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(73) Proprietor: **Damen 40 B.V.**
4200 AA Gorinchem (NL)

(72) Inventor: **Van Schaik, Jan Hendrik**
4031 KS Ingen (NL)

(74) Representative: **De Vries & Metman**
Overschiestraat 180
1062 XK Amsterdam (NL)

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Description

[0001] The present invention relates to a tug boat comprising a hull including a bow and a stern and having a length-to-beam ratio which is smaller than 5:1, wherein the hull has a vertical centre plane extending in a direction from the bow to the stern.

[0002] Such a vessel is known, for example in the form of a tug boat of which the length-to-beam ratio is about 3:1. A typical known tug boat has two azimuth thrusters for propelling and manoeuvring the tug boat, which azimuth thrusters are located at either side of the centre plane. The azimuth thrusters are drivably coupled to respective diesel engines and can be operated by a helmsman, for example by means of respective joysticks.

[0003] WO 2016/023080 is related to a marine craft for surface level operation which comprises a body, at least one propulsion drive coupled to the body and a controller carried by the body and configured to control operation of the at least one propulsion drive. The marine craft further comprises a wireless transceiver communicably coupled to the controller to facilitate wireless communication between the controller and a remote computing device and at least one coupler to removably couple the craft to a vessel, wherein the marine craft is configured for unmanned surface level operation to couple to the vessel and decouple from the vessel under control of the controller.

[0004] US 4,580,517 is related to a semisubmersible vessel which comprises an operating platform carried by columns from two parallel hulls, each hull forming a closed unit defined by a deck and side and bottom plating, each hull further carrying propulsion means including a number of 360° rotatable thruster propellers mounted in housings projecting from the hulls,

[0005] US 3,750,607 is related to a shallow-draft boat that is operated by omni-directional thruster means lying below the flat hull, which is stabilized and protected by one or more skegs. The boat has a high beam-to-length ratio, a low depth-to-length ratio, and a low depth-to-beam ratio. Its hull is double-ended and symmetric along both the longitudinal axis and the transverse axis, and the hull has a fully developable surface enabling construction from flat plates without compound curving.

[0006] CN 103 482 037 is related to a small-sized tugboat which belongs to the technical field of tugboats and comprises a tugboat body, a mooring rope, a stern roller, a shark jaw, a large tow, a superstructure, an anchor windlass, anchors, bow propellers, a left propeller, a middle propeller, a right propeller and cushion tires. The tugboat body is formed by welding steel plates, the stern of the tugboat body is provided with the cylindrical stern roller, the superstructure is arranged on the upper surface of the main deck of the tugboat body, the anchor windlass is arranged in front of the superstructure, the anchors are arranged on the anchor windlass in a suspension mode through anchor chains, the large tow is arranged behind the superstructure, the shark jaw is ar-

ranged between the large tow and the stern roller, the midpoints of the large tow, the stern roller and the shark jaw form a straight line, the bottom of a bow is provided with the bow propeller, the bottom of the stern is provided with the left propeller, the middle propeller and the right propeller from left to right, and the periphery of the tugboat is provided with the cushion tires.

[0007] US 3,934,531 is related to an elongated flat bottom, vertical side cargo unit vessel with a specially configured high-speed bow featuring a forwardly cantilevered horizontal bottom panel of full hull width, predetermined projecting length and vertical thickness controlling bow wave of the hull, with a multi-skeged upsloped stern bottom. A plurality of detachably connected power module vessels and a single control module vessel arranged abreast are detachably connected to each other and to the stern. Submerged to adjustable depths, torpedo-shaped drive units of the power module vessels support upright housings thereon projecting above water level and pass through flotation collars which provide flotation and stability for the power module vessels as independent craft when detached from the cargo unit vessel.

[0008] An object of the invention is to provide a highly manoeuvrable vessel.

[0009] This object is achieved with the tug boat according to claim 1. Hence, a row of at least four azimuth thrusters extends in transverse direction of the hull. In practice, the same number of azimuth thrusters will be located at both sides of the centre plane.

[0010] Due to the relatively small length-to-beam ratio the relatively wide beam provides the possibility to apply a plurality of azimuth thrusters at each side of the centre plane. For achieving a similar power level, an increasing number of azimuth thrusters may have decreasing propeller diameters of the individual azimuth thrusters. Consequently, the total height of the series of azimuth thrusters can be kept relatively small.

[0011] The application of relatively small azimuth thrusters also provides the opportunity to apply relatively small cooperating prime movers. An advantage of relatively small azimuth thrusters and prime movers is that their response time is relatively short, which leads to improved manoeuvrability of the vessel.

[0012] In a practical embodiment the azimuth thrusters are aligned in transverse direction of the centre plane.

[0013] Distances between centrelines of the propellers of each two neighbouring azimuth thrusters may be the same in order to achieve a symmetric arrangement. The distance between centrelines of the propellers of the neighbouring azimuth thrusters which are located at either side of the central plane, i.e. the two azimuth thrusters which are located closest to the central plane, may be different from the distance between the centrelines of the propellers of each two neighbouring azimuth thrusters at each side of the centre plane.

[0014] In a particular embodiment the propellers of the at least two azimuth thrusters have different diameters.

The propeller of one of the at least two azimuth thrusters which is located at a larger distance from the centre plane than the other one of the at least two azimuth thrusters may have a larger diameter than the propeller of the other one of the at least two azimuth thrusters.

[0015] The azimuth thrusters may be located at the bow or at the stern.

[0016] At least one of the prime movers is an internal combustion engine. The internal combustion engine is a diesel engine having a maximum speed above 1000 rpm. Such a diesel engine may be known as a high-speed diesel engine. If the desired power per individual azimuth thruster is relatively large such that a low-speed diesel engine must be applied, it is according to the present invention preferred to apply a higher number of relatively small azimuth thrusters including high-speed diesel engines instead of applying a smaller number of relatively large azimuth thrusters including low-speed diesel engines.

[0017] The at least two azimuth thrusters and their prime movers may be functionally coupled to a common controller for operating the at least two azimuth thrusters simultaneously. The common controller may be a joystick such that an operator can operate two joysticks, one for simultaneously controlling the at least two azimuth thrusters including their prime movers at one side of the centre plane and one for simultaneously controlling the at least two azimuth thrusters including their prime movers at the other side of the centre plane.

[0018] In a particular embodiment at each side of the centre plane a skeg is mounted to a lower side of the hull, which skeg extends in longitudinal direction of the hull, for example from the bow to about halfway the hull. In this embodiment the tug boat has at least two skegs which may have a relatively small height, which reduces draught of the tug boat, improves seakeeping behaviour and facilitates easy docking. Furthermore, at least two skegs improve course stability and manoeuvrability and allows relatively large steering forces during escorting a large vessel.

[0019] The skeg may be located at a horizontal position between axes of rotation of the respective propellers of the at least two azimuth thrusters as seen in a direction from the stern to the bow.

[0020] Furthermore, the maximum height of the skeg may be smaller than the diameter or 1.5 times the diameter of each of the propellers of the respective azimuth thrusters, or even smaller than 80% thereof.

[0021] The invention will hereafter be elucidated with reference to very schematic drawings showing embodiments of the invention by way of example.

Fig. 1 is a side view of an embodiment of a vessel according to the invention.

Fig. 2 is a plan view of a part of the vessel as shown in Fig. 1 on a larger scale.

Fig. 3 is a rear view of the vessel as shown in Fig. 1 on a larger scale.

Fig. 4 is a similar view as Fig. 3, but showing an alternative embodiment.

[0022] Figs. 1-3 show an embodiment of a vessel according to the invention. The vessel is a tug boat 1, which has a hull 2 including a bow 3 and a stern 4. Such a tug boat 1 is typically used as an escort tug, anchor handling tug, salvage tug, oil recovery vessel, safety stand-by vessel or as ship handling tug near offshore terminals and FPSOs (Floating Production Storage and Offloading vessels). The tug boat 1 may be used for assisting large ships which are much larger than the tug boat 1. The tug boat 1 may be connected to the large ship by a towing cable for towing the large ship in a specific direction or the tug boat 1 is manoeuvred against the large ship in order to be able to push it in a certain direction.

[0023] The hull 2 of the tug boat 1 as shown in Figs. 1-3 has a length of about 50 m and a beam of about 16 m, hence a length-to-beam ratio of about 3. The hull 2 has a vertical centre plane CP which extends in a direction from the bow 3 to the stern 4, see Figs. 2 and 3. A central skeg 5 is mounted to a lower side of the hull 2. The central skeg 5 extends in longitudinal direction of the hull 2 from the bow 3 to about halfway the hull 2 at the centre plane CP.

[0024] The tug boat 1 is provided with a series of four azimuth thrusters 6, which are arranged in an aligned row that extends in transverse direction of the centre plane CP. The azimuth thrusters 6 have respective propellers 6a which are located below the hull 2, in this case at the stern 4. In an alternative embodiment the azimuth thrusters 6 may be located at the bow 3 or elsewhere in between.

[0025] The application of an azimuth thruster for propelling a vessel is well-known, for example in ASD (azimuth-stern-drive) tug boats. The entire propulsion unit can turn in the horizontal plane and thrust can be produced in any desired direction.

[0026] In the embodiment as shown in Figs. 1-3 at each side of the centre plane two azimuth thrusters 6 are located next to each other in transverse direction of the centre plane CP and the azimuth thrusters 6 are drivably coupled to respective prime movers in the form of high-speed diesel engines 7 via respective propeller shafts 8. The high-speed diesel engines 7 are located within the hull 2 below a deck 9. The high-speed diesel engines 7 provide a fast response when increased thrust is desired.

[0027] Fig. 3 shows that the propellers 6a of the outer two azimuth thrusters 6 have larger diameters than the propellers 6a of the inner two azimuth thrusters 6.

[0028] The pair of azimuth thrusters 6 and their prime movers 7 at one side of the centre plane CP can be operated simultaneously by a first joystick and the pair of azimuth thrusters 6 and their prime movers 7 at the other side of the centre plane CP can be operated simultaneously by a second joystick.

[0029] Fig. 4 shows an alternative embodiment, which distinguishes from the embodiment as shown in Fig. 3 in

that two skegs 5a, 5b are mounted to a lower side of the hull 2. The skegs 5 extend in longitudinal direction of the hull 2 from the bow 3 to about halfway the hull 2 at a distance from the centre plane CP. As seen from behind of the hull 2, each of the skegs 5a, 5b is located at a horizontal position between axes of rotation of the propellers 6a of the neighbouring azimuth thrusters 6. Due to the application of two skegs 5a, 5b their dimensions in vertical direction are relatively small, which creates a relatively small draught. Hence, the combination of at least two relatively small azimuth thrusters 6 and at least one skeg 5a, 5b at each side of the centre plane CP allows a small draught and facilitates docking, for example. The height of each of the skegs 5a, 5b may vary along its longitudinal direction. The maximum height may be smaller than the diameter or 1.5 times the diameter of each of the propellers 6a.

[0030] The invention is not limited to the embodiments shown in the drawings and described hereinbefore, which may be varied in different manners within the scope of the claims

Claims

1. A tug boat (1) comprising a hull (2) including a bow (3) and a stern (4) and having a length-to-beam ratio which is smaller than 5:1, wherein the hull (2) has a vertical centre plane (CP) extending in a direction from the bow (3) to the stern (4), wherein the tug boat (1) has at least two azimuth thrusters (6) including respective propellers (6a), which azimuth thrusters (6) are located next to each other in transverse direction of the centre plane (CP) and wherein each azimuth thruster (6) is drivably coupled to its own prime mover (7), wherein the at least two azimuth thrusters (6) are at each side of the centre plane (CP), i.e. making up at least four azimuth thrusters in total, wherein at least one of the prime movers is a diesel engine (7) which has a maximum speed above 1000 rpm.
2. A tug boat (1) according to claim 1, wherein the azimuth thrusters (6) are aligned in transverse direction of the centre plane (CP).
3. A tug boat (1) according to claim 1 or 2, wherein distances between centrelines of the propellers (6a) of each two neighbouring azimuth thrusters (6) are the same.
4. A tug boat (1) according to any one of the preceding claims, wherein the propellers (6a) of the at least two azimuth thrusters (6) have different diameters.
5. A tug boat (1) according to claim 4, wherein the propeller (6a) of one of the at least two azimuth thrusters (6) which is located at a larger distance from the cen-

tre plane (CP) than the other one of the at least two azimuth thrusters (6) has a larger diameter than the propeller (6a) of the other one of the at least two azimuth thrusters (6).

- 5 6. A tug boat (1) according to any one of the preceding claims, wherein the azimuth thrusters (6) are located at the bow (3) or at the stern (4).
- 10 7. A tug boat (1) according to any one of the preceding claims, wherein the at least two azimuth thrusters (6) and their prime movers (7) are functionally coupled to a common controller for operating the at least two azimuth thrusters (6) simultaneously.
- 15 8. A tug boat (1) according to claim 7, wherein the common controller is a joystick such that an operator can operate two joysticks, one for simultaneously controlling the at least two azimuth thrusters including their prime movers at one side of the centre plane and one for simultaneously controlling the at least two azimuth thrusters including their prime movers at the other side of the centre plane.
- 20 9. A tug boat (1) according to any one of the preceding claims, wherein at each side of the centre plane (CP) a skeg (5a, 5b) is mounted to a lower side of the hull (2), which skeg (5a, 5b) extends in longitudinal direction of the hull (2) .
- 30 10. A tug boat (1) according to claim 9, wherein the skeg (5a, 5b) is located at a horizontal position between axes of rotation of the respective propellers (6a) of the at least two azimuth thrusters (6) as seen in a direction from the stern (4) to the bow (3).
- 35 11. A tug boat (1) according to claim 9 or 10, wherein the maximum height of the skeg (5a, 5b) is smaller than the diameter or 1.5 times the diameter of each of the propellers (6a) of the respective azimuth thrusters (6).
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Patentansprüche

1. Schleppschiff (1), das einen Rumpf (2) mit einem Bug (3) und einem Heck (4) umfasst und ein Verhältnis der Länge zur größten Schiffsbreite hat, das kleiner als 5:1 ist, hat, wobei der Rumpf (2) eine vertikale Mittelebene (CP) hat, die sich in einer Richtung von dem Bug (3) zu dem Heck (4) erstreckt, wobei das Schleppschiff (1) wenigstens zwei Azimutschuberzeuger (6) mit jeweiligen Propellern (6a) hat, wobei die Azimutschuberzeuger (6) in der Querrichtung der Mittelebene (CP) nebeneinander angeordnet sind, und wobei jeder Azimutschuberzeuger (6) mit seiner eigenen Antriebsmaschine antreibbar gekoppelt ist, wobei die wenigstens zwei Azimutschuber-
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- zeuger (6) auf jeder Seite der Mittelebene (CP) sind, d.h. insgesamt wenigstens vier Azimut-schuberzeuger bilden, wobei wenigstens eine der Antriebsmaschinen ein Dieselmotor (7) ist, der eine Maximalgeschwindigkeit von mehr als 1000 U/Min hat.
2. Schleppschiff (1) nach Anspruch 1, wobei die Azimut-schuberzeuger (6) in der Querrichtung der Mittelebene (CP) ausgerichtet sind.
3. Schleppschiff (1) nach Anspruch 1 oder 2, wobei Abstände zwischen Mittellinien der Propeller (6a) jedes von zwei benachbarten Azimut-schuberzeugern (6) gleich sind.
4. Schleppschiff (1) nach einem der vorhergehenden Ansprüche, wobei die Propeller (6a) der wenigstens zwei Azimut-schuberzeuger (6) verschiedene Durchmesser haben.
5. Schleppschiff (1) nach Anspruch 4, wobei die Propeller (6a) eines der wenigstens zwei Azimut-schuberzeuger (6), der in einem größeren Abstand von der Mittelebene (CP) als der andere der wenigstens zwei Azimut-schuberzeuger (6) angeordnet ist, einen größeren Durchmesser als der Propeller (6a) des anderen der wenigstens zwei Azimut-schuberzeuger (6) hat.
6. Schleppschiff (1) nach einem der vorhergehenden Ansprüche, wobei die Azimut-schuberzeuger (6) an dem Bug (3) oder an dem Heck (4) angeordnet sind.
7. Schleppschiff (1) nach einem der vorhergehenden Ansprüche, wobei die wenigstens zwei Azimut-schuberzeuger (6) und ihre Antriebsmaschinen (7) mit einer gemeinsamen Steuerung zum gleichzeitigen Bedienen der Azimut-schuberzeuger (6) funktional gekoppelt sind.
8. Schleppschiff (1) nach Anspruch 7, wobei die gemeinsame Steuerung ein Steuerhebel ist, so dass ein Bediener zwei Steuerhebel, einen zum gleichzeitigen Steuern der wenigstens zwei Azimut-schuberzeuger mit ihren Antriebsmaschinen auf einer Seite der Mittelebene und einen zum gleichzeitigen Steuern der wenigstens zwei Azimut-schuberzeuger mit ihren Antriebsmaschinen auf der anderen Seite der Mittelebene, bedienen kann.
9. Schleppschiff (1) nach einem der vorhergehenden Ansprüche, wobei an jeder Seite der Mittelebene (CP) ein Skeg (5a, 5b) an einer Unterseite des Rumpfs (2) montiert ist, wobei das Skeg (5a, 5b) sich in der Längsrichtung des Rumpfs (2) erstreckt.
10. Schleppschiff (1) nach Anspruch 9, wobei das Skeg (5a, 5b) in einer Richtung von dem Heck (4) zu dem

Bug (3) gesehen in einer horizontalen Position zwischen Drehachsen der jeweiligen Propeller (6a) der wenigstens zwei Azimut-schuberzeuger (6) angeordnet ist.

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11. Schleppschiff (1) nach Anspruch 9 oder 10, wobei die maximale Höhe des Skegs (5a, 5b) kleiner als der Durchmesser oder das 1,5-fache des Durchmessers jedes der Propeller (6a) der jeweiligen Azimut-schuberzeuger (6) ist.

Revendications

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1. Remorqueur (1) comprenant une coque (2) comportant une proue (3) et une poupe (4) et ayant un rapport longueur/faisceau qui est inférieur à 5:1, dans lequel la coque (2) a un plan central (CP) vertical s'étendant dans une direction allant de la proue (3) à la poupe (4), dans lequel le remorqueur (1) a au moins deux propulseurs azimutaux (6) comportant des propulseurs (6a) respectifs, lesquels propulseurs azimutaux (6) sont situés l'un à côté de l'autre dans une direction transversale du plan central (CP) et dans lequel chaque propulseur azimutal (6) est couplé par entraînement à son propre moteur d'entraînement (7),

dans lequel les au moins deux propulseurs azimutaux (6) se trouvent de chaque côté du plan central (CP), ce qui représente au moins quatre propulseurs azimutaux au total, dans lequel au moins l'un des moteurs d'entraînement est un moteur diesel (7) qui a une vitesse maximale supérieure à 1 000 tr/min.

2. Remorqueur (1) selon la revendication 1, dans lequel les propulseurs azimutaux (6) sont alignés dans la direction transversale du plan central (CP).

3. Remorqueur (1) selon la revendication 1 ou 2, dans lequel des distances entre des lignes centrales des propulseurs (6a) de chaque paire de propulseurs azimutaux (6) voisins sont identiques.

4. Remorqueur (1) selon l'une quelconque des revendications précédentes, dans lequel les propulseurs (6a) des au moins deux propulseurs azimutaux (6) ont des diamètres différents.

5. Remorqueur (1) selon la revendication 4, dans lequel le propulseur (6a) de l'un des au moins deux propulseurs azimutaux (6) qui est situé à une distance plus grande par rapport au plan central (CP) que l'autre des au moins deux propulseurs azimutaux (6) a un diamètre plus important que celui du propulseur (6a) de l'autre des au moins deux propulseurs azimutaux (6).

6. Remorqueur (1) selon l'une quelconque des revendications précédentes, dans lequel les propulseurs azimutaux (6) sont situés à la proue (3) ou à la poupe (4). 5
7. Remorqueur (1) selon l'une quelconque des revendications précédentes, dans lequel les au moins deux propulseurs azimutaux (6) et leurs moteurs d'entraînement (7) sont couplés fonctionnellement à un dispositif de commande commun pour faire fonctionner les au moins deux propulseurs azimutaux (6) simultanément. 10
8. Remorqueur (1) selon la revendication 7, dans lequel le dispositif de commande commun est un levier de commande de sorte qu'un opérateur puisse utiliser deux leviers de commande, un pour commander simultanément les au moins deux propulseurs azimutaux, y compris leurs moteurs d'entraînement, sur un côté du plan central et un pour commander simultanément les au moins deux propulseurs azimutaux, y compris leurs moteurs d'entraînement, sur l'autre côté du plan central. 15
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9. Remorqueur (1) selon l'une quelconque des revendications précédentes, dans lequel sur chaque côté du plan central (CP), une plaque de protection (5a, 5b) est montée sur un côté inférieur de la coque (2), laquelle plaque de protection (5a, 5b) s'étend dans une direction longitudinale de la coque (2). 25
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10. Remorqueur (1) selon la revendication 9, dans lequel la plaque de protection (5a, 5b) est située à une position horizontale entre des axes de rotation des propulseurs (6a) respectifs des au moins deux propulseurs azimutaux (6) telle que vue dans une direction allant de la poupe (4) à la proue (3). 35
11. Remorqueur (1) selon la revendication 9 ou 10, dans lequel la hauteur maximale de la plaque de protection (5a, 5b) est inférieure au diamètre ou représente 1,5 fois le diamètre de chacun des propulseurs (6a) des propulseurs azimutaux (6) respectifs. 40
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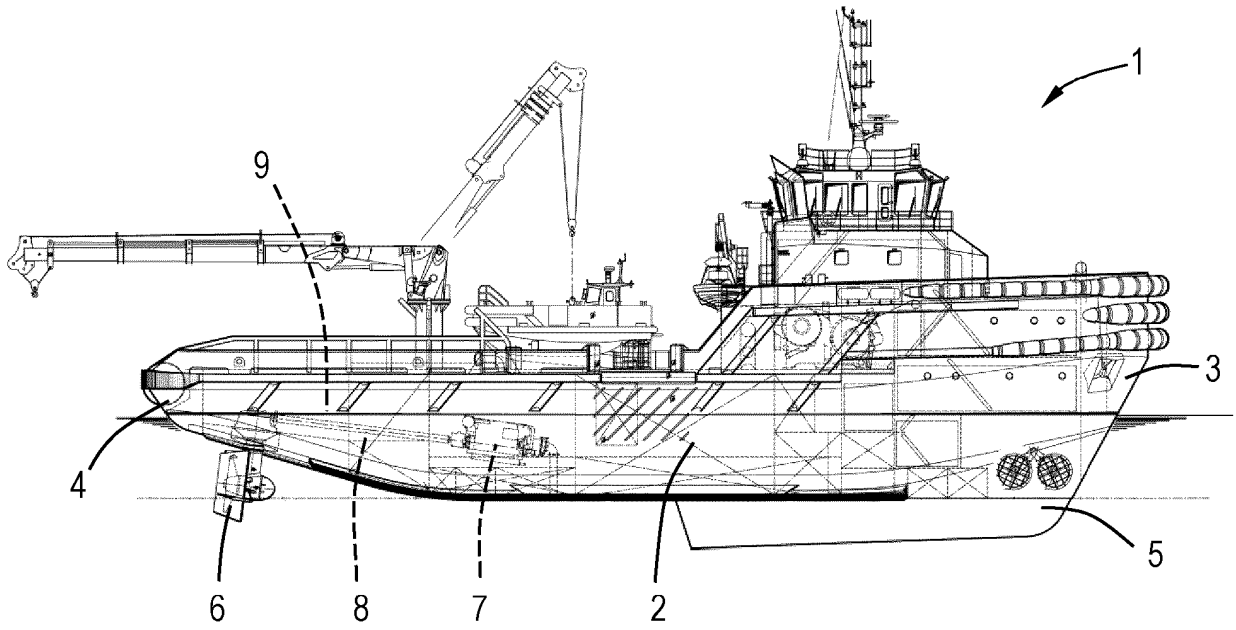


Fig.1

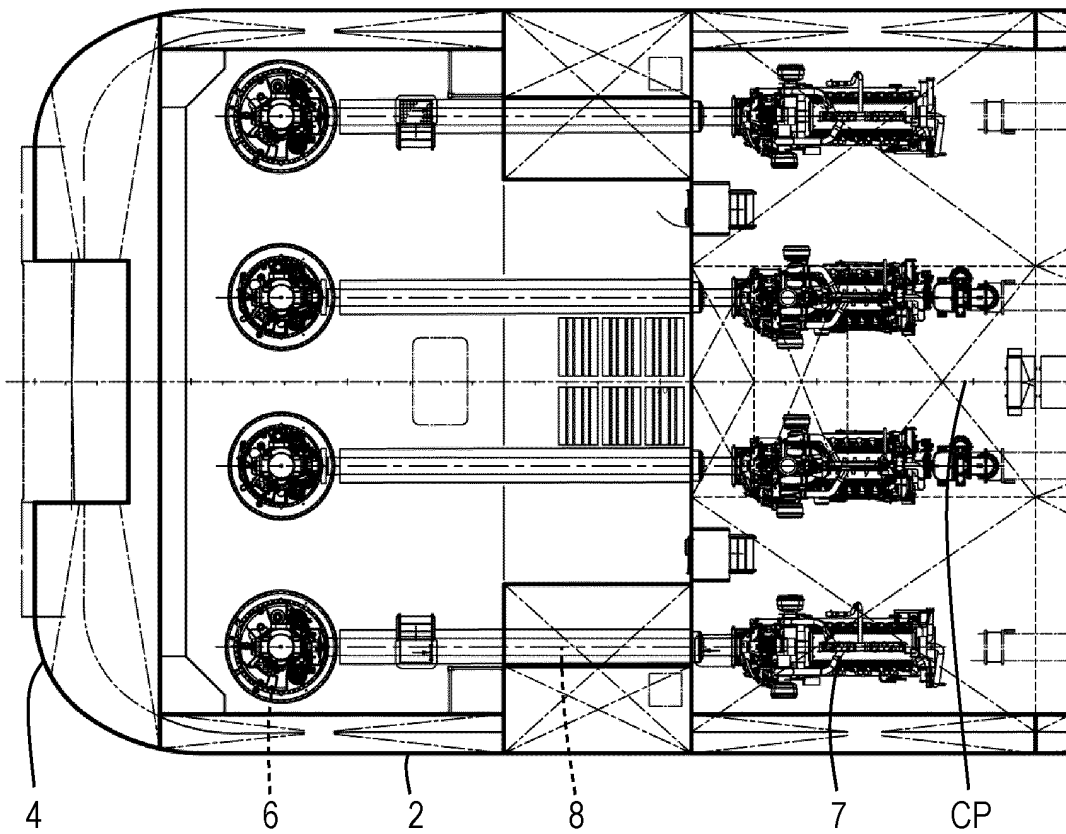


Fig.2

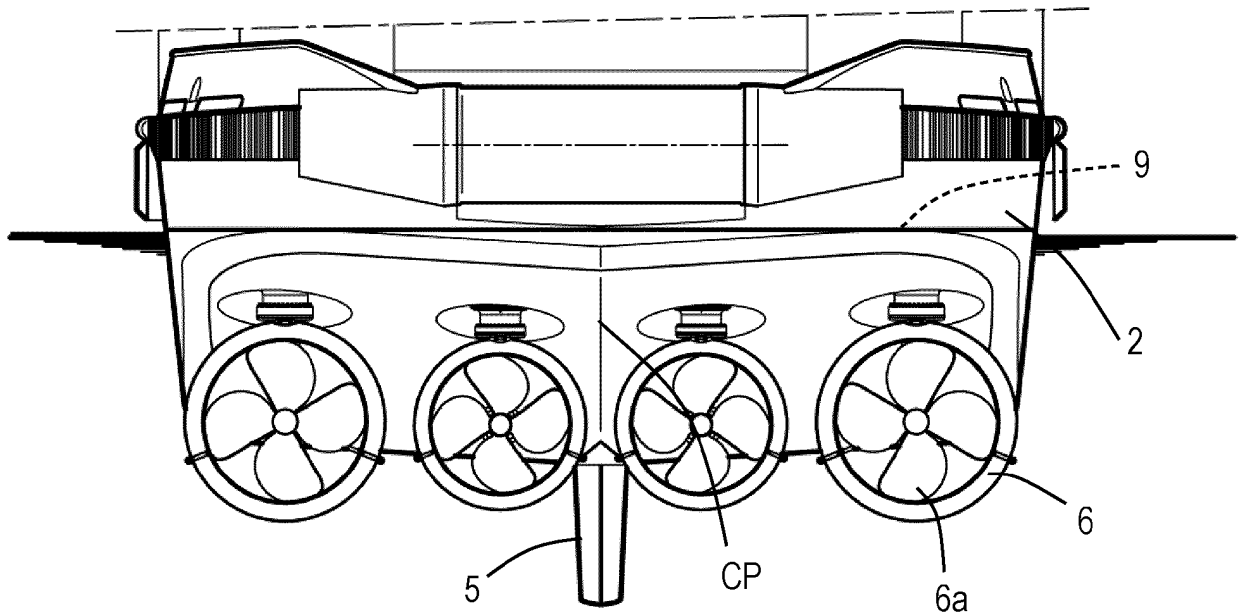


Fig.3

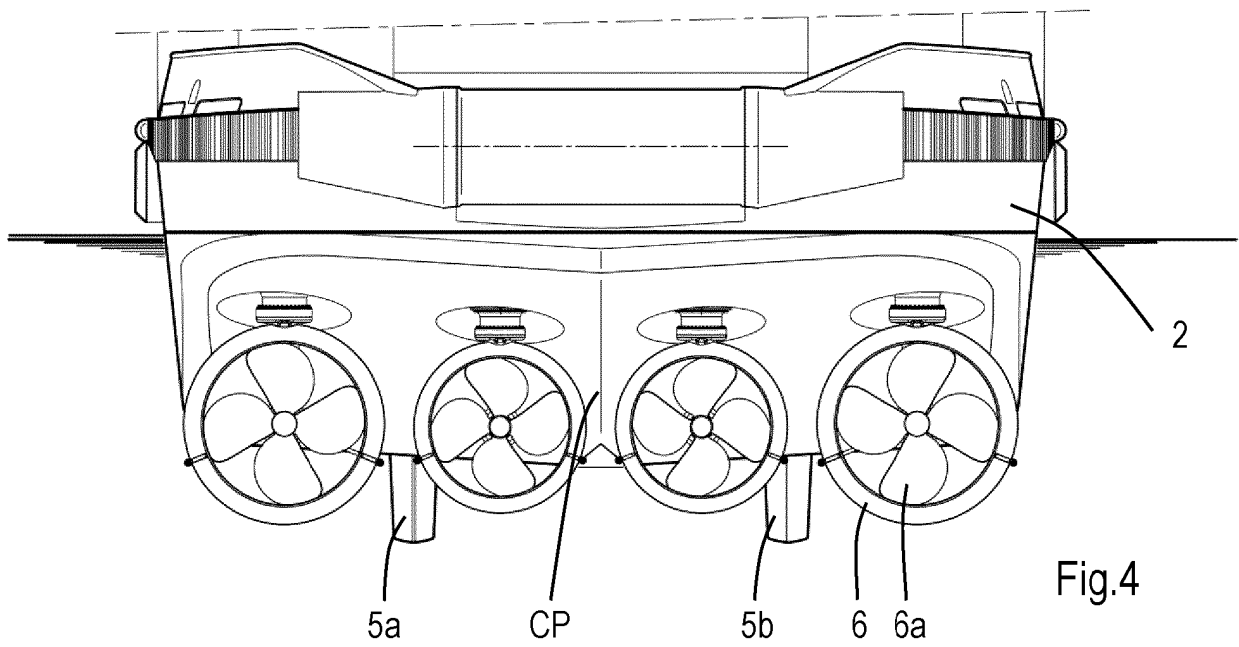


Fig.4

REFERENCES CITED IN THE DESCRIPTION

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