(19) Europäisches Patentamt
European Patent Office
Office européen des brevets

(11) Publication number: **0 159 144**
A1

(12) # EUROPEAN PATENT APPLICATION

(21) Application number: **85301833.1**

(22) Date of filing: **15.03.85**

(51) Int. Cl.⁴: **B 63 H 25/42**

(30) Priority: **15.03.84 JP 37203/84**

(43) Date of publication of application:
23.10.85 Bulletin 85/43

(84) Designated Contracting States:
GB NL

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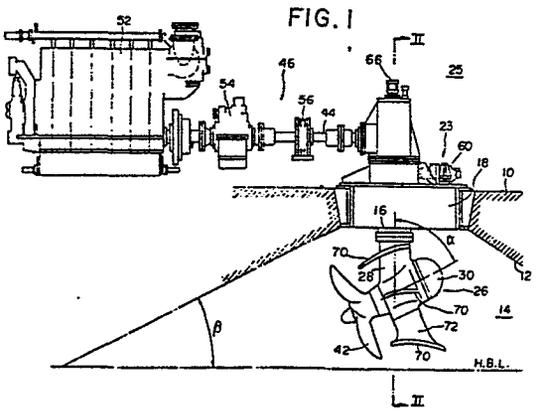
(54) **Azimuth thruster for use in ships.**

(57) The azimuth thruster includes: an outboard housing (26) mounted within a substantially conical recess (17) to turn about a vertically axis, the conical recess formed in the bottom of a hull of the ship to converge upwards; a turning unit (23), mounted to the hull, for turning the outboard housing about the vertical axis; a propeller shaft rotatably supported by the outboard housing to cross the vertical axis of the outboard housing with an acute angle (α); a propeller (42) mounted on the lower end of the propeller shaft to be located outside the outboard housing and within the conical recess and to provide a thrust upwards in the direction of the propeller shaft; and a propulsion unit (52) for rotating the propeller shaft.

FIG. 1



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BACKGROUND OF THE INVENTION

The present invention relates to an azimuth thruster for use in ships, the azimuth thruster being mounted to ships together with a screw for improving maneuverability.

Heretofore, the thruster for ships is mounted to the bow or stern other than the screw. Most conventional thrusters are a type of the tunnel type oneway thruster directed to the port and starboard. As the 360 degree rotatable thruster, there have been developed the Z-peller propeller and the like thrusters. However, since these thrusters have a structure such that the propeller thereof projects downwards from the bottom of the ship, they are disadvantageous in that their use is largely restricted in depth of water in shallow sea, particularly near quay and hence are not widely used.

To avoid this disadvantage there is proposed a cone-jet thruster in Japanese Patent Publication No. 58-35919, published on August 5, 1983, (corresponding to West German Patent Application No. P 2757454.5), in which a frustoconical casing, which is provided with a through water passage having a water inlet and outlet opening at the bottom thereof and directed obliquely downward, is rotatably received in a recess formed in the bottom of a ship, the casing having a propeller pump mounted within the water passage. However, this thruster is complicated in structure.

SUMMARY OF THE INVENTION

Accordingly, it is an object of the present invention to provide a 360 degree rotatable azimuth thruster which is less complicated in structure and is operable at a relatively small depth of water, particularly near quay.

With these and other objects in view the present invention provides an azimuth thruster for a ship, including: an outboard housing mounted within a substantially conical recess to turn about a vertically axis, the conical recess formed in the bottom of a hull of the ship to converge upwards; a turning unit, mounted to the hull, for turning the outboard housing about the

vertical axis; a propeller shaft rotatably supported by the outboard housing to cross the vertical axis of the outboard housing with an acute angle; a propeller mounted on the lower end of the propeller shaft to be located outside the outboard housing and within the conical recess and to provide a thrust upwards in the direction of the propeller shaft; and a propulsion unit for rotating the propeller shaft.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a partial vertical section taken along the longitudinal direction of a ship, illustrating an azimuth thruster constructed according to the present invention;

FIG. 2 is a cross-sectional view taken along the line II-II in FIG. 1;

FIG. 3 is an enlarged plan view of the turning unit in FIG. 1; and

FIG. 4 is an enlarged vertical section of the azimuth thruster in FIG. 1.

DETAILED DESCRIPTION OF PREFERRED EMBODIMENTS

Referring to FIGS. 1 and 2, reference numeral 10 designates a hull of a ship, in the bottom 12 of which is formed a conical, more exactly, frustoconical recess 14 which converge upwards. As clearly shown in FIG. 4, a cylindrical casing 16 vertically passes through a frame 18, which defines the top of the frustoconical recess 14, and is supported in a conventional watertight manner by the frame 18 to be rotatable about its axis. 78 and 82 indicate bearing members and sealing member respectively. The cylindrical casing 16 has at its top a worm gear 20 integrally and concentrically formed with it, the worm gear 20 engaging a worm 22 which forms part of an outboard housing turning unit 23 mounted on the frame 18 within a thruster room 25. The cylindrical casing 16 is rotated by a hydraulic oil motor 60 (FIG. 3) through the worm 22 and the worm gear 20. At the bottom end 24 of the cylindrical casing 16 there is provided an outboard housing 26 which has a hollow tubular portion 28 and a propeller shaft supporting portion 30 integrally formed with the tubular

portion 28 and having a teardrop or streamline shape. The tubular portion 28 of the outboard housing 26 is concentrically and watertightly bolted to the lower end 24 of the cylindrical casing 16 as shown in FIG. 4. A vertical shaft 32 coaxially extends through and rotatably supported by the cylindrical casing 16 and the tubular portion 28 of the outboard housing 26 through bearing members 76 and 76, the vertical shaft 32 having an upper beveled gear 34 mounted at its upper end and a lower beveled gear 36 at its lower end. A propeller shaft 38 is rotatably supported by the propeller shaft supporting portion 30 of the outboard housing 26 through bearing members 74 and 74 to cross the axis of the vertical shaft 32 at an angle α. The lower end 40 of the propeller shaft 38 projects form the propeller shaft supporting portion 30 and has a propeller 42 mounted on it to provide a thrust upwards and in the direction of the axis of the propeller shaft 38. 80 designates a sealing member. The upper beveled gear 34 of the vertical shaft 32 engages a drive beveled gear 42 mounted on an output shaft 44 of a propulsion unit 46 and the lower beveled gear 36 engages a driven beveled gear 48 mounted on an upper end portion 50 of the propeller shaft 38. With such a construction, the driving force of the propulsion unit 46 is transmitted to the propeller shaft 38 through the output shaft 44, drive beveled gear 42, upper beveled gear 34, vertical shaft 32, lower beveled gear 36 and driven beveled gear 48, thereby rotating the propeller 42. Further, actuation of the turning unit 23 rotates the cylindrical casing 16 and the outboard casing 26 to thereby turn the propeller 42 about the axis of the vertical shaft 32.

In this embodiment, the inclined angle α defined between the axis of the vertical shaft 32 and the propeller shaft 38 is set to 65° and the inclined angle β formed between the wall of the recess 14 of the hull base line or the horizontal line H.B.L. is set to 25°. The angle α is generally in the range from 45° to 75° and the

angle β is generally in the range from 15° to 45°. The shape of the recess 14 need not be exactly frustoconical, and may be substantially conical.

The propulsion unit 46 includes a main engine 52, which is connected to the output shaft 44 through a clutch 54 which incorporates an oil hydraulic pump (not specifically shown) into it. The output shaft 44 is provided with an air brake 56 for preventing the rotation of the propeller 42 when the clutch 54 is disengaged. The turning unit 23 includes the oil hydraulic pump which is incorporated within the clutch 54, an oil hydraulic motor 60 (FIG. 3) actuated by the hydraulic pump, a cooler 62 for cooling the operating oil, a filter 64 for filtering the operating oil and an oil pump 66 for lubricating rotating portions of the unit. The rotation of the oil hydraulic motor 60 is transmitted through the worm 22, the worm gear 20, and the cylindrical casing 16 to the outboard housing 26. The rotation angle of the outboard housing 26 is detected by a turning angle detector 68. The outboard housing 26 is provided at its tubular portion 28 and propeller shaft supporting portion 30 with several fairing or straightening plates 70. 72 designates a fixing plate integrally formed with each straightening plate 70 for attaching it to the outboard housing 26 and has a streamline shape. FIG. 1 illustrates a state in which the propeller 42 is directed toward the stern (to the left). When the propulsion unit 46 is actuated in this state, the propeller 42 is, as previously described, rotated to thereby produce a thrust at the same angle as the inclined angle α, that is, a thrust directed upwards and parallel to the axis of the propeller shaft 38. Thus, the ship is propelled to the right in FIG. 1. During this operation, water flows in the form of an arc along the wall of the recess 14 from the right to the left in FIG. 1. Since the outboard housing 26 is provided with the straightening plates 70, water flows to the propeller 42 smoothly or less turbulently. Thus, the efficiency of the

propeller 42 is increased and the generation of cavitation is reduced. Further, the oscillation of the bottom 12 of the ship due to turbulent flow is reduced.

In order to change the direction of thrust of the propeller 42, the turning unit 23 is actuated to thereby turn the propeller 42 toward a desired direction together with the outboard housing 26. FIG. 2 shows the outboard housing 26 turned 90^{o} from the position in FIG. 1. The outboard housing 26 may be rotated 360^{o} or more and equal thrust is obtained at any turned position of the outboard housing 26.

The number and dimensions of the straightening plates 70 depend on dimensions of the propeller 42 but the straightening plates 70 are not necessarily provided.

The propulsion unit and the turning unit are not restricted to those shown in the drawings. For example, the driven beveled gear 48 may be mounted on the propeller shaft 38 as indicted by the phantom line in FIG. 4, in which case the lower beveled gear 36 is modified to engage the driven beveled gear indicated by the phantom line. Various combinations of toothed wheels other than toothed wheels shown in the drawings or other transmission means may be adopted.

While the invention has been disclosed in specific detail for purposes of clarity and complete disclosure, the appended claims are intended to include within their meaning all modifications and changes that come within the true scope of the invention.

CLAIMS:

1. An azimuth thruster for a ship, comprising:

an outboard housing mounted within a substantially conical recess to turn about a vertically axis, the conical recess formed in the bottom of a hull of the ship to converge upwards;

turning means, mounted to the hull, for turning the outboard housing about the vertical axis;

a propeller shaft rotatably supported on the outboard housing to cross the vertical axis of the outboard housing with an acute angle;

a propeller mounted on a lower end of the propeller shaft to be located outside the outboard housing and within the conical recess and to provide a thrust upwards in the direction of the propeller shaft; and

propulsion means for rotating the propeller shaft.

2. An azimuth thruster as recited in Claim 1, wherein the outboard housing comprises a tubular portion vertically supported on the conically recessed bottom of the hull to be rotatable about its axis and a streamlined, propeller shaft supporting portion integrally formed with the tubular portion.

3, An azimuth thruster as recited in Claim 2, wherein the acute angle is within a range of about 45 to about 75^{o}; and wherein an angle formed between the wall of the conical recess and a horizontal line is within a range of about 15 to about 45^{o}.

4. An azimuth thruster as recited in Claim 3, wherein the outboard housing comprises a plurality of straightening plates mounted thereon so that water flow is supplied to the propeller less turbulently.

5, An azimuth thruster as recited in Claim 4, wherein: the turning means comprises a cylindrical casing vertically and watertightly passing through and rotatably supported on an apex portion of the wall of the conical recess, the cylindrical casing having a lower end concentrically watertightly bolted to the upper end of the tubular portion of the outboard housing; a worm gear coaxially and integrally formed with the upper end of the cylindrical casing; and a worm engaging with the worm gear.

6. An azimuth thruster as recited in Claim 5, wherein the propulsion means comprises a vertical shaft concentrically passing through and rotatably supported on the cylindrical casing and the tubular portion of the outboard housing, the vertical shaft connected at an upper end portion thereof to a prime mover; a first beveled gear mounted on the lower end of vertical shaft; and a second beveled gear mounted on the propeller shaft to engage the first beveled gear for transmitting the rotational force to the propeller shaft.

FIG. 1

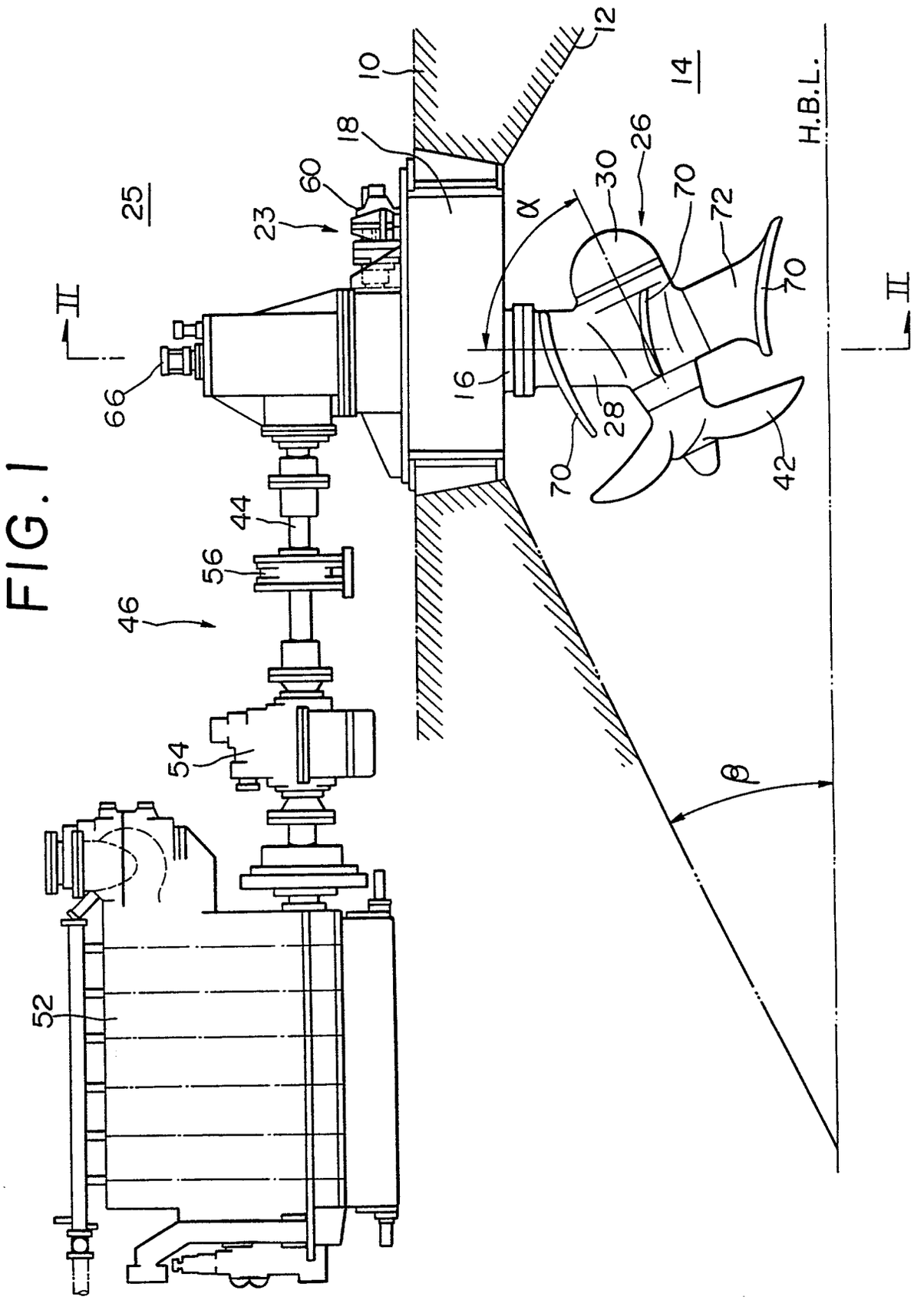

12
10
14
H.B.L.
18
26
60
30
70
72
25
23
α
II
II
66
16
70
28
70
42
44
56
46
54
β
52

FIG. 2

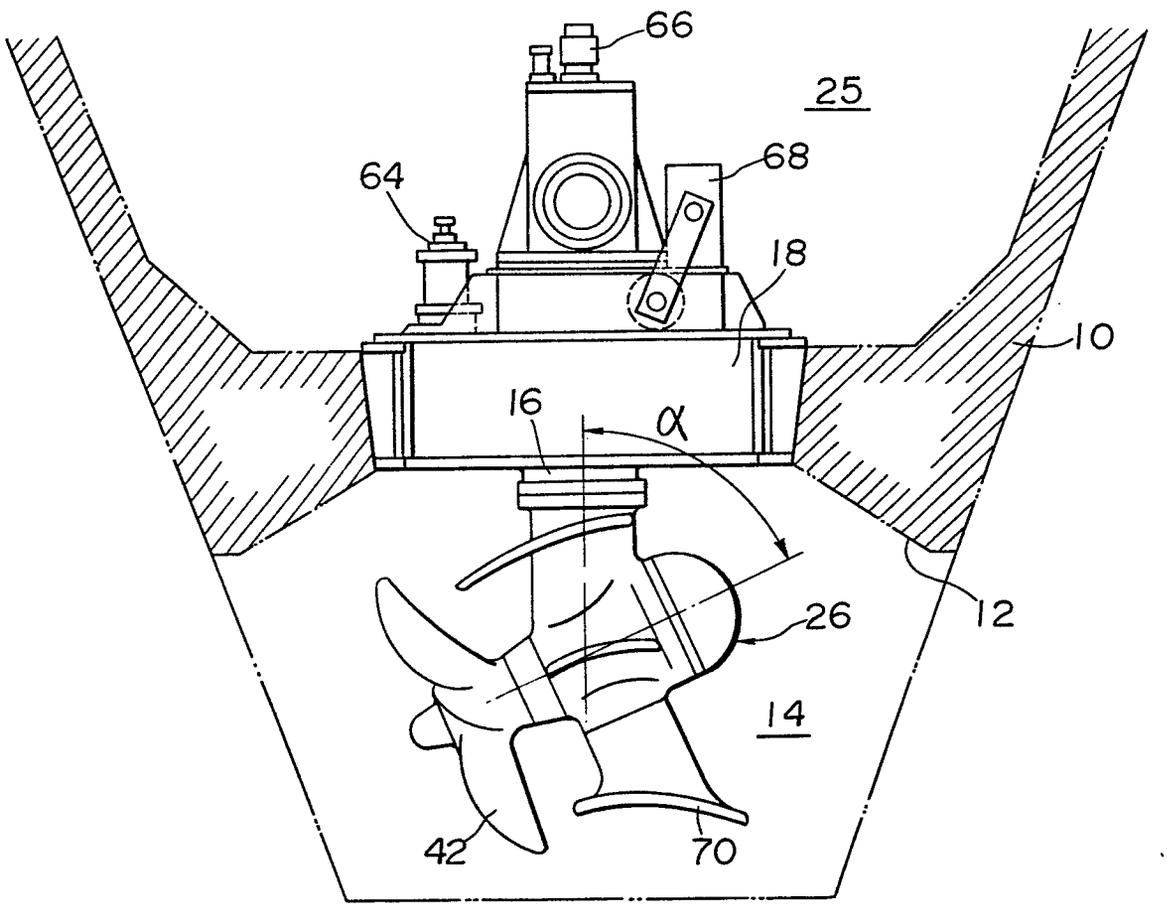


FIG. 3

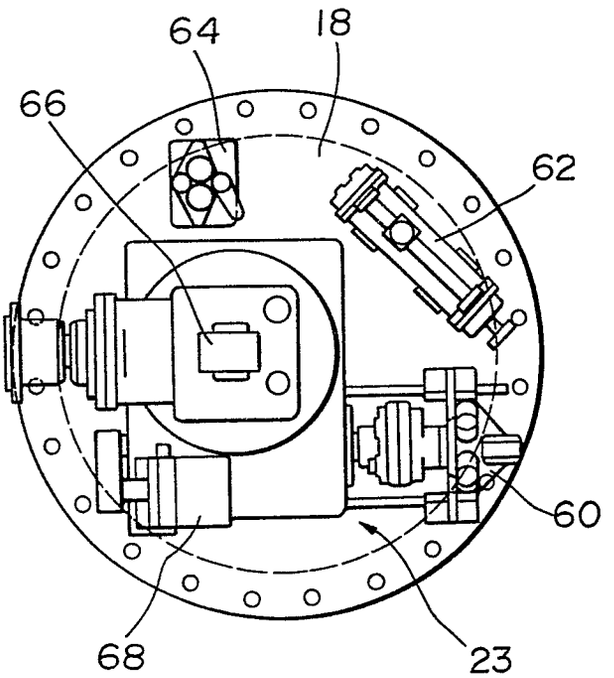
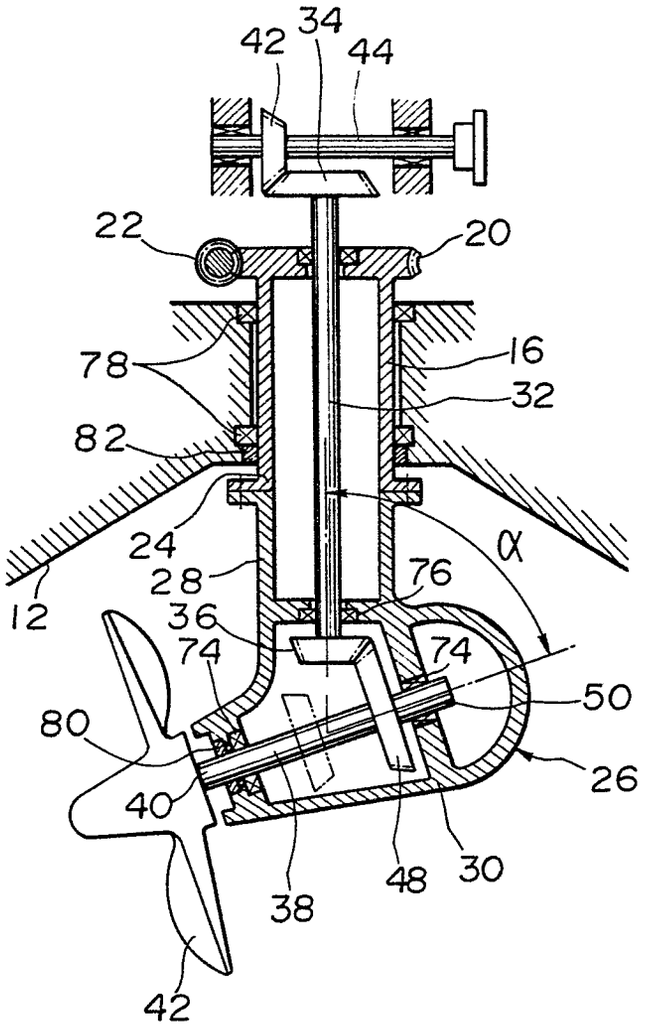


FIG.4



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EUROPEAN SEARCH REPORT

0159144
Application number

EP 85 30 1833

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	EP-A-0 035 600 (DE KONING) * The whole document *	1,4,5	B 63 H 25/42
A		2,3	

TECHNICAL FIELDS SEARCHED (Int. Cl.4)

B 63 H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
THE HAGUE	24-06-1985	DE SCHEPPER H.P.H.

CATEGORY OF CITED DOCUMENTS

X : particularly relevant if taken alone
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E : earlier patent document, but published on, or after the filing date
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