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[Continued on next page]

(54) Title: HEAT SHIELD FOR A CASING

(57) Abstract: A gas turbine engine includes a casing, a fairing, and a heat shield. The fairing is annularly shaped and disposed adjacent the casing. The heat shield is connected to the casing and includes a first portion and a second portion. The first portion is generally cylindrically shaped and extends between the fairing and the casing and the second portion extends generally radially away from the casing and the first portion toward the fairing.

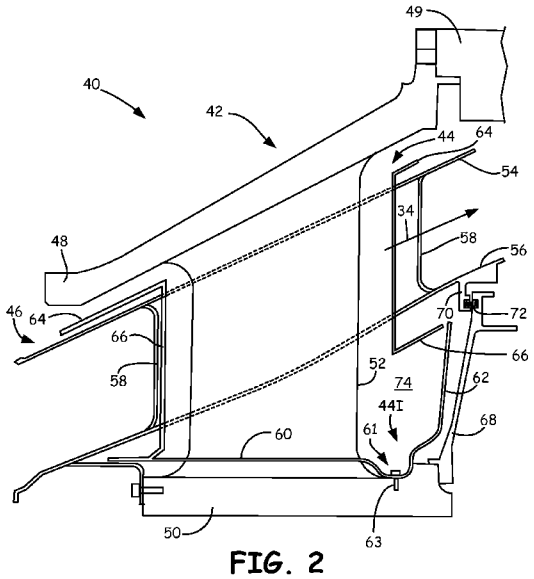


FIG. 2

WO 2014/105602 A1

Declarations under Rule 4.17:

— *of inventorship (Rule 4.17(iv))*

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HEAT SHIELD FOR A CASING

BACKGROUND

The disclosure relates to gas turbine engines, and more particularly to heat shields used in gas turbine engines.

Gas turbine engines operate according to a continuous-flow, Brayton cycle. A compressor section pressurizes an ambient air stream, fuel is added and the mixture is burned in a central combustor section. The combustion products expand through a turbine section where bladed rotors convert thermal energy from the combustion products into mechanical energy for rotating one or more centrally mounted shafts. The shafts, in turn, drive the forward compressor section, thus continuing the cycle. Gas turbine engines are compact and powerful power plants, making them suitable for powering aircraft, heavy equipment, ships and electrical power generators. In power generating applications, the combustion products can also drive a separate power turbine attached to an electrical generator.

For many stator vane assemblies, a fairing is disposed about a frame in order to define a main gas flow path for the gas turbine engine. As the fairing is directly exposed to gas flow including combustion gases, the fairing can be heated to high temperatures during operation. Heat from the fairing can heat the frame in an undesirable manner.

SUMMARY

A gas turbine engine includes a casing, a fairing, and a heat shield. The fairing is annularly shaped and disposed adjacent the casing. The heat shield is connected to the casing and includes a first portion and a second portion. The first portion is generally cylindrically shaped and extends between the fairing and the casing and the second portion extends generally radially away from the casing and the first portion toward the fairing.

A heat shield assembly for a gas turbine engine includes a mounting region, a segment of a cylinder portion, and a flange. The segment of the cylinder portion is supported from the mounting region and has an edge that forms a notch. The flange is supported from the mounting region. The flange extends away from the mounting portion and the segment of the cylinder portion.

A method includes disposing the plurality of heat shield segments adjacent a casing and between a plurality of struts that extend from the casing,

connecting the segments to the casing, and attaching the segments together to form a heat shield having a first portion positioned adjacent the casing and a second portion extending away from the casing.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an industrial turbine cross-section.

FIG. 2 is a cross-section of an assembly including a frame, a fairing, and a heat shield arranged together.

FIG. 2A is a perspective view of a segment of the frame of FIG. 2 with heat shields mounted within the frame.

FIG. 3 illustrates segments of an inner radial shield being inserted into the frame.

DETAILED DESCRIPTION

This application discloses a shaped heat shield with a segmented cylinder portion that is disposed along an inner case of the frame to protect the inner case of the frame from radiation heating. The heat shield is additionally mounted to the inner case and has a flange that extends radially outward from the inner case and is disposed adjacent a seal support of the frame. The heat shield design blocks radiation heating from the inner case and seal support, and therefore, allows less expensive materials (steel) to be used for those components.

An exemplary industrial gas turbine engine 10 is circumferentially disposed about a central, longitudinal axis or axial engine centerline axis 12 as illustrated in FIG. 1. The engine 10 includes, in series order from front to rear, low and high pressure compressor sections 16 and 18, combustor section 20 and high and low pressure turbine sections 22 and 24. In some examples, free turbine section 26 is disposed aft of low pressure turbine 24. Although illustrated with reference to an industrial gas turbine engine, this application also extends to aero engines with a fan or gear driven fan, and engines with more or fewer sections than illustrated.

In gas turbines, incoming ambient air 30 becomes pressurized air 32 in compressors 16 and 18. Fuel mixes with the pressurized air 32 in combustor section 20, where it is burned to produce combustion gases 34 that expand as they flow through turbine sections 22, 24 and power turbine 26. Turbine sections 22 and 24 drive high and low pressure rotor shafts 36 and 38 respectively, which rotate in response to the combustion products and thus the attached compressor sections 18, 16. Free turbine

section 26 may, for example, drive an electrical generator, pump, or gearbox (not shown).

It is understood that FIG. 1 provides a basic understanding and overview of the various sections and the basic operation of an industrial gas turbine engine. The present application is applicable to all types of gas turbine engines, including those with aerospace applications.

FIG. 2 shows a cross-section of assembly 40 with heat shield 44 installed between frame 42 and fairing 46. FIG. 2A shows a perspective view of a section of assembly 40 with fairing 46 removed. Assembly 40 includes frame 42, heat shield 44, and fairing 46. Frame 42 includes outer radial casing 48, inner radial casing 50, struts 52, and seal support 68. Fairing 46 (only shown in FIG. 2) includes outer radial platform 54, inner radial platform 56, strut liners 58, and rib 72. Heat shield 44 includes inner radial shield 44I, outer radial shield 64, and strut shields 66. Inner radial shield 44I includes cylindrical section 60, mounting region 61, and flange 62.

Frame 42 comprises a stator component of gas turbine engine 10 (FIG. 1) and can form portions of compressor sections 16 and 18 or turbine sections 22 and 24. Heat shield 44 and fairing 46 are shown installed within frame 42 in FIG. 2. Both heat shield 44 and fairing 46 are connected to frame 42. In FIG. 2, heat shield 44 is connected to frame 42 in a different location than fairing 46. Fairing 46 is disposed within frame 42 to form the main gas flow path for a portion of gas turbine engine 10. It should be understood that the embodiments of heat shield 44 are provided in relation to a specific embodiment of frame 42, in particular, a frame that comprises a low pressure turbine exhaust case, but heat shield 44 described is applicable to other gas turbine sections and elements including stator vane components.

As illustrated in FIGS. 2 and 2A, outer radial casing 48 of frame 42 is conically shaped and forms a portion of the casing of gas turbine engine 10 (FIG. 1), for example, in low pressure turbine section 24. As shown in FIG. 2, outer radial casing 48 abuts and is connected to second outer radial casing 49 of another module of gas turbine engine 10. Inner radial casing 50 is disposed generally radially inward of outer radial casing 48 and is connected thereto by struts 52 (only one is shown in FIGS. 2 and 2A). Seal support 68 is connected to inner radial casing 50 and extends toward the outer radial casing 48 and fairing 46.

Fairing 46 is adapted to be disposed within frame 42 between outer radial casing 48 and inner radial casing 50. Outer radial platform 54 of fairing 46 has a

generally conical shape. Similarly, inner radial platform 56 has a generally conical shape. Rib 70 extends generally radially from an aft portion of inner radial platform 56 adjacent seal support 68. Inner radial platform 56 is spaced from outer radial platform 54 by strut liners 58. Strut liners 58 are adapted to be disposed around struts 52 of frame 42 as well as strut shields 66 of heat shield 44 when fairing 46 is assembled on frame 42 as illustrated in FIG. 2. As discussed previously, outer radial platform 54, inner radial platform 56, and strut liners 58 form the main gas flow path, which directs combustion gases 34 through the portion of gas turbine engine illustrated in FIG. 2.

Heat shield 44 is disposed between frame 42 and fairing 46. In one embodiment, heat shield is comprised of a nickel alloy sheet metal. As illustrated in FIGS. 2 and 2A, inner radial shield 44I, which is a subassembly of heat shield 44, is affixed to and extends generally along inner radial casing 50 and seal support 68. In particular, cylindrical section 60 is disposed adjacent to and extends axially across inner casing 50. Cylindrical section 60 transitions or is connected to mounting region 61, which is adapted to be affixed to inner radial casing 50. In the embodiment shown in FIGS. 2 and 2A, inner radial shield 44I is supported by mounting region 61 from inner radial casing 50. In the embodiment shown in FIG. 2, mounting region 61 is affixed to frame 42 by fasteners 63. In other embodiments, mounting region 61 can be affixed to frame 42 by welding, riveting, brazing, bolting, or other connection. Heat shield 44I is disposed between inner radial casing 50 and fairing 46 to block line-of-sight from inner radial casing 50 to frame 42. As used therein, block line-of-sight means that no portion of frame 42 (for example casing 50) is exposed to faring 46 travelling axially from a forward end of frame 42 to an aft end. Thus, to block line-of-sight a part of heat shield assembly 44I is interposed between inner radial casing 50 and fairing 46.

Flange 62 extends generally radially from mounting region 61 toward fairing 46 and strut shields 66. In particular, flange 62 is disposed adjacent to and extends along a length of seal support 68 to adjacent rib 70 and seal 72. Rib 70 provides stiffness to fairing 46 and retains seal 70, which is also retained by seal support 68. Together, fairing 46, seal 70, and seal support 68 regulate the flow of a secondary air within assembly 40. In the embodiment of FIG. 2, flange 62 is disposed with a small gap relative to strut shields 66. Strut shields 66 extend about struts 52 (only one is shown in FIGS. 2 and 2A) and are disposed between strut liner 58 and struts 52. Each strut shield 66 extends generally radially and is connected to outer radial shield 64. Outer radial shield 64 is disposed between outer radial casing 48 and outer radial platform 54. In one

embodiment, outer radial shield 64 is comprised of a single annular ring and a plurality of strut shields 66 extend circumferentially from the outer radial shield 64 and are disposed within strut liner 58.

Strut shields 66 can initially be divided (as illustrated in FIG. 2A) for installation around struts 52. Outer radial shield 64 and strut shields 66 can be connected together by welding, brazing, riveting or other means.

Inner radial shield 44I, including cylindrical section 60 and flange 62, along with struts 52 and strut shield 66, act to define cavity 74. In some embodiments, cavity 74 can contain secondary air.

In the embodiment shown in FIGS. 2 and 2A, strut shields 66 and outer radial shield 64 are connected to one another by welding, riveting, brazing, or other means. In other embodiments, strut shields 66 and outer radial shield 64 can comprise separate components, can be axially or otherwise segmented, or can comprise subassemblies of several components. Similarly, in the embodiment shown in FIGS. 2 and 2A, inner radial shield 44I including cylindrical section 60, mounting region 61, and flange 62 comprise a single unitary component that is formed by machining, rolling, stamping, curling, punching, and/or another method of fabrication. In other embodiments, inner radial shield 44I can comprise separate components, can be axially or otherwise segmented, or can comprise subassemblies of several components. For example, in other embodiments, one or more components of heat shield 44I such as cylindrical section 60, mounting region 61, and flange 62 may not be connected together but instead can be disposed with gaps therebetween.

In FIG. 3 a plurality of heat shield segments are joined together to form an annular body. FIG. 3 is an exploded view of frame 42 and inner radial shield 44I with fairing 46 (FIG. 2) and the remainder of heat shield 44 (FIGS. 2 and 2A) removed. In addition to showing components of frame 42 including outer radial casing 48, inner radial casing 50, and struts 52, FIG. 3 illustrates that cylindrical section 60, mounting region 61, and flange 62 are circumferentially segmented. In the embodiment of FIG. 3, inner shield 44I is divided into six separate segments. The segments are adapted to interface with one another when installed and are connected to one another by welding, riveting, brazing, or other means. As shown in FIG. 3, cylindrical sections 60 can be assembled to comprise a full cylinder about struts 52 of frame 42. In the embodiment of FIG. 3, cylindrical sections 60 include notches 75 along the axially extending edges thereof. These notches are adapted to receive the base of struts 52 therein. Axially

extending edges of cylindrical sections 60 are adapted to interface and abut with one another forward and aft of notches. When assembled, cylindrical sections 60 are then attached together forward and aft of struts 52.

As shown in FIG. 3, the segments of inner radial shield 44I are disposed adjacent inner radial casing 50 and between struts 52 that extend from inner radial casing 50. Inner radial shield 44I is inserted into frame 42 and is connected to inner radial casing 50, for example, via mounting region 61 and fasteners 63 (FIG. 1). After being inserted and connected to frame 42, the segments of inner radial shield 44I can be joined together to form a full assembly.

This application discloses a shaped heat shield with a segmented cylinder portion that is disposed along an inner case of the frame to protect the inner case of the frame from radiation heating. The heat shield is additionally mounted to the inner case and has a flange that extends radially outward from the inner case and is disposed adjacent a seal support of the frame. The heat shield design blocks radiation heating from the inner case and seal support, and therefore, allows less expensive materials (steel) to be used for those components.

Discussion of Possible Embodiments

The following are non-exclusive descriptions of possible embodiments of the present invention.

A gas turbine engine includes a casing, a fairing, and a heat shield. The fairing is annularly shaped and disposed adjacent the casing. The heat shield is connected to the casing and includes a first portion and a second portion. The first portion is generally cylindrically shaped and extends between the fairing and the casing and the second portion extends generally radially away from the casing and the first portion toward the fairing.

The gas turbine of the preceding paragraph can optionally include, additionally and/or alternatively, any one or more of the following features, configurations and/or additional components:

the casing comprises a portion of a frame that includes struts that extend between an inner radial casing and an outer radial casing;

the first portion and second portion define a portion of a cavity that extends about a portion of the struts;

the casing includes a seal support that is connected to the inner radial casing and extends toward the outer radial casing;

the second portion is disposed adjacent to and extends along a length of the seal support;

together the first portion and the second portion block all line-of-sight from the fairing to the casing and seal support;

the first portion is comprised of a plurality of connected arcuate segments; and

the arcuate segments have an edge that defines a notch adapted to receive the strut.

A heat shield assembly for a gas turbine engine includes a mounting region, a segment of a cylinder portion, and a flange. The segment of the cylinder portion is supported from the mounting region and has an edge that forms a notch. The flange is supported from the mounting region. The flange extends away from the mounting portion and the segment of the cylinder portion.

The heat shield assembly of the preceding paragraph can optionally include, additionally and/or alternatively, any one or more of the following features, configurations and/or additional components:

a frame including struts extending between a inner radial casing and a outer radial casing;

the notch is adapted to receive the strut;

the mounting region is connected to the inner radial casing;

the flange extends away from the inner radial casing toward the outer radial casing;

a seal support mounted to the inner radial casing and extending toward the outer radial casing, and the flange is disposed adjacent to and extends along a length of the seal support;

the segment of the cylinder portion is disposed adjacent to and extends along the inner radial casing;

the segment of the cylinder portion is joined to comprise a full ring; and

the notch is adapted to receive the strut.

A method includes disposing the plurality of heat shield segments adjacent a casing and between a plurality of struts that extend from the casing, connecting the segments to the casing, and attaching the segments together to form a heat shield having a first portion positioned adjacent the casing and a second portion extending away from the casing.

The method of the preceding paragraph can optionally include, additionally and/or alternatively, any one or more of the following features, configurations and/or additional components:

the segments are attached together forward and aft of the struts; and

disposing a support arm adjacent the second segment, and connecting a support arm to the casing.

While the invention has been described with reference to an exemplary embodiment(s), it will be understood by those skilled in the art that various changes may be made and equivalents may be substituted for elements thereof without departing from the scope of the invention. In addition, many modifications may be made to adapt a particular situation or material to the teachings of the invention without departing from the essential scope thereof. Therefore, it is intended that the invention not be limited to the particular embodiment(s) disclosed, but that the invention will include all embodiments falling within the scope of the appended claims.

CLAIMS:

1. A gas turbine engine comprising:

an inner radial casing;

an annularly shaped fairing disposed adjacent the inner radial casing; and

a heat shield connected to the inner radial casing and including a first portion and a second portion, wherein the first portion is generally cylindrically shaped and extends between the fairing and the inner radial casing and the second portion extends generally radially away from the inner radial casing and the first portion toward the fairing.

2. The engine of claim 1, wherein the casing comprises a portion of a frame that includes struts that extend between the inner radial casing and an outer radial casing.

3. The engine of claim 2, wherein the first portion and second portion define a portion of a cavity that extends about a portion of the struts.

4. The engine of claim 2, wherein the casing includes a seal support that is connected to the inner radial casing and extends toward the outer radial casing.

5. The engine of claim 4, wherein the second portion is disposed adjacent to and extends along a length of the seal support.

6. The engine of claim 4, wherein together the first portion and the second portion block all line-of-sight from the fairing to the casing and seal support.

7. The engine of claim 2, wherein the first portion is comprised of a plurality of connected arcuate segments.

8. The engine of claim 7, wherein the arcuate segments each have an edge that defines a notch adapted to receive the strut.

9. A heat shield assembly for a gas turbine engine, comprising:

a mounting region;

a segment of a cylinder portion supported from the mounting region, wherein the segment of the cylinder portion has an edge that forms a notch; and

a flange supported from the mounting region, wherein the flange extends away from the mounting portion and the segment of the cylinder portion.

10. The heat shield assembly of claim 9, further comprising:

a frame including struts extending between a inner radial casing and a outer radial casing.

11. The heat shield assembly of claim 10, wherein the notch is adapted to receive the strut.

12. The heat shield assembly of claim 10, wherein the mounting region is connected to the inner radial casing.

13. The heat shield assembly of claim 11, wherein the flange extends away from the inner radial casing toward the outer radial casing.

14. The heat shield assembly of claim 11, further comprising a seal support mounted to the inner radial casing and extending toward the outer radial casing, wherein the flange is disposed adjacent to and extends along a length of the seal support.

15. The heat shield assembly of claim 11, wherein the segment of the cylinder portion is disposed adjacent to and extends along the inner radial casing.

16. The heat shield assembly of claim 10, and further comprising a plurality the segments of the cylinder portion are joined to comprise a full ring.

17. The heat shield assembly of claim 16, wherein adjacent notches are adapted to form a socket that receives the strut.

18. A method comprising:

disposing a plurality of heat shield segments adjacent a casing and between a plurality of struts that extend from the casing;

connecting the segments to the casing; and

attaching the segments together to form a heat shield having a first portion positioned adjacent the casing and a second portion extending away from the casing.

19. The method of claim 18, wherein the segments are attached together forward and aft of the struts.

20. The method of claim 18, further comprising:

disposing a support arm adjacent the second segment; and

connecting a seal support to the casing.

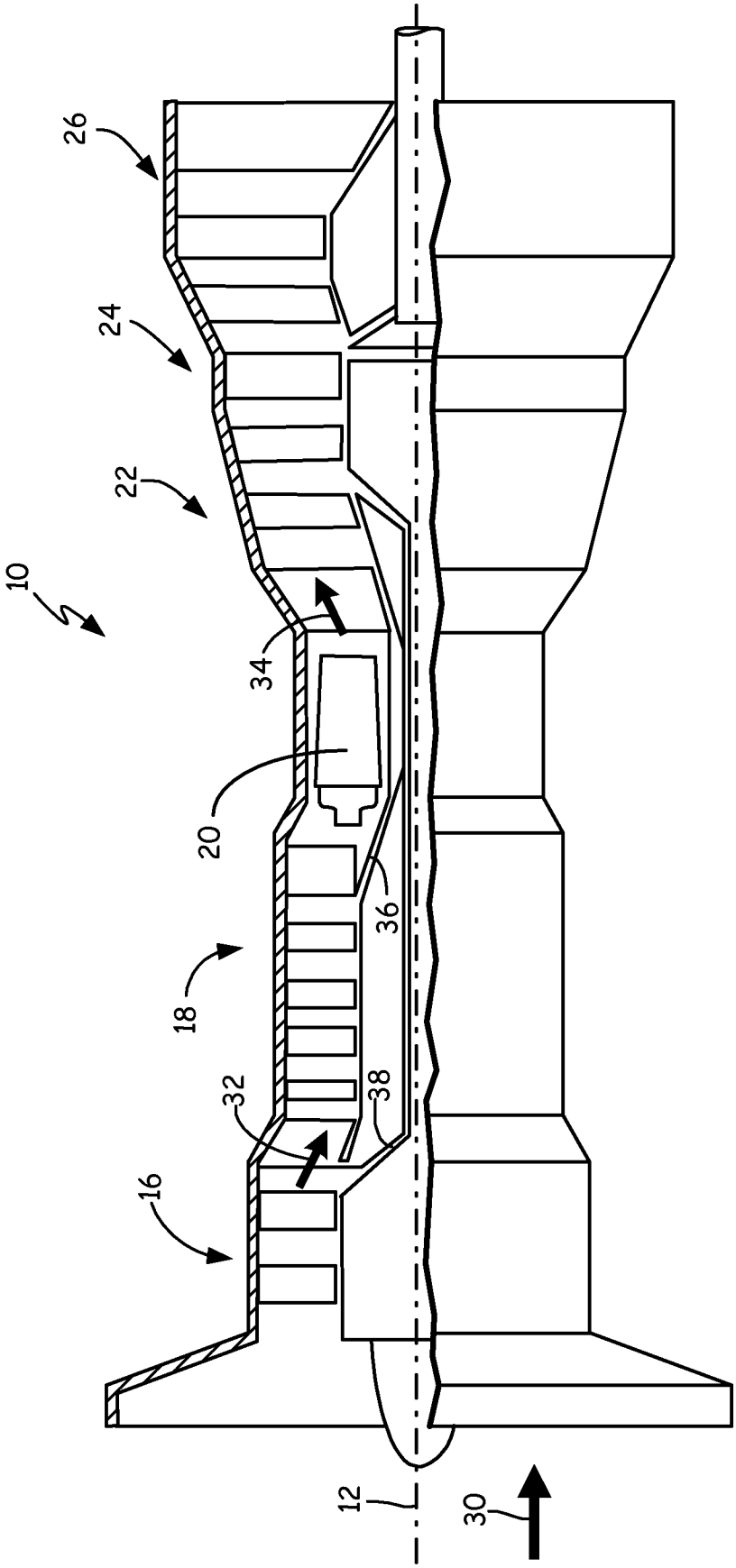


FIG. 1

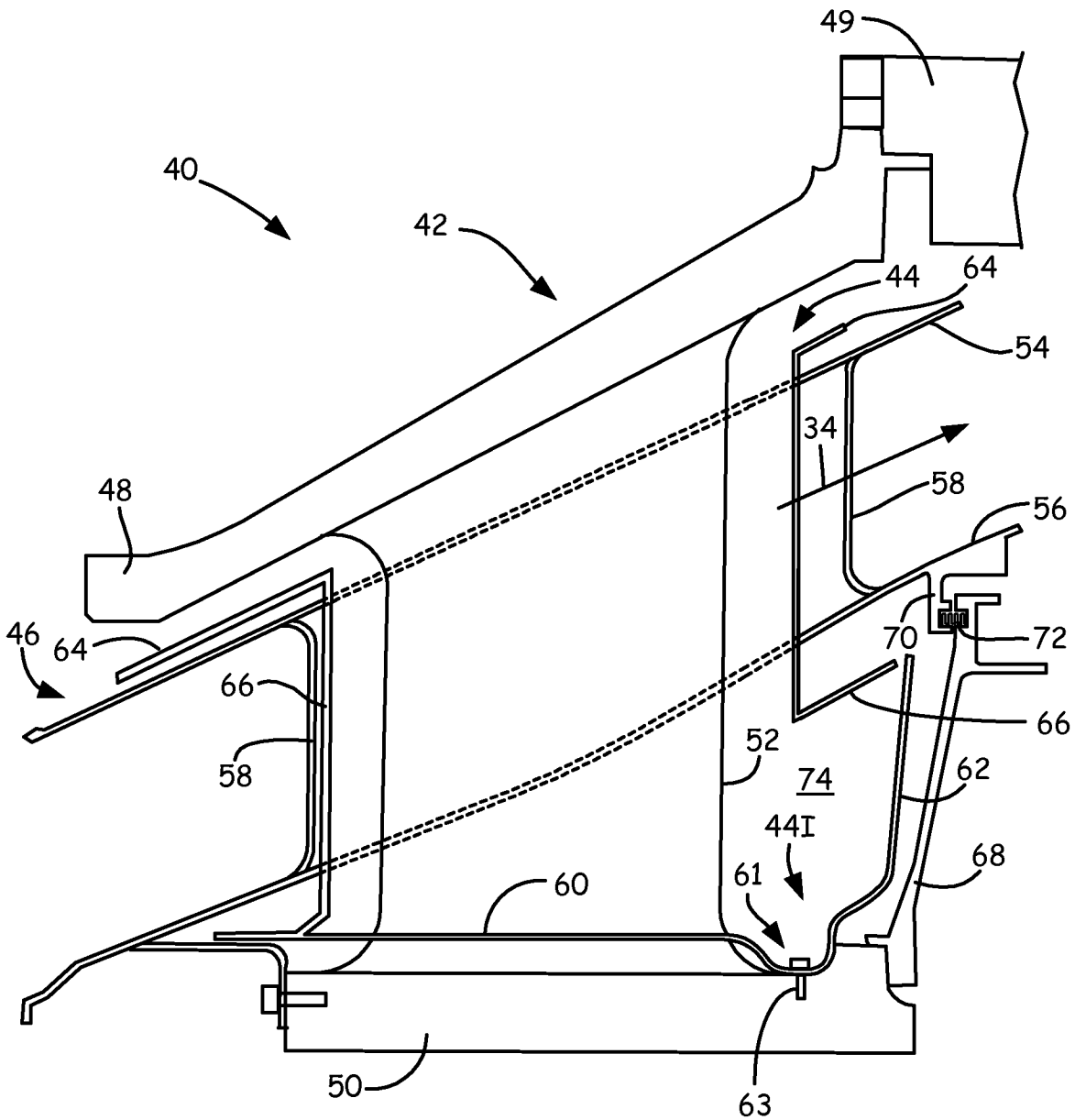

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FIG. 2

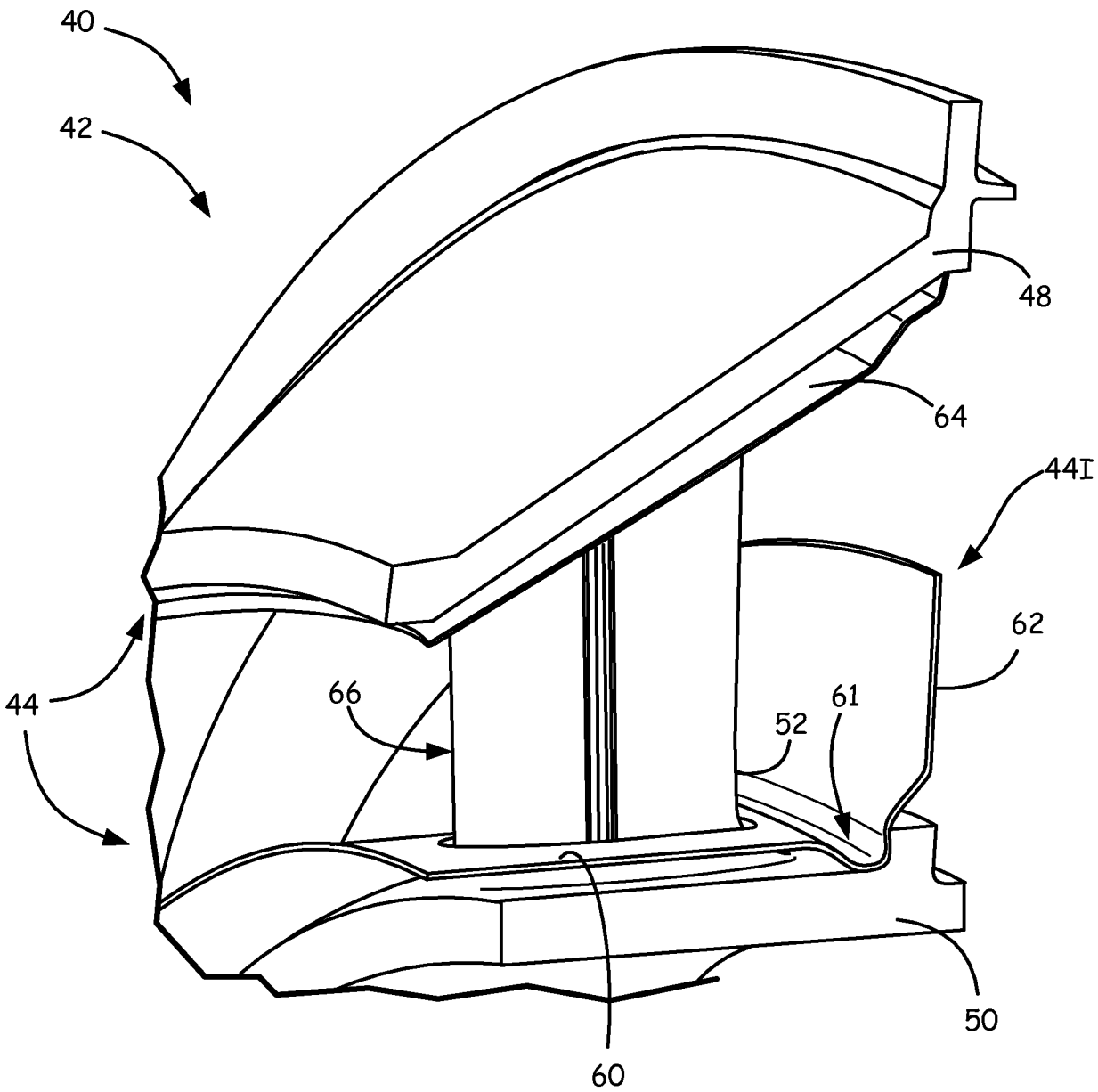


FIG. 2A

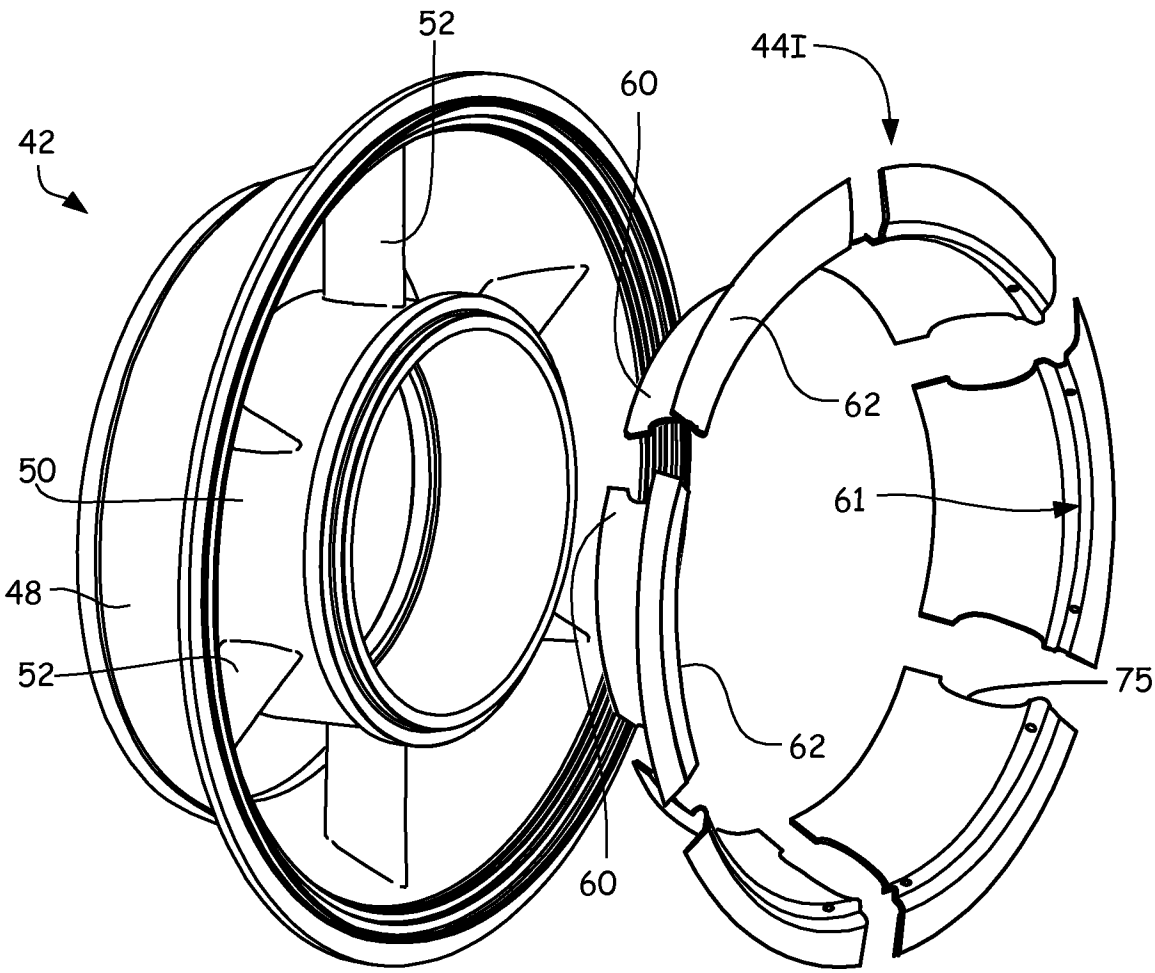


FIG. 3

INTERNATIONAL SEARCH REPORT

International application No.
PCT/US2013/076385

A. CLASSIFICATION OF SUBJECT MATTER

F02C 7/24(2006.01)i, F02C 7/20(2006.01)i, F01D 25/24(2006.01)i

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)
F02C 7/24; F02C 7/20; F04D 17/16; F03B 3/00; F02K 3/10; F01D 25/24

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
Korean utility models and applications for utility models
Japanese utility models and applications for utility models

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
eKOMPASS(KIPO internal) & keywords: casing, fairing, heat shield, notch, flange, strut, and gas turbine engine

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 4987736 A (CIOKAJLO et al.) 29 January 1991 See abstract, column 5, line 52 - column 6, line 53, and figures 2,10.	1-3,7-13,15-19
Y		4-6,14,20
Y	US 5289677 A (JARRELL, DAVID W.) 01 March 1994 See abstract, column 3, line 65 - column 4, line 13, and figure 3.	4-6,14,20
A	US 4993918 A (MYERS et al.) 19 February 1991 See abstract, column 3, lines 31-54, and figures 2,4.	1-20
A	US 4920742 A (NASH et al.) 01 May 1990 See abstract, column 6, lines 9-43, and figures 4-6.	1-20
A	US 6463739 B1 (MUELLER et al.) 15 October 2002 See abstract, column 4, lines 7-24, and figure 3.	1-20

☐ 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 application or patent but published on or after the international filing date
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"P" document published prior to the international filing date but later than the priority date claimed
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"&" document member of the same patent family

Date of the actual completion of the international search	Date of mailing of the international search report
10 April 2014 (10.04.2014)	**11 April 2014 (11.04.2014)**

Name and mailing address of the ISA/KR
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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No.
PCT/US2013/076385

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