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AIRCRAFT VERTICAL STABILIZER WITH MOVEABLE PROPULSION SYSTEM(S)

Abstract

An assembly is provided for an aircraft. This assembly includes a vertical stabilizer, a first turbine engine, a second turbine engine and an actuation system. The vertical stabilizer extends spanwise from a stabilizer base to a stabilizer tip. The vertical stabilizer extends longitudinally from a stabilizer leading edge to a stabilizer trailing edge. The vertical stabilizer extends laterally between a stabilizer first side and a stabilizer second side. The first turbine engine is movably mounted to the vertical stabilizer at the stabilizer first side. The second turbine engine is moveably mounted to the vertical stabilizer at the stabilizer second side. The actuation system is configured to move the first turbine engine and the second turbine engine relative to the vertical stabilizer.

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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 propulsion system arrangements for the aircraft.

2. Background Information

[0002] Various propulsion system arrangements for an aircraft are known in the art. While these known propulsion system arrangements 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 vertical stabilizer, a first turbine engine, a second turbine engine and an actuation system. The vertical stabilizer extends spanwise from a stabilizer base to a stabilizer tip. The vertical stabilizer extends longitudinally from a stabilizer leading edge to a stabilizer trailing edge. The vertical stabilizer extends laterally between a stabilizer first side and a stabilizer second side. The first turbine engine is movably mounted to the vertical stabilizer at the stabilizer first side. The second turbine engine is moveably mounted to the vertical stabilizer at the stabilizer second side. The actuation system is configured to move the first turbine engine and the second turbine engine relative to the vertical stabilizer.

[0004] According to another aspect of the present disclosure, another assembly is provided for an aircraft. This assembly includes a vertical stabilizer, a first propulsion system, a second propulsion system and an actuation system. The vertical stabilizer extends spanwise from a stabilizer base to a stabilizer tip. The vertical stabilizer extends longitudinally from a stabilizer leading edge to a stabilizer trailing edge. The vertical stabilizer extends laterally between a stabilizer first side and a stabilizer second side. The first propulsion system includes a first propulsor rotor rotatable about a first axis. The first propulsion system is movably coupled to the vertical stabilizer at the stabilizer first side. The second propulsion system includes a second propulsor rotor rotatable about a second axis. The second propulsion system is movably coupled to the vertical stabilizer at the stabilizer second side. The actuation system is configured to move the first axis and the second axis relative to the vertical stabilizer.

[0005] According to still another aspect of the present disclosure, another assembly is provided for an aircraft. This assembly includes an aircraft body, a vertical stabilizer, a first turbine engine and an actuation system. The aircraft body extends along a centerline from a body forward end to a body aft end. The aircraft body is configured as or otherwise includes a fuselage. The vertical stabilizer projects vertically out from the aircraft body. The first turbine engine is movably mounted with the vertical stabilizer. The first turbine engine includes a first engine rotating assembly rotatable about a first engine axis. The first engine rotating assembly includes a first engine turbine rotor. The actuation system is configured to change an angle between the first engine axis and the centerline by moving the first turbine engine relative to the vertical stabilizer.

[0006] The assembly may also include a second turbine engine movably mounted with the vertical stabilizer. The second turbine engine may include a second engine rotating assembly rotatable about a second engine axis that is offset from the first engine axis. The second engine rotating assembly may include a second engine turbine rotor. The actuation system may also be configured to change an angle between the second engine axis and the centerline by moving the second turbine engine relative to the vertical stabilizer.

[0007] The first propulsor rotor may be a first ducted propulsor rotor. The second propulsor rotor may be a second ducted propulsor rotor.

[0008] The first propulsion system may be configured as or otherwise include a first turbine engine. The second propulsion system may be configured as or otherwise include a second turbine engine.
[0009] The actuation system may be configured to move the first turbine engine and the second turbine engine together.
[0010] The first turbine engine and the second turbine engine may each be pivotally mounted to the vertical stabilizer.
[0011] The actuation system may be configured to: pivot the first turbine engine about a first pivot axis; and pivot the second turbine engine about a second pivot axis that is concentric with the first pivot axis.
[0012] The assembly may also include an aircraft body extending along a centerline between a body forward end and a body aft end. The first turbine engine may include a first engine rotating assembly rotatable about a first engine axis. The first engine rotating assembly may include a first engine turbine rotor. The actuation system may be configured to change an angle between the first engine axis and the centerline by moving the first turbine engine relative to the vertical stabilizer. The second turbine engine may include a second engine rotating assembly rotatable about a second engine axis. The second engine rotating assembly may include a second engine turbine rotor. The actuation system may be configured to change an angle between the second engine axis and the centerline by moving the second turbine engine relative to the vertical stabilizer.
[0013] The assembly may also include a first horizontal stabilizer and a second horizontal stabilizer. The first horizontal stabilizer may project out from the stabilizer first side to the first turbine engine. The second horizontal stabilizer may project out from the stabilizer second side to the second turbine engine.
[0014] The assembly may also include a first horizontal stabilizer and a second horizontal stabilizer. The first horizontal stabilizer may be moveably mounted to the vertical stabilizer at the stabilizer first side. The first turbine engine may be fixedly mounted to the first horizontal stabilizer. The second horizontal stabilizer may be moveably mounted to the vertical stabilizer at the stabilizer second side. The second turbine engine may be fixedly mounted to the second horizontal stabilizer.
[0015] The actuation system may be configured as or otherwise include a linear actuator in the vertical stabilizer. The linear actuator may be configured to move the first turbine engine and the second turbine engine together relative to the vertical stabilizer.
[0016] The assembly may also include an aircraft body extending along a centerline between a body forward end and a body aft end. The vertical stabilizer may be connected to the aircraft body at the body aft end. The vertical stabilizer may project vertically out from a gravitational top side of the aircraft body.
[0017] The assembly may also include a first aircraft propulsion system and a second aircraft propulsion system. The first aircraft propulsion system may be mounted to the aircraft body at the gravitational top side of the aircraft body. The second aircraft propulsion system may be mounted to the aircraft body at the gravitational top side of the aircraft body with the vertical stabilizer located laterally between the first aircraft propulsion system and the second aircraft propulsion system.
[0018] The aircraft body may be configured as or otherwise include a fuselage.
[0019] The aircraft body may be configured as a blended wing body.
[0020] The first turbine engine may be configured as or otherwise include a first turbofan engine. The second turbine engine may be configured as or otherwise include a second turbofan engine.
[0021] The assembly may also include a control system configured to control operation of the first turbine engine and the second turbine engine to concurrently provide equal levels of thrust.
[0022] The assembly may also include a control system configured to control operation of the first turbine engine and the second turbine engine to concurrently provide different levels of thrust.
[0023] The present disclosure may include any one or more of the individual features disclosed

above and/or below alone or in any combination thereof.

[0024] 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

[0025] FIG. **1** is a plan view illustration of an aircraft.

[0026] FIG. **2** is a side view illustration of the aircraft.

[0027] FIG. **3** is a rear end view illustration of the aircraft.

[0028] FIG. **4**A is a partial side view illustration of a section of the aircraft along a first side of a vertical stabilizer.

[0029] FIG. **4**B is a partial side view illustration of a section of the aircraft along a second side of the vertical stabilizer.

[0030] FIG. **5** is a plan view illustration of an empennage with multiple secondary propulsion systems.

[0031] FIG. **6** is an end view illustration of the empennage with the secondary propulsion systems.

[0032] FIGS. **7**A-C are partial side view illustrations of a section of the aircraft along the vertical stabilizer with a respective secondary propulsion system in various positions.

[0033] FIG. **8** is a schematic illustration of the secondary propulsion systems with a control system.

[0034] FIG. **9** is a side sectional schematic illustration of a turbofan turbine engine.

DETAILED DESCRIPTION

[0035] FIG. **1** illustrates a blended wing body (BWB) aircraft **20**. This aircraft **20** includes an airframe **22**, one or more primary propulsion systems **24**A and **24**B (generally referred to as "**24**") and one or more secondary propulsion systems **25**A and **25**B (generally referred to as "**25**"). The aircraft airframe **22** includes a body **26** (e.g., a fuselage), one or more wings **28**A and **28**B (generally referred to as "**28**"), a vertical stabilizer **30** and one or more horizontal stabilizers **32**A and **32**B (generally referred to as "**30**"). Briefly, the vertical stabilizer **30** and the horizontal stabilizers **32** may form an empennage of the aircraft airframe **22**.

[0036] The aircraft body **26** extends longitudinally along a longitudinal centerline **34** between and to an upstream, forward end **36** 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 or ten 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**.

[0037] The aircraft wings **28**A and **28**B of FIGS. **1** and **3** are arranged to the opposing lateral sides **44**A and **44**B 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**A, **28**B 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**A, **28**B. At the wing tip **46**A, **46**B, the respective aircraft wing **28**A, **28**B may (or may not) be configured with a winglet **48**A, **48**B. Each of the aircraft wings **28** of FIG. **1** extends longitudinally along a mean line of the respective aircraft wing **28** from a leading edge **50** of the respective aircraft wing **28** to a trailing edge **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.

[0038] The vertical stabilizer **30** of FIGS. **1** and **3** is disposed along the body top side **42**. This vertical stabilizer **30** is arranged laterally between the primary propulsion systems **24** longitudinally at (e.g., on, adjacent or proximate) the body aft end **38**. The vertical stabilizer **30** is connected to (e.g., fixed to) the aircraft body **26** at the body top side **42**.

[0039] The vertical stabilizer **30** may be configured as or may otherwise include a stationary vane. The vertical stabilizer **30** of FIGS. **4**A and **4**B, for example, projects spanwise along a span line **54** of the vertical stabilizer **30** (e.g., vertically) away from the aircraft body **26** and its body top side **42**. More particularly, the vertical stabilizer **30** of FIGS. **4**A and **4**B projects spanwise out from an exterior surface **56** (e.g., an outermost aero surface) of the aircraft body **26** at the body top side **42** to a distal tip **58** of the vertical stabilizer **30**. The vertical stabilizer **30** extends longitudinally along a mean line **60** (e.g., a chord line where the vertical stabilizer **30** is symmetrical) of the vertical stabilizer **30** from a leading edge **62** of the vertical stabilizer **30** to a trailing edge **64** of the vertical stabilizer **30**. Referring to FIG. **5**, the vertical stabilizer **30** extends laterally (e.g., perpendicular to the vertical stabilizer mean line **60**) between and to opposing lateral sides **66**A and **66**B (generally referred to as "**66**") of the vertical stabilizer **30**. These vertical stabilizer lateral sides **66** extend longitudinally along the vertical stabilizer mean line **60** between and meet at the vertical stabilizer leading edge **62** and the vertical stabilizer trailing edge **64**. Referring to FIGS. **4**A and **4**B, each of the vertical stabilizer elements **62**, **64**, **66**A and **66**B extends spanwise from a base **68** of the vertical stabilizer **30** at the body top side **42** to the vertical stabilizer tip **58**.

[0040] Referring to FIG. **6**, the horizontal stabilizers **32**A and **32**B are arranged to the opposing lateral sides **66**A and **66**B of the vertical stabilizer **30**. The horizontal stabilizers **32** of FIG. **6** are arranged vertically at or near the vertical stabilizer tip **58**. However, it is contemplated the horizontal stabilizers **32** may alternatively be spaced vertically further down from vertical stabilizer tip **58**.

[0041] Referring to FIG. **5**, each of the horizontal stabilizers **32** may be configured as or otherwise include a movable vane. Each of the horizontal stabilizers **32**A, **32**B of FIG. **5**, for example, projects spanwise along a span line **70** of the respective horizontal stabilizer **32** (e.g., laterally relative to the centerline **34**) away from the vertical stabilizer **30** and its respective vertical stabilizer lateral side **66**A, **66**B. More particularly, each of the horizontal stabilizers **32**A, **32**B of FIG. **5** projects spanwise out from the vertical stabilizer **30** at its respective vertical stabilizer lateral side **66**A, **66**B to a respective one of the secondary propulsion systems **25**A, **25**B. Each of the horizontal stabilizers **32** extends longitudinally along a mean line **72** (e.g., a chord line where the respective horizontal stabilizer **32** has no camber) of the respective horizontal stabilizer **32** from a leading edge **74** of the horizontal stabilizer **32** to a trailing edge **76** of the respective horizontal stabilizer **32**. Referring to FIG. **6**, each of the horizontal stabilizers **32** extends (e.g., vertically) between and to vertically opposing bottom and top sides **78** and **80** of the respective horizontal stabilizer **32**. These horizontal stabilizer vertical sides **78** and **80** extend longitudinally along the respective horizontal stabilizer mean line **72** (see FIG. **5**) between and meet at the respective horizontal stabilizer leading edge **74** and the respective horizontal stabilizer trailing edge **76**.

[0042] Each of the horizontal stabilizers **32** is movably mounted to the vertical stabilizer **30**. Each of the horizontal stabilizers **32** of FIG. **5**, for example, is pivotally mounted to the vertical stabilizer **30** through a pivot coupling **82**A, **82**B (generally referred to as "**82**") (e.g., a pin connection) at a base of the respective horizontal stabilizer **32**. Each of the horizontal stabilizers **32** is configured to pivot about a respective pivot axis **84**A, **84**B (generally referred to as "**84**") of the respective pivot coupling **82**A, **82**B, where the pivot axes **84** of FIG. **5** are coaxial with one another. However, it is contemplated the pivot axes **84** may alternatively be angularly offset from one another (e.g., swept aft) while still being longitudinally and vertically aligned along the vertical stabilizer **30**.

[0043] Referring to FIGS. **7**A-C, each horizontal stabilizer **32** is operatively coupled to an actuation system **86**. This actuation system **86** is configured to move each horizontal stabilizer **32** relative to the vertical stabilizer **30** and, thus, the aircraft body **26**. The actuation system **86** of FIGS. **7**A-C, for example, is configured to pivot each horizontal stabilizer **32** about the pivot axis **84** such that the respective horizontal stabilizer leading edge **74** moves vertically up and down along the vertical stabilizer **30**. Of course, the actuation system **86** may also or alternatively pivot each horizontal stabilizer **32** about the pivot axis **84** such that the respective horizontal stabilizer trailing edge **76** moves vertically up and down along the vertical stabilizer **30**.
[0044] The actuation system **86** of FIGS. **7**A-C includes a linear actuator **88** housed within the vertical stabilizer **30**; see also FIG. **5**. A movable member **90** of the linear actuator **88** is pivotally connected to each vertical stabilizer **30** at a location that is spanwise spaced from the respective pivot coupling **82** and its pivot axis **84**. The linear actuator **88** may thereby move its movable member **90** vertically up or down to push or pull the respective horizontal stabilizer leading edge **74** up or down. An example of the linear actuator **88** is a leadscrew, where the movable member **90** is a leadscrew nut block. Here, the single linear actuator **88** is provided to move (e.g., pivot) both of the horizontal stabilizers **32** of FIGS. **5** and **6**. Movement of the horizontal stabilizers **32** is thereby synchronized and the same. It is contemplated, however, the actuation system **86** may alternatively include a plurality of linear actuators, where each linear actuator independently moves a respective one of the horizontal stabilizers **32**. Moreover, while the actuation system **86** is described above with the linear actuator **88** (or multiple linear actuators), it is contemplated other types of actuators may alternatively be utilized.
[0045] Referring to FIG. **1**, each of the primary propulsion systems **24** is connected to (e.g., fixed to) the aircraft body **26** at the body top side **42** and the body aft end **38**. These primary propulsion systems **24** may be located longitudinally upstream, forward of the secondary propulsion systems **25** along the centerline **34**. The primary propulsion systems **24** are arranged to the opposing lateral sides of the vertical stabilizer **30**. The first primary propulsion system **24**A of FIG. **1**, for example, is spaced laterally from the vertical stabilizer **30** at the vertical stabilizer first side **66**A by a lateral first distance. The second primary propulsion system **24**B of FIG. **1** is spaced laterally from the vertical stabilizer **30** at the vertical stabilizer second side **66**B by a lateral second distance, which second distance may be equal to the first distance. The vertical stabilizer **30** may thereby be arranged laterally midway between the primary propulsion systems **24**. The vertical stabilizer **30** of FIG. **1** may also longitudinally overlap a portion or an entirety of each primary propulsion system **24** along the centerline **34**.
[0046] Each primary propulsion system **24** of FIG. **1** is configured as a ducted rotor aircraft propulsion system. Examples of the ducted rotor aircraft propulsion system include, but are not limited to, a turbofan propulsion system and a turbojet propulsion system. Each primary propulsion system **24** of FIG. **1**, for example, includes an aircraft powerplant **92** and a ducted bladed rotor **94** (e.g., a propulsor rotor such as a fan rotor, a first stage compressor rotor, etc.) rotationally driven by the aircraft powerplant **92**. The aircraft powerplant **92** may be configured as or otherwise include a turbine engine powered by traditional fuels or alternative fuels (e.g., sustainable aviation fuel, liquid or gaseous hydrogen (H.sub.2), etc.). Alternatively, the aircraft powerplant **92** may be configured as or otherwise include a rotary engine (e.g., a Wankel cycle engine), a hybrid-electric engine, or any other internal combustion (IC) engine or electric motor operable to drive rotation of the bladed rotor **94**. The present disclosure, however, is not limited to the foregoing exemplary primary propulsion system and/or powerplant types or configurations. It is contemplated, for example, each primary propulsion system **24** may alternatively be configured as an open rotor aircraft propulsion system. Examples of the open rotor aircraft propulsion system include, but are not limited to, a pusher fan propulsion system and a propfan propulsion system.
[0047] Referring to FIG. **5**, each of the secondary propulsion systems **25** is connected to (e.g., fixed to) a respective one of the horizontal stabilizers **32** at, for example, an outer distal end of the

respective horizontal stabilizer **32**. Each of the secondary propulsion systems **25** is thereby movably (e.g., pivotally) mounted to the vertical stabilizer **30** through the respective horizontal stabilizer **32** and its respective pivot coupling **82**. Each of the secondary propulsion systems **25** is also moveable relative to the vertical stabilizer **30** and, thus, the aircraft body **26** using the actuation system **86** of FIGS. **7**A-C.

[0048] Each secondary propulsion system **25** of FIG. **5** is configured as a ducted rotor aircraft propulsion system. Examples of the ducted rotor aircraft propulsion system include, but are not limited to, a turbofan propulsion system and a turbojet propulsion system. Each secondary propulsion system **25** of FIG. **5**, for example, includes an aircraft powerplant **96** and a ducted bladed rotor **98** (e.g., a propulsor rotor such as a fan rotor, a first stage compressor rotor, etc.) rotationally driven by the aircraft powerplant **96**. The aircraft powerplant **96** may be configured as or otherwise include a turbine engine powered by traditional fuels or alternative fuels (e.g., sustainable aviation fuel, liquid or gaseous hydrogen (H.sub.2), etc.). Alternatively, the aircraft powerplant **96** may be configured as or otherwise include a rotary engine (e.g., a Wankel cycle engine), a hybrid-electric engine, or any other internal combustion (IC) engine or electric motor operable to drive rotation of the bladed rotor **98**. The present disclosure, however, is not limited to the foregoing exemplary secondary propulsion system and/or powerplant types or configurations. It is contemplated, for example, each secondary propulsion system **25** may alternatively be configured as an open rotor aircraft propulsion system. Examples of the open rotor aircraft propulsion system include, but are not limited to, a pusher fan propulsion system and a propfan propulsion system.

[0049] During operation of the aircraft **20** of FIG. **1**, the primary propulsion systems **24** are operated to provide a majority of or even all (during certain operating modes) aircraft thrust for aircraft flight. The primary propulsion systems **24** may be sized such that the aircraft **20** may fly solely under primary propulsion system power. The secondary propulsion systems **25** may be operated, on the other hand, to enhance aircraft operation. The secondary propulsion systems **25**, for example, may be operated to boost aircraft thrust during certain relatively high thrust maneuvers. Examples of these relatively high thrust maneuvers include, but are not limited to, aircraft takeoff, aircraft climb and/or high speed aircraft flight. The secondary propulsion systems **25** may also or alternatively be operated to enhance aircraft maneuvering, particularly where the aircraft is a blended wing body aircraft. The actuation system **86** of FIGS. **7**A-C, for example, may be operated to selectively vector secondary propulsion system thrust. For example, where the actuation system **86** moves the horizontal stabilizer leading edge **74** vertically up to the position of FIG. **7**B, a rotational axis **100** of the bladed rotor **98** of each secondary propulsion system **25** is (e.g., positively) acutely angled relative to the centerline **34**. Here, the secondary propulsion system thrust may facilitate pitching the aircraft **20** and its body forward end **36** (see FIG. **2**) vertically down; e.g., towards ground. In another example, where the actuation system **86** moves the horizontal stabilizer leading edge **74** vertically down to the position of FIG. **7**C, the rotational axis **100** of the bladed rotor **98** of each secondary propulsion system **25** is (e.g., negatively) acutely angled relative to the centerline **34**. Here, the secondary propulsion system thrust may facilitate pitching the aircraft **20** and its body forward end **36** (see FIG. **2**) vertically up; e.g., away from the ground. Thus, by moving the secondary propulsion system **25** relative to the vertical stabilizer **30** and, thus, the aircraft body **26**, the secondary propulsion system thrust may be used to change and/or trim the aircraft pitch.

[0050] FIG. **8** illustrates a control system **102** for the secondary propulsion systems **25**. This control system **102** may be configured as or otherwise include an onboard engine controller; e.g., an electronic engine controller (EEC), an electronic control unit (ECU), a full-authority digital engine controller (FADEC), etc. The control system **102** is in signal communication with (e.g., hardwired and/or wirelessly coupled to) various system components for each secondary propulsion system **25**. The control system **102** of FIG. **8** is configured to control operation of the secondary propulsion systems **25**. The control system **102**, for example, may signal the secondary propulsion systems **25** to concurrently provide equal levels of thrust. In another example, the control system **102** may signal the secondary propulsion systems **25** to concurrently provide different levels of thrust. By providing different levels of thrust, the secondary propulsion systems **25** may be used to change or trim aircraft yaw. The control system **102** may also be in signal communication with and configured to control operation of the actuation system **86** of FIGS. **5** and **7**A-C.

[0051] FIG. **9** illustrates an exemplary one of the secondary propulsion systems **25**. This secondary propulsion system **25** of FIG. **9** is configured as a turbofan turbine engine **104**. The secondary propulsion system **25** of FIG. **9**, for example, extends axially along a centerline axis **106** (e.g., the axis) between an upstream airflow inlet **108** and a downstream airflow exhaust **110**. The secondary propulsion system **25** of FIG. **9** includes a fan section **112**, a compressor section **113**, a combustor section **114** and a turbine section **115**. The turbine section **115** includes a high pressure turbine (HPT) section **115**A and a low pressure turbine (LPT) section **115**B, which LPT section **115**B may also be referred to as a power turbine (PT) section.

[0052] The engine sections **112-115**B are arranged within an engine housing **118**. This engine housing **118** includes an inner housing structure **120** and an outer housing structure **122**. The inner housing structure **120** may house one or more of the engine sections **113-115**B; e.g., a core of the turbine engine **104**. The outer housing structure **122** may house at least the fan section **112**. The inner and the outer housing structures **120** and **122** of FIG. **9** also form a bypass duct.

[0053] Each of the engine sections **112**, **113**, **115**A and **115**B includes a respective bladed rotor **124-127**. The fan rotor **124** (e.g., the bladed rotor **98**) is connected to and driven by the LPT rotor **127** through a low speed shaft **130**. At least (or only) the fan rotor **124**, the LPT rotor **127** and the low speed shaft **130** may collectively form a low speed rotating assembly. The compressor rotor **125** is connected to and driven by the HPT rotor **126** through a high speed shaft **132**. At least (or only) the compressor rotor **125**, the HPT rotor **126** and the high speed shaft **132** may collectively form a high speed rotating assembly. The engine shafts **130** and **132** are rotatably supported by a plurality of bearings (not shown) about the centerline axis **106** (e.g., the axis). Each of these bearings is connected to the engine housing **118** by at least one stationary structure.

[0054] During operation, air enters the secondary propulsion system **25** of FIG. **9** through the airflow inlet **108**. This air is directed through the fan section **112** and into a core flowpath **134** and a bypass flowpath **136**. The core flowpath **134** extends sequentially through the engine sections **113-115**B. The air within the core flowpath **134** may be referred to as “core air”. The bypass flowpath **136** extends through the bypass duct, which bypasses (e.g., flows along and outside of) the engine core. The air within the bypass flowpath **136** may be referred to as “bypass air”.

[0055] The core air is compressed by the compressor rotor **125** and directed into a combustion chamber **138** (e.g., annular combustion chamber) of a combustor **140** (e.g., annular combustor) in the combustor section **114**. Fuel is injected into the combustion chamber **138** and mixed with the compressed core air to provide a fuel-air mixture. This fuel air mixture is ignited and combustion products thereof flow through and sequentially cause the HPT rotor **126** and the LPT rotor **127** to rotate. The rotation of the HPT rotor **126** drives rotation of the compressor rotor **125** and, thus, compression of the air received from a core airflow inlet. The rotation of the LPT rotor **127** drives rotation of the fan rotor **124**. The rotation of the fan rotor **124** propels the bypass air through and out of the bypass flowpath **136** to provide a majority of the second propulsion system thrust. Some of the second propulsion system thrust may also come from the combustion products exhausted from the core flowpath **134**.

[0056] Each secondary propulsion system **25** may be configured as or otherwise include various turbine engines other than the one described above. The turbine engine **104**, for example, may be a geared turbine engine or a direct drive turbine engine. The turbine engine **104** may include a single spool, two spools (e.g., see FIG. **9**), or more than two spools. Moreover, while the turbine engine **104** is shown in FIG. **9** as the turbofan turbine engine, the turbine engine **104** may alternatively be

configured as a turbojet turbine engine or any other suitable turbine engine.
[0057] In some embodiments, referring to FIGS. **7**A-C, the actuation system **86** is coupled to each secondary propulsion system **25** through the respective horizontal stabilizer **32**. However, in other embodiments, each secondary propulsion system **25** may alternatively be independently movably (e.g., pivotally) mounted to the vertical stabilizer **30** such that the respective secondary propulsion system **25** may move independent of the respective horizontal stabilizer **32**. Moreover, in still other embodiments, each secondary propulsion system **25** may alternatively be mounted to the vertical stabilizer **30** without the respective horizontal stabilizer **32** therebetween; e.g., the horizontal stabilizers **32** may be omitted or arranged elsewhere. With such embodiments, each secondary propulsion system **25** may be movably (e.g., pivotally) mounted to the vertical stabilizer **30** though, for example, a respective pylon structure.
[0058] In some embodiments, one or more of the secondary propulsion systems **25** may (or may not) also be configured as an auxiliary power unit (APU) for the aircraft **20**. One or more of the secondary propulsion systems **25**, for example, may be configured to generate electricity for use elsewhere in the aircraft **20**. One or more of the secondary propulsion systems **25** may also or alternatively be configured to provide bleed air to one or more other aircraft systems; e.g., compressed air for starting the primary propulsion systems **24**, compressed air for an aircraft environmental control system (ECS), etc.
[0059] 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: an aircraft body extending along a centerline between a body forward end and a body aft end; a vertical stabilizer extending spanwise from a stabilizer base to a stabilizer tip, the vertical stabilizer extending longitudinally from a stabilizer leading edge to a stabilizer trailing edge, the vertical stabilizer extending laterally between a stabilizer first side and a stabilizer second side, the vertical stabilizer connected to the aircraft body at the body aft end, and the vertical stabilizer projecting vertically out from a gravitational top side of the aircraft body; a first turbine engine movably mounted to the vertical stabilizer at the stabilizer first side; a second turbine engine moveably mounted to the vertical stabilizer at the stabilizer second side; an actuation system configured to move the first turbine engine and the second turbine engine relative to the vertical stabilizer; a first aircraft propulsion system mounted to the aircraft body at the gravitational top side of the aircraft body; and a second aircraft propulsion system mounted to the aircraft body at the gravitational top side of the aircraft body with the vertical stabilizer located laterally between the first aircraft propulsion system and the second aircraft propulsion system.
2. The assembly of claim 1, wherein the actuation system is configured to move the first turbine engine and the second turbine engine together.
3. The assembly of claim 1, wherein the first turbine engine and the second turbine engine are each pivotally mounted to the vertical stabilizer.
4. The assembly of claim 1, wherein the actuation system is configured to pivot the first turbine engine about a first pivot axis; and pivot the second turbine engine about a second pivot axis that is concentric with the first pivot axis.
5. The assembly of claim 1, further comprising: the first turbine engine comprising a first engine

rotating assembly rotatable about a first engine axis, the first engine rotating assembly comprising a first engine turbine rotor, and the actuation system configured to change an angle between the first engine axis and the centerline by moving the first turbine engine relative to the vertical stabilizer; and the second turbine engine comprising a second engine rotating assembly rotatable about a second engine axis, the second engine rotating assembly comprising a second engine turbine rotor, and the actuation system configured to change an angle between the second engine axis and the centerline by moving the second turbine engine relative to the vertical stabilizer.
6. The assembly of claim 1, further comprising: a first horizontal stabilizer projecting out from the stabilizer first side to the first turbine engine; and a second horizontal stabilizer projecting out from the stabilizer second side to the second turbine engine.
7. The assembly of claim 1, further comprising: a first horizontal stabilizer moveably mounted to the vertical stabilizer at the stabilizer first side, and the first turbine engine fixedly mounted to the first horizontal stabilizer; and a second horizontal stabilizer moveably mounted to the vertical stabilizer at the stabilizer second side, and the second turbine engine fixedly mounted to the second horizontal stabilizer.
8. The assembly of claim 1, wherein the actuation system comprises a linear actuator in the vertical stabilizer; and the linear actuator is configured to move the first turbine engine and the second turbine engine together relative to the vertical stabilizer.
9. (canceled)
10. (canceled)
11. The assembly of claim 1, wherein the aircraft body comprises a fuselage.
12. The assembly of claim 1, wherein the aircraft body is configured as a blended wing body.
13. The assembly of claim 1, wherein the first turbine engine comprises a first turbofan engine; and the second turbine engine comprises a second turbofan engine.
14. The assembly of claim 1, further comprising a control system configured to control operation of the first turbine engine and the second turbine engine to concurrently provide equal levels of thrust.
15. The assembly of claim 1, further comprising a control system configured to control operation of the first turbine engine and the second turbine engine to concurrently provide different levels of thrust.
16. An assembly for an aircraft, comprising: a vertical stabilizer extending spanwise from a stabilizer base to a stabilizer tip, the vertical stabilizer extending longitudinally from a stabilizer leading edge to a stabilizer trailing edge, and the vertical stabilizer extending laterally between a stabilizer first side and a stabilizer second side; a first propulsion system comprising a first ducted propulsor rotor rotatable about a first axis, the first propulsion system movably coupled to the vertical stabilizer at the stabilizer first side; a second propulsion system comprising a second ducted propulsor rotor rotatable about a second axis, the second propulsion system movably coupled to the vertical stabilizer at the stabilizer second side; and an actuation system configured to move the first axis and the second axis relative to the vertical stabilizer.
17. (canceled)
18. The assembly of claim 16, wherein the first propulsion system comprises a first turbine engine; and the second propulsion system comprises a second turbine engine.
19. An assembly for an aircraft, comprising: an aircraft body extending along a centerline from a body forward end to a body aft end, the aircraft body comprising a fuselage; a vertical stabilizer projecting vertically out from the aircraft body; a first turbine engine movably mounted with the vertical stabilizer, the first turbine engine comprising a first engine rotating assembly rotatable about a first engine axis, and the first engine rotating assembly comprising a first engine turbine rotor; an actuation system configured to change an angle between the first engine axis and the centerline by moving the first turbine engine relative to the vertical stabilizer; and a first aircraft propulsion system mounted to the aircraft body at a gravitational top side of the aircraft body.
20. The assembly of claim 19, further comprising: a second turbine engine movably mounted with

the vertical stabilizer, the second turbine engine comprising a second engine rotating assembly rotatable about a second engine axis that is offset from the first engine axis, and the second engine rotating assembly comprising a second engine turbine rotor; and the actuation system further configured to change an angle between the second engine axis and the centerline by moving the second turbine engine relative to the vertical stabilizer.