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(54) Title: MARINE VESSEL

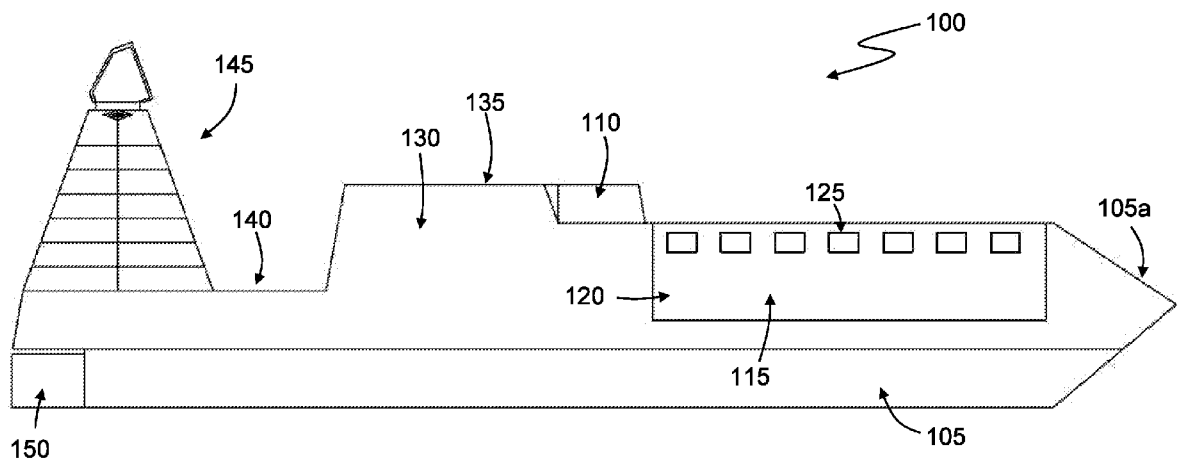


Figure 1

(57) Abstract: A marine vessel and a method for landing troops on a coastal region is provided. The marine vessel includes a passenger area, for transporting a plurality of passengers, and one or more doors providing access to the passenger area. The one or more doors are elongate along a length of the vessel, and pivot around an axis that extends along a length of the vessel and is adjacent to an upper end of the door.



WO 2020/056461 A1

## MARINE VESSEL

## TECHNICAL FIELD

[0001] The present invention relates to marine vessels, and in particular, although not exclusively, to assault boats, patrol boats, small reconnaissance vessels and the like.

## BACKGROUND ART

[0002] Combat boats which are configured to carry troops to a coastal region are known. An example of such boats is the CB90 fast assault craft originally developed for the Swedish Navy. These boats are relatively fast and agile, and are able to unload troops directly to a beach using a landing ramp at a bow of the boat.

[0003] The boats include a troop-carrying area, and a passageway extends from the troop-carrying area to the landing ramp at the bow. As the combat boats are designed to be fast and agile, the bow is generally narrow.

[0004] A problem with these boats is that the landing ramp area, being at the bow of the boat, is narrow and as such only allows single-file access to or from the boat. As a result, it takes time for the troops to get on or off from the boat by the landing ramp. It is generally not possible to widen the landing ramp, e.g. to enable multi-file access to or from the boat, without significantly altering hull characteristics of the boat, which will in turn, affect the speed and agility of the boat.

[0005] A further problem with such boats is that they are difficult to transport due to their size. Large trailers may be used to transport the boats over land, and the boats may be transported on large ships across sea. However, reliance on large trailers or ships for transportation is undesirable, particularly for smaller missions.

[0006] A further problem is that such boats are not easily reconfigurable. While these boats may include armed and unarmed configurations, as well as be specifically configured to military transport, for coast guard or border force activities, such configuration is generally performed at manufacture and cannot be reconfigured without significant overhaul.

[0007] Smaller, open boats, are easier to transport due to their smaller size, and being open, allow for rapid deployment of troops and may be more easily reconfigured. However, such boats only allow transport of a small number of soldiers, can carry limited weaponry, and provide limited protection to passengers due to the open nature.

[0008] As such, there is clearly a need for improved marine vessels that may overcome at least one of the abovementioned disadvantages.

[0009] It will be clearly understood that, if a prior art publication is referred to herein, this reference does not constitute an admission that the publication forms part of the common general knowledge in the art in Australia or in any other country.

#### SUMMARY OF INVENTION

[0010] The present invention is directed to marine vessels which may at least partially overcome at least one of the abovementioned disadvantages or provide the consumer with a useful or commercial choice.

[0011] With the foregoing in view, the present invention in one form, resides broadly in a marine vessel including:

a passenger area, for transporting a plurality of passengers;

one or more doors providing access to the passenger area;

wherein the one or more doors are elongate along a length of the vessel, and

wherein the one or more doors pivot around an axis that extends along a length of the vessel and is adjacent to an upper end of the door.

[0012] Advantageously, the doors of the vessel, being elongate along a length of the vessel enables a large number of passengers to disembark simultaneously. As the doors pivot around an axis that extends along a length of the vessel and is adjacent to an upper end of the door, they may open in a manner that does not block a view from the passenger area, and enables the vessel to function much like an open vessel.

[0013] The passengers may be soldiers. The vessel may comprise a fast assault or coastal defence boat, a patrol boat or a special operations support vessel. The passenger area may comprise a troop compartment.

[0014] The vessel may include a pair of opposing doors, one on each side of the vessel. The doors may open symmetrically.

[0015] The doors may be at least twice as wide as they are high. The doors may be at least three times as wide as they are high.

[0016] The doors may each include a plurality of windows.

[0017] The doors may comprise substantially planar panels. The doors may each

comprise a plurality of substantially planar panels. The panels may comprise an upper panel and a lower panel. The upper panel may be joined to the lower panel at an angle of about 135 degrees.

[0018] The doors may be hingedly attached to a hull of the vessel. The doors may be hingedly attached to an upper portion of the passenger area.

[0019] An upper portion of the doors may define at least part of a roof portion of the passenger area.

[0020] The passenger area may be substantially enclosed in a first configuration, and have substantially open sides in a second configuration. The first and second configurations may be provided by opening and closing the doors.

[0021] The passenger area may be located at a bow end of the vessel. The passenger area may extend across a width of the vessel. The passenger area may extend substantially an entire height of the vessel.

[0022] The passenger area may include a plurality of seating positions. The passenger area may be sized to accommodate about 12 fully armed soldiers.

[0023] The seating positions may be provided in two outwardly facing rows.

[0024] A cockpit may be provided in a central portion of the vessel, aft of the passenger area. The cockpit portion may extend above a height of the passenger area, to enable an unobstructed forward view from the cockpit.

[0025] A storage compartment may be provided aft of the passenger cabin.

[0026] A telescoping radar may be provided adjacent to a stern of the vessel. The telescoping radar may extend telescopically in a vertical direction. The telescoping radar may be configurable between an extended configuration and a compact configuration. In the extended configuration, the radar may comprise a highest part of the vessel. In the compact configuration, another part of the vessel may be the highest part of the vessel.

[0027] The telescoping radar may extend upwardly from a deck aft of the cockpit.

[0028] The vessel may be driven by one or more water jets. The water jets may be located adjacent to a stern of the vessel. The jets may be pivotable around a vertical steering axis, to provide for steering of the vessel.

[0029] A utility bay may be provided at outer edges of the passenger area. The utility bay may be reconfigurable, and in one configuration includes a plurality of mounted weapons.

[0030] The vessel may be formed of substantially planar panels to reduce a radar signature of the vessel.

[0031] The hull of the vessel may comprise a chine hull. The hull may have a reverse sheer.

[0032] The bow of the vessel may be pointed.

[0033] The hull and doors may provide ballistic protection to the passenger area.

[0034] The hull may be constructed primarily from aluminium.

[0035] The vessel may be configurable to operate in an unmanned configuration. The vessel may be used for reconnaissance, surveillance and intelligence gathering operations.

[0036] The vessel may be configured to be received in a Hercules C-130.

[0037] The vessel may be about 12m long.

[0038] In another form, the invention resides broadly in a method for landing troops on a coastal region, the method comprising:

loading troops into an assault boat having gullwing doors that are elongate along a length of the boat;

transporting the troops via the boat to the coastal region with the gullwing doors closed;

opening the gullwing doors; and

unloading the troops from the boat using the gullwing doors.

[0039] Any of the features described herein can be combined in any combination with any one or more of the other features described herein within the scope of the invention.

[0040] The reference to any prior art in this specification is not, and should not be taken as an acknowledgement or any form of suggestion that the prior art forms part of the common general knowledge.

#### BRIEF DESCRIPTION OF DRAWINGS

[0041] Various embodiments of the invention will be described with reference to the following drawings, in which:

[0042] Figure 1 illustrates a side view of a marine vessel, according to an embodiment of the present invention.

[0043] Figure 2 illustrates a top view of the marine vessel of Figure 1, according to an embodiment of the present invention.

[0044] Figure 3 illustrates a front view of the vessel of Figure 1, according to an embodiment of the present invention.

[0045] Figure 4 illustrates a front view of the vessel of with the doors open, according to an embodiment of the present invention.

[0046] Preferred features, embodiments and variations of the invention may be discerned from the following Detailed Description which provides sufficient information for those skilled in the art to perform the invention. The Detailed Description is not to be regarded as limiting the scope of the preceding Summary of the Invention in any way.

#### DESCRIPTION OF EMBODIMENTS

[0047] Figure 1 illustrates a side view of a marine vessel 100, according to an embodiment of the present invention. Figure 2 illustrates a top view of the marine vessel 100, and Figure 3 illustrates a front view of the vessel 100. The vessel 100 can, for example, function as a fast assault and coastal defence boat, a patrol boat or as a special operations support vessel. The vessel may also be used for reconnaissance, surveillance and intelligence gathering operations.

[0048] The marine vessel 100 comprises a hull 105, including a cockpit 110 in an upper portion of the hull 105 and centrally along a length of the vessel 100, and a troop compartment 115, adjacent to a bow 100a of the vessel 100.

[0049] The cockpit 110 may accommodate a crew of typically 1 to 2 persons, and includes a control area enabling the crew to control the vessel 100. The control area would generally include directional controls, engine controls and navigation equipment, as is known in the art.

[0050] The cockpit 110 is surrounded by windows to provide a view to the crew in forward and side directions. As the cockpit 110 is located at a height above the troop compartment 115, a clear line of sight is provided in the forward direction despite the cockpit 110 being located aft troop compartment 115.

[0051] The troop compartment 115 is elongate, and extends along a length of the vessel 100 from a bow 105a to a central portion of the vessel 100 adjacent to the cockpit 110. Elongate

gull-wing doors 120 are provided at respective sides of the troop compartment 115 to enable troops to enter and leave the vessel, as outlined below.

[0052] The troop compartment 115 is reconfigurable, as outlined below, but may include a plurality of seating positions, and be sized to accommodate about 12 fully armed soldiers. In one embodiment, the seating positions are provided in two outwardly facing rows (i.e. facing the doors 120).

[0053] The doors 120 each include a plurality of windows 125 extending along a length thereof. Each of the windows 125 may correspond to a seating position, thus enabling each soldier to see outside of the vessel while facing forwards in their seating position.

[0054] A storage area 130 is provided adjacent to the cockpit 110, which may be used to store equipment, such as weapons or medical supplies. In some embodiments, the storage area 130 comprises a medical area, including stretchers and other medical supplies to assist injured soldiers or persons. The storage area 130 may be accessible from the troop compartment 115 and/or the cockpit 110.

[0055] Furthermore, the storage area 130 may house sensors, weapon control systems, vessel control systems, RF communications, and the like.

[0056] An upper deck 135 is provided above the storage area 130, on which a weapon, such as a machine gun or a grenade launcher, may be mounted. The weapon may be controlled directly from the deck 135, or remotely from the cockpit 110 or from any other area.

[0057] As will be appreciated by the skilled addressee, the weapon may comprise a gun turret, that allows the weapon to be aimed, while protecting either the soldier operating the weapon, or the mechanism in which the weapon is controlled.

[0058] The upper deck 135 may be accessible from the storage area 130 or the cockpit 110, e.g. through an opening in a base of the deck 135.

[0059] A lower deck 140 is provided aft of the storage area 130. A telescoping pyramidal radar 145 extends upwardly from the lower deck 140, and is configurable between an extended configuration and a compact configuration. In an extended configuration (as illustrate in Figures 1-4), the pyramidal radar 145 extends above the upper deck 135, and thus enables 360-degree radar data to be captured. In a compacted configuration (not shown), an upper end of the radar 145 is below a level of the upper deck 135, and thus does not increase a height of the hull.

[0060] Such configuration enables the vessel 100 to be transported in an extremely

compact configuration. In particular, the vessel 100 is transportable by small cargo aircraft, such as a C-130 Hercules, and on a trailer.

[0061] An engine compartment (not illustrated) is provided in an aft portion of the hull, below the lower deck 140, and houses two engines driving respective water jets 150. The engines may comprise diesel engines, but the skilled addressee will readily appreciate that any suitable type of engine may be used, whether an internal combustion engine or otherwise.

[0062] The water jets 150 comprise impellers which are driven by the engines, and are each pivotable around a vertical steering axis, the steering of which is controllable from the cockpit 110. The use of the water jets 150, together with the low draft hull 105, allows speed and manoeuvrability, including in shallow water, enabling the vessel 100 to make sharp turns even at high speeds. Furthermore, such configuration is particularly useful when the vessel is used in littoral waters

[0063] As best illustrated in Figures 1 and 3, the hull 105 is a chine hull, with reverse sheer. The hull 105 is low profile, and includes predominantly planar surfaces, which provides a small radar cross section and provides a reduced radar signature.

[0064] The hull 105 is further streamlined in that the bow is pointed, rather than squared off like prior art vessels that have a ramp at their bow.

[0065] Figure 4 illustrates a front view of the vessel 100 with the doors 120 open, according to an embodiment of the present invention.

[0066] A hinge assembly attaches an upper portion of the doors 120 to an upper portion of the troop compartment 115, the hinge assembly having a rotational axis extending along a length of the vessel 100. As such, the door 120 is configured to rotate outwardly and upwardly. By opening upwardly and outwardly in such manner, a view from an inside of the troop compartment 115 is not blocked as is the case for doors that open outwardly around a vertical axis.

[0067] The doors 120 comprise upper and lower planar panels, which are angled relative to each other by an angle of about 135 degrees relative to each other. In a closed configuration form a roof portion and a wall portion respectively. When open, lower panel shields an outer portion of the troop compartment 115, e.g. from sun or rain.

[0068] The hinge assembly couples the doors 120 to the upper portion of the troop compartment 115 at a central portion thereof. As such, when the doors 120 are opened, a height in a substantial part of the troop compartment (i.e. all but a central portion) is significantly increased.

[0069] As outlined above, the doors 120 may be used to enter and exit the vessel 100 by the soldiers, and extend along a length of the troop compartment 115. This allows each of the troops to exit the vessel simultaneously, rather than single file as is the case in prior art vessels having a narrow ramp

[0070] Furthermore, the doors 120 may be opened to provides wide open access to the troop compartment 115, and thus enabling the vessel to function much like an open vessel. When open, the doors 120 provide shelter to a utility bay of the troop compartment directly thereunder.

[0071] This utility bay may be rapidly reconfigured for various mission profiles. As an illustrative example, the utility bay may be configured to include retractable weapons bays that enable the soldiers to fire the weapons from inside the troop compartment 115. For example, a weapon bay including a mounted machine gun may be provided in association with one or more of the seating positions.

[0072] The skilled addressee will readily appreciate that the weapons described above are described for exemplary purposes and may take any suitable form, including missiles, machine guns, cannons, grenade launchers, and the like.

[0073] During a cruise-and-surveillance configuration, the doors 120 are shut, which both provides protection and comfort to the soldiers, but also provides a streamlined and aerodynamic hull. The hull 105 and doors 120 provide full ballistic protection (NIJ Class 3+) to those inside, and the troop compartment 115 can comprise a climate-controlled cabin to ensure that troops transported therein arrive in peak physical condition.

[0074] Upon arrival, the doors open, and the soldiers are able to exit simultaneously.

[0075] As outlined above, the doors may also be opened to provide an attack configuration, in which the doors 120 are opened to allows the soldiers to operate weaponry from inside (or an edge of) the troop compartment 115. The doors 120 may be closed rapidly should retreat be necessary, thus reclosing the vessel 100.

[0076] The hull 105 is constructed from aluminium, which is both strong and lightweight.

[0077] In the above description, the vessel 100 is manned from the cockpit 110. The vessel 100 may, however, operate in an unmanned configuration. In such case, the vessel may be operated by a remote operator (e.g. in a nearby ship, or on land), or operate automatically. As an illustrative example, the vessel 100 may be configured to operate according to predefined instructions (much like an autopilot). Such functions can include navigation to a particular

destination or along a define path. Similarly, the functions may include holding the vessel in a particular position (e.g. for surveillance purposes, or for waiting further instructions), and in such case, the water jets 150 may be automatically adjusted to hold the vessel in that particular position.

[0078] In one embodiment, the vessel 100 may be controlled remotely to navigate into hostile area, to recover soldiers, and transport the soldiers away from the hostile area.

[0079] Whether manned or unmanned, the vessel 100 is particularly useful for long range infiltration/exfiltration of special operations personnel in a manner that may be difficult to detect by enemy forces. Other roles in which the vessel 100 is suited include missile attack, command and control and electronic surveillance.

[0080] The vessel 100 described above is small and easy to transport, including by small cargo aircraft, such as the Hercules C-130. This enables the vessel 100 to be quickly deployed in areas as needed, and easily moved around the world.

[0081] The vessel 100 provides superior protection to crew and soldiers compared with other vessels that are easy to transport, and ensures that soldiers arrive in peak physical condition, while also providing fast exit.

[0082] The vessel 100 is easy reconfigurable to suit different tasks. As an illustrative example, the vessel 100 may be configured to safely and comfortably transport soldiers or other persons, and subsequently reconfigured to for combat where weapons can be used by the soldiers from the vessel 100 through the open doors 120. As such, the vessel 100 provides much of the benefits of an open vessel as well as the benefits of a vessel with ballistic protection.

[0083] A method for landing troops on a coastal region is also provided. The method comprises loading troops into an assault boat having gullwing doors that are elongate along a length of the boat. An example of such boat is the vessel 100.

[0084] The troops are then transported via the boat to the coastal region with the gullwing doors closed, to protect the troops and to provide a comfortable environment for the troops so that they arrive in peak condition.

[0085] Upon arrival, the gullwing doors are opened, and the troops are unloaded from the boat using the gullwing doors. This enables the troops to be unloaded simultaneously, e.g. by jumping out of the boat.

[0086] In the present specification and claims (if any), the word 'comprising' and its

derivatives including 'comprises' and 'comprise' include each of the stated integers but does not exclude the inclusion of one or more further integers.

[0087] Reference throughout this specification to 'one embodiment' or 'an embodiment' means that a particular feature, structure, or characteristic described in connection with the embodiment is included in at least one embodiment of the present invention. Thus, the appearance of the phrases 'in one embodiment' or 'in an embodiment' in various places throughout this specification are not necessarily all referring to the same embodiment. Furthermore, the particular features, structures, or characteristics may be combined in any suitable manner in one or more combinations.

[0088] In compliance with the statute, the invention has been described in language more or less specific to structural or methodical features. It is to be understood that the invention is not limited to specific features shown or described since the means herein described comprises preferred forms of putting the invention into effect. The invention is, therefore, claimed in any of its forms or modifications within the proper scope of the appended claims (if any) appropriately interpreted by those skilled in the art.

## CLAIMS

1. A marine vessel including:
  - a passenger area, for transporting a plurality of passengers;
  - one or more doors providing access to the passenger area;wherein the one or more doors are elongate along a length of the vessel, and wherein the one or more doors pivot around an axis that extends along a length of the vessel and is adjacent to an upper end of the door.
2. The marine vessel of claim 1, wherein the passengers are soldiers.
3. The marine vessel of claim 1, comprising a fast assault or coastal defence boat, a patrol boat or a special operations support vessel.
4. The marine vessel of claim 1, wherein the passenger area comprises a troop compartment.
5. The marine vessel of claim 1, wherein the one or more doors comprise a pair of opposing doors, one on each side of the vessel.
6. The marine vessel of claim 5, wherein the pair of doors open symmetrically.
7. The marine vessel of claim 1, wherein the doors are at least twice as wide as they are high.
8. The marine vessel of claim 1, wherein the doors are at least three times as wide as they are high.
9. The marine vessel of claim 1, wherein the doors each include a plurality of windows.
10. The marine vessel of claim 1, wherein the doors comprise substantially planar panels.
11. The marine vessel of claim 10, wherein the doors each comprise a plurality of substantially planar panels.
12. The marine vessel of claim 11, wherein the panels comprise an upper panel and a lower panel.
13. The marine vessel of claim 12, wherein the upper panel is joined to the lower panel at an angle of about 135 degrees.

14. The marine vessel of claim 1, wherein the doors are hingedly attached to a hull of the vessel.
15. The marine vessel of claim 14, wherein the doors are hingedly attached to an upper portion of the passenger area.
16. The marine vessel of claim 1, wherein an upper portion of the doors may define at least part of a roof portion of the passenger area.
17. The marine vessel of claim 1, wherein the passenger area is substantially enclosed in a first configuration, and has substantially open sides in a second configuration, wherein the first and second configurations are provided by opening and closing the doors.
18. The marine vessel of claim 1, wherein the passenger area is located at a bow end of the vessel.
19. The marine vessel of claim 1, wherein the passenger area extends across a width of the vessel.
20. The marine vessel of claim 1, wherein the passenger area extends substantially an entire height of the vessel.
21. The marine vessel of claim 1, wherein the passenger area includes a plurality of seating positions.
22. The marine vessel of claim 1, wherein the passenger area is sized to accommodate about 12 fully armed soldiers.
23. The marine vessel of claim 21, wherein the seating positions are provided in two outwardly facing rows.
24. The marine vessel of claim 1, wherein a cockpit is provided in a central portion of the vessel, aft of the passenger area, the cockpit extending above a height of the passenger area, to enable an unobstructed forward view from the cockpit.
25. The marine vessel of claim 1, wherein a storage compartment is provided aft of the passenger cabin.
26. The marine vessel of claim 1, including a telescoping radar adjacent to a stern of the vessel, wherein the telescoping radar may extend telescopically in a vertical direction, the telescoping radar configurable between an extended configuration and a compact configuration,

wherein in the extended configuration the radar is a highest part of the vessel, and in the compact configuration another part of the vessel is the highest part of the vessel.

27. The marine vessel of claim 1, wherein the vessel is driven by one or more water jets, located adjacent to a stern of the vessel, the jets pivotable around a vertical steering axis, to provide for steering of the vessel.

28. The marine vessel of claim 1, wherein a utility bay is provided at outer edges of the passenger area, the utility bay reconfigurable, and in one configuration includes a plurality of mounted weapons.

29. The marine vessel of claim 1, wherein the vessel may be formed of substantially planar panels to reduce a radar signature of the vessel.

30. The marine vessel of claim 1, wherein the hull of the vessel comprises a chine hull.

31. The marine vessel of claim 1, wherein the hull is a reverse sheer hull.

32. The marine vessel of claim 1, wherein the bow of the vessel is pointed.

33. The marine vessel of claim 1, wherein the hull and doors may provide ballistic protection to the passenger area.

34. The marine vessel of claim 1, wherein the hull is constructed primarily from aluminium.

35. The marine vessel of claim 1, wherein the vessel is configurable to operate in an unmanned configuration.

36. The marine vessel of claim 1, wherein the vessel is configured to be received in a Hercules C-130.

37. The marine vessel of claim 1, wherein the vessel is about 12m long.

38. A method for landing troops on a coastal region, the method comprising:

loading troops into an assault boat having gullwing doors that are elongate along a length of the boat;

transporting the troops via the boat to the coastal region with the gullwing doors closed;

opening the gullwing doors; and

unloading the troops from the boat using the gullwing doors.

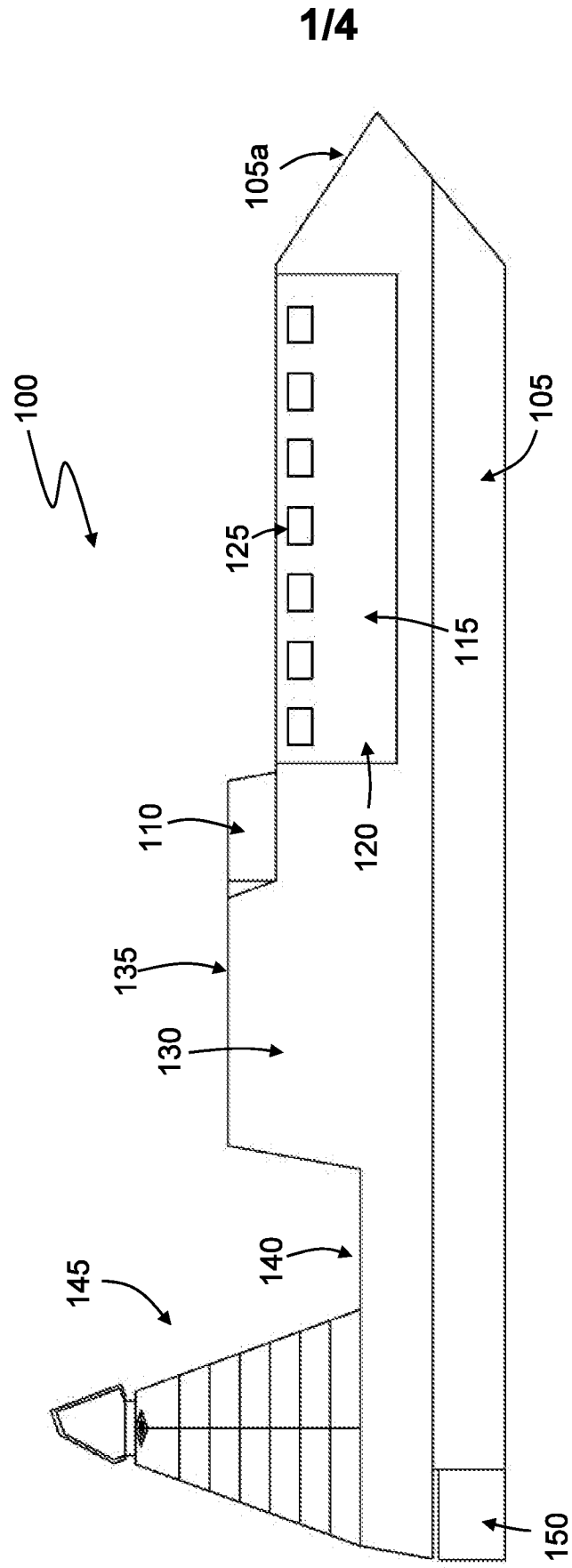


Figure 1

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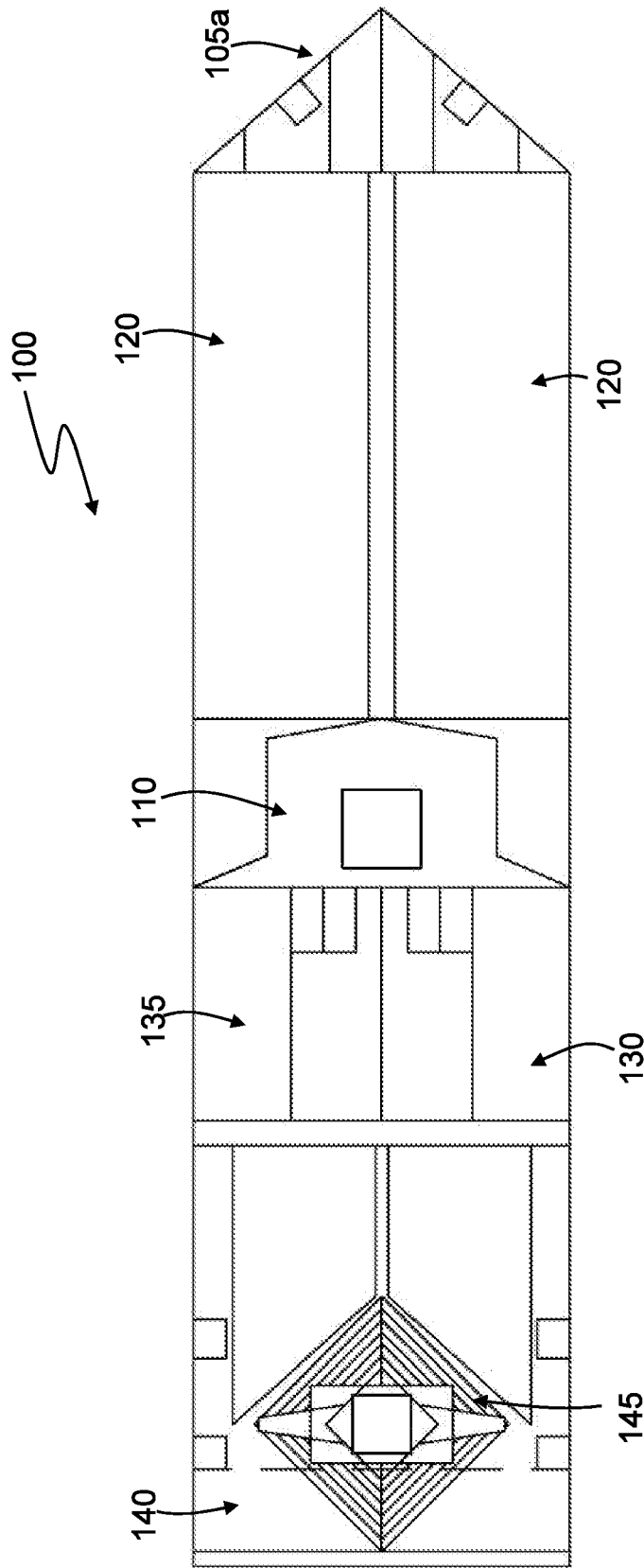


Figure 2

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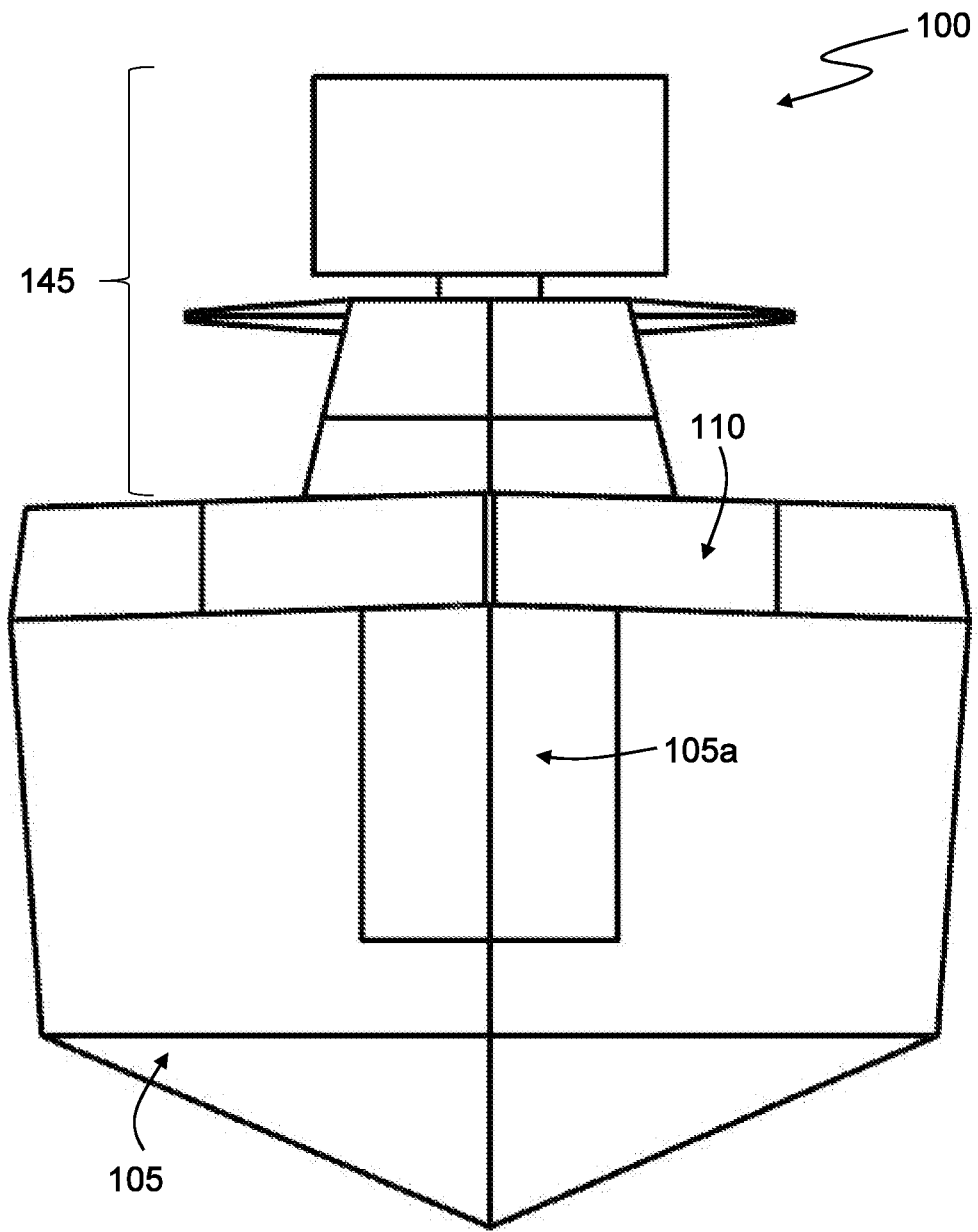


Figure 3

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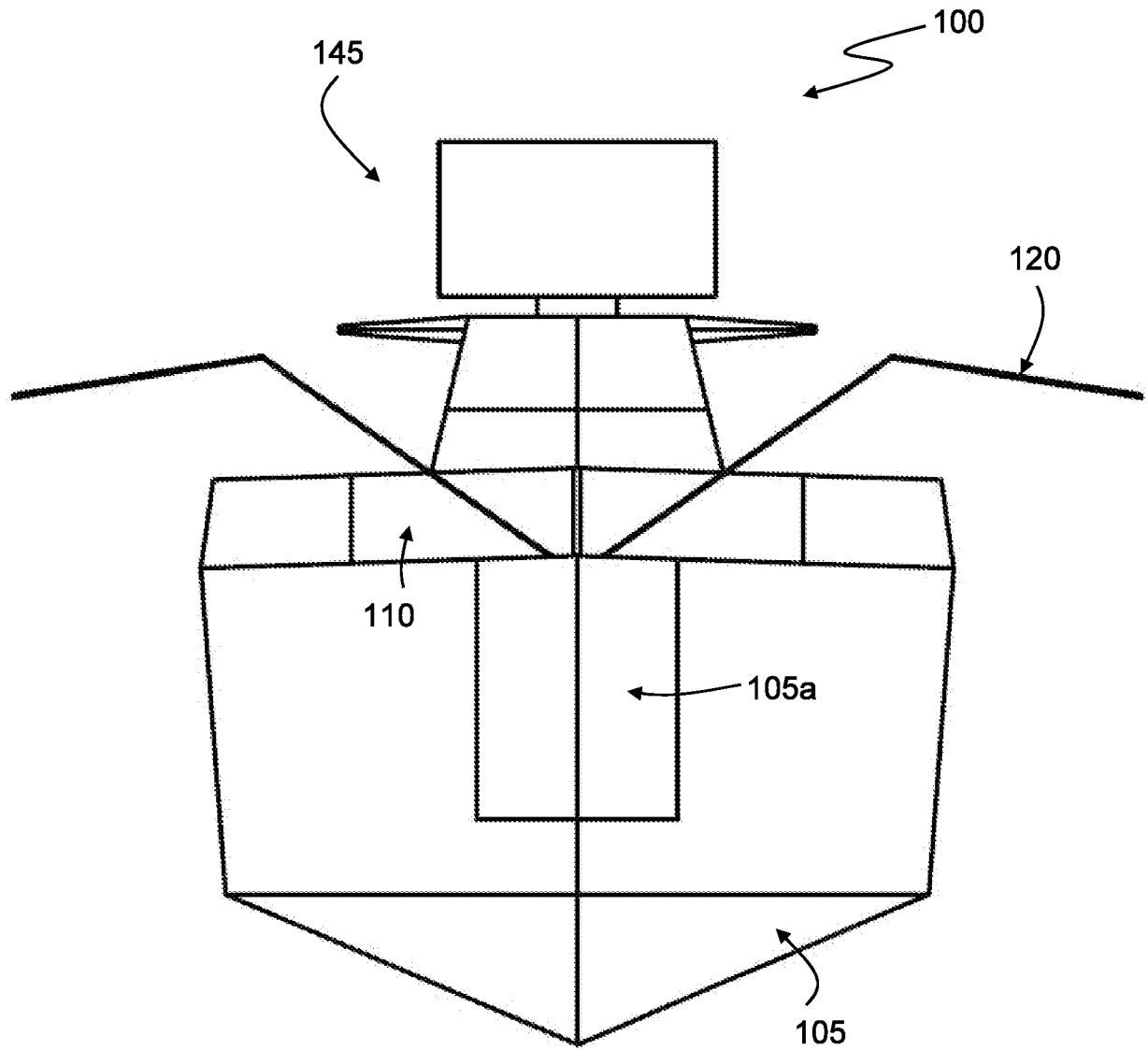


Figure 4

## A. CLASSIFICATION OF SUBJECT MATTER

**B60J 5/04 (2006.01) B63B 19/08 (2006.01) B63B 27/00 (2006.01)**

According to International Patent Classification (IPC) or to both national classification and IPC

## B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)

Database (PATENW): IPCs, CPCs B60J5/0463, B63B19/08, B63B19/00, B63B27/143, B63B2019/0007, B63B27/00, B63B35/00/LOW, Keywords (ship, gull-wing, door, longitudinal, pivot, troops) and like terms., Espacenet (Worldwide), AusPat &amp; Internal Databases provided by IP Australia: Applicant and inventor name search. Cited and citing documents for relevant prior art

## C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
Documents are listed in the continuation of Box C		

 Further documents are listed in the continuation of Box C See patent family annex

* Special categories of cited documents:		
"A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention	
"D" document cited by the applicant in the international application	"X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step when the document is taken alone	
"E" earlier application or patent but published on or after the international filing date	"Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art	
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"O" document referring to an oral disclosure, use, exhibition or other means		
"P" document published prior to the international filing date but later than the priority date claimed		

Date of the actual completion of the international search  
17 October 2019Date of mailing of the international search report  
17 October 2019

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INTERNATIONAL SEARCH REPORT		International application No.
C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT		PCT/AU2019/051000
Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	CN 202807043 U (NINGBO KINGBAY YACHT MANUFACTURING CO., LTD) 20 March 2013 Figure 1, machine translation.	1-4, 7-25, 27, 30-32, 34, 35, 37
A	US 4811680 A (GENTH) 14 March 1989 Whole document particularly Figure 1	1-38
A	US 2903296 A (BARENYI) 08 September 1959 Whole document particularly Figures 2-5	1-38
A	US 2938749 A (PODOLAN et al.) 31 May 1960 Whole document particularly Figure 1	1-38
A	CN 107406024 A (SEKI ARKEMA CO LTD) 28 November 2017 Whole document particularly Figures 1-3	1-38
A	GB 2152448 B (FRUEHAUF CORPORATION) 07 August 1985 Figure 1, page 3-page 7	1-38
P,X	US 2019/0061489 A1 (HOGGARTH et al.) 28 February 2019 Whole document particularly Figures 1-2, paragraph [0024]	1-13, 15- 25, 27, 29-32, 34-37

**INTERNATIONAL SEARCH REPORT**

Information on patent family members

International application No.

**PCT/AU2019/051000**

This Annex lists known patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

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<b>End of Annex</b>			

Due to data integration issues this family listing may not include 10 digit Australian applications filed since May 2001.

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