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COOLING NOZZLE VANES OF A TURBINE ENGINE

Abstract

An assembly for a turbine engine includes a nozzle structure, a septum and a plurality of cooling vanes. The nozzle structure includes a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis. The septum axially and circumferentially overlaps the first platform with a cooling cavity formed by and radially between the septum and the first platform. The septum includes a plurality of cooling apertures aligned with the nozzle vanes. Each of the cooling apertures extends radially through the septum to the cooling cavity. The cooling cavity includes a cavity outlet fluidly coupled to a flowpath. The cooling vanes are arranged circumferentially about the axis and project from the first platform into the cooling cavity. The cooling vanes are located between the cooling apertures and the cavity outlet along the cooling cavity.

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Background/Summary

BACKGROUND OF THE DISCLOSURE

1. Technical Field

[0001] This disclosure relates generally to a turbine engine and, more particularly, to a stationary structure for the turbine engine.

2. Background Information

[0002] A gas turbine engine includes a stationary engine structure for housing and/or supporting internal rotating components of the gas turbine engine. Various stationary engine structures are known in the art. While these known stationary engine structures have various benefits, there is still room in the art for improvement.

SUMMARY OF THE DISCLOSURE

[0003] According to an aspect of the present disclosure, an assembly is provided for a turbine engine. This assembly includes a nozzle structure, a septum and a plurality of cooling vanes. The nozzle structure includes a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis. The first platform forms a first boundary of a flowpath through the nozzle structure. The second platform forms a second boundary of the flowpath. The nozzle vanes extend radially across the flowpath from the first platform to the second platform. The septum axially and circumferentially overlaps the first platform with a cooling cavity formed by and radially between the septum and the first platform. The septum includes a plurality of cooling apertures aligned with the nozzle vanes. Each of the cooling apertures extends radially through the septum to the cooling cavity. The cooling cavity includes a cavity outlet fluidly coupled to the flowpath. The cooling vanes are arranged circumferentially about the axis and project from the first platform into the cooling cavity. The cooling vanes are located between the cooling apertures and the cavity outlet along the cooling cavity.

[0004] According to another aspect of the present disclosure, another assembly is provided for a turbine engine. This assembly includes a combustor, a nozzle structure, a septum and a baffle. The combustor is arranged in a plenum and includes a combustion chamber. The nozzle structure is arranged at an outlet from the combustion chamber. The nozzle structure includes a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis. The nozzle vanes extend radially across a flowpath from the first platform to the second platform. The septum extends axially and circumferentially along the first platform with a cooling cavity formed by and radially between the septum and the first platform. The septum includes a plurality of cooling apertures aligned with the nozzle vanes. Each of the cooling apertures extends radially through the septum from a feed cavity to the cooling cavity. The baffle extends axially and circumferentially along the septum with the feed cavity formed by and radially between the baffle and the septum. The baffle includes a plurality of ports extending radially through the baffle from the plenum to the feed cavity.

[0005] According to still another aspect of the present disclosure, another assembly is provided for a turbine engine. This assembly includes a combustor, a nozzle structure and a septum. The combustor is arranged in a plenum and includes a combustion chamber. The nozzle structure is arranged at an outlet from the combustion chamber. The nozzle structure includes a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis. The nozzle vanes extend radially across a flowpath from the first platform to the second platform. The nozzle vanes include a first nozzle vane. The first nozzle vane extends longitudinally between a leading edge and a trailing edge. The septum extends axially and circumferentially along the first platform with a cooling cavity formed by and radially between the septum and the first platform. The septum includes a plurality of cooling apertures extending radially through the septum from a

feed cavity to the cooling cavity. A first set of the cooling apertures are axially and circumferentially aligned with the first nozzle vane. A density of cooling apertures in the first set of the cooling apertures is greater in an area aligned with the trailing edge than in an area aligned with the leading edge.
[0006] The assembly may also include a plurality of cooling elements connected to the first platform and projecting partially into the cooling cavity.
[0007] The assembly may also include a turbine wall and an intermediate structure. The
[0008] The turbine wall may axially and circumferentially overlap the combustor. The intermediate structure may extend between a downstream end of the first platform and an upstream end of the turbine wall. The septum and the baffle may each extend axially to the intermediate structure.
[0009] The cavity outlet may be located upstream of the first platform along the flowpath.
[0010] Each of the cooling apertures may be configured to direct a stream of air across the cooling cavity against the first platform.
[0011] The cooling apertures may be axially aligned along the axis and arranged circumferentially about the axis in an annular array.
[0012] The cooling apertures may be equispaced circumferentially about the axis in the annular array.
[0013] The nozzle vanes may include a first nozzle vane. The cooling apertures may include a first cooling aperture. The first cooling aperture may be axially and circumferentially aligned with the first nozzle vane.
[0014] The nozzle vanes may include a first nozzle vane and a second nozzle vane that circumferentially neighbors the first nozzle vane with a channel formed by and extending circumferentially between the first nozzle vane and the second nozzle vane. A first set of the cooling apertures may be axially and circumferentially aligned with the first nozzle vane. A second set of the cooling apertures may be axially and circumferentially aligned with the second nozzle vane. A section of the septum may be non-perforated. The section of the septum may extend circumferentially between the first set of the cooling apertures and the second set of the cooling apertures. The section of septum may axially overlap at least a major portion of the channel.
[0015] The nozzle vanes may include a first nozzle vane. The first nozzle vane may extend longitudinally between a leading edge and a trailing edge. A first set of the cooling apertures may be axially and circumferentially aligned with the first nozzle vane. A density of cooling apertures in the first set of the cooling apertures may be greater in an area aligned with the trailing edge than in an area aligned with the leading edge.
[0016] The cooling vanes may include a first cooling vane. The first cooling vane may project radially and/or axially from the first platform to an unsupported distal end of the first cooling vane.
[0017] The cooling vanes may be axially offset from the nozzle vanes.
[0018] The cooling vanes may include a first cooling vane. The first cooling vane may be configured as or otherwise include a cambered cooling vane.
[0019] The nozzle vanes may be configured to swirl combustion products in a circumferential direction about the axis. The cooling vanes may be configured to swirl air in the circumferential direction about the axis.
[0020] The assembly may also include a baffle axially and circumferentially overlapping the septum with a feed cavity formed by and radially between the baffle and the septum. The septum may be radially between the baffle and the first platform with the cooling apertures fluidly coupling the feed cavity to the cooling cavity.
[0021] The assembly may also include a turbine wall and an intermediate structure. The intermediate structure may extend between a downstream end of the first platform and an upstream end of the turbine wall. The septum may extend axially to the intermediate structure. The baffle may extend axially to the intermediate structure with one or more ports formed through the baffle adjacent the intermediate structure.

[0022] The assembly may also include a combustor wall radially between and bordering a plenum and a combustion chamber. A downstream end of the combustor wall may be axially spaced from an upstream end of the first platform to form the cavity outlet.
[0023] The assembly may also include a combustor disposed in a plenum and including a combustion chamber. The nozzle structure may be arranged at an outlet from the combustion chamber. The cooling aperture may be configured to receive air from the plenum to direct across the cooling cavity onto the first platform.
[0024] The assembly may also include a monolithic body that includes the nozzle structure, the septum and the cooling vanes.
[0025] The first platform may be an inner platform which circumscribes the septum and the cooling vanes. The second platform may be an outer platform which circumscribes the inner platform.
[0026] The present disclosure may include any one or more of the individual features disclosed above and/or below alone or in any combination thereof.
[0027] The foregoing features and the operation of the invention will become more apparent in light of the following description and the accompanying drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS
[0028] FIG. **1** is a schematic side sectional illustration of a turbine engine.
[0029] FIG. **2** is a schematic side sectional illustration of a portion of the turbine engine at a combustor.
[0030] FIG. **3** is a perspective cutaway illustration of a portion of the turbine engine at a turbine nozzle and a cooling structure.
[0031] FIG. **4** is a sectional plan view illustration of the turbine engine at a cooling structure baffle.
[0032] FIG. **5** is a sectional plan view illustration of the turbine engine at a cooling structure septum.
[0033] FIGS. **6** and **7** are plan view illustrations of various cooling vane arrangements.
[0034] FIG. **8** is a perspective cutaway illustration of a portion of the turbine engine with another cooling structure.
DETAILED DESCRIPTION
[0035] FIG. **1** is a side sectional illustration of a turbine engine **20**. The turbine engine **20** of FIG. **1** is configured as a single spool, radial-flow turbojet gas turbine engine. This turbine engine **20** is configured for propelling an aircraft such as, but not limited to, an airplane, a drone (e.g., an unmanned aerial vehicle (UAV)), a spacecraft or any other manned or unmanned aerial vehicle or system. The present disclosure, however, is not limited to such an exemplary turbojet turbine engine configuration nor to an aircraft propulsion system application. For example, the turbine engine **20** may alternatively be configured as an auxiliary power unit (APU) for the aircraft, or an industrial gas turbine engine.
[0036] The turbine engine **20** of FIG. **1** extends axially along an axis **22** from a forward, upstream airflow inlet **24** into the turbine engine **20** to an aft, downstream combustion products exhaust **26** from the turbine engine **20**. The axis **22** may be a centerline axis of the turbine engine **20** and/or a centerline axis of various components within the turbine engine **20**. The axis **22** may also or alternatively be a rotational axis for various components within the turbine engine **20**; e.g., an engine rotating assembly **27**.
[0037] The turbine engine **20** includes a core flowpath **28**, an inlet section **30**, a compressor section **31**, a (e.g., reverse flow) combustor section **32**, a turbine section **33** and an exhaust section **34**. At least (or only) the compressor section **31**, the combustor section **32** and the turbine section **33** may form a core **36** of the turbine engine **20**. The turbine engine **20** also includes a stationary structure

38. Briefly, this stationary structure **38** may house and/or form the engine sections **31-33**. The stationary structure **38** may also form the engine sections **30** and **34**.
[0038] The core flowpath **28** extends within the turbine engine **20** and its engine core **36** from an airflow inlet **40** into the core flowpath **28** to a combustion products exhaust **42** from the core flowpath **28**. More particularly, the core flowpath **28** of FIG. **1** extends sequentially through the inlet section **30**, the compressor section **31**, the combustor section **32**, the turbine section **33** and the exhaust section **34** between the core inlet **40** and the core exhaust **42**. The core inlet **40** of FIG. **1** forms the engine inlet **24** into the turbine engine **20**. The core exhaust **42** of FIG. **1** forms the engine exhaust **26** from the turbine engine **20**. However, the core inlet **40** may alternatively be discrete and downstream from the engine inlet **24** and/or the core exhaust **42** may alternatively be discrete and upstream from the engine exhaust **26**.
[0039] The compressor section **31** includes a bladed compressor rotor **44**. The turbine section **33** includes a bladed turbine rotor **46**. Each of these engine rotors **44**, **46** includes a rotor base (e.g., a hub or a disk) and a plurality of rotor blades (e.g., vanes or airfoils) arranged circumferentially around and connected to the rotor base. The rotor blades, for example, may be formed integral with or mechanically fastened, welded, brazed and/or otherwise attached to the respective rotor base.
[0040] The compressor rotor **44** may be configured as a radial flow compressor rotor (e.g., an axial inflow-radial outflow compressor rotor), and the compressor section **31** may be configured as a radial flow compressor section. The turbine rotor **46** may be configured as a radial flow turbine rotor (e.g., a radial inflow-axial outflow turbine rotor), and the turbine section **33** may be configured as a radial flow turbine section. The compressor rotor **44** is connected to the turbine rotor **46** through an engine shaft **48**. At least (or only) the compressor rotor **44**, the turbine rotor **46** and the engine shaft **48** collectively form the engine rotating assembly **27**. This engine rotating assembly **27** and its engine shaft **48** are rotatably supported by the stationary structure **38** through a plurality of bearings **50**; e.g., rolling element bearings, journal bearings, etc.
[0041] The combustor section **32** includes an annular combustor **52** with an annular combustion chamber **54**. The combustor **52** of FIG. **1** is configured as a reverse flow combustor. Inlet ports **56** and/or flow tubes into the combustion chamber **54**, for example, may be arranged at (e.g., on, adjacent or proximate) and/or towards an aft bulkhead wall **58** of the combustor **52**. An outlet from the combustor **52** may be arranged axially aft of an inlet to the turbine section **33**. The combustor **52** may also be arranged radially outboard of and/or axially overlap at least a (e.g., aft) portion of the turbine section **33**. With this arrangement, the core flowpath **28** of FIG. **1** reverses direction (e.g., from a forward-to-aft direction to an aft-to-forward direction) a first time as the core flowpath **28** extends from an annular diffuser plenum **60** surrounding the combustor **52** into the combustion chamber **54**. The core flowpath **28** of FIG. **1** then reverses direction (e.g., from the aft-to-forward direction to the forward-to-aft direction) a second time as the core flowpath **28** extends from the combustion chamber **54** into the turbine section **33**.
[0042] During turbine engine operation, air enters the turbine engine **20** through the inlet section **30** and its core inlet **40**. The inlet section **30** directs the air from the core inlet **40** into the core flowpath **28** and the compressor section **31**. The air entering the core flowpath **28** may be referred to as “core air”. This core air is compressed by the compressor rotor **44**. The compressed core air is directed through a diffuser and its diffuser plenum **60** into the combustion chamber **54**. Fuel is injected and mixed with the compressed core air to provide a fuel-air mixture. This fuel-air mixture is ignited within the combustion chamber **54**, and combustion products thereof flow through the turbine section **33** and drive rotation of the turbine rotor **46** about the axis **22**. The rotation of the turbine rotor **46** drives rotation of the compressor rotor **44** about the axis **22** and, thus, compression of the air received from the core inlet **40**. The exhaust section **34** directs the combustion products out of the turbine engine **20** into an environment external to the aircraft to provide forward engine thrust.
[0043] Referring to FIG. **2**, the stationary structure **38** includes the combustor **52** and one or more

engine walls **62** and **64** (e.g., cases) forming the diffuser plenum **60** along the combustor **52**. The stationary structure **38** of FIG. **2** also includes a diffuser nozzle **66**, a turbine nozzle **68** and a cooling structure **70**. Referring to FIG. **3**, the cooling structure **70** includes an endwall **72**, a baffle **74**, a septum **76** and one or more cooling vanes **78** (or other cooling elements).

[0044] The combustor **52** of FIG. **2** includes a radial outer combustor wall **80**, a radial inner combustor wall **82** and the bulkhead wall **58**. The combustor **52** and each of its combustor walls **58**, **80** and **82** extends circumferentially about (e.g., completely around) the axis **22**. The combustor **52** and each of its combustor walls **80** and **82** may thereby have a full-hoop (e.g., tubular) geometry, and the bulkhead wall **58** may have a full-hoop (e.g., annular, frustoconical, etc.) geometry.

[0045] The outer combustor wall **80** is arranged axially between the bulkhead wall **58** and the turbine nozzle **68**. The outer combustor wall **80** of FIG. **2**, for example, projects axially along the axis **22** (e.g., in the forward direction) out from the bulkhead wall **58** to a radial outer platform **84** of the turbine nozzle **68**. The outer combustor wall **80** of FIG. **2** is connected to (e.g., formed integral with) the bulkhead wall **58** at a radial outer end of the bulkhead wall **58**. The outer combustor wall **80** of FIG. **2** is also connected to (e.g., formed integral with) the turbine nozzle outer platform **84** at an upstream, aft end of the turbine nozzle outer platform **84**.

[0046] The inner combustor wall **82** is arranged axially between the bulkhead wall **58** and the turbine nozzle **68**. The inner combustor wall **82** of FIG. **2**, for example, projects axially along the axis **22** (e.g., in the forward direction) out from the bulkhead wall **58** towards a radial inner platform **86** of the turbine nozzle **68**. More particularly, referring to FIG. **3**, the inner combustor wall **82** extends axially along the axis **22** to a forward, downstream end **88** of the inner combustor wall **82**, where the inner combustor wall downstream end **88** is axially next to and (e.g., slightly) spaced from an aft, upstream end **90** of the turbine nozzle inner platform **86**. The inner combustor wall **82** of FIG. **2** is connected to (e.g., formed integral with) the bulkhead wall **58** at a radial inner end of the bulkhead wall **58**.

[0047] The bulkhead wall **58** is arranged radially between the outer combustor wall **80** and the inner combustor wall **82**. The bulkhead wall **58** of FIG. **2**, for example, projects radially (e.g., outward away from the axis **22**) out from the inner combustor wall **82** to the outer combustor wall **80**. The bulkhead wall **58** of FIG. **2** is connected to the outer combustor wall **80** at an aft end of the outer combustor wall **80**. The bulkhead wall **58** of FIG. **2** is connected to the inner combustor wall **82** at an aft, upstream end of the inner combustor wall **82**.

[0048] The combustor walls **58**, **80** and **82** collectively form the combustion chamber **54** of FIG. **2** within the combustor **52**. An interior surface **92** (e.g., a tubular radial inner surface) of the outer combustor wall **80** borders (e.g., lines) the combustion chamber **54** and, more particularly, forms a radial outer peripheral boundary of the combustion chamber **54**. An interior surface **94** (e.g., a tubular radial outer surface) of the inner combustor wall **82** borders the combustion chamber **54** and, more particularly, forms a radial inner peripheral boundary of the combustion chamber **54**. An interior surface **96** (e.g., an annular forward surface) of the bulkhead wall **58** borders the combustion chamber **54** and, more particularly, forms a side peripheral boundary of the combustion chamber **54**. The combustion chamber **54** thereby extends radially within the combustor **52** between the inner combustor wall **82** and its interior surface **94** and the outer combustor wall **80** and its interior surface **92**. The combustion chamber **54** projects axially into the combustor **52** from the outlet of the combustion chamber **54** (e.g., at the turbine nozzle **68**) to the bulkhead wall **58** and its interior surface **96**.

[0049] The diffuser wall **62** is spaced radially outboard from the combustor **52** and the turbine nozzle **68**. The diffuser wall **62** extends axially along the axis **22**, and axially overlaps the combustor **52** and its outer combustor wall **80**. The diffuser wall **62** may also axially overlap the turbine nozzle **68** and its turbine nozzle outer platform **84**. The diffuser wall **62** of FIG. **2**, for example, includes a diffuser sidewall **98** and a diffuser endwall **100**. The diffuser sidewall **98** projects axially (e.g., in the forward direction) out from the diffuser endwall **100**, axially along the outer combustor wall **80** and the turbine nozzle outer platform **84**, to the diffuser nozzle **66**. This diffuser sidewall **98** of FIG. **2** is connected to (e.g., formed integral with) the diffuser endwall **100** at a radial outer end of the diffuser endwall **100**. The diffuser sidewall **98** of FIG. **2** is also connected to (e.g., formed integral with) a radial outer platform **102** of the diffuser nozzle **66** at a downstream, aft end of the turbine nozzle outer platform **84**. The diffuser endwall **100** projects radially (e.g., outward away from the axis **22**) out from the turbine wall **64**, along the bulkhead wall **58**, to the diffuser sidewall **98**. This diffuser endwall **100** of FIG. **2** is connected to (e.g., formed integral with) the diffuser sidewall **98** at a downstream, aft end of the diffuser sidewall **98**, and to the turbine wall **64**. The diffuser wall **62** and its members **98** and **100** extend circumferentially about (e.g., completely around) the axis **22**. The diffuser wall **62** and its members **98** and **100** may thereby circumscribe the combustor **52** and/or the turbine wall **64**.

[0050] The diffuser nozzle **66** is a vane array structure. This diffuser nozzle **66** is configured to condition the core air leaving the compressor section **31** (see FIG. **1**) and entering the diffuser plenum **60**. The diffuser nozzle **66** of FIG. **2**, for example, includes one or more diffuser vanes **104** (e.g., guide vanes) configured to impart swirl to the core air. These diffuser vanes **104** are arranged (e.g., equispaced) circumferentially about the axis **22** in an annular diffuser vane array. Each of the diffuser vanes **104** extends radially across the core flowpath **28**. Each of the diffuser vanes **104** of FIG. **2**, for example, extends radially between and is connected to (e.g., formed integral with) the diffuser nozzle outer platform **102** and a radial inner platform **106** of the diffuser nozzle **66**. Here, the diffuser nozzle inner platform **106** may be partially (or completely) formed by the turbine nozzle **68** and its turbine nozzle outer platform **84**. However, in other embodiments, the diffuser nozzle inner platform **106** and the turbine nozzle outer platform **84** may be discrete from one another; e.g., axially offset from one another.

[0051] The turbine wall **64** is spaced radially outboard of the turbine rotor **46**. The turbine wall **64** extends axially along the axis **22**, and axially overlaps at least a downstream, aft portion of the turbine rotor **46**. The turbine wall **64** extends circumferentially about (e.g., completely around) the axis **22**, and circumscribes at least the aft portion of the turbine rotor **46**. The turbine wall **64** thereby houses at least the aft portion of the turbine rotor **46**. The turbine wall **64** also forms a radial outer peripheral boundary of the core flowpath **28** across at least the aft portion of the turbine rotor **46**.

[0052] The turbine wall **64** of FIG. **2** is spaced radially inboard from the combustor **52** and the turbine nozzle **68**. The turbine wall **64** may be connected to the turbine nozzle inner platform **86** by an (e.g., annular) intermediate structure **108**. This intermediate structure **108** may have a curved and/or folded-over geometry (e.g., a substantially U-shaped geometry, a semi-circular geometry, etc.) which extends from a forward, upstream end of the turbine wall **64** to a forward, downstream end of the turbine nozzle inner platform **86**. With this arrangement, at least (or only) the turbine wall **64**, the turbine nozzle inner platform **86** and the intermediate structure **108** may collectively form a flowpath wall structure **110** that forms a peripheral boundary of the core flowpath **28** in the turbine section **33**. This flowpath wall structure **110** of FIG. **2** wraps around one or more members of the cooling structure **70**; e.g., the structure baffle **74** and the structure septum **76**.

[0053] The engine walls **58**, **62**, **64**, **80** and **82** collectively form the diffuser plenum **60** of FIG. **2** around the combustor **52**. A (e.g., tubular) radial inner surface **112** of the diffuser sidewall **98** forms a radial outer peripheral boundary of the diffuser plenum **60** radially outboard of the combustor **52** and its outer combustor wall **80**. A (e.g., tubular) radial outer surface **114** of the turbine wall **64** forms a radial inner peripheral boundary of the diffuser plenum **60** radially inboard of the combustor **52** and its inner combustor wall **82**. An (e.g., annular) axial side surface **116** of the diffuser endwall **100** forms a side peripheral boundary of the diffuser plenum **60** axially to a side of the combustor **52** and its bulkhead wall **58**. With this arrangement, a radial outer portion of the diffuser plenum **60** extends radially between, is formed by and thereby is bordered by the diffuser wall **62** and the outer combustor wall **80**. A radial inner portion of the diffuser plenum **60** extends radially between, is formed by and thereby is bordered by (a) the turbine wall **64** and (b) the inner combustor wall **82**, the structure endwall **72** and the structure baffle **74**. An axial end portion of the diffuser plenum **60** extends axially between, is formed by and thereby is bordered by the diffuser endwall **100** and the bulkhead wall **58**. The diffuser plenum **60** may thereby extend axially along each combustor wall **80**, **82** and radially along the bulkhead wall **58**. With this arrangement, the diffuser plenum **60** may wrap around the combustor **52** from or about the diffuser nozzle **66** to the intermediate structure **108**.

[0054] The turbine nozzle **68** is a vane array structure. This turbine nozzle **68** is configured to condition the combustion products exiting the combustor **52** and its combustion chamber **54**. The turbine nozzle **68** of FIG. **2**, for example, includes one or more turbine vanes **118** (e.g., guide vanes) configured to impart swirl to the combustion products. These turbine vanes **118** are arranged (e.g., and equispaced) circumferentially about the axis **22** in a turbine vane array. Each of the turbine vanes **118** extends radially across the core flowpath **28**. Each of the turbine vanes **118** of FIG. **2**, for example, extends radially between and is connected to (e.g., formed integral with) the turbine nozzle outer platform **84** and the turbine nozzle inner platform **86**. Here, a radial outer surface **120** of the turbine nozzle inner platform **86** forms a radial inner peripheral boundary of the core flowpath **28** (e.g., axially) through the turbine nozzle **68**. A radial inner surface **122** of the turbine nozzle outer platform **84** forms a radial outer peripheral boundary of the core flowpath **28** through the turbine nozzle **68** which is radially opposite the inner peripheral boundary formed by the turbine nozzle inner platform **86**.

[0055] Referring to FIG. **3**, the structure endwall **72** is connected to (e.g., formed integral with) the inner combustor wall **82** at the inner combustor wall downstream end **88**. The structure endwall **72** of FIG. **3** projects radially inward from and may project axially forward from the inner combustor wall **82** to an aft end of the structure baffle **74**. The structure endwall **72** extends circumferentially about (e.g., completely around) the axis **22** providing the structure endwall **72** with, for example, a full-hoop (e.g., annular) geometry.

[0056] The structure baffle **74** is located radially between and is radially spaced from the turbine wall **64** and the structure septum **76**. The structure baffle **74** is connected to (e.g., formed integral with) and axially between the structure endwall **72** and the intermediate structure **108**. The structure baffle **74** of FIG. **3**, for example, extends axially forward from and may extend radially outward from a radial inner end of the structure endwall **72** to the intermediate structure **108**. The structure baffle **74** extends circumferentially about (e.g., completely around) the axis **22** providing the structure baffle **74** with, for example, a full-hoop (e.g., tubular) geometry. With this configuration, the structure baffle **74** may axially and circumferentially overlap the turbine nozzle inner platform **86** and an upstream portion of the turbine wall **64**. A (e.g., tubular) radial inner surface **124** of the structure baffle **74** borders the diffuser plenum **60**. More particularly, the baffle inner surface **124** forms a radial outer peripheral boundary of the inner portion of the diffuser plenum **60** axially next to the intermediate structure **108**. A (e.g., tubular) radial outer surface **126** of the structure baffle **74** borders a (e.g., annular) feed cavity **128** in the cooling structure **70**. More particularly, the baffle outer surface **126** forms a radial inner peripheral boundary of the feed cavity **128**. The structure baffle **74** is thereby radially between and substantially separates the diffuser plenum **60** from the feed cavity **128**.

[0057] The structure baffle **74** is configured with one or more ports **130**. Referring to FIG. **4**, the baffle ports **130** are arranged (e.g., and equispaced) circumferentially about the axis **22** in an array; e.g., a circular array. Referring to FIG. **3**, the baffle ports **130** may be formed between the intermediate structure **108** and the structure baffle **74**. Each baffle port **130** of FIG. **3**, for example, projects axially into the structure baffle **74** from an intersection between the structure baffle **74** and the intermediate structure **108**. Of course, it is contemplated one or more of the baffle ports **130** may alternatively be axially spaced from the intermediate structure **108** and fully formed in the structure baffle **74**. Referring again to FIG. **3**, each baffle port **130** extends radially though the structure baffle **74** from the diffuser plenum **60** and its inner portion to the feed cavity **128**. The baffle ports **130** thereby fluidly couple the diffuser plenum **60** and its inner portion to the feed cavity **128**.

[0058] The structure septum **76** is located radially between and is radially spaced from the turbine nozzle inner platform **86** and the structure baffle **74**. The structure septum **76** is connected to (e.g., formed integral with) and axially between the structure endwall **72** and the intermediate structure **108**. The structure septum **76** of FIG. **3**, for example, extends axially forward from and may extend radially outward from the structure endwall **72** to the intermediate structure **108**. The structure septum **76** extends circumferentially about (e.g., completely around) the axis **22** providing the structure septum **76** with, for example, a full-hoop (e.g., tubular) geometry. With this configuration, the structure septum **76** may axially and circumferentially overlap the turbine nozzle inner platform **86** and an upstream portion of the turbine wall **64** as well as the structure baffle **74**. A (e.g., tubular) radial inner surface **132** of the structure septum **76** borders the feed cavity **128**. More particularly, the septum inner surface **132** forms a radial outer peripheral boundary of the feed cavity **128**. A (e.g., tubular) radial outer surface **134** of the structure septum **76** borders a (e.g., annular) cooling cavity **136** in the cooling structure **70**. More particularly, the septum outer surface **134** forms a radial inner peripheral boundary of the cooling cavity **136**. The structure septum **76** is thereby radially between and substantially separates the feed cavity **128** and the cooling cavity **136**.

[0059] The structure septum **76** is configured with one or more cooling apertures **138**A and **138**B (generally referred to as "**138**"); e.g., impingement apertures. Each of these cooling apertures **138** extends radially through the structure septum **76** from the feed cavity **128** to the cooling cavity **136**. The cooling apertures **138** thereby fluidly couple the feed cavity **128** to the cooling cavity **136**.

[0060] Referring to FIG. **5**, the platform cooling apertures **138**A may be arranged axially forward of the vane cooling apertures **138**B along the cooling cavity **136**. The platform cooling apertures **138**A are arranged (e.g., and equispaced) circumferentially about the axis **22** in an array; e.g., a circular array. These platform cooling apertures **138**A may be axially aligned with one another along the axis **22**. The platform cooling aperture array and its platform cooling apertures **138**A may be axially aligned with (or otherwise axially proximate to) trailing edges **140** of the turbine vanes **118**. Briefly, each turbine vane **118** extends longitudinally along a mean line (e.g., a camber line) of the respective turbine vane **118** from a leading edge **142** of the respective turbine vane **118** to the trailing edge **140** of the respective turbine vane **118**; see also FIG. **3**.

[0061] The vane cooling apertures **138**B are arranged into one or more sets **144**. Each vane cooling aperture set **144** is associated with a respective one of the turbine vanes **118**. The vane cooling apertures **138**B in each set **144** of FIG. **5**, for example, are axially and circumferentially aligned with a respective one of the turbine vanes **118**. Here, the vane cooling apertures **138**B in each set **144** are within and/or otherwise (e.g., partially or completely) overlap a footprint of the respective turbine vane **118**. A density of the vane cooling apertures **138**B in each set **144** may change as the respective turbine vane **118** extends longitudinally between its leading edge **142** and its trailing edge **140**. For example, the density of the vane cooling apertures **138**B in an area aligned with the respective turbine vane trailing edge **140** may be greater than the density of the vane cooling apertures **138**B in an area aligned with the respective turbine vane leading edge **142**. However, it is contemplated the density of the vane cooling apertures **138**B may alternatively remain uniform (e.g., constant) as the respective turbine vane **118** extends longitudinally between its leading edge **142** and its trailing edge **140**.

[0062] A section **146** of the structure septum **76** between each circumferentially neighboring pair of the vane cooling aperture sets **144** may be non-perforated; e.g., configured without any apertures extending therethrough. Each septum section **146** extends circumferentially between and to the respective circumferentially neighboring pair of the vane cooling aperture sets **144**. Each septum section **146** axially overlaps at least a major portion (e.g., more than 50%, 70% or 90%) of an inter-vane channel **148**. Each septum section **146** of FIG. **5**, for example, extends axially along its neighboring vane cooling aperture sets **144** to the array of platform cooling apertures **138**A. Briefly, each inter-vane channel **148** is formed by and extends radially between a respective circumferentially neighboring pair of the turbine vanes **118**. Referring to FIG. **3**, these inter-vane channels **148** may collectively form the core flowpath **28** in the turbine nozzle **68**, at least longitudinally along the turbine vanes **118**.

[0063] The feed cavity **128** may be collectively formed by the structure baffle **74**, the structure septum **76**, the intermediate structure **108** and the structure endwall **72**. The feed cavity **128** of FIG. **3**, for example, extends radially from the structure baffle **74** and its baffle outer surface **126** to the structure septum **76** and its septum inner surface **132**. The feed cavity **128** extends axially from the intermediate structure **108** to the structure endwall **72**. The feed cavity **128** extends circumferentially about (e.g., completely around) the axis **22**. Here, the only inlet into the feed cavity **128** may be through the baffle ports **130** and/or the only outlet from the feed cavity **128** may be through the cooling apertures **138**.

[0064] The cooling cavity **136** may be collectively formed by the structure septum **76**, the turbine nozzle inner platform **86**, the intermediate structure **108** and the structure endwall **72**. The cooling cavity **136** of FIG. **3**, for example, extends radially from the structure septum **76** and its septum outer surface **134** to the turbine nozzle inner platform **86**. The cooling cavity **136** extends axially from the intermediate structure **108** to the structure endwall **72**. The cooling cavity **136** extends circumferentially about (e.g., completely around) the axis **22**. At the structure endwall **72**, an annular outlet **150** from the cooling cavity **136** may project radially outwards to the combustion chamber **54** and, more generally, the core flowpath **28**. This cooling cavity outlet **150** may be formed by and extends axially between the inner combustor wall **82** at its downstream end **88** and the turbine nozzle inner platform **86** at its upstream end **90**. The cooling cavity outlet **150** fluidly couples the cooling cavity **136** to the combustion chamber **54** and, more generally, the core flowpath **28**; e.g., upstream of the turbine nozzle **68** and its turbine nozzle inner platform **86** along the core flowpath **28**. Here, the only inlet into the cooling cavity **136** may be through the cooling apertures **138**A and **138**B and/or the only outlet from the cooling cavity **136** may be through the cooling cavity outlet **150**.

[0065] The cooling vanes **78** are arranged (e.g., and equispaced) circumferentially about the axis **22** in an array; e.g., a circular array. Each of these cooling vanes **78** is connected to (e.g., formed integral with) the turbine nozzle **68** and its turbine nozzle inner platform **86**. Each of the cooling vanes **78** projects radially out from the turbine nozzle inner platform **86** (in a radial inward direction towards the axis **22**) into the cooling cavity **136** to a radial inner distal end **152** of the respective cooling vane **78**. More particularly, each cooling vane **78** projects out from the turbine nozzle inner platform **86** along a span line of the respective cooling vane **78** to its distal vane end **152**. This distal vane end **152** of FIG. **3** is (e.g., completely) radially spaced from the structure septum **76** by a gap; e.g., an air gap, an open volume, etc. Each cooling vane **78** may thereby be cantilevered from the turbine nozzle inner platform **86**, where the distal vane end **152** of each cooling vane **78** may be structurally unsupported. With this arrangement, each cooling vane **78** may extend substantially radially across the cooling cavity **136** towards the structure septum **76** and its outer surface **134**.

[0066] The cooling vanes **78** are located between some or all of the cooling apertures **138** and the cooling cavity outlet **150**. The cooling vanes **78** may also or alternatively be axially offset from the turbine vanes **118**; e.g., the cooling vane array may not axially overlap the turbine vane array. The cooling vanes **78** of FIG. **3**, for example, are disposed approximately at or near the cooling cavity outlet **150**. More particularly, the cooling vanes **78** of FIG. **3** are disposed at (or may be slightly spaced forward from) the inner platform upstream end **90**. With this arrangement, the cooling vanes **78** may be configured to condition (e.g., impart swirl to) cooling air directed out of the cooling cavity **136** into the core flowpath **28** and its combustion chamber **54**.

[0067] During turbine engine operation, some of the compressed core air (e.g., cooling air) is directed from the diffuser plenum **60** through the ports **130** into the feed cavity **128**. The cooling apertures **138** direct the cooling air from the feed cavity **128** into the cooling cavity **136**. Each cooling aperture **138**, for example, directs a stream (e.g., a jet) of the cooling air received from the feed cavity **128** across the cooling cavity **136** to impinge against the turbine nozzle inner platform **86**. The stream of cooling air may also or alternatively coalesce with other streams of the cooling air to form a blanket of cooling air. This blanket of cooling air may flow along/wash over the inner surface of the turbine nozzle inner platform **86** to film cool the turbine nozzle inner platform **86**. Such impingement cooling and/or film cooling of the turbine nozzle inner platform **86** may facilitate cooling of the turbine vanes **118** by drawing heat energy out of the turbine vanes **118** into the turbine nozzle inner platform **86** for convection into the cooling air. Additional heat energy may also be drawn out of the turbine vanes **118** through the turbine nozzle inner platform **86** and into the cooling vanes **78** for additional convection into the cooling air. The cooling structure **70** is thereby operable to cool the turbine nozzle **68** and its turbine vanes **118** during turbine engine operation. Cooling the turbine nozzle **68** and its turbine vanes **118** reduces an operating temperature of the turbine vanes **118**, which may reduce thermal erosion and/or degradation of the turbine vanes **118**.

[0068] In some embodiments, referring to FIG. **6**, each cooling vane **78** may be configured as a cambered cooling vane. Each cooling vane **78**, for example, may extend longitudinally along a curved mean line—a camber line **154**—of the respective cooling vane **78** between a leading edge **156** of the respective cooling vane **78** and a trailing edge **158** of the respective cooling vane **78**. In other embodiments, referring to FIG. **7**, one, some or all of the cooling vanes **78** may alternatively extend longitudinally along a straight mean line—a chord line **160**—of the respective cooling vane **78** between its leading edge **156** and its trailing edge **158**.

[0069] In some embodiments, referring to FIG. **5**, the turbine nozzle **68** and its turbine vanes **118** may be configured to swirl the combustion products in a first circumferential direction about the axis **22**. The cooling structure **70** and its cooling vane **78** may also be configured to swirl the cooling air in the first circumferential direction about the axis **22**.

[0070] In some embodiments, referring to FIG. **3**, one, some or all of the cooling vanes **78** may each project radially into the cooling cavity **136**. In other embodiments, referring to FIG. **8**, one, some or all of the cooling vanes **78** may alternatively (or also) project axially into the cooling cavity **136** and/or its cooling cavity outlet **150**.

[0071] Referring to FIG. **2**, at least a portion (or an entirety) of the stationary structure **38** may be formed as a monolithic body **162**; see also FIG. **1**. At least the stationary structure members **52**, **62**, **64**, **66**, **68** and **70** of FIG. **2**, for example, are included in the monolithic body **162**. Herein, the term “monolithic” may describe an apparatus which is formed as a single, unitary body. The stationary structure members **52**, **62**, **64**, **66**, **68** and **70**, for example, may be additively manufactured, cast, machined and/or otherwise formed together as an integral, unitary body. By contrast, a non-monolithic body may include multiple parts which are discretely formed from one another, where those parts are subsequently mechanically fastened and/or otherwise attached to one another.

[0072] The turbine engine **20** is described above as a single spool, radial-flow turbojet gas turbine engine for ease of description. The present disclosure, however, is not limited to such an exemplary turbine engine. The turbine engine **20**, for example, may alternatively be configured as an axial flow gas turbine engine. The turbine engine **20** may be configured as a direct drive gas turbine engine. The turbine engine **20** may alternatively include a geartrain that connects one or more rotors together such that the rotors rotate at different speeds. The turbine engine **20** may be configured with a single spool (e.g., see FIG. **1**), two spools, or with more than two spools. The turbine engine **20** may be configured as a turbofan engine, a turbojet engine, a propfan engine, a pusher fan engine or any other type of turbine engine. In addition, while the turbine engine **20** is described above with an exemplary reverse flow annular combustor, the turbine engine **20** may also or alternatively include any other type/configuration of annular, tubular (e.g., CAN), axial flow

and/or reverse flow combustor. The present disclosure therefore is not limited to any particular types or configurations of turbine engines.
[0073] While various embodiments of the present disclosure have been described, it will be apparent to those of ordinary skill in the art that many more embodiments and implementations are possible within the scope of the disclosure. For example, the present disclosure as described herein includes several aspects and embodiments that include particular features. Although these features may be described individually, it is within the scope of the present disclosure that some or all of these features may be combined with any one of the aspects and remain within the scope of the disclosure. Accordingly, the present disclosure is not to be restricted except in light of the attached claims and their equivalents.

Claims

1. An assembly for a turbine engine, comprising: a nozzle structure including a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis, the first platform forming a first boundary of a flowpath through the nozzle structure, the second platform forming a second boundary of the flowpath, and the plurality of nozzle vanes extending radially across the flowpath from the first platform to the second platform; a septum axially and circumferentially overlapping the first platform with a cooling cavity formed by and radially between the septum and the first platform, the septum comprising a plurality of cooling apertures aligned with the plurality of nozzle vanes, each of the plurality of cooling apertures extending radially through the septum to the cooling cavity, and the cooling cavity comprising a cavity outlet fluidly coupled to the flowpath; and a plurality of cooling vanes arranged circumferentially about the axis and projecting from the first platform into the cooling cavity, the plurality of cooling vanes located between the plurality of cooling apertures and the cavity outlet along the cooling cavity.
2. The assembly of claim 1, wherein the cavity outlet is located upstream of the first platform along the flowpath.
3. The assembly of claim 1, wherein each of the plurality of cooling apertures is configured to direct a stream of air across the cooling cavity against the first platform.
4. The assembly of claim 1, wherein the plurality of cooling apertures are axially aligned along the axis and arranged circumferentially about the axis in an annular array.
5. The assembly of claim 1, wherein the plurality of nozzle vanes comprise a first nozzle vane; and the plurality of cooling apertures comprises a first cooling aperture, and the first cooling aperture is axially and circumferentially aligned with the first nozzle vane.
6. The assembly of claim 1, wherein the plurality of nozzle vanes include a first nozzle vane and a second nozzle vane that circumferentially neighbors the first nozzle vane with a channel formed by and extending circumferentially between the first nozzle vane and the second nozzle vane; a first set of the plurality of cooling apertures are axially and circumferentially aligned with the first nozzle vane; a second set of the plurality of cooling apertures are axially and circumferentially aligned with the second nozzle vane; and a section of the septum is non-perforated, the section of the septum extends circumferentially between the first set of the plurality of cooling apertures and the second set of the plurality of cooling apertures, and the section of septum axially overlaps at least a major portion of the channel.
7. The assembly of claim 1, wherein the plurality of nozzle vanes comprise a first nozzle vane, and the first nozzle vane extends longitudinally between a leading edge and a trailing edge; and a first set of the plurality of cooling apertures are axially and circumferentially aligned with the first nozzle vane, and a density of cooling apertures in the first set of the plurality of cooling apertures is greater in an area aligned with the trailing edge than in an area aligned with the leading edge.
8. The assembly of claim 1, wherein the plurality of cooling vanes comprise a first cooling vane; and the first cooling vane projects radially and/or axially from the first platform to an unsupported

distal end of the first cooling vane.
9. The assembly of claim 1, wherein the plurality of cooling vanes are axially offset from the plurality of nozzle vanes.
10. The assembly of claim 1, wherein the plurality of cooling vanes comprise a first cooling vane; and the first cooling vane comprises a cambered cooling vane.
11. The assembly of claim 1, wherein the plurality of nozzle vanes are configured to swirl combustion products in a circumferential direction about the axis; and the plurality of cooling vanes are configured to swirl air in the circumferential direction about the axis.
12. The assembly of claim 1, further comprising: a baffle axially and circumferentially overlapping the septum with a feed cavity formed by and radially between the baffle and the septum; and the septum radially between the baffle and the first platform with the plurality of cooling apertures fluidly coupling the feed cavity to the cooling cavity.
13. The assembly of claim 12, further comprising: a turbine wall; and an intermediate structure extending between a downstream end of the first platform and an upstream end of the turbine wall; the septum extending axially to the intermediate structure; and the baffle extending axially to the intermediate structure with one or more ports formed through the baffle adjacent the intermediate structure.
14. The assembly of claim 1, further comprising: a combustor wall radially between and bordering a plenum and a combustion chamber; a downstream end of the combustor wall axially spaced from an upstream end of the first platform to form the cavity outlet.
15. The assembly of claim 1, further comprising: a combustor disposed in a plenum and comprising a combustion chamber; the nozzle structure arranged at an outlet from the combustion chamber; and the plurality of cooling aperture configured to receive air from the plenum to direct across the cooling cavity onto the first platform.
16. The assembly of claim 1, further comprising a monolithic body that includes the nozzle structure, the septum and the plurality of cooling vanes.
17. The assembly of claim 1, wherein the first platform is an inner platform which circumscribes the septum and the plurality of cooling vanes; and the second platform is an outer platform which circumscribes the inner platform.
18. An assembly for a turbine engine, comprising: a combustor arranged in a plenum and comprising a combustion chamber; a nozzle structure arranged at an outlet from the combustion chamber, the nozzle structure including a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis, and the plurality of nozzle vanes extending radially across a flowpath from the first platform to the second platform; a septum extending axially and circumferentially along the first platform with a cooling cavity formed by and radially between the septum and the first platform, the septum comprising a plurality of cooling apertures aligned with the plurality of nozzle vanes, and each of the plurality of cooling apertures extending radially through the septum from a feed cavity to the cooling cavity; and a baffle extending axially and circumferentially along the septum with the feed cavity formed by and radially between the baffle and the septum, the baffle comprising a plurality of ports extending radially through the baffle from the plenum to the feed cavity.
19. The assembly of claim 18, further comprising a plurality of cooling elements connected to the first platform and projecting partially into the cooling cavity.
20. An assembly for a turbine engine, comprising: a combustor arranged in a plenum and comprising a combustion chamber; a nozzle structure arranged at an outlet from the combustion chamber, the nozzle structure including a first platform, a second platform and a plurality of nozzle vanes arranged circumferentially about an axis, the plurality of nozzle vanes extending radially across a flowpath from the first platform to the second platform, the plurality of nozzle vanes comprising a first nozzle vane, and the first nozzle vane extending longitudinally between a leading edge and a trailing edge; and a septum extending axially and circumferentially along the first

platform with a cooling cavity formed by and radially between the septum and the first platform, the septum comprising a plurality of cooling apertures extending radially through the septum from a feed cavity to the cooling cavity; a first set of the plurality of cooling apertures are axially and circumferentially aligned with the first nozzle vane, wherein a density of cooling apertures in the first set of the plurality of cooling apertures is greater in an area aligned with the trailing edge than in an area aligned with the leading edge.