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⑰ **Azimuth thruster for use in ships.**

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Description

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 manoeuvrability.

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 conejet 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.

In EP-A-35600 there is described a downwardly-angled propeller mounted in a frustoconical recess in the bottom of the hull of a ship, the propeller being surrounded by a jet tube supported by three supports connecting the jet tube to the main spindle of the propeller. The supports are in the form of thin flat blades and two of them project substantially horizontally from the main spindle in the path of the water flow to the propeller. The essential function of the blades is to support the jet tube and being flat and at an angle to the incident water flow are likely to give rise to turbulence.

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 a quay. With these objects in view the thruster comprises generally a downwardly angled propeller mounted in a frustoconical recess in the bottom of the hull of the ship and, to assist in improving the efficiency of the propeller and reduce cavitation in the water flow, the thruster includes means to smoothly direct the initially upwardly inclined water flow into the frustoconical recess through an arcuate path into a downwardly inclined flow to the propeller.

The present invention therefore provides an azimuth thruster for a ship, comprising

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

turning means, mounted on 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 at 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, characterised in that:

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;

the propeller shaft supporting portion comprising a head portion formed at one end thereof and a tail portion at the other end thereof at which is located the propeller, the propeller shaft supporting portion converging in streamlined manner from the head portion to the tail portion which has a smaller radial diameter than the head portion;

the propeller shaft supporting portion also carrying between the head and tail portions a vertically-downward projecting fixing plate;

the tubular portion, the propeller shaft supporting portion between the head and tail portions and the fixing plate each carrying a laterally extending straightening plate, each straightening plate being of arcuate cross section with the concave surface facing downwards for smoothly directing the water flow in the form of an arc to the propeller.

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 from 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° from the position in FIG. 1. The outboard housing 26 may be rotated 360° 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 indicated 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.

Claims

1. An azimuth thruster for a ship, comprising:
 - an outboard housing (20) mounted within a substantially conical recess (14) to turn about a vertical axis, the conical recess formed in the bottom of a hull of the ship to converge upwards;
 - turning means, mounted on the hull, for turning the outboard housing about the vertical axis;
 - a propeller shaft (50) rotatably supported on the outboard housing to cross the vertical axis of the outboard housing at an acute angle;
 - a propeller (42) 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, characterised in that:

the outboard housing comprises a tubular portion (28) vertically supported on the conically recessed bottom of the hull to be rotatable about its axis and a streamlined, propeller shaft supporting portion (30) integrally formed with the tubular portion;

the propeller shaft supporting portion comprising a head portion formed at one end thereof and a tail portion at the other end thereof at which is located the propeller, the propeller shaft supporting portion converging in streamlined manner from the head portion to the tail portion which has a smaller radial diameter than the head portion;

the propeller shaft supporting portion (30) also carrying between the head and tail portions a vertically-downward projecting fixing plate (72);

the tubular portion (28), the propeller shaft supporting portion (30) between the head and tail portions and the fixing plate (72) each carrying a laterally extending straightening plate (70), each straightening plate being of arcuate cross section with the concave surface facing downwards for smoothly directing the water flow in the form of an arc to the propeller.

2. An azimuth thruster as claimed in claim 1, characterised in that the acute angle is within a range of about 45 to about 75°; 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°.

3. An azimuth thruster as claimed in claim 1 or claim 2, characterised in that 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.

4. An azimuth thruster as claimed in claim 3, characterised in that 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.

Patentansprüche

1. Azimuthalpropeller für ein Schiff mit einem Außenbordgehäuse (20) in einer im wesentlichen

konischen Aussparung (14) zur Drehbarkeit um eine vertikale Achse, wobei die konische Aussparung im Boden der Schiffsbordwand angeordnet ist und sich nach oben verjüngt;

5 einem Drehmittel auf der Schiffsaußenverkleidung zum Drehen des Außengehäuses um die vertikale Achse;

10 einer Propellerwelle (5), die auf dem Außenbordgehäuse gelagert ist, um die vertikale Achse des Außenbordgehäuses unter einem spitzen Winkel zu schneiden;

15 einem Propeller (42) am unteren Ende der Propellerwelle außerhalb des Außenbordgehäuses, innerhalb der konischen Aussparung und ohne nach oben in Richtung der Propellerwelle gerichteten Schub und

Antriebsmittel zum Drehen der Propellerwelle dadurch gekennzeichnet, daß

20 das Außenbordgehäuse einen rohrförmigen Abschnitt (28), der vertikal auf dem Boden der konischen Aussparung der Schiffsbordwand, um seine Achse drehbar gelagert ist, sowie einen stromlinienförmig ausgebildeten, mit dem rohrförmigen Abschnitt einstückig ausgebildeten

25 Lagerungsteil (30) für die Propellerwelle aufweist; der Lagerungsteil der Propellerwelle am einen Ende ein Kopfteil und am anderen Ende einen Schwanzabschnitt aufweist, an dem der Propeller angeordnet ist, wobei der Lagerungsteil der Propellerwelle sich vom Kopfteil mit größerem Durchmesser zum Schwanzabschnitt mit geringerem Durchmesser stromlinienförmig verjüngt;

30 der Lagerungsteil (30) der Propellerwelle zwischen Kopfteil und Schwanzabschnitt mit einer vertikal nach unten gerichteten Fixierplatte (72) versehen ist;

35 der rohrförmige Abschnitt (28), der Lagerungsteil (30) für die Propellerwelle (5) zwischen Kopfteil und Schwanzabschnitt und die Fixierplatte (72) jeweils eine sich quer erstreckende Versteifungsplatte (70) aufweisen, wobei jede Versteifungsplatte einen bogenförmigen Querschnitt hat, dessen konkave Seite nach unten weist, um das Wasser in einer geglätteten bogenförmigen Strömung dem Propeller zuzuführen.

40 2. Azimuthalpropeller wie in Anspruch 1 beansprucht, dadurch gekennzeichnet, daß der spitze Winkel etwa im Bereich von 45 bis 75° liegt, wobei der Winkel zwischen der Wand der konischen Aussparung und einer horizontal verlaufenden Linie etwa im Bereich von 15 bis 45° liegt.

45 3. Azimuthalpropeller wie in Anspruch 1 oder 2 beansprucht, dadurch gekennzeichnet, daß das Drehmittel ein zylindrisches Gehäuse aufweist, das vertikal und wasserdicht durch einen Spitzenabschnitt der Wand der konischen Aussparung hindurchgeführt und in ihm drehbar gelagert ist, wobei das zylindrische Gehäuse einen unteren Abschnitt hat, der konzentrisch und wasserdicht mit dem oberen Ende eines rohrförmigen Abschnittes des Außenbordgehäuses verbolzt ist, während ein Schneckenrad koaxial und einstückig mit dem oberen Ende des zylindrischen Gehäuses ausgebildet ist und mit einer Getriebeschnecke zusammenwirkt.

4. Azimuthalpropeller wie in Anspruch 3 beansprucht, dadurch gekennzeichnet, daß das Antriebsmittel eine vertikale Welle aufweist, die konzentrisch durch das zylindrische Gehäuse und den rohrförmigen Abschnitt des Außenbordgehäuses hindurchgeführt und dabei drehbar gelagert ist, während sie am oberen Endabschnitt mit einem ersten Bewegungserzeuger verbunden ist, daß weiter ein erstes Kegelzahnrad auf dem unteren Ende der vertikalen Welle angeordnet ist und daß schließlich ein zweites Kegelzahnrad auf der Propellerwelle gelagert ist, um zur Drehmomentübertragung auf die Propellerwelle mit dem ersten Kegelzahnrad zusammenzuwirken.

Revendications

1.- Un propulseur orientable pour un bateau, comprenant:

- un carter hors-bord (26) monté à l'intérieur d'une cavité sensiblement conique (14) pour tourner autour d'un axe vertical, la cavité conique étant formée dans le fond d'une coque du bateau de façon à converger vers le haut;

- des moyens d'orientation en rotation, montés sur la coque, pour orienter le carter hors-bord en rotation autour de l'axe vertical;

- un arbre d'hélice (50) supporté à rotation sur le carter hors-bord pour traverser l'axe vertical du carter hors-bord selon un angle aigu;

- une hélice (42) montée à une extrémité inférieure de l'arbre d'hélice pour se trouver à l'extérieur du carter hors-bord et à l'intérieur de la cavité conique et pour fournir une poussée vers le haut dans la direction de l'arbre d'hélice; et

- des moyens de propulsion pour entraîner en rotation l'arbre d'hélice,

caractérisé en ce que le carter hors-bord comporte une partie tubulaire (28) supporté verticalement sur le fond de la cavité conique de la coque de manière à être susceptible de tourner autour de son axe et une partie de support d'arbre d'hélice hydrodynamiquement profilée (30) et formée monobloc avec la partie tubulaire;

la partie de support de l'arbre d'hélice comportant une partie de tête formée à l'une de ses extrémités et une partie de queue à son autre extrémité où est située l'hélice, la partie de support de l'arbre d'hélice convergeant d'une façon hydrodynamique depuis la partie de tête vers la

partie de queue qui présente un diamètre radial inférieur à celui de la partie de tête;

la partie de support de l'arbre d'hélice (30) portant également entre les parties de tête et de queue une plaque de fixation (72) verticale et en saillie vers le bas;

la partie tubulaire (28), la partie de support de l'arbre d'hélice (30) entre les parties de tête et de queue et la plaque de fixation (72) portant chacune une plaque de redressement d'écoulement (70) s'étendant latéralement, chaque plaque de redressement présentant une section transversale arquée dont la surface concave est tournée vers le bas pour diriger progressivement l'écoulement d'eau en forme d'arc vers l'hélice.

2.- Un propulseur orientable selon la revendication 1, caractérisé en ce que l'angle aigu est compris entre environ 45° et environ 75° et dans lequel un angle formé entre la paroi de la cavité conique et une ligne horizontale est comprise entre environ 15° et environ 45°.

3.- Un propulseur orientable selon la revendication 1 ou 2, caractérisé en ce que les moyens d'orientation en rotation comportent: une enveloppe cylindrique traversant verticalement et de façon étanche à l'eau une partie de pointe de la paroi de la cavité conique en étant supporté à rotation par cette partie de pointe, l'enveloppe cylindrique présentant une extrémité inférieure boulonnée concentriquement et de façon étanche à l'eau sur l'extrémité supérieure de la partie tubulaire du carter hors-bord; une roue dentée de système à roue et vis sans fin formée coaxialement et de façon monobloc avec l'extrémité supérieure de l'enveloppe cylindrique et une vis engrenée sur la roue dentée à vis sans fin.

4.- Un propulseur orientable selon la revendication 3, caractérisé en ce que les moyens de propulsion comportent un arbre vertical traversant de façon concentrique l'enveloppe cylindrique en étant supporté à rotation par cette enveloppe et sur la partie tubulaire du carter hors-bord, l'arbre vertical étant relié à sa partie d'extrémité supérieure à un moteur principal, une première roue d'engrenage conique montée à l'extrémité inférieure de l'arbre vertical; et une seconde roue d'engrenage conique montée sur l'arbre d'hélice pour venir engrener avec la première roue d'engrenage conique afin de transmettre le couple de rotation à l'arbre d'hélice.

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FIG. 1

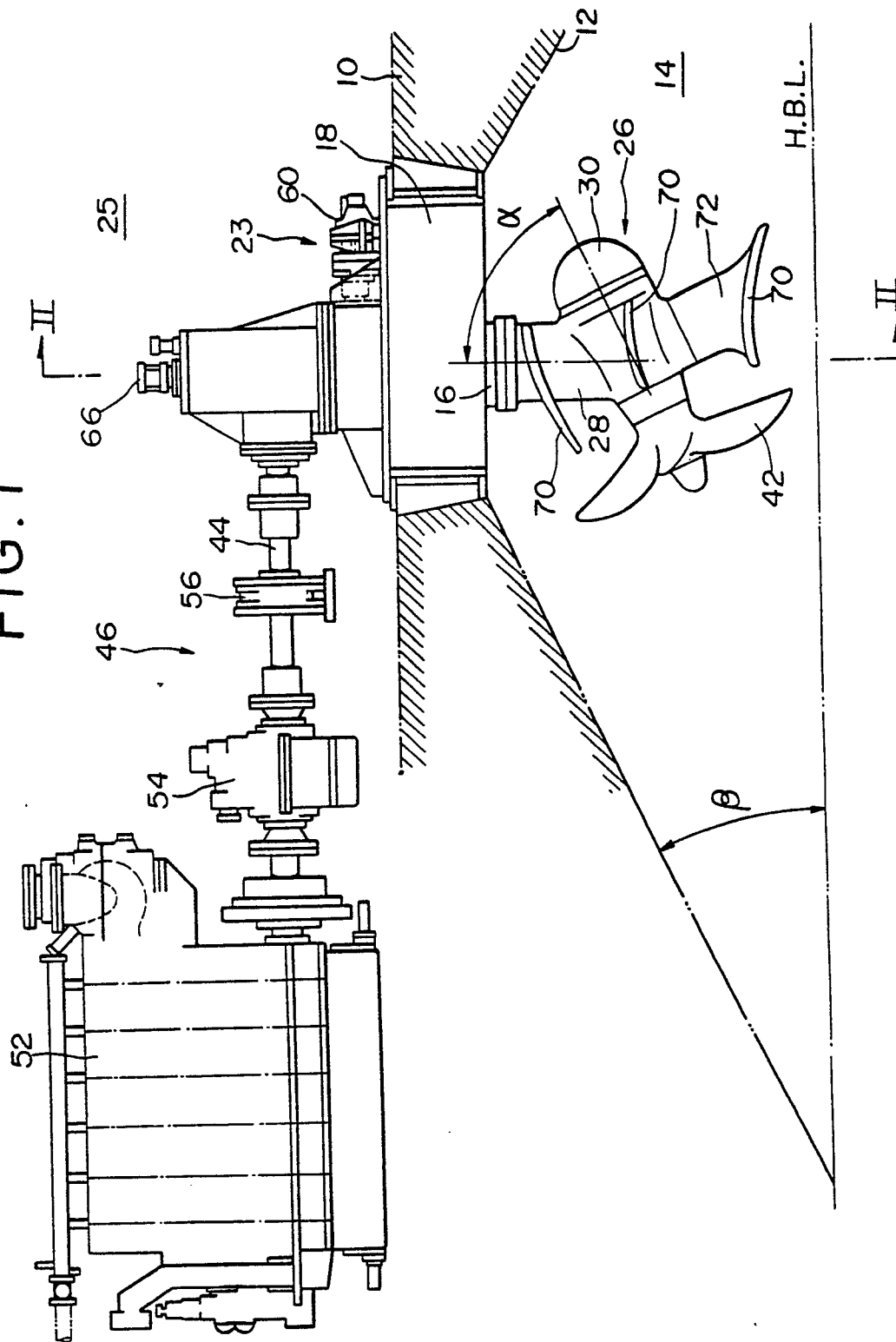


FIG. 2

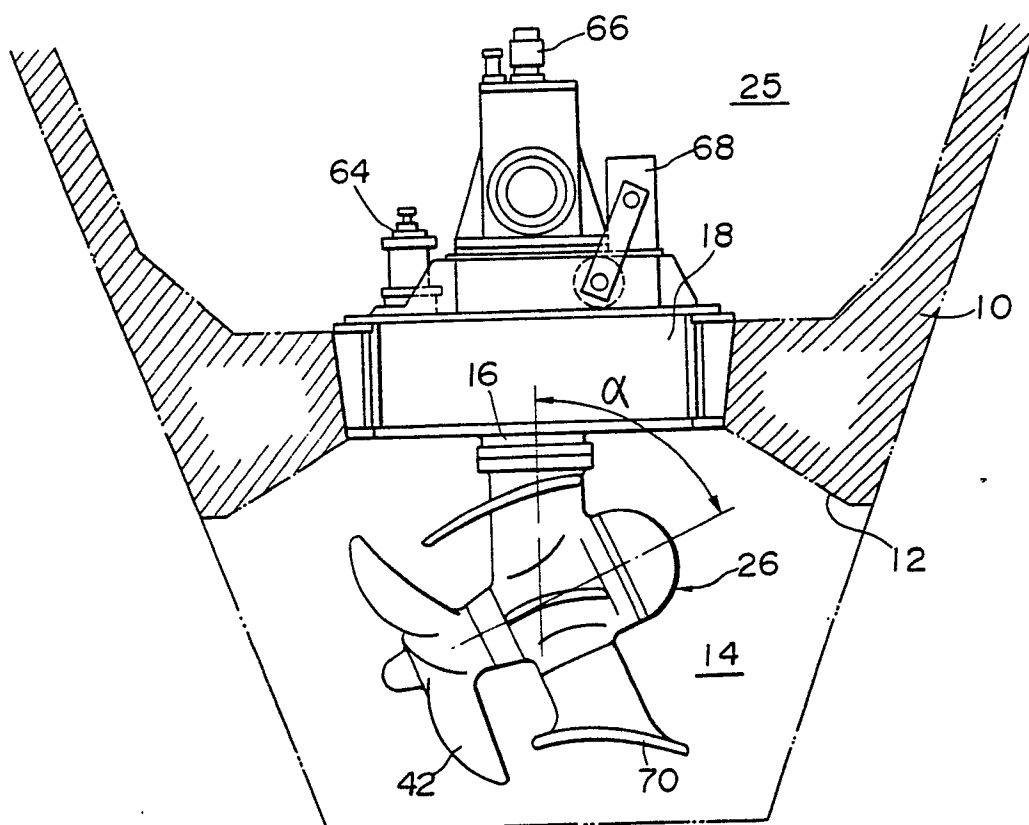


FIG. 3

