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Strang

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[54] **HIGH PERFORMANCE STERN DRIVE**

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[52] **U.S. Cl.** **115/35**

[51] **Int. Cl.** **B63h 25/42**

[58] **Field of Search**.. 115/34 R, 35 R, 41 R, 41 HT, 115/18 R, 18 A, 26; 74/480 B; 114/144 R

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[57] **ABSTRACT**

Disclosed herein is a marine propulsion installation including a hinge pin pivotally connecting a mounting bracket to a mounting plate for vertical swinging movement about a tilt axis, a King pin pivotally connecting a propulsion unit to the mounting bracket for common vertical swinging movement and for horizontal swinging movement therebetween about a steering axis, a first drive shaft rotatably supported by the mounting bracket about an axis extending perpendicularly to and vertically spaced from the tilt axis and perpendicularly to and in intersecting relation to the steering axis, a second drive shaft rotatably supported by the propulsion unit, an adjusting screw for adjustably vertically swinging the mounting bracket and the propulsion unit relative to the mounting plate through a limited range about the tilt axis, a universal joint extending across the steering axis and connecting the first and second drive shafts notwithstanding vertical swinging movement of the mounting bracket and the propulsion unit relative to the mounting plate and steering movement of the propulsion unit relative to the mounting bracket, an engine mounted in the boat hull and including an output shaft connected to the first drive shaft for common rotation therewith, by a telescopic drive shaft and a universal coupling, whereby to accommodate vertical swinging movement of the mounting bracket and the propulsion unit relative to the mounting plate.

17 Claims, 4 Drawing Figures

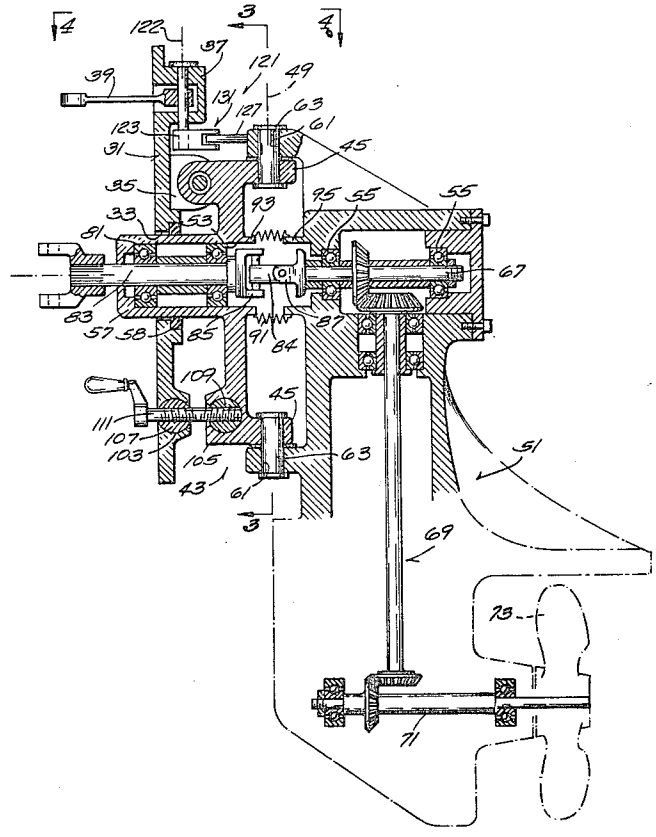


Fig. 4

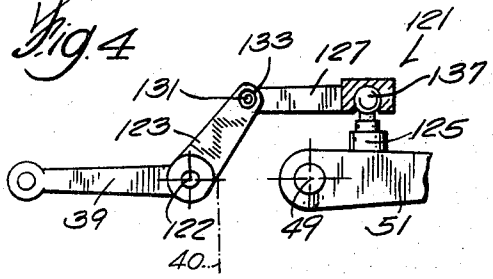


Fig. 3

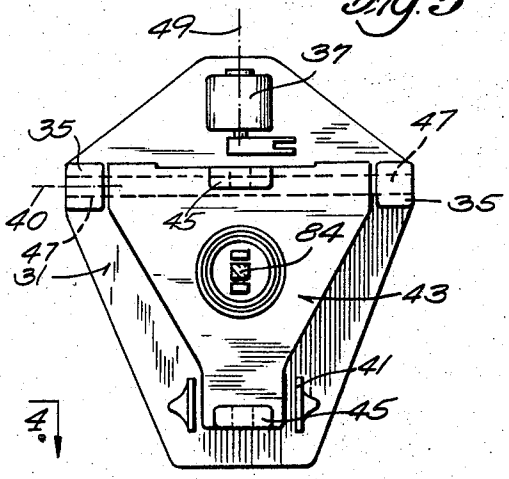


Fig. 2

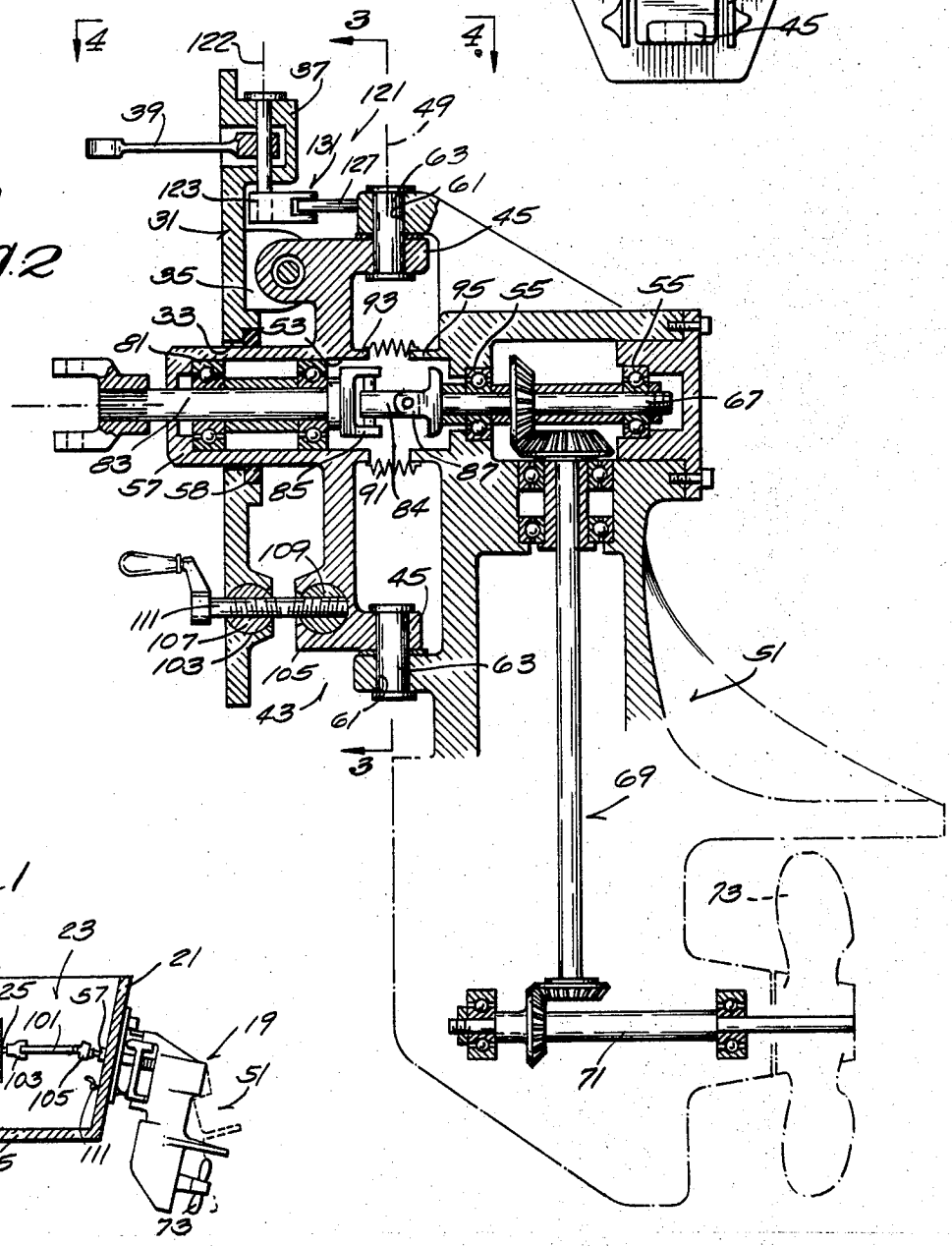


Fig. 1

HIGH PERFORMANCE STERN DRIVE

BACKGROUND OF THE INVENTION

The invention relates generally to marine propulsion devices, and more particularly, the invention relates to stern drive marine propulsion installations. Still more particularly, the invention relates to stern drive units which are particularly adapted for racing events.

Examples of prior art stern drive marine installations are disclosed in the following Unites States patents.

Name	Number	Issue Date
Griffith	1,780,075	October 28, 1930
Demichelis	2,064,195	December 15, 1963
Hedges	2,114,633	April 19, 1938
Patty	2,936,730	May 17, 1960
Bergstedt	2,977,923	May 24, 1961
MacDonald	3,368,516	February 13, 1968
MacDonald	3,368,517	February 13, 1968
Wynne	3,376,842	April 9, 1968

SUMMARY OF THE INVENTION

The invention provides a stern drive unit wherein the trim or tilt axis is located forwardly of the steering axis, wherein the drive train extends in the propulsion unit rearwardly below the tilt axis and aft of the steering axis, wherein the propulsion unit can be trimmed through a limited range so as to obtain maximum boat performance, and wherein transmission of rotary power and steering control are continuously maintained notwithstanding trimming.

The invention also provides a marine propulsion installation including a stern drive unit such as that described in the immediately preceding paragraph, together with an engine which is substantially stationarily mounted in a boat hull and connected to a vertically swingable stern drive unit drive shaft by means including a telescopic universal joint located forwardly of the stern drive unit.

More particularly, the invention provides a marine propulsion installation including a stern drive unit comprising a mounting plate adapted for attachment to a boat transom or hull and having therein a central aperture, a mounting bracket pivotally connected to the mounting plate about a horizontal trim or tilt axis and including a forwardly projecting tubular portion extending through the mounting plate aperture and at least partially through an associated opening in the boat transom, and a propulsion unit connected to the vertically tiltable mounting bracket for common vertical swinging movement therewith and for steering movement relative thereto about a steering axis located aft of the tilt axis.

The propulsion unit includes a drive train operably connected between a propeller and a drive shaft which is supported in the propulsion unit for rotation about an axis extending generally fore and aft in a plane perpendicular to the steering axis. The drive shaft, in turn, is connected through a universal joint or coupling aligned with the steering axis, to another drive shaft which is rotatably journaled in the tubular portion of the tiltable mounting bracket and which, in turn, is connected through a telescopic universal joint with the output shaft of an engine which is stationarily mounted in the boat hull. Also included are means for adjustably trimming the propulsion unit relative to the boat hull by adjustably pivoting or tilting the mounting bracket relative to the mounting plate without interrupting the transmission of rotary power from the engine to the propeller, together with a parallel linkage steering control which is continuously operable notwithstanding adjustment of the trim condition of the propulsion unit.

One of the principal objects of the invention is the provision of a stern drive unit which is particularly adapted for racing and which includes a propulsion unit which is adjustably pivotable about a horizontal axis through a limited range to afford trimming of the propulsion unit relative to the boat hull and thereby to obtain maximum boat performance, without permitting such tilting of the propulsion unit through a full tilt range so as to remove the propeller from the water.

Another one of the principal objects of the invention is the provision of a high performance stern drive unit which is designed for simplicity, strength, minimum weight and low cost.

Another of the principal objects of the invention is the provision of a stern drive unit affording trimming of the propulsion unit under way so as to afford maximum boat performance and without interrupting continuous transmission of rotary power to the propeller and propulsion unit steering control.

Other objects and advantages of the invention will become known with reference to the following description, claims and drawings.

THE DRAWINGS

FIG. 1 is a somewhat schematic side elevational view, partially in section, of a marine propulsion installation embodying various of the features of the invention.

FIG. 2 is an enlarged view, in section, of various of the components illustrated in FIG. 1.

FIG. 3 is a fragmentary view taken along line 3—3 of FIG. 2, with parts omitted.

FIG. 4 is a fragmentary view, taken along line 4—4 of FIG. 2, with parts omitted.

GENERAL DESCRIPTION

Shown in FIG. 1 of the drawings is a marine propulsion installation or device 11 which includes any suitable internal combustion engine 13 stationarily mounted in a boat hull 15 by suitable means illustrated at 17, together with a stern drive unit 19 which is mounted to the boat hull 15, and particularly to the boat transom 21, and power transmission means 23 connecting the engine output shaft 25 to the stern drive unit 19.

The stern drive unit 19 is more fully illustrated in FIG. 2 and includes a mounting bracket or plate 31 which can be suitably fixed or attached to the boat transom 21 and which includes a central aperture 33, together with a horizontally spaced, aligned pair of pillow blocks 35 located above the central aperture 33, and an enlarged portion 37 adapted to pivotally mount a tiller 39 as will hereinafter be disclosed in greater detail. If desired, as shown in FIG. 3, the mounting plate 31 can also include, at the lower end thereof, two spaced abutments 41 to provide additional stability to a mounting bracket 43 which is pivotally carried from the mounting plate 31 for limited vertical swinging movement on a horizontal tilt axis 40 extending through the pillow blocks 35.

More particularly, the mounting bracket **43** is generally of triangular shape, as shown in FIG. **3**, and includes a relatively narrow lower portion extending between the abutments **41** and a relatively enlarged upper portion extending between the pillow blocks **35**. Also included in the mounting bracket **43** are vertically spaced upper and lower pillow blocks **45** which provide a steering axis **49** for a propulsion or drive unit **51** still to be described. The steering axis **49** extends perpendicularly to the horizontal tilt axis **40** in a generally vertical direction and is located in spaced relation from, and aft of, the horizontal tilt axis **40**.

Adjacent its relatively enlarged upper end, the mounting bracket **43** includes a pair of horizontally extending stub shafts **47** which are rotatably received in the pillow blocks **35** of the mounting plate **31** to provide for vertical swinging movement of the mounting bracket **43** relative to the mounting plate **31**.

Also included in the mounting bracket **43** is a central aperture **53** and a forwardly projecting tubular portion **57** which extends from the aperture **53** and projects through the aperture **33** in the mounting plate **31** and at least partially through an opening in the boat transom **21**. The outer diameter of the tubular portion **57** is smaller than the aperture **33** in the mounting plate **31** so as to accommodate limited vertical swinging movement of the mounting bracket **43** about the horizontal tilt axis **40** relative to the mounting plate **31** and boat hull **15**. A flexible rubber boot or seal **58** extends between the mounting plate **31** and the tubular portion **57** to exclude moisture.

The propulsion unit **51** includes two vertically spaced and aligned apertures **61** which receive respective stub shafts or king pins **63** extending through the mounting bracket pillow blocks **45** so as to afford horizontal swinging movement or steering of the propulsion unit **51** about the steering axis **49** relative to the mounting bracket **43** and boat hull **15**, while also affording common vertical swinging movment with the mounting bracket **43** about the horizontal axis **40** and relative to the mounting plate **31** and boat hull **15**.

Rotatably supported by bearings **55** carried in the propulsion unit **51** is a drive shaft **67** which extends generally in the fore and aft direction and in generally perpendicular relation to the steering axis **49**.

The drive shaft **67** forms part of a suitable drive train **69** which connects the drive shaft **67** to a propeller shaft **71** which is rotatably mounted in the propulsion unit **51** and carries a propeller **73**. If desired, the drive train **69** can include a reversing transmission (not shown) either on the drive shaft **67** or on the propeller shaft **71** or elsewhere in the drive train **69**. Preferably, the drive train **69** is designed to permit maximum transmission of power while minimizing the horizontal cross sectional area of that portion of the propulsion unit **51** which is normally immersed in water during operation.

Rotatably supported by bearings **81** mounted in the tubular portion **57** of the mounting bracket **43** is another drive shaft **83** which extends generally in the fore and aft direction, and in perpendicular relation to the steering axis **49**, and in co-planar relation to the drive shaft **67**, and in vertically spaced relation to the horizontal tilt axis **40**. As illustrated in FIG. **2**, the drive shaft **83** extends in spaced relation below the horizontal tilt axis **40**.

Means are provided for drivingly connecting the rearward end of the drive shaft **83** to the forward end of the drive shaft **67** for rotary power transmission, notwithstanding steering movement of the propulsion unit **51** relative to the mounting bracket **43**. Various arrangements can be employed. The illustrated construction employs a universal coupling in the form of an intermediate stub shaft **84** and two "U" joint pivotal connections **85** and **87** which connect the stub shaft **84** to the drive shafts **67** and **83** and which are arranged with their respective pivotal axes at right angles to each other.

In order to protect the universal coupling from moisture as well as to prevent entry of moisture into the drive train **67** and into the tubular portion **57** of the mounting bracket **43**, a flexible, hollow bellows **91** extends around the universal coupling from oppositely lips or flanges **93** and **95** located respectively on the mounting bracket **43** and on the propulsion unit **51**.

The before mentioned power transmission means **23** connects the engine output shaft **25** to the forward end of the drive shaft **83** which is vertically swingable in accordance with the vertical swinging movement of the mounting bracket **43**. While other constructions could be employed, in the illustrated construction, the power transmission means **23** comprises a telescopic drive shaft **101** including two telescopically movable members (not shown) subject to common rotation. In addition, the engine output shaft **25** is connected to the forward end of the telescopic shaft **101** by "U" joint pivotal connection **103** while the rear of the telescopic shaft **101** is connected to the forward end of the drive shaft **83** by a second "U" joint pivotal connection **105** arranged with its pivot axis at a right angle with respect to the pivot axis of the "U" joint connection **103**. As a consequence, the power transmission means **23** constitutes, in effect, a telescopic universal coupling which accommodates vertical swinging movement of the drive shaft **83** relative to the engine output shaft **25**, while permitting continuous transmission of rotary power.

In further accordance with the invention, there is provided means for tilting or trimming the propulsion unit **51** relative to the mounting plate **31** or boat hull **15** through a limited range so as to afford maximum propulsive effect. Various hydraulic or mechanical or other arrangements can be employed. In the illustrated construction, there is provided a pivotal connection of adjustable length between the mounting bracket **43** and the mounting plate **31**. More specifically, each of the mounting plate **31** and mounting bracket **43** are provided, below the respective apertures **33** and **53**, with facing, partially spherical sockets **103** and **105** respectively receiving ball members **107** and **109** which are diametrically bored and oppositely threaded. The ball members **107** and **109** are connected by a crank **111** having threaded portions received in the threaded bores of the ball members **107** and **109** such that rotatable crank movement is effective, within a limited range, i.e., less than about 30°, to trim the propulsion unit **51** relative to the boat hull **15**, while the boat is under way and without affecting transmission of rotary power from the engine **13** to the propeller **71**.

In still further accordance with the invention, the marine propulsion device or installation **11** includes a propulsion unit steering control means in the form of the before mentioned tiller **39** which is pivotally mounted

on the enlarged portion 37 of the mounting plate 31 and which extends inwardly of the boat hull 15 forwardly of the transom 21, together with a linkage 121 connecting the tiller 39 to the propulsion unit 51. While various other arrangements could be employed, in the illustrated construction, the tiller 39 is pivotally mounted on the mounting plate 31 about a tiller axis 122 which extends vertically and in fore and aft alignment with the steering axis 49 and which can intersect the horizontal tilt axis 40.

The linkage 121 includes a first steering arm 123 which extends fixedly from the tiller 39 and a second steering arm 125 which extends fixedly from the propulsion unit 51. In addition, the linkage 121 includes a connecting link 127, and means respectively pivotally connecting the opposite ends of the connecting link 127 to the first and second steering arm 123 and 125. When the steering axis 49 is vertical, i.e. parallel to the tiller axis 122, the arrangement is such that the steering arms 123 and 125 (relative to the appropriate axes at each end) are of equal length and extend in general parallel relation to each other, and such that the connecting link 127 extends in the fore and aft direction and has a length (between its pivotal connections) substantially equal to the fore and aft distance between the tiller axis 122 and the steering axis 49. Thus there is provided a parallel linkage which is operative to steer the propulsion unit 51 in proportion to the steering movement applied to the tiller 39.

In order to accommodate the permissable limited vertical swinging movement of the propulsion unit 51 relative to the mounting plate 31, the means pivotally connecting the steering arms 123 and 125 to the ends of the connecting link 127 each afford pivotal movement about two axes at right angles to each other. More specifically, the pivotal connection between the tiller steering arm 123 and the forward end of the connecting link 127 is provided by a "U" joint pivotal connection 131 providing a vertical axis to afford horizontal swinging movement and including a somewhat oversized aperture 133 in the associated end of the connecting link 127, whereby to afford vertical swinging movement of the connecting link 127 relative to the tiller 39 as seen generally in FIG. 2. The pivotal connection between the rearward end of the connecting link 127 and the propulsion unit steering arm 125 is a ball and socket connection 137.

The disclosed marine propulsion installation 11 is particularly adapted for use in racing events and permits limited tilting of the propulsion unit 51 relative to the boat hull 15 so as to optimize the propulsive effect of the rotating propeller 71, while affording continuous steering control and continuous transmission of rotary power from the engine 13 to the propeller 71. In addition, the disclosed construction is relatively economic to build and maintain, and combines the advantages of low weight and structural strength.

Various of features of the invention are set forth in the following claims.

I claim:

1. A marine propulsion device comprising a mounting plate adapted to be fixed to the hull of a boat, a mounting bracket, means pivotally connecting said mounting bracket to said mounting plate for vertical swinging movement about an axis which is approximately horizontal when said mounting plate is attached to the boat hull, a propulsion unit including a rotatably mounted propeller, means pivotally connecting said propulsion unit to said mounting bracket for common vertical swinging movement of said propulsion unit with said mounting bracket and for steering movement of said propulsion unit relative to said mounting bracket about a steering axis extending rearwardly of said horizontal axis, a first drive shaft supported by said mounting bracket for rotation about an axis extending perpendicularly to and vertically spaced from said horizontal axis and perpendicularly to and in intersecting relation to said steering axis, a second drive shaft drivingly connected to said propeller and supported by said propulsion unit for rotation about an axis perpendicular to said steering axis and co-planar with the axis of said first drive shaft, means for adjustably vertically swinging said mounting bracket and said propulsion unit relative to said mounting plate through a limited range about said horizontal axis, and a universal joint extending across said steering axis and connecting said first and second drive shafts notwithstanding vertical swinging movement of said mounting bracket and said propulsion unit relative to said mounting plate and steering movement of said propulsion unit relative to said mounting bracket.

2. A marine propulsion device in accordance with claim 1 wherein said first drive shaft is vertically spaced below said horizontal axis.

3. A marine propulsion device in accordance with claim 1 and further including a watertight flexible bellows surrounding said universal joint and extending between said mounting bracket and said propulsion unit.

4. A marine propulsion device in accordance with claim 1 wherein said mounting plate includes therein an aperture, and wherein said mounting bracket includes a forwardly projecting tubular portion extending in said aperture, and further including flexible sealing means extending between said mounting plate and said tubular portion.

5. A marine propulsion device in accordance with claim 4 and further including a pair of spaced bearings supported within said tubular portion and journaling said first drive shaft.

6. A marine propulsion device in accordance with claim 1 and further including an engine mounted in said boat hull and including an output shaft, and means connecting said output shaft and said first drive shaft for common rotation and including telescopic drive means and universal coupling means, whereby to accommodate vertical swinging movement of said mounting bracket and said propulsion unit relative to said mounting plate.

7. A marine propulsion device in accordance with claim 1 and further including a tiller supported by said mounting plate for pivotal movement about a generally vertical tiller axis, and means connecting said tiller to said propulsion unit for steering said propulsion unit in response to tiller movement, notwithstanding vertical swinging movement of said propulsion unit relative to said mounting plate.

8. A marine propulsion device in accordance with claim 7 wherein said means connecting said tiller to said propulsion unit includes a first steering arm extending fixedly from said tiller for common movement therewith, a second steering arm extending fixedly from said propulsion unit, a steering link, and means

pivotally connecting said steering link to said first and second steering arms.

9. A marine propulsion device in accordance with claim 8 wherein said first and second arms are substantially parallel when said tiller axis and said steering axis are parallel.

10. A marine propulsion device in accordance with claim 8 wherein said tiller axis is aligned fore and aft with said steering axis and wherein said link has a length substantially equal to the fore and aft distance between said tiller axis and said steering axis when said tiller axis and said steering axis are parallel.

11. A marine propulsion device in accordance with claim 8 wherein said tiller axis is aligned fore and aft with said steering axis and wherein said first and second arms have substantially the same length and are substantially parallel when said tiller axis and said steering axis are parallel and wherein said link has a length substantially equal to the fore and aft distance between said tiller axis and said steering axis when said tiller axis and said steering axis are parallel.

12. A marine propulsion device in accordance with claim 11 wherein said means pivotally connecting said steering link to said first and second steering arms provides pivotal movement of said link relative to each of said first and second steering arms about two axes at right angles to each other to accommodate vertical swinging movement of said steering axis relative to said tiller axis.

13. A marine propulsion device comprising a mounting plate adapted to be fixed to the hull of a boat, a mounting bracket, means pivotally connecting said mounting bracket to said mounting plate for vertical swinging movement about a tilt axis which is approximately horizontal when said mounting plate is attached to the boat hull, a propulsion unit, means pivotally connecting said propulsion unit to said mounting bracket for common vertical swinging movement of said propulsion unit with said mounting bracket and for steering movement of said propulsion unit relative to said mounting bracket about a steering axis extending rearwardly of said tilt axis and transversely thereof, a tiller supported by said mounting plate for pivotal movement about a tiller axis extending in generally parallel relation to and in fore and aft alignment with said steering axis, a first steering arm extending fixedly from said tiller for common movement therewith, a second steering arm extending fixedly from said propulsion unit, a steering link having a length substantially equal to the fore and aft distance between said tiller axis and said steering axis, and means pivotally connecting said steering link to said first and second steering arms.

14. A marine propulsion device in accordance with claim 13 wherein said first and second arms are substantially parallel.

15. A marine propulsion device comprising a mounting plate adapted to be fixed to the hull of a boat, a mounting bracket, means pivotally connecting said mounting bracket to said mounting plate for vertical swinging movement about a tilt axis which is approximately horizontal when said mounting plate is attached to the boat hull, a propulsion unit, means pivotally connecting said propulsion unit to said mounting bracket for common vertical swinging movement of said propulsion unit with said mounting bracket and for steering movement of said propulsion unit relative to said mounting bracket about a steering axis extending rearwardly and transversely of said tilt axis, a tiller supported by said mounting plate for pivotal movement about a tiller axis extending substantially parallel to and in fore and aft alignment with said steering axis, a first steering arm extending rigidly from said tiller for common movement therewith, a second steering arm extending rigidly from said propulsion unit, said first and second arms having substantially the same length and being substantially parallel, a steering link having a length substantially equal to the fore and aft distance between said tiller axis and said steering axis and means pivotally connecting said steering link to said first and second steering arms.

16. A marine propulsion device in accordance with claim 15 wherein said means pivotally connecting said steering link to said first and second steering arms provides pivotal movement of said link relative to each of said first and second steering arms about two axes at right angles to each other to accommodate vertical swinging movement of said steering axis relative to said tiller axis.

17. A marine propulsion device comprising a mounting plate adapted to be fixed to the hull of a boat, a mounting bracket, means pivotally connecting said mounting bracket to said mounting plate for vertical swinging movement about an axis which is approximately horizontal when said mounting plate is attached to the boat hull, a propulsion unit including a rotatably mounted propeller, means pivotally connecting said propulsion unit to said mounting bracket for common vertical swinging movement of said propulsion unit with said mounting bracket and for steering movement of said propulsion unit relative to said mounting bracket about a steering axis extending rearwardly of said horizontal axis, a first drive shaft supported by said mounting bracket for rotation about an axis extending fore and aft, a second drive shaft drivingly connected to said propeller and supported by said propulsion unit for rotation about an axis extending fore and aft, and a universal joint connecting said first and second drive shafts notwithstanding vertical swinging movement of said mounting bracket and said propulsion unit relative to said mounting plate and steering movement of said propulsion unit relative to said mounting bracket.

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