US 20130170960A1

(19) United States
(12) Patent Application Publication
Babu
(10) Pub. No.: US 2013/0170960 A1
(43) Pub. Date: Jul. 4, 2013

(54) TURBINE ASSEMBLY AND METHOD FOR REDUCING FLUID FLOW BETWEEN TURBINE COMPONENTS

(75) Inventor: **Ramesh Kempanna Babu**, Bangalore (IN)

(73) Assignee: **GENERAL ELECTRIC COMPANY**, Schenectady, NY (US)

(21) Appl. No.: **13/343,145**

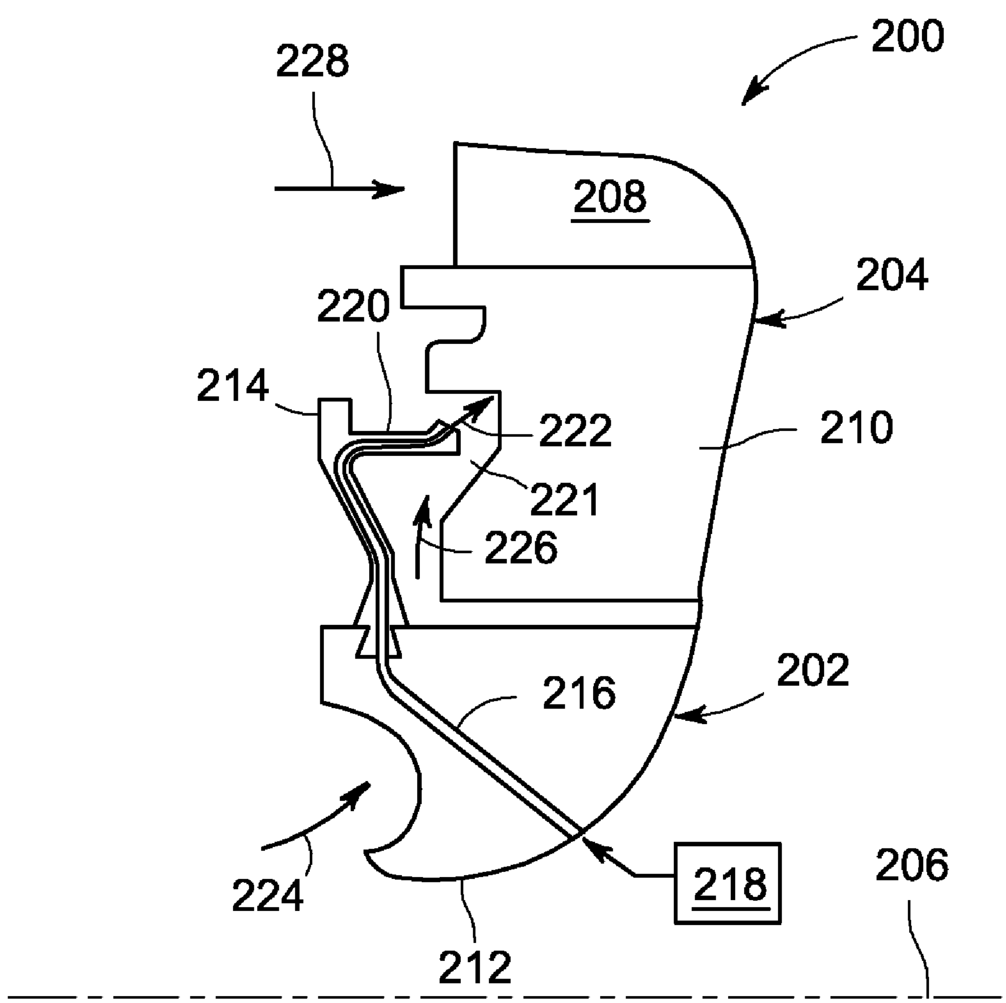
(22) Filed: **Jan. 4, 2012**

Publication Classification

(51) Int. Cl.
F01D 11/10 (2006.01)
(52) U.S. Cl.
USPC **415/170.1**

(57) ABSTRACT

According to one aspect of the invention, a turbine assembly includes a stator and a rotor adjacent to the stator. The turbine assembly also includes a passage formed in a member coupled to the rotor to form a fluid curtain between the rotor and stator, wherein the fluid curtain reduces a flow between the stator and rotor.



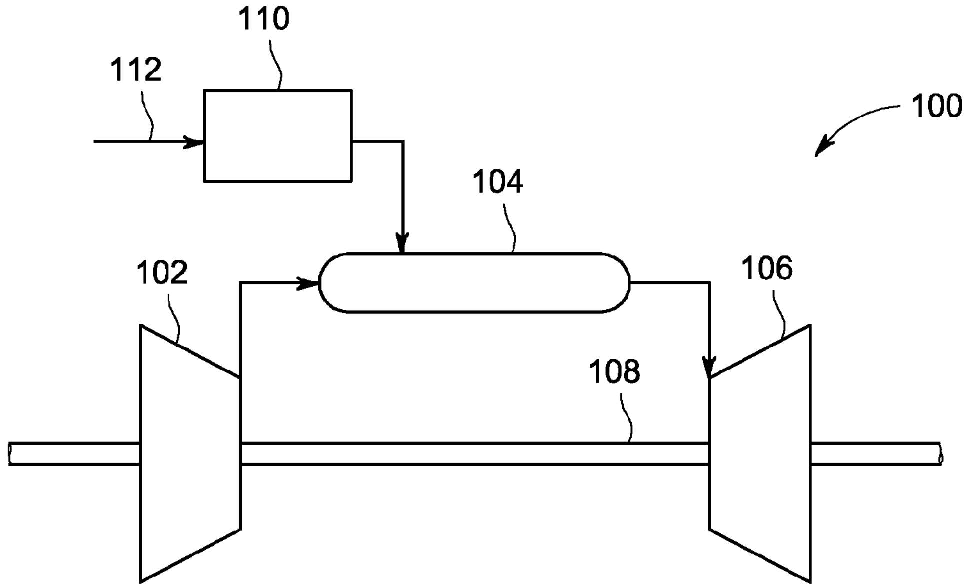

110
112
100
104
102
106
108

FIG. 1

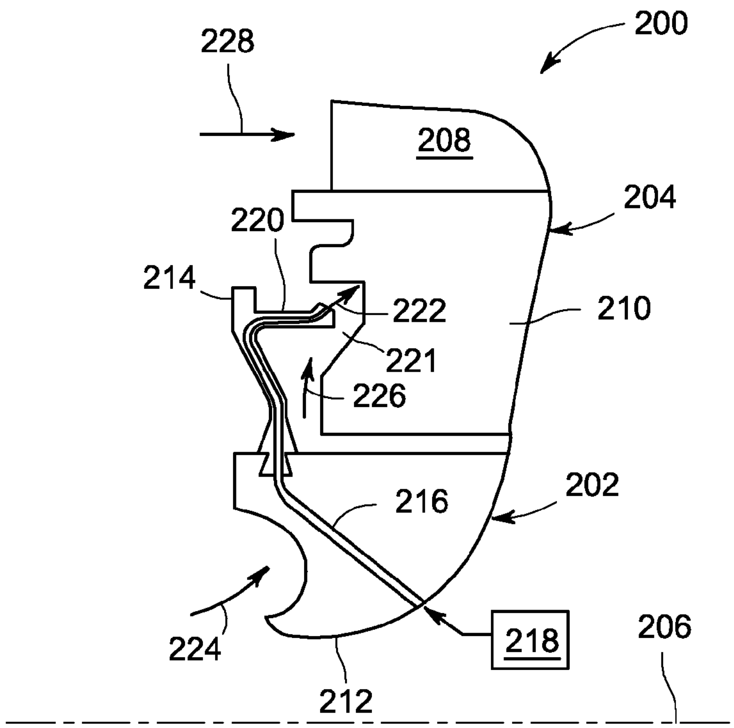

200
228
208
204
220
214
222
210
221
226
202
216
224
218
206
212

FIG. 2

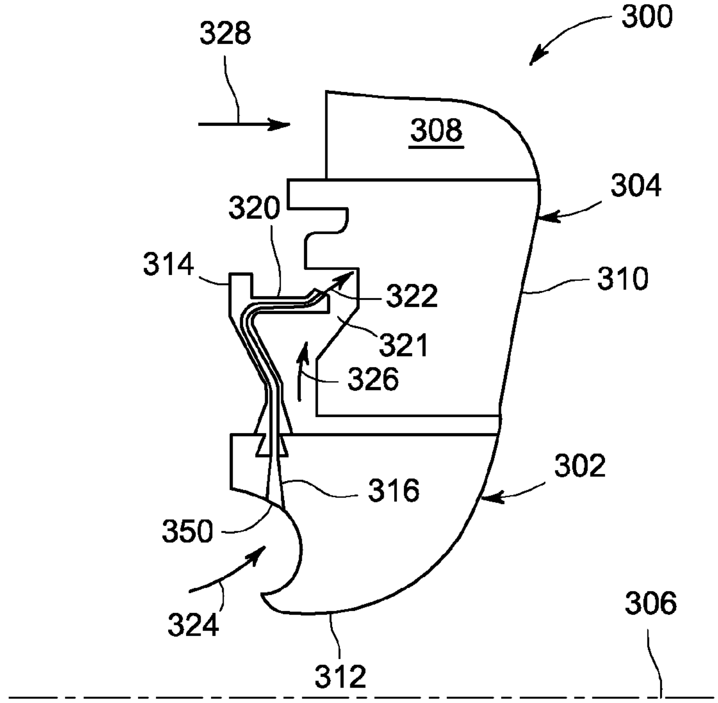

300
328
308
304
320
314
322
310
321
326
302
316
350
324
306
312

FIG. 3

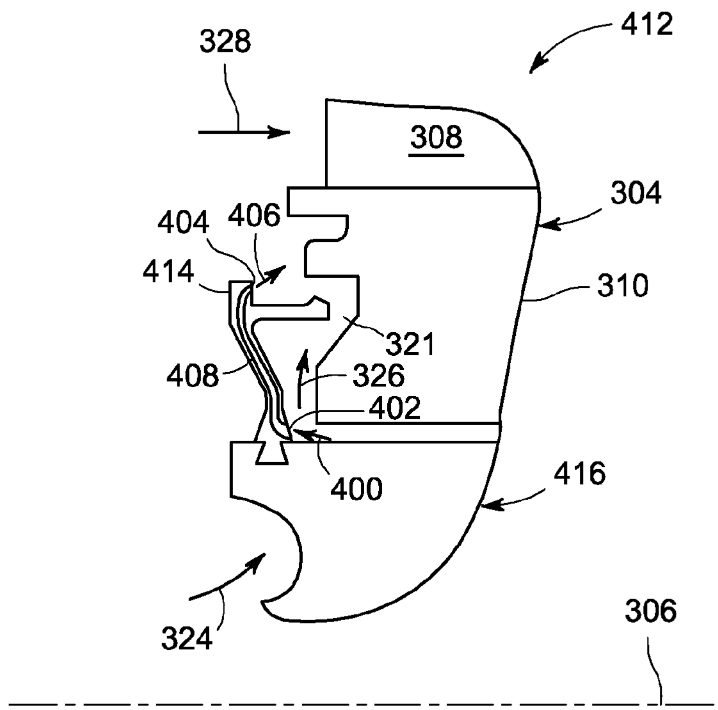

412
328
308
304
404
406
414
310
321
408
326
402
400
416
324
306

FIG. 4

TURBINE ASSEMBLY AND METHOD FOR REDUCING FLUID FLOW BETWEEN TURBINE COMPONENTS

BACKGROUND OF THE INVENTION

[0001] The subject matter disclosed herein relates to turbines. More particularly, the subject matter relates to reducing fluid flow between components of turbines.

[0002] In a gas turbine, a combustor converts chemical energy of a fuel or an air-fuel mixture into thermal energy. The thermal energy is conveyed by a fluid, often compressed air from a compressor, to a turbine where the thermal energy is converted to mechanical energy. In some turbine embodiments, leakage of fluid between components into the compressed hot air causes a reduced power output and lower efficiency for the turbine. Leaks of fluid may be caused by thermal expansion of certain components and relative movement between components during operation of the gas turbine. Accordingly, reducing fluid leaks between components can improve efficiency and performance of the turbine.

BRIEF DESCRIPTION OF THE INVENTION

[0003] According to one aspect of the invention, a turbine assembly includes a stator and a rotor adjacent to the stator. The turbine assembly also includes a passage formed in a member coupled to the rotor to form a fluid curtain between the rotor and stator, wherein the fluid curtain reduces a flow between the stator and rotor.

[0004] According to another aspect of the invention, a method for reducing fluid flow between turbine components includes flowing a hot gas across a stator and flowing the hot gas across a rotor adjacent to the stator. The method also includes flowing a cooling air flow through radially inner portions of the stator and rotor and flowing a fluid from a member on the rotor to the stator to reduce leaking of the flow of cooling air and the flow of hot gas between the stator and rotor.

[0005] These and other advantages and features will become more apparent from the following description taken in conjunction with the drawings.

BRIEF DESCRIPTION OF THE DRAWING

[0006] The subject matter, which is regarded as the invention, is particularly pointed out and distinctly claimed in the claims at the conclusion of the specification. The foregoing and other features, and advantages of the invention are apparent from the following detailed description taken in conjunction with the accompanying drawings in which:

[0007] FIG. **1** is a schematic drawing of an embodiment of a gas turbine engine, including a combustor, fuel nozzle, compressor and turbine;

[0008] FIG. **2** is a side sectional view of a portion of an exemplary turbine assembly;

[0009] FIG. **3** is a side sectional view of a portion of another exemplary turbine assembly; and

[0010] FIG. **4** is a side sectional view of a portion of yet another exemplary turbine assembly.

[0011] 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

[0012] FIG. **1** is a schematic diagram of an embodiment of a gas turbine system **100**. The system **100** includes a compressor **102**, a combustor **104**, a turbine **106**, a shaft **108** and a fuel nozzle **110**. In an embodiment, the system **100** may include a plurality of compressors **102**, combustors **104**, turbines **106**, shafts **108** and fuel nozzles **110**. The compressor **102** and turbine **106** are coupled by the shaft **108**. The shaft **108** may be a single shaft or a plurality of shaft segments coupled together to form shaft **108**.

[0013] In an aspect, the combustor **104** uses liquid and/or gas fuel, such as natural gas or a hydrogen rich synthetic gas, to run the engine. For example, fuel nozzles **110** are in fluid communication with an air supply and a fuel supply **112**. The fuel nozzles **110** create an air-fuel mixture, and discharge the air-fuel mixture into the combustor **104**, thereby causing a combustion that heats a pressurized gas. The combustor **104** directs the hot pressurized exhaust gas through a transition piece into a turbine nozzle (or "stage one nozzle") and then a turbine bucket, causing turbine **106** rotation. The rotation of turbine **106** causes the shaft **108** to rotate, thereby compressing the air as it flows into the compressor **102**. The turbine components or parts are configured to allow for thermal expansion and relative movement of the parts while hot gas flows through the turbine **106**. By reducing flow of a fluid that is cooler than the hot gas, turbine efficiency is improved. Specifically, reducing leakage of fluid into the hot gas path or compressed gas flow increases the volume of hot gas flow along the desired path, enabling more work to be extracted from the hot gas. Methods, systems and arrangements to reduce fluid leakage between turbine parts, such as stators and rotors, are discussed in detail below with reference to FIGS. **2-4**. The depicted arrangements provide a fluid curtain or seal to reduce fluid leakage into the hot gas flow, thereby increasing the work available to be extracted from the hot gas. Further, the fluid curtain is substantially lower maintenance as compared to other seals made of rubber and/or other material, which may wear out over time.

[0014] As used herein, "downstream" and "upstream" are terms that indicate a direction relative to the flow of working fluid through the turbine. As such, the term "downstream" refers to a direction that generally corresponds to the direction of the flow of working fluid, and the term "upstream" generally refers to the direction that is opposite of the direction of flow of working fluid. The term "radial" refers to movement or position perpendicular to an axis or center line. It may be useful to describe parts that are at differing radial positions with regard to an axis. In this case, if a first component resides closer to the axis than a second component, it may be stated herein that the first component is "radially inward" of the second component. If, on the other hand, the first component resides further from the axis than the second component, it may be stated herein that the first component is "radially outward" or "outboard" of the second component. The term "axial" refers to movement or position parallel to an axis. Finally, the term "circumferential" refers to movement or position around an axis. Although the following discussion primarily focuses on gas turbines, the concepts discussed are not limited to gas turbines and may apply to other rotating machinery, such as steam turbines.

[0015] Referring now to FIG. **2**, a side sectional view of a portion of an exemplary turbine assembly **200** is shown. The turbine assembly **200** includes a rotor **202** and a stator **204** disposed about an axis **206**. The stator **204** includes a base **210**

with an airfoil **208** (also referred to as a "nozzle") extending from the base **210**. The rotor **202** includes a disk **212** and a member **214** coupled to the disk **212**. The member **214** may be any suitable structure, such as a cover plate, and is configured to restrict flow of cooling fluid **224**, such as air, into a hot gas flow **228** (also referred to as "hot gas path"). The disk **212** and member **214** include a passage **216** to receive a fluid from a fluid source **218**, wherein the fluid is directed into a cavity **221** to form a fluid curtain **222**. The fluid curtain **222** (also referred to as "fluid barrier", "fluid seal" or "fluid flow") forms a restriction between the rotor **202** and stator **204** to reduce flow of the cooling fluid **224** and **226** into the hot gas flow **228**. Further, the fluid curtain **222** reduces hot gas flow **228** radially inward between the rotor **202** and stator **204**, thereby reducing thermal stress on assembly parts. In an embodiment, the fluid flows through the passage **216** through a projection **220** of the member **214**, wherein the fluid curtain **222** flows at an angle with respect to the axis **206**. The angle may be any suitable angle for forming the fluid curtain **222** and may be altered based on a variety of factors, such as fluid type, temperatures, geometry of cavity **221** and/or projection **220**. In an embodiment, the angle may range from about −45 to about 45 degrees. In another embodiment, the angle may range from about 15 to about 70 degrees. In yet another embodiment, the angle may range from about 20 to about 60 degrees. In another embodiment, the angle may range from about −15 to about 30 degrees.

[0016] The fluid curtain **222** may be formed by a fluid flow from any suitable fluid source, such as the fluid source **218** (e.g., air, water or other coolant) for temperature control of turbine components. The depicted formation of fluid curtain **222** between the rotor **202** and stator **204** provides improved performance by increasing the amount of work available to be extracted from the hot gas flow **228** while also providing a low maintenance seal or barrier that will not wear out or need replacement.

[0017] FIG. **3** is a side sectional view of a portion of an exemplary turbine assembly **300**. The turbine assembly **300** includes a rotor **302** and a stator **304** disposed about an axis **306**. The stator **304** includes a base **310** with an airfoil **308** (also referred to as a "nozzle") extending from the base **310**. The rotor **302** includes a disk **312** and a member **314** coupled to the disk **312**. The member **314** may be any suitable structure, such as a cover plate, and is configured to restrict flow of cooling fluid **324**, such as air, into a hot gas flow **328**. Further, the fluid curtain **322** reduces hot gas flow **328** radially inward between the rotor **302** and stator **304**, thereby reducing thermal stress on assembly parts. The disk **312** and member **314** include a passage **316** to receive a fluid from the passage **316**, where the passage receives the cooling fluid **324** through an inlet **350**. The fluid flows through a projection and into a cavity **321** to form a fluid curtain **322**. The fluid curtain **322** (also referred to as "fluid barrier", "fluid seal" or "fluid flow") forms a restriction between the rotor **302** and stator **304** to reduce flow of the cooling fluid **324** and **326** into the hot gas flow **328**. The cooling fluid **324** and **326** is fluid that flows through radially inner portions of the rotor **302** and stator **304** to control temperatures of the components. In one embodiment, the passage **316** is a narrowing passage to cause an increased fluid flow velocity within the passage, thereby increasing flow velocity of the fluid curtain **322**. In an embodiment, the fluid flows through the passage **316** through the projection **320** of the member **314**, wherein the fluid curtain **322** flows at an angle with respect to the axis **306**. As discussed above with reference to FIG. **2**, the angle may be any suitable angle to restrict fluid flow into the hot gas flow **328**.

[0018] FIG. **4** is a side sectional view of a portion of an exemplary turbine assembly **412** including a member **414** disposed in a rotor **416**. As depicted, the member **414** includes a passage **408** to receive a cooling fluid **400** from an inlet **402**. The passage **408** directs the cooling fluid through an outlet **404** in the member **314** to form the fluid curtain **406**. As depicted, the fluid curtain **406** forms a restrictive barrier between the rotor **416** and stator **304**, thereby reducing fluid leakage across the turbine assembly **412**. In embodiments, the turbine assembly may have one or more passage form one or more fluid curtain, such as the curtains **406** and **322**, reduce fluid flow between the rotor **416** and stator **304**.

[0019] While the invention has been described in detail in connection with only a limited number of embodiments, it should be readily understood that the invention is not limited to such disclosed embodiments. Rather, the invention can be modified to incorporate any number of variations, alterations, substitutions or equivalent arrangements not heretofore described, but which are commensurate with the spirit and scope of the invention. Additionally, while various embodiments of the invention have been described, it is to be understood that aspects of the invention may include only some of the described embodiments. Accordingly, the invention is not to be seen as limited by the foregoing description, but is only limited by the scope of the appended claims.

1. A turbine assembly comprising:

a stator,

a rotor adjacent to the stator; and

a passage formed in a member coupled to the rotor to receive a flow of fluid to form a fluid curtain between the rotor and stator, wherein the fluid curtain reduces a fluid flow between the stator and rotor.

2. The turbine assembly of claim **1**, wherein the member comprises a cover plate.

3. The turbine assembly of claim **2**, wherein the fluid curtain is directed from a projection in the cover plate.

4. The turbine assembly of claim **1**, wherein the passage is supplied the flow of fluid from a fluid source, wherein the fluid source provides fluid for controlling a temperature of portions of the turbine assembly.

5. The turbine assembly of claim **1**, wherein the passage comprises a narrowing passage to cause an increased fluid flow velocity within the passage to form the fluid curtain.

6. The turbine assembly of claim **1**, wherein the passage directs the fluid curtain at an angle with respect to a turbine axis.

7. The turbine assembly of claim **1**, wherein the reduced fluid flow comprises a reduced cooling air flow that flows through radially inner portions of the stator and rotor.

8. The turbine assembly of claim **7**, wherein the fluid curtain is formed from the cooling air flow.

9. A method for reducing fluid flow between turbine components comprising:

flowing a hot gas across a stator;

flowing the hot gas across a rotor adjacent to the stator;

flowing a cooling air flow through radially inner portions of the stator and rotor; and

flowing a fluid from a member on the rotor to the stator to reduce leaking of the flow of cooling air and the flow of hot gas between the stator and rotor.

10. The method of claim **9**, wherein flowing the fluid from the member comprises forming a fluid curtain.

11. The method of claim **10**, wherein the fluid curtain is formed from the cooling air flow.

12. The method of claim **9**, wherein flowing the fluid comprises flowing the fluid through a passage in a projection of the member.

13. The method of claim **12**, wherein the passage comprises a narrowing passage to cause increased fluid flow velocity within the passage to form a fluid curtain between the rotor and stator.

14. The method of claim **12**, wherein the passage is supplied the fluid from a fluid source, wherein the fluid source provides fluid for controlling a temperature of portions of the turbine assembly.

15. The method of claim **9**, wherein the member comprises a cover plate.

16. The method of claim **9**, wherein flowing the fluid comprises directing the flow of fluid at an angle with respect to a turbine axis.

* * * * *