

[72] Inventor **George Richard Grant Lewison**
Feitham, England
[21] Appl. No. **714,978**
[22] Filed **March 21, 1968**
[45] Patented **Sept. 29, 1970**
[73] Assignee **National Research Development**
Corporation
London, England,
a British body corporate
[32] Priority **March 22, 1967**
[33] **Great Britain**
[31] **13,516/67**

[54] **CATAMARAN-TYPE SHIPS**
6 Claims, 14 Drawing Figs.

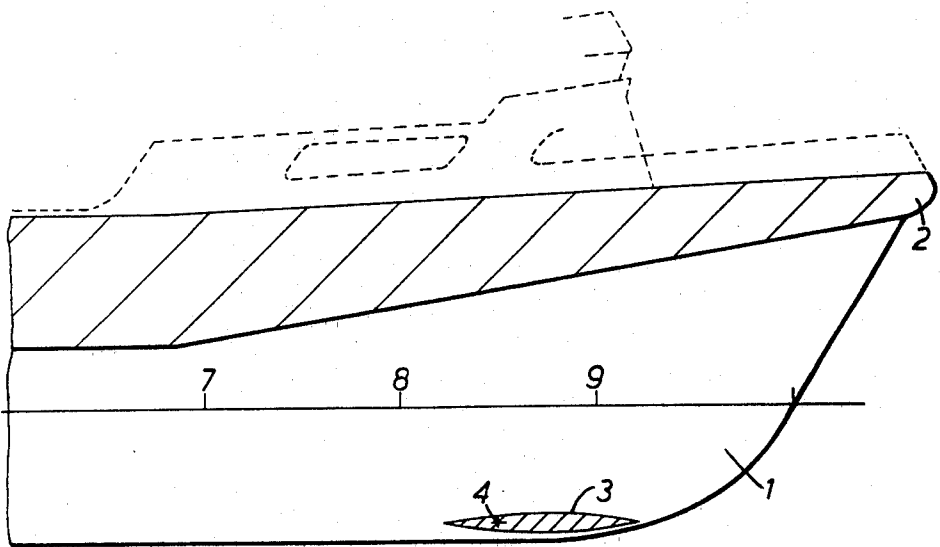
[52] U.S. Cl. **114/61,**
114/126

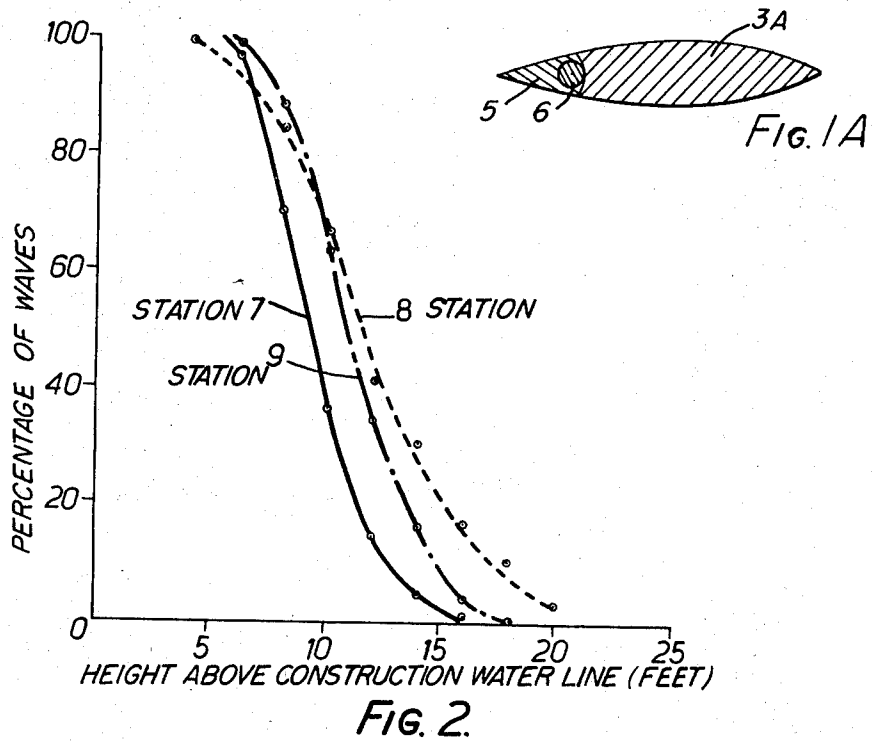
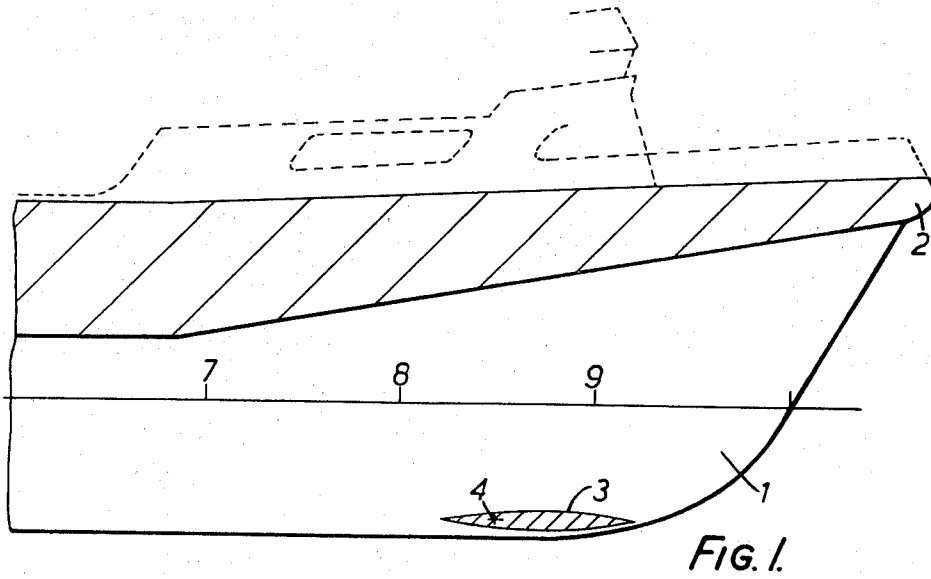
[51] Int. Cl. **B63b 39/06**
[50] Field of Search **114/126, 61**

[56] References Cited			
UNITED STATES PATENTS			
2,937,608	5/1960	Vandersteel	114/126
3,236,202	2/1966	Quady et al.	114/61X
FOREIGN PATENTS			
1,169,968	1/1959	France	114/61
1,296,469	5/1962	France	114/61

Primary Examiner—Andrew H. Farrell
Attorney—Cushman, Darby and Cushman

ABSTRACT: A catamaran-type ship is provided with a plate-like anti-pitching member disposed below the still water line, the member joining the two hulls near the fore end.





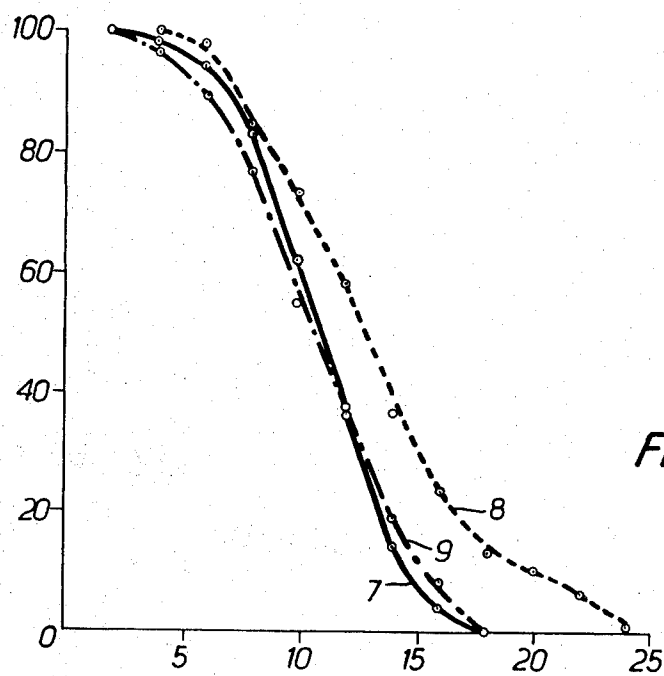


FIG. 3.

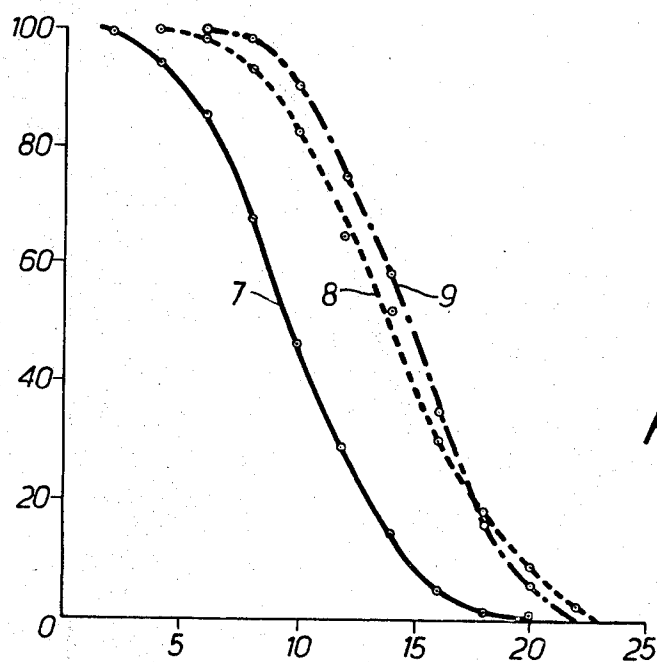


FIG. 4.

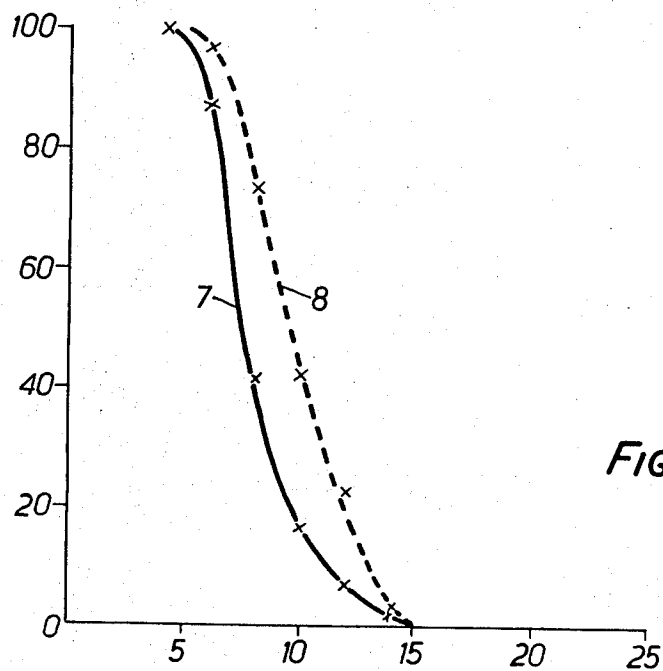


FIG. 5.

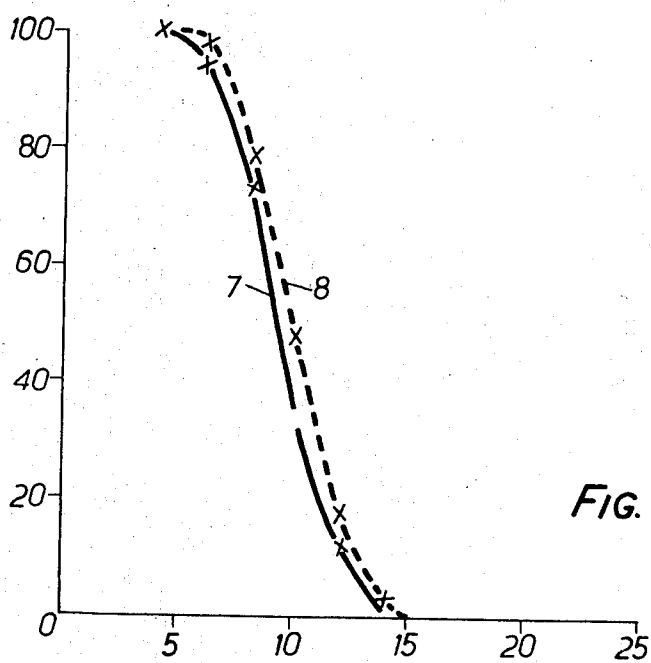


FIG. 6.

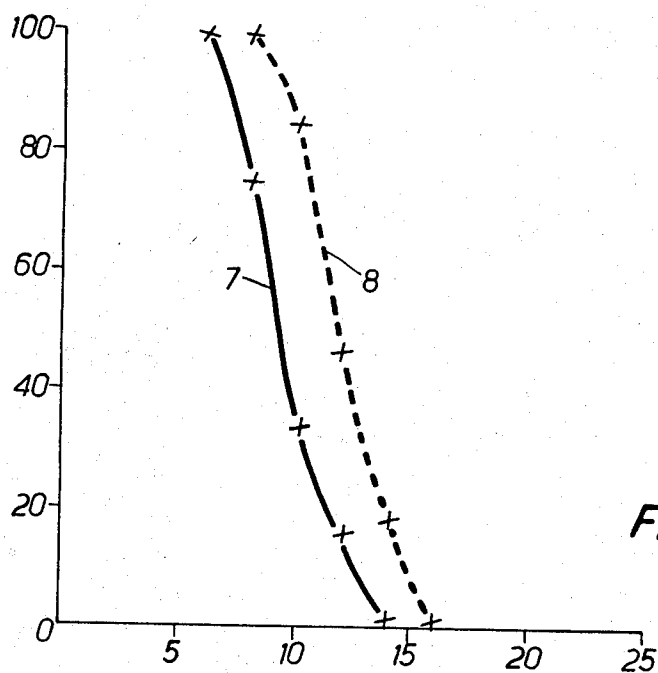


FIG. 7

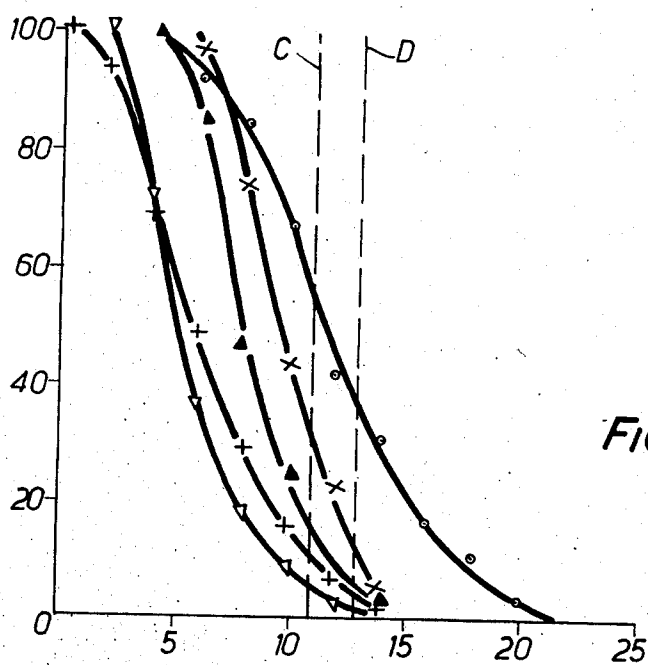


FIG. 9

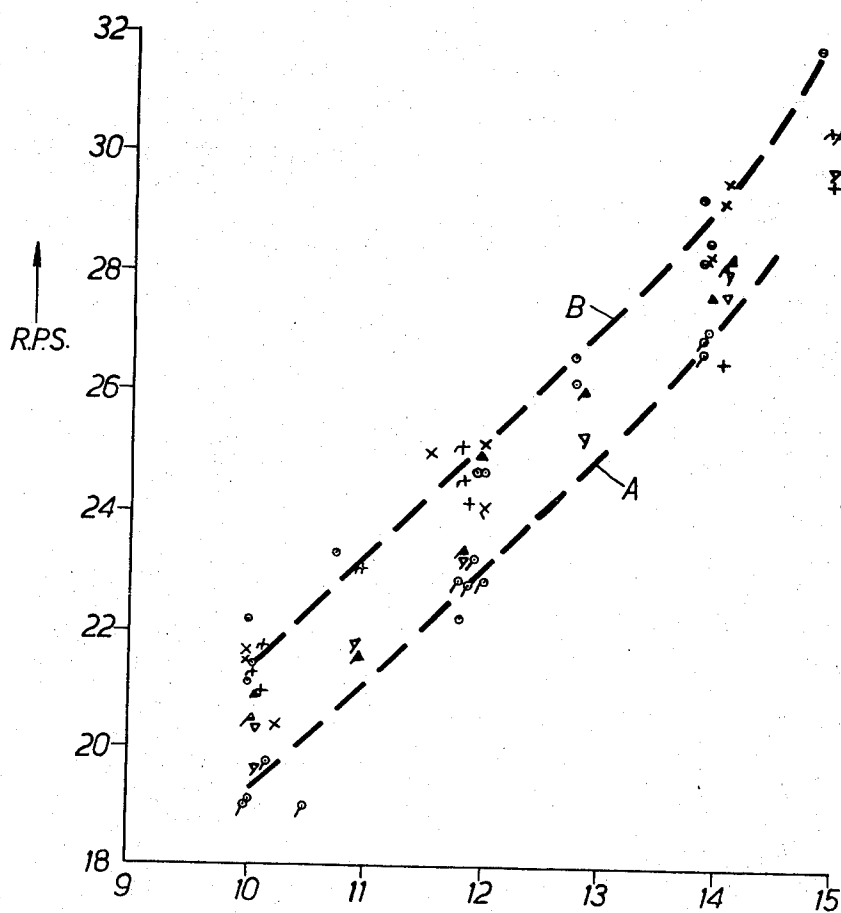


FIG. 8.

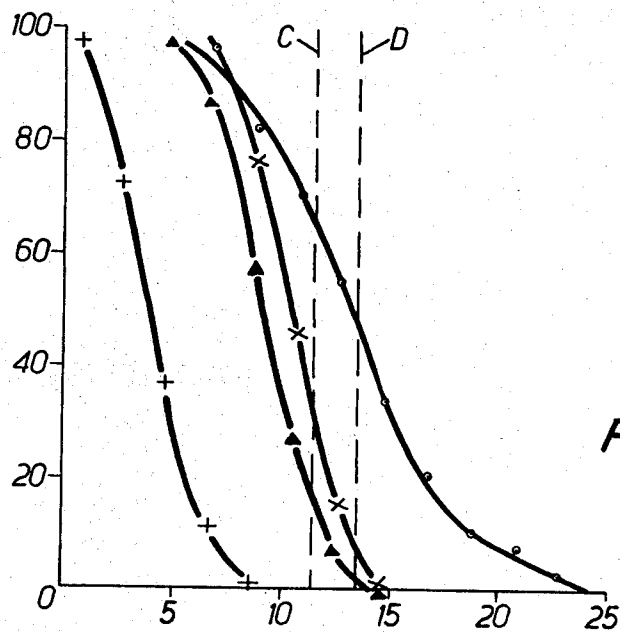


FIG. 10.

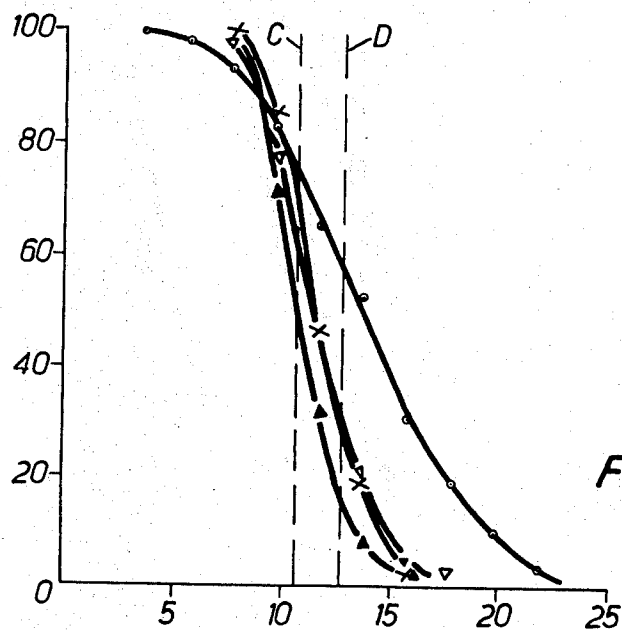


FIG. 11.

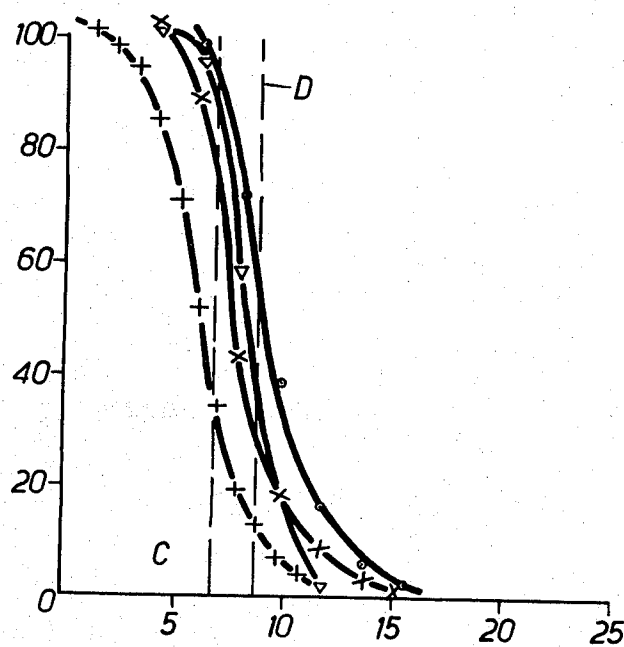


FIG. 12.

∞	
○, ●	—
×, ×	0°
▲, ▲	4.5°
▽, ▽	9°
+, +	13.5°

FIG. 13.

CATAMARAN-TYPE SHIPS

This invention relates to catamaran-type ships, that is ships which, to provide great lateral stability, comprise a pair of hulls united into a stiff structure by cross connections. Considerations of strength and stiffness call for the cross connections to extend well fore and aft, and to extend down as close to the water line as possible. Such cross connections may include one or more continuous spandecks from end to end or only at the fore part and stern. There will be wave motion in the space between the hulls of such a vessel and the magnitude of this motion will depend principally on three factors, namely, the speed of the vessel, the force of the sea in which it is traveling, and the direction of the vessel relative to that of the sea. In general, the wave motion in question will increase as the speed of the vessel increases and as the sea becomes heavier, and the highest waves will occur with the vessel traveling into a head sea, other things being equal for each factor.

Also, the waves in the space between the hulls are of the greatest height in the neighbourhood of the fore-end of the vessel and it is customary for this reason to carry the spandeck or the lowest spandeck upwardly towards the fore-end. If the waves strike the underside of this spandeck slamming may occur. In order to avoid slamming, the spandeck must be at such a level that, at the most, only a proportion, say 30 percent, of the waves strike it. This may require the spandeck to be located at such a level as to reduce the stiffness and resistance of the complete structure to stresses, particularly to torsion and racking stresses when the vessel is in an oblique sea.

According to the present invention a catamaran-type ship is provided with an anti-pitching member in the form of plate-like means extending between the two hulls near the bottom fore-ends thereof, the general plane of the said plate-like means being set at an angle to the horizontal substantially between zero and a small positive angle of incidence.

Such a member reduces the relative bow motion between the vessel and the water and so reducing or even eliminating slamming on the underside of the spandeck. It decreases the pitching motion of the ship and the vertical accelerations, thus making for comfort. Finally it provides additional stiffening to the fore part of the ship, especially in torsion thus reducing racking stresses when the ship is in an oblique sea.

The member is desirably of hydrofoil section and may be set at zero angle of incidence or at a small positive angle of incidence, say 7° , in which case as the speed of the ship increases, so a greater lift is obtained thus counteracting the effect of speed in increasing the wave motion under the spandeck. It would be possible to provide for variation of the angle of incidence but as a rule the advantages do not justify the complication and expense. But it may be worthwhile to provide the member with an adjustable or controllable flap pivoted to the trailing edge of the member. Alternatively other water flow control devices could be used.

An anti-pitching member of adequate size to have the above effects, is of hydrofoil section and at a small angle of incidence, is found not only to present low additional resistance to propulsion, but in medium to heavy head seas actually to reduce resistance to propulsion. The overall effect in the case of a ship operating mostly in moderate seas, of Beaufort 3-5, say, may be a slight net gain in propulsive efficiency.

The accompanying drawings illustrate, in FIGS. 1 and 1A, a specific example of a power driven ship according to the present invention tested in model form and, in FIGS. 2 to 12, the results of the tests as applied to the corresponding full size ship in various conditions simulated during the tests. The remaining figure, FIG. 13, indicates the meaning to be attached to various symbols used in FIGS. 2 to 12, namely, the absence of an anti-pitching member and the values of the angle of incidence α of such a member when used.

FIG. 1 more particularly illustrates the forward part of the tested model in longitudinal cross section between the hulls. Thus, this figure indicates the port hull at 1, the spandeck at 2, and an anti-pitching member at 3. The member 3 was made pivotally adjustable about an axis 4 for testing the effects of

different angles of incidence α . In practice the advantages of pivotal adjustment of the member 3 are not likely as a rule to justify the complication and expense but it may be worthwhile to form a member with an adjustable or controllable flap pivoted to the trailing edge of the member as a water flow control device and such an arrangement is diagrammatically indicated in FIG. 1A which shows a flap 5 pivoted at 6 to the trailing edge of a member 3A, which is otherwise similar to the member 3 shown in FIG. 1 and would be similarly positioned and secured. Also indicated in this figure are the stations 7, 8 and 9 to which various data of the test results relate. FIG. 1 is drawn to a scale such that substantially 1/16 inch in the figure equals 1 foot of actual vessel size.

Turning to FIGS. 2 to 12, these illustrate the test results graphically. Each of these figures, except FIG. 8, indicates the percentage of waves which reached various heights above the construction water line at different ones of the stations 7, 8 and 9 and in different conditions. In this connection it is noted that the station to which any characteristic of the last-mentioned figures relates is denoted by the reference number of the relevant station, and the percentage exceedance and wave heights, the latter in feet, are respectively indicated by reference to the Y-axes and X-axes. The sea conditions simulated during the tests represented by these figures are Beaufort force 6 head seas.

More particularly, FIGS. 2, 3 and 4 concern the ship without an anti-pitching member in association with respective ship speeds of 10, 12 and 14 knots and resultant wave motions at stations 7, 8 and 9. FIGS. 5, 6 and 7 show respectively corresponding results with use of the member 3 disposed horizontally, $\alpha = 0$, but only for resultant wave motions at stations 7 and 8.

FIGS. 9 to 11 show further respectively corresponding results for resultant wave motions at station 8, for different positive angles of incidence for the member 3. FIG. 12 is similar, but concerns station 7. In addition FIGS. 9 to 12 show the corresponding individual characteristics for the case of no anti-pitching member and a horizontal member from FIGS. 2 to 7 so that comparison is facilitated.

FIG. 8 shows comparative results of the actual vessel speeds achieved in terms of knots for the full size ship for different propeller rotation rates in terms of revolutions per second for the model, the model being self-propelled for this purpose, under different sea conditions, namely calm water and a simulated Beaufort force 6 head sea, with an anti-pitching member at different angles of incidence. The symbols of FIG. 13 are used in the last connection, it being noted that the first set of symbols denote the head sea condition, and the second set of symbols, which correspond to the first set with the addition of a "tail" line, denote calm water. The broken line characteristics A and B in FIG. 8 indicate the corresponding results without member 3 in the calm water and head sea conditions, respectively.

The tests just discussed were initiated to determine at what height the spandeck should be for the full size ship corresponding to the model in order that not more than 30 percent of waves encountered should strike the spandeck. The most severe conditions to be taken into account were represented by a ship speed of 14 knots into a Beaufort 6 head sea.

The results of tests without an anti-pitching member indicated that the spandeck would in fact need to be raised as a whole by 5 feet relative to the position represented by the model of FIG. 1. Moreover it is not inconceivable that more severe conditions could arise than the worst represented in the tests.

The results from use of an anti-pitching member according to the invention on the other hand indicated that a significant reduction in the number of waves striking the spandeck could be achieved without raising the spandeck. Furthermore, the indications are that, with use of the anti-pitching member, the initially desired results can be obtained by raising the spandeck only 2 feet and all chance of severe slamming eliminated.

3

4

Consideration of this small increase in spandek height relative to that tested is facilitated by the broken lines C and D in FIGS. 9 to 12 which respectively represent the spandek height above the still water line as tested and with a rise of 2 feet.

More general results of the tests indicate that the anti-pitching member should preferably have a length equal to about 10 percent of the vessel hull length. Also, the member should preferably be positioned between stations $8\frac{1}{2}$ and $9\frac{1}{2}$ longitudinally of the vessel.

I claim:

1. A catamaran-type ship provided with an anti-pitching member in the form of plate-like means extending between the two hulls only near the bottom fore-ends thereof, the general plane of the said plate-like means being set at an angle

to the horizontal substantially between zero and a small positive angle of incidence.

2. A ship according to claim 1 wherein said member is of hydrofoil section.

3. A ship according to claim 2 wherein said member is adjustable in respect of its angle of incidence.

4. A ship according to claim 2 wherein said member is provided with an adjustable flap pivotally connected to its trailing edge.

5. A ship according to claim 2 wherein said member has a length equal to about 10 percent of the vessel hull length.

6. A ship according to claim 2, wherein said member is positioned between stations $8\frac{1}{2}$ and $9\frac{1}{2}$ longitudinally of the vessel.

20

25

30

35

40

45

50

55

60

65

70

75