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(54) Cooled gas turbine stator assembly

(57) A stator assembly (100) for a gas turbine engine is provided having an annular body (10), an inner gas path platform (30), a plurality of fairings (20), and at least one nozzle (50). The annular body (10) has an outer gas path platform (12) and a circumferentially extending annular cavity (14) disposed radially outside of the outer gas path platform (12). The fairings (20) extend radially between the inner gas path platform (30) and the outer

gas path platform (12). Each fairing (20) includes a gas passage (22) extending from the annular cavity (14) through the inner gas path platform (30). The at least one nozzle (50) has an inlet orifice (52) disposed outside of the annular cavity (14) and an exit orifice (54) disposed within the annular cavity (14). The exit orifice (54) is oriented within the annular cavity (14) such that cooling air exiting the nozzle (50) travels in a substantially circumferential direction within the annular cavity (14).

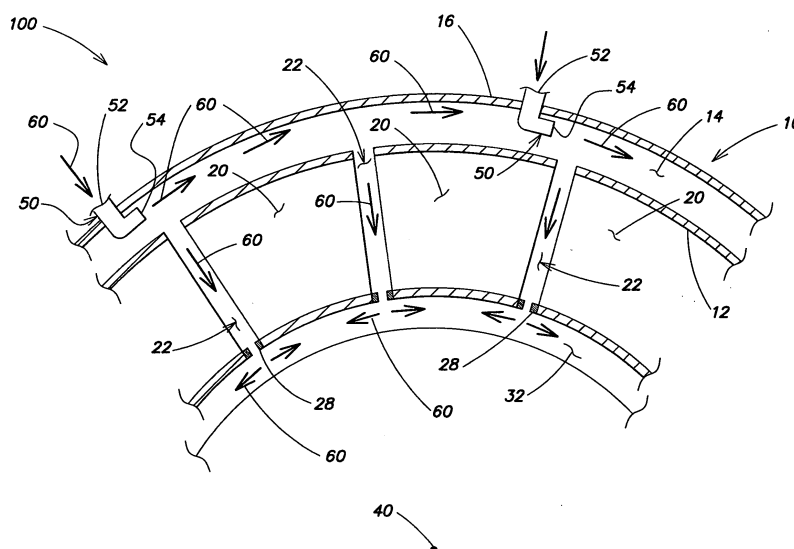


FIG. 2

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Description

BACKGROUND OF THE INVENTION

1. Technical Field

[0001] This disclosure relates generally to stators in a gas turbine engine and, in particular, to cooled stator fairings.

2. Background Information

[0002] Stator fairing assemblies, also known in the art as stator vane assemblies and stator assemblies, are used to direct fluid flow entering or exiting rotor assemblies within a gas turbine engine. Each stator fairing assembly typically includes a plurality of stator fairings extending radially between an inner platform and an outer platform. The temperature of a core gas flow passing through the stator fairing assembly typically requires cooling within the stator fairing assembly.

[0003] It is known to radially impinge cooling air against the outer platform to cool the outer platform. A problem associated with impinging cooling air against the outer platform is that impingement cooling creates discrete cooling zones around the circumference of the outer platform. As a result, the outer platform is non-uniformly cooled around its circumference and consequently susceptible to thermal distortion. It is also known to provide hollow fairings extending between the inner and outer platforms, for the purpose of providing a cooling air gas path between the regions radially inside of the stator assembly and radially outside of the stator assembly. A problem with the hollow fairings in combination with the impingement cooling is that the cooling air flow rate through the fairings can vary from fairing to fairing. As a result, the inner radial region receives a circumferentially non-uniform distribution of cooling air which can lead to thermal distortion within the inner radial region and problems associated therewith. Therefore, there is a need for a stator fairing assembly with an internal structure that promotes uniform cooling within the assembly.

SUMMARY OF THE DISCLOSURE

[0004] According to the present invention, a stator assembly for a gas turbine engine is provided having an annular body, an inner gas path platform, a plurality of fairings, and at least one nozzle. The annular body has an outer gas path platform and a circumferentially extending annular cavity disposed radially outside of the outer gas path platform. The fairings extend radially between the inner gas path platform and the outer gas path platform. Each fairing includes a gas passage extending from the annular cavity through the inner gas path platform. The at least one nozzle has an inlet orifice disposed outside of the annular cavity and an exit orifice disposed within the annular cavity. The exit orifice is oriented within

the annular cavity such that cooling air exiting the nozzle travels in a substantially circumferential direction within the annular cavity.

[0005] These and other features and advantages of the present invention method and apparatus will become apparent in light of the detailed description of the invention provided below and the accompanying drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006]

FIG. 1 is a side sectional view illustrating one example of a stator assembly;

FIG. 2 is a cross-sectional view illustrating the stator assembly in FIG. 1;

FIG. 3A illustrates the net flow through a prior art stator assembly; and

FIG. 3B illustrates the net flow through the stator assembly in FIG. 1.

DETAILED DESCRIPTION OF THE INVENTION

[0007] Now referring to FIG. 1, a stator assembly 100 for a gas turbine engine is provided. The gas turbine engine has a plurality of rotor assemblies rotatable about an axial centerline 40 of the gas turbine engine. In FIG. 1, the stator assembly is shown as a mid turbine stator assembly disposed between a first rotor assembly 90 and a second rotor assembly 95 within the turbine section of the gas turbine engine. The present invention stator assembly 100 can be utilized in a plurality of positions within a gas turbine engine and is not, therefore, limited to the aforesaid mid turbine stator position. The stator assembly 100 has an annular body 10, an inner gas path platform 30, a plurality of fairings 20, and at least one nozzle 50.

[0008] The annular body 10 has an outer gas path platform 12, an outer body panel 16, and a circumferentially extending annular cavity 14 disposed between the outer gas path platform 12 and the outer body panel (illustrated in FIG. 2). In some embodiments, the annular body 10 is formed as a single annular structure. In other embodiments the annular body 10 is manufactured in circumferentially defined sections that are combined to form the annular body 10. In those embodiments where the annular body 10 is formed from a plurality of sections, seals are typically disposed between adjacent sections to reduce leakage flow therebetween. In some embodiments, the outer gas path platforms 12 and the outer body panel 16 are attached to one another by mechanical fasteners. In the embodiment shown in FIG. 1, the annular cavity 14 has a height that is substantially uniform around the circumference of the annular body 10. The forward and aft sections of the annular body include one or more apertures that function as cooling gas leakage paths to permit flow of cooling air outside of the annular cavity 14 (not shown).

[0009] Each of the plurality of fairings 20 extends radially between the inner gas path platform 30 and the outer gas path platform 12. The annular body 10 is disposed radially outside of the fairings 20. Each fairing 20 has a pair of faces extending between a leading edge 24 and a trailing edge 26. Further, each fairing 20 includes a gas passage 22 extending radially through the fairing 20. The passage 22 provides a cooling air gas path from the cavity 14, through the inner annular platform 30, and into an inner cavity 32 defined in part by the inner gas path platform 30. In some embodiments, one or more tie rods 80 and/or service lines (not shown) are disposed within one or more of the plurality of fairings 20.

[0010] The at least one nozzle 50 is mounted relative to the annular body 10, and extends through the outer body panel 16. The nozzle has an inlet orifice 52 disposed outside of the annular body 10 and an exit orifice 54 disposed within the cavity 14. The nozzle 50 is shaped and oriented within the cavity 14 such that cooling gas passing through the nozzle 50 and into the cavity 14 exits the nozzle 50 in a substantially circumferential direction. FIG. 2 diagrammatically illustrates a plurality of nozzles 50, each having an approximately ninety degree (90°) turn. The present invention is not limited to nozzles 50 of this configuration, however. In those embodiments having a plurality of nozzles 50, the geometry of the nozzles 50 may vary from nozzle to nozzle, for example, to accommodate structure within the cavity 14, improve circumferential gas flow, etc. The number of nozzles 50 may vary between applications, and is not limited. In one embodiment having a plurality of nozzles, the nozzles are uniformly disposed circumferentially around the annular body 10. In embodiments where the annular body 10 has a plurality of circumferentially defined sections, at least one nozzle 50 may be provided in each section. The cooling gas flow within the cavity 14 collectively exiting from the plurality of nozzles 50 creates a circumferentially directed cooling gas flow within the cavity 14 (illustrated in FIG. 2).

[0011] In some embodiments, a metering plate 28 having at least one orifice is disposed within the passage 22 of at least one of the fairings 20 and is configured to create a pressure drop across the orifices in the metering plate. The use of a metering plate 28 within a particular passage 22, and the characteristics of the metering plate (e.g., size and number of orifices), are varied to suit particular applications. For example, in some embodiments a metering plate 28 may be disposed in each fairing 20 and the characteristics of each metering plate are "tuned" to create uniform cooling gas flow through each of the fairings 20. In some embodiments, the position of the metering plate 28 within each fairing 20 is the same. For example, FIG. 2 illustrates the metering plates 28 disposed at or near a radially inner end of the fairings 20. In other embodiment, the position of the metering plate 28 is varied between fairings 20.

[0012] During the operation of the engine, hot core gas 200 flows through the first rotor stage 90, between the

outer gas path platform 12 and the inner gas path platform 30, around each of the fairings 20, and through to the second rotor stage 95. As the gas flow 200 travels through the assembly 100, it causes each fairing 20 to increase in temperature. To counteract the temperature rise, cooling air flow 60 is injected into the cavity 14 through the nozzles 50. The cooling air exiting the nozzles 50 is directed in a substantially circumferential direction within the cavity 14. The circumferentially traveling cooling air flow 60 created by the cooling air exiting the nozzles 50 increases the uniformity of the cooling around the circumference of the annular body 10. In addition, the increased uniformity of the cooling air flow within the annular body 10 also increases the uniformity of the cooling air flow through the fairings 20 (illustrated in FIG. 3B), as compared to the prior art (illustrated in FIG. 3A). The metering plates 28 disposed within the passages 22 further increase the uniformity of the cooling air flow through the fairing passages 22, and thereby increase the uniformity of cooling gas flow into the region radially inside of the stator assembly 100.

[0013] While various embodiments of the stator assembly have been disclosed, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of this disclosure. Accordingly, this disclosure is not to be restricted except in light of the attached claims and their equivalents.

Claims

1. A stator assembly (100) for a gas turbine engine, comprising:

an annular body (10) having an outer gas path platform (12) and a circumferentially extending annular cavity (14) disposed radially outside of the outer gas path platform (12);
 an inner gas path platform (30);
 a plurality of fairings (20) extending radially between the inner gas path platform (30) and the outer gas path platform (12), each fairing (20) including a gas passage (22) extending from the annular cavity (14) through the inner gas path platform (30); and
 at least one nozzle (50) having an inlet orifice (52) disposed outside of the annular cavity (14) and an exit orifice (54) disposed within the annular cavity (14), wherein the exit orifice (54) is oriented within the annular cavity (14) such that gas exiting the nozzle (50) travels in a substantially circumferential direction within the annular cavity (14).

2. The stator assembly of claim 1, further comprising a metering plate (28) disposed within at least one of the plurality of gas passages (22).

3. The stator assembly of claim 2, where metering plate (28) is disposed at an inner end of at least one of the plurality of gas passages (20).
4. The stator assembly of claim 2 or 3, comprising a metering plate (28) disposed within each of the plurality of gas passages (22). 5
5. The stator assembly of claim 4, wherein each metering plate (28) has at least one orifice operable to meter the flow of cooling air through the gas passage (22) in which the metering plate (28) is disposed. 10
6. The stator assembly of any preceding claim, wherein the annular body (10) has a plurality of circumferentially defined sections. 15
7. The stator assembly of claim 6, wherein the plurality of circumferentially defined sections include the outer gas path platform (12) and an outer body panel (16). 20
8. The stator assembly of claim 6 or 7, further comprising a seal configured between at least two of the sections. 25
9. The stator assembly of any of claims 6 to 8, further comprising at least one nozzle (50) disposed in each section of the annular body (10). 30
10. The stator assembly of any preceding claim, further comprising a plurality of nozzles (50) uniformly disposed around the annular body (10).
11. The stator assembly of any preceding claim, further comprising at least one of a tie rod (80) and a service line disposed within at least one of the fairings (20). 35
12. The stator assembly of any preceding claim, wherein the circumferentially extending annular cavity (14) has a uniform height. 40

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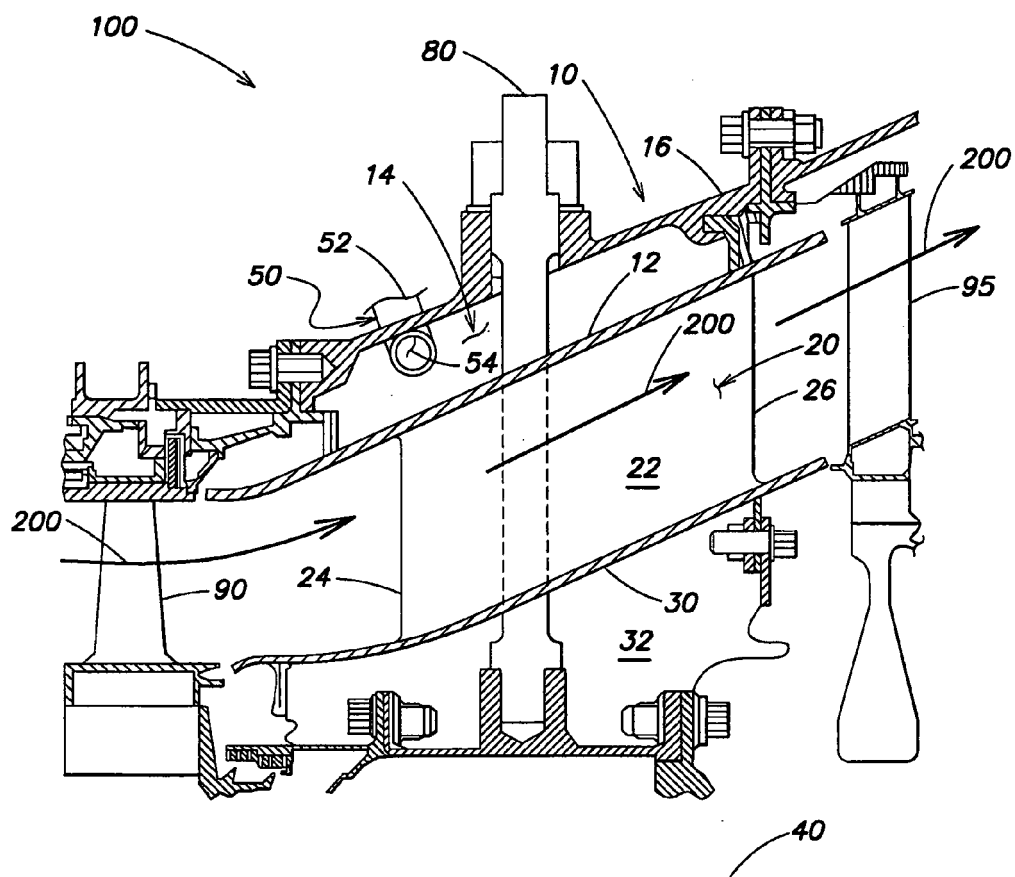


FIG. 1

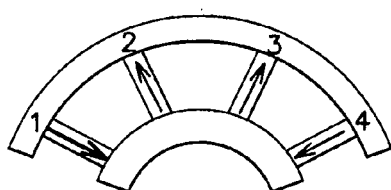


FIG. 3A
(Prior Art)

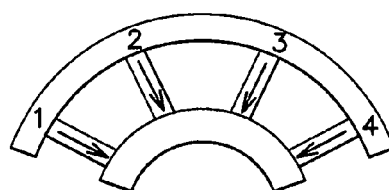


FIG. 3B

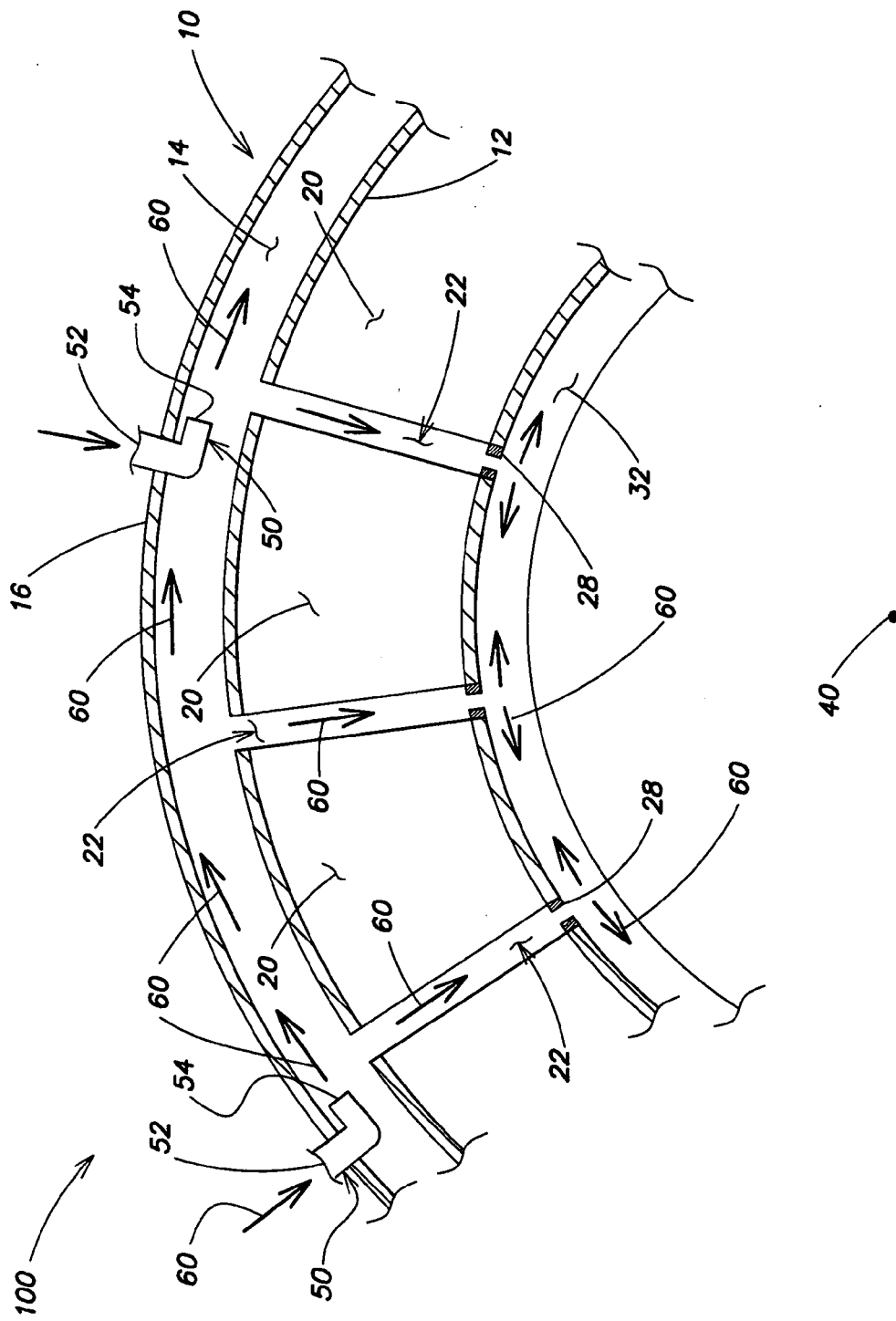


FIG. 2