

[54] **STEERING ASSEMBLY**
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3,511,209 5/1970 Becker115/35

FOREIGN PATENTS OR APPLICATIONS

437,978 7/1948 Italy115/35

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[57] **ABSTRACT**

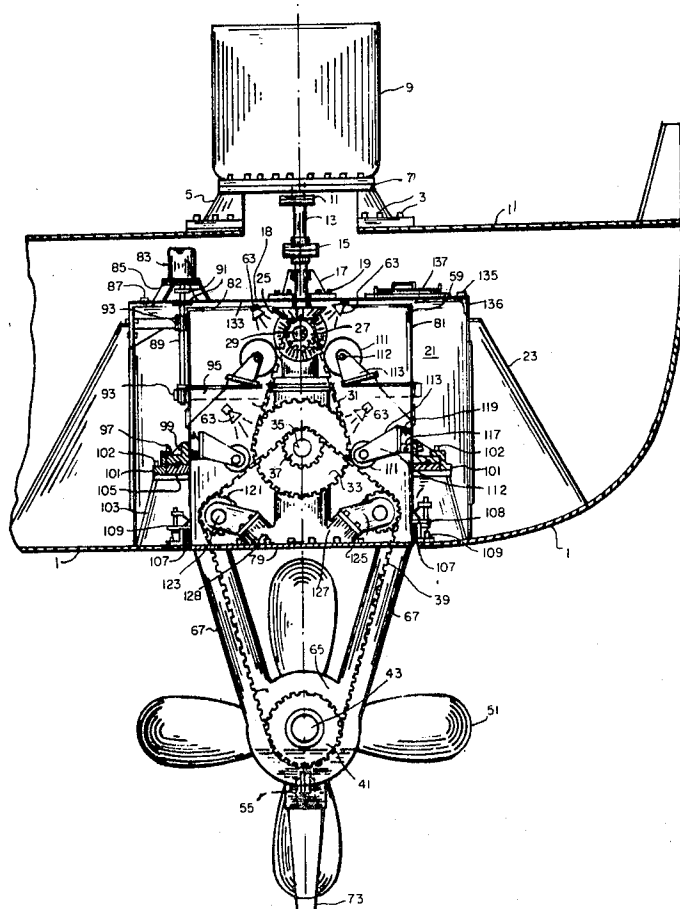
A combined power propulsion and steering mechanism assembly for use especially in ocean-going vessels wherein the assembly comprises a flexible drive transmission for connecting the power unit to the propeller drive shaft, the drive transmission and its associated gearing being housed within a power-operated, rotating steering cylinder capable of laterally rotating the propeller about a vertical axis a complete 360°.

[56] **References Cited**

UNITED STATES PATENTS

1,774,956	9/1930	Wilson	115/35
3,013,519	12/1961	Wiggerman	115/35
3,094,967	6/1963	Willis, Jr.	115/35
840,548	1/1907	Atwood	115/35
2,691,356	10/1954	Waterval	115/37
743,700	11/1903	Dupuis	115/35

19 Claims, 5 Drawing Figures



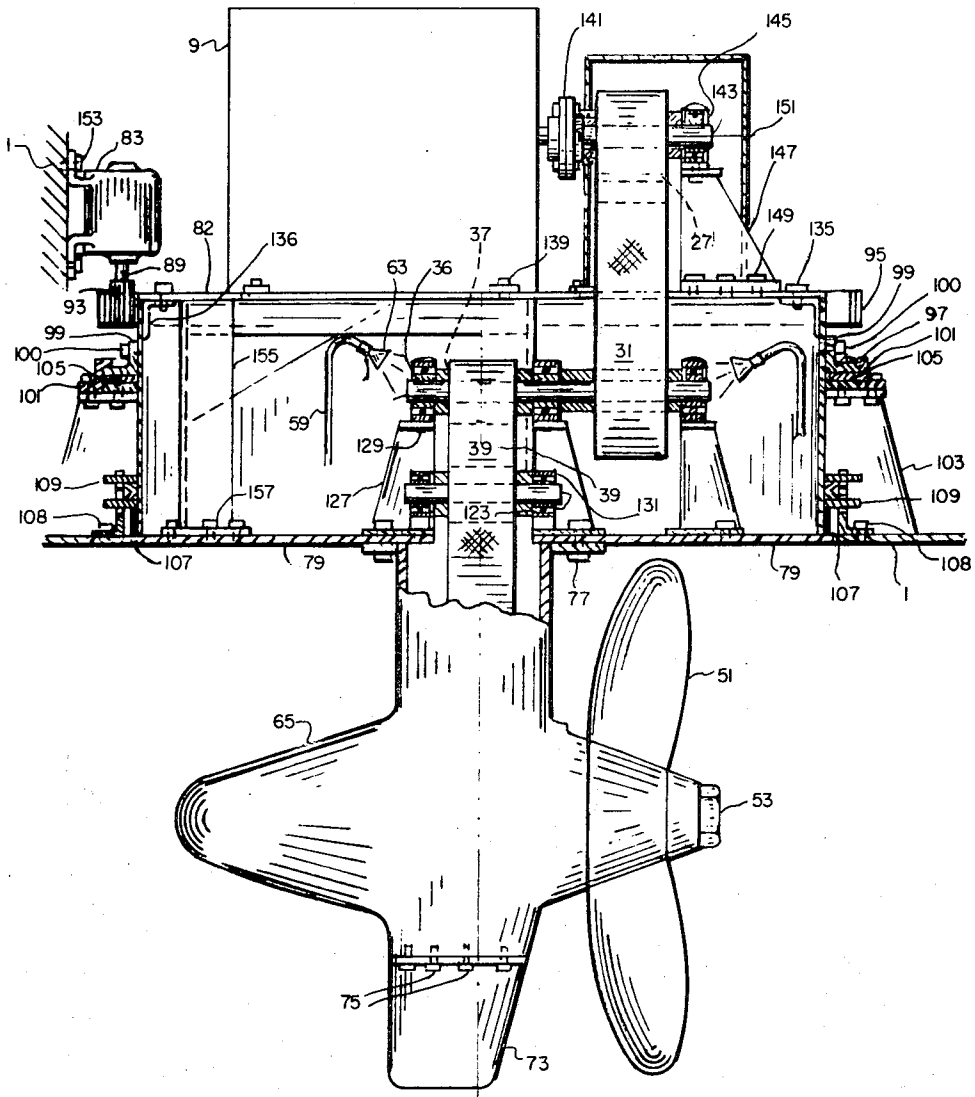
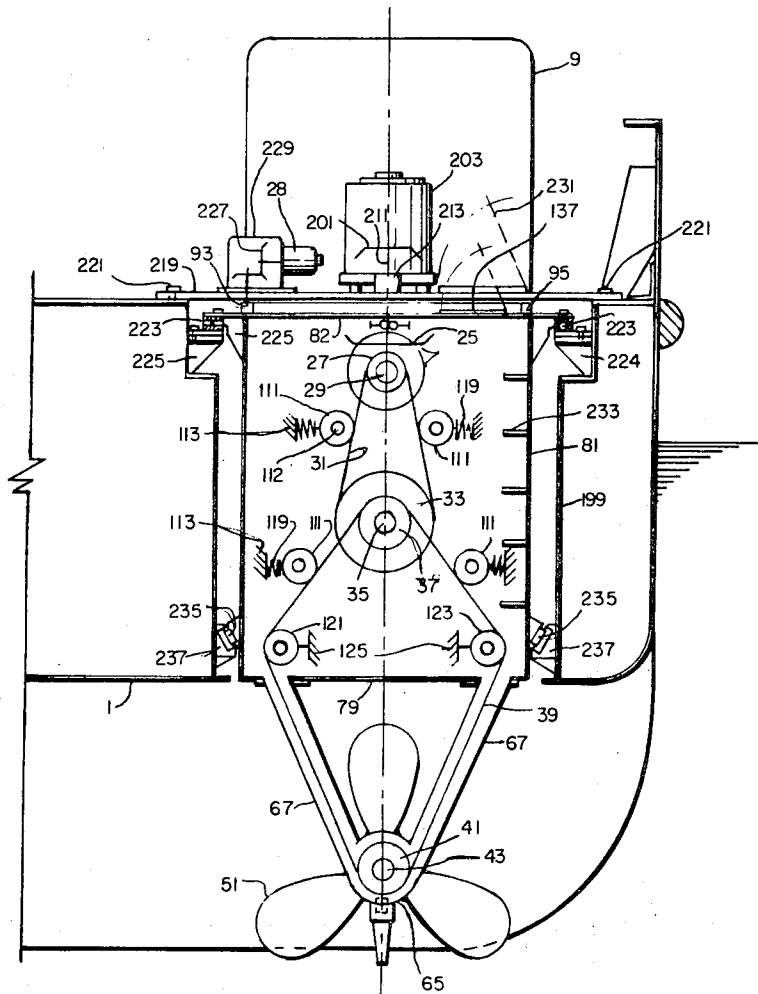


FIG. 3



STEERING ASSEMBLY

BACKGROUND OF THE INVENTION

The present invention relates to a combined marine propulsion and steering assembly adapted especially for use on large ocean-going type vessels wherein the actual steering of the vessel may be effected in the absence of conventional rudder means.

Heretofore in the prior art, such combined propulsion and steering assemblies usually comprised a suitable power means for driving the propeller through speed reduction gearing or transmission means. Steering was effected by either pivoting the propeller about a vertical axis or by providing the vessel with a pivotable rudder means for directing the ship's course. The power transmission means in such systems usually comprises a stiff, vertical drive shaft in conjunction with right angle gear sets or flexible drive belts in conjunction with direct drive belt wheels connected to the drive shaft of the power unit source. By way of examples, Wanzer U.S. Pat. No. 2,499,339, Sterling et al. U.S. Pat. No. 3,266,454, Shimanckar U.S. Pat. No. 3,478,620 and Becker U.S. Pat. No. 3,511,209 all teach combined marine propulsion and steering systems wherein power is conveyed to the propellers through stiff, vertical drive shafts and right angle gearing assemblies in a basic Z-shaped arrangement. However, steering is effected in all these examples by pivoting the drive shaft housing about a vertical axis of only approximately 120°. The limited steering capabilities of these systems are basically a disadvantage. However, a more serious problem manifested in such rigid power transmission connections with right angle gear sets is that very strong axial turning moments are set up during their operation thereby affecting the power needed to laterally rotate the propeller unit for steering purposes. A still further disadvantage of such prior art systems is that since the size of the right angle gear in a steerable right angle drive unit depends upon the power to be transmitted, any lower gear train with a large reduction ratio will necessarily require a proportionally large underwater gear housing. As such, if an underwater gear housing is utilized which is too large in relation to the screw propeller diameter, the flow of water to the propeller will be restricted and hence undesirable wake effects will be created.

A minimization of the above described axial turning moments can occur through the use of a flexible drive transmission between the power unit's gearing and the propeller assembly's gearing. Such an arrangement is not new as evidenced by the flexible chain drive of the system disclosed by Salom U.S. Pat. No. 778,763. Another, more recent example of this type of system is the flexible belt driven propeller of the outboard marine motor disclosed by Brindley U.S. Pat. No. 2,722,193. Though both Salom and Brindley teach the use of flexible drive transmissions in conjunction with outboard motors which are principally adapted for use on small boats, the more conventional use for such drives is within the propulsion systems of large, ocean-going vessels. Examples of the latter type vessels are clearly shown by the Diamantides U.S. Pat. No. 2,400,339 and Pleuger U.S. Pat. No. 3,185,122. Although Brindley, Diamantides and Pleuger all teach that a direct drive connection between the power unit's drive shaft and the propeller can be achieved through a

flexible belt transmission in the absence of right angle gear sets, the systems of these patents fail to provide for adequate cooling and lubrication of the transmission's moving parts. It is well known that flexible drive transmissions generate tremendous amounts of heat as a result of the friction created between the cooperating moving parts, a situation which is not as serious in the case of the stiff, vertical drive transmissions discussed previously. In order to minimize the effects of such heat in preventing premature failure of the working parts, it is necessary to bathe the parts in a continuously renewed film of lubrication. Such a practice has heretofore not been seriously considered by the flexible drive transmission systems of the prior art. As is also the case, the flexible drive propulsion systems of the above discussed prior art patents fail to show any provision whereby a complete 360° lateral steering of the propeller can be effected in the absence of rudders or similar auxiliary steering mechanism.

SUMMARY OF THE INVENTION

It is therefore an object of the present invention to provide a combined power propulsion and steering mechanism assembly for use especially in large, ocean-going vessels wherein complete 360° steerability of the latter can be achieved in the absence of rudders.

It is another object of the present invention to provide a combined power propulsion and steering mechanism in which there is an absolute minimum of axial turning moments for affecting the lateral steerability of the propeller.

It is a further object of the present invention to provide a combined power propulsion and steering mechanism assembly of such a nature that the assembly may be secured either to the edge of the vessel's hull perimeter in an outboard fashion or secured within and projected below the hull of the vessel.

It is still a further object of this invention to provide a combined power propulsion and steering mechanism assembly capable of being installed within the hull of a vessel and subsequently removed and reinstalled within the vessel while the latter remains afloat.

The present invention has as still another object the provision of a combined power propulsion and steering mechanism assembly wherein the assembly has an effective lubrication system for both cooling and lubricating the moving parts of the assembly with a continuously renewed film of lubricant.

Another object of the present invention is to provide a combined power propulsion and steering mechanism having a transmission housing structure which serves not only to assist the vessel in course-keeping, but also to minimize still further any axial turning moments which should occur.

In order to accomplish these and other objects, the invention comprises a combined power propulsion and steering mechanism assembly wherein there is provided a flexible drive transmission connecting the power unit with the propeller. The flexible drive transmission and its associated gearing are housed within a rotating cylinder which is capable of laterally rotating the propeller through a complete circle of 360°. Streamlined skegs, fixedly secured to and extending below the rotating cylinder, serve to house a portion of the flexible drive transmission. A lubrication system operating

off of the propeller's drive shaft provides a continuously renewed film of lubricant over the moving parts of the assembly.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a cross-section elevation view of the preferred embodiment of the invention incorporated within the hull of a vessel;

FIG. 2 is a side view of the invention as depicted in FIG. 1;

FIG. 3 is a side view of another embodiment of the invention as incorporated within the hull of a vessel;

FIG. 4 is a schematic illustration in side elevation of a third embodiment of the invention as incorporated within the hull of a vessel; and

FIG. 5 is a schematic illustration in end view of the invention as depicted by FIG. 4.

DETAILED DESCRIPTION OF THE FIRST EMBODIMENT

Referring now to FIGS. 1 and 2, there is depicted a hull 1 of a water-borne vessel on the upper deck of which is secured, by a plurality of bolts 3, a mounting bracket assembly 5. Attached to the latter assembly 5 is at least one plate 7 supporting a power unit 9. The latter unit 9 may be either an electrically driven motor or a fuel driven engine, such as a diesel engine. Directly below the power unit 9 is a first coupling 11 which is drivingly connected to a vertical drive shaft 13. A second coupling 15 drivingly connects and extends the drive shaft 13 down through a guide bracket 17 which is secured onto a top 19 of a steering mechanism casing 21. The latter casing 21 is supported by means of a plurality of casing support struts 23. A right-angle gear set 25 is drivingly secured to the vertical drive shaft 13 and a first drive sprocket 27 with its associated first horizontal drive shaft 29 which rotates within bearing assemblies 30. A first flexible drive belt 31 is wrapped around the first drive sprocket 27 and driven thereby. Drive belt 31 is depicted as an inverted tooth belt but may be substituted by its mechanical equivalent such as V-shaped, chain-type or other such belts as are well known in the art. The lower portion of the first flexible drive belt 31 is wrapped around and drives a first chain wheel 33 and a second horizontal drive shaft 35. The latter drive shaft 35 rotates within bearing assemblies 36. Also connected to drive shaft 35 and driven thereby is a second drive sprocket 37 around which is wrapped a second flexible drive belt 39 which is physically similar to the first flexible drive belt 31. The lower portion of drive belt 39 is wrapped around and drives a second chain wheel 41 and its associated propeller shaft 43. The propeller shaft 43 rotates within bearing assemblies 45 and anti-friction packing 47 secured by a bolt and bracket assembly 49. The propeller 51 is connected to drive shaft 43 by means of a bolt 53 or any other conventional connecting means well known in the art. A piston pump 55 is driven by propeller shaft 43 through a cam means 57. The pump 55 sends oil or lubrication through a line 59 from an oil sump 61 to lubrication spray nozzles 63 which serve to distribute the lubrication over the moving parts such as the gearing, sprockets and wheels. Propeller shaft 43, bearing assemblies 45, and pump 55 are housed within a pod 65 in the form of a fluid tight, streamlined housing. Ex-

tending upwardly from pod 65 and constructed integrally therewith are streamlined dual skegs 67 which house the lower portions of the second flexible drive belt 39. An end piece cover plate 69 is secured by means of bolts 71 to pod 65. Likewise, a fin 73 is secured to the underportion of pod 65 by means of bolts 75. The upper ends of skegs 67 are connected by means of bolts 77 to a rotating bottom plate 79 of the rotary steering cylinder 81. The top 82 of cylinder 81 is provided with an aperture for receiving the right angle gear set 25. The steering cylinder 81 is rotated by a power unit 83 which, through mounting bracket 85, is secured to the casing top 18 by means of bolt 87. A drive shaft 89 with couplings 91 extend downwardly from power unit 83. Spur pinions 93 are rotated by drive shaft 89 and serve to rotate the rotary steering cylinder 81 by meshing with a spur gear 95 secured circumferentially to cylinder 81.

An anti-friction bearing assembly 97 is provided comprising a keeper ring 99 secured to cylinder 81 by bolts 100 and a carrier ring 101 secured by bolts 102 to a pedestal 103, with the latter being either an integral part of the vessel's hull or connected thereto by an suitable attachment means such as welds, bolts and the like. The bearing assembly 97 is filled with an anti-friction packing material which permits free rotation of cylinder 81 by power unit 83. The cylinder 81 is further provided with a guide bearing 107 which is secured against the cylinder by a retainer ring 108 which is in turn connected to the hull 1 by bolts 109. Two pairs of smooth idler wheels 111 serve to tension the first and second flexible drive belts 31 and 39. The wheels 111 are mounted for free wheeling on axles 112 and their corresponding supports 113. An upper support strut 114 is provided for securing drive shaft mounts 115 by means of bolts 116. Supports 113 may either be fixedly secured to the inner walls of cylinder 81 by the use of rivets, bolts and the like or, alternatively, may be secured to cylinder 81 by means of pivot mounts 117 and springs 119, the latter providing a resilient bias for the idler wheels 111. In addition to smooth idler wheels 111, there may also be provided a pair of toothed idler wheels 121 mounted for free-wheeling on axles 123. The latter axles are supported by struts 127. Struts 127 also serve to support bearing assemblies 36 of the second horizontal drive shaft 35. The assemblies 36 are secured to both the inner wall of cylinder 81 and struts 127. Axles 123 rotate within a set of bearing assemblies 131. A set of bolts 135 are provided for securing casing top 18 to the angle braces 136 attached by welds to the inner top wall surface of rotary steering cylinder 81. An access hatch lid 137 is provided over a corresponding aperture in casing top 18 in order to permit access into casing 21 for maintenance of the steering assembly.

OPERATION OF THE PREFERRED EMBODIMENT

The operation of the steering assembly as shown by FIGS. 1 and 2 is as follows: Power is transmitted to power unit 9 from power sources (not shown) which are conventional and well known in the art. Such power sources may be located at other areas within the hull 1 of the vessel and may comprise an electric generation plant should power unit 9 be an electric motor, or a fuel supply and carburetion assembly should unit 9 be a fuel-driven engine. The power from unit 9 is trans-

mitted through vertical drive shaft 13 to the right angle gear set 25. The rotation of gear set 25 in turn drives the first flexible drive belt 31 through the first drive sprocket 27. The first flexible drive belt 31 then drives first chain wheel 33 which in turn rotates the propeller shaft 43 through the secured flexible drive belt 39, the second drive sprocket 37 and the second chain wheel 41. Propeller drive shaft 43 directly rotates propeller 51, thereby propelling the vessel in the desired direction. The rotation of propeller shaft 43 drives the lubrication piston pump 55 through cam 57 thereby serving to force lubrication from oil sump 61 into lubrication line 59 leading to spray nozzles 63. The lubrication is sprayed over the wheels, sprockets and bearings within steering cylinder 81 and provides these moving parts with a continuously renewed film bath of lubrication. The spent lubrication then falls to the lower portion of cylinder 81 and drains down through skegs 67, over the bearing assemblies 45, and settles in the oil sump 61 located at the bottom of pod 65. It is then recycled by pump 55. An important feature to note is that all the moving parts of the steering mechanism assembly are continually bathed in a sprayed film bath of lubrication which is continuously renewed by the above described circulation process. This system has been proven to be extremely effective in obtaining the maximum beneficial results from the lubricant employed in both cooling and lubricating the moving parts in order to minimize the effects of friction.

The vessel is steered by rotating steering cylinder 81 through the power unit 83 and the associated spur pinion 93 and spur gear 95. As is evident, rotation of cylinder 81 can be effected through a complete circle of 360 degrees thereby permitting the vessel to turn and advance in virtually any direction. During the operation of the entire assembly, the smooth and toothed idler wheels 111 and 121, respectively, serve to tension and guide the flexible drive belts 31 and 39 so that maximum transmission of power to the propeller drive shaft 43 can be achieved. Also, guide bearings 107 and anti-friction material 105 assure that the steering cylinder 81 will rotate smoothly in its direction of the propeller. By employing flexible power transmission means in the form of belts 31 and 39, the usual lateral rotational turning moments associated with right angle gear trains and rigid, non-flexible transmission means are substantially minimized and reduced to the level where they will only slightly effect the lateral rotation of the screw propeller by actuation of steering cylinder 81. Also, the use of flexible belts 31 and 39 provides for more simplified and efficient speed reduction ratios which will permit the use of a high speed propulsive power unit to drive large screw propellers at slow turning speeds, thereby improving the vessel's propulsive efficiency. It must also be noted that the streamlined skegs 67, which extend considerably below the lower surface of hull 1, serve not only to assist in maintaining directional course-keeping of the moving vessel due to their lateral area of water contact, but also act to further restrain the aforementioned minimum degree of axial turning moments created by the upper right angle gear train and flexible drive transmission combination of the invention.

DETAILED DESCRIPTION OF THE SECOND EMBODIMENT

Referring now to FIG. 3, there is depicted a second embodiment of the steering assembly of the invention as described above and shown by FIGS. 1 and 2. The instant embodiment differs in that the power unit 9, which may be either an electrically driven motor or a fuel driven engine, is secured, by means of bolts 139, directly to the cylinder top 82 in a horizontal position. A coupling means 141 drivingly connects the power unit's drive shaft 143 which is rotatably secured within a bearing assembly 145. The latter assembly 145 is connected to cylinder top 82 through a support means 147 and bolts 149. A housing 151 is provided for enclosing drive shaft 143, its associated bearings 145 and the upper portion of flexible drive belt 31 and its associated first drive sprocket 27.

OPERATION OF THE SECOND EMBODIMENT

The operation of this complete assembly is exactly the same as described for the FIGS. 1 and 2 embodiment with the exception that the power unit 9, being secured to the cylinder top 82, necessarily rotates therewith. In addition, with the direct connection between first drive sprocket 27 and drive shaft 143 of the horizontal power unit, the right angle gear set 25 is thereby eliminated so that the entire power train drive system depicted by FIG. 3 is in the basic form of a Z-shaped arrangement. Steering is effected through power unit 83, spur pinion 93 and spur gear 95 as previously described above.

DETAILED DESCRIPTION OF THE THIRD EMBODIMENT

FIGS. 4 and 5 comprise a schematic illustration of yet another embodiment of the steering mechanism of the present invention. The rotary cylinder in the instant case is installed within a vertical trunk 199 formed within the hull 1 of the vessel. The power unit 9, secured to the deck of the vessel's hull 1, is located laterally aside from the vertical axis of rotary cylinder 81. The drive shaft 13 of power unit 9 is drivingly coupled to a first cardan-universal joint assembly 200. The latter joint 200 is drivingly connected to a first right angle gear set 201, enclosed in a housing 203, through drive shafts 205 and its associated bearing assemblies 207 enclosed within a bearing housing 209. A vertical drive shaft 211 extends from gear set 201 down through guide bearing 213 secured to the bottom portion of gearing housing 203. Drive shaft 211 extends through cylinder top 82 and is drivingly connected to right angle gear set 25 located within rotary cylinder 81. A second cardan-universal joint assembly 217 is disposed within and serves as a part of the first horizontal drive shaft 29 for drivingly connecting the right angle gear set 25 to the first drive sprocket 27. The first right angle gear set 201 and its associated housing 203 are mounted on the top of a deck plate 219 which is secured over the vertical trunk 199 of the hull 1 by means of bolts 221. The peripheral rim of cylinder top 82 revolves upon a set of bearings 223 secured by corresponding bracket assemblies 225. A right angle gear set 227 is enclosed within a housing 229 and serves to drivingly connect the steering cylinder power unit 83

with spur pinion 93 and spur gear 95. A deck hatch lid 231 permits access to a cylinder lid 232 which in turn permits entrance into rotary cylinder 81 for maintenance and repair of the moving parts enclosed therein. A series of step rungs 233 enable a workman to reach the lower portions of cylinder 81. A set of friction bearings 235 and their associated bearing supports 237 provide alignment and rotary support for the lower portion of cylinder 81. Bearing supports 237 are secured to the inner wall of vertical trunk 199 by any conventional means well known in the art.

OPERATION OF THE THIRD EMBODIMENT

The operation of the embodiment depicted in FIGS. 4 and 5 is similar to that described for the first two embodiments discussed above. In this case, the power from unit 9 is transmitted to the first and second flexible drive belts 31 and 39 through the pair of cardan-universal joints 200 and 217 and the pair of right angle gear sets 201 and 215 disposed and drivingly connected therebetween. Steering is effected by energizing steering power unit 83 so that power from the latter is transmitted to spur pinion 93 and spur gear 95 through right angle gear set 227 enclosed within housing 229.

I claim:

1. A combined power propulsion and steering assembly for waterborne vessels comprising:
 - a. a power means;
 - b. a transmission means connected to and driven by the power means and including:
 1. a first flexible drive belt means connected to and driven by the power means; and driven by the first flexible drive belt means;
 2. means drivingly connected to the transmission means for rotating same about a vertical axis in an arc of greater than 120°; and
 3. a propelling means connected to and driven by the transmission means for moving the vessel.
 - c. a propelling means connected to and driven by the transmission means for moving the vessel.
2. The assembly as defined in claim 1 wherein said arc is approximately 360°.
3. The assembly as defined in claim 1 wherein the means for rotating the transmission means includes:
 - a. a rotary housing for containing the transmission means; and
 - b. a power unit means drivingly connected to the rotary housing means for rotating same.
4. The assembly as defined in claim 1 wherein the propelling means includes:
 - a. a propeller drive shaft means connected to and driven by the transmission means; and
 - b. a propeller means connected to and driven by the propeller drive shaft.
5. A combined power propulsion and steering assembly for waterborne vessels comprising:
 - a. a power means;
 - b. a transmission means connected to and driven by the power means and including:
 1. a first flexible drive belt means connected to and driven by the power means; and
 2. a second flexible drive belt means connected to and driven by the first flexible drive belt means;
 3. a propelling means connected to and driven by the transmission means for moving the vessel; and
 4. a lubrication means connected to and driven by the propelling means for providing a continuously

renewed film of lubricant over the transmission means.

6. The assembly as defined in claim 5 wherein the lubrication means includes:
 - a. a sump means for containing lubricant;
 - b. a pump means connected to and driven by the propelling means;
 - c. a spraying means for applying lubricant to the transmission means; and
 - d. a line means for connecting the pump means to the spraying means.
7. The assembly as defined in claim 3 wherein the connection between the power unit means and the rotary housing means includes:
 - a. a vertical drive shaft extending downwardly from the power unit means and driven by same;
 - b. a spur pinion connected to the drive shaft and driven thereby; and
 - c. a spur gear circumferentially secured to the rotary housing and driven by the spur pinion.
8. The assembly as defined in claim 1 wherein:
 - a. the connection between the first flexible drive belt means and the power means includes a first horizontal drive shaft means; and
 - b. the connection between the first flexible drive belt means and the second flexible drive belt means includes a second horizontal drive shaft means.
9. The assembly as defined in claim 1 including a plurality of roller means for tensioning and guiding the first and second flexible drive belt means.
10. The assembly as defined in claim 3 including:
 - a. a support means secured to the vessel; and
 - b. anti-friction means secured to the support means for engagement against the outer surface of the rotary housing.
11. The assembly as defined in claim 3 including a streamlined housing secured to and extending below the rotary housing wherein the streamlined housing includes:
 - a. a pair of hollow skeg means for housing at least a portion of the transmission means; and
 - b. a hollow pod means for housing at least a portion of the propelling means.
12. The assembly as defined in claim 11 further including a fin means secured to and extending below the pod means.
13. The assembly as defined in claim 1 wherein:
 - a. the power means is secured to the upper portion of the vessel and includes a vertical drive shaft extending downwardly therefrom; and
 - b. the connection means between the power means and the transmission means includes a right angle gear set drivingly coupled to the vertical drive shaft.
14. The assembly as defined in claim 1 wherein:
 - a. the power means is secured to the means for rotating the transmission means and is rotated therewith; and
 - b. the connection means between the power means and the transmission means includes a first horizontal drive shaft means.
15. The assembly as defined in claim 1 wherein the connection means between the power means and the transmission means includes:
 - a. at least one universal joint means drivingly connected to the power means; and

b. at least one right angle gear set drivingly connected to the universal joint means.

16. The assembly as defined in claim 3 further including closure means connected to the rotary housing for permitting access therein.

17. The assembly as defined in claim 1 wherein the

power means is an electrically driven motor.

18. The assembly as defined in claim 1 wherein the power means is a fuel-driven engine.

19. The assembly as defined in claim 1 wherein said arc is greater than 270°.

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