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Propulsion system for a seagoing vessel

Abstract

A propulsion system for a seagoing vessel includes a rotatable frame and either (a) at least two masts coupled to the frame and each having a sail and a boom, or (b) at least two blades coupled to the frame. The rotatable frame and either the rotatable boom or at least two blades may be locked in position in a locked mode and unlocked and freely rotatable in an unlocked mode. A control system that is in communication in communication with a frame lock and either a boom lock or a blade lock and may be configured to determine when the vertical axis wind turbine should be in either the locked mode or the unlocked mode based on the direction of the wind and a direction that the seagoing vessel is traveling.

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Background/Summary

CROSS-REFERENCE TO RELATED APPLICATION (1) This application claims priority to U.S. Provisional Patent Application Ser. No. 63/252,789 filed on Oct. 6, 2021, the entire contents of which are hereby incorporated by reference in its entirety.

TECHNICAL FIELD
(1) The subject matter described herein relates, in general, to propulsion systems for seagoing vessels.
BACKGROUND
(2) The background description provided is to present the context of the disclosure generally. Work of the inventor, to the extent it may be described in this background section, and aspects of the description that may not otherwise qualify as prior art at the time of filing are neither expressly nor impliedly admitted as prior art against the present technology.
(3) Seagoing vessels may utilize a number of different propulsion systems for propelling the seagoing vessel through a body of water. For example, some seagoing vessels utilize one or more sails attached to a mast. The sail functions to capture the wind and transfer the forces from the wind to the mast of the seagoing vessel, which then propels the seagoing vessel. Using sails to capture wind to propel the seagoing vessel has certain advantages, namely, the ability to propel the

seagoing vessel without the need for complex machinery that requires fuel. However, using wind to propel a seagoing vessel also has drawbacks, as the propulsion of the seagoing vessel is based on the direction and speed of the wind. If the speed and direction of the wind is unfavorable, the propulsion of the seagoing vessel may be significantly impacted.

(4) In another example, some seagoing vessels utilize one or more propellers in mechanical communication with a machine, such as an engine, which can rotate the propeller. A propeller is a device with a rotating hub and radiating blades set at a pitch to form a helical spiral that, when rotated, acts similar to Archimedes' screw. It transforms rotational power into linear thrust by acting upon a working fluid such as water or air. However, unlike sails, the propeller must be driven by a machine, which requires fuel. The machine may be in the form of an engine that utilizes gasoline, diesel fuel, and the like. In other examples, the machine may be a nuclear power plant that generates steam that turns a turbine that turns one or more propellers.

SUMMARY

(5) This section generally summarizes the disclosure and is not a comprehensive explanation of its full scope or all its features.

(6) A propulsion system for a seagoing vessel includes a vertical axis wind turbine having a locked mode and an unlocked mode. The vertical axis wind turbine may have a frame having a frame lock. The frame is freely rotatable about a central axis in the unlocked mode and non-rotatable about the central axis in the locked mode. The frame may also include either (a) at least two masts coupled to the frame and each having a sail or (b) at least two blades coupled to the frame. The at least two masts may include at least one boom having an axis of rotation defined by one of the at least two masts that are rotatable about the axis of rotation defined by one of the at least two masts when in the unlocked mode and non-rotatable about the axis defined by one of the at least two masts when in a locked mode. The at least two blades may be rotatable about axes of rotation substantially perpendicular to the central axis when in the unlocked mode and non-rotatable about the axes of rotation substantially perpendicular to the central axis when in the locked mode.

(7) The propulsion system also includes a control system that is in communication in communication with a frame lock and either a boom lock or a blade lock. The control system is configured to lock the frame lock, and either the boom lock or the blade lock when in the locked mode and unlock the frame lock and either the boom lock or the blade lock when in the unlocked mode. The control system may be configured to determine when the vertical axis wind turbine should be in either the locked mode or the unlocked mode based on the direction of the wind and the direction that the seagoing vessel is traveling

(8) Further areas of applicability and various methods of enhancing the disclosed technology will become apparent from the description provided. The description and specific examples in this summary are intended for illustration only and are not intended to limit the scope of the present disclosure.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

(1) The accompanying drawings, which are incorporated in and constitute a part of the specification, illustrate various systems, methods, and other embodiments of the disclosure. It will be appreciated that the illustrated element boundaries (e.g., boxes, groups of boxes, or other shapes) in the figures represent one embodiment of the boundaries. In some embodiments, one element may be designed as multiple elements or multiple elements may be designed as one element. In some embodiments, an element shown as an internal component of another element may be implemented as an external component and vice versa. Furthermore, elements may not be drawn to scale.

(2) FIG. **1** illustrates a vertical axis turbine for providing propulsion for a seagoing vessel;
(3) FIG. **2** illustrates a top view of the vertical axis turbine of FIG. **1**;
(4) FIG. **3** illustrates another embodiment of the vertical axis turbine that utilizes blades;
(5) FIG. **4** illustrates a vertical axis turbine that utilizes a mechanical member embedded into the frame of the vertical axis turbine;
(6) FIG. **5** illustrates an example of using an additional cord to regulate the movement and position of the boom and/or blades of the vertical axis turbine;
(7) FIG. **6** illustrates an example of a vertical axis turbine that utilizes one or more motors to position the boom and/or blade of the vertical axis turbine;
(8) FIG. **7** illustrates a seagoing vessel incorporating the vertical axis turbine in an unlocked mode;
(9) FIG. **8** illustrates the seagoing vessel of FIG. **7** incorporating the vertical axis turbine in a locked mode;
(10) FIG. **9** illustrates the seagoing vessel of FIG. **7** incorporating the vertical axis turbine in a locked mode when the seagoing vessel experiences adverse weather conditions, such as hurricane force winds; and
(11) FIG. **10** illustrates a control system for the vertical axis turbine.

DETAILED DESCRIPTION

(12) A propulsion system for a seagoing vessel includes at least one vertical axis wind turbine that operates in either a locked mode or an unlocked mode. Moreover, the vertical axis wind turbine may include a frame that is rotatable about a central axis. Attached to the frame may be either masts, each having a boom and a sail or blades. The booms are rotatable about the axes defined by the masts, and the blades are rotatable about an axis substantially perpendicular to the central axis.
(13) In the unlocked mode, the frame and either the booms or the blades are freely rotatable. When the wind interacts with the vertical axis wind turbine, the wind causes the frame to turn. The turning of the frame can then be used to provide power to a propulsion system, either directly or indirectly, via either a mechanical or an electrical system. The unlocked mode may be used in situations where the direction of the wind is not substantially similar to the direction that the seagoing vessel wishes to travel.
(14) In the unlocked mode, the frame and either the booms or the blades are locked into place and are not freely rotatable. In this situation, the wind that interacts with the sails or the blades provides propulsion to the seagoing vessel in a more traditional manner, similar to a sailboat. It has been observed that if the direction of the wind in the direction that the seagoing vessel wishes to travel are similar, it is more efficient to utilize the vertical axis wind turbine in a locked position, wherein the sails or blades of the vertical axis wind turbine capture the wind and propel the seagoing vessel by transferring force through the mast or blades of the vertical axis wind turbine.
(15) Referring to FIG. **1**, a vertical axis turbine **10** for providing propulsion for a seagoing vessel is shown. The vertical axis turbine **10** may be similar to any of the vertical axis turbines described in U.S. Pat. No. 9,752,557 entitled “Vertical Axis Turbine,” which is hereby incorporated by reference in its entirety. The vertical axis turbine **10** includes a frame **12** rotatable about a central axis **14**. The frame may take any one of a number of suitable shapes or be made from any number of suitable materials, such as steel, aluminum, plastic, ceramic, metal alloys, and the like.
(16) Here, the frame **12** includes a substantially circular portion **16**. Within this substantially circular portion **16** are spokes **18**A-**18**D. The spokes converge from the substantially circular portion **16** to a central portion **20** located proximate to the central axis **14**. Any one of a number of different spokes may be utilized, so long as the spokes can support the frame **12** and later described components.
(17) Additionally, other types of variations can be considered as well. For example, the central rotational axis **14** may be a central vertical shaft rather than a hub **20** and may be attached to the individual masts **22**A-**22**D via a network of reinforcing girders in place of the cables attaching the tops of the individual masts **22**A-**22**D. For instance, one set of girders may span from near the base

of this vertical shaft **20** to the tops of the masts **22**A-**22**D, a second from an upper segment of the vertical shaft to the tops of the masts, a third between the tops of the masts\ and optionally a fourth from frame **12** to a short distance up the central vertical shaft to resist deflection of this central vertical shaft. More girders may attach this network to anchoring points on the larger container ship far above the waterline. The vertical shaft described in this paragraph may house one or more additional horizontal axis wind turbines on its top. These vertical and horizontal axis wind turbines might rotate at different frequencies, transmitting power to the propellers by concentric shafts or electrical wires.

(18) The vertical axis turbine **10** also includes wind capturing devices **21**A-**21**D for capturing wind energy. It should be understood that the wind capturing device **21**A-**21**D can be utilized to capture the movement of any liquid or gas medium, not just wind. For example, the wind-capturing device **21**A-**21**D could be used to capture the movement of water or other fluids. The devices **21**A-**21**D may be blades or may be a mast and sail system. The blade may be essentially a mast, sail, and or boom that is one unitary and generally rigid structure. Therefore, it should be understood that any description of masts, sails and/or booms are equally applicable to a blade.

(19) As the wind **44** interacts with the wind capturing devices **21**A-**21**D, the frame **12** may rotate, as indicated by arrows **50** and **52**, which can then be used to provide power through either a mechanical connection to a propeller of the seagoing vessel and/or via an electrical connection, such as a generator. The vertical axis turbine **10** may also include a lock **25** that, when in a locked mode, prevents the frame **12** from rotating and, when in an unlocked mode, allows the frame **12** to rotate freely.

(20) The lock **25** can be any type of device capable of selectively preventing the rotation of the frame **12**. In some examples, the lock **25** can be one or more pins that are selectively extended through the base **48** such that the rotation of the frame **12** is prevented when the pin is selected through a portion of the masts base **48**. Other types of locks can also be used, such as frictional locks that frictionally engage sidewalls of the base **48** preventing the rotation of the frame **12**. Further still, the lock **25** can be one or more electric motors that can be energized to allow or prevent the rotation of frame **12**.

(21) In this example, the device **21**A-**21**D may have masts. Generally, these masts define a length that is substantially perpendicular to a plane defined by the frame **12**. In this embodiment, each mast has a generally opposing mast. More specifically, mast **22**A generally opposes mast **22**C across the central axis **14**. In like manner, mast **22**B is generally opposing mast **22**D across the central axis **14** as well. As stated before, any even number of masts can be used, so long as each mast has a generally opposing mast.

(22) Attached to each of the masts **22**A-**22**D are booms **24**A-**24**D. These booms generally extend substantially perpendicular to the length defined by the masts **22**A-**22**D. Furthermore, these booms are generally rotatable about an axis generally defined by each of the masts **22**A-**22**D. Sails **26**A-**26**D are attached to both their respective masts **22**A-**22**D and their respective booms **24**A-**24**D. The sails **26**A-**26**D may be made of a cloth-like and flexible material or may be made of a semi-rigid material. There may also be an additional portion of the sails **26**A-**26**D below the booms **24**A and attaching to the masts **22**A.

(23) The device **21**A-**21**D may also include locks **23**A-**23**D that function to lock the booms **24**A-**24**D into place. By so doing, the booms **24**A-**24**D cannot rotate freely when the vertical axis turbine **10** is in a locked mode. Conversely, when the vertical axis turbine **10** is in an unlocked mode, the locks **23**A-**23**D are unlocked and therefore allow the booms **24**A-**24**D to rotate freely.

(24) The locks **23**A-**23**D can be any type of device capable of selectively preventing the rotation of the booms **24**A-**24**D. In some examples, the locks **23**A-**23**D can be one or more pins that are selectively extended through the masts **22**A-**22**D such that the rotation of the booms **24**A-**24**D is prevented when the pin is selected through a portion of the masts **22**A-**22**D. Other types of locks can also be used, such as frictional locks that frictionally engage sidewalls of the masts **22**A-**22**D,

preventing the rotation of the masts **22**A-**22**D and, therefore, movement of the booms **24**A-**24**D. Further still, the locks **23**A-**23**D can be one or more electric motors that can be energized such that they can allow or prevent the rotation of the masts **22**A-**22**D and, therefore, movement of the booms **24**A-**24**D.

(25) Alternatively, as mentioned above, the devices **21**A-**21**D may be blades. As such, the devices **21**A-**21**D may only include masts **22**A-**22**D and sails **26**A-**26**D that form a unitary blade. Generally, this blade is rigid but may also be made out of a semi-rigid or bendable material. An example of a blade will be given later in this description. There may also be an additional portion of the blades below the booms **24**A and attaching to the masts **22**A.

(26) Attached to the frame are retaining members in the form of eyelets **28**A-**28**D. Generally, the eyelets are located proximate to the mast **22**A-**22**D. Each of the eyelets **28**A-**28**D are located with respect to the masts **22**A-**22**D such that the distance between each of the masts **22**A-**22**D and the corresponding eyelets **28**A-**28**D are substantially similar in both distance and orientation. Each of the eyelets defines an opening **30**A-**30**D. The eyelets **28**A-**28**D may be any suitable shape, but here they are shown as substantially semicircular, with both ends of the semicircular structure attached to the frame **12**. While the retaining members are shown in this example to be eyelets **28**A-**28**D, other forms of retaining members may be used instead of or in combination, such as hooks.

(27) The vertical axis turbine **10** also includes a first cord **32** and a second cord **34**. The first cord **32** has ends **36** and **38**. The first end **36** is attached to boom **24**A. The second end **38** of the cord **32** is attached to the boom **24**C. The cord **32** extends from boom **24**A through the opening **30**A of the eyelet **28**A and across the central axis **14**. From there, the cord **32** extends through the opening **30**C of the eyelet **28**C and is attached to the boom **24**C.

(28) Similarly, the second cord **34** has a first end **40** and a second end **42**. The first end **40** is attached to the boom **24**B and extends through the opening **30**B of the eyelet **28**B and generally across the central axis **14**. From there, the cord **34** extends through the opening **30**B, wherein the second end **42** is attached to the boom **24**D.

(29) The cords **32** and **24** can be made of any one of a number of different materials, such as rope, string, or wire. The cords **32** and **34** can also be made out of synthetic materials, such as plastic. The cords **32** and **34** may also be configured to lengthen or detach from the booms **24**A-**24**D or blades when tension exceeds a predetermined threshold.

(30) It is also important to note that the length of the cords **32** and **34** is critical. More specifically, when a wind **44** is directed towards the vertical axis turbine **10**, the sails **26**A-**26**D will move to the appropriate orientation based on the movement and length of the cords **32** and **34** to capture this energy generated by the wind **44**. As the sails **26**A-**26**D capture this wind, the frame **12** rotates about the central axis **14**. A generator **46** located near a base **48** of the vertical axis turbine converts this movement into electricity. As shown in this embodiment, the vertical axis wind turbine would rotate in a clockwise direction, indicated by arrows **50** and **52**.

(31) Referring to FIG. **2**, a top view of the vertical axis turbine **10** of FIG. **1** is shown. Like before, like reference numerals have been used to refer to like components, and the description of these previous elements is equally applicable to this figure. Here, as wind **44** interacts with the vertical axis turbine **10**, the vertical axis turbine **10** turns clockwise as indicated by arrows **50** and **52** when the locks **23**A-**23**D and the lock **25** are unlocked.

(32) As stated previously, the cords **32** and **34** regulate the position of the sails by regulating the position of the booms **24**A-**24**D. Here, as the sail **26**D interacts with the wind **44**, the boom **24**D will rotate from the position indicated by dotted lines **45** to its solid line drawn position on the outside of the frame. As the booms **24**D, **24**C, **24**B, and **24**A rotate about the central axis **14** (shown in FIG. **1**), these booms will replicate the orientation of each boom whose position they fill. By so doing, the vertical axis turbine is more efficient than fixed sail or fixed blade vertical axis turbines, which do not move the position of the sails or blades.

(33) Here, the cord **34** is pulled almost completely by the opposing sail **26**D, such that the boom

24B is pointing directly into the wind **44**. Similarly, as the sail **26**B interacts with the wind **44**, the flexible sail **26**B will momentarily head the wind **44** and pause between both the inside and outside of the frame **12**, as indicated by dotted lines **47**. As the sail **26**B passes across this point, the wind **44** gradually pushes the sail **26**B from being substantially outside the frame **12** to substantially inside the frame **12**, while the cord **34** gradually releases the sail **26**B directly above and below the central portion **20** of the frame **12**. Likewise, the wind shifts from billowing the sail **26**B outside the frame **12** to pushing the sail **26**B inside the frame **12**.

(34) As can be shown in FIG. **2**, the sail attached to boom **24**B is essentially in a position less likely to capture the wind **44**, allowing it to more freely directly into the wind **44**, but the sails attached to booms **24**A, **24**C, and especially **24**D are in a position more capable of efficiently receiving the wind **44** in a manner that pushes them in an appropriate direction to rotate the frame **12**. Sails **26**A and **26**C are harvesting a substantial portion of the wind **44** by their airfoil-like shape, which captures energy via Bernoulli's principle. By so doing, the vertical axis turbine **10** can be more efficient with receiving the wind **44** by maximizing the capture of the wind as the frame **12** rotates about the central axis **14**, shown in FIG. **1**.

(35) Referring to FIG. **3**, another embodiment of the vertical axis turbine **110** is shown. In this embodiment of the vertical axis turbine **110**, similar reference numerals have been utilized to indicate similar elements previously described in FIG. **1**. The description of these elements is applicable to this embodiment of the vertical axis wind turbine **110**.

(36) In this embodiment, the devices **21**A-**21**D are comprised of blades. Like the previous embodiment and further embodiments discussed in this specification, the devices **21**A-**21**D may replace the masts **22**A-**22**D and/or booms **24**A-**24**D and/or sails **26**A-**26**D, or any combination thereof, with blades **29**A-**29**D. The blades **29**A-**29**D may be a single unitary structure, and they may be made out of a rigid or semi-rigid material. Further, while blades **29**A-**29**D are shown to be substantially triangular, the blades **29**A-**29**D may take any one of a different number of shapes, such as substantially quadrilateral. Each device **21**A-**21**D may also comprise a plurality of separate blades. Also, like the vertical axis turbine **10** of FIG. **1**, the device **21**A-**21**D may also include locks **23**A-**23**D that function to lock the blades **29**A-**29**D into place. By so doing, the blades **29**A-**29**D cannot rotate freely when the vertical axis turbine **10** is in a locked mode. Conversely, when the vertical axis turbine **10** is in an unlocked mode, the locks **23**A-**23**D are unlocked and therefore allow the blades **29**A-**29**D to rotate freely.

(37) Additionally, the vertical axis turbine **110** differs from the vertical axis turbine **10** of FIG. **1** in that two additional cords **54** and **56** have been added. The cord **54** has a first end **58** and a second end **60**. The first end **58** is attached to the top of the blade **29**A, while the second end **60** is attached to the top of the blade **29**C. Similarly, cord **56** has a first end **62** and a second end **64**. The first end **62** is attached to blade **29**B, while the second end **64** is attached to blade **29**D. By attaching the cords **54** and **56** to their respective blades **29**A-**29**D, the position of blades **29**A-**29**D can be canted or tilted with respect to the frame **12** when the wind **44** is received by the vertical axis turbine **110**. Further, it should be understood that the cords **54** and **56** can be attached in a different configuration, such as between devices **21**A and **21**D, **21**B and **21**C, **21**C and **21**D, **21**A and **21**B, or any other possible combination.

(38) It should be noted that if cords **54** and **56** are substantially taut, such that all of the blades **29**A-**29**D are tilted inward with respect to the central axis **14**, the vertical axis turbine **110** can capture wind provided to it from any direction, essentially making the vertical axis turbine **110** omnidirectional. For example, wind originating below the vertical axis turbine **110** would cause the blades **29**A-**29**D (or sails **26**A-**26**D of FIGS. **1** and **2**) to pivot outward to capture the wind energy coming from below the vertical axis turbine **110**.

(39) This wind energy will be captured in the same fashion as the sloped blades of a conventional horizontal axis wind turbine. All of the blades **29**A-**29**D will be sloped at the same angle, allowing them to transfer the upward force of the wind into a constant horizontal force tangential to the

frame **12** and thus produce torque. In like manner, a wind originating from above the vertical axis turbine **110** would cause the blades **29**A-**29**D (or sails **26**A-**26**D of FIGS. **1** and **2**) to pivot inward to capture the wind energy coming from above the vertical axis turbine **110**. Likewise, if the blades **29**A-**29**D are tilted outward with respect to the central axis **14**, then the wind turbine **110** will again be omnidirectional because the opposite will occur: the blades **29**A-**29**D will pivot outward if a wind originates from above and inward if a wind originates from below.

(40) Furthermore, as stated before, the blades **29**A-**29**D may be replaced with masts **22**A-**22**D, booms **24**A-**24**D, and sails **26**A-**26**D, as shown in FIG. **1**. In this configuration, the first end **58** of cord **54** is connected to the top of mast **22**A, while the first end **60** of the cord **54** is connected to mast **22**C. Likewise, the first end **62** of the second cord **56** is connected to the top of mast **22**B, while the second end **64** of the second cord **56** is connected to the top of mast **22**D

(41) However, the cords **54** and **56** could be attached differently to maintain the position of the masts **22**A-**22**D or blades **29**A-**29**D. For example, cord **54** could have a first end **58** attached to the top of the mast **22**A, while the second end **60** of cord **54** could be attached to either mast **22**B and/or mast **22**C.

(42) Referring to FIG. **4**, another embodiment of the frame **12** having devices **21**A-**21**D is shown. In this embodiment, a mechanical member **77** is situated within the frame **12** and configured to interact with each device **21**A-**21**D. In this example, the devices **21**A-**21**D are similar to the devices shown in FIG. **1**, when the devices include masts **22**A-**22**D, sails **26**A-**26**D, and booms **24**A-**24**D. However, it should be understood that the features of this embodiment are equally applicable in situations where the devices **21**A-**21**D include blades, such as the blades **29**A-**29**D shown in FIG. **3**.

(43) The movement of one of the devices **21**A-**21**D causes the mechanical member **77** to move the other devices **21**A-**21**D. As such, in this example, the mechanical member **77** is used in lieu of the cord **54** to regulate the movement of the devices **21**A-**21**D. In one example, the mechanical member **77** may be a rope or chain that interacts with a gear of each of the devices **21**A-**21**D. The movement of the mechanical member **77** causes a rotation of the gear of each of the devices **21**A-**21**D, thus causing the devices **21**A-**21**D to move. If the mechanical member **77** is locked into place, the movement of the devices **21**A-**21**D is restricted and is fixed. As such, the mechanical member **77** may be in communication with a lock **78** that can lock and prevent the movement of the mechanical member **77** and therefore prevent the movement of the devices **21**A-**21**D. The lock **78** can be any type of lock that can prevent the movement of the mechanical member **77**, such as a pin lock, frictional lock, electric motor, and the like.

(44) FIG. **5** illustrates another example of regulating the movement of the devices **21**A-**21**D. In this example, the devices **21**A-**21**D are similar to the devices shown in FIG. **1**, which include masts **22**A-**22**D, sails **26**A-**26**D, and booms **24**A-**24**D. However, it should be understood that the features of this embodiment are equally applicable in situations where the devices **21**A-**21**D include blades, such as the blades **29**A-**29**D shown in FIG. **2**.

(45) Here, like before, the position of the boom **24**A is regulated by the cord **32**. However, when in a locked mode, the cord **32** may be pulled taught to prevent the movement of the boom **24**A in one direction. Another cord **79** may be connected to a mechanical lock **81** that can retract and lock the cord **79** in place. The mechanical lock **81** can be any type of suitable locking device, such as a pin, frictional lock, and the like. By so doing, the position of the boom **24**A and, therefore, the sail **26**A can be put into a specific position based on the length of the cords **32** and **79**.

(46) FIG. **6** illustrates another embodiment of how to position the sail **26**A of the device **21**A. Like before, it should be understood that the features of this embodiment are equally applicable in situations where the devices **21**A-**21**D include blades, such as the blades **29**A-**29**D shown in FIG. **2**.

(47) Here, an electric motor **83**A is in mechanical communication with the mast **22**A. The boom **24**A, in this example, may be fixed to the mast **22** A. As such, the rotation of the mast **22**A by the

electric motor **83**A functions to move the boom **24**A and, therefore, the position of the sail **26**A. Alternatively, the electric motor **83**A may be disposed of within the mast **22**A and may cause the boom **24**A to rotate about the mast **22**A. A locking device **85**A may be incorporated within the electric motor **83**A and/or be located outside the electric motor **83**A to be able to lock the position of the boom **24**A into place when the vertical axis turbine is in a locked position. The locking device **85**A can be any type of suitable locking device, such as a pin, frictional lock, and the like.

(48) Referring to FIG. **7**, an example of a seagoing vessel **200** incorporating two vertical axis turbines **10** is shown. In this example, the seagoing vessel **200** is traveling along a trajectory (direction) indicated by arrow **202**. A wind **244** has a wind direction that is substantially perpendicular to the direction **202** of the seagoing vessel **200**. In this example, as explained earlier in this description, the vertical axis turbines **10** rotate freely based on the interaction with the wind **244**. In this example, the vertical axis turbines **10** are in an unlocked mode and therefore rotate freely. The rotation of the vertical axis turbines **10** can be used to convert energy from the wind **244** into either mechanical energy and/or electrical energy. The mechanical and/or electrical energy can then be used to drive a propeller **210** of the seagoing vessel **200** or, alternatively, could be used to provide electricity or mechanical power to any of a number of different systems and subsystems that form the seagoing vessel **200**.

(49) The seagoing vessel **200** can be any type of vessel capable of traversing water by flotation. As such, the seagoing vessel **200** can be a container ship, bulk carrier, barge, schooner, tanker, tugboat, frigate, passenger ship, and the like. In one example, the seagoing vessel **200** may also be a detachable "tugboat" for larger container ships, only attaching to the larger container ships once out at sea to preserve port operations of the existing container ships and providing additional thrust or auxiliary electrical power. This attachment could be via cables, magnetic clamps, or direct mechanical couplings.

(50) Referring to FIG. **8**, the seagoing vessel **200** of FIG. **7** is shown. In this example, wind **244** has a wind direction similar to that of the direction **202** of the seagoing vessel **200**. In this example, the vertical axis turbines **10** are placed in the locked position wherein the frames **12** of the vertical axis turbines **10** do not rotate. Furthermore, the devices **21**A-**21**D are also locked in the place and do not rotate either. As such, if the devices **21**A-**21**D utilize booms, masts, and sails, the booms are locked into place, strategically positioning the sails. If the devices **21**A-**21**D are blades, the blades are locked in place.

(51) In this example, it has been observed that the efficiency of propelling the seagoing vessel **200** forward can be improved by locking the vertical axis turbines **10** into place and using the devices **21**A-**21**D to capture wind energy from the wind **244** and propel the seagoing vessel **200** along its direction **202** by transferring the forces captured from the wind **244** by the devices **21**A-**21**D to the structure of the seagoing vessel **200**. As such, in the locked mode, placement of the devices **21**A-**21**D can essentially turn the seagoing vessel **200** into a sailboat, wherein at least a portion of the propulsion of the seagoing vessel **200** is provided by directly using energy from the wind **244** to propel the seagoing vessel **200** along the direction **202**. It should be understood that the seagoing vessel **200** may also be propelled by the propeller **210** in addition to forces captured from the wind **244** by the locked vertical axis turbines **10**.

(52) It should be noted that the direction **202** that the seagoing vessel wishes to travel in the direction of the wind **244** plays a role in determining if the vertical axis turbines **10** should be placed in a locked or unlocked mode. For example, based on the direction of the wind **244** and the direction **202** of the seagoing vessel **200**, one or more calculations can be performed as to what is more efficient—either capturing energy from the wind **244** by rotation of the vertical axis turbines **10** and using that energy to provide propulsion to the seagoing vessel **200** or, capturing energy to propel the seagoing vessel **200** by locking the vertical axis turbines **10** and providing propulsion to the seagoing vessel **200** by converting forces received from the wind **244** that are transferred down into the structure of the seagoing vessel **200**, therefore, propelling the seagoing vessel **200** forward,

similar to a sailboat.
(53) FIG. **9** illustrates one example of the seagoing vessel **200**, including the vertical axis turbines **10**. In this example, the seagoing vessel **200** is experiencing significant wind **344**, which may be hurricane-like winds. To prevent damage to the vertical axis turbines **10**, the devices **21**A-**21**D may be rotated into one of two configurations. Moreover, in one configuration, the devices **21**A-**21**D may be rotated to cut directly into the wind, as shown in the vertical axis turbine **10** on the upper right. In another configuration shown in the vertical axis turbine **10** on the lower left, the devices **21**A-**21**D may be in a closed configuration, wherein the devices **21**A-**21**D essentially guide the wind **344** around the exterior of the frame **12** of the vertical axis turbines **10**.
(54) Referring to FIG. **10**, a control system **300** for the seagoing vessel propulsion systems described in the previous paragraphs and figures is shown. In this example, the control system **300** includes a control module **302** that may include a processor **304** and a memory **306**. The processor **304** may be a single processor or may be multiple processors acting in concert. The memory **306** may be any type of memory device capable of storing electronic information. As such, the memory **306** may be a solid-state memory device, a magnetic memory device, an optical memory device, and the like. The memory **306** may store instructions that cause the processor **304** to perform any one of the methods described in this specification.
(55) The processor **304** is also in communication with the sensor system **330**. The sensor system **330** may include a wind sensor **332** that can determine the speed and/or direction of wind received by the vertical axis turbines **10**. The sensor system **330** may also have a vessel direction sensor **334**, which indicates the direction of the seagoing vessel. It should be understood that the vessel direction sensor **334** may not be a sensor but may alternatively be a trajectory along a path that the seagoing vessel wishes to travel.
(56) One or more motor controllers **320** may be in communication with the processor **304**. For example, a boom/blade controller **322** may be in communication with the processor **304** that controls the position and movement of the boom/blade depending on the type of wind-capturing devices **21**A-**21**D being utilized. The motor controllers **320** may also include a frame controller **324** that controls an electric motor that is in communication with the frame of the vertical axis turbine **10** and can, therefore, control the movement of the frame **12** of the vertical axis turbine **10**.
(57) A locking system **309** may also be in communication with the processor **304**. The locking system **309** may include one or more boom/blade lock controllers **310** that cause the locking or unlocking of one or more locks, such as locks **23**A-**23**D that allow the boom and/or blade to rotate freely in the unlocked mode but restrict the rotation in the locked mode. The locking system **309** may also include a frame lock controller **312** that controls the locking of the lock **25** of the frame **12** of the vertical axis turbines **10**.
(58) As stated before, the memory **306** may include any one of a number of different instructions that cause the processor **304** to perform any of the methods disclosed in this specification. In one example, the memory **306** includes instructions that, when executed by the processor **304**, cause the processor **304** to determine the wind direction of any wind received by the seagoing vessel by monitoring the wind sensor **332** in determining the direction of the seagoing vessel by receiving information for the vessel direction sensor **334**. Based on the analysis of the wind direction and speed in the direction of the seagoing vessel, the processor **304** may determine regarding if the vertical axis turbine **10** should be in a locked or unlocked mode. For example, if the wind direction of the wind in the direction of the seagoing vessel or substantially similar, the processor **304** may determine that it is more efficient to place the vertical axis turbine **10** in a locked mode. Conversely, if it is determined that the direction of the wind interacting with the seagoing vessel is substantially perpendicular to the direction of the seagoing vessel, the processor **304** may determine that the vertical axis turbine **10** should be in the unlocked mode to collect energy from the rotation of the frame of the vertical axis turbine **10**.
(59) It should be understood that a number of different calculations can be utilized by the processor

304 to determine what type of mode the vertical axis turbine **10** should be placed in. Furthermore, the processor **304** may receive information from the sensor system **330** that indicates that the seagoing vessel is traveling through adverse weather conditions that may include hurricane-force winds. If such a situation arises, the processor **304** instructs the motor controllers **322** to orientate the devices **21**A-**21**D as previously described in the paragraphs above that refer to FIG. **9**.

(60) It should be appreciated that any of the systems described in this specification can be configured in various arrangements with separate integrated circuits and/or chips. The circuits are connected via connection paths to provide for communicating signals between the separate circuits. Of course, while separate integrated circuits are discussed, in various embodiments, the circuits may be integrated into a common integrated circuit board. Additionally, the integrated circuits may be combined into fewer integrated circuits or divided into more integrated circuits.

(61) In another embodiment, the described methods and/or their equivalents may be implemented with computer-executable instructions. Thus, in one embodiment, a non-transitory computer-readable medium is configured with stored computer-executable instructions that, when executed by a machine (e.g., processor, computer, and so on), cause the machine (and/or associated components) to perform the method.

(62) Detailed embodiments are disclosed herein. However, it is to be understood that the disclosed embodiments are intended only as examples. Therefore, specific structural and functional details disclosed herein are not to be interpreted as limiting, but merely as a basis for the claims and as a representative basis for teaching one skilled in the art to variously employ the aspects herein in virtually any appropriately detailed structure. Further, the terms and phrases used herein are not intended to be limiting but rather to provide an understandable description of possible implementations.

(63) The systems, components and/or processes described above can be realized in hardware or a combination of hardware and software and can be realized in a centralized fashion in one processing system or in a distributed fashion where different elements are spread across several interconnected processing systems. Any kind of processing system or another apparatus adapted for carrying out the methods described herein is suited. A combination of hardware and software can be a processing system with computer-usable program code that, when being loaded and executed, controls the processing system such that it carries out the methods described herein. The systems, components, and/or processes also can be embedded in a computer-readable storage, such as a computer program product or other data programs storage device, readable by a machine, tangibly embodying a program of instructions executable by the machine to perform methods and processes described herein. These elements also can be embedded in an application product which comprises all the features enabling the implementation of the methods described herein and, when loaded in a processing system, can carry out these methods.

(64) Furthermore, arrangements described herein may take the form of a computer program product embodied in one or more computer-readable media having computer-readable program code embodied, e.g., stored, thereon. Any combination of one or more computer-readable media may be utilized. The computer-readable medium may be a computer-readable signal medium or a computer-readable storage medium. The phrase “computer-readable storage medium” means a non-transitory storage medium. A computer-readable medium may take forms, including, but not limited to, non-volatile media and volatile media. Non-volatile media may include, for example, optical disks, magnetic disks, and so on. Volatile media may include, for example, semiconductor memories, dynamic memory, and so on. Examples of such a computer-readable medium may include but are not limited to a floppy disk, a flexible disk, a hard disk, a magnetic tape, other magnetic medium, an ASIC, a graphics processing unit (GPU), a CD, other optical medium, a RAM, a ROM, a memory chip or card, a memory stick, and other media from which a computer, a processor or other electronic device can read. In the context of this document, a computer-readable storage medium may be any tangible medium that can contain or store a program for use by or in

connection with an instruction execution system, apparatus, or device.
(65) The following includes definitions of selected terms employed herein. The definitions include various examples and/or forms of components that fall within the scope of a term, and that may be used for various implementations. The examples are not intended to be limiting. Both singular and plural forms of terms may be within the definitions.
(66) References to “one embodiment,” “an embodiment,” “one example,” “an example,” and so on, indicate that the embodiment(s) or example(s) so described may include a particular feature, structure, characteristic, property, element, or limitation, but that not every embodiment or example necessarily includes that particular feature, structure, characteristic, property, element or limitation. Furthermore, repeated use of the phrase “in one embodiment” does not necessarily refer to the same embodiment, though it may.
(67) Program code embodied on a computer-readable medium may be transmitted using any appropriate medium, including but not limited to wireless, wireline, optical fiber, cable, RF, etc., or any suitable combination of the foregoing. Computer program code for carrying out operations for aspects of the present arrangements may be written in any combination of one or more programming languages, including an object-oriented programming language such as Java™, Smalltalk, C++, or the like and conventional procedural programming languages, such as the “C” programming language or similar programming languages. The program code may execute entirely on the user's computer, partly on the user's computer, as a stand-alone software package, partly on the user's computer and partly on a remote computer, or entirely on the remote computer or server. In the latter scenario, the remote computer may be connected to the user's computer through any type of network, including a local area network (LAN) or a wide area network (WAN), or the connection may be made to an external computer (for example, through the Internet using an Internet Service Provider).
(68) The terms “a” and “an,” as used herein, are defined as one or more than one. The term “plurality,” as used herein, is defined as two or more than two. The term “another,” as used herein, is defined as at least a second or more. The terms “including” and/or “having,” as used herein, are defined as comprising (i.e., open language). The phrase “at least one of . . . and . . . .” as used herein refers to and encompasses any and all possible combinations of one or more of the associated listed items. As an example, the phrase “at least one of A, B, and C” includes A only, B only, C only, or any combination thereof (e.g., AB, AC, BC, or ABC).
(69) Aspects herein can be embodied in other forms without departing from the spirit or essential attributes thereof. Accordingly, reference should be made to the following claims rather than to the foregoing specification, as indicating the scope hereof.

Claims

1. A propulsion system for a seagoing vessel, the propulsion system comprising: a vertical axis wind turbine having a locked mode and an unlocked mode, the vertical axis wind turbine having: a frame having that is rotatable about a central axis when in the unlocked mode and non-rotatable about the central axis when in the locked mode, either (a) at least two masts coupled to the frame, each having a sail and a boom that is rotatable when in the unlocked mode and non-rotatable when in the locked mode, or (b) at least two blades coupled to the frame, the at least two blades when in the unlocked mode and non-rotatable in the locked mode, and a mechanical member having a first portion coupled to the boom of one of the at least two masts and a second portion coupled to the boom of the other of the at least two masts or having the first portion of the mechanical member coupled to one blade of the at least two blades and the second portion of the mechanical member coupled to the other blade of the at least two blades, the mechanical member being configured to regulate positions of the two sails or two blades when in the unlocked mode; and a control system configured to selectively change the vertical axis wind turbine between the locked mode and the

unlocked mode.

2. The propulsion system of claim 1, further comprising: a wind direction sensor in communication with the control system, the wind direction sensor is configured to determine a direction of a wind that is received by either one of the sail or a blade of at least two blades; and wherein the control system is configured to determine when the vertical axis wind turbine should be in either the locked mode or the unlocked mode based on the direction of the wind and a direction that the seagoing vessel is traveling.

3. The propulsion system of claim 2, wherein the control system is configured to determine that the vertical axis wind turbine should be in the locked mode when the direction of the wind is substantially similar to the direction that the seagoing vessel is traveling.

4. The propulsion system of claim 2, wherein the control system is configured to determine that the vertical axis wind turbine should be in the unlocked mode when the direction of the wind is dissimilar to the direction that the seagoing vessel is traveling.

5. The propulsion system of claim 2, further comprising a propeller for providing propeller propulsion to move the seagoing vessel, the propeller propulsion being generated at least in part by a rotation of the frame about the central axis.

6. The propulsion system of claim 5, wherein the control system is configured to determine that the vertical axis wind turbine should be in the locked mode when propeller propulsion is less than propulsion provided by the sails or by the at least two blades by the wind received by the sail or the at least two blades when in the locked mode.

7. The propulsion system of claim 5, wherein the frame is in mechanical communication with the propeller.

8. The propulsion system of claim 5, wherein the frame is in mechanical communication with an electrical generator.

9. The propulsion system of claim 2, further comprising each boom is coupled to a boom motor or each blade coupled to a blade motor, wherein each boom motor is configured to change a rotational position of the respective boom, and each blade motor is configured to change the rotational position of the respective blade.

10. The propulsion system of claim 9, wherein the control system is in communication with the boom motor or the blade motor.

11. The propulsion system of claim 10, wherein the control system is configured to change the rotational positions of the booms or blades based on the direction of the wind that is received by either the sails or the blades.