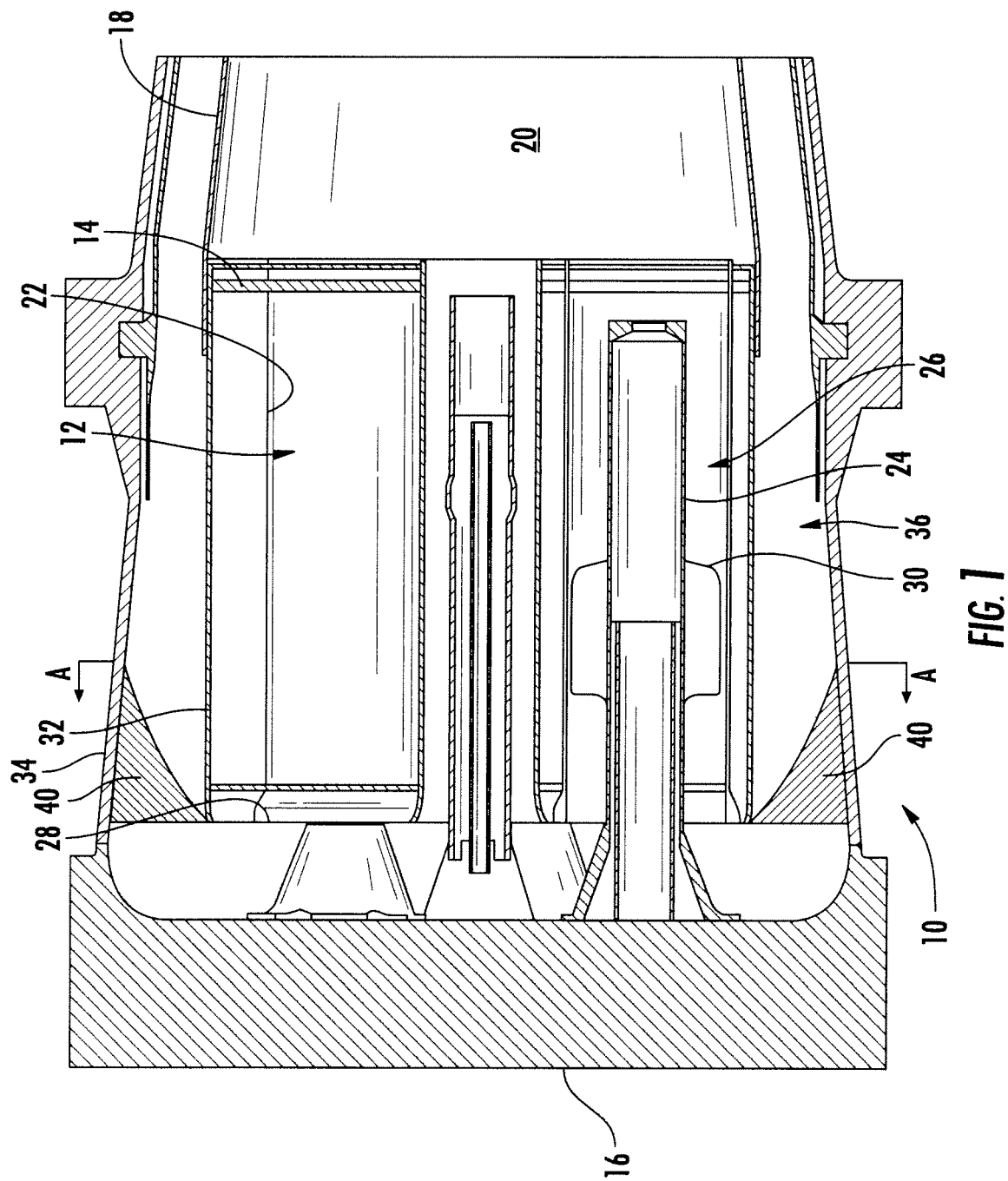


FIG. 1

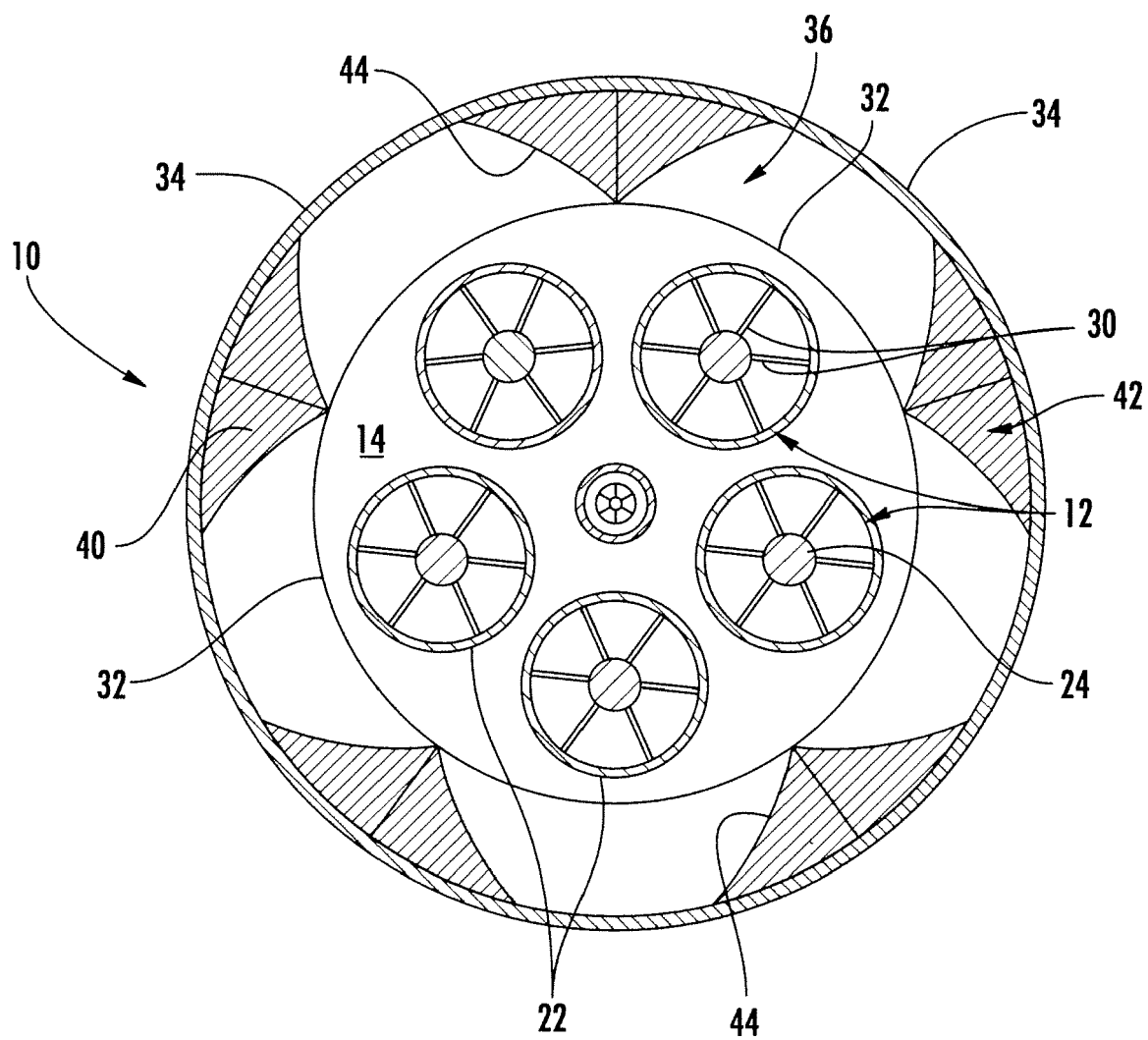


FIG. 2

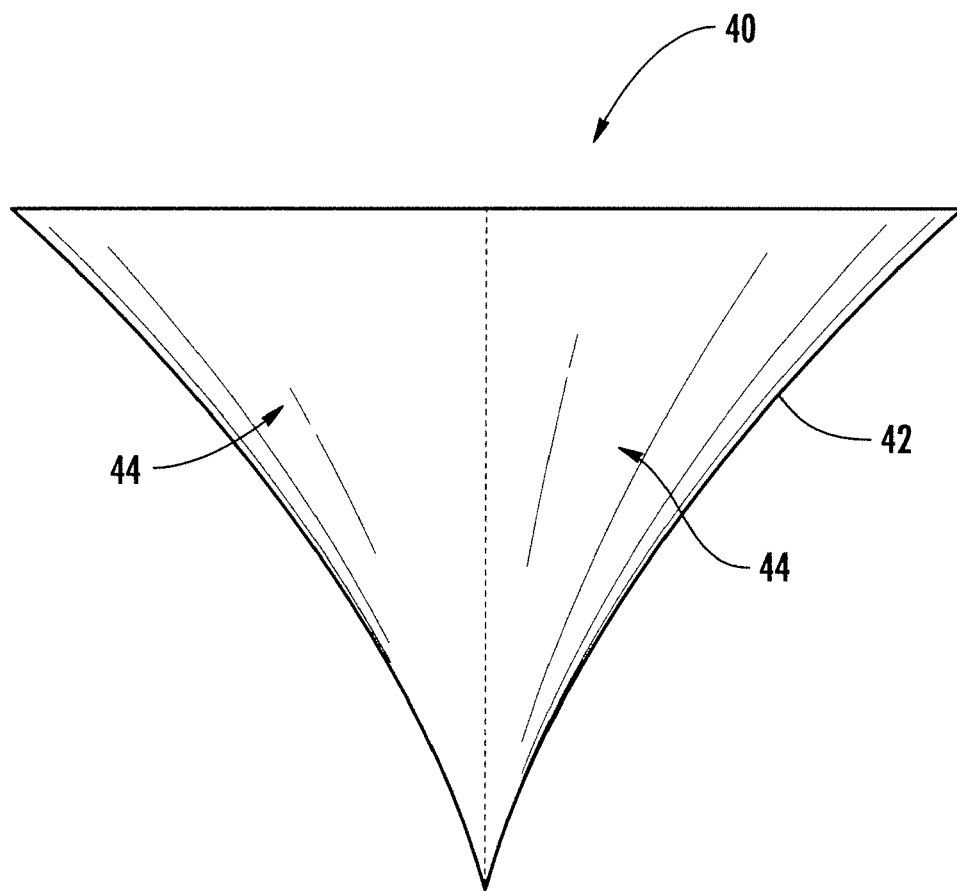


FIG. 3

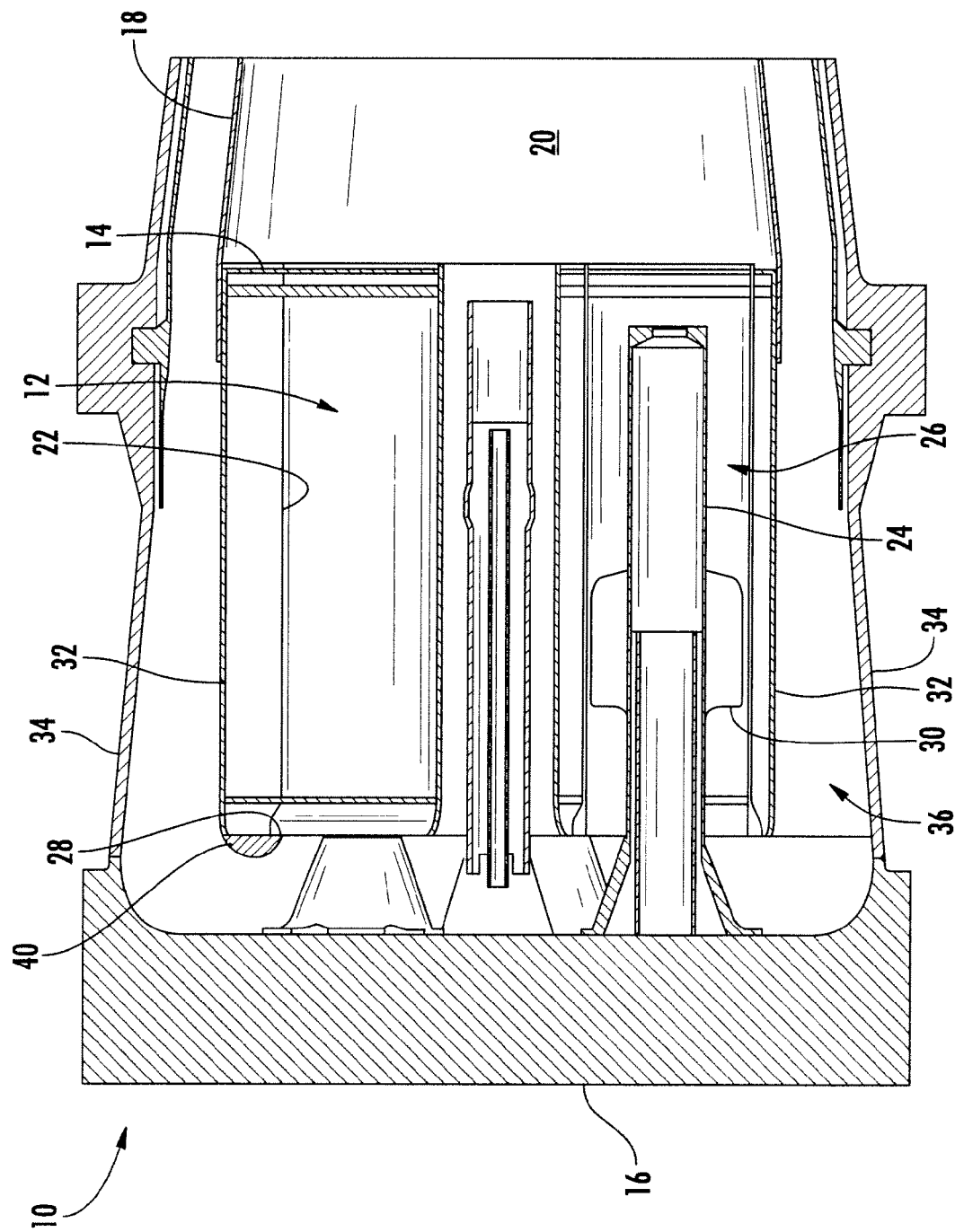


FIG. 4

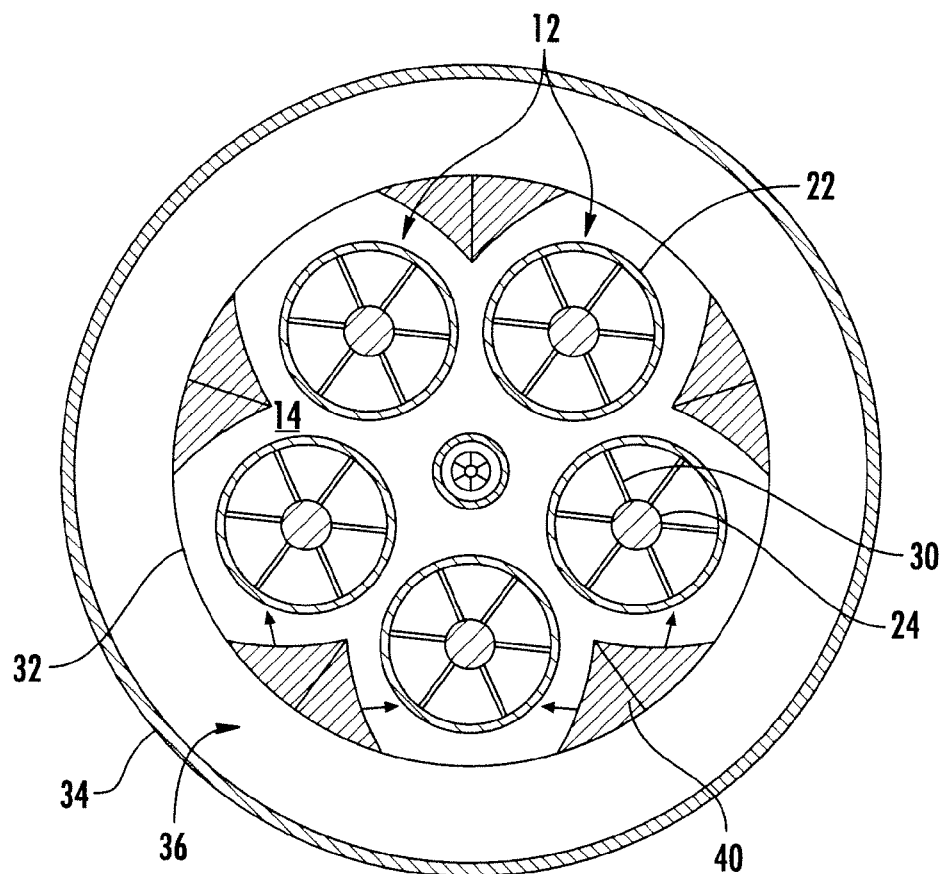


FIG. 5

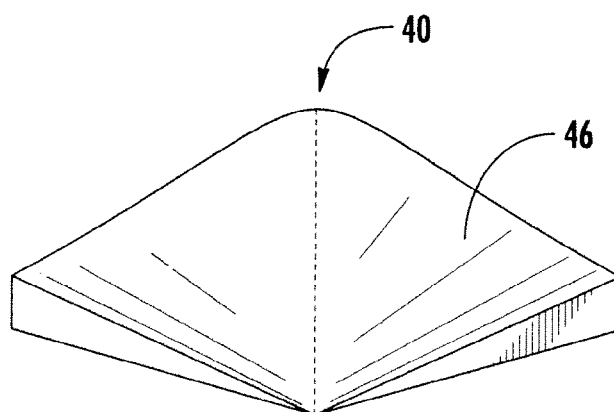


FIG. 6