

A MODULAR ROTOR ASSEMBLY TO PROPEL A VESSEL BY GENERATING LIFT FORCE

FIELD OF INVENTION

[0001] Embodiments of the present disclosure relate to the field of marine propulsion and more particularly to a modular rotor assembly to propel a vessel by generating lift force.

BACKGROUND

[0002] Ships are propelled by rotating propellers. The propellers are powered by combustion engines that consume fossil fuels. In addition to the combustion engines, Flettner rotors are being used to propel the ship by generating lift force. The Flettner rotors include a corresponding cylinder spun along a corresponding longitudinal axis. As air passes at right angles across the corresponding cylinder, an aerodynamic force may be generated in a direction perpendicular to the longitudinal axis and a direction of airflow.

[0003] The cylinder of the currently existing Flettner rotors measures at least 18 meters in length and 3 meters in diameter, thereby making the cylinder bulky. The bulky nature of the cylinder makes the logistics of the same a costly and challenging affair. Apart from that, the cylinder is fabricated by joining multiple shorter tubes that are resin-infused sandwich structures. The shorter tubes also require reinforcement with materials such as carbon fiber and stitched glass, making the manufacturing process costly.

[0004] Hence, there is a need for an improved modular rotor assembly to propel a vessel by generating lift force to address the aforementioned issue(s).

BRIEF DESCRIPTION

[0005] In accordance with an embodiment of the present disclosure, a modular rotor assembly to propel a vessel by generating lift force is provided. The modular rotor assembly includes a support unit mounted on a weather deck of the vessel. The support unit includes an electric motor adapted to rotate upon receiving electrical energy from a power source. The modular rotor assembly also includes a motor plate unit positioned above the support unit. The motor plate unit is adapted to rotate corresponding to rotation of the electric motor. The motor plate unit includes a plurality of radial stiffeners mounted on a motor plate. The plurality of radial

stiffeners are circumferentially connected by one or more corresponding webs. The motor plate is mounted around a central hub mechanically coupled to the electric motor through a shaft. The modular rotor assembly further includes a rotor surface unit mechanically coupled to the motor plate unit. The rotor surface unit includes a cylindrical structure fabricated by interconnecting a plurality of arc shaped structures. The rotor surface unit is adapted to rotate corresponding to the rotation of the motor plate unit. The rotor surface unit is also adapted to modify direction of flow of air striking the rotor surface unit during operation of the vessel upon rotating to generate the lift. The rotor surface unit is adapted to rotate corresponding to the direction of an incoming wind to generate the lift force along the direction of heading of the vessel, thereby propelling the vessel.

[0006] To further clarify the advantages and features of the present disclosure, a more explicit description of the disclosure will follow by reference to specific embodiments thereof, which are illustrated in the appended figures. It is to be appreciated that these figures depict typical embodiments of the disclosure and are therefore not to be considered limiting in scope. The disclosure will be described and explained with additional details with the appended figures.

BRIEF DESCRIPTION OF THE DRAWINGS

[0007] The disclosure will be described and explained with additional specificity and detail with the accompanying figures in which:

[0008] FIG. 1 is a schematic representation of a cross sectional view depicting a modular rotor assembly to propel a vessel by generating lift force in accordance with an embodiment of the present disclosure;

[0009] FIG. 2 is a schematic representation of one embodiment of a system of FIG. 1, depicting exploded view of a support unit in accordance with an embodiment of the present disclosure;

[0010] FIG. 3 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting detailed view of an electric motor in accordance with an embodiment of the present disclosure;

[0011] FIG. 4 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting exploded view of a motor plate unit in accordance with an embodiment of the present disclosure;

[0012] FIG. 5 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting detailed view of a bearing housing and a shaft in accordance with an embodiment of the present disclosure; and

[0013] FIG. 6 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting exploded view of a rotor surface unit in accordance with an embodiment of the present disclosure.

[0014] Further, those skilled in the art will appreciate that elements in the figures are illustrated for simplicity and may not have necessarily been drawn to scale. Furthermore, in terms of the construction of the device, one or more components of the device may have been represented in the figures by conventional symbols, and the figures may show only those specific details that are pertinent to understanding the embodiments of the present disclosure so as not to obscure the figures with details that will be readily apparent to those skilled in the art having the benefit of the description herein.

DETAILED DESCRIPTION

[0015] To promote an understanding of the principles of the disclosure, reference will now be made to the embodiment illustrated in the figures and specific language will be used to describe them. It will nevertheless be understood that no limitation of the scope of the disclosure is thereby intended. Such alterations and further modifications in the illustrated system, and such further applications of the principles of the disclosure as would normally occur to those skilled in the art are to be construed as being within the scope of the present disclosure.

[0016] The terms ``comprises", "comprising", or any other variations thereof, are intended to cover a non-exclusive inclusion, such that a process or method that comprises a list of steps does not include only those steps but may include other steps not expressly listed or inherent to such a process or method. Similarly, one or more devices or sub-systems or elements or structures or components preceded by "comprises... a" does not, without more constraints, preclude the existence of other devices, sub-systems, elements, structures, components, additional devices, additional sub-systems, additional elements, additional structures, or additional components.

Appearances of the phrase "in an embodiment", "in another embodiment" and similar language throughout this specification may, but not necessarily do, all refer to the same embodiment.

[0017] Unless otherwise defined, all technical and scientific terms used herein have the same meaning as commonly understood by those skilled in the art to which this disclosure belongs. The system, methods, and examples provided herein are only illustrative and not intended to be limiting.

[0018] In the following specification and the claims, reference will be made to a number of terms, which shall be defined to have the following meanings. The singular forms "a", "an", and "the" include plural references unless the context clearly dictates otherwise.

[0019] Embodiments of the present disclosure relate to a modular rotor assembly to propel a vessel by generating lift force. The modular rotor assembly includes a stationary unit installed on the weather deck of the vessel. The support unit includes an electric motor adapted to rotate upon receiving electrical energy from a power source. The modular rotor assembly also includes a motor plate unit positioned above the support unit. The motor plate unit is adapted to rotate corresponding to rotation of the electric motor. The motor plate unit includes a plurality of radial stiffeners mounted on a motor plate. The plurality of radial stiffeners are circumferentially connected by one or more corresponding webs. The motor plate is mounted around a central hub mechanically coupled to the electric motor through a shaft. The modular rotor assembly further includes a rotor surface unit mechanically coupled to the motor plate unit. The rotor surface unit includes a cylindrical structure fabricated by interconnecting a plurality of arc shaped structures. The rotor surface unit is adapted to rotate corresponding to the rotation of the motor plate unit. The rotor surface unit is also adapted to modify direction of flow of air striking the rotor surface unit during operation of the vessel upon rotating to generate the lift. The rotor surface unit is adapted to rotate corresponding to the direction of an incoming wind to generate the lift force along the direction of heading of the vessel, thereby propelling the vessel.

[0020] FIG. 1 is a schematic representation of a cross sectional view depicting a modular rotor assembly (10) to propel a vessel by generating lift force in accordance with an embodiment of the present disclosure. The modular rotor assembly (10) includes a stationary unit (20) installed on a weather deck the vessel (not shown in FIG. 1). In one embodiment, the vessel may include, but not limited to, a ship, a boat and the like. The stationary unit (20) includes an electric motor (30) adapted to rotate upon receiving electrical energy from a power source (not shown in FIG.

1). In some embodiments, the power source may include, an alternating current source, a direct current source and the like.

[0021] Further, the modular rotor assembly (10) also includes a motor plate unit (40) positioned above the stationary unit (20). The motor plate unit (40) is adapted to rotate corresponding to rotation of the electric motor (30). The modular rotor assembly (10) further includes a rotor surface unit (100) mechanically coupled to the motor plate unit (40). The rotor surface unit (100) is adapted to rotate corresponding to the rotation of the motor plate unit (40). The rotor surface unit (100) is also adapted to modify direction of flow of air striking the rotor surface unit (100) during operation of the vessel upon rotating to generate the lift. The rotor surface unit (100) is adapted to rotate corresponding to the direction of an incoming wind to generate the lift force along the direction of heading of the vessel, thereby propelling the vessel. Exploded view of the support unit (20) is shown in FIG. 2.

[0022] FIG. 2 is a schematic representation of one embodiment of a system of FIG. 1, depicting exploded view of the support unit (20) in accordance with an embodiment of the present disclosure. In one embodiment, the support unit (20) may include a frustoconical segment (130) molded on a tubular segment (140). In such an embodiment, the frustoconical segment (130) may include a plurality of rotor stoppers (150) adapted to hold or restrict the shaft when not in use or intended to be stopped (not shown in FIG. 2). In a specific embodiment, the frustoconical segment (130) may include a manhole (160) adapted to provide access into the support unit (20). Detailed view of the electric motor (30) is shown in FIG. 3.

[0023] FIG. 3 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting detailed view of the electric motor (30) in accordance with an embodiment of the present disclosure. In one embodiment, the electric motor (30) may include at least one of an alternating current motor, and a direct current motor. Exploded view of the motor plate unit (40) is shown in FIG. 4.

[0024] FIG. 4 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting exploded view of the motor plate unit (40) in accordance with an embodiment of the present disclosure. The motor plate unit (40) includes a plurality of radial stiffeners (50) mounted on a motor plate (60). The plurality of radial stiffeners (50) are circumferentially connected by one or more corresponding webs (70). The motor plate (60) is mounted around a central hub (80) mechanically coupled to the electric motor (30) through the shaft (FIG. 5, (90)).

In one embodiment, the motor plate (60) may be fabricated by interconnecting a plurality of semi-circular structures around the central hub (80).

[0025] Further, in one embodiment, the plurality of radial stiffeners (50) may be mounted on the motor plate (60) along respective base of the plurality of radial stiffeners (50). In some embodiments, the plurality of radial stiffeners (50) may be mounted on the motor plate (60) through a plurality of corresponding radial angle connectors (180). In a specific embodiment, the plurality of radial stiffeners (50) and the web (70) may be connected via a plurality of corresponding circumferential angle connectors (190) Detailed view of the shaft (FIG. 5, (90)) is shown in FIG. 5.

[0026] FIG. 5 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting detailed view of a bearing housing and the shaft (90) in accordance with an embodiment of the present disclosure. The electric motor (30) and the rotor surface unit (40) may be connected via the bearing housing and shaft (90). Exploded view of the rotor surface unit (100) is shown in FIG. 6.

[0027] FIG. 6 is a schematic representation of yet another embodiment of a system of FIG. 1, depicting exploded view of the rotor surface unit (100) in accordance with an embodiment of the present disclosure. The rotor surface unit (100) includes a cylindrical structure fabricated by interconnecting a plurality of arc shaped structures (110). In one embodiment, the rotor surface unit (100) may be adapted to generate a low pressure region and a high pressure region around the rotor surface unit (100) simultaneously by modifying the direction of flow of the air striking the rotor surface unit (100). In some embodiments, the rotor surface unit (100) may be composed of a material including glass or carbon fibers-built composites.

[0028] Further, in some embodiments, the plurality of arc shaped structures (110) may be interconnected by a plurality of corresponding stiffeners (170) adapted to provide structural stability to the rotor surface unit (100). In such an embodiment, the plurality of corresponding stiffeners (170) may be mounted inside the rotor surface unit (100) along an axis parallel to longitudinal axis (120) of the rotor surface unit (100). In one embodiment, the plurality of corresponding stiffeners (170) may include a central stiffener (200) adapted to neutralize bending stress acting on the rotor surface unit (100). In a specific embodiment, the plurality of corresponding stiffeners (170) may include an end stiffener (210) adapted to prevent relative motion between the plurality of arc shaped structures (110).

[0029] Furthermore, in a specific embodiment, the plurality of radial stiffeners (50) may be coupled to the rotor surface unit (100) through the plurality of corresponding stiffeners (170). In one embodiment, a plurality of end discs (220) may be coupled to a top end of the rotor surface unit (100) and a bottom end of the rotor surface unit (100). In such an embodiment, the plurality of end discs (220) may be fabricated by interconnecting a plurality of corresponding semi-circular shaped structures. The plurality of end discs (220) may be adapted to guide the air towards the rotor surface unit (100).

[0030] Moreover, in one embodiment, the rotor surface unit (100) may include a plurality of radial hoop stiffeners (230) adapted to prevent radial displacement of the plurality of arc shaped structures (110). In such an embodiment, the plurality of radial hoop stiffeners (230), a plurality of corresponding stiffeners (170), and the rotor surface unit (100) are coupled together by a plurality of corresponding shear clips (240). In a specific embodiment, the rotor surface unit (100) may include a plurality of end hoop stiffeners (250) adapted to radially interconnect the plurality of arc shaped structures (110). In one embodiment, the electric motor (30), the motor plate unit (40), and the rotor surface unit (100) may be adapted to rotate co-axially about a longitudinal axis (120) of the modular rotor assembly (10).

[0031] Various embodiments of the modular rotor assembly to propel a vessel by generating lift force described above enable various advantages. The support unit, the motor plate unit, and the rotor surface unit are modular, thereby enabling hassle free transportation, and easy installation. The modular rotor assembly is capable of being transported via a 40 feet container, thereby reducing transportation cost. Semi-monocoque construction method used for fabricating the support unit, the motor plate unit, and the rotor surface unit enables reduction of weight of the modular rotor assembly without compromising the structural strength. Further, fabrication of the rotor surface unit by the fiber glass helps to reduce the manufacturing cost.

[0032] It will be understood by those skilled in the art that the foregoing general description and the following detailed description are exemplary and explanatory of the disclosure and are not intended to be restrictive thereof. While specific language has been used to describe the disclosure, any limitations arising on account of the same are not intended.

[0033] The figures and the foregoing description give examples of embodiments. Those skilled in the art will appreciate that one or more of the described elements may well be combined into a single functional element. Alternatively, certain elements may be split into multiple functional

elements. Elements from one embodiment may be added to another embodiment. For example, the order of processes described herein may be changed and is not limited to the manner described herein. Moreover, the actions of any flow diagram need not be implemented in the order shown; nor do all the acts need to be necessarily performed. Also, those acts that are not dependent on other acts may be performed in parallel with the other acts. The scope of embodiments is by no means limited by these specific examples.

WE CLAIM:

1. A modular rotor assembly (10) to propel a vessel by generating lift force comprising:

a support unit (20) mounted on a weather deck of the vessel, wherein the support unit (20) comprises an electric motor (30) adapted to rotate upon receiving electrical energy from a power source;

a motor plate unit (40) positioned above the support unit (20), wherein the motor plate unit (40) is adapted to rotate corresponding to rotation of the electric motor (30), wherein the motor plate unit (40) comprises a plurality of radial stiffeners (50) mounted on a motor plate (60),

wherein the plurality of radial stiffeners (50) are circumferentially connected by one or more corresponding webs (70); wherein the motor plate (60) is mounted around a central hub (80) mechanically coupled to the electric motor (30) through a shaft (90),

a rotor surface unit (100) mechanically coupled to the motor plate unit (40), wherein the rotor surface unit (100) comprises a cylindrical structure fabricated by interconnecting a plurality of arc shaped structures (110), wherein the rotor surface unit (100) is adapted to:

rotate corresponding to the rotation of the motor plate unit (40); and

modify direction of flow of air striking the rotor surface unit (100) during operation of the vessel upon rotating to generate the lift force,

wherein the rotor surface unit is adapted to rotate corresponding to the direction of an incoming wind to generate the lift force along the direction of heading of the vessel, thereby propelling the vessel.

2. The modular rotor assembly (10) as claimed in claim 1, wherein the electric motor (30), the motor plate unit (40), and the rotor surface unit (100) are adapted to rotate co-axially about a longitudinal axis (120) of the modular rotor assembly (10).

3. The modular rotor assembly (10) as claimed in claim 1, wherein the support unit (20) comprises a frustoconical segment (130) molded on a tubular segment (140), wherein the frustoconical segment (130) comprises a plurality of rotor stoppers (150) adapted to hold the shaft (90) when the modular rotor assembly is inoperative.

4. The modular rotor assembly (10) as claimed in claim 3, wherein the frustoconical segment (130) comprises a manhole (160) adapted to provide access into the support unit (20).
5. The modular rotor assembly (10) as claimed in claim 1, wherein the motor plate (60) is fabricated by interconnecting a plurality of semi-circular structures around the central hub (80).
6. The modular rotor assembly (10) as claimed in claim 1, wherein the plurality of radial stiffeners (50) are coupled to the rotor surface unit (100) through a plurality of corresponding stiffeners (170).
7. The modular rotor assembly (10) as claimed in claim 1, wherein the plurality of radial stiffeners (50) are mounted on the motor plate (60) along respective base of the plurality of radial stiffeners (50).
8. The modular rotor assembly (10) as claimed in claim 1, wherein the plurality of radial stiffeners (50) are mounted on the motor plate (60) through a plurality of corresponding radial angle connectors (180).
9. The modular rotor assembly (10) as claimed in claim 1, wherein the plurality of radial stiffeners (50) and the web (70) are connected via a plurality of corresponding circumferential angle connectors (190).
10. The modular rotor assembly (10) as claimed in claim 1, wherein the rotor surface unit (100) is adapted to generate a low pressure region and a high pressure region around the rotor surface unit (100) simultaneously by modifying the direction of flow of the air striking the rotor surface unit (100).
11. The modular rotor assembly (10) as claimed in claim 1, wherein the rotor surface unit (100) is composed of a material comprising fiber glass.
12. The modular rotor assembly (10) as claimed in claim 1, wherein the plurality of arc shaped structures (110) are interconnected by a plurality of corresponding stiffeners (170) adapted to provide structural stability to the rotor surface unit (100).

13. The modular rotor assembly (10) as claimed in claim 12, wherein the plurality of corresponding stiffeners (170) are mounted inside the rotor surface unit (100) along an axis parallel to longitudinal axis (120) of the rotor surface unit (100).

14. The modular rotor assembly (10) as claimed in claim 12, wherein the plurality of corresponding stiffeners (170) comprises:

a central stiffener (200) adapted to neutralize bending stress acting on the rotor surface unit (100); and

an end stiffener (210) adapted to prevent relative motion between the plurality of arc shaped structures (110).

15. The modular rotor assembly (10) as claimed in claim 1, comprising a plurality of end discs (220) coupled to a top end of the rotor surface unit (100) and a bottom end of the rotor surface unit (100), wherein the plurality of end discs (220) are adapted to guide the air towards the rotor surface unit (100);

16. The modular rotor assembly (10) as claimed in claim 15, wherein the plurality of end discs (220) are fabricated by interconnecting a plurality of corresponding semi-circular shaped structures.

17. The modular rotor assembly (10) as claimed in claim 1, wherein the rotor surface unit (100) comprises a plurality of radial hoop stiffeners (230) adapted to prevent radial displacement of the plurality of arc shaped structures (110).

18. The modular rotor assembly (10) as claimed in claim 17, wherein the plurality of radial hoop stiffeners (230), a plurality of stiffeners (170), and the rotor surface unit (100) are coupled together by a plurality of corresponding shear clips (240).

19. The modular rotor assembly (10) as claimed in claim 1, wherein the rotor surface unit (100) comprises a plurality of end hoop stiffeners (250) adapted to radially interconnect the plurality of arc shaped structures (110).

20. The modular rotor assembly (10) as claimed in claim 1, wherein the electric motor (30) comprises at least one of an alternating current motor, and a direct current motor.