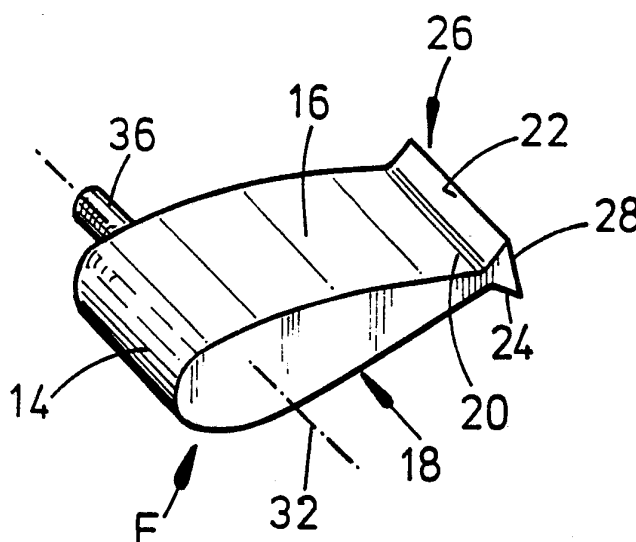




INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

(51) International Patent Classification ⁵ : B63B 39/06, 1/24	A1	(11) International Publication Number: WO 92/12046 (43) International Publication Date: 23 July 1992 (23.07.92)
(21) International Application Number: PCT/GB91/02310 (22) International Filing Date: 23 December 1991 (23.12.91) (30) Priority data: 9100116.4 4 January 1991 (04.01.91) GB (71) Applicant (for all designated States except US): VICKERS PLC [GB/GB]; Vickers House, Millbank Tower, London SW1P 4RA (GB). (72) Inventor; and (75) Inventor/Applicant (for US only) : McDIARMID, William, David [GB/GB]; 14 Cuguen Place, Lasswade, Edinburgh EH18 1AD (GB). (74) Agents: McCALLUM, William, Potter et al.; Cruikshank & Fairweather, 19 Royal Exchange Square, Glasgow G1 3AE (GB).		(81) Designated States: AT (European patent), BE (European patent), CH (European patent), DE (European patent), DK (European patent), ES (European patent), FR (European patent), GB, GB (European patent), GR (European patent), IT (European patent), JP, LU (European patent), MC (European patent), NL (European patent), SE (European patent), US. Published <i>With international search report.</i>

(54) Title: HYDRODYNAMIC FIN FOR WATER-BORNE CRAFT



(57) Abstract

The invention relates to a hydrodynamic fin member for use on water-borne craft and particularly suitable to act as a stabilising means for the craft. The body portion of the fin (F) has a smoothly rounded leading edge zone (14) converging upper and lower surfaces (16, 18) and a trailing zone (20). A ridge-like member formed by two diverging surfaces (22, 24) which merge smoothly with the zone (20) has a wedge-shaped cross-section terminating in an end wall (28). The stabilising fin (F) is adapted for adjustment by pivoting about an axis (32). A tip fence (34) may be provided if preferred.

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HYDRODYNAMIC FIN FOR WATER-BORNE CRAFT

The invention is concerned with improvements in or relating to a hydrodynamic fin for water-borne craft, particularly but not exclusively a stabilising fin for a ship.

It is customary to provide ocean-going ships for example with anti-roll stabilising means in the form of fins projecting outwardly from the ship's hull below the water-line to act to correct any tendency for the ship to roll with the movement of the water. Such fins will conveniently have a hydrodynamic cross-sectional profile and may resemble that shown in Figure 1 of the drawings, which shows a section of a fin 2 comprising a main body portion 4, provided with a movable trailing edge portion 6. The fin 2 is adapted to project from a ship's hull 8 as shown in Figure 2 and to be rotated as required about an axis 10 to vary the operating angle. The axis 10 is arranged transversely to a line extending lengthwise of the ship 8.

In addition the edge portion 6 is hinged so as to be movable with respect to the body portion 4 by an angle greater than that of the rotation of the latter about axis 10. Where necessary a fin housing 12 is provided in the hull to receive the fin 2 when in a retracted, non-operative position.

It will be appreciated that the provision of the movable trailing edge portion 6, while providing an

acceptable level of performance, involves a very complex construction and complicated control mechanisms.

It is an object of the invention to minimise the above disadvantages while obtaining a satisfactory level of performance in reducing roll.

The invention therefore provides a hydrodynamic fin member for use on water-borne craft, comprising an elongate body portion having a generally streamlined cross-section including a tapering portion reducing in a direction from a leading to a trailing zone thereof, a ridge-like member having an at least substantially wedge-shaped cross-section and being provided at a location rearward of said tapering portion, said wedge-shaped cross-section diverging in said direction and terminating in an end wall.

Advantageously, the end wall may lie at least substantially in a plane transverse to said direction. Conveniently the profile of said end wall may be planar, or may be concave or include an obtuse or acute angle if desired.

Preferably, the fin member may be mounted with respect to a hull for rotation about an axis substantially transverse to a line extending fore-and-aft of said hull, said rotation providing a continuously variable operating angle in a predetermined range. Advantageously, the angle range may be $\pm 20^\circ$ with respect to zero deflection.

Conveniently, the fin member may project from the hull in a horizontal or downwardly inclined attitude, at an

angle preferably between 0° and 30° .

Advantageously, diverging surfaces of said ridge-like member are arranged to include an angle between 20° and 90° , in one example the angle being 70° .

Advantageously, the maximum, heightwise, thickness of the fin may be between 12% and 33% of the overall, fore-and-aft, width of the fin and preferably may be between 21% and 33% of said width, for example 26%.

Advantageously, the maximum height of the end wall of the ridge-like section may be between 30% and 70% of the thickness of the fin, and preferably may be 50%.

When installed in a ship's hull, provision may be made for retracting the fins into an out-of-the-way condition as required, either by being withdrawn into a housing or by being pivoted either foreward or aft to be received in a stowing recess.

If desired, a fin according to the invention may be provided with a tip plate or fence at the outboard end thereof for purposes which will be explained.

There will now be described, with reference to the relevant drawings, an example of a fin according to the invention. It will be understood that the description is given by way of example only and not by way of limitation.

In the drawings:-

Figures 1 to 3 illustrate a fin according to the prior art;

Figure 4 is a perspective view of a fin according to

the invention;

Figure 5 is a perspective view of a fin according to the invention;

Figure 6 illustrates three of the various angular positions available for the fin;

Figure 7 is a graph comparing the position of the chordwise centres of pressure for the fins of Figure 1 (prior art) and of Figure 5 for a range of fin angle values;

Figure 8 is a diagrammatic view of the position of permanently fixed fins with respect to a ship's hull;

Figure 9 is a diagrammatic view of the position of retractable fins with respect to a ship's hull;

Figure 10 is an outline representation of the cross-sectional profile of a fin as shown in Figure 4; and

Figure 11 is an outline representative of the cross-sectional profile of a fin as shown in Figure 5.

The prior art arrangement illustrated in Figures 1 to 3 has been described above.

Figure 4 shows a fin F according to the invention, having a hydrodynamically efficient profile comprising a smoothly rounded leading edge zone 14, an upper surface 16 and a lower surface 18 which converge in a direction towards a trailing zone 20. Merging smoothly respectively with the surfaces 16 and 18 at the zone 20, two diverging surfaces 22 and 24 define a ridge-like member 26 having a wedge-shaped cross-section. An end wall 28 lies in a

plane transverse and substantially perpendicular to a line 30 extending fore-and-aft of the fin (see Figure 10). The fin is adapted to be pivotally adjusted about a transverse axis 32 in a manner similar to the adjustment about axis 10 of the fin of the prior art.

Figure 5 shows a similar fin to that of Figure 4 with the addition of a plate 34 of the kind commonly known as a tip fence. Such plates are known to increase the slope of the lift curve for a given operating angle. Thus the required angle may be reduced if a tip fence is present.

Moreover, the presence of a tip fence assists in increasing maximum lift by suppressing fin tip flow losses.

Figure 6 illustrates the adjustment of the operating angle of the fin about the axis 32 with a 20° angle of adjustment both above and below a position of zero deflection shown in full lines. The centre of pressure for the fin section is located approximately at the zone of maximum thickness t (see Figure 10). Figure 7 shows the movement of the position of the centre of pressure for a range of angular deflections for the prior art fin shown in Figures 1 and 3 (curve A) and for the fin of Figure 5 (curve B). The upper curve A shows the amount of movement of the chordwise centre of pressure (CCp) over the range 5° - 20° and the lower curve (B) illustrates that the centre of pressure of the fin according to the present invention shows virtually no change in the same range.

Thus, the optimum shaft position (on axis 32) occurs

at a zone where the largest diameter shaft can be accommodated. Because there is so little movement of the centre of pressure along the fore-and-aft chord line 30, with increasing fin angle, it will be appreciated that a relatively small torque is required to operate the fin over the preferred operating range.

While a fixed mounting arrangement which does not provide for retraction into a hull recess is suitable for hulls having a contour such as is shown in Figure 8, the configuration of hulls such as shown at H in Figure 9 requires a retraction facility. The fins F may be retracted in a forward or aft direction as preferred or may, as indicated in that Figure, be withdrawn inwardly into a recess 12'

Figures 10 and 11 illustrate more clearly a preferred profile or outline for the cross-section of a fin F according to the invention, Figure 11 shown also the provision of a plate 34.

The dimensions are identified as follows:-

$\underline{c}$ = chord length (line 30)

$\underline{t}$ = thickness of the fin F

$\underline{w}$ = height of the end wall 28 when in an operative orientation.

β = angle included by the diverging surfaces 22 and 24 of the ridge-like member 26.

In the example shown the values are, where $c = 1$ unit of length

$$\underline{t} = 0.26 \underline{c}$$

$$\underline{w} = 0.13 \underline{c} \text{ (i.e. } 0.5\underline{t}\text{)}$$

$$\beta = 70^\circ$$

The value of $\underline{t}$ as $0.26 \underline{c}$ has the advantage that a suitably large structure is available in which to mount a shaft 36 along the axis 32 to sustain the various levels of imposed loads. The value of $\underline{w}$, which is selected to be 50% of that of $\underline{t}$ gives a compromise between adequate lift and an acceptable level of drag. The value for β is selected bearing in mind that the more shallow the angle the less drag and lift. Although a value of 70° is given by way of the present example, a value as low as 20° may be used. Preferably in such an instance, the value of $\underline{w}$ is suitably increased by way of compensation.

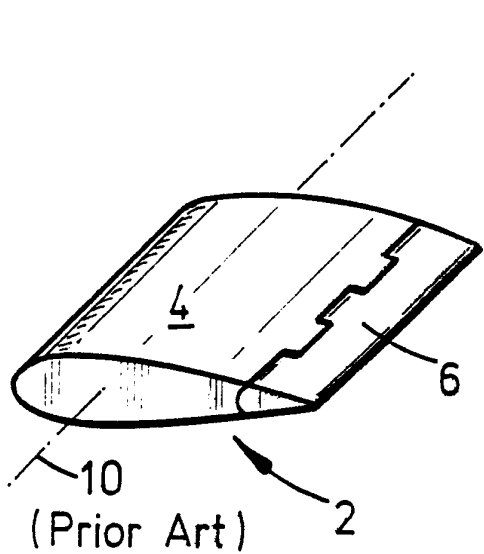
Figure 11 shows the preferred profile of the tip fence plate 34. Since the maximum areas of effective operation of the plate 34 are at the positions X and Y, the outline of the plate 34 has been chosen to reduce its height, dimension D, to a minimum. This facility has the practical advantage that the mouth opening of the hull recess can be reduced accordingly.

Various modifications may be made within the scope of the invention.

CLAIMS

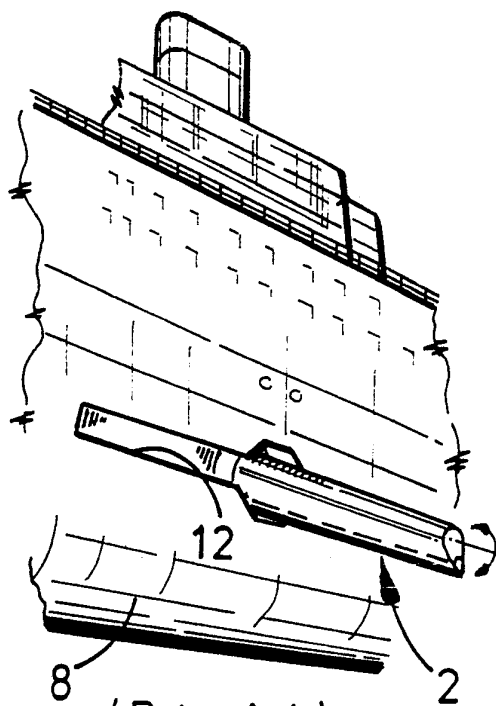
1. A hydrodynamic fin member for use on water-borne craft, comprising an elongate body portion having a generally streamlined cross-section including a tapering portion reducing in a direction from a leading to a trailing zone thereof, a ridge-like member having an at least substantially wedge-shaped cross-section and being provided at a location rearward of said tapering portion, said wedge-shaped cross-section diverging in said direction and terminating in an end wall.
2. A member as claimed in claim 1 wherein the end wall lies at least substantially in a plane transverse to said direction.
3. A member as claimed in either one of claims 1 and 2, wherein the profile of the end wall is planar or concave or includes an obtuse or acute angle.
4. A member as claimed in any one of the preceding claims, mounted with respect to a hull for rotation about an axis substantially transverse to a line extending fore-and-aft of said hull, said rotation providing a continuously variable operating angle in a predetermined range.

5. A member as claimed in claim 1, wherein diverging surfaces of said ridge-like member are arranged to include an angle between 20° and 90°.
6. A member as claimed in any one of the preceding claims, provided with a tip plate or fence at the outboard end thereof.



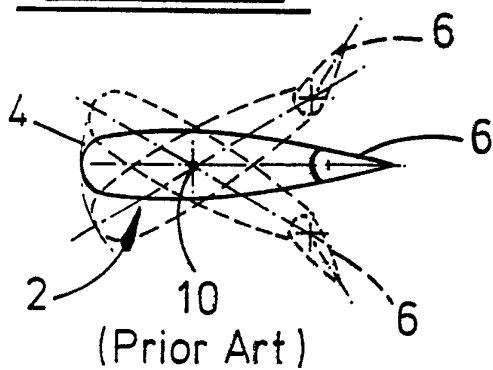
(Prior Art)

FIG. 1



(Prior Art)

FIG. 2



(Prior Art)

FIG. 3

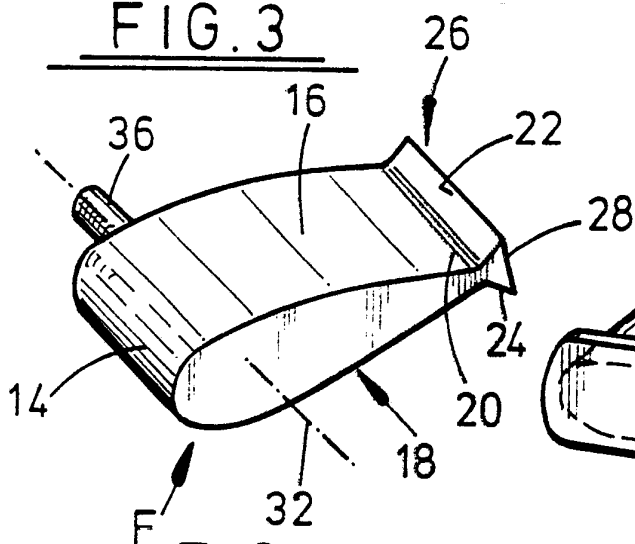


FIG. 4

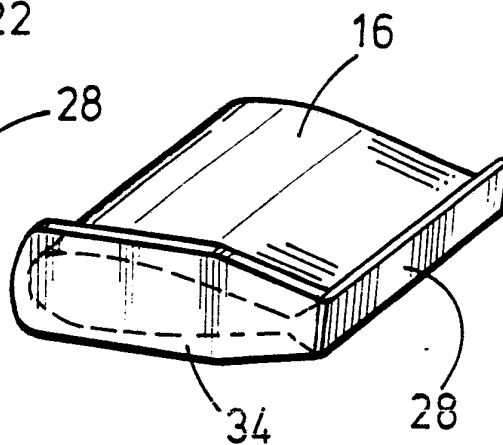


FIG. 5

2 / 3

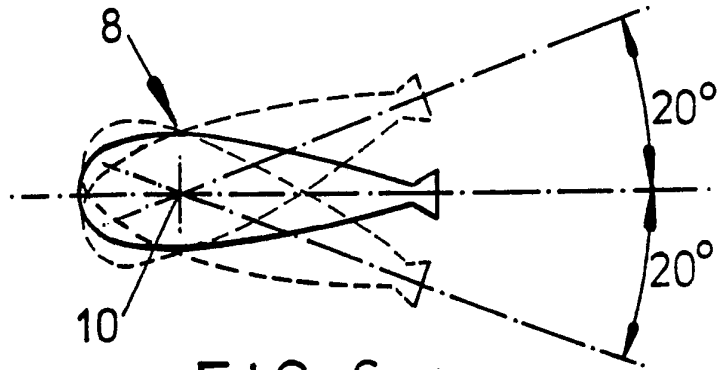


FIG. 6

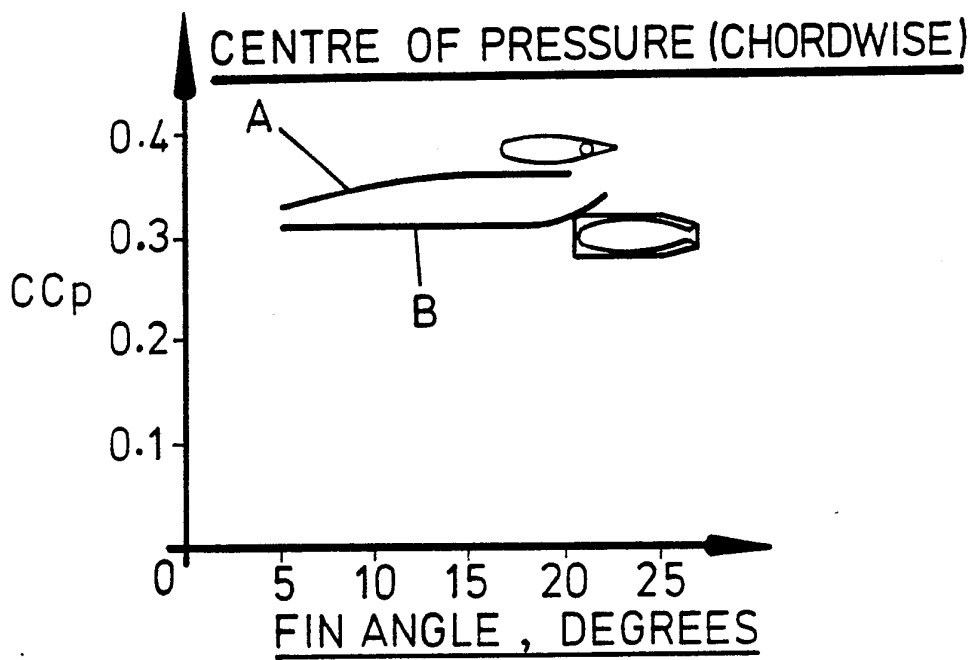


FIG. 7

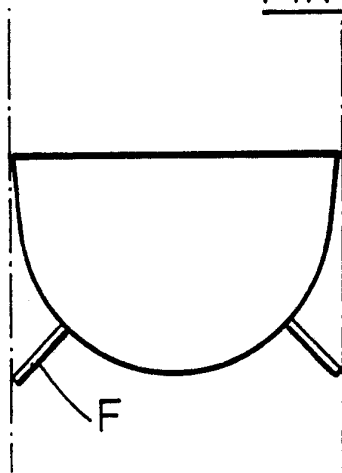


FIG. 8

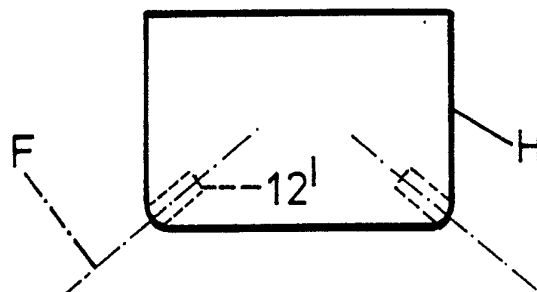


FIG. 9

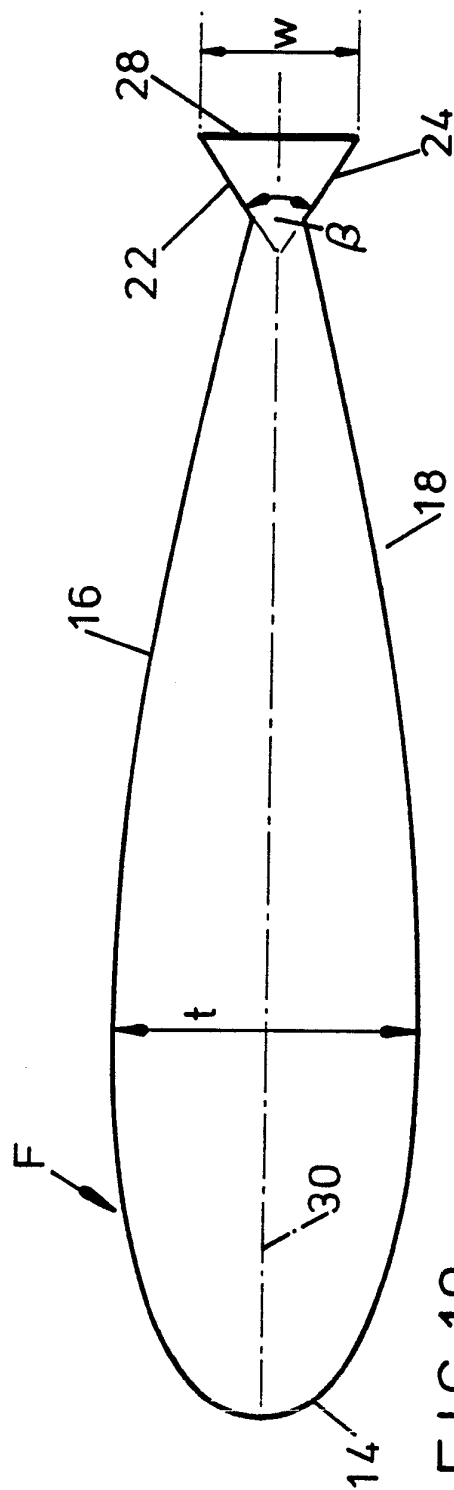


FIG. 10

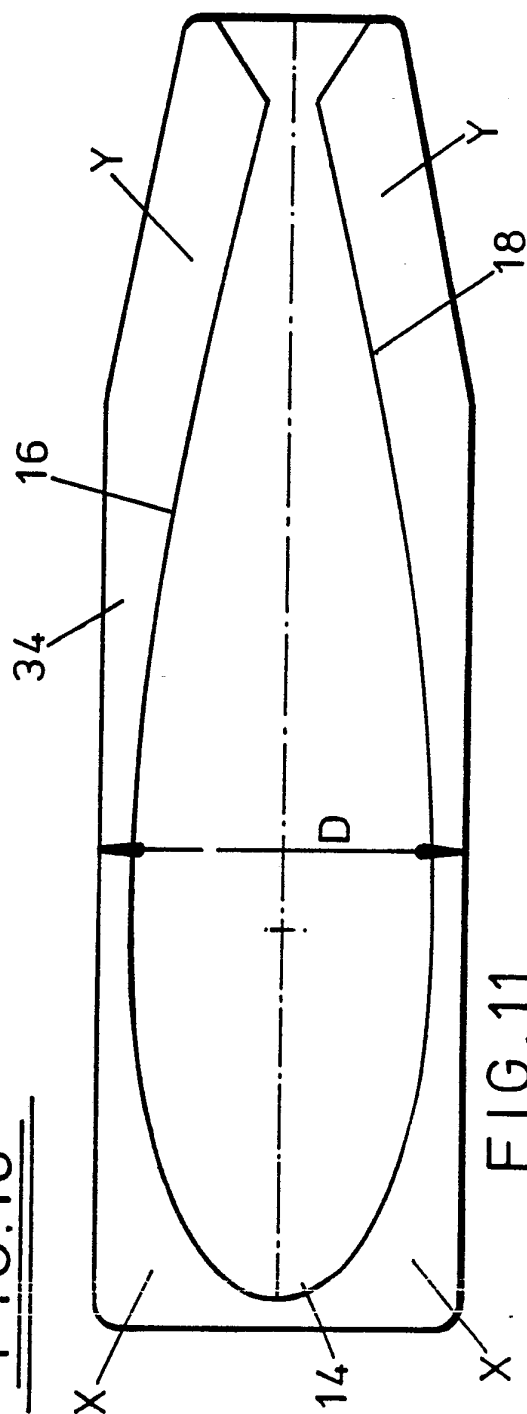
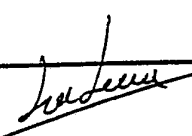


FIG. 11

INTERNATIONAL SEARCH REPORT

PCT/GB 91/02310

International Application No

I. CLASSIFICATION OF SUBJECT MATTER (if several classification symbols apply, indicate all) ⁶		
According to International Patent Classification (IPC) or to both National Classification and IPC		
Int.Cl. 5 B63B39/06; B63B1/24		
II. FIELDS SEARCHED		
Minimum Documentation Searched ⁷		
Classification System	Classification Symbols	
Int.Cl. 5	B63B ; B63H	
Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched ⁸		
III. DOCUMENTS CONSIDERED TO BE RELEVANT⁹		
Category ¹⁰	Citation of Document, ¹¹ with indication, where appropriate, of the relevant passages ¹²	Relevant to Claim No. ¹³
X, P A	US,A,5 046 444 (VORUS) 10 September 1991 see the whole document ---	1-5 6
X	FR,A,2 214 633 (WERFTUNION G.M.B.H. & CO. WESERWERFT) 19 August 1974 see the whole document ---	1-6
X	US,A,3 847 104 (KAUFER) 12 November 1974 see column 4, line 5 - line 52; figures 1-4 ---	1-6
X	DE,A,2 013 048 (LICENTIA PATENT-VERWALTUNGS-G.M.B.H.) 4 November 1971 see page 7, paragraph 2; figure 4 ---	1-5
X	DE,A,3 303 424 (WERFTUNION G.M.B.H. & CO.) 9 August 1984 see page 1; claims 1-3; figures 1-3 ---	1-5
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¹⁰ Special categories of cited documents : "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "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 "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 "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "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. "&" document member of the same patent family		
IV. CERTIFICATION		
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01 APRIL 1992	7. 04. 92	
International Searching Authority	Signature of Authorized Officer	
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III. DOCUMENTS CONSIDERED TO BE RELEVANT (CONTINUED FROM THE SECOND SHEET)

Category °	Citation of Document, with indication, where appropriate, of the relevant passages	Relevant to Claim No.
A	NAVY TECHNICAL DISCLOSURE BULLETIN vol. 1, no. 5, September 1976, ARLINGTON US pages 19 - 23; ROBERT L. WAID: 'ventilation tolerant control rudder' see page 23, line 19 - line 21; figure 4 ---	1-5

**ANNEX TO THE INTERNATIONAL SEARCH REPORT
ON INTERNATIONAL PATENT APPLICATION NO. GB 9102310
SA 54975**

This annex lists the patent family members relating to the patent documents cited in the above-mentioned international search report.
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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
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