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(54) **PLATFORM COOLING ARRANGEMENT IN A TURBINE COMPONENT AND A METHOD OF CREATING A PLATFORM COOLING ARRANGEMENT**

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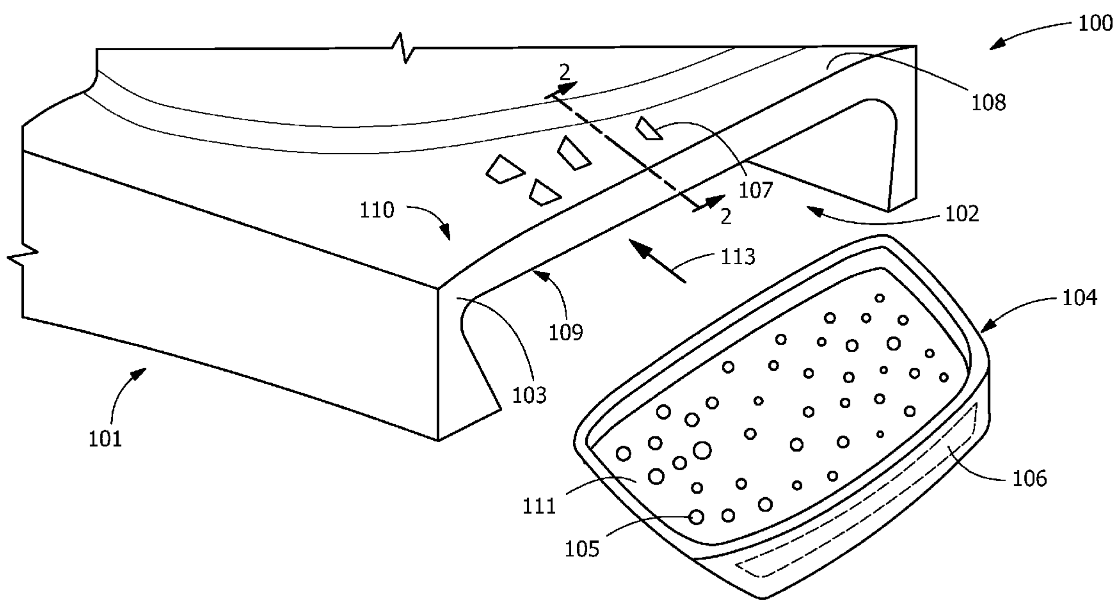
(57) **ABSTRACT**

A method of creating a cooling arrangement for a turbine component, and a cooling arrangement are provided. The turbine component includes an interior cooling passage formed therein. The method comprises a step of forming a slot through a sidewall of the turbine component. The method further comprises a step of forming an insert having one or more cooling features and a cavity. The method further comprises a step of positioning the insert within the slot. The method further comprises a step of securing the insert within the slot. The method further comprises a step of forming at least one passage in fluid communication with the internal cooling passage, the insert, and an exterior surface of the turbine component.



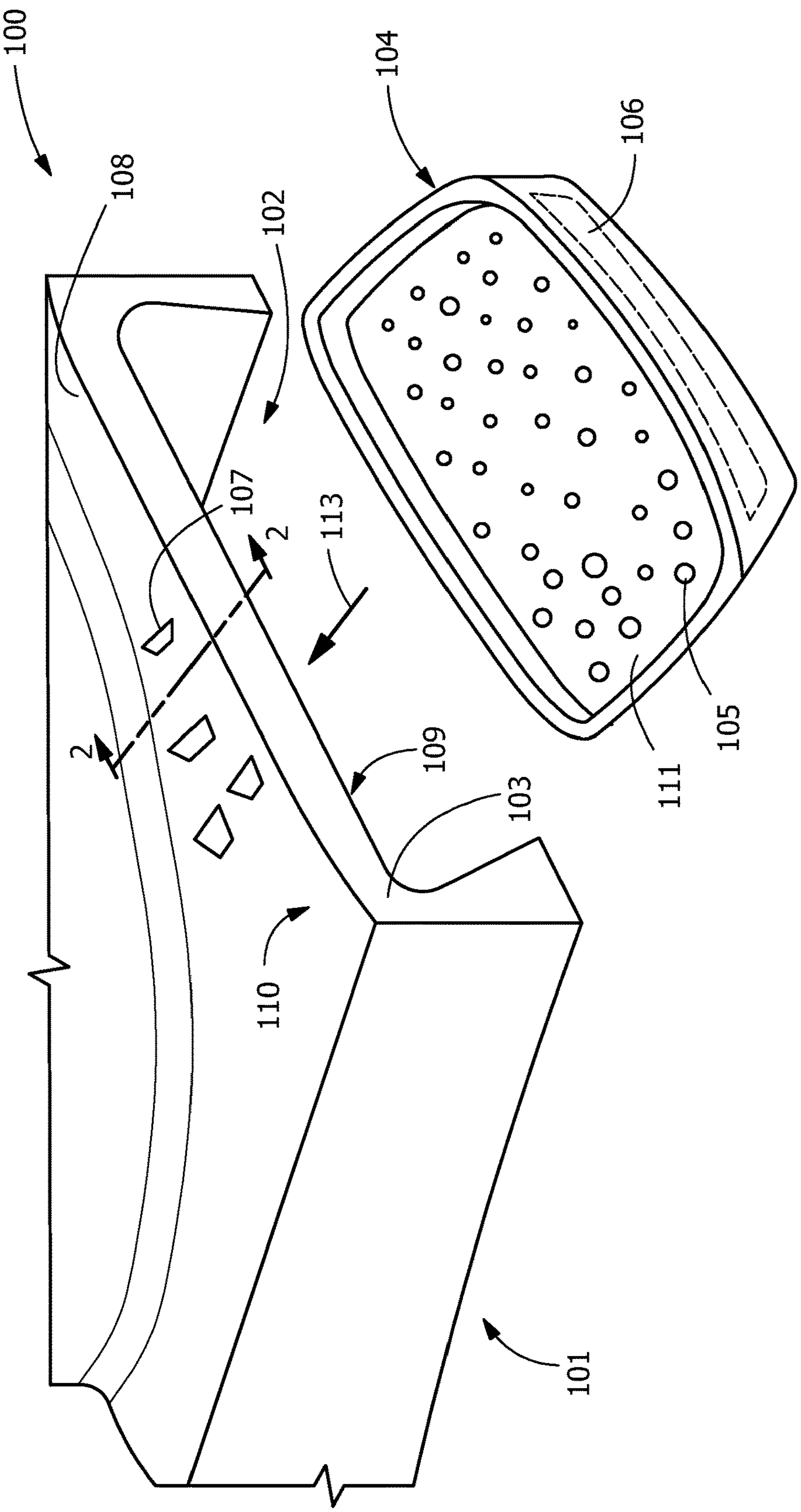


FIG. 1

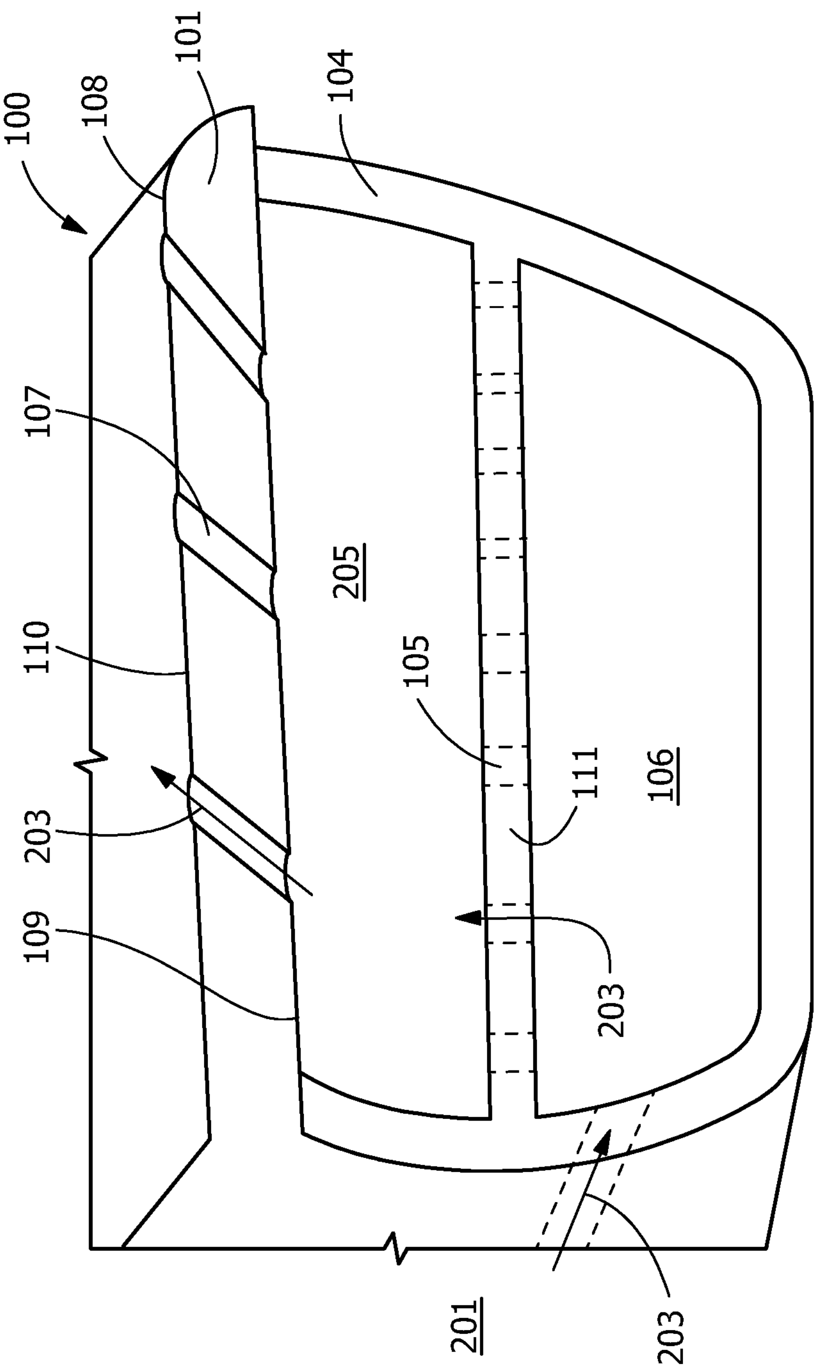


FIG. 2

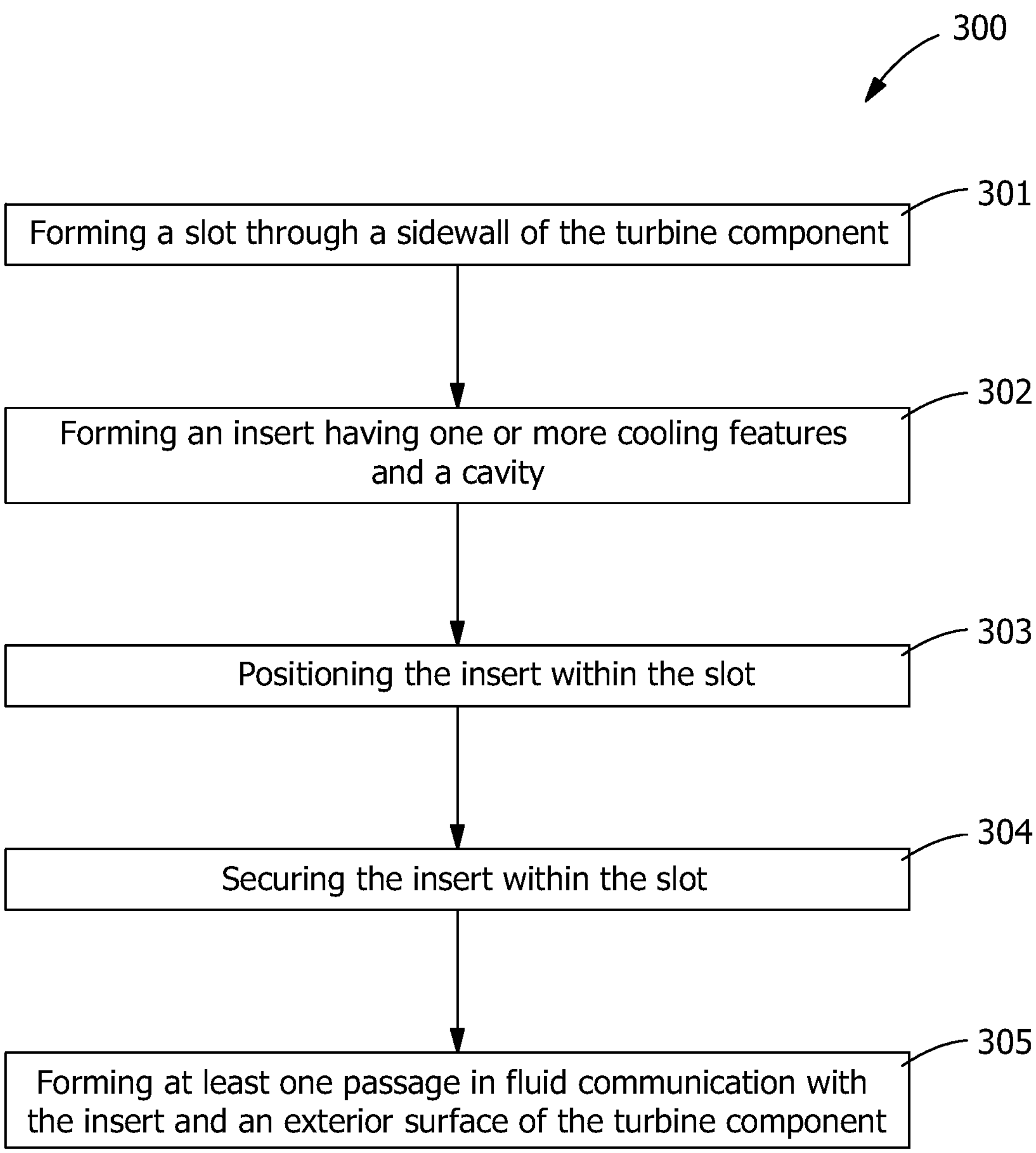

300
301
Forming a slot through a sidewall of the turbine component
302
Forming an insert having one or more cooling features and a cavity
303
Positioning the insert within the slot
304
Securing the insert within the slot
305
Forming at least one passage in fluid communication with the insert and an exterior surface of the turbine component

FIG. 3

PLATFORM COOLING ARRANGEMENT IN A TURBINE COMPONENT AND A METHOD OF CREATING A PLATFORM COOLING ARRANGEMENT

FIELD OF THE INVENTION

[0001] The present invention is generally directed to a cooling arrangement and a method of creating a cooling arrangement. More specifically, the present invention is directed to a cooling arrangement in a turbine component and a method of creating a cooling arrangement for a turbine component.

BACKGROUND OF THE INVENTION

[0002] Certain components, such as gas turbine components operate at high temperatures and under harsh conditions. Cooling passages may be formed in gas turbine components to help circulate coolant for extending the service life of these components. However, incorporating cooling passages, such as by casting, is expensive.

BRIEF DESCRIPTION OF THE INVENTION

[0003] In an exemplary embodiment, a method of creating a cooling arrangement for a turbine component having a surface is provided. The turbine component includes an interior cooling passage formed therein. The method comprises a step of forming a slot through a sidewall of the turbine component. The method further comprises a step of forming an insert having one or more cooling features, and a cavity. The method further comprises a step of positioning the insert within the slot. The method further comprises a step of securing the insert within the slot. The method further comprises a step of forming at least one passage in fluid communication with the internal cooling passage, the insert, and an exterior surface of the turbine component.

[0004] In another exemplary embodiment, a cooling arrangement in a turbine component having a surface is provided. The turbine component includes an interior cooling passage formed therein. The cooling arrangement comprises a slot formed through a sidewall of the turbine component. The cooling arrangement further comprises an insert secured within the slot. The insert has one or more cooling features, and a cavity. The cooling arrangement further comprises at least one passage in fluid communication with the internal cooling passage, the insert, and an exterior surface of the turbine component.

[0005] Other features and advantages of the present invention will be apparent from the following more detailed description of the preferred embodiment, taken in conjunction with the accompanying drawings, which illustrate, by way of example, the principles of the invention.

BRIEF DESCRIPTION OF THE DRAWINGS

[0006] FIG. **1** illustrates a perspective view of a turbine component and an insert in disassembled state according to an exemplary embodiment of the present disclosure.

[0007] FIG. **2** illustrates a partial sectional view of taken **2-2** of FIG. **1** in assembled state according to an exemplary embodiment of the present disclosure.

[0008] FIG. **3** illustrates a method according to an exemplary embodiment of the present disclosure.

[0009] Wherever possible, the same reference numbers will be used throughout the drawings to represent the same parts.

DETAILED DESCRIPTION OF THE INVENTION

[0010] The detailed description set forth below in connection with the appended drawings where like numerals reference like elements is intended as a description of various embodiments of the disclosed subject matter and is not intended to represent the only embodiments. Each embodiment described in this disclosure is provided merely as an example or illustration and should not be construed as preferred or advantageous over other embodiments. The illustrative examples provided herein are not intended to be exhaustive or to limit the claimed subject matter to the precise forms disclosed.

[0011] Provided are exemplary methods and platform cooling arrangements. Embodiments of the present disclosure, in comparison to methods and platform cooling arrangements not utilizing one or more features disclosed herein, enable lower cost, increased heat transfer coefficients, higher engine performance and less cooling flow by allowing more complicated interior geometries.

[0012] All numbers expressing quantities of ingredients and/or reaction conditions are to be understood as being modified in all instances by the term "about", unless otherwise indicated.

[0013] All percentages and ratios are calculated by weight unless otherwise indicated. All percentages are calculated based on the total weight of a composition unless otherwise indicated. All component or composition levels are in reference to the active level of that component or composition, and are exclusive of impurities, for example, residual solvents or by-products, which may be present in commercially available sources.

[0014] The articles "a" and "an," as used herein, mean one or more when applied to any feature in embodiments of the present invention described in the specification and claims. The use of "a" and "an" does not limit the meaning to a single feature unless such a limit is specifically stated. The article "the" preceding singular or plural nouns or noun phrases denotes a particular specified feature or particular specified features and may have a singular or plural connotation depending upon the context in which it is used. The adjective "any" means one, some, or all indiscriminately of whatever quantity.

[0015] The term "at least one," as used herein, means one or more and thus includes individual components as well as mixtures/combinations.

[0016] The term "comprising" (and its grammatical variations), as used herein, is used in the inclusive sense of "having" or "including" and not in the exclusive sense of "consisting only of"

[0017] With reference to FIG. **1**, a cooling arrangement **100** in a turbine component **101** having a surface in dissembled state is provided. Turbine component **101** includes an interior cooling passage (not shown) formed therein. Turbine component **101** further includes a hot side **110** and a cold side **109**. Cooling arrangement **100** comprises a slot **102** formed through a sidewall **103** of turbine component **101**. Cooling arrangement **100** further comprises a recessed insert **104** secured within slot **102**. Insert **104** includes one or more cooling features **105** on an impingement surface

111, and a cavity **106** (pre-impingement). The cooling arrangement **100** further comprises at least one passage **107** in fluid communication with the internal cooling passage (not shown), insert **104**, and an exterior surface **108** of turbine component **101**. Recessed insert **104** is capable of sliding into slot **102** of turbine component **101** in a direction **113**.

[0018] With reference to FIG. **2**, a partial sectional view of taken **2-2** of FIG. **1** in assembled state is provided. Insert **104** is secured to slot **102** of turbine **101**. The outer contour of insert **104** is continuously and smoothly jointed to sidewall **103** of turbine component **101** so that an aerodynamic profile is maintained. Coolant gas path **203** flows from an internal cooling passage **201** through a high-pressure connector **202** into cavity **106** (pre-impingement). Coolant gas path **203** then impinges through one or more cooling features **105** of impingement surface **111** into another cavity **205** (post-impingement) formed between impingement surface **111** and cold side **109** comprising an inner surface **112** when assembled as shown. When disassembled, cavity **205** may not exist. In one embodiment, cooling features **105** may include, but not be limited to, one or more impingement hole. In one embodiment, cooling features **105** are distributed uniformly on impingement surface **111**. In another embodiment, cooling features **105** are distributed not uniformly on impingement surface **111**. Coolant gas path **203** then flows outside cavity **205** through at least one passage **107**. In one embodiment, passage **107** is aligned to induce maximized cooling effects. In one embodiment, coolant gas path **203** forms a cooling stream and/or film on the surface of turbine component **101**, thereby protecting turbine component **101** from high temperature environments.

[0019] In one embodiment, sidewall **103** is a sidewall other than a slashface. In another embodiment, sidewall **103** is a slashface. In another embodiment, sidewall **103** is both a sidewall and a slashface.

[0020] In one embodiment, turbine component **101** includes more than one slot **102** to which more than one insert **104** is inserted or secured.

[0021] In one embodiment, pressure connector **202** is also directly connected to cavity **205** when assembled. In another embodiment, pressure connector **202** is connected to either cavity **205** or cavity **206** when assembled.

[0022] In one embodiment, insert **104** comprises a material including, but not limited to, a nickel based superalloy, a cobalt based superalloy, a titanium based super alloy, and combinations thereof. A person skilled in the art will appreciate other materials for insert **104**.

[0023] In one embodiment, insert **104** is the same material as turbine component **101**. In another embodiment, insert **104** is not the same material as turbine component **101**.

[0024] In one embodiment, insert **104** is arranged and disposed to provide impingement cooling on inner surface **112** of slot **102**.

[0025] In one embodiment, turbine component **101** includes, but not limited to, nozzle, blade, shroud, combustor liner, and combinations thereof. A person skilled in the art will appreciate other turbine components.

[0026] With reference to FIG. **3**, a method **300** of creating a cooling arrangement **100** for a turbine component **101** having a surface is provided. Turbine component **101** includes an interior cooling passage **201** formed therein. Method **300** comprises a step of forming a slot **102** through a sidewall **103** of turbine component **101** (step **301**). Method **300** further comprises a step of forming an insert **104** having one or more cooling features **105** and a cavity **106** (step **302**). Method **300** further comprises a step of positioning insert **104** within slot **102** (step **303**). Method **300** further comprises a step of securing insert **104** within slot **102** (step **304**). Method **300** further comprises a step of forming at least one passage **107** in fluid communication with internal cooling passage **201**, insert **104**, and an exterior surface of turbine component **101**(step **305**).

[0027] In one embodiment, insert **104** is formed via an additive manufacturing process including direct metal laser melting (DMLM), direct metal laser sintering (DMLS), casting, 3D printing, fabrication, and combinations thereof. A person skilled in the art will appreciate other additive manufacturing process.

[0028] In one embodiment, insert **104** is secured to sidewall **103** via a process selected from the group consisting of mechanical joining, welding, and combinations thereof

[0029] While the invention has been described with reference to a preferred embodiment, 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 the particular embodiment disclosed as the best mode contemplated for carrying out this invention, but that the invention will include all embodiments falling within the scope of the appended claims.

What is claimed is:

1. A method of creating a cooling arrangement for a turbine component having a surface, wherein the turbine component includes an interior cooling passage formed therein, the method comprising steps of:

forming a slot through a sidewall of the turbine component;

forming an insert having one or more cooling features and a cavity;

positioning the insert within the slot;

securing the insert within the slot; and

forming at least one passage in fluid communication with the internal cooling passage, the insert, and an exterior surface of the turbine component.

2. The method of claim **1**, wherein the sidewall is a sidewall other than a slashface.

3. The method of claim **1**, wherein the step of forming the insert comprises an additive manufacturing process selected from the group consisting of direct metal laser melting, direct metal laser sintering, casting, 3D printing, fabrication, and combinations thereof.

4. The method of claim **1**, wherein the step of securing the insert within the slot comprises a process selected from the group consisting of mechanical joining, brazing, welding, and combinations thereof.

5. The method of claim **1**, wherein the insert comprises a metal selected from a nickel based superalloy, a cobalt based superalloy, a titanium based super alloy, and combinations thereof.

6. The method of claim **1**, wherein the insert is the same material as the turbine component.

7. The method of claim **1**, wherein the insert is arranged and disposed to provide impingement cooling on an inner surface of the slot.

8. The method of claim **1**, wherein the insert comprises an impingement surface, the impingement surface comprising the one or more cooling features.

9. The method of claim **8**, wherein the insert is in fluid communication with an exterior surface of the turbine component through at least one passage.

10. The method of claim **1**, wherein the turbine component is selected from the group consisting of nozzle, blade, shroud, combustor liner, and combinations thereof.

11. A cooling arrangement in a turbine component having a surface, wherein the turbine component includes an interior cooling passage formed therein, the cooling arrangement comprising:

a slot formed through a sidewall of the turbine component;

an insert secured within the slot, the insert having one or more cooling features and a cavity; and

at least one passage in fluid communication with the internal cooling passage, the insert, and an exterior surface of the turbine component.

12. The cooling arrangement of claim **11**, wherein the sidewall is a sidewall other than a slashface.

13. The cooling arrangement of claim **11**, wherein the insert is formed via an additive manufacturing process selected from the group consisting of direct metal laser melting, direct metal laser sintering, casting, 3D printing, fabrication, and combinations thereof.

14. The cooling arrangement of claim **11**, wherein the insert is secured to the sidewall via a process selected from the group consisting of mechanical joining, welding, and combinations thereof.

15. The cooling arrangement of claim **11**, wherein the insert comprises a metal selected from a nickel based superalloy, a cobalt based superalloy, a titanium based super alloy, and combinations thereof.

16. The cooling arrangement of claim **11**, wherein the insert is the same material as the turbine component.

17. The cooling arrangement of claim **11**, wherein the insert is arranged and disposed to provide impingement cooling on an inner surface of the slot.

18. The cooling arrangement of claim **11**, wherein the insert comprises an impingement surface, the impingement surface comprising the one or more cooling features.

19. The cooling arrangement of claim **18**, wherein insert is in fluid communication with an exterior surface of the turbine component through at least one passage.

20. The cooling arrangement of claim **11**, wherein the turbine component is selected from the group consisting of nozzle, blade, shroud, combustor liner, and combinations thereof.

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