Summary of the invention

[0006A] According to a first aspect, there is provided a method of operating a tugboat comprising a single hull (2), a deck (3) and a towing system (4) having a circular or oval base (5) connected to the deck, the base having a centre point (CP), and a cart (6) that is moveable over the base over 360^o, wherein the cart comprises a powered winch (7) during use provided with a tug cable (8) for towing vessels (9), wherein a propulsion system (10) is connected to the hull for providing a propulsive force in a body of water (11), wherein the propulsion system comprises two propulsion units (12) each capable of providing thrust over 360^o in a plane perpendicular to a vertical plane of symmetry (13) extending in a longitudinal direction (X) of the tugboat, wherein the propulsion units are positioned in the vertical plane of symmetry and are aligned in the longitudinal direction, wherein one of the propulsion units is positioned in front of the centre point and the other one is positioned behind the centre point and a distance between the propulsion units is at least 10% of a length (L) of the tugboat in the longitudinal direction, wherein the tugboat is configured in such a way that during towing a vertical distance (H_{cp}) between the centre point (SP) and the waterline (14) divided by a vertical distance (H_p) between the centre of thrust of the propulsion units and the waterline is 0,3 – 1,5, wherein the method comprises the steps of: configuring the tugboat to attain such a draft during towing that the vertical (H_{cp}) distance between the centre point and the waterline (14) divided by the vertical distance (H_p) between the centre of thrust of the propulsion units and the waterline (14) is 0,3 – 1,5; connecting the tug cable to a vessel to be towed and maneuvering the tugboat in such a way that the tug cable extends at an angle of 45 - 90^o to the longitudinal direction of the vessel; operating the powered winch such that the tug cable is under tension, wherein a hydrodynamic resistance force created by the submerged hull is used to increase the tension of the tug cable; and using the propulsion units to correct the orientation of the tugboat with respect to the vessel to be towed.

[0007] Hereto, the tugboat according to an example is characterized in that the propulsion system comprises two propulsion units (12) each capable of providing thrust over 360^o in a plane perpendicular to a vertical plane of symmetry (13) extending in a longitudinal direction (X) of the tugboat, wherein the propulsion units are positioned in the vertical plane of symmetry and are aligned in the longitudinal direction, wherein

one of the propulsion units is positioned in front of the centre point and the other one is positioned behind the centre point and the distance between the propulsion units is at least 10% of a length (L) of the tugboat in the longitudinal direction, wherein the tugboat is configured in such a way that during towing the vertical distance between the centre point and the waterline (H_{cp}) divided by the vertical distance between the centre of thrust of the propulsion units and the waterline (H_p) is 0,3 – 1,5. Preferably the ratio is 0,6 – 1,1.

[0008] These combined features, and in particular the described values, allow the power of the carrousel-type tug system to be fully utilized and less engine thrust is needed to generate sufficiently large towing forces. The resistance of the hull itself can be advantageously used to create a counterforce opposed to the pulling force of the tug cable and thus tension in the tug cable can be increased to huge values without needing a lot of engine thrust. This is particularly relevant when pulling in a direction perpendicular to the longitudinal direction of the tugboat. The applicant has found that the stated values for Hp provide optimal stability to the tugboat. For values larger than 1,5 applicant has found that the tugboat gets elevated too much above the waterline, causing the positive effect on stability to be almost fully negated. The vertical distance between the centre point and the waterline (H_{cp}) can for instance be 1,5 – 4,5 m. The vertical distance between the centre of thrust of the propulsion units and the waterline (H_p) can for example be 3 – 5 m.

[0009] Having one of the propulsion units positioned in front of the centre point and the other one positioned behind the centre point, wherein the distance between the propulsion units is at least 10%, preferably at least 20% or more preferably at least 30%, of a length (L) of the vessel in the longitudinal direction, allows for correction of

Claims

1. Method of operating a tugboat comprising a single hull (2), a deck (3) and a towing system (4) having a circular or oval base (5) connected to the deck, the base having a centre point (CP), and a cart (6) that is moveable over the base over 360^{o}, wherein the cart comprises a powered winch (7) during use provided with a tug cable (8) for towing vessels (9), wherein a propulsion system (10) is connected to the hull for providing a propulsive force in a body of water (11), wherein the propulsion system comprises two propulsion units (12) each capable of providing thrust over 360^{o} in a plane perpendicular to a vertical plane of symmetry (13) extending in a longitudinal direction (X) of the tugboat, wherein the propulsion units are positioned in the vertical plane of symmetry and are aligned in the longitudinal direction, wherein one of the propulsion units is positioned in front of the centre point and the other one is positioned behind the centre point and a distance between the propulsion units is at least 10% of a length (L) of the tugboat in the longitudinal direction, wherein the tugboat is configured in such a way that during towing a vertical distance (H_{cp}) between the centre point (SP) and the waterline (14) divided by a vertical distance (H_p) between the centre of thrust of the propulsion units and the waterline is 0,3 – 1,5,

wherein the method comprises the steps of:

- configuring the tugboat to attain such a draft during towing that the vertical (H_{cp}) distance between the centre point and the waterline (14) divided by the vertical distance (H_p) between the centre of thrust of the propulsion units and the waterline (14) is 0,3 – 1,5;
- connecting the tug cable to a vessel to be towed and maneuvering the tugboat in such a way that the tug cable extends at an angle of 45 - 90^{o} to the longitudinal direction of the vessel;
- operating the powered winch such that the tug cable is under tension, wherein a hydrodynamic resistance force created by the submerged hull is used to increase the tension of the tug cable; and
- using the propulsion units to correct the orientation of the tugboat with respect to the vessel to be towed.

2. Method according to claim 1, wherein the propulsion units comprise one or more Voith Schneider Propellers.

3. Method according to claim 1 or 2, wherein the propulsion units comprise one or more azimuth thrusters.

4. Method according to claim 1, wherein the orientation of the tugboat is corrected with the propulsion units in such a way, that the tug cable remains at an angle of 45 - 90^{o} to the longitudinal direction of the tugboat.

5. Method according to claim 4, wherein the orientation of the tugboat is corrected with the propulsion units in such a way, that the tug cable remains at an angle of about 90^{o} to the longitudinal direction of the tugboat.

6. Method according to claim 1, wherein the tugboat has a longitudinal direction, the single hull is an elongated hull, the towing system is a carousel-type towing system, and wherein the base is a circular base.

7. Method according to claim 6, wherein each of the two propulsion units (12) is arranged below the hull's draft and capable of providing thrust over 360^{o} in a plane below the hull's draft and perpendicular to vertical plane of symmetry (13) of the tugboat, wherein the vertical plane of symmetry (13) extends in the longitudinal direction of the tugboat.

8. Method according to claim 6, wherein the vertical distance (Hcp) between the centre point (Cp) and the water line (14) is in the range of 1,5 – 4,5 m, and wherein the vertical distance between the centre of thrust of the propulsion units and the water line is in the range of 3 – 5 m.

9. Method according to claim 1, wherein the tugboat (1) is configured in such a way that during towing the vertical distance (Hcp) between the centre point (CP) and the waterline (14) divided by the vertical distance (Hp) between the centre of thrust of the propulsion units (12) and the waterline (14) is 0,6 – 1,1.

10. Method according to claim 1, wherein the distance between the propulsion (12) units is at least 30% of the length (L) of the vessel in the longitudinal direction.

11. Method according to claim 1, wherein one of the propulsion units is positioned in front of the centre point (CP) and the base (5) and the other one is positioned behind the centre point (CP) and the base (5) when seen along the longitudinal direction (X).