March 30, 1965 K. A. BERGSTEDT 3,175,529

MARINE PROPULSION MECHANISMS

Filed Jan. 23, 1963 2 Sheets-Sheet 1

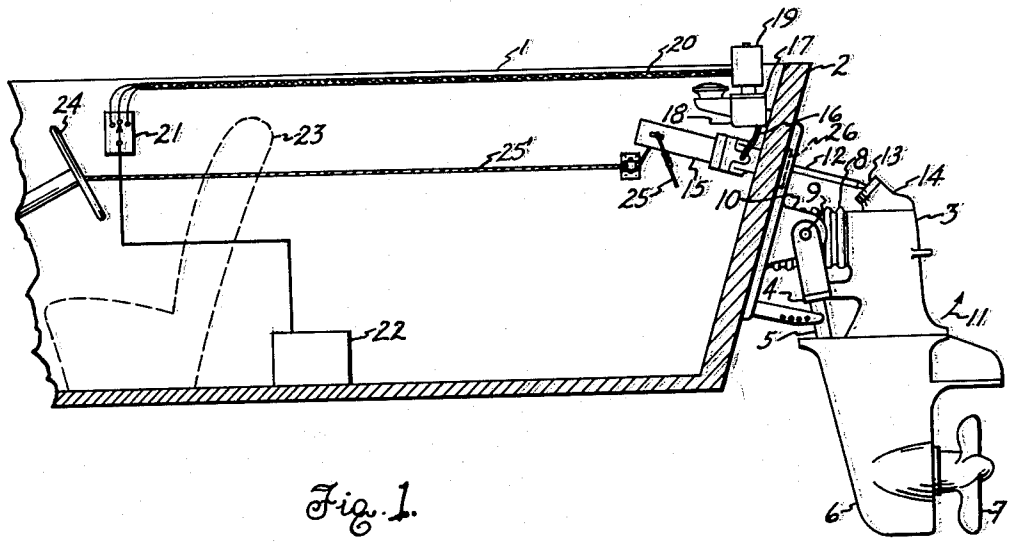


Fig. 1.

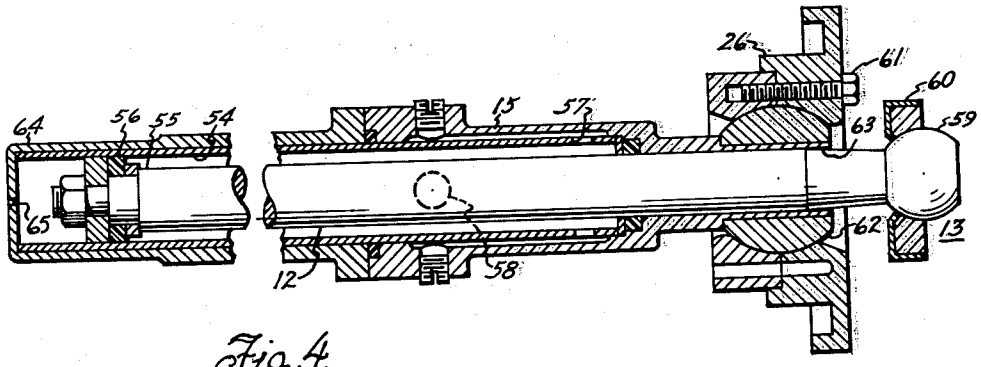


Fig. 4.

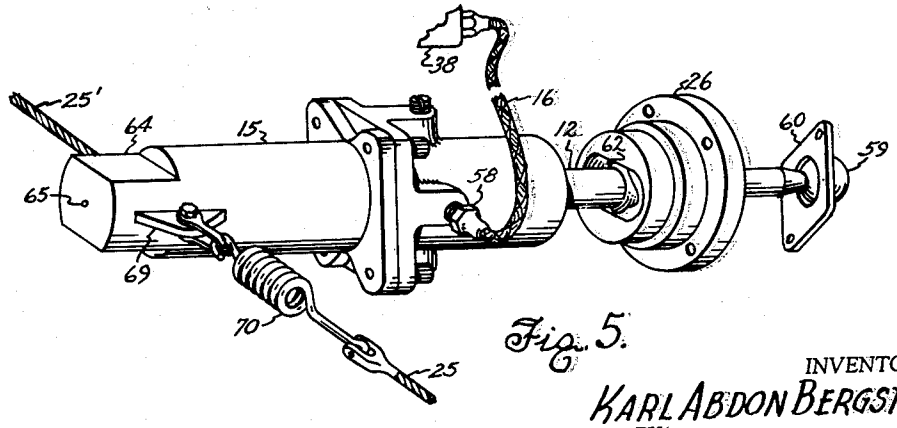


Fig. 5.

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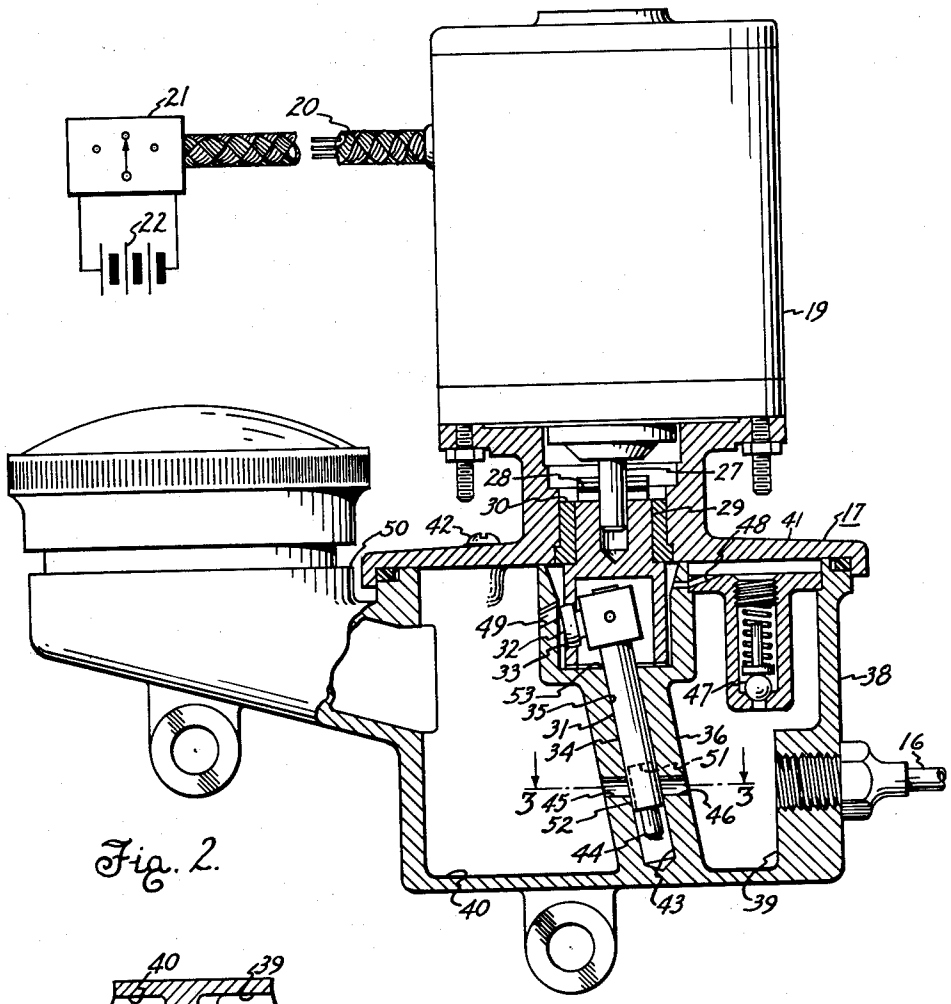


Fig. 2.

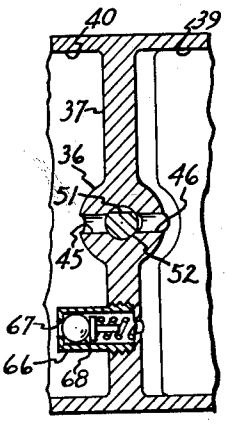


Fig. 3.

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MARINE PROPULSION MECHANISMS

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Filed Jan. 23, 1963, Ser. No. 253,377
4 Claims. (Cl. 115—35)

This invention pertains to marine propulsion mechanisms, and particularly to means for steering and tilting outboard drive units for boats.

An object of the invention is to provide improved means for tilting outboard drive units for boats and, particularly, for tilting gimbal mounted drive units of the type shown in United States Letters Patent No. 3,006,311.

The novel features which are believed to be characteristic of this invention are set forth with particularity in the appended claims. The invention itself, however, both as to its organization and method of operation, together with further objects and advantages thereof, may best be understood by reference to the following description taken in connection with the accompanying drawings, in which:

FIG. 1 is a side elevational view of an outboard drive unit including a steering and tilting system shown installed in a boat, portions being shown in fragment and in section for clarity;

FIG. 2 is a side elevational view partially in section of an electrically operated hydraulic pump, and including power and control means represented schematically, comprising parts of the system of FIG. 1;

FIG. 3 is a sectional view of a portion of the pump taken along line 3—3 of FIG. 2.

FIG. 4 is a sectional view of an element of the system of FIG. 1; and

FIG. 5 is a perspective view showing the element of FIG. 4 and associated portions partially in fragment of the system of FIG. 1.

Referring to FIG. 1, a system is shown which includes a boat 1 having mounted thereon behind transom 2 an outboard drive unit 3. The unit 3 and the mounting yoke or gimbal 4 which supports the unit are typically in accord with the disclosure of U.S. Patent No. 3,006,311, from which it will be understood that the unit 3 is mounted to swing about an upright pivot 5 from side to side in directions to steer the boat by propeller reaction and by reaction of the streamlined underwater housing portion 6. An inboard engine (not shown) is provided to drive propeller 7 through universal joint means (not shown) disposed within flexible boot 8, all as described in the aforementioned patent.

The unit 3, together with yoke 4, are supported on a horizontal pivot 9 and connected therethrough to ears 10 fixed to the boat, whereby the unit and yoke may tilt on pivot 9 in the direction indicated by arrow 11 to clear obstructions, to raise the propeller out of the water and for other purposes.

A steering rod 12 is connected by a ball and socket universal joint 13 to the upper end portion 14 of the unit 3. When the unit is in straight ahead operating position, the rod 12 extends in a direction in or parallel to a vertical plane through the centerline of the boat, and the unit is also aligned in or parallel to such plane.

The rod 12 extends from joint 13 forwardly and slightly upwardly to and through the boat transom terminating within a cylinder unit 15. The unit 15 is connected to a flexible hydraulic line 16 through which hydraulic fluid is selectively supplied under pressure into cylinder unit 15 from an electrically operated pump unit 17 to raise or tilt the outboard unit and through which fluid returns to the pump when the outboard unit

is returning from tilted position to its normal upright drive position shown in the drawing. The pump unit 17 is located in the boat in a position adjacent to unit 15 and is conveniently attached to the transom as shown.

The pump unit 17 comprises a pump and sump body 18 and an electric motor 19, the motor being connected through an electric cable 20 to a control switch 21 through which current is supplied to the motor from a battery represented at 22. Switch 21 is located adjacent the operator's seat shown in broken lines at 23 and is a three position switch for connecting the motor 19 for forward and reverse rotation and for disconnecting the motor, respectively.

Also arranged adjacent the operator's seat is a steering wheel 24 connected through steering cables 25 and 25' to the unit 15, the wheel being operable in known manner to reel in cable 25' while paying out cable 25 to steer in one direction and to reel in cable 25 while paying out cable 25' to steer in the opposite direction.

Rod 12 and cylinder unit 15 are telescopically interconnected and therefore remain in coaxial alignment. The cylinder unit is swingably mounted to the transom by means including a ball joint socket member 26 shown in broken lines in FIG. 1 and, upon swinging from side to side, causes rod 12 to swing in directions to swing, in turn, the outboard unit on the generally upright axis of pivot 5.

In accord with the invention, operation of switch 21 into one position causes pump unit 17 to force fluid into cylinder unit 15 and, as later further explained, to move rod 12 in a direction into the cylinder unit. Such retraction or drawing in of rod 12 into the cylinder unit pulls portion 14 of the outboard unit upwardly and forwardly tilting the outboard unit on horizontal pivots 9.

The pump unit 17 will be best understood with reference to FIGS. 2 and 3, wherein it will be seen that shaft 27 of reversible electric motor 19 is connected by a pin and socket connection 28 to drive pump rotor 29 in bearing 30. Rotor 29 is coupled to rotatable piston member 31 by means of a knob 32 affixed to and extending laterally from the piston member and engaged in a socket 33 offset from the axis of the piston member and from the axis of the pump rotor. Accordingly, the socket 33 and knob 32, upon rotation of the rotor, revolve in a circular path in a plane normal to the axis of the rotor 29, which, with the pump in the upright position shown in the drawing, would be a horizontal plane. The axis of the piston member 31 preferably intersects the axis of the rotor 29, and the point of intersection is approximately opposite or on a level with the knob 32 and socket 33 whereby the movement of the ball in the socket during rotation of the rotor is minimized.

The axis of the pump piston 31 is inclined with respect to the rotor axis a few degrees, such as substantially 10 degrees in the practical embodiment illustrated. The angle of inclination of the pump piston axis from the rotor axis may vary, however, from as little as 1 or 2 degrees to as much as 20 or 30 degrees, and the exact angle selected will be dependent upon many factors, including the lateral offset of the ball 32 and socket 33 from the axis of the rotor, the desired length of piston stroke, motor speed, desired pressure and volume of fluid to be pumped, and the permissible geometry of the parts. Geometry imposes practical limits as 45 degrees of inclination is approached, and a small angle as used herein is thus intended to be substantially or appreciably less than 45 degrees.

The body portion 34 of piston 33 is slideably and rotatably disposed fittingly within cylindrical bore 35 in an enlarged or cylinder block portion 36 of partition 37.

It will be seen that pump body portion 38 of unit 17 is hollow. Partition 37 separates the hollow body portion 38 into a pressure chamber 39 and a storage chamber or sump 40. The chambered pump body is closed by a cover 41 held thereon by bolts, such as bolt 42, and on which the motor 19 is carried, the cover with the motor attached thereto removable to permit convenient assembly and disassembly of the pump.

Cylinder 35 has a closed bottom end pressure portion 43 in which the lower end portion 44 of the piston moves up and down to pump hydraulic fluid between the sump 40 and pressure chamber 39 through intake port 45 and outlet port 46. The pump is reversible and operative in a forward direction to pump fluid from sump 40 through intake port 45 into portion 43 of the cylinder and thence through outlet port 46 into chamber 39 from which the liquid may flow into outlet conduit 16, or from which it may be released through a spring loaded pressure relief valve 47, which is set to relieve pressures above a predetermined maximum pressure, and thence through conduits 48 and 49 back into sump 40. When the pump is reversed, the piston operates to pump fluid from pressure chamber 39 into sump 40 and the intake and outlet ports serve then as outlet and intake ports. A capped fill pipe 50 connected to the pump body 17 in communication with the sump 40 to permit addition of fluid.

The lower end portion 44 of the piston is seen to be relieved, and a side chamfer 51 is provided on the piston extending upwardly from the relieved portion of the piston along that part 52 of the piston which lies between the cylinder ports 45 and 46. The chamfer terminates upwardly well below the upper end 53 of the cylinder. The chamfer 51 is at all times in unrestricted communication with the interior of the lower operative end portion 43 of the cylinder around the relieved portion 44 of the piston whereby the fluid in cylinder portion 43 and in chamfer 51 constitutes a continuous body of fluid.

The portion 52 of the piston acts as a valve in cooperation with the ports, closing both of the ports except when the chamfer 51 is in communication with one or the other of the ports. It will be clearly seen in FIG. 3 that the chamfer 51 extends into the piston to a depth substantially less than a radius of the piston and that, accordingly, at no time does the chamfer comprise a communication between the ports.

A suction relief check valve 66, including a passageway 67 communicating between sump 40 and pressure chamber 39, is arranged in partition 37. The passageway 67 is normally closed by spring-loaded ball valve member 68 but when the pressure in sump 40, which is typically atmospheric pressure, exceeds the pressure in chamber 39 by a small predetermined amount, the valve opens to permit fluid to flow from the sump into the pressure chamber.

Operation of the pump results from rotation of rotor 29, which causes dog or knob 32 to revolve in a circular path in a plane which is at right angles to the axis of rotor 29 but which is inclined from a right angle position with respect to the axis of the piston 31. The knob 32 and socket 33 are seen to be rounded and of spheroidal shape to permit smooth rocking motion of the rotor. As seen in FIG. 2, if the rotor is turned in a direction to cause knob 32 to retreat from the viewer, chamfer 51 turns toward outlet port 46 and, at the same time, piston 31 moves downwardly in the cylinder forcing liquid from the operative lower portion 43 of the cylinder, through chamfer 51 and port 46 into pressure chamber 39. This action continues with the rotating of the rotor until just before the chamfer 51 comes into position facing toward the viewer, that is, just before a full half revolution, when the valve portion 52 of the piston closes off port 46. At this time, knob 32 will have reached a position toward the right as seen in FIG. 2 and it will be apparent that this position corresponds to maximum inward and downward stroke of the piston in cylinder 35.

Upon continued rotation in the same direction, chamfer 51 opens into communication with intake port 45 and the piston rises, increasing the volume in portion 43 of the cylinder below piston end portion 44, whereby fluid flows from sump 40 through port 45 and chamfer 51 into the cylinder. The intake stroke continues for almost a full half revolution, until chamfer 51 moves out of communication with intake port 45 and both ports become closed by the land portion 52 of the piston, this position being illustrated in FIG. 3. Continued rotation in this forward direction, which, as viewed in FIG. 3 corresponds to clockwise rotation, provides successive pumping and intake strokes to pump fluid from sump 40 into pressure chamber 39. Operation of the motor in reverse rotation, to rotate piston 31 in a counterclockwise direction as viewed in FIG. 3, will cause, on the other hand, pumping of fluid from chamber 39 into sump 40, since, with such reverse rotation, the piston will move downwardly in a direction inwardly of the cylinder while chamfer 51 communicates with port 45 and upwardly while the chamfer communicates with port 46. The pump thus operates in response to forward motor rotation to pump fluid from sump 40 into chamber 39 and thence into conduit 47, and, in response to reverse rotation, to pump fluid from chamber 39 into sump 40 and to draw fluid from conduit 47. With the motor at rest, at least one of ports 45 and 46 will be closed by piston portion 52 and fluid cannot then flow between chamber 39 and sump 40, except in the event that pressure in chamber 39 exceeds the pressure to which relief valve 47 responds, whereupon this valve opens to bypass fluid from chamber 39 into the sump through passageways 48 and 49.

The conduit 16 carries fluid, which is preferably an incompressible hydraulic oil or hydraulic liquid, to and from the pump and cylinder unit 15 to control the tilting of the outboard unit 3, unit 15 acting as an expansible chamber device.

The details of the unit 15 and its operation may be understood with reference to FIG. 4 wherein the rod 12 is shown in maximum housed or telescoped position in cylinder 54, corresponding to maximum tilted position of unit 3.

The rod 12 carries at its end 55 within cylinder 54 a seal or piston 56 against which hydraulic fluid exerts pressure when such fluid is pumped into the cylinder through ports 57, which are in turn connected through conduit means, of which the position is represented by by broken line at 58, to the hydraulic line 16 from the pump. The conduit means 58 will be understood to be located in the near wall of the cylinder unit 15, which wall is omitted in the sectional view of FIG. 4.

The outer or rearward end of rod 12 comprises a ball 59 which nests in socket member 60, and ball 59 and member 60 together comprise the major elements of the ball and socket joint seen at 13 in FIG. 1. The member 60 is suitably fixed to the upper end portion 14 of unit 3.

The socket member 26 seen in FIG. 4 is fixedly attached to the boat, preferably by being bolted to the transom by bolts such as bolt 61. A ball 62 is caged in socket 26 to form therewith a universal sliding joint between rod 12 and the transom. Rod 12 passes slidingly through bore 63 of ball 62, and cylinder unit 15 is seen to be fixedly connected to the ball 62 and to extend forwardly therefrom with the axes of cylinder 54 and cylindrical bore 63 in alignment. It will be seen, accordingly, that cylinder unit 15 may swing up and down and back and forth about the geometric center of ball 62 as the ball rotates in socket 26, that rod 12 remains in coaxial alignment in cylinder 54, and that the rod 12 may move longitudinally inwardly and outwardly of cylinder 54 through bore 63.

The pumping of fluid through line 16 and ports 57 into cylinder 54 forces piston 56 toward the free end 64 of cylinder unit 15 retracting rod 12 into unit 15 and pulling ball 59 forwardly toward the boat transom, resulting in the tilting of unit 3 on pivot 9 in the direction

of arrow 11. Air vent 65 is provided in end 64 of the cylinder. If pump 17 is operated in a forward direction after unit 3 is in maximum tilted position, or after rod 12 is fully retracted, excess pressure in line 16 is relieved by valve 47 of the pump.

During normal operation of the outdrive, the pump 17 is not operating. If the outboard unit 3 meets an obstruction, it will kick up on pivots 9 moving rod 12 inwardly of cylinder unit 15 and thus reducing the pressure in cylinder 54 and line 16 below atmospheric pressure. Valve 66 now opens permitting liquid to flow through passageway 67 through the partition 37 from sump 40 into chamber 39, whereby to supply the necessary liquid to maintain the line 20 and cylinder 54 filled with liquid at substantially or very nearly atmospheric pressure.

As soon as the obstruction has been cleared, if the propeller is being driven, the outdrive unit will return to normal position, liquid being forced through relief valve 47. The adjustment of valve 47, however, is such that the pressure in chamber 39 and cylinder 54 necessary to upwardly tilt the unit when the propeller is inoperative is not sufficient to open the valve 47, but the unit may be forced down by the application of about ten or fifteen pounds of force to the unit at or adjacent the propeller, which might be applied manually or by propeller reaction, in a typical exemplary embodiment. In normal use, the outboard unit 3 will be tilted forward by operation of switch 21, such as when the boat is moved into shallow water or is being beached, when the boat is to remain in the water and idle for a period of time and it is desired to have the unit out of water, when the boat is being hauled out of the water onto a tilt bed trailer, when the boat is being trailered, or when it is necessary to inspect or replace the propeller. The unit is normally lowered from tilted into operating position by reverse operation of pump 17 as selected and controlled by means of switch 21.

In order to lower outboard unit 3 from tilted position into upright position, pump 17 is caused to operate in reverse by suitable operation of switch 21, and rod 12 moves in a direction outwardly of cylinder 54 while fluid flows out of cylinder 54, through ports 57 and conduit means 58 into line 16 and thence into pump chamber 39, through the pump cylinder 35 and finally into sump 40.

It will be apparent from FIGS. 1, 4 and 5 that, as unit 3 tilts on axis 9, the rod ball 59 moves upwardly and forwardly and that, to accommodate such movement, the cylinder unit 15 must swing up and down about the center of ball 62. As heretofore explained, the cylinder unit including the mounting ball 62 are free to swing about the geometric center of the mounting ball 62 in directions to raise and lower forward end 64 of the cylinder unit thus to accommodate tilting of the outboard unit.

The cylinder unit 15 and rod 12 are employed in connection with steering of the outboard unit. For this purpose, as seen in FIGS. 1 and 5, steering cables 25 and 25' are connected to respective ears, of which only one ear 69 is shown, on respectively opposite sides of the cylinder unit disposed forwardly of ball 62. A tension spring 70 is shown interposed in cable 25 to take up any slack and maintain the cables taut. The steering wheel 24 is connected to the cables operable to pay out one while pulling the other and thus to swing the cylinder unit selectively toward the sides of the boat, as mentioned above. Tiller rod member 12, in response to movement of the steering cables, swings on the center of ball 62 in directions to move the rod ball 59 and the upper end 14 of the outboard unit to port and starboard, swinging the outboard unit on upright pivot 5 to steer the boat. The steering action is substantially independent of the tilting action whereby the outboard unit may tilt regardless of its steering direction and may be steered when tilted. Since movements of the unit on its steering and tilting axes are produced by forces applied by ball 59 to portion 14 of the unit, it will be apparent that ball 59 and portion 14 must be located spacedly from both axes.

While only certain preferred embodiments of this invention have been shown and described by way of illustration, many modifications will occur to those skilled in the art and it is, therefore, desired that it be understood that it is intended in the appended claims to cover all such modifications as fall within the true spirit and scope of this invention.

What is claimed as new and what it is desired to secure by Letters Patent of the United States is:

1. In a marine propulsion mechanism for a vessel comprising a propulsion unit disposed rearwardly of the transom of the vessel and means mounting said unit on the vessel, said mounting means providing tilting and steering movements of said unit about respective horizontal and upright axes located generally between the unit and the transom, a tiller member, joint means connecting said member to said unit, said joint means being spaced rearwardly of both of said axes, an hydraulic cylinder extending generally longitudinally with respect to the vessel, means pivotally mounting said cylinder to said vessel, said tiller member being telescopically engaged in said cylinder, a piston fixed to said tiller member and disposed in said cylinder, steering means connected to a portion of said cylinder spaced therealong from said pivotal mounting means therefor for swinging said cylinder on its said pivotal mounting in directions to swing said tiller member and therethrough to swing said joint means laterally from side to side, a reversible hydraulic pump connected to said cylinder, means for operating said pump in one direction to apply force on said piston in a direction to tilt up said outboard unit on said horizontal axis and selectively in the opposite direction to release such tlting force.

2. In a marine propulsion mechanism for a vessel comprising a propulsion unit disposed rearwardly of the transom of the vessel and means mounting said unit on the vessel, said mounting means providing tilting and steering movements of said unit about respective horizontal and upright axes located generally between the unit and the transom, a tiller member, joint means connecting said member to said unit, said joint means being spaced rearwardly of both of said axes, an hydraulic cylinder extending generally longitudinally with respect to the vessel, means pivotally mounting said cylinder to said vessel, said tiller member being telescopically engaged in said cylinder, a piston fixed to said tiller member and disposed in said cylinder, steering means connected to a portion of said cylinder spaced therealong from said pivotal mounting means therefor for swinging said cylinder on its said pivotal mounting in directions to swing said tiller member and therethrough to swing said joint means laterally from side to side, a reversible hydraulic pump connected to said cylinder, said pump comprising a rotatable and reciprocable pump piston having a lateral chamfered portion, a pump cylinder element having two ports alternately and respectively opened by communication with said chamfer and closed by the body of said pump piston in response to rotation of said pump piston, said pump cylinder including a pressure chamber portion in communication with said chamfer and in which the operative end of said pump piston reciprocates to provide pumping action through said ports, means for simultaneously rotating and reciprocating said pump piston, said means being selectively reversible to apply force to said first piston in a direction to tilt up said outboard unit on said horizontal axis and selectively to apply force to said unit in a direction to oppose such tilting thereof.

3. In an inboard-outboard drive mechanism for a boat, a drive unit, a mounting gimbal for mounting said unit on said boat including means establishing an upright steering axis and a horizontal tilt axis for said unit, means for steering and tilting said unit on said axes comprising a

telescoping cylinder and piston rod, a first universal pivot connection between said cylinder and said boat, said first pivot connection being located above said horizontal axis, a second universal pivot connection between said rod and said unit disposed spacedly from both said axes, a reversible pump for pumping hydraulic fluid to and from said cylinder thereby to cause said second universal pivot connection to approach and to separate from said first pivot connection to tilt said drive unit between normal upright drive position and a tilted inoperative position, and steering cable means attached to said cylinder spaced therealong from said first pivot for swinging said cylinder and rod back and forth on said first pivot and thereby causing said second pivot connection to swing said unit on said steering axis.

4. In a marine propulsion mechanism for a vessel comprising a propulsion unit disposed rearwardly of the transom of the vessel and means mounting said unit on the vessel, said mounting means providing tilting and steering movements of said unit about respective horizontal and upright axes located generally between the unit and the transom, a tiller member, joint means connecting said member to said unit, said joint means being spaced rearwardly of both of said axes, an hydraulic cylinder extending generally longitudinally with respect to the vessel, means pivotally mounting said cylinder to said vessel, said tiller member being telescopically engaged in said cylinder, a piston fixed to said tiller member and disposed in said cylinder, steering means connected to a portion of said cylinder spaced therealong from said pivotal mounting means therefor for swinging said cylinder on its said pivotal mounting in directions to swing said tiller member and therethrough to swing said joint means laterally from side to side, a reversible hydraulic pump connected to said cylinder, an electric power source, a reversible electric motor connected to said pump for operating said pump in one direction to apply force on said piston in a direction to tilt up said outboard unit on said horizontal axis and selectively in the opposite direction to release such tilting force, and a manual switch having forward and reverse positions for connecting said source to said motor and controlling the direction of operation of said motor and pump.

References Cited by the Examiner

UNITED STATES PATENTS

1,733,731	10/29	Harris	103—157
2,755,766	7/56	Wanzer.	
2,927,243	3/60	Albright	115—41 X
3,006,311	10/61	Hansson et al.	103—157
3,083,678	4/63	Leipert	115—41

FOREIGN PATENTS

110,457	8/28	Austria.

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