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(54) Title: GAS TURBINE ENGINE WITH COMPRESSOR DISCHARGE CASING COMPRISING A FLOW SPLITTER

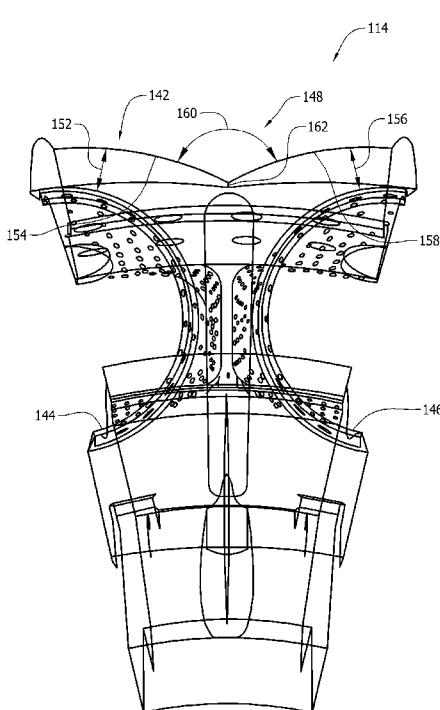


FIG. 4

(57) Abstract: A splitter (148) is provided for improving a pressure recovery of a compressor discharge casing (CDC) (114) of a gas turbine engine. The CDC includes an annular wall (142) that extends generally axially along at least a portion of the CDC. The CDC is configured to house a first combustor and a second combustor (106). The splitter extends from the annular wall between the first and second combustors. The splitter includes a first surface (154) that is configured to direct fluid towards the first combustor and a second surface (158) that is configured to direct fluid towards the second combustor.



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- *as to the applicant's entitlement to claim the priority of the earlier application (Rule 4.17(iii))*

GAS TURBINE ENGINE WITH COMPRESSOR DISCHARGE CASING COMPRISING A FLOW SPLITTER

BACKGROUND OF THE INVENTION

The subject matter disclosed herein relates generally to gas turbine engines and, more particularly, to a gas turbine engine including a compressor assembly with a splitter.

At least some known gas turbine engines channel air through a compressor assembly and, more specifically, a compressor discharge casing (CDC) that encases an array of combustors. As the air is channeled through the CDC, the air is compressed between adjacent combustors, and vortices form along the meridional planes of the CDC. The compression of the air produces a local acceleration and weak diffusion air stream that may result in a low pressure recovery. Accordingly, a more efficient method and/or system for channeling air through the compressor assembly are desired.

BRIEF SUMMARY OF THE INVENTION

In one aspect, a method is provided for assembling a gas turbine engine. The method includes providing a compressor discharge casing (CDC) including an annular wall that extends generally axially along at least a portion of the CDC. The CDC is coupled to a combustor casing such that a first combustor and a second combustor are housed within the annular wall. A splitter extends from the annular wall between the first and second combustors. The splitter includes a first surface that is configured to direct fluid towards the first combustor and a second surface that is configured to direct fluid towards the second combustor.

In another aspect, a compressor assembly is provided for use with a gas turbine engine. The compressor assembly includes a compressor discharge casing (CDC) including an annular wall that extends generally axially along at least a portion of the CDC. The CDC is configured to house a first combustor and a second combustor. A splitter extends from the annular wall between the first and second combustors. The splitter includes a first surface that is configured to direct fluid towards the first

combustor and a second surface that is configured to direct fluid towards the second combustor.

In yet another aspect, a gas turbine engine is provided. The gas turbine engine includes a first combustor, a second combustor, a compressor discharge casing (CDC), and a splitter. The CDC includes an annular wall that extends generally axially along at least a portion of the CDC. The CDC houses the first and second combustors. The splitter extends from the annular wall between the first and second combustors. The splitter includes a first surface that is configured to direct fluid towards the first combustor and a second surface that is configured to direct fluid towards the second combustor.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an illustration of a side perspective of an exemplary gas turbine engine;

FIG. 2 is an illustration of a side perspective of an exemplary combustor that may be used with the gas turbine engine shown in FIG. 1;

FIG. 3 is an illustration of a side perspective of an exemplary compressor discharge casing (CDC) that may be used with the gas turbine engine shown in FIG. 1; and

FIG. 4 is an illustration of an end perspective of the CDC shown in FIG. 3.

DETAILED DESCRIPTION OF THE INVENTION

The methods and systems described herein facilitate improving a pressure recovery of a compressor discharge casing (CDC) by substantially aligning a fluid vortex about a longitudinal axis of a gas turbine engine.

As used herein, the terms “axial” and “axially” refer to directions and orientations extending substantially parallel to a longitudinal axis of a gas turbine engine. Moreover, the terms “radial” and “radially” refer to directions and orientations extending substantially perpendicular to the longitudinal axis of the gas turbine engine.

FIG. 1 is an illustration of a side perspective of an exemplary gas turbine engine 100. In the exemplary embodiment, gas turbine engine 100 includes, in serial flow arrangement, a compressor 102, a combustor assembly 104 including a plurality of combustors 106, and a turbine 108. Combustors 106 are spaced in an annular array extending about a shaft 110 that extends between and rotatably couples compressor 102 and turbine 108.

FIG. 2 is an illustration of a side perspective of one combustor 106. In the exemplary embodiment, compressor 102 includes a diffuser 112 defined therein. Moreover, in the exemplary embodiment, compressor 102 includes a compressor discharge casing (CDC) 114 including a compressor discharge plenum 116 defined therein.

In the exemplary embodiment, combustor assembly 104 includes a combustor casing 118 that is coupled to CDC 114 via a fastener 120. In the exemplary embodiment, combustor casing 118 extends about combustor assembly 104 and houses a plurality of fuel nozzle assemblies 122 and a combustor liner 124 including a combustion chamber 126 defined therein.

In the exemplary embodiment, combustor assembly 104 also includes a transition piece assembly 128. More specifically, in the exemplary embodiment, CDC 114 houses transition piece assembly 128 defining an annular passage 130 that extends between an inner wall 132 and an outer wall 134 of transition piece assembly 128. Inner wall 132 includes a guide cavity 136 defined therein. In one embodiment, inner wall 132 may be referred to as a transition piece, and outer wall 134 may be referred to as an impingement sleeve.

In the exemplary embodiment, inner wall 132 channels combustion gases generated in combustion chamber 126 downstream towards a turbine nozzle 138. In the exemplary embodiment, outer wall 134 includes a plurality of openings 140 defined therein.

During operation, turbine 108 drives compressor 102 via shaft 110. As compressor 102 is rotated, air is compressed as it flows downstream therethrough. Compressed air discharged from compressor 102 is channeled towards combustor 106, wherein the

compressed air is mixed with fuel and ignited to generate combustion gases. More specifically, in the exemplary embodiment, compressor 102 discharges compressed air through diffuser 112 and compressor discharge plenum 116 towards combustor 106, as illustrated by the associated arrows. More specifically, in the exemplary embodiment, compressed air is discharged through compressor discharge plenum 116 and into annular passage 130 via openings 140.

Compressed air entering annular passage 130 is directed into fuel nozzle assemblies 122, wherein the compressed air is mixed with fuel. The mixture is ignited within combustion chamber 126 to generate combustion gases. Combustion gases are discharged from combustion chamber 126 through guide cavity 136 and towards turbine nozzle 138. Turbine 108 converts the gas thermal energy of the combustion gases into mechanical rotational energy for use in rotating shaft 110.

FIG. 3 is an illustration of a side perspective of CDC 114, and FIG. 4 is an illustration of an end perspective of CDC 114. In the exemplary embodiment, CDC 114 includes a wall 142 that extends generally axially along at least a portion of CDC 114. Moreover, in the exemplary embodiment, wall 142 is coupled to combustor casing 118 via fastener 120. Wall 142 and combustor casing 118 house combustors 106 and, more specifically, a plurality of transition piece assemblies 128 therein. More specifically, in the exemplary embodiment, combustor casing 118 houses a first combustor surface 144 and a second combustor surface 146. In one embodiment, combustor surfaces 144 and 146 may be referred as impingement sleeves.

In the exemplary embodiment, a splitter 148 extending from wall 142 facilitates improving the pressure recovery of CDC 114. More specifically, splitter 148 extends radially inward from an inner surface 150 of wall 142. Moreover, in the exemplary embodiment, splitter 148 extends substantially circumferentially between two adjacent transition piece assemblies 128, such as first and second combustor surfaces 144 and 146. More specifically, in the exemplary embodiment, splitter 148 is positioned and/or spaced substantially equidistantly from first and second combustor surfaces 144 and 146 such that a distance 152 from a point on a first surface 154 to a point on first combustor surface 144 is approximately equal to a distance 156 from a

corresponding point on a second surface 158 to a corresponding point on second combustor surface 146. Alternatively, splitter 148 may be positioned anywhere within CDC 114 that enables a desired air flow being formed, as described herein.

In the exemplary embodiment, first and second surfaces 154 and 158 are formed so that each is generally concave. Alternatively, first surface 154 and/or second surface 158 may be formed with any shape that enables a desired air flow to be formed. For example, in the exemplary embodiment, second surface 158 is displaced at an angle 160 from first surface 154 such that first surface 154 is oriented to direct fluid towards first combustor surface 144, and second surface 158 is oriented to direct fluid towards second combustor surface 146. In the exemplary embodiment, first and second surfaces 154 and 158 are formed integrally with wall 142. Alternatively, splitter 148 may include a coupling surface (not shown) that is coupled to wall 142.

First and second surfaces 154 and 158 extend generally axially along at least a portion of CDC 114. In the exemplary embodiment, first surface 154 is coupled to second surface 158 at an apex 162 that extends axially along a portion of CDC 114. Alternatively, first surface 154 and/or second surface 158 may be coupled to a surface (not shown) extending between first surface 154 and second surface 158. In the exemplary embodiment, first surface 154 is oriented in a mirrored relationship with respect to second surface 158 such that first and second surfaces 154 and 158 are substantially symmetrical about apex 162. Alternatively, first surface 154 and/or second surface 158 may be oriented in any non-symmetrical orientation that enables a desired air flow to be formed.

During operation, compressed air is channeled through compressor discharge plenum 116. Splitter 148 redirects a portion of the air flow within compressor discharge plenum 116 to facilitate increasing a circulation about an axis of gas turbine engine 100. More specifically, in the exemplary embodiment, first surface 154 directs a first air flow towards first combustor surface 144, and second surface 158 directs a second air flow towards second combustor surface 146. In the exemplary embodiment, the first air flow circulates in a counterclockwise direction about the longitudinal axis and the second air flow circulates in a clockwise direction about the longitudinal axis.

The separation of the first and second air flows facilitate reducing a cross communication of air flow between combustor surfaces 144 and 146.

Exemplary embodiments of the compressor discharge casing and methods for assembling the compressor discharge casing are described above in detail. The methods and systems are not limited to the specific embodiments described herein, but rather, components of the methods and systems may be utilized independently and separately from other components described herein. For example, the methods and systems described herein may have other industrial and/or consumer applications and are not limited to practice with gas turbine engines as described herein. Rather, the present invention can be implemented and utilized in connection with many other industries.

As used herein, an element or step recited in the singular and proceeded with the word “a” or “an” should be understood as not excluding plural said elements or steps, unless such exclusion is explicitly stated. Further, references to “one embodiment” are not intended to be interpreted as excluding the existence of additional embodiments that also incorporate the recited features. Moreover, unless explicitly stated to the contrary, embodiments “comprising,” “including,” or “having” an element or a plurality of elements having a particular property may include additional such elements not having that property.

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 examples are intended to be within the scope of the claims if they have 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.

WHAT IS CLAIMED IS:

1. A method for operating a gas turbine engine, said method comprising:
providing a compressor discharge casing (CDC) including an annular wall that extends generally axially along at least a portion of the CDC;
coupling the CDC to a combustor casing such that a first combustor and a second combustor are housed within the annular wall; and
extending a splitter from the annular wall between the first and second combustors, wherein the splitter includes a first surface configured to direct fluid towards the first combustor and a second surface configured to direct fluid towards the second combustor.
2. A method in accordance with Claim 1, wherein extending a splitter further comprises spacing the splitter substantially equidistantly from the first and second combustors.
3. A method in accordance with Claim 1, wherein extending a splitter further comprises forming at least one of the first and second surfaces to have a generally concave shape.
4. A method in accordance with Claim 1, wherein extending a splitter further comprises forming the splitter integrally with an inner surface of the annular wall such that the splitter extends radially inward from the annular wall.
5. A method in accordance with Claim 1, wherein extending a splitter further comprises coupling the first surface to the second surface at an apex that extends generally axially along at least a portion of the CDC.
6. A method in accordance with Claim 1, wherein extending a splitter further comprises orienting the first surface to be substantially symmetrical to the second surface.
7. A compressor assembly comprising:

a compressor discharge casing (CDC) comprising an annular wall that extends generally axially along at least a portion of said CDC, said CDC configured to house a first combustor and a second combustor; and

a splitter extending from said annular wall between the first and second combustors, said splitter comprising a first surface configured to direct fluid towards the first combustor and a second surface configured to direct fluid towards the second combustor.

8. A compressor assembly in accordance with Claim 7, wherein said splitter is positioned substantially equidistantly from the first and second combustors.

9. A compressor assembly in accordance with Claim 7, wherein at least one of said first and second surfaces has a generally concave shape.

10. A compressor assembly in accordance with Claim 7, wherein said splitter is formed integrally with said annular wall such that said splitter extends radially inward from said annular wall.

11. A compressor assembly in accordance with Claim 7, wherein said first surface is coupled to said second surface at an apex that extends generally axially along at least a portion of said CDC.

12. A compressor assembly in accordance with Claim 7, wherein said first surface is substantially symmetrical to said second surface.

13. A gas turbine engine comprising:

a first combustor;

a second combustor;

a compressor discharge casing (CDC) comprising an annular wall that extends generally axially along at least a portion of said CDC, said CDC housing said first and second combustors; and

a splitter extending from said annular wall between said first and second combustors, said splitter comprising a first surface configured to direct fluid towards said first combustor and a second surface configured to direct fluid towards said second combustor.

14. A gas turbine engine in accordance with Claim 13, wherein said splitter is positioned substantially equidistantly from said first and second combustors.

15. A gas turbine engine in accordance with Claim 13, wherein at least one of said first and second surfaces has a generally concave shape.

16. A gas turbine engine in accordance with Claim 13, wherein said splitter is formed integrally with said annular wall such that said splitter extends radially inward from said annular wall.

17. A gas turbine engine in accordance with Claim 13, wherein said first surface is coupled to said second surface at an apex that extends generally axially along at least a portion of said CDC.

18. A gas turbine engine in accordance with Claim 13, wherein said first surface is substantially symmetrical to said second surface.

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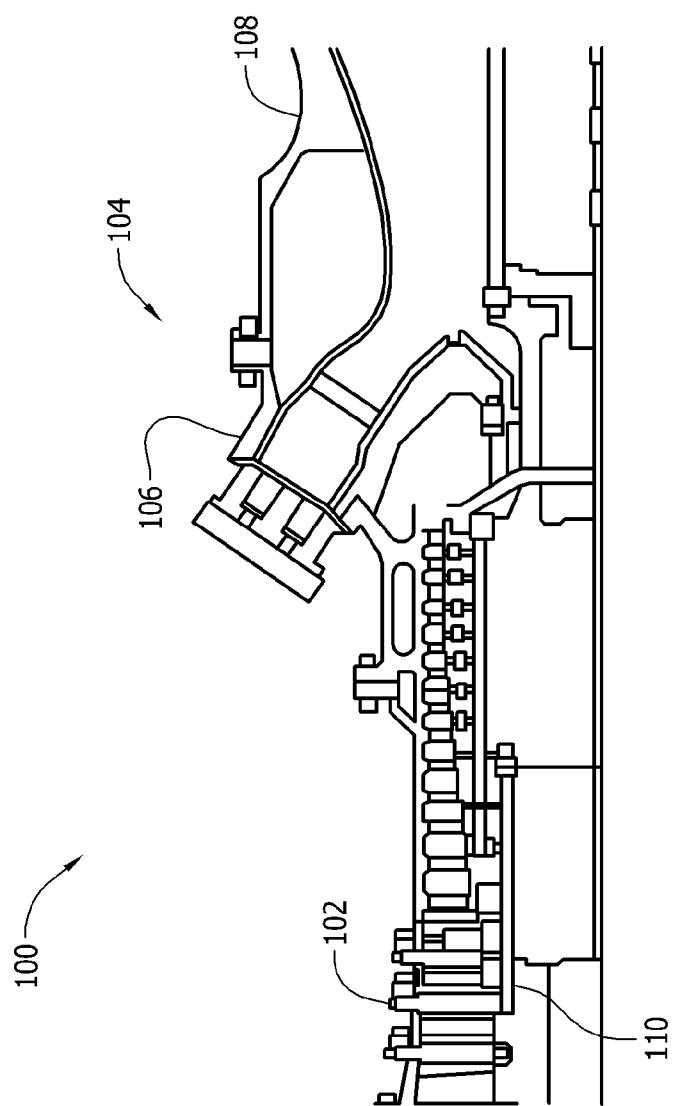


FIG. 1

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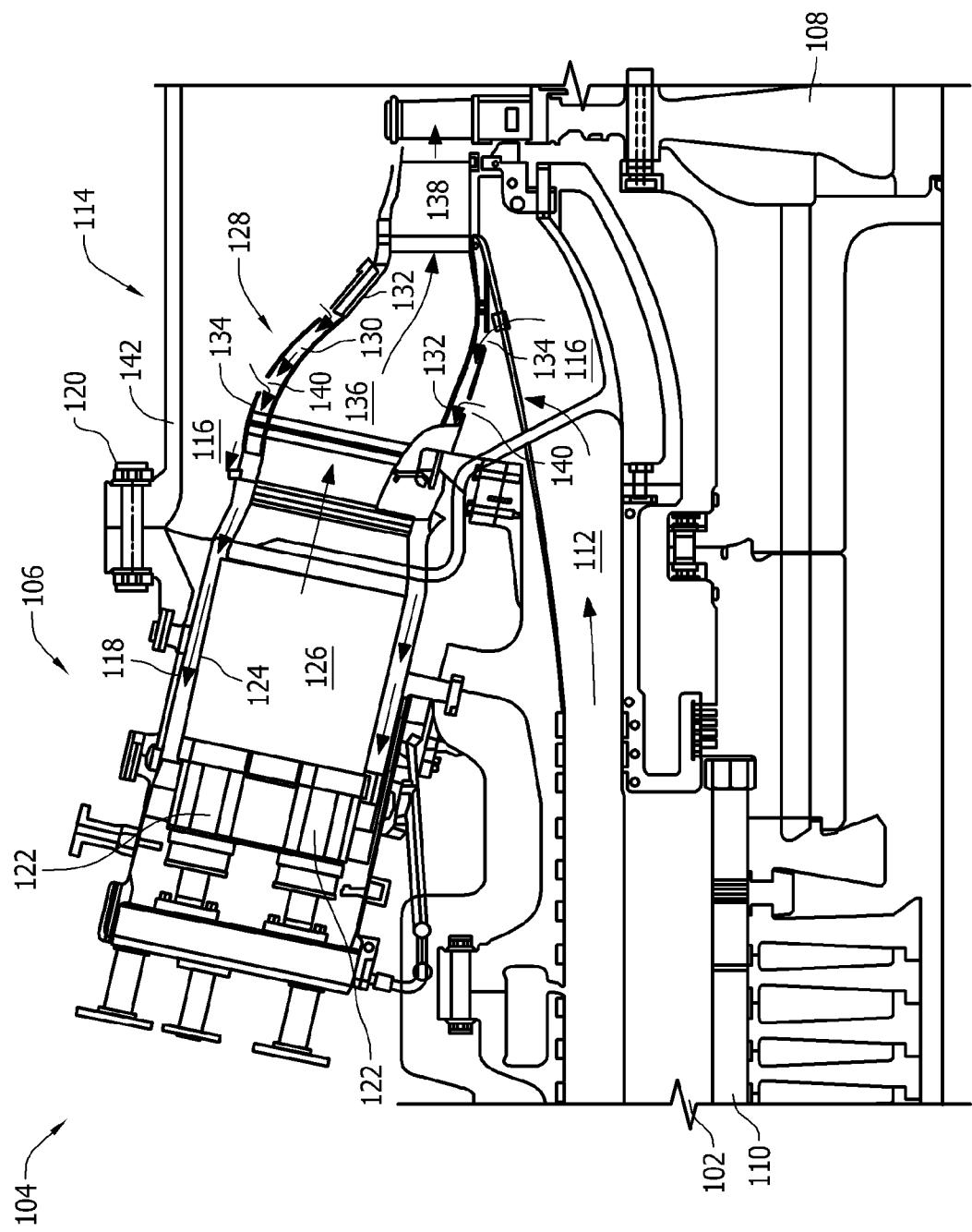


FIG. 2

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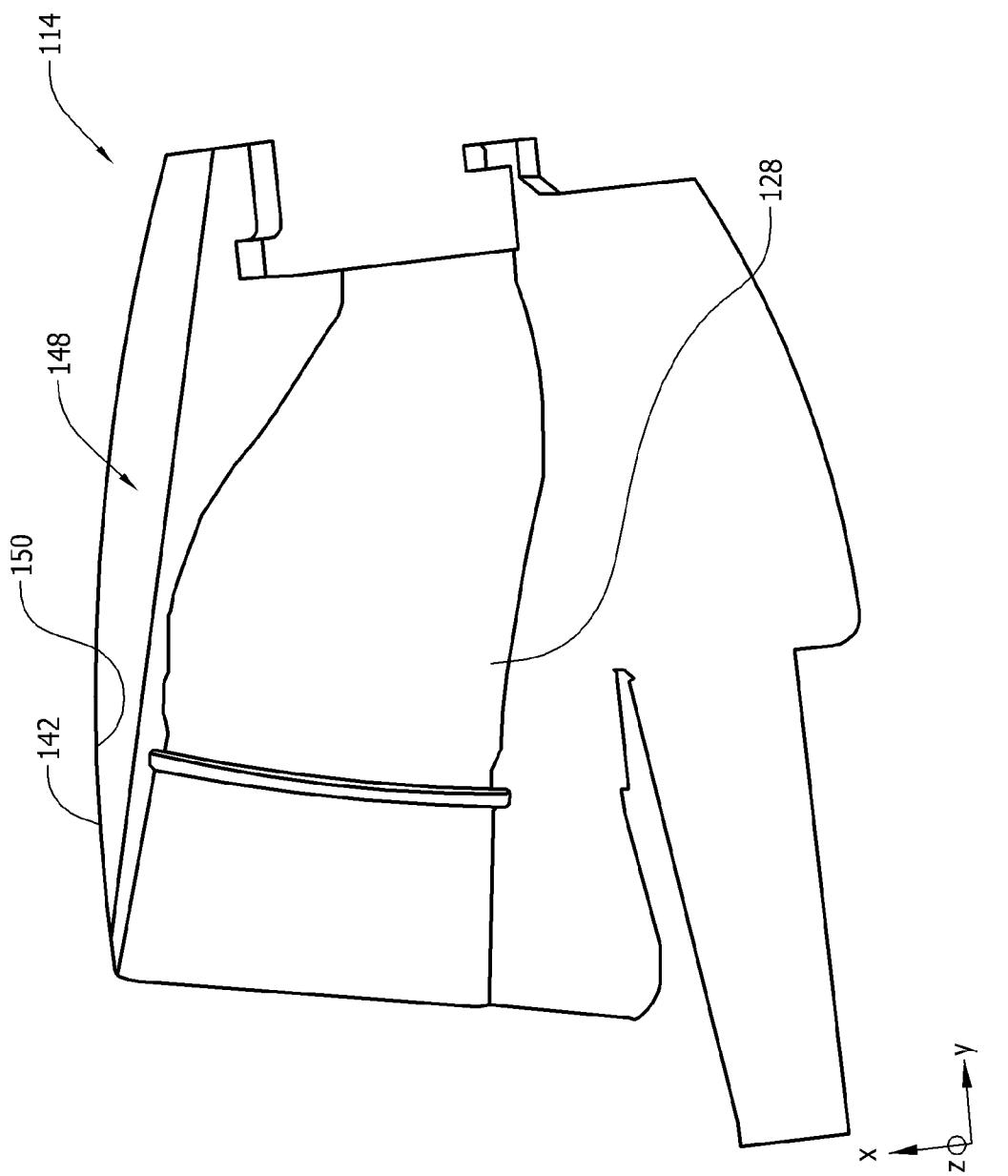


FIG. 3

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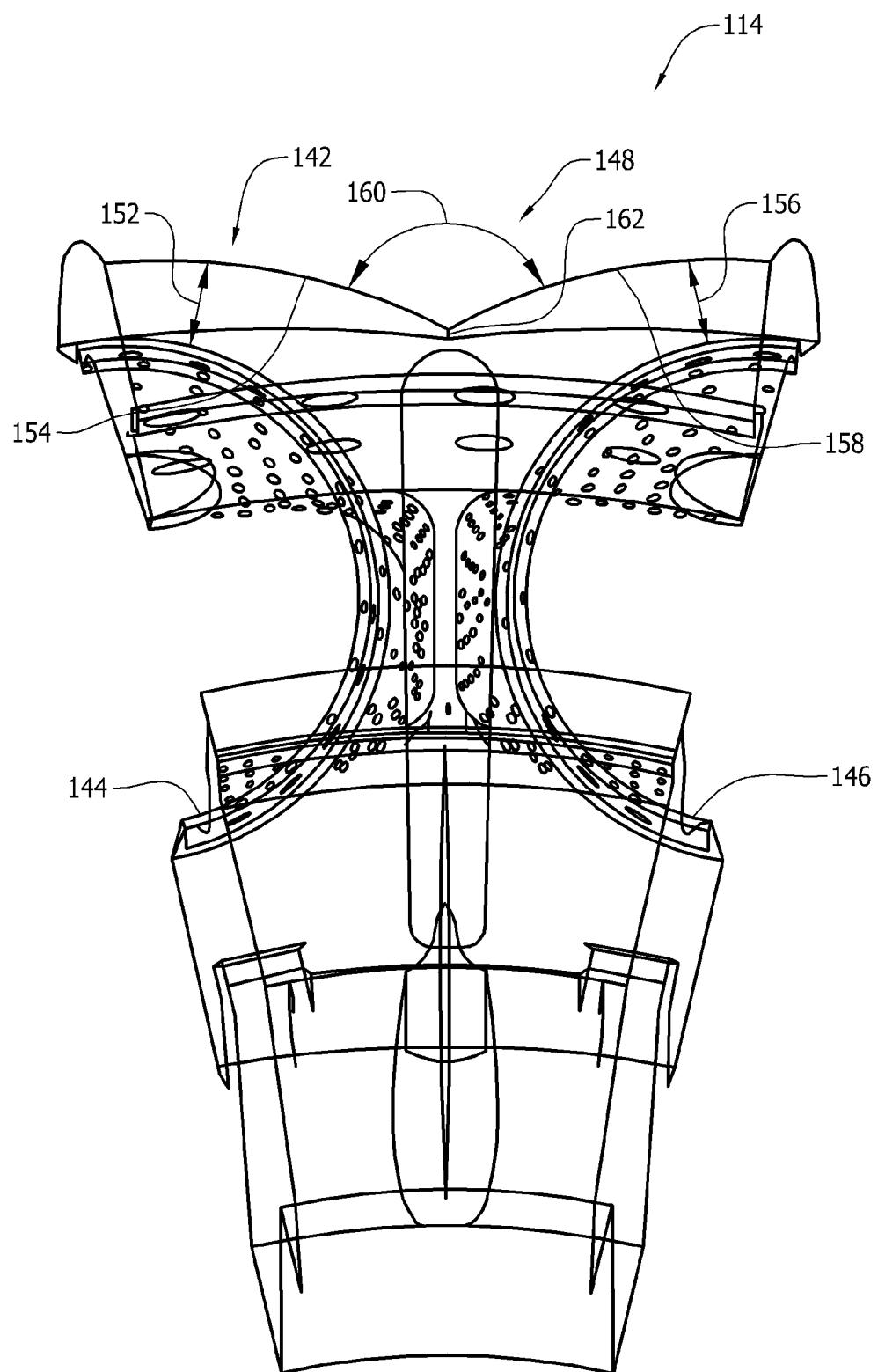


FIG. 4

INTERNATIONAL SEARCH REPORT

International application No
PCT/US2011/030452

A. CLASSIFICATION OF SUBJECT MATTER	
INV. F01D9/02	F01D25/24
ADD.	F02C3/14 F23R3/04 F23R3/46

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
F01D F02C F23R

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practical, search terms used)

EPO-Internal

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4 297 843 A (SATO ISAO ET AL) 3 November 1981 (1981-11-03) column 2, line 43 - column 4, line 35; figures 1-4 -----	1-18
A	US 2007/271923 A1 (DAWSON ROBERT W [US]) 29 November 2007 (2007-11-29) figures 2-5 -----	1-18
A	EP 0 789 195 A1 (GEN ELECTRIC [US]) 13 August 1997 (1997-08-13) column 2, line 48 - column 3, line 50; figures 1,2 -----	1-18
A	US 5 335 501 A (TAYLOR JACK R [US]) 9 August 1994 (1994-08-09) column 2, line 40 - column 3, line 18; figure 1 ----- -/-	1-18

Further documents are listed in the continuation of Box C.

See patent family annex.

* Special categories of cited documents :

- "A" document defining the general state of the art which is not considered to be of particular relevance
- "E" earlier document but published on or after the international filing date
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- "O" document referring to an oral disclosure, use, exhibition or other means
- "P" document published prior to the international filing date but later than the priority date claimed

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- "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone
- "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art.
- "&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
26 August 2011	06/09/2011

Name and mailing address of the ISA/ European Patent Office, P.B. 5818 Patentlaan 2 NL - 2280 HV Rijswijk Tel. (+31-70) 340-2040, Fax: (+31-70) 340-3016	Authorized officer Souris, Christophe
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INTERNATIONAL SEARCH REPORT

International application No
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C(Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	GB 2 440 343 A (SIEMENS AG [DE]) 30 January 2008 (2008-01-30) line 24 - page 7, line 15; figure 8 -----	1-18

INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/US2011/030452

Patent document cited in search report		Publication date		Patent family member(s)		Publication date
US 4297843	A	03-11-1981	JP	55054636 A		22-04-1980
US 2007271923	A1	29-11-2007	NONE			
EP 0789195	A1	13-08-1997	DE	69726626 D1		22-01-2004
			DE	69726626 T2		16-09-2004
			JP	4097734 B2		11-06-2008
			JP	9310622 A		02-12-1997
			US	5737915 A		14-04-1998
US 5335501	A	09-08-1994	NONE			
GB 2440343	A	30-01-2008	CN	101495715 A		29-07-2009
			EP	2044296 A2		08-04-2009
			WO	2008012294 A2		31-01-2008
			ES	2346159 T3		11-10-2010
			RU	2009106437 A		27-08-2010
			US	2009246010 A1		01-10-2009