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Inventor(s)	Kupratis; Daniel B.

PARTIALLY SHROUDED AIRCRAFT PROPULSION SYSTEM

Abstract

An assembly is provided for an aircraft. This assembly includes a first propulsor rotor, a powerplant and a propulsion system housing. The powerplant is configured to drive rotation of the first propulsor rotor about an axis. The propulsion system housing includes an inner structure and an outer structure with a bypass flowpath radially between the inner structure and the outer structure. The bypass flowpath is downstream of the first propulsor rotor and extends axially along the inner structure and the outer structure within the propulsion system housing. The inner structure extends axially along and circumferentially around the powerplant. The outer structure extends axially along and partially circumferentially about the first propulsor rotor to cover an outer periphery of a first circumferential sector of the first propulsor rotor. A remaining second circumferential sector of the first propulsor rotor is open to an environment outside of the propulsion system housing.

Inventors:	**Kupratis; Daniel B. (Wallingford, CT)**
Applicant:	**RTX Corporation** (Farmington, CT)
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Background/Summary

BACKGROUND OF THE DISCLOSURE

1. Technical Field

[0001] This disclosure relates generally to an aircraft and, more particularly, to a propulsion system for the aircraft.

2. Background Information

[0002] Various types and configurations of aircraft propulsion systems are known in the art. Some of these known aircraft propulsion systems include a ducted propulsor rotor, and some of the known aircraft propulsion systems include one or more open propulsor rotors. While these known aircraft propulsion systems 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 an aircraft. This assembly includes a first propulsor rotor, a powerplant and a propulsion system housing. The powerplant is configured to drive rotation of the first propulsor rotor about an axis. The propulsion system housing includes an inner structure and an outer structure with a bypass flowpath radially between the inner structure and the outer structure. The bypass flowpath is downstream of the first propulsor rotor and extends axially along the inner structure and the outer structure within the propulsion system housing. The inner structure extends axially along and circumferentially around the powerplant. The outer structure extends axially along and partially circumferentially about the first propulsor rotor to cover an outer periphery of a first circumferential sector of the first propulsor rotor. A remaining second circumferential sector of the first propulsor rotor is open to an environment outside of the propulsion system housing.

[0004] According to another aspect of the present disclosure, another assembly is provided for an aircraft. This assembly includes an airframe structure, an aircraft propulsion system and a propulsion system bypass flowpath. The aircraft propulsion system is mounted to the airframe structure. The aircraft propulsion system includes a first propulsor rotor, a powerplant, a propulsion system housing and a powerplant bypass flowpath. The powerplant is configured to drive rotation of the first propulsor rotor about an axis. The propulsion system housing includes an inner structure and an outer structure. The inner structure houses the powerplant. The outer structure houses a first circumferential sector of the first propulsor rotor with a remaining second circumferential sector of the first propulsor rotor exposed to an environment outside of the aircraft propulsion system. The powerplant bypass flowpath is between the inner structure and the outer structure and bypasses the powerplant. The propulsion system bypass flowpath is between the outer structure and the airframe structure and bypasses the aircraft propulsion system.

[0005] According to still another aspect of the present disclosure, another assembly is provided for an aircraft. This assembly includes a first propulsor rotor, a powerplant and a propulsion system housing. The powerplant is configured to drive rotation of the first propulsor rotor about an axis. The propulsion system housing includes an inner structure, an outer structure and a plurality of guide vanes with a bypass flowpath radially between the inner structure and the outer structure. The bypass flowpath is downstream of the first propulsor rotor and extends axially along the inner structure and the outer structure within the propulsion system housing. The inner structure circumscribes the powerplant. The outer structure extends circumferentially about the first propulsor rotor and the inner structure between opposing circumferential sides of the outer structure. Each of the opposing circumferential sides of the outer structure is exposed to an environment outside of the propulsion system housing. Each of the guide vanes extends radially across the bypass flowpath from the inner structure to the outer structure.

[0006] The outer structure may extend circumferentially about the axis, between one-hundred and twenty degrees and one-hundred and eighty degrees, between opposing circumferential sides of the outer structure.

[0007] The outer structure may extend circumferentially about the axis between opposing circumferential sides of the outer structure. Each of the opposing circumferential sides of the outer structure may be exposed to the environment outside of the aircraft propulsion system.

[0008] The first circumferential sector may extend circumferentially about the axis between ninety degrees and two-hundred and forty degrees. The remaining second circumferential sector may extend circumferentially about the axis between and to opposing circumferential ends of the first circumferential sector.

[0009] A first portion of the first propulsor rotor within the first circumferential sector may be operable as a ducted propulsor rotor. A second portion of the first propulsor rotor within the first circumferential sector may be operable as an open propulsor rotor.

[0010] The propulsion system housing may be configured as or otherwise include a nacelle.

[0011] The assembly may also include a plurality of guide vanes arranged circumferentially about the axis. Each of the guide vanes may extend radially across the bypass flowpath and couple the inner structure to the outer structure.

[0012] The guide vanes may include a first guide vane, a second guide vane and a third guide vane disposed circumferentially between and next to the first guide vane and the second guide vane. The first guide vane may be circumferentially spaced from the third guide vane by a first circumferential distance. The second guide vane may be circumferentially spaced from the third guide vane by a second circumferential distance that is different than the first circumferential distance.

[0013] The assembly may also include a lobed mixer configured to mix bypass air exhausted from the bypass flowpath with combustion products exhausted from a turbine engine core. The powerplant may include the turbine engine core. The lobed mixer may be configured with a plurality of mixer lobes. Each of the mixer lobes may be circumferentially aligned with a respective one of the guide vanes.

[0014] The guide vanes may include a plurality of ducted guide vanes. The assembly may also include a guide vane structure including the ducted guide vanes and a plurality of open guide vanes arranged with the ducted guide vanes in an annular array about the axis.

[0015] The assembly may also include an arcuate guide vane structure which includes the guide vanes.

[0016] The assembly may also include a lobed mixer configured to mix bypass air exhausted from the bypass flowpath with combustion products exhausted from a turbine engine core. The powerplant may include the turbine engine core. The lobed mixer may extend axially along and partially circumferentially about the axis. The lobed mixer may be circumferentially aligned with the outer structure about the axis.

[0017] The assembly may also include a second propulsor rotor. The powerplant may be configured to drive rotation of the first propulsor rotor a first direction about the axis. The powerplant may also be configured to drive rotation of the second propulsor rotor a second direction about the axis.

[0018] The powerplant may include a turbine engine core.

[0019] The assembly may also include a nose cone upstream of and rotatable with the first propulsor rotor. A tip of the nose cone may be axially aligned with or axially recessed from a leading edge of the outer structure.

[0020] The assembly may also include a pylon projecting radially out from the outer structure.

[0021] The assembly may also include an airframe structure, an aircraft propulsion system and a second bypass flowpath. The aircraft propulsion system may be mounted to the airframe structure. The aircraft propulsion system may include the first propulsor rotor, the powerplant and the propulsion system housing. The second bypass flowpath may be formed by and between the outer structure and the airframe structure. The second bypass flowpath may extend axially along the outer structure and the airframe structure outside of the aircraft propulsion system.

[0022] The airframe structure may be configured as a fuselage of a blended wing body aircraft.

[0023] The aircraft propulsion system may be disposed to a gravitational top side of the airframe

structure.
[0024] The aircraft propulsion system may be disposed in a recess in the airframe structure.
[0025] A corner between a leading edge of the outer structure and a circumferential side of the outer structure may be eased.
[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 plan view illustration of an aircraft.
[0029] FIG. **2** is a side view illustration of the aircraft.
[0030] FIG. **3** is a rear end view illustration of the aircraft.
[0031] FIG. **4** is a schematic side sectional illustration of a propulsion system mounted to an airframe component.
[0032] FIG. **5** is a schematic cross-sectional illustration of the propulsion system at an upstream, forward propulsor rotor.
[0033] FIG. **6** is a schematic cross-sectional illustration of the propulsion system at a downstream, aft propulsor rotor.
[0034] FIG. **7** is a schematic cross-sectional illustration of the propulsion system at a guide vane array with a lobed mixer overlaid on the guide vane array in dashed lines.
[0035] FIG. **8** is a schematic cross-sectional illustration of the propulsion system at the lobed mixer.
[0036] FIGS. **9**A and **9**B are partial schematic side sectional illustrations of the propulsion system with various other nose cone arrangements.
[0037] FIGS. **10**A and **10**B are partial schematic side sectional illustrations of the propulsion system with various other housing arrangements.
[0038] FIG. **11** is a partial front end view illustration of a first propulsion system mounted to the aircraft.
[0039] FIG. **12** is a partial front end view illustration of a second propulsion system mounted to the aircraft.
[0040] FIG. **13** is a schematic cross-sectional illustration of the propulsion system with an annular guide vane array.
[0041] FIG. **14** is a schematic side sectional illustration of the propulsion system mounted to the airframe component, where the propulsion system includes the annular guide vane array with fixed open guide vanes.
[0042] FIG. **15** is a schematic side sectional illustration of the propulsion system mounted to the airframe component, where the propulsion system includes the annular guide vane array with variable open guide vanes.
DETAILED DESCRIPTION
[0043] FIG. **1** illustrates a blended wing body (BWB) aircraft **20**. This aircraft **20** includes an airframe **22** and one or more propulsion systems **24**A and **24**B (generally referred to as “24”), schematically and generically shown in FIGS. **1-3**. The aircraft airframe **22** of FIG. **1** includes a body **26** (e.g., a fuselage) and one or more wings **28**A and **28**B (generally referred to as “28”).
[0044] The aircraft body **26** extends longitudinally along a centerline **34** between and to an upstream, forward end **36** (e.g., a nose) of the aircraft body **26** and a downstream, aft end **38** of the aircraft body **26**. This centerline **34** may be a centerline axis of the aircraft **20**, the aircraft airframe

22 and/or the aircraft body **26**. Referring to FIG. **2**, the centerline **34** may be substantially (e.g., within +/−five degrees) or completely parallel with a horizon line when the aircraft **20** is flying in level flight. The aircraft body **26** extends vertically between and to opposing vertical bottom and top sides **40** and **42** of the aircraft body **26**. The body bottom side **40** is vertically below the body top side **42** with respect to a gravitational direction when the aircraft **20** is flying in level flight. Referring to FIGS. **1** and **3**, the aircraft body **26** extends laterally between and to opposing lateral sides **44**A and **44**B (generally referred to as “44”) of the aircraft body **26**.

[0045] The aircraft wings **28** of FIGS. **1** and **3** are arranged to the opposing lateral sides **44** of the aircraft body **26**. Each of the aircraft wings **28** is connected to (e.g., fixed to) the aircraft body **26**. Each of the aircraft wings **28**A, **28**B projects spanwise along a span line of the respective aircraft wing **28** out from the aircraft body **26**, at the respective body lateral side **44**A, **44**B, to a distal tip **46**A, **46**B of the respective aircraft wing **28**. At the wing tip **46**A, **46**B, the respective aircraft wing **28** may (or may not) be configured with a winglet **48**A, **48**B. Each of the aircraft wings **28**A, **28**B of FIG. **1** extends longitudinally along a mean line of the respective aircraft wing **28**A, **28**B from a leading edge **50**A, **50**B (generally referred to as “50”) of the respective aircraft wing **28** to a trailing edge **52**A, **52**B (generally referred to as “52”) of the respective aircraft wing **28**. The wing leading edge **50** of FIG. **1**, at a base of the respective aircraft wing **28**, is longitudinally spaced aft, downstream from the body forward end **36**. The wing trailing edge **52** of FIG. **1**, at the wing base, is longitudinally spaced forward, upstream from the body aft end **38**. The present disclosure, however, is not limited to such an exemplary aircraft wing arrangement.

[0046] Referring to FIG. **4**, each aircraft propulsion system **24** extends axially along an axis **54** from an upstream, forward end **56** of the respective aircraft propulsion system **24** to a downstream, aft end **58** of the respective aircraft propulsion system **24**. This axis **54** may be a centerline axis of the respective aircraft propulsion system **24** and/or one or more components of the respective aircraft propulsion system **24**. The axis **54** may also or alternatively be a rotational axis of one or more components of the respective aircraft propulsion system **24**. Each aircraft propulsion system **24** includes one or more propulsion system propulsor rotors **60** and **62** (e.g., counterrotating propulsor rotors), a propulsion system powerplant **64** and a propulsion system housing **66**. For ease of description, the propulsion system powerplant **64** is described below as a core **68** of a turbine engine **70** (e.g., a gas generator), where the turbine engine core **68** is configured to drive rotation of the propulsor rotors **60** and **62** of the turbine engine **70**. The present disclosure, however, is not limited to turbine engine aircraft propulsion systems. The propulsion system powerplant **64**, for example, may alternatively be configured as a rotary internal combustion (IC) engine, a hybrid-electric engine or an electric motor which drives rotation of the propulsor rotors **60** and **62**.

[0047] The first propulsor rotor **60** (e.g., an upstream, forward propulsor rotor) is configured to rotate a first circumferential direction (e.g., a clockwise direction, or a counterclockwise direction) about the axis **54**. This first propulsor rotor **60** includes a first rotor base **72** (e.g., a hub or a disk) and a plurality of first propulsor blades **74**. The first propulsor blades **74** are arranged circumferentially around the first rotor base **72** in an array; e.g., a circular array. The first propulsor blades **74** are connected to (e.g., formed integral with or otherwise attached to) the first rotor base **72**. Each of the first propulsor blades **74** projects spanwise along a span line of the respective first propulsor blade **74** out from the first rotor base **72** to an outer tip of the respective first propulsor blade **74**.

[0048] The second propulsor rotor **62** (e.g., a downstream, aft propulsor rotor) is configured to rotate a second circumferential direction (e.g., the counterclockwise direction, or the clockwise direction) about the axis **54**, where the second circumferential direction is opposite of the first circumferential direction. This second propulsor rotor **62** includes a second rotor base **76** (e.g., a hub or a disk) and a plurality of second propulsor blades **78**. The second propulsor blades **78** are arranged circumferentially around the second rotor base **76** in an array; e.g., a circular array. The second propulsor blades **78** are connected to (e.g., formed integral with or otherwise attached to) the second rotor base **76**. Each of the second propulsor blades **78** projects spanwise along a span line of the respective second propulsor blade **78** out from the second rotor base **76** to an outer tip of the respective second propulsor blade **78**.

[0049] The first propulsor rotor **60** is arranged forward and upstream of the second propulsor rotor **62**. The first propulsor rotor **60** of FIG. **4**, for example, is located axially between and next to (e.g., adjacent) an inlet nose cone **80** and the second propulsor rotor **62**. This nose cone **80** may be configured as a spinner. The nose cone **80** of FIG. **4**, for example, is coupled to and rotates with the first propulsor rotor **60**. The second propulsor rotor **62** of FIG. **4** is located axially between the first propulsor rotor **60** and the propulsion system powerplant **64**; e.g., the turbine engine core **68**.

[0050] The propulsion system powerplant **64** of FIG. **4** includes a compressor section **82**, a combustor section **83** and a turbine section **84**. The compressor section **82** of FIG. **4** includes a low pressure compressor (LPC) section **82**A and a high pressure compressor (HPC) section **82**B. The turbine section **84** of FIG. **4** includes a high pressure turbine (HPT) section **84**A and a low pressure turbine (LPT) section **84**B.

[0051] Each of the powerplant sections **82**A, **82**B, **84**A and **84**B includes a respective bladed rotor **86-89**. Each of these bladed rotors **86-89** includes a plurality of rotor blades arranged circumferentially around and connected to one or more respective rotor disks or hubs. The rotor blades, for example, may be formed integral with or mechanically fastened, welded, brazed and/or otherwise attached to the respective rotor disk(s) or hub(s).

[0052] The HPC rotor **87** is coupled to and rotatable with the HPT rotor **88**. The HPC rotor **87** of FIG. **4**, for example, is connected to the HPT rotor **88** through a high speed shaft **92**. At least (or only) the HPC rotor **87**, the HPT rotor **88** and the high speed shaft **92** may collectively form a high speed rotating assembly **94**; e.g., a high speed spool of the turbine engine core **68**. The high speed rotating assembly **94** of FIG. **4** and its members **87**, **88** and **92** are configured to rotate about the axis **54**.

[0053] The LPC rotor **86** is coupled to and rotatable with the LPT rotor **89**. The LPC rotor **86** of FIG. **4**, for example, is connected to the LPT rotor **89** through a low speed shaft **96**. At least (or only) the LPC rotor **86**, the LPT rotor **89** and the low speed shaft **96** may collectively form a low speed rotating assembly **98**; e.g., a low speed spool of the turbine engine core **68**. The low speed rotating assembly **98** of FIG. **4** and its members **86**, **89** and **96** are configured to rotate about the axis **54**.

[0054] The low speed rotating assembly **98** is coupled to and rotatable with each of the counterrotating propulsor rotors **60** and **62** through a drivetrain **100**. The drivetrain **100** of FIG. **4** is configured as a geared drivetrain, where a geartrain **102** (e.g., a transmission, a speed change device, an epicyclic geartrain, etc.) is disposed between and operatively couples each propulsor rotor to the low speed rotating assembly **98** and its LPT rotor **89**. With this arrangement, the counterrotating propulsor rotors **60** and **62** may each rotate at a different (e.g., slower) rotational velocity than the low speed rotating assembly **98** and its LPT rotor **89**. Moreover, the geartrain **102** may facilitate the rotation of the propulsor rotors **60** and **62** in their opposing circumferential directions about the axis **54**.

[0055] An annular core flowpath **104** extends through the propulsion system powerplant **64** (e.g., the turbine engine core **68**) from an airflow inlet **106** into the core flowpath **104** to a combustion products exhaust **108** from the core flowpath **104**. The core flowpath **104** of FIG. **4**, for example, extends sequentially through the LPC section **82**A, the HPC section **82**B, the combustor section **83**, the HPT section **84**A and the LPT section **84**B between the core inlet **106** and the core exhaust **108**. The core inlet **106** of FIG. **4** is disposed axially downstream of and next to the second propulsor rotor **62**.

[0056] The powerplant sections **82**A-**84**B are arranged (e.g., sequentially along the axis **54**) within a full-hoop stationary inner structure **110** of the propulsion system housing **66**. The housing inner structure **110** of FIG. **4** includes a full-hoop inner case **112** (e.g., a core case) and a full-hoop inner structure **114** of a nacelle for the respective aircraft propulsion system **24**; e.g., an inner fixed structure (IFS). The inner case **112** houses the propulsion system powerplant **64** and its powerplant sections **82**A-**84**B. The inner case **112** of FIG. **4**, for example, extends axially along and circumferentially around (e.g., circumscribes) each of the powerplant sections **82**A-**84**B and the respective powerplant section rotors **86-89**. The nacelle inner structure **114** houses and provides an aerodynamic cover over the inner case **112** and, thus, the propulsion system powerplant **64** and its powerplant sections **82**A-**84**B. The nacelle inner structure **114** of FIG. **4**, for example, extends axially along and circumferentially around (e.g., circumscribes) the inner case **112**.

[0057] The counterrotating propulsor rotors **60** and **62** are arranged partially within (e.g., partially shrouded by) an arcuate stationary outer structure **116** of the propulsion system housing **66**. The housing outer structure **116** of FIG. **4**, for example, includes an arcuate outer case **118** (e.g., fan case, a containment case, etc.) and an arcuate outer structure **120** of the nacelle. The outer case **118** partially houses the counterrotating propulsor rotors **60** and **62**. The outer case **118** of FIG. **4**, for example, extends axially along each of the counterrotating propulsor rotors **60** and **62**. Referring to FIGS. **5** and **6**, the outer case **118** extends partially circumferentially about each propulsor rotor **60**, **62** and the axis **54** between opposing circumferential sides **122**A and **122**B (generally referred to as "122") of the outer case **118**. Referring to FIG. **4**, the nacelle outer structure **120** houses and provides an aerodynamic cover over the outer case **118** and, thus, the counterrotating propulsor rotors **60** and **62**. The nacelle outer structure **120** is also spaced radially outboard from and overlaps at least an axial portion (e.g., an entirety) of the nacelle inner structure **114** downstream of the counterrotating propulsor rotors **60** and **62**. The nacelle outer structure **120** of FIG. **4**, for example, extends axially along the counterrotating propulsor rotors **60** and **62** and the nacelle inner structure **114** from a leading edge **124** of the propulsion system housing **66** and its nacelle outer structure **120** to a trailing edge **126** of the propulsion system housing **66** and its nacelle outer structure **120**. Referring to FIGS. **5** and **6**, the nacelle outer structure **120** extends partially circumferentially about each propulsor rotor **60**, **62**, the nacelle inner structure **114** and the axis **54** opposing circumferential sides **128**A and **128**B (generally referred to as "128") of the housing outer structure **116** and its nacelle outer structure **120**.

[0058] The housing outer structure **116** and its members **118** and **120** cover (e.g., shroud) an outer periphery of a shrouded (e.g., ducted) circumferential sector **130** (e.g., a circular sector) of each propulsor rotor **60**, **62**. By contrast, a remaining open circumferential sector **132** of each propulsor rotor **60**, **62** is uncovered; e.g., unshrouded. The open circumferential sector **132** of each propulsor rotor **60**, **62** of FIGS. **5** and **6** is thereby open to an environment **134** external to the respective aircraft propulsion system **24** and, more generally, the aircraft. The shrouded circumferential sector **130** may extend circumferentially about the axis **54** between ninety degrees (90°) and two-hundred and forty degrees (240°); e.g., between one-hundred and twenty degrees (120°) and one-hundred and eighty degrees (180°) or two-hundred degrees (200°). The open circumferential sector **132** extends circumferentially about the axis **54** between and to the opposing circumferential sides **128** of the housing outer structure **116** and its nacelle outer structure **120**. With this arrangement, a portion of each propulsor rotor **60**, **62** in the shrouded circumferential sector **130** may operate as a ducted/shrouded propulsor rotor (e.g., a fan rotor) of the respective aircraft propulsion system **24**. A remaining portion of each propulsor rotor **60**, **62** in the open circumferential sector **132** may operate as an open (e.g., un-ducted, un-shrouded) propulsor rotor of the respective aircraft propulsion system **24**.

[0059] Referring to FIG. **4**, an arcuate powerplant bypass flowpath **136** is formed within the propulsion system housing **66** radially between the housing inner structure **110** and the housing outer structure **116**. This powerplant bypass flowpath **136** extends longitudinally (e.g., axially along the axis **54**) from an airflow inlet **138** into the powerplant bypass flowpath **136** to an airflow exhaust **140** from the powerplant bypass flowpath **136**. The powerplant bypass inlet **138** of FIG. **4** is disposed axially downstream of and next to the second propulsor rotor **62**. This powerplant bypass inlet **138** is radially outboard of and may be substantially axially aligned with the core inlet **106**. The powerplant bypass exhaust **140** is disposed at the outer structure trailing edge **126**. The housing inner structure **110** and its nacelle inner structure **114** form a radial inner peripheral boundary of the powerplant bypass flowpath **136**. The housing outer structure **116** and its members **118** and **120** form a radial outer peripheral boundary of the powerplant bypass flowpath **136**. The powerplant bypass flowpath **136** also extends circumferentially about the axis **54** through the propulsion system housing **66** between opposing circumferential open sides of the powerplant bypass flowpath **136**. With the arrangement of FIG. **4**, the powerplant bypass flowpath **136** bypasses (e.g., extends around and outside of) the propulsion system powerplant **64** and its powerplant sections **82**A-**84**B.

[0060] The outer structure trailing edge **126** and, thus, the powerplant bypass exhaust **140** may have a canted configuration. At least a section or an entirety of the outer structure trailing edge **126** of FIG. **4**, for example, is angularly offset from the axis **54** by an offset angle **142** when viewed, for example, in a first reference plane parallel with (e.g., including or laterally offset from) the axis **54**. The offset angle **142** is a non-zero acute angle, which offset angle **142** may vary between fifteen degrees (15°) and eight-five degrees (85°) for example.

[0061] The outer structure trailing edge **126** is axially spaced from the axially closest propulsor rotor (e.g., the second propulsor rotor **62**) by an axial distance **144**. More particularly, the outer structure trailing edge **126** of FIG. **4** is axially spaced from a second reference plane **146** defined by an aft, downstream side of the second propulsor rotor **62** by the axial distance **144**, which second reference plane **146** is perpendicular to the axis **54**. The axial distance **144** increases as each half of the outer structure trailing edge **126** extends circumferentially about the axis **54** from a respective one of the opposing circumferential sides **128** of the housing outer structure **116** and its nacelle outer structure **120** towards (or to) a circumferential intermediate location (e.g., a midpoint) or a circumferential intermediate region along the outer structure trailing edge **126**. This increase in the axial distance **144** may be continuous or iterative. A slope of the increase in the axial distance **144** may be constant or variable. For example, the increase in the axial distance **144** from each circumferential side **128** to the intermediate point or the intermediate region in FIG. **4** is continuous with a variable slope. With this arrangement, at least a portion or an entirety of each half of the outer structure trailing edge **126** may be curved; e.g., splined, arcuate, wavy, etc.

[0062] Each aircraft propulsion system **24** of FIG. **4** also includes a guide vane structure **148** and a lobed mixer **150**. The guide vane structure **148** is arranged along the powerplant bypass flowpath **136** between the second propulsor rotor **62** and the powerplant bypass exhaust **140**. The guide vane structure **148** of FIG. **4**, for example, is disposed at (e.g., on, adjacent or proximate) the powerplant bypass inlet **138**. Referring to FIG. **7**, the guide vane structure **148** includes a plurality of guide vanes **152** arranged circumferentially about the axis **54** in an arcuate array; e.g., a semi-circular array. Each of the guide vanes **152** extends radially across the powerplant bypass flowpath **136** from the inner peripheral boundary of the powerplant bypass flowpath **136** to the outer peripheral boundary of the powerplant bypass flowpath **136**. Referring to FIG. **4**, each of the guide vanes **152** may also be connected (e.g., structurally tied) to the outer case **118** and a frame structure **154** of the housing inner structure **110**, which frame structure **154** is connected to the inner case **112**. With this arrangement, the guide vane structure **148** and its guide vanes **152** are configured to condition (e.g., straighten out) air propelled into the powerplant bypass flowpath **136** by the counterrotating propulsor rotors **60** and **62**.

[0063] The lobed mixer **150** is configured to mix bypass air exhausted from the powerplant bypass flowpath **136** with combustion products exhausted from the propulsion system powerplant **64** and its core flowpath **104**. The lobed mixer **150** of FIG. **4**, for example, is arranged at and radially between the powerplant bypass exhaust **140** and the core exhaust **108**. This lobed mixer **150** is connected to at least one component of the housing inner structure **110** radially between the powerplant bypass flowpath **136** and the core flowpath **104**; e.g., the inner case **112** and/or the nacelle inner structure **114**.

[0064] Referring to FIG. **8**, the lobed mixer **150** is configured as an arcuate lobed mixer; e.g., a semi-annular lobed mixer. The lobed mixer **150** of FIG. **8**, for example, extends partially circumferentially about the axis **54** between circumferentially opposing sides **158**A and **158**B of the lobed mixer **150**, where the mixer sides **158**A, **158**B may be circumferentially aligned with (or near) the structure sides **128**A, **128**B. The lobed mixer **150** of FIG. **8** includes a plurality of mixer lobes **160** arranged circumferentially about the axis **54** between the mixer sides **158**A, **158**B in an arcuate array; e.g., a semi-circular array. One of the mixer lobes **160** may define the first mixer side **158**A and where another one of the mixer lobes **160** may define the second mixer side **158**B. Each of the mixer lobes **160** may have a similar or a common (the same) configuration; e.g., shape, dimensions (e.g., radial height, circumferential width), etc. The present disclosure, however, is not limited to such an exemplary arrangement.

[0065] Referring to FIG. **1**, the aircraft propulsion systems **24** are arranged laterally side-by-side along the aircraft body **26** at the body top side **42** and/or the body aft end **38**. These aircraft propulsion systems **24** are disposed to opposing lateral sides of the centerline **34**, where the axis **54** of each aircraft propulsion system **24** may be arranged parallel with the centerline **34**. The aircraft propulsion systems **24** are also equilaterally spaced from the centerline **34**. Referring to FIGS. **1** and **3**, each aircraft propulsion system **24** may be disposed in a recess **162** (e.g., a pocket, an indentation, etc.) in the aircraft body **26**. This recess **162** projects vertically into the aircraft body **26** and laterally within the aircraft body **26** at the body top side **42**. The recess **162** may also project longitudinally into the aircraft body **26** from the body aft end **38**.

[0066] Referring to FIG. **4**, each aircraft propulsion system **24** is connected (e.g., mechanically fixed) to the aircraft body **26**. The housing outer structure **116**, for example, is mounted to the aircraft body **26** by a pylon structure **164**. With this arrangement, each aircraft propulsion system **24** and its housing outer structure **116** are spaced radially outward/vertically from the aircraft body **26**. A propulsion system bypass flowpath **166** is thereby formed by and radially between the aircraft body **26** and the housing outer structure **116**. This propulsion system bypass flowpath **166** extends longitudinally along the aircraft body **26** and the housing outer structure **116** from an airflow inlet **168** into the propulsion system bypass flowpath **166** to an airflow exhaust **170** from the propulsion system bypass flowpath **166**. The propulsion system bypass inlet **168** is disposed at the outer structure leading edge **124**. The propulsion system bypass exhaust **170** is disposed at the outer structure trailing edge **126**. The housing outer structure **116** forms a radial inner peripheral boundary of the propulsion system bypass flowpath **166**. The aircraft body **26** forms a radial outer peripheral boundary of the propulsion system bypass flowpath **166**. The propulsion system bypass flowpath **166** also extends circumferentially about the axis **54** between opposing circumferential open sides of the propulsion system bypass flowpath **166**. With the arrangement of FIG. **4**, the propulsion system bypass flowpath **166** bypasses (e.g., extends around and outside of) the respective aircraft propulsion system **24**.

[0067] During operation of each aircraft propulsion system **24**, ambient air from the external environment **134** is directed across the counterrotating propulsor rotors **60** and **62** and (in parallel) into the core flowpath **104** through its core inlet **106** and into the powerplant bypass flowpath **136** through its powerplant bypass inlet **138**. The air entering the core flowpath **104** may be referred to as “core air”. The air entering the powerplant bypass flowpath **136** may be referred to as the “bypass air”.

[0068] The core air is compressed by the LPC rotor **86** and the HPC rotor **87** and directed into a (e.g., annular) combustion chamber **172** of a (e.g., annular) combustor in the combustor section **83**. Fuel is injected into the combustion chamber **172** and mixed with the compressed core air to provide a fuel-air mixture. This fuel-air mixture is ignited and the combustion products thereof flow through and sequentially drive rotation of the HPT rotor **88** and the LPT rotor **89** about the axis **54**. The rotation of the HPT rotor **88** and the LPT rotor **89** respectively drive rotation of the

HPC rotor **87** and the LPC rotor **86** about the axis **54**. The rotation of the LPT rotor **89** also drives rotation of the counterrotating propulsor rotors **60** and **62** about the axis **54** through the drivetrain **100**. The rotation of the counterrotating propulsor rotors **60** and **62** propels the bypass air through the powerplant bypass flowpath **136** and out of the respective aircraft propulsion system **24** through the powerplant bypass exhaust **140** to provide forward aircraft thrust. The rotation of the counterrotating propulsor rotors **60** and **62** also propels an external stream of air in the external environment **134** along and outside of the housing inner structure **110** to provide additional aircraft thrust. This propulsion of the bypass air and the external stream of air may account for a majority of thrust generated by the respective aircraft propulsion system **24**, e.g., more than seventy-five percent (75%) of thrust. The aircraft propulsion system **24** of the present disclosure, however, is not limited to the foregoing exemplary thrust ratio.

[0069] As the bypass air is exhausted from the powerplant bypass flowpath **136** and the combustion products are exhausted from the core flowpath **104**, the lobed mixer **150** mixes some of the exhausted bypass air with some of the exhausted combustion products. For example, with the arrangement of FIG. **4** (see also FIG. **8**), the lobed mixer **150** mixes the bypass air flowing out of the powerplant bypass exhaust **140** with the combustion products flowing out of a first sector (e.g., a vertical bottom half) of the core exhaust **108** to provide mixed exhaust gas. This mixed exhaust gas may have a different (e.g., slower) flow velocity than the external stream of air flowing above the powerplant bypass exhaust **140**. This flow velocity differential may impart a net torque and force on the aircraft **20** which may cause the aircraft **20** and its body forward end **36** (see FIG. **2**) to pitch down. Providing the aircraft **20** with a slight propensity to pitch down (or up) may be advantageous for some aircraft designs.

[0070] Concurrently with operation of each aircraft propulsion system **24**, boundary layer air flowing along the aircraft body **26** is directed into the propulsion system bypass flowpath **166**. This boundary layer air is thereby directed around and outside of the respective aircraft propulsion system **24**. By routing the boundary layer air outside of the respective aircraft propulsion system **24** and through the propulsion system bypass flowpath **166**, each aircraft propulsion system **24** may receive a substantially free stream of air; e.g., clean air, low turbulence air, etc. Directing this free stream of air into each aircraft propulsion system **24** may increase propulsion system efficiency.

[0071] In some embodiments, referring to FIG. **7**, each of the mixer lobes **160** may be circumferentially aligned with a respective one of the guide vanes **152**. Such an arrangement may reduce aerodynamic drag along the powerplant bypass flowpath **136**. In other embodiments, however, one or more of the mixer lobes **160** may alternatively be slightly or completely circumferentially offset from a respective circumferentially closest one of the guide vanes **152**.

[0072] In some embodiments, referring to FIG. **7**, the guide vanes **152** may be variably spaced (e.g., non-equispaced) circumferentially about the axis **54**. For example, the guide vanes **152** closest to the structure sides **128** may be closer together than the guide vanes **152** in a middle of the powerplant bypass flowpath **136**. Each circumferentially neighboring (e.g., adjacent) pair of the guide vanes **152**, for example, are spaced circumferentially apart by a circumferential distance **174**; e.g., measured along the outer peripheral boundary of the powerplant bypass flowpath **136**. The distance **174** between the neighboring guide vanes **1521** and **1522** is less than the distance **174** between the neighboring guide vanes **1522** and **1523**, the distance **174** between the neighboring guide vanes **1522** and **1523** is less than the distance **174** between the neighboring guide vanes **1523** and **1524**, and the distance **174** between the neighboring guide vanes **1523** and **1524** is less than the distance **174** between the neighboring guide vanes **1524** and **1525**. With such an arrangement, the guide vanes **152** may be tuned to reduce or prevent pressure oscillations on the counterrotating propulsor rotors **60** and **62** imparted by the provision of the lobed mixer **150** and/or the canted powerplant bypass exhaust **140** (see FIG. **4**).

[0073] In some embodiments, referring to FIG. **4**, a tip **176** of the nose cone **80** may be axially recessed from the outer structure leading edge **124** by a distance **178**. This distance **178** may be equal to or less than one-half of a diameter **180** of the closest propulsor rotor; e.g., the first propulsor rotor **60**. In other embodiments, referring to FIG. **9**A, the tip **176** of the nose cone **80** may be axially aligned with the outer structure leading edge **124**. In still other embodiments, referring to FIG. **9**B, the nose cone **80** may project axially out from the outer structure leading edge **124** to the tip **176**.

[0074] In some embodiments, referring to FIGS. **10**A and **10**B, each corner of the housing outer structure **116** and its members **118** and/or **120** may be cased (e.g., rounded, chamfered, etc.) at the propulsion system forward end **56**/the leading edge **124**. Each corner of FIGS. **10**A and **10**B, for example, is rounded with a corner radius **182**. In some embodiments, referring to FIG. **10**A, the corner radius **182** may be equal to or less than one-half (½) of the distance **178**. In other embodiments, referring to FIG. **10**B, the corner radius **182** may be equal to or greater than the distance **178**; e.g., up to two times (2×) the distance **178**.

[0075] In some embodiments, referring to FIGS. **5** and **6**, the circumferential sides **122**A and **122**B of the outer case **118** may be aligned; e.g., vertically aligned with respect to the gravitational direction when the aircraft is flying in level flight. Similarly, the circumferential sides **128**A and **128**B of the nacelle outer structure **120** may be aligned; e.g., vertically aligned with respect to the gravitational direction when the aircraft is flying in level flight. Moreover, the respective sides **122**A and **128**A, **122**B and **128**B may be aligned; e.g., vertically aligned with respect to the gravitational direction when the aircraft is flying in level flight. The present disclosure, however, is not limited to such an exemplary arrangement. For example, referring to FIGS. **11** and **12**, the circumferential sides **122**A and **122**B of the outer case **118** may be misaligned; e.g., vertically offset from one another with respect to the gravitational direction when the aircraft is flying in level flight. Similarly, the circumferential sides **128**A and **128**B of the nacelle outer structure **120** may be misaligned; e.g., vertically offset from one another with respect to the gravitational direction when the aircraft is flying in level flight. Thus, a reference line **184** extending through the sides **122**A and **122**B and/or **128**A and **128**B is angularly offset from the horizon line when the aircraft is flying in level flight. In addition, a distance **186** between the side **122**A, **128**A and the body top side **42** may be equal to or different than a distance **188** between the side **122**B, **128**B and the body top side **42**. In particular, the housing outer structure **116** and its members **118** and/or **120** may be configured (e.g., shaped, positioned, oriented, etc.) based on a contour of the body top side **42** and/or flow dynamics between the aircraft propulsion systems **24**.

[0076] In some embodiments, referring to FIG. **7**, the guide vane structure **148** may be configured with the arcuate array of the guide vanes **152** about the axis **54**. In other embodiments, referring to FIG. **13**, the guide vane structure **148** may alternatively be configured with a full annular array of guide vanes **152**A and **152**B (generally referred to as “152”) about the axis **54**. The guide vane structure **148** of FIGS. **14** and **15** and its ducted guide vanes **152**A may thereby condition (e.g., straighten) the air propelled within the powerplant bypass flowpath **136**, and the guide vane structure **148** and its open guide vanes **152**B may condition (e.g., straighten) the air propelled within the external environment **134**/outside of the powerplant bypass flowpath **136**. In some embodiments, referring to FIG. **14**, one or more or all of the open guide vanes **152**B may be fixed guide vanes. In other embodiments, referring to FIG. **15**, one or more or all of the open guide vanes **152**B may be variable guide vanes. An actuation system **190**, for example, may be included to move (e.g., pivot) each open guide vane **152**B about a respective pivot axis **192**. By contrast, the ducted guide vanes **152**A of FIG. **15** (e.g., as well as of FIG. **14**) may be fixed guide vanes.

[0077] In some embodiments, referring to FIG. **4**, each aircraft propulsion system **24** may include multiple of the propulsor rotors **60** and **62**. In other embodiments, however, each aircraft propulsion system **24** may be configured with a single propulsor rotor; e.g., the propulsor rotor **60** or **62** may be omitted.

[0078] 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 an aircraft, comprising: a first propulsor rotor; a powerplant configured to drive rotation of the first propulsor rotor about an axis; and a propulsion system housing including an inner structure and an outer structure with a bypass flowpath radially between the inner structure and the outer structure, the bypass flowpath downstream of the first propulsor rotor and extending axially along the inner structure and the outer structure within the propulsion system housing, the inner structure extending axially along and circumferentially around the powerplant, the outer structure extending axially along and partially circumferentially about the first propulsor rotor to cover an outer periphery of a first circumferential sector of the first propulsor rotor, wherein a remaining second circumferential sector of the first propulsor rotor is open to an environment outside of the propulsion system housing.
2. The assembly of claim 1, wherein the first circumferential sector extends circumferentially about the axis between ninety degrees and two-hundred and forty degrees; and the remaining second circumferential sector extends circumferentially about the axis between and to opposing circumferential ends of the first circumferential sector.
3. The assembly of claim 1, wherein a first portion of the first propulsor rotor within the first circumferential sector is operable as a ducted propulsor rotor; and a second portion of the first propulsor rotor within the first circumferential sector is operable as an open propulsor rotor.
4. The assembly of claim 1, wherein the propulsion system housing comprises a nacelle.
5. The assembly of claim 1, further comprising a plurality of guide vanes arranged circumferentially about the axis, each of the plurality of guide vanes extending radially across the bypass flowpath and coupling the inner structure to the outer structure.
6. The assembly of claim 5, wherein the plurality of guide vanes includes a first guide vane, a second guide vane and a third guide vane disposed circumferentially between and next to the first guide vane and the second guide vane, the first guide vane is circumferentially spaced from the third guide vane by a first circumferential distance, and the second guide vane is circumferentially spaced from the third guide vane by a second circumferential distance that is different than the first circumferential distance.
7. The assembly of claim 5, further comprising: a lobed mixer configured to mix bypass air exhausted from the bypass flowpath with combustion products exhausted from a turbine engine core, the powerplant comprising the turbine engine core; the lobed mixer configured with a plurality of mixer lobes, and each of the plurality of mixer lobes circumferentially aligned with a respective one of the plurality of guide vanes.
8. The assembly of claim 5, wherein the plurality of guide vanes comprises a plurality of ducted guide vanes, and the assembly further comprises a guide vane structure including the plurality of ducted guide vanes and a plurality of open guide vanes arranged with the plurality of ducted guide vanes in an annular array about the axis.
9. The assembly of claim 5, further comprising an arcuate guide vane structure comprising the plurality of guide vanes.
10. The assembly of claim 1, further comprising: a lobed mixer configured to mix bypass air exhausted from the bypass flowpath with combustion products exhausted from a turbine engine core, the powerplant comprising the turbine engine core; the lobed mixer extending axially along

and partially circumferentially about the axis, and the lobed mixer circumferentially aligned with the outer structure about the axis.

11. The assembly of claim 1, further comprising: a second propulsor rotor; the powerplant configured to drive rotation of the first propulsor rotor a first direction about the axis, and the powerplant configured to drive rotation of the second propulsor rotor a second direction about the axis.

12. The assembly of claim 1, wherein the powerplant comprises a turbine engine core.

13. The assembly of claim 1, further comprising: a nose cone upstream of and rotatable with the first propulsor rotor; a tip of the nose cone axially aligned with or axially recessed from a leading edge of the outer structure.

14. The assembly of claim 1, further comprising a pylon projecting radially out from the outer structure.

15. The assembly of claim 1, further comprising: an airframe structure; an aircraft propulsion system mounted to the airframe structure, the aircraft propulsion system including the first propulsor rotor, the powerplant and the propulsion system housing; and a second bypass flowpath formed by and between the outer structure and the airframe structure, the second bypass flowpath extending axially along the outer structure and the airframe structure outside of the aircraft propulsion system.

16. The assembly of claim 15, wherein the airframe structure is configured as a fuselage of a blended wing body aircraft.

17. The assembly of claim 15, wherein the aircraft propulsion system is disposed in a recess in the airframe structure.

18. The assembly of claim 1, wherein a corner between a leading edge of the outer structure and a circumferential side of the outer structure is eased.

19. An assembly for an aircraft, comprising: an airframe structure; an aircraft propulsion system mounted to the airframe structure, the aircraft propulsion system including a first propulsor rotor, a powerplant, a propulsion system housing and a powerplant bypass flowpath, the powerplant configured to drive rotation of the first propulsor rotor about an axis, the propulsion system housing including an inner structure and an outer structure, the inner structure housing the powerplant, the outer structure housing a first circumferential sector of the first propulsor rotor with a remaining second circumferential sector of the first propulsor rotor exposed to an environment outside of the aircraft propulsion system, and the powerplant bypass flowpath between the inner structure and the outer structure and bypassing the powerplant; and a propulsion system bypass flowpath between the outer structure and the airframe structure and bypassing the aircraft propulsion system.

20. An assembly for an aircraft, comprising: a first propulsor rotor; a powerplant configured to drive rotation of the first propulsor rotor about an axis; and a propulsion system housing including an inner structure, an outer structure and a plurality of guide vanes with a bypass flowpath radially between the inner structure and the outer structure, the bypass flowpath downstream of the first propulsor rotor and extending axially along the inner structure and the outer structure within the propulsion system housing, the inner structure circumscribing the powerplant, the outer structure extending circumferentially about the first propulsor rotor and the inner structure between opposing circumferential sides of the outer structure, each of the opposing circumferential sides of the outer structure exposed to an environment outside of the propulsion system housing, and each of the plurality of guide vanes extending radially across the bypass flowpath from the inner structure to the outer structure.