

[54] **BOAT PROPULSION SYSTEM**

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[21] Appl. No.: **292,960**

**Related U.S. Application Data**

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1972.

[52] U.S. Cl. .... **115/18 R, 115/35, 115/41 HT**

[51] Int. Cl. .... **B63h 21/26**

[58] Field of Search ..... 115/17, 18, 34, 35, 41 HT;  
114/154, 150, 144, 145, 146, 153; 74/478,  
480 B, 404, 665 F, 665 G, 665 GA, 665 H,  
665 S

[56] **References Cited**

**UNITED STATES PATENTS**

|           |        |                  |        |
|-----------|--------|------------------|--------|
| 2,946,306 | 7/1960 | Leipert .....    | 115/41 |
| 3,583,357 | 6/1971 | Shimanckas ..... | 115/41 |
| 2,253,757 | 8/1941 | Bugatti .....    | 115/35 |
| 1,824,213 | 9/1931 | Johnson .....    | 115/35 |
| 3,091,977 | 6/1963 | Kiekhaefer ..... | 115/18 |

|           |         |                  |        |
|-----------|---------|------------------|--------|
| 3,350,879 | 11/1967 | Boda et al. .... | 115/17 |
| 1,903,269 | 3/1933  | Peck .....       | 115/35 |
| 1,866,482 | 7/1932  | Olsen .....      | 115/35 |
| 2,975,750 | 3/1961  | Smith .....      | 115/41 |
| 2,739,561 | 3/1956  | Kiekhaefer ..... | 115/18 |

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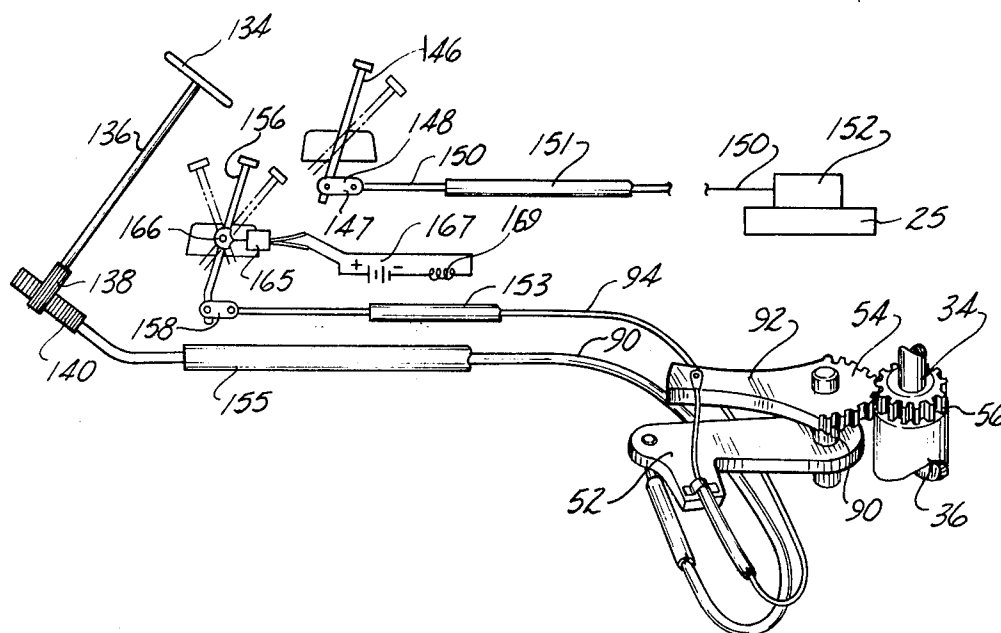
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Dumont

[57]

**ABSTRACT**

A system for controlling the forward and reverse operation of a boat having a propulsion unit, which unit is mounted on the boat in an appropriate location, fore or aft, and swivelable about a substantially vertical axis to provide normal steering of the boat. Included is a mechanism for providing a rapid turning of the propulsion unit itself through a turn of approximately one-half circle to redirect the force of the propulsion forwardly and in this manner provide reverse drive of the boat. The system further includes a mounting and control arrangement for the propulsion unit which makes possible the selective inclination of the propulsion unit about the substantially vertical axis to provide both trim and tilt of the propulsion unit.

**10 Claims, 7 Drawing Figures**



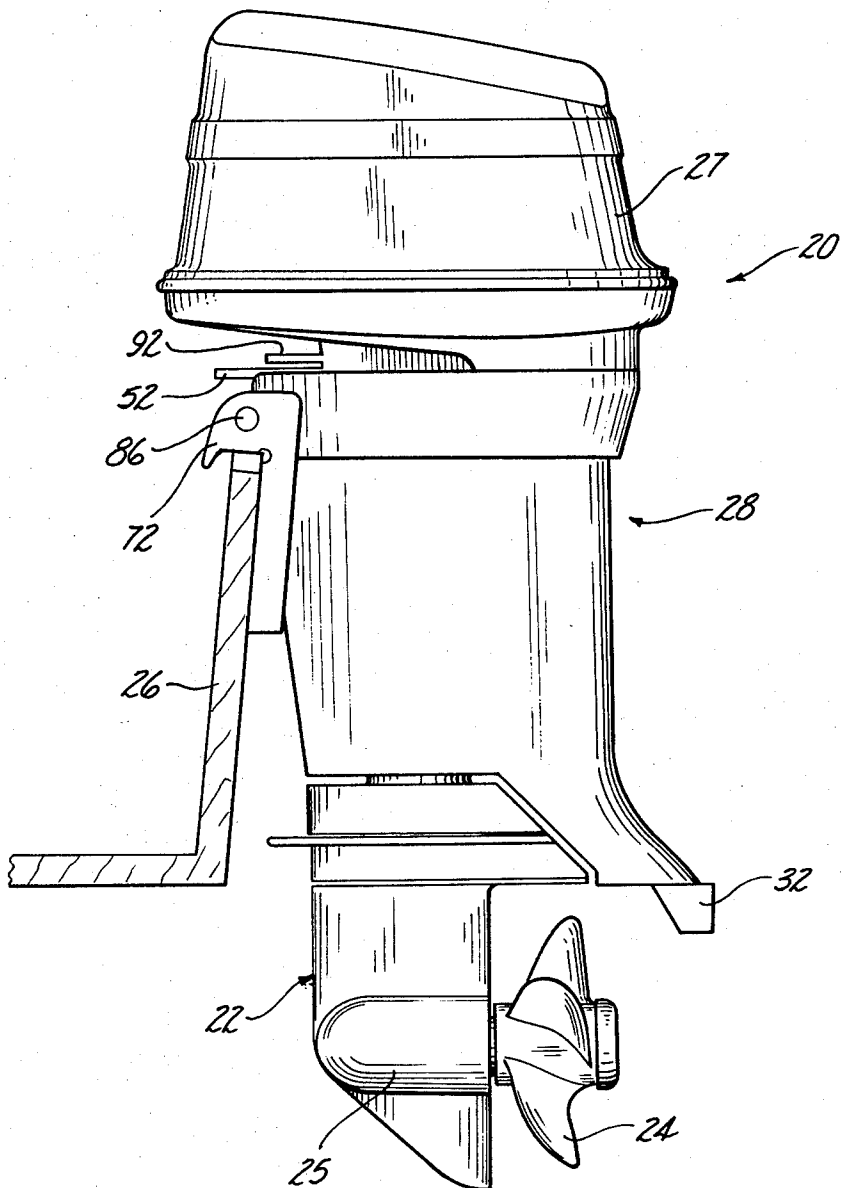


Fig-1

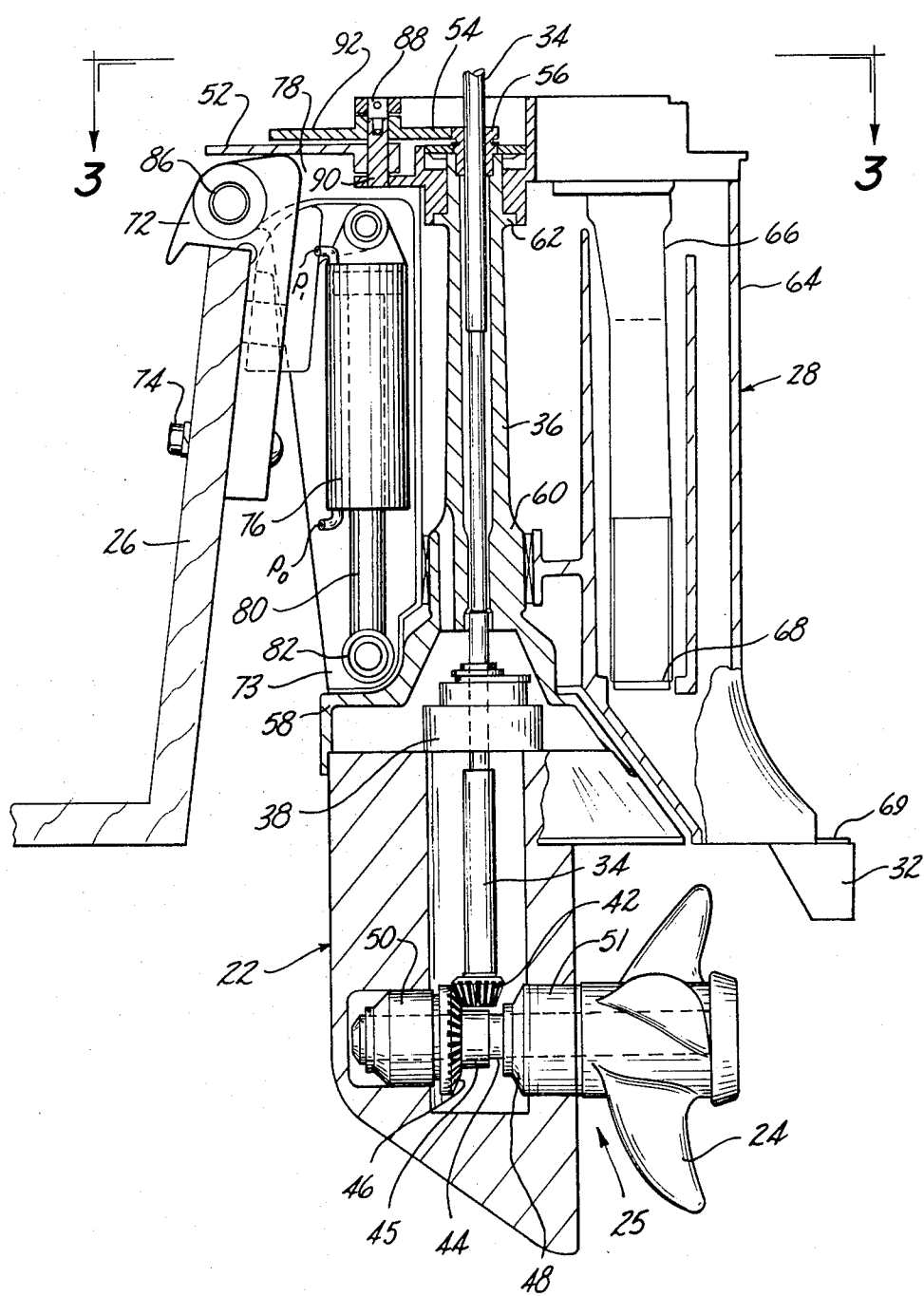


Fig-2

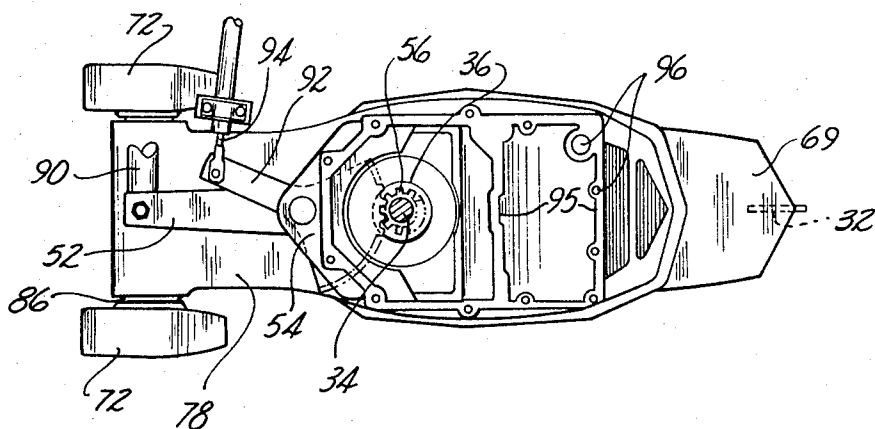


Fig - 3

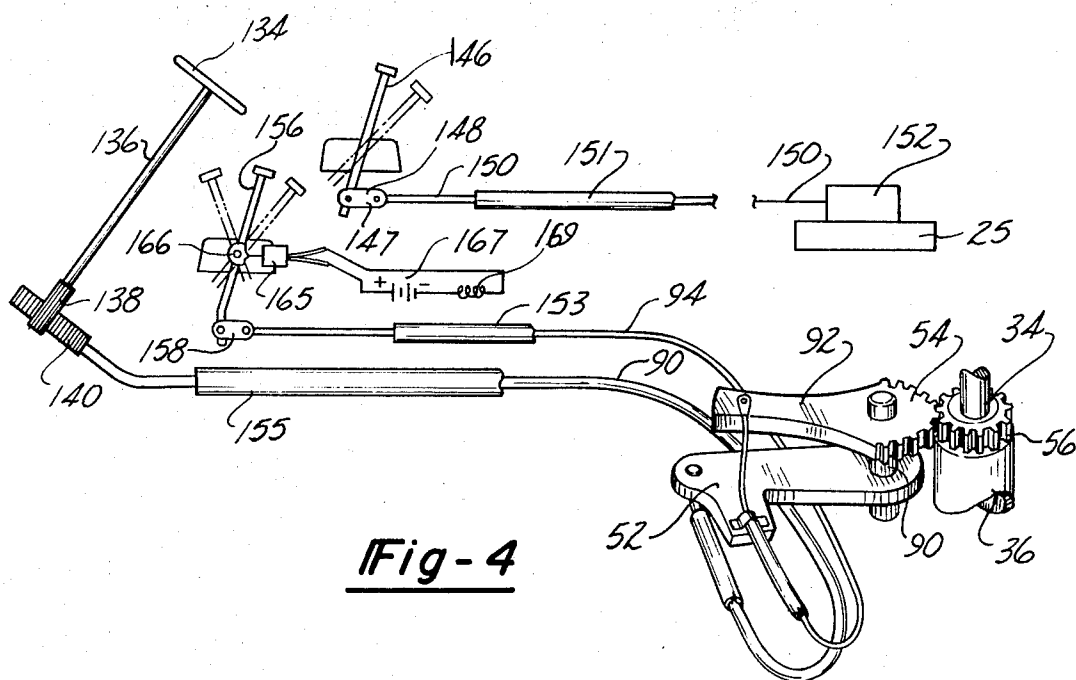
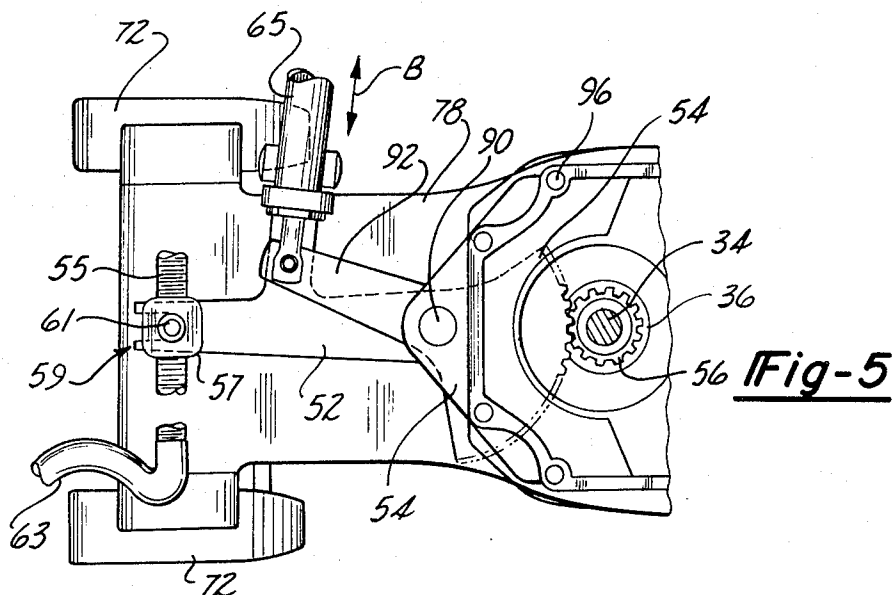
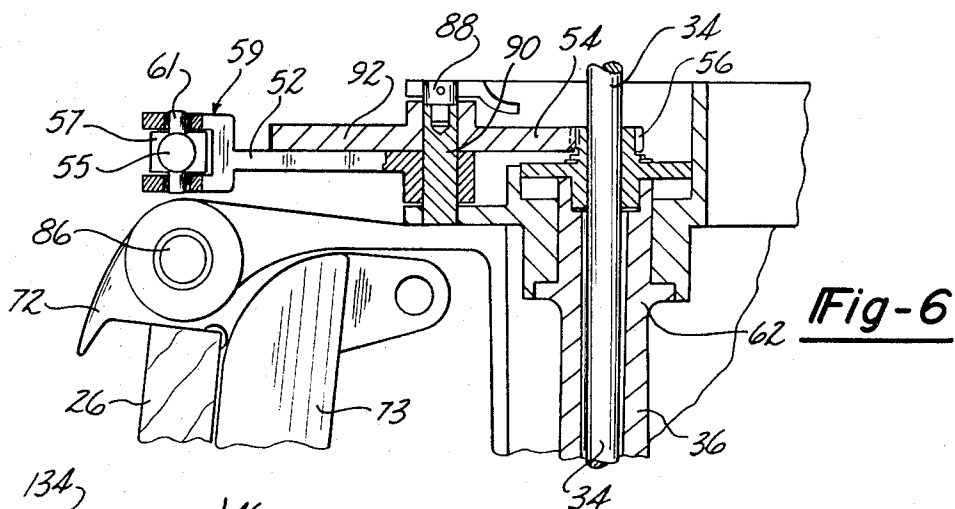
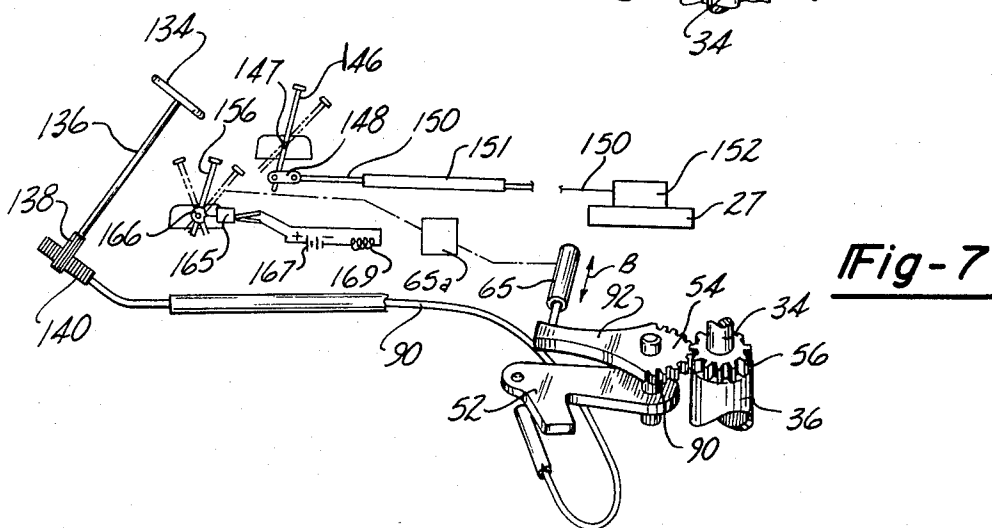


Fig - 4



## BOAT PROPULSION SYSTEM

### CROSS REFERENCE TO RELATED APPLICATION

This application is a continuation-in-part of U. S. application Ser. No. 249,168 filed in behalf of Joseph E. Smith on May 1, 1972 for "Boat Steering and Reversing System," which application is of common ownership herewith.

### BACKGROUND OF THE INVENTION

This invention relates to a steering and reversing system for boats or other watercraft in which there is provided a propulsion unit adapted to provide a variable magnitude thrust force rearwardly of the boat to propel it in a forward direction. The invention is particularly suitable for a propulsion system in which the propulsion unit is rotatable about an upstanding and substantially vertical axis to provide for controllable steering of the boat without requirement for a separate rudder or complicated steering mechanism. The propulsion unit itself may incorporate a modified and simplified rudder construction when the rudder effect is desired. The major directional and normal steering controls are through selective directing of the thrust force.

It will be seen that the present invention is particularly suitable for systems in which the engine driving the propulsion unit is outboard mounted and in which an internal combustion engine and a propeller are included for providing the actual thrust force. Preferably the propulsion unit includes an internal combustion engine. The changeover as between forward and reverse operation of the boat is achieved through provision of a special rapid reversing mechanism which controls and turns the propulsion unit itself to reorient the thrust direction.

The prior art related to propulsion systems for watercraft shows a variety of systems in which there is included a propulsion unit generally incorporating a propeller shaft and propeller, sometimes combined with a modified trim tab or rudder. The entire propulsion unit is typically mounted in a manner freely swivelable for normal steering. An example of this basic type of mechanism is shown and described in U. S. Pat. No. 1,693,590. U. S. Pat. No. 1,866,482 shows a similar arrangement, but one in which the motor unit is fixed to the boat hull and in which the steering is achieved by swiveling the boat propeller through a cable and bevel gear arrangement. U. S. Pat. No. 1,824,213 makes a like showing of an outboard motor again having the propeller housing swivelably controlled relative to the motor housing for steering the boat. The swiveling action is provided by a sector gear and rack mechanism.

Other mechanisms are known like that disclosed in U. S. Pat. No. 1,774,956 in which the propulsion and steering unit includes a turret-like structure which includes and encloses the driveshaft and the lowermost projecting portion of the propulsion unit. In these embodiments, for normal steering the turret assembly is rotated about a substantially vertical axis through a gear coupled to the steering wheel and in mesh with a ring gear mounted on the turret structure.

It is also known that it is possible to use swiveling of the propulsion unit to carry it through a turn of essentially 180° in order to reverse the direction of the thrust force and hence the direction in which the boat is driven.

Mechanisms are known which are directly operable through the steering wheel and normal steering linkage. The extent of turning in these cases is not precisely controlled by the operator. Also, the changeover between forward and reverse direction cannot be carried out rapidly in the manner in which the present invention is capable of operation. Examples of mechanisms of this type are shown in U. S. Pat. No. 3,397,638, which uses the manual turning of the steering cable itself to provide reversing turning.

Other patents have steering systems which make only general reference to the rapid turning of the propulsion unit through the 180° turn, but they refer in a general manner, for example as in U. S. Pat. No. 2,834,313, to providing a quick rotation. There is made no actual disclosure of the actual mechanism or means whereby such turning may be achieved.

The prior art further is lacking of a showing in which a propulsion unit capable of a rapid turning for reversing operation may be readily combined with tilting movement of the entire propulsion unit about the substantially vertical axis which forms its axis of rotation.

The teachings of the prior art have been insufficient and inadequate to meet the problem of providing a low cost propulsion system for boats in which it is possible without the use of an expensive and complicated reversing gear mechanism to make a quick changeover between forward and reverse operation of the boat.

The present invention further includes a throttle control and clutch mechanism for causing the engine to idle during reverse changeover and further to disengage the propeller from the engine drive during the exceedingly brief but perceptible interval when the reverse changeover is occurring.

### SUMMARY OF THE PRESENT INVENTION

The present invention relates to a rapid reversal mechanism for reorienting a boat propulsion unit in which the reversing mechanism is operable separately of the normal steering system without providing a complicated and expensive reverse drive gear mechanism. In conjunction with the rapid turning mechanism, there is provided a control means for inclining the propulsion unit itself about a substantially vertical axis for controlling the trim of the boat to optimize the drive angle of the engine, and alternately for providing a means for tilting the engine out of rocks and sand.

The present invention further includes a system in which the internal combustion engine associated with the propulsion unit is not itself rotated during turning, but rather remains fixed in its mounting to the boat. To achieve the objects of the present invention, there is included a hydraulic cylinder and piston system which is capable of altering the angle of the propulsion unit relative to the vertical axis with which the propulsion unit is aligned to provide the selected tilt and trim.

### BRIEF DESCRIPTION OF THE DRAWINGS

The present invention will be understood by reference to the accompanying specification and by reference to the accompanying drawings wherein like reference characters are used to refer to like parts as they may appear throughout the several views, and in which:

FIG. 1 is a side elevation view of an outboard motor propulsion unit, incorporating the present invention, mounted on the transom of a boat;

FIG. 2 is a longitudinal sectional view of the propulsion unit portion of FIG. 1 with parts broken away and showing the hydraulic cylinder actuator for tilting and trimming the propulsion unit;

FIG. 3 is a top plan view of the propulsion unit from line 3—3 of FIG. 2 with parts broken away to illustrate the steering and reversal control elements associated therewith;

FIG. 4 is a schematic view showing the manual and electrical control system associated with the reversing and steering of the propulsion unit;

FIG. 5 is a top plan view of the propulsion unit similar to FIG. 3 but showing a different embodiment of the steering and reversal control system;

FIG. 6 is a side elevational view of the propulsion unit, partly in longitudinal section; and

FIG. 7 is schematic view showing a different embodiment of the electrical and manual control system used.

#### DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

As shown in FIG. 1, a drive unit 20 for a boat, according to the present invention, comprises a propulsion unit 22 which is mounted rotatable through substantially a full circle turn below a stationary housing 28 on the top of which is mounted a vertical shaft internal combustion engine 27. A propeller 24 is rotatably mounted in the housing 25 of the propulsion unit 22, with its axis of rotation substantially horizontal, its direction of rotation and the pitch of its blades such as to provide normally a thrust force rearwardly of the boat when the drive unit 20 is mounted on the boat transom 26. The detail of the internal construction of the drive train for the propeller 24 and the manner in which the propulsion unit 22 is mounted and pivotably rotatable relative to the remainder of the drive unit 20 are best shown in connection with FIG. 2. The actual rotation of the propulsion unit 22 is provided by the turning of an internal steering tube 36. Also included in the propulsion unit 22 and attached to the rearward lower extending portion of the housing 28 from the engine mount for the engine 27 is a trim tab 32 which adds to the stability of the boat during forward operation. It should be noted that the need for a separate, operator-controlled rudder for steering is eliminated by the system constructed in accordance with the present invention.

As best seen in FIG. 2, a driveshaft 34, connected to or being an extension of the engine output shaft, extends downwardly through the steering tube 36. The impeller of a water pump 38 is keyed on an intermediate portion of the driveshaft 34, and suitable bearings, not shown, are provided to journal the driveshaft 34 for free rotation relative to the steering tube 36 and the housing of the propulsion unit 22. A bevel gear 42 is keyed on the lower end of the driveshaft 34. The gear 42 is in mesh with a gear 46 mounted for free rotation about a propeller shaft 44 journaled in bearings 48 and 50. A neutral clutch 45 is slidably mounted by way of a spline, or sliding keyway arrangement, on the propeller shaft 44 and is controllably engageable with the face of the gear 46 to couple the gear with shaft 44 on the end of which, projecting from housing 25, is mounted the propeller 24.

The steering tube 36 has coupled to its upper end the mechanism which provides both steering and reversal

control. Included in this mechanism is a steering lever 52, which lever is coupled to a steering gear segment 54. The upper end of the steering tube 36 has pinned to it a steering pinion gear 56 which has its teeth in mesh with those of the steering gear 54 so that as the steering lever 52 is rotated the entire steering tube 36 and lower propulsion unit 22 are rotated to provide normal steering. The steering tube 36 includes at its lower end an enlarged turret 58 which carries mounted in it the clutch and gear system just described. The steering tube 36 is further supported for rotation by suitable bearings at its central portion 60 and its end portion 62. At the right-hand side of the steering tube 36 there is included a strut 64 and an exhaust tube 66 having a seal 68 at its lower end. The trim tab 32 is mounted on a horizontal plate 69 at the lower right-hand end of the strut 64.

At the left-hand side of the steering tube 36 there is illustrated the detail of the mechanism for mounting the engine 27 on the boat transom 26. Included is a bifurcated stern mounting bracket 72 with a bolt and nut fastener 74 for locking the motor to the boat. A hydraulic cylinder 67 is connected with its cylinder upper end 77 engageable with the bracket 72 which is pivotally mounted on a downwardly extending arm 73 of the bracket 72. The end of the piston rod 80 is pivotally connected to a bushing 82 fixed between the lower ends of the arm 73 which are part of the strut 64. A bushing assembly 86 is used to rotatably support the plate 78 which is part of the strut 64 and contains the system's shock mounts between the arm 73 of the bracket 72. It will be seen that according to the shortening or lengthening of the lever arm provided by the cylinder 76 and its piston rod 80 in response to control pressures  $P_1$  and  $P_0$  applied by a suitable manually operated control valve, not shown but located at either end of the cylinder 76, the motor 27 and propulsion unit 22 will be tilted around the fulcrum provided by the upper bushing 86 so that the desired degree of tilt or trim may be obtained, or, alternatively, the engine may be tilted all the way for storage out of the water. The detail of the water circulation and pump system has been omitted in the interest of brevity, but it will be understood that such system is provided for cooling the engine by means of flexible tubes, rotary valve, or collector ring. Included at the upper end of the steering tube 36 is the means for fastening the steering lever 52 to the steering gear segment 54, which includes a pin 88.

FIG. 3 shows the upper end of the steering tube 36 and the steering pinion 56 mounted thereon. Also shown is the segment steering gear 54 which has its teeth in engagement with those of the steering pinion 56. The steering lever 52 has attached at its left-hand end a steering cable 90. The manner in which the steering cable 90 is controlled will be further explained in connection with FIG. 4 hereinafter.

A reversing lever 92 is also coupled to the gear segment 54 to provide for rapid reversal by turning the gear segment 54 a sufficient amount to rotate the steering tube 36 108° and thus reorient the propeller to provide an opposite direction thrust for reversing. A reversing cable 94 is connected to the left-hand end of the reversing lever 92 as shown. Lever 92 is part of the gear segment 54. The conduit of the cable 94 is fixed to the steering lever 52 which maintains a relationship between gear 54 and lever 52 for steering.

It will be understood that in the FIG. 3 drawing, the cover of the uppermost located internal combustion engine 27 is removed to clarify the detail of construction of the lower drive and the propulsion unit 22. Accordingly, the upper casting surface on which the engine 27 is normally secured is shown exposed. The casting includes a plurality of cross-brace sections 95 and a number of openings 96 for bolts used to fasten the engine 27 in place.

FIG. 4 illustrates the manual control system used in conjunction with the propulsion unit 22, and more particularly with the propulsion steering tube 36 and the upper steering pinion 56. A portion of the vertical driveshaft 34 is shown extending downwardly through the steering tube 36.

Included in the manual control system is a throttle control lever 146 and the mechanism connecting between the throttle lever 146 and the carburetor 152 of the engine 27. A rotatable steering means in the form of a steering wheel 134 and a steering column 136 are used to provide for normal steering. The rotation of the wheel 134 is transmitted through a pinion gear 138 and a rack gear 140 to effect a longitudinal steering movement of the steering cable 90. It will be understood that the wheel 134 is normally positioned at the front of the boat. The several connecting control cables used are passed through suitable guide conduits to insure their protection and free sliding movement. The conduit for the throttle cable 150 is indicated by the numeral 151; the conduit for the reversing cable 94 is indicated by the numeral 153; and the conduit for the steering cable 90 is indicated by the numeral 155.

The throttle control lever 146 is shown in solid line in its forward "on" position and in phantom line in its rearward "neutral" position. The lever 146 is pivotally mounted on a transverse pin 147 and is connected through a link 148 to the forward end of the cable 150. The control of the fuel mixture supplied to the internal combustion engine 27 is provided through an appropriate operating mechanism for the carburetor 152.

In the control system illustrated in the FIG. 4 drawing, neutral operation is provided through a solenoid actuated clutch 45 as was shown in the FIG. 2 drawing. The reversing lever 156 is illustrated in solid line in its intermediate or neutral operating position. The left-hand phantom line showing is that of the lever 156 in its "forward" position, while the right-hand phantom line showing is that of the lever 156 in its "reverse" position. The clutch 45 is actuated during the neutral position of the lever 156 by means of a cam operated switch 165. The switch 165 is operated by a cam 166 fixed near the central portion of the lever 156 in the position shown. A DC source 167 is used to provide the electrical signals to operate the solenoid coil 169 for the clutch 45. The reversing mechanism is controlled through the connecting link 158 and the reversing cable 94. The reversing cable 94 is coupled at its rear end to the lever 92, which in turn has fixed to and forms part of the sector gear 54 for providing a rapid turning of the steering column 36.

FIGS. 5 and 6 show an alternate embodiment of the steering and reversing system in which a hydraulically or pneumatically operated cylinder 65 is used to provide reversal, while a separate threaded shaft and slave-nut construction is used to control normal steering. The upper end of the steering tube 36 is shown with the steering pinion 56 mounted thereon. Also shown is the

segment gear 54 which has its teeth in engagement with those of the steering pinion 56. A steering lever 52, which is a left-hand extension of the gear 54, has mounted proximate its left-hand end a threaded shaft 55, which shaft carries a slave-nut 57. The steering lever 52 further terminates at its left-hand end in a forked extension 59 which is adapted to engage and retain an upwardly extending pin 61 which is fixed to the upper and lower surface of the slave-nut 57. The rotation of the segment gear 54 about its center 90 is provided by the rotation of the shaft 55 preferably through a flexible tube 63, which tube may be coupled to the lower end of the steering shaft such as steering shaft 136 shown in FIG. 7 hereinafter. A turning of the steering wheel 134 thus provides a rotary movement of the gear segment 54 and a resultant turning of the steering tube 36.

The reversing action in a manner similar to the mechanism illustrated in FIG. 3 is provided by the turning of the reversing lever 92 which is a part of the gear 54 to provide for rapid reversal by turning the gear 54 a sufficient distance to rotate the steering tube 36 through a 180° turn and accordingly reorient the propeller to provide an opposite direction thrust for reversing. This rapid movement of reversing lever 92 is provided by the operation of the hydraulic cylinder 65 which has its piston coupled to the end of the reversing lever 92. It will be understood that the piston associated with the cylinder 65 is movable to apply a force in the direction indicated by the arrows B according to its actuation through a suitable hydraulic valve. The hydraulic valve may be either manually actuated or operated electrically through a valve control coil controlled by lever 156 as will be shown in FIG. 7 hereinafter.

FIG. 7 illustrates the complete control system used in conjunction with the propulsion unit 22. A short portion of the vertical driveshaft 34 is shown extending into the steering tube 36. Included in the manual control system is a throttle control lever 146 and the mechanism connecting between the lever 146 and the carburetor 152 associated with the engine 27. A rotatable steering means in the form of a steering wheel 134 and a steering column 136 again are used to provide for normal steering. The rotation of the wheel 134 is transmitted to a pinion gear 138 and a rack gear 140 to effect a longitudinal steering movement of the steering cable 90. It will be understood that the steering wheel 134 is normally positioned at the front or central portion of the boat. Alternately, the steering control system may be of the type illustrated in FIGS. 5 and 6 in which a flexible steering tube 63 is operatively coupled to the lower end of the steering shaft 136 and used to provide a rotary motion to the threaded shaft 55 to move the nut 57 rightwardly or leftwardly on the shaft and thus rotate the gear segment 54 and the pinion gear 56 for normal steering.

The mechanism used for controlling reversing operation of the boat is associated with the reversal control lever 156. The basic control and the actuating force for the lever 92 and thus the segment 54 is provided by the piston 65. The reversing lever 156 is illustrated in solid line in its intermediate or "neutral" output position. The left-hand phantom line showing is that of the lever 156 in its "forward" position, while the right-hand phantom line showing is that of the "reverse" position. The clutch 45 is actuated in the neutral position of the lever 156 by means of a cam operated switch 165. The

switch 165 is operated by cam 166 fixed near the central portion of the lever 156 as shown. The DC source 167 is used to provide the electrical signal to operate the solenoid coil 169 for the clutch 45 as was previously illustrated in the FIG. 2 drawing. The reversing mechanism is controlled in the manner shown through a similar switch arrangement, not shown, but operated by the lever 156 in its right-hand reverse position. This will initiate the operation of an electrical control valve 65a which in turn operates the hydraulic piston 65 to move it in either direction as indicated by the arrows B to place the gear 54 into or away from reversing position. In this manner the reversing operation provided through the gear segment 54 can be either mechanically operated in the manner shown in the FIG. 4 drawing or hydraulically operated in the manner shown in the FIG. 7 drawing.

It will thus be seen that the present invention provides a simplified propulsion system for boats combined with a simplified system for both tilt and trim control.

What is claimed is:

1. A propulsion unit mounted on a boat rotatable about a substantially vertical axis for normal steering, steering means, a steering cable connected between said steering means and said propulsion unit for normally steering the boat in a generally forward direction, a control means operatively connected to and controlling said propulsion unit for rapidly turning it about said axis through substantially 180° to effect a change-over between forward and reverse drive of the boat, a means operably connected to said propulsion unit for inclining it a predetermined degree from alignment with said axis for controlling vertical trim of said boat, an engine connected to said propulsion unit for driving it, and a clutch means operatively connected between said engine and said propulsion unit, said clutch operated in unison with said control means to provide for disconnect of drive from said engine during the rapid turning of said unit.

2. The combination as set forth in claim 1 wherein said control means includes a separate reversing cable operatively connected to said propulsion unit, said reversing cable operable to initiate the rapid turning of said propulsion unit.

3. The combination as set forth in claim 1 wherein said control means includes a fluid operated cylinder operatively connected to said propulsion unit for initiating the rapid turning of said unit.

4. The combination as set forth in claim 1 wherein said last mentioned means comprises a hydraulic cylinder having a piston differentially movable therein, and

wherein one end of said cylinder is coupled to a tiltable mounting means for said propulsion unit and said piston is coupled to said propulsion unit for inclining said propulsion unit.

5. The combination as set forth in claim 1 wherein a rearwardly and downwardly extending strut is mounted proximate said propulsion unit, said strut having mounted at its lower end a trim tab likewise inclinable with said unit for trim control.

6. A propulsion unit pivotally mounted on a boat and rotatable about an upstanding axis, steering means, means connected between said steering means and said propulsion unit for swiveling it for normal steering, reversing means operatively connected to said propulsion unit for rapidly turning it through substantially a half-circle turn about said axis to provide a changeover between forward and reverse drive of the boat, said propulsion unit including a steering tube and a steering gear mounted thereon, a pivotal lever mounted on said unit proximate said steering gear, a control gear mounted on said lever and having its teeth engaged with the teeth of said steering gear, said lever coupled to said steering means for providing normal steering, said lever further coupled to said reversing means and rockable by it to provide a rapid half-circle turn of the steering gear and propulsion unit, and means operatively connected to said propulsion unit for pivoting it a predetermined degree from alignment with said upstanding axis to provide tilt of said propulsion unit.

7. The combination as set forth in claim 6 wherein said control gear comprises a sector gear mounted at one end of said lever, said sector gear having its center proximate the pivotal point of said lever.

8. The combination as set forth in claim 6 wherein said reversing means includes a hydraulic cylinder operably connected to said lever and actuable to provide said rapid half-circle turn.

9. The combination as set forth in claim 6 wherein a rotatable threaded shaft is mounted proximate said lever end, said shaft having a nut threadably mounted thereon, said nut operably coupled to said lever for pivoting it to provide normal steering responsive to rotation of said threaded shaft, and a means comprising a flexible tube is connected between said steering means and said shaft for controlling its rotation.

10. The combination as set forth in claim 6 wherein an internal combustion engine is connected to said propulsion unit for driving it, and wherein a throttle means is operatively connected to said engine for initiating its idling operation during the rapid turning of said propulsion unit.

\* \* \* \* \*

UNITED STATES PATENT OFFICE  
CERTIFICATE OF CORRECTION

Patent No. 3,799,102

Dated March 26, 1974

Inventor(s) Joseph E. Smith

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 2, line 7, change "operating" to --operation--.

Column 3, line 30, change "sub-stantially" to  
--substantially--.

Column 4, line 23, change "67" to --76--;

line 61, change "108°" to --180°--.

Column 7, line 29, change "turn-ing" to --turning--;

line 34, change "con-trolling" to  
--controlling--.

Signed and sealed this 16th day of July 1974.

(SEAL)  
Attest

McCOY M. GIBSON, JR.  
Attesting Officer

C. MARSHALL DANN  
Commissioner of Patents