



- (51) International Patent Classification: Not classified
- (21) International Application Number: PCT/US2013/075422
- (22) International Filing Date: 16 December 2013 (16.12.2013)
- (25) Filing Language: English
- (26) Publication Language: English
- (30) Priority Data: 13/730,898 29 December 2012 (29.12.2012) US
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- (81) Designated States (unless otherwise indicated, for every kind of national protection available): AE, AG, AL, AM, AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY, BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM, DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT, HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR, KZ, LA, LC, LK, LR, LS, LT, LU, LY, MA, MD, ME, MG, MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM, PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC, SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.
- (84) Designated States (unless otherwise indicated, for every kind of regional protection available): ARIPO (BW, GH, GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU, TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU, LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK, SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, KM, ML, MR, NE, SN, TD, TG).

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(54) Title: PLATE FOR DIRECTING FLOW AND FILM COOLING OF COMPONENTS

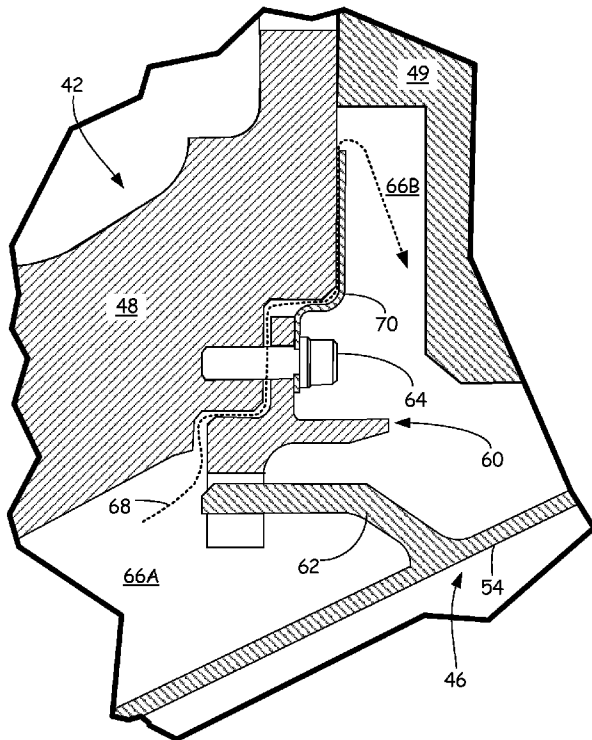
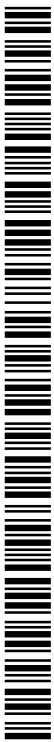


FIG. 3

(57) Abstract: An assembly includes a gas turbine engine component and a plate. The plate is spaced from a surface of the component and generally conforms to the shape of the surface. The plate and component form a passageway that allows for passage of a secondary gas flow between the component and the plate.



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## PLATE FOR DIRECTING FLOW AND FILM COOLING OF COMPONENTS

### BACKGROUND

The invention relates to gas turbine engines, and more particularly to the  
5 purging of cavities and the film cooling of components within 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  
10 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  
15 attached to an electrical generator.

Components such as finger seals are used in gas turbine engines and seal  
off cavities from one another. In some instances, these cavities may become dead spaces  
filled with relatively warm stagnant air that is not desirable.

### SUMMARY

20 An assembly includes a gas turbine engine component and a plate. The  
plate is spaced from a surface of the component and generally conforms to the shape of  
the surface. The plate and component form a passageway that allows for passage of a  
secondary gas flow between the component and the plate.

An assembly for a gas turbine engine includes an outer radial casing and a  
25 plate. The plate is attached to the outer radial casing and extends along and generally  
conforms with a surface of the casing to form a passageway that allows for a secondary  
gas flow between the casing and the plate.

An assembly for a gas turbine engine includes a first casing, a fairing, and  
a plate. The fairing is disposed within the casing to form a main gas flow path for the gas  
30 turbine engine. The fairing has a rib that extends therefrom. The plate is mounted to the  
rib and extends along a surface of the component to form a passageway therealong. The  
passageway allows for a secondary gas flow between the component and the plate.

## BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is an industrial turbine cross-section.

FIG. 2A is an exploded view of an assembly including a fairing, a flange,  
5 and a frame.

FIG. 2B is a cross-section of the assembly including the fairing, the flange,  
plates, and the frame arranged together.

FIG. 3 is an enlarged cross-sectional view of one embodiment of the plate  
that allows for film cooling along a portion of the frame.

FIG. 4A is an enlarged cross-sectional view of another embodiment of the  
10 plate mounted to the fairing to allow for film cooling along a portion of the fairing.

FIG. 4B is an enlarged cross-sectional view of the fairing and plate of FIG.  
4A.

## DETAILED DESCRIPTION

15 This application discloses the use of a plate to direct a secondary air flow  
for purging dead cavities within gas turbine engines. Additionally, the plate can be used  
to direct air flow to provide for film cooling along a surface of a component to which the  
plate is mounted. The cooling provided by the arrangement described can be used to  
control deflection of the hardware as desired.

20 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, a central combustor section 20 and high and low  
pressure turbine sections 22 and 24. In some examples, a free turbine section 26 is  
25 disposed aft of the 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.

As is well known in the art of gas turbines, incoming ambient air 30  
becomes pressurized air 32 in the compressors 16 and 18. Fuel mixes with the  
30 pressurized air 32 in the 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. It will become apparent to those skilled in the art that the present application is applicable to all types of gas turbine engines, including those with aerospace applications.

FIG. 2A shows an exploded view of assembly 40 with frame 42, fairing 46, and first plate 70. FIG. 2B shows a cross-section of assembly 40 with first plate 70 installed on an aft end of frame 42 and second plate 74 installed on an aft end of fairing 46. Assembly 40 includes frame 42, fairing 46, mount 60, first plate 70, and second plate 74 (shown in FIG. 2B only). Frame 42 includes outer radial casing 48, inner radial casing 50, and struts 52. Fairing 46 includes outer radial platform 54, inner radial platform 56, strut liners 58, first rib 62, and second rib 72.

Frame 42 comprises a stator component of gas turbine engine 10 (FIG. 1) and can form portions of compressor sections 16 and 18 and/or turbine sections 22 and 24. Fairing 46 is connected to the frame 42 when installed. Additionally, when installed fairing 46 is disposed within the frame 42 to form the main gas flow path for a portion of gas turbine engine 10 through which combustion gases 34 can flow.

As illustrated in FIGS. 2A and 2B, 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 high pressure turbine section 22. Inner radial casing 50 is disposed generally radially inward of outer radial casing 48 and is connected thereto by struts 52.

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. First rib 62 extends from an aft end of outer radial platform 54 toward outer radial casing 48. Second rib 72 extends from an aft end of inner radial platform 56. Inner radial platform 56 has a generally conical shape and 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 when fairing 46 is assembled on frame 42. As discussed previously, outer radial platform 54, inner radial platform 56, and strut liners 58, form the main gas flow path for a portion of gas turbine engine 10 when assembled.

Outer radial casing 48 abuts and is affixed to a second outer radial casing 49 of another module of gas turbine engine 10 (FIG. 1). In the embodiment of FIGS. 2A and 2B, mount 60 is mounted to an aft end of outer radial casing 48 adjacent second outer

radial casing 49 (FIG. 2B). In the embodiment shown, mount 60 comprises a flange shaped ring. Slots in mount 60 receive portions of first rib 62 therein. Mount 60 is attached to outer radial casing 48 by fasteners 64 (only one is shown in FIG. 2B).

In some embodiments, mount 60 acts as a seal land or seal mounting component for various types of seals such as finger seals (not shown). The seals and mount 60 act to separate first cavity 66A from second cavity 66B within gas turbine engine 10. First cavity 66A is formed between outer radial casing 48 and outer radial platform 54. Second cavity 66B is formed between aft end of outer radial casing 48 and forward end of inner radial casing 49.

First plate 70 is affixed to aft end of outer radial casing 48 and to mount 60 by fasteners 64. First plate 70 interfaces with second cavity 66B along a free end. First plate 70 is spaced from aft surface of outer radial casing 48 and generally conforms to the shape of aft surface. In one embodiment, first plate 70 can be formed of a sheet metal that is fabricated to generally conform to the shape of aft surface of outer radial casing 48. In another embodiment, first plate 70 can be formed from a turned ring.

Second rib 72 extends generally radially from a non-main flow path side of inner radial platform 56. Second plate 74 is mounted to second rib 72 by fasteners 76 (only one is shown in FIG. 2B). Similar to first plate 70, second plate 74 is spaced from inner surface of inner radial platform 56 and generally conforms to the shape of inner surface of inner radial platform 56. In one embodiment, second plate 74 can be formed of a sheet metal that is fabricated to generally conform to the shape of inner surface. In another embodiment, second plate 74 can be formed from a turned ring.

FIG. 3 shows an enlarged cross-sectional view of one embodiment of first plate 70 affixed to aft end of frame 42 via mount 60. FIG. 3 illustrates frame 42, fairing 46, outer radial casing 48, second outer radial casing 49, outer radial platform 54, mount 60, and first rib 62, fasteners 64 (only one is shown in FIG. 3), first cavity 66A, second cavity 66B, and secondary flow 68.

In FIG. 3, mount 60 is affixed to aft end of outer radial casing 48 by fasteners 64. Fasteners 64 additionally hold first plate 70 to mount 60. First plate 70 extends from mount 60 and is spaced from aft surface of outer radial casing 48. Thus, first plate 70 is fixed at a first end and is free at a second end.

First cavity 66A is disposed between outer radial platform 54 and outer radial casing 48. Second cavity 66B is disposed between an aft portion of outer radial casing 48 and a forward portion of second outer radial casing 49. Mount 60 and seals

(not shown) separate first cavity 66A from second cavity 66B. Secondary air flow 68 travels between outer radial casing 48 and mount 60 via passages or clearances instead of passing between mount 60 and seals (not shown). First plate 70 is spaced from aft surface of outer radial casing 48 to form a passage. Secondary air flow 68 (after exiting  
5 from between mount 60 and outer radial casing 48) travels along this passage between first plate 70 and aft surface. Secondary air flow 68 exits to second cavity 66B along an outer radial extent of first plate 70. Thus, the spaced arrangement of first plate 70 relative to aft surface of outer radial casing 48 allows for passage of secondary gas flow 68 from first cavity 66A to second cavity 66B.

10 The passage formed by the spaced arrangement of first plate 70 relative to aft surface allows for air flow between first cavity 66A and second cavity 66B. Thus, first cavity 66A and second cavity 66B can be purged with air flow if desired. Additionally, first plate 70 allows air flow to film cool the aft surface of outer radial casing 48 that interfaces with first plate 70. Providing film cooling increases the  
15 operation life of outer radial casing 48.

FIG. 4A shows an enlarged cross-sectional view of one embodiment of second plate 74 mounted to second rib 72 of fairing 46. FIG. 4B shows a perspective view of inner radial platform 56, second rib 72, and second plate 74. FIGS. 4A and 4B illustrate fairing 46 with inner radial platform 56 and strut liner 58 (shown in FIG. 4A  
20 only), second rib 72, second plate 74, and fasteners 76. Second rib 72 includes apertures 81. Second plate 74 includes standoffs 82.

Second rib 72 extends generally inward radially from a non-main flow path side of inner radial platform 56. Second plate 74 is affixed to second rib 72 via fasteners 76. Second plate 74 extends rearward toward an aft end of fairing 46 and is spaced from inner surface of inner radial platform 56. Second plate 74 generally  
25 conforms to the shape of inner surface of inner radial platform 56 and second rib 72. In FIG. 4B, second plate 74 is shown with standoffs 82 projecting from an aft end thereof. In the embodiment shown, standoffs 82 comprise projections such as dimples that contact inner surface of inner radial platform 56 to keep second plate 74 spaced from inner radial  
30 platform 56. This arrangement allows for the passage of secondary air flow 80 therebetween.

First cavity 78A is disposed radially inwards of inner radial platform 56 and forward of second rib 72. Second cavity 78B is disposed radially inwards of inner radial platform 56 and generally aft of second rib 72 and second plate 74. In the

embodiment shown, second cavity 78B extends aft of fairing 46. As shown in FIGS. 4A and 4B, second rib 72 generally separates first cavity 78A from second cavity 78B. In other embodiments, additional components such as seals and seal supports may separate first cavity 78A from second cavity 78B.

5                   Secondary air flow 80 travels through second rib 72 via apertures 81. Second plate 74 is spaced from inner surface of inner radial platform 56 to form a passage. Secondary air flow 80 (after exiting from apertures 81) travels along this passage between second plate 74 and inner surface of inner radial platform 56. Secondary air flow 68 exits to second cavity 78B along an aft end of second plate 74 and  
10 inner radial platform 56. Thus, the spaced arrangement of second plate 74 relative to inner radial platform 56 allows for passage of secondary gas flow 80 from first cavity 78A to second cavity 78B.

The passage formed by the spaced arrangement of second plate 74 relative to inner radial platform 56 allows for air flow between first cavity 78A and second cavity  
15 78B. Thus, first cavity 78A and second cavity 78B can be purged with air flow if desired. Additionally, second plate 74 allows air flow to film cool surfaces of fairing 46 that interface with second plate 74. Providing film cooling increases the operation life of fairing 46. Additionally, the cooling provided by the arrangement described can be used to control deflection of the hardware as desired.

20                   This application discloses the use of a plate to direct a secondary air flow for purging dead cavities within gas turbine engines. Additionally, the plate can be used to direct air flow to provide for film cooling along a surface of a component to which the plate is mounted. The cooling provided by the arrangement described can be used to control deflection of the hardware as desired.

#### 25                   **Discussion of Possible Embodiments**

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

An assembly includes a gas turbine engine component and a plate. The plate is spaced from a surface of the component and generally conforms to the shape of  
30 the surface. The plate and component form a passageway that allows for passage of a secondary gas flow between the component and the plate.

The 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 mount affixed to the component and wherein a portion of the plate is affixed to the mount;

the component comprises a turbine frame;

the plate is mounted to an outer radial casing of the turbine frame;

5 the component comprises a fairing that defines a main gas flow path of the gas turbine engine;

the fairing includes a rib with one or more apertures therein that allow for the secondary air flow to enter the passageway between the plate and the fairing;

10 the plate has a plurality of standoffs that contact the surface of the component and space the plate from the surface; and

the plate is fixed at a first end and is free at a second end.

An assembly for a gas turbine engine includes an outer radial casing and a plate. The plate is attached to the outer radial casing and extends along and generally conforms with a surface of the casing to form a passageway that allows for a secondary gas flow between the casing and the plate.

15 The 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:

the outer radial casing comprises a portion of a turbine frame;

20 the plate has a plurality of standoffs that contact the surface of the casing and space the plate from the surface; and

the plate is fixed at a first end and is free at a second end.

An assembly for a gas turbine engine includes a first casing, a fairing, and a plate. The fairing is disposed within the casing to form a main gas flow path for the gas turbine engine. The fairing has a rib that extends therefrom. The plate is mounted to the rib and extends along a surface of the component to form a passageway therealong. The passageway allows for a secondary gas flow between the component and the plate.

25 The 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:

30 the rib has one or more apertures therein that allow the secondary air to flow to enter the passageway between the plate and the fairing;

the rib extends away from the main gas flow path of the gas turbine engine;

the plate has a plurality of projects that contact the surface of the component to standoff the plate from the surface;

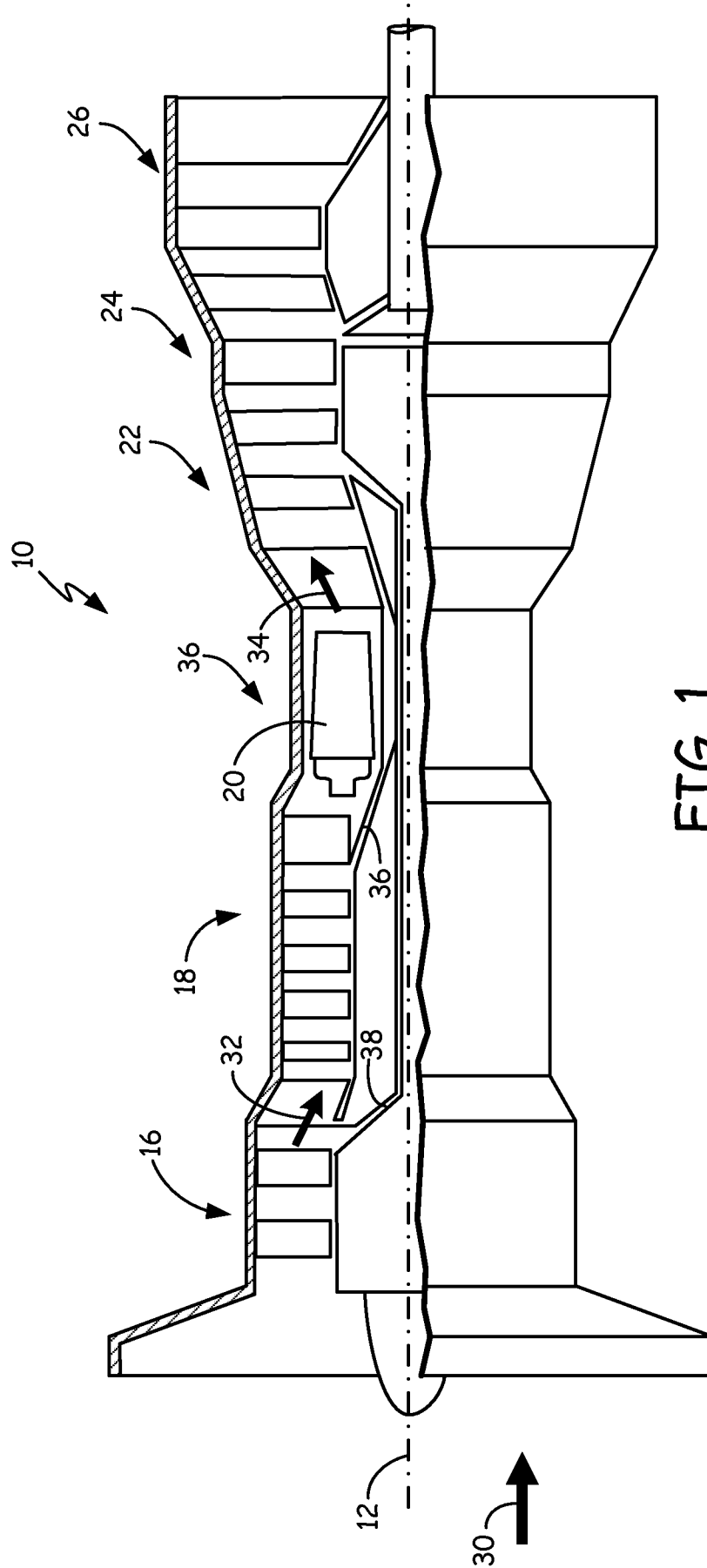
the plate is fixed at a first end and is free at a second end.

While the invention has been described with reference to an exemplary  
5 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  
10 the particular embodiment(s) disclosed, but that the invention will include all  
embodiments falling within the scope of the appended claims.

## CLAIMS:

1. An assembly comprising:  
a gas turbine engine component; and  
a plate spaced from a surface of the component and generally conforming  
5 to the shape of the surface, wherein the plate and the component  
form a passageway that allows for passage of a secondary gas flow  
between the component and the plate.
2. The assembly of claim 1, further comprising a mount affixed to the  
component and wherein a portion of the plate is affixed to the mount.
- 10 3. The assembly of claim 1, wherein the component comprises a turbine  
frame.
4. The assembly of claim 3, wherein the plate is mounted to an outer radial  
casing of the turbine frame.
5. The assembly of claim 1, wherein the component comprises a fairing that  
15 defines a main gas flow path of the gas turbine engine.
6. The assembly of claim 5, wherein the fairing includes a rib with one or  
more apertures therein that allow for the secondary air flow to enter the passageway  
between the plate and the fairing.
7. The assembly of claim 1, wherein the plate has a plurality of standoffs that  
20 contact the surface of the component to space the plate from the surface.
8. The assembly of claim 1, wherein the plate is fixed at a first end and is free  
at a second end.
9. An assembly for a gas turbine engine, comprising:  
an outer radial casing; and  
25 a plate attached to the outer radial casing and extending along and  
generally conforming with a surface of the casing to form a  
passageway that allows for a secondary gas flow between the  
casing and the plate.
10. The assembly of claim 9, wherein the outer radial casing comprises a  
30 portion of a turbine frame.
11. The assembly of claim 9, wherein the plate has a plurality of standoffs that  
contact the surface of the casing to space the plate from the surface.
12. The assembly of claim 9, wherein the plate is fixed at a first end and is free  
at a second end.

13. An assembly for a gas turbine engine, comprising:  
a first casing;  
a fairing disposed within the casing to form a main gas flow path for the  
5 gas turbine engine, wherein the fairing has a rib that extends  
therefrom; and  
a plate mounted to the rib and extending along a surface of the component  
to form a passageway therealong, wherein the passageway allows  
for a secondary gas flow between the component and the plate.
- 10 14. The assembly of claim 13, wherein the rib has one or more apertures  
therein that allow the secondary air to flow to enter the passageway between the plate and  
the fairing.
15. The assembly of claim 13, wherein the rib extends away from the main gas  
flow path of the gas turbine engine.
- 15 16. The assembly of claim 13, wherein the plate has a plurality of projects that  
contact the surface of the component to standoff the plate from the surface.
17. The assembly of claim 13, wherein the plate is fixed at a first end and is  
free at a second end.



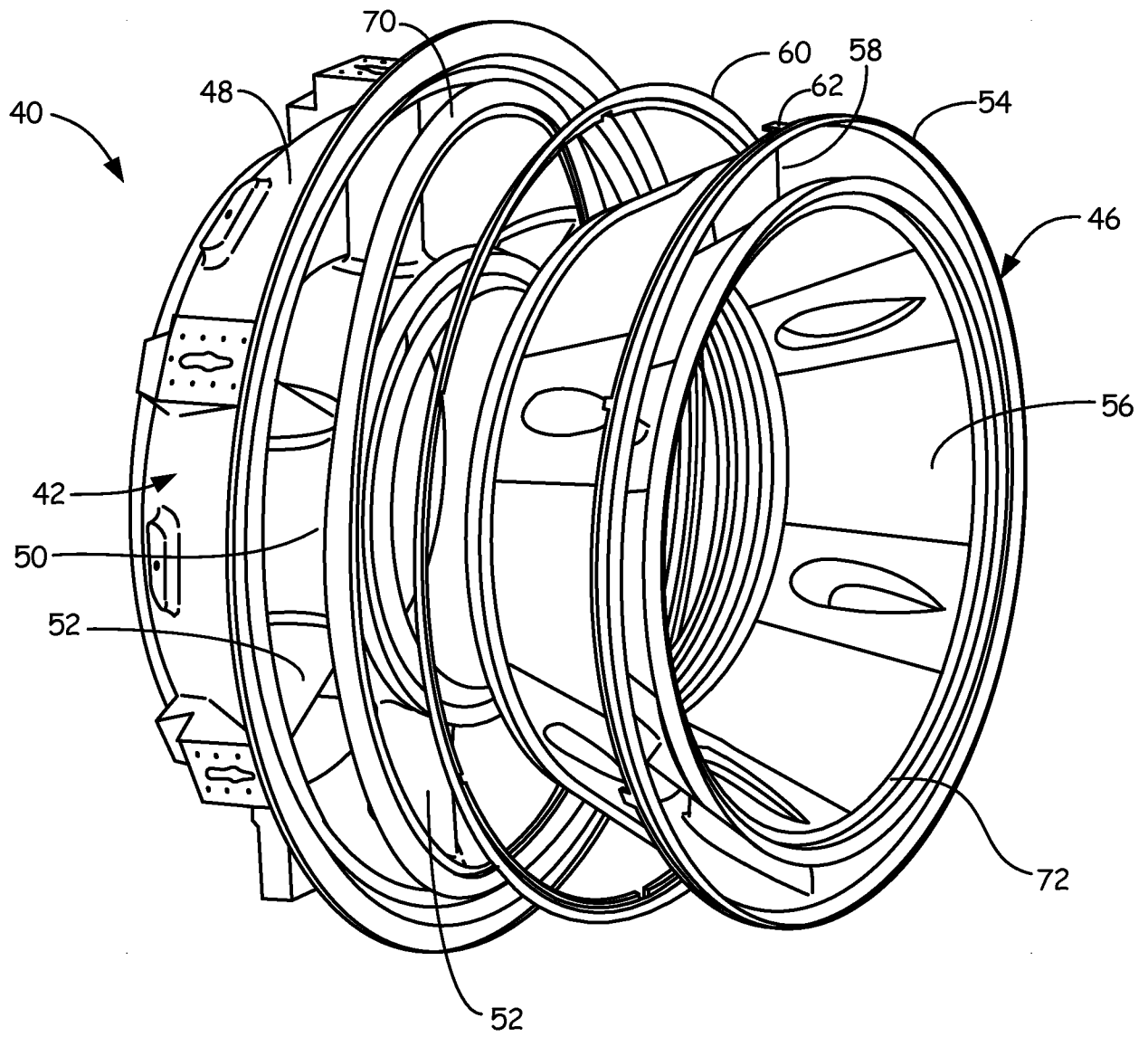


FIG. 2A

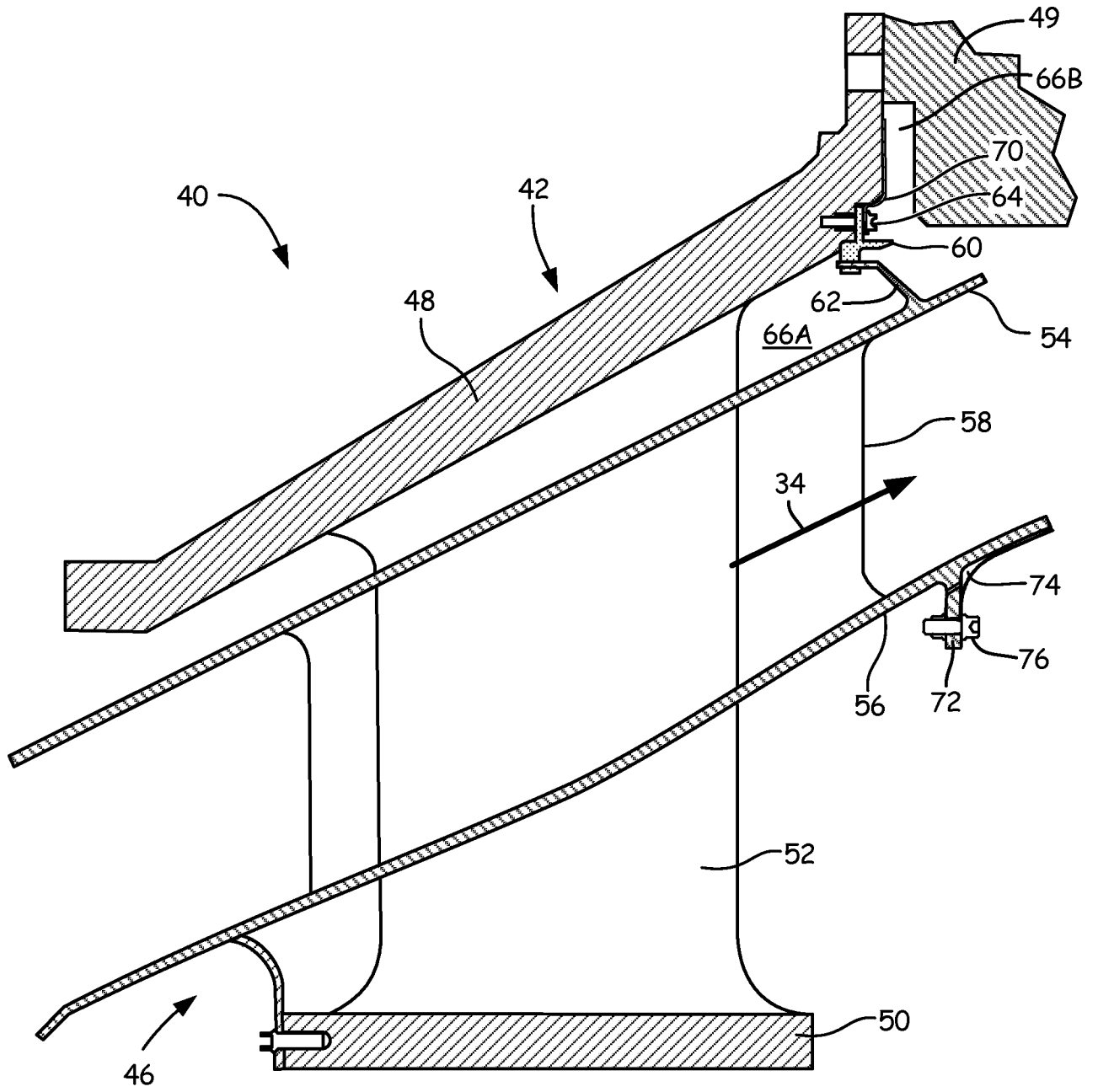


FIG. 2B

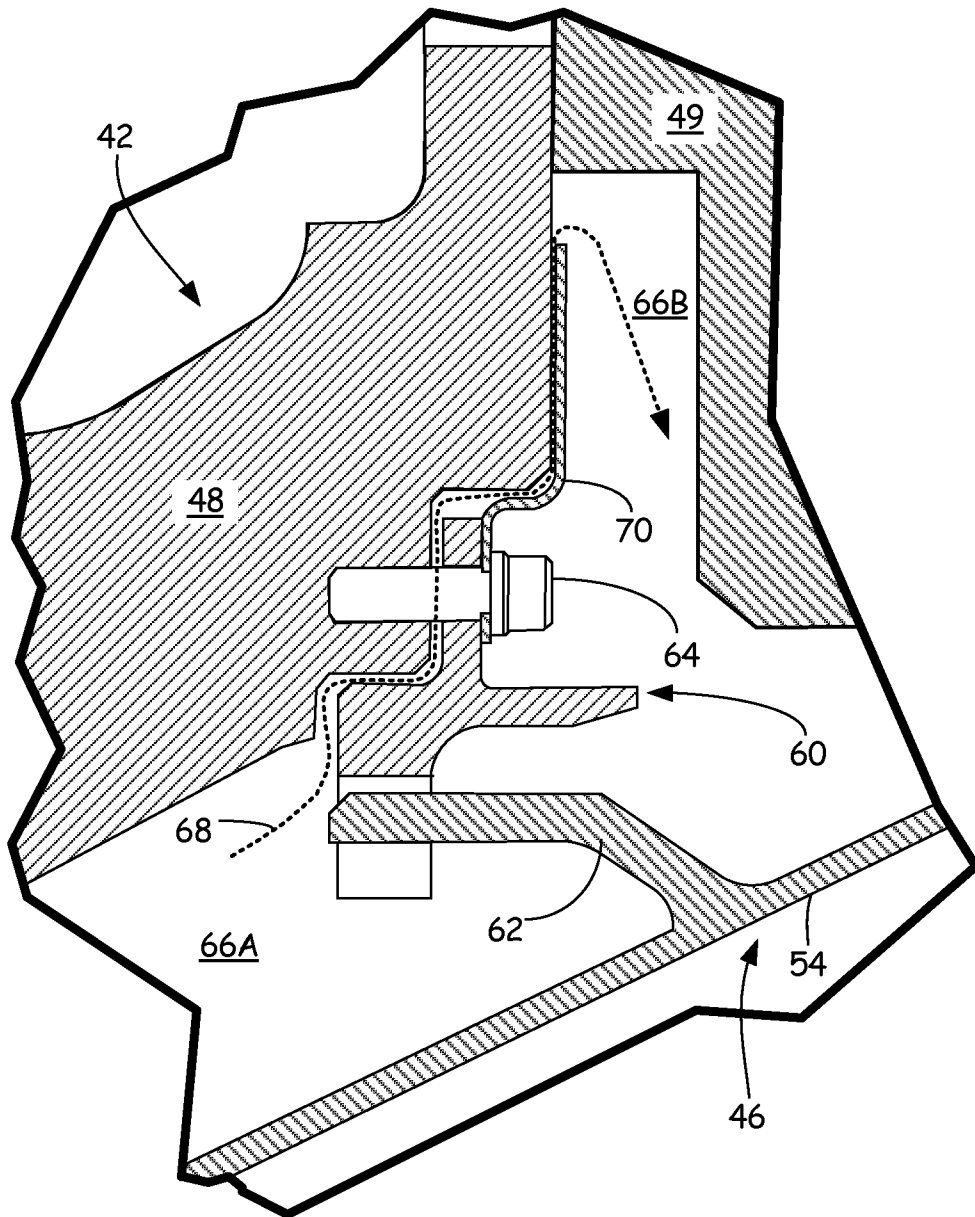
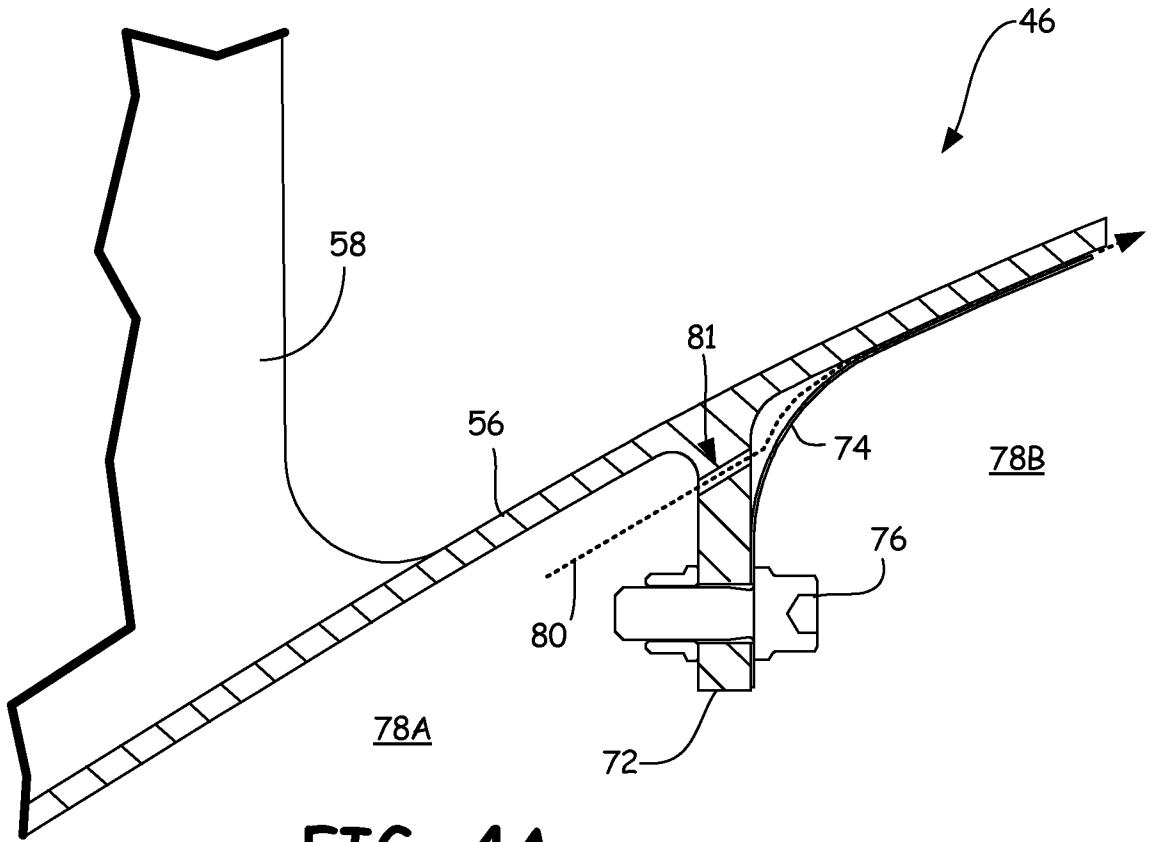
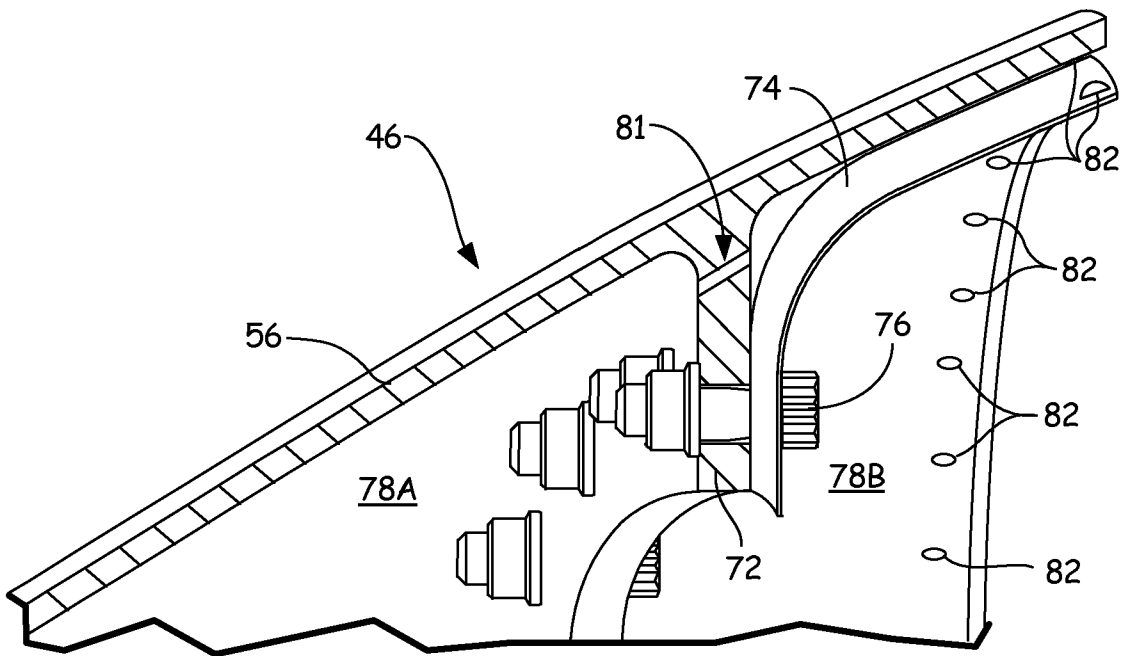


FIG. 3



**FIG. 4A**



**FIG. 4B**