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JOYSTICK FOR CONTROLLING MARINE PROPULSION

Abstract

A marine propulsion system for a marine vessel includes a single rear marine drive configured to be positioned near a stern of the marine vessel, a joystick comprising a joystick handle configured to be movable by a user to provide steering demand input, wherein the joystick is configured such that the joystick handle is movable in a forward direction to demand a forward motion of the marine vessel, in a backward direction to demand backward motion of the marine vessel, and twistable to demand rotational motion of the marine vessel, wherein the joystick is configured to restrict movement of the joystick handle in a lateral direction, and a control system configured to control steering and/or thrust of the single rear marine drive based on the steering demand input to generate the demanded forward motion, the backward motion, and the rotational motion of the marine vessel.

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Background/Summary

FIELD

[0001] The present disclosure generally relates to systems for controlling vessel propulsion, and more particularly to joysticks and marine propulsion systems comprising joysticks.

BACKGROUND

[0002] Many different types of marine drives are well known to those skilled in the art. For example, steerable marine drives may be mounted to or in the rear of the vessel, such as outboard motors that are attached to the transom of a marine vessel and stern drive systems that extend in a rearward direction from the stern of a marine vessel. Marine drives generally comprise a powerhead, such as an electric motor or an internal combustion engine, driving rotation of a drive shaft that is directly or indirectly connected to a propeller on a propeller shaft and that imparts rotation thereto. Some marine propulsion systems include groups of two or more and separately steerable marine drives at the rear of the marine vessel to enable surge, sway, and yaw directional control. The steerable marine drives are each steerable about their steering axis to a range of steering angles, which is effectuated by a remotely controlled steering actuator, often referred to as a steer-by-wire system. User input control of such multi-drive propulsion systems is often provided by a joystick, which is configured to move forward, backward, and sideways to any position on a horizontal plane to command a thrust direction, as well as to twist to command a yaw rotation of the vessel.

SUMMARY

[0003] This Summary is provided to introduce a selection of concepts that are further described below in the Detailed Description. This Summary is not intended to identify key or essential features of the claimed subject matter, nor is it intended to be used as an aid in limiting the scope of the claimed subject matter.

[0004] According to one aspect of the present disclosure, a marine propulsion system for a marine vessel includes a single rear marine drive configured to be positioned near (e.g., mounted on) a stern of the marine vessel, a joystick comprising a joystick handle configured to be movable by a user to provide steering demand input, wherein the joystick is configured such that the joystick handle is movable in a forward direction to demand a forward motion of the marine vessel, in a backward direction to demand backward motion of the marine vessel, and twistable to demand rotational motion of the marine vessel, wherein the joystick is configured to restrict movement of the joystick handle in a lateral direction, and a control system configured to control steering and/or thrust of the single rear marine drive based on the steering demand input to generate the demanded forward motion, the backward motion, and the rotational motion of the marine vessel.

[0005] In one embodiment, the joystick is configured to prevent lateral movement of the joystick handle in right and left lateral directions such that the joystick handle is configured to be movable only in the forward direction, the backward direction, and to twist about a shaft axis of a shaft connected to the joystick handle.

[0006] In another embodiment, the system the joystick further includes a base below the joystick handle, a shaft connected to the joystick handle and extending into the base, wherein the shaft is

configured to move when the user manipulates the joystick handle, and a plate inside the base and positioned around the shaft, wherein the plate is configured to restrict lateral movement of the shaft and the joystick handle and to permit forward and backward movement of the shaft and the joystick handle and permit twist movement of the shaft and the joystick handle about a shaft axis of the shaft.

[0007] In another embodiment, the plate prevents lateral movement of the shaft and the joystick handle so as to only permit the forward, backward, and twist movements of the shaft and the joystick handle.

[0008] In another embodiment, the plate comprises an elongated hole configured to restrict the lateral movement of the shaft. In another embodiment, the elongated hole has a width that is slightly larger than a diameter of the shaft and a length that is substantially larger than the diameter of the shaft.

[0009] In another embodiment, the control system is further configured to calculate a thrust command for each of the lateral marine drive and the rear marine drive and a steering position command for the rear marine drive based on the propulsion demand input and a location of each of at least the lateral marine drive and the rear marine drive with respect to a center of turn of the marine vessel. In another embodiment, the elongated hole is centered around the shaft when the shaft is in a neutral position.

[0010] In another embodiment, the single rear marine drive is steerable about a steering axis to a range of steering angles. In another embodiment, the range of steering angles is no greater than between +45 degrees and −45 degrees of a centered steering position.

[0011] In another aspect of the present disclosure, a joystick for controlling propulsion of a marine vessel includes a joystick handle configured to be manipulated by a user to steer a marine vessel, a base below the joystick handle, a shaft connected to the joystick handle and extending into the base, wherein the shaft is configured to move when the user manipulates the joystick handle, and a plate inside the base and positioned around the shaft, wherein the plate is configured to restrict lateral movement of the shaft and the joystick handle and to permit forward and backward movement of the shaft and the joystick handle and permit twist movement of the shaft and the joystick handle about a shaft axis of the shaft.

[0012] In one embodiment, the joystick is configured to be installed on a marine vessel to control steering and/or thrust of a single rear marine drive on the marine vessel.

[0013] In another embodiment, the plate is mounted within the base such that it is centered around the shaft when the shaft is in a neutral position and configured to symmetrically restrict the lateral movement of the shaft in right and left lateral directions.

[0014] In another embodiment, the plate prevents lateral movement of the shaft and the joystick handle so as to only permit the forward, backward, and twist movements of the shaft and the joystick handle.

[0015] In another embodiment, the plate includes an elongated hole configured to restrict the lateral movement of the shaft. In another embodiment, the elongated hole has a width that is slightly larger than a diameter of the shaft and a length that is substantially larger than the diameter of the shaft. In another embodiment, the width of the elongated hole is between 1.01 and 1.2 times the diameter of the shaft. In another embodiment, the length of the elongated hole is between 1.5 and 2.5 times the diameter of the shaft.

[0016] In another embodiment, the elongated hole is arc-shaped at each end, wherein a radius of the arc is slightly larger than a radius of the shaft.

[0017] In another embodiment, the elongated hole is centered around the shaft when the shaft is in a neutral position.

[0018] In another embodiment, the plate is comprised of metal.

[0019] Various other features, objects, and advantages of the invention will be made apparent from the following description taken together with the drawings.

Description

BRIEF DESCRIPTION OF THE DRAWINGS

[0020] The present disclosure is described with reference to the following Figures.

[0021] FIG. **1** is a schematic illustration of a marine vessel with one embodiment of a marine propulsion system according to the present disclosure.

[0022] FIG. **2** is a schematic illustration of motion control achievable by a propulsion system with a single rear drive according to one embodiment of the present disclosure.

[0023] FIGS. **3**A-**3**B are schematic illustrations of various movements of a marine vessel.

[0024] FIG. **4** illustrates an exemplary joystick user input device.

[0025] FIGS. **5**A-**5**B are section views of an exemplary joystick according to one embodiment of the present disclosure.

[0026] FIGS. **6**A-**6**B are exemplary illustrations of a plate that restricts lateral movement of a joystick, according to one embodiment of the present disclosure.

[0027] FIG. **6**C is a schematic illustration of a plate with dimensions, according to one embodiment of the present disclosure.

DETAILED DESCRIPTION

[0028] The inventors have recognized a need for vessel control systems and methods that provide a user input device, such as a joystick, that provides movement directions that are correlated with feasible with a single rear marine drive while restricting movement directions that are not feasible with a single rear marine drive. Certain movement directions, such as sideways movement (or sway) and turning in place, are not possible on vessels with only a single rear marine drive and no other means of propulsion control. Thus, single drive vessels are not able to perform a full range of movements normally associated with joystick control of a multi-drive system. For example, lateral sideways movements of the marine vessel are not achievable with only one rear marine drive situated at or near the rear of the vessel due to the limitations on propulsion that can be effectuated by the single rear marine drive.

[0029] The inventors have recognized that the typical joystick system used for controlling multi-drive propulsion systems is problematic for controlling a single drive propulsion system because the single drive system is not capable of achieving propulsion in all of the directions that the joystick is configured to move. When unactionable movements of the joystick are received by the control system, the control system is unable to effectuate steering and/or thrust that sufficiently correlates to the demanded motion. When the system is unresponsive, users of the marine propulsion system may become confused or frustrated.

[0030] Based on the foregoing problems and challenges in the relevant art, the inventors developed the disclosed joystick and corresponding propulsion system providing a range of joystick control that correlates with the motion achievable on vessels with only a single rear marine drive and no other propulsion device. The joystick is configured to provide control input for the single rear marine drive—i.e., to control steering and thrust of the rear marine drive and confine the joystick motion so as to enable propulsion demand input at the joystick only in those directions that correlate with feasible motion of the single drive system. The joystick restricts lateral movement of the joystick handle while allowing the joystick handle to be moved in a forward direction to demand a forward motion of the marine vessel, in a backward direction to demand backward motion of the marine vessel, and twistable to demand rotational motion of the marine vessel. The control system is configured to control steering and/or thrust of the single rear marine drive based on the steering demand input to generate the demanded forward motion, the backward motion, and the rotational motion of the marine vessel. In one embodiment, the joystick includes a plate configured to confine movement of the shaft connected to the joystick handle, wherein the plate is configured to restrict lateral movement of the shaft and the joystick handle and to permit forward, backward, and twist movement of the shaft and the joystick handle.

[0031] FIG. **1** is a schematic representation of a marine vessel **10** equipped with a marine propulsion system **100** including one rear marine drive **21** positioned on or near the stern **24**, such as attached to the transom. The single rear marine drive **21** may be mounted along a centerline CL of vessel **10**, which is to be understood as generally laterally centered with respect to the beam of the vessel **10** such that when the steerable rear marine drive **21** is in a centered steering position it propels the marine vessel approximately or exactly straight ahead (under ideal conditions with no current, wind, or other lateral forces). The single rear marine drive **21** may be, for example, an outboard drive, a stern drive, an inboard drive, a jet drive, or any other type of steerable drive. The rear marine drive **21** is steerable, having a steering actuator **13** configured to rotate the drive **21** about its vertical steering axis **31**. The single rear marine drive **21** may be steerable about the steering axis **31** to a range of steering angles **32**, such as wherein the range of steering angles **32** is no greater than between +30 and −30 degrees of a centered steering position, or between +45 degrees and −45 degrees of a centered steering position, or between some other range. In another embodiment, the range of steering angles **32** may be no greater than between +90 degrees and −90 degrees of a centered steering position. The steering axis **31** is positioned at a distance X from the center of turn (COT) **30**, which could also be the effective center of gravity (COG). The marine vessel **10** is maneuvered by causing the rear marine drive to rotate about its steering axis **31**. The rear marine drive **21** is rotated in response to an operator's manipulation of the steering wheel **12** or joystick **40**, which is communicatively connected through the control system **33** to the steering actuator **13** to rotate the marine drive **21**. Rotating the rear marine drive **21** and effectuating thrust thereby cause rotation of the marine vessel **10** about the effective COT **30**.

[0032] The control system **33** may be configured to utilize yaw rate, such as from an inertial measurement unit (IMU) **26** or other rotational sensor capable of measuring yaw of the marine vessel **10**, as the basis for controlling steering and thrust magnitude and direction from the single rear marine drive **21**. The sensed yaw rate can be used as feedback control for adjusting the steering and/or thrust commands. Namely, the control system **33** may determine an expected yaw rate, or yaw velocity, associated with a rotational thrust command from the joystick **40** and may compare the measured yaw rate from the IMU **26** to the expected value(s) and adjust the thrust and/or steering commands to reduce the difference between the measured and expected values, such as between the measured yaw rate and the expected yaw rate.

[0033] Where the single rear marine drive **21** is an electric drive—i.e., having a powerhead being an electric motor—the marine propulsion system **100** will include a power storage device powering the motor(s) thereof. The power storage device, such as a battery (e.g., lithium-ion battery) or bank of batteries, stores energy for powering the electric motor(s) (e.g., motor) and is rechargeable, such as by connection to shore power. The power storage device may include a battery controller configured to monitor and/or control aspects of the power storage device. The battery controller may be configured to communicate a charge level and other values to the central controller **34** and/or another controller within the control system **33**.

[0034] Steering with a single rear marine drive has navigational limitations, as is described above. For example, the ability to effectuate lateral movement of the vessel is restricted by the placement and limitation of steering range angles associated with a single rear marine drive. The inventors have developed the disclosed joystick system configured specifically for controlling a single-drive propulsion system, wherein the joystick is configured to restrict movement of the joystick handle to those directions that correlate with feasible propulsion output of the system.

[0035] Referring now to FIGS. **2-4**, the control system may be configured to control steering and/or thrust of the single rear marine drive **21** based on steering demand input to generate a demanded forward **50** motion, the backward **52** motion, and/or rotational motion **55** of the marine vessel **10**. The marine propulsion system may include a joystick **40**, such as configured to be installed at the helm of the marine vessel **10**, to control the steering and/or thrust of the single rear marine drive on the marine vessel.

[0036] Referencing FIG. **4**, the joystick **40** device comprises a base **68**, a shaft **70**, and a moveable joystick handle **66** suitable for movement by an operator to provide steering demand input. Typically, the handle can be moved forward and back (represented by arrow **67***a*), as well as twisted (represented by arrow **67***b*) relative to the base **68** to provide corresponding movement commands for the propulsion system. The joystick **40** is configured such that the joystick handle **66** is movable in a forward **50** direction to demand a forward **50** motion of the marine vessel, in a backward **52** direction to demand backward **52** motion of the marine vessel, and twistable to demand rotational motion of the marine. When the joystick is twisted to demand a rotational motion, the movement effectuated by the single rear drive necessarily includes some forward or backward motion due to the propulsion constraints of the single drive, as indicated by the rotational arrow **55**. The joystick **40** is configured to prevent lateral movement of the joystick handle **66** in right and left lateral directions to prevent propulsion commands in the lateral directions **54**. Thus, the joystick **40** is configured such that the joystick handle **66** movable only in the forward direction, the backward direction, and to twist about an axis of a shaft connected to the joystick handle.

[0037] FIGS. **3**A-**3**B illustrate exemplary vessel movements that may be commanded via the joystick **40**. FIG. **3**A shows the vessel **10** moving in the forward **50** direction and backward **52** direction, also known as surge movement. FIG. **3**B illustrates a combination of yaw movement, represented by arrow **62**, and surge and sway translation in the forward and starboard directions, represented by arrow **60**.

[0038] The disclosed system enables movement of the marine vessel, such as that illustrated in FIGS. **3**A-**3**B, by effectuating steering and thrust control of the rear marine drive **21**. If the drive angle of the marine drive **21** is known, then vector analysis can be performed to effectuate any rotational movement. The system **100** is configured to provide translational movement in the forward and backward translational directions and to combine forward/reverse and yaw by adjusting the steering angle of the single rear marine drive.

[0039] The user steering inputs provided at the joystick **40** are received by the control system **33**, which may include multiple control devices communicatively connected via a communication link, such as a CAN bus (e.g., a CAN Kingdom Network), to control the marine propulsion system **100** as described herein. In the embodiment of FIG. **1**, the control system **33** includes a central controller **34** communicatively connected to the drive control module (DCM) **41** of the rear marine drive **21** and may include other control devices. Thereby, the controller **34** can communicate instructions to the DCM **41** of the rear drive to effectuate a commanded magnitude of thrust and a commanded direction of thrust (forward or reverse), as is necessary to effectuate the rotational steering inputs commanded at the joystick **40**. The controller **34** also communicates a steering position command to the steering actuator **13** to steer the marine drive **21**. Drive position sensor **44** is configured to sense the steering angle, or steering position, of the drive **21**. A person of ordinary skill in the art will understand in view of the present disclosure that other control arrangements could be implemented and are within the scope of the present disclosure, and that the control functions described herein may be combined into a single controller or divided into any number of a plurality of distributed controllers that are communicatively connected. The control system **33** may include one or multiple hardware controllers, which in various embodiments and arrangements may be communicatively connected by a communication bus, such as a CAN bus, or configured for wireless communication.

[0040] FIGS. **5**A-**5**B are orthogonal cross-section views of an exemplary joystick comprising a plate **74**, including sides **74***a*, **74***b*. FIG. **5**A is a cross-section view from a side-to-side view of the joystick (e.g., a cross-section from the right to left sides from the perspective of the user). FIG. **5**B depicts a longitudinal view (front-to-back) of the joystick. The joystick is configured with the base **68** below the joystick handle (not illustrated), wherein the shaft **70** of the joystick is connected to the joystick handle (not visible) and extends into the base **68**, wherein the shaft **70** is configured to move when the user manipulates the joystick handle. The base **68** may include a seal **75** and a housing **69**, wherein the seal **75** and housing **69** prevent obstruction and/or separation of components within the joystick, such as the shaft **70**, springs (illustrated in FIG. **5**B), and the plate **74**. A sensing arrangement configured to sense the position of the joystick shaft **70**, and thus the user input, may also be contained in the housing **69**. The seal **75** and the housing **69** of the base **68** may be configured as a unified product, whereby the joystick may be sold and handled as a unit and configured to be installed on a marine vessel.

[0041] Located within the base **68** and positioned around the shaft **70**, the plate **74** is an element configured to restrict lateral movement of the shaft **70** and the joystick handle, to permit forward and backward movement of the shaft **70** and the joystick handle, and to permit twist movement of the shaft **70** and the joystick handle about the shaft axis **73** of the shaft **70**. The plate **74** (e.g., **74***a* and **74***b*) may prevent lateral movement of the shaft **70** and the joystick handle. The distance formed between the two edges of the plate **74***a*, **74***b* and the outer edge of the shaft **70** when the shaft is in the neutral position (the position illustrated in FIGS. **5**A-**5**B) may be minimal, for example to supply sufficient clearance to avoid friction between the two surfaces as the shaft **70** is moved straight forward and backward while still preventing lateral movement of the shaft **70** and the joystick handle. For example, the width of the elongated hole may be between 1.01 and 1.2 times the diameter of the shaft, as explained in greater detail below.

[0042] The plate **74** is mounted within the base **68** such that the elongated hole **80** is centered around the shaft **70** when the shaft **70** is in a neutral position and configured to symmetrically restrict the lateral movement of the shaft **70** to minimize or prevent movement of the joystick handle and shaft **70** in right and left lateral directions. In one embodiment, the plate **74** may be a singular component, wherein **74***a* and **74***b* are two sides of a single plate **74** where the shaft passes through an elongated hole in the center of the plate **74***a*, **74***b*. The ends of the elongated hole may provide stop points for movement, being configured to define a stop point for forward and backward movement of the joystick handle moved in the forward direction and backward direction. In another embodiment, **74***a* and **74***b* may be two separate longitudinal plates **74***a*, **74***b* or elements that are mounted within the housing but disconnected from one another. The plates **74***a*, **74***b* restrict lateral movement of the shaft **70** and the joystick handle but does not impact movement of the shaft **70** and the joystick handle in the forward direction and the backward direction.

[0043] Referring also to FIGS. **6**A-**6**B and **7**, the length of the elongated hole **80** may be substantially larger than the diameter of the shaft **70** to allow for movement of the shaft and joystick handle in the forward direction and the backward direction. As the shaft is moved via a user's interaction with the joystick handle, on or more springs **76** connected to the shaft may be configured to resist movement of the shaft **70** away from the neutral position at the center of the elongated hole **80** and to return the position of the shaft **70** to the neutral position when the user releases the handle or is otherwise not interacting with the joystick. Likewise, a ramped retaining arrangement **78** may be provided around the shaft **70** and configured to urge the shaft toward a the neutral position at the center. The seal **75** may comprise a flexible material, such as a rubber, that moves with the movement of the joystick handle and shaft **70**, thereby maintaining a seal between the shaft **70**, the joystick handle, and the housing **69** of the base **68**.

[0044] FIGS. **6**A-**6**B are exemplary embodiments of a plate **74** that restricts lateral movement of the joystick. The plate **74** may be produced from a variety of materials such as metal or plastic, and formed by a number of different manufacturing processes, such as by stamping, machining, casting, injection molding, or any other process to produce a plate **74** of sufficient strength and durability. If the plate **74** is made of plastic, the plastic may be a load-bearing plastic configured to withstand a load of at least 75 lbf without breaking or deforming, as an example.

[0045] Different processes may produce different plate shapes and may utilize different materials, such as metal or plastic. For example, using a stamping process on metal to create the plate **74** may result in a region of curved metal proximal to the elongated hole **80***a*, as exemplified in FIG. **6**A. This type of plate **74** is also exemplified in FIG. **5**A and FIG. **5**B, where the curved shape from stamping is evident in the region of the plate **74** proximal to the shaft **70**. Machining metal, such as any of various alloys, to produce a plate **74** may result in a plate **74** resembling the embodiment of FIG. **6**B.

[0046] As illustrated in FIG. **6**A and FIG. **6**B, the elongated hole **80***a*, **80***b* may be arc-shaped at each end, wherein a radius of the arc is slightly larger than a radius of the shaft. Although both FIG. **6**A and FIG. **6**B have rounded ends within the elongated hole **80***a*, **80***b*, in other embodiments the ends may be squared to form a rectangular end. Regardless of the shape of the ends of the elongated hole **80***a*, **80***b*, the length of the elongated hole **80***a*, **80***b* (including the ends) may be sufficient such that the length allows for movement of the shaft and joystick handle in the forward direction, the backward direction to demand forward and backward thrusts, and rotationally if the joystick is twisted to demand rotational motion.

[0047] Referring now to FIG. **6**C, the plate **74** comprises an elongated hole **80***a* configured to restrict the lateral movement of the shaft A. The dimensions of the elongated hole **80***a* may be determined by the diameter of the shaft A of the joystick and/or the range of movement of the shaft A and joystick handle in the forward direction and the backward direction. The location of holes **77** required for securing the plate **74** to the housing of the base may be dependent on the dimensions of the joystick and the components therein. The dimensions of the elongated hole **80***a* have sufficient tolerance to both avoid friction contact between the plate **74** and the shaft A and restrict lateral movement of the shaft A and the joystick handle. In embodiments where the elongated hole **80***a* is arc-shaped at each end, the radius of the arc B is slightly larger than the radius of the shaft A.

[0048] The elongated hole **80***a* has a width W that is slightly larger than a diameter of the shaft A and a length L that is substantially larger than the diameter of the shaft A. The width W is to restrict the lateral movement of the shaft while allowing movement in the forward direction and the backward direction. In various embodiments, the width W of the elongated hole **80***a* may be between 1.01 and 1.2 times the diameter of the shaft A. In various embodiments, the length L of the elongated hole **80***a* may be between 1.5 and 2.5 times the diameter of the shaft.

[0049] This written description uses examples to disclose the invention, including the best mode, and also to enable any person skilled in the art to make and use the invention. Certain terms have been used for brevity, clarity, and understanding. No unnecessary limitations are to be inferred therefrom beyond the requirement of the prior art because such terms are used for descriptive purposes only and are intended to be broadly construed. The patentable scope of the invention is defined by the claims and may include other examples that occur to those skilled in the art. Such other examples are intended to be within the scope of the claims if they have features or structural elements that do not differ from the literal language of the claims, or if they include equivalent features or structural elements with insubstantial differences from the literal languages of the claims.

Claims

1. A marine propulsion system for a marine vessel, the marine propulsion system comprising: a single rear marine drive configured to be positioned near a stern of the marine vessel; a joystick comprising a joystick handle configured to be movable by a user to provide steering demand input; wherein the joystick is configured such that the joystick handle is movable in a forward direction to demand a forward motion of the marine vessel, in a backward direction to demand backward motion of the marine vessel, and twistable to demand rotational motion of the marine vessel; wherein the joystick is configured to restrict movement of the joystick handle in a lateral direction; and a control system configured to control steering and/or thrust of the single rear marine drive based on the steering demand input to generate the demanded forward motion, the backward motion, and the rotational motion of the marine vessel.

2. The system of claim 1, wherein the joystick is configured to prevent lateral movement of the joystick handle in right and left lateral directions such that the joystick handle is configured to be movable only in the forward direction, the backward direction, and to twist about a shaft axis of a shaft connected to the joystick handle.

3. The system of claim 1, wherein the joystick further comprises: a base below the joystick handle; a shaft connected to the joystick handle and extending into the base, wherein the shaft is configured to move when the user manipulates the joystick handle; and a plate inside the base and positioned around the shaft, wherein the plate is configured to restrict lateral movement of the shaft and the joystick handle and to permit forward and backward movement of the shaft and the joystick handle and permit twist movement of the shaft and the joystick handle about a shaft axis of the shaft.

4. The system of claim 3, wherein the plate prevents lateral movement of the shaft and the joystick handle so as to only permit the forward, backward, and twist movements of the shaft and the joystick handle.

5. The system of claim 3, wherein the plate comprises an elongated hole configured to restrict the lateral movement of the shaft.

6. The system of claim 5, wherein the elongated hole has a width that is slightly larger than a diameter of the shaft and a length that is substantially larger than the diameter of the shaft.

7. The system of claim 5, wherein the elongated hole is centered around the shaft when the shaft is in a neutral position.

8. The system of claim 1, wherein the single rear marine drive is steerable about a steering axis to a range of steering angles.

9. The system of claim 8, wherein the range of steering angles is no greater than between +45 degrees and −45 degrees of a centered steering position.

10. A joystick for controlling propulsion of a marine vessel, the joystick comprising: a joystick handle configured to be manipulated by a user to steer a marine vessel; a base below the joystick handle; a shaft connected to the joystick handle and extending into the base, wherein the shaft is configured to move when the user manipulates the joystick handle; and a plate inside the base and positioned around the shaft, wherein the plate is configured to restrict lateral movement of the shaft and the joystick handle and to permit forward and backward movement of the shaft and the joystick handle and permit twist movement of the shaft and the joystick handle about a shaft axis of the shaft.

11. The joystick of claim 10, wherein the joystick is configured to be installed on a marine vessel to control steering and/or thrust of a single rear marine drive on the marine vessel.

12. The joystick of claim 10, wherein the plate is mounted within the base such that it is centered around the shaft when the shaft is in a neutral position and configured to symmetrically restrict the lateral movement of the shaft in right and left lateral directions.

13. The joystick of claim 10, wherein the plate prevents lateral movement of the shaft and the joystick handle so as to only permit the forward, backward, and twist movements of the shaft and the joystick handle.

14. The joystick of claim 10, wherein the plate comprises an elongated hole configured to restrict the lateral movement of the shaft.

15. The joystick of claim 14, wherein the elongated hole has a width that is slightly larger than a diameter of the shaft and a length that is substantially larger than the diameter of the shaft.

16. The joystick of claim 15, wherein the width of the elongated hole is between 1.01 and 1.2 times the diameter of the shaft.

17. The joystick of claim 15, wherein the length of the elongated hole is between 1.5 and 2.5 times the diameter of the shaft.

18. The joystick of claim 14, wherein the elongated hole is arc-shaped at each end, wherein a radius of the arc is slightly larger than a radius of the shaft.

19. The joystick of claim 14, wherein the elongated hole is centered around the shaft when the shaft is in a neutral position.
20. The joystick of claim 10, wherein the plate is comprised of metal.
