

(51) International Patent Classification:
B63B 1/32 (2006.01)(21) International Application Number:
PCT/GB2016/050877(22) International Filing Date:
29 March 2016 (29.03.2016)

(25) Filing Language: English

(26) Publication Language: English

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Tunbridge Wells, Kent TN4 8EL (GB).(81) Designated States (unless otherwise indicated, for every
kind of national protection available): AE, AG, AL, AM,AO, AT, AU, AZ, BA, BB, BG, BH, BN, BR, BW, BY,
BZ, CA, CH, CL, CN, CO, CR, CU, CZ, DE, DK, DM,
DO, DZ, EC, EE, EG, ES, FI, GB, GD, GE, GH, GM, GT,
HN, HR, HU, ID, IL, IN, IR, IS, JP, KE, KG, KN, KP, KR,
KZ, LA, LC, LK, LR, LS, LU, LY, MA, MD, ME, MG,
MK, MN, MW, MX, MY, MZ, NA, NG, NI, NO, NZ, OM,
PA, PE, PG, PH, PL, PT, QA, RO, RS, RU, RW, SA, SC,
SD, SE, SG, SK, SL, SM, ST, SV, SY, TH, TJ, TM, TN,
TR, TT, TZ, UA, UG, US, UZ, VC, VN, ZA, ZM, ZW.(84) Designated States (unless otherwise indicated, for every
kind of regional protection available): ARIPO (BW, GH,
GM, KE, LR, LS, MW, MZ, NA, RW, SD, SL, ST, SZ,
TZ, UG, ZM, ZW), Eurasian (AM, AZ, BY, KG, KZ, RU,
TJ, TM), European (AL, AT, BE, BG, CH, CY, CZ, DE,
DK, EE, ES, FI, FR, GB, GR, HR, HU, IE, IS, IT, LT, LU,
LV, MC, MK, MT, NL, NO, PL, PT, RO, RS, SE, SI, SK,
SM, TR), OAPI (BF, BJ, CF, CG, CI, CM, GA, GN, GQ,
GW, KM, ML, MR, NE, SN, TD, TG).

Published:

— with international search report (Art. 21(3))

(54) Title: IMPROVEMENTS TO BOAT HULLS WHEN SLAMMING

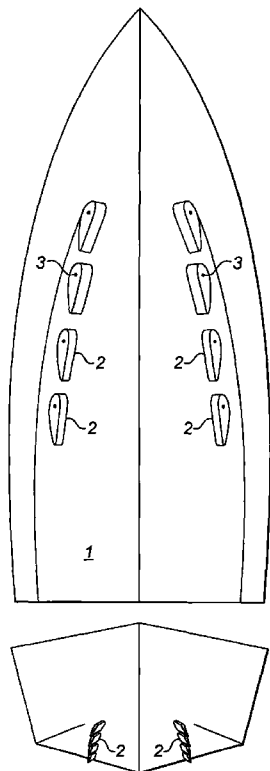


FIG. 1

(57) Abstract: The invention relates to hulls for boats. In heavy swell or chop, the hull of a fast motorboat travelling over the crest of a wave initially rises and, after travelling over the crest, drops heavily and makes contact with the downward slope of the wave. This is commonly known as "slamming" and is uncomfortable for the occupants of the boat and heavily loads the structure of the craft. On slamming, the boat also experiences a deceleration as the bow noses into the water causing further discomfort and stress to the hull. With the aid of under hull flaps, this invention improves the slamming phenomenon by reducing the deceleration and can actually achieve acceleration during the slam, alleviating discomfort and reducing hull loads. A plurality of flaps (2), which are preferably pivotally-mounted but may alternatively flex, extend from the hull surface, each flap being movable by the incident water flow between a first position and a second position, the flap having a greater angle from the centreline of the hull in the second position than in the first position. During slamming, the flap (2) adopts the second position, in which the angle of the flap from the centreline is constrained to be less than the angle of the water flow outward from the centreline of the hull, such that the impact of the water flow on the flap (2) produces a forward thrust to the flap and to the hull.



Improvements to Boat Hulls when Slamming

This invention relates to hulls for boats.

Background

In wavy conditions of heavy swell or chop, the hull of a fast motorboat travelling over the crest of a wave initially rises and, after travelling over the crest, drops heavily and makes contact with the downward slope of the wave. This is commonly known as “slamming” and is uncomfortable for the occupants of the boat and heavily loads the structure of the craft. On slamming, the boat also experiences a deceleration as the bow noses into the water causing further discomfort and stress to the hull.

- 5 This invention improves the slamming phenomenon by reducing the deceleration and can actually achieve acceleration during the slam alleviating discomfort and reducing hull loads.

Using the same principles of this invention, improvement in the performance of a boat can be achieved in normal running conditions by harnessing the energy of the bow waves into useful forward thrust.

15 Statements of Invention

In accordance with the invention, there is provided a hull for a boat comprising a plurality of flaps extending from the hull surface, each flap being movable by the incident water flow between a first position and a second position, the flap having a greater angle from the centreline of the hull in the second position than in the first position, wherein the first and second positions are configured such that during normal running conditions the flap adopts substantially the angle of the water flow along the hull and during slamming the flap adopts the second position, in which the angle of the flap from the centreline is constrained to be less than the angle of the water flow outward from the centreline of the hull, such that the impact of the water flow on the flap produces a forward thrust to the flap and to the hull.

- 20 The flaps may extend from the hull surface at any suitable angle relative to the hull surface at that location. Preferably, however, the flaps extend normally or substantially normally from the hull surface at that location.

In one embodiment, each flap or at least part of each flap is flexible, such that the flap flexes between the first and second positions. In an alternative embodiment, the flaps are pivotally-mounted and pivot between the first and second positions.

5 In this alternative embodiment, each flap is preferably biased towards the first position by means of a spring. This produces a forward thrust at lesser angles than the angle of the constrained second position mentioned above. The spring may be mounted on the external or internal side of the hull, and if the latter, a mechanism to transfer the biasing force to the flap on the external surface of the hull is provided.

10 In a preferred embodiment, flaps are positioned on the hull at or near the bow to be impacted by the bow wave. The invention can therefore be used to harness the momentum of the bow wave.

Preferably, the angle of each flap in the second position is adjustable. The angle can be adjusted to maximise forward thrust, and this may be from inside or outside the hull.

15 In preferred embodiments, the angle of each flap in the second position, the shape of each flap and/or the spacing between each flap can vary depending on the location on the hull.

The invention also extends to a boat comprising the hull described above.

Detailed Description

Embodiments of the invention will now be described by way of example only and with reference to the accompanying drawings, in which:

20 Fig. 1 shows plan and front views of the hull of a boat in accordance with an embodiment of the invention;

Fig. 2 shows a flap of the invention in two positions, position (a) and position (b) and a side, section view taken along line A-A' of the position (a) view;

25 Fig. 3 shows plan and front views of the hull of a boat in accordance with the invention, illustrating the basic principle of the invention;

Fig. 4 shows different methods of springing a flap in accordance with the invention;

Fig. 5 shows a side view of a further embodiment of the invention, in which flaps are set on the hull at or near the bow wave;

Fig. 6 shows plan and front views of the hull of a boat in accordance with a second embodiment of the invention, including a longer flap; and

5 Figs. 7A and 7B show an embodiment in which the flap is sprung from inside the hull.

Figure 1 shows one embodiment of the invention by way of an example only where the view is an underside of a typical speed boat which has a deep-V entry, turning into a relatively shallow V at the stern common to the art. The hull 1 has elements 2, hereinafter called “flaps” placed along or near the chines or in between the strakes or a position found most
10 beneficial. The flaps are pivotally mounted on pivots 3 shown also in Figure 2. The pivots are set substantially normal to the hull surface and in a position towards the front of the flaps so that the flaps freely pivot to take up the angle of the water flow in a streamline.

In Figure 2 Section A-A’ a side view of the pivot 2 in this embodiment are attached to plate 4 which is attached to the hull base 5 of the boat with screws, bolts or glue or mounted
15 directly to the hull following the principles herein.

In normal running conditions, these freely pivoted flaps would settle at a water flow direction approximately longitudinal to the hull, with a slight outward angle as the hull parts the water throwing it with a sideways component. On slamming the water flow would have a sudden greater angle from the centreline of the boat there being a large outward
20 component of the water flow. It is at the greater outward component of water flow, that the flaps would be constrained to pivot less than the outward component of the water, thereby their reaction giving the boat substantial forward thrust dependent on the chosen angle of constraint and the size and shape of the flap coupled with the angle of slam flow which produces an angle of attack on the flap.

25 Figure 2 shows in Position (a) and Position (b) one embodiment by way of example only a way of constraining the flap. Position (a) the flap is in a normal running state and Position (b) its position after the slam. Flap 2 has lug 6 (Section A-A’) which nestles in slot 7 in the

mounting plate 4 which allows flap to pivot until it reaches end of slot at 8. This constraint allows the flap to produce the forward thrust from the slam.

Figure 3 shows at (c) the direction of water flow 9 during a slam and angle of flap 2 in its constrained position thereby producing vector 10 with a forward thrust component vector 11 created by the angle of attack of flow 9 on flap 2. This illustrates the basic principle of the invention.

A more detailed analysis is shown in Figure 3 at (d) where vector R is the slam resultant of lift vector L and drag vector D of the flap, here drawn with Lift to Drag ratio of 12. The forward component of thrust is vector T which drives the boat forward.

10 A further embodiment of the invention is that the flaps are spring loaded to increase their resistance to rotate giving an incremental forward reaction rather than the sudden force on hitting the stop. The flap would then return aided by its spring to its initial position creating extra thrust by virtue of its stored energy which would be dependent of the stiffness of the spring. Furthermore this also produces a forward thrust at lesser intensity of slam in the
15 case where the stop position is not reached. By not having a spring loaded flap or "soft" stop to the slot could be damaging to the system.

Figure 4 shows two methods of springing, by way of example only, where spring 12 Position (a) and Position (b) gives lateral resistance to the flap creating a forward thrust at lesser angles than the flap hitting the stop. The springing can be done in various ways known to
20 the art such as coil or rubber or as a concentric coil spring 13 fixed to flap 2 at one end and base 4 at the other as shown around the pivot post 3.

A further embodiment of the invention has flaps set on the hull at or near the bow wave at such an angle to increase the net forward thrust to the hull by harnessing the momentum of the bow wave.

25 This is shown in Figure 5 where hull 14 has flap 15 rigidly mounted to the hull at an angle such that the bow wave spray 16 produces vector lift L on the flap which has a vector thrust T in the direction of travel.

In further embodiments of bow flaps the set angle of the flap can be trimmed for maximum forward thrust and its position altered upwardly or longitudinally inside the boat and also the number of flaps can be increased. It should be noted that the lift L produces a beneficial effect on hull drag represented by thrust T.

- 5 In further embodiments of the invention, the length and depth and thickness and profile of the flaps on the base of a hull can be altered to suit the characteristic desired. The size and shape and number of flaps can vary at different positions of the hull. The angle of constraint can vary with respect to their position on the hull. The angle of constraint can be altered both from the underside of the hull or from inside the hull whilst underway. The
- 10 flaps can be sprung to produce forward thrust at lesser intensity of slam. The flaps can be adjustable from outside the hull or inside the hull and trimmed from the helm. The flaps can be retracted into the hull to maintain an orthodox hull surface.

Figure 6 shows a further embodiment of the invention, which includes a longer-profile flap 2' pivoted at point 3'.

- 15 Figures 7A and 7B show an embodiment in which the flap is sprung from inside the hull. Figure 7B is the view along line B-B' in Figure 7A. Such a springing method is suitable for use with the longer-profile flap of Figure 6, but may of course be employed with a flap of any length. Pin 3 is rigidly fixed in flap 2. A bearing insertion 17 is mounted in hull 5 and allows the pin/shaft 3 to freely rotate. Crank lever 18 is rigidly fixed to pin/shaft 3. Rod 19 extends
- 20 pivotally from crank lever 18 via guide 20 and terminates in a stop 21. Guide 20 is fixed to the hull and provides alignment of the rod 19 as well as a contact surface for spring 22, which is located on the rod 19, between stop 21 and guide 20. Guide 20 may be pivoted to provide improved location of rod 19 as its angle changes. As the flap 2 moves outboard towards the second position, crank lever 18 moves in the direction of the arrow. Firstly the
- 25 unsprung distance 23 is taken up, but when the inner end of spring 22 contacts guide 20, the movement of the flap 2 starts to act against the biasing force of spring 22. Gap 23 can be zero or negative, the latter representing pretensioning of the spring 22.

Claims

1. A hull for a boat comprising a plurality of flaps extending from the hull surface, each flap being movable by the incident water flow between a first position and a second position, the flap having a greater angle from the centreline of the hull in the second position than in the first position, wherein the first and second positions are configured such that during normal running conditions the flap adopts substantially the angle of the water flow along the hull and during slamming the flap adopts the second position, in which the angle of the flap from the centreline is constrained to be less than the angle of the water flow outward from the centreline of the hull, such that the impact of the water flow on the flap produces a forward thrust to the flap and to the hull.
2. The hull of claim 1, wherein at least part of each flap is flexible such that the flap flexes between the first and second positions.
3. The hull of claim 1, wherein the flaps are pivotally-mounted and pivot between the first and second positions.
4. The hull of claim 3, wherein each flap is biased towards the first position by means of a spring.
5. The hull of claim 4, wherein the spring is mounted on the external side of the hull.
6. The hull of claim 4, wherein the spring is mounted on the internal side of the hull.
7. The hull of claim any preceding claim, wherein flaps are positioned on the hull at or near the bow to be impacted by the bow wave.
8. The hull of any preceding claim, wherein the angle of each flap in the second position is adjustable.
9. The hull of claim 8, wherein the angle of each flap in the second position is adjustable from inside the hull.

10. The hull of any preceding claim, wherein the angle of each flap in the second position, the shape of each flap and/or the spacing between each flap varies depending on the location on the hull.
11. A boat comprising the hull of any preceding claim.

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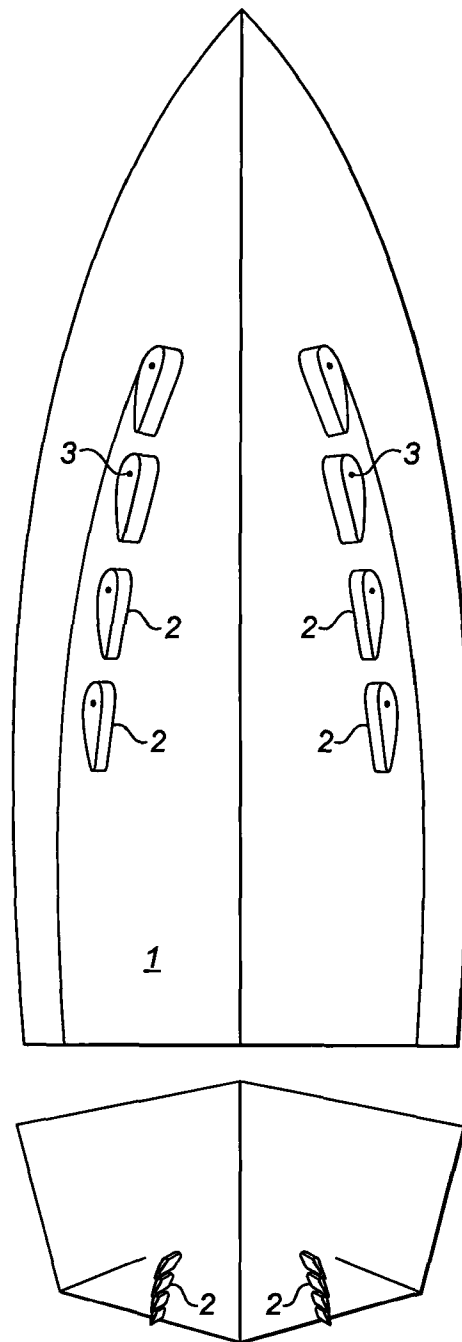


FIG. 1

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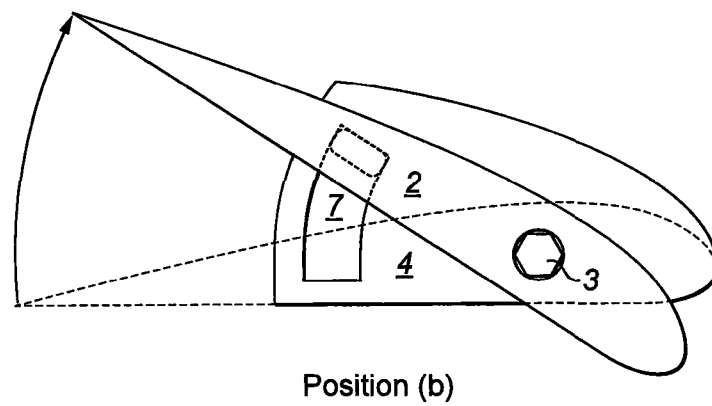
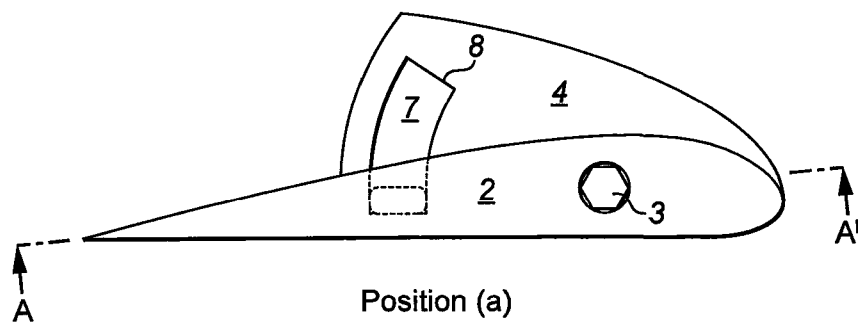
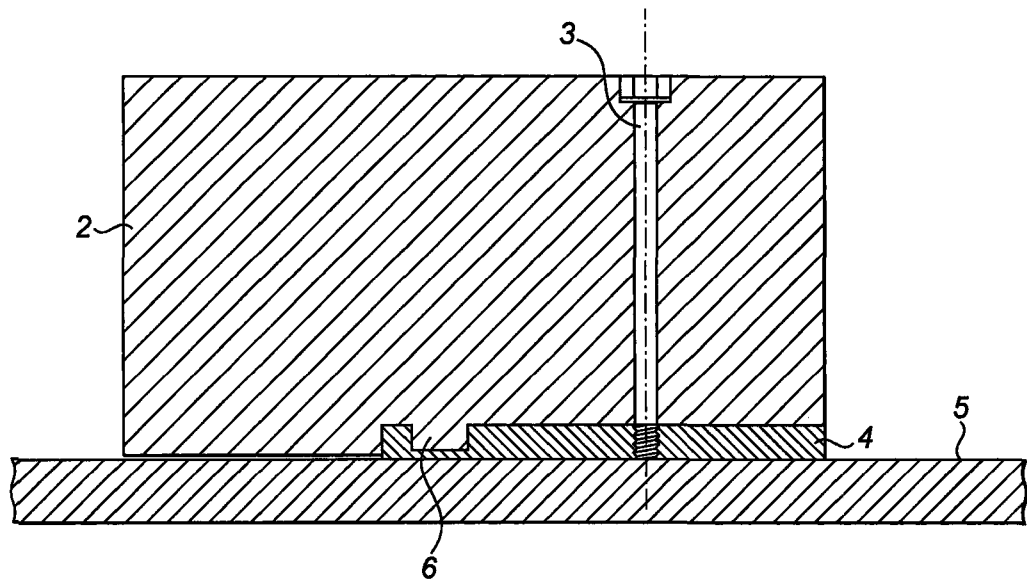


FIG. 2

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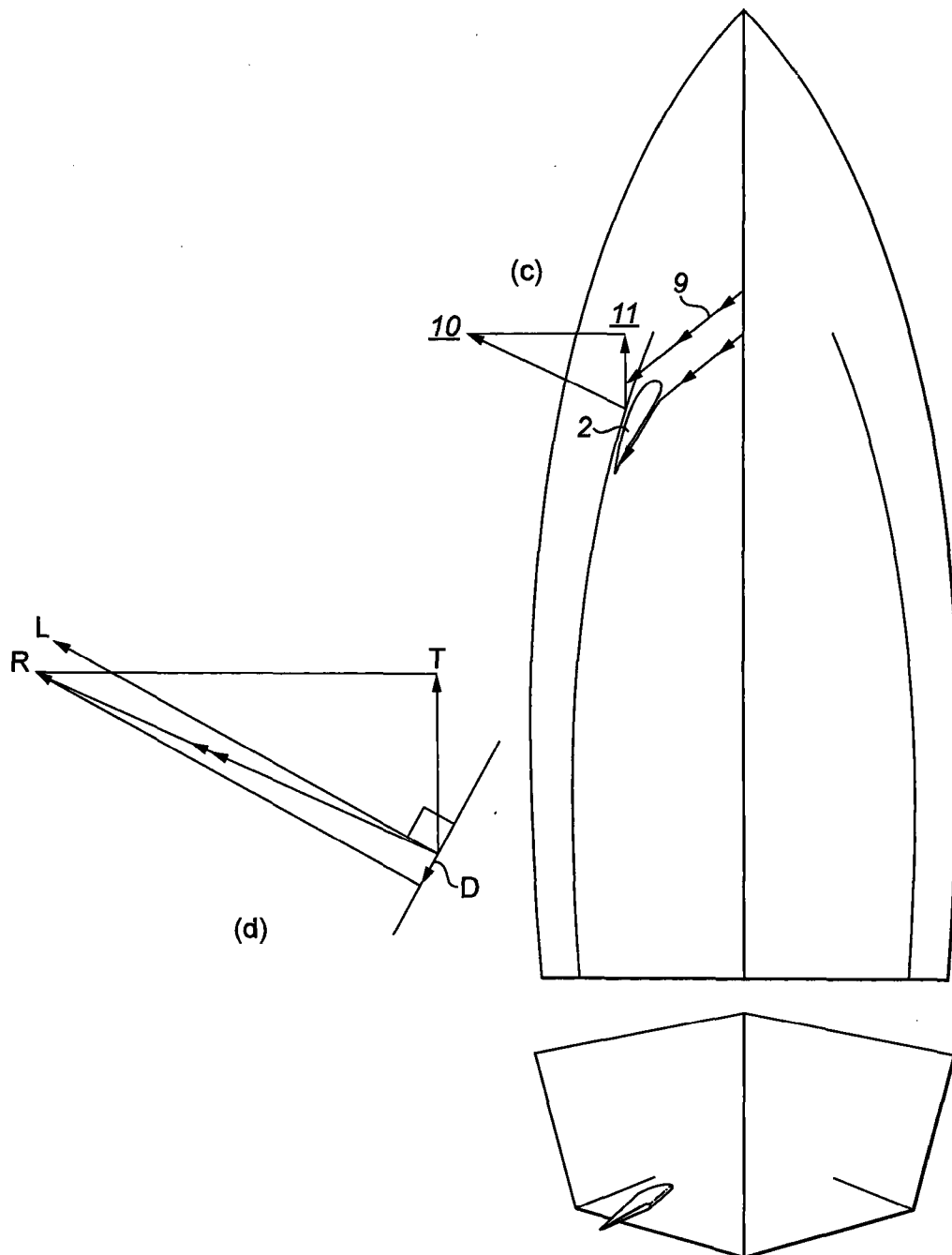


FIG. 3

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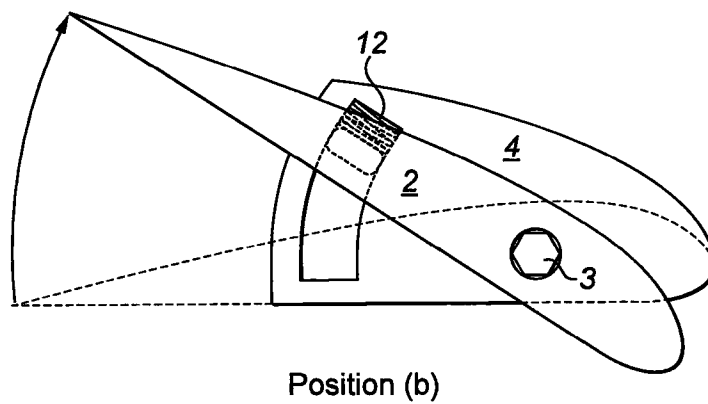
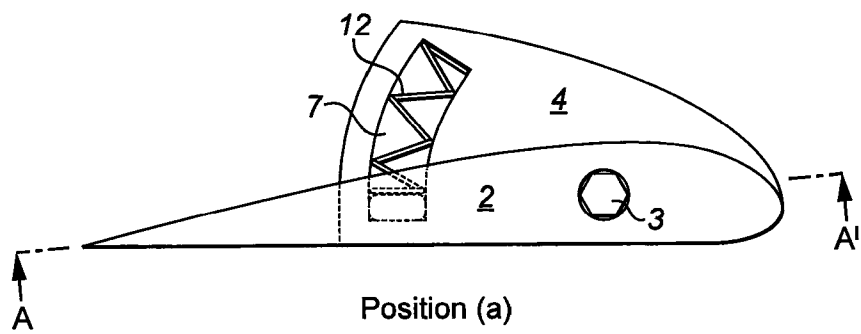
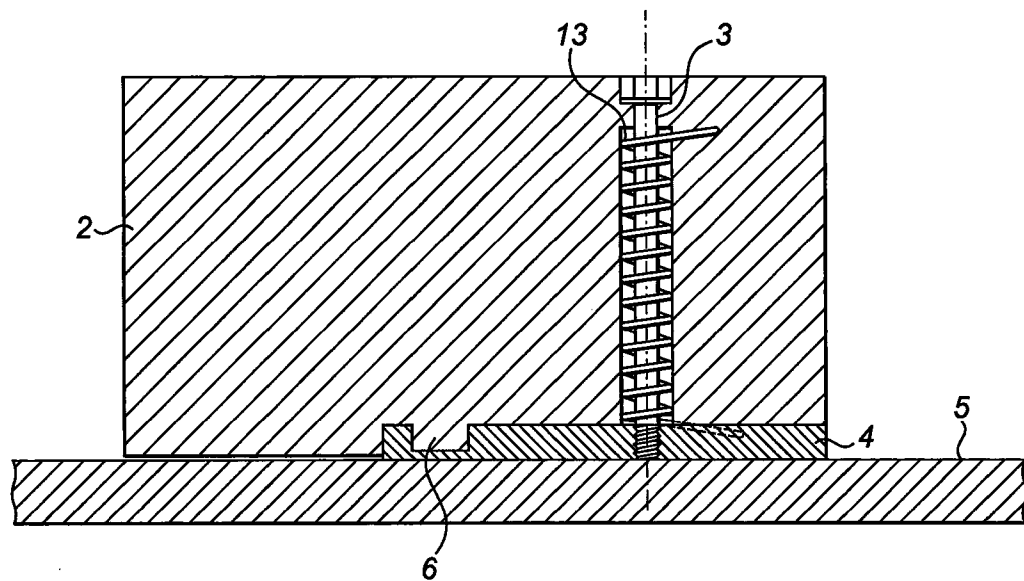


FIG. 4

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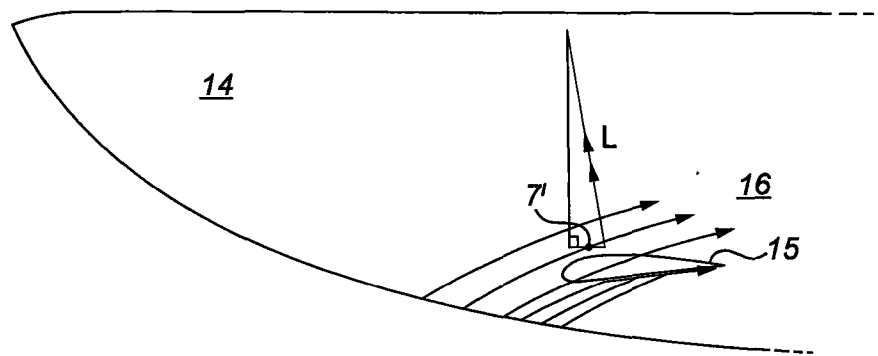


FIG. 5

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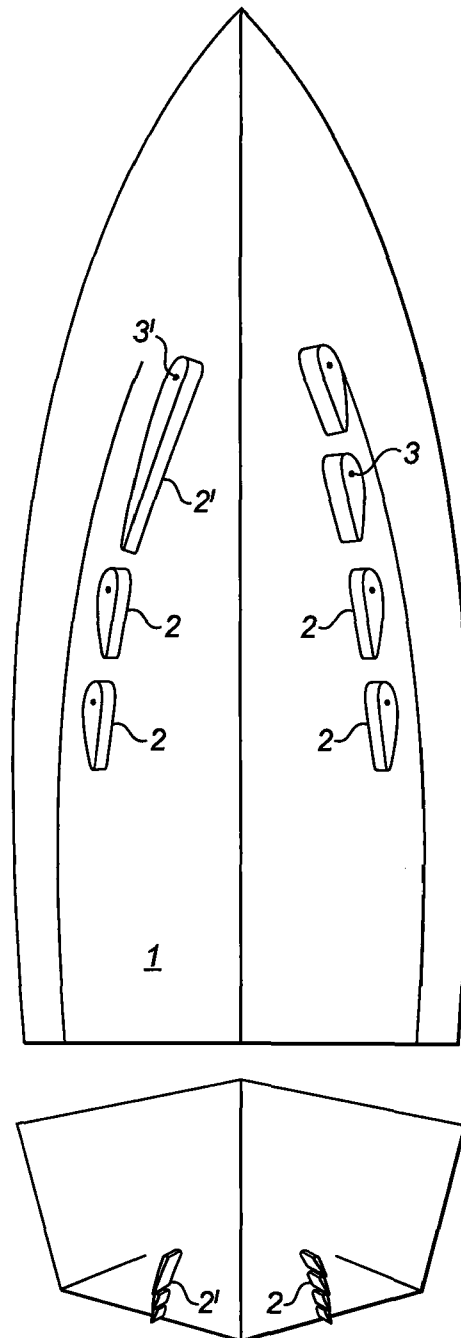


FIG. 6

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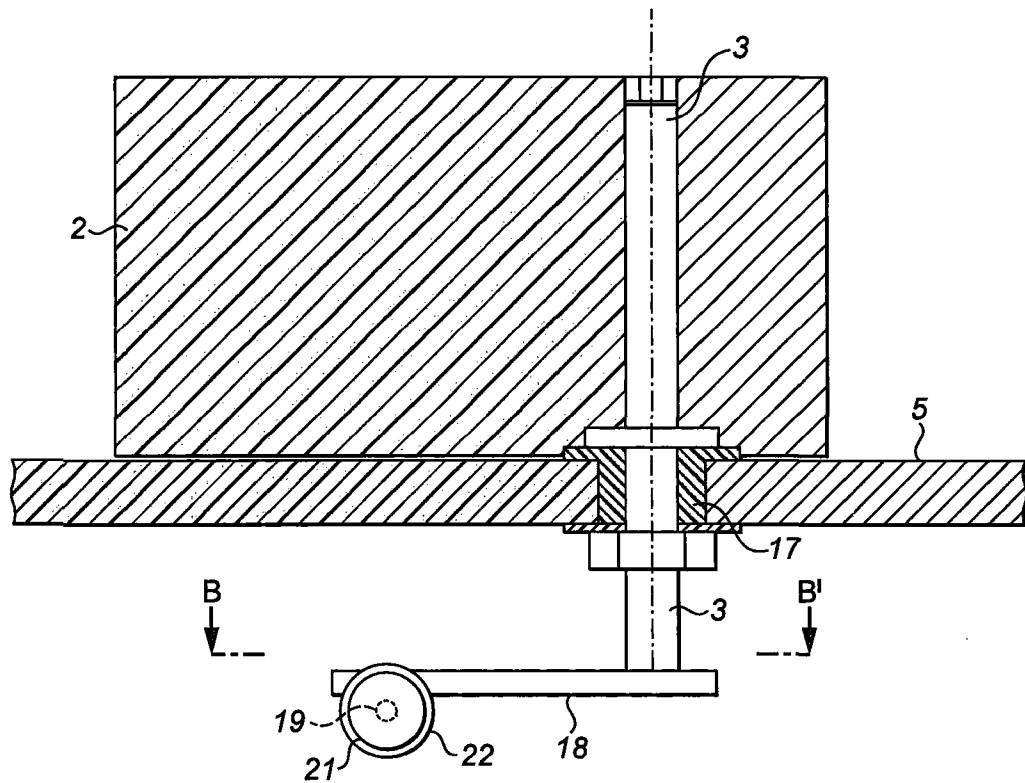


FIG. 7A

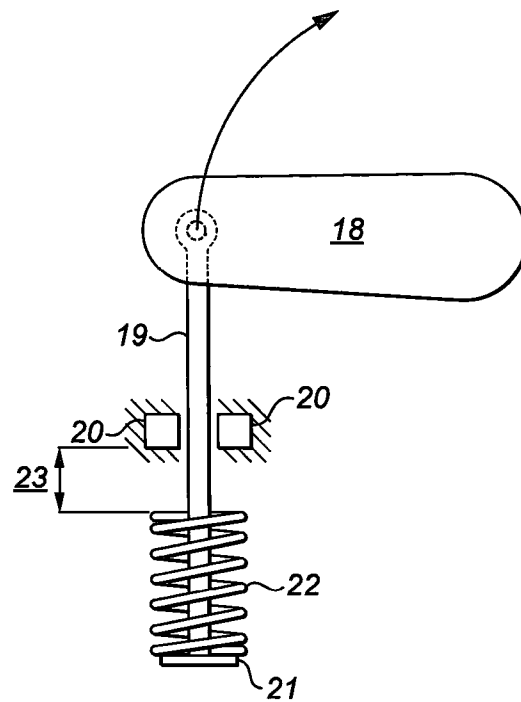


FIG. 7B
(VIEW B-B')

INTERNATIONAL SEARCH REPORT

International application No
PCT/GB2016/050877

A. CLASSIFICATION OF SUBJECT MATTER
INV. B63B1/32
ADD.

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)
B63B

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)

EPO-Internal, WPI Data

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	US 2 919 669 A (SHIZUO KIKUHARA) 5 January 1960 (1960-01-05) column 2, line 10 - column 2, line 71; figures 9,10 -----	1-11
A	WO 99/44885 A1 (BJOERN SVENSSON MARINE CONSULT [SE]; SVENSSON BJOERN [SE]) 10 September 1999 (1999-09-10) page 6, line 9 - page 11, line 26; figures 1A-4 -----	1-11
A	GB 1 304 511 A (-) 24 January 1973 (1973-01-24) page 2, line 1 - page 5, line 86; figures 1-10 -----	1-11



Further documents are listed in the continuation of Box C.



See patent family annex.

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Date of the actual completion of the international search

2 December 2016

Date of mailing of the international search report

09/12/2016

Name and mailing address of the ISA/

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INTERNATIONAL SEARCH REPORT

Information on patent family members

International application No

PCT/GB2016/050877

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