



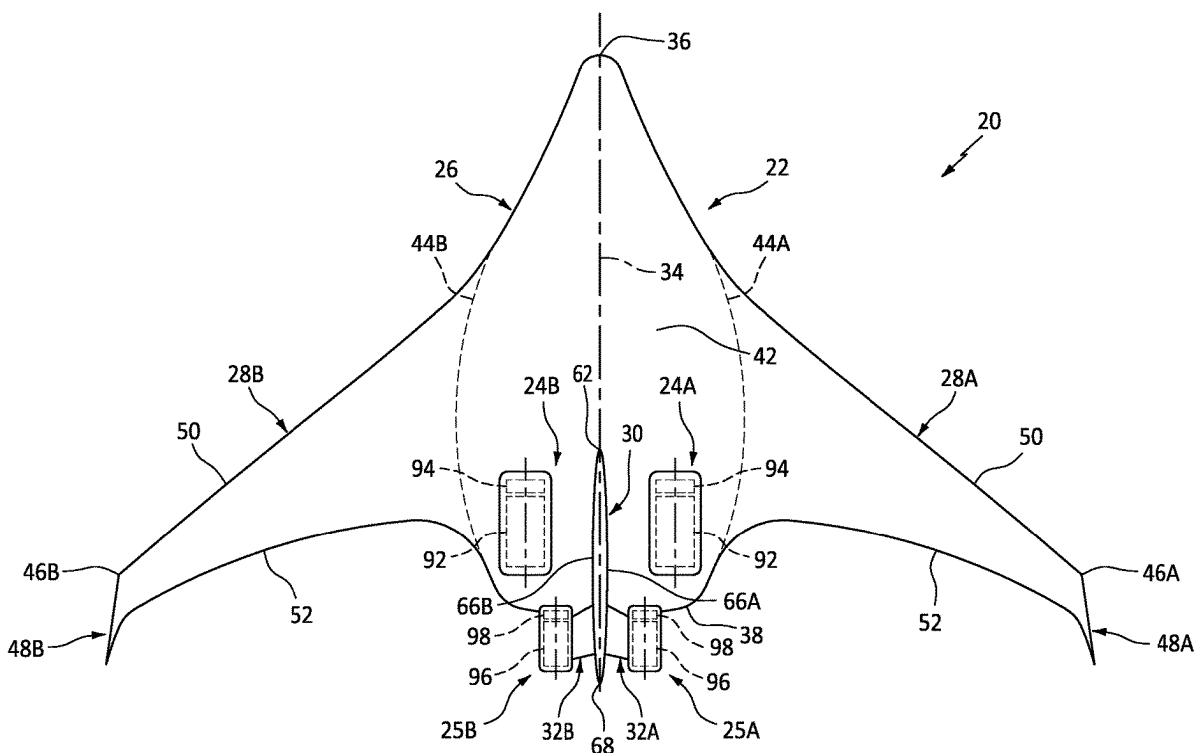
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(19) **United States**(12) **Patent Application Publication**
Kupratis et al.(10) **Pub. No.: US 2025/0256833 A1**(43) **Pub. Date: Aug. 14, 2025**(54) **AIRCRAFT VERTICAL STABILIZER WITH
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(57)

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.



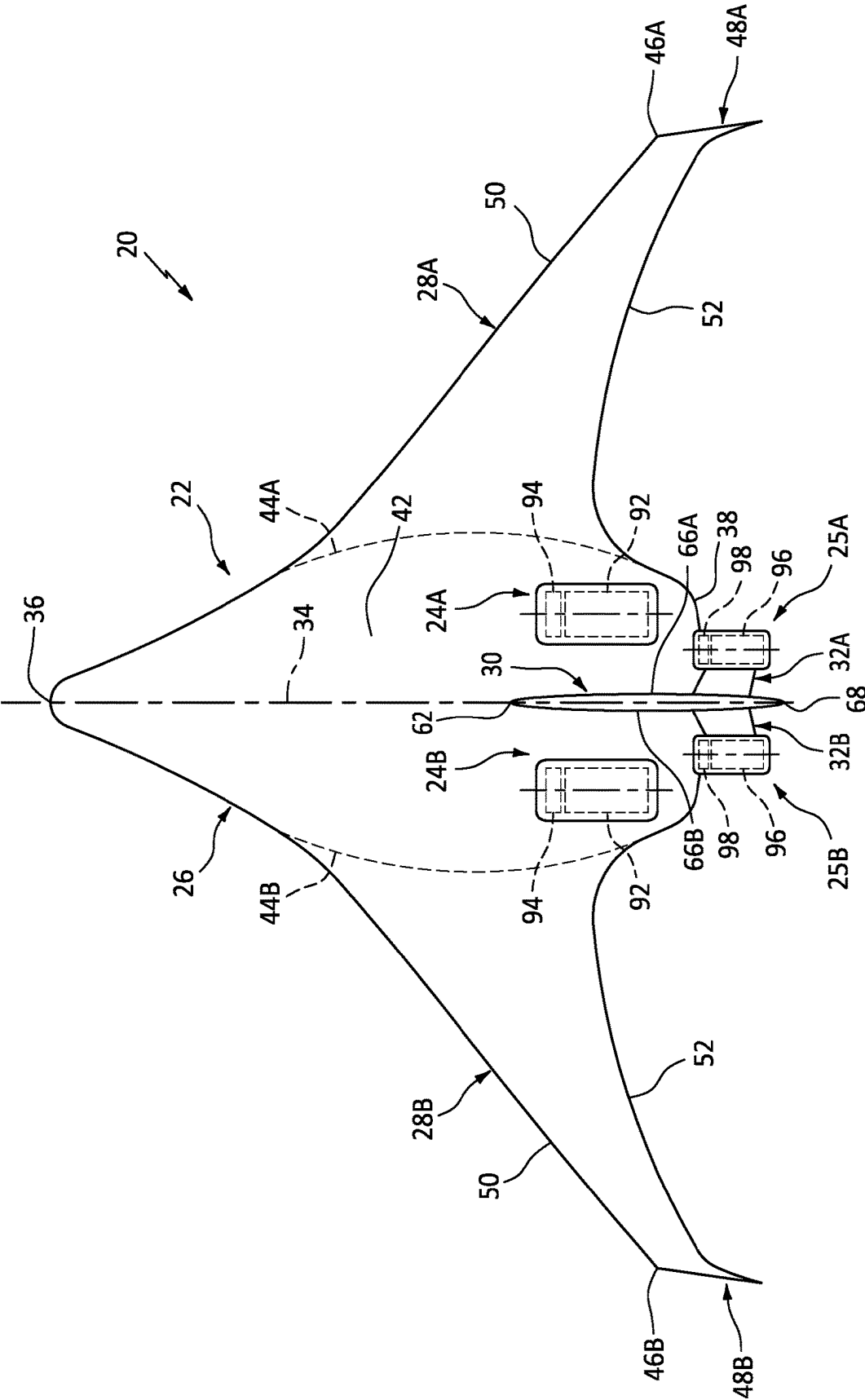


FIG. 1

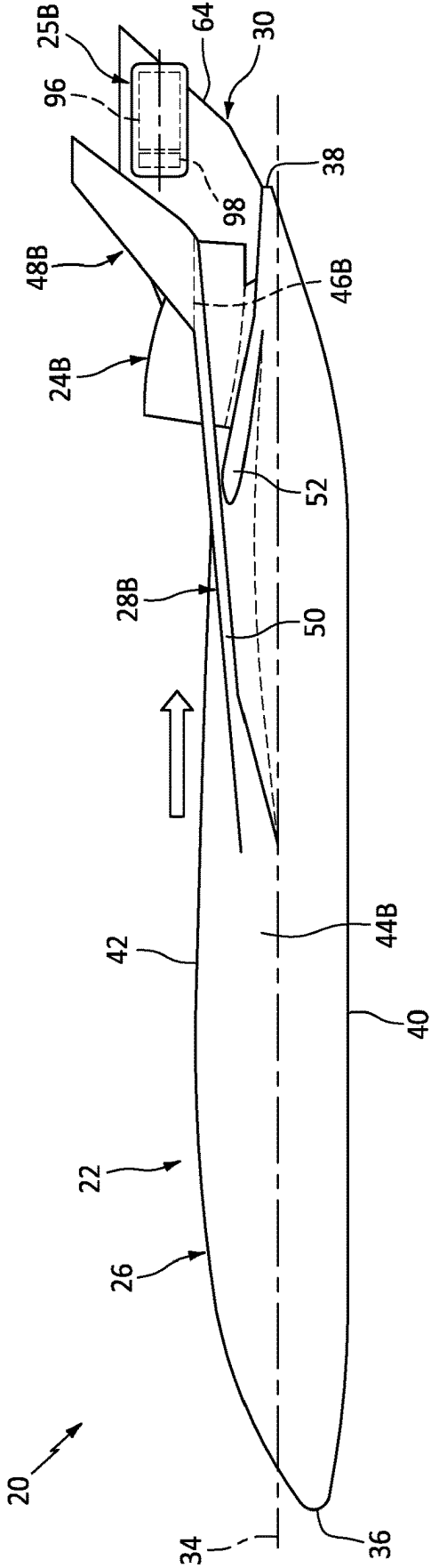
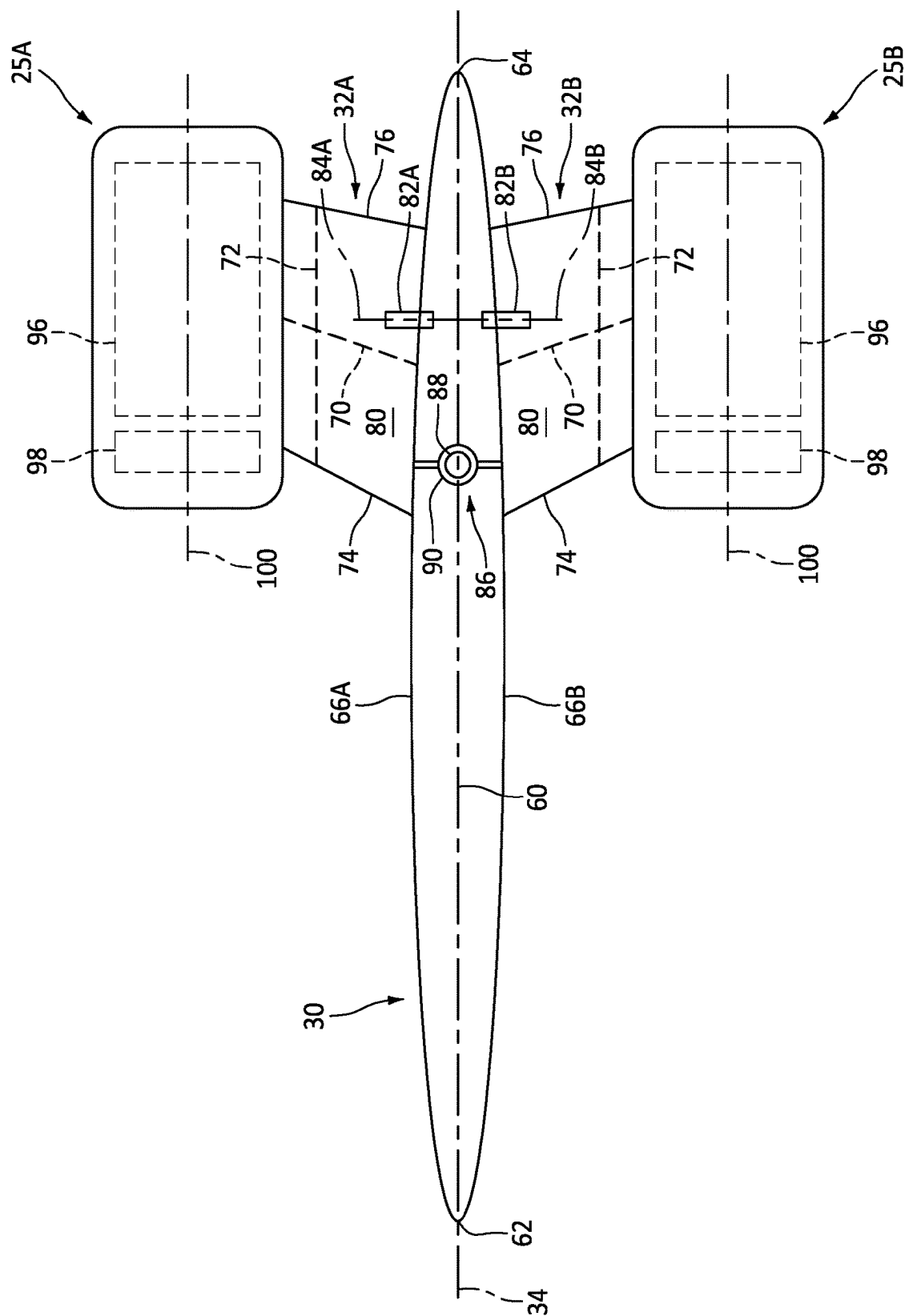


FIG. 2



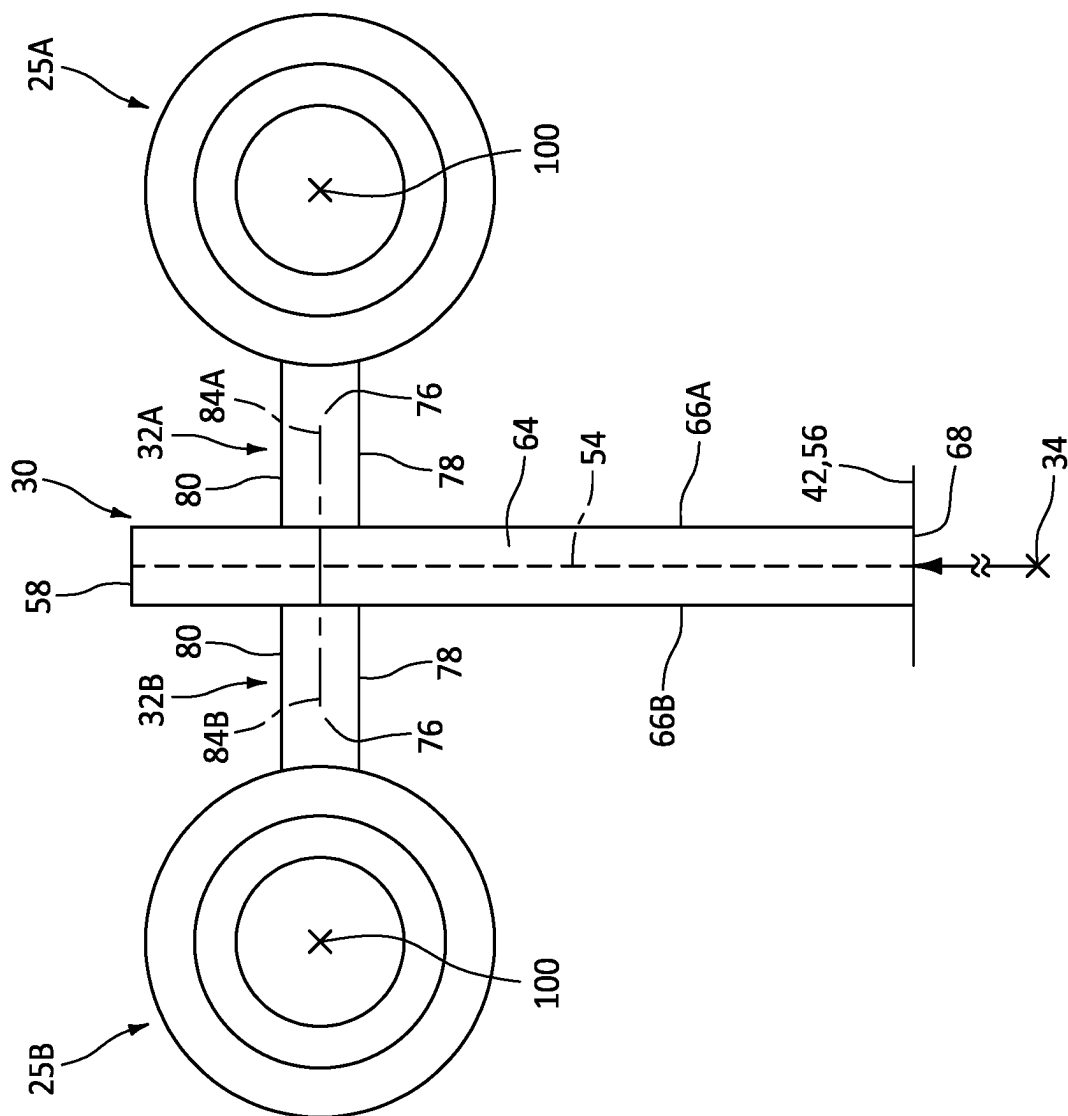


FIG. 6

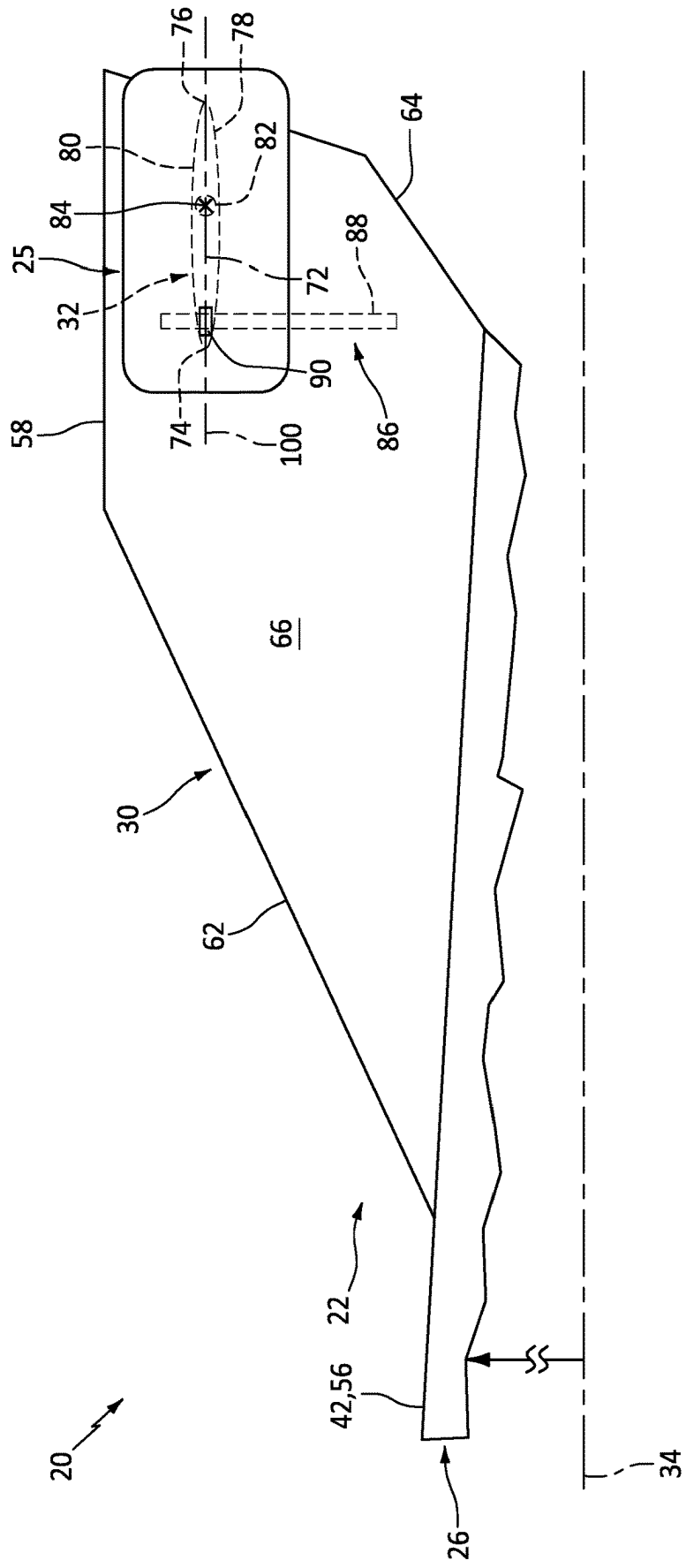
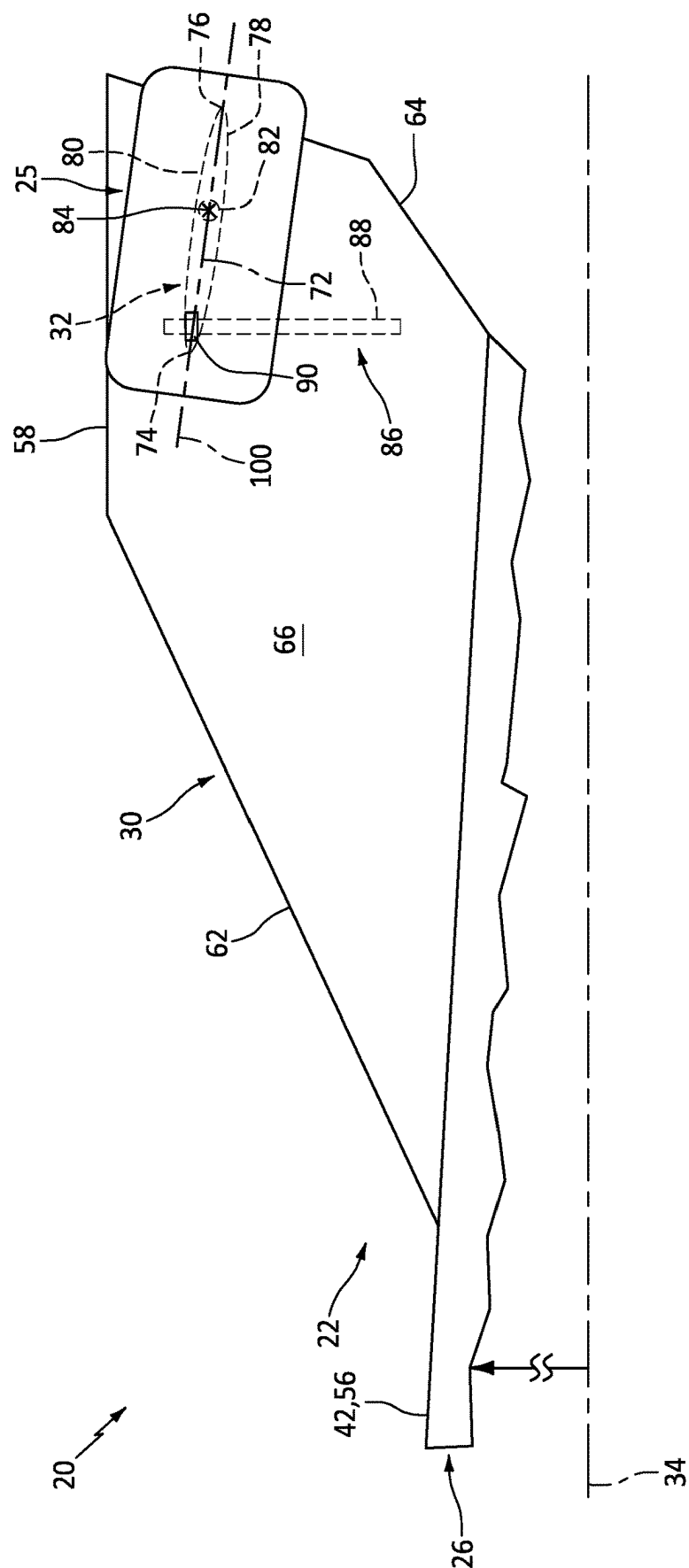


FIG. 7A



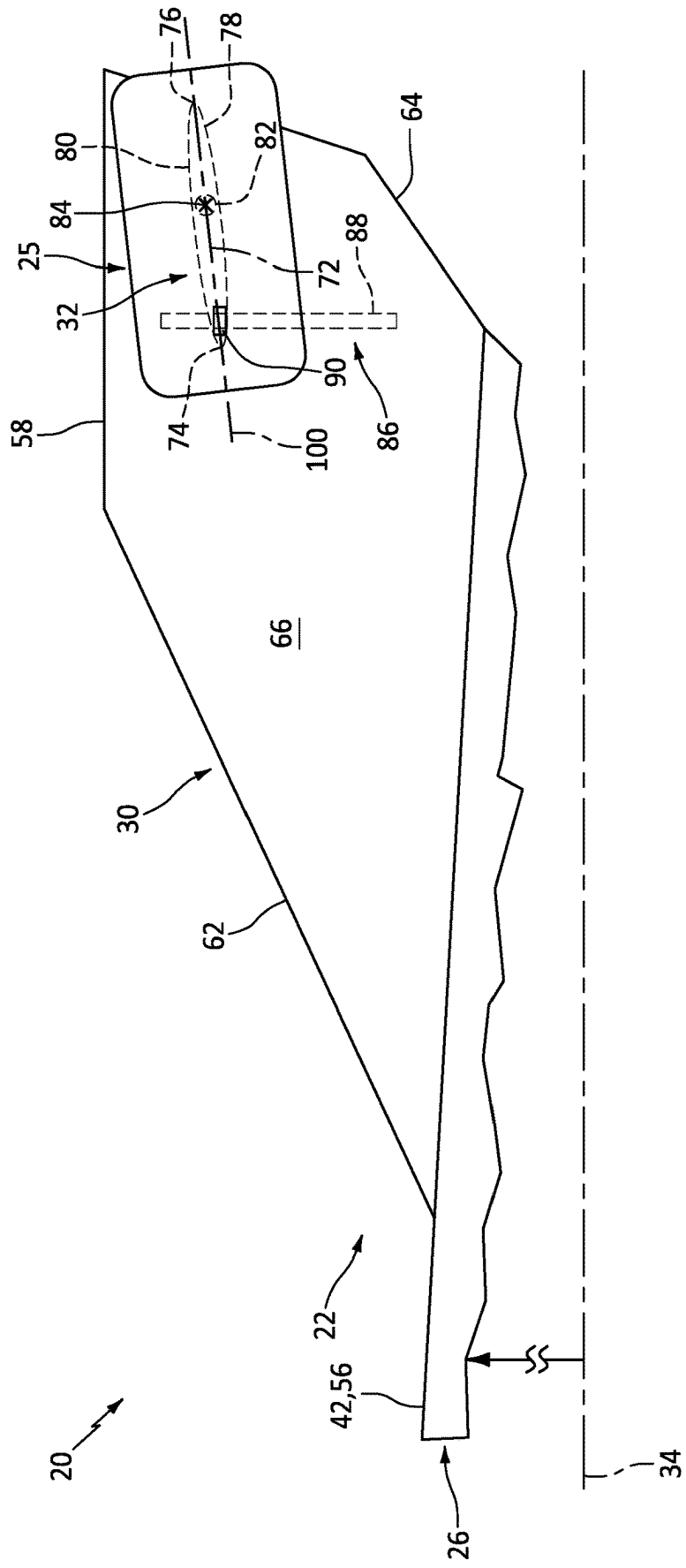


FIG. 7C

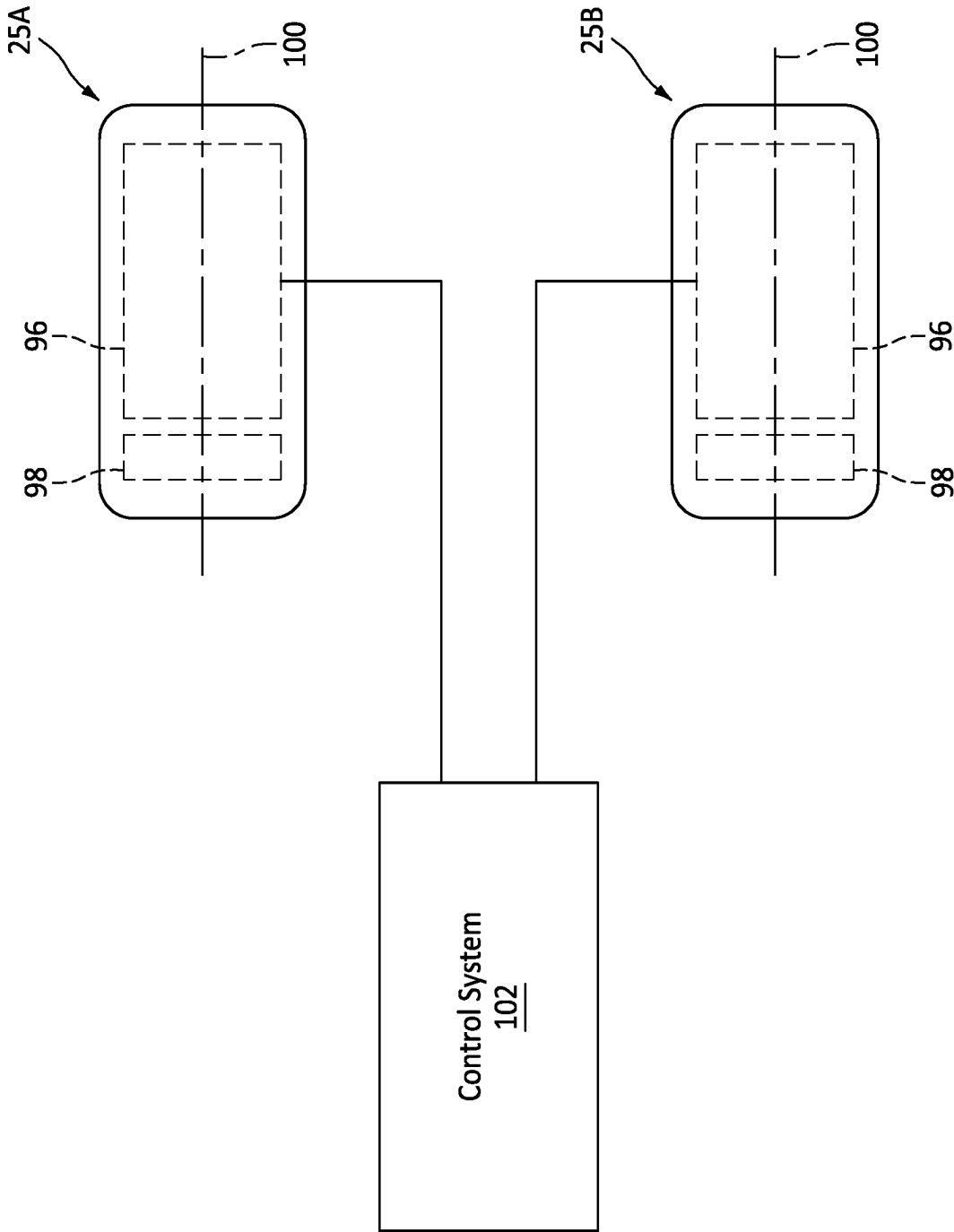


FIG. 8

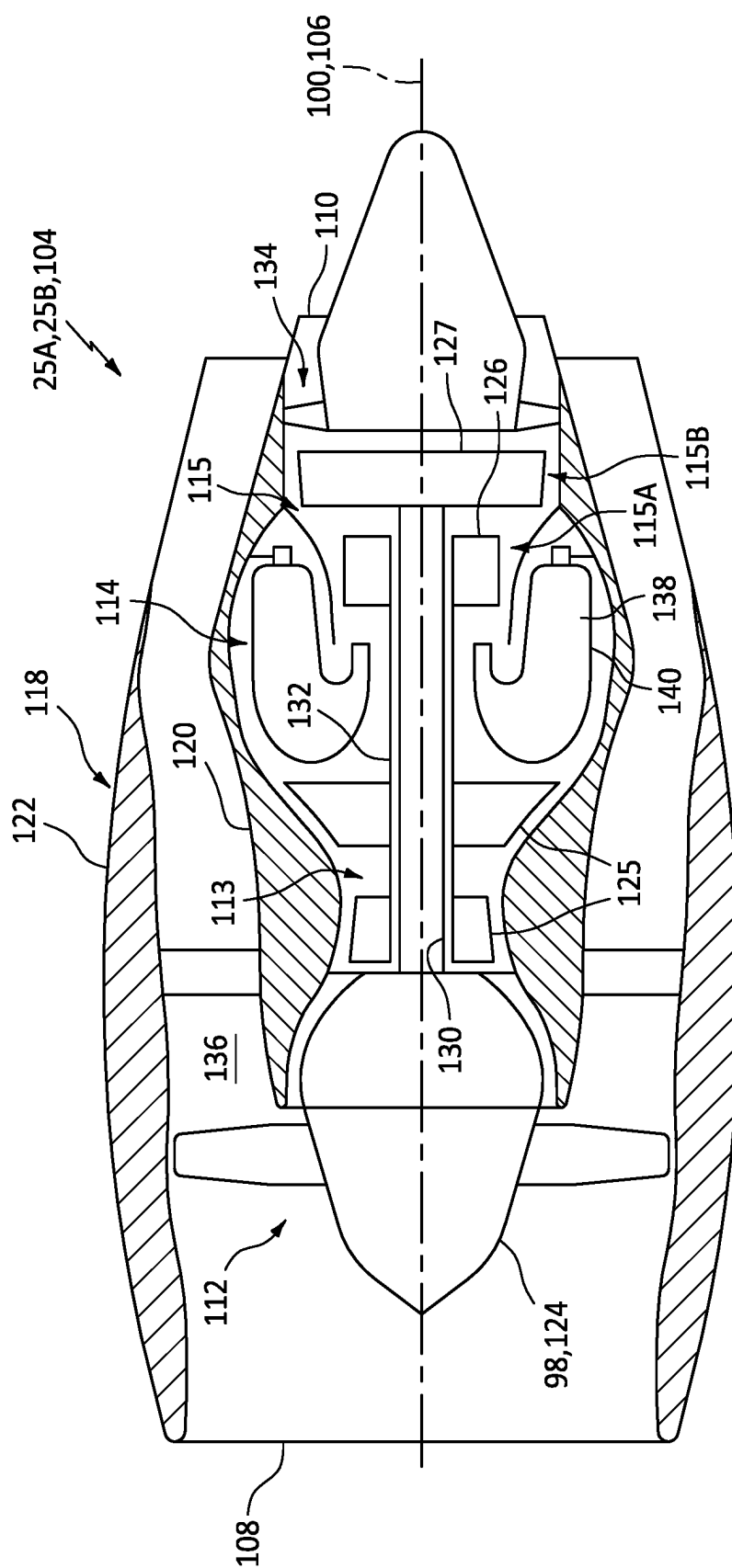


FIG. 9

AIRCRAFT VERTICAL STABILIZER WITH MOVEABLE PROPULSION SYSTEM(S)

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.

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. 4A is a partial side view illustration of a section of the aircraft along a first side of a vertical stabilizer.

[0029] FIG. 4B 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. 7A-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 24A and 24B (generally

referred to as “24”) and one or more secondary propulsion systems 25A and 25B (generally referred to as “25”). The aircraft airframe 22 includes a body 26 (e.g., a fuselage), one or more wings 28A and 28B (generally referred to as “28”), a vertical stabilizer 30 and one or more horizontal stabilizers 32A and 32B (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 \pm 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 44A and 44B (generally referred to as “44”) of the aircraft body 26.

[0037] The aircraft wings 28A and 28B of FIGS. 1 and 3 are arranged to the opposing lateral sides 44A and 44B 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 28A, 28B projects spanwise along a span line of the respective aircraft wing 28A, 28B out from the aircraft body 26, at the respective body lateral side 44A, 44B, to a distal tip 46A, 46B of the respective aircraft wing 28A, 28B. At the wing tip 46A, 46B, the respective aircraft wing 28A, 28B may (or may not) be configured with a winglet 48A, 48B. 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. 4A and 4B, 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. 4A and 4B 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 66A and 66B (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. 4A and 4B, each of the vertical stabilizer elements 62, 64, 66A and 66B 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 32A and 32B are arranged to the opposing lateral sides 66A and 66B 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 32A, 32B 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 66A, 66B. More particularly, each of the horizontal stabilizers 32A, 32B of FIG. 5 projects spanwise out from the vertical stabilizer 30 at its respective vertical stabilizer lateral side 66A, 66B to a respective one of the secondary propulsion systems 25A, 25B. 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 82A, 82B (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 84A, 84B (generally referred to as “84”) of the respective pivot coupling 82A, 82B, 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. 7A-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.

7A-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. 7A-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 24A of FIG. 1, for example, is spaced laterally from the vertical stabilizer 30 at the vertical stabilizer first side 66A by a lateral first distance. The second primary propulsion system 24B of FIG. 1 is spaced laterally from the vertical stabilizer 30 at the vertical stabilizer second side 66B 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 (H₂), 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. 7A-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 (H₂), 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. 7A-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. 7B,

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. 7C, 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 7A-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 **115A** and a low pressure turbine (LPT) section **115B**, which LPT section **115B** may also be referred to as a power turbine (PT) section.

[0052] The engine sections **112-115B** 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 **113-115B**; 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**, **115A** and **115B** 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 **113-115B**. 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. **7A-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.

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.

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