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(54) **injection Apparatus**

Injektionsvorrichtung

Appareil d'injection

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Description

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to an injection apparatus and, more particularly, to an injection apparatus for attachment to an outer vessel disposed about an inner vessel formed to define a main flowpath.

[0002] A typical turbomachine, such as a gas turbine engine, includes a compressor, a combustor and a turbine. The compressor compresses inlet gas to produce compressed gas, which is transmitted to the combustor. Within the combustor, the compressed gas is mixed with fuel and combusted to produce high temperature fluids. These high temperature fluids are then directed to the turbine for power and/or electricity generation. In some cases, a transition piece may be disposed between the combustor and the turbine such that the high temperature fluids flow through the transition piece prior to entering the turbine.

[0003] As a result of the process described above, pollutants, such as oxides of nitrogen (NOx) may be produced and emitted to the atmosphere. Recently, efforts have been undertaken to reduce pollutant production and emission. Such efforts include the development of axially staged fuel injection systems, such as late lean injection (LLI) systems. In LLI systems, a quantity of fuel and air are injected into the main flowpath through the combustor or the transition piece downstream of the main combustion zone.

[0004] A problem with such systems, however, is that axially staged or LLI injectors must be integrally mounted to the transition piece, which is a complicated process that may lead to further assembly issues with the transition piece impingement sleeve.

[0005] US 7000396 describes a combustor for a gas turbine including a combustor body having an aperture and a casing enclosing the combustor body and defining a passageway therebetween for carrying compressor discharge air. At least one injection tube supplies an amount of the compressor discharge air into the combustor body and the injection tube is disposed between the aperture and through the casing. A collar having a plurality of openings is disposed at the passageway and surrounds the injection tube so that the injection tube passes through the collar. A gap is disposed between the collar and the injection tube.

BRIEF DESCRIPTION OF THE INVENTION

[0006] The invention resides in an injection apparatus as defined in the appended claims.

BRIEF DESCRIPTION OF THE DRAWING

[0007] Embodiments of the present invention will now be described, by way of example only, with reference to the accompanying drawings in which:

A schematic side view of an injection apparatus in accordance with embodiments.

[0008] The detailed description explains embodiments of the invention, together with advantages and features, by way of example with reference to the drawings.

DETAILED DESCRIPTION OF THE INVENTION

[0009] With reference to the sole figure, an injection apparatus 10 is provided. The injection apparatus 10 is attachable to an outer vessel 11, such as an impingement sleeve or a flow sleeve of an exemplary turbomachine transition piece. The outer vessel 11 may be disposed about an inner vessel 12, which may be the turbomachine transition piece and may be formed to define a main flowpath 120. During turbomachine operations, high temperature fluids are produced in a combustor and directed toward a turbine by way of the turbomachine transition piece. The flow of the high temperature fluids thus proceeds along the main flowpath 120 of the inner vessel 12. It is, however, to be understood that the injection apparatus 10 may be attachable to other vessels in the turbomachine and/or other systems. As an alternate example, the injection apparatus 10 may be attachable to a forward end of the impingement sleeve (i.e., proximate to the axial injection flow sleeve), the aft end of the impingement sleeve or to a flow sleeve of the combustor.

[0010] The injection apparatus 10 includes a ring-shaped or annular base 20 and a tubular body 40. The annular base 20 is configured to be fastened to the outer vessel 11 by one or more of bolting, welding, sealing and butt welding. The annular base 20 has a first surface 21 that is formed to define an injection hole location 200 and a protrusion 25. The protrusion 25 protrudes from an interior facing surface 26 of the annular base 20 and extends perimetrically about the injection hole location 200 such that the protrusion 25 is axisymmetric about a centerline of the inner vessel 12. The protrusion 25 includes a first part 27 and a connector 30. The first part 27 protrudes from the interior facing surface 26 such that the first part 27 is axisymmetric about the centerline of the inner vessel 12. The connector 30 has a first end 31, which is configured to be fastened by, for example, welding to a distal end of the protrusion 25 perimetrically about the injection hole location 200, and a second end 32. The first end 31 and the second end 32 supportively meet at bend 33, which may be angular or curved, such that the second end 32 defines a secondary injection hole location 201, which may correspond to the injection hole location 200.

[0011] In accordance with embodiments, the injection hole location 200 and the secondary injection hole location 201 may be round or, in some cases, substantially circular. Similarly, the protrusion 25, the connector 30 and the tubular body 40 may also have round or, in some

cases, substantially circular cross-sections (i.e., they may be ring-shaped) in correspondence with the shape of the injection hole location 200 and the secondary injection hole location 201.

[0012] The tubular body 40 has sufficient length to extend across an annulus defined between the outer vessel 11 and the inner vessel 12 and has an interior facing surface 41 that is formed to define a tubular injection hole 400. The tubular body 40 is sealably fastened to the first surface 21 of the annular base 20 at the injection hole location 200 by way of, for example, bolt 42 that engages with the annular base 20. The tubular body 40 also has a protrusion 45 that may be sealably fastened to the second end 32 of the connector 30 at the secondary injection hole location 201. Seals 46, such as o-rings or c-seals, may be sealably disposed between the tubular body 40 and the first surface 21 and between the protrusion 45 and the second end 32 of the connector 30. The tubular injection hole 400 permits fluid communication between an exterior of the outer vessel 11 and the main flowpath 120.

[0013] In accordance with embodiments, at an inlet end of the tubular body 40, the tubular body 40 may include a flange 47. The annular base 20 may include an exterior facing surface 28 that faces radially outwardly and away from the main flowpath 120. This exterior facing surface 28 may have a fastening surface 280 formed thereon at the injection hole location 200 where the exterior facing surface 28 is machined to be flat and/or smooth and therefore configured for mating with the flange 47. Where bolt 42 is employed to fasten the tubular body 40 to the annular base 20, the bolt 42 extends through both the flange 47 and the fastening surface 280 of the exterior facing surface 28.

[0014] The tubular body 40, the connector 30, the protrusion 25 and the annular base 20 may cooperatively define a plenum 50. The tubular body 40 is further formed to define an additional injection hole 401 for permitting fluid communication between an interior of the plenum 50 and the tubular injection hole 400. The additional injection hole 401 may be defined as a plurality of additional injection holes 401, which are arrayed about the tubular injection hole 400 of the tubular body 40 at the plenum 50. Separation between adjacent additional injection holes 401 may be uniform or non-uniform.

[0015] Where the injection apparatus 10 is attachable to an impingement sleeve or another similar feature of a turbomachine, the plenum 50 may be supplied with fuel and the exterior of the outer vessel 11 may include compressed air, such as compressor discharge air that is produced by a compressor of the turbomachine. In these cases, the compressed air flows through the tubular injection hole 400 and entrains a flow of the fuel from the plenum 50 into the tubular injection hole 400. The fuel is thereby mixed with the compressed air and injected into the main flowpath 120 as a fuel/air mixture. As such, the injection apparatus 10 may be employed as part of an axially staged injection system of a turbomachine or, more particularly, as part of a late lean injection (LLI) system of the turbomachine. In the latter case, the fuel/air mixture may be lean such that combustion of the fuel/air mixture within the main flowpath 120 serves to reduce the production and subsequent emission of pollutants, such as oxides of nitrogen (NOx).

[0016] The annulus defined between the outer vessel 11 and the inner vessel 12 is generally supported by support structures 60, such as a-spacers arrayed about the inner vessel 12. In accordance with embodiments, these support structures 60 may be disposed between an exterior facing surface of the inner vessel 12 and the interior facing surface 26 of the annular base 20.

[0017] In accordance with aspects of the invention, the injection hole location 200 (and the accompanying structures as described above) may be provided as a plurality of injection hole locations 200. In these cases, the plural injection hole locations 200 may be arrayed about the outer vessel 11 and the inner vessel 12 as non-axisymmetric features. Separation between adjacent injection hole locations 200 may be uniform or non-uniform. In accordance with an exemplary embodiment, four injection hole locations 200 may be clustered about respective lower portions of the outer vessel 11 and the inner vessel 12.

[0018] The invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

Claims

1. An injection apparatus, comprising:

an annular base (20) defining an injection hole location (200) and having a protrusion (25) about the injection hole location (200);

said protrusion (25) extending from an interior facing surface (26) of the annular base (20) and perimetrically about the injection hole location (200);

a connector (30) having a first end (31) fastened to a distal end of the protrusion (25) perimetrically about the injection hole location (200) and a second end (32); and

a tubular body (40) formed to define an injection hole (400), the tubular body (40) being sealably fastened to the annular base (20) at the injection hole location (200) and having a protrusion (45) sealably fastened to the second end (32) of the connector (30); wherein

the tubular body (40), the connector (30), the protrusion (25) of the annular base (20) and the annular base (20) cooperatively define a plenum (50), which is communicative with the injection hole (400).

2. The injection apparatus according to claim 1, where-

in the annular base (20) includes an exterior facing surface (28) having a fastening surface (280) formed thereon at the injection hole location (200).

3. The injection apparatus according to claim 1 or 2, further comprising seals (46) disposed between the tubular body (40) and the annular base (20) and between the connector (30) and the protrusion (45) of the tubular body (40).

4. The injection apparatus according to any of claims 1 to 3, wherein the tubular body (40) is further formed to define a plurality of additional injection holes (401) configured for fluid communication between an interior of the plenum (50) and the injection hole (400).

5. The injection apparatus according to claim 4, wherein the additional injection holes (401) are arrayed about a circumference of the injection hole (400) defined by the tubular body (40).

6. The injection apparatus according to any of claims 1 to 5, further comprising an outer vessel (11) disposed about an inner vessel (12) formed to define a main flowpath (120), wherein the annular base (20) is fastened to the outer vessel (11) and the injection hole (400) permits communication between an exterior of the outer vessel (11) and the main flowpath (120).

7. The injection apparatus according to claim 6, wherein the outer vessel (11) comprises an impingement sleeve of a turbomachine transition piece.

8. The injection apparatus according to claim 6 or 7, wherein the plenum (50) is supplied with fuel and the exterior of the outer vessel (11) comprises compressed air.

9. The injection apparatus according to any of claims 6 to 8, wherein the annular base (20) is fastened to the outer vessel (11) by one or more of bolting, welding, sealing and butt welding.

10. The injection apparatus according to any of claims 6 to 9, further comprising support structures (60) to support the annular base (20) on the inner vessel (12).

11. The injection apparatus according to any preceding claim, further comprising a plurality of injection hole locations (200) defined in the annular base (20).

12. The injection apparatus according to claim 11, wherein the injection hole locations (200) are non-uniformly separated from one another.

13. The injection apparatus according to claim 11, wherein the injection hole locations (200) are clustered.

Patentansprüche

1. Einspritzvorrichtung, umfassend:

eine ringförmige Basis (20), die eine Einspritzöffnungsposition (200) definiert, mit einer um die Einspritzöffnungsposition (200) herum angeordneten Auskragung;
wobei die Auskragung (25) von einer nach innen gerichteten Oberfläche (26) der ringförmigen Basis (20) ausgeht und um die Einspritzöffnungsposition (200) herum angeordnet ist;
einen Anschluss (30) mit einem ersten Ende (31), befestigt an einem distalen Ende der Auskragung (25) um die Einspritzöffnungsposition herum (200), und einem zweiten Ende (32); und
einen rohrförmigen Körper (40), geformt, um eine Einspritzöffnung (400) zu definieren, wobei der rohrförmige Körper (40) abdichtend an der ringförmigen Basis (20) der Einspritzöffnungsposition (200) befestigt ist und eine Auskragung (45) hat, die abdichtend an dem zweiten Ende (32) des Anschlusses (30) befestigt ist; wobei der rohrförmige Körper (40), der Anschluss (30), die Auskragung (25) der ringförmigen Basis (20) und die ringförmige Basis (20) gemeinsam eine Kammer (50) definieren, welche mit der Einspritzöffnung (400) in Verbindung steht.

2. Einspritzvorrichtung nach Anspruch 1, wobei die ringförmige Basis (20) eine nach außen weisende Oberfläche (28) mit einer darauf ausgebildeten Befestigungsfläche (280) an der Einspritzöffnungsposition (200) hat.

3. Einspritzvorrichtung nach Anspruch 1 oder 2, ferner umfassend Dichtungen (46) zwischen dem rohrförmigen Körper (40) und der ringförmigen Basis (20) sowie zwischen dem Anschluss (30) und der Auskragung (45) des rohrförmigen Körpers (40).

4. Einspritzvorrichtung nach einem der Ansprüche 1 bis 3, wobei der rohrförmige Körper (40) ferner ausgeformt ist, um mehrere zusätzliche Einspritzöffnungen (401) zur Fluidverbindung zwischen einer Innenseite der Kammer (50) und der Einspritzöffnung (400) zu definieren.

5. Einspritzvorrichtung nach Anspruch 4, wobei die zusätzlichen Einspritzöffnungen (401) um einen Umfang der Einspritzöffnung (400), definiert durch den rohrförmigen Körper (40), angeordnet sind.

6. Einspritzvorrichtung nach einem der Ansprüche 1

bis 5, ferner umfassend einen äußeren Behälter (11), welcher um einen inneren Behälter (12) herum ausgebildet ist, um einen Hauptströmungsweg (120) zu definieren, wobei die ringförmige Basis (20) am äußeren Behälter (11) befestigt ist und die Einspritzöffnung (400) die Kommunikation zwischen einem Außenbereich um den äußeren Behälter (11) herum und dem Hauptströmungsweg (120) ermöglicht.

7. Einspritzvorrichtung nach Anspruch 6, wobei der äußere Behälter (11) eine Prallhülse eines Übergangsteils einer Strömungsmaschine umfasst.

8. Einspritzvorrichtung nach Anspruch 6 oder 7, wobei die Kammer (50) mit Kraftstoff versorgt wird und der Außenbereich um den äußeren Behälter (11) Druckluft enthält.

9. Einspritzvorrichtung nach einem der Ansprüche 6 bis 8, wobei die ringförmige Basis (20) durch Anschrauben, Schweißen, Versiegeln und/oder Stumpfschweißen am äußeren Behälter (11) befestigt ist.

10. Einspritzvorrichtung nach einem der Ansprüche 6 bis 9, ferner umfassend Stützvorrichtungen (60), um die ringförmige Basis (20) auf dem inneren Behälter (12) abzustützen.

11. Einspritzvorrichtung nach einem der vorhergehenden Ansprüche, ferner umfassend mehrere in der ringförmigen Basis (20) definierte Einspritzöffnungspositionen (200).

12. Einspritzvorrichtung nach Anspruch 11, wobei die Einspritzöffnungspositionen (200) uneinheitlich voneinander beabstandet sind.

13. Einspritzvorrichtung nach Anspruch 11, wobei die Einspritzöffnungspositionen (200) in Gruppen angeordnet sind.

Revendications

1. Un appareillage d'injection, comprenant :

une base annulaire (20) ménageant un endroit pour un orifice d'injection (200) et ayant une protubérance (25) autour de l'endroit de l'orifice d'injection (200) ; ladite protubérance (25) s'étendant de la surface tournée vers l'intérieur (26) de la base annulaire (20) et sur le périmètre autour de l'endroit de l'orifice d'injection (200) ;
un connecteur (30) ayant une première extrémité (31) fixée à une extrémité distale de la protubérance (25) sur le périmètre autour de l'endroit de l'orifice d'injection troué (200) et une seconde extrémité (32) ; et
un corps tubulaire (40) formé pour définir un orifice d'injection (400), le corps tubulaire (40) étant fixé de manière étanche à la base annulaire (20) à l'endroit de l'orifice d'injection (200) et ayant une protubérance (45) fixée de manière étanche à la seconde extrémité (32) du connecteur (30) ;
dans lequel
le corps tubulaire (40), le connecteur (30), la protubérance (25) de la base annulaire (20) et la base annulaire (20) coopèrent pour définir un plenum (50) qui est en communication avec l'orifice d'injection (400).

2. L'appareillage d'injection selon la revendication 1, dans lequel la base annulaire (20) inclut une surface tournée vers l'extérieur (28) ayant une surface de fixation (280) formée dessus à l'endroit de l'orifice d'injection (200).

3. L'appareillage d'injection selon la revendication 1 ou 2 comprenant en outre des joints (46) disposés entre le corps tubulaire (40) et la base annulaire (20) et entre le connecteur (30) et la protubérance (45) du corps tubulaire (40).

4. L'appareillage d'injection selon une quelconque des revendications 1 à 3, dans lequel le corps tubulaire est en outre formé pour définir une pluralités d'orifices d'injection additionnels (401) configurés pour une communication fluidique entre un intérieur du plenum (50) et l'orifice d'injection (400).

5. L'appareillage d'injection selon la revendication 4, dans lequel les orifices d'injection additionnels (401) sont alignés le long d'une circonférence de l'orifice d'injection (400) défini par le corps tubulaire (40).

6. L'appareillage d'injection selon une quelconque des revendications 1 à 5, comprenant en outre une enceinte extérieure (11) disposée autour d'un enceinte intérieure (12) formé pour définir un trajet de flux principal (120), où la base annulaire (20) est fixée à l'enceinte extérieure (11) et l'orifice d'injection (400) permet la communication entre un extérieur de l'enceinte extérieure (11) et le trajet de flux principal (120).

7. L'appareillage d'injection selon la revendication 6, dans lequel l'enceinte extérieure (11) comprend un manchon de heurt d'une pièce de transition de turbomachine.

8. L'appareillage d'injection selon la revendication 6 ou 7, dans lequel le plenum (50) est alimenté en carburant et l'extérieur de l'enceinte extérieure (11) comprend de l'air comprimé.

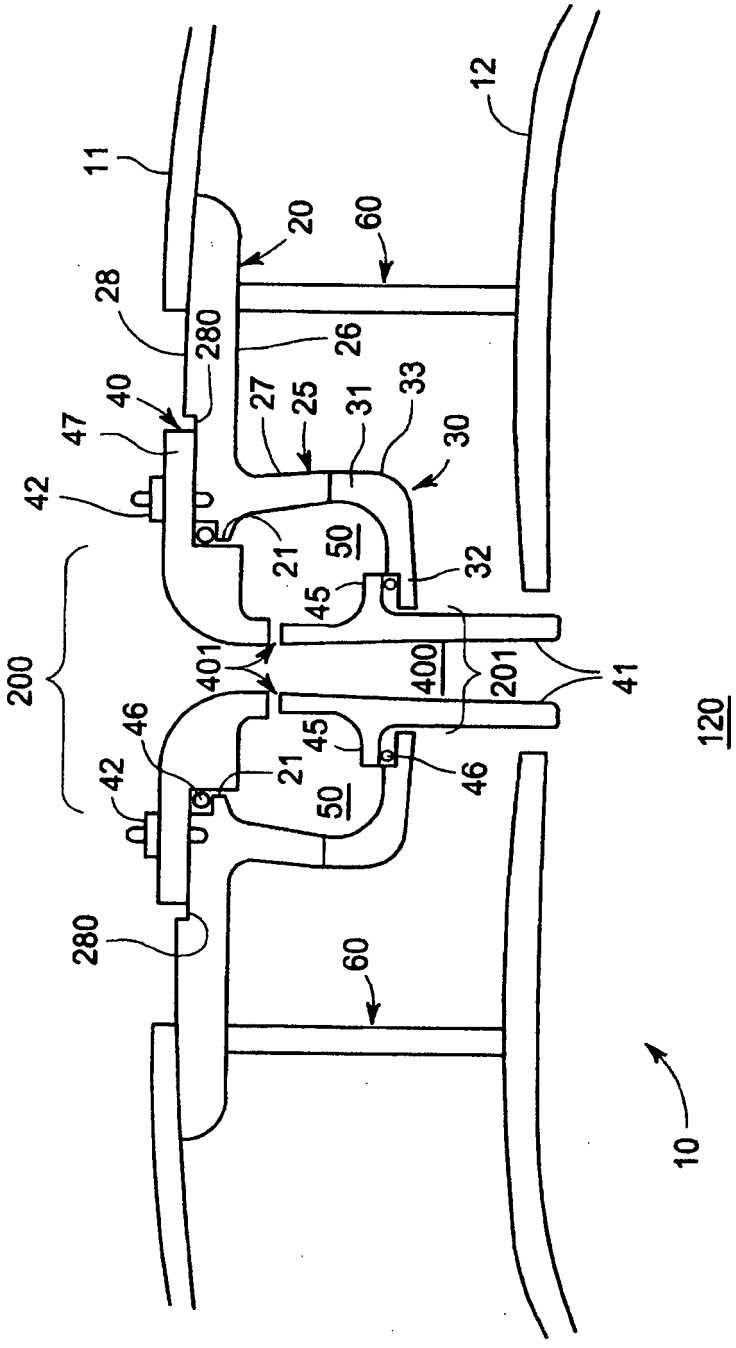
9. L'appareillage d'injection selon une quelconque des revendications 6 à 8, dans lequel la base annulaire (20) est fixée à l'enceinte extérieure (11) par l'un ou l'autre d'un vissage, soudage, scellement et soudage bout-à-bout.

10. L'appareillage d'injection selon une quelconque des revendications 6 à 9, comprenant en outre des structures supports (60) pour monter la base annulaire (20) sur l'enceinte interne (12).

11. L'appareillage d'injection selon une quelconque des revendications précédentes, comprenant en outre une pluralité d'orifices d'injection (200) définis dans la base annulaire (20).

12. L'appareillage d'injection selon la revendication 11, dans lequel les endroits des orifices d'injection (200) sont non uniformément séparés l'un de l'autre.

13. L'appareillage d'injection selon la revendication 11, dans lequel les endroits des orifices d'injection (200) sont groupés.


11
12
20
60
28
280
26
40
47
27
25
31
33
30
42
21
50
32
45
200
401
400
201
41
46
120
42
21
45
50
46
280
60
10

REFERENCES CITED IN THE DESCRIPTION

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Patent documents cited in the description

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