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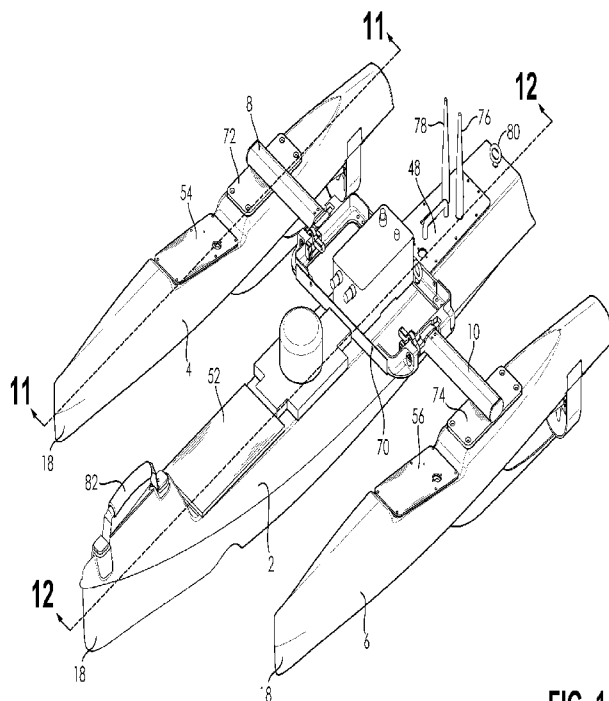


FIG. 1

(57) Abstract: An improved trimaran of a type having a central hull, a starboard outrigger, a port outrigger, a starboard crossbar for attaching the starboard outrigger laterally to the starboard of the central hull, and a port crossbar for attaching the port outrigger laterally to the port of the central hull is provided. The improvement comprises a starboard propulsor attached to the starboard outrigger for propelling the trimaran, a port propulsor attached to the port outrigger for propelling the trimaran; and a motor controller connected to both the starboard and port propulsors for controlling the combined propulsion of the starboard and port propulsors for controlling both the speed and direction of the trimaran by tank steering.



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TRIMARAN HAVING OUTRIGGERS WITH PROPULSORS

Description

Related Applications

- 5 This application claims priority from U.S. Provisional Application No. 61/705,101, filed on September 24 2012, the contents of which are hereby incorporated by reference herein.

Technical Field of the Invention:

- The invention relates to water craft. More particularly, the invention relates to trimarans
10 and to propulsion systems for trimarans.

Background:

- Trimaran sail boats were first developed by Polynesians around 1400 BC in conjunction with their expansion across the Pacific. (*On the road of the wings: an archaeological history of*
15 *the Pacific Islands before European contact*, (2000), Kirch, P. V.)

- In general terms, a trimaran is a water vessel having three hulls, viz., a central hull with two parallel outriggers attached laterally to either side. The central hull was conventionally employed for load carrying and has a wider beam than the outriggers. The outriggers are
20 conventionally very narrow and non-load bearing. When under sail, a trimaran will tilt leeward, causing the leeward outrigger to lower into the water and the windward outrigger to lift up from the water. This lifting and lowering of the outriggers when the trimaran heels changes the center of buoyancy of the trimaran and provides the trimaran with significant righting moment for minimizing further heeling by the central hull. The use of outriggers
25 reduces the possibility of the trimaran capsizing due to wind.

In the absence of wind, the trimaran can be propelled by persons sitting in the central hull rowing. More modernly, a trimaran sail boat may be propelled, in the absence of wind, by motorized propulsion from the central hull. Propulsion from the outriggers is considered

impractical, in part, because, in a strong wind and heavy seas, the outriggers can frequently become submerged when they hit a wave.

Trimarans need not be sail boats. For example, the US Navy has developed a littoral combat
5 ship, USS *Independence* (LCS-2), employing motorized propulsors for propelling the vessel from the central hull. The USS *Independence* (LCS-2) has a shallow draft while providing a large stable platform for aircraft.

In contrast, a catamaran is a water vessel having two parallel hulls connected to one
10 another. Historically, the catamaran also started out as a sail boat. However, since it lacked a central load bearing hull, sail catamarans are conventionally connected to one another by a common platform or deck. The common platform or deck serves as the load bearing portion of the catamaran.

15 However, catamarans need not be sail boats. In such instances, the vessels may be propelled by motorized propulsors. For example, Ruis (US Patent App. No. 2006/0228959) discloses a pontoon type catamaran having inboard propulsion within each pontoon. Sinko (US Pat. No. 6,152,791) discloses a small waterplane area twin hull vessel (SWATH) having externally driven propulsors on each of the twin hulls. Leonov (US Pat. No. 7,255,618)
20 discloses a novel screw propulsion mechanism employable with a twin hull vessel. And finally, Delfoose (US Pat. No. 6,470,817) discloses a twin hull waterplane having propulsors in each hull. Each of the above catamarans and pontoon type catamarans has a common platform or deck extending between the two hulls of the vessel for bearing a load. Although these vessels may employ wave-piercing hulls, submersion of the common platform or deck
25 in heavy seas while cruising is generally to be avoided due to instability resulting from the hydrodynamics of the platform or deck while submerged.

What was needed was a trimaran having outrigger propulsion with tank steering capability, combined with a wave-piercing design and submersion capability.

Summary of Invention

One aspect of the invention is directed to an improved trimaran of a type having a central hull, a starboard outrigger, a port outrigger, a starboard crossbar for attaching the starboard outrigger laterally to the starboard of the central hull, and a port crossbar for attaching the port outrigger laterally to the port of the central hull. The improvement comprises a
5 starboard propulsor attached to the starboard outrigger for propelling the trimaran, a port propulsor attached to the port outrigger for propelling the trimaran; and a motor controller connected to both the starboard and port propulsors for controlling the combined propulsion of the starboard and port propulsors for controlling both the speed and direction
10 of the trimaran by tank steering.

In one embodiment of this aspect of the invention, the trimaran lacks a common deck or platform simultaneously overlaying, at least in part, the central hull and both the port and starboard outriggers.

15

In another embodiment of this aspect of the invention, the trimaran lacks a rudder.

In another embodiment of this aspect of the invention, the central hull, port outrigger, and starboard outrigger each have hull conformations and buoyancy, and weight distribution for
20 wave-piercing.

In another embodiment of this aspect of the invention, the trimaran lacks a common deck or platform simultaneously overlaying, at least in part, the central hull and both the port and starboard outriggers, while, simultaneously, the central hull, port outrigger, and starboard
25 outrigger each have hull conformations and buoyancy, and weight distribution for wave-piercing. In a preferred mode of this embodiment, the hull, port outrigger, and starboard outrigger each have a topside deck submersible during wave-piercing.

In another embodiment of this aspect of the invention, the starboard cross bar includes a first hinge for rotating the starboard outrigger from an extended position employable for water navigation and a folded position for folding the starboard outrigger below the bottom side of the central hull for transporting the trimaran out of water; and the port cross bar
5 includes a second hinge for rotating the port outrigger from an extended position employable for water navigation and a folded position for folding the port outrigger below the bottom side of the central hull for transporting the trimaran out of water.

In another embodiment of this aspect of the invention, the starboard and port propulsors
10 are both inboard.

In another embodiment of this aspect of the invention, the starboard and port propulsors are both outboard.

15 In another embodiment of this aspect of the invention, the trimaran further comprises remote control electronics connected to the motor controller for controlling the trimaran remotely in an unmanned fashion. In a preferred mode of this embodiment, the remote control electronics executes pre-planned path navigation for controlling the speed and direction of the trimaran for survey purposes.

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In another embodiment of this aspect of the invention, the central hull defines an instrument well for housing hydrological or other instrumentation.

In another embodiment of this aspect of the invention, the trimaran further comprises an
25 energy source housed in the central hull and port and starboard power lines connected to and running from the energy source to the port and starboard propulsors for powering the port and starboard propulsors.

Another aspect of the invention is directed to a method for steering a trimaran having port and starboard propulsors in port and starboard outriggers respectively. The method comprises the step of exerting differential control of the propulsion from the port and starboard propulsors for controlling the speed and direction of the trimaran by tank steering.

Brief Description of Drawings:

Fig 1 is a perspective view illustrating the topside of trimaran having a central hull and two outriggers connected to the central hull. Hinged crossbars in an extended position secure the outriggers laterally from the central hull. When the crossbars are locked in their extended position, the triamaran is employable for water navigation. The outriggers are illustrated with inboard type propulsors.

Fig 2A is a perspective view of the trimaran of Fig 1 illustrating the underside of the vessel and one aspect of the process of tank steering. The pitch of the propellers on the port and starboard outriggers are mirror images on another so that to propel the vessel forward or backward, the two propellers must be rotated in opposite directions. Forward propulsion is illustrated in Fig 2 A.

Fig 2B is identical to Fig 2A except it illustrates a different aspect of tank steering. As explained in Fig 2A, due to their mirror image pitch, the propellers are counter-rotated to propel the trimaran in a forward direction. However, Fig 2B illustrates that the yaw of the trimaran may be rotated for turning the trimaran in a new direction by rotating the propellers in the same direction. More commonly, the trimaran is steered by controlling the differential rates of rotation of the port and starboard propellers.

Fig 3 is a perspective view of the trimaran of Fig 2 A,B illustrating the two outriggers in their folded position beneath the underside of the central hull. Folding is achieved by unlocking

the hinged crossbar and rotating them about their hinge into their folded positions. Once the outriggers are rotated into their folded position, the position may be secured by locking the hinge. In its folded position, the trimaran is easier to transport but unsuitable for water navigation.

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Fig 4 is a perspective view illustrating an alternative embodiment of the trimaran of Fig 1. The inboard type propulsors of the outriggers have been replaced with a azimuthing pod employing an electric underwater trolling motor. Conventional outboard motors may also be employed.

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Fig's 5-7 are a sequence illustrating the process of wave-piercing.

Fig 5 is a perspective view of the trimaran of Fig 1 illustrating the approach of the trimaran toward a wave.

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Fig 6 is a perspective view of the trimaran of Fig 5 after its bow has pierced the wave, causing the topside decks of the central hull and the outriggers to be awash by the wave, rendering the trimaran partially submerged.

20 Fig 7 is a perspective view of the trimaran of Fig 6 after the trimaran has largely emerged from the wave, except for the topside of the stern of the trimaran, which is not yet emerged and is awash by the wave.

Fig 8 is a perspective view of the crossbar of Fig 1 in its extended position.

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Fig 9 is an exploded view of the crossbar of Fig 8, illustrating the hinge pin.

Fig 10 is a block diagram illustrating the remote control system and the motor controller.

Fig 11 is a sectional view of the starboard outrigger of Fig 1, illustrating the inboard motor, drive shaft, and propeller and an absence of a rudder.

Fig 12 is a sectional view of the central hull of Fig 1, with the superstructure removed from the topside deck, illustrating the storage area for the battery and electronics within the hull and providing an interior perspective of the instrument well toward the bow, for housing oceanographic, hydrographic, or hydrologic deployment equipment (not shown).

Fig 13 is a block diagram illustrating the motor controller for an autonomous guidance mode, employing GPS for guiding the trimaran along a preplanned path.

Detailed Description:

The present invention was motivated by a need to provide a mobile platform for performing surveys on bodies of water using oceanographic, hydrographic, or hydrologic instrumentation or surveying sensors. What was needed was an inexpensive unmanned mobile water vessel to serve as an instrument platform for survey instruments that could be remotely controlled to follow a pre-planned survey path and speed, while determining location and velocity of the vessel by use of global position system (gps), compass, and inertial information for adjusting the speed and direction of the vessel to conform to the desired pre-planned survey path. Additionally, the instrument platform should maintain as much stability as possible with respect to pitching and heeling as it traverses through heavy weather.

The trimaran of the present invention satisfies these needs. As illustrated in Fig. 1, the trimaran has a central hull (2), a starboard outrigger (4), a port outrigger (6), a starboard crossbar (8) for attaching the starboard outrigger (4) laterally to the starboard of the central hull (2), and a port crossbar (10) for attaching the port outrigger (6) laterally to the port of the central hull (2). Propulsors (12 and 14) are attached to the starboard and port outriggers

(4 and 6) for propelling the trimaran. It is essential that a motor controller (16) be employed to coordinate the combined propulsion of the starboard and port propulsors for controlling both the speed and direction of the trimaran by tank steering. Since tank steering is employed, no rudder is needed. Stability with respect to pitching in heavy weather is achieved by designing the weight and buoyancy distribution of the vessel and the conformations of the central hull (2), port outrigger (6), starboard outrigger (4), and their respective bows (18) to achieve wave-piercing characteristics. However, it is disclosed herein that, even with these wave-piercing characteristics, it is critical that the trimaran lack a common deck or platform, i.e., a common deck or platform that simultaneously overlays, at least in part, the central hull (2) and both the port and starboard outriggers (4 and 6). As illustrated in Fig's 5-7, the central hull (2), port outrigger (6), and starboard outrigger (4) each have a topside deck (19) submersible during wave-piercing. It is disclosed herein that a vessel having a common deck or platform can become unstable during the wave-piercing process due to the hydrodynamic properties of the common deck or platform as it interacted with the wave.

Wave-piercing is generally accomplished by implementing one or more design features. For example, wave-piercing may be accomplished by employing sharp bow entry. Sharp bow entry reduces reserve buoyancy, thereby reducing the tendency of the bow to rise over a wave. Wave-piercing may be accomplished by employing a reversed bow rake to reduce reserve buoyancy.

A wave piercing hull is a hull having a narrow beam and a fine bow with little or no flare and reduced buoyancy, the reduced buoyancy of the bow being sufficient for enabling the bow to pierce through waves under standard operating conditions, instead of riding over waves. A wave piercing hull materially reduces the wave making resistance of the vessel and increases its operating efficiency.

Wave-piercing catamarans and trimarans are described in US Pat. No. 5,191,848, which disclosure is incorporated herein by reference. Wave piercing hulls are designed to push through waves rather than ride over them. Riding over waves requires the hull to pitch up and down. Such pitching increases hull resistance, requiring more power for a given speed, and creates additional load on virtually all structures and systems, thus reducing their reliability and useful lifetimes while increasing maintenance. It is disclosed herein that such pitching motion detracts from the accuracy of hydrographic, oceanographic, hydrologic, other instruments supported by the central hull (2).

- 10 A preferred embodiment of the invention is directed to a trimaran that lacks a common deck or platform, i.e., a planar structure simultaneously subtending or underlain by, at least in part, by all three hulls of a trimaran for supporting a load thereon, such as people, cargo, or other loads. Pontoon vessels having a common deck or platform are impractical for wave-piercing applications due to their hydrodynamics during the submersion phase of the wave-piercing process.

Hulls that are designed to push through waves must be able to withstand the pressure of the immersion into the wave. Furthermore, the bow of such hulls must be prevented from plunging into the water to a depth that results in stopping or crushing the vessel.

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- The potential tendency of a wave-piercing hull to plunge too deeply into the trough between waves may be overcome by providing the hull with sufficient length and slenderness so that the mass and moment arm of the trailing part of the hull prevents plunging. Additionally, the immersed bottom of the bow may be made slightly wider and flatter to provide hydrodynamic lift at higher speeds. The sharp bow may also be made higher to produce needed buoyancy in very large wave conditions, as illustrated by the bow of the central hull in Fig. 1 and Fig's 5-6.

One aspect of the present invention is directed to trimarans having wave-piercing hulls that are fully submersible, i.e., capable of becoming submersed as a result of wave piercing action without being swamped and/or without suffering a significant loss of buoyancy.

- 5 The central hull (2) should have greater displacement, as compared to the outriggers, and should have a wave-piercing conformation. The central hull (2) should be employed for bearing load. In a preferred embodiment, the central hull (2) includes a well (40) which is open on the bottom, for carrying hydrographic, oceanographic, hydrologic, and other instrumentation requiring contact with the body of water that supports the vessel.
- 10 Optionally, the well (40) may be covered by a topside cover (52). To the extent possible, consistent with the invention, load born by the trimaran should be distributed to the central hull (2), due to its greater displacement.

For example, the batteries (42) or other energy sources should be distributed to the central hull (2). Fig 12 illustrates batteries (42) sitting in a foam tray within a compartment sealed

15 by a hatch (50) within the central hull (2). The batteries (42) power both motors (58 and 60) via port and starboard power lines (44 and 46), the remote control receiver (34), and motor controller (16), all of which equipment is housed by the central hull (2) under hatches (48 and 50). The motors (58 and 60) are covered by topside hatches (54 and 56) to maintain the

20 water integrity of the topside deck (19) of the outriggers during the submersion phase of wave-piercing (Fig 6).

The outriggers should have lesser displacement, as compared to the central hull (2), and should be slender with a wave-piercing conformation. The invention disclosed herein

25 teaches that the outriggers should include propulsors. In certain regards, powering the outriggers of a trimaran has disadvantages. Locating propulsor on the outriggers increases their load and reduces the overall energy efficiency of the vessel. However, the present invention discloses that, in applications wherein energy efficiency is not a primary design

factor, locating propulsors on the outriggers enables the vessel to be rudderless and to employ tank steering.

In a preferred embodiment, the trimaran of the invention may be folded for ease of transport. When folded, each outrigger is rotated about a hinge (20 or 24) so as to fold the outrigger below the central hull (2), as illustrated in Fig. 3. Foldable crossbars (8 and 10) are illustrated in Fig's 8 and 9, with Fig. 9 illustrating an exploded view of the hinges (20 and 24) about which the outriggers are folded. The hinges (20 and 24) include a lock and release mechanism (22 and 26) for securing the outriggers in their extended position and releasing the outriggers for rotation into their folded position. The foldable crossbars (8 and 10) are supported by and connected to the central hull (2) via a brace (70); and are supported by and connected to the port and starboard outriggers (6 and 4) via topside plates (72 and 74), respectively. When folded, the trimaran may be carried by means of a forward handle (80) and aft handle (82).

The trimaran may employ inboard propulsors (28), as illustrated in Fig 1, or outboard propulsor (30), as illustrated in Fig 4. The electric motor (58 or 60) for powering the propeller (66 or 68), illustrated in Fig 11, may be of a type employed as conventional automotive blower motors. The term "propulsor" is employed generically herein to mean any mechanism for generating thrust for propelling a vessel by propelling water in a direction opposite to the direction of thrust for the vessel.

Powered propellers are preferred propulsors. Any conventional type of marine propeller may be employed, e.g., screw propeller, Voith Schneider cycloid drive propeller, azimuth thrusters, etc. The propellers may be ducted or unducted. Powered propellers may be either inboard (28) or outboard (30). An inboard powered propeller includes a power unit (58 or 60), housed within the hull of the outrigger, attached to a drive shaft (62 or 64) or other drive mechanism that extends through the hull to the propeller. In contrast, an outboard powered propeller includes a power unit attached externally to the outrigger. In

each case, the power unit (58 or 60) powers the drive shaft (62 or 64) or other drive mechanism so as to rotate a propeller (66 or 68) to which it is coupled. When in operation, the propeller (66 or 68) is generally maintained below the water surface and is rotated so as to create a forward or backward thrust. Other types propulsors (12 or 14) include pump-jets, Kort nozzles, and magnetohydrodynamic drive propulsors.

The invention specifically excludes the use of sails for providing thrust, i.e., the trimaran of the invention lacks any type of wind sail that serves to propel the vessel.

When employed in its unmanned mode, the trimaran includes remote control electronics (32 and 34) for controlling the motor controller (16) and the trimaran remotely, as illustrated in Fig. 10. In an alternative embodiment of the unmanned mode, as illustrated in Fig. 13, the control electronics may be switched between a remote control mode and an autonomous mode by means of selector (84).

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In a preferred embodiment of the invention, the trimaran is unmanned and remote controlled. A preferred arrangement is to mount the control electronics to the underside of the hatch (48) to which the antennae (76 and 78) are attached and are suspended inside the central hull (2). Conventional remote control transmitter/ receivers (32 and 34) may be employed. For example, remote control transmitter/ receivers (32 and 34) from Hitec spread spectrum (Korea and San Diego) or Futaba may be employed. Preferred RC antennae are a pair of whip antennae (76 and 78).

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Another aspect of the invention is directed to a method for steering a trimaran having port and starboard propulsors (14 and 12) in port and starboard outriggers (4 and 6) respectively. The method comprises the step of exerting differential control of the propulsion from the port and starboard propulsors (14 and 12) for controlling the speed and direction of the trimaran by tank steering.

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In a preferred mode, the trimaran of the present invention employs tank steering. Tank steering may be achieved by any type of differential steering mechanism wherein propulsors are made to exert different propulsion forces or even propulsion forces of opposite directions to bring about a change of course, speed, or direction. Tank steering is practical only with vessels having two or more propulsors oppositely disposed from the central beam of the vessel and having sufficient lateral displacement from the central beam to exert enough yaw to steer the vessel when differential propulsion is applied.

The differential propulsion required to achieve tank steering may be achieved employing a conventional Electronic Speed Controller (ESC). For example, SDC2130 (Roboteq, Inc., Scottsdale Arizona) may be employed as an Electronic Speed Controller to achieve tank steering. There are two types of tank steering ESC's, viz., independent or mixed steering ESC's.

Independent steering employs an independent ESC for each propulsor, with the user employing separate controllers for each propulsor. For example, a left hand stick may control the left side motor(s) and a right hand stick may control the right side motor(s). If both sticks are pushed forward simultaneously, the vessel is propelled forward. If one stick is moved back and the other stick forward, a very fast turn is achieved.

Mixed steering employs a mixed ESC wherein a single stick controls both forward and reverse directions along a Y axis (up & down) and left and right turns along an X axis (side to side). Mixed steering type ESC's achieve one handed drive, leaving the other hand to perform other functions, possibly with another stick.

Fig. 13 illustrates an exemplary flow diagram for an autonomous guidance system for guiding a trimaran along a preplanned path by means of differential steering, i. e., tank-type steering. An autonomous guidance box, incorporating the autonomous guidance system, may be housed under hatch (48). When the autonomous mode is selected, using selector

(84), the trimaran is guided along a pre-planned path of navigation according to data stored in memory unit (86). The state and position of the vessel is determined or estimated by GPS, compass, and/or inertial sensors/ accelerometers within locator unit (88). After the location of the vessel is determined by locator unit (88), calculations of the heading and velocity setpoints are made by setpoint calculator unit (90). Estimation of external disturbances may be made by external disturbance estimator unit (92). Then, calculations of the heading and velocity corrections are made by correction calculator unit (94) and differential thrust calculations are allocated and applied, differentially, by applicator unit (96), via control or power lines leading to propulsors (66 and 68) housed in their respective outriggers (4 and 6). Differential application of power to the two propulsors results in the desired tank-type steering, without need of a rudder. Passage over the preplanned path enables the oceanographic, hydrographic, or other hydrologic deployment equipment housed in the instrument well (40) to record survey results at the desired locations. A further example of a system for autonomous control over a vessel requiring differential control with respect to a set of propulsors to achieve guidance along a preplanned path is described in US Pat. No. 6678589, incorporated herein by reference.

Definitions:

Trimaran: The term "trimaran" is employed herein to mean a water traversing vessel having three substantially parallel hulls, viz., a central hull and outriggers on either side.

Hull: The term "hull" is employed herein to mean the portion of vessel and associated structures and surfaces connected thereto having contact with water for providing and maintaining the buoyancy of the vessel.

Outrigger: The term "outrigger" is employed herein to mean a hull on either side of a central hull of a trimaran, connected to the central hull by means of connectors for maintaining the outrigger in a partially submerged position and in a substantially parallel orientation with respect to the central hull for providing the central hull, by means of its buoyancy, with righting moment with respect to torque forces about the lengthwise axis of the central hull.

Wave piercing: The term “wave piercing” is employed herein to mean a type of hull design having a narrow beam and a fine bow with little or no flare and reduced buoyancy, the reduced buoyancy of the bow being sufficient for enabling the bow to pierce through waves under standard operating conditions, instead of riding over waves, for materially
5 reducing the wave making resistance of the vessel and increasing its operating efficiency.

Submersible: The term “submersible” is employed herein to mean being capable of becoming submersed as a result of wave piercing action without being swamped and/or without suffering a significant loss of buoyancy.

10 **Propulsor:** The term “propulsor” is employed herein to mean any mechanism for generating thrust for propelling a vessel by propelling water in a direction opposite to the direction of thrust for the vessel.

Energy source: The term “energy source” is employed herein to mean any source of energy capable of providing power to a propulsor.

15 **Motor controller:** The term “motor controller” is employed herein to mean any control mechanism for differentially controlling power output to port and starboard propulsors and their direction of propulsion, i.e., forward or reverse, for achieving tank steering.

Tank steering: The term “tank steering” is employed herein, in the context of a water traversing vessel, to mean any type of steering employing a differential steering
20 mechanism wherein propulsors are made to exert different propulsion forces or even propulsion forces of opposite directions to bring about a change of course, speed, or direction. Tank steering is practical only with vessels having two or more propulsors oppositely disposed from the central beam of the vessel and having sufficient lateral displacement from the central beam to exert enough yaw to steer the vessel when
25 differential propulsion is applied.

Rudder: The term “rudder” is employed herein to mean any substantially flat material projecting from a vessel with the flat surface oriented essentially parallel to water flow for steering the vessel and being capable of reorientation for changing the direction of the vessel.

Sail: The term “sail” is employed herein to mean any fabric employed for propelling a vessel by wind.

Common Deck or Platform: The term “common deck or platform” is employed herein to mean any planar structure simultaneously overlaying, at least in part, by all three hulls of a trimaran for supporting a load thereon, such as people, cargo, or other loads. Pontoon vessels having a common deck or platform are impractical for wave-piercing applications due to their hydrodynamics during the submersion phase of the wave-piercing process.

Topside: The term “topside” is employed herein to mean the top most deck.

What is claimed is:

1. An improved trimaran of a type having a central hull, a starboard outrigger, a port
5 outrigger, a starboard crossbar for attaching the starboard outrigger laterally to the
starboard of the central hull, and a port crossbar for attaching the port outrigger laterally to
the port of the central hull, wherein the improvement comprises:
 - a starboard propulsor attached to the starboard outrigger for propelling the trimaran;
 - a port propulsor attached to the port outrigger for propelling the trimaran; and
 - 10 a motor controller connected to both the starboard and port propulsors for controlling
the combined propulsion of the starboard and port propulsors for controlling both
the speed and direction of the trimaran by tank steering.
2. An improved trimaran as described in Claim 1 wherein:
15 the trimaran lacking a common deck or platform simultaneously overlaying, at least in
part, the central hull and both the port and starboard outriggers.
3. An improved trimaran as described in Claim 1 wherein:
the trimaran lacking a rudder.
20
4. An improved trimaran as described in Claim 1 wherein:
the central hull, port outrigger, and starboard outrigger each having hull
conformations and buoyancy, and weight distribution for wave-piercing.
- 25 5. An improved trimaran as described in Claim 4 wherein:
the trimaran lacking a common deck or platform simultaneously overlaying, at least in
part, the central hull and both the port and starboard outriggers.
6. An improved trimaran as described in Claim 5 wherein:

the hull, port outrigger, and starboard outrigger each having a topside deck submersible during wave-piercing.

7. An improved trimaran as described in Claim 1 wherein:

5 the starboard cross bar includes a first hinge for rotating the starboard outrigger from an extended position employable for water navigation and a folded position for folding the starboard outrigger below the bottom side of the central hull for transporting the trimaran out of water; and
the port cross bar includes a second hinge for rotating the port outrigger from an
10 extended position employable for water navigation and a folded position for folding the port outrigger below the bottom side of the central hull for transporting the trimaran out of water.

8. An improved trimaran as described in Claim 1 wherein:

15 said starboard and port propulsors both being inboard.

9. An improved trimaran as described in Claim 1 wherein:

 said starboard and port propulsors both being outboard.

20 10. An improved trimaran as described in Claim 1 wherein the trimaran further comprising:
 remote control electronics connected to the motor controller for controlling the trimaran remotely in an unmanned fashion.

11. An improved trimaran as described in Claim 10 wherein:

25 said remote control electronics executing pre-planned path navigation for controlling the speed and direction of the trimaran for survey purposes.

12. An improved trimaran as described in Claim 11 wherein:

said remote control electronics executing pre-planned path navigation with differential power being applied to said starboard and port propulsors for controlling the speed and direction of the trimaran by means of tank type steering.

5 13. An improved trimaran as described in Claim 1 wherein:

the central hull defining an instrument well for housing hydrological or other instrumentation.

14. An improved trimaran as described in Claim 1 wherein the trimaran further comprising:

10 an energy source housed in the central hull and

port and starboard power lines connected to and running from said energy source to said port and starboard propulsors for powering said port and starboard propulsors.

15. A method for steering a trimaran having port and starboard propulsors in port and

15 starboard outriggers respectively, the method comprising the step of:

exerting differential control of the propulsion from the port and starboard propulsors for controlling the speed and direction of the trimaran by tank steering.

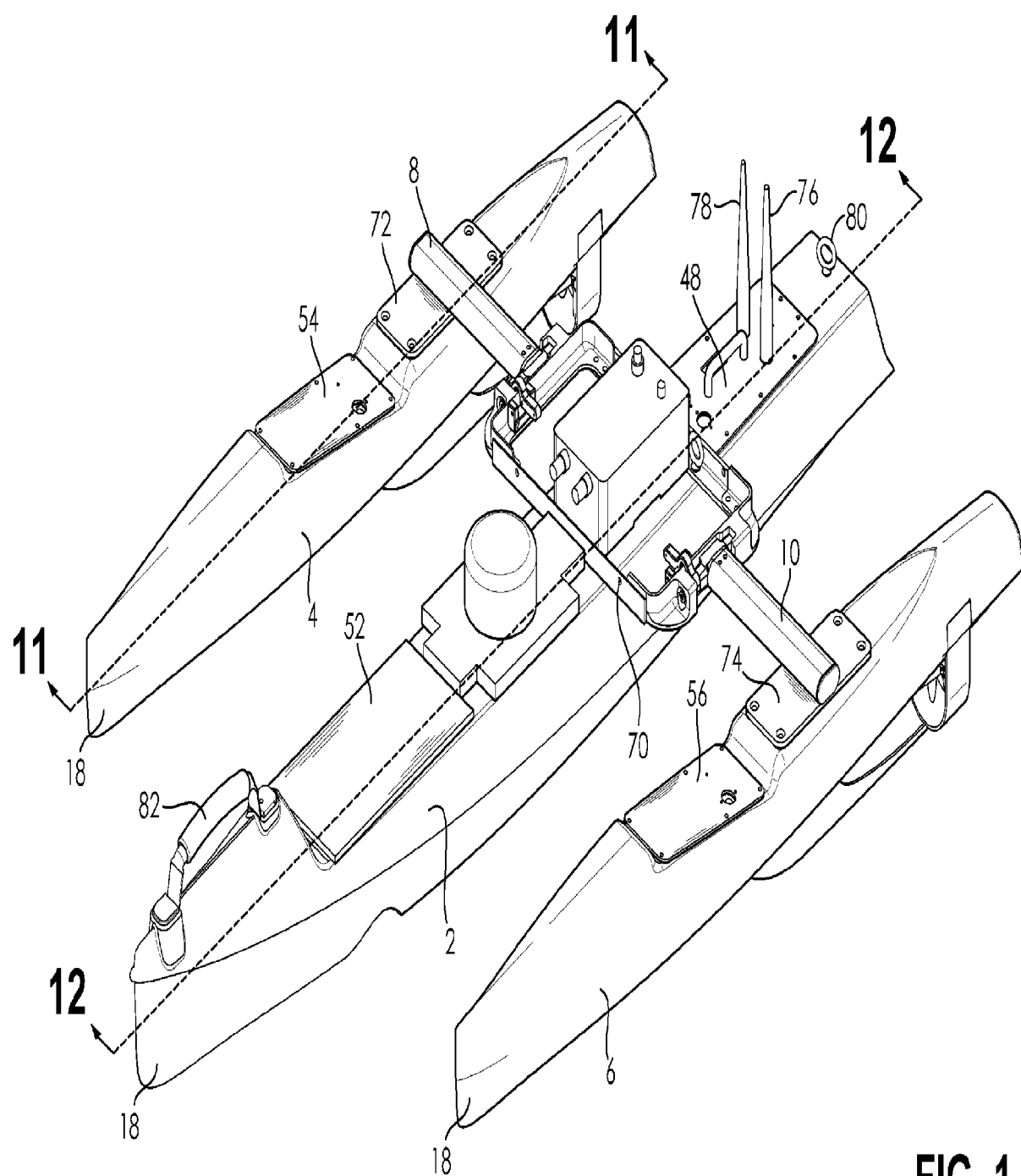


FIG. 1

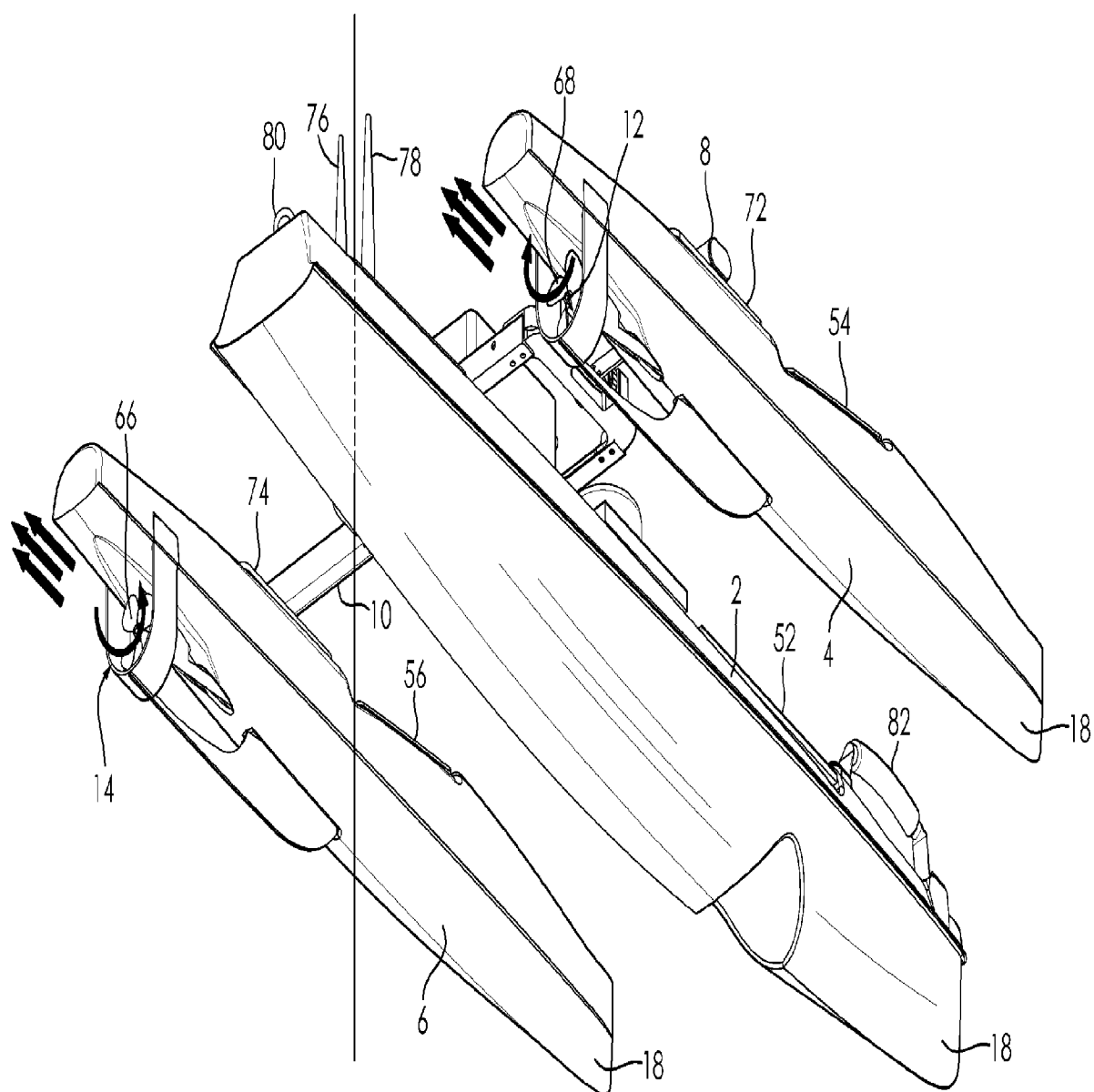


FIG. 2A

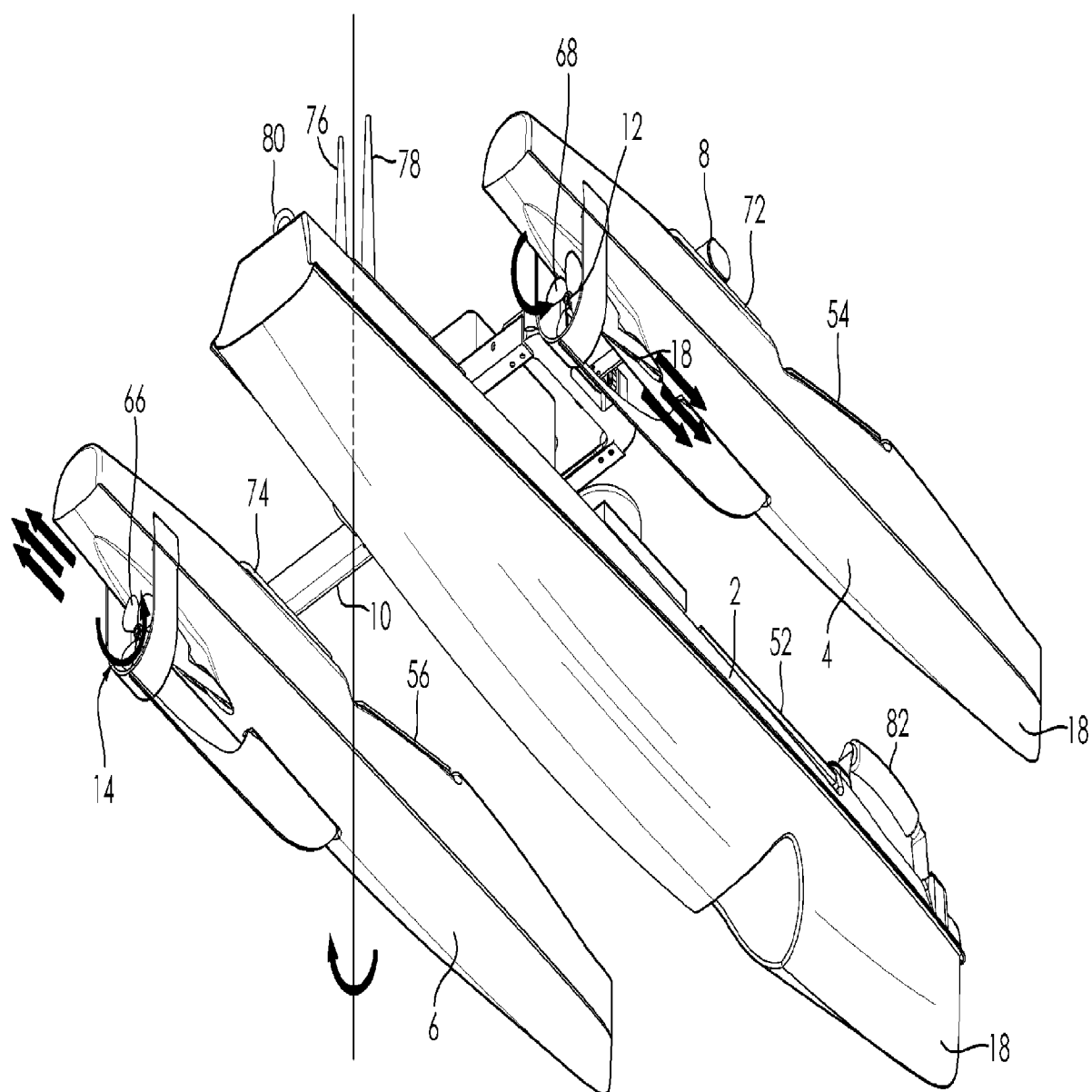
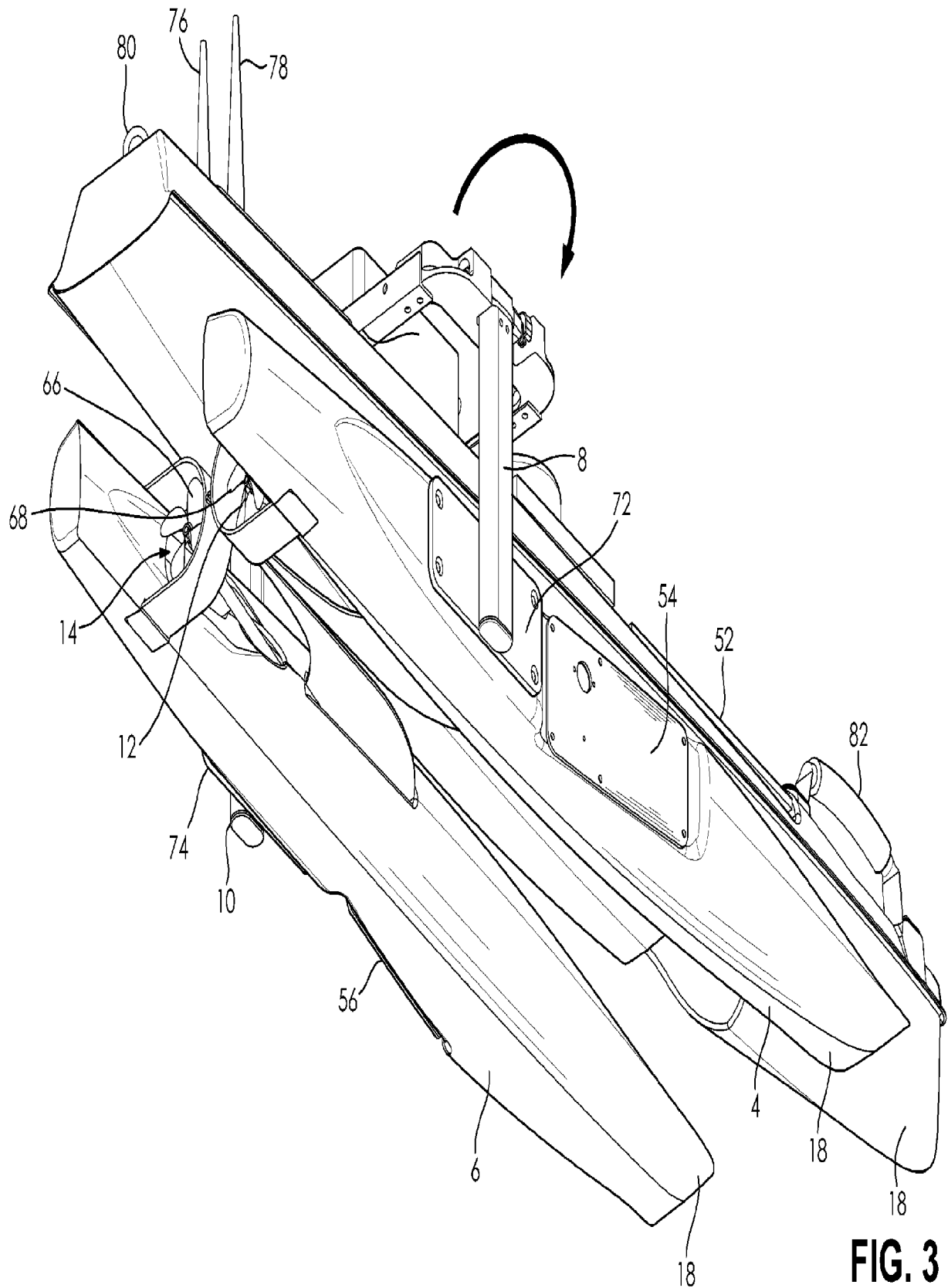


FIG. 2B



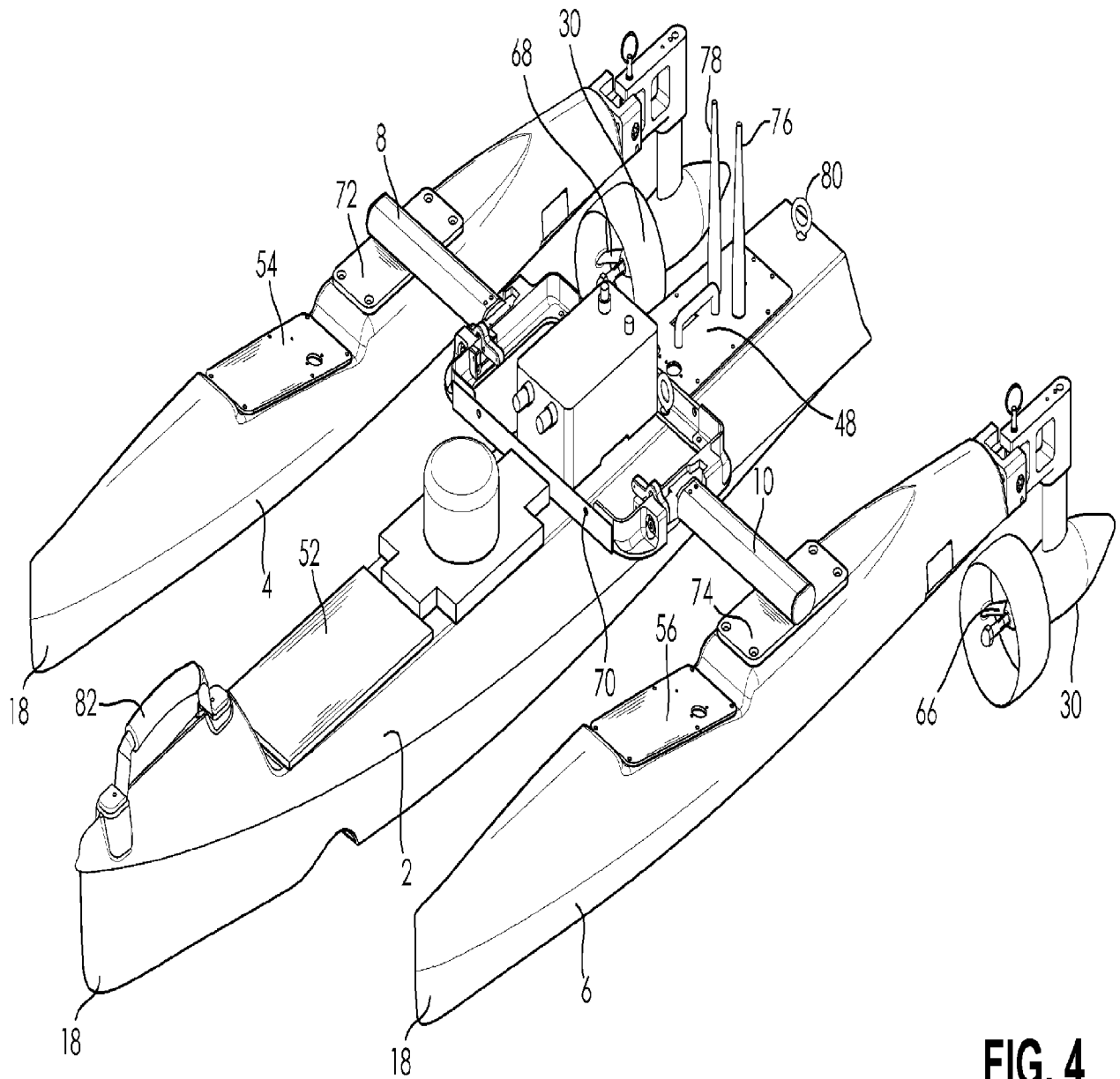


FIG. 4

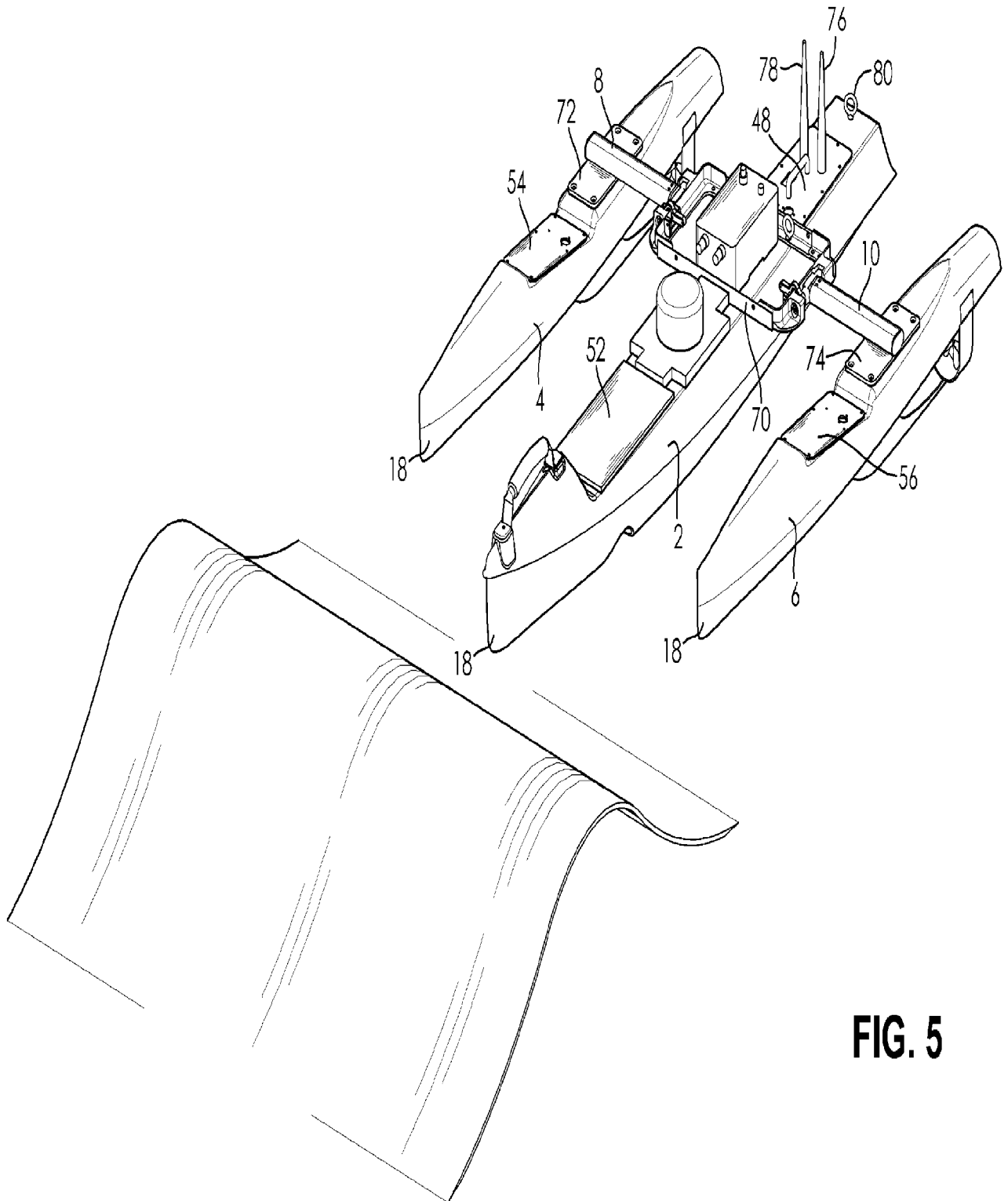


FIG. 5

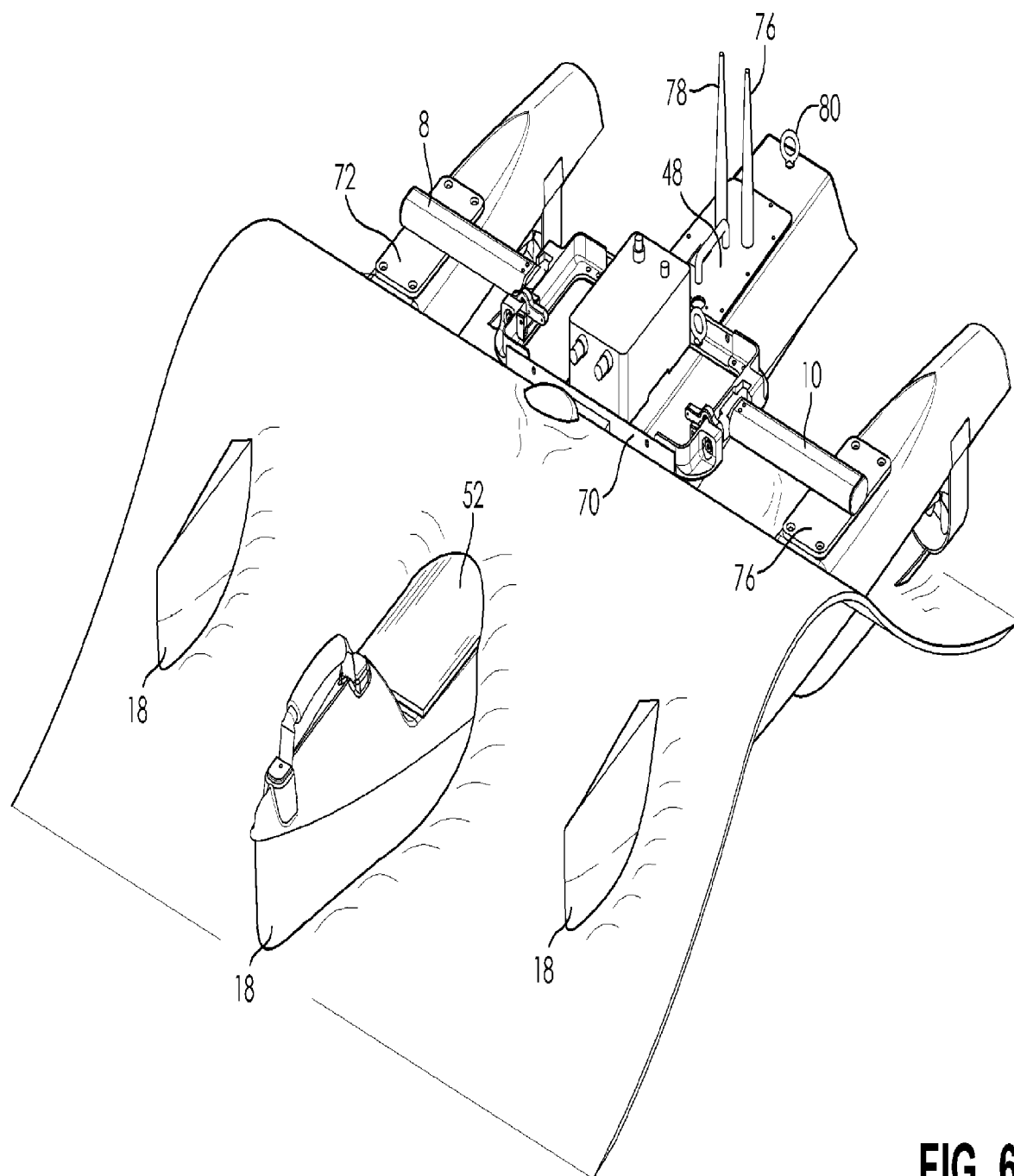
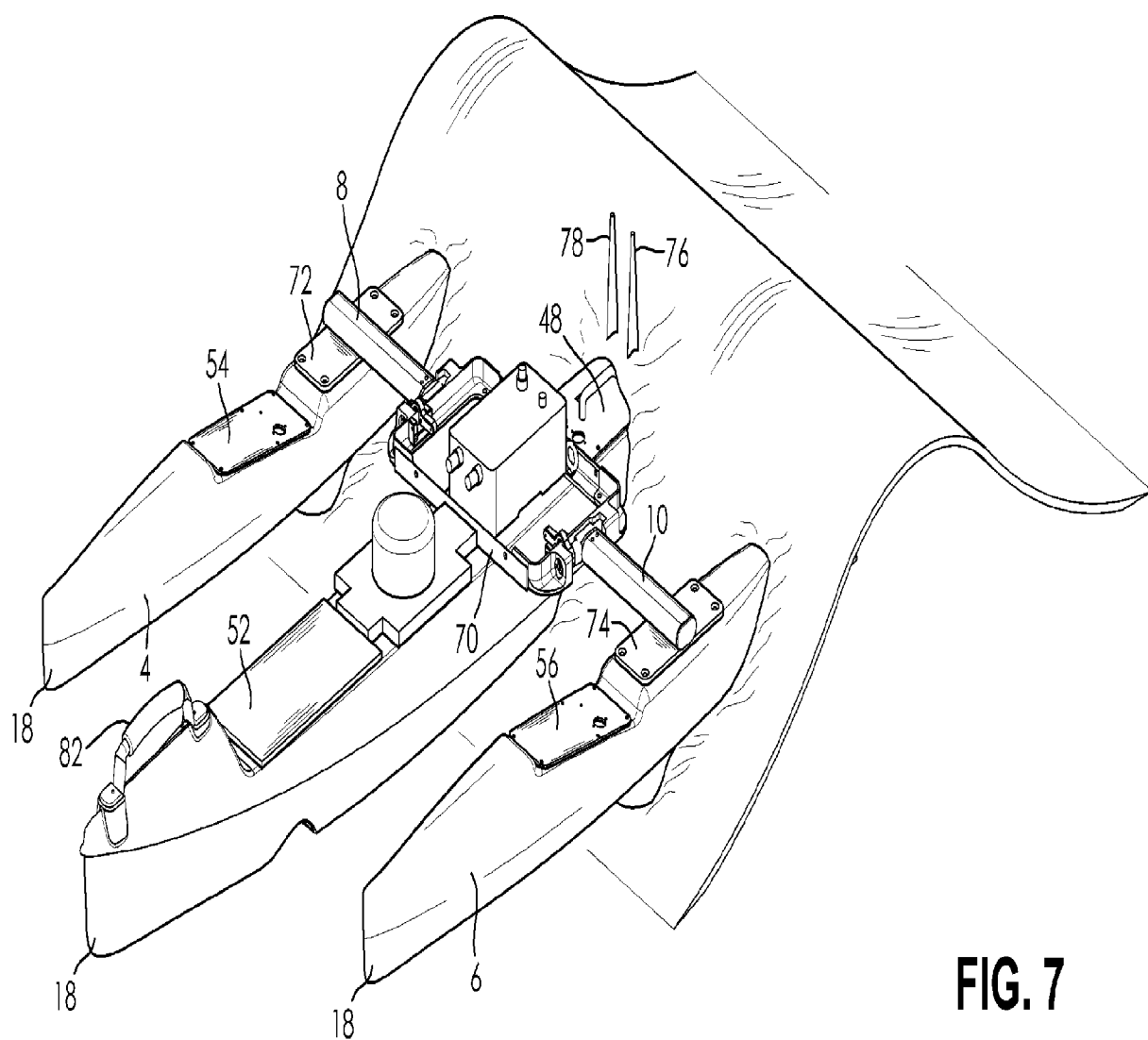


FIG. 6



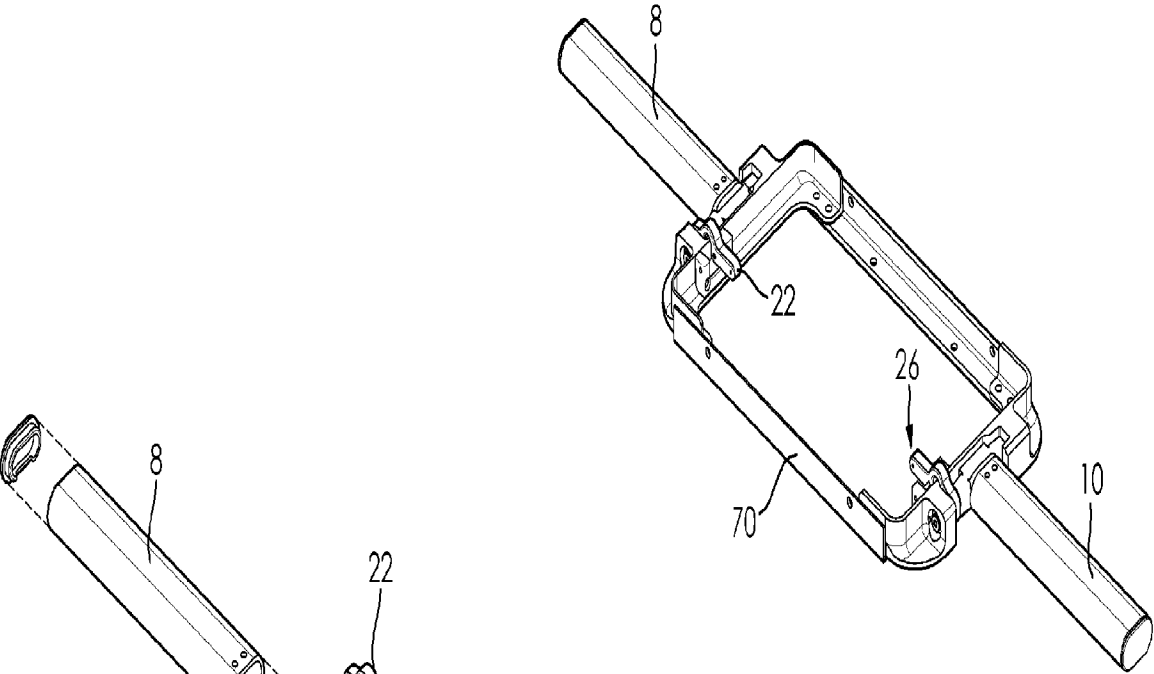


FIG. 8

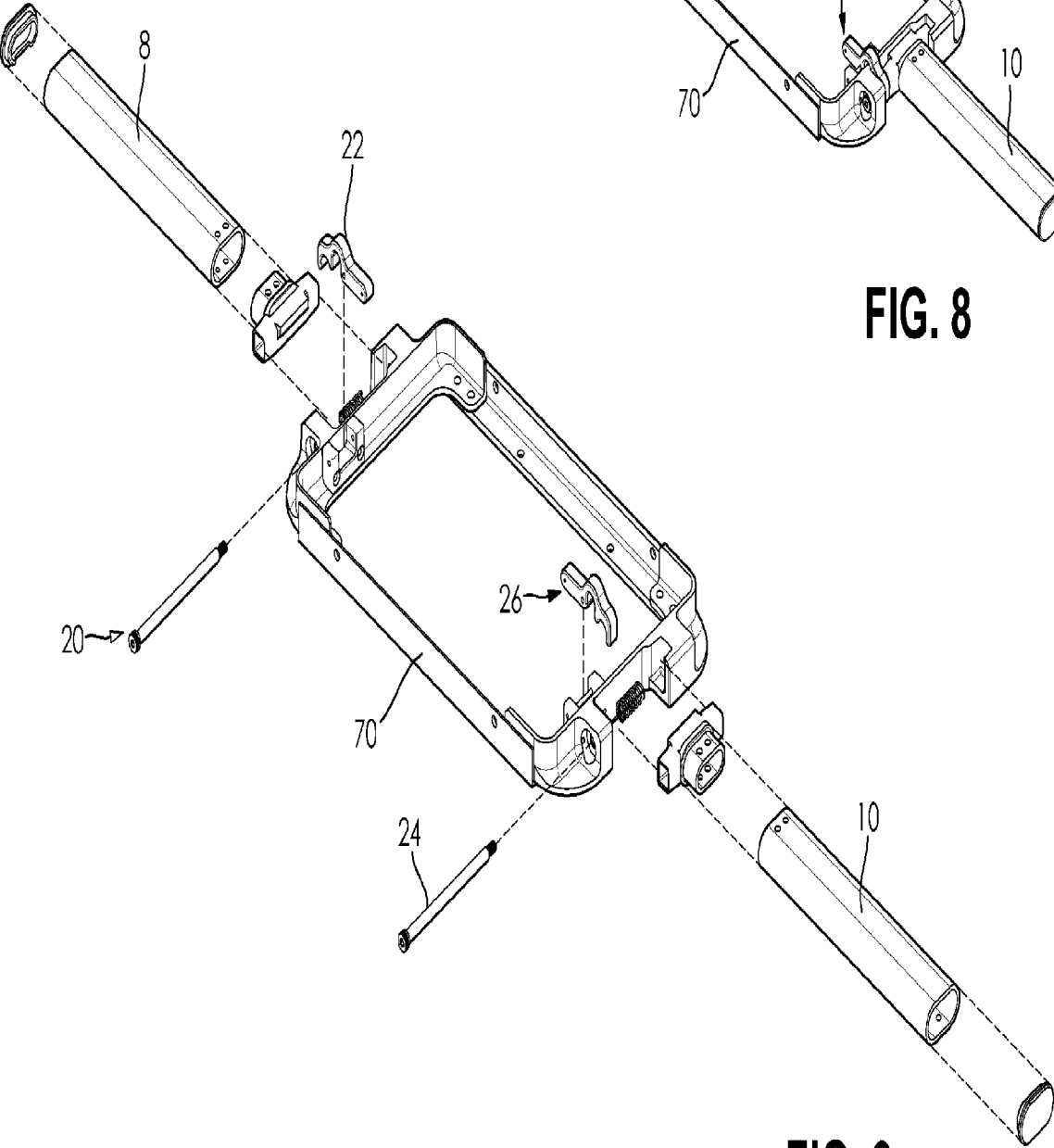
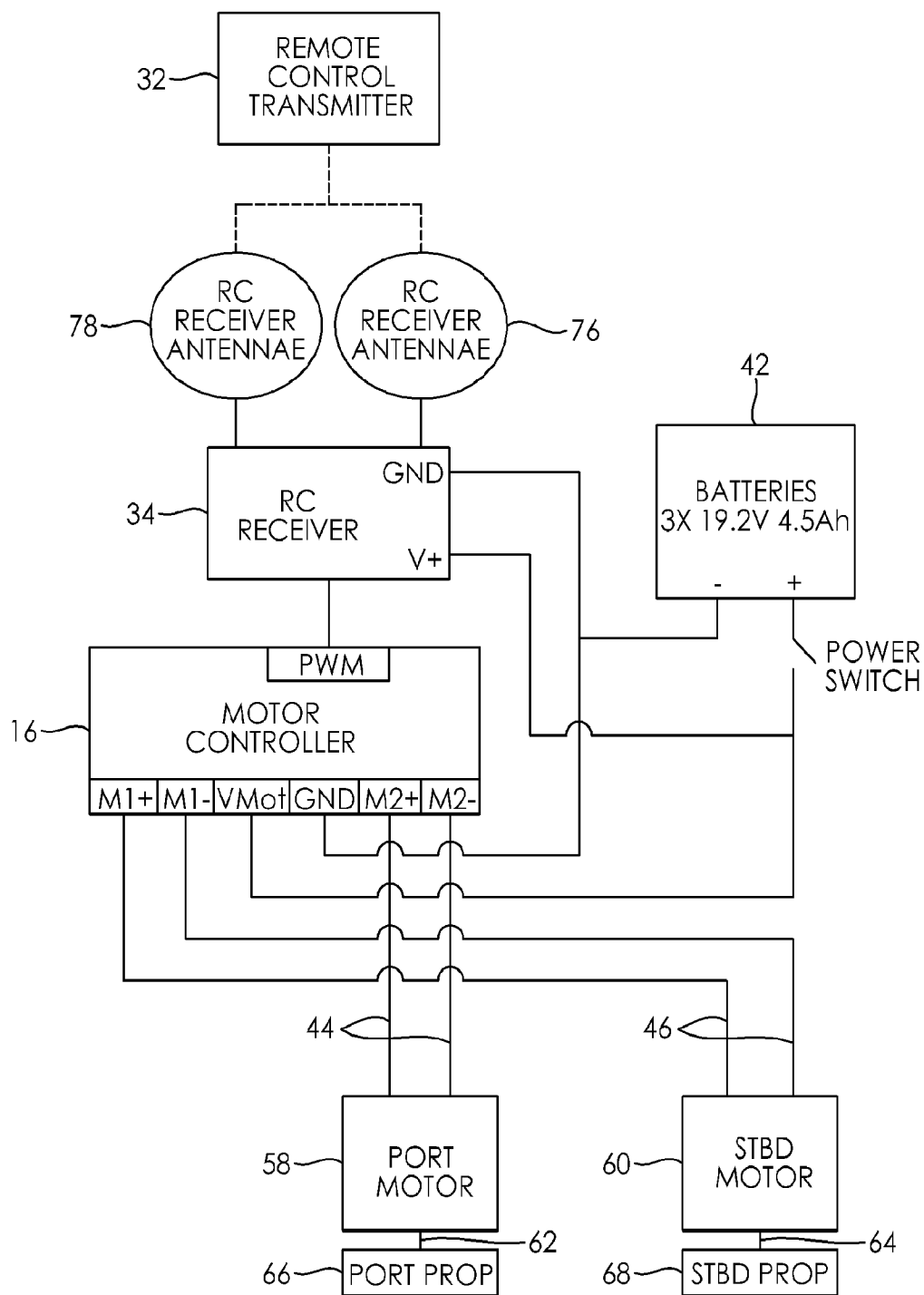


FIG. 9

**FIG. 10**

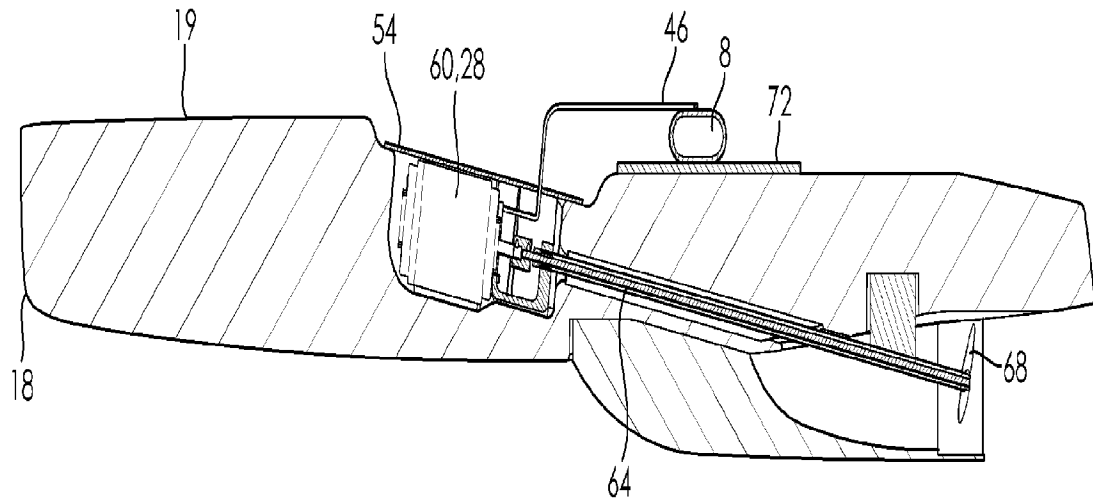


FIG. 11

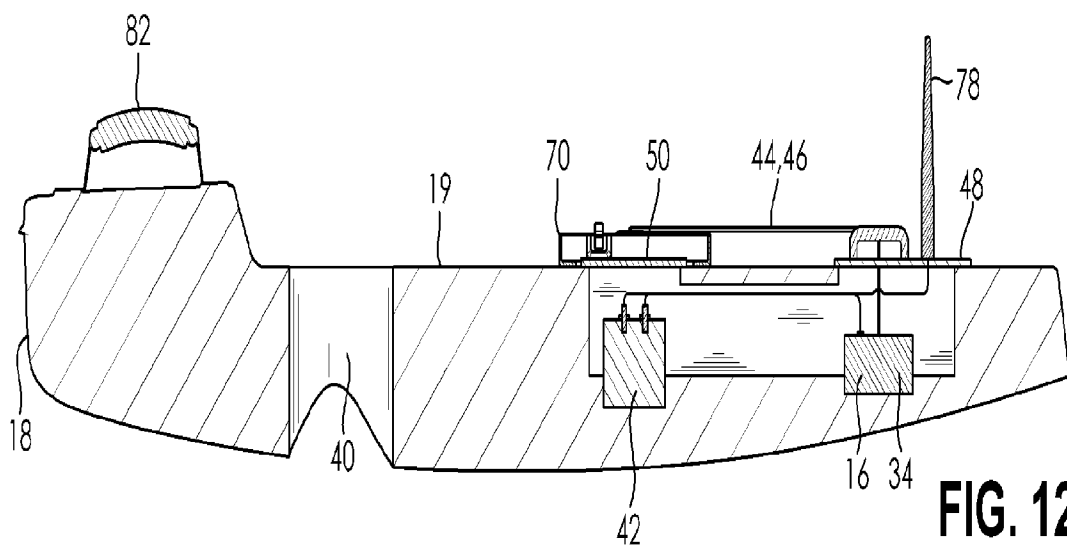


FIG. 12

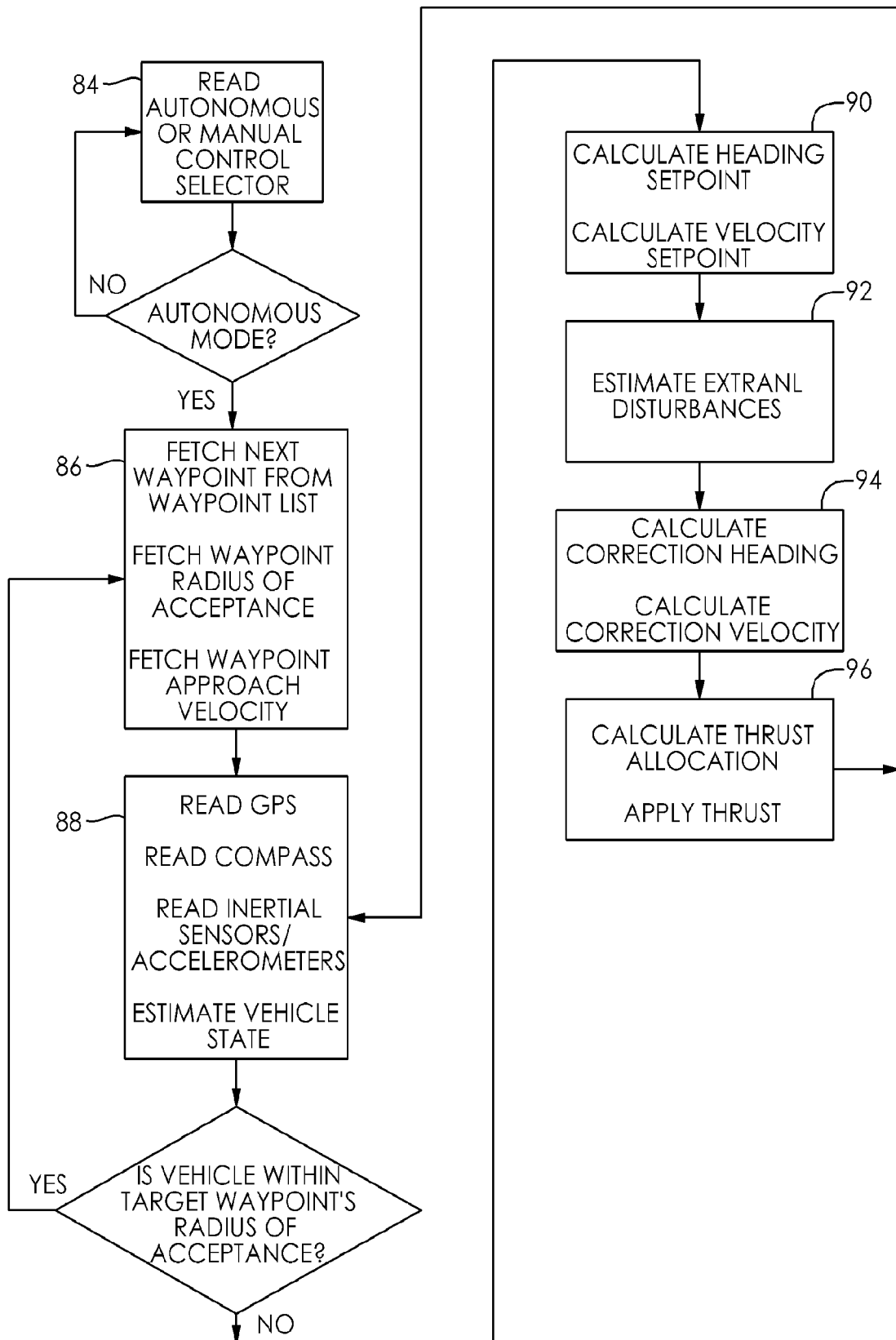


FIG. 13