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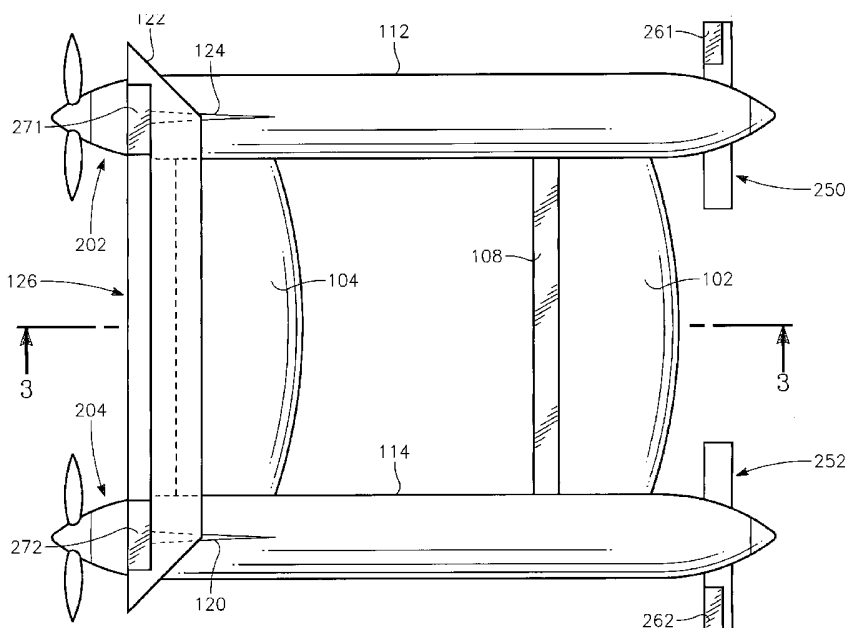
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(54) Title: HIGH-LIFT, LOW-DRAG DUAL FUSELAGE AIRCRAFT



(57) Abstract: Disclosed is an aircraft including forward and aft wings (102,104), interposed between a port fuselage and a starboard fuselage, the port fuselage (112) being substantially parallel to and coplanar with the starboard fuselage (114); a T-tail stabilizer system having a port vertical stabilizer (124), a starboard vertical stabilizer (12), and at least one horizontal stabilizer (122); propulsion systems (202, 204) mounted to each of the fuselages (112, 114); and, in some embodiments, deflectable canards (261, 262), tillable wings (306, 312) and wing-mounted propulsion systems (302, 303).

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*For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.*

**DESCRIPTION****TITLE: HIGH-LIFT, LOW-DRAG DUAL FUSELAGE AIRCRAFT**

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**TECHNICAL FIELD**

The present invention relates to aerial vehicles and more specifically to aircraft having one or more horizontal airfoils having spans bounded in dual fuselage configurations.

10

**BACKGROUND ART**

Aircraft, having multiple fuselages, and amphibious aircraft, having multiple hulls, have been proposed as high lift and low draft air vehicles achieved via one or more horizontal wings bounded on each of their tips by a fuselage. US Patent No. 3,844,432 to Blanchard, Jr. et al. discloses an aircraft having multiple fuselages addressing large nose-down pitching moments generated by the flap high-lift forces. Elevator control is achieved via horizontal tails extended outboard from each to the outmost fuselages. Rudder control is achieved via vertical tails extending upwards from each of the outmost fuselages.

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US Patent No. 3,159,361 to Weiland discloses an amphibious aircraft having multiple fuselages or hulls having interposed between them a forward negatively swept horizontal wing and an aft negatively swept horizontal wing in tandem. The tandem negatively swept horizontal wings each have a pair of pivotally mounted turbo-props. Rudder control is achieved via vertical stabilizers extending upwards from each of the hulls. Elevator control is achieved via a horizontal stabilizer

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above the plane of the tandem wings and connected to upper ends of the vertical stabilizers.

US Patent No. 3,244,246 to Weiland discloses an  
5 amphibious aircraft having multiple fuselages or hulls having interposed between them a forward horizontal wing and an aft horizontal wing in tandem. The tandem horizontal wings exploit ground effects using a plenum volume created via extendable vanes between the underside  
10 of each of the horizontal wings and the ground or water surface. Rudder control is achieved via vertical stabilizers extending upwards from each of the hulls. Elevator control is achieved via a horizontal stabilizer above the plane of the tandem wings and connected to  
15 upper ends of the vertical stabilizers.

There remains a need for aircraft having two or more wings having substantially parallel fuselages at each of the wingtips where turboprops or other propulsion systems  
20 are mounted at the nose or tail of each of the fuselages or where turboprops or other propulsion systems, when mounted on a wing section, the wing section may be articulated to orient the thrust vector. Further, there remains a need for aircraft having two or more wings  
25 having substantially parallel fuselages at each of the wingtips where canards may be used for finer pitch control absent adverse acceleration and aileron-induced roll control.

### 30 **DISCLOSURE OF INVENTION**

The invention in its several embodiments is an aircraft having port and starboard fuselages and at least two wings or bounded airfoils interposed between the fuselages. The port fuselage of the exemplary aircraft

has a substantially cylindrical body with a port centerline, a nose portion, a mid-body portion and a tail portion. A port vertical stabilizer mounted topside and proximate to the tail portion of the port fuselage may be used or a T-tail stabilizer system. Some embodiments have an outboard port canard, proximate to the nose portion of the port fuselage. The outboard port canard may be complemented by an inboard port canard. The outboard port canard may have deflectable panel. A port propulsion unit may be mounted, preferably along the port centerline, at either the nose or the tail of the port fuselage. The starboard fuselage of the exemplary aircraft is substantially parallel to and coplanar with the port fuselage, and the starboard fuselage is also a substantially cylindrical body having a starboard centerline, a nose portion, a mid-body portion and a tail portion. A starboard vertical stabilizer is mounted topside and proximate to the tail portion of the starboard fuselage or T-tail stabilizer may be used. Some embodiments have an outboard starboard canard, proximate to the nose portion of the starboard fuselage. The outboard starboard canard may be complemented by an inboard starboard canard. The outboard starboard canard may have deflectable panel. A starboard propulsion unit may be mounted, preferably along the starboard centerline, at either the nose or the tail of the starboard fuselage. The propulsion unit may be a turbo-prop or a turbojet/turbofan, for example. Preferably a pusher turbo-prop propulsion system is mounted at the tail portion of the fuselages. The exemplary aircraft has a forward wing that may be described as having a leading edge and a trailing edge. The forward wing, as a substantially aerodynamic planar member, spans a region between the mid-body portion of the port fuselage and the

mid-body portion of the starboard fuselage. Accordingly, the fuselages may be described as at the wingtips of the forward wing. The exemplary aircraft also has an aft wing that may be described as having a leading edge and a trailing edge. The aft wing, as a substantially aerodynamic planar member, spans a region between the mid-body portion of the port fuselage and the mid-body portion of the starboard fuselage so that it is substantially parallel to and above the plane of the forward wing and preferably aligned so that the leading edge of the aft wing is aft of the trailing edge of the forward wing. When each fuselage does not have its own respective T-tail stabilizer system, then a horizontal stabilizer spans from an upper section of the port vertical stabilizer to an upper section of the starboard vertical stabilizer.

Other embodiments of the invention include an aircraft having additional propulsion units, preferably a forward wing propulsion unit mounted at substantially the mid-span region of the forward wing and proximate to the leading edge of the forward wing and an aft wing propulsion unit mounted at substantially mid-span of the forward wing and proximate to the leading edge of the aft wing. In some embodiments the forward wing, the aft wing, or both wings are adapted to pivot substantially about the leading edge of each respective wing wherein the trailing edge of the respective wing preferably subtends an angle of less than twenty-one degrees.

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#### **BRIEF DESCRIPTION OF THE DRAWINGS**

For a further understanding of the nature and objects of the present invention, reference should be made to the following detailed description, taken in conjunction with

the accompanying drawings, in which like elements are given the same or analogous reference numbers and wherein:

- 5 FIG. 1. is a top perspective view of an aircraft configuration, in accordance with an embodiment of the present invention;
- FIG. 2 is a top view of an aircraft configuration, in accordance with an embodiment of the present invention;
- 10 FIG. 3A is a side view of an aircraft configuration, in accordance with an embodiment of the present invention;
- FIG. 3B is a side view of an aircraft configuration having tilting wings, in accordance with an embodiment of the present invention;
- 15 FIG. 4A is a front view of an aircraft configuration having a partial T-tail stabilizer system, in accordance with an embodiment of the present invention;
- FIG. 4B is a front view of an aircraft configuration having a full T-tail stabilizer system, in accordance
- 20 with an embodiment of the present invention;
- FIG. 5A is a top view of an aircraft configuration having alternate cockpit locations and propeller locations, in accordance with an embodiment of the present invention);
- FIG. 5B is a top view of a canard-nosecone assembly of a
- 25 fuselage of an aircraft configuration, in accordance with an embodiment of the present invention; and
- FIG. 5C is a side view of an aircraft configuration having a canard system, in accordance with an embodiment of the present invention.

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#### **BEST MODE FOR CARRYING OUT THE INVENTION**

The synergistic arrangement of wings between and bounded by fuselages that may also serve as cargo components of an aircraft provides for optimum aerodynamic and mission

performance including amphibious take off and landing operations. The configurations of the invention improve the operations of current aircraft having conventional wing-fuselage configurations. Such operational

5 improvements may include: an increased in range due to higher lift-to-drag ratios; an increase in payload due to an increase in lift and a reduction in structural weight; an improvement in airport and carrier operations due to significant reductions in wing span; a reduction in take-

10 off speeds and distances due to higher wing lift at low speeds; and a significant reduction in production costs due to manufacturing preferably through composite construction. Preferably, the aircraft configuration of the present invention includes two or more wings located

15 between two aerodynamic cargo bays or fuselages and a tail stabilizer assembly.

FIG 1. illustrates an embodiment of an aircraft configuration **100** including a forward wing **102**, an aft wing **104**, and a T-tail stabilizer system **106**. The forward wing **102** and an aft wing **104** in the preferred embodiment are interposed between two cargo bays or fuselages, namely a port fuselage **112** and a starboard fuselage **114**. Preferably, the aircraft configuration illustrated in

20 FIG. 1 has an entire span that is considerably less than conventional single wing-body aircraft configurations having otherwise similar flight characteristics. The forward wing **102** and aft wing **104**, which are generally of equal length or span, have at least one forward wing flap

25 **108** and at least one aft wing flap **110**, respectively. In some embodiments of the invention, the aircraft configuration includes three or more wings. In other embodiments, the wings may each have one or more leading edge flaps.

The T-tail stabilizer system **106** of the embodiment illustrated in FIG. **1** includes a port vertical stabilizer/tail **124** having a port rudder (not shown), a  
5 starboard stabilizer/tail **118** having a starboard rudder **120** and a horizontal stabilizer **122** having at least one elevator **126**.

FIG. **2** is a top, planform, view of an embodiment of the  
10 present aircraft invention where exemplary propulsion and where roll control surfaces are shown. Illustrated in FIG. **2** is a port propulsion system **202**, shown as a propeller pusher system, located at the rear of the port fuselage **112**, and a starboard propulsion system **204**,  
15 shown also as a propeller pusher system, located at the rear of the starboard fuselage **114**. The propulsion systems **202**, **204** and associated control systems may be any of a number of subsonic propulsion systems known to those of ordinary skill in the art including piston  
20 engines and jet engines, for example. The embodiment illustrated in FIG. **2** also has a port canard assembly **250** and a starboard canard assembly **252**. Also shown in FIG. **2** are surfaces that may be deflected as ailerons. Some embodiments may have an outboard port canard aileron  
25 panel **261** and an outboard starboard canard aileron panel **262**, some embodiments may have a port aileron panel **271** and starboard aileron panel **272** as part of the horizontal stabilizer **122**, and others may use all four panels.

30 FIG. **3A** is a transverse view of an aircraft configuration of FIG. **2**. as indicated by **3**. FIG. **3A** further illustrates the respective locations of the forward wing **102**, the aft wing **104**, and the T-tail stabilizer system **106** in an embodiment of the present invention. In this view the

port rudder **320** can be seen. While the inboard port canard surface is not illustrated in this figure, the port propulsion system **202** is illustrated as a propeller pusher system.

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FIG. **3B** illustrates another embodiment of the present invention where one or more of the wings, in this example the aft wing **104** and forward wing **102**, are tilting wings capable of being rotated approximately 20 degrees in the preferred embodiment about an axis in a horizontal plane perpendicular to the longitudinal axis of each of the fuselages of the aircraft configuration. Each of the wings, as a pivoting and motorized tilting forward wing **306**, having a flap **304** that may be retractable, and as a pivoting and motorized tilting aft wing **312** having a flap **308** that may be retractable, may further include a propulsion system, shown by example as a forward wing propeller **302** and an aft wing propeller **303** each preferably mounted at the leading edge of each wing. The propulsion systems may be turbo-prop systems or turbojet/turbofan systems preferably mounted substantially bisected the span of each wing. Being mounted mid-span may include attached to the wing within a nacelle or otherwise preferably aerodynamically attached with the engine portion shielded by a cowling.

Referring again to FIG. **3B**, the forward tilting wing **306** is illustrated in a substantially horizontal orientation with respect to the direction of flight, while the aft tilting wing **308** is illustrated in an initial horizontal position moving into angled position with steeper angle of attack as shown with a direction arrow. Later in flight, the angle may be restored to level. These tilting wings **306** and **308** allow for maximal exploitation

of the airfoil of the wing and provide re-directable thrust.

FIG. **4A** is a frontal view of an exemplary aircraft configuration illustrating a port T-tail stabilizer system **402** and a starboard T-tail stabilizer system **403** in one embodiment of the present invention. As shown, each of the two fuselages **112**, **114** includes a T-tail stabilizer system **402**, **403** projecting vertically from the upper surface of the fuselage. Centrally disposed at the top of each of the T-tail stabilizer systems **402**, **403** are horizontal stabilizers. The horizontal stabilizers, including the port horizontal stabilizer **406** and the starboard horizontal stabilizer **408**, have separate control surfaces that preferably include individual elevators and may include aileron panels for those embodiments where the elevators are not preferred for small amounts of aileron deflection.

An alternative embodiment of the aircraft configuration as illustrated by example in FIG. **4B**, has a T-tail stabilizer system that is a full T-tail stabilizer system **404** including a horizontal stabilizer **410** in the form of a single, continuous control surface that spans from the port vertical stabilizer **124** to the starboard vertical stabilizer **120**.

FIG. **5A** illustrates a forward portion of the planform view of an exemplary embodiment of the present invention where propulsion systems are mounted to one or more of the wings. In this illustration, a forward propulsion system **518** is mounted on a forward wing **502** and an aft propulsion system is mounted on an aft wing **504**. In some

embodiments, a cockpit **531** for manned flight or for autopilot electronics is integrated into the upper portion of the port fuselage **112**, midway between the forward wing **102** and aft wing **104**. Likewise, in some  
5 embodiments, a cockpit **533** for manned flight or for autopilot electronics is integrated into the upper portion of the starboard fuselage **114**, midway between the forward wing **102** and aft wing **104**. In some embodiments, a cockpit **532** may be centrally located in the forward  
10 wing **102**.

FIG. **5B** is a top planform view of a forward section of a port fuselage **112** of an exemplary embodiment providing further detail of an exemplary port canard-nosecone  
15 assembly **250**. The exemplary canard-nosecone assembly **250** includes a nosecone **581**, an outboard surface **582** and an inboard surface **583**. In this embodiment, a symmetric starboard canard-nosecone assembly **252** is preferably integrated with the starboard fuselage **114**.

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FIG. **5C** illustrates another embodiment of the present invention having for example a port canard system **250** as viewed from the side, and indicated by view **5** of FIG. **5B**, where the canard surfaces are actuated and thereby act as  
25 part of the overall vehicle control system. The direction of motion is indicated by the bidirectional arrow **591**. The outboard port canard **582** may also have an aileron flap **261** (see FIG. **2**). The aileron flap **261** may be used to control and induce rolling motion for the aircraft.

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**CLAIMS:**

We claim:

1. An aircraft comprising:
  - a port fuselage comprising:
    - 5 a substantially cylindrical body having a port centerline, a nose portion, a mid-body portion and a tail portion;
    - a port vertical stabilizer mounted topside and proximate to the tail portion of the port fuselage;
    - 10 an outboard port canard, proximate to the nose portion of the port fuselage, and
    - a port propulsion unit mounted along the port centerline;
    - 15 a starboard fuselage substantially parallel to and coplanar with the port fuselage, the starboard fuselage comprising:
      - a substantially cylindrical body having a starboard centerline, a nose portion, a mid-
      - 20 body portion and a tail portion;
      - a starboard vertical stabilizer mounted topside and proximate to the tail portion of the starboard fuselage;
      - an outboard starboard canard, proximate to the
      - 25 nose portion of the starboard fuselage; and
      - a starboard propulsion unit mounted along the starboard centerline;
    - a forward wing having a leading edge and a trailing edge, the forward wing interposed between the
    - 30 mid-body portion of the port fuselage and the mid-body portion of the starboard fuselage;
    - an aft wing having a leading edge and a trailing edge, the aft wing interposed between the mid-body portion of the port fuselage and the mid-body

- portion of the starboard fuselage and substantially parallel to and above the plane of the forward wing wherein the leading edge of the aft wing is aft of the trailing edge of the forward wing; and
- 5 a horizontal stabilizer spanning from an upper section of the port vertical stabilizer and an upper section of the starboard vertical stabilizer.
- 10 2. The aircraft as claimed in claim 1 further comprising a forward wing propulsion unit mounted at substantially mid-span of the forward wing and proximate to the leading edge of the forward wing and an aft wing propulsion unit mounted at substantially mid-span of the forward wing and
- 15 proximate to the leading edge of the aft wing.
3. The aircraft as claimed in claim 1 wherein the forward wing is adapted to pivot substantially about the leading edge of the forward wing wherein the trailing edge subtends an angle of less than twenty-one degrees.
- 20
4. The aircraft as claimed in claim 1 wherein the outboard port canard has a deflectable aileron panel and the outboard starboard canard has a deflectable aileron
- 25 panel.
5. The aircraft as claimed in claim 1 wherein the port propulsion unit is a turbo-prop system mounted at the nose portion of the port fuselage and the starboard
- 30 propulsion unit is a turbo-prop system mounted at the nose portion of the starboard fuselage.
6. The aircraft as claimed in claim 1 wherein the port propulsion unit is a pusher turbo-prop system mounted at

the tail portion of the port fuselage and the starboard propulsion unit is a pusher turbo-prop system mounted at the tail portion of the starboard fuselage.

5 7. The aircraft as claimed in claim 1 wherein the port fuselage further comprises in inboard canard proximate to the nose portion of the port fuselage and wherein the starboard fuselage further comprises in inboard canard proximate to the nose portion of the starboard fuselage.

10

8. An aircraft comprising:

a port fuselage comprising:

a substantially cylindrical body having a port centerline, a nose portion, a mid-body portion and a tail portion;

15

a port T-tail stabilizer system mounted topside and proximate to the tail portion of the port fuselage;

an outboard port canard, proximate to the nose portion of the port fuselage, and

20

a port propulsion unit mounted along the port centerline;

a starboard fuselage substantially parallel to and coplanar with the port fuselage, the starboard fuselage comprising:

25

a substantially cylindrical body having a starboard centerline, a nose portion, a mid-body portion and a tail portion;

a starboard T-tail stabilizer system mounted topside and proximate to the tail portion of the starboard fuselage;

30

an outboard starboard canard, proximate to the nose portion of the starboard fuselage; and

a starboard propulsion unit mounted along the  
starboard centerline;

a forward wing having a leading edge and a trailing  
edge, the forward wing interposed between the  
5 mid-body portion of the port fuselage and the mid-  
body portion of the starboard fuselage;

an aft wing having a leading edge and a trailing edge,  
the aft wing interposed between the mid-body  
portion of the port fuselage and the mid-body  
10 portion of the starboard fuselage and  
substantially parallel to and above the plane of  
the forward wing wherein the leading edge of the  
aft wing is aft of the trailing edge of the  
forward wing; and

15 a horizontal stabilizer spanning from an upper section  
of the port vertical stabilizer and an upper  
section of the starboard vertical stabilizer.

9. The aircraft as claimed in claim 8 further comprising  
20 a forward wing propulsion unit mounted at substantially  
mid-span of the forward wing and proximate to the leading  
edge of the forward wing and an aft wing propulsion unit  
mounted at substantially mid-span of the forward wing and  
proximate to the leading edge of the aft wing.

25 10. The aircraft as claimed in claim 8 wherein the  
forward wing is adapted to pivot substantially about the  
leading edge of the forward wing wherein the trailing  
edge subtends an angle of less than twenty-one degrees.

30 11. The aircraft as claimed in claim 8 wherein the  
outboard port canard has a deflectable aileron panel and  
the outboard starboard canard has a deflectable aileron  
panel.

12. The aircraft as claimed in claim 8 wherein the port  
propulsion unit is a turbo-prop system mounted at the  
nose portion of the port fuselage and the starboard  
5 propulsion unit is a turbo-prop system mounted at the  
nose portion of the starboard fuselage.

13. The aircraft as claimed in claim 8 wherein the port  
propulsion unit is a pusher turbo-prop system mounted at  
10 the tail portion of the port fuselage and the starboard  
propulsion unit is a pusher turbo-prop system mounted at  
the tail portion of the starboard fuselage.

14. The aircraft as claimed in claim 8 wherein the port  
15 fuselage further comprises in inboard canard proximate to  
the nose portion of the port fuselage and wherein the  
starboard fuselage further comprises in inboard canard  
proximate to the nose portion of the starboard fuselage.

20 15. An aircraft comprising:

a port fuselage comprising:

a substantially cylindrical body having a nose  
portion, a mid-body portion and a tail  
portion;

25 a port vertical stabilizer mounted topside and  
proximate to the tail portion of the port  
fuselage; and

a port propulsion unit mounted proximate to the  
tail portion of the port fuselage;

30 a starboard fuselage substantially parallel to and  
coplanar with the port fuselage, the starboard  
fuselage comprising:

a substantially cylindrical body having a nose portion, a mid-body portion and a tail portion;

5 a starboard vertical stabilizer mounted topside and proximate to the tail portion of the starboard fuselage;

an outboard starboard canard, proximate to the nose portion of the starboard fuselage; and

10 a starboard propulsion unit mounted proximate to the tail portion of the starboard fuselage;

a forward wing having a leading edge and a trailing edge, the forward wing interposed between the mid-body portion of the port fuselage and the mid-body portion of the starboard fuselage;

15 an aft wing having a leading edge and a trailing edge, the aft wing interposed between the mid-body portion of the port fuselage and the mid-body portion of the starboard fuselage and

20 substantially parallel to and above the plane of the forward wing wherein the leading edge of the aft wing is aft of the trailing edge of the forward wing; and

a horizontal stabilizer spanning from an upper section of the port vertical stabilizer and an upper

25 section of the starboard vertical stabilizer.

16. The aircraft as claimed in claim 15 further comprising a forward wing propulsion unit mounted at substantially mid-span of the forward wing and proximate

30 to the leading edge of the forward wing and an aft wing propulsion unit mounted at substantially mid-span of the forward wing and proximate to the leading edge of the aft wing.

17. The aircraft as claimed in claim 15 wherein the forward wing is adapted to pivot substantially about the leading edge of the forward wing wherein the trailing edge subtends an angle of less than twenty-one degrees.

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18. The aircraft as claimed in claim 15 wherein the port fuselage further comprises an outboard port canard extending from the nose portion of the port fuselage and the starboard fuselage further comprises an outboard  
10 starboard canard extending from the nose portion of the starboard fuselage wherein the outboard port canard has a deflectable aileron panel and the outboard starboard canard has a deflectable aileron panel.

15 19. The aircraft as claimed in claim 18 wherein the port fuselage further comprises an inboard canard proximate to the nose portion of the port fuselage and wherein the starboard fuselage further comprises an inboard canard proximate to the nose portion of the starboard fuselage.

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20. The aircraft as claimed in claim 15 wherein the port propulsion unit is a pusher turbo-prop system and the starboard propulsion unit is a pusher turbo-prop system.

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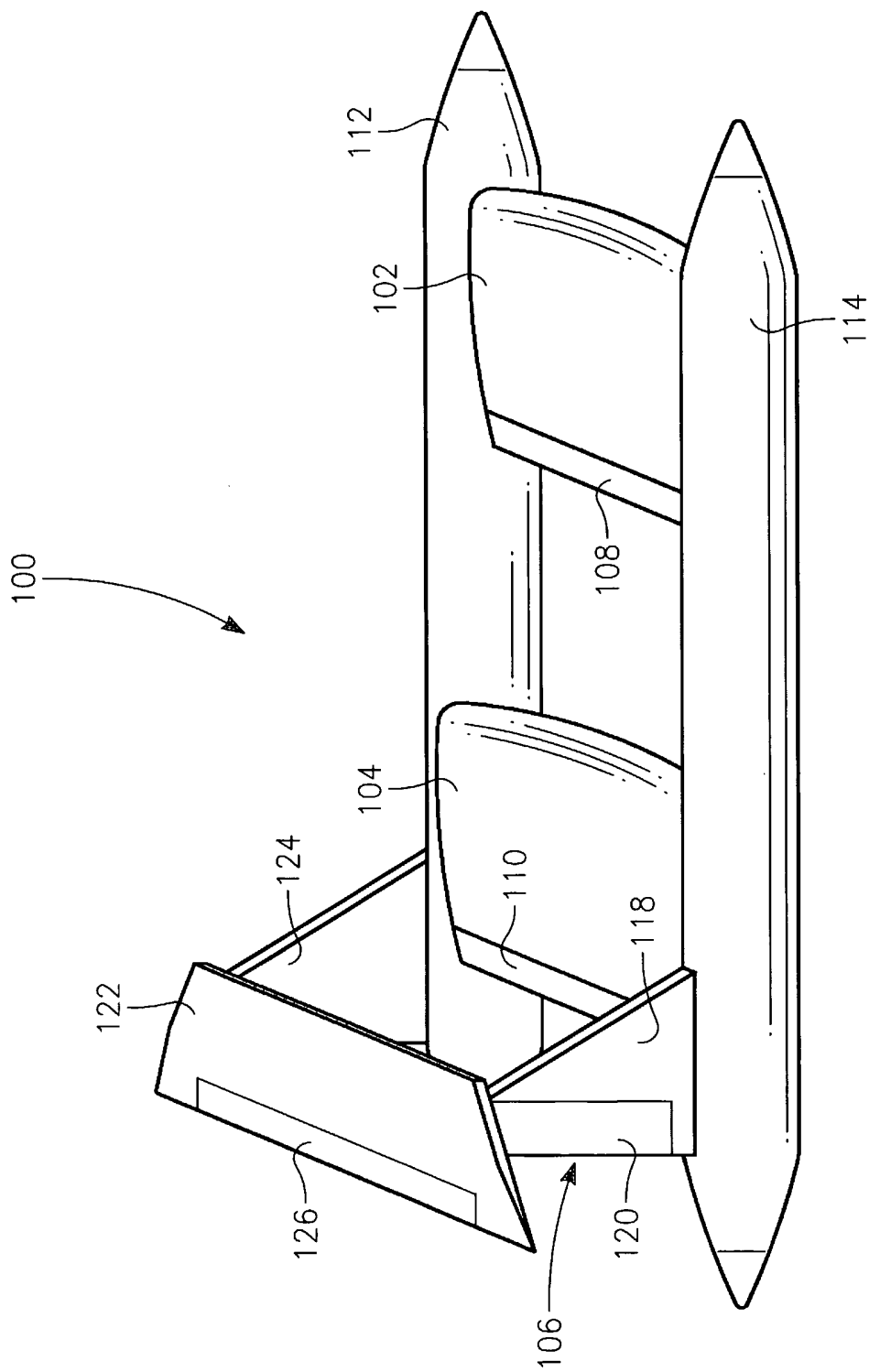


FIG. 1

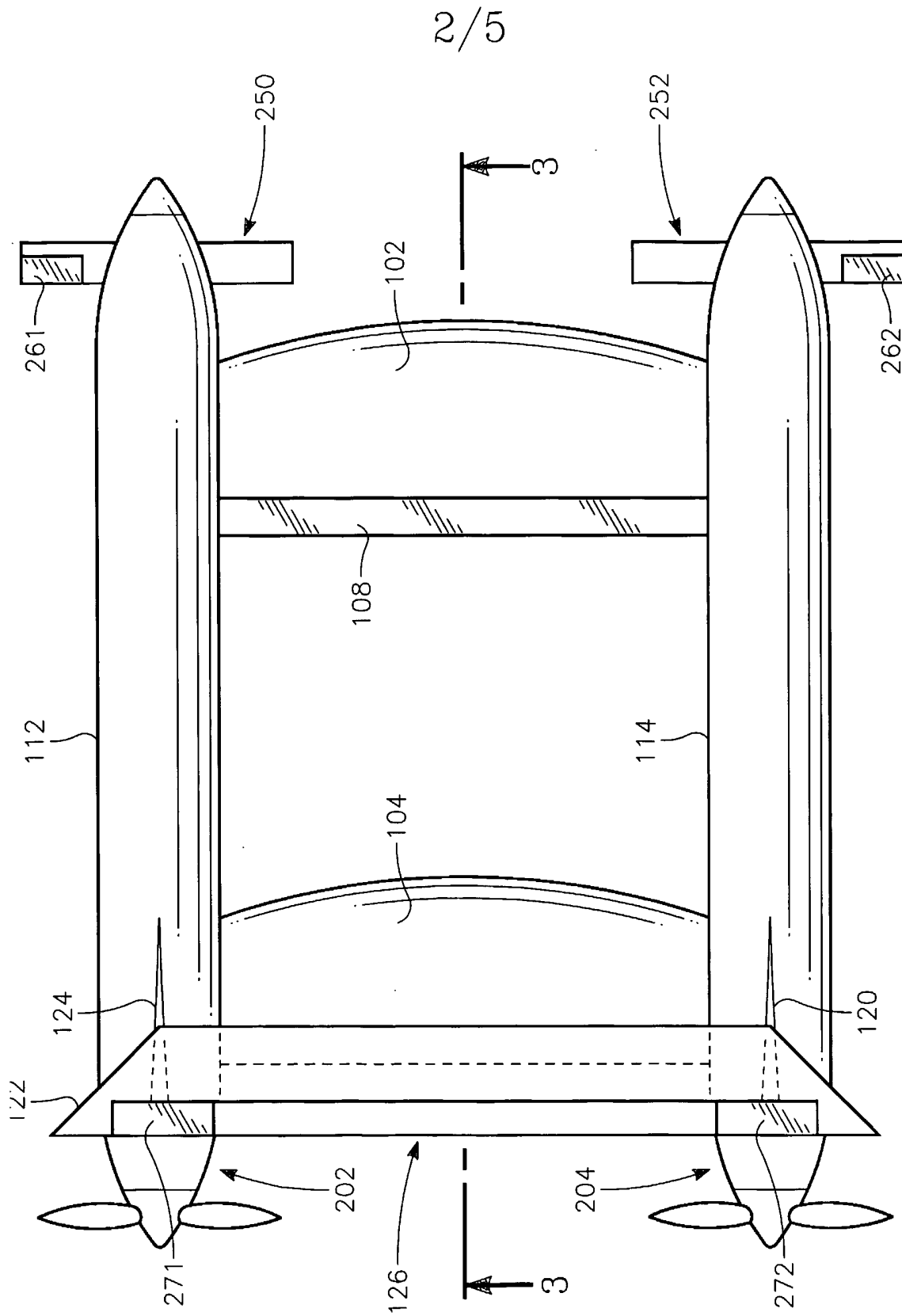


FIG. 2

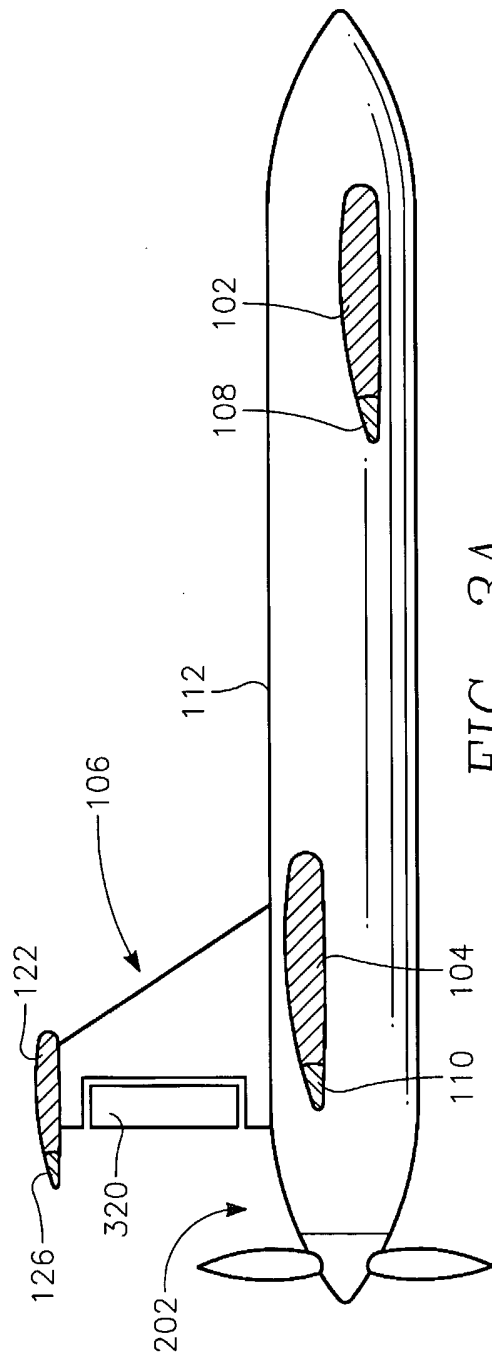


FIG. 3A

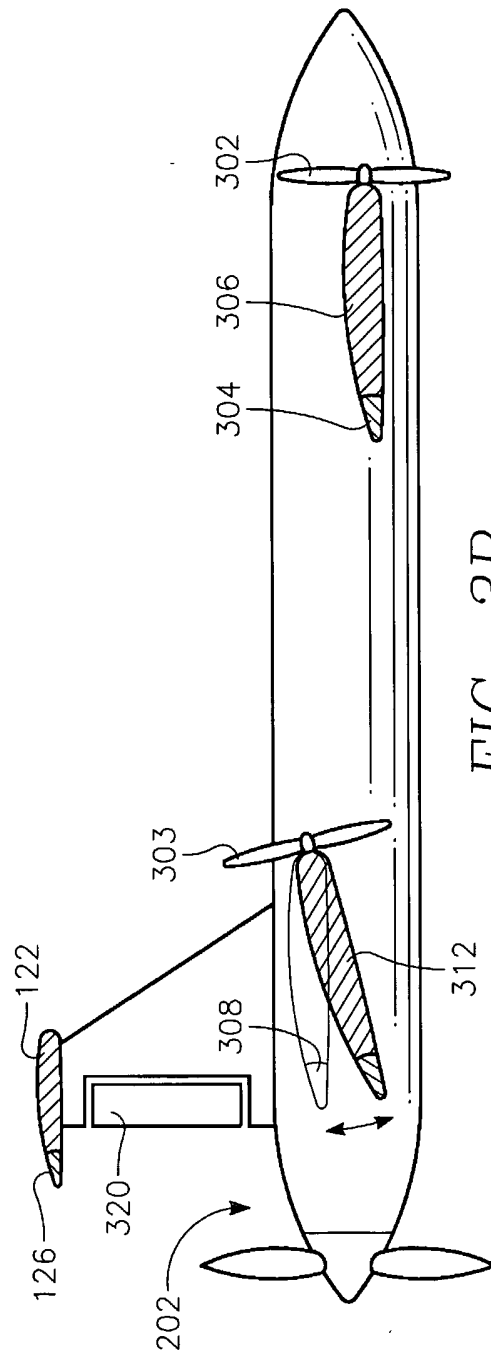


FIG. 3B

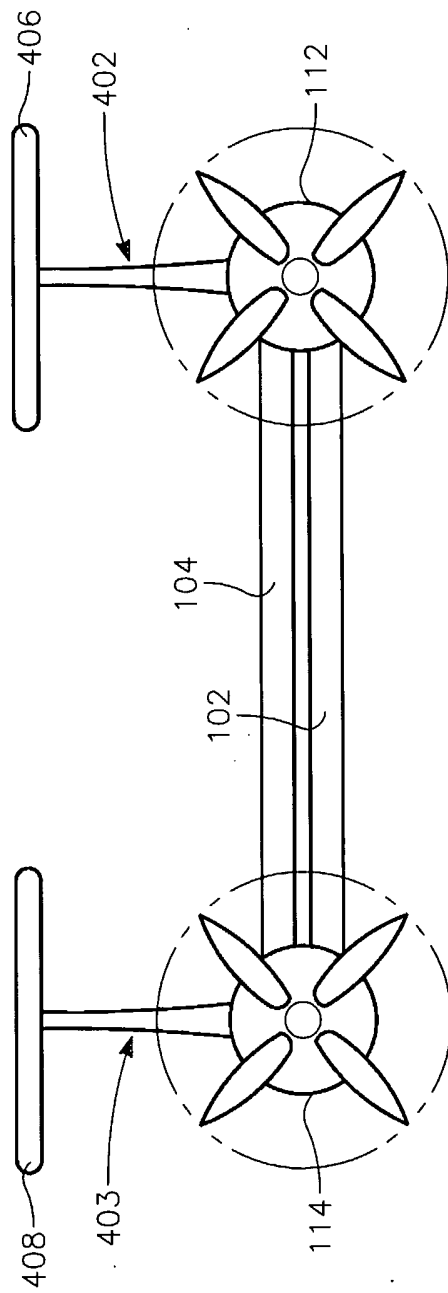


FIG. 4A

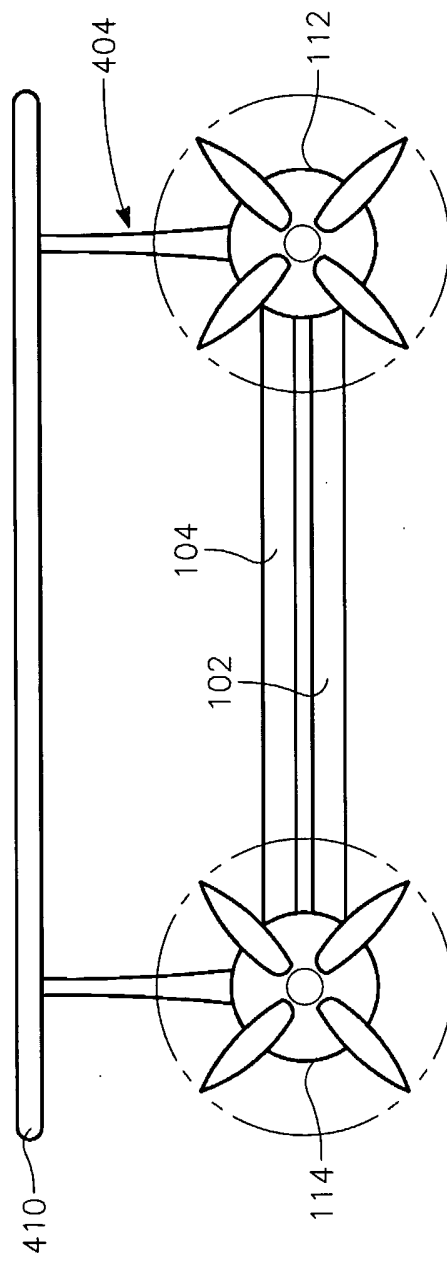


FIG. 4B

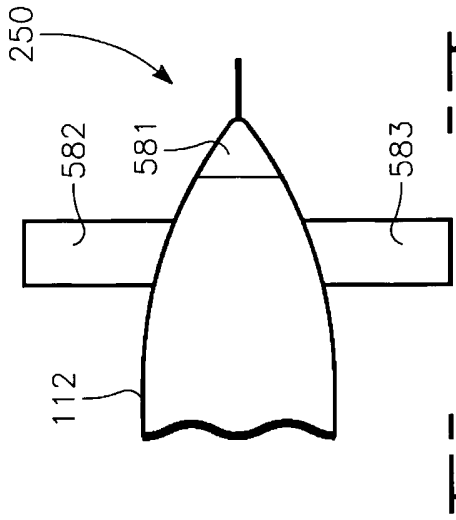


FIG. 5B

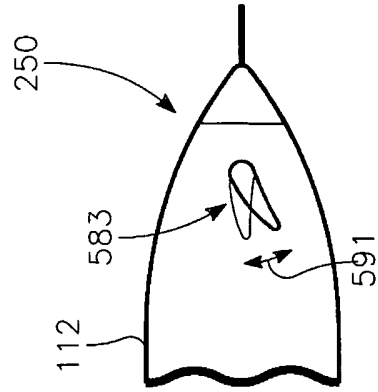


FIG. 5C

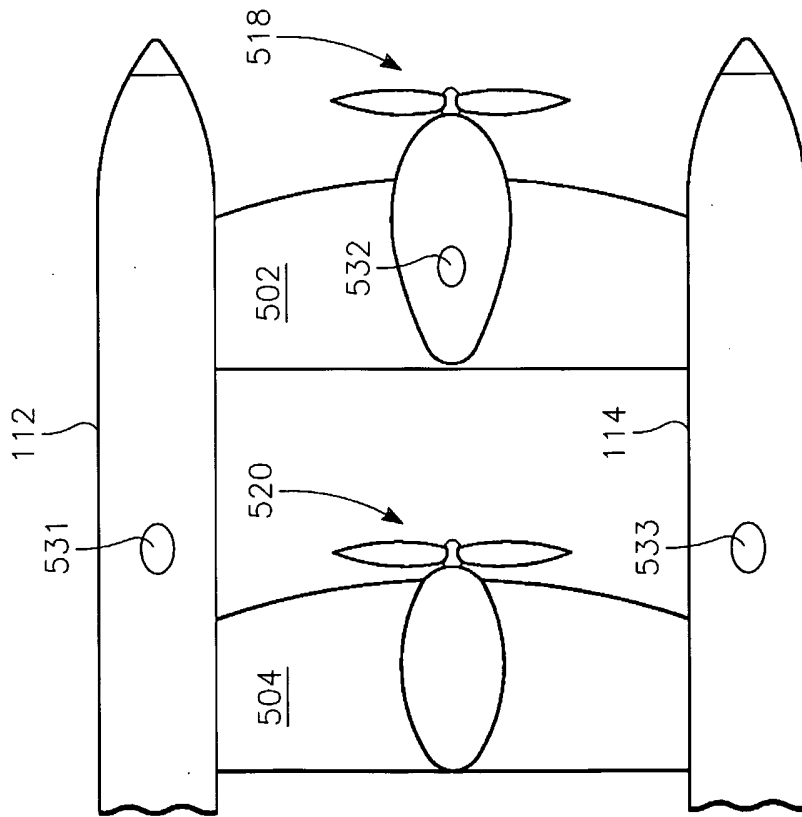


FIG. 5A