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Customer No. 23523

MULTI-HULL SURFACE VESSEL WITH DRAG REDUCTION ON LATERAL HULLS

TO ALL WHOM IT MAY CONCERN:

BE IT KNOWN THAT (1) RICHARD B. PHILIPS, employee and of the United States Government and (2) ROBERT LATORRE, citizens of the United States of America, and residents of (1) Barrington, County of Bristol, State of Rhode Island, and (2) Metairie, County of Jefferson, State of Louisiana, have invented certain new and useful improvements entitled as set forth above, of which the following is a specification.

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3 MULTI-HULL SURFACE VESSEL WITH DRAG REDUCTION ON LATERAL HULLS

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5 STATEMENT OF GOVERNMENT INTEREST

6 The invention described herein may be manufactured and used
7 by or for the Government of the United States of America for
8 Governmental purposes without the payment of any royalties
9 thereon or therefor.

10

11 BACKGROUND OF THE INVENTION

12 (1) Field of the Invention

13 The invention relates to reduction of drag, and its
14 attendant advantages for marine surface vessels, and is directed
15 more particularly to the reduction of drag caused by additional
16 hulls in multi-hull vessels, such as trimarans and pentamarans.

17 (2) Description of the Prior Art

18 Multi-hull surface vessels, such as trimarans and
19 pentamarans, are used for civilian and military applications. A
20 multi-hull design provides the advantages of vessel stability at
21 high speeds and increased deck space. In a typical trimaran, the
22 multi-hulls or lateral hulls are substantially smaller than the
23 main hull and have a substantially smaller subsurface area.

24 While a multi-hull vessel offers the advantages set forth
25 above, the presence of a plurality of hulls increases the drag

1 forces of the vessel, thereby requiring more power to gain the
2 high speeds desired.

3 The theoretical advantages of encompassing a hull with
4 microbubbles to reduce drag are known and have been realized in
5 laboratories with model ships operating at modest speeds.
6 However, the use of microbubbles with full-sized vessels has
7 generally been unsuccessful because the air/gas flow required for
8 encompassing the sides of full-sized hulls is too large. A large
9 air/gas flow requires large air/gas compressors, or the like.
10 Further, the presence of microbubbles reduces the effectiveness
11 of exterior propulsion units, such as the vessel's propellers.

12 As such, there is a need to eliminate the increased drag of
13 a multi-hull vessel, preferably through efficient microbubble
14 generation, so that the advantages of such vessels may be
15 exploited to a greater degree.

16

17 SUMMARY OF THE INVENTION

18 Accordingly, it is a general purpose and primary object of
19 the present invention to provide a multi-hull vessel in which the
20 drag of the lateral hulls of the vessel is reduced, thereby
21 reducing the overall drag of the vessel.

22 It is a further object of the present invention to
23 accomplish drag reduction of the lateral hulls by utilization of
24 microbubbles without a need for compressors on board, and without
25 affecting propeller efficiency.

1 With the above and other objects in view, as will
2 hereinafter appear, there is provided a marine surface vessel
3 having a main hull and at least two lateral hulls disposed
4 respectively on opposite sides of the main hull. The vessel is
5 provided with a gas turbine engine disposed in the main hull and
6 adapted in operation to drive the propellers and, in addition, to
7 produce exhaust gas and cooling air, microbubble injectors
8 disposed in subsurface areas of each of the lateral hulls, and
9 conduits placing at least one of the exhaust gas and cooling air
10 discharges in communication with the microbubble injectors.
11 During operation of the gas turbine engine, the gas turbine
12 exhaust and/or cooling air is directed by the conduits to the
13 microbubble injectors to effect generation of microbubbles on the
14 subsurface areas of the lateral hulls to occasion microbubble
15 drag reduction on the lateral hulls.

16 The above and other features of the invention, including
17 various novel details of construction and combinations of parts,
18 will now be more particularly described with reference to the
19 accompanying drawings and pointed out in the claims. It will be
20 understood that the particular device embodying the invention is
21 shown by way of illustration only and not as a limitation of the
22 invention. The principles and features of this invention may be
23 employed in various and numerous embodiments without departing
24 from the scope of the invention.

1 BRIEF DESCRIPTION OF THE DRAWINGS

2 Reference is made to the accompanying drawings in which is
3 shown an illustrative embodiment of the invention, from which its
4 novel features and advantages will be apparent, wherein
5 corresponding reference characters indicate corresponding parts
6 throughout the several views of the drawings and wherein:

7 FIG. 1 is a side view of one form of multi-hull vessel
8 illustrative of an embodiment of the present invention;

9 FIG. 2 is a top view of the vessel illustrative of the
10 embodiment of the present invention with the view taken from
11 reference line 2-2 of FIG. 1; and

12 FIG. 3 is a front view of the vessel illustrative of the
13 embodiment of the present invention with the view taken from
14 reference line 3-3 of FIG. 2.
15

16 DESCRIPTION OF THE PREFERRED EMBODIMENT

17 It has been found that the application of microbubble drag
18 reduction is rendered attractive in multi-hull vessels in view of
19 the underwater area of lateral hulls, that is, the hulls outboard
20 of the main hull. A microbubble system used only on lateral
21 hulls, which are not provided with propellers, avoids the issues
22 associated with the negative impact of microbubble systems on the
23 performance of propulsion propellers.

1 It will be apparent that the above description pertaining to
2 a trimaran vessel applies equally to a pentamaran vessel, or
3 other multi-hull type of surface vessel.

4 Referring now to FIGS. 1-3 wherein like numerals refer to
5 like elements throughout the several views, it will be seen that
6 a traditional trimaran 20 is provided with a main hull 22 on
7 which is mounted at least one propulsion propeller 24, and
8 outboard of the main hull a first lateral hull 26 to port of the
9 main hull 22, and a second lateral hull 28 to starboard of the
10 main hull 22. An athwartship extending deck structure 30 is
11 supported by all three hulls 22, 26, 28.

12 The vessel 20 is powered by a gas turbine engine 32 which
13 produces exhaust gas and cooling gas through discharge lines 34;
14 however alternative gas-producing power generators may be used in
15 lieu of the gas turbine engine 32.

16 The discharge lines 34 convey gas to distribution lines 36,
17 each of which extends to a microbubble injector 38 located in an
18 outside area but preferably a subsurface area 40 of one of the
19 lateral hulls 26, 28. The subsurface area 40 is defined as the
20 area of the lateral hulls 26 normally under the surface of the
21 water.

22 The microbubble injectors 38 typically are strips or plates
23 of porous material, typically in the range of 40% - 50% open area
24 defined by holes in the range of 1/16 to 1/8 inch. The plates
25 preferably are disposed every twenty feet, or so, along the

1 subsurface area of the lateral hulls. The microbubble injectors
2 38 may extend completely around the bottom of the lateral hulls
3 26 and 28, as shown in FIG. 3.

4 The microbubbles are generated by either, or both, of the
5 gas turbine exhaust gas and cooling air, both of which are
6 otherwise vented to the atmosphere and/or underwater.

7 Surface effect ships (SES) are surface vessels provided with
8 an air cushion capability. Such ships ride on an air cushion, at
9 least in part. Such vessels, in operation, experience relatively
10 low surface area in contact with the water. Thus, a multi-hull
11 SES presents even less of a subsurface area than a regular multi-
12 hull vessel.

13 To improve performance in either an SES or non-SES type
14 vessel, a non-wetting hull coating (teflon, silicon, or the like)
15 may be applied to the surface areas of the hull of the SES.

16 There is thus provided a multi-hull vessel in which the drag
17 of the lateral hulls is reduced, thereby reducing the overall
18 drag of the vessel, and permitting increased speed and reduced
19 fuel requirements. The drag reduction is accomplished without
20 affecting the efficiency of the propulsion propellers mounted on
21 the main hull.

22 It will be understood that many additional changes in the
23 details, materials, steps and arrangement of parts, which have
24 been herein described and illustrated in order to explain the
25 nature of the invention, may be made by those skilled in the art

- 1 within the principles and scope of the invention as expressed in
- 2 the appended claims.

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5 ABSTRACT OF THE DISCLOSURE

6 A marine surface vessel having a main hull and at least two
7 lateral hulls disposed respectively on opposite sides of the main
8 hull. The vessel includes an engine disposed in the main hull
9 producing exhaust gas and cooling air, microbubble injectors
10 disposed in subsurface areas of each of the lateral hulls, and
11 conduits in fluid communication with the microbubble injectors.
12 Upon operation of the engine, the exhaust and/or cooling air
13 produced by the engine is directed by the conduits to the
14 injectors to effect generation of microbubbles on the subsurface
15 areas of the lateral hulls to occasion microbubble drag reduction
16 on the lateral hulls.

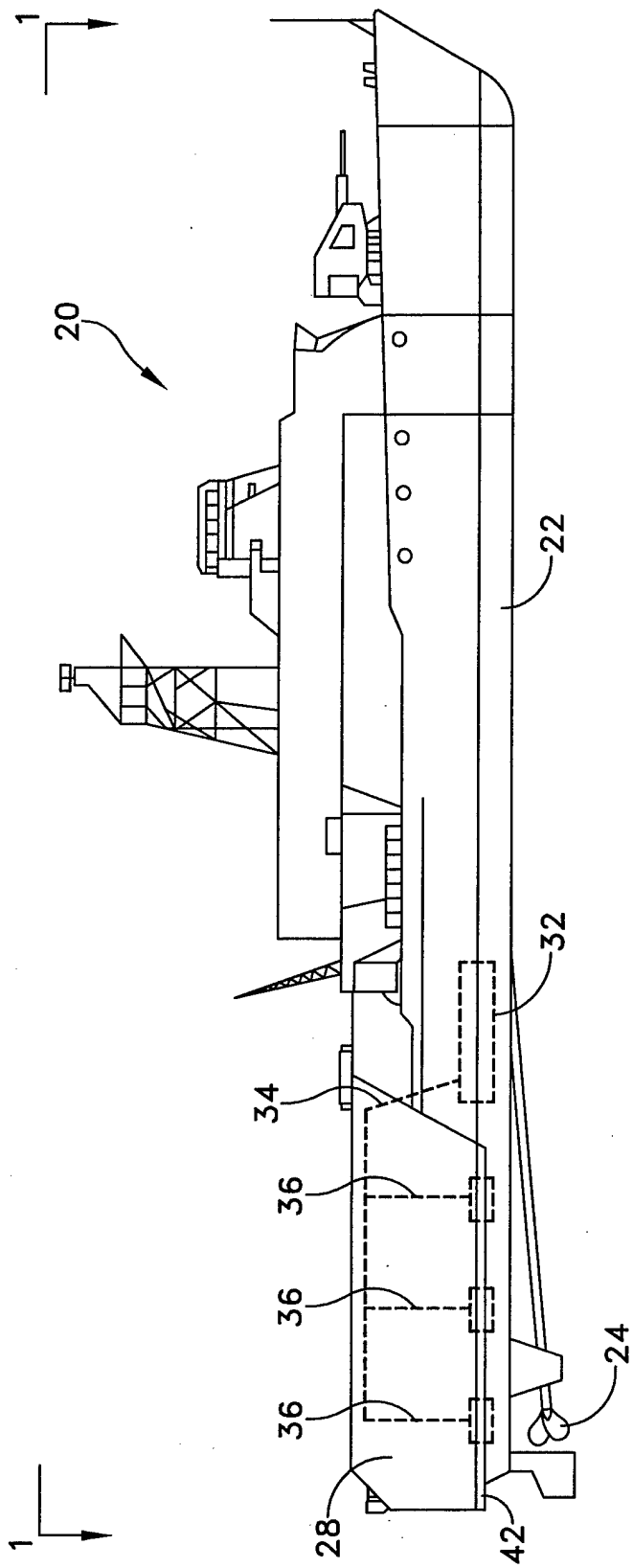


FIG. 1

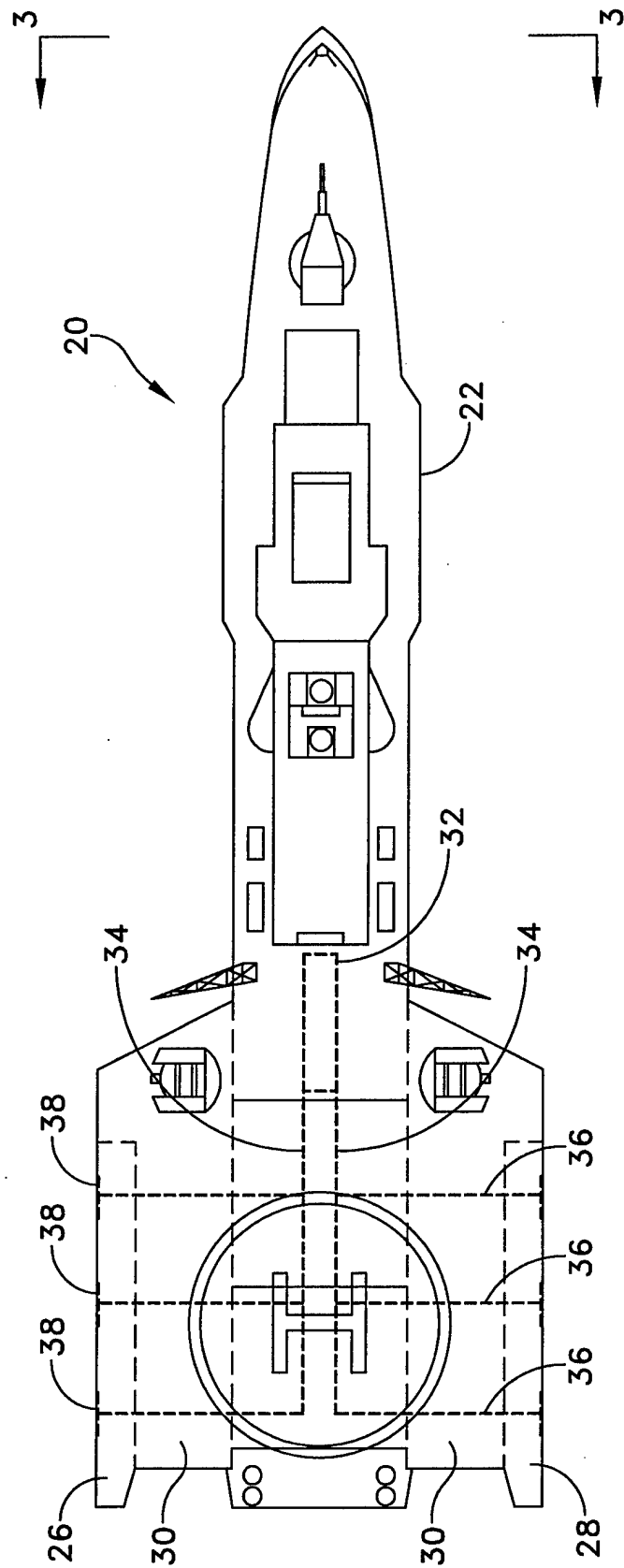


FIG. 2

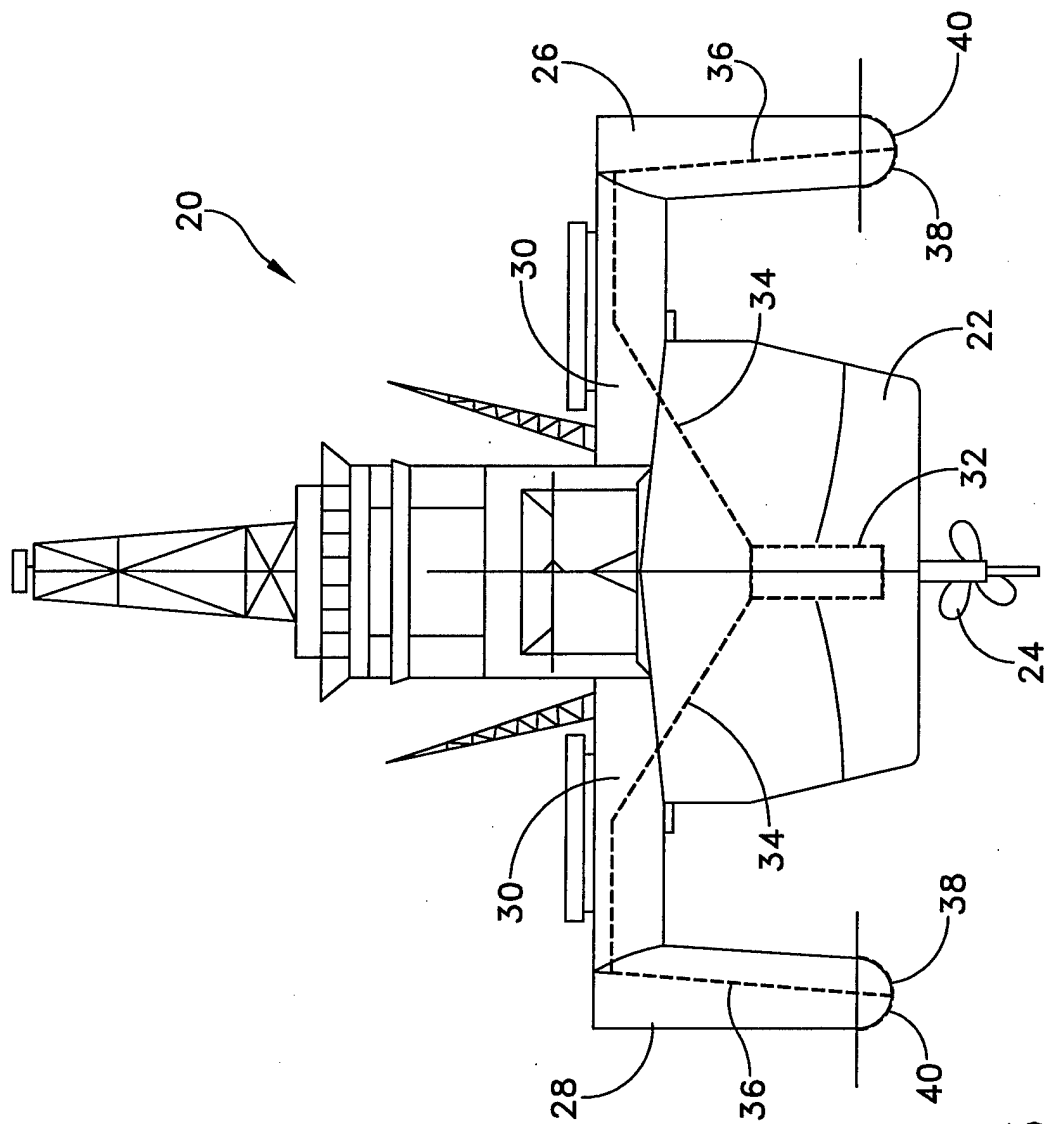


FIG. 3