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(54) **HYDRODYNAMIC FIN FOR WATER-BORNE CRAFT**
HYDRODYNAMISCHE FLOSSE FÜR WASSERFAHRZEUGE
AILERON HYDRODYNAMIQUE POUR NAVIRE

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- **NAVY TECHNICAL DISCLOSURE BULLETIN vol. 1, no. 5, September 1976, ARLINGTON US pages 19 - 23; ROBERT L.WAID: 'ventilation tolerant control rudder'**

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The file contains technical information submitted after the application was filed and not included in this specification

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Description

The invention is concerned with improvements in or relating to a hydrodynamic stabilizing fin for water-borne craft.

It is customary to provide ocean-going ships for example with anti-roll stabilizing 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 constructions 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.

In U.S. Patent No. 5046444 there is described a hydrofoil comprising a first, horizontal, hydrofoil arranged transversely beneath a craft and supported on the full thereof by two hydrofoil struts. The hydrofoils have a fish-shaped cross-section intended to be of benefit in the ventilation of the negative pressure area behind the "fish-tail". Full ventilation is achieved by inducing air flow along a trailing edge.

French Patent specification No. 2214633 discloses a ship's rudder having an elongated cross-section having a middle parallel sided section between a front streamlined section and a tail portion. The rudder is arranged to pivot about a vertical axis at a point immediately forward of the parallel-sided section.

The present invention provides a hydrodynamic stabilising fin for use in a submerged condition on water-borne craft, said fin member comprising a single one-piece member having 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, and a ridge-like portion 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, mounting means being provided to mount the member so as to project in use from a hull of said craft.

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 ±20° 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 foreword 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 three 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:-

- c = chord length (line 30)
- t = thickness of the fin F
- 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

- t = 0.26 c
- w = 0.13 c (i.e. 0.5t)
- β = 70°

The value of t as 0.26 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 w, which is selected to be 50% of that of 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 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 stabilising fin for use in a submerged condition on water-borne craft, said fin comprising a single one-piece member having an elongate body portion (F) having a generally streamlined cross-section including a tapering portion reducing in a direction from a leading (14) to a trailing zone (20) thereof, and a ridge-like portion (26) 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 (22,24) in said direction and terminating in an end wall (28), mounting means (32,36) being provided to mount the member so as to project in use from a hull (8) of said craft.

2. A fin as claimed in claim 1 wherein the end wall (28) lies at least substantially in a plane transverse to

said direction.

3. A fin as claimed in either one of claims 1 and 2, wherein the profile of the end wall (28) is planar or concave or includes an obtuse or acute angle.

4. A fin as claimed in any one of the preceding claims, wherein said one-piece member is mounted on a shaft (36) with respect to said hull (8) for rotation about an axis (32) 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 fin as claimed in claim 1, wherein diverging surfaces (22,24) of said ridge-like member (26) are arranged to include an angle between 20° and 90°.

6. A fin as claimed in any one of the preceding claims, provided with a tip plate or fence (34) at the outboard end thereof.

Patentansprüche

1. Hydrodynamische Stabilisierungsflosse für den Gebrauch unter Wasser in Wasserfahrzeugen, mit
einem einzigen einstückigen Teil, das einen langgestreckten Körperabschnitt (F) mit im wesentlichen stromlinienförmigem Querschnitt aufweist, der einen Abschnitt umfaßt, der sich in einer Richtung von einer vorderen (14) zu einer rückwärtigen Zone (20) davon verjüngt,
ein Rückenteil (26), das zumindest einen im wesentlichen keilförmigen Querschnitt hat und an einer rückwärtigen Position des sich verjüngenden Bereichs angeordnet ist, wobei der keilförmige Bereich in dieser Richtung auseinanderläuft (22, 24) und in einer Stirnwand (28) endet und
Befestigungsmitteln (32, 36), die vorgesehen sind zur Befestigung des Teils der Art, daß dieses während des Gebrauchs von einem Rumpf (8) des Fahrzeugs vorsteht.

2. Flosse nach Anspruch 1, dadurch gekennzeichnet, daß die Stirnwand (28) zumindest im wesentlichen in einer Ebene liegt, die quer zu dieser Richtung liegt.

3. Flosse nach einem der Ansprüche 1 und 2, dadurch gekennzeichnet, daß das Profil der Stirnwand (28) planar oder konkav ist oder einen stumpfen oder spitzen Winkel einschließt.

4. Flosse nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß das einstückige Teil an einer Welle (36) in bezug auf den Rumpf (8) um eine Achse (32) drehbar befestigt ist, die im wesentlichen quer zu einer Linie verläuft, die sich längsschiffs des Rumpfs erstreckt, wobei die Rotation einen kontinuierlich variablen Betriebswinkel in einem vorbestimmten Bereich gewährleistet.

5. Flosse nach Anspruch 1, dadurch gekennzeichnet, daß die auseinanderlaufenden Flächen (22, 24) des Rückenteils (26) derart angeordnet sind, daß diese einen Winkel zwischen 20 und 90° einschließen.

6. Flosse nach einem der vorhergehenden Ansprüche, dadurch gekennzeichnet, daß diese an ihrem Außenbordende mit einer Randplatte oder Umrandung (34) versehen ist.

Revendications

1. Aileron stabilisateur hydrodynamique destiné à l'utilisation à l'état immergé sur des embarcations aquatiques, cet aileron comprenant un élément unique monobloc avec une portion de corps allongé (F) ayant une section transversale de façon générale aérodynamique comprenant une portion allant en s'amenuisant à partir de sa zone d'attaque (14) jusqu'à sa zone de fuite (20), une portion en forme de crête (26) ayant une section transversale au moins sensiblement en forme de coin et étant disposée en un emplacement à l'arrière de cette portion allant en s'amenuisant, la section transversale divergente en forme de coin (22,24) selon la direction et aboutissant dans une paroi d'extrémité (28), des moyens de montage (32,36) étant prévus pour monter l'élément de façon à faire saillie dans l'utilisation à partir d'une coque (8) de l'embarcation.

2. Aileron selon la revendication 1, dans lequel la paroi d'extrémité (28) se situe au moins sensiblement dans un plan transversal à ladite direction.

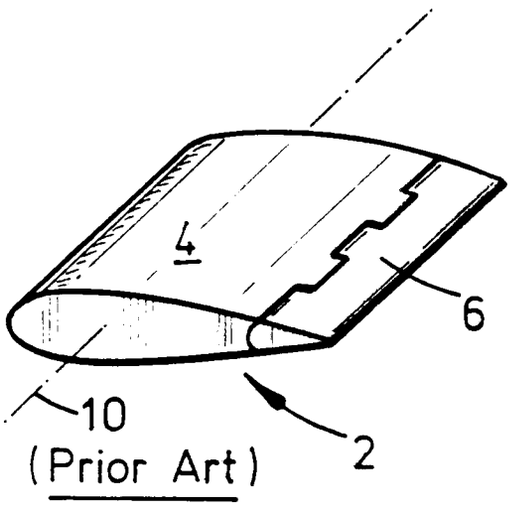
3. Aileron selon l'une ou l'autre des revendications 1 et 2, dans lequel le profil de la paroi d'extrémité (28) est de géométrie plane concave ou comprend un angle obtus ou aigu.

4. Aileron selon l'une quelconque des revendications précédentes, dans lequel l'élément monobloc est monté sur un axe (36) par rapport à la coque (8) pour la rotation autour d'un axe (32) sensiblement transversal à une ligne s'étendant de l'avant à l'arrière de la coque, cette rotation donnant un angle de fonctionnement variable en continu dans une plage prédéterminée.

5. Aileron selon la revendication 1, dans lequel les surfaces divergentes (22,24) de l'élément en forme de crête (26) sont disposées de façon à inclure un angle entre 20° et 90°.

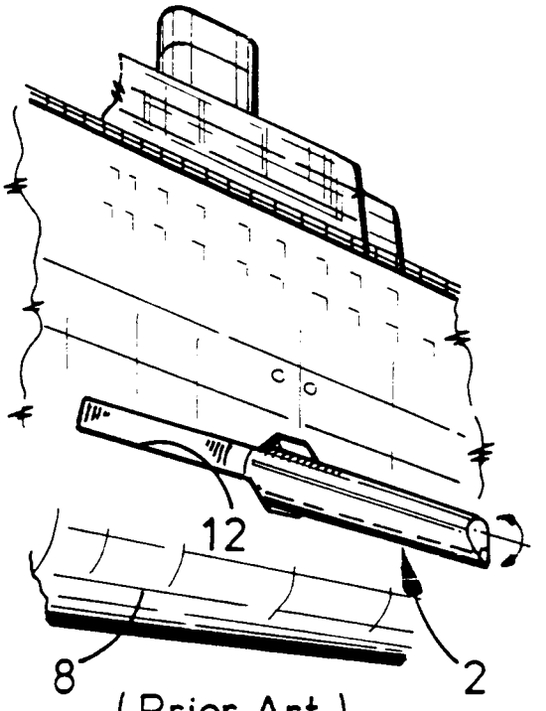
6. Aileron selon l'une quelconque des revendications

précédentes, muni d'une plaque pour protection d'extrémité (34) sur son extrémité hors bord.



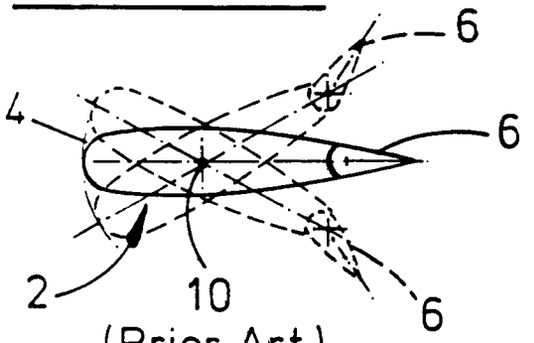
(Prior Art)

FIG.1



(Prior Art)

FIG.2



(Prior Art)

FIG.3

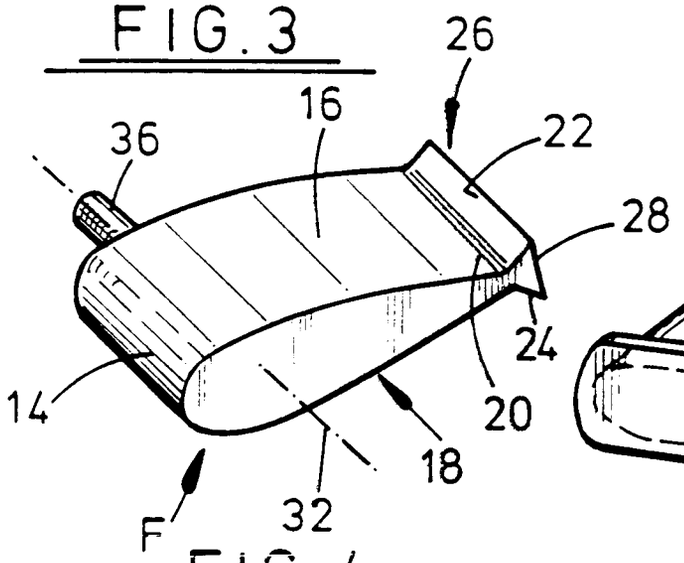


FIG.4

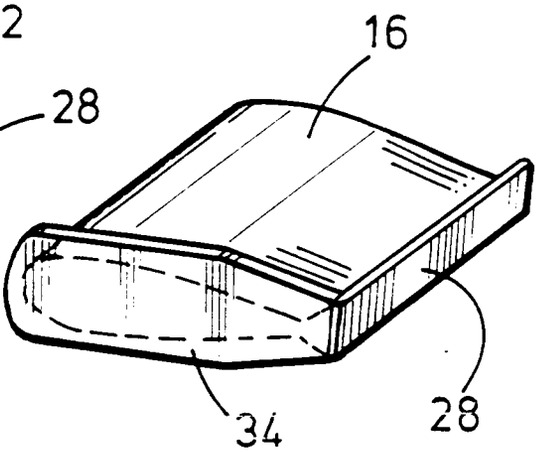


FIG.5

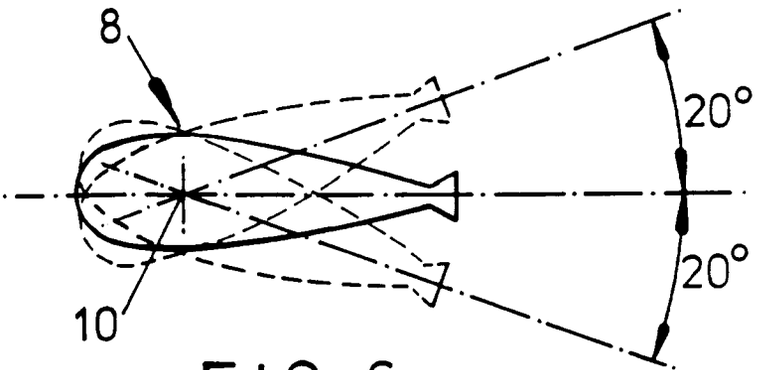


FIG. 6

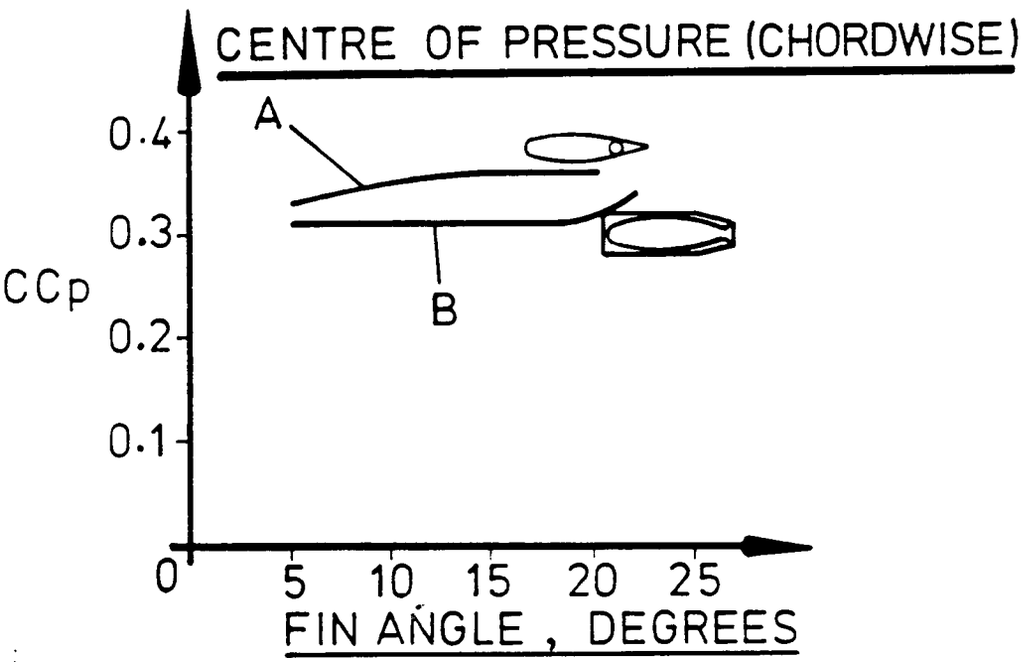


FIG. 7

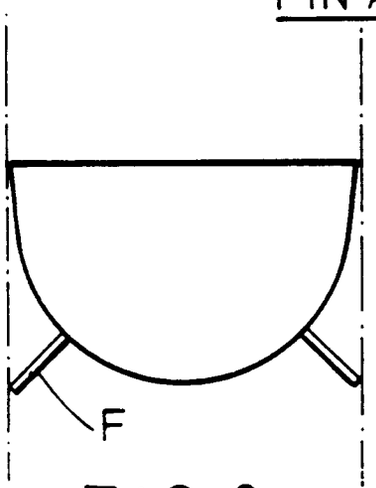


FIG. 8

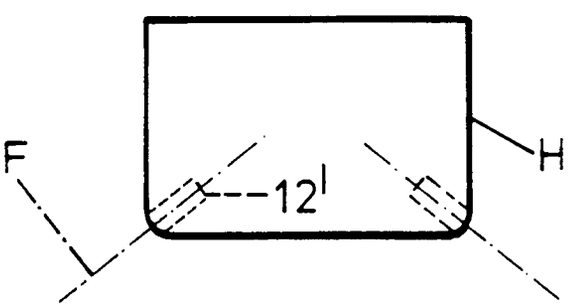


FIG. 9

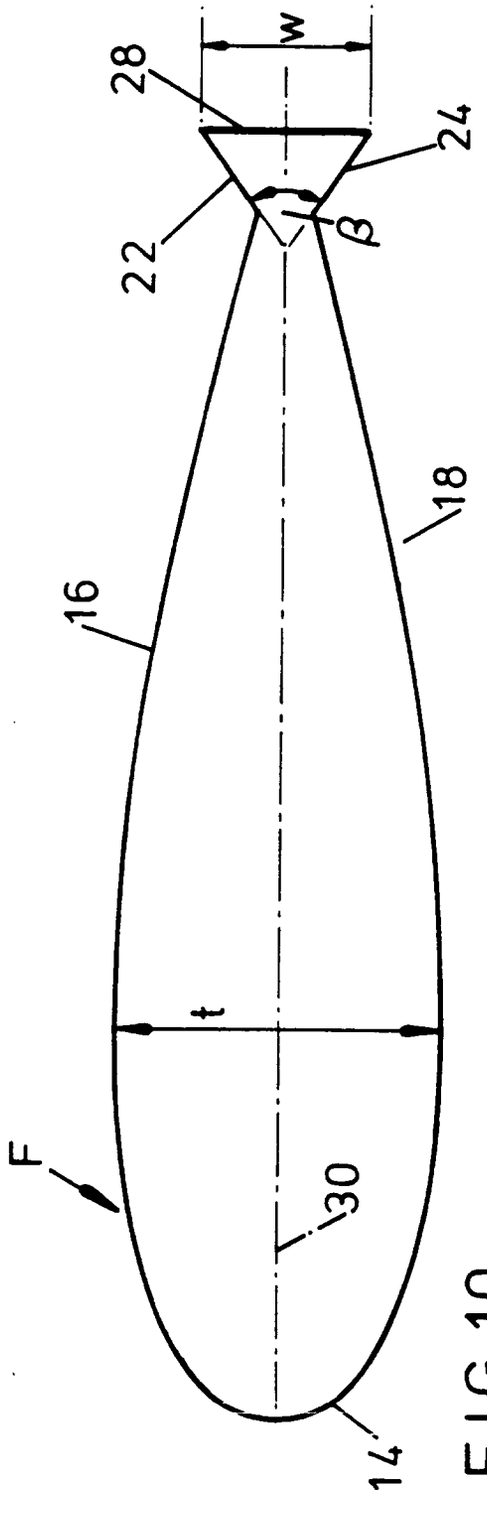


FIG.10

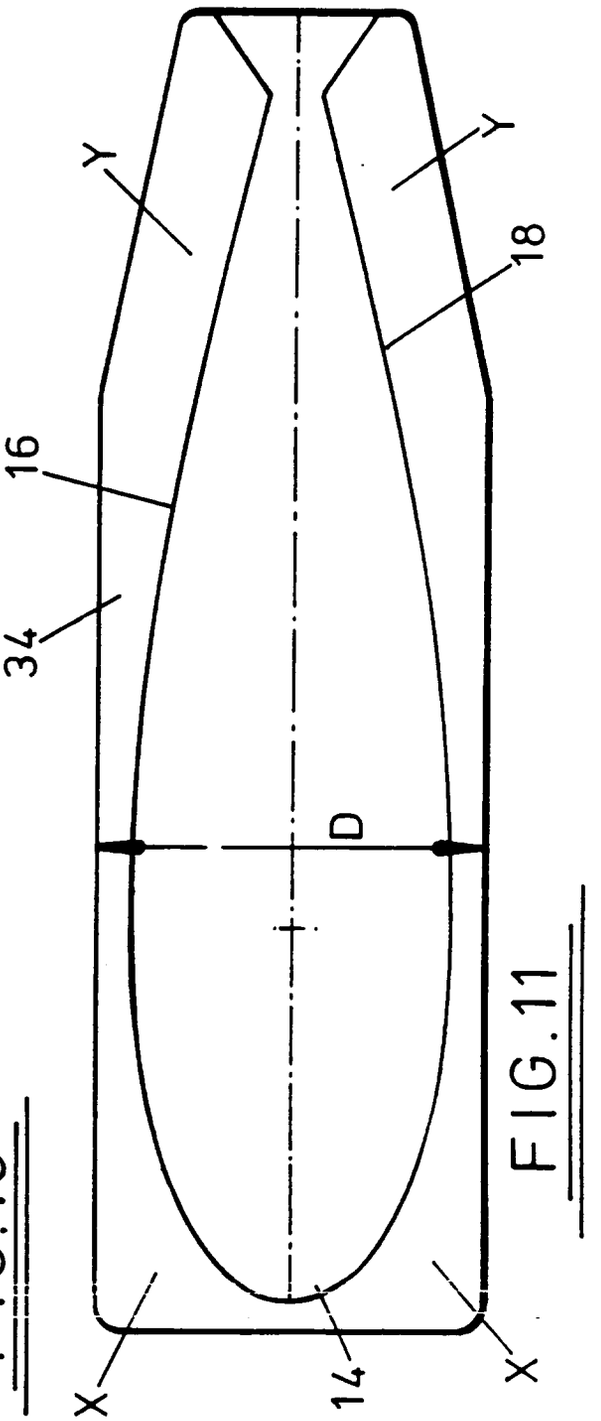


FIG.11