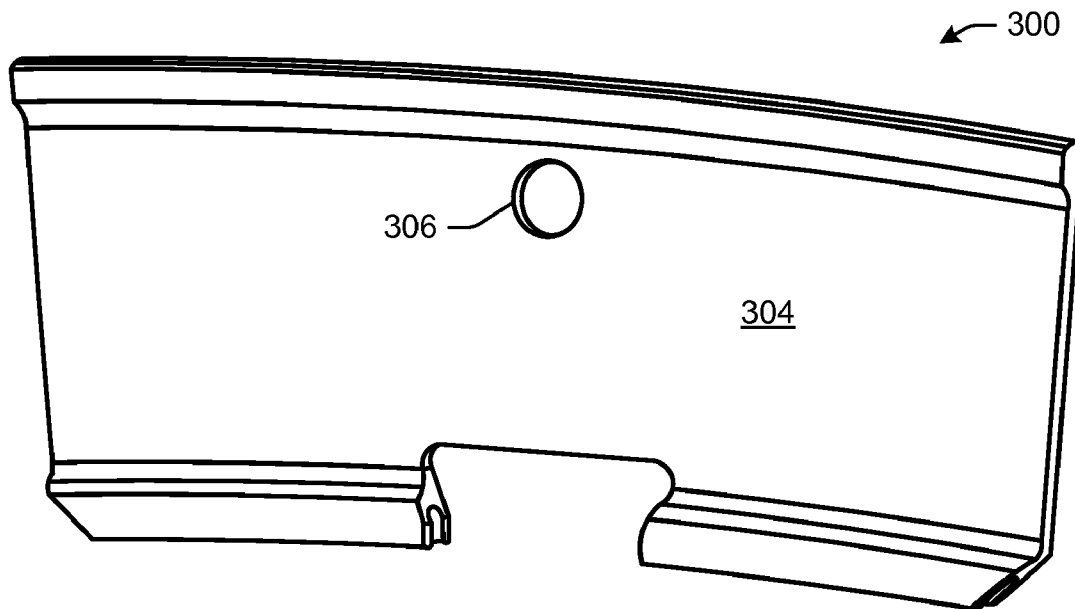




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Giametta(10) **Pub. No.: US 2014/0193272 A1**(43) **Pub. Date: Jul. 10, 2014**(54) **GAS TURBINE ENGINE COOLING SYSTEMS
AND METHODS INCORPORATING ONE OR
MORE COVER PLATE ASSEMBLIES HAVING
ONE OR MORE APERTURES THEREIN****Publication Classification**(51) **Int. Cl.**
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Schenectady, NY (US)(21) Appl. No.: **13/736,511**(22) Filed: **Jan. 8, 2013**(57) **ABSTRACT**

Turbine cooling systems and methods are disclosed herein. The turbine cooling system may include a rotor disk having a bucket attached thereto. The bucket may include a shank cavity. The turbine cooling system may also include a cover plate positioned at least partially about the rotor disk and the shank cavity. The cover plate may be configured to separate a first flow of cooling fluid from a second flow of cooling fluid. At least one aperture may be disposed in the cover plate about the shank cavity. The at least one aperture may be configured to provide the first flow of cooling fluid to the shank cavity.



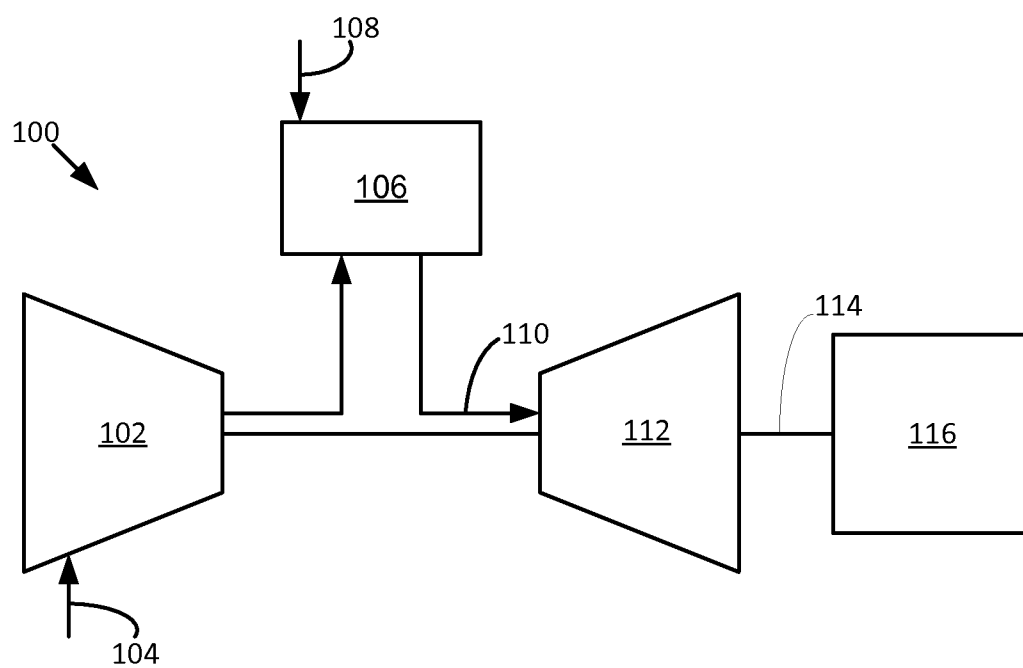


FIG. 1

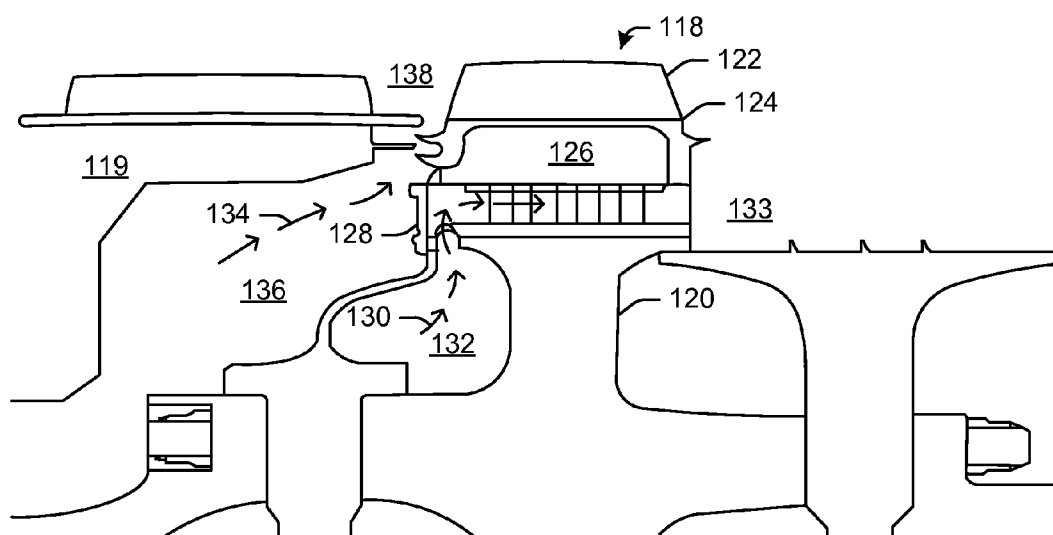


FIG. 2

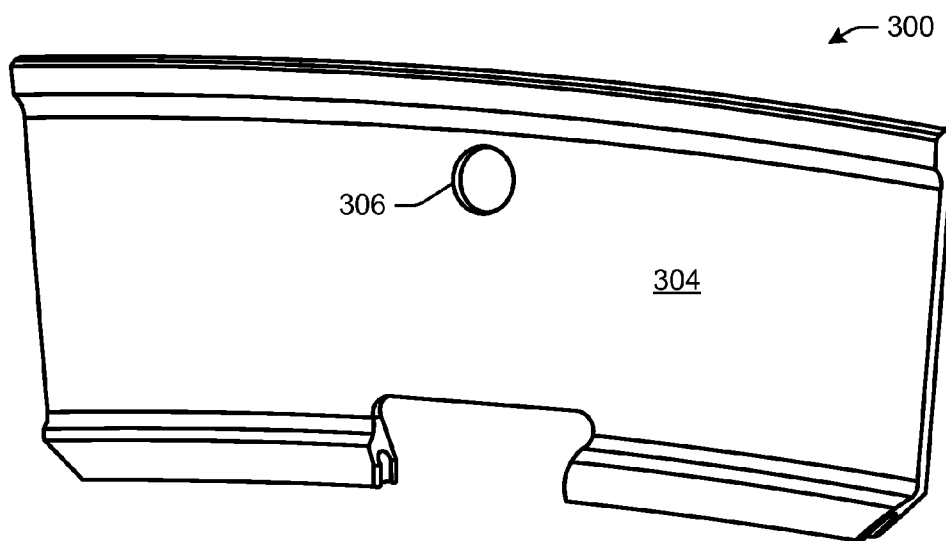


FIG. 3A

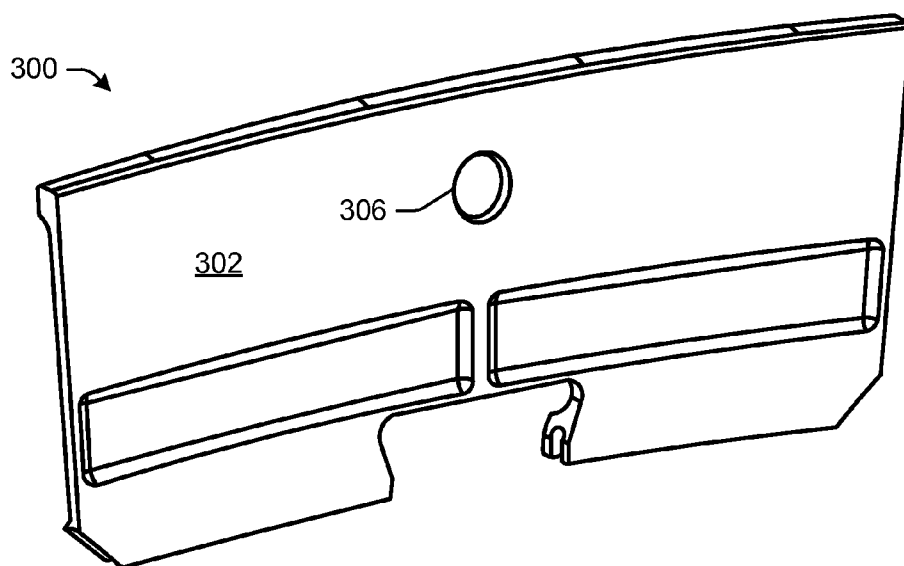


FIG. 3B

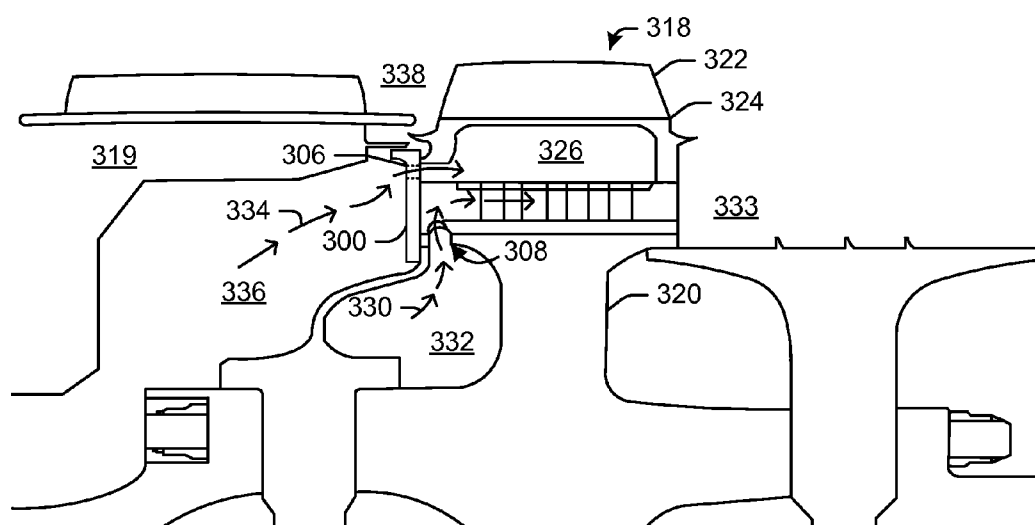


FIG. 4

GAS TURBINE ENGINE COOLING SYSTEMS AND METHODS INCORPORATING ONE OR MORE COVER PLATE ASSEMBLIES HAVING ONE OR MORE APERTURES THEREIN

FIELD OF THE DISCLOSURE

[0001] Embodiments of the disclosure relate generally to gas turbine engines and more particularly to cover plate assemblies having one or more apertures therein.

BACKGROUND OF THE DISCLOSURE

[0002] Gas turbine engines are widely utilized in fields such as power generation. A conventional gas turbine engine may include a compressor, a combustor, and a turbine. The compressor may supply compressed air to the combustor, where the compressed air may be mixed with fuel and burned to generate a working fluid. The working fluid may be supplied to the turbine, where energy may be extracted from the working fluid to produce work. The working fluid may exit the turbine via an exhaust section.

[0003] In some instances, a portion of the compressed air may be diverted from the compressor to one or more components of the gas turbine engine for cooling purposes. The diverted air may be divided into any number of cooling flows. The temperature of the cooling flows may vary depending on the location and path of the cooling flows. Accordingly, it is desirable to separate and/or combine the cooling flows depending on the material properties and functions of the various components being cooled by the cooling flows.

BRIEF DESCRIPTION OF THE DISCLOSURE

[0004] Some or all of the above needs and/or problems may be addressed by certain embodiments of the present disclosure. According to an embodiment, there is disclosed a turbine cooling system. The turbine cooling system may include a rotor disk having a bucket attached thereto. The bucket may include a shank cavity. The turbine cooling system may also include a cover plate positioned at least partially about the rotor disk and the shank cavity. The cover plate may be configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid. At least one aperture may be disposed in the cover plate about the shank cavity. The at least one aperture may be configured to provide the first flow of cooling fluid to the shank cavity.

[0005] According to another embodiment, there is disclosed a turbine cooling system. The turbine cooling system may include a cover plate configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid. At least one aperture may be disposed in the cover plate. The at least one aperture may be configured to allow the first flow of cooling fluid to at least partially pass through the cover plate.

[0006] Further, according to another embodiment, there is disclosed a system. The system may include a turbine assembly. The system may also include a cover plate associated with the turbine assembly. The cover plate may be configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid. Moreover, at least one aperture may be disposed in the cover plate. The at least one aperture may be configured to allow the first flow of cooling fluid to at least partially pass through the cover plate.

[0007] Other embodiments, aspects, and features of the disclosure will become apparent to those skilled in the art

from the following detailed description, the accompanying drawings, and the appended claims.

BRIEF DESCRIPTION OF THE DRAWINGS

[0008] Reference will now be made to the accompanying drawing, which is not necessarily drawn to scale.

[0009] FIG. 1 is a schematic view of an example gas turbine engine, according to an embodiment.

[0010] FIG. 2 is a schematic cross-sectional view of an example turbine stage with a cover plate assembly, according to an embodiment.

[0011] FIG. 3A is a schematic perspective view of an example cover plate assembly, according to an embodiment.

[0012] FIG. 3B is a schematic perspective view of an example cover plate assembly, according to an embodiment.

[0013] FIG. 4 is a schematic cross-sectional view of an example turbine stage with a cover plate assembly, according to an embodiment.

DETAILED DESCRIPTION OF THE DISCLOSURE

[0014] Illustrative embodiments will now be described more fully hereinafter with reference to the accompanying drawing, in which some, but not all embodiments are shown. The present disclosure may be embodied in many different forms and should not be construed as limited to the embodiments set forth herein. Like numbers refer to like elements throughout.

[0015] Illustrative embodiments are directed to, among other things, gas turbine engine cooling systems and methods incorporating one or more cover plate assemblies. For example, in certain embodiments, a cover plate assembly is disclosed herein that is configured to separate a first flow of cooling fluid from a second flow of cooling fluid. In some instances, the cover plate assembly may include at least one aperture. The aperture may be configured to allow the first flow of cooling fluid to at least partially pass through the cover plate assembly. For example, the cover plate assembly may be positioned at least partially about a rotor disk and a shank cavity of a turbine bucket (or blade). In this manner, the aperture may be positioned in the cover plate assembly about the shank cavity such that the aperture provides the first flow of cooling fluid to the shank cavity.

[0016] In addition, the cover plate assembly may form at least one passage to the shank cavity. The passage may be configured to provide the second flow of cooling fluid to the shank cavity. In this manner, the cover plate assembly may separate the first flow of cooling fluid from the second flow of cooling fluid, while still enabling at least a portion of the first flow of cooling fluid to enter the shank cavity, thereby cooling and/or pressurizing the shank cavity.

[0017] In some instances, the first flow of cooling fluid may be relatively warmer than the second flow of cooling fluid. In other instances, the first flow of cooling fluid may include an exterior flow of cooling air in an exterior wheel space adjacent to static hardware, and the second flow of cooling fluid may include an interior flow of cooling air in an interior wheel space adjacent to a rotor disk. That is, the first flow of cooling air in the exterior wheel space adjacent to the static hardware may be relatively warmer (e.g., have a greater temperature) than the second flow of cooling air in the interior wheel space adjacent to the rotor disk. In this manner, the first and second flows of cooling air may be individually and/or collectively

supplied to various components of the turbine assembly having different material capabilities (e.g., thermal tolerances).

[0018] In certain embodiments, the cover plate assembly may include a number of cover plate segments. For example, each of the cover plate segments may extend about one or more buckets. Moreover, the cover plate segments may be positioned adjacent to one another circumferentially about the rotor disk and the shank cavity of the turbine bucket.

[0019] Turning now to the drawings, FIG. 1 depicts an example schematic view of a gas turbine engine assembly 100 as may be used herein. The gas turbine engine assembly 100 may include a gas turbine engine having a compressor 102. The compressor 102 may compress an incoming flow of air 104. The compressor 102 may deliver the compressed flow of air 104 to a combustor 106. The combustor 106 may mix the compressed flow of air 104 with a pressurized flow of fuel 108 and ignite the mixture to create a flow of combustion gases 110. Although only a single combustor 106 is shown, the gas turbine engine may include any number of combustors 106. The flow of combustion gases 110 may be delivered to a turbine 112. The flow of combustion gases 110 may drive the turbine 112 so as to produce mechanical work. The mechanical work produced in the turbine 112 may drive the compressor 102 via a shaft 114 and an external load 116, such as an electrical generator or the like.

[0020] The gas turbine engine may use natural gas, various types of syngas, and/or other types of fuels. The gas turbine engine may be any one of a number of different gas turbine engines offered by General Electric Company of Schenectady, New York, including, but not limited to, those such as a 7 or a 9 series heavy duty gas turbine engine and the like. The gas turbine engine may have different configurations and may use other types of components. The gas turbine engine may be an aeroderivative gas turbine, an industrial gas turbine, or a reciprocating engine. Other types of gas turbine engines also may be used herein. Multiple gas turbine engines, other types of turbines, and other types of power generation equipment also may be used herein together.

[0021] In certain embodiments, as schematically depicted in FIG. 2, the turbine 112 of FIG. 1 may include one or more stages. For example, the turbine 112 may include a first stage 118. Although the first stage 118 is shown, the cover plate assembly described herein may be incorporated at any stage in the turbine 112. Each stage may include static hardware 119 and a rotor disk 120. The rotor disk 120 may be attached to the shaft 114 of FIG. 1 for rotation therewith.

[0022] A number of blades or buckets 122 may be removably attached to the rotor disk 120. For example, each bucket 122 may include a shank portion 124 that includes a dovetail that engages a corresponding dovetail groove on the rotor disk 120 to secure the bucket 122 to the rotor disk 120. The shank portion 124 may also include an internal shank cavity 126 configured to receive one or more flows of cooling air or the like. Moreover, each bucket 122 may include one or more conduits in communication the shank cavity 126 for cooling the buckets 122.

[0023] When the dovetail of the shank portion 124 is inserted into the corresponding dovetail groove on the rotor disk 120, a gap may exist at interfaces therebetween. In some instances, cooling air or wheel space purge flow may escape through these gaps. Accordingly, a cover plate assembly 128 may be positioned about the dovetail and the corresponding dovetail groove on the rotor disk 120 to block the leakage flow therethrough. For example, the cover plate assembly 128 may

create a seal that forms a passage (via one or more openings) that directs an interior flow of cooling air 130 from an interior wheel space 132 to an external wheel space 133. The interior wheel space 132 may be adjacent to the rotor disk 120. Conversely, the cover plate assembly 128 may create a seal that prevents an external flow of cooling air 134 in an external wheel space 136 from entering the external wheel space 133. The external wheel space 136 may be adjacent to the static hardware 119.

[0024] FIGS. 3A-4 schematically depict a cover plate assembly 300 according to an embodiment. In some instances, the cover plate assembly 300 may include a number of arcuate cover plate segments. For example, the cover plate segments may be positioned adjacent to one another circumferentially about one or more shank cavities 326 of the buckets 322. That is, one of the cover plate segments may extend across multiple shank cavities 326. The cover plate assembly 300 may include a first side 302 that is positioned adjacent to the shank cavity 326 of the bucket 322. For example, the first side 302 may face the shank cavity 326. Moreover, the cover plate assembly 300 may include a second side 304 that is positioned opposite the shank cavity 326. For example, the second side 304 may face the external wheel space 336.

[0025] In some instances, the cover plate assembly 300 may include at least one aperture 306 extending therethrough. The aperture 306 may be positioned on the cover plate assembly 300 so as to be in communication with the shank cavity 326 of the bucket 322. In this manner, the aperture 306 may be configured to allow at least a portion of the external flow of cooling air 334 to pass through the cover plate assembly 300 and into the shank cavity 326. For example, the cover plate assembly 300 may be positioned at least partially about the shank cavity 326 of the bucket 322, and the aperture 306 may be positioned in the cover plate assembly 300 adjacent to the shank cavity 326 such that the aperture 306 may enable at least a portion of the external flow of cooling air 334 to enter the shank cavity 326 of the bucket 322.

[0026] FIG. 4 schematically depict the cover plate assembly 300 positioned within the first stage 318 of the turbine 114 of FIG. 1 so as to separate a first flow of cooling fluid (e.g., the external flow of cooling air 334) from a second flow of cooling fluid (e.g., the interior flow of cooling air 330). Accordingly, the cover plate assembly 300 may create a seal that forms a passage 308 (via one or more openings in the cover plate assembly 300) that directs the interior flow of cooling air 330 from the interior wheel space 332 into the external wheel space 333. The interior wheel space 332 may be adjacent to the rotor disk 320. The aperture 306 enables at least a portion of the external flow of cooling air 334 to enter the shank cavity 326 of the bucket 314. The external wheel space 336 may be adjacent to the static hardware 319. In this manner, the cover plate assembly 300 may separate the external flow of cooling air 334 from the interior flow of cooling air 330, while still enabling at least a portion of the external flow of cooling air 334 to enter the shank cavity, thereby pressurizing the shank cavity.

[0027] The systems and methods described herein utilize the potential excess air in wheel space 336 to cool the bucket 322. That is, the systems and methods described use of the excess air instead of wasting it into the hot gas path 338.

[0028] Although embodiments have been described in language specific to structural features and/or methodological acts, it is to be understood that the disclosure is not necessar-

ily limited to the specific features or acts described. Rather, the specific features and acts are disclosed as illustrative forms of implementing the embodiments.

That which is claimed:

1. A turbine cooling system, comprising:
a rotor disk comprising a bucket attached thereto, wherein the bucket comprises a shank cavity;
a cover plate positioned at least partially about the rotor disk and the shank cavity, wherein the cover plate is configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid; and
at least one aperture disposed in the cover plate about the shank cavity, wherein the at least one aperture is configured to provide the first flow of cooling fluid to the shank cavity.
2. The turbine cooling system of claim 1, further comprising at least one passage formed by the cover plate, wherein the at least one passage is configured to provide the second flow of cooling fluid to an exterior wheel space.
3. The turbine cooling system of claim 2, wherein the first flow of cooling fluid is relatively warmer than the second flow of cooling fluid.
4. The turbine cooling system of claim 3, wherein the first flow of cooling fluid comprises an exterior flow of cooling air, and wherein the second flow of cooling fluid comprises an interior flow of cooling air.
5. The turbine cooling system of claim 4, wherein the first flow of cooling air pressurizes the shank cavity.
6. The turbine cooling system of claim 1, wherein the cover plate comprises a plurality of cover plate segments.
7. The turbine cooling system of claim 6, wherein each of the plurality of cover plate segments are positioned about one or more buckets.
8. The turbine cooling system of claim 6, wherein each of the plurality of cover plate segments comprise an arcuate shape.
9. A turbine cooling system, comprising:
a cover plate configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid; and
at least one aperture disposed in the cover plate, wherein the at least one aperture is configured to allow the first flow of cooling fluid to at least partially pass through the cover plate.

10. The turbine cooling system of claim 9, further comprising a bucket comprising a shank cavity, wherein the cover plate is positioned at least partially about the shank cavity.

11. The turbine cooling system of claim 10, wherein the at least one aperture is configured to provide the first flow of cooling fluid to the shank cavity.

12. The turbine cooling system of claim 10, further comprising at least one passage formed by the cover plate, wherein the at least one passage is configured to provide the second flow of cooling fluid to an exterior wheel space.

13. The turbine cooling system of claim 9, wherein the first flow of cooling fluid is relatively warmer than the second flow of cooling fluid.

14. The turbine cooling system of claim 9, wherein the first flow of cooling fluid comprises an exterior flow of cooling air in an exterior wheel space, and wherein the second flow of cooling fluid comprises an interior flow of cooling air in an interior wheel space.

15. The turbine cooling system of claim 14, wherein the first flow of cooling air pressurizes the shank cavity.

16. The turbine cooling system of claim 9, wherein the cover plate comprises a plurality of cover plate segments.

17. The turbine cooling system of claim 16, wherein the plurality of cover plate segments each extend about one or more buckets.

18. The turbine cooling system of claim 16, wherein each of the plurality of cover plate segments comprise an arcuate shape.

19. A system, comprising:

a turbine assembly;

a cover plate associated with the turbine assembly, wherein the cover plate is configured to at least partially separate a first flow of cooling fluid from a second flow of cooling fluid; and

at least one aperture disposed in the cover plate, wherein the at least one aperture is configured to allow the first flow of cooling fluid to at least partially pass through the cover plate.

20. The system of claim 19, further comprising at least one passage formed by the cover plate, wherein the at least one passage is configured to provide the second flow of cooling fluid to an exterior wheel space.

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