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(54) Title: VARIABLE PLANING INFLATABLE HULL SYSTEM

(57) Abstract: Variable planing inflatable hull system having a planing surface on inflatable hulls at the side and disposable central hull. The central hull is typically a rigid hull, with the inflatable hulls providing low wetted area planing surfaces for speed, shock absorbing and efficiency of the vessels. Various embodiments are disclosed.

VARIABLE PLANING INFLATABLE HULL SYSTEM

CROSS-REFERENCE TO RELATED APPLICATION

This application claims the benefit of U.S. Provisional Patent Application No. 61/013,482 filed December 13, 2007.

BACKGROUND OF THE INVENTION

1. Field of the Invention

The present invention relates generally to inflatable marine vessel design.

2. Prior Art

Inflatable hulls offer stability, buoyancy and shock mitigation. However, existing vessels that use inflatable structures generally do not effectively take advantage of all three aspects. For example, RIBs (rigid inflatable boats) use the stability and buoyancy of the inflatable hull but rely on a separate rigid bottom for the planing surface.

Also propulsion systems advantageous to shallow water operations, e.g. surface drives and jets, encounter loss of efficiency because, in certain combinations of speed and seaway, the propellers or the jets suction come out of the water.

Improvements in vessels with inflatable hulls are disclosed in United States Patent No. 6,874,439 entitled Flexible ocean-going vessels with surface conforming hulls, the disclosure of which is incorporated herein by reference. That patent discloses vessels having a pair of flexible hulls flexibly coupled to a "cabin" between

and above the hulls, thereby allowing the hulls to independently follow the surface of the water. Motor pods are hinged to the back of the hulls to maintain the propulsion system in the water, even if the stern of one or both hulls tends to lift out of the water when crossing swells and the like.

BRIEF DESCRIPTION OF THE DRAWINGS

Figure 1 is a rear view of a vessel with a variable planing inflatable hull system in accordance with the present invention.

Figure 2 illustrates the vessel of Figure 1 in a stowed or minimum width configuration.

Figure 3 is a section view illustrating a hinged engine pod system for the vessel of Figure 1.

Figure 4 presents views of a variable planing inflatable hull vessel in accordance with the present invention.

Figure 5 illustrates a pressure control system for a vessel in accordance with the present invention.

Figure 6 illustrates a vessel with a variable planing inflatable hull system in accordance with the present invention having hydraulic controlled-length struts.

Figure 7 illustrates a vessel with a variable planing inflatable hull system in accordance with the present invention having spring loaded struts.

Figure 8 illustrates a vessel with a variable planing inflatable hull system in accordance with the present

invention having air cushions as a spring or shock absorbing system.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENTS

This invention provides for a vessel that utilizes a variable planing inflatable hull system in order to increase speed, efficiency, acceleration, shock absorption and maneuverability. A hinged engine pod can be added to ensure proper propulsion. The engine pod will itself follow the water surface, assuring that the propeller remains in the water under all operating conditions, but could be withdrawn up against the central hull section when not in use. Such vessel can also reduce its footprint considerably using this technique, so that it can be stowed and shipped in a smaller space. For example, a vessel with a 50'L x 17'W x 8'H configuration could be reduced to 40'L x 9'W x 6'H and transported in the cargo hold of a C-130 aircraft.

Figure 1 shows the "D" shaped inflatable air chambers attached to a more conventional boat hull, typically a rigid (in comparison to the inflatable hull sections) such as may be fabricated of fiberglass or other composite materials or metal. We call this inflatable structure a "planing inflatable hull". This planing inflatable hull allows the vessel to achieve the higher speeds associated with planing hulls. The "D" shape of the inflatable section is achieved by connecting a traditional inflated tube to a structure with a straight section forming the planing surface that remains flat or with limited curvature and with limited flexibility under the forces exerted by the air pressure inside the inflated part (a planing member). Limited flexibility is defined as being more rigid than the inflatable sections they are connected to. These planing members support the vessel

when operated at a planing speed, much like water skis support a person above the water, thereby providing a high speed capability and high efficiency of operation by minimizing the wetted surface when planing.

The planing inflatable hull is attached to the rest of the vessel via a continuous fixed attachment and multiple spring-loaded (see Figure 7) and/or controlled-length struts (see Figure 6). This boat design technology is referred to as a "variable planing inflatable hull system". The variable planing inflatable hull system allows the planing inflatable hulls to move within the range shown in Figure 1. This range increases the maneuverability of the vessel and reduces the shock loading caused by wave impact. As an alternative, a smaller diameter inflatable tube could also be used between the inflatable hulls and rigid central hull as shown in Figure 8 to achieve similar results.

Shock loading is reduced in 2 ways:

1. By adjusting the inflatable hulls air pressure with the pressure control system as shown in Figure 5, at the moment the boat impacts the water, the inflated part will naturally deform to an extent that is related to the air pressure and the intensity of the impact. As a bonus to the capability of changing the air pressure in the inflated hulls, the draft of the vessel can be controlled to some extent: lowering the pressure of the inflatable hulls makes the hull section more horizontally elongated thereby widening the footprint and reducing the draft.

2. By making the struts that connect the outboard part of the inflated hulls to the rigid part of the vessel spring loaded, the hulls, under impact load, will move up (see Fig. 1); this has two effects: 1) it transfers the impact energy

to the springs of the struts; 2) changes the shape of the immersed hull from flat to V shaped; these two effects reduce the shock to the rigid part of the vessel and to the crew within.

Also, if the struts are made such that their length can be controlled (for example with an hydraulic system), the very shape of the vessel hulls can be changed underway to adapt to varying sea conditions and to further reduce the effects of impact with waves. Using variable geometry struts, a vessel with inflatable hulls connected to the rigid part of the vessel can reduce its width underway or for stowing without deflation of the inflatable hulls. In that regard, the embodiments of the invention shown illustrate the hulls rotatable with respect to the rigid center structure, though the inflatable hulls may be supported away from the rigid center structure by fixed or variable geometry struts of relatively rigid or flexible construction.

Figure 2 shows the stowing capability of the planing inflatable hulls. First, the planing inflatable hulls are deflated. Next, the planing inflatable hull's spring-loaded or controlled-length struts are released at the pivot point such that the deflated hulls can be drawn up along side the vessel. The planing inflatable hulls remain connected to the center structure at the continuous fixed attachment and the deflated hulls are stretched up from that point and secured. With a system of the proper geometry, this operation can be performed at sea reducing the width of the vessel and the height of the visible (radar or optical) part of the vessel.

If the design of a boat is such that the central hull is suspended above the water by the buoyancy of two lateral inflatable hulls, a centrally located power plant will have the problem of keeping the propeller in the water at all

times in varying sea conditions. Figure 3 shows the hinged engine pod concept. The engine pod is centrally located and rotates about a transverse hinge. This allows the rear of the engine pod to follow the surface of the waves and keeps the propulsion system in the water at all times. The result is maximum efficiency in the propulsion system.

The hinged motor pod, or other technique for varying the elevation of the propulsion system with respect to the center structure, can become important in the case of boats that use the variable planing inflatable hull system as the distance of the central hull to the water will vary under variable inflatable hull configurations and during dynamic changes due to impact with waves at high speed.

Also, it should be noted that while twin planing inflatable hull water vehicles have been disclosed in exemplary embodiments herein, the invention is not limited to twin inflatable planing hull systems, but may be realized in water vehicles with a different number of planing inflatable hulls, such as three or more.

Figure 4 offers an example of a vessel that employs both features described in the invention outlined above. The variable planing inflatable hull system, engine pod and minimum and maximum configurations are sized for the payload and minimum and maximum footprint requirements of the intended use. It is important to note that this invention is scalable depending on the requirements as defined by the intended use.

The present invention maximizes the advantages of a boat with inflatable hull in at least the following ways:

1. A planing surface is part of the inflatable hull.

2. The inflatable hulls can be dynamically deflated while underway to minimize the footprint of the vessel as well as the optical and radar signatures.

3. The shape of the inflatable hull can be changed by varying the air pressure inside the hull and by varying the geometry of the connections between the rigid part of the vessel and the inflatable hull.

4. Shock absorption by the inflatable hulls can be adjusted by varying the air pressure inside the hulls.

This invention can eliminate that loss of efficiency by various means, such as using a hinged engine pod as in United States Patent No. 6,874,439.

Thus the present invention has a number of aspects, which aspects may be practiced alone or in various combinations or sub-combinations, as desired. While certain preferred embodiment of the present invention have been disclosed and described herein for purposes of illustration and not for purposes of limitation, it will be understood by those skilled in the art that various changes in form and detail may be made therein without departing from the spirit and scope of the invention as defined by the full breadth of the following claims.

CLAIMS

What is claimed is:

1. A water vessel comprising:

a central hull section

first and second inflatable hulls, each disposed at and connected to a respective side of the central hull section;

the first and second inflatable hulls each having a planing member located adjacent the bottom thereof when the first and second inflatable hulls are deployed to support the central hull section above a water surface;

the central hull section including a propulsion system for the water vessel.

2. The water vessel of claim 1 wherein the central hull section has a central hull section extension connected thereto through a transverse hinge, the central hull section extension, the propulsion system being in the central hull section extension.

3. The water vessel of claim 1 wherein the transverse hinge allows the hull section extension to rotate as required to maintain the propulsion system in the water.

4. The water vessel of claim 1 further comprising a control system for controlling air pressure in the first and second inflatable hulls.

5. The water vessel of claim 1 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough adjustable struts, wherein the position of the first and second inflatable hulls may be adjusted relative to the central hull section to control the angle the planing members make with the water.

6. The water vessel of claim 5 wherein the adjustable struts are hydraulically controlled struts.

7. The water vessel of claim 1 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough adjustable struts, wherein the first and second inflatable hulls may be withdrawn to a position adjacent the central hull section and at least partially deflated to reduce the width of the water vessel.

8. The water vessel of claim 1 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough spring loaded struts.

9. The water vessel of claim 1 wherein the inflatable hulls are attached to the central hull section thorough longitudinal attachments that allow the inflatable hulls to rotate upward around the longitudinal attachments, the inflatable hulls being held with the planing members downward by inflatable cushions above and between the inflatable hulls and the central hull section.

10. The water vessel of claim 1 wherein the central hull section is a rigid hull section.

11. A water vessel comprising:

a rigid central hull section;

first and second inflatable hulls, each disposed at and connected to a respective side of the central hull section;

the first and second inflatable hulls each having a planing member located adjacent the bottom thereof when the

first and second inflatable hulls are deployed to support the central hull section above a water surface;

the central hull section including a central hull section extension connected thereto through a transverse hinge and having a propulsion system for the water vessel, the transverse hinge allowing the hull section extension to rotate as required to maintain the propulsion system in the water.

12. The water vessel of claim 11 further comprising a control system for controlling air pressure in the first and second inflatable hulls.

13. The water vessel of claim 11 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough adjustable struts, wherein the position of the first and second inflatable hulls may be adjusted relative to the central hull section to control the angle the planing members make with the water.

14. The water vessel of claim 13 wherein the adjustable struts are hydraulically controlled struts.

15. The water vessel of claim 11 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough adjustable struts, wherein the first and second inflatable hulls may withdrawn to a position adjacent the central hull section and at least partially deflated to reduce the width of the water vessel.

16. The water vessel of claim 11 wherein the first and second inflatable hulls are each connected to a respective side of the central hull section thorough spring loaded struts.

17. The water vessel of claim 11 wherein the inflatable hulls are attached to the central hull section thorough longitudinal attachments that allow the inflatable hulls to rotate upward around the longitudinal attachments, the inflatable hulls being held with the planing members downward by inflatable cushions above and between the inflatable hulls and the central hull section.

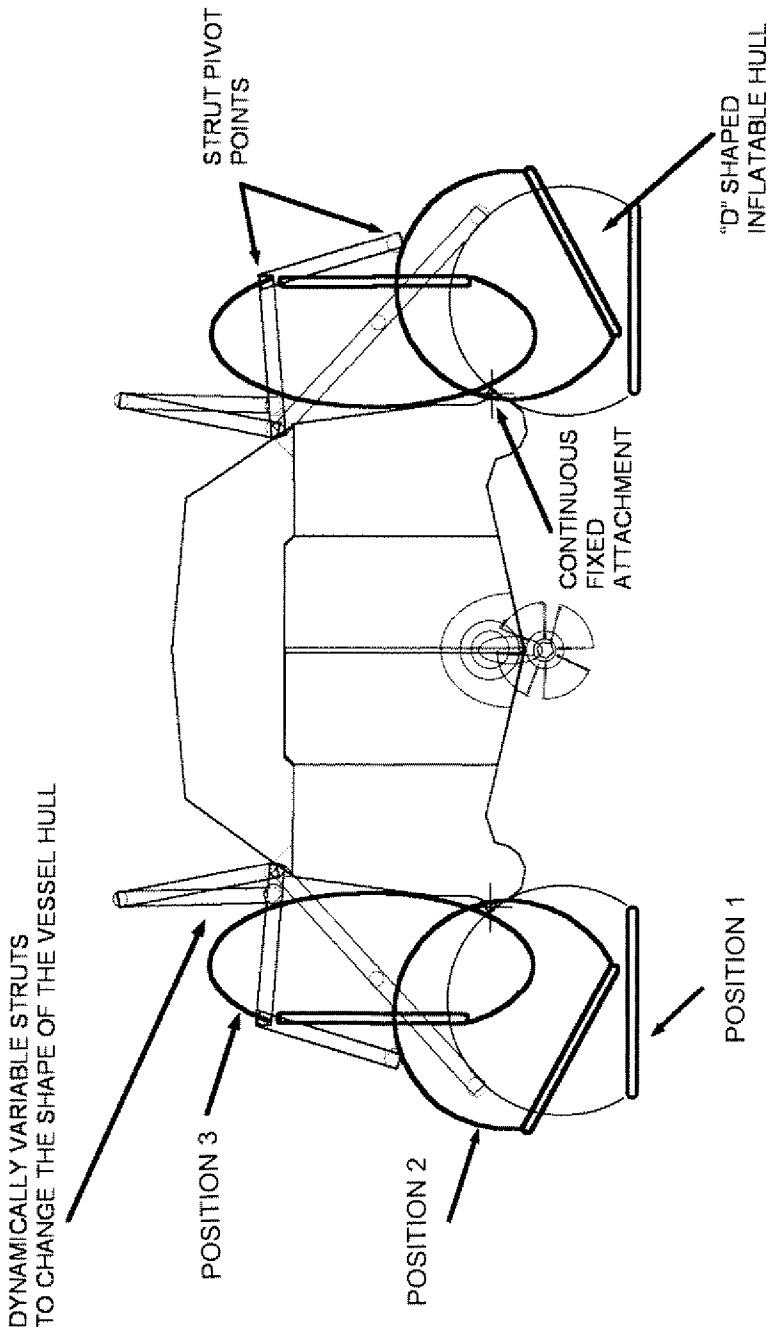


FIGURE 1: EXAMPLE OF A VESSEL WITH
VARIABLE PLANING INFLATABLE HULL SYSTEM

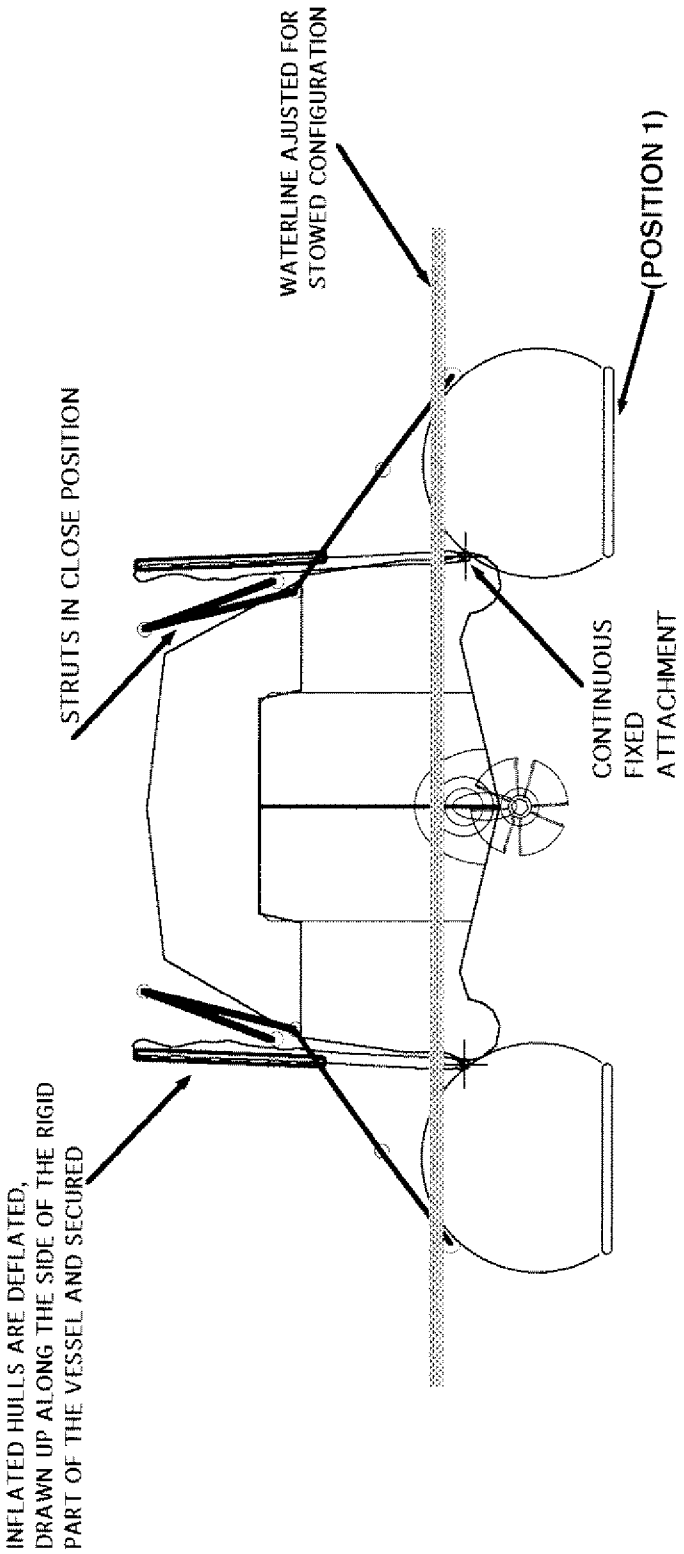


FIGURE 2: STOWED OR MINIMUM WIDTH CONFIGURATION

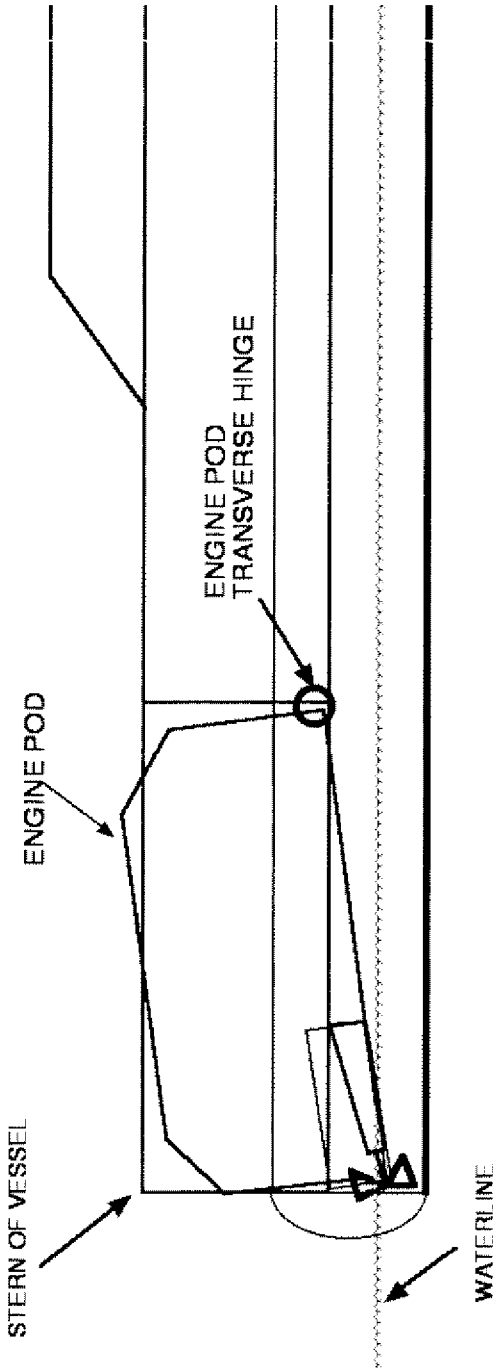


FIGURE 3: HINGED ENGINE POD SYSTEM (SECTION VIEW)

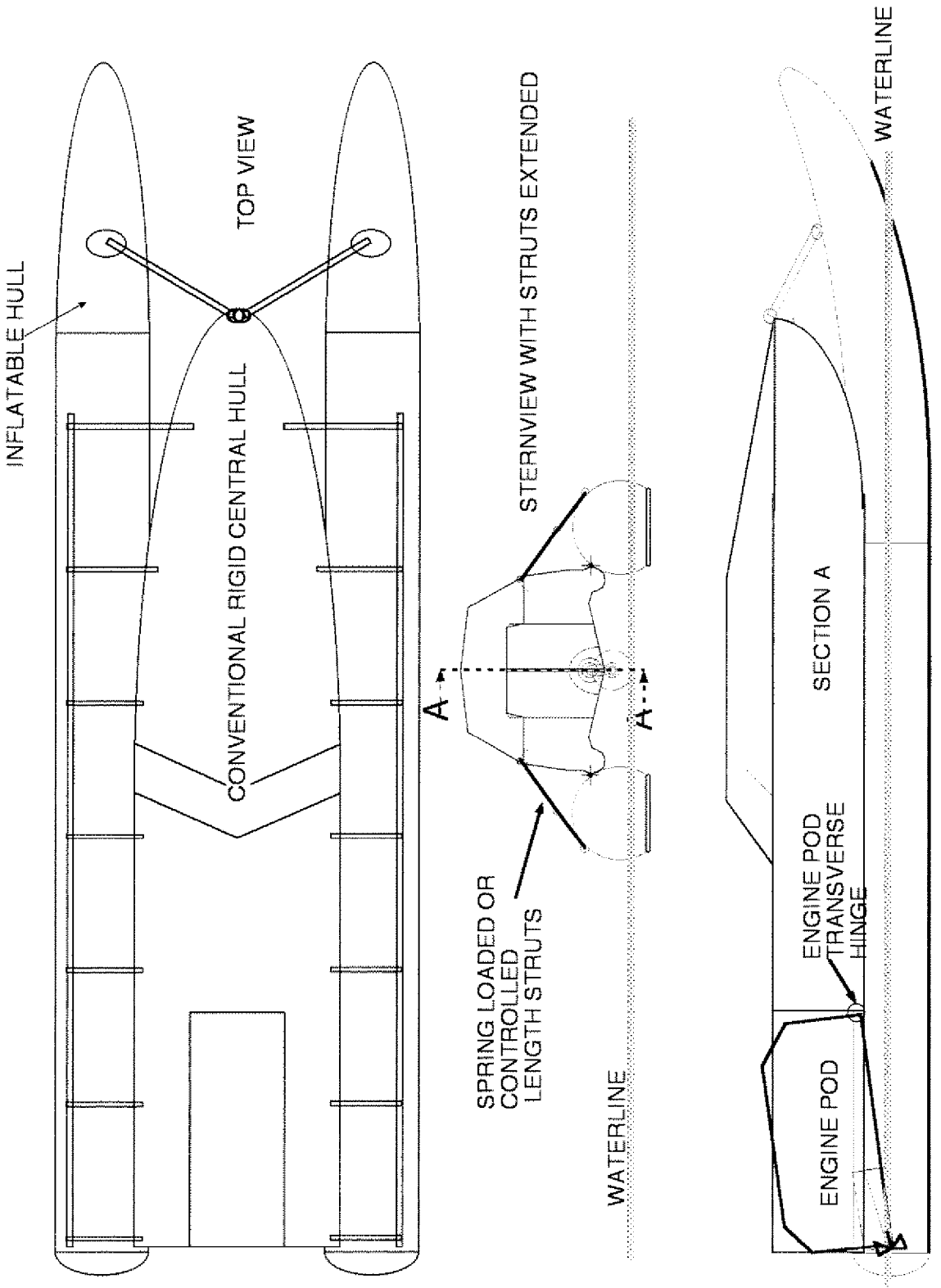


FIGURE 4: EXAMPLE OF A VARIABLE PLANING INFLATABLE HULL VESSEL

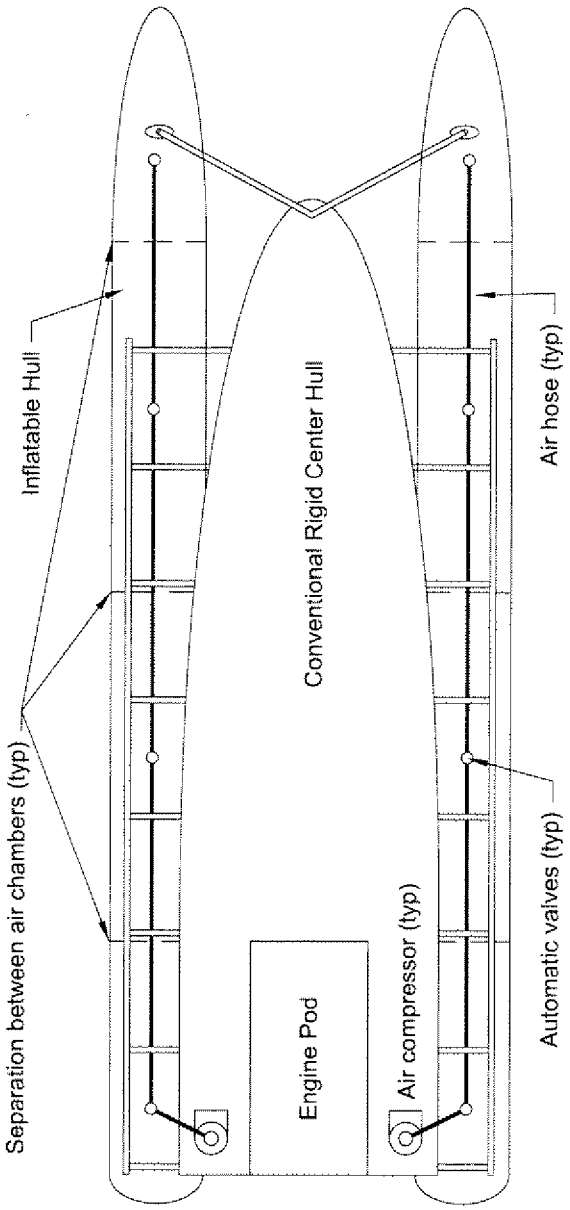
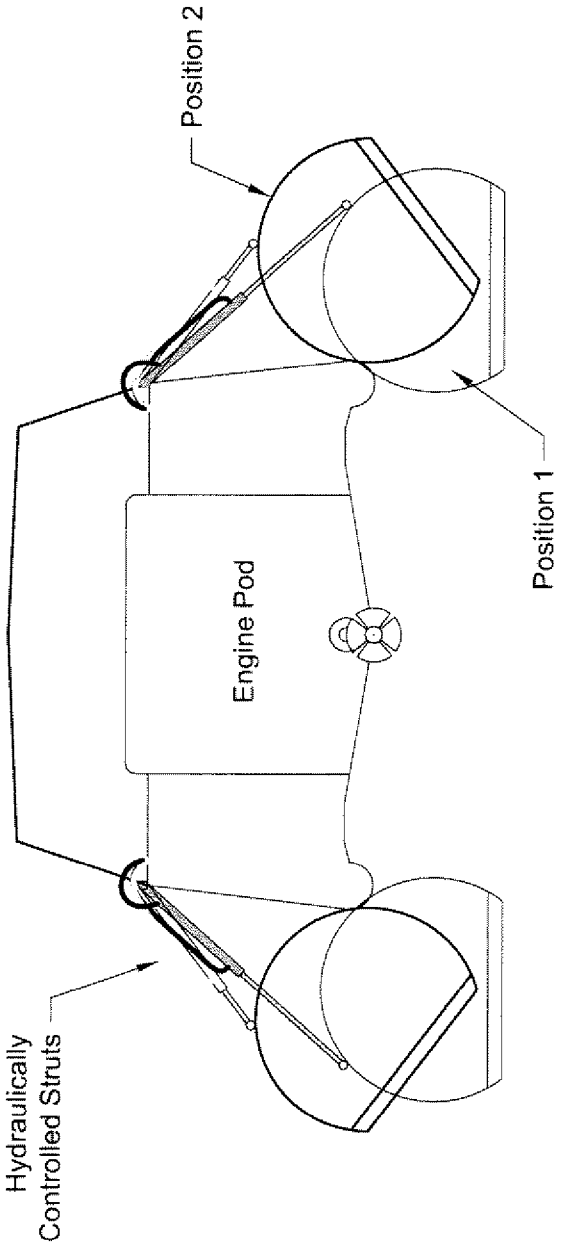


FIGURE 5: EXAMPLE OF PRESSURE CONTROL SYSTEM



Note: Positions 1 and 2 shown are two of the many positions within the range of motion that can be achieved by this system.

FIGURE 6: EXAMPLE OF HYDRAULIC CONTROLLED-LENGTH STRUTS

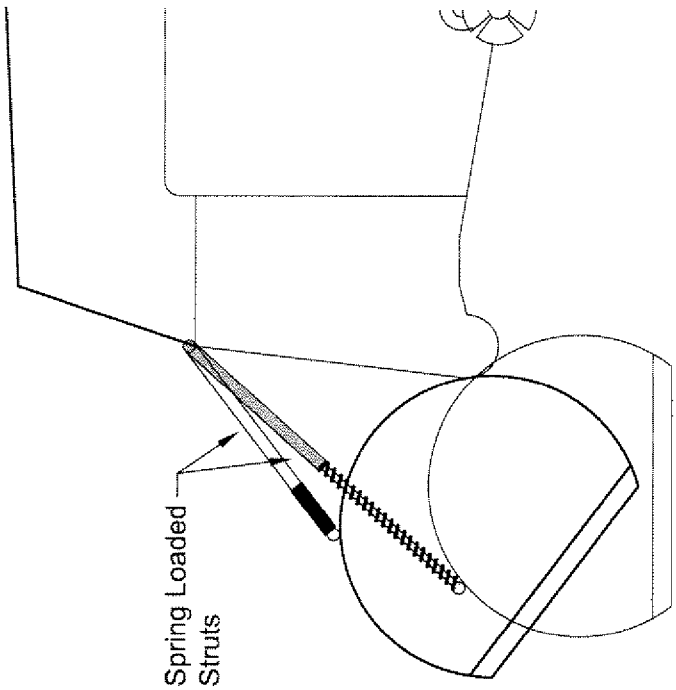


FIGURE 7: SPRING LOADED STRUTS

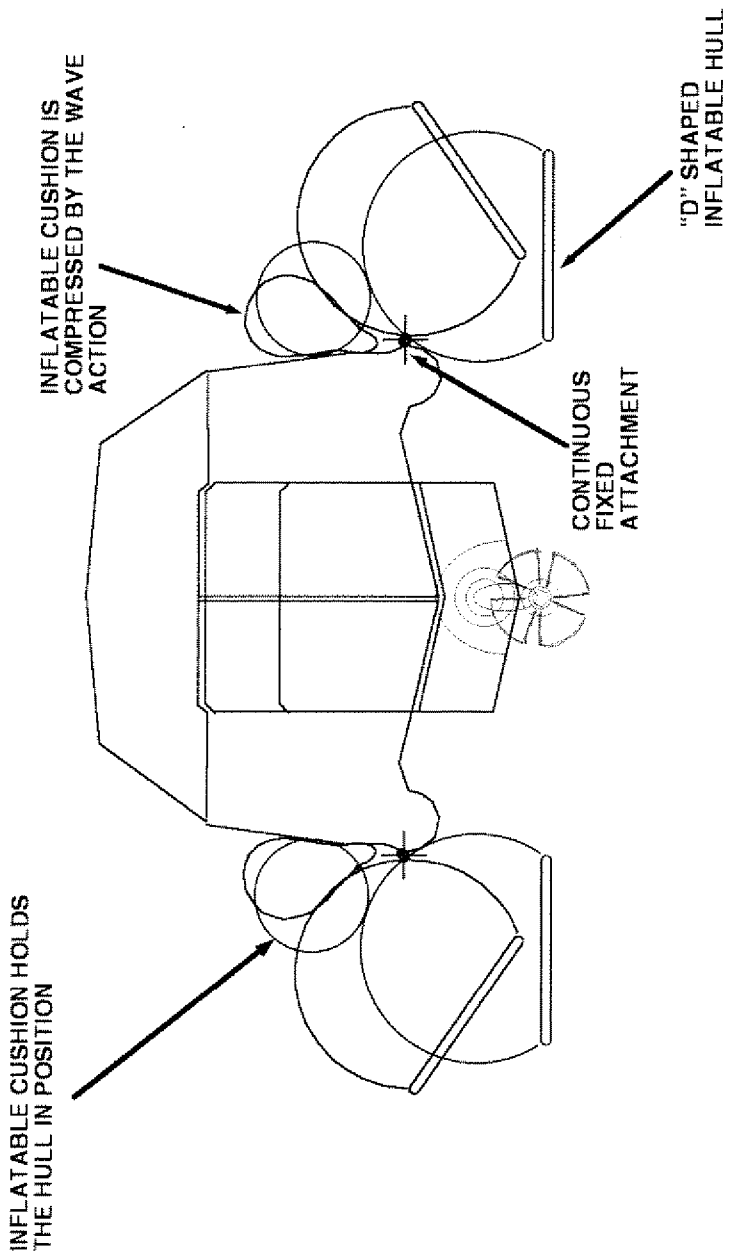


FIGURE 8: VARIABLE PLANING INFLATABLE HULLS WITH AIR CUSHION AS A SPRING SYSTEM