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## (54) Finkeel for boats, with movable lee-boards

(57) The invention relates to a finkeel (3) for boats, having a fixed part (30) attached to the hull (2) of the boat and a movable part consisting of two lee-boards (32, 33) hinged with respect to an axis lying in the mid-plane (M) of the finkeel.

The two lee-boards (32, 33) rotate independently of each other, so that one may be used to counter heel the inclination of the boat caused by the wind during sailing, while the other allows to keep unchanged the resistance to the leeway of the hull.

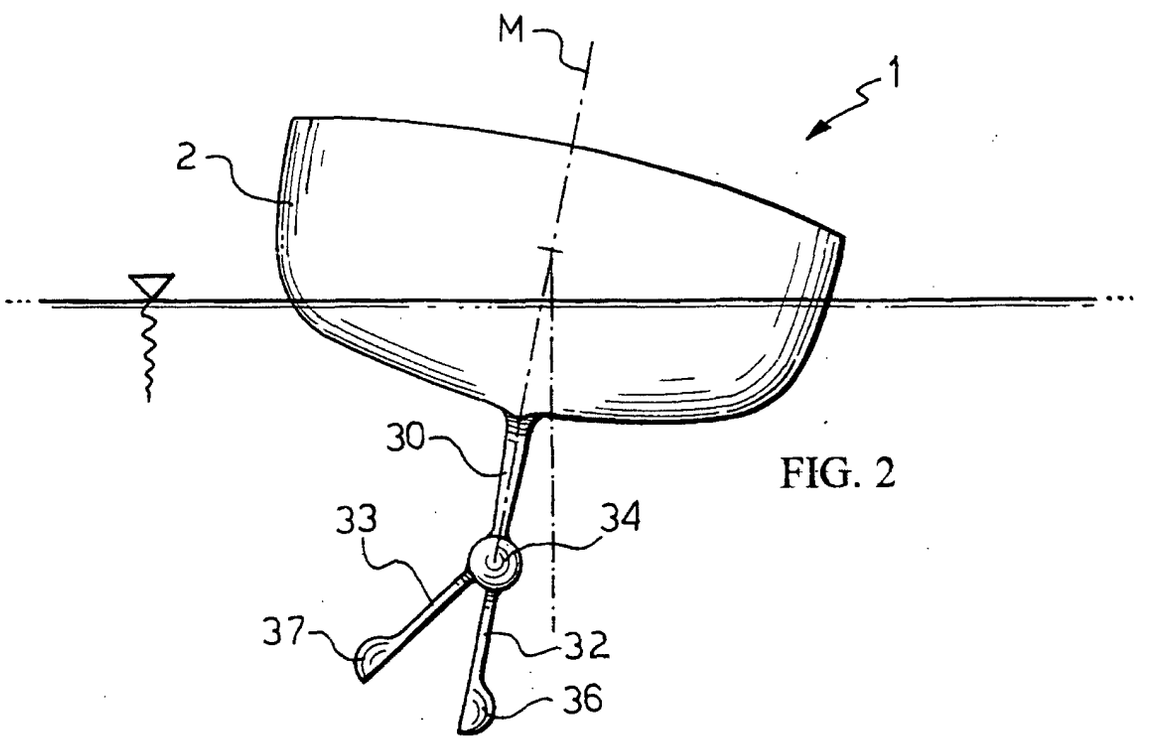


FIG. 2

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## Description

**[0001]** The invention relates to boats, in particular sailing boats, equipped with a finkeel.

**[0002]** As is known, sailing boats normally have a keel with a fin protruding downward from the hull, called finkeel, at the ends of which there may be a bulb containing lead or other heavy material suitable to form a ballast.

**[0003]** In small boats the fin may be raised or lowered manually in its plane, to extract it from the hull or immerse it in the water at different depths, while in larger boats it is fitted to the keel in a fixed manner, i.e. such that it cannot be extracted from the hull.

**[0004]** The present invention relates in particular to this second type of finkeel which may be, in turn, rigid, i.e. integral with the hull, or movable with respect thereto for adjusting the trim of the boat.

**[0005]** Finkeels allow to obtain advantageous effects including that of counter-heeling the inclination of the boat caused by the wind.

**[0006]** In order to improve this effect, finkeels have been developed that can swing to the right or to the left with respect to a longitudinal midplane of the boat.

**[0007]** To this purpose the finkeel is hinged at the bottom of the hull and is canted with respect to its hinging axis, by means of actuators, according to needs.

**[0008]** This type of finkeel is effective as regards the righting moment of the boat when the latter is subject to heel, because rotation of the finkeel allows the distribution of the weights to be changed, thereby better offsetting the force of the wind.

**[0009]** Indeed, the righting moment is equivalent to the product of the weight of the finkeel, by the distance of its centre of gravity from the longitudinal axis of rotation of the boat.

**[0010]** However, by rotating the finkeel as mentioned above, the hull transverse resistance to the leeway is reduced considerably as a result of the reduction in the effective resisting surface of the finkeel itself.

**[0011]** Indeed, for righting the boat it is necessary to displace the finkeel towards the side where the wind is blowing: this however results in a reduction in its effective surface opposing to the leeway.

**[0012]** For compensating this effect, it is known to provide on boats additional movable foils which are lowered into the sea when sailing with the finkeel in the displaced position.

**[0013]** It is clear that this provision involves additional difficulties since it requires the use of specific means and manoeuvres, which in any case it would be better to avoid from doing or using.

**[0014]** The technical problem underlying the present invention is therefore that of overcoming the limitations of the state of the art considered above and, more generally, improving the performance of the finkeels in known boats.

**[0015]** The idea for solving this problem is that of providing a finkeel having a fixed base portion fixed with respect to the hull, and a moving end portion formed by two lee-boards hinged in book arrangement at the end of the fixed portion, rotatable independently of each other.

**[0016]** In this way it is possible to modify the righting moment of the boat with an optimum ratio between the righting moment and the weight of the finkeel, without adversely affecting its resistance to the leeway and with the considerable advantage of having the weight of the finkeel situated at a lower level, although not affecting the draught of the boat.

**[0017]** The characterising features of the invention are specifically set forth in the appended claims; they will result better in view of the description provided below, of a pair of embodiments of the invention illustrated in the accompanying drawings wherein:

- Fig. 1 shows the hull of a boat with a finkeel according to the invention;
- Fig. 2 shows a cross-section through the hull of Fig. 1;
- Figs. 3 and 4 show the finkeel of the above hull, in respective operating conditions;
- Fig. 5 is a partially sectioned side view of the finkeel of Figs. 3 and 4;
- Fig. 6 is a cross-section along the line VI-VI in Fig. 5;
- Figs. 7 and 8 show respective details of Fig. 5;
- Figs. 9 and 10 show another embodiment of the finkeel above.

**[0018]** With reference to the drawings, numeral 1 denotes a boat whose hull 2 is equipped with a finkeel 3 according to the invention.

**[0019]** The finkeel 3 comprises a fixed portion 30 extending downwards from the hull 2 in a manner similar to that of conventional finkeels, and a moving portion consisting of two fins 32 and 33 projecting from the fixed part and rotating with respect to a common horizontal hinging axis X, lying in the midplane M of the finkeel.

**[0020]** The fixed portion 30 is applied to the hull 2 at a connection end 30a, using fixing means not shown in the drawings and known per se; the junction may be of the removable type, preferably obtained by means of mechanical systems (bolts, cramps, etc.), or of the permanent and stable type obtained by applying resins or other materials, suitable for rigidly joining the connection end of the finkeel to the hull.

**[0021]** The moving lee-boards 32, 33 may be closed or opened like a book (Figs. 3 and 4) independently of each other, by causing them to rotate about the hinging axis X; for this purpose a bulb-shaped part 34 is present at the end of the fixed portion 30, housing means for rotation of the lee-boards.

**[0022]** The latter are moreover configured symmetrically with respect to the midplane M of the finkeel and in this example are each equipped with a respective ballast element 36 and 37.

**[0023]** The rotation of the lee-boards mentioned

above takes place independently of each other by means of a system which may be of the electromechanical, hydraulic or other type.

**[0024]** In the example shown, operation of lee-board 33 is made by means of a shaft 40 which is rotatably supported inside the bulb-shaped part 34, by two bearings 41 and 42; at the opposite ends of the shaft 40, respective pairs of radial arms 43 and 44 are present, while a sleeve 45 formed as one piece with the lee-board 33 is keyed in its central zone. Keying may be achieved by means of longitudinal grooves or in any other suitable way known per se.

**[0025]** The lee-board 33 is then displaced, integrally with the central sleeve 45 by the rotations of the shaft 40, which are imparted by hydraulic actuators 47 and 48 acting on the arms 43 and 44 located at its ends; the hydraulic actuators are fed with operating fluid by a pump situated on-board the boat and connected thereto by means of ducts passing inside the fixed portion 30 of the finkeel. Neither the pump nor the ducts are shown in the drawings since they are known per se.

**[0026]** Furthermore on the shaft 40 there are mounted idle, by means of bearings 50, two cylindrical sleeves 51 and 52 formed as one piece with the other lee-board and having two extensions 51a, 52a, with which pairs of radial arms 53 and 54 are respectively associated.

**[0027]** Likewise before, said arms are operated by respective hydraulic actuators 55 and 56 which cause rotation of the sleeves 51, 52 and of the lee-board 32, together therewith; also in this case the actuators are connected to a supply pump arranged on-board the boat, by means of through-ducts passing in the fixed portion of the finkeel.

**[0028]** From what has been explained hitherto it is easy to understand the mode of operation of the finkeel according to the invention.

**[0029]** Indeed, during ordinary sailing conditions of the boat 1, the two lee-boards 32, 33 of the finkeel 30 are closed, thereby providing the latter with the configuration of a traditional finkeel.

**[0030]** On the other hand, when the hull 2 is inclined and it is needed to counter heel this inclination, it is sufficient to cant the lee-board 33 of the finkeel 30 which is situated on the windward side namely, in the case of Figure 2, the lefthand side.

**[0031]** In this manner the lee-board 33 together with the ballast 37 is displaced, moving away its centre of gravity from the midplane M such that its weight increases the moment that counter-heels the inclination of the boat caused by the wind.

**[0032]** Canting of the lee-board 33 is obtained by rotating the shaft 40 on which its sleeve 45 is keyed; as explained above, rotation of the shaft is in turn performed by the actuators 47, 48.

**[0033]** In Figure 2, the other lee-board 32.remains immobile in the initial position aligned with the midplane M, so that the transverse resistance to the leeway of the hull 2 remains unchanged with respect to its normal sailing condition.

**[0034]** It is obvious that, when the inclination of the boat occurs in the opposite direction to that of Fig. 2, the lee-board 32 will be displaced in order to right it; this operation takes place as a result of rotation of the sleeves 51, 52 integrally with the lee-board 32.

**[0035]** For this purpose the actuators 55, 56 operate the radial arms 53, 54 of the extensions 51a, 52a of the sleeves, in a manner similar to that already seen above; in this case the lee-board 33 will remain aligned with the midplane M.

**[0036]** As can be seen, therefore, the finkeel 3 considered above solves the technical problem underlying the present invention.

**[0037]** Indeed, while in the known art the displacement of the movable finkeel for righting the boat increases the tendency of the hull to drift, now with the two independent movable lee-boards 32, 33 it is possible to obtain simultaneously the dual effect of counter heeling the inclination of the hull and keeping unvaried its resistance to the leeway.

**[0038]** With reference to Fig. 2 it is further pointed that if the lee-board 32 is rotated so as to lay it vertically, the resistance to the leeway is also increased; however, it must be pointed out that in the finkeel according to the invention the lee-boards 32, 33 may also be rotated in the same direction, to increase the righting moment of the hull.

**[0039]** There are, however, other important advantageous effects achieved by the finkeel according to the invention.

**[0040]** Firstly it must emphasized that the two lee-boards 32, 33 are symmetrical with respect to the axis of rotation X and have a limited length, because the finkeel 3 also comprises a fixed portion 30: consequently, in normal sailing conditions, i.e. with the boat not inclined as explained above, the two lee-boards 32 and 33 may be used as fixed lee-boards of the type used nowadays on some boats. Fig. 4 shows a possible use of the lee-boards in this condition.

**[0041]** The division of the finkeel into a fixed portion and a moving portion with the lee-boards is moreover advantageous for the draught of the boat.

**[0042]** Indeed, as is known in some ports there is a limited depth which does not allow the entry of boats with a draught greater than a certain predefined value; it can be easily understood that with the finkeel according to the invention, it is possible to fold the lee-boards upwards thereby reducing the draught to the sole fixed portion.

**[0043]** The symmetry of the lee-boards allows to effectively reduce the draught without heeling the boat, contrarily to what would happen in the case of boats of the known type, where if the sole rotating finkeel is canted to reduce the draught, the centre of gravity is also displaced thereby resulting in an imbalance of the boat's trim.

**[0044]** It is also evident that short lee-boards such as

those according to the invention require motors, pumps, racks or other means generally intended for rotation thereof, smaller and lighter than those used in the known art, with the obvious advantages arising therefrom.

**[0045]** Of course, variations of the invention with respect to the foregoing are possible.

**[0046]** For example, it is clear that the solutions for mounting and rotating of the lee-boards may vary greatly; it is therefore possible to use alternative systems in which, instead of the hydraulic actuators, there are mechanisms with connecting rods and cranks or gears which transmit the movement to the shaft 40, or other solutions in which there are electric motors arranged inside the bulb-shaped part 34, which directly actuate the shaft 40 and the sleeves 51, 52.

**[0047]** Also as regards the form of the lee-boards it is possible to provide alternative designs; for example Figs. 9 and 10 show a finkeel wherein the lee-board 32 is divided into two elements 32', 32", while the lee-board 33 has a width such that it can be arranged between these elements.

**[0048]** As can be seen, in the vertically aligned condition this solution is equivalent to the one above since the lee-boards are joined together; however, in the case of the same total weight of the finkeel, the centre of gravity is located in a lower point.

**[0049]** Finally, as a further possible variant it may be to envisaged to provide a finkeel according to the invention, in which the lee-boards 32, 33 are respectively hinged about two parallel axes (X' and X") arranged on the fixed portion 30, instead of about a single axis X as in the previous cases.

**[0050]** This solution has the advantage of giving the possibility to use lee-boards of the "open" type like those in Figs. 9 and 10, which however are symmetrical since they do not have to penetrate inside each other as shown in Fig. 9 because they may be arranged adjacent to each other, being hinged on two different axes. It just matters to be added that the hinging and actuation of these lee-boards is entirely similar to that explained above.

**[0051]** Last, also in relation to the actuation of the lee-boards it must be pointed out how the shaft and the sleeve elements are simple and reliable, also because they are suitable for the use of sealing means between the parts in relative movement; this is applicable to the sleeve elements 51, 45 and 52 between which sealing rings made of material resistant to sea water, such as teflon or the like, may be arranged.

**[0052]** It is nevertheless possible to design different systems depending also on the form of the lee-boards above.

**[0053]** All of these variants nevertheless fall within the scope of the following claims.

## Claims

1. Finkeel for boats, **characterized in that** it comprises a fixed portion (30) with an end (30a) of connection to a hull (2) and a moving portion comprising a pair of lee-boards (32, 33) arranged on the fixed portion, rotatable in a hinged manner on opposite sides with reference to a midplane (M) of the fixed part.

2. Finkeel according to Claim 1, wherein the lee-boards (32, 33) are rotatable independently of each other.

3. Finkeel according to Claims 1 and 2, wherein the lee-boards, (32, 33) are provided with respective ballast elements (36, 37).

4. Finkeel according to Claim 3, wherein the ballast elements (36, 37) are arranged at the ends of the respective lee-boards (32, 33).

5. Finkeel according to the preceding claims, wherein the lee-boards (32, 33) are rotatable with respect to a same axis (X) lying on a midplane (M) of the fixed portion.

6. Finkeel according to Claim 5, wherein the lee-boards (32, 33) are hinged on a shaft (40) arranged along their axis of rotation (X), by means of respective sleeves (45; 51, 52).

7. Finkeel according to Claim 6, wherein at least one of said sleeves (45) is rotationally integral with the shaft (40) where the arms (43, 44) are arranged, said arms being operated by respective actuators (47, 48).

8. Finkeel according to Claim 7, wherein at least one of said sleeves (51, 52) is idle with respect to the shaft (40) and is provided with arms (53, 54) operated by respective actuators (55, 56).

9. Finkeel according to the preceding claims, wherein the lee-boards (32, 33) are substantially symmetrical and adjacent to each other in the condition aligned with the midplane (M) of the hull.

10. Finkeel according to Claims 1 to 8, wherein the lee-boards have a matching form with elements (32', 32", 33) interposing with each other, in the condition aligned with the midplane (M) of the fixed part (30).

11. Finkeel according to Claims 1 to 4, wherein the lee-boards (32, 33) are rotatable about respective parallel axes (X', X") arranged on opposite sides with respect to the midplane (M) of the fixed part (30).

**12.** Finkeel according to the preceding claims, wherein the lee-boards extend from the end of the fixed part (30), opposite to the connection end (30a) thereof.

**13.** Finkeel according to the preceding claims, wherein the axes of rotation of the lee-boards are arranged parallel to the longitudinal axis of the boat's hull.

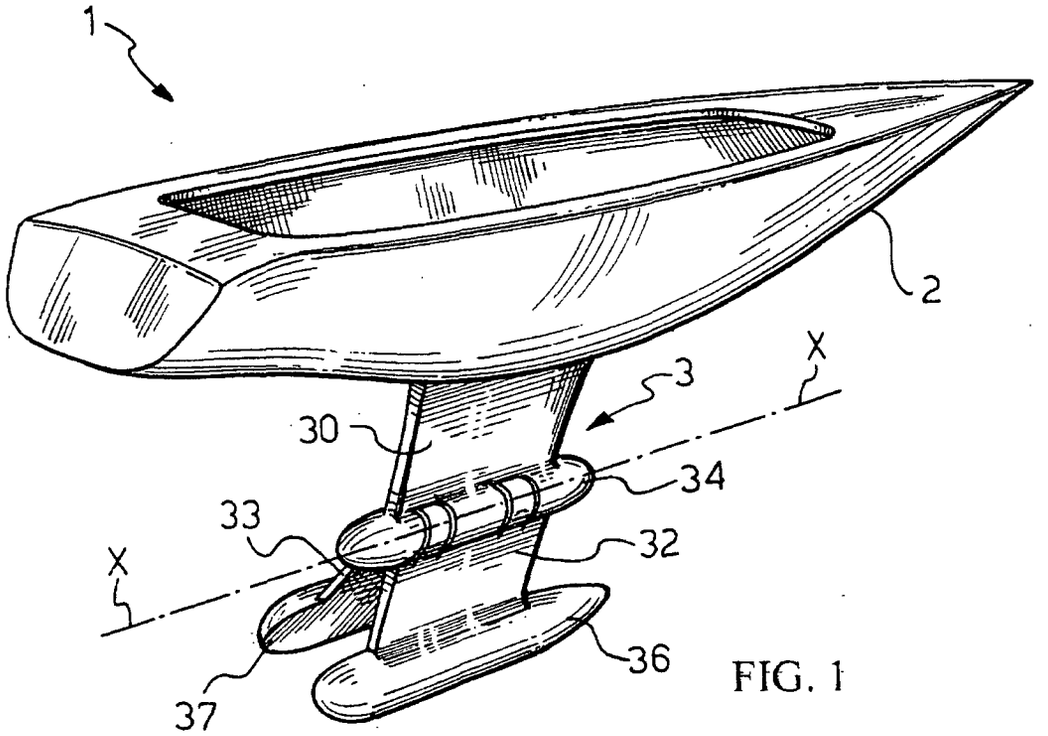


FIG. 1

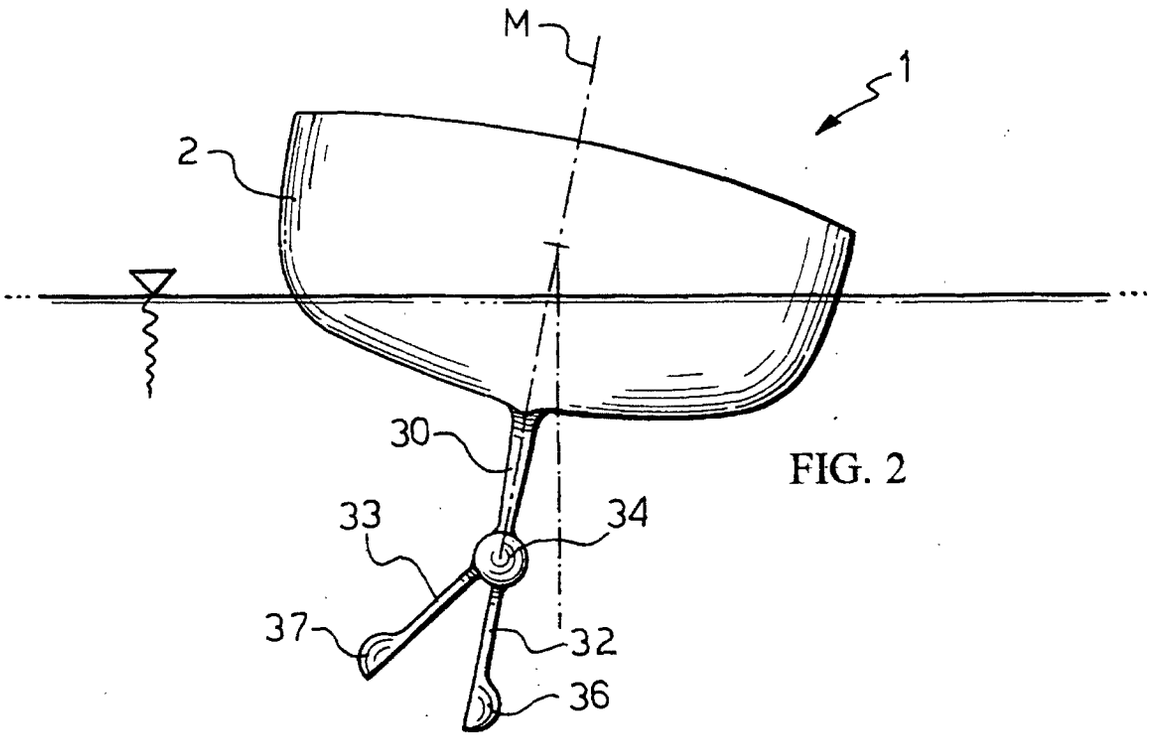


FIG. 2

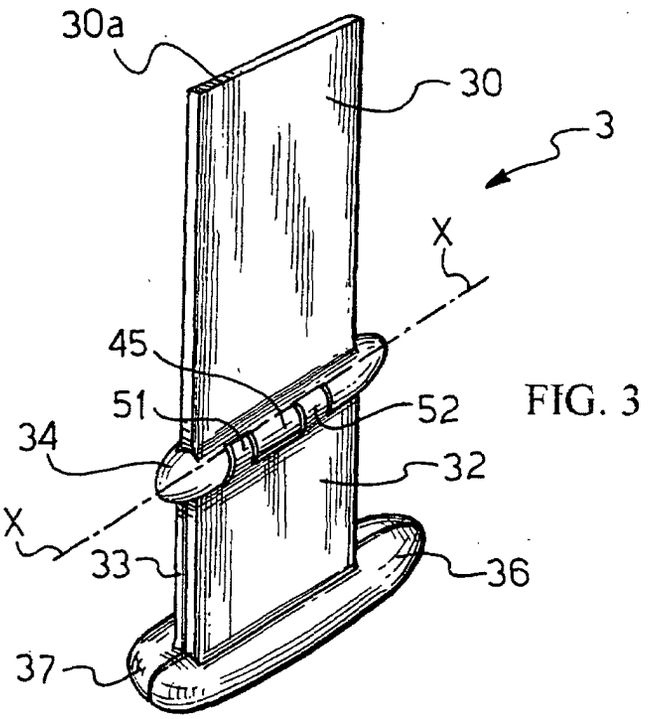


FIG. 3

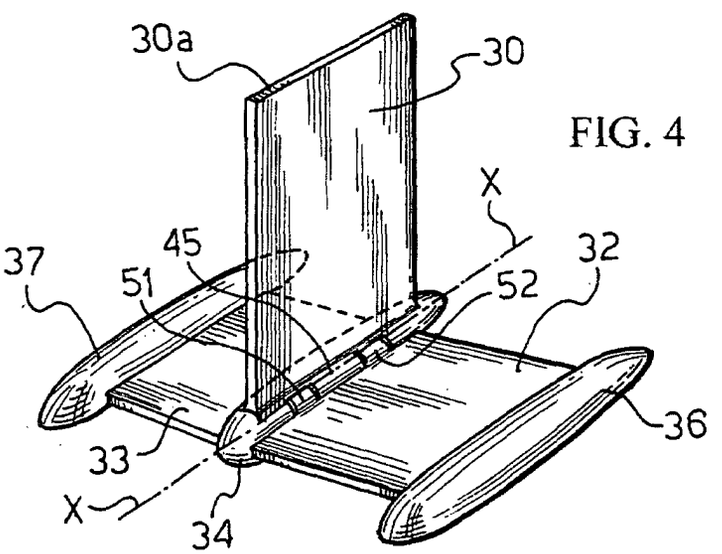


FIG. 4

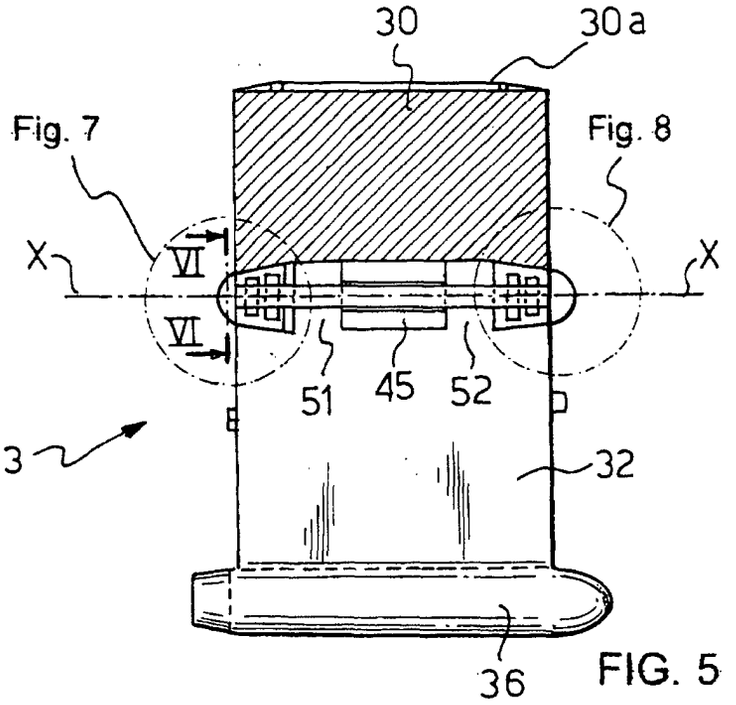


FIG. 5

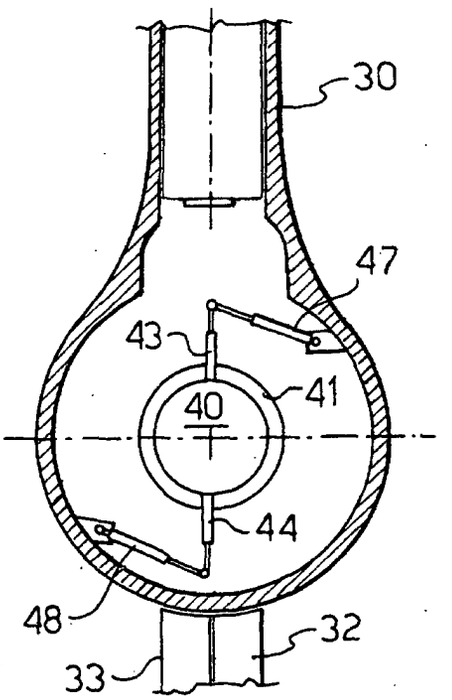


FIG. 6

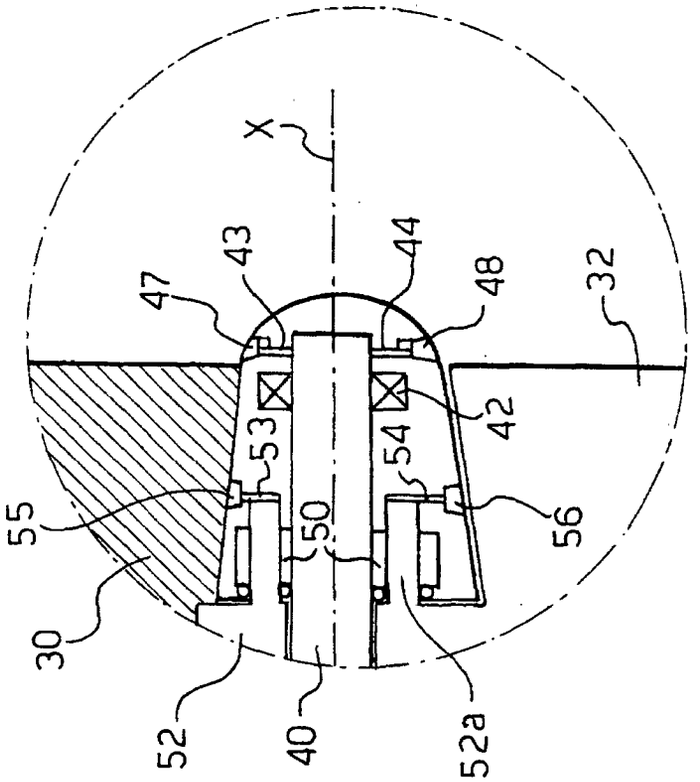
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FIG. 8

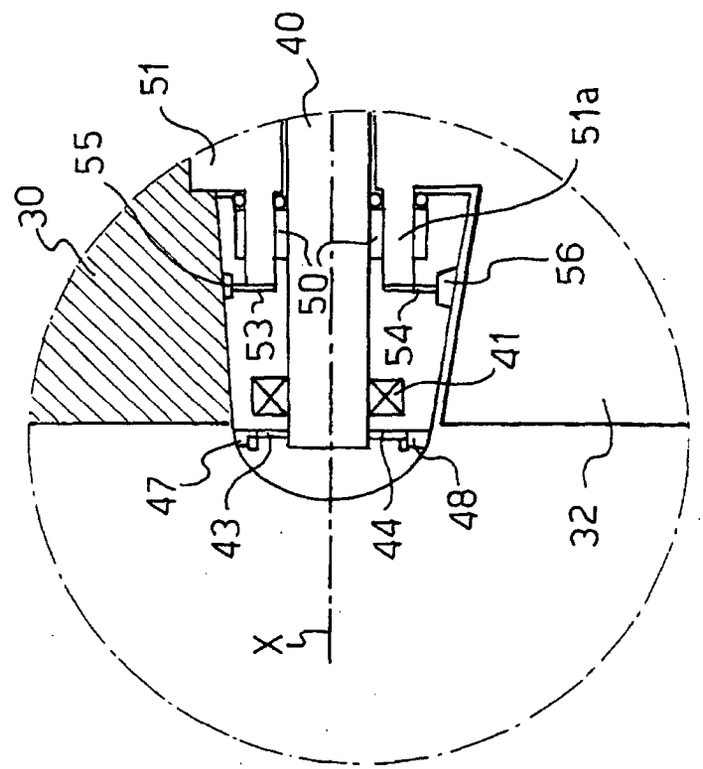
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FIG. 7

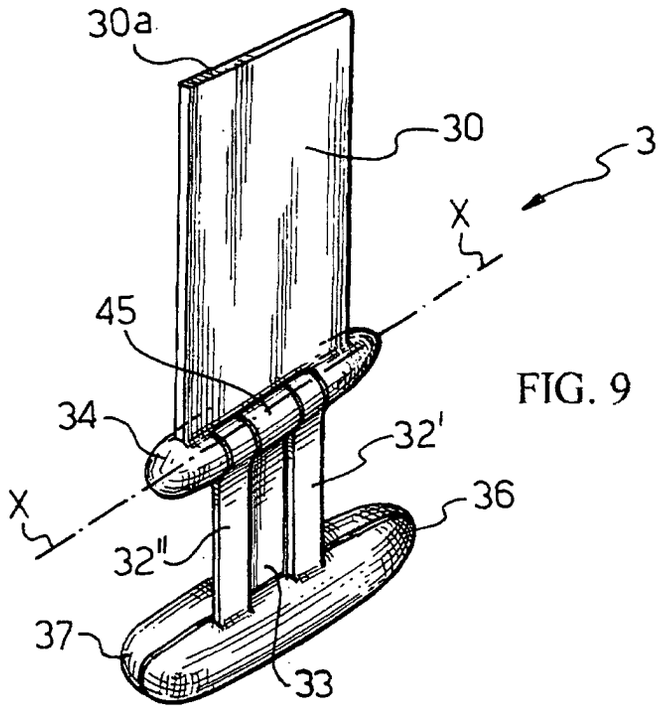


FIG. 9

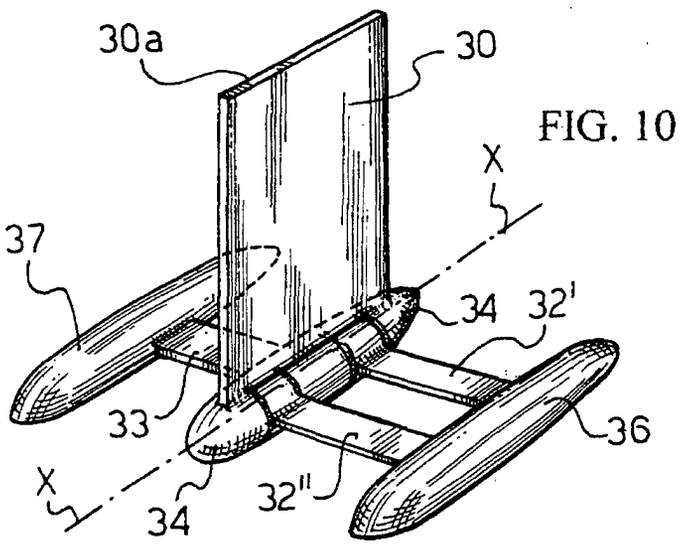


FIG. 10

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The present search report has been drawn up for all claims

| Place of search | Date of completion of the search | Examiner |
|---|---|---|
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P : intermediate document

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E : earlier patent document, but published on, or after the filing date
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## ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 03 42 5207

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