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

(11) **EP 2 995 549 A1**

(12) **EUROPEAN PATENT APPLICATION**

(43) Date of publication:
16.03.2016 Bulletin 2016/11

(21) Application number: **14184360.7**

(22) Date of filing: **11.09.2014**

(51) Int Cl.:
B63H 5/125 *(2006.01)* ***B63H 5/20*** *(2006.01)*
B63H 21/17 *(2006.01)* ***B63H 21/38*** *(2006.01)*
B63H 25/42 *(2006.01)*

(84) Designated Contracting States:
AL AT BE BG CH CY CZ DE DK EE ES FI FR GB GR HR HU IE IS IT LI LT LU LV MC MK MT NL NO PL PT RO RS SE SI SK SM TR
Designated Extension States:
BA ME

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(54) **A retractable thruster**

(57) The retractable thruster comprises a cylindrical first housing (21) extending in a first direction downwards from a bottom of a hull (10) of a vessel and a second housing (22) being attached to a lower end (21A) of the first housing (21). A first shaft (31) extends in the first direction within the first housing (21) and a second shaft (41) extends in a second direction within the second housing (22). The two shafts (31, 41) are connected with a transmission (34, 44). A propeller (50, 51) is attached to an outer end (41 B) of the second shaft (41). A lifting arrangement (80, 81, 82, 83) is arranged within the vessel for lifting and lowering the first housing (21). A first electric motor (60) positioned within the first housing (21) drives the propeller (50, 51) via the first shaft (31), the transmission (34, 44) and the second shaft (41). The first electric motor (60) is directly cooled to sea water surrounding the first housing (21).

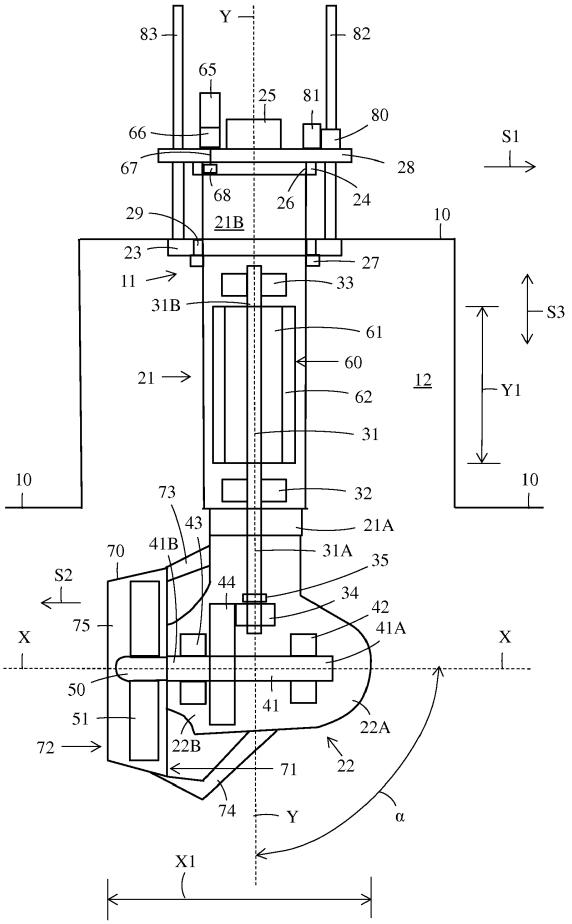

FIG. 1

EP 2 995 549 A1

Description

FIELD OF THE INVENTION

[0001] The present invention relates to a retractable thruster according to the preamble of claim 1.

BACKGROUND ART

[0002] A retractable thruster comprises a cylindrical first housing extending in a first direction downwards from a bottom of a hull of a vessel. A second housing is attached to a lower end of the first housing. The upper end of the first housing extends through a hole in the bottom of the hull of the vessel into the interior of the hull. The first housing is attached in the interior of the hull by means of a slewing bearing. A first shaft extends from the interior of the hull through the first housing into the second housing. A second shaft extends in a second direction within the second housing. The first shaft is connected with a transmission to the second shaft. A propeller is attached to an outer end of the second shaft protruding from the second housing. A first electric motor is positioned within the hull of the vessel. An upper end of the first shaft is connected to the first electric motor. The retractable thruster can be moved between a first position in which the thruster is positioned at least partly within the hull and a second position in which the thruster is positioned outside the hull. The retractable thruster can at least in the second position be turned by a slewing drive.

[0003] A nozzle surrounding the propeller may further be attached to the second housing. The nozzle forms a central duct with an axial flow path for water from a first end to a second end of the nozzle. The thrust produced by the propeller is amplified by the nozzle at low speeds.

[0004] US patent 7,641,526 discloses a vessel and underwater mountable azimuthing thruster. The vessel has a hull and a hull bottom, with a first well and a second well formed in the hull. The wells extend in the vertical direction within the hull of the vessel and face downwards toward a sea floor. The wells comprise a movable canister, which is integrally connected to an azimuthing thruster. The canisters and thereby also the thrusters can be lowered to a deployed position from a retracted position. The propeller in the azimuting thruster is driven by a vertically in the canister positioned first electric motor. The first electric motor is connected with a vertical shaft and a transmission to the propeller shaft extending in the thruster housing. The azimuting thruster has a propeller connected to the propeller shaft and a nozzle surrounding the propeller. The thruster is positioned completely within the hull of the ship in the retracted position and in the water below the bottom of the hull in the deployed position. The first electric motor will in all situations be positioned within the movable canister within the hull of the vessel. The azimuting thruster is connected to a turning wheel within the movable canister within the hull of the vessel. The slewing bearing and thus also the azimuting thruster is rotated with a slewing drive connected to the slewing bearing. The height of the retractable thruster in this arrangement becomes considerable. This means that also the height of the well within the vessel becomes considerable. The arrangement will thus require a lot of space within the vessel.

[0005] The first electric motor being positioned in prior art solutions within a movable canister or within the hull of the vessel is normally air cooled with a cooling system located next to the first electric motor. Such a cooling system may consist of a fan for circulating the air between the first electric motor and the air-to water cooler for transferring excessive heat to the cooling water system of the vessel.

BRIEF DESCRIPTION OF THE INVENTION

[0006] An object of the present invention is to achieve an improved retractable thruster.

[0007] The retractable thruster according to the invention is characterized by what is stated in the characterizing portion of claim 1.

[0008] The retractable thruster comprises:

a cylindrical first housing extending in a first direction downwards from a bottom of a hull of a vessel, an upper end of said first housing extending through an opening in the bottom of the hull into the interior of the hull, said first housing being rotatable attached within the hull of the vessel by means of a slewing bearing,

a second housing being attached to a lower end of the first housing,

a first shaft having a first end and a second opposite end, an axial centre line of the first shaft extending in the first direction within the first housing, said first shaft being rotatably supported with first radial and axial bearings,

a second shaft having a first end and a second opposite end, an axial centre line of the second shaft extending in a second direction within the second housing, said second shaft being rotatably supported with second radial and axial bearings, said second end of the second shaft protruding from the second end of the second housing,

a transmission connecting the first end of the first shaft to the second shaft,

a propeller being attached to the second end of the second shaft outside the second end of the second housing, said propeller rotating with the second shaft,

a lifting arrangement for moving the thruster through the hole in the bottom of the hull between a first position in which at least the first housing is positioned fully within the hull of the vessel and a second position in which the thruster is positioned outside the hull of the vessel.

[0009] The retractable thruster is characterised in that it further comprises:

a first electric motor being positioned within the first housing, said first electric motor comprising a rotor and a stator surrounding the rotor, said first electric motor being directly cooled to sea water surrounding the first housing through a shell of the first housing, said rotor extending along the axial centre line of the first shaft and being attached to the first shaft, whereby the first electric motor drives the propeller via the first shaft, the transmission and the second shaft.

[0010] The first electric motor can be of any technology that is available today. The rotation speed of the first electric motor could be higher compared to the rotation speed of an electric motor that drives the propeller directly. This is due to the transmission, which makes it possible to lower the rotation speed of the first electric motor to a rotation speed suitable for the propeller. The torque that can be produced by an electric machine is proportional to the volume of the active parts in the electric machine. By using e.g. a gear ratio of 4 in the transmission, one could reduce the volume of the first electric motor by one fourth. The outer diameter of the first electric motor could thus be halved compared to a first electric motor driving the propeller directly if the length of the electric machine would be kept the same. The power P of the electric machine is $P=M*\omega$. The power of the electric machine will thus increase when the rotation speed ω of the electric machine is increased in a situation where the torque M of the electric machine is kept the same.

[0011] The first electric motor can be cooled directly to the sea water surrounding the first housing. The stator of the first electric motor can be arranged so that heat produced in the stator is transferred directly to the shell of the first housing and further from the shell to the sea water surrounding the first housing. This means that the separate cooling system, which is needed in case the first electric motor is situated within the vessel or within a movable canister can be eliminated in the invention.

[0012] The position of the first electric motor in the first housing instead of within the vessel or within a movable canister saves space within the vessel and makes it possible to have a more simple solution. In a case where the first electric motor is within the vessel the first electric motor and the cooling system of the first electric motor must be raised within the vessel which requires a lot of space within the vessel. The other possibility is to use a so called Z-drive transmission in which the first electric motor is in a horizontal position inside the vessel and arrange a releasable clutch between the first electric motor and the Z-drive transmission. The idea with the releasable clutch is to avoid the movement of the first electric motor and the cooling system of the first electric motor when the thruster is moved between the first position and the second position. The electric motor can in the second alternative be positioned in a horizontal position outside the perimeter of area which is needed for the underwater equipment to be raised into the hull of the vessel and lowered out from the hull of the vessel. A rather big releasable clutch is, however, needed and also some auxiliary equipment for coupling and decoupling the clutch. The releasable clutch is opened and closed every time the thruster is raised from the sea. All of these problems are avoided with the invention.

[0013] The retractable thruster according to the invention where the first electric motor is positioned within the first housing and the driving means driving the propeller are situated within the second housing leads to a compact integrated package. This integrated package is easy to install at a shipyard and there is no need to align the first electric motor and the thruster as is the case in prior art solutions.

[0014] There is also no need for a separate housing for the first electric motor and for the bearings of the first electric motor due to the integrated construction in the invention. The total weight of the housing structures will thus be lower compared to prior art solutions having a separate first electric motor. The number of rotating shafts and bearings is also lower compared to prior art solutions having a separate first electric motor. There are only two rotating shafts in the propeller drive train in the thruster according to the invention. There are at least three rotating shafts and the number of bearings is thus also higher in prior art solutions in the propeller drive train. A reduction in the number of bearings leads to a higher reliability and lower maintenance costs compared to prior art solutions.

[0015] The position of the first electric motor within the first housing means that the torque of the first electric motor does not affect the steering torque of the thruster. The stator of the first electric motor is within the first housing and the first housing is rigidly connected to the second housing where the transmission between the first shaft and the second shaft is positioned. The torque of the stator and the torque of the first pinion are acting in the opposite direction within the housing arrangement. The load acting on the steering arrangement including the slewing gear ring, the pinion, the gear box and the second electric motor is lower compared to a solution with a separate first electric motor. This leads to a lower weight and lower costs for these components.

[0016] The retractable thruster according to the invention is especially suitable to be used in vessels, which are often used in dynamic positioning (DP). The retractable thruster according to the invention is especially suitable for use with a first electric motor having a power in the range of 500 to 3000 kW.

[0017] The retractable thruster according to the invention my further comprise an annular nozzle fixedly supported at the second housing. The axial centre line of the second shaft would also then form an axial centre line of the annular nozzle. The annular nozzle surrounds an outer perimeter of the propeller and forms a duct for water flowing through the interior of the annular nozzle.

BRIEF DESCRIPTION OF THE DRAWINGS

[0018] In the following the invention will be described in greater detail by means of preferred embodiments with reference to the attached drawings, in which:

Figure 1 shows a retractable thruster according to the invention.

DETAILED DESCRIPTION OF THE INVENTION

[0019] Figure 1 shows a retractable thuster according to the invention. The propeller is pushing the vessel forwards in a first direction S1. The retractable thruster comprises a first housing 21 extending downwards from a bottom of a hull 10 of a vessel. An upper end 21 B of the first housing 21 extends through an opening 11 in the bottom of the hull 10 of the vessel into the interior of the hull of the vessel. A second housing 22 is rigidly attached to a lower end 21A of the first housing 21. The second housing 22 has a first end 22A and a second end 22B. The first housing 21 is essentially cylindrical. The first housing 21 is rotatably supported at the hull 10 of the vessel by means of a slewing bearing 26. The slewing bearing 26 is attached to an upper frame 28 within the hull 10 of the vessel. The opening 11 in the bottom of the hull 10 of the vessel is sealed against sea water by means of a slewing sealing 27.

[0020] A first shaft 31 having a first end 31A and a second opposite end 31 B is situated within the first housing 21. An axial centre line Y of the first shaft 31 extends in a first direction within the first housing 21. The first shaft 31 is rotatably supported with a first bearing arrangement including radial bearings 32, 33 within the first housing 21. One of the radial bearings 32, 33 of the first shaft 31 is advantageously a combined radial and axial bearing. A combined radial and axial bearing is needed in order to carry the load caused by the first shaft 31 and the gear. In addition, a radial bearing 35 may be used at the lower end of the first shaft 31 in order to carry the radial load of the pinion 34 at the lower end of the first shaft 31.

[0021] A second shaft 41 having a first end 41 A and a second opposite end 41 B is situated within the second housing 22. An axial centre line X of the second shaft 41 extends in a second direction within the second housing 22. The second shaft 41 is rotatably supported with a second bearing arrangement including radial bearings 42, 43 within the second housing 22. One of the radial bearings 42, 43 of the second shaft 41 is advantageously a combined radial and axial bearing. A combined radial and axial bearing is needed in order to transfer the axial thrust produced by the propeller 50, 51 from the second shaft 41 to the second housing 22 and further to the hull 10 of the vessel. The second end 41 B of the second shaft 41 protrudes from the second end 22B of the second housing 22. The second direction X is essentially perpendicular to the first direction Y.

[0022] A transmission 34, 44 is situated between the first end 31A of the first shaft 31 and the second shaft 41. The transmission 34, 44 is formed of a first pinion 34 attached to the first shaft 31 and a second pinion 44 attached to the second shaft 41. The cogs on the periphery of the pinions 34, 44 are in contact with each other so that the rotation of the first shaft 31 also rotates the second shaft 41. The first shaft 31 will rotate with a first rotation speed and the second shaft 41 will rotate with a second rotation speed determined by the transmission 34, 44 i.e. the pitch diameters of the pinions 34, 44. The second rotation speed will be lower than the first rotation speed.

[0023] A propeller 50, 51 comprising a propeller hub 50 provided with propeller blades 51 is attached to the second end 41 B of the second shaft 41. The propeller may also by a monoblock type propeller in which the propeller hub 50 and the propeller blades 51 are integrated into a monoblock construction. The propeller hub 50 is attached to the second end 41 B of the second shaft 41 outside the second end 22B of the second housing 22. The propeller 50, 51 rotates with the second shaft 41.

[0024] An annular nozzle 70 is fixedly supported at the second housing 22. The axial centre line X of the second shaft 41 forms also an axial centre line of the annular nozzle 70. The annular nozzle 70 surrounds an outer perimeter of the propeller 51 and forms a duct 75 with an axial flow path for water flowing through the interior of the annular nozzle 70. The annular nozzle 70 is attached to the second housing 22 with an upper support part 73 and with at least one second lower support part 74. The lower support part 74 extends downwards from the second housing 22. The rotating propeller 50, 51 causes water to flow through the central duct 75 from the first end 71 of the central duct 75 to the second end 72 of the central duct 75 in a second direction S2, which is opposed to the first direction S1. The thrust produced by the propeller 50, 51 is amplified by the annular nozzle 70 at low speeds. A nozzle 70 around the propeller 50, 51 is advantageously used in thrusters when a high thrust is needed at low speed, for example in so called Dynamic Positioning (DP) vessels used in oil drilling. There may be several thrusters in such vessels and the vessel is kept steady in position by the thrusters. A high thrust is needed at low speed in order to keep the vessel continuously in position especially in rough seas. The thruster or the thrusters can be retractable from a second outer position to a first inner position within the hull 10 of the vessel. The thruster or thrusters are retracted to the inside of the hull of the vessel when the vessel is operated at higher speeds. The main propellers are then used to propel the vessel. The situation where the thruster or thrusters are retracted within the vessel when the main propellers propel the vessel will reduce the resistance of the vessel and save fuel.

[0025] A first electric motor 60 is positioned within the first housing 21. The first electric motor 60 comprises a rotor 61 and a stator 62 surrounding the rotor 61. The

rotor 61 of the first electric motor 60 extends along the axial centre line Y of the first shaft 31. The rotor 61 of the first electric motor 60 is attached to the first shaft 31 so that the first shaft 31 rotates with the rotor 61 of the first electric motor 60. The rotation of the rotor 61 of the first electric motor 60 is thus transferred via the first shaft 31, the transmission 34, 44 and the second shaft 41 to the propeller 50 51. The first electric motor 60 drives the propeller 50,51.

[0026] The upper end 21 B of the first housing 21 extends through a flange 23 positioned in the opening 11 at the bottom of the hull 10 into the interior of the hull 10. The upper end 21 B of the first housing 21 is attached to a slewing gear ring 24 within the hull 10 of the vessel. A second electric motor 65 is connected via a gear box 66 and a third shaft 67 to a third pinion 68 being in contact with the slewing gear ring 24. The cogs on the periphery of the third pinion 68 are in contact with the cogs on the periphery of the slewing gear ring 24. The second electric motor 65 will thus turn the slewing gear ring 24 and thereby also the first housing 21 as well as the second housing 22 fixedly attached to the first housing 21. The first housing 21 is thus rotatable supported on the hull 10 of the vessel by the slewing bearing 26 and can be rotated 360 degrees around a vertical centre axis Y in relation to the hull 10 of the vessel. The figure shows only one second electric motor 65 connected to the slewing gear ring 24, but there could naturally be two or more second electric motors 65 driving the slewing gear ring 24. A lower radial support bearing 29 may be attached to the flange 23 in order to carry a part of the radial load and the tilting moment and thus reduce the loading of the slewing bearing 26.

[0027] There is further a lifting arrangement 80, 81, 82, 83 for moving the thruster through the hole 11 in the bottom of the hull 10 of the vessel between a first position in which at least the first housing 21 is positioned fully within the hull 10 of the vessel and a second position in which the thruster is positioned outside the hull 10 of the vessel. The lifting arrangement 80, 81, 82, 83 may consist of a third electric motor, a gear box, a pinion and a toothed rack, but also other as such known lifting mechanisms can be used. The lifting arrangement 80, 81, 82, 83 in the figure comprises a drive motor 81 e.g. a third electric motor, a gear box 80 and guiding means 82, 83. The drive motor 81 is attached to the upper frame 28. The guiding means 82, 83 are supported on the hull 10 of the vessel. The guiding means 82, 83 support and guide the upper frame 28 and all the equipment attached thereto during the lifting and the lowering process. In addition, the guiding means 82, 83 prevent the rotation of the upper frame 28 during the rotation of the lower parts of the thruster i.e. the first housing 21 and the second housing 22 about the vertical centre axis Y. The first housing 21, the second housing 22, the slewing gear ring 24 and the upper frame 28 with associated equipment can be lifted in a third direction S3 coinciding with the first centre axis Y upwards and downwards with the lifting arrangement 80, 81, 82, 83. The figure shows the apparatus in the second position where the second housing 22 and the nozzle 70 are positioned fully outside the cavity 12 formed in the bottom of the hull 10. The second housing 22 and he nozzle 70 will be positioned fully within the cavity 12 formed in the bottom of the hull 10 or fully within the hull 10 of the vessel in the first position.

[0028] The electric power needed in the first electric motor 60 is produced within the hull 10 of the ship. The electric power can be produced by a generator connected to a combustion engine. The electric power to the stator 62 of the first electric motor 60 is supplied by cables and/or bus bars running from the generator within the interior of the hull 10 of the vessel to the first electric motor 60. A slip ring arrangement 25 is needed within the hull 10 in order to transfer electric power from the stationary hull 10 to the rotatable first housing 21 and the first electric motor 60 inside the first housing 21.

[0029] The first electric motor 60 can be designed so that sufficient cooling of the stator 62 directly to the surrounding sea water can be achieved. The sea water flowing on the outer surface of the first housing 21 will cool the shell of the first housing 21. The stator 62 of the first electric motor 60 can be arranged in contact with the shell of the first housing 21. The cooling of the stator 62 can thus be arranged as a passive cooling directly to the sea water.

[0030] The axial length X1 of the second housing 22 and the annular nozzle 70 is much smaller than the corresponding length of an arrangement where the first electric motor 60 is situated within the second housing 22. The axial length Y1 of the first electric motor 60 can be adapted according to the axial length of the first housing 21.

[0031] The swivel axis of the first housing 21 coincides with the swivel axis Y of the first shaft 31 in the embodiment shown in the figures. It is advantageous that the swivel axis of the first housing 21 as well as the swivel axis Y of the first shaft 31 extends vertically downwards from the hull 10.

[0032] The centre axis X of the second shaft 41 is directed in the horizontal direction in the embodiment shown in the figures. The centre axis X of the second shaft 41 could, however, be inclined in relation to the horizontal direction. The second housing 22 would thus be inclined in relation to the horizontal direction. This might in some circumstances result in hydrodynamic advantages.

[0033] The angle α between the swivel axis of the first shaft 31 i.e. the first axial centre line Y and the swivel axis of the second shaft 41 i.e. the second axial centre line X is advantageously 90 degrees. The angle α between the first swivel axis and the second swivel axis could on the other hand be less than 90 degrees or more than 90 degrees. The transmission 34, 44 has to be adapted to the angle α between the first and the second axial centre lines Y, X.

[0034] Most advantageously, when the thruster is

moved to the first position, the whole thruster i.e. the first housing 21 and the second housing 22 as well as the nozzle 70 is moved inside the hull 10 the vessel. The arrangement can, however, also be such that the second housing 22 and the nozzle 70 remain partly outside the hull of the vessel when the retractable thruster is moved to the first position. Only the first housing 21 and the first electric motor 60 within the first housing 21 would thus be moved into the hull of the vessel. The first electric motor 60 could in both cases be serviced from within the hull of the vessel.

[0035] The first electric motor 60 is in the figure positioned in the first housing 21 so that the whole axial length Y1 of the first electric motor 21 is positioned below the hull 10 of the vessel when the thruster is in the second position. This is an advantageous situation. There might, however, in some cases be a need to use a very long first electric motor 60 in which case a small part of the first electric motor 60 might in the second position be positioned within the hull 10 of the vessel. At least 90% of the axial length Y1 of the first electric motor 60 would in any case in the second position be positioned outside the hull 10 of the vessel.

[0036] The invention and its embodiments are not limited to the examples described above but may vary within the scope of the claims.

Claims

1. A retractable thruster comprising:

a cylindrical first housing (21) extending in a first direction downwards from a bottom of a hull (10) of a vessel, an upper end (21 B) of said first housing (21) extending through an opening (11) in the bottom of the hull (10) into the interior of the hull (10), said first housing (21) being rotatable attached within the hull (10) by means of a slewing bearing (26),
a second housing (22) being attached to a lower end (21 A) of the first housing (21),
a first shaft (31) having a first end (31A) and a second opposite end (31 B), an axial centre line (Y) of the first shaft (31) extending in the first direction within the first housing (21), said first shaft (31) being rotatably supported with first radial and axial bearings (32, 33),
a second shaft (41) having a first end (41 A) and a second opposite end (41 B), an axial centre line (X) of the second shaft (41) extending in a second direction within the second housing (22), said second shaft (41) being rotatably supported with second radial and axial bearings (42, 43), said second end (41 B) of the second shaft (41) protruding from the second end (22B) of the second housing (22),
a transmission (34, 44) connecting the first end (31 A) of the first shaft (31) to the second shaft (41),
a propeller (50, 51) being attached to the second end (41 B) of the second shaft (41) outside the second end (22B) of the second housing (22), said propeller (50, 51) rotating with the second shaft (41),
a lifting arrangement (80, 81, 82, 83) for moving the thruster through the hole (11) in the bottom of the hull (10) of the vessel between a first position in which at least the first housing (21) is positioned fully within the hull (10) of the vessel and a second position in which the thruster is positioned outside the hull (10) of the vessel,
characterized in that the retractable thruster further comprises:

a first electric motor (60) being positioned within the first housing (21), said first electric motor (60) comprising a rotor (61) and a stator (62) surrounding the rotor (61), said first electric motor (60) being directly cooled to sea water surrounding the first housing (21) through a shell of the first housing (21), said rotor (61) extending along the axial centre line (Y) of the first shaft (31) and being attached to the first shaft (31), whereby the first electric motor (60) drives the propeller (50, 51) via the first shaft (31), the transmission (34, 44) and the second shaft (41).

2. A retractable thruster according to claim 1, **characterized in that** an annular nozzle (70) is fixedly supported at the second housing (22), said axial centre line (X) of the second shaft (41) also forming an axial centre line of the annular nozzle (70), said annular nozzle (70) surrounding an outer perimeter of the propeller (50, 51) and forming a duct (75) for water flowing through the interior of the annular nozzle (70).

3. A retractable thruster according to claim 1 or 2, **characterized in that** said slewing bearing (26) is rotated by at least one second electric motor (65), a gear box (66), a pinion (68) and a slewing gear ring (24).

4. A retractable thruster according to any one of claims 1 to 3, **characterized in that** the second direction (X) is essentially perpendicular to the first direction (Y).

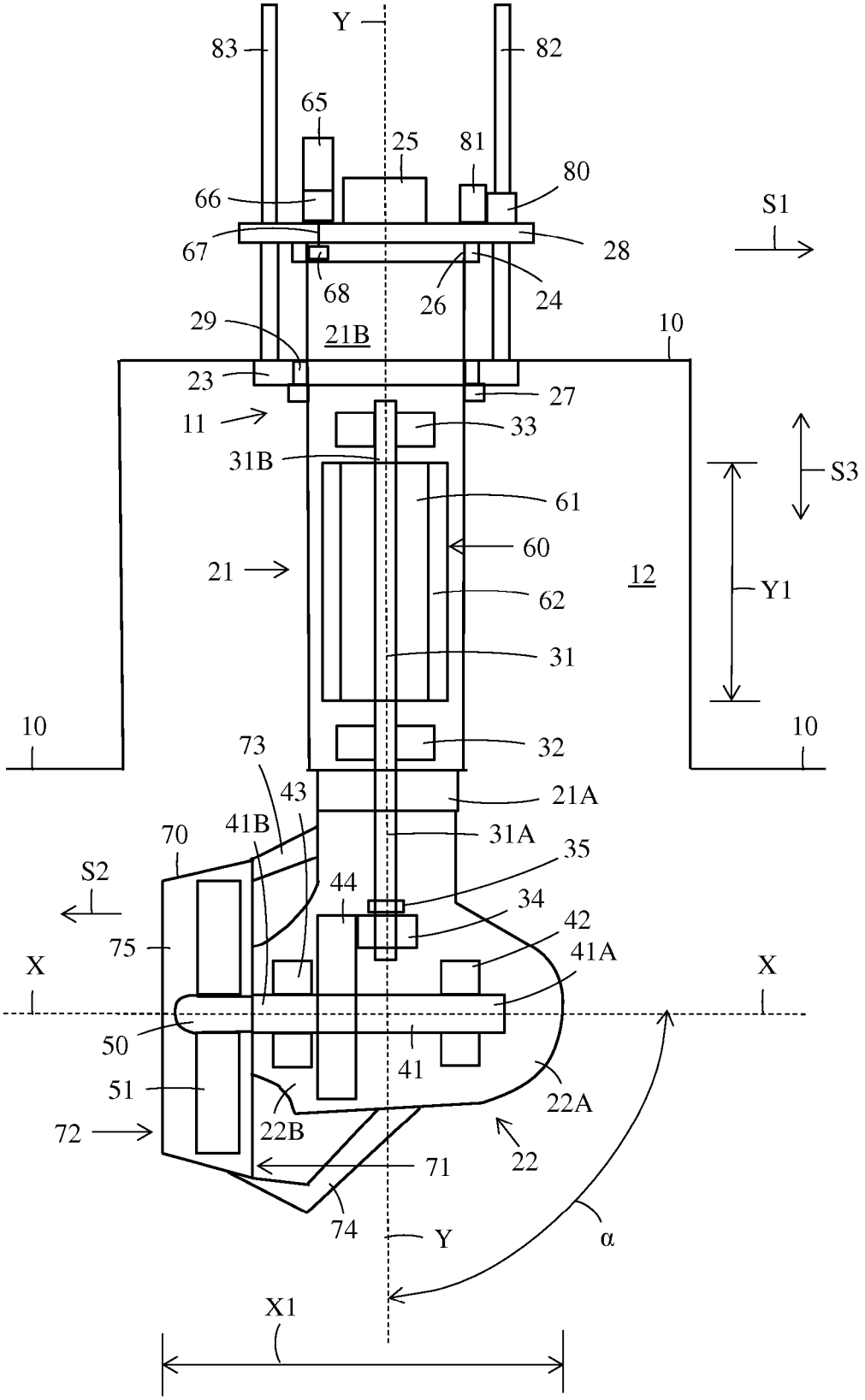
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FIG. 1

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EUROPEAN SEARCH REPORT

Application Number
EP 14 18 4360

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (IPC)
Y	US 7 641 526 B1 (BEKKER JOANNES RAYMOND MARI [US]) 5 January 2010 (2010-01-05) * column 2, line 47 - column 4, line 64; figures 1-3 *	1-4	INV. B63H5/125 B63H5/20 B63H21/17 B63H21/38 B63H25/42
Y	US 2003/166362 A1 (VARIS JUKKA [FI]) 4 September 2003 (2003-09-04) * paragraphs [0012] - [0022] *	1-4	
A	WO 2010/114380 A1 (MAROTEC AS [NO]; HASLUM KRISTIAN [NO]) 7 October 2010 (2010-10-07) * page 2, line 29 - page 3, line 9; figure 4 *	1-4	
Y	US 2013/298816 A1 (VAN DER KAM AAD [NL]) 14 November 2013 (2013-11-14) * paragraphs [0027] - [0034]; figure 1 *	1-4	
Y	US 2011/318978 A1 (KRACKHARDT ERNST-CHRISTOPH [DE] ET AL) 29 December 2011 (2011-12-29) * paragraphs [0059] - [0061]; figures 9, 10 *	1-4	TECHNICAL FIELDS SEARCHED (IPC) B63H

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
Munich	19 February 2015	Brumer, Alexandre

CATEGORY OF CITED DOCUMENTS

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EPO FORM 1503 03.82 (P04C01)

ANNEX TO THE EUROPEAN SEARCH REPORT ON EUROPEAN PATENT APPLICATION NO. EP 14 18 4360

This annex lists the patent family members relating to the patent documents cited in the above-mentioned European search report. The members are as contained in the European Patent Office EDP file on
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19-02-2015

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